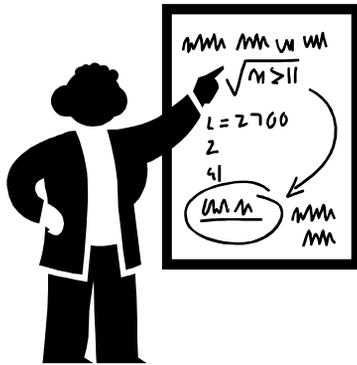


The Atlanta Regional Commission Transportation Model

Presentation Made to the 2004 TMIP
NCDOT Modeling Peer Review

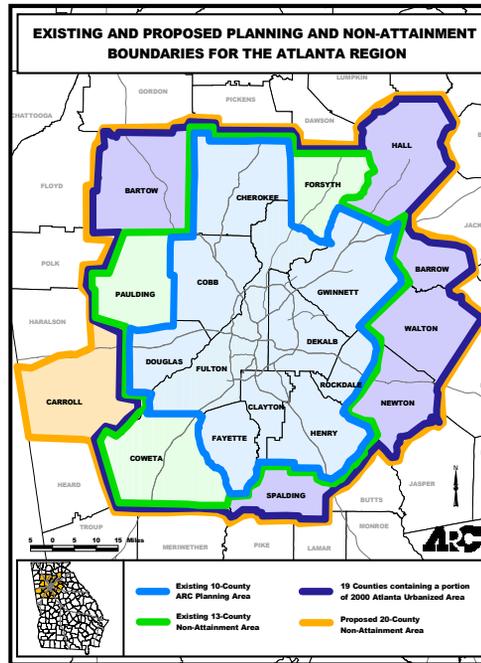


ARC Transportation Planning

- **Departmental Organization**
 - **Long Range Planning**
 - **Short Range Planning**
 - **Modeling, Analysis & Data**
 - **Air Quality**

What is the Atlanta Region?

- 10-county ARC planning area
- 19 counties containing a portion of 2000 Atlanta UAB (ARC will likely expand to 18 counties)
- 13 counties classified as Serious ozone nonattainment area by 1990 CAAA (reclassification to Severe effective January 2004)
- 20 counties proposed for 8-hour nonattainment area



- 10 county planning boundary based on 1990 census definition of UAB
- UAB expanded to 19 (portion of) 19 counties based on 2000 census.
- Reclassification to Severe based on finding of nonattainment by November 1999 (disapproval of extension policy).

Number One Challenge - Growth



- This truly is our number one challenge- accommodating 2.3 M between 2000 and 2030 (within 13-county area alone).

ARC Travel Demand Modeling Team

Guy Rousseau, Program Manager

Modeling Applications & Models Development

Claudette Dillard, Principal Planner

Highway Network Coding, Surveys & Studies

Curt Davis, Principal Planner

Highway Network Coding, Database Implementation

Laura Chen, Senior Planner

Highway Network Coding, GIS-T & Census / SE Data

Kandace Lewis, Senior Planner

Highway Network Coding, Performance Measures

Jean Hee Park, Senior Planner

Transit Network Coding, Development of Regional Impact (DRI)

ARC Forecasts

Two step process

First produce forecast for entire area
(13 Counties) using IPEF (Interactive
Population and Econometric
Forecasting) model

Disaggregate area forecast to smaller
areas using DRAM/EMPAL
(Disaggregate Residential Allocation
Model / Employment Allocation)

IPEF – economic unit – minimize geography

D/E – disaggregates

Requires policy inputs that you will develop in the coming year.

TAG – 9 experts in economics and demography – advised and approved this forecast

Surveys and Studies

- 2000-1 Household Travel Survey (SMARTRAQ):
2-day survey, 8000 households surveyed, or about 1/200 household
- 2001 Transit On-Board Survey
- 1999 Establishment Survey
- 2000 Hartsfield Jackson International Airport Survey
- 2000-2001 Speed Studies & Travel Time Studies

Traffic Modeling Platform/Environment

- Converted Model Stream from TRANPLAN to TP+

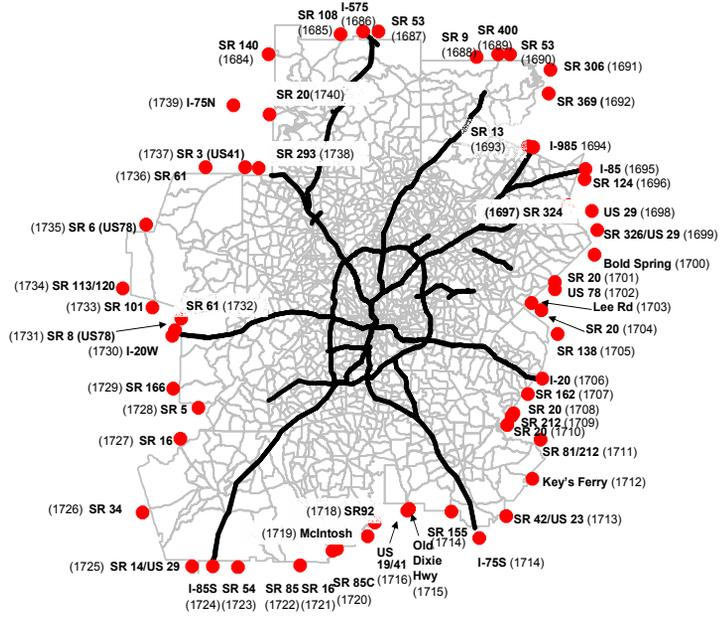
Socio-Economic (SE) Data

- Updated Using Census 2000 Datasets (CTPP)
- Updated Base Year 2000 Colleges & Universities Enrollment
- 589 Census Tracts (from DRAM/EMPAL) SE Data
disaggregated into 1683 internal TAZ

ARC Highway Networks & Related TAZ structure

- Expanded Zonal Structure from 948 internal TAZ to 1683, maintained External Stations to 57 zones, for a grand total of 1740 TAZ, compared to 1005 previously
- QA/QC 2000 Base Year Highway Network using GIS-T techniques and Aerial Photography
- Revisited Centroid Connectors to accommodate new internal TAZ geometric reconfiguration
- Expanded facility type definitions
- Refined Facility Types Definitions using ARC CMS Strategic Arterial System Definitions
- Updated Free-Flow Speeds and Capacities Look-Up Tables, based upon 2000-2001 travel times and speed studies

