

TS EM11
SRESP Transportation Evacuation Model
Users Training - *Organized by John Wilson*



Monday May 24, 8:30 a.m. - 5:00 p.m.
Tuesday May 25, 8:30 a.m. - 5:00 p.m.

Acknowledgements

Lead Agency:	Florida Division of Emergency Management
Project Manager:	Jeff Alexander, Northeast Florida Regional Council
Partner Agencies:	Florida Department of Community Affairs Florida Department of Transportation Apalachee Regional Planning Council Central Florida Regional Planning Council East Central Regional Planning Council North Central Regional Planning Council Northeast Florida Regional Council South Florida Regional Planning Council Southwest Florida Regional Planning Council Tampa Bay Regional Planning Council Treasure Coast Regional Planning Council West Florida Regional Planning Council Withlacoochee Regional Planning Council

What is SRESP?

- Statewide Regional Evacuation Study Program
- Study and Update Regional Hurricane Evacuation in light of new legislation (HB 1359 –SB 7121)
- Utilize New LIDAR data combined with updated SLOSH modeling
- Utilize consistent methodology and format to ensure complete transparency and visibility
- Expected completion in 2010

Before SRESP

- Each Regional Planning Council responsible for its own hurricane evacuation study
- Different data and methodologies for each region
- Different standards and definitions of terms used by each region
- Regional evacuation studies updated at different intervals
- Minimal inter-regional coordination during evacuation study update process

After SRESP

- Each Regional Planning Council still responsible for its own hurricane evacuation study; **but,**
- Same data and methodologies for each region
- Same standards and definitions of terms used by each region
- Regional evacuation studies updated at same time
- Maximum inter-regional coordination during evacuation study update process

SRESP – Phase I

- Demographic and Land Use Analysis
- Critical Facilities Inventory
- Shelter Analysis
- Regional Evacuation Transportation Networks
- Definition of relevant terms
- Behavioral Analysis

- Will yield updated basis for plans and mitigation strategy.

SRESP – Phase II

- New Light Detection and Ranging (LIDAR) topographic data
- New Sea, Lake, Overland Surge from Hurricane (SLOSH) model runs
- Vulnerability Analysis
 - delineation of the storm tide limits and evacuation zones
 - identification of population-at-risk and evacuation populations
 - storm surge analysis of critical facilities
 - evacuation transportation analysis

SRESP Coordination

- Combined effort between multiple state and regional agencies
- Monthly working group meetings
 - Meetings travel around the state
 - local agencies have an opportunity to participate
- Certain working group members designated as discipline leaders such as:
 - Lead demographer
 - Hazards Analysis Leader
- Periodic conference calls as the need arises to address specialized concerns

SRESP Transportation Analysis

- Consistent evacuation modeling methodology
- Builds on the fruits of all prior work conducted by the SRESP, such as:
 - Evacuation zones based on new LIDAR and SLOSH data
 - Evacuation response rates based on new behavioral data
 - Incorporate demographic data estimates developed by the RPCs
 - Utilize most recent evacuation route data
- Provides meaningful statistics consistent with terms and definitions set forth by the SRESP

Objectives

- This training session will provide hands on instruction on the application of the transportation evacuation model developed for each Regional Planning Council (RPC) as part of the SRESP.
- The session is divided into two major parts (with a total of five sections).

Objectives

- Part 1 – Modeling Overview and Theory
 - Discuss general concepts and practices behind transport modeling
 - Cover the basics of four-step modeling
 - Distinguish between typical transport modeling and evacuation modeling
 - Discuss the methodology used for evacuation modeling in the SRESP
- This part will be covered on the first day and is primarily composed of lecture material

Objectives

- Part 2 – SRESP Model Application
 - Discuss the TIME interface
 - Hands on practice with the time interface
 - Discuss in more detail specific files, data formats, and software components used in the SRESP model
 - Hands on review of data and applications at a deeper level
- This part will be covered on the second day and is primarily hands-on work with the model

Agenda

- Two day workshop
- Start at 8:30 AM
- End at 5:00 PM
- Breaks
 - 10:00 a.m. - 10:30 a.m. – Mid-morning break
 - Noon - 1:30 p.m. – Lunch break
 - 3:00 p.m. – 3:30 p.m. – Mid-afternoon break

Agenda

- Day 1:
 - Introduction
 - What is Modeling?
 - Evacuation Modeling
- Day 2:
 - TIME
 - Nuts and Bolts

Facility Logistics

- Restrooms
- Security
- Food

Contacts: WSA

- **Roberto Miquel** : RMiquel@WilburSmith.com
Senior Model Developer
421 Fayetteville Street, Suite 1303
Raleigh, NC 27601
w: 919-755-0583 d: 919-573-4184 f: 919-832-8798
- **Gabrielle Matthews** : GMatthews@WilburSmith.com
Transportation Planner
2940 Kerry Forest Parkway, Suite 201
Tallahassee, FL 32309
w: 850-309-0838 f: 850-309-0927

Contacts: WSA

- **Bob Hamm, P.E.** : BHamm@WilburSmith.com
SRESP Transportation Analysis Project Manager
2940 Kerry Forest Pkwy, Suite 201
Tallahassee, FL 32309
w: 850-309-0838, ext. 231 f: 850-309-0927

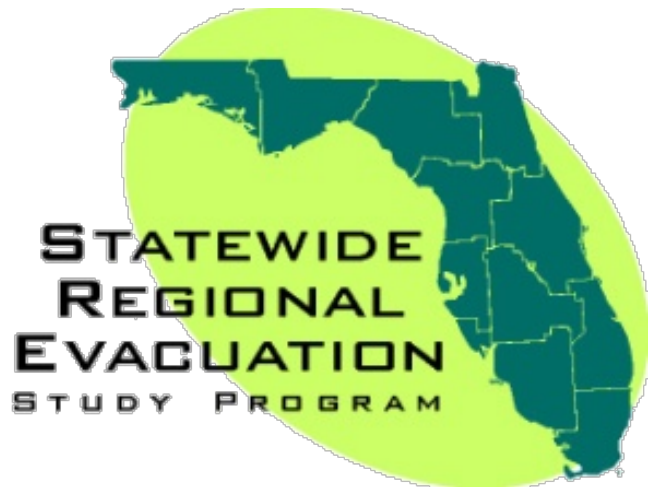
Contacts: SRESP

- **Jeff Alexander** : jalex@nefrc.org
SRESP Project Manager
6850 Belfort Oaks Place
Jacksonville, FL 32216
w: 904-279-0885, ext.134

Introductions

- Please introduce yourselves:
 - Name
 - Agency/Firm
 - Experience in Evacuation Planning/Operations
 - Experience in Transportation Planning/Modeling

Section 2



What is Modeling?

Outline

- What is a Model?
- Components of a Model
- What are Models used for
- What kinds of Models are there?
- Basic Modeling Concepts
- Four Step Modeling
 - Trip Generation
 - Trip Distribution
 - Mode Choice
 - Assignment

What is a Model?

- A model is something which stands in the place of something else
- Models can be objects such as:
 - Model buildings
 - Model trains
 - Model airplanes
- Models can be people such as:
 - Runway model
 - Magazine model
 - An artist's subject

What is a Model?

- Models can also be mathematical constructs representing the behavior of complex systems such as:
 - Economic models
 - Land-use models
 - Meteorological models

What is a Model?

- A travel demand model is a mathematical construct which tries to explain the relationship between:
 - The travel behavior of individuals in a region (demand); and,
 - The transportation system of roads and transit within that region (supply)
- The purpose of a travel demand model is to forecast future travel behavior

What is a Model?

- The terms “travel demand modeling” and “travel demand forecasting” are often used interchangeably
- Travel demand modeling refers specifically to the act of representing travel behavior through the use of mathematical formulas
- Travel demand forecasting refers specifically to the use of travel demand models to predict future travel patterns

Components of a Model

- The “Model”:
 - Data, such as demographics, employment, and roads
 - Equations, such as those that calculate the number of trips
 - Parameters, such as those that tell the model how accurate to be
- The “Software”:
 - Complex calculations require the use of computers
 - Software automates much of the modeling process
- Both the model and the software are required to run a travel demand model.

What are Models Used For?

- Models are used to predict the impacts of transportation projects at a regional level
- Originally used to help understand the regional impacts of large-scale transportation projects such as interstate highways
- Cheaper and faster than building new roads to see if they work

What are Models Used For?

- Over time, models have been used to answer more complicated questions
- New modeling methods and technologies are continuously being developed to meet this need
- As computing power becomes cheaper and more available, travel demand models will become more complex and will yield more data

What are Models Used For?

- MPO Planning
- Statewide Corridor Planning
- Traffic Impact Analysis
- DRI Review
- FTA New Starts
- High-Speed Rail
- Interchange Justification/Modification Reports
- Air Quality Analysis
- ITS Evaluation
- Traffic and Revenue Forecasting for Tolls
- Comprehensive Planning
- Project Development and Environment (PD&E)
- Evacuation Planning

Kinds of Models

- Models can be distinguished by geographical extent:
 - Urban area models
 - Regional models
 - Statewide models
- Models can be distinguished by mode of travel:
 - Highway models
 - Transit models
 - Truck/Freight models
 - Toll models

Kinds of Models

- Some models have a very specialized purpose:
 - Sub-area model
 - Corridor model
 - Special event model (game days)
 - Evacuation model

Basic Modeling Concepts

- There are certain key concepts to keep in mind when discussing travel demand models
 - Socioeconomic Data
 - Traffic Analysis Zones
 - Transportation Networks
 - Mathematical Models
 - Outputs

Socioeconomic Data

- Socioeconomic data are a fundamental component of travel demand models
- These data form the basis from which travel demand is calculated
- Socioeconomic data usually consist of two general categories:
 - Demographics
 - Employment

Socioeconomic Data

- Demographic data identify the population characteristics in a travel demand model
- Typical demographic data include information on:
 - Population
 - Dwelling units (amount by type)
 - Automobile ownership
 - Vacancy rates
- Demographic data are usually developed from the Census or from mid-Census estimates

Socioeconomic Data

- Employment data correspond to the economic component of the model
- These data identify the number of employees by employment category, such as:
 - Industrial
 - Commercial
 - Service
- Employment codes are developed from ranges of Standard Industrial Classification (SIC) codes

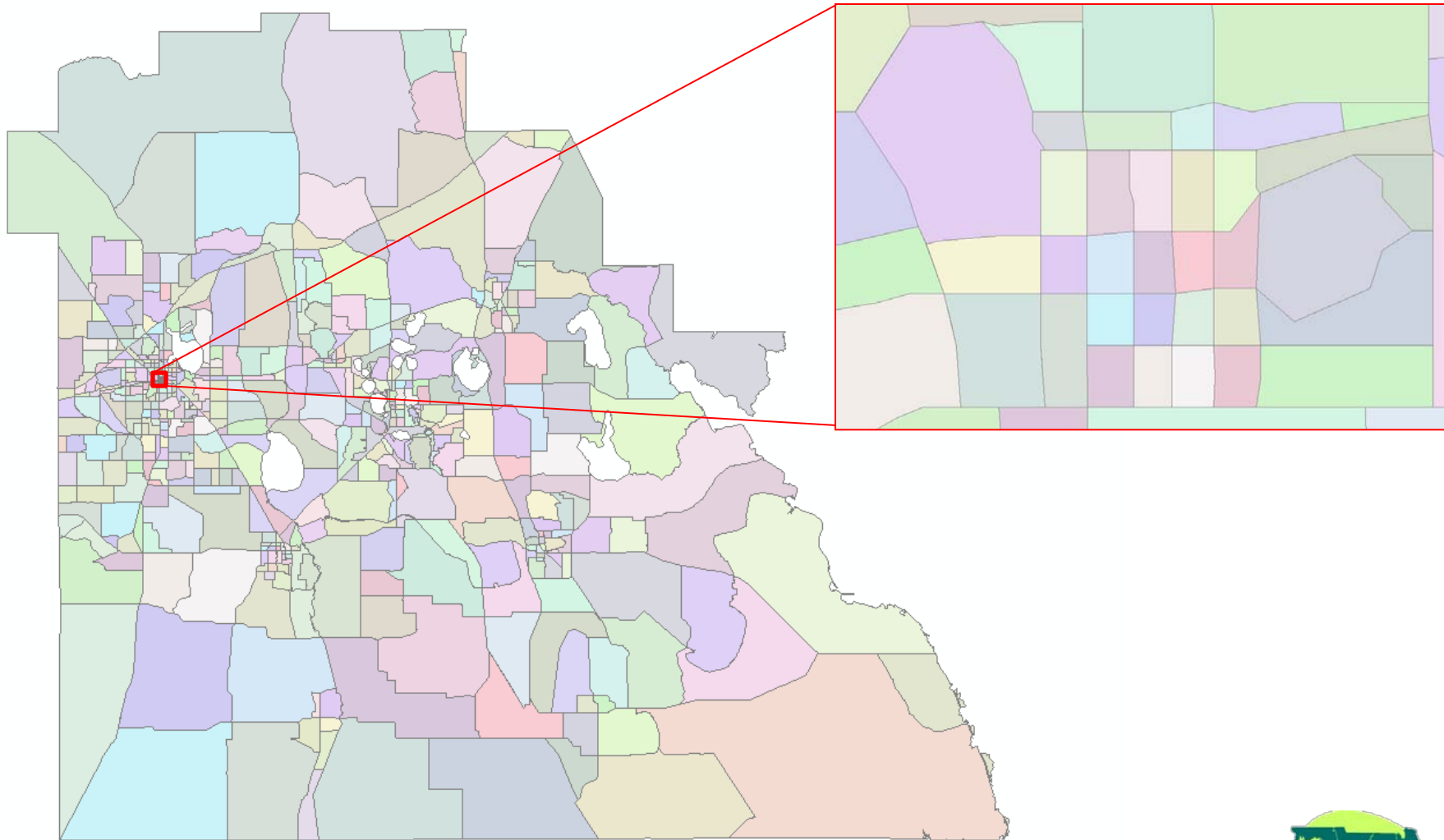
Traffic Analysis Zones

- Travel demand models are divided into small areas known as Traffic Analysis Zones (TAZ)
- The basic unit of analysis in a travel demand model is a TAZ
- All trips begin and end in a TAZ
- Socioeconomic data are placed into TAZs

Traffic Analysis Zones

- A Traffic Analysis Zone may as small as a single downtown city block or as large as hundreds of rural acres
- When the model is used to represent growth in a future year, larger TAZs are often split into smaller TAZs and new development is placed into the split TAZ

Traffic Analysis Zones



Transportation Network

- A transportation network is a representation of the transportation system found within the area being modeled
- Transportation networks can be multi-modal:
 - Highway
 - Transit
 - Bicycle and Pedestrian (less common)

Transportation Network

- There are two key structural components to a transportation network:
 - Nodes
 - Links
- A node is a point in the network that carries positional data (XY coordinates)
- A link is a connection between any given pair of nodes
- A network is a set of interconnected links and nodes

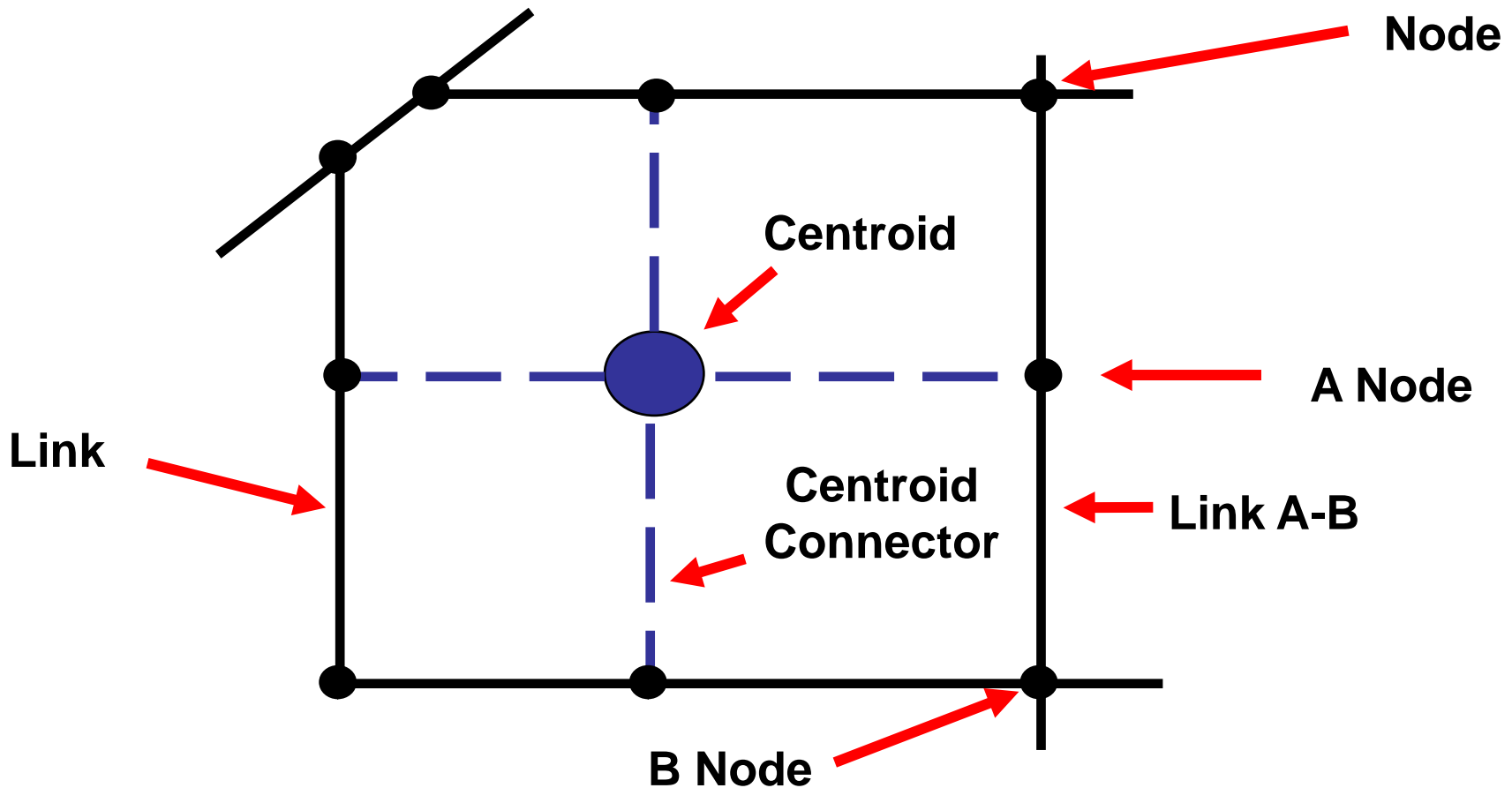
Transportation Network

- Links carry data concerning the individual road segments found in a model
- These data include:
 - Distance
 - Travel times
 - Speeds
 - Capacities
 - Facility types
 - Area types
 - Number of lanes

Transportation Network

- Centroids are special nodes that represent the center of activity within a TAZ
- Centroid connectors are special links that connect centroids to the transportation network
- All trips that load onto a network start at a centroid, travel along a centroid connector to get onto the transportation network, leave the network along another centroid connector, and end their trip at another centroid

Transportation Network



Mathematical Models

- Mathematical models are at the heart of travel demand models
- They are made up of different sets of equations that attempt to explain relationship between the socioeconomic data and the transportation network
- Common models used in Florida include:
 - Cross-classification (trip generation)
 - Gravity (trip distribution)
 - Nested logit (mode choice)
 - User equilibrium (trip assignment)

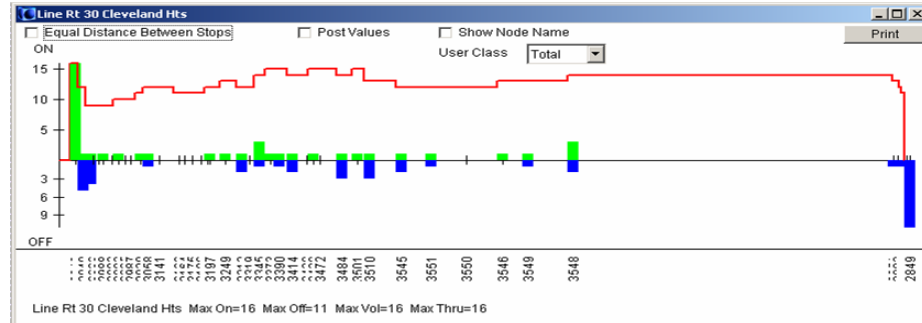
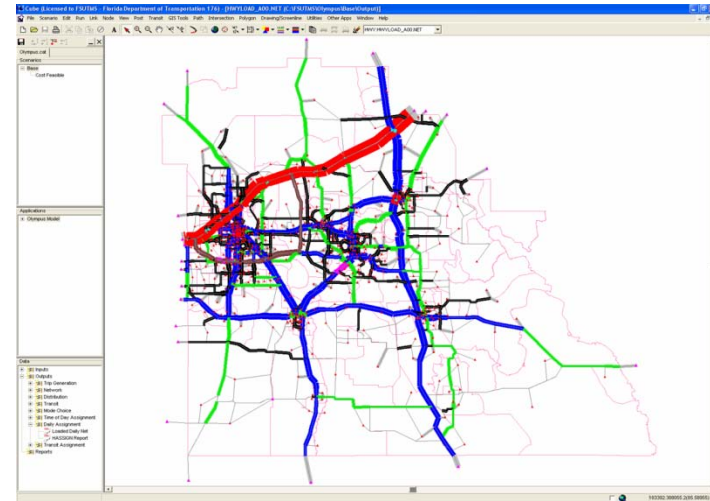
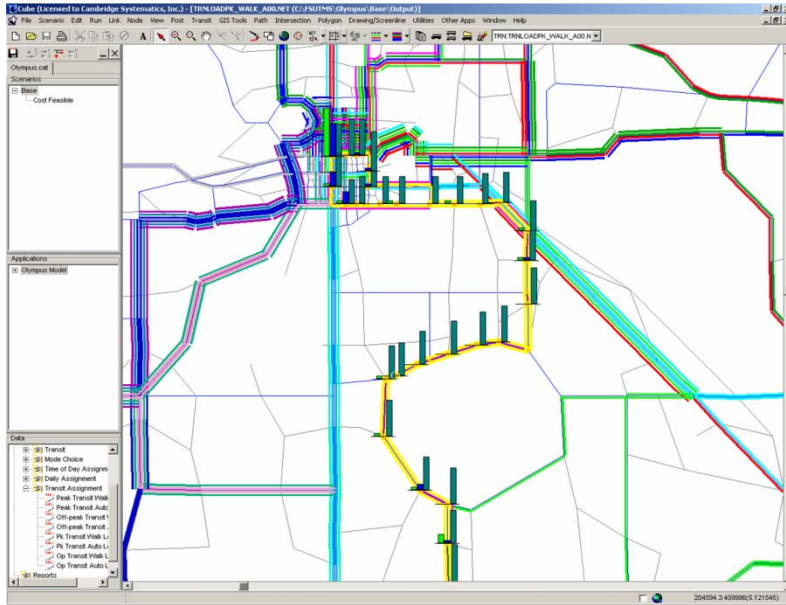
Outputs

- The data that goes into the model that is supplied by the user is known as “input data”
- After the model finishes executing its calculations it provides information known as “output data”
- Output data describe the travel behavior predicted by the model and are analyzed by planners to make important decisions concerning future transportation projects in their region.

Outputs

- Output data can describe:
 - The number of vehicles traveling along a road
 - The number of riders on a new rail line
 - The amount of individuals predicted to travel between two different cities in the region
 - The percentage of individuals expected to take the bus
 - The average trip length in the region
 - How much time is lost to congestion
 - How much congestion is reduced because of a new transportation project
 - And more...

Outputs



Four Step Modeling

- The standard travel demand model is comprised of four basic steps
 - Trip Generation: How many trips are being made?
 - Trip Distribution: Where are the trips going?
 - Mode Choice: How are the trips getting there?
 - Trip Assignment: Which route is each trip taking?
- Often, additional auxiliary steps are executed to process data

Trip Generation

- Trip generation is the process of calculating the number of trip ends in the model
- A trip end is either a production end or an attraction end
- These are calculated based on the demographic and employment data
- There are two trip ends per trip

Trip Generation

- The number of productions and attractions are calculated at the TAZ level
- Trip generation classifies trips by trip purpose
 - Home-based Work
 - Home-based Shopping
 - Home-based Social/Recreational
 - Home-based Other
 - Non-home Based

Trip Generation

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Olympus.cat

Scenarios

- Base

Applications

- Olympus Model
 - Create New Scenario Inputs
 - Mode Choice Calibration
- HPMS

Data

- Inputs
- Outputs
- Reports

Keys

Key	Value
Scen. Name	Base
AlternativeInfo	(Note)
Alt	B
year	00
DESC	Olympus
Input Files	(Note)
UNIT	0.01 Miles
TIMEOFDAYMODELING	(Note)
TODModeling	1
Select Model Steps for	(Note)
GENSTEP	1

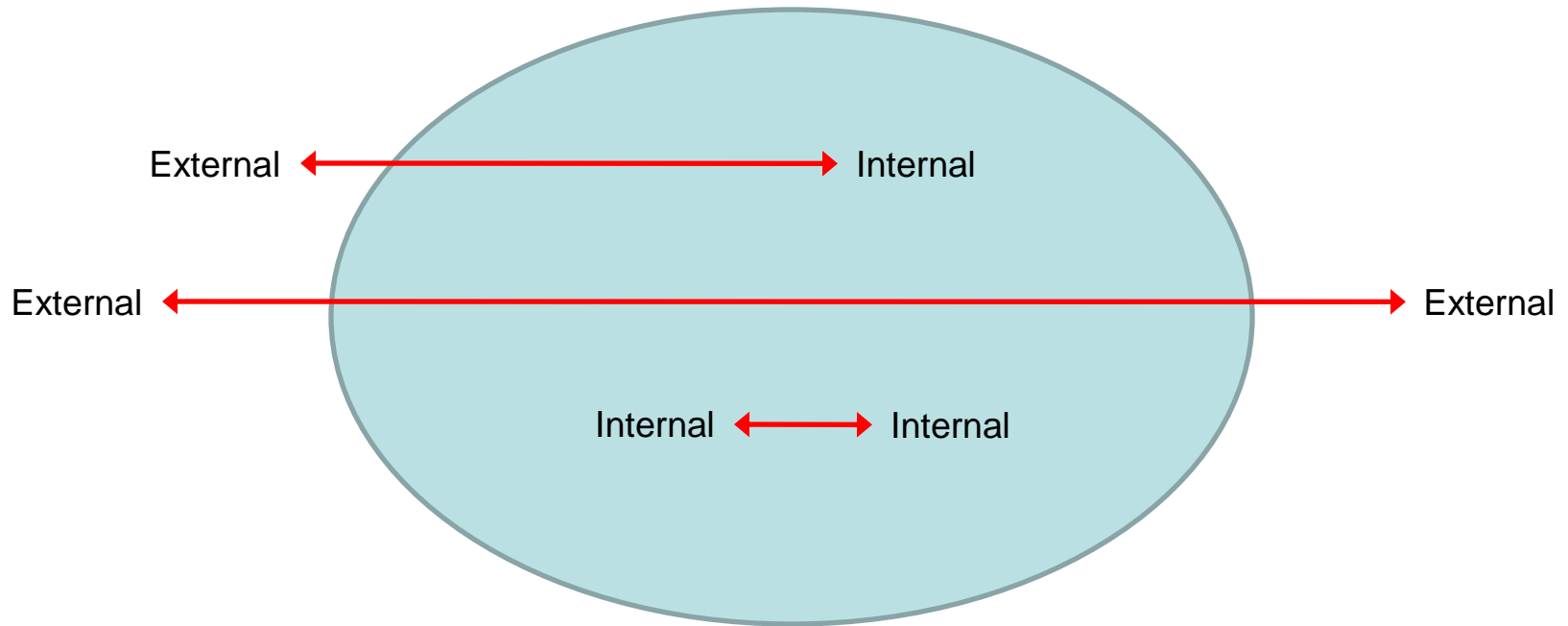
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2	0	98	0	15	0	4	0	27	38	38	41	41	0	20	79	243
3	39	1910	27	3083	22	285	49	2069	4119	4119	796	796	0	1087	5052	13349
4	181	55	104	15	103	75	326	65	84	84	43	43	0	33	841	370
5	62	1108	39	1235	37	152	148	988	1828	1828	466	466	0	509	2580	6286
6	783	154	452	6	450	285	1247	151	184	184	143	143	0	95	3259	1018
7	43	30	24	46	23	21	57	36	68	68	17	17	0	20	232	238
8	38	44	24	15	23	15	64	15	26	26	22	22	0	13	197	150
9	728	281	420	111	413	294	1143	344	458	458	191	191	0	156	3353	1835
10	2837	1038	1728	539	1585	1377	4006	2166	1670	1670	796	796	0	700	12622	8286
11	40	457	30	176	24	67	46	278	413	413	198	198	0	138	751	1727
12	1337	358	702	68	705	562	2087	368	472	472	302	302	0	212	5605	2342
13	1454	342	775	53	800	571	2613	356	450	450	299	299	0	208	6391	2279
14	281	782	201	0	178	167	488	87	104	104	369	369	0	147	1601	1656
15	76	33	49	28	45	41	175	36	59	59	25	25	0	22	429	244
16	2156	490	1156	61	1169	857	3556	485	622	622	440	440	0	301	9089	3266
17	89	116	60	198	50	71	147	152	288	288	63	63	0	81	697	969
18	457	282	265	330	272	188	782	252	483	483	163	163	0	160	2432	1858
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	735	167	420	10	408	281	1063	169	204	204	147	147	0	99	2977	1077
21	2233	714	1249	49	1200	980	2645	776	929	929	559	559	0	388	8815	4385
22	117	152	82	206	67	87	157	165	308	308	83	83	0	92	814	1093
23	1131	314	604	10	624	447	1972	258	311	311	254	254	0	161	4996	1755
24	298	100	180	25	172	132	502	106	137	137	77	77	0	56	1366	633
25	352	83	201	25	198	135	525	87	117	117	72	72	0	52	1465	571
26	774	256	406	21	408	324	1208	199	248	248	195	195	0	124	3239	1367
27	301	1157	173	21	170	121	541	80	106	106	511	511	0	190	1802	2186
28	526	166	352	0	302	336	731	169	202	202	162	162	0	107	2275	1142
29	771	489	409	505	413	356	1283	574	948	948	287	287	0	290	4111	3449
30	587	124	330	6	323	243	787	128	155	155	119	119	0	80	2301	855
31	552	232	318	25	313	227	867	1331	342	342	153	153	0	180	2545	2490
32	98	1500	61	536	57	164	153	1027	1456	1456	630	630	0	452	2455	5785
33	0	947	0	887	0	93	0	743	1229	1229	391	391	0	354	1620	4444
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35	19	111	12	6	11	11	40	23	29	29	48	48	0	21	159	249
36	2	627	1	132	1	45	1	349	464	464	259	259	0	159	728	2035
37	143	46	86	0	87	63	332	52	60	60	36	36	0	25	744	282
38	695	683	480	107	428	420	1229	652	801	801	383	383	0	273	4016	3319
39	195	162	145	89	119	150	240	167	244	244	106	106	0	86	1049	1004

