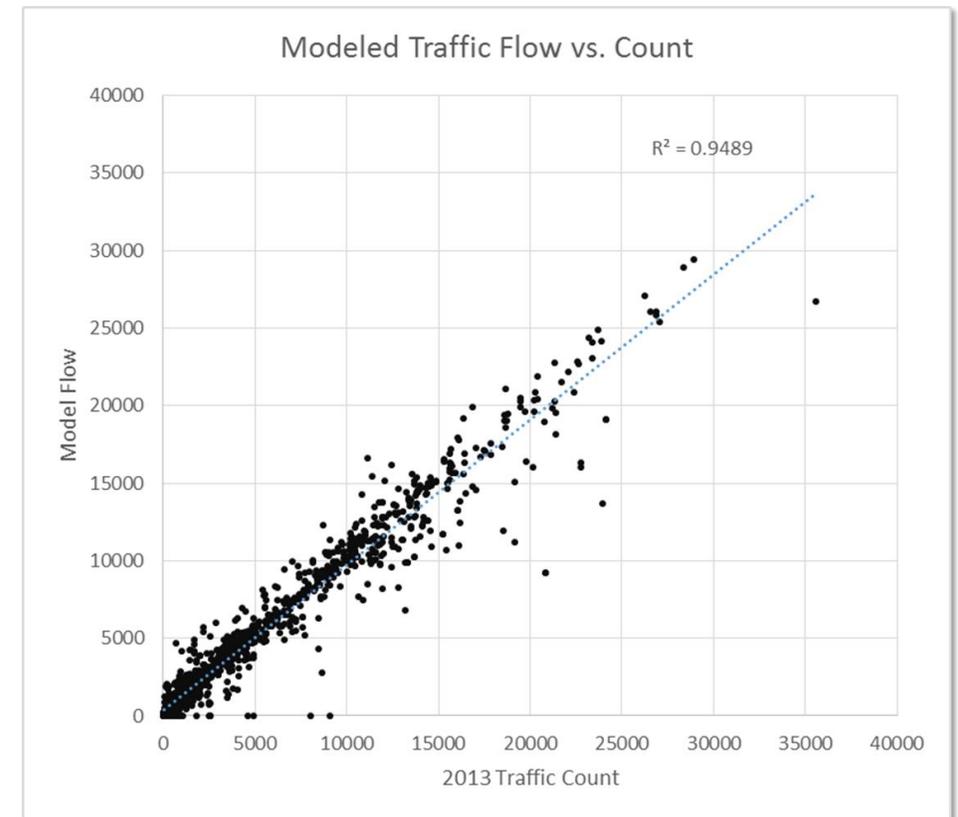


# Validation Measures

# Model Update

Validation Measure	Volume Group								Grand Total
	0-1K	1K-2K	2K-5K	5K-10K	10K-15K	15K-20K	20K-25K	25K-50K	
Number of Counts	466	155	261	199	175	53	29	8	1,346
Sum of AADT	193,763	221,433	878,493	1,482,507	2,119,613	900,640	637,432	226,520	6,660,401
Sum of Model Flow	274,187	284,805	944,441	1,514,153	2,092,784	860,036	571,727	215,470	6,757,602
Sum of FlowVMT	88,436	56,852	149,248	249,865	429,862	152,087	97,223	36,527	1,260,100
Sum of CountVMT	52,464	43,825	133,815	240,492	424,772	153,690	102,850	38,285	1,190,194
Average AADT	416	1,429	3,366	7,450	12,112	16,993	21,980	28,315	4,948
Average Truck Count	15	59	229	543	807	1,168	949	855	313
Loading Error	41.5%	28.6%	7.5%	2.1%	-1.3%	-4.5%	-10.3%	-4.9%	1.5%
VMT Error	-68.6%	-29.7%	-11.5%	-3.9%	-1.2%	1.0%	5.5%	4.6%	-5.9%
%RMSE	124.0%	60.1%	30.2%	18.4%	12.9%	14.2%	20.0%	11.5%	26.2%