ARC 57 External Stations



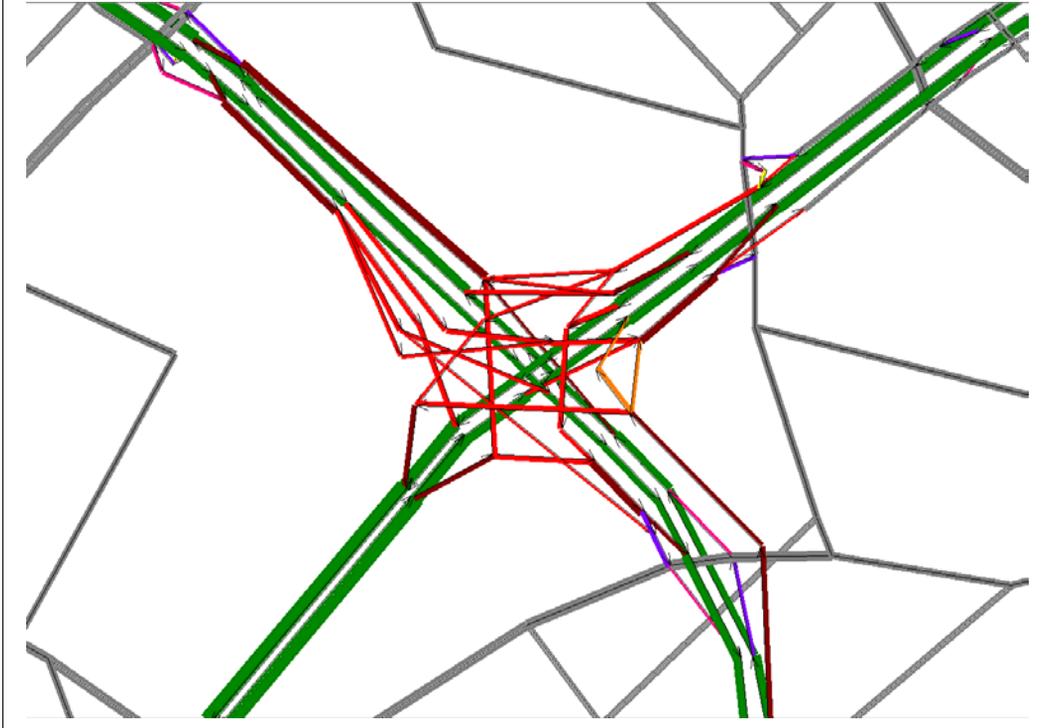
ARC Facility Types

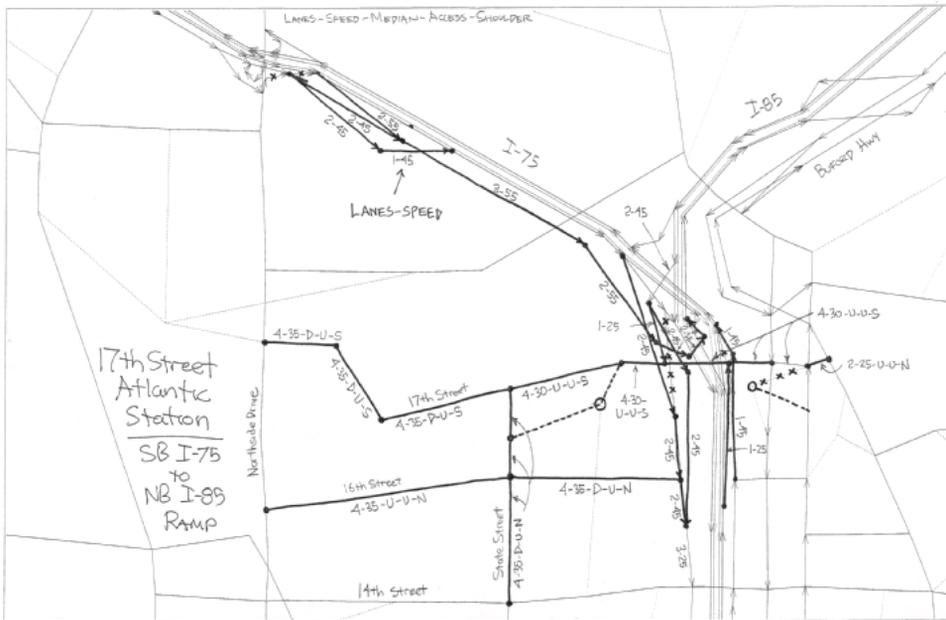
- 0 Centroid Connectors
- 1 Interstate / Freeway
- 2 Parkway
- 3 HOV Buffer Separated
- 4 HOV Barrier Separated
- 5 High Speed Ramp / CD Road
- 6 Medium Speed Ramp
- 7 Low Speed Ramp
- 8 Loop Ramp
- 9 Off Ramp w/ Intersection
- 10 On Ramp w/ Intersection
- 11 Expressway
- 12 Principal Arterial - Class I
- 13 Principal Arterial - Class II
- 14 Minor Arterial - Class I
- 15 Minor Arterial - Class II
- 16 HOV - Arterial (all classes)
- 17 Major Collector
- 18 Minor Collector / Other Local
- 19 Planned Ramps w/ Intersections
- 20 Planned Directional Ramps
- 50 Transit Only Link: Neighborhood Local
- 51 Transit Only Link: Local Roads and Collectors
- 52 Transit Only Link: Park-n-ride lot connector
- 53 Transit Only Link: Transfer links between rail and bus
- 54 Associated with BRT Routes (Future year coding)

“Spaghetti Junction” (I-85 @ I-285)



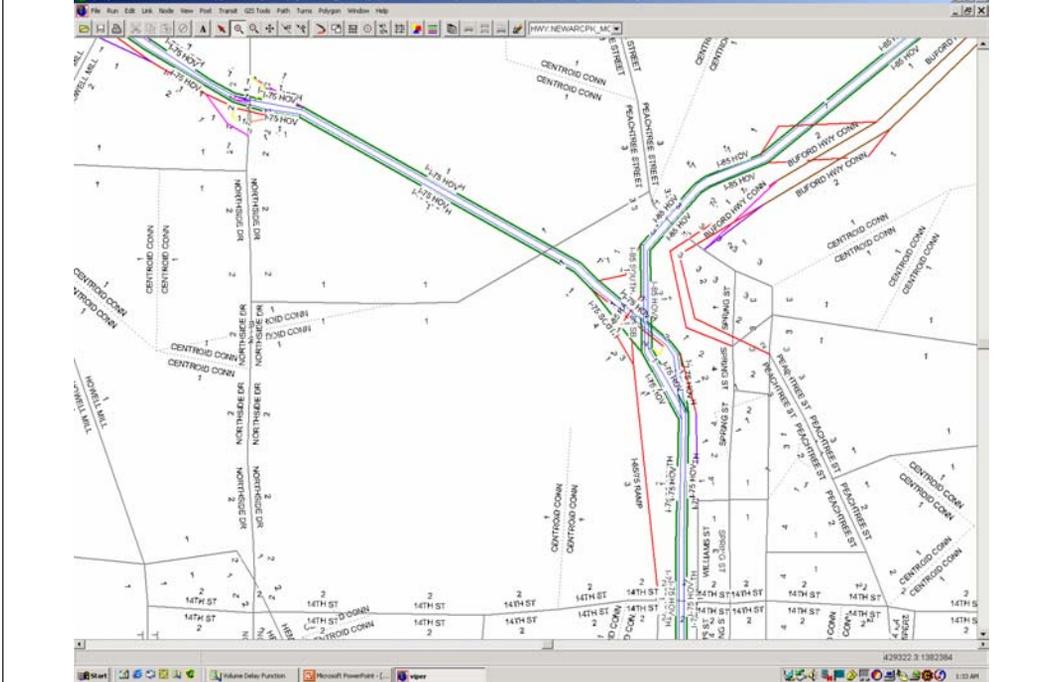
"Spaghetti Junction" (I-85 @ I-285)