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STATEWIDE REGIONAL EVACUATION STUDY PROGRAM

Trip Generation



Trip Distribution

- Trip Distribution is the process of determining where each trip is coming from and going to
- This is done by the model connecting each production to a specific attraction
- The resulting trips are placed in to a trip matrix
- In Florida, this is typically done using a Gravity Model

Trip Distribution

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Base	126.03	0.16	0.35	6.34	0.15	4.36	0.51	0.14	0.18	0.51	0.28	1.23	0.22	0.17	2.16	0.08	1.19	0.24	0.49	0.00	
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	181.04	0.17	0.27	4.14	0.84	3.36	1.37	0.20	0.14	0.39	0.24	0.79	0.25	0.18	1.40	0.05	4.82	0.15	0.29	0.00	
	61.91	0.07	0.14	2.10	0.04	2.33	0.16	0.05	0.09	0.18	0.14	0.50	0.14	0.10	1.03	0.06	0.37	0.14	0.29	0.00	
	783.00	0.92	1.55	24.61	2.15	19.42	4.96	1.05	0.81	1.74	1.35	4.54	1.03	0.74	8.34	0.30	14.42	0.86	1.73	0.00	
	42.96	0.07	0.11	1.79	0.08	1.41	0.28	0.07	0.07	0.13	0.09	0.34	0.07	0.05	0.61	0.02	0.66	0.06	0.13	0.00	
Applications	38.00	0.04	0.10	1.57	0.03	1.43	0.11	0.04	0.06	0.12	0.08	0.30	0.06	0.04	0.53	0.03	0.26	0.07	0.14	0.00	
Olympus Model	727.99	0.40	1.42	40.40	0.26	8.95	0.75	0.21	0.38	17.25	3.75	7.07	10.68	2.94	9.06	0.33	1.87	1.45	3.66	0.00	
Create New Scenario Inputs	2637.06	0.52	1.58	32.03	0.40	17.39	1.40	0.37	0.58	8.84	245.69	9.27	11.06	31.50	13.52	0.62	3.27	2.63	7.45	0.00	
Mode Choice Calibration	39.91	0.03	0.09	1.73	0.02	0.74	0.06	0.02	0.03	0.21	0.11	0.40	0.16	0.11	0.63	0.03	0.13	0.09	0.21	0.00	
HPMS	1336.91	0.27	1.15	23.79	0.26	10.80	0.68	0.17	0.29	16.21	7.12	8.25	27.84	6.92	11.85	0.43	1.84	2.39	6.47	0.00	
	1454.02	0.28	1.09	22.43	0.25	10.14	0.66	0.17	0.27	5.98	27.19	7.78	9.28	19.44	11.16	0.40	1.79	2.25	6.10	0.00	
	280.81	0.20	0.59	11.46	0.11	6.21	0.42	0.12	0.19	1.06	0.67	2.56	0.92	0.64	4.08	0.24	0.92	0.60	1.31	0.00	
Data	75.87	0.05	0.19	3.73	0.03	2.15	0.10	0.03	0.06	0.25	0.20	0.83	0.21	0.15	1.52	0.09	0.22	0.20	0.42	0.00	
Inputs	2155.94	1.79	2.91	45.15	6.36	36.30	12.10	2.10	1.54	3.64	2.61	8.38	2.32	1.69	15.31	0.56	41.57	1.59	3.27	0.00	
Outputs	88.93	0.05	0.17	3.39	0.03	1.76	0.09	0.03	0.05	0.36	0.28	0.81	0.39	0.27	1.26	0.07	0.20	0.19	0.44	0.00	
Reports	457.07	0.21	0.79	15.94	0.11	7.97	0.41	0.11	0.23	1.99	1.72	3.91	2.32	1.63	6.08	0.30	0.91	0.95	2.16	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	734.98	0.91	1.16	17.83	1.03	14.46	4.13	0.88	1.31	1.41	1.03	2.78	0.92	0.65	5.32	0.27	8.30	0.66	1.36	0.00	
	2233.01	1.88	3.08	47.58	4.28	38.46	12.17	2.63	1.63	3.78	2.15	8.87	2.23	1.57	16.14	0.59	33.39	1.46	2.97	0.00	
	116.94	0.07	0.22	4.25	0.04	2.50	0.13	0.04	0.08	0.37	0.30	1.00	0.42	0.30	1.61	0.09	0.29	0.24	0.54	0.00	
Keys	1130.95	0.79	1.24	19.52	3.55	15.52	6.65	0.94	0.66	1.91	1.16	3.70	1.20	0.88	6.63	0.23	25.17	0.68	1.35	0.00	
Key	297.96	0.06	0.22	4.66	0.05	2.13	0.13	0.03	0.06	1.23	5.89	1.66	1.98	3.22	2.33	0.08	0.33	0.46	1.24	0.00	
Scen. Name	Base	351.78	0.14	0.54	11.02	0.07	5.19	0.26	0.07	1.76	1.51	2.86	1.98	1.39	4.39	0.20	0.59	0.71	1.64	0.00	
AlternativeInfo	(None)	774.01	0.17	0.70	14.57	0.11	6.48	0.32	0.09	0.18	4.77	6.28	4.94	7.06	5.40	7.05	0.25	0.79	1.36	3.48	0.00
Alt	B	300.97	0.10	0.16	2.76	0.50	2.01	0.93	0.12	0.08	0.39	0.21	0.55	0.18	0.14	0.94	0.04	4.88	0.12	0.25	0.00
year	00	526.03	0.29	0.94	18.53	0.16	10.66	0.57	0.16	0.32	1.83	1.53	4.36	2.15	1.51	6.99	0.37	1.27	1.05	2.37	0.00
DESC	Olympus	771.06	0.17	0.63	13.14	0.11	5.90	0.32	0.09	0.17	3.47	8.86	4.56	5.45	6.17	6.55	0.23	0.80	1.28	3.35	0.00
Input Files	(None)	587.05	0.15	0.62	12.76	0.09	5.71	0.28	0.08	0.16	3.62	3.48	4.19	5.24	3.20	6.10	0.23	0.62	1.09	2.62	0.00
UNIT	0.01 Miles	552.09	0.21	0.83	17.04	0.11	8.18	0.41	0.12	0.24	2.64	2.27	4.28	2.98	2.09	6.59	0.31	0.93	1.06	2.41	0.00
TIMEOFDAYMODELING	(None)	97.85	0.09	0.15	2.85	0.07	2.86	0.24	0.09	0.13	0.18	0.20	0.67	0.19	0.13	1.42	0.08	0.54	0.19	0.39	0.00
TODModeling	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Select Model Steps for	(None)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
GENSTEP	1	18.81	0.01	0.03	0.65	0.01	0.39	0.02	0.01	0.01	0.05	0.04	0.15	0.06	0.04	0.25	0.01	0.04	0.04	0.08	0.00

Start | Inbox - Microsoft Outlook | Draft | Workshop Outline.docx | (2) What is Modeling Les... | 11-FSU-01_What is a Mo... | Cube | untitled - Paint | 9:59 PM

Mode Choice

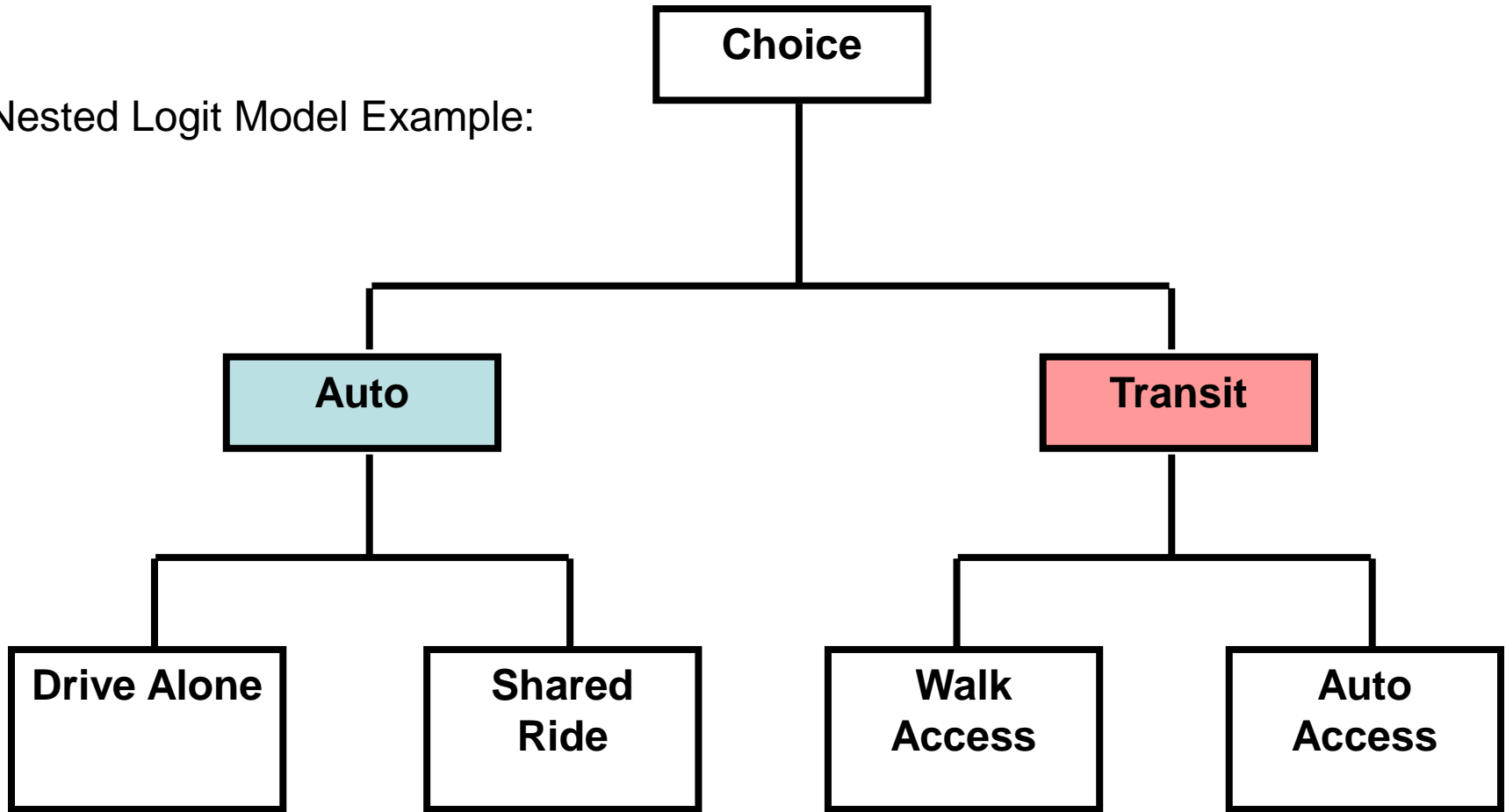
- Determines how many individuals take each mode of transportation
- Typically divided between automobile and transit modes and sub-modes, such as:
 - Drive Alone
 - Car Pool
 - Local Bus
 - Commuter Rail
- Areas without well developed transit systems may use highway only models instead

Mode Choice

- Highway only models apply an auto-occupancy factor to the model person trips to arrive at a number of vehicle trips
- Nested Logit models are used in Florida for models with well developed transit systems or in areas planning for FTA New Starts applications

Mode Choice

Nested Logit Model Example:



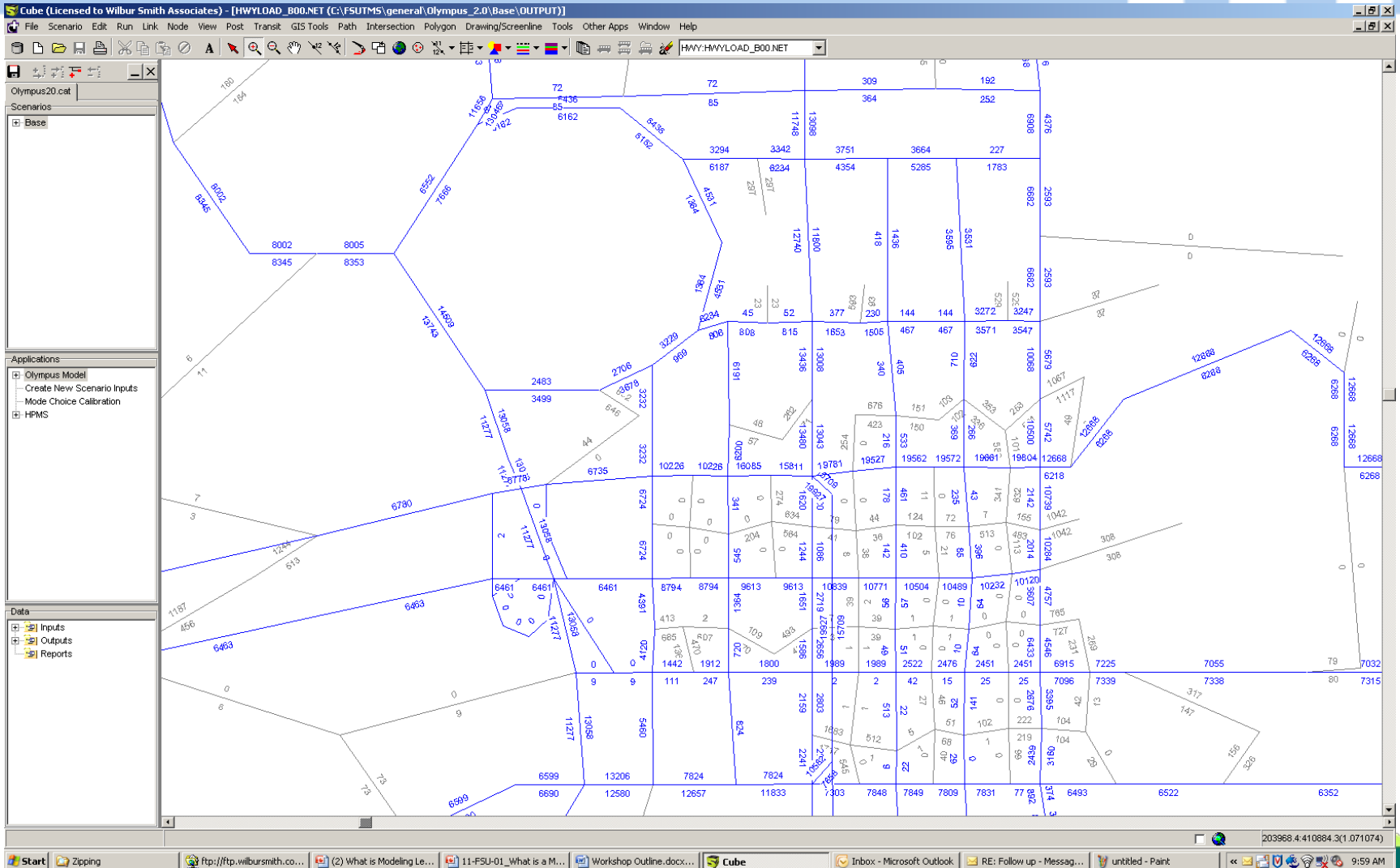
Trip Assignment

- Trip assignment models determine which route along the transportation network any given trip will take
- Trips are routed through the network using a User Equilibrium routine, a method that takes into account congestion
- Most models in Florida reflect a single 24 hour daily period, although more work is being done to develop time of day models that can specifically reflect the peak period

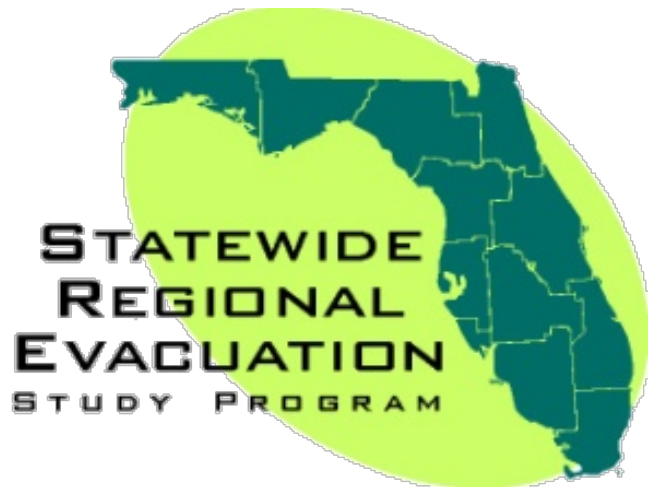
Trip Assignment

- User Equilibrium is a technique used for modeling highway trips
- This technique is static: this means that all of the trip for the period are loaded simultaneously over multiple iterations
- Trips are loaded along the fastest route between two zones in each iteration and new congested travel times are calculated. At the end of each iteration, trips are divided amongst all possible routes until equilibrium is achieved.

Trip Assignment



Section 3



Evacuation Modeling

Outline

- Basic Concepts in Evacuation Modeling
- SRESP Evacuation Method
- Initialization
- Calculating Demand
- Trip Distribution
- Segment Trips
- Assign Trips
- Reporting
- Clearance Times

Basic Concepts

- Evacuation models are a specialized type of travel demand model
- Though many of the mechanics are similar to standard travel demand models, there are considerations unique to evacuation modeling that makes it different
- Someone familiar with travel demand modeling should be able to work with an evacuation model with only a minimal learning curve

Response

- Response is the determination of how a population reacts to an imminent threat with regard to evacuating toward safety
- There are two principal components to response:
 - The number of individuals that evacuate, known as “participation” or “demand”; and,
 - When those individuals choose to begin their evacuation journey, known as the “response curve”

Demand

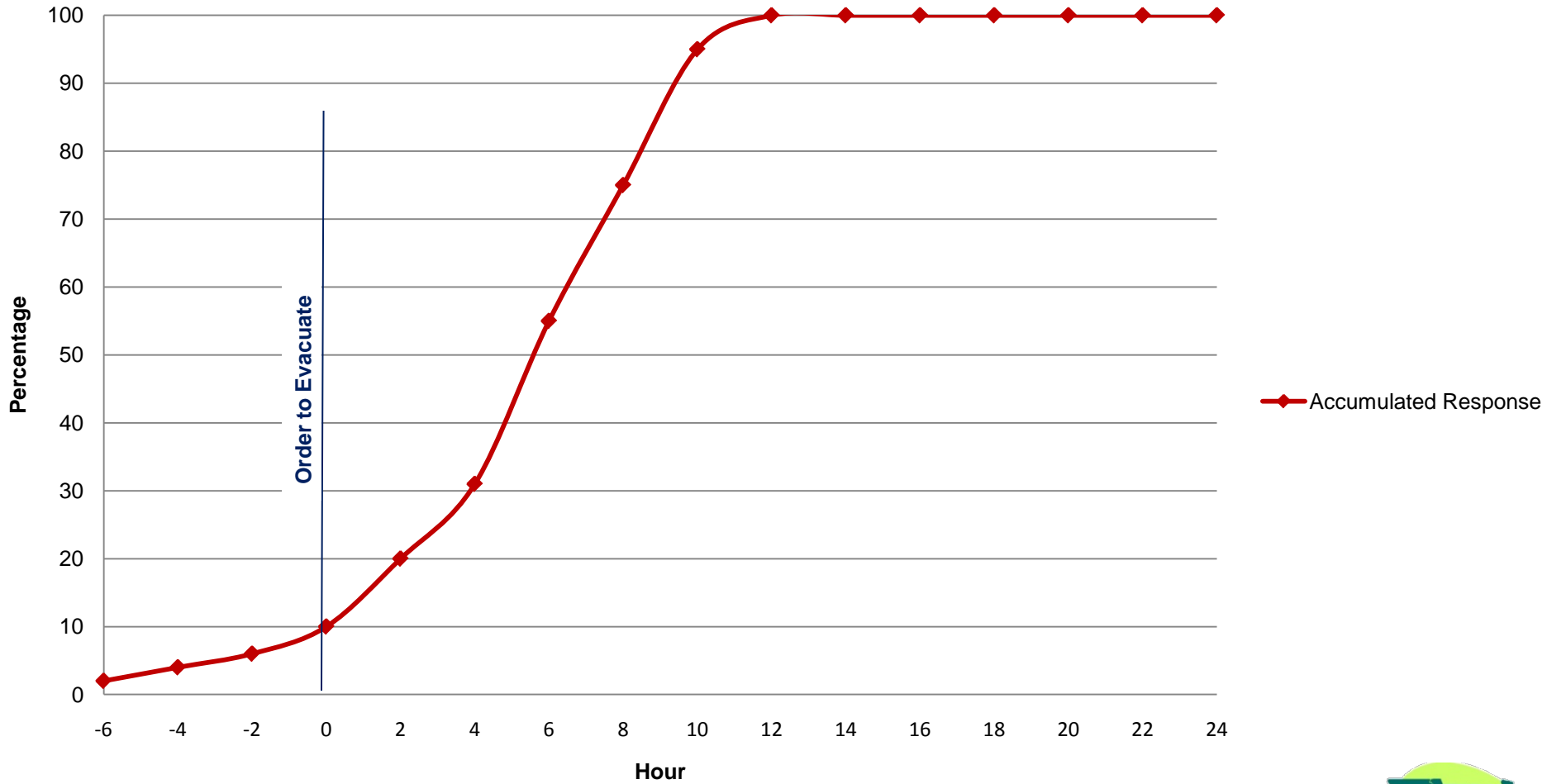
- Demand is the amount of involvement from the population during an evacuation scenario
- Demand includes not only the population, but ultimately, the number of vehicles that will be making their journey
- There are various methods to calculate demand, but the use of participation rates is the most common
- Participation rates are typically derived from behavioral surveys

Response Curve

- Response Curves describe at what time each individual in the region begins their evacuation
- These curves are expressed as a percentage of the population at a given interval of time
- The curves are based off of when an order to evacuate is given and accounts for population evacuating before an order is given and after

Response Curve

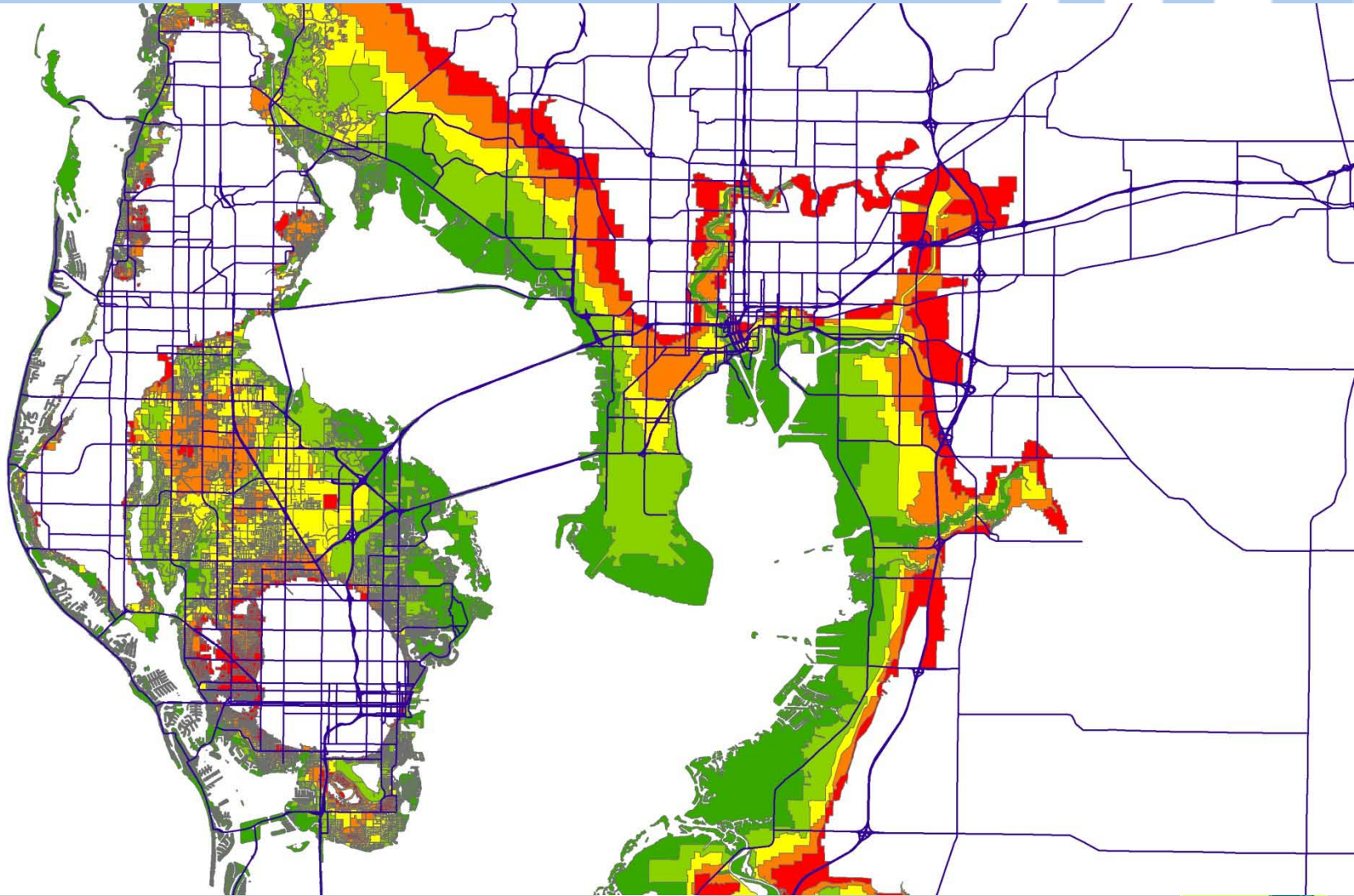
Response Curve: 12 Hours



Evacuation Zones

- An evacuation zone is an area of a county that will be ordered to evacuate when a storm threat becomes imminent
- Different evacuation zones are designated depending on the severity of the event anticipated
- Evacuation zones are designated based on the likelihood of an area experience surge flooding during a storm and the ability of emergency management staff to effectively communicate an evacuation order