Validation Measure	Area Type					Grand Total
	Rural	Suburban	Urban	Commercial	CBD	
Number of Counts	222	133	714	217	60	1,346
Sum of AADT	461,860	563,980	3,503,133	1,673,264	458,164	6,660,401
Sum of Model Flow	533,286	608,184	3,445,493	1,697,904	472,737	6,757,602
Sum of FlowVMT	346,972	252,171	381,590	257,480	21,888	1,260,100
Sum of CountVMT	300,619	238,049	379,360	250,908	21,258	1,190,194
Average AADT	2,080	4,240	4,906	7,711	7,636	4,948
Average Truck Count	126	416	265	522	587	313
Loading Error	15.5%	7.8%	-1.6%	1.5%	3.2%	1.5%
VMT Error	-15.4%	-5.9%	-0.6%	-2.6%	-3.0%	-5.9%
%RMSE	28.5%	23.3%	30.1%	18.2%	14.0%	26.2%



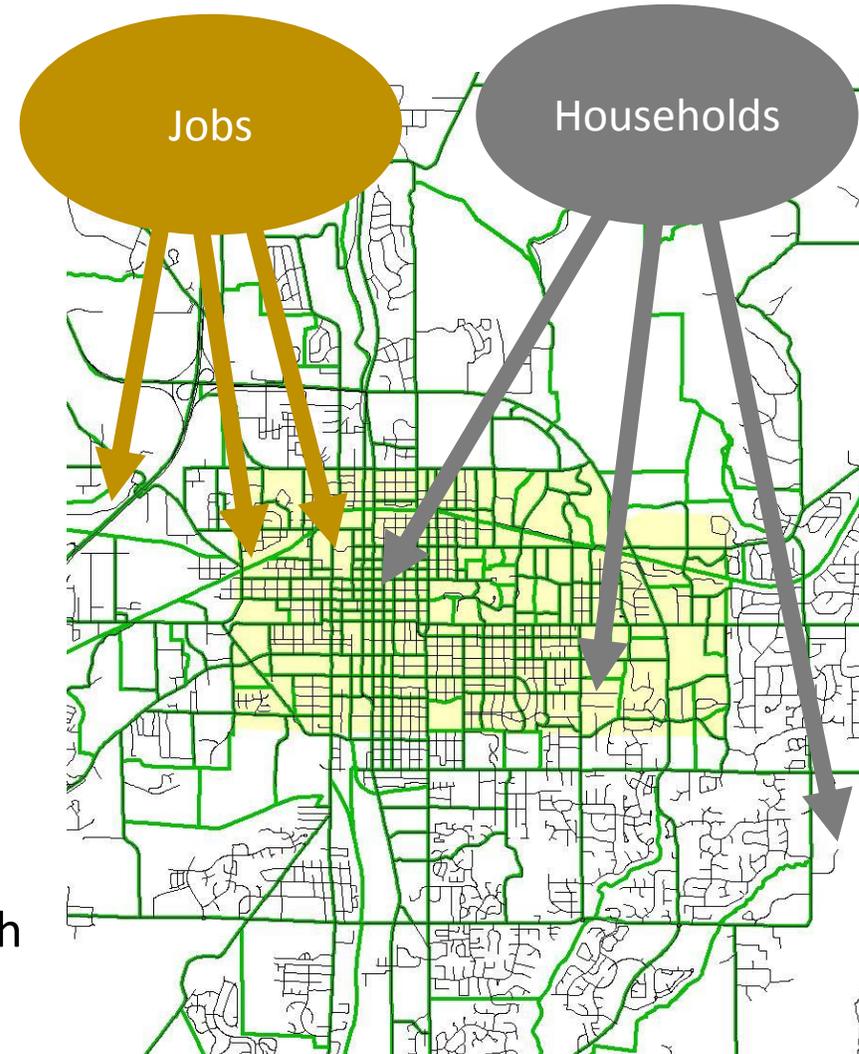
# Scenario Development

## Overall Growth Forecasting

- Historical growth trends
- Economic drivers
- County household and population forecast
- County employment forecast by sector
- Range of choices