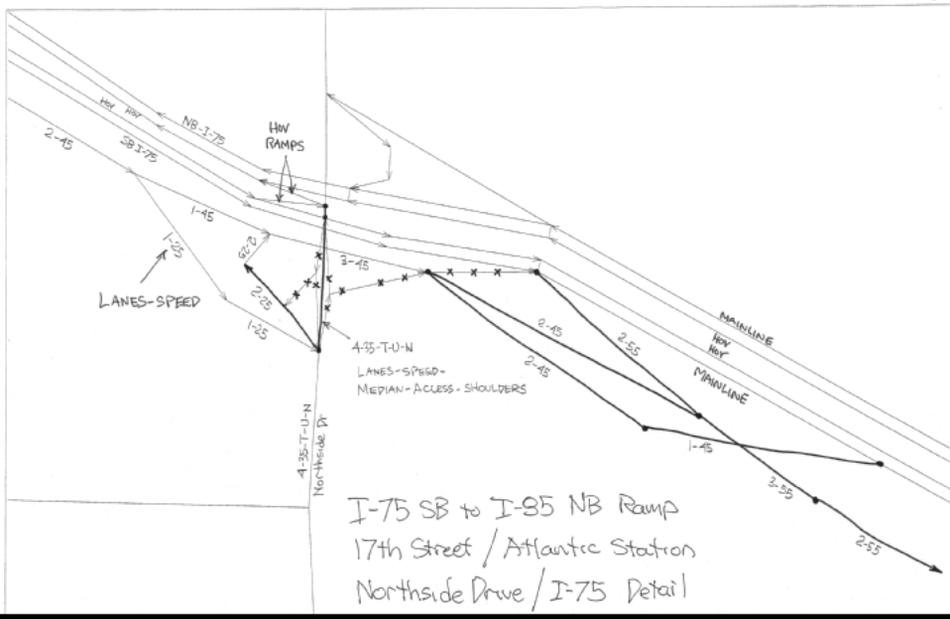




Atlantic Steel Site Development

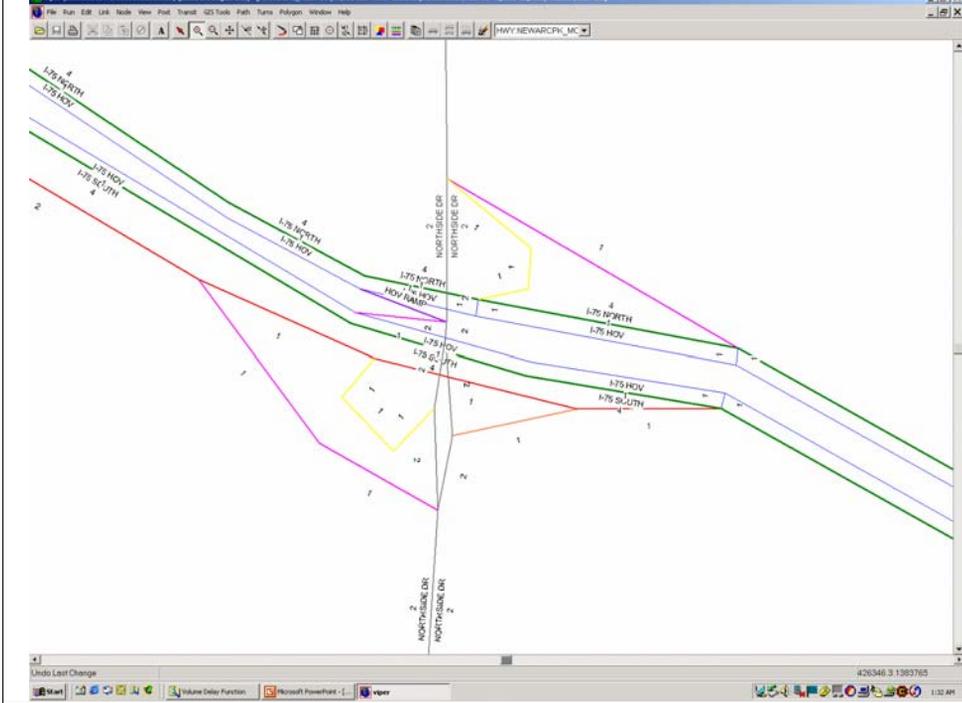
Atlantic Steel Site



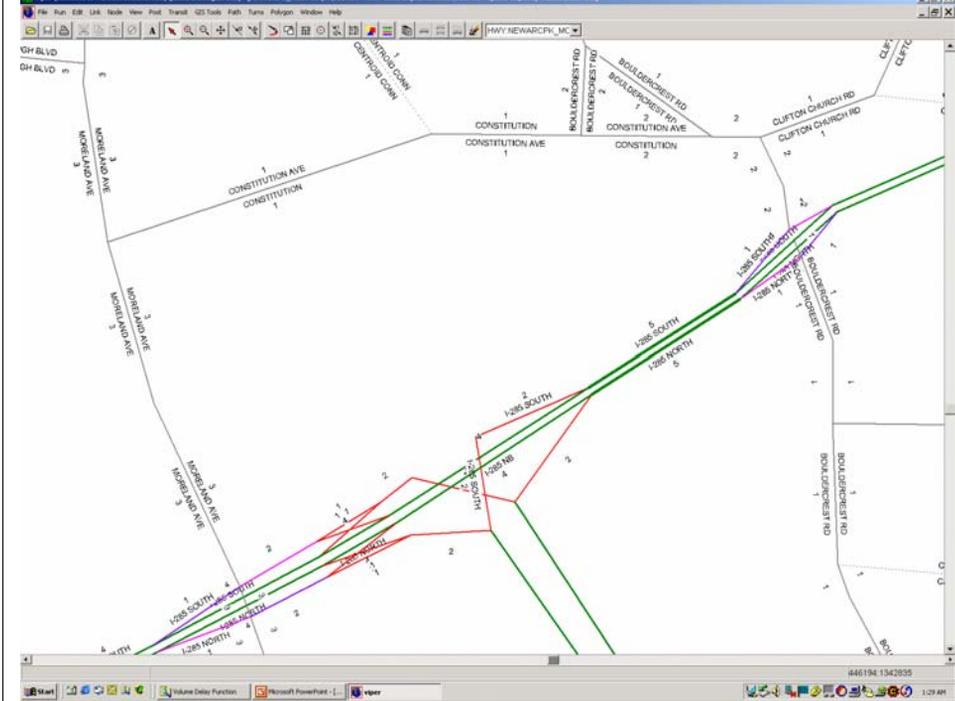


Northside Drive @ I-75

Northside Drive @ I-75



Bouldercrest Road @ I-285



Downtown Connector (I-75 / I-85) @ I-20



ARC-Coded ITS Strategies for Future Network Years (2030)

- Advanced Traffic Signal Coordination and Control
- Fiber-optic Communications
- Video Surveillance and Data Collection on Entire Corridors
- Activity Center Surveillance at Interstate Highway Crossings, Industrial Yards, Shopping Malls, Cross Regional Corridors
- Facilities Parallel to Interstate Highways
- Variable Message Signs (VMS) at Major Decision Points on Freeways
- Transit Vehicle Signal Priority
- Automated Vehicle Location (AVL) for Transit
- Electronic Fare Payment for Transit Service
- Queue Jumper Lanes for Transit
- Ramp Metering on Freeways

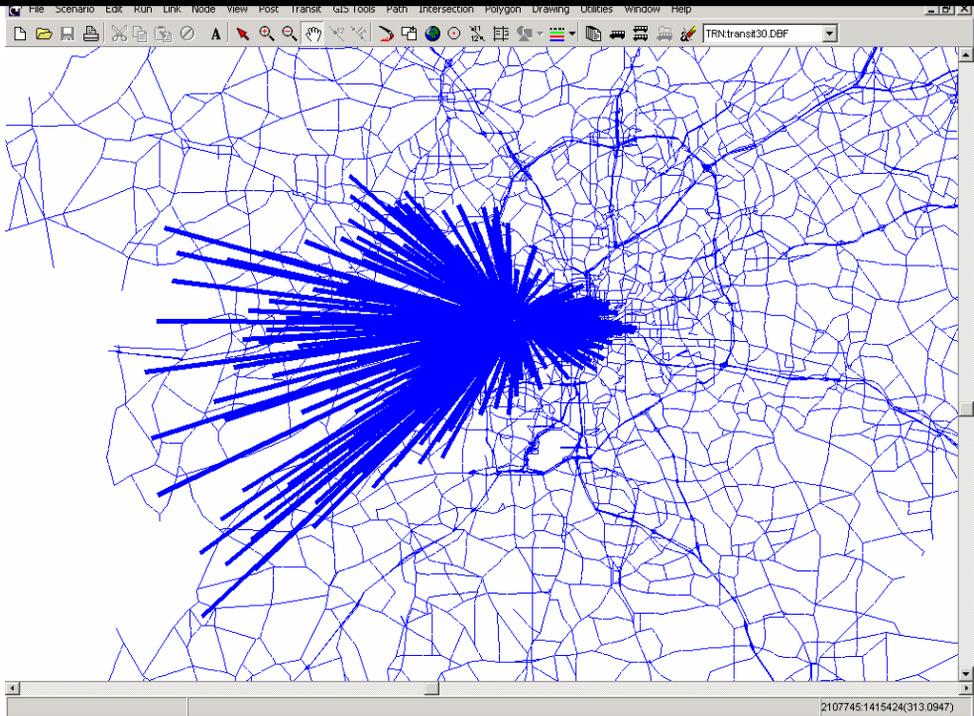
ITS benefits expressed in terms of:

- travel time savings
- delay reductions
- free-flow speeds increases
- localized transit mode share increases

ARC's Transit Networks

- Developed a Bus Speed Model
 - Empirical model to hook bus speeds with congested highway travel times, reflecting mixed flow of traffic operating conditions
 - Stratified by area types and facility types
- Defined 3 types of transit service access
 - Walk to local bus service
 - Walk to premium (with local bus & rail)
 - Drive to transit
- Separated walk to local from walk to premium
- Automated procedures for walk-to-transit links, with maximum length based on area of zone
- Separated Park-And-Ride (PNR) lots by types, local VS premium
 - Local, max access time = 15 minutes
 - Premium, max access time = 60 minutes
- Created procedures to build drive to premium PNR lots to focus on appropriate market, minimizing illogical paths. Max access time increases as market direction is approached
- Refined mode-to-mode transfer prohibitions, improving transit paths
- Improved Bus Rapid Transit (BRT) coding methods

ARC's Drive Connectors to PNR Lot on Highway Network



ARC's Trip Generation

- Production Model: Set of Logit Models stratified by trip purposes and person types
 - 6 Trip Purposes
 - HBW Home-Based Work
 - HBShop Home-Based Shop
 - HBO Home-Based Other
 - HBU Home-Based University (age of traveler: 19+)
 - HBSchool Home-Based Grade School (age of traveler: under 19)
 - NHB Non-Home Based
 - 3 Person Types
 - Adult worker (age 16+ with full or part time job)
 - Non-Working Adult
 - Child (age 15 or younger)
 - 5 Socio-Economic Independent Variables, by household
 - Household size (1,2,3,4+)
 - Household income (\$0-\$20K, 20-50, 50-100, \$100K+)
 - Workers per Household (0,1,2,3+)
 - Children per Household (0,1,2,3+)
 - Autos per Household (0,1,2,3+)

ARC's Trip Generation – Production Model

- Estimates probabilities of a person making:
 - 0 trip, 1 trip, 2 trips, 3 trips, 4+ trips
- Converts to trip rates/person by person type
- Estimates non-motorized trips, including consideration of household access by income for transit and highway time
- Based on 2000-2001 household travel survey

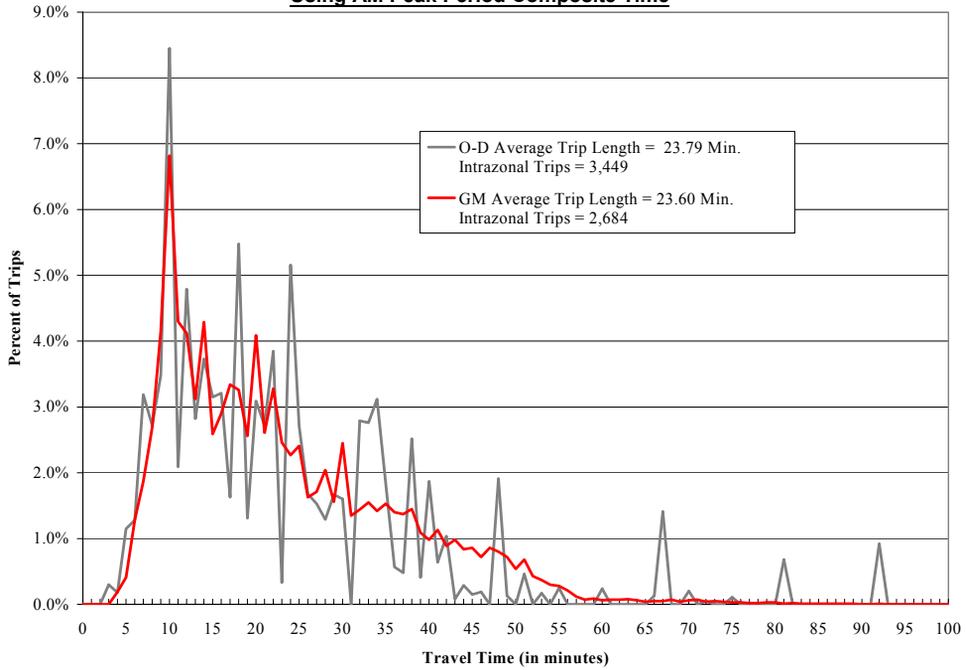
ARC's Trip Generation – Attraction Model