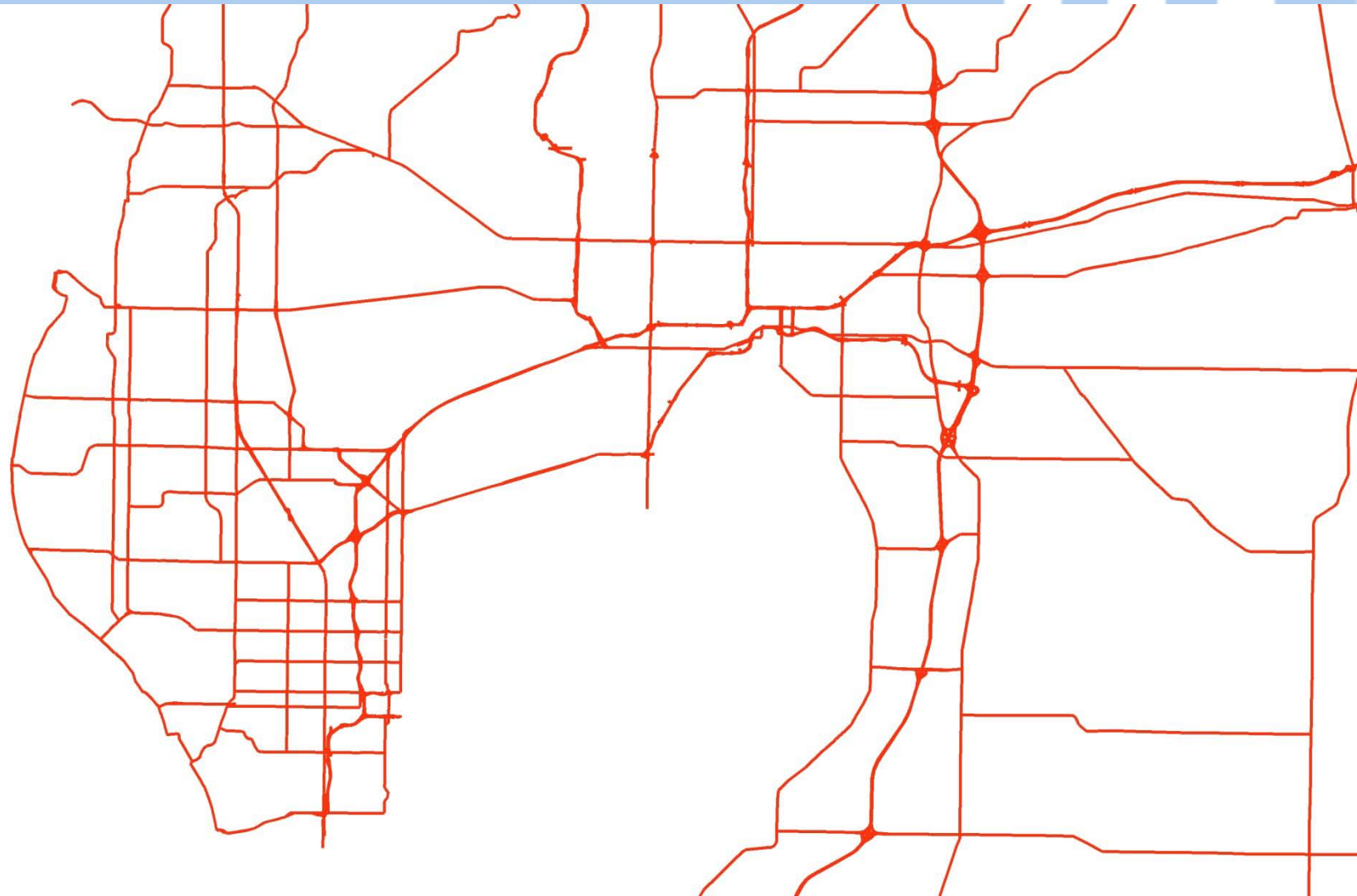
Evacuation Zones



Evacuation Network

- An evacuation network is a series of roads that have been identified as evacuation routes
- Evacuation models must at a minimum contain all of the roads identified in the evacuation network
- These roads represent what is believed to be the most efficient way of getting evacuees to safety throughout the state

Evacuation Network



Clearance Times

- A clearance time is the time it takes for trips to vacate the network after beginning their journey
- Clearance times are used by emergency management staff to:
 - Determine the window of opportunity available to initiate an evacuation order;
 - To ensure that evacuees have enough time to reach safety before the storm arrives
- The SRESP has defined various sets of clearance time that will be discussed later on in this section

SRESP Evacuation Method

- Satisfy State Requirements
 - Standardized definitions for clearance times
- Statewide Consistency
 - All RPC regions use same transportation methodology
- Single or Multi-Region Analysis
 - Each RPC has ability to conduct own analysis
- Model Interface
 - Allows users ability to easily create and run evacuation scenarios

SRESP Evacuation Method

- One SRESP model:
 - Single set of data
 - Single set of equations
 - Single set of programs
- Designed to focus on specific regions of Florida depending on which RPC is running the model
- Each RPC will receive a customized interface
- Not all counties will be available as an origin for evacuation trips in each interface

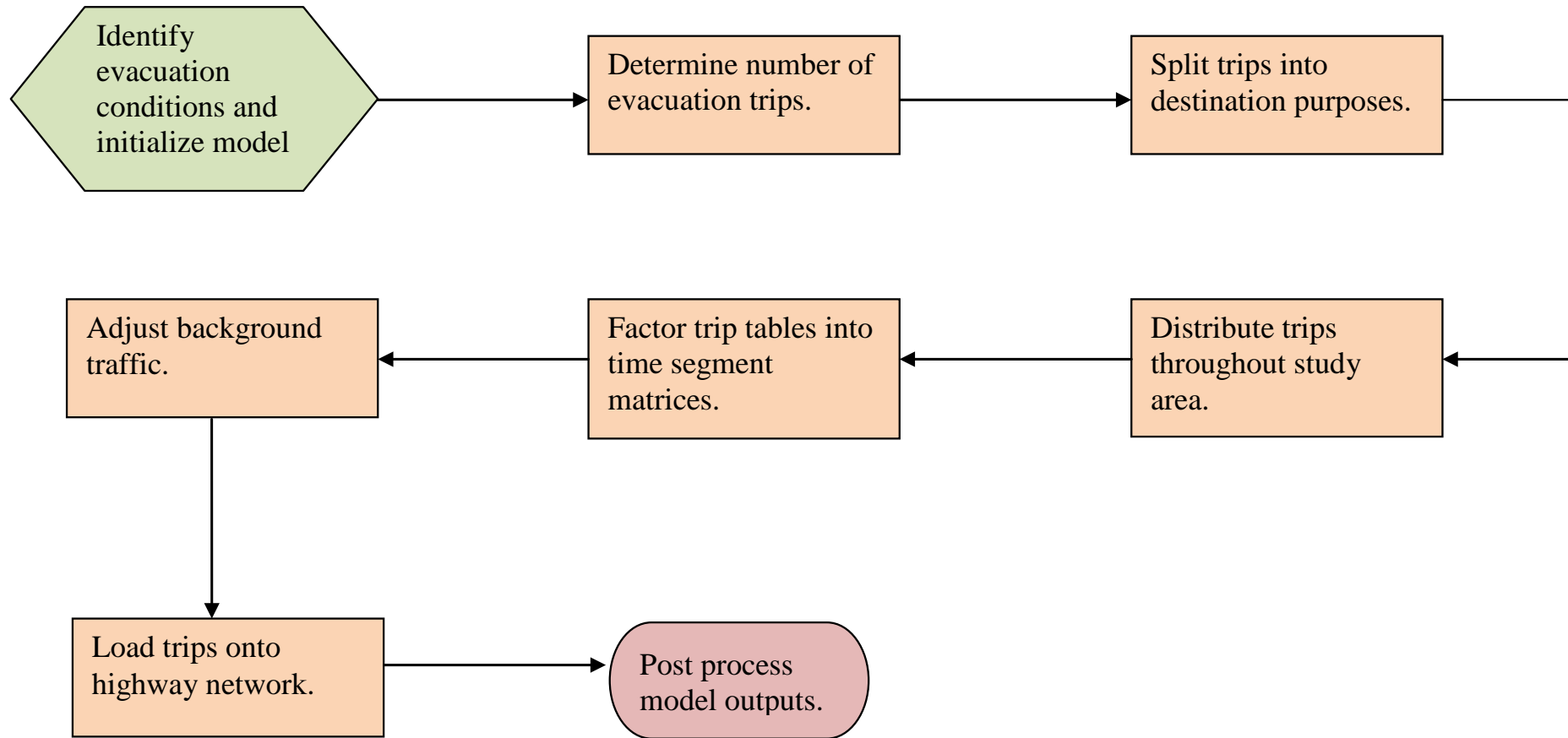
SRESP Evacuation Method

- The sequence of processes which occur while a model is running can be thought of as a stream with successive inputs being introduced into a set of programs
- This sequence continues until the model has finished executing
- This can be thought of as the model flow
- The model flow for the evacuation model is somewhat similar to the model flow for traditional Four-Step travel demand models

SRESP Evacuation Method

- Only trip generation, trip distribution, and trip assignment are used
- These steps are further subdivided into a total of eight modeling steps:
 - Identify evacuation conditions and initialize model;
 - Determine number of evacuation trips;
 - Split trips into destination purposes;
 - Distribute trips throughout study area;
 - Factor trip tables into time segment matrices;
 - Adjust background traffic;
 - Load trips onto highway network; and,
 - Post process model outputs.

SRESP Evacuation Method



Initialization

Initialization

Identify evacuation conditions and initialize model

Determine number of evacuation trips.

Split trips into destination purposes.

Adjust background traffic.

Factor trip tables into time segment matrices.

Distribute trips throughout study area.

Load trips onto highway network.

Post process model outputs.

Initialization

- Model needs to determine the hazard conditions representing the particular scenario that will be analyzed
- This allows the model to accurately identify the areas that are be subject to evacuation and to determine the intensity of the evacuation event
- This process establishes the appropriate rates that will be used to determine the number of evacuation trips that will be generated

Initialization

- The modeler begins any scenario run by establishing a set of parameters specific to the evacuation scenario that the modeler wishes to analyze
- These parameters let the evacuation model know which sets of data to use and which evacuation rates are appropriate for a given scenario
- The parameters that can be selected by the user on the following slide

Initialization

- Parameters:
 - Which counties evacuate
 - Evacuation level / severity
 - Behavioral rates
 - Response curve
 - School session for university students
 - Whether to include tourists in the evacuation
 - Which shelters should be open
 - Which one way flow operations plans should be active
 - Analysis Year

Counties

- The SRESP model contains all 67 counties in the State of Florida and also includes two coastal counties in Alabama (Baldwin and Mobile) and two coastal counties in Georgia (Camden and Glynn)
- Monroe county separated into 5 distinct parts: mainland, upper keys, middle keys, lower keys, and Key West
- Each county (or part of Monroe County) can be assigned its own set of parameters separate from other counties

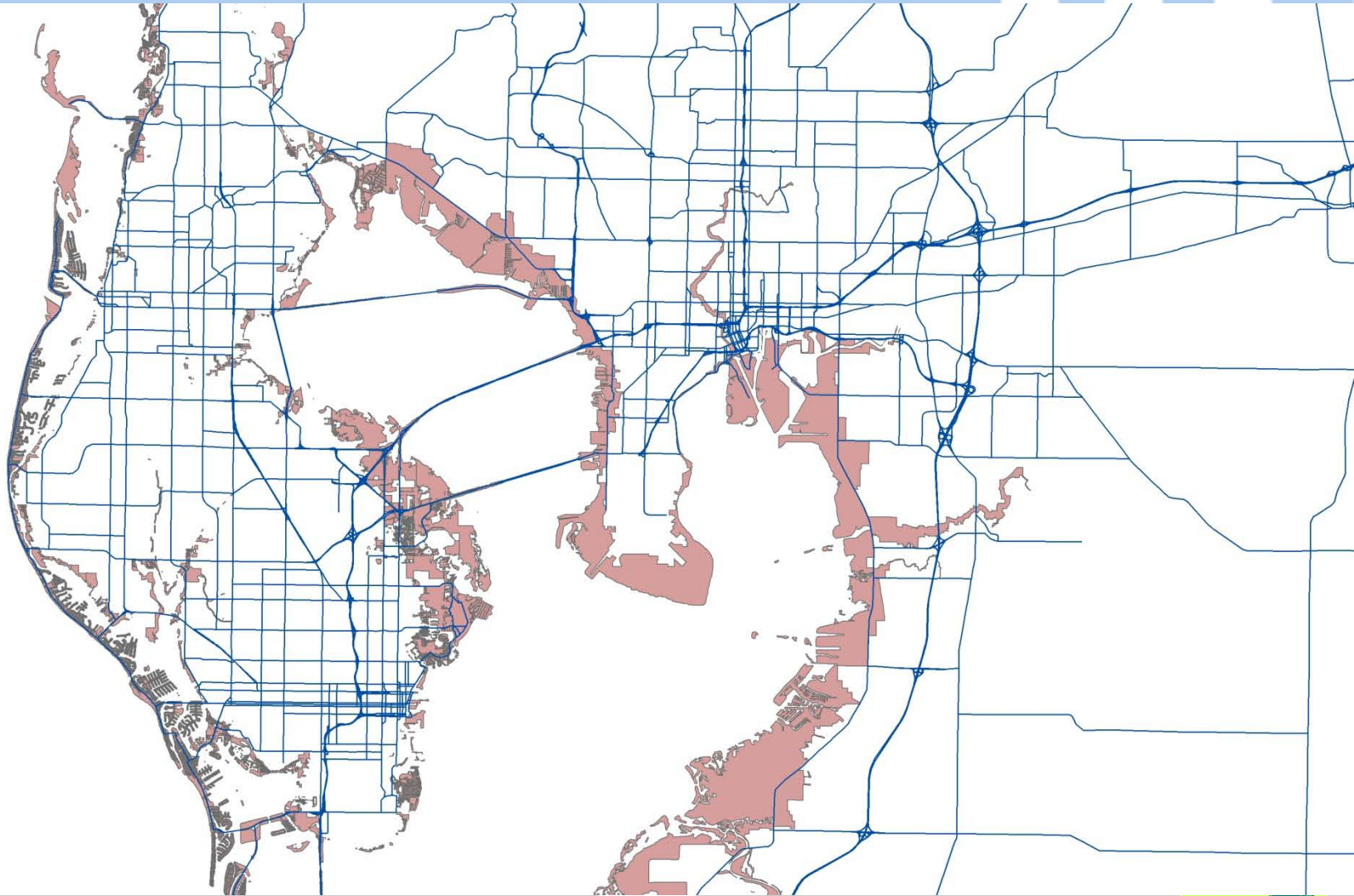
Evacuation Level

- Evacuations are modeled in the SRESP model by designating an intensity of evacuation for each county
- This intensity, or evacuation level, is consistent with the evacuation zones designated by each county:
 - A
 - B
 - C
 - D
 - E
- No evacuation level = No evacuation

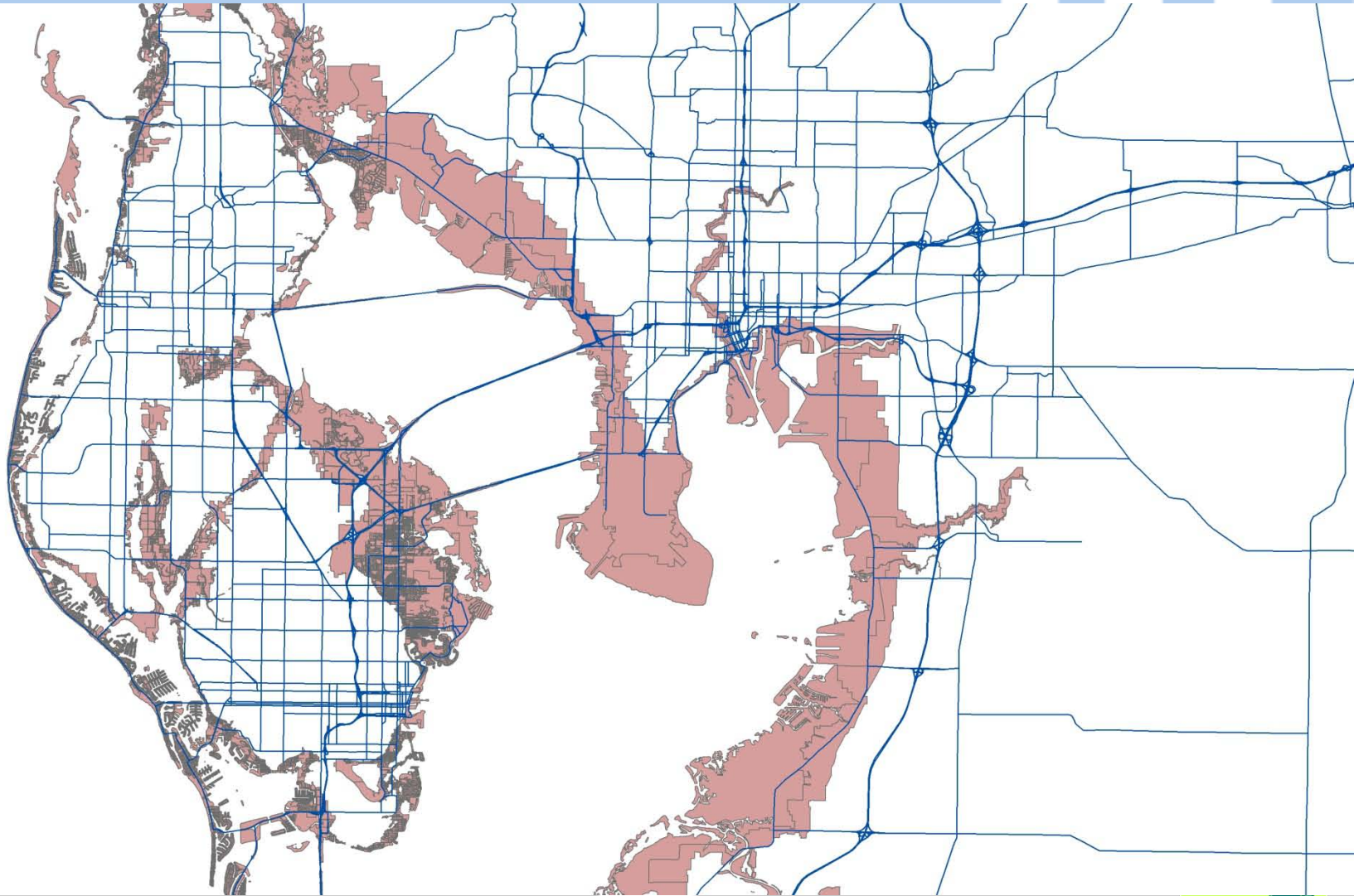
Evacuation Level

- Each greater zone is inclusive of all lesser zones such that an evacuation level of B will evacuate both zones A and B
- Evacuation zones are provided to the study by the counties and are included into the model data set
- The evacuation level has a direct impact on the amount of evacuation traffic that is ultimately loaded onto the model's highway network
 - This depends heavily on where households are located in relation to the evacuation zones

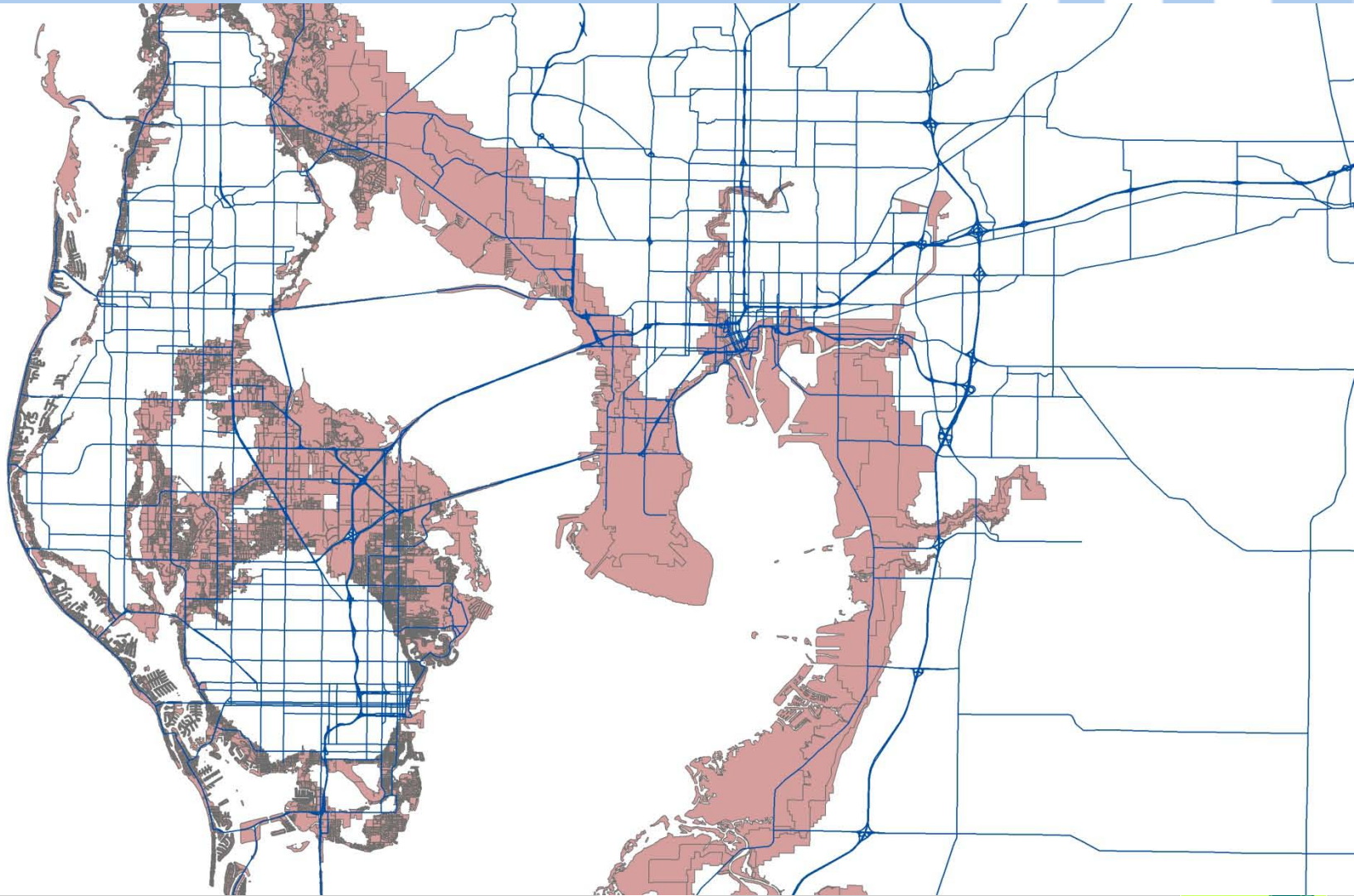
Evacuation Level - A



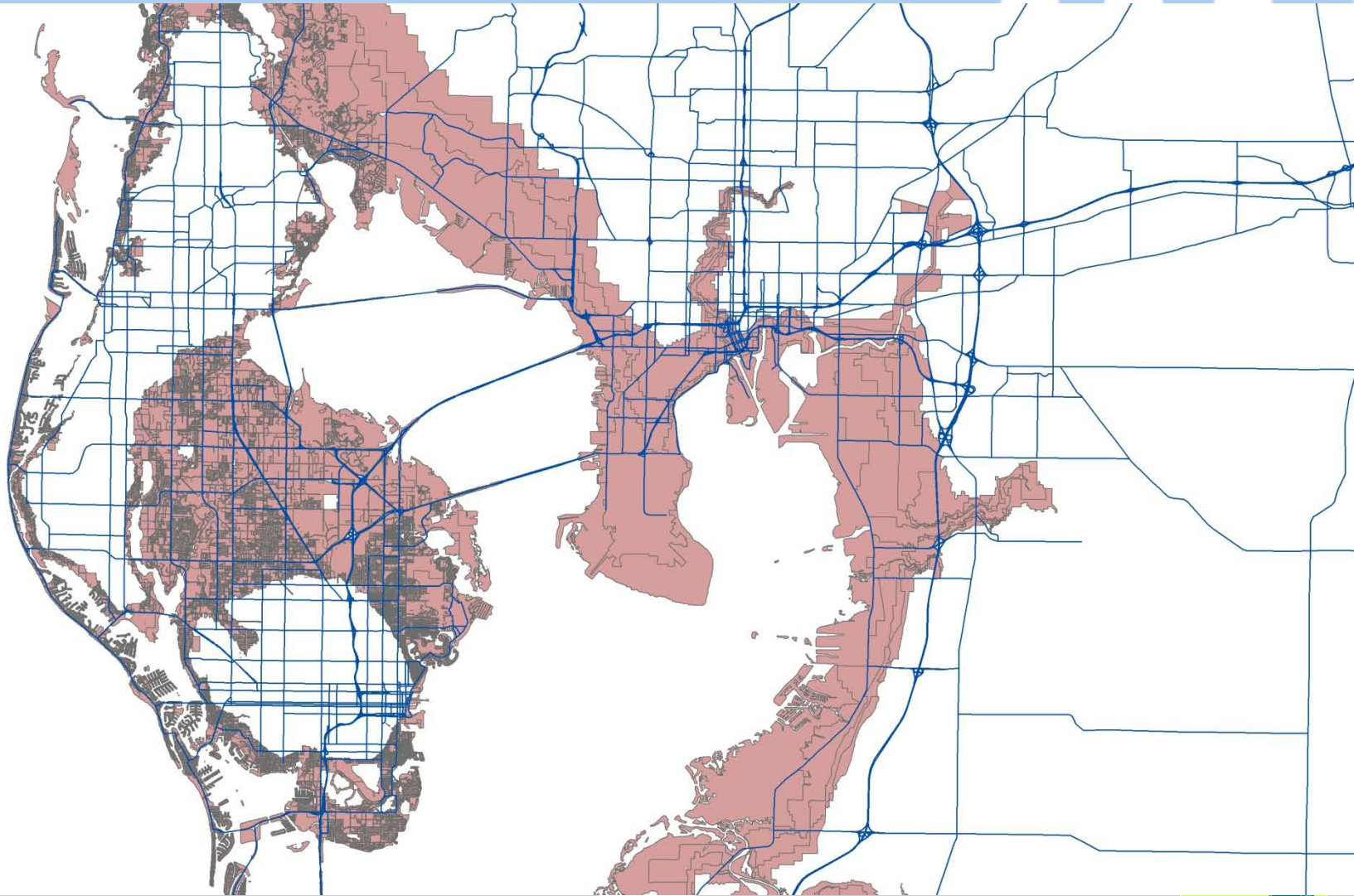
Evacuation Level - B



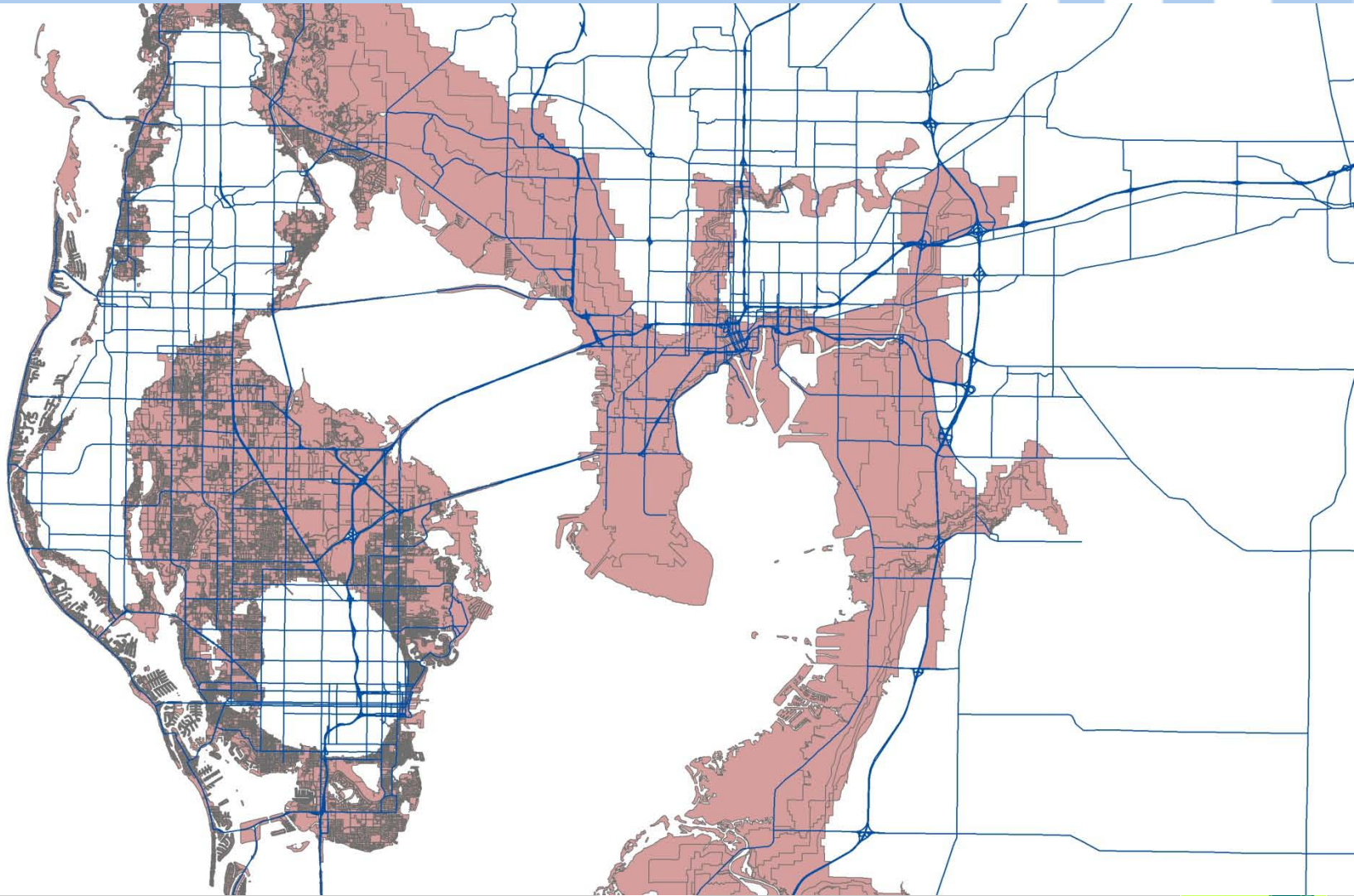
Evacuation Level - C



Evacuation Level - D



Evacuation Level - E



Behavioral Rates

- Behavioral data collected and analyzed as part of the SRESP effort
- County specific planning rates developed from behavioral data:
 - Participation rates
 - Vehicle use rates
 - Out-of-County evacuation rates
 - Public shelter use rates
 - Friends and Family rates
 - Hotel/Motel use rates
 - Other destinations rates

Behavioral Rates

- Rates are distinguished between site-built and mobile home dwelling units
- Model user can select between to basic rate types for each scenario:
 - Planning rates response: Evacuation response is consistent with the planning rates developed from the SRESP behavioral survey for each county
 - 100% response rates: 100% of site-built homes in the evacuation zone plus 100% of mobile homes plus shadow evacuations outside of the evacuation zone

Response Curves

- Response curves developed for the SRESP were based on observed evacuation data from prior storms
- Temporal data not available from recent round of behavioral studies
- Standard curves are described as fast (12 hours), medium (18 hours), and slow (24 hours)
- No clearance time can be shorter than the response curve

