Good Modeling Practice at the Regional, Corridor and Site Impact Levels

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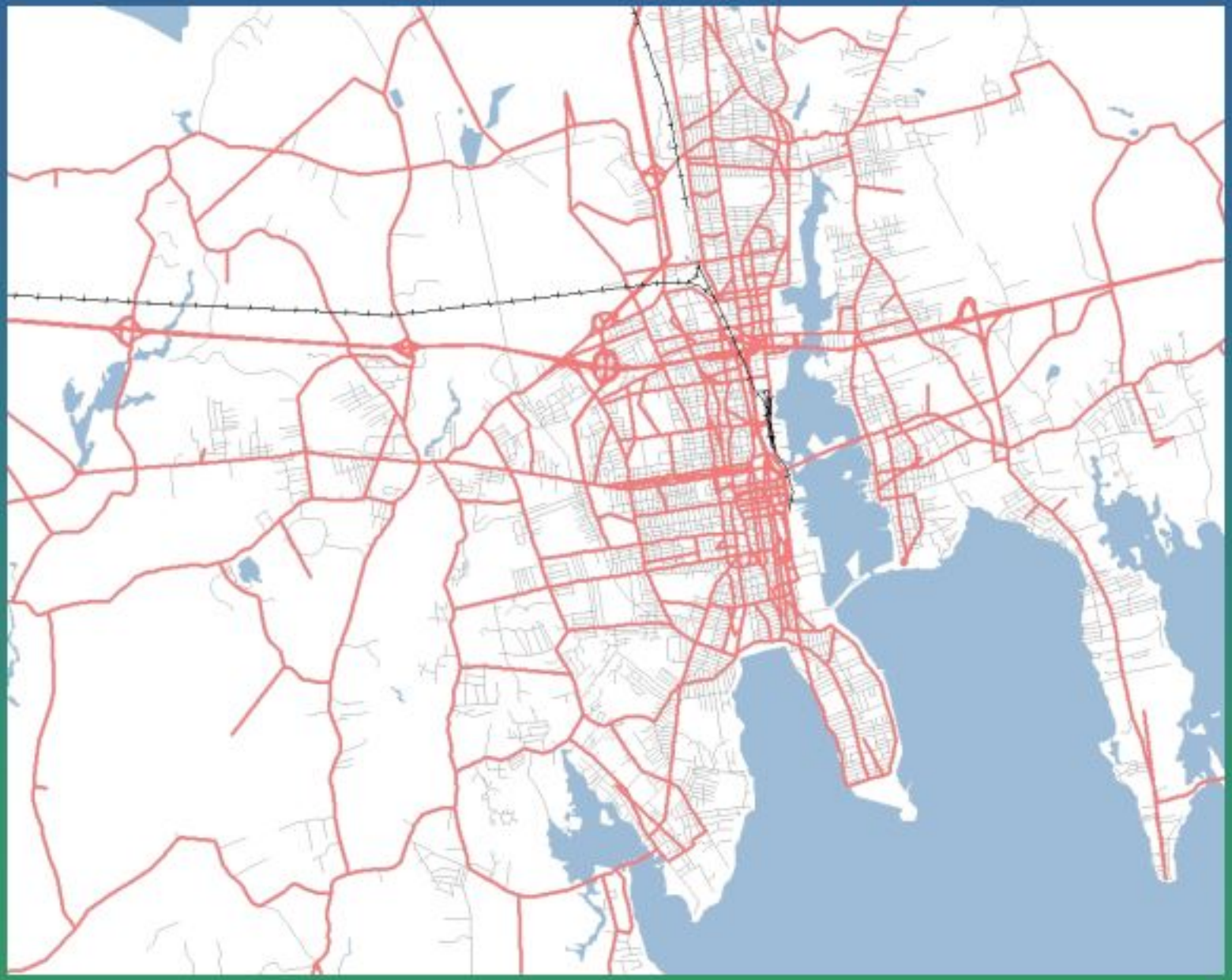
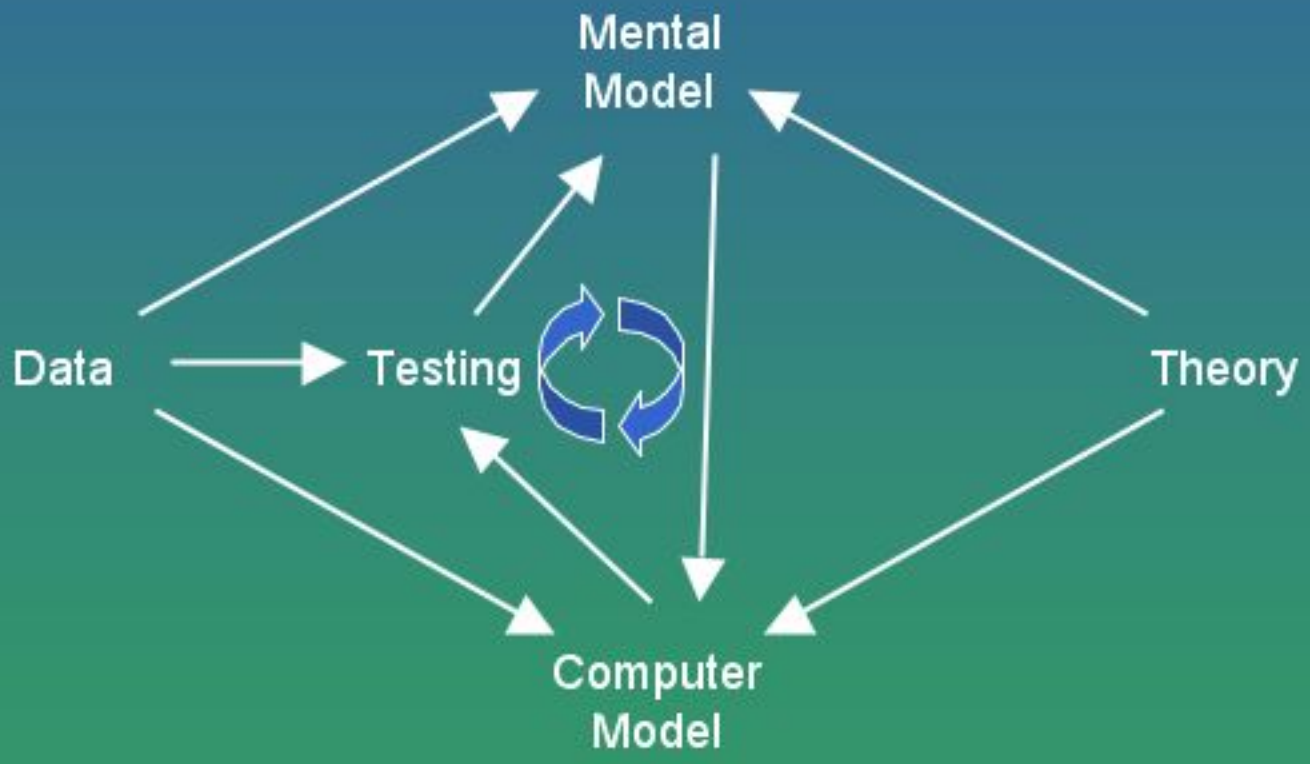
Regional Models

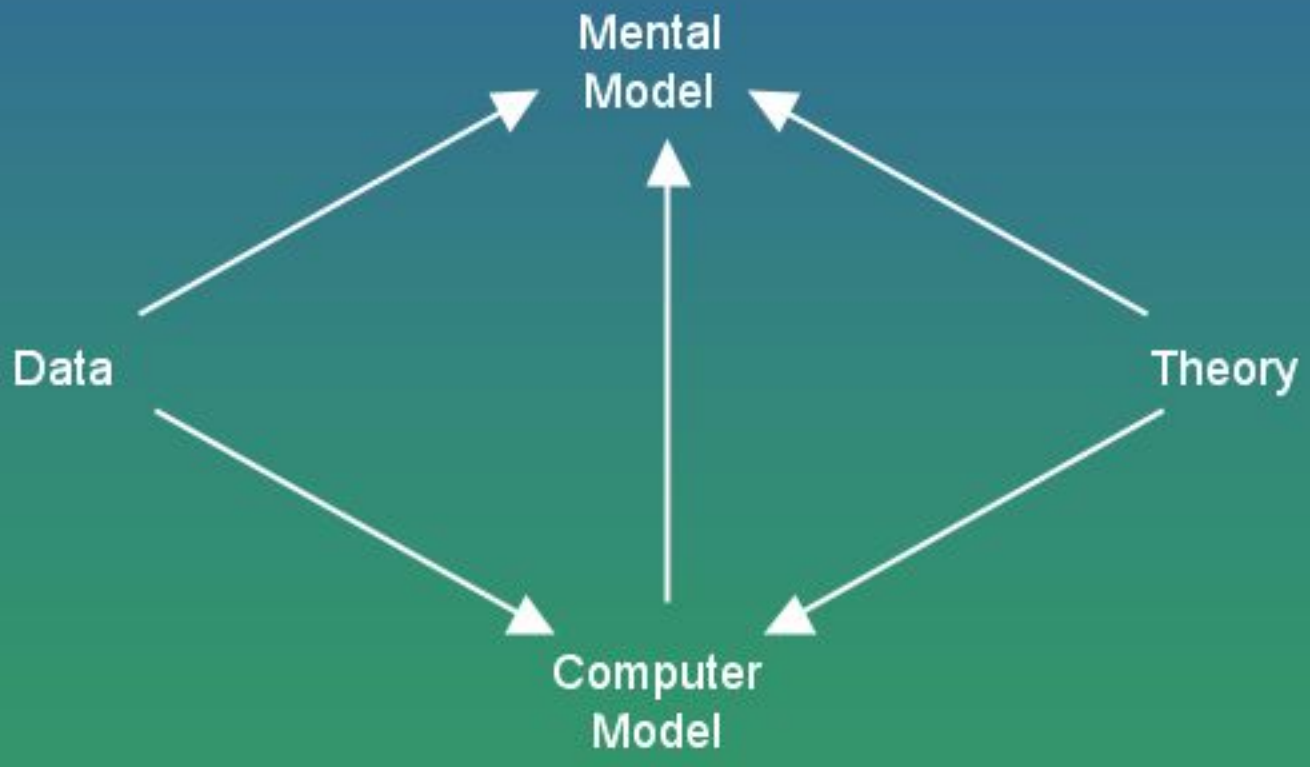
- Used for metropolitan transportation planning and air quality conformity
- Intended to provide overall picture at regional level, often very inaccurate for specific facilities
- Examples of software: TransCAD, TP+, EMME2, . . .