## Growth Allocation

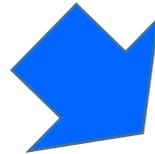
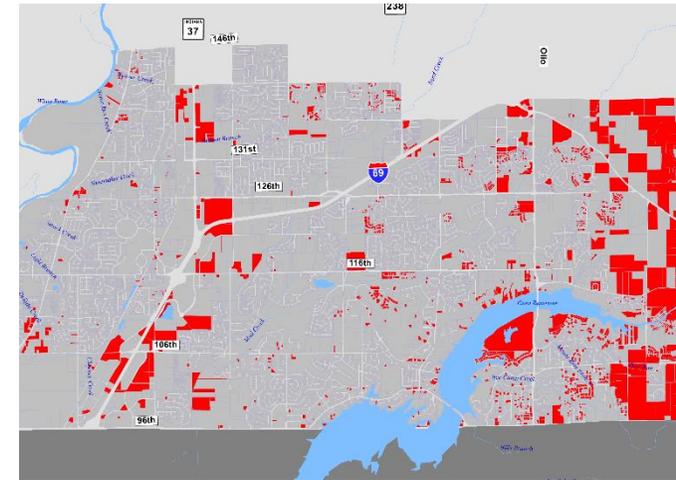
- Depends on land use policies
- Allocation process takes overall growth and applies policies



# Scenario Development

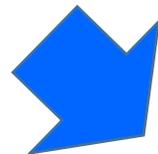
## Growth Allocation Toolkit Inputs

- Input #1: Total Household, Population, and Employment forecast for metro area as control total
- Input #2: Parcel data with current land use and allowed land use policies. Info on redevelopment
- Input #3: Inputs on carrying capacity (max densities, max FAR, etc.)
- Input #4: Transportation network scenario



## Growth Allocation Toolkit Outputs

- TAZ level allocation of households, household types, and employment by each sector



## Model Outputs

- Changes in: Auto ownership, trip generation, destination choice, mode choice, traffic flow by mode, system performance