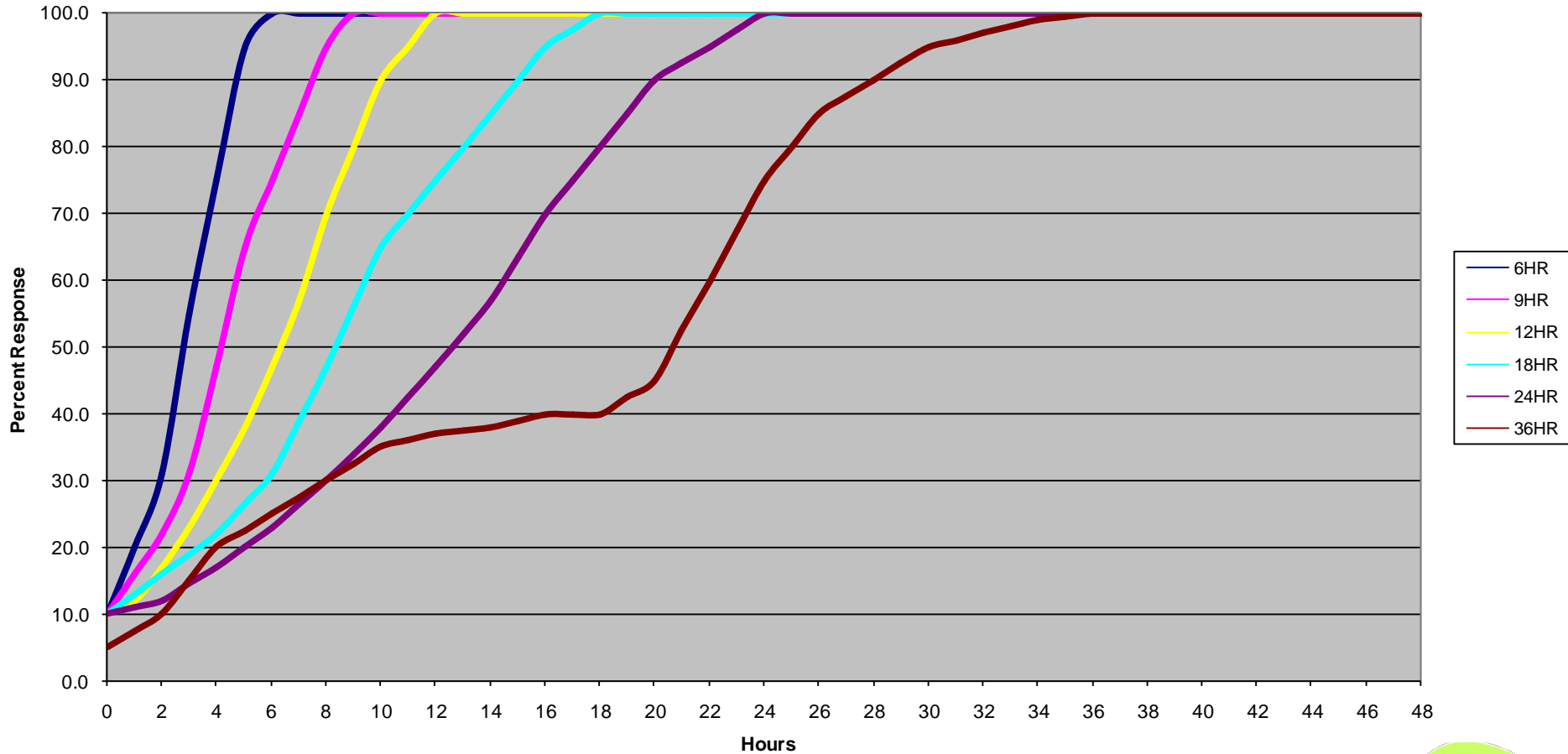
Response Curves

- The modeler can select between six different curves:
 - 6 hours
 - 9 hours
 - 12 hours
 - 18 hours
 - 24 hours
 - 36 hours
- The first five curves assume that 10% of all evacuees leave and are clear before the order to evacuate is given; the last curve assumes 5%

Standard SRESP curves

Response Curves

Accumulated Response



Universities

- The model includes data on the major universities in Florida
- Assumes two persons per dorm room
- Modeler can choose between the following:
 - Fall / Spring semester (full student population)
 - Summer semester (half student population)
 - Out of session (no student population)
- Students living in an evacuation zone evacuate with site-built population

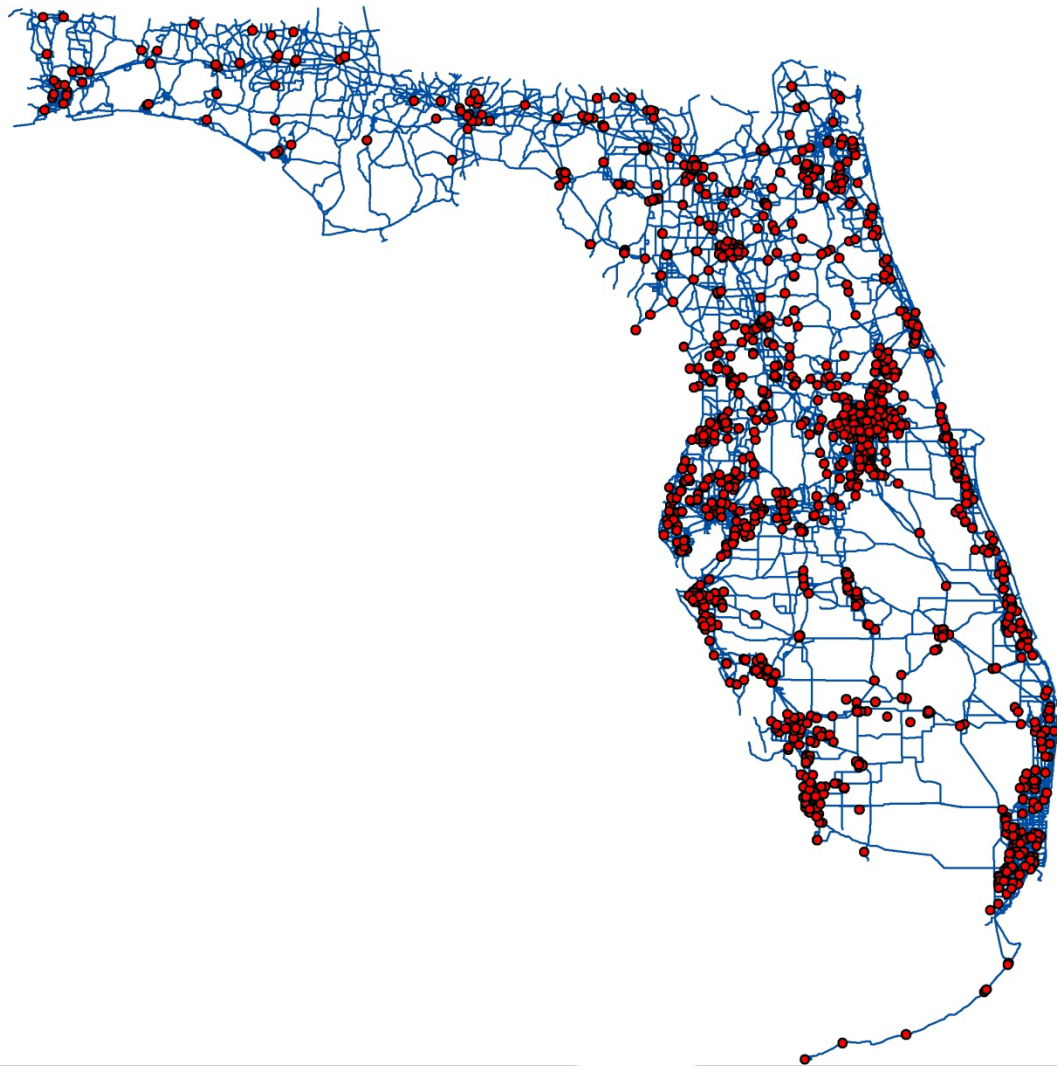
Tourists

- The model contains data on tourists
- Model user can override the tourist data by either excluding tourists or modifying the tourist occupancy rates to increase or decrease the number of tourists
- Tourists evacuate only if the majority of their traffic evacuation zone is threatened by the storm, otherwise, tourists stay in place
- Evacuating tourists are assumed to have access to one vehicle per family

Shelters

- The model contains data on shelters throughout Florida
- Each shelter has a designated capacity in terms of available beds
 - The model assumes 1.85 persons per automobile for trips heading to shelters
- Each shelter is designated as with **primary** or **other**
- The model user can identify which shelters are open or closed and can modify the shelter capacities if needed

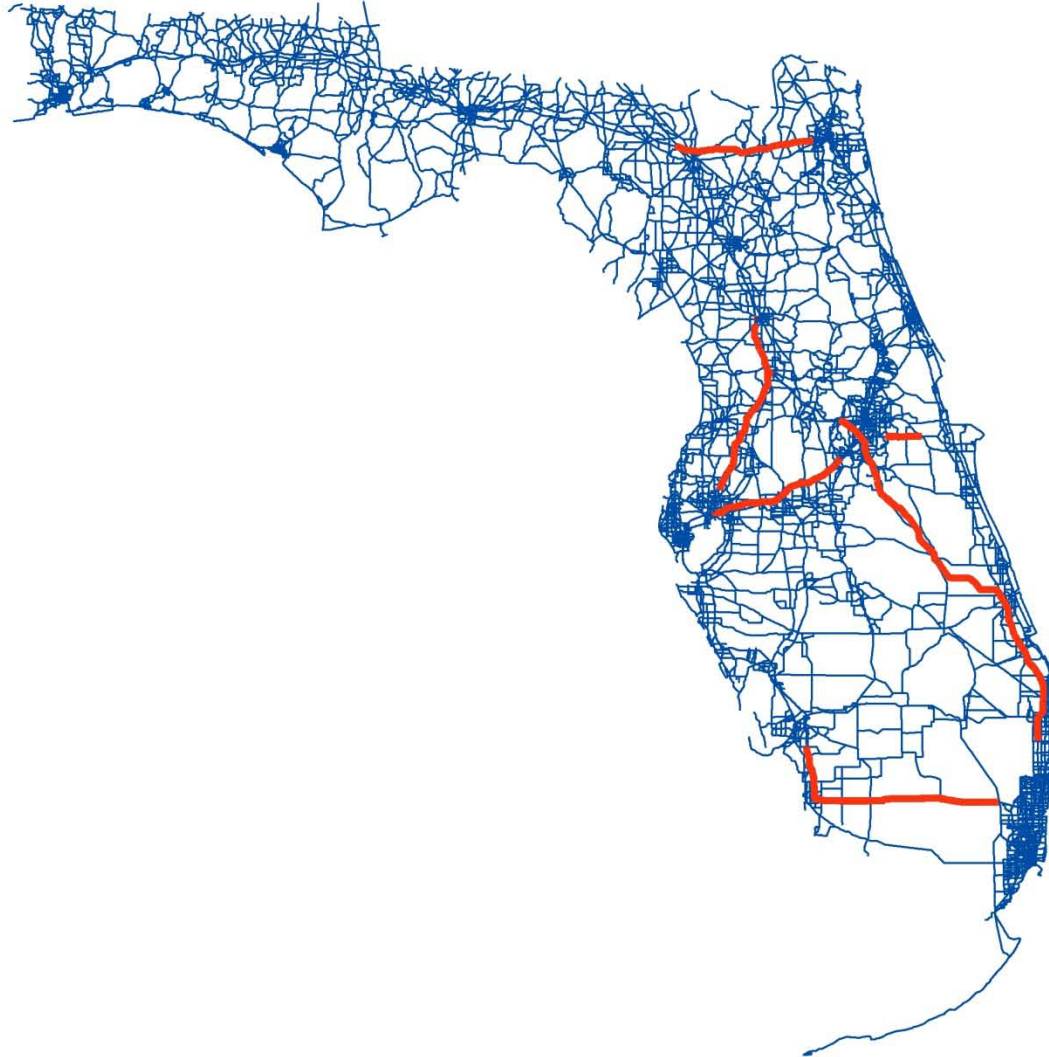
Shelters



One-Way Evacuation Operations

- There are currently seven FDOT one-way evacuation operations plan in the State of Florida:
 - I-10: Jacksonville to I-75
 - SR 528: West toward Orlando
 - I-4: Tampa to Orlando
 - Florida's Turnpike: Palm Beach County to Orlando
 - I-75 Alligator Alley: Naples to Ft. Lauderdale
 - I-75 Alligator Alley: Ft. Lauderdale to Naples
 - I-75: Tampa to Wildwood
- The modeler can activate a one-way operation plan in a scenario if it exists in the region being modeled

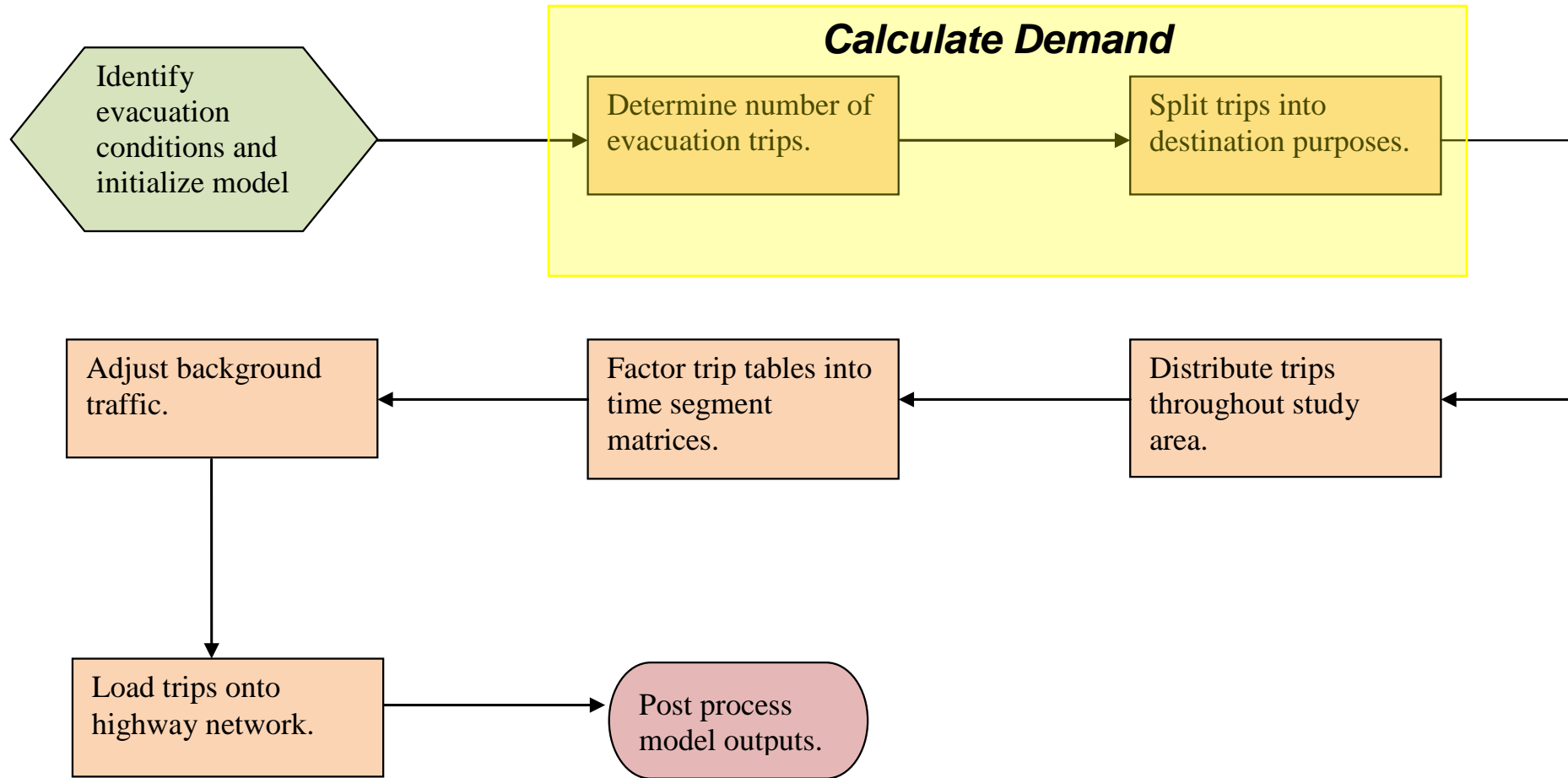
One-Way Evacuation Operations



Analysis Years

- The model has data for the following years:
 - 2006
 - 2010
 - 2015
- The model user can select a year for each scenario
- Population data and roadway characteristics are automatically updated based on the year selected

Calculating Demand



Traffic Evacuation Zones

- Demographic data were developed by the RPCs at the small area level:
 - Census block groups
 - Metropolitan Planning Organization (MPO) TAZs
- Small area data geographies were aggregated into larger units called Traffic Evacuation Zones (TEZ)
- TEZs form the basic unit of analysis in the evacuation model similar to how traffic analysis zones form the basic unit of analysis in a standard travel demand model

Traffic Evacuation Zones

- The TEZ system was developed so that the small area geographies will nest completely within one TEZ or another
- Eliminates any potential for split data and will ensure that data in the TEZ system can be updated with relative ease.
- The final TEZ system has 17,328 zones, a number that provides sufficient detail to accurately assign trips onto an evacuation network

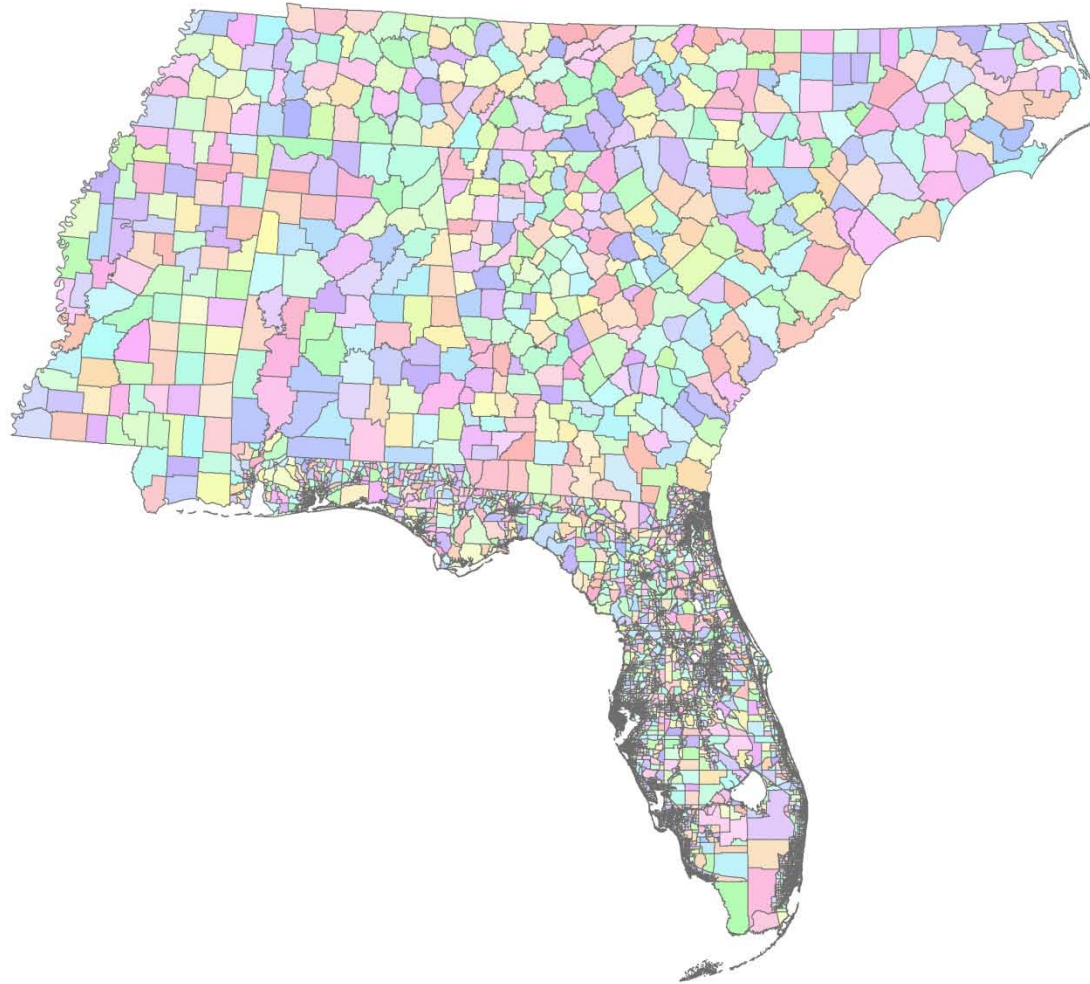
Traffic Evacuation Zones

- TEZs exist for all of Florida and all of the following states in the SRESP model: Georgia, Alabama, Mississippi, South Carolina, North Carolina, and Tennessee
- TEZs in Florida and in Baldwin County, AL, Mobile County, AL, Camden County, GA, and Glynn County, GA are at a sub-county level
- TEZs in the rest of the model are at the county level

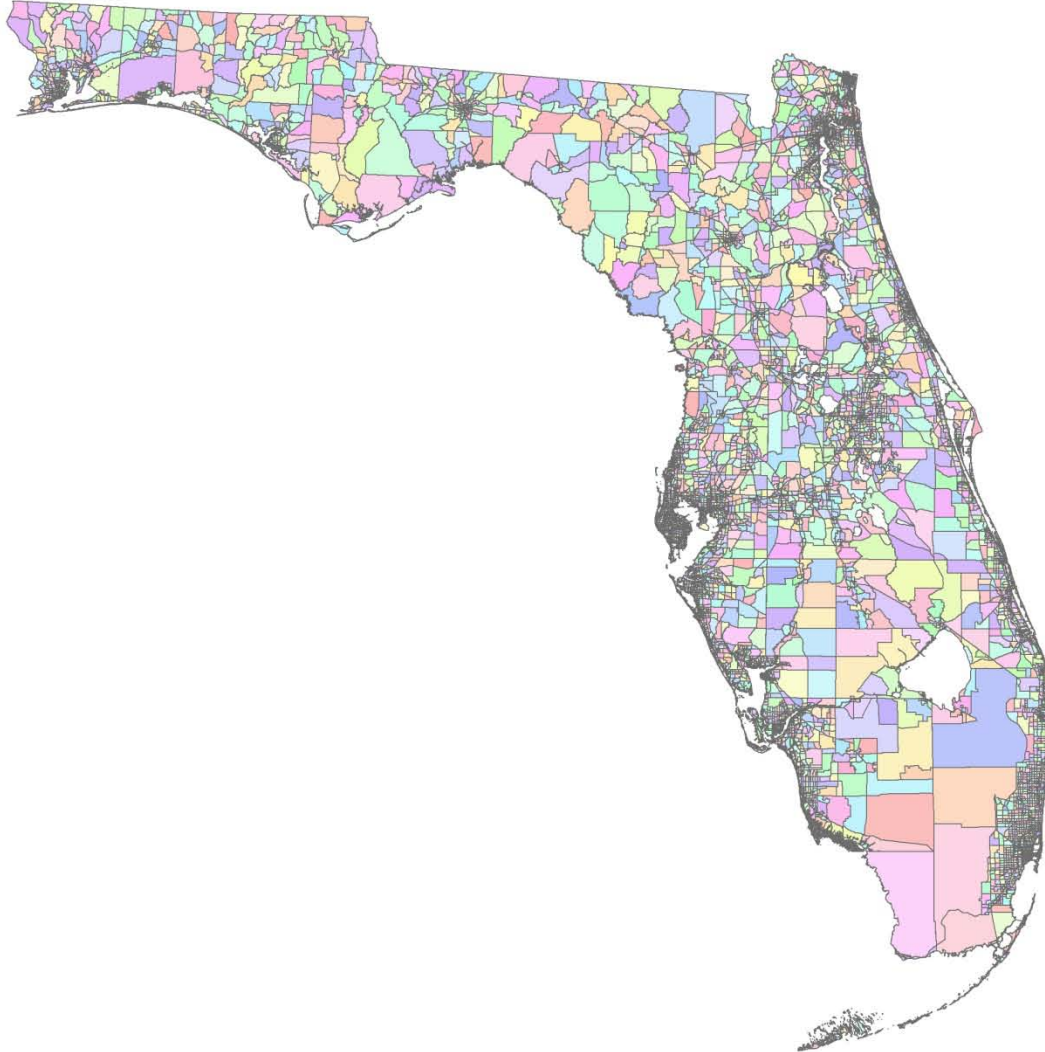
Traffic Evacuation Zones

- TEZs are typically smaller along the coasts and larger inland
- Some coastal TEZs in rural counties are built from very large Census block groups and are larger than typical coastal TEZs
- All evacuation trips begin and end in a TEZ

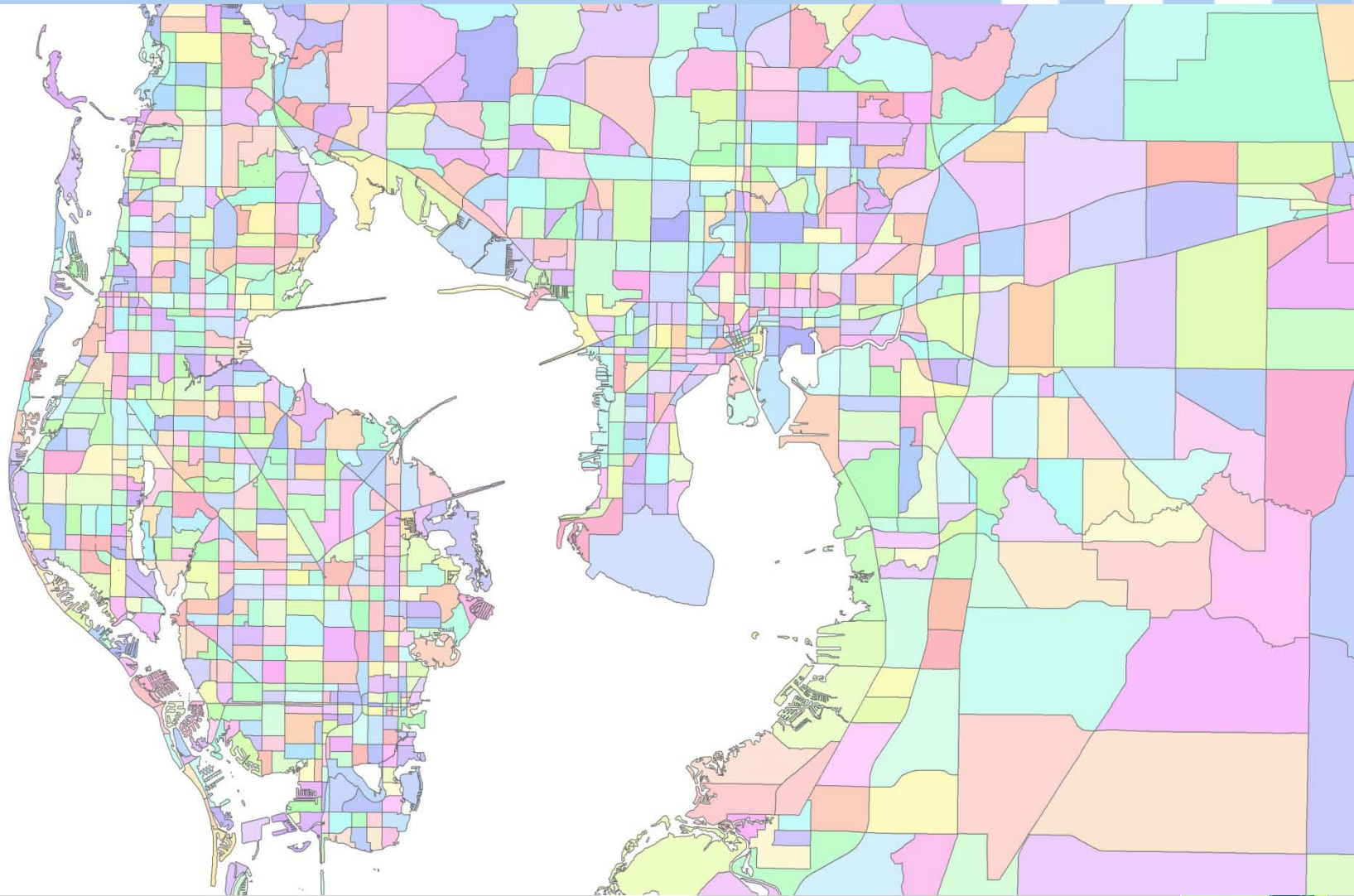
Traffic Evacuation Zones



Traffic Evacuation Zones



Traffic Evacuation Zones



Demographic Data

- Each TEZ has associated demographic data:
 - Dwelling units
 - Population
 - Vacancy rates
 - Auto ownership
 - Tourists
 - University population
 - PCAT
- Data exist for each analysis year and are distinguished between site-built and mobile homes
- The evacuation model has no economic component

Demographic Data

Cube (Licensed to Wilbur Smith Associates) - [TEZ_Working.dbf (C:\SRESP_EM\Base)]