Ideal Modeling Process – Individual and Organizational Learning

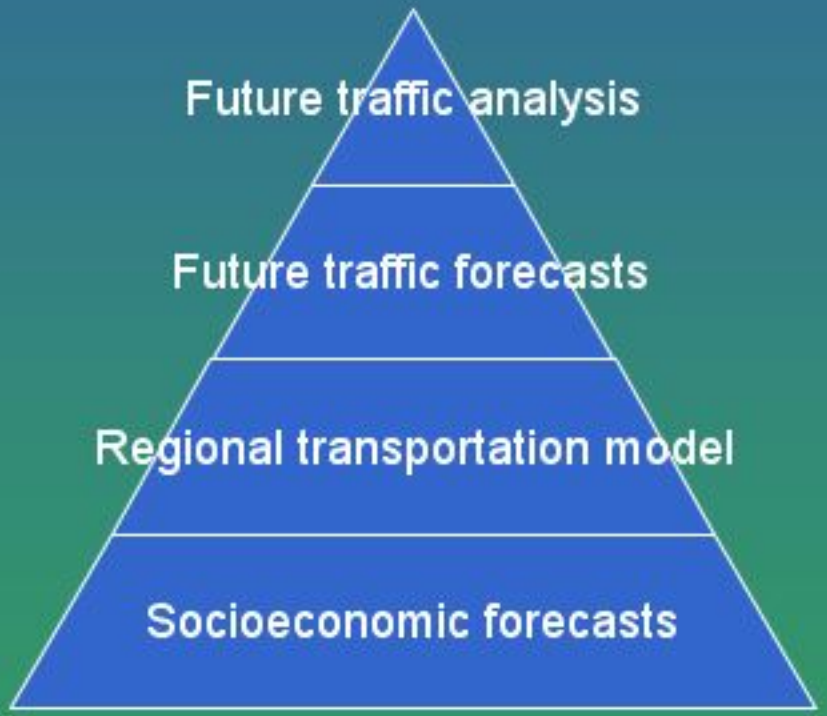


Common Modeling Process – Learned Dumbness



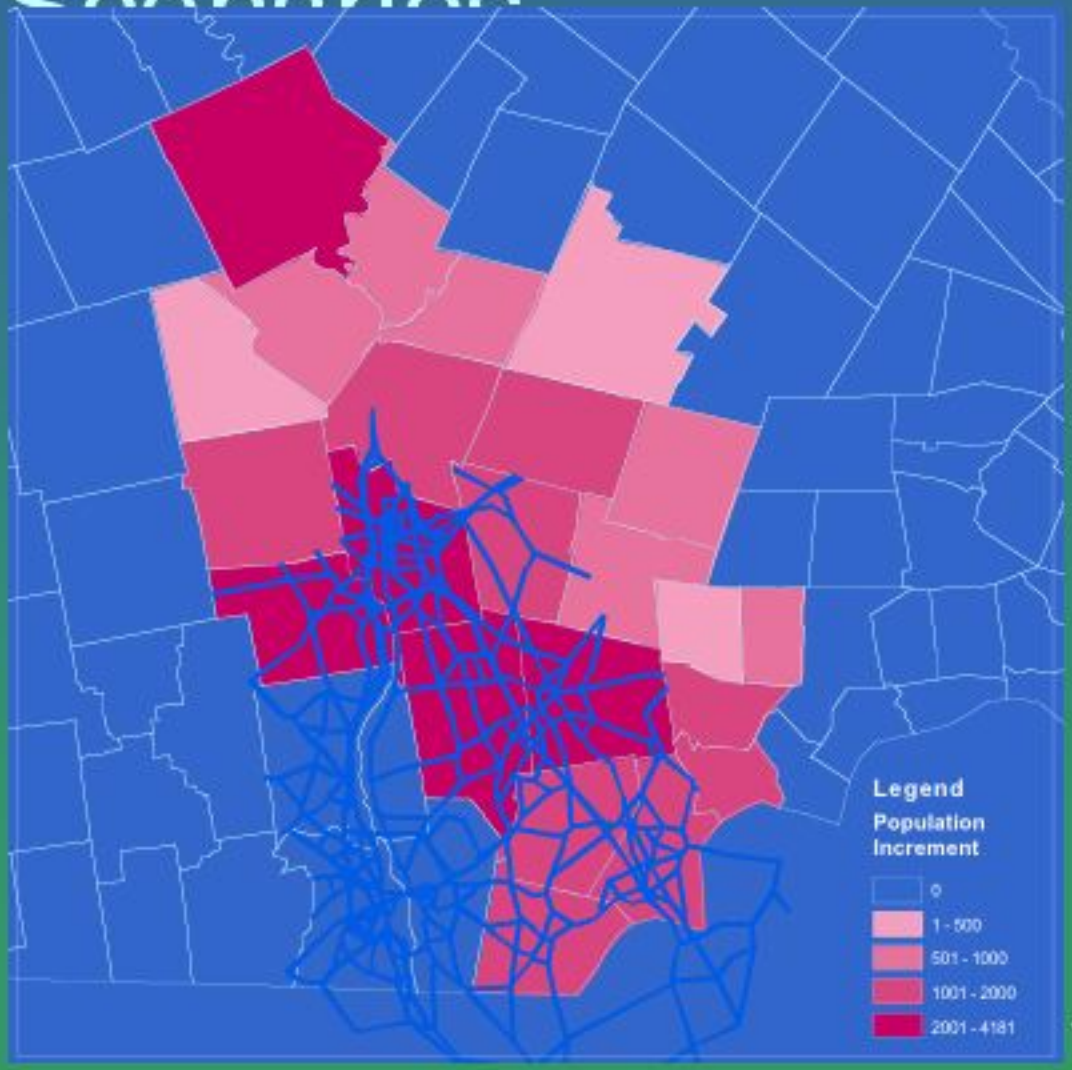
Regional Level

- Metropolitan Planning Organization (MPO) travel demand models
- Regional planning & air quality conformity
- Major transportation projects
- Major developments (varies by jurisdiction)