- Cross classification for HBW, HBShop, HBO, NHB
Regression for HBSchool, HBU
- Stratified by 4 trip purposes, all 4 are a 2-way cross-class matrix of trip rates per employee, or person, or household.
- Trip rates for each of the 4 purposes, one for each type of demographic data: types of households, persons and employment (8 types, construction, manufacturing, retail, TCU, wholesale, FIRE, service, government), and one for each of the 7 area types (based on density, CBD, Urb Com, Urb Res, Suburb Com, Suburb Res, Exurb, Rural)
- Based on 1999 Establishment Survey

ARC's Trip Distribution

- Use separate gravity model for each of the 6 trip purposes
- Separate friction factors for each of the 6 trip purposes by the 4 income groups
- Composite time (highway and transit time) used as impedance variable
- HBW uses AM peak period skims
- All other trip purposes use free-flow skims with separate topographic penalties added, those are area biases, such as the Chattahoochee River

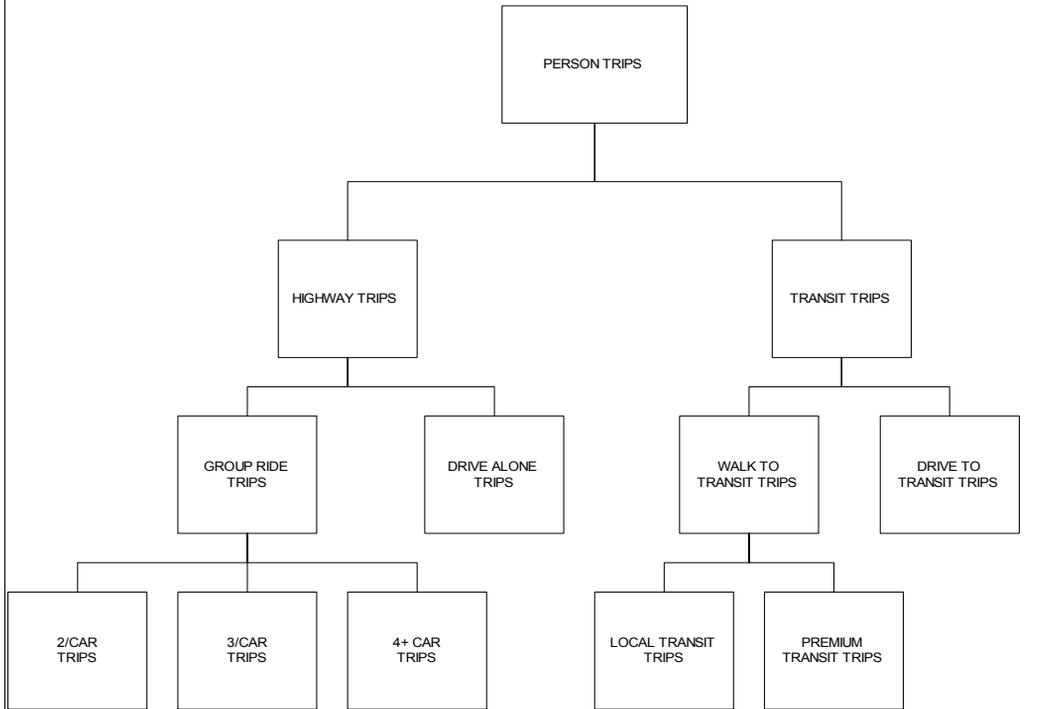
ARC's Trip Length Frequency Distribution (TLFD)
HBW Income Group 1 Trips (O-D vs. GM)
Using AM Peak Period Composite Time



ARC's Mode Split

- Fully Nested Logit for HBW, HBO (or HBNW, Non-Work), NHB
- HBW uses AM peak period skims
- HBO & NHB use mid-day skims
- Use TP+ procedures for % walk to transit by taz, via a grid with results similar to GIS TIGER path
- Added bus miles, local only transit service and suburban drive variables
- Automated bus miles calculations
- Calibration targets from MARTA/CCT boarding and local surveys, using ALOGIT software
- Works with FTA's New Starts 'Summit' Program

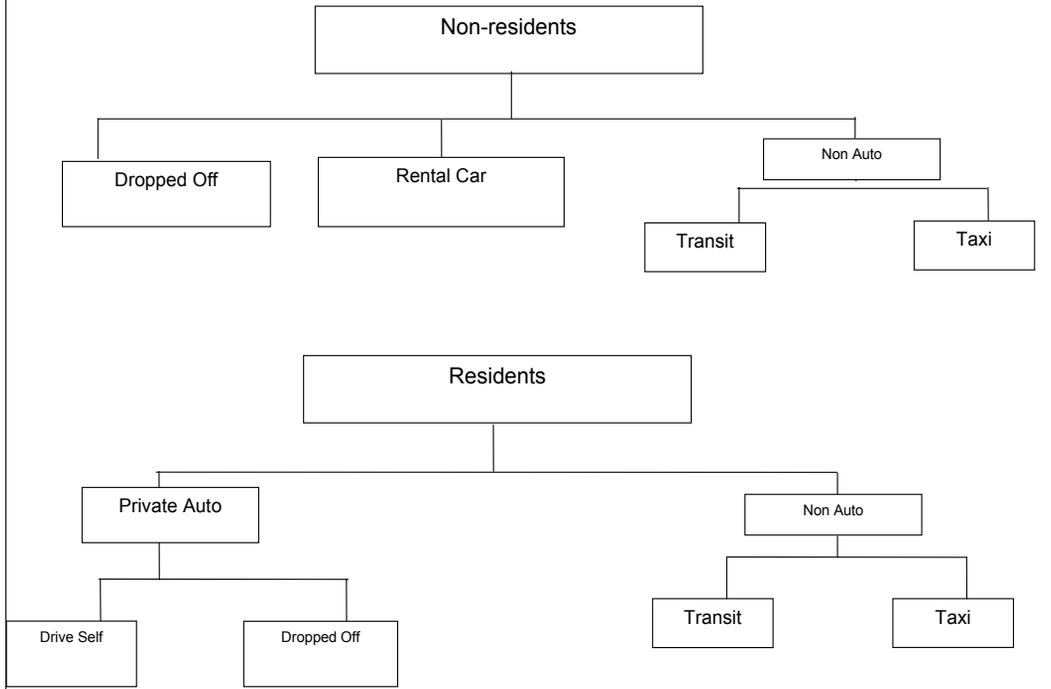
ARC Mode Choice Nesting Structure



ARC Special Generator: Airport Passenger Model

- Estimates average daily air passengers to and from the airport by:
 - Purpose (business VS leisure)
 - Residence Type (resident VS non-resident)
- Total air passengers are allocated to ground site locations based on:
 - Households by income level
 - Total employment
- Features a nested logit model with different structures and modal options for residents and non-residents
- Based on 2000 Hartsfield Air Passenger Survey