File Scenario Edit Run Database Tools Other Apps Window Help

A

SRESP_EM.cat	Z	SWTEZ	EAZ	DSSB_06	DMSB_06	DTSB_06	PCSSO_06	PCMSO_06	PCTSO_06	ODSSB_06	ODMSB_06	ODTSB_06	PHSSB_06	PHMSB_06	PHTSB_06	PSSB_06	PMSB_06	P
Base	15300	15300	696	382	4	386	0.76	1	0.88	290	4	294	2.43	1.75	2.09	705	7	
	15301	15301	696	301	15	316	0.91	1	0.95	274	15	289	2.43	1.75	2.09	665	26	
	15302	15302	696	228	0	228	0.71	1	0.85	162	0	162	2.43	1.75	2.09	393	0	
	15303	15303	696	295	10	305	0.91	1	0.95	268	10	278	2.43	1.75	2.09	652	18	
	15304	15304	696	582	39	621	0.83	0.86	0.85	488	35	523	2.43	1.75	2.09	1185	62	
	15305	15305	696	523	110	633	0.94	0.82	0.88	492	90	582	2.43	1.75	2.09	1195	158	
	15306	15306	696	590	99	689	0.93	0.91	0.92	552	93	645	2.43	1.75	2.09	1340	163	
	15307	15307	696	378	0	378	0.93	1	0.96	352	0	352	2.43	1.75	2.09	855	0	
	15308	15308	696	145	5	150	0.87	1	0.94	127	5	132	2.43	1.75	2.09	308	9	
SRESP_EM	15309	15309	696	409	10	419	0.85	1	0.93	348	10	358	2.43	1.75	2.09	945	18	
	15409	15409	696	291	35	326	0.87	0.56	0.72	253	20	273	2.4	1.81	2.11	608	35	
	15410	15410	696	365	99	464	0.83	0.93	0.88	303	92	395	2.4	1.81	2.11	727	167	
	15411	15411	696	832	94	926	0.92	1	0.96	770	94	864	2.4	1.81	2.11	1847	170	
	15412	15412	696	585	29	614	0.92	1	0.96	531	29	560	2.4	1.81	2.11	1274	52	
	15413	15413	696	392	4	396	0.92	1	0.96	361	4	365	2.4	1.81	2.11	866	7	
	15414	15414	696	311	0	311	0.9	1	0.95	280	0	280	2.4	1.81	2.11	672	0	
	15415	15415	696	128	10	138	0.83	1	0.92	106	10	116	2.4	1.81	2.11	254	18	
Inputs	15416	15416	696	340	0	340	0.89	1	0.94	302	0	302	2.4	1.81	2.11	725	0	
Outputs	15417	15417	696	304	14	318	0.84	0.86	0.85	255	12	267	2.4	1.81	2.11	612	22	
Reports	15418	15418	696	302	4	306	0.91	1	0.95	275	4	279	2.4	1.81	2.11	660	7	
	15419	15419	696	506	11	517	0.88	1	0.94	445	11	456	2.4	1.81	2.11	1069	20	
	15420	15420	696	491	0	491	0.88	1	0.94	432	0	432	2.4	1.81	2.11	1036	0	
	15421	15421	696	716	0	716	0.72	1	0.86	516	0	516	2.4	1.81	2.11	1238	0	
	15422	15422	696	336	6	342	0.91	0.7	0.81	305	4	310	2.4	1.81	2.11	733	8	
	15296	15296	696	317	0	317	0.88	1	0.94	278	0	278	2.43	1.75	2.09	675	0	
	15297	15297	696	384	3	387	0.85	1	0.93	326	3	329	2.43	1.75	2.09	792	5	
	15298	15298	696	319	14	333	0.89	0.37	0.63	284	5	289	2.43	1.75	2.09	690	9	
	15299	15299	696	294	0	294	0.82	1	0.91	241	0	241	2.43	1.75	2.09	586	0	
	15522	15522	696	752	426	1178	0.86	0.57	0.72	645	244	890	2.54	2.01	2.28	1639	491	
	15523	15523	696	215	719	934	0.86	0.57	0.72	184	412	597	2.54	2.01	2.28	469	829	
	15524	15524	696	285	471	756	0.86	0.57	0.72	245	270	515	2.54	2.01	2.28	621	543	
	15525	15525	696	1293	2079	3372	0.86	0.57	0.72	1109	1193	2302	2.54	2.01	2.28	2818	2397	
	15526	15526	696	438	1615	2053	0.86	0.57	0.72	376	926	1302	2.54	2.01	2.28	955	1862	
	15527	15527	696	2	2531	2533	0.86	0.57	0.72	2	1452	1453	2.54	2.01	2.28	4	2918	
	15528	15528	696	24	446	470	0.86	0.57	0.72	21	256	276	2.54	2.01	2.28	52	514	
	15529	15529	696	2	774	776	0.86	0.57	0.72	2	444	446	2.54	2.01	2.28	4	892	
	15530	15530	696	2	1383	1385	0.86	0.57	0.72	2	793	795	2.54	2.01	2.28	4	1595	
	15531	15531	696	0	390	390	0.86	0.57	0.72	0	224	224	2.54	2.01	2.28	0	450	

Start | GHC Slides | Evac.Study | (3) Evacuation M... | NARC Presentati... | Workshop Outlin... | Prototype Model ... | Evac.Traffic Wor... | Cube | Inbox - Microsoft... | untitled - Paint | 3CRV524H_for m... | TripRatesMaster... | 3:25 PM

Calculating Demand

- Estimating an appropriate number of trips is essential to ensuring that the model accurately reflects evacuation behavior
- The participation rates developed from the behavioral study is a critical component of calculating demand
- The model calculates the demand by applying the participation rates to the households in the model to determine how many households are evacuating

Calculating Demand

- There are three key factors considered by the model when deciding which rates to apply to which households:
 - Dwelling unit type
 - Evacuation level
 - Evacuation zone in which the household is located
- Evacuation zones and TEZ boundaries do not line up
- The PCAT fields are used to determine which evacuation zone each household is in

Calculating Demand

- There are six PCAT fields in the TEZ database:
 - PCAT1: percentage of households in evacuation zone A
 - PCAT2: percentage of households in evacuation zone B
 - PCAT3: percentage of households in evacuation zone C
 - PCAT4: percentage of households in evacuation zone D
 - PCAT5: percentage of households in evacuation zone E
 - PCAT6: percentage of households not in an evacuation zone
- PCAT assumes an even distribution of population in a TEZ
 - Since most TEZs near evacuation zones are small, this is safe assumption
 - Some rural coastal TEZs needed to be adjusted manually

Calculating Demand

- Once the number of households located in an evacuation zone is determined, the model then applies the participation rates to see how many households evacuate for that scenario
- Once the number of evacuating households are known, the vehicle use rates are applied to determine how many vehicles will be on the roads as a result of the evacuation

Calculating Demand

- The participation rates always assume that 100% of site-built homes in the evacuation zones are ordered to evacuate and 100% of all mobile homes in the county are ordered to evacuate; some shadow evacuation is always part of the rates for site-built homes
- Just because 100% of the people are order to evacuate does not mean that 100% of the people will evacuate
- Unless the 100% response scenario is selected by the modeler, the model will always assume that less than 100% of the threatened population will evacuate

Calculating Demand

- Trip productions are determined by the participation rates
- No data on calculating credible attractions, so the following assumptions are used:
 - 2 attractions per home not in an evacuation zone
 - One for friends and family
 - One for other
 - 1 attraction per unoccupied hotel room not in an evacuation zone
 - 1 attraction for every 1.85 shelter beds
- The resulting attractions are very high and need to be factored down (*balancing of attractions*)

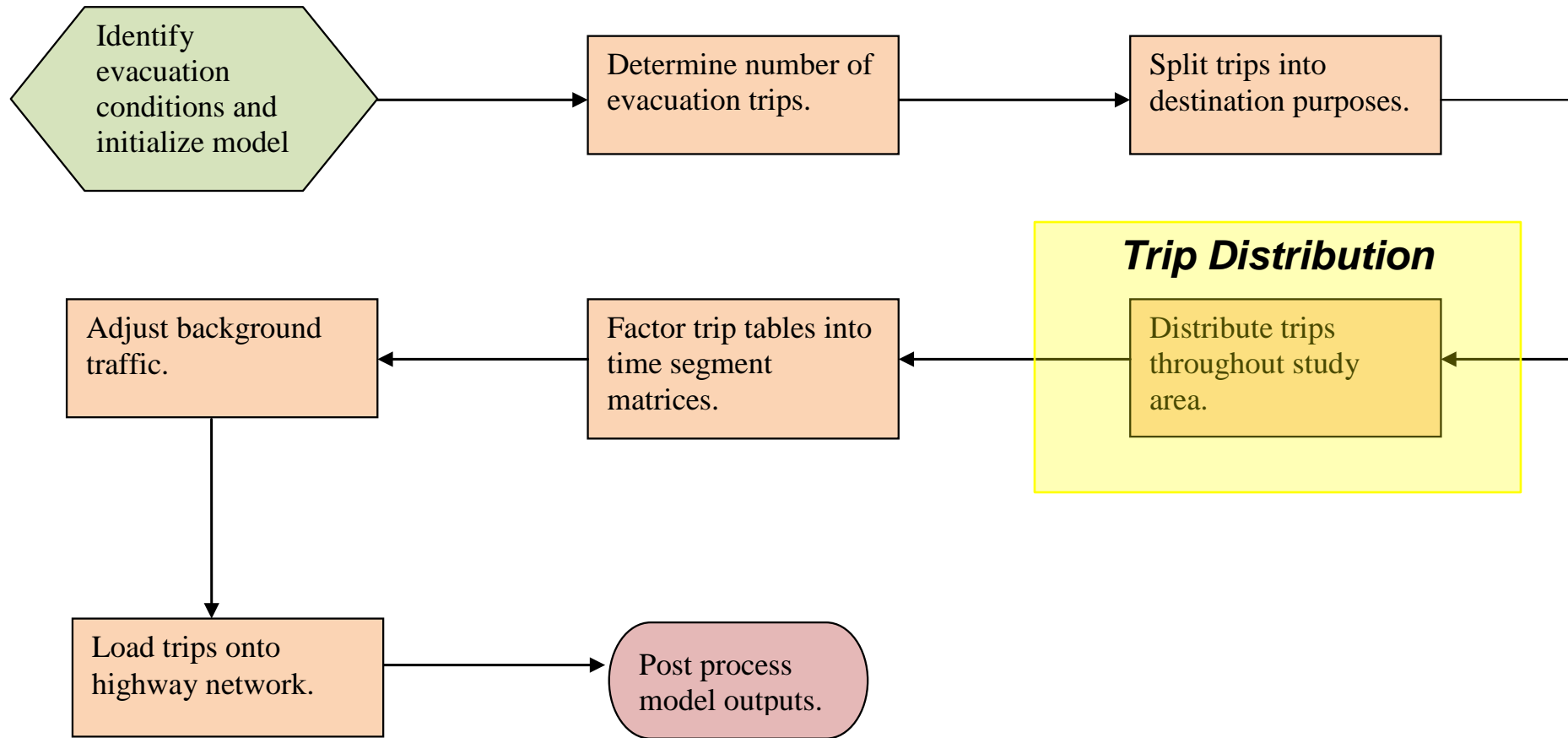
Destination Purposes

- Trip purposes for the SRESP model are not based on the reason for the trip, all trips have the same reason: to flee from danger; rather,
- Trip purposes for the SRESP model are based on the type of destination where the evacuee wants to go and where that destination is located

Destination Purposes

- The types of destination in the SRESP model are:
 - Friends and Family
 - Public Shelter
 - Hotel / Motel
 - Other
- These destinations can either be:
 - In-county; or,
 - Out-of-county
- Trips are split into the different destination purposes using rates developed from the behavioral surveys

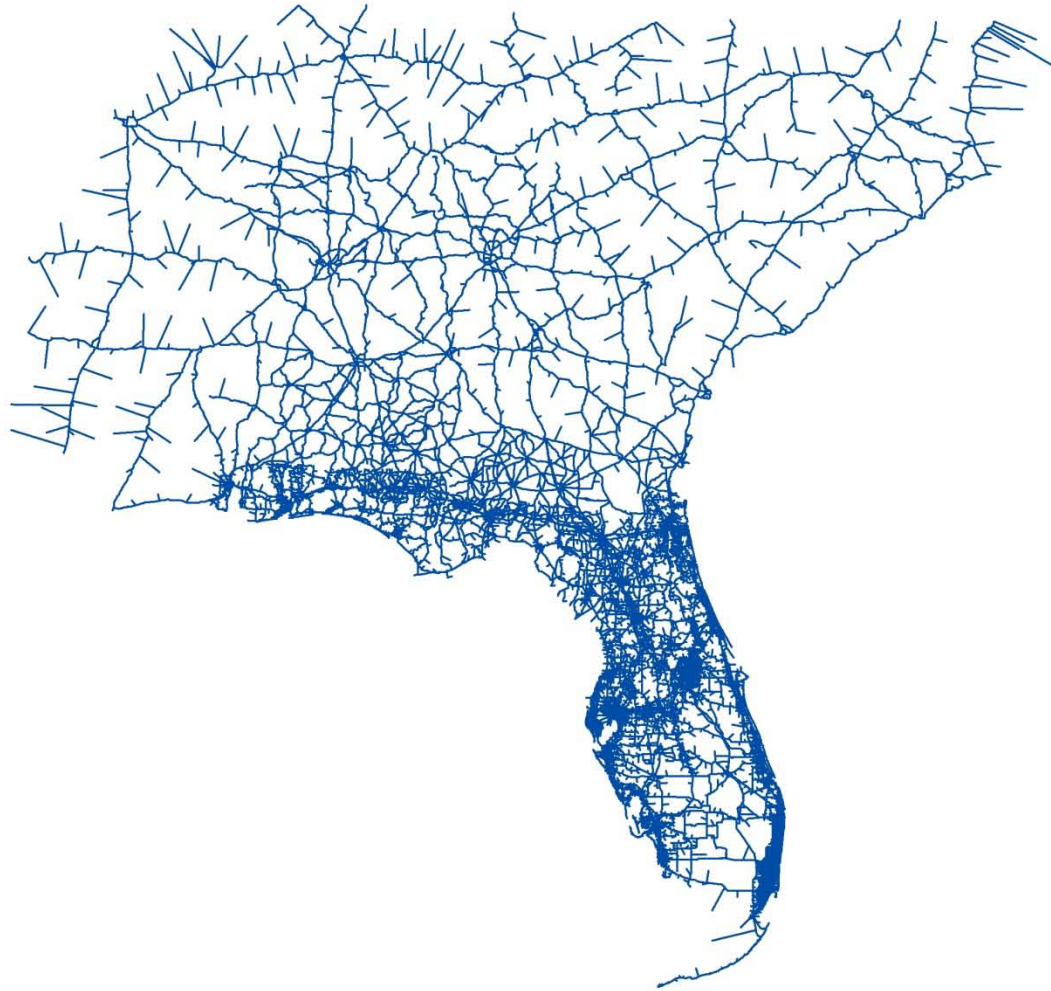
Trip Distribution



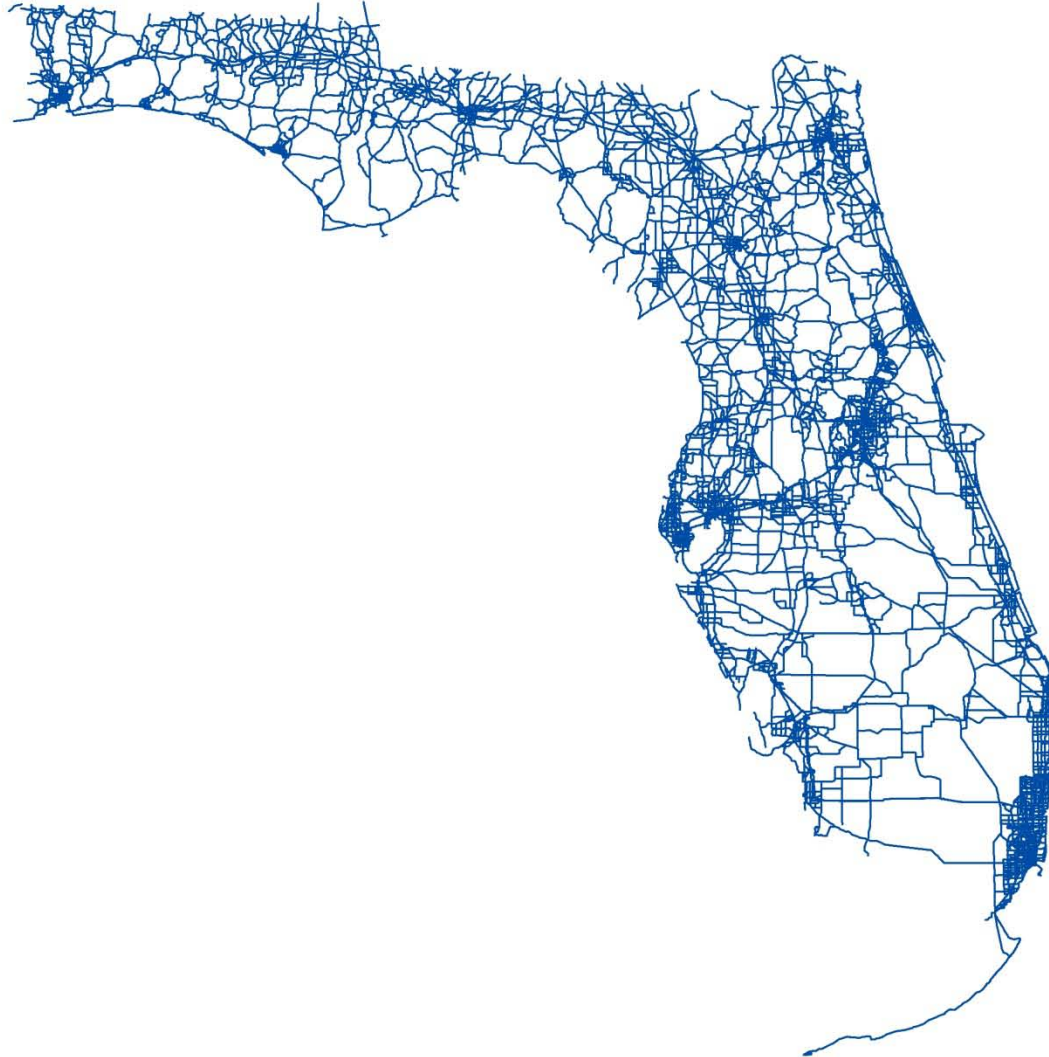
Highway Network

- SRESP model highway network is originally based off of the Florida Statewide Model
- The highway network is stored as a geodatabase:
 - It can be opened in ESRI ArcGIS (if Cube is installed on that machine); but,
 - Can only be edited in Cube
- The network is a master network: it contains data for 2006, 2010, and 2015

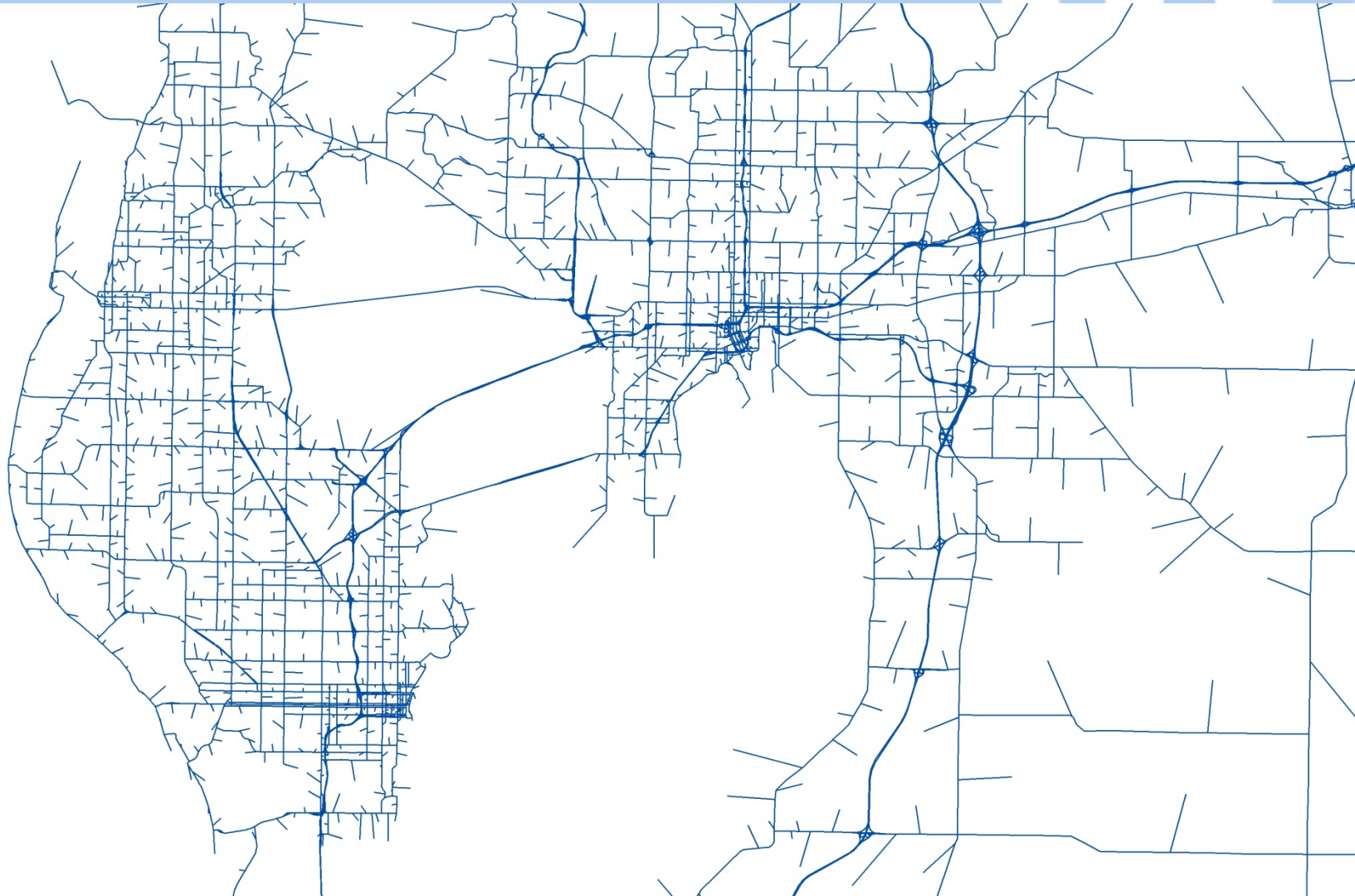
Highway Network



Highway Network



Highway Network



Trip Distribution

- Trips need to be distributed throughout the model in order to connect trip ends
- This process creates a series of evacuation trips
- Data from the behavioral survey made the creation of trip length frequency data very difficult
- The principal component of how trip distribution is directed is based on how the attractions are balanced

Trip Distribution

- Trip attractions are balanced regionally
- This prevents skewing of where trips want to go
- Regional distribution data was extracted from the behavioral survey
- Using a regional balancing of attractions helps to ensure that trips are properly distributed throughout the model
- The regional balancing applies only to out-of-county trips

Trip Distribution

Out-of-County Trips: Regional Distributions

Region	Apalachee	Central	East Central	North Central	Northeast	South	Southwest	Tampa Bay	Treasure Coast	West	Withlacoochee	Out-of-State
Apalachee	31.19%	0.13%	1.10%	2.28%	2.11%	0.00%	0.13%	0.72%	0.30%	3.50%	0.76%	57.80%
Central	5.91%	9.82%	13.00%	4.41%	4.69%	0.00%	4.19%	5.91%	5.41%	0.73%	1.73%	44.20%
East Central	2.53%	1.71%	27.11%	5.41%	5.88%	1.53%	2.65%	6.70%	0.76%	1.41%	3.12%	41.20%
North Central	5.23%	0.73%	3.63%	15.17%	6.26%	0.31%	0.33%	3.09%	0.23%	1.26%	1.99%	61.80%
Northeast	3.72%	0.75%	4.21%	6.59%	10.33%	0.59%	0.59%	1.79%	0.16%	1.89%	1.99%	67.40%
South	1.99%	3.37%	20.91%	2.07%	3.37%	24.51%	5.75%	2.07%	8.96%	0.54%	3.06%	23.40%
Southwest	1.39%	5.23%	15.94%	3.91%	3.28%	4.60%	11.03%	8.38%	3.15%	0.76%	5.36%	37.00%
Tampa Bay	3.21%	3.73%	14.12%	2.81%	4.48%	2.18%	1.32%	15.67%	2.01%	0.52%	7.35%	42.60%
Treasure Coast	2.77%	1.52%	22.84%	3.04%	4.36%	4.49%	3.96%	9.37%	11.48%	0.20%	1.98%	34.00%
West	6.25%	0.24%	2.10%	0.90%	3.49%	0.42%	0.07%	0.31%	0.31%	8.68%	0.80%	76.40%
Withlacoochee	2.39%	1.66%	12.35%	7.37%	3.27%	0.99%	0.67%	6.54%	0.47%	1.25%	15.00%	48.00%

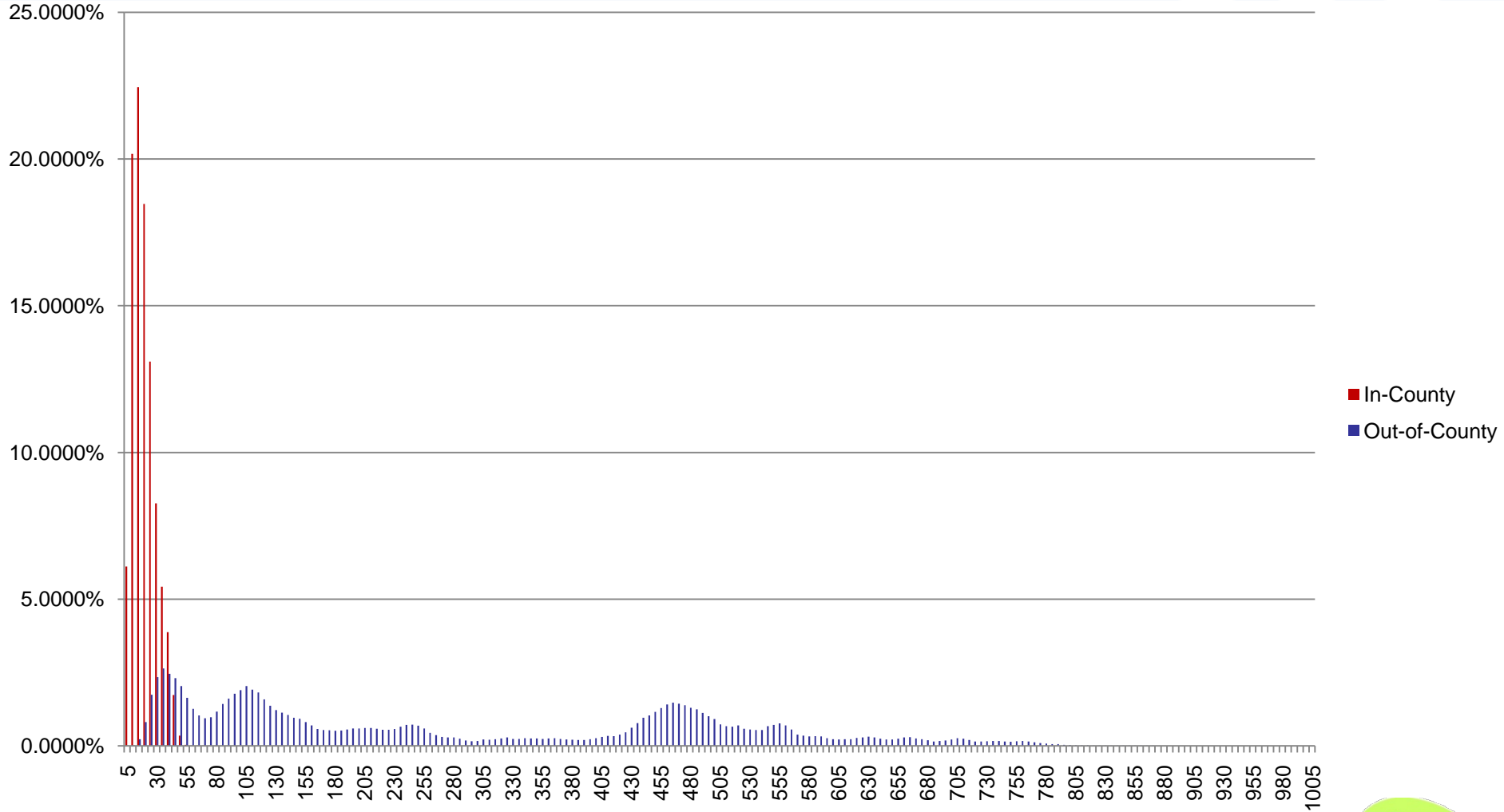
Trip Distribution

- Trip attraction balancing favors highly populated TEZs
- Regional balancing helps to even out the impacts of heavily populated TEZs
- Model then uses a simplified gravity model to distribute trips in-county and out-of-county by destination purpose
- The end result is a trip table for in-county and out-of-county trips

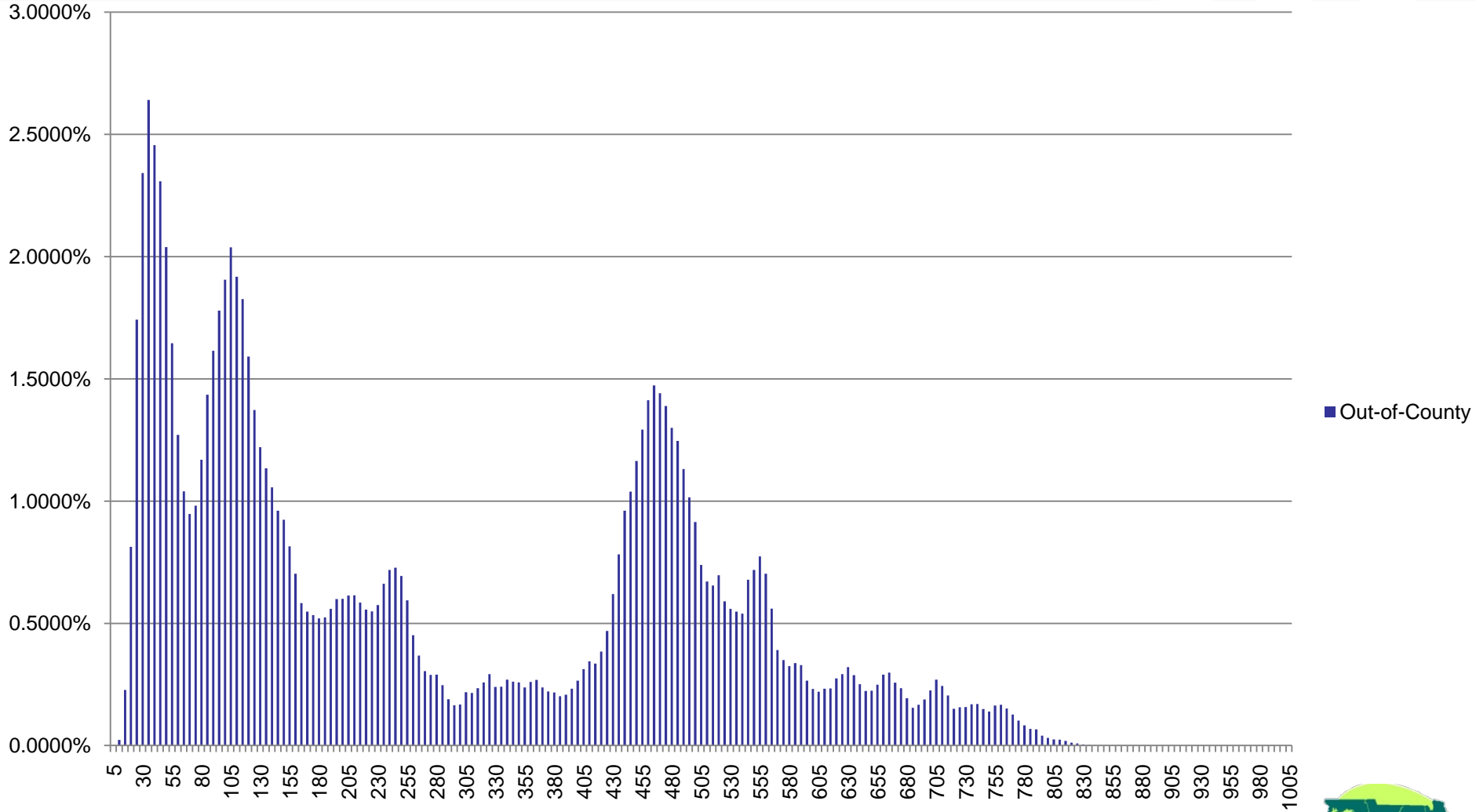
Trip Distribution

- The gravity model favors destinations that have more population and are closer to the origins
- Friction factors are flat, trip length data from survey heavily favored larger cities but derived curves tended to distribute trips too heavily to rural areas
- Unlike traditional travel demand models that use travel times for trip distribution, the SRESP model uses distances.