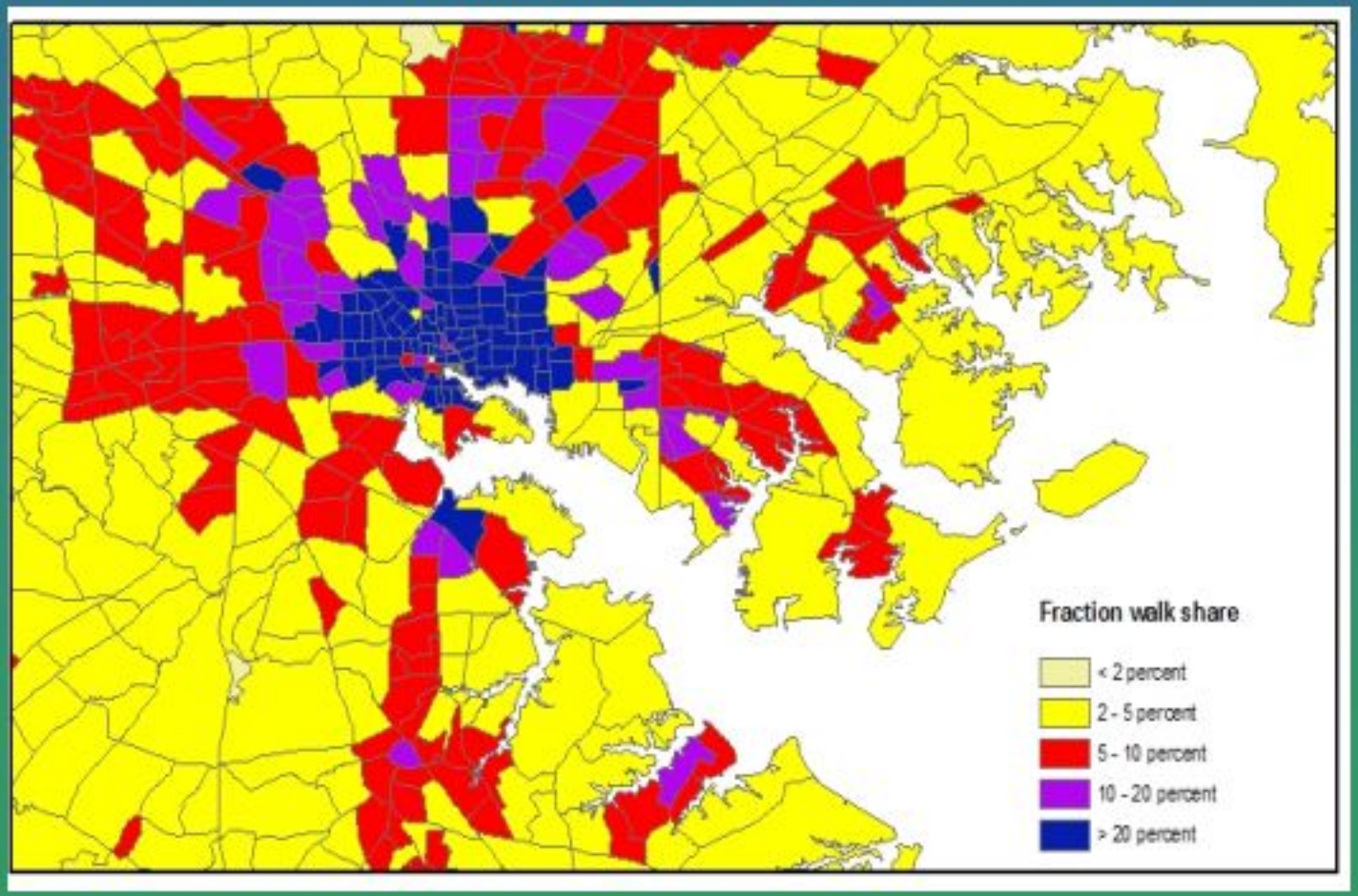
Different Future Land Use for Different Transportation Scenarios

- Land use allocation model, or
- Expert panel
- Example: expert panel said widening I-93 in N.H. would add 40,000 residents



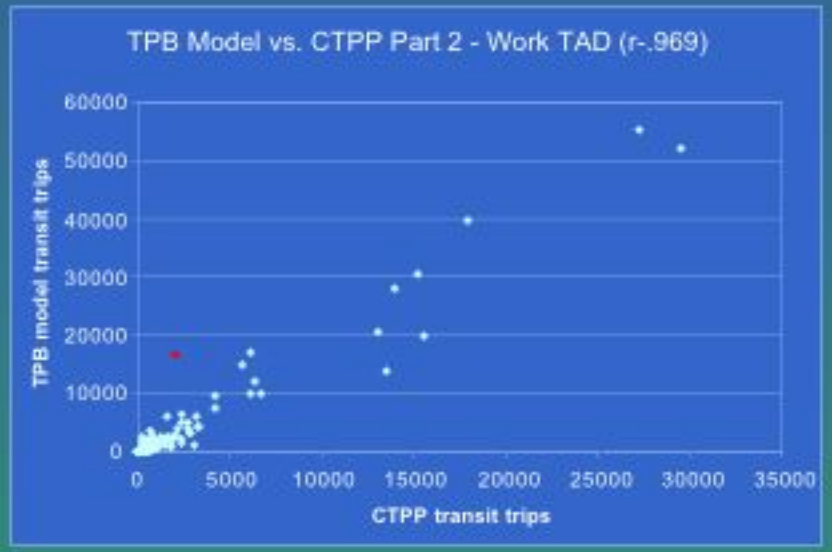
"3 D" Density, Diversity and Design Impacts in Mode Choice Model

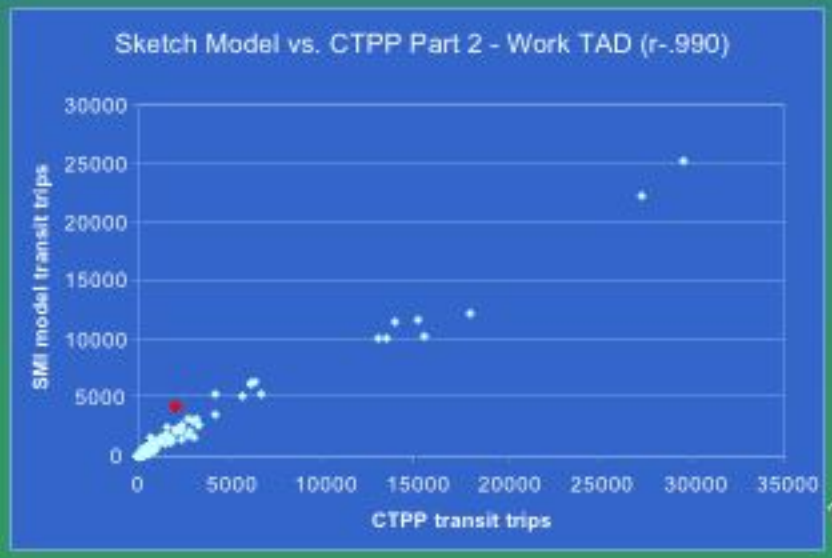
- Example: Baltimore retail trips % walk



Validate Transit Ridership

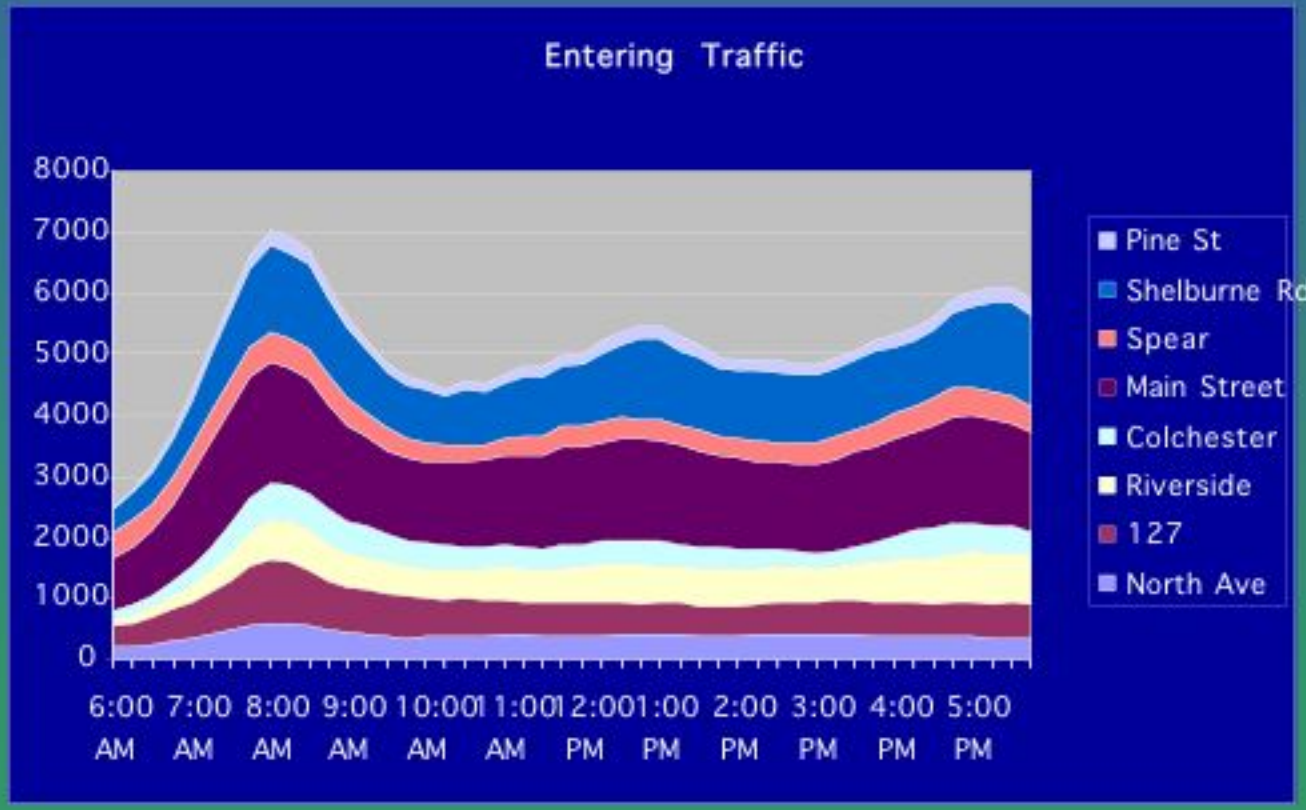
- Most MPO models fail to predict transit ridership correctly due to lack of land use variables
- Washington D.C. example: MPO model vs. model with 3 D land use factors