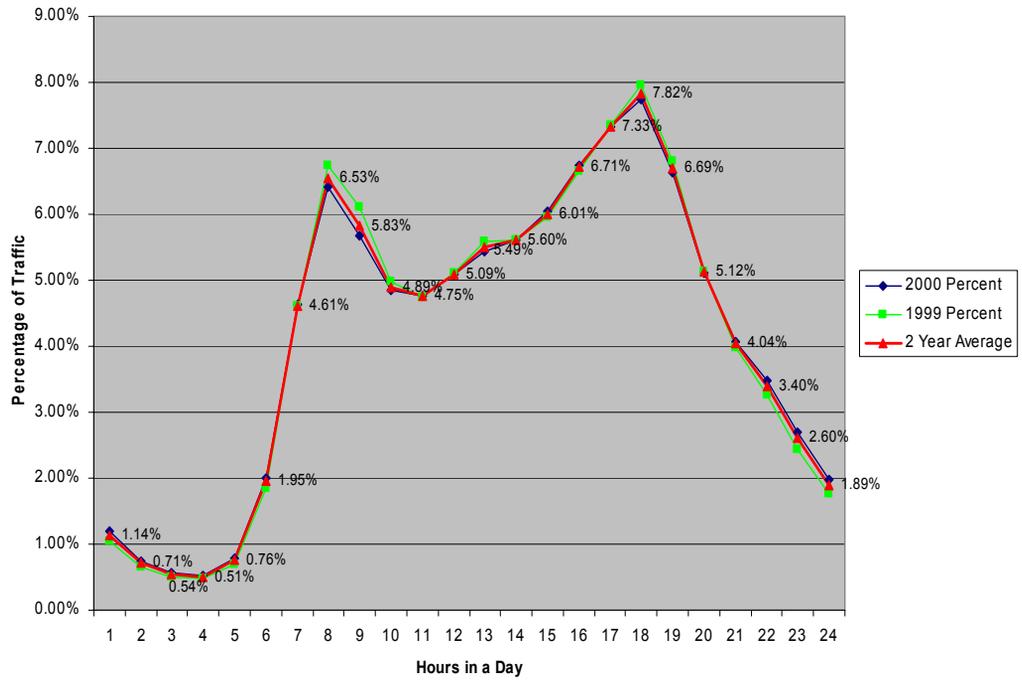
ARC Air Passenger Mode Choice Structure



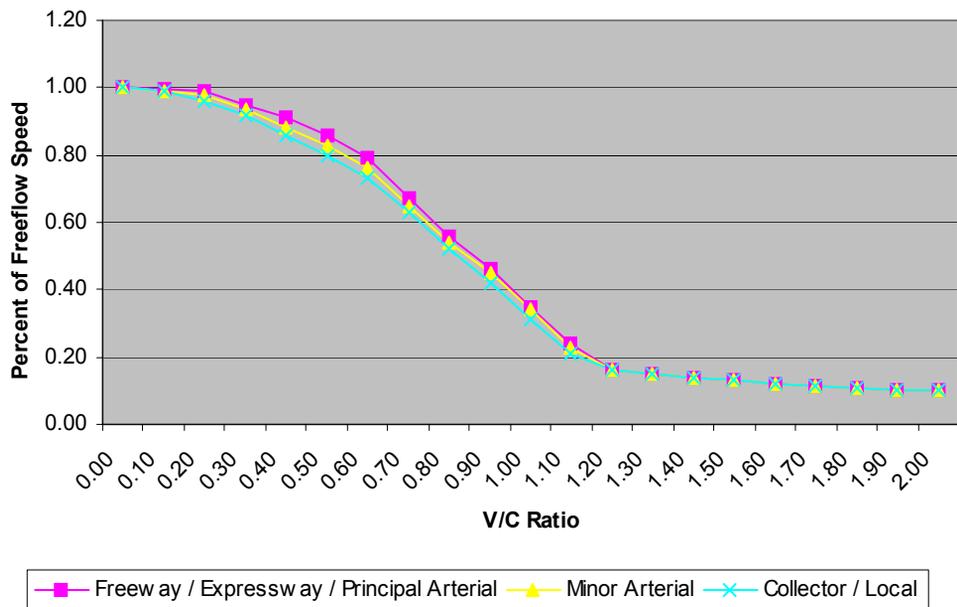
ARC's Highway Assignment

- Created 4 time of day (TOD) assignments:
 - AM peak (6am-10am)
 - Mid-day (10am-3 pm)
 - PM peak (3pm-7pm)
 - Evening/Night (7pm-6am)
- VDF curves grouped by facility types and TOD
- Revised toll diversion model, where time penalty use value-of-time conversion (fixed toll on GA-400)
- Managed lanes (HOT lanes): toll for SOV and trucks based on previous assignment iteration's link v/c ratio, where the toll is distance-based (toll on a per mile basis)
- Feedback loop extends from trip generation to highway assignment (5 feedback loops, 25 equilibrium iterations)
- Tested Induced Demand / Induced Travel effects caused by highway improvements. ARC model includes induced trip effects, both in route diversion and total trip changes. The model shows induced effects, in route diversion, similar to the elasticity produced by research and observed traffic changes.