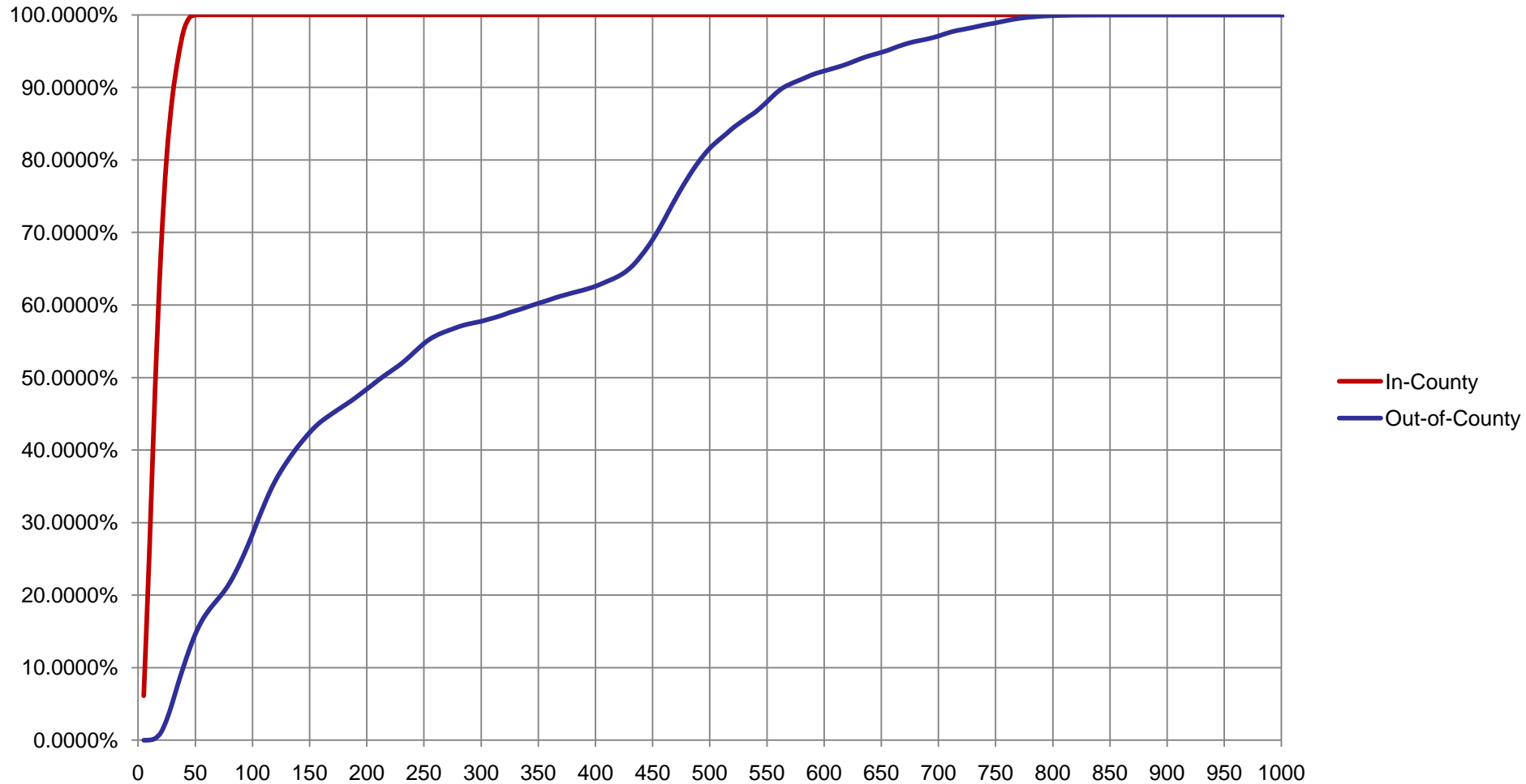
Trip Distribution: F&F



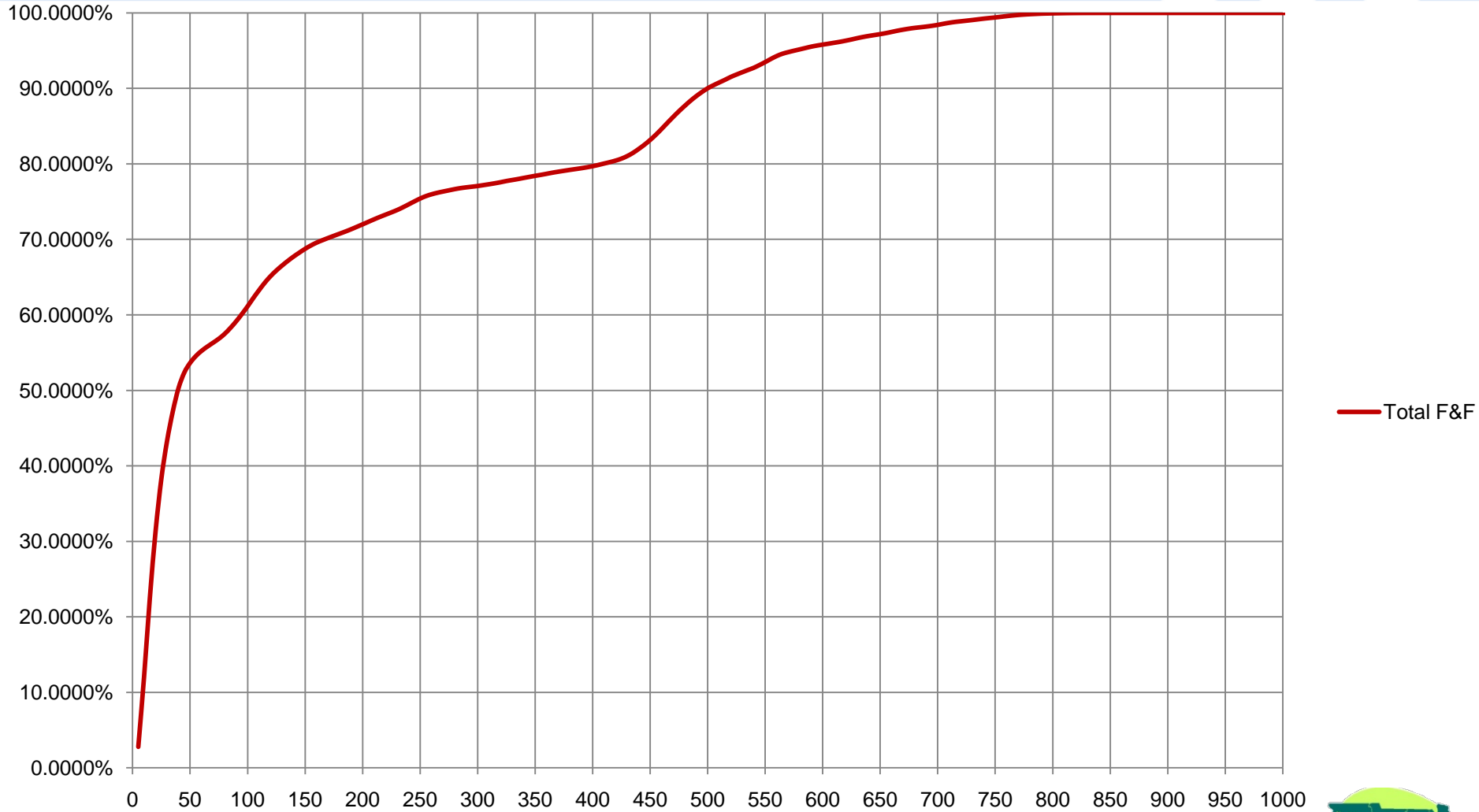
Trip Distribution: F&F



Trip Distribution: F&F



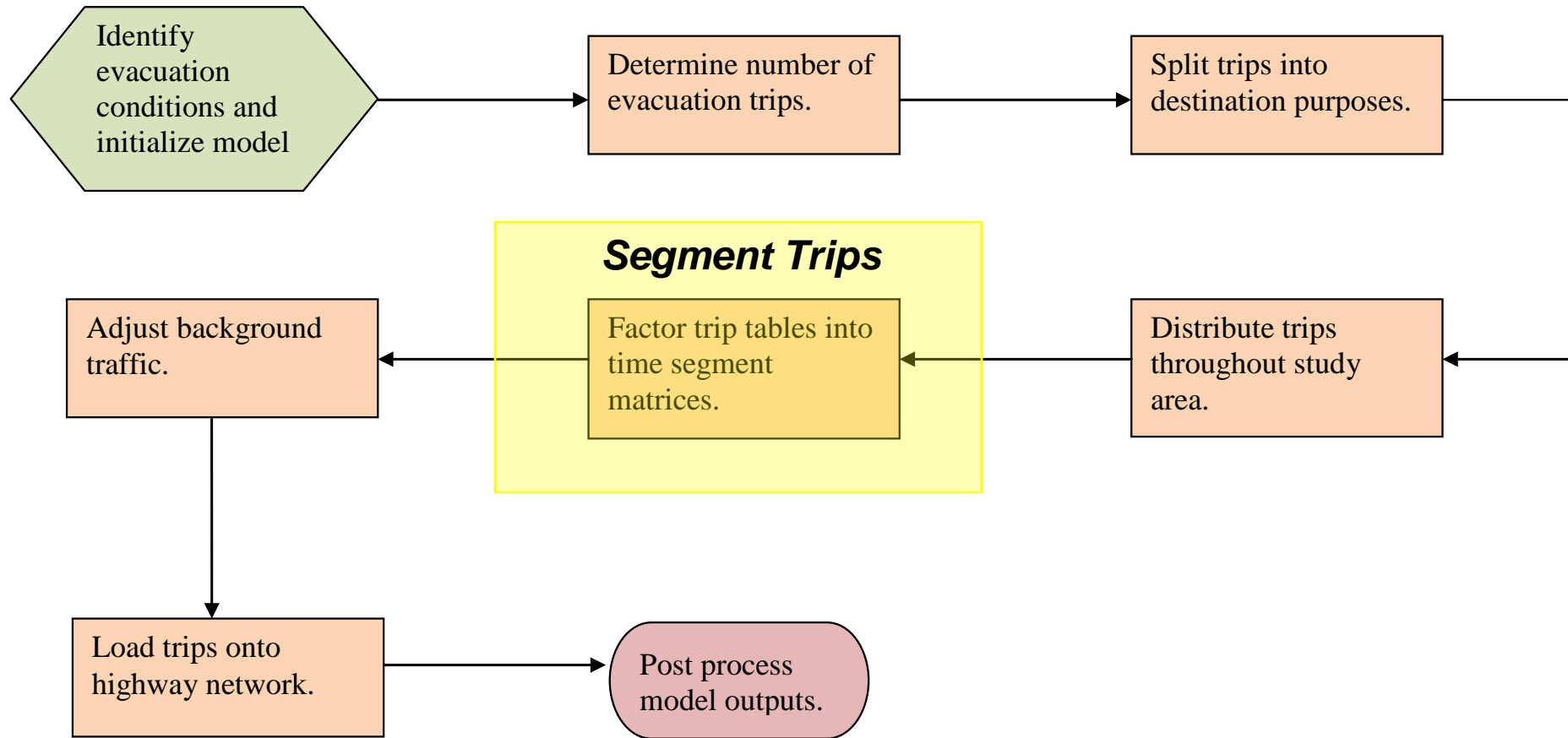
Trip Distribution: F&F



— Total F&F



Segment Trips



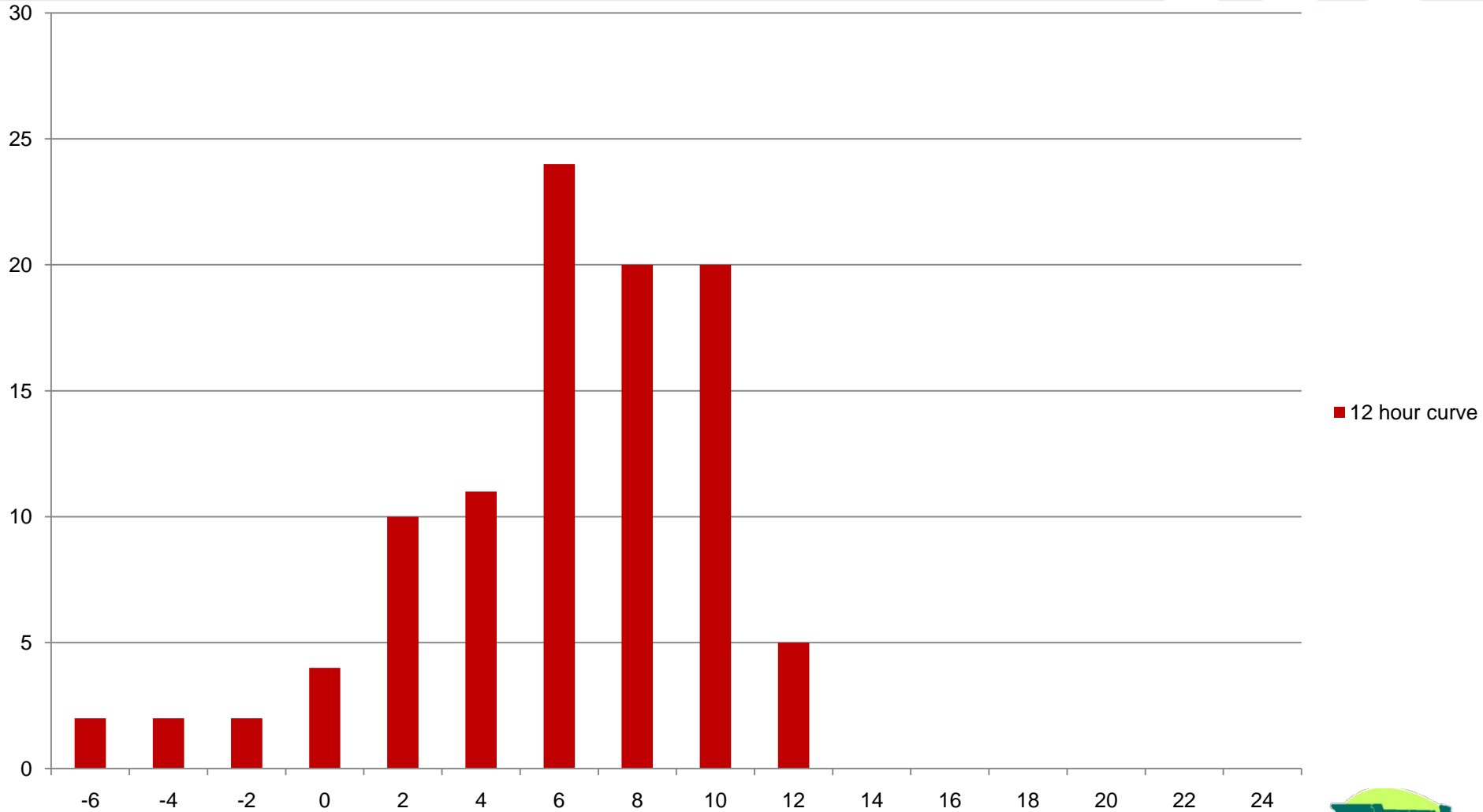
Segment Trips

- During an evacuation, trips load onto the network over time – *not all at once*
- To do this the trip table will need to be parceled out into separate tables for each time interval
- This process is known as time segmentation
- The response curves used by the model are factors that are applied to the trip table in order to get the necessary time segments

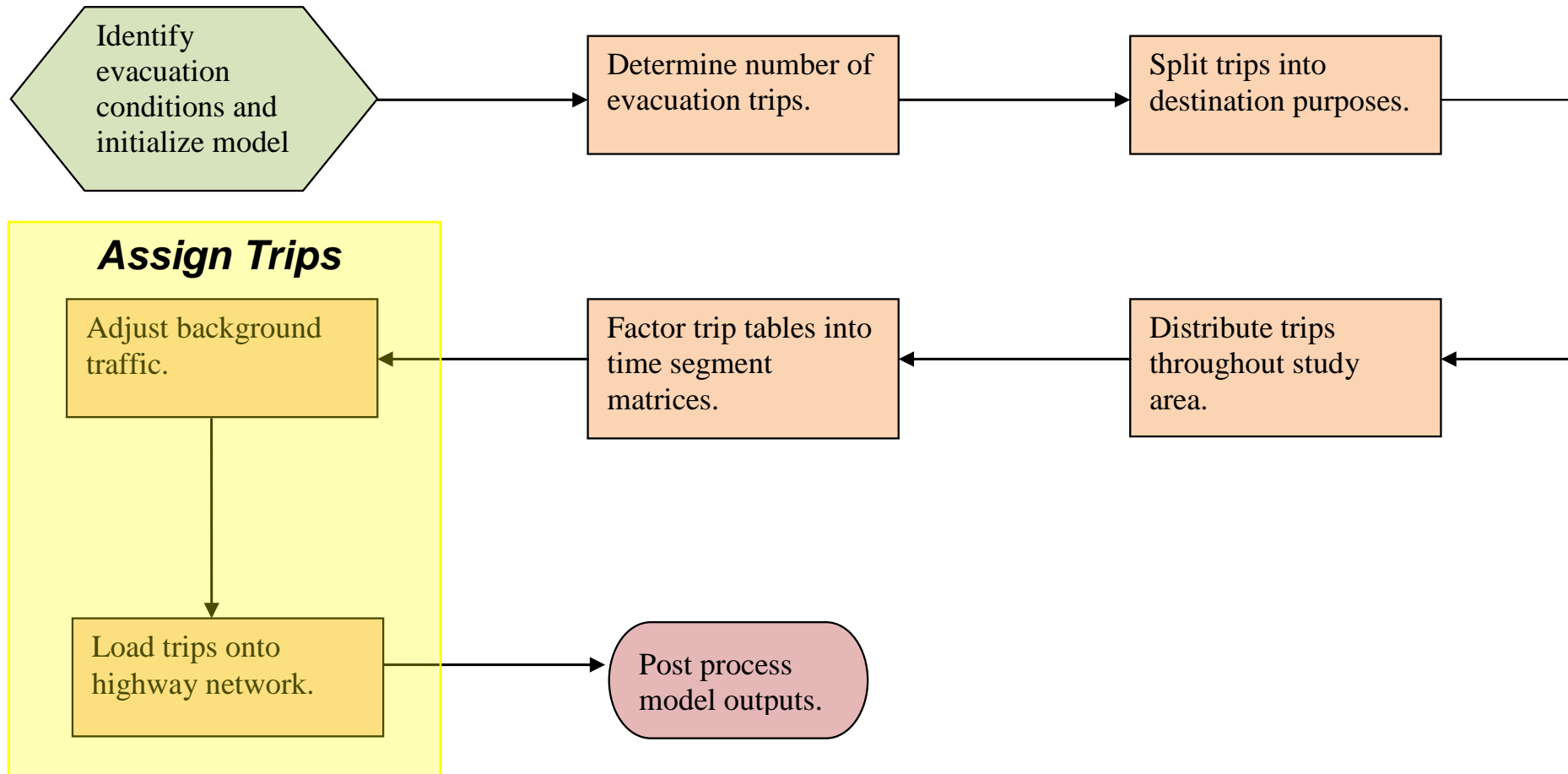
Segment Trips

- Time segments are half-hour long
- There are 192 time segments in the model, representing:
 - A period of 96 hours; or,
 - Four days
- Each of the two trip tables coming out of trip distribution are divided into 192 segments
- The time segmentation assumes that there is lead time to initiating an evacuation (securing property, collecting family members, leaving work, etc.)

Segment Trips



Assign Trips



Assign Trips

- Once the demand has been calculated by the model and the trip tables generated and segmented, the model begins to put trips on the model network. This is called trip assignment.
- The traffic that consumes the roadway capacity of a transportation system during an evacuation can be divided into two groups:
 - Background Traffic
 - Evacuation Traffic

Background Traffic

- Background traffic, as its name implies, is not the primary focus of an evacuation transportation analysis
- It is accounted for primarily to impede the movement of evacuation trips through the network
- These trips represent individuals going about their daily business mostly unconcerned with the evacuation event

Background Traffic

- Background traffic represents trips that are relatively insensitive to an order to evacuate and are thus said to be occurring in the “background”
- Even though background traffic is relatively insensitive to evacuation orders, it can have a dramatic impact on available roadway capacity
- This in turn can severely affect evacuation clearance times

Background Traffic

- There are two dynamics at work when evacuation traffic and background traffic interact with one another:
 - The effect of background traffic displacing evacuation traffic as background traffic attempts to use the same roads as the evacuation traffic; and,
 - The effect of evacuation traffic displacing background traffic.
- As vehicles move along the network and try to get onto certain roads they leave less room for other vehicles to use those same roads – This is what is known as consuming capacity

Background Traffic

- As background traffic builds up there is less room for evacuation traffic to move, and vice versa
- The effect that evacuation traffic has on background traffic may be of some interest to those who are concerned with disruptions in daily trip making behavior during an evacuation event; but,
- For the purposes of this study we are much more interested in the effect that background traffic has on evacuation clearance times

Background Traffic

- The task of processing the evacuation model places a severe burden on today's computing technology
- The sheer volume of trips over vast stretches of the state strains against existing hardware and software limitations
- It would not be possible to model both the evacuation trips and the background traffic directly
- An alternative method is needed for background traffic

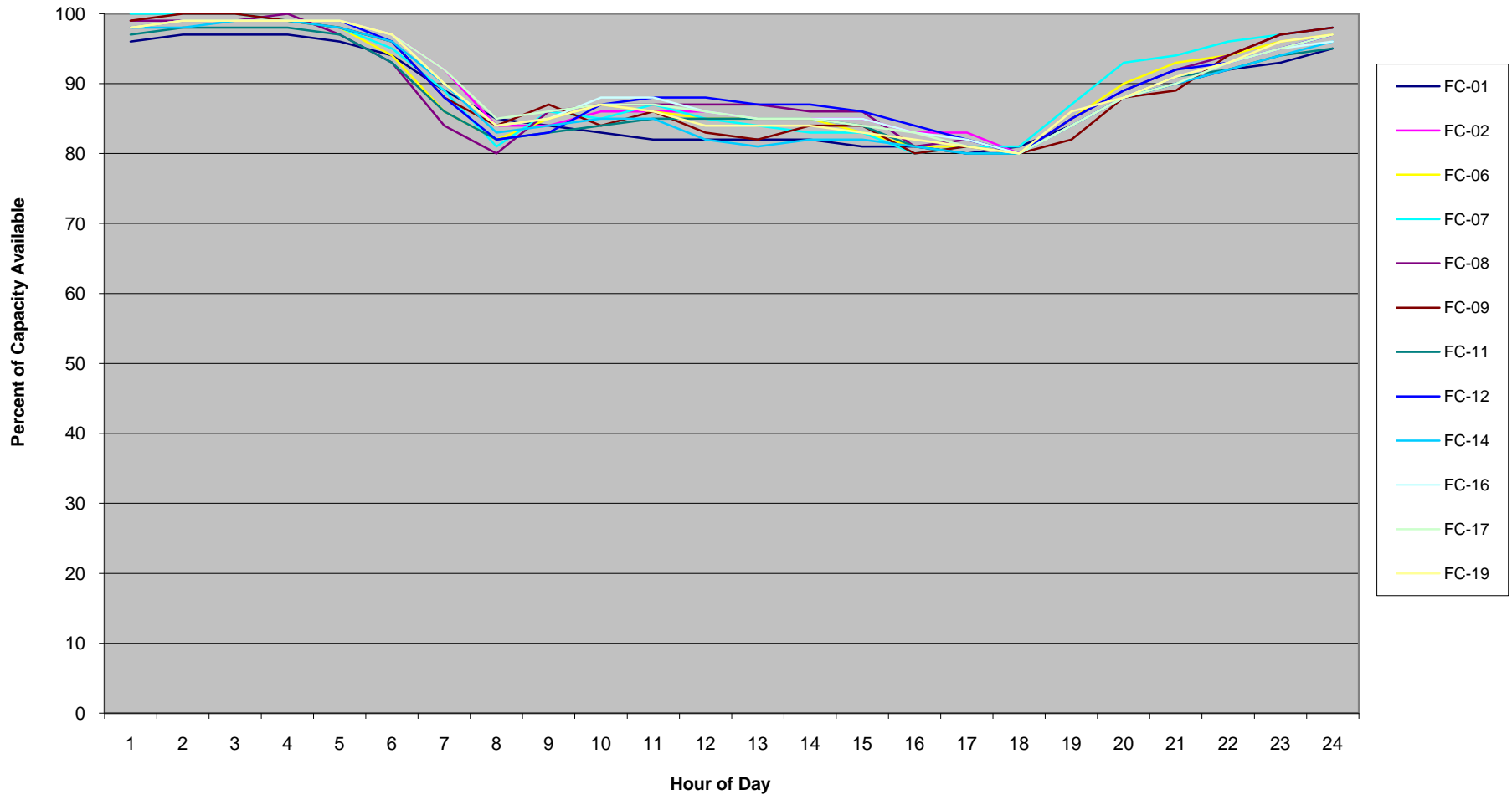
Background Traffic

- The effect that background traffic has on evacuation traffic can be stated in terms of available capacity
- The more background traffic there is on a segment of road, the less capacity is available for evacuation traffic to use
- Following this logic, it becomes apparent that by causing the available capacity to fluctuate throughout the evacuation event, one is able to sufficiently account for the impact of background traffic

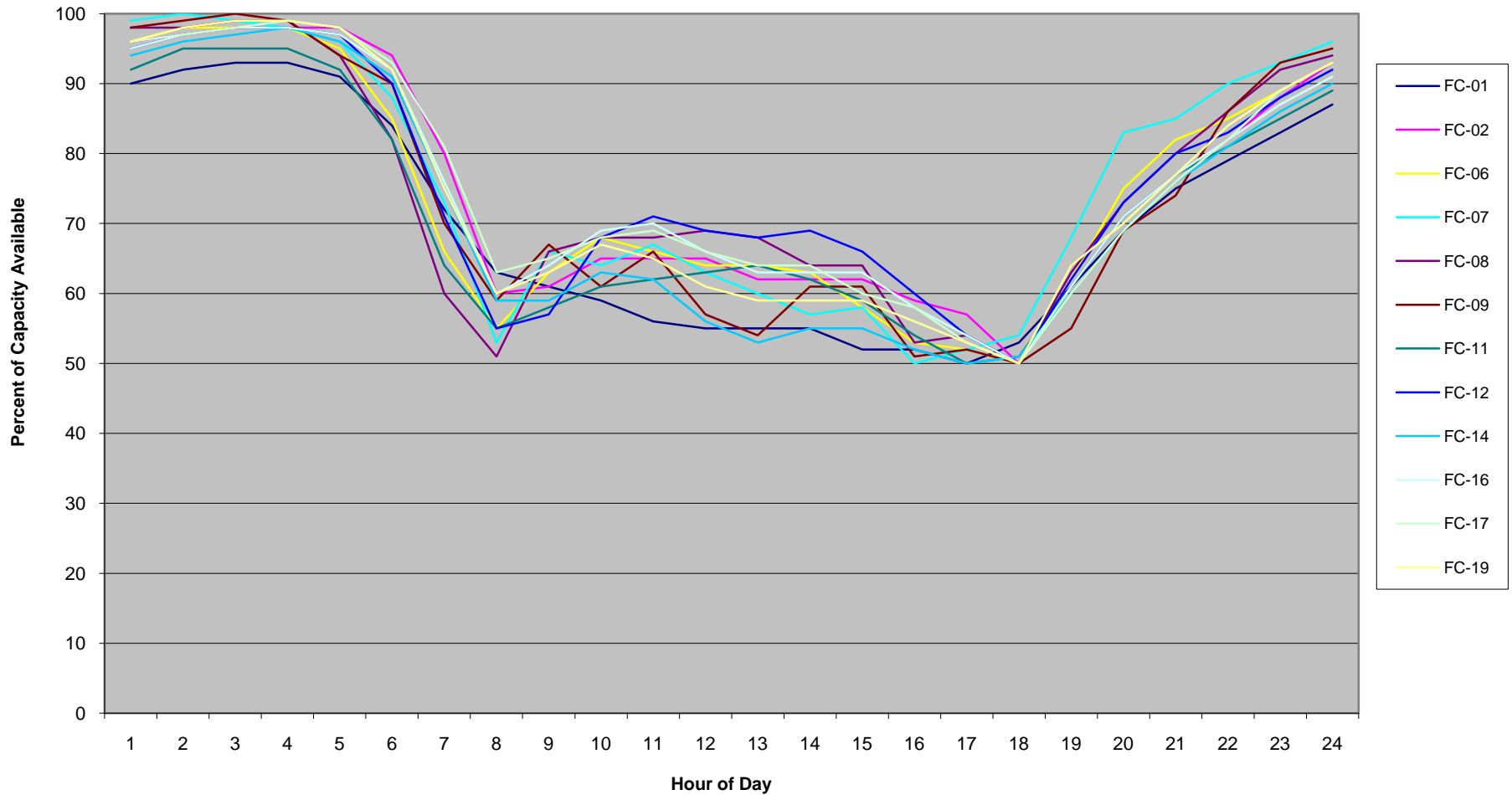
Background Traffic

- The *Florida Traffic Information* DVD was used to develop average peaking characteristics for various functional classes of roadways throughout the state
- These characteristics were analyzed to determine how much capacity is available throughout a given day during an evacuation and a set of factors representing the available capacity is then applied by the model during trip assignment
- The model assumes less background traffic in evacuating coastal counties

Available Capacity – Coastal



Available Capacity – Other



Evacuation Traffic

- The trips that represent evacuees leaving the area are the evacuation traffic
- These trips must be modeled directly in order to develop the necessary clearance time statistics
- Traditional travel demand assignment techniques are static
- Static assignments produce only a snapshot of traffic for the whole day and can not develop clearance times

Evacuation Traffic

- Instead, the SRESP model uses **Dynamic Traffic Assignment (DTA)**
- DTA works by assigning a certain number of vehicles to the highway network in a given interval of time and tracking the progress of these trips through the network over the interval
- Another set of vehicles is assigned during the following time interval and the progress of these trips are tracked along with the progress of the trips loaded in the previous time interval.