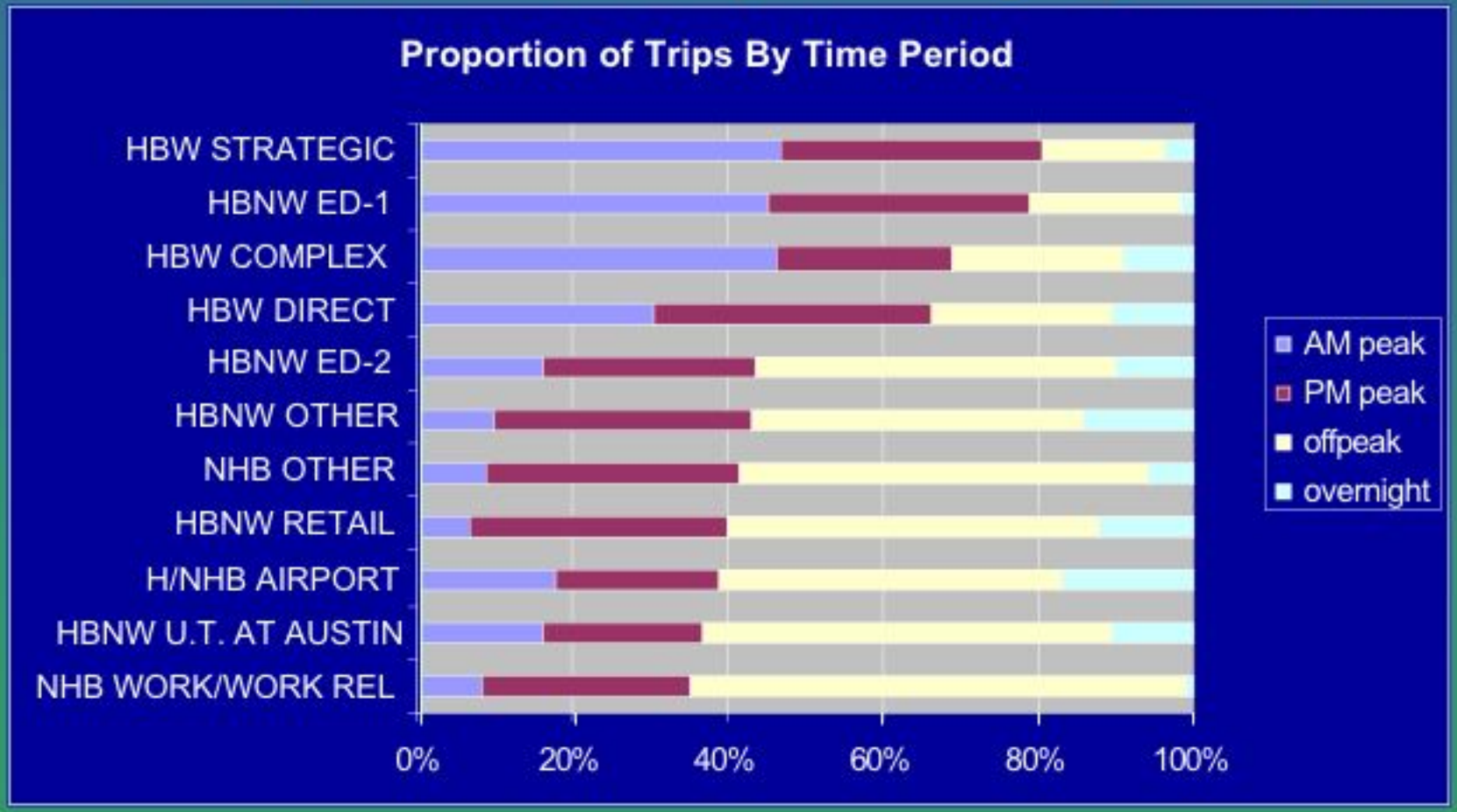
Separate Morning Peak, Afternoon Peak and Off-Peak Time Periods

- Burlington, VT example: inbound traffic by hour

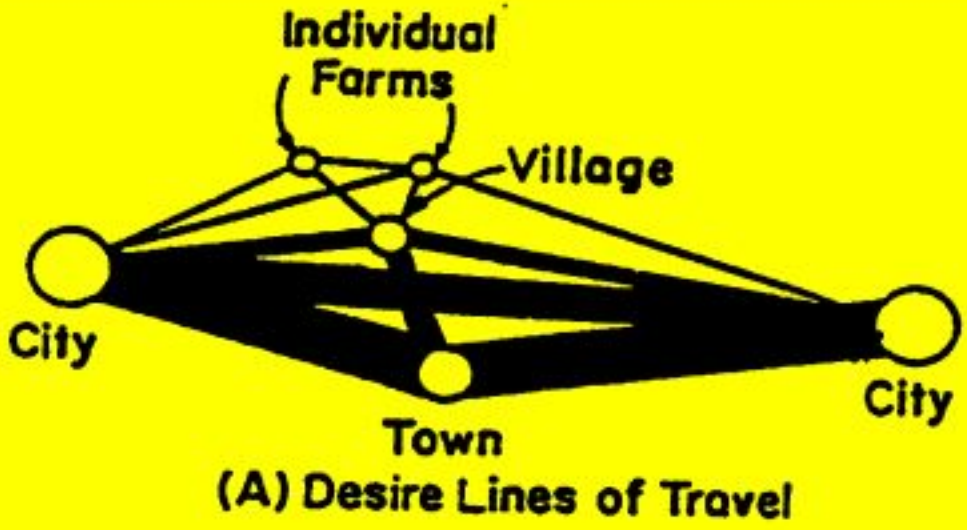


Feed Back Realistic Travel Times for Each Time Period

- Example: Austin trip making by time period



The AASHTO Theory of Transportation Networks



(A) Desire Lines of Travel

(B) Road Network Provided

Realistic Street Capacity

- Include all through streets in model
- Use lower marginal capacity for added arterial lanes, i.e. 6-lane arterial has less than 3 times the capacity of 2-lane arterial
- Austin model example

Capacity Facility	Capacity (vphpl)	1 lane (vph)	2 lanes (vph)	3 lanes (vph)	4 lanes (vph)
Freeway	2,200				
Expressway	1,500				
Principal Arterial - divided	-	1,130	2,000	2,836	3,537
Principal Arterial - undivided	-	1,017	1,800	2,553	3,183
Minor Arterial - divided	-	678	1,200	1,702	2,122
Minor Arterial - undivided	-	565	1,000	1,418	1,768
Collector	-	452	800	1,134	1,415
Local	-	452	800	1,134	1,415
Ramp	1,500				
Frontage Road	-	1,130	2,000	2,836	3,537

Based on research from "Effectiveness of Additional Lanes at Signalized Intersections", ITE Journal, Jan. 2003

Avoid Arbitrary Adjustments

- 2000 Census vs. 2001 models – Share of internal work trips that originate in Douglas County (Denver Region) and also end there

Corridor Level

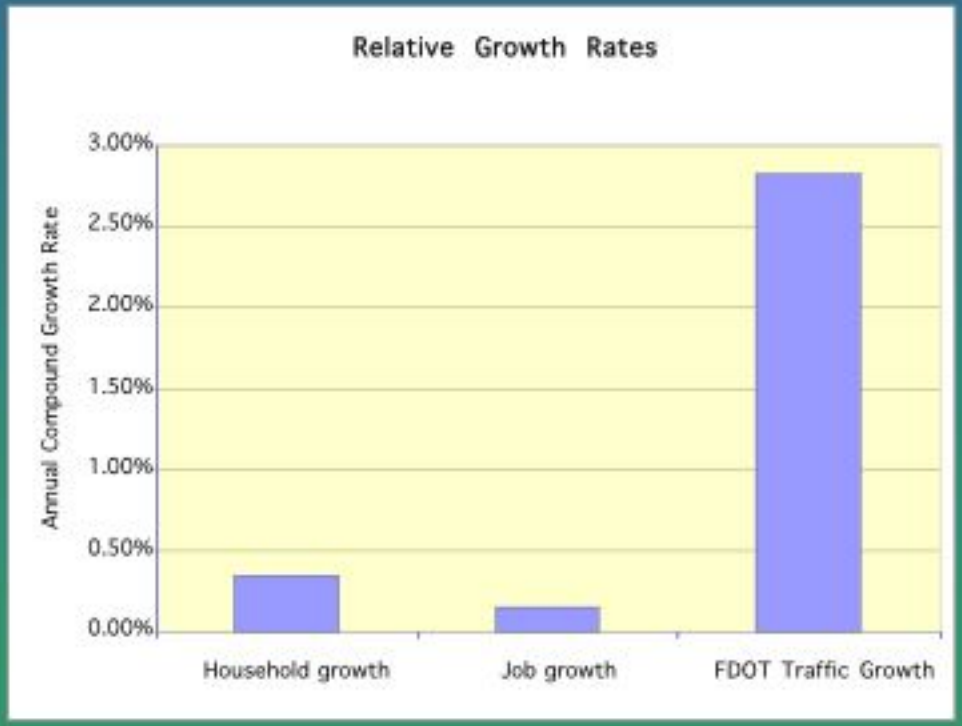
- Road projects and/or transit projects
  - Departments of Transportation
  - Toll Authorities
  - Transit Agencies
  - Municipalities
- Major developments (varies by jurisdiction)

Traffic Forecast Models

- Traffic Forecasts based on regional model; detail added and "calibrated" to match local conditions
- Straight line forecasts: Assume traffic will grow by X percent per year based on past history.