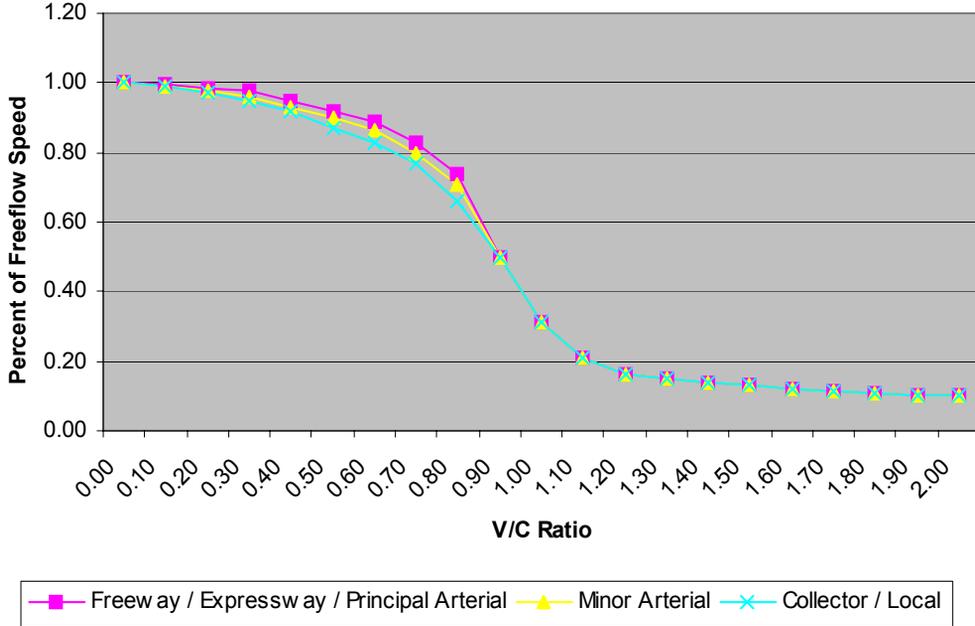
Atlanta Traffic Distribution By Hour



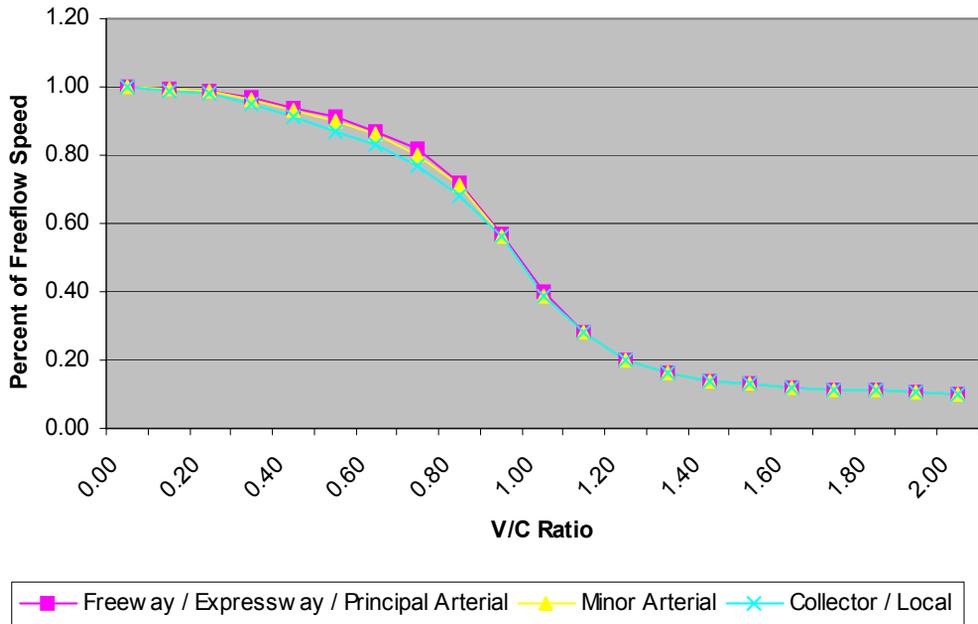
AM Period Volume-Delay Functions



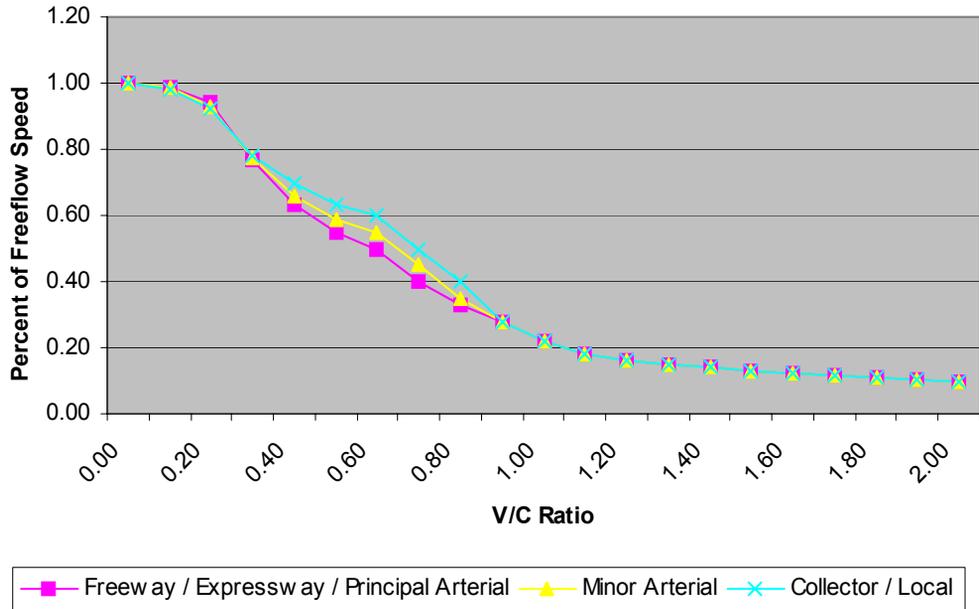
Midday Period Volume-Delay Functions



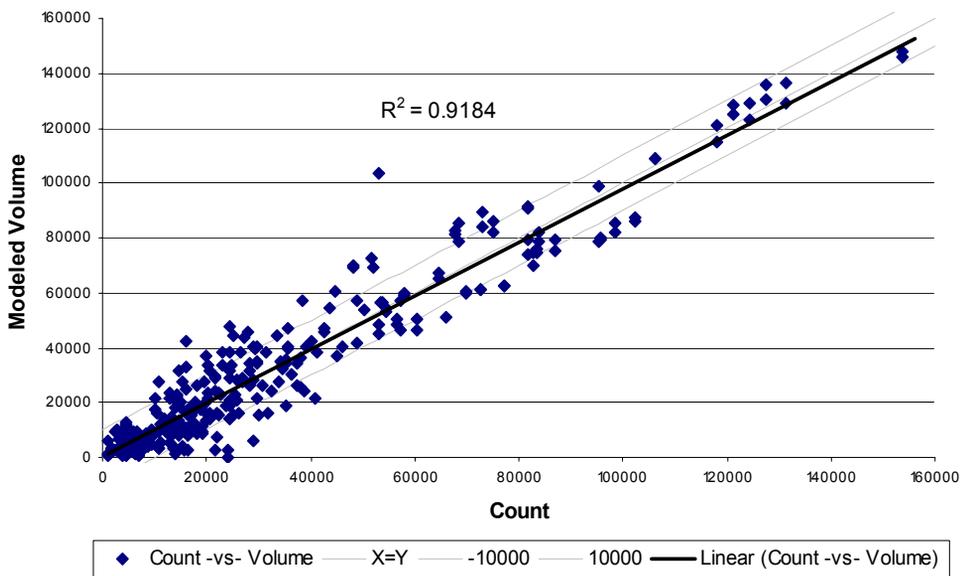
PM Period Volume-Delay Functions

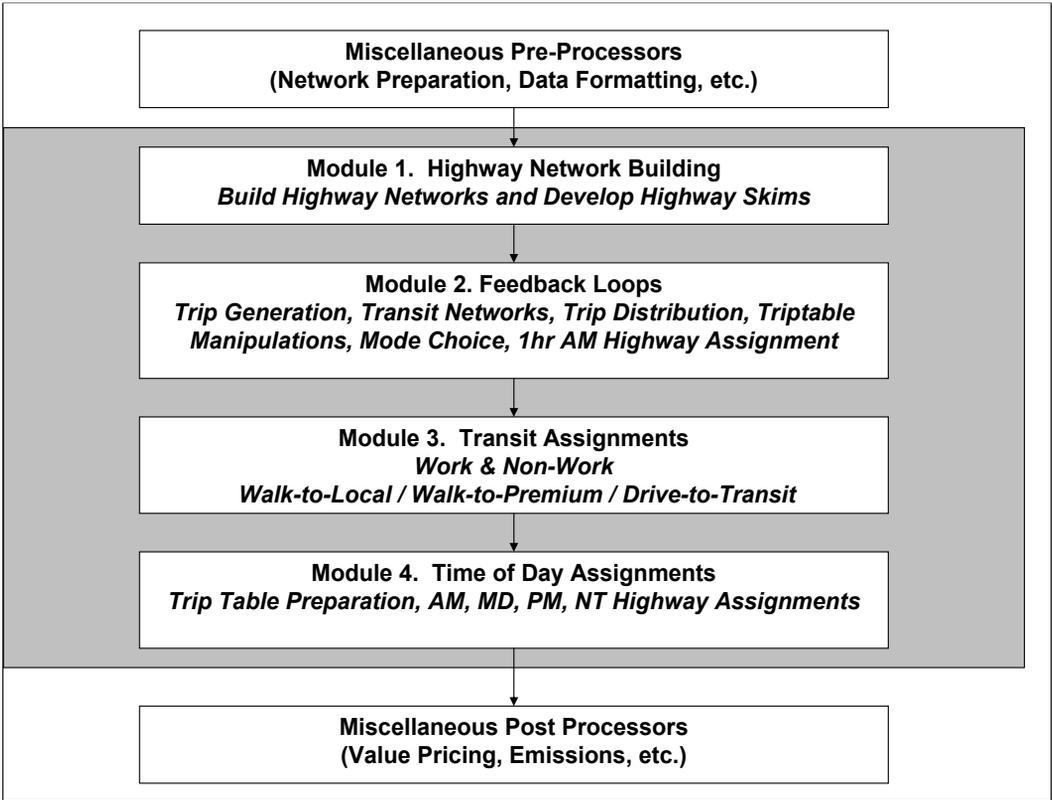


Night Period Volume-Delay Functions

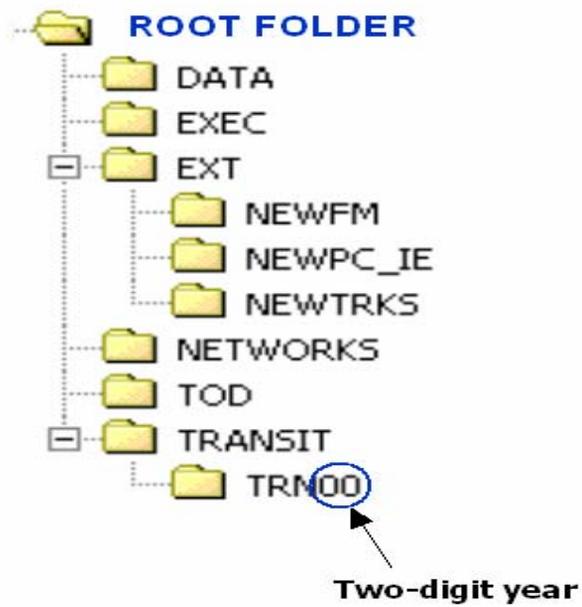


Atlanta 2000 Travel Demand Model Scatter Plot





ARC Modeling Directory Structure



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Done Cancel

Welcome to the Atlanta Travel Demand Model -- Version 2003

Enter Parameters

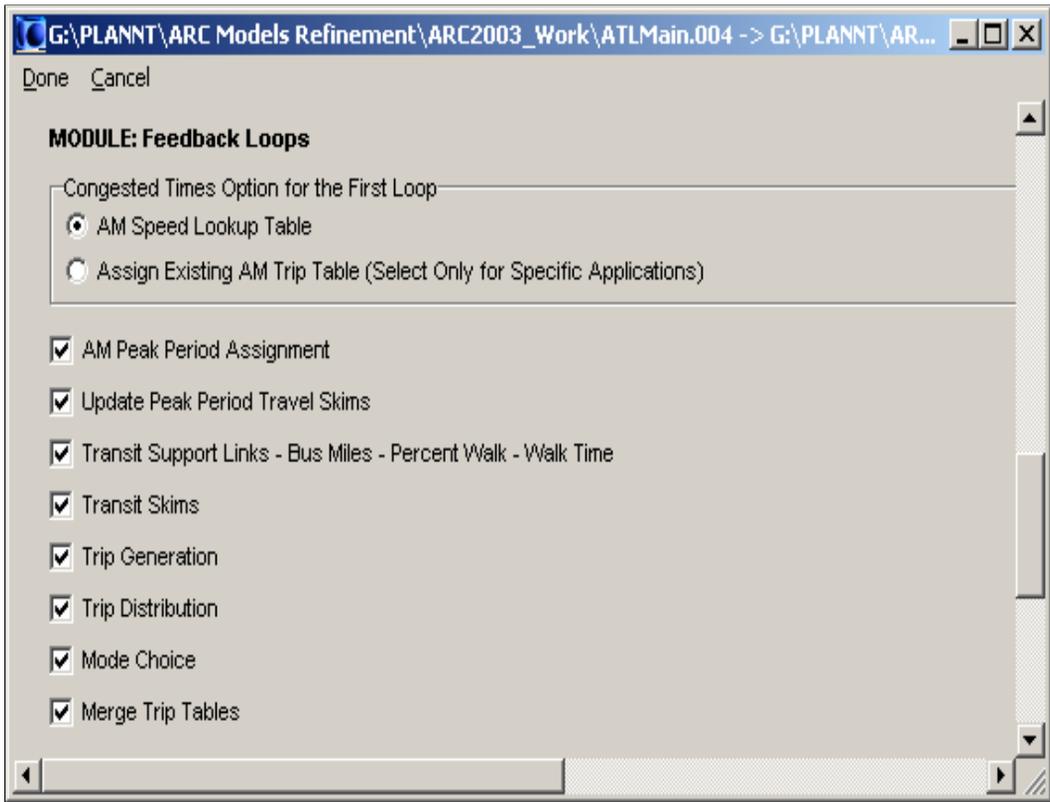
Year (Two-digit)	00
Max Assignment Iterations	25
Number of Feedback Loops	5
Total Zones (w/Externals)	1740
Range of Internal Zones	1-1683
Last Internal Before Externals	1683
First External Station	1684
Last External Station	1740
Airport Zone Number	1322
Hartsfield Annual Enplanements	39277901
Dobbins Zone Number	803