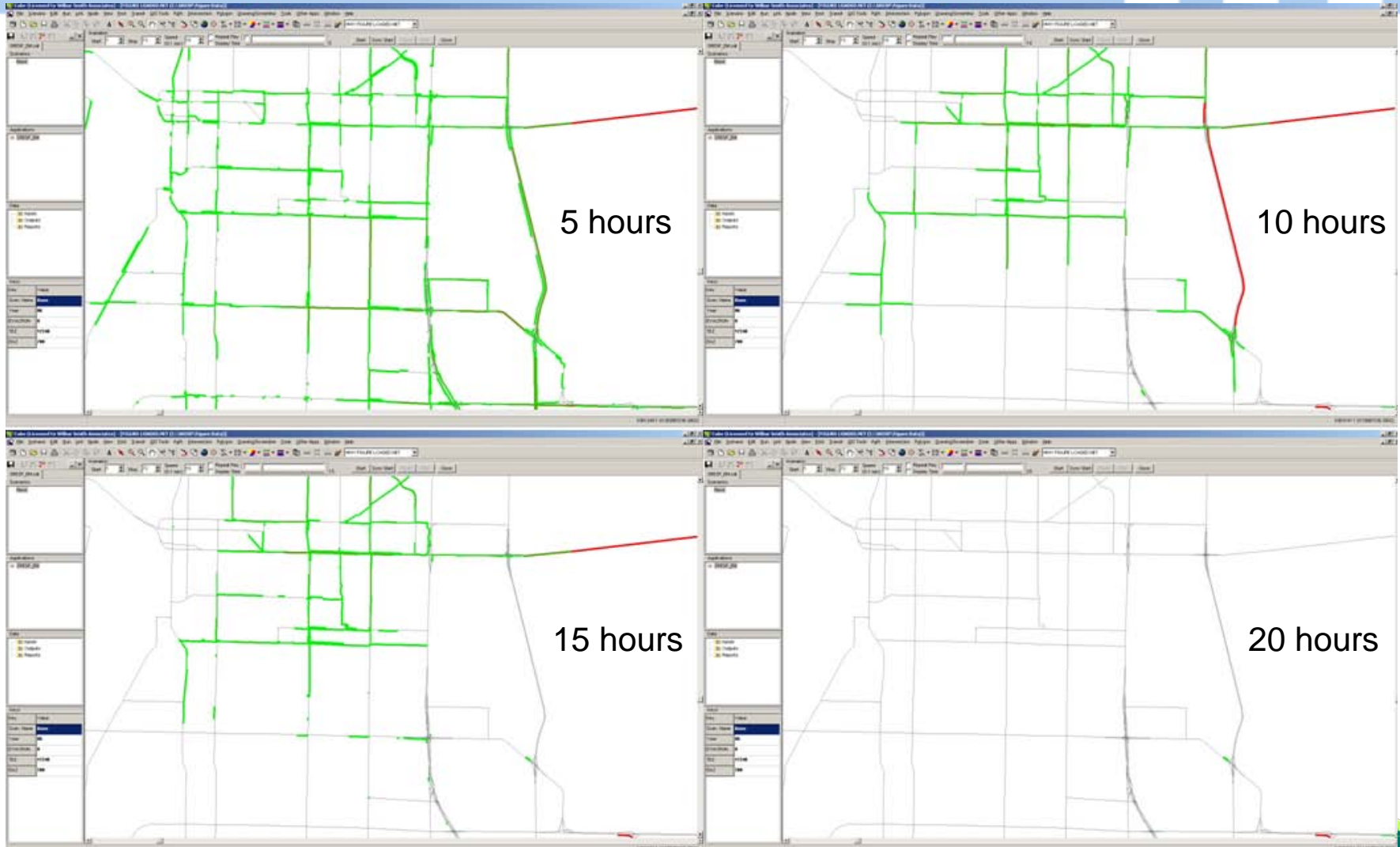
Evacuation Traffic

- As vehicles begin to arrive at the same segments of roadway, they interact with one another to create congestion
- When vehicles that were loaded to the network in subsequent intervals of time arrive at the congested links, they contribute to the congestion as well. This results in a slowing down of the traffic along with spill-backs and queuing delays

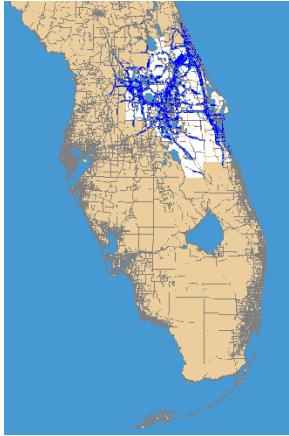
Evacuation Traffic

- By dynamically adjusting the travel times and speeds of the vehicles moving through the network as they respond to congestion the model is able to do the following:
 - Estimate the critical clearance time statistics needed for this study;
 - Take into account the impact of compounded congestion from multiple congestion points;
 - Adjust the routing of traffic throughout the network as a function of congestion as it occurs throughout the evacuation; and,
 - Adjust the capacities from time segment to time segment, making it possible to represent such phenomena as reverse lane operations and background traffic.

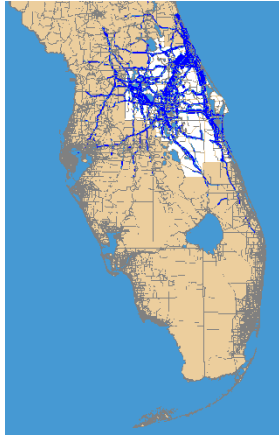
Evacuation Traffic



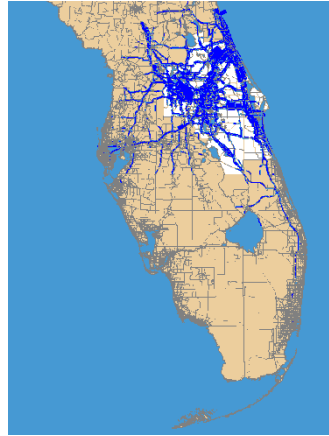
Evacuation Traffic



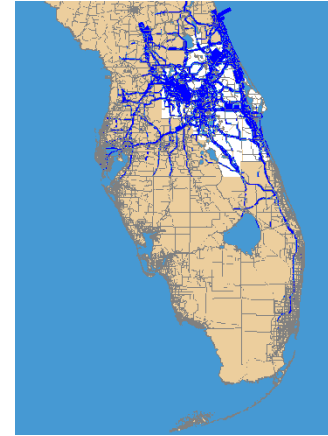
Hour 1



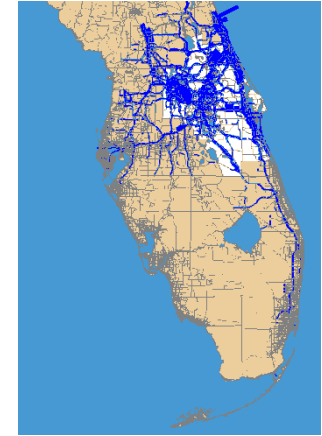
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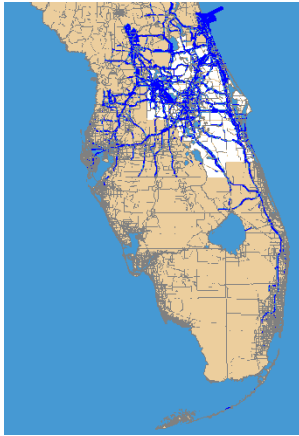
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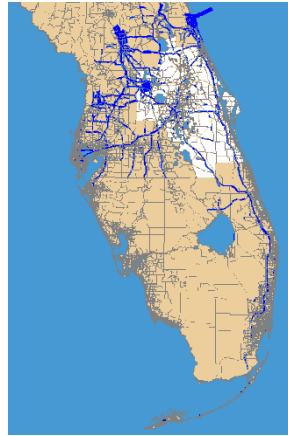
Hour 4



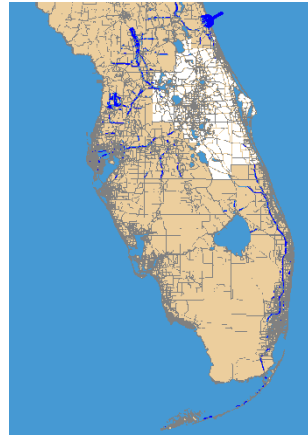
Hour 5



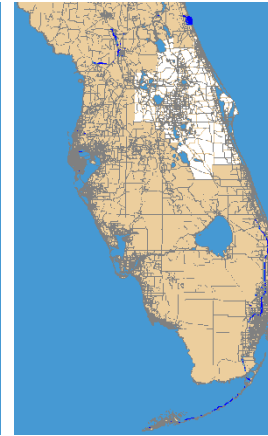
Hour 6



Hour 7

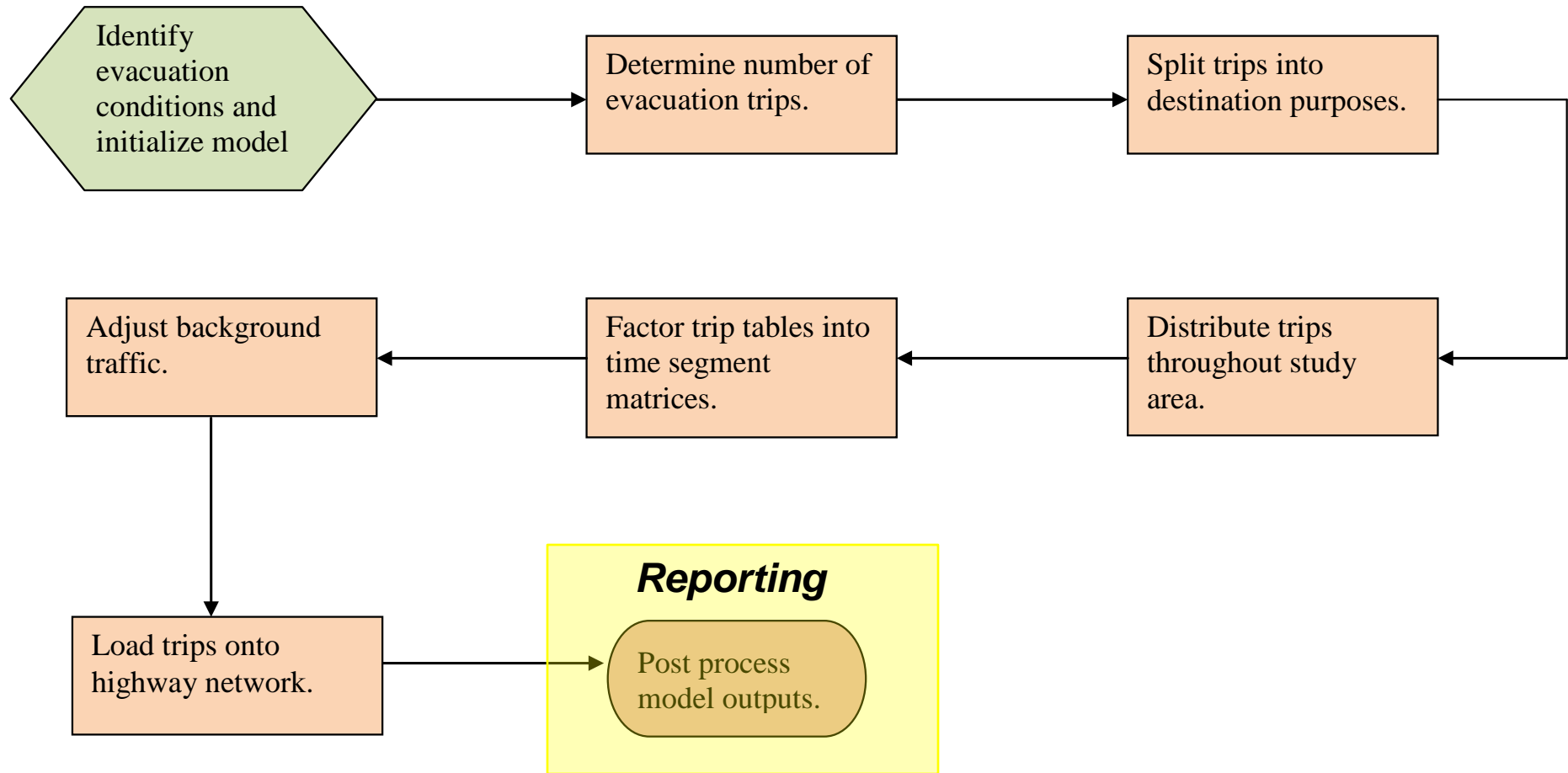


Hour 8



Hour 9

Reporting



Reporting

- Once the assignment has finished running, post processing occurs
- Data are converted into CSV file formats for easy interaction with Excel for graphing, tables, and charts
- Default reporting provides statistics on demand and clearance times along with charts for evacuation traffic

Reporting

Evacuation Model Run Summary

Region: Tampa Bay

Year: 2010

Scenario Parameters

	Hillsborough	Manatee	Pasco	Pinellas
Evacuation Level	A	A	A	A
Response Curve	12 hours	12 hours	12 hours	12 hours
100% Response?	Yes	Yes	Yes	Yes

Clearance Times

	Hillsborough	Manatee	Pasco	Pinellas
In-County	16	14	14	14
Out-of-County	16.5	14.5	17	14
To Shelter	16	13	14	13

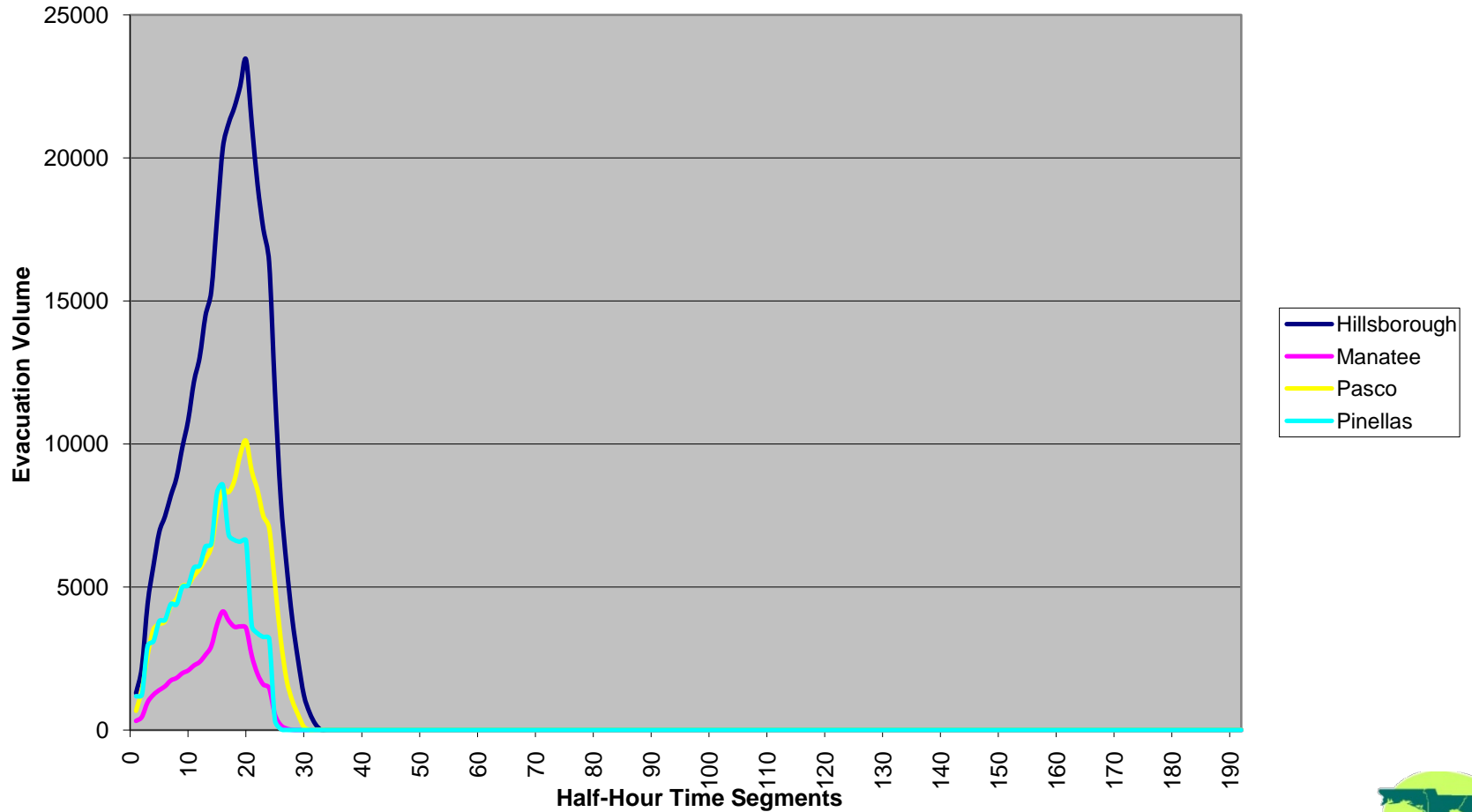
Regional Clearance Time: 17

Evacuation Demand

	Hillsborough	Manatee	Pasco	Pinellas
<i>Population -</i>				
Site-Built	193,151	70,770	84,230	248,937
Mobile Home	65,336	24,536	68,215	44,317
Tourists	8,641	9,703	1,232	18,688
Total	267,128	105,009	153,677	311,942
<i>Shelter Demand -</i>				
	15,547	7,061	15,078	22,892
<i>Trips -</i>				
Site-Built	94,873	29,979	44,202	167,731
Mobile Home	31,242	14,910	36,470	24,679
Tourists	2,931	3,234	419	6,228
Total	129,046	48,123	81,091	198,638

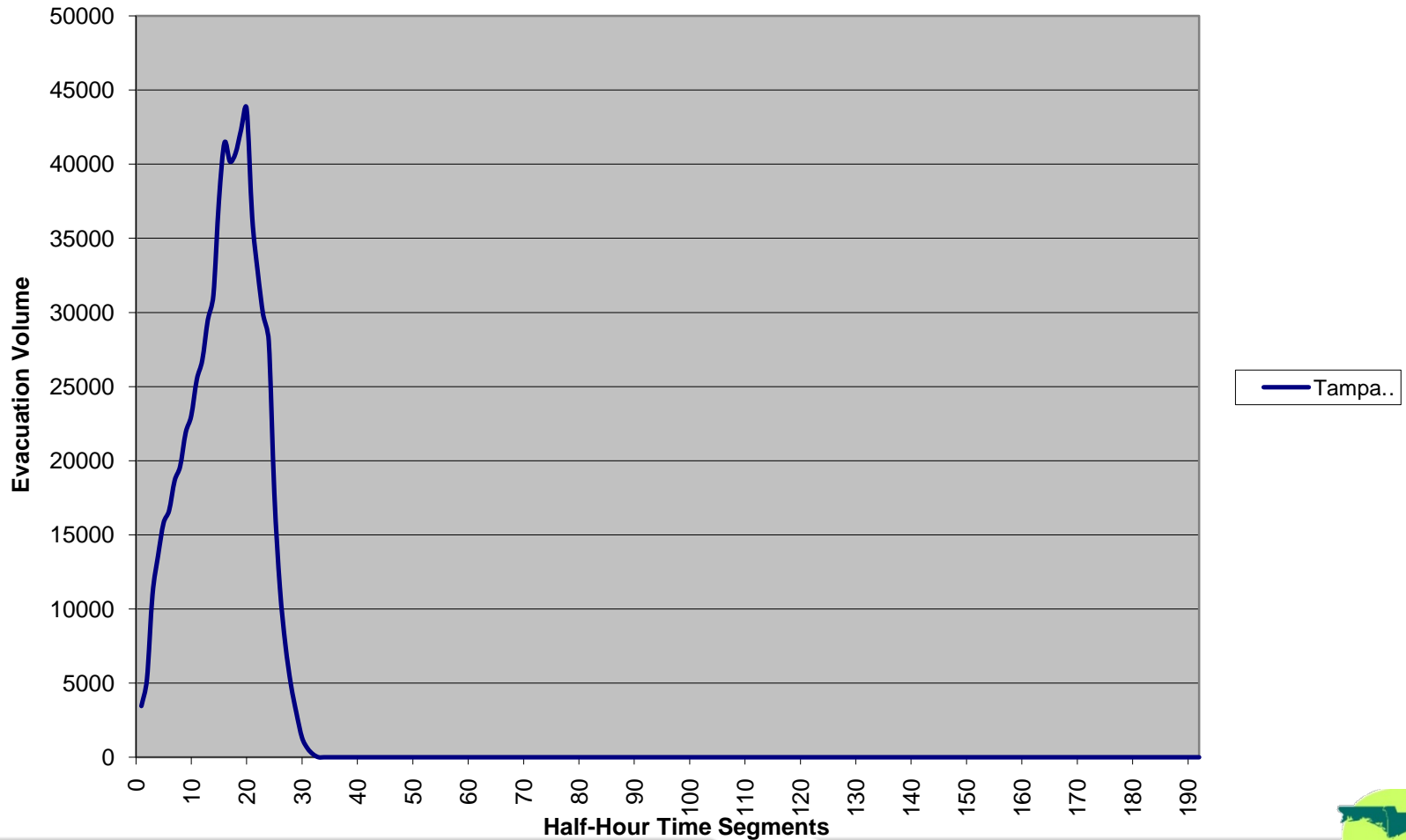
Reporting

Countywide Evacuation



Reporting

Regional Evacuation



Clearance Time

- Clearance times are used as a measure for how long an evacuation can be expected to take place once it has begun
- The legislation driving the SRESP identifies the following four clearance times:
 - Clearance Time, In-County
 - Clearance Time, Out-of-County
 - Clearance Time, To Shelter
 - Regional Clearance Times

Clearance Time, In-County

- The time required from the point an evacuation order is given until the last evacuee can either leave the evacuation zone or arrive at safe shelter within the County. This does not include those evacuees leaving the County, on their own.
 - All in-county trips reach their destination w/in county
 - All out-of-county trips exit the evacuation zone, but may still be located in the county
 - Does not include out-of-county pass-through trips from adjacent counties, unless they evacuate through an evacuation zone

Clearance Time, Out-of-County

- The time necessary to safely evacuate vulnerable residents and visitors to a “point of safety” within the county based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from the point an evacuation order is given to the point in time when the last vehicle assigned an external destination exits the county.
 - Roadway network within county is clear.
 - All out-of-county trips exit the county, including out-of-county pass-through trips from adjacent counties.
 - All in-county trips reach their destination.

Clearance Time, To Shelter

- The time necessary to safely evacuate vulnerable residents and visitors to a “point of safety” within the county based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from the point in time when the evacuation order is given to the point in time when the last vehicle reaches a point of safety within the county.
 - All in-county trips reach their destination w/in county.
 - Does not include any out-of-county trips.

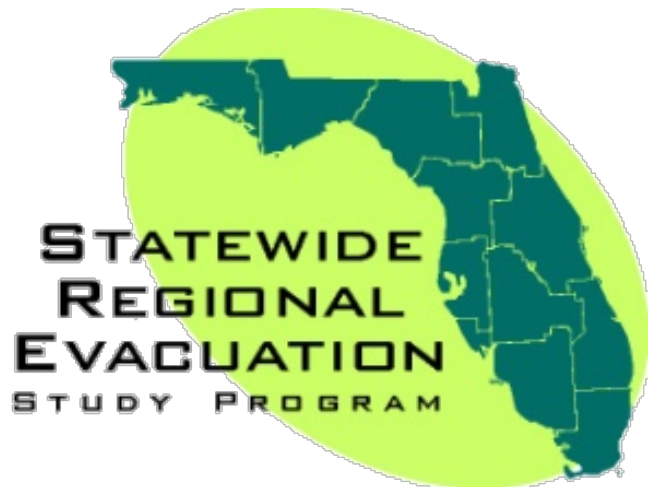
Regional Clearance Time

- The time necessary to safely evacuate vulnerable residents and visitors to a “point of safety” within the (RPC) region based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from the point in time when the evacuation order is given to the point in time when the last vehicle assigned an external destination exits the region.
 - Roadway network within RPC is clear.
 - All out-of-county trips exit the RPC, including out-of-county pass-through trips from adjacent counties.
 - All in-county trips reach their destination.

Calculating Clearance Times

- Volumes are stored on the network by time segment
- Model reads the loaded network data and determines the time segments in which trips first enter and last leave a given area:
 - Evacuation Zone
 - County
 - Region
- The difference between the two is the duration of time segments for which there were trips present; when multiplied by 0.5, this gives the clearance times

Section 4



TIME

Outline

- What is TIME?
- Why Time?
- How does it work?
- Layout of TIME Interface
- Walk Through

What is TIME?

- Transportation Interface for Modeling Evacuations (TIME)
- A custom written interface for scenario management and model execution for the SRESP Evacuation Model
- Allows the user to prepare new scenarios or edit existing scenarios and run the model without needing to know Cube or FSUTMS

Why TIME ?