Straight Line Growth

- Not sensitive to
  - local growth patterns
  - capacity of local road network
- Only use for short term forecasts (5 years)
- Check to see how growth rates of traffic compare with projected growth rates of housing and



Traffic Operations Models

- Highway Capacity Manual "Static" models of road and intersection operations (level of service)
- Simulation models: dynamic models of corridor operations and corridor performance measures

Level of *Automobil* Service

Level of service	General operating conditions
A	Free flow
B	Reasonably free flow
C	Stable flow
D	Approaching unstable flow
E	Unstable flow
F	Forced or breakdown flow

Note: Specific definitions of levels-of-service A through F vary by facility type and are presented in the HCM (15).

Exhibit 2-31. General Definitions of Levels of Service

Functional class	Appropriate level of service for specified combinations of area and terrain type			
	Rural level	Rural rolling	Rural mountainous	Urban and suburban
Freeway	B	B	C	C
Arterial	B	B	C	C
Collector	C	C	D	D
Local	D	D	D	D

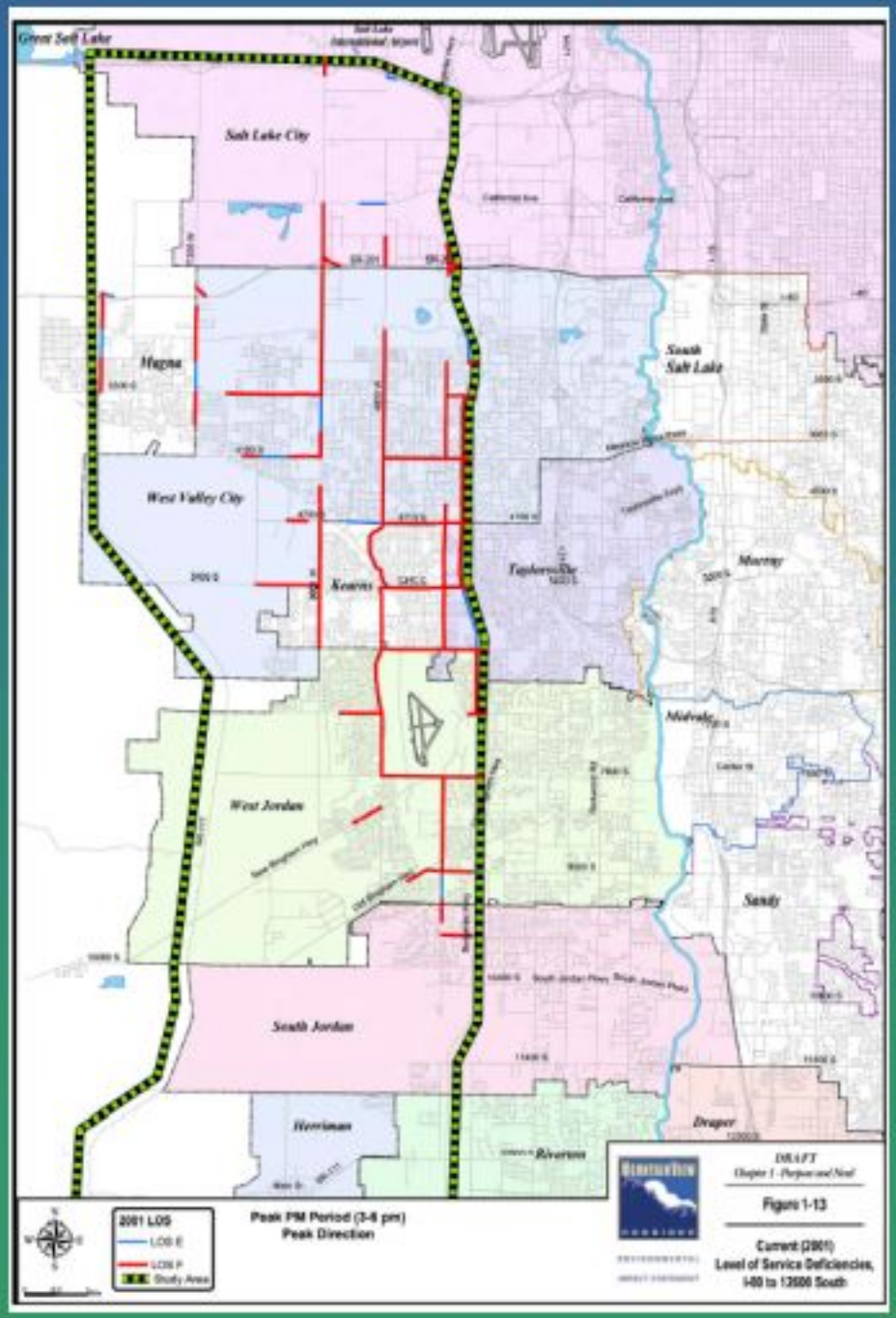
Exhibit 2-32. Guidelines for Selection of Design Levels of Service

Level of Service Selection

- Most important traffic design decision, not covered adequately in CNU/ITE Manual
- AASHTO recommends those levels, but specifically leaves selection of LOS up to the designer.
- FHWA does not require a design exception for selecting different level of service criteria.
- We need to consider balancing poor vehicular LOS with high walkability, transit

Segment LOS

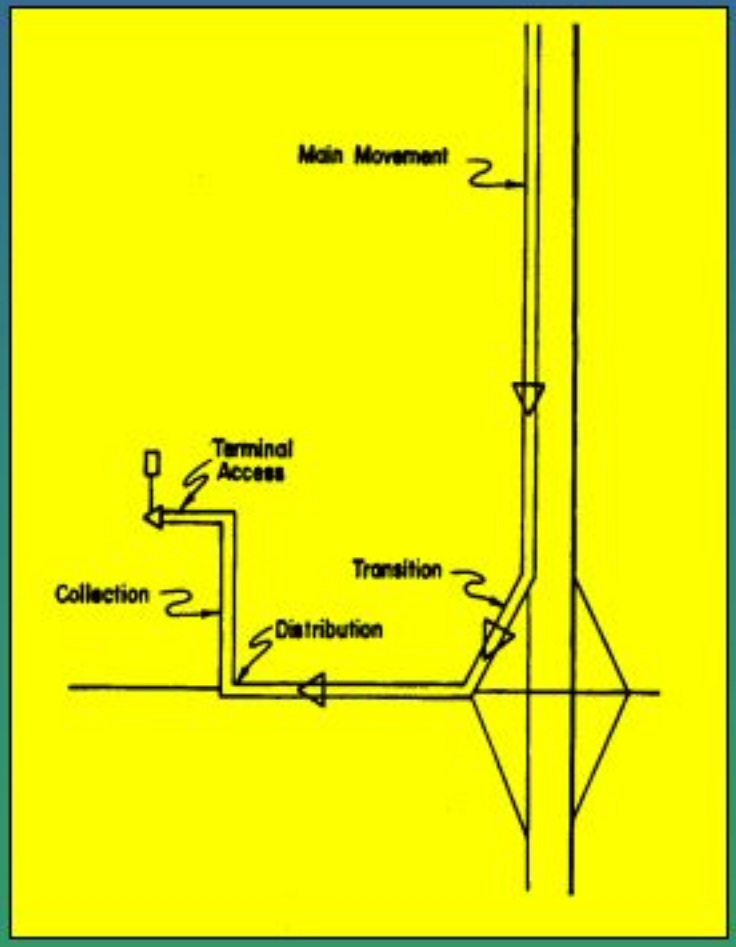
- Segment LOS often presented as a justification for widening.
- This is a measure that is not appropriate for use in urban areas. It is a rural measure based on speed.