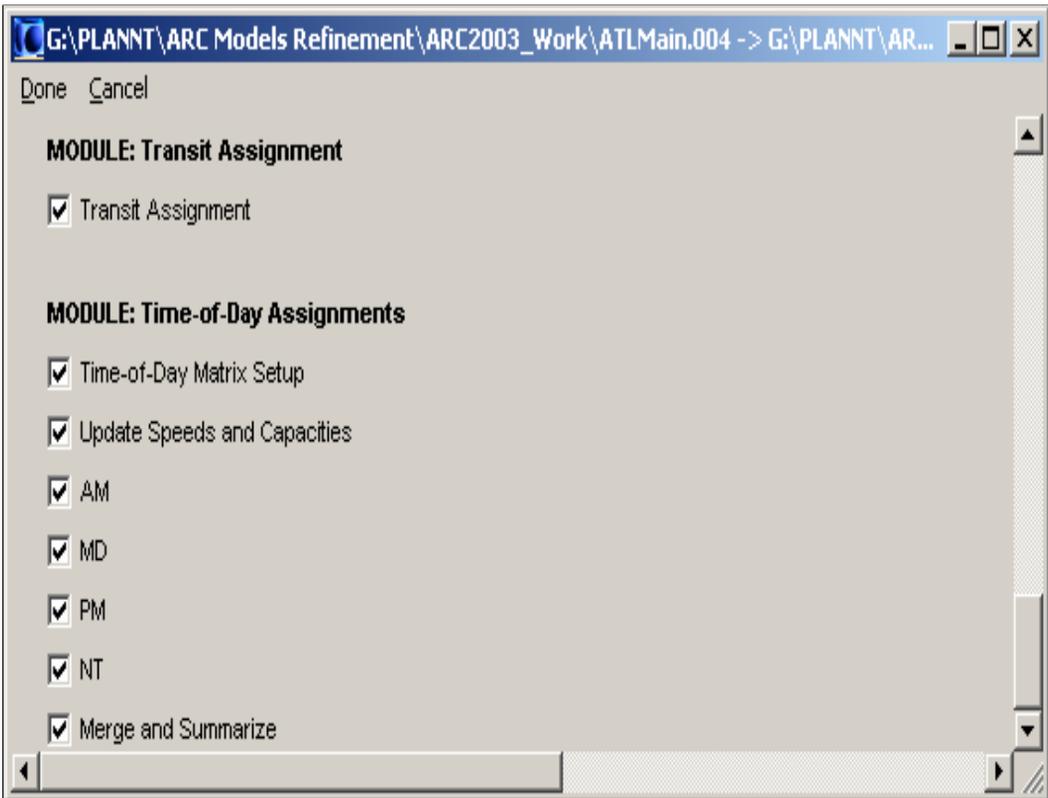
Select the MODULES to Run

- Highway Network Building
- Feedback Loops
- Transit Assignment
- Time of Day Assignments

MODULE: Highway Network Building

- Assign Area Types
- Build Networks
- Build Peak Period Skims
- Build Free-Flow Skims
- Build Midday Skims





ARC 2000 Base Year & 2030 Model Results

POPULATION	3,630,560	5,869,086
HOUSEHOLDS	1,356,058	2,323,443
EMPLOYMENT	2,067,000	3,310,428
HOME-BASED WORK		
Walk to Local Transit Trips	41,727	81,018
Walk to Premium Transit Trips	88,009	156,553
Drive to Transit Trips	33,039	58,105
Low Occupancy (SOV) Vehicle Trips	2,101,702	3,326,176
Low Occupancy (SOV) Person Trips	2,101,702	3,326,176
High Occupancy (HOV) Vehicle Trips	100,773	161,864
High Occupancy (HOV) Person Trips	265,608	425,497
Total HBW Transit	162,775	295,676
Total HBW Vehicles	2,202,475	3,488,040
Total HBW Persons	2,530,085	4,047,349
Percent HBW Mode Split	6.4%	7.3%

MODE CHOICE SUMMARY AFTER APPLICATION OF AIR PASSENGER

TOTAL TRANSIT TRIPS	300,394	536,311
Total Walk to Local Transit	67,607	127,385
Total Walk to Premium Transit	174,396	305,416
Total Drive to Transit	58,391	103,510
TOTAL VEHICLE TRIPS	8,704,643	13,913,716
Total SOV Vehicle Trips	7,086,937	11,418,287
Total HOV Vehicle Trips	1,617,706	2,495,429
TOTAL PERSON TRIPS	11,919,551	18,939,249
Total SOV Person Trips	7,086,937	11,418,287
Total HOV Person Trips	4,532,220	6,984,651
Total Transit Trips	300,394	536,311
TOTAL MODE SPLIT (Percent)	2.5%	2.8%

EXTERNAL-EXTERNAL VEHICLE TRIPS

Passenger Cars	46,347	82,116
Trucks	15,482	25,538
TOTAL E-E TRIPS	61,829	107,654

PERSON TRIP TABLE BY PURPOSE

Home-Based Work	2,530,080	4,047,349
Home-Based Other	5,597,463	8,701,930
Non Home-Based	3,689,765	5,960,941
TOTAL PERSON TRIPS	11,817,308	18,710,220

INTERNAL-EXTERNAL TRIPS

WORK TRIPS

I-E Work - Interstate	136,630	258,988
I-E Work - Non-Interstate	153,887	310,221
Total I-E Work Trips	290,517	569,209

NON-WORK TRIPS

I-E Non-Work - Interstate	172,343	324,150
I-E Non-Work - Non-Interstate	194,604	392,302
Total I-E Non-Work Trips	366,947	716,452

TOTAL I-E TRIPS	657,464	1,285,661
------------------------	----------------	------------------

TRUCK TRIPS

I-I Light Duty Trucks	1,002,446	1,601,795
I-I Heavy Duty Trucks	325,539	526,210
I-E Light Duty Trucks	67,423	121,047
I-E Heavy Duty Trucks	41,308	73,564

TOTAL TRUCK TRIPS	1,436,716	2,322,616
--------------------------	------------------	------------------

TOTAL DAILY VEHICLE TRIP TABLE

Truck Vehicle Trips	1,452,644	2,348,623
SOV Vehicle Trips	7,791,171	12,786,515
HOV Vehicle Trips	1,618,118	2,495,860

TOTAL DAILY VEHICLE TRIPS	10,861,933	17,630,998
----------------------------------	-------------------	-------------------

TIME OF DAY VEHICLE TRIP TABLES

	<u>AM</u>		
Truck Vehicle Trips		441,335	713,524
SOV Vehicle Trips		1,666,374	2,725,832
HOV Vehicle Trips		242,891	374,991
TOTAL AM VEHICLE TRIPS		2,350,600	3,814,347
	<u>MD</u>		
Truck Vehicle Trips		673,011	1,088,369
SOV Vehicle Trips		2,237,793	3,673,823
HOV Vehicle Trips		541,564	842,693
TOTAL MD VEHICLE TRIPS		3,452,368	5,604,885
	<u>PM</u>		
Truck Vehicle Trips		249,231	402,959
SOV Vehicle Trips		3,002,758	4,915,170
HOV Vehicle Trips		666,732	1,020,788
TOTAL PM VEHICLE TRIPS		3,918,721	6,338,917
	<u>NT</u>		
Truck Vehicle Trips		88,584	143,245
SOV Vehicle Trips		879,626	1,464,552
HOV Vehicle Trips		165,961	256,106
TOTAL NT VEHICLE TRIPS		1,134,171	1,863,903

VEHICLE MILES TRAVELED

AM VMT	29,231,507	46,269,810
MD VMT	34,755,605	56,293,733
PM VMT	40,286,588	64,089,408
NT VMT	13,398,933	21,578,644
TOTAL DAILY VMT	117,672,632	188,231,596

**44% of VMT on freeway
39% of VMT on arterial
17% of VMT on local/collector**

**While freeways have more VMT than arterials in 2000,
they have only 60% of the hourly capacity of the arterials.
However per-lane freeway capacity is 4 to 5 times as great as arterials.**

VEHICLE HOURS TRAVELED

AM VHT	834,692	1,360,637
MD VHT	1,011,084	1,682,856
PM VHT	1,196,474	1,964,960
NT VHT	375,714	599,284
TOTAL DAILY VHT	3,417,963	5,607,736

CONGESTED VEHICLE HOURS TRAVELED

AM CONGESTED VHT	985,136	1,801,623
MD CONGESTED VHT	1,202,100	2,242,139
PM CONGESTED VHT	1,397,435	2,557,559
NT CONGESTED VHT	449,635	823,561
TOTAL DAILY CONGESTED VHT	4,034,306	7,424,882

AVERAGE HIGHWAY SPEEDS

Daily Free-Flow Average Speed	34.4	33.6
Daily Congested Average Speed	29.2	25.4

VEHICLE MILES TRAVELED SUMMARY

VMT per Capita	32.4	32.1
VMT per Household	86.8	81.0
VMT per Job	56.9	56.9

VEHICLE HOURS TRAVELED SUMMARY

VHT per Capita	1.1	1.3
VHT per Household	3.0	3.2
VHT per Job	2.0	2.2

A Few Recommended Performance Measures for 2030 Plan Analysis

Source: Tim Lomax, TTI, Texas A&M University

"It's more than just Volume/Capacity Ratios"

- Individual Delay per Person
- Individual Travel Time per Person ("Planning Time")
- Individual Cost Per Person
- Congestion Index from Texas Transportation Institute
- Total Travel Time
- Total Delay Hours
- Total Cost of Travel & Delay

Mobile Source Emissions Modeling



ARC utilizes a traditional link-based procedure to estimate mobile source emissions.