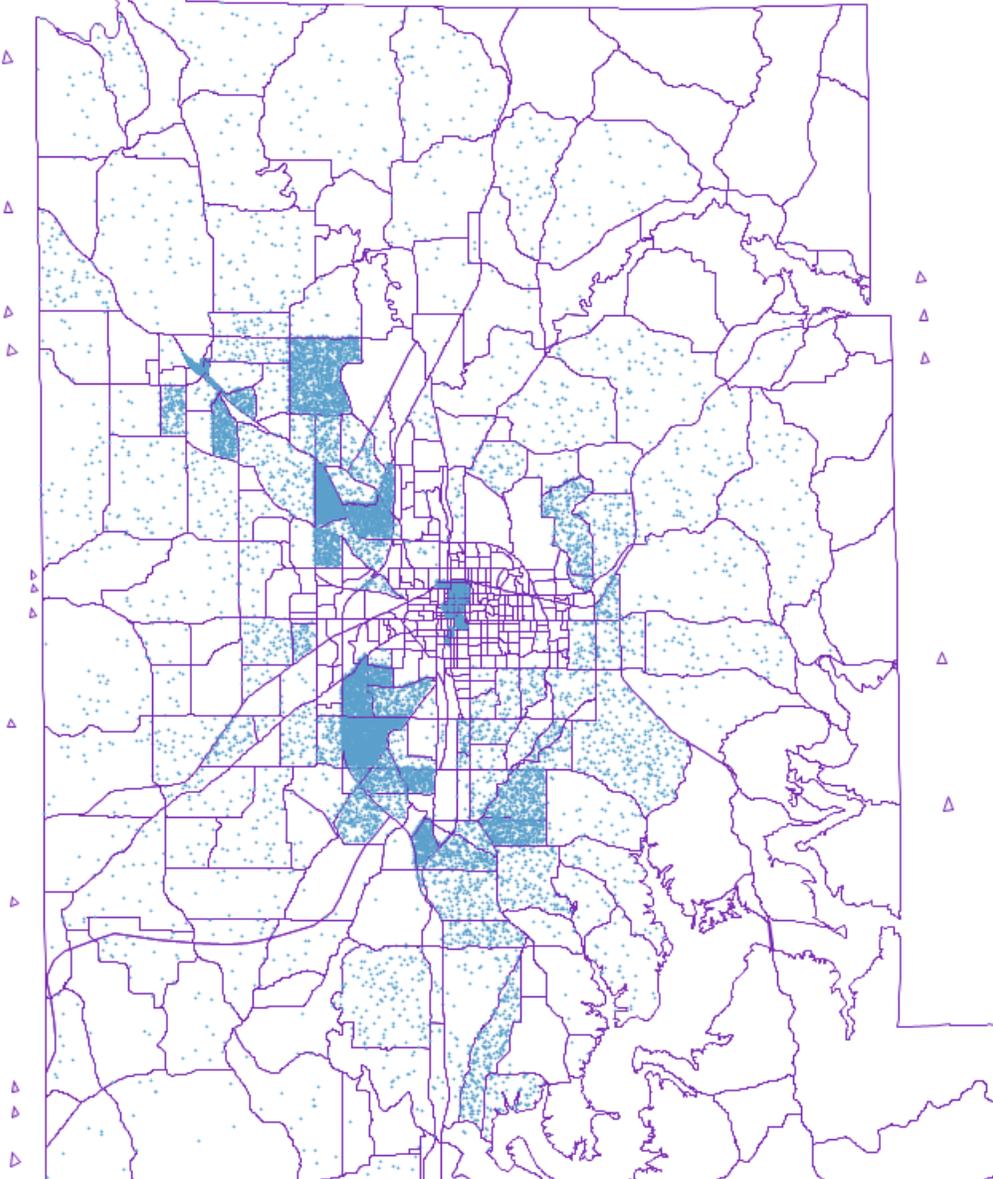
Land Use Scenario Development - Forecasts 2040		Overall Growth Scenario --->	Low Growth			Mid-Range Growth			High Growth		
		Development Style --->	Standard	Compact	Low Density	Standard	Compact	Low Density	Standard	Compact	Low Density
<b>Global Assumptions (apply to all TAZs)</b>											
<b>Control Totals</b>											
Households	Number of households by scenario	64,431	64,431	64,431	72,952	72,952	72,952	82,552	82,552	82,552	
Population	Total population by scenario	153,209	153,209	153,209	173,784	173,784	173,784	185,234	185,234	185,234	
Employment	Total employment by scenario	94,240	94,240	94,240	107,135	107,135	107,135	118,443	118,443	118,443	
K-12 Enrollment	School enrollment	15,762	15,762	15,762	17,879	17,879	17,879	19,057	19,057	19,057	
University Enrollment	IU enrollment forecast	48,500	48,500	48,500	49,000	49,000	49,000	50,000	50,000	50,000	
<b>Global Attributes</b>											
Emp. Growth portion to existing establishments	Percentage	55.0%	50.0%	40.0%	55.0%	50.0%	40.0%	55.0%	50.0%	40.0%	
Emp. Growth portion to undeveloped sites	Percentage	25.0%	10.0%	50.0%	25.0%	10.0%	50.0%	25.0%	10.0%	50.0%	
Emp. Growth portion to re-development sites	Percentage	20.0%	40.0%	10.0%	20.0%	40.0%	10.0%	20.0%	40.0%	10.0%	
		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Portion of New Housing as Low Density Residential	Percentage	50.0%	10.0%	80.0%	50.0%	10.0%	80.0%	50.0%	10.0%	80.0%	
Portion of New Housing as Medium Density Residential	Percentage	25.0%	50.0%	19.0%	25.0%	50.0%	19.0%	25.0%	50.0%	19.0%	
Portion of New Housing as High Density Residential	Percentage	25.0%	40.0%	1.0%	25.0%	40.0%	1.0%	25.0%	40.0%	1.0%	
		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Portion of New Med. Density Housing on Existing Sites (Aux units, splitting, etc.)	Percentage	10.0%	50.0%	1.0%	10.0%	50.0%	1.0%	10.0%	50.0%	1.0%	
Portion of New High Density Housing on Re-Developed Sites	Percentage	70.0%	90.0%	30.0%	70.0%	90.0%	30.0%	70.0%	90.0%	30.0%	
Minimum Single Family Density - Rural	Units per acre	0.2	0.1	2	0.2	0.1	2	0.2	0.1	2	
Minimum Single Family Density - Urban	Units per acre	8	12	5	8	12	5	8	12	5	
Max Growth Rate for Rural	Percentage	0.5%	0.1%	1.0%	0.5%	0.1%	1.0%	0.5%	0.1%	1.0%	