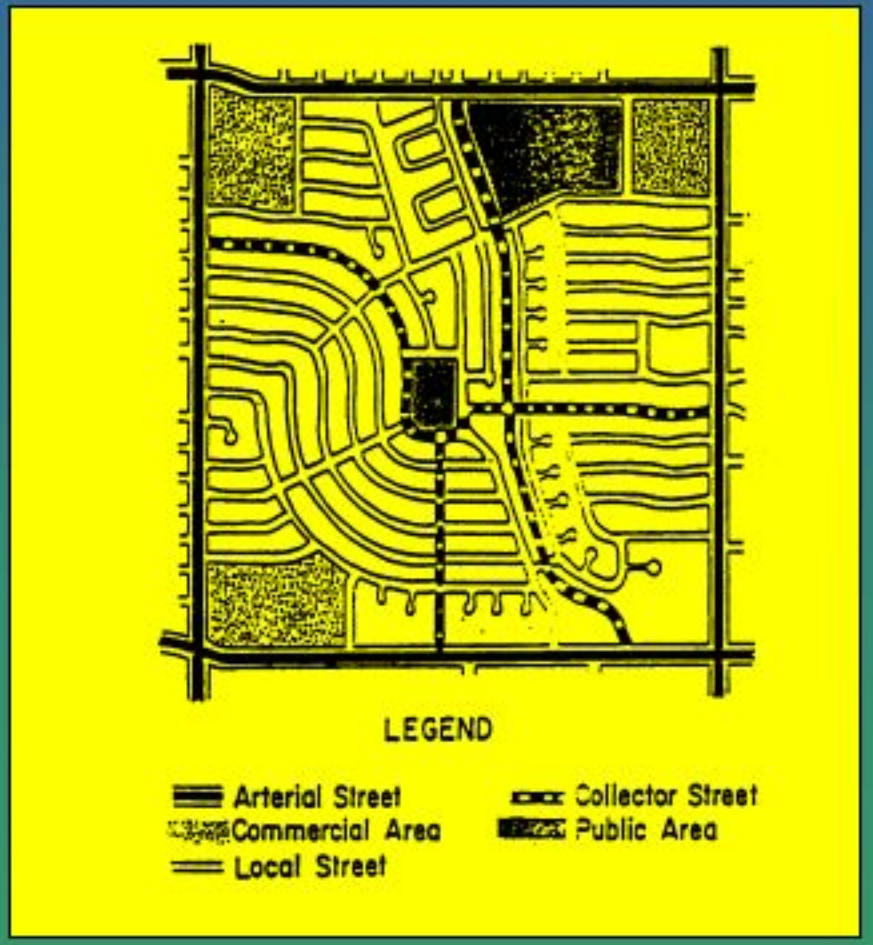


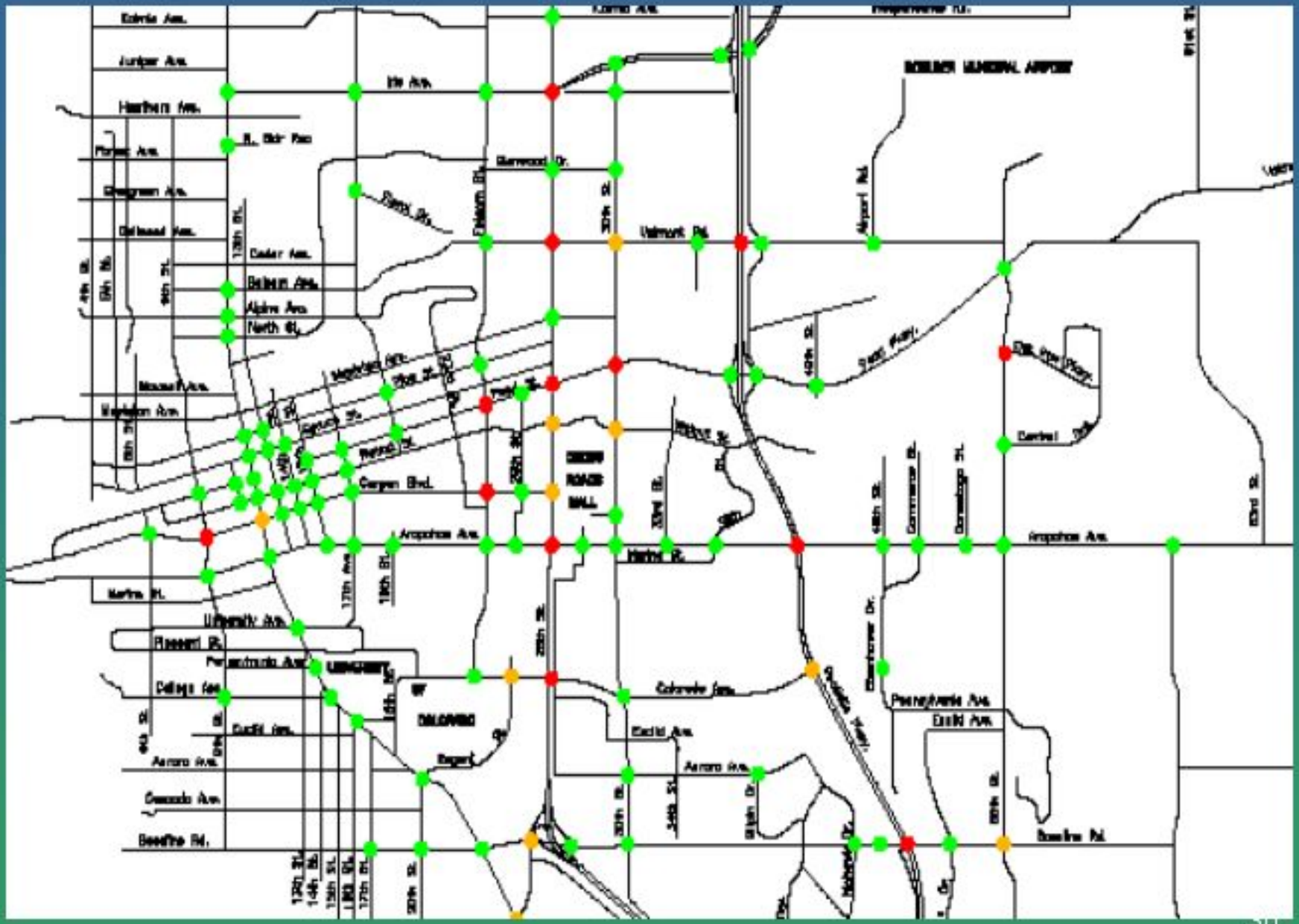
Intersection LOS Calculations

- Intersections are always the most critical points in an urban street network
- LOS is calculated with highly prescribed formulas in the *Highway Capacity Manual* (the other Bible)
- Influenced by numerous variables:
  - Traffic Volumes, percent large trucks
  - Number, Type and Width of Lanes
  - Traffic Signal Phasing (i.e. protected left turns vs. permitted)
  - Pedestrian signals/crossings, Transit use
  - Peak Hour Factor (should be 0.98 in urban areas)
  - Many more . . . .

How We Get Around






Juniper Ave.
Hawthorn Ave.
Cedar Ave.
Balsam Ave.
Alpine Ave.
North St.
Mapleton Ave.
Iris Ave.
Glenwood Dr.
Valmont Rd.
Airport Rd.
Canyon Blvd.
Arapahoe Ave.
Marine St.
Pleasant St.
College Ave.
Euclid Ave.
Aurora Ave.
Cascade Ave.
Baseline Rd.
Colorado Ave.
Pennsylvania Ave.
Central Park
Commerce St.
Broadway

Multimodal Level of Service

- Florida has standards for Bicycle and Pedestrian LOS
- Many other sources of “walkability” and “bikeability” checklists
- Still Needed: Balance of the different modal LOS. i.e. if you have a high walkability, you can lower your vehicular LOS.

Simulation Models

- HCM only works well at isolated intersections
- Simulation used for more complex corridors where there may be metering or queuing from adjacent intersections.
- Additional variables include driver behavior, following distances, aggressiveness
- Can adjust many more factors and calibrate to urban driving habits.