- **Satisfies federal transportation conformity regulations that direct regional emissions analyses**
Transportation Conformity Rule - Section 93.122(b)
- **Consistent with methodology used to develop emissions inventories needed to establish MVEB as part of the SIP**



Interface with Travel Demand Model



To calculate emissions, need link-based travel attributes from the travel demand model.

Two primary variables affecting mobile source emission estimates:

- VMT
- Speed

Emissions model “reads” loaded networks for each time-of-day period and post-processes speeds and VMT for emissions modeling purposes.



C:\tracy_work\Emissions_2030RTP\modeling files\emiss_mob6a_new.000 -> C:\tracy_work\Emissions_2030RTP\modeling files\emiss_mob6a

Done Cancel

Enter Year	2000	Browse ...
Enter Title for Reports:	2000 Base Year	Browse ...
Enter Second line of Title for Reports:	Include Post Processing of Speeds Using MOBILE6	Browse ...
Enter Total Number of Zones:	1740	Browse ...
Enter Starting Node Number for External Stations:	1684	Browse ...
Enter Ending Node Number for External Stations:	1740	Browse ...
Enter AM Peak Period Loaded Network:	lod00am_fin.net	Browse ...
Enter Mid Day Period Loaded Network:	lod00md_fin.net	Browse ...
Enter PM Peak Period Loaded Network:	lod00pm_fin.net	Browse ...
Enter Night Period Loaded Network:	lod00nt_fin.net	Browse ...
Enter Filename with HPMS VMT Adjustments:	HPMS_test.DAT	Browse ...
Enter Filename with HPMS Corrections Mapping:	HPMS_CORR.DAT	Browse ...
Enter Filename with FIPS Codes:	TAZ1683_FIPS.PRN	Browse ...
Enter Filename with Emission Factors:	EF_MOB6_2000.DAT	Browse ...
Enter Output Emissions Summary Filename by Facility Type:	Emissions_fac_2000.lst	Browse ...
Enter Output Emissions Summary Filename by HPMS Code:	Emissions_hpms_2000.lst	Browse ...
Enter Output Text Filename of Links for All Periods:	Lod00_mob6.txt	Browse ...
Enter Output Filename for Links with Bad HPMS Codes:	links_bad.txt	Browse ...

Post-Processing VMT – HPMS Adjustment



EPA guidance requires HPMS based forecasts of VMT for emission analyses.

- **Average daily, summer-adjusted HPMS VMT estimates for year 2000 compared to average daily travel model VMT for same year, at functional class level**

- **Adjustment factors applied at link level using HPMS functional class code**



HPMS Functional Class (Code)	2000 HPMS VMT Summer-Adjusted Average Daily VMT	2000 Travel Demand Model VMT Average Daily VMT	HPMS Adjustment Factors
Rural Interstate (1)	5,840,728	8,488,287	0.69
Rural Principal Arterial (2)	3,569,720	3,090,694	1.15
Rural Minor Arterial (6)	3,811,482	3,168,965	1.20
Rural Major Collector (7)	3,708,389	3,452,056	1.07
Rural Minor Collector (8)	1,249,317	1,091,894	1.14
Rural Local (9)	3,490,796	12,864,647	0.27
Urban Interstate (11)	37,694,171	34,376,364	1.10
Urban Other Freeway (12)	6,478,628	2,348,406	2.76
Urban Principal Arterial (14)	10,350,324	15,653,577	0.66
Urban Minor Arterial (16)	21,924,642	18,473,757	1.19
Urbanized Collector (17)	7,617,087	6,174,256	1.23
Urbanized Local (19)	15,412,042	7,999,419	1.93
Total VMT	121,147,325	117,182,322	

Emission Factors



Most important change with update to MOBILE6.2 is implementation of emission factors by roadway type (drive cycle).

- Arterials/Collectors
- Freeways/Interstates
- Ramps
- Local Roads

Only emissions for arterials/collectors and freeways/interstates are speed sensitive.

Emission factors produced for 2.5 mph, then 3 mph to 65 mph, inclusive, in one mph increments.



Emissions Modeling Process Summary



Loaded Networks for Each Time Period

- Final assigned VMT and VHT from a capacity-restrained assignment procedure

HPMS Adjustment Factors

Emission Factors

HPMS "Equivalencies"

TP+ Emissions Model

- Post-process link congested flow speed
- Post-process link VMT
- Calculate link emissions
- Summarize link-level emissions over entire network for four time periods



Multi-Year Program - Activity/Tour-Based Model

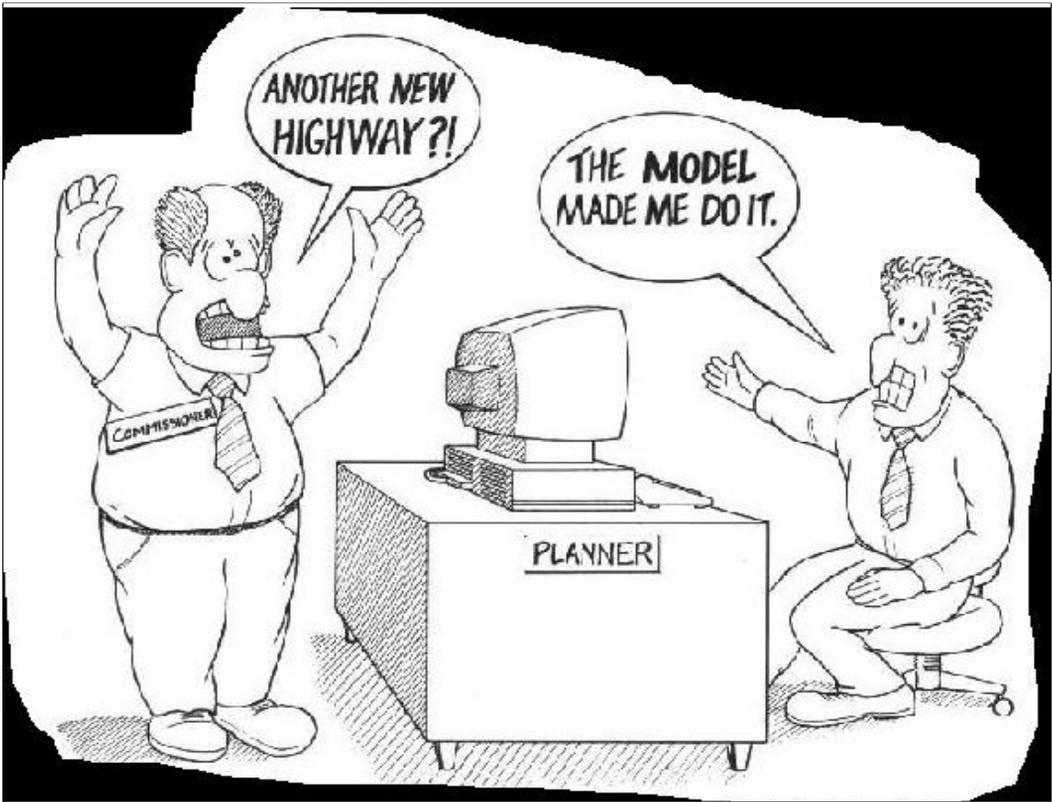
		<i>Completed</i>		<i>Proposed</i>	<i>Anticipated</i>	
		2001/2002	2003	2004	2005	2006
1	General Approach to Activity/Tour-Based Models	*****				
2	Detailed Model Specifications	***	*			
3	Data Development: OC and Estimation Files	**	**			
4	Initial Estimation - Tour-based Models					
a	Population Synthesizer		*****			
b	Household Activity Models		**	**		
c	Tour Details Models		*	**	*	
5	Model Applications Development & Testing					
a	Population Synthesizer		***	*		
b	Household Activity Models				*****	
c	Tour Details Models				**	**
6	Calibration / Validation					
a	Population Synthesizer		*	**	*	
b	Household Activity Models				*****	
c	Tour Details Models				**	**
d	Highway / Transit Assignment					*****
7	Model Application Optimization / Reporting				*	***
8	Documentation & Training				*	***
9	Work Plan to Complete TB with Conversion Strategy		*	*	*	*
10	Integration /Cross-Validation with Trip-Base Models				*	***

Next Steps...

- Conversion to Cube's Application Manager, Scenario Manager / Flowchart Approach
- Refine EJ Performance Measures
- Refine Evening / Night TOD Model
- Summarize Model Output by Activity Centers & Town Centers (LCI sites)
- Review the Externals Model

Next Steps (Continued)

- Refine Transit Coding / Modeling & Commuter Rail with “Externals” Input
- Continue Tour-Based & Activity-Based Model Development
- Refine Sketch Modeling Methods
- Perform Commercial Vehicle / Truck Survey and Use Transearch Reebie Data
- Freight Model Development



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