- The SRESP identified the need to have a relatively easy and intuitive way of interacting with the evacuation model
- RPC and county staff could not be expected to maintain highly trained modeling staff to run and maintain the evacuation model
- Something was needed that could allow planners and emergency management staff to use the model with a minimal learning curve

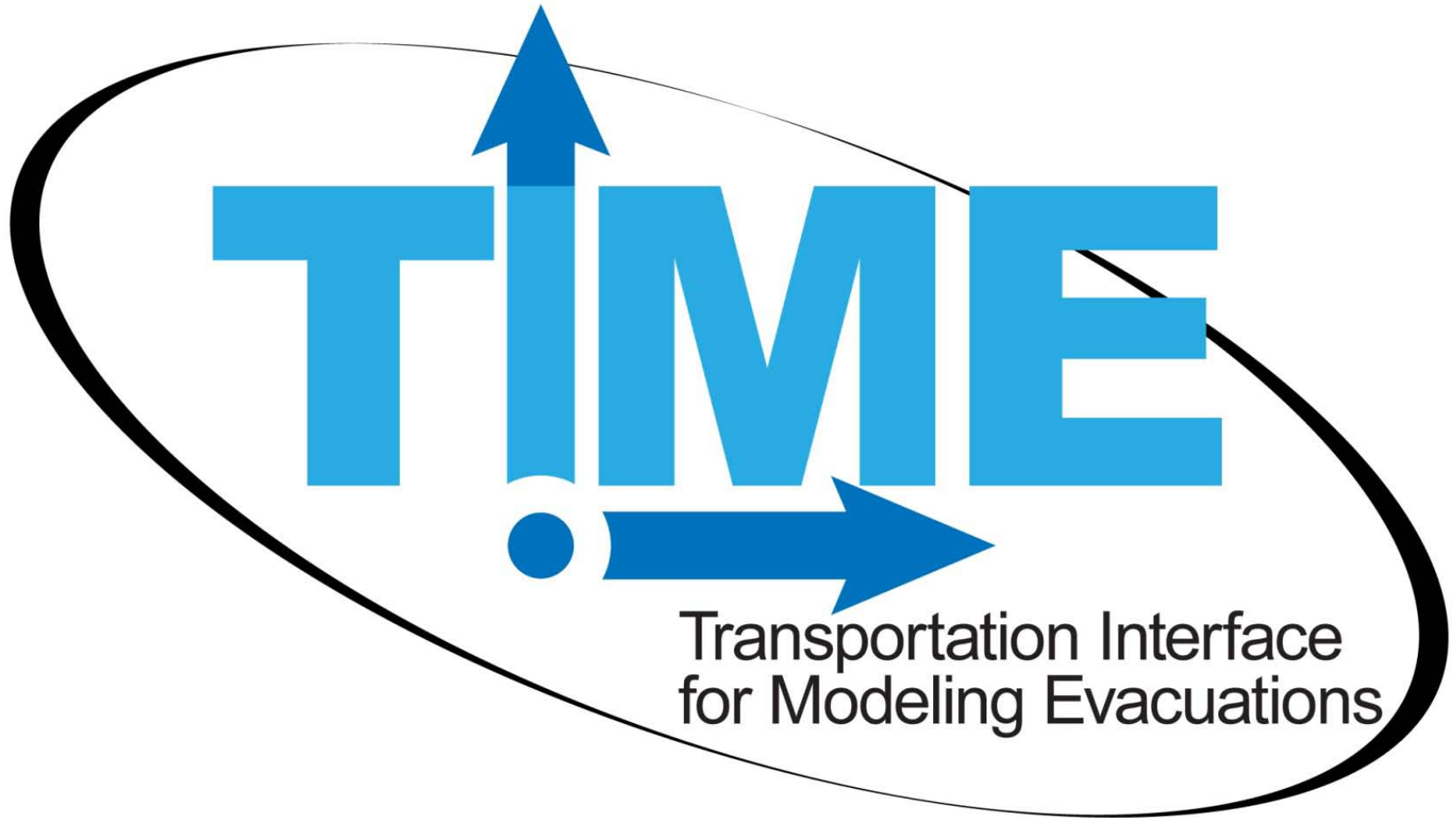
How does it work?

- TIME is a custom written GIS program that leverages existing ESRI technology to interact with the model's data
- The SRESP model uses geodatabases and dBase files as a principal data format for most of its processes
- The SRESP model was designed to allow for easy interaction with GIS software
- TIME allows the user to update key databases in the model needed for preparing evacuation scenarios

How does it work?

- All of the common evacuation scenario parameters can be updated through TIME, including:
 - Which counties evacuate
 - Evacuation level
 - Response curves
 - Active shelters
 - Roadway lanes
 - Demographics
 - And more...
- Some model features cannot be edited in TIME and require skilled modeling knowledge and experience with Cube

Layout of TIME Interface





Transportation Interface for Modeling Evacuations



- Open** Open an Existing Evacuation Scenario
- New** Create a New Evacuation Scenario
- Import** Import an Existing Evacuation Scenario
- Results** View Results from Scenario Report
- Delete** Delete Existing Scenario



Exit





Evacuation Model Settings (Regional)



- Region-wide** | County-wide | Reverse Lane | Shelter | Network | Growth Mgmt. | Demographic | No-Go

Region-wide Settings

Analysis Time Period:

Behavioral Response:

- Run Full Model
- Run Trip Generation Only





Evacuation Model Settings (County)

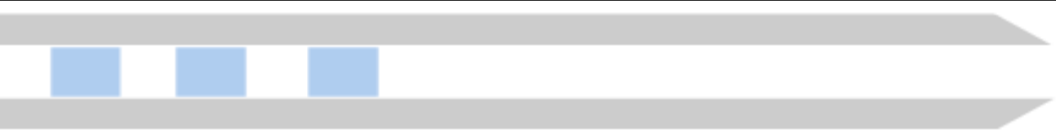


[Region-wide](#) |
 [County-wide](#) |
 [Reverse Lane](#) |
 [Shelter](#) |
 [Network](#) |
 [Growth Mgmt.](#) |
 [Demographic](#) |
 [No-Go](#)

County-wide Settings

	County	Evac. Level	Response Curves	Phasings
*	Hillsborough	A	12-hour curve	Evacuation begins in hour 1
*	Manatee	A	12-hour curve	Evacuation begins in hour 1
*	Pasco	A	12-hour curve	Evacuation begins in hour 1
*	Pinellas	A	12-hour curve	Evacuation begins in hour 1
	Charlotte	-	-	-
	Citrus	-	-	-
	DeSoto	-	-	-
	Hardee	-	-	-
	Hernando	-	-	-
	Lake	-	-	-
	Orange	-	-	-

[< Regional Settings](#) |
 [Reverse Lane Settings](#)





Evacuation Model Settings (Regional)



[Region-wide](#) | [County-wide](#) | **[Reverse Lane](#)** | [Shelter](#) | [Network](#) | [Growth Mgmt.](#) | [Demographic](#) | [No-Go](#)

Active Reverse Lane Evacuation Plans:

- Plan 02 - SR 528 WB
- Plan 03 - Florida Turnpike NB
- Plan 04 - I-4 EB

Select All

[< County-wide Settings](#) | [Shelter Settings >](#)





Shelter Settings



[Region-wide](#) | [County-wide](#) | [Reverse Lane](#) | **[Shelter](#)** | [Network](#) | [Growth Mgmt.](#) | [Demographic](#) | [No-Go](#)

Shelter Map | Shelter List

The map displays the state of Florida with county boundaries and numerous red and green dots representing shelter locations. A toolbar at the top of the map includes icons for zooming in/out, panning, and other map controls. An 'Edit' button is located in the top right corner of the map frame.

Counties

- Hillsborough**
- Manatee**
- Pasco**
- Pinellas**
- Charlotte*
- Citrus*
- DeSoto*
- Hardee*
- Hernando*
- Lake*
- Orange*
- Osceola*
- Polk*
- Sarasota*
- Sumter*

- All Shelters**
 - Primary Only**
- Open/Close Shelters

< Reverse Lane

Network Settings >





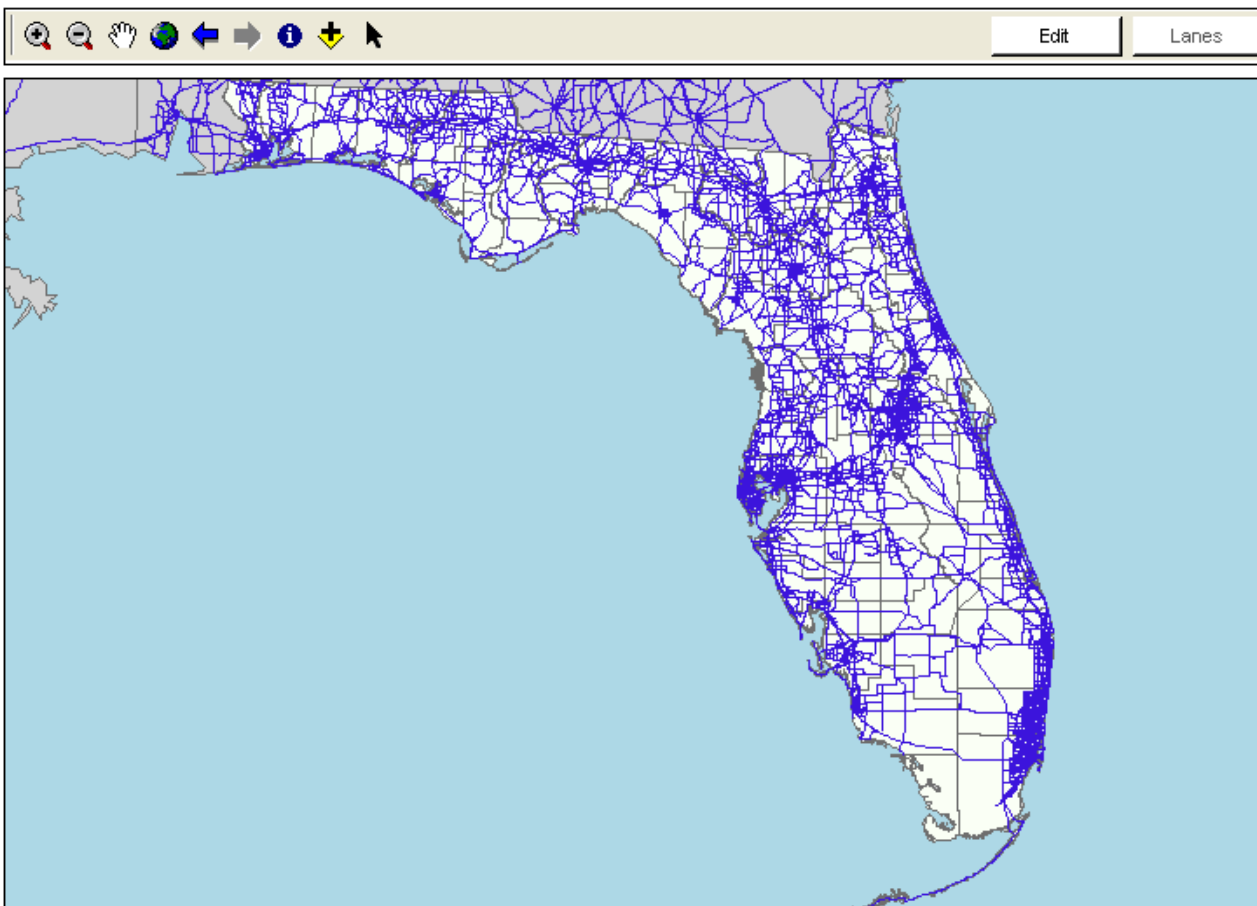
Network Information



Region-wide | County-wide | Reverse Lane | Shelter | **Network** | Growth Mgmt. | Demographic | No-Go

Counties

- Hillsborough**
- Manatee**
- Pasco**
- Pinellas**
- Charlotte*
- Citrus*
- DeSoto*
- Hardee*
- Hernando*
- Lake*
- Orange*
- Osceola*
- Polk*
- Sarasota*
- Sumter*



< Shelter Settings

Growth Settings >





Growth Management Considerations

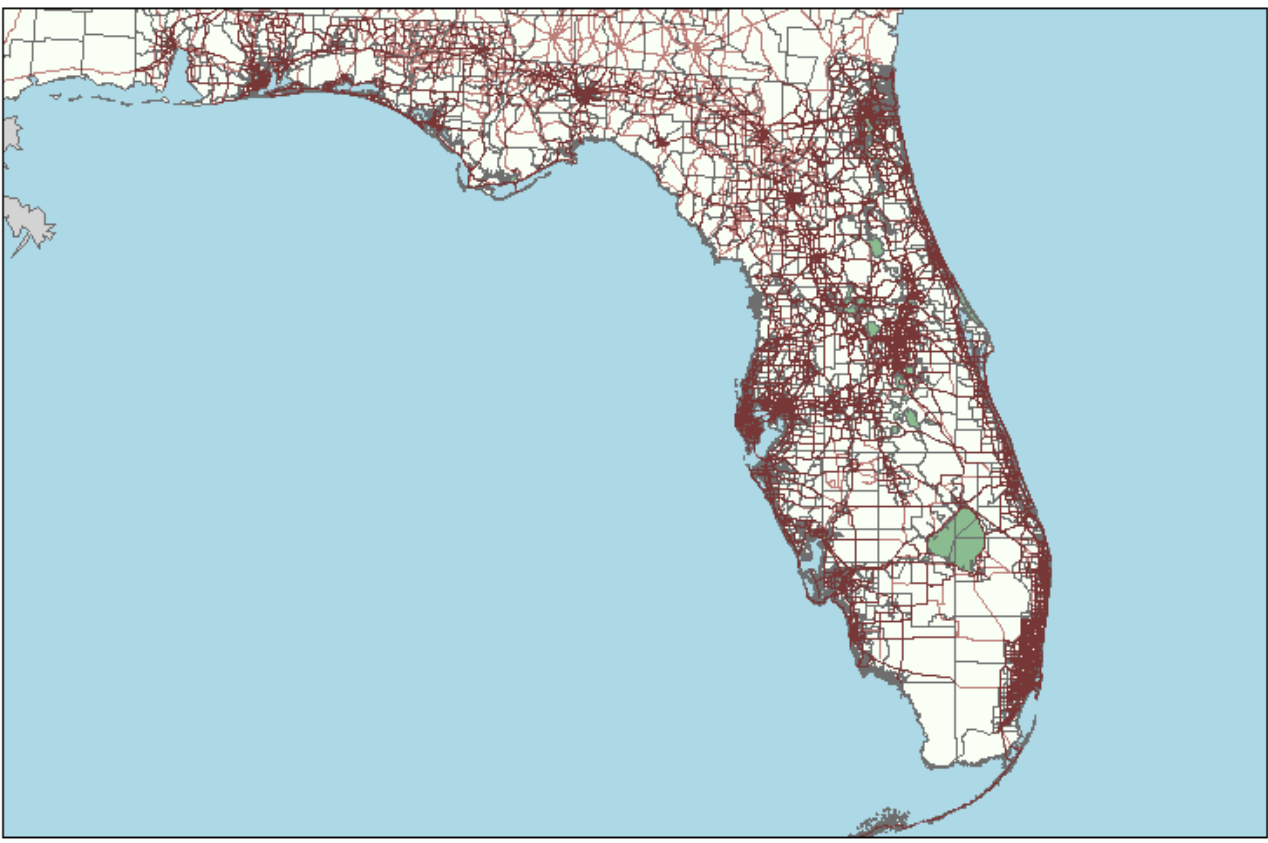


Region-wide | County-wide | Reverse Lane | Shelter | Network | **Growth Mgmt.** | Demographic | No-Go

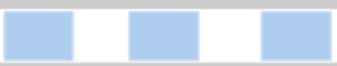
Counties

- Hillsborough**
- Manatee**
- Pasco**
- Pinellas**
- Charlotte*
- Citrus*
- DeSoto*
- Hardee*
- Hernando*
- Lake*
- Orange*
- Osceola*
- Polk*
- Sarasota*
- Sumter*

Map navigation toolbar:
 🔍
🔍
👤
🌐
⬅️
➡️
📍
⬇️
🖱️
Edit



< Network Settings | Demographic Settings >





Demographic Settings



[Region-wide](#) |
 [County-wide](#) |
 [Reverse Lane](#) |
 [Shelter](#) |
 [Network](#) |
 [Growth Mgmt.](#) |
 [Demographic](#) |
 [No-Go](#)

Region-wide Settings

University Population:

County-wide Settings

	County	Tourists	Override Tourist Occupancy Rate?	Rates
*	Hillsborough	Include	No	0%
*	Manatee	Include	No	0%
*	Pasco	Include	No	0%
*	Pinellas	Include	No	0%
	Charlotte	Do Not Inclu...	No	0%
	Citrus	Do Not Inclu...	No	0%
	DeSoto	Do Not Inclu...	No	0%
	Hardee	Do Not Inclu...	No	0%
	Hernando	Do Not Inclu...	No	0%
	Lake	Do Not Inclu...	No	0%
	Orange	Do Not Inclu...	No	0%
	Osceola	Do Not Inclu...	No	0%

< Growth Settings

"No-Go" Settings >



Evacuation Model Settings (Regional)


[Region-wide](#)
[County-wide](#)
[Reverse Lane](#)
[Shelter](#)
[Network](#)
[Growth Mgmt.](#)
[Demographic](#)
[No-Go](#)

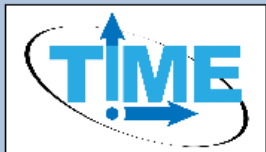
"No-Go" Counties and Regions

Regions not able to receive evacuation trips.

- | | | | |
|------------------------------------|---------------------------------------|-------------------------------------|--|
| <input type="checkbox"/> Alachua | <input type="checkbox"/> Hamilton | <input type="checkbox"/> Nassau | <input type="checkbox"/> Washington |
| <input type="checkbox"/> Baker | <input type="checkbox"/> Hardee | <input type="checkbox"/> Okaloosa | <input type="checkbox"/> Mid-Atlantic Region |
| <input type="checkbox"/> Bay | <input type="checkbox"/> Hendry | <input type="checkbox"/> Okeechobee | <input type="checkbox"/> Others... |
| <input type="checkbox"/> Brevard | <input type="checkbox"/> Hernando | <input type="checkbox"/> Orange | |
| <input type="checkbox"/> Brevard | <input type="checkbox"/> Highlands | <input type="checkbox"/> Osceola | |
| <input type="checkbox"/> Broward | <input type="checkbox"/> Hillsborough | <input type="checkbox"/> Palm Beach | |
| <input type="checkbox"/> Calhoun | <input type="checkbox"/> Holmes | <input type="checkbox"/> Pasco | |
| <input type="checkbox"/> Charlotte | <input type="checkbox"/> Indian River | <input type="checkbox"/> Pinellas | |
| <input type="checkbox"/> Citrus | <input type="checkbox"/> Jackson | <input type="checkbox"/> Polk | |
| <input type="checkbox"/> Clay | <input type="checkbox"/> Jefferson | <input type="checkbox"/> Putnam | |
| <input type="checkbox"/> Collier | <input type="checkbox"/> Lafayette | <input type="checkbox"/> St. Johns | |
| <input type="checkbox"/> Columbia | <input type="checkbox"/> Lake | <input type="checkbox"/> St. Lucie | |
| <input type="checkbox"/> De Soto | <input type="checkbox"/> Lee | <input type="checkbox"/> Santa Rosa | |
| <input type="checkbox"/> Dixie | <input type="checkbox"/> Leon | <input type="checkbox"/> Sarasota | |
| <input type="checkbox"/> Duval | <input type="checkbox"/> Levy | <input type="checkbox"/> Seminole | |
| <input type="checkbox"/> Escambia | <input type="checkbox"/> Liberty | <input type="checkbox"/> Sumter | |
| <input type="checkbox"/> Flagler | <input type="checkbox"/> Madison | <input type="checkbox"/> Suwannee | |
| <input type="checkbox"/> Franklin | <input type="checkbox"/> Manatee | <input type="checkbox"/> Taylor | |
| <input type="checkbox"/> Gadsden | <input type="checkbox"/> Marion | <input type="checkbox"/> Union | |
| <input type="checkbox"/> Gilchrist | <input type="checkbox"/> Martin | <input type="checkbox"/> Volusia | |
| <input type="checkbox"/> Glades | <input type="checkbox"/> Miami-Dade | <input type="checkbox"/> Wakulla | |
| <input type="checkbox"/> Gulf | <input type="checkbox"/> Monroe | <input type="checkbox"/> Walton | |

Select All

[< Demographic Settings](#)
[Summary >](#)



Scenario Summary and Confirmation



Behavioral Assumption: Survey Response

Analysis Period: 2010

Model: Run Full Model

Counties Evacuating (zone): Hillsborough (A), Manatee (A), Pasco (A), Pinellas (A), Charlotte (-), Citrus (-), DeSoto (-), Hardee (-), Hernando (-), Lake (-), Orange (-), Osceola (-), Polk (-), Sarasota (-), Sumter (-)

Reverse Lane:

Shelters Modified:

Roadway Network Modified:

Small Area Data Modified:

University Population Fall/Spring Session (100% in residence)

Counties Including Tourist Population: Hillsborough (D), Manatee (D), Pasco (D), Pinellas (D)

"No-Go" Counties:

< "No-Go" Settings

Save Scenario Settings to File

Print Scenario Settings

Run Model

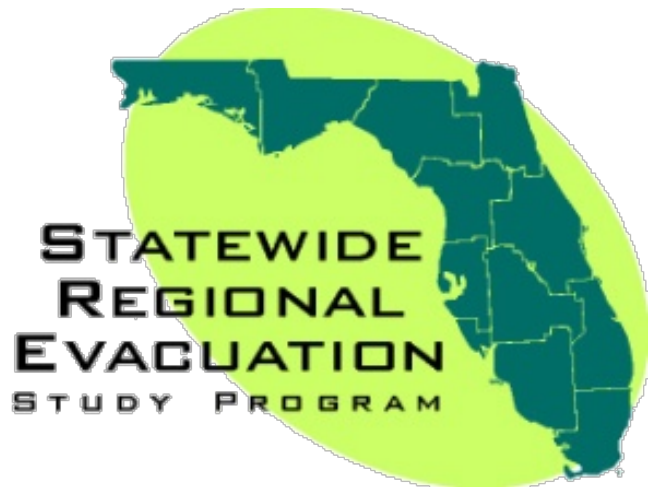
Create Reports



Walk Through



Section 5



Nuts and Bolts

Outline

- What is CUBE?
- Catalog File
- Scenarios
- Catalog Keys
- Control.DBF
- Geodatabase
- Loaded Network
- Walk Through

What is CUBE

- The Cube software suite is a comprehensive set of modules that support transportation planning, including transportation forecasting and system analysis.
- There are three basic software elements that are relevant to the evacuation model
 - Base
 - Voyager
 - Avenue

Cube - Base

- Cube Base offers an integrated graphical environment that supports transportation planning
- Combines the functionality of a network editor, a transit line editor, a matrix editor, a database editor, a job script editor, and a model job launcher in one package
- Includes a number of GIS-oriented features, which allow you to view and query a wide variety of GIS and image files

Cube - Voyager

- Cube Voyager is designed to be an integrated modeling system for transportation planning
- Flexible control language referred to as a scripting language
- Users may implement any model formulation desired in the scripting language
- Contains all of the programs needed to run a model

Cube - Avenue

- Cube Avenue is the Cube Voyager program for performing dynamic traffic assignment
- Older traffic models tend to fall into two categories:
 - Operational traffic models
 - Planning models
- Operational traffic models are useful for modeling network component interactions as queues and delays vary during the model period.

Cube - Avenue

- However, operational models are not useful for forecasting routing
- Planning models do capture how drivers' experiences over long periods of time allow them to pick optimal travel routes for regular and frequent trips, such as travel to work; but,
- Planning models cannot capture operational characteristics such as spill-backs and queuing

Cube - Avenue

- Cube Avenue tries to find a middle ground between these two extremes
- Cube Avenue uses a path builder in a capacity-restraint loop to model drivers finding routes and modifying those routes based on experience; however,
- To evaluate the costs generated by a set of routing decisions, Cube Avenue simulates the movement of vehicles through the network.

Catalog File

- The catalog file contains all of the linkages needed to put a Cube model together
- By opening the catalog file, the user can access all of the model's data, scripts, and parameters
- All scenario settings are also stored in the catalog file

Scenarios

- Scenarios are used to test the effects of variations in input data
- Scenarios allow the user to designate new input files and parameters, and to modify existing model files
- This allows the user to use the same model for different alternatives

Catalog Keys

- A catalog key is a parameter that is used throughout the model and may occur in multiple scripts and applications in the model
- Using catalog keys can reduce the potential for error in the model by preventing the modeler from having to update the values for a given parameter in each script independently

Control.DBF

- The creation of a scenario in the SRESP model can entail the selection of a number of specific parameters that may change not only from scenario to scenario, but also from county to county within in the same scenario
- As a way to minimize the number of catalog keys used in the model and to enhance the flexibility and comprehensiveness of scenario specific parameters, a control file has been developed

Control.DBF

- A control file has been structured such that it allows users to modify specific parameters between scenarios
- This file allows the TIME interface to interact with the model, allowing the user to define scenario parameters as needed.

Geodatabase

- A geodatabase is a database that stores geographic information
- Stores and organizes data, and relates data spatially and relates data with common attributes
- Cube can access data in a geodatabase and present that data in maps and use that data in modeling steps

Geodatabase

- A geodatabase stores map data
- The geodatabase does not contain maps
- The Cube GIS window displays maps by interpreting the information in the geodatabase
- Similarly, a geodatabase stores information that a Cube Voyager model can use; however, the geodatabase does not contain any model steps

Geodatabase

- A Cube geodatabase includes the structure for transportation networks
- You can use a Cube geodatabase to store highway network data in addition to geographic data stored in shapefiles and DBF files
- The Cube geodatabase format is derived from the ESRI ArcGIS 9.2 personal geodatabase format.

Loaded Network

- Final output is a loaded model network
- Contains time segment data on volumes, travel times, and queues for every link
- This is the file that is read by the post-processor to develop clearance times

Loaded Network

Cube (Licensed to Wilbur Smith Associates) - [LOADED.NET (c:\TBRPC_EM\BASEB2015E)]

File Scenario Edit Run Link Node View Post Transit GIS Tools Path Intersection Polygon Drawing/Screenline Tools Other Apps Window Help

HWY:LOADED.NET

SRESP_EM.cat

Scenarios

- Base
 - Master
 - B2015E

Applications

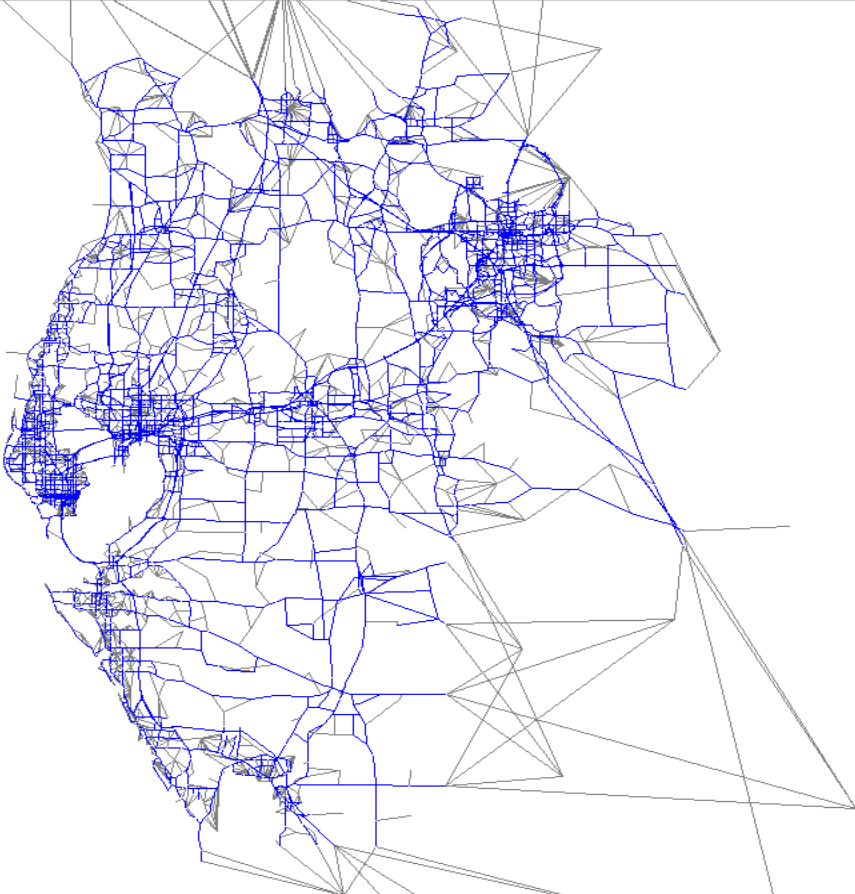
- SRESP_EM

Data

- Inputs
- Outputs
- Reports

Keys

Key	Value
Scen. Name	B2015E
Year	15
EVACRGN	8
TEZ	17328
EAZ	613
UNIVERSITY	2
SFOLDER	c:\TBRPC_EM\B\
GDB	SRESP_EM.mdb
GENREP	0



318670.7:3057535(381.6812)

start C:\Zipping ftp://ftp.wilbursmith... Cube Desktop 2:23 PM

Loaded Network

Cube (Licensed to Wilbur Smith Associates) - [LOADED.NET (c:\TBRPC_EM\BASE\B2015E)]

File Scenario Edit Run Link Node View Post Transit GIS Tools Path Intersection Polygon Drawing/Screenline Tools Other Apps Window Help

SRESP_EM.cat

Scenarios

- Base
 - Master
 - B2015E

Applications

- SRESP_EM

Data

- Inputs
- Outputs
- Reports

Keys

Key	Value
Scen. Name	B2015E
Year	15
EVACRGN	8
TEZ	17328
EAZ	613
UNIVERSITY	2
SFOLDER	c:\TBRPC_EM\B\
GDB	SRESP_EM.mdb
GENREP	0

264472:3066314(381.6812)

start C:\Zipping ftp://ftp.wilbursmith... Cube Document1 - Microsof...

Desktop 2:29 PM

Walk Through