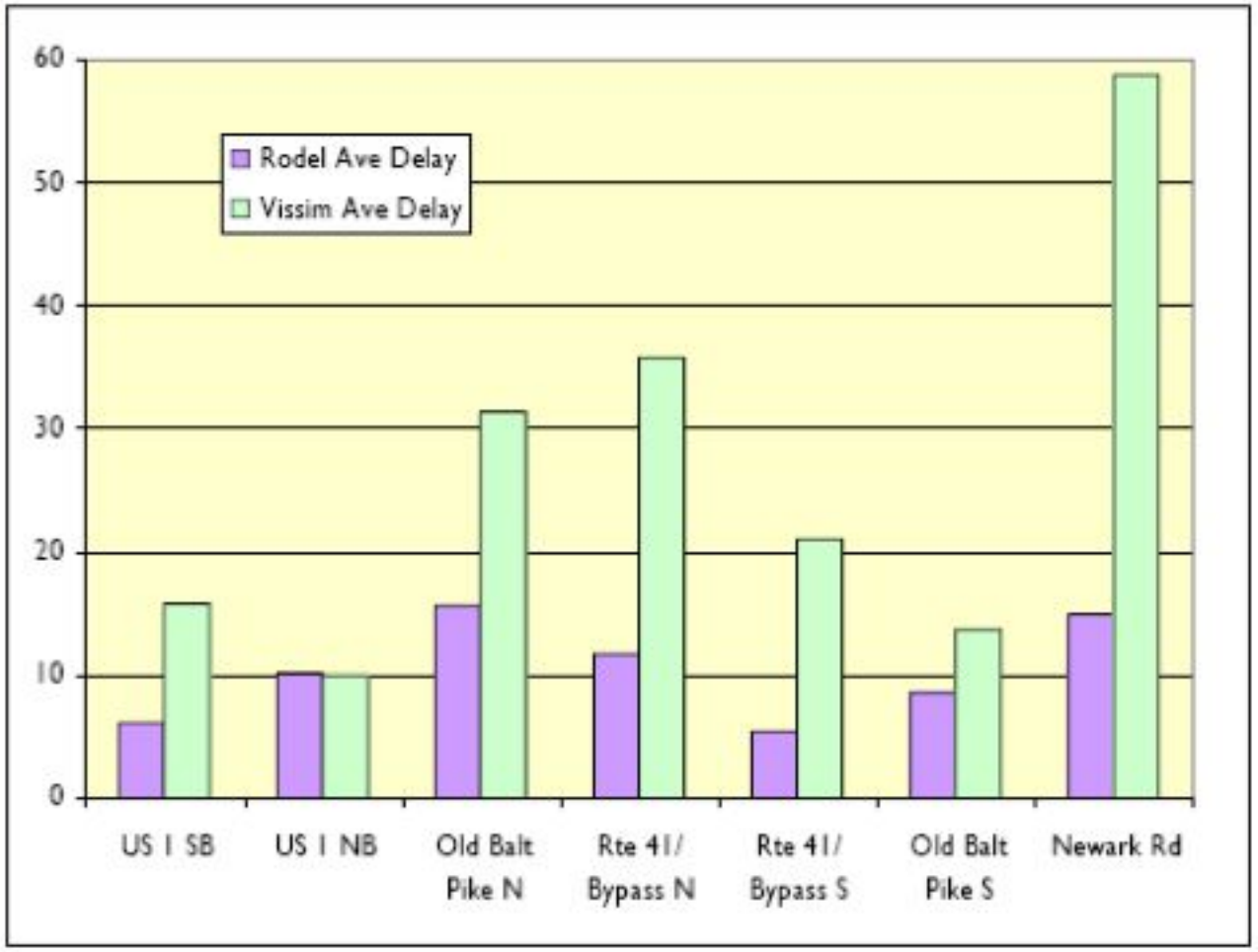

US 7
Exit 20 NB
VT 207
Handy/Drive In
Wal*Mart
Auto Dealer
Exit 20 SB
VT 207
US 7
Highgate Commons
Mobil
Franklin Park
Price Chopper

Roundabout Level of Service

- FHWA published “rule of thumb” guidelines years ago. These are highly conservative, and should only be used as a screen for more detailed analysis.
- Software that specifically analyzes roundabouts: aaSIDRA, RODEL, Arcady
- Do not rely on these for roundabouts: SimTraffic, VISSIM, Synchro

Competing Software

Figure 2: Average Delays of OR January 2004 VISSIM vs. RODEL



Project or Site Impact Level

- Traffic impact analysis
  - Trip generation
  - Distribution of trips
  - Level of service
- Site review
  - Access
  - Internal streets
  - Parking

ITE Trip Generation Model

- Predicts traffic coming from specific land uses based on their size
- Added to "background" traffic to predict traffic conditions with development and need for "mitigation" "improvements"

Motel
(320)

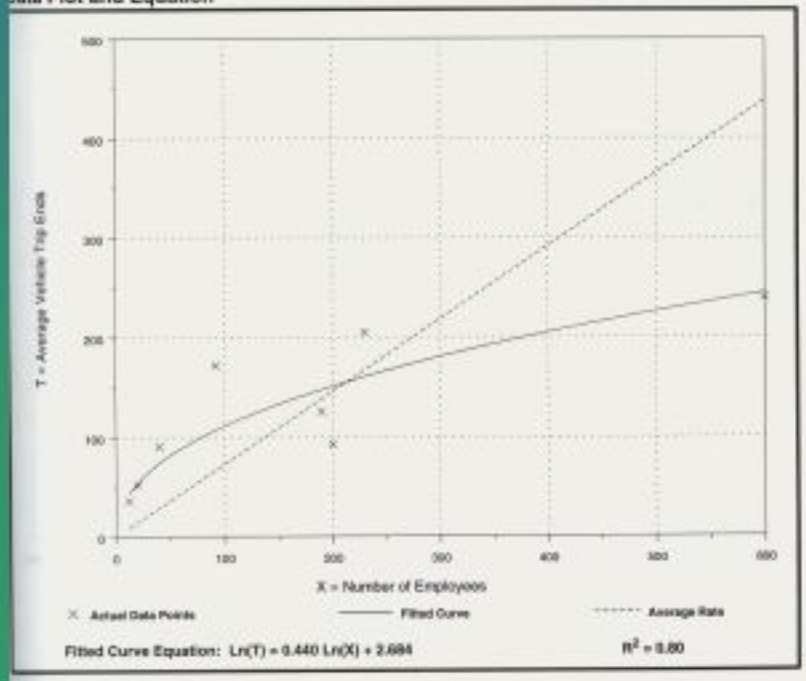
Average Vehicle Trip Ends vs: **Employees**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 8
Avg. Number of Employees: 173
Directional Distribution: 54% entering, 46% exiting

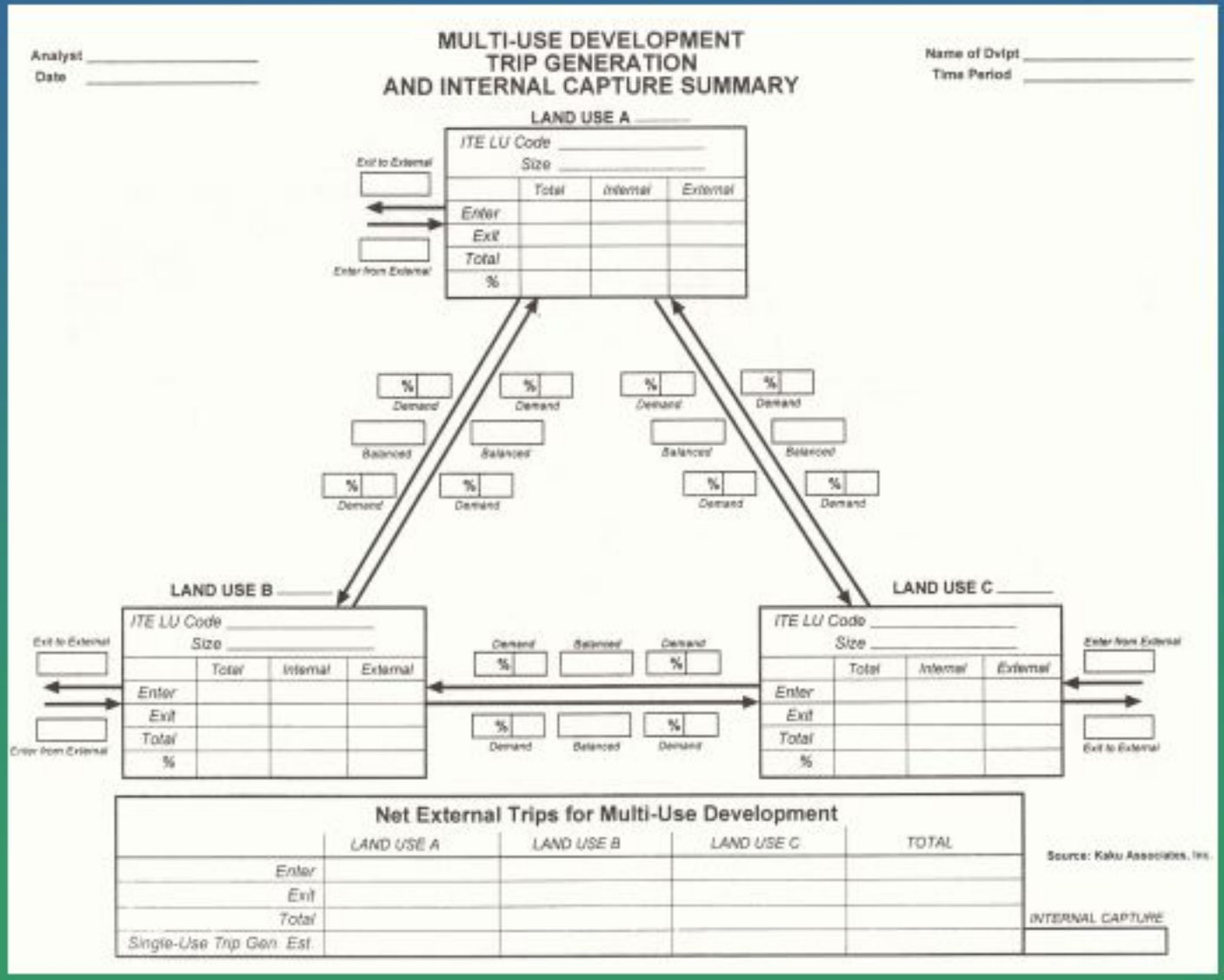
Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.73	0.40 - 3.00	1.02

Data Plot and Equation



Mixed Use Trip Generation



Mixed Uses per ITE

Table 6-2: Trip Generation and Reduction for Big Box Development

Land Use	Acres	Units	National Ave. Trips	Gross Local Adj. Trips	Net Local Adj. Trips	Percent Mixed Use Reduction	Net External Trips
Single Family Residential	0	0	0	0	0	0.0%	0
Multi-Family Residential	0	0	0	0	0	0.0%	0
Condominium Residential	0	0	0	0	0	0.0%	0
Regional Retail	28	244	12,093	12,093	12,093	0.0%	9,675
Community Retail	12	174	9,740	9,740	9,740	0.0%	6,818
Neighborhood Retail	0	0	0	0	0	0.0%	0
Office	0	0	0	0	0	0.0%	0
Industrial	0	0	0	0	0	0.0%	0
Public Facilities	0	0	0	0	0	0.0%	0
Open Space	0	0	0	0	0	0.0%	0
Total of All Sub-Areas	40		21,833	21,833	21,833	0.0%	16,493

Figure 6-2: 40 Acre Big Box Development

Table 6-1: Trip Generation and Reduction for Mixed-Use Development

Land Use	Acres	Units	National Ave. Trips	Gross Local Adj. Trips	Net Local Adj. Trips	Percent Mixed Use Reduction	Net External Trips
Single Family Residential	8	64	688	925	844	8.8%	633
Multi-Family Residential	5	100	734	860	727	15.5%	545
Condominium Residential	5	100	651	764	642	15.9%	482
Regional Retail	0	0	0	0	0	0.0%	0
Community Retail	6	87	6,237	6,237	5,811	6.8%	4,068
Neighborhood Retail	6	131	5,316	5,316	4,670	12.1%	2,802
Office	8	349	4,041	4,041	3,744	7.3%	3,183
Industrial	0	0	0	0	0	0.0%	0
Public Facilities	0	0	0	0	0	0.0%	0
Open Space	2	2	5	5	4	3.2%	0
Total	40		17,671	18,148	16,442	9.4%	11,712

Figure 6-1: 40 Acre Mixed-Use Development

Few Streets Serve Most Traffic

Systems	Volume (%)	Length (%)
Arterials	65-80	12-25
Collectors	5-10	5-10
Locals	10-30	65-80

Many Streets Serve Little Traffic

Arlington VA Transportation Survey

- Arlington residents rely less on driving than the Metropolitan Washington regional average: Of Arlington residents who commute to work:
  - 47% drive alone vs. 74% regionally
  - 27% take the train vs. 13% regionally
  - 12% take the bus vs. 6 % regionally
  - 6% walk vs. 1 % regionally
- 88% of County residents rate their quality of life as Good or Very Good.

Portland Example

Table 15 Trip Reduction Factors (Portland, 1995)

Minimum Floor Area Ratio	Mixed-Use	Commercial Near Bus	Commercial Near LRT Station	Mixed-Use Near Bus	Mixed-Use Near LRT
No minimum	-	1%	2.0%	-	-
0.5	1.9%	1.9%	2.9%	2.7%	3.9%
0.75	2.4%	2.4%	3.7%	3.4%	4.9%
1.0	3.0%	3.0%	5.0%	4.3%	6.7%
1.25	3.6%	3.6%	6.7%	5.1%	8.9%
1.5	4.2%	4.2%	8.9%	6.0%	11.9%
1.75	5.0%	5.0%	11.6%	7.1%	15.5%
2.0	7.0%	7.0%	15.0%	10.0%	20%

Mixed-Use means commercial, restaurants and light industry with 30% or more floor area devoted to residential. Near bus or LRT (Light Rail Transit) means location within ¼-mile of a bus corridor or LRT station. Floor Area Ratio (FAR) = ratio of floor space to land area.

Parking Ratios

6.8.2.4 Business and Commercial/Industrial Uses:

Retail and Service Shops: 4 parking spaces per 1000 square feet of floor area.

Shopping Centers: 5 parking spaces per 1000 square feet of floor area.

Auditoriums, Theaters, Membership Clubs, and Assembly Halls: 0.3 parking spaces per seat of total capacity.

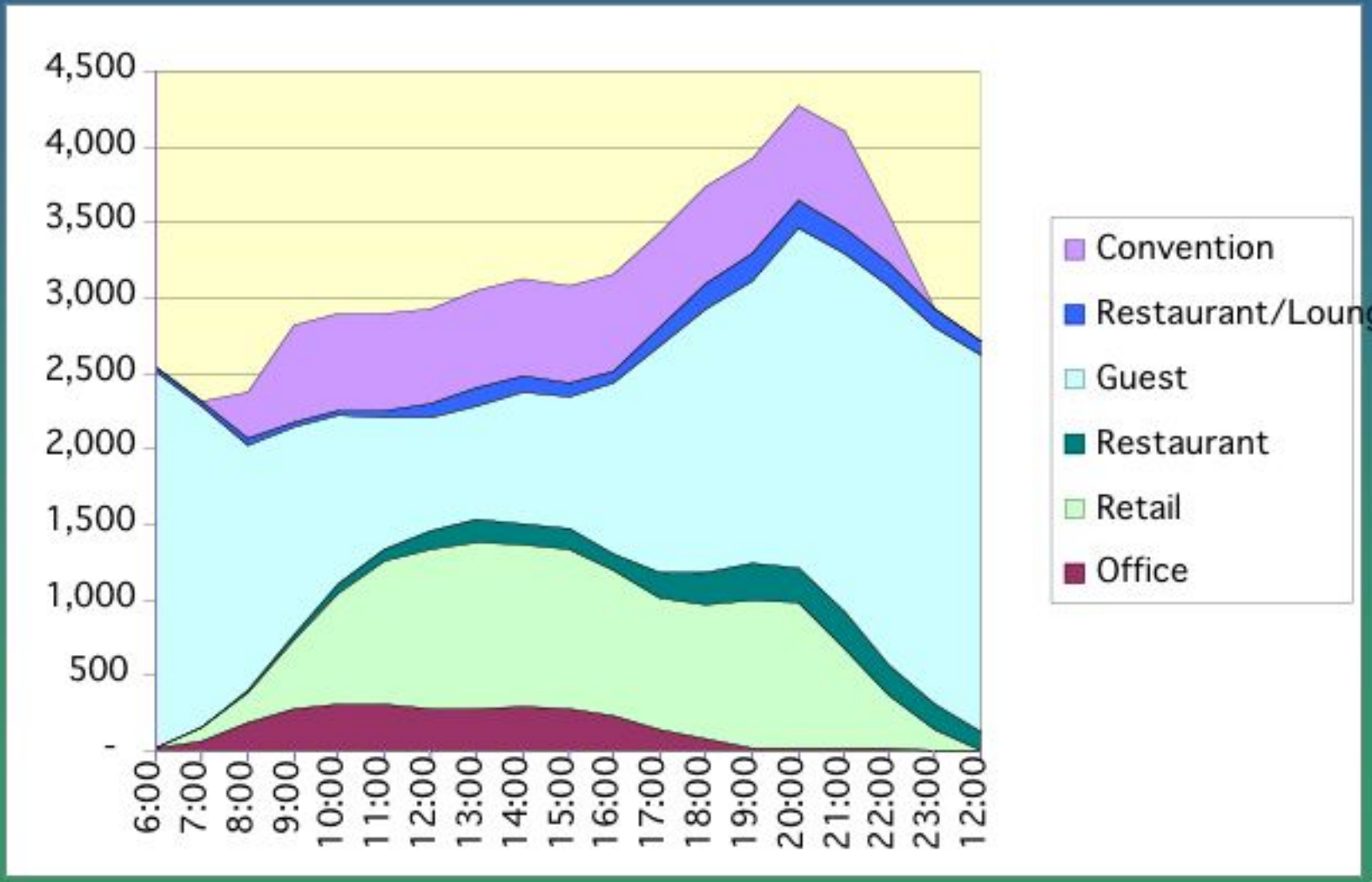
Restaurants: 0.3 parking spaces per seat (including bar capacity).

Religious Institutions: 0.25 parking spaces per seat of total capacity.

Retirement Housing: 0.5 parking spaces per single unit.

Office Buildings and Banks and Research Testing Facilities: 4 parking spaces per 1000 square feet of floor area.

Shared Parking



The High Cost of Free Parking

- Cost of parking is one of greatest factors in choosing transit rather than driving
- We subsidize parking by requiring developers to supply excess parking and targeting public investments in parking
- Parking has a huge negative impact on urban fabric
- More parking = more traffic congestion

Shoupian Parking

- A Free Market Economic Model for Parking
- For Urban Areas with transit, sidewalks, and mobility options
- Price parking so that there are always 15% vacant, especially for on-street spaces
- No parking ratios or requirements – let the market decide

Conclusions

- As part of the Project for Transportation Reform, transportation modeling practices should adapt for new urbanism.
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  - Norman Marshall nmarshall@smartmobility.com
  - Lucy Gibson lgibson@smartmobility.com

Network Planning Approach

AASHTO Network

- Most traffic uses few arterials
- Arterials give priority to vehicle level of service
- Design guided on level of service for future traffic volumes

New Urban Network

- Less concentration of traffic onto arterials
- More alternative routes and modes
- Arterials are multimodal, not designed for vehicle level of service

Model Evolution

- Most Transportation Models evolved with the AASHTO network. However, many of these models can be adapted to work in a multimodal urban environment

Levels of Modeling

- Regional: Metropolitan Area or Statewide models, predict larger patterns of growth and traffic distribution. Not intended for "local" use
- Corridor: Used to evaluate a particular major facility: freeway, arterial or transit line
- Site or Project: Used to evaluate the traffic from a proposed development; or to evaluate small scale (i.e. intersection) "improvements".

Some Analyses Combine Modeling Tools at Different Levels