Detailed Summary After Applying Assumptions:

		Overall Growth Scenario ---->			Mid-Range Growth			High Growth		
		Development Style ---->			Standard	Compact	Low Density	Standard	Compact	Low Density
<b>Employment</b>										
Total Employment 2040										
	RETAIL	7,945	7,945	7,945	9,032	9,032	9,032	9,986	9,986	9,986
	INDUST	9,853	9,853	9,853	11,201	11,201	11,201	12,383	12,383	12,383
	OFFICE	3,603	3,603	3,603	4,096	4,096	4,096	4,528	4,528	4,528
	SERVICE	72,839	72,839	72,839	82,805	82,805	82,805	91,545	91,545	91,545
	TOTAL_EMP	94,240	94,240	94,240	107,135	107,135	107,135	118,443	118,443	118,443
Net Employment Growth 2010-2040										
	RETAIL	(430)	(430)	(430)	657	657	657	1,611	1,611	1,611
	INDUST	(219)	(219)	(219)	1,129	1,129	1,129	2,311	2,311	2,311
	OFFICE	685	685	685	1,178	1,178	1,178	1,610	1,610	1,610
	SERVICE	14,595	14,595	14,595	24,561	24,561	24,561	33,301	33,301	33,301
	TOTAL_EMP	14,627	14,627	14,627	27,522	27,522	27,522	38,830	38,830	38,830
Employment Growth in Existing Establishments										
	RETAIL	(516)	(516)	(516)	362	329	263	886	805	644
	INDUST	(263)	(263)	(263)	621	564	452	1,271	1,156	924
	OFFICE	377	343	274	648	589	471	886	805	644
	SERVICE	8,027	7,297	5,838	13,509	12,281	9,824	18,316	16,651	13,321
	TOTAL_EMP	7,625	6,861	5,333	15,139	13,763	11,010	21,358	19,417	15,533
Employment Growth in Undeveloped Sites										
	RETAIL	48	17	72	164	66	329	403	161	805
	INDUST	24	9	37	282	113	564	578	231	1,156
	OFFICE	171	69	343	295	118	589	403	161	805
	SERVICE	3,649	1,459	7,297	6,140	2,456	12,281	8,325	3,330	16,651
	TOTAL_EMP	3,892	1,463	7,314	6,880	2,752	13,761	9,708	3,883	19,415
Employment Growth in Re-developed Sites										
	RETAIL	38	69	14	131	263	66	322	644	161
	INDUST	19	35	7	226	452	113	462	924	231
	OFFICE	137	274	69	236	471	118	322	644	161
	SERVICE	2,919	5,838	1,459	4,912	9,824	2,456	6,660	13,321	3,330
	TOTAL_EMP	3,114	5,851	1,463	5,504	11,009	2,752	7,766	15,532	3,883
<b>Housing</b>										
Rural Housing Units										
	Max allowed by growth rate	11,273	9,804	13,411	11,273	9,804	13,411	11,273	9,804	13,411
	Net HU growth in rural	1,806	337	3,944	1,806	337	3,944	1,806	337	3,944
	Rural acres needed	9,028	3,370	1,972	9,028	3,370	1,972	9,028	3,370	1,972
Urban Housing Units										
	Total urban HU in 2040	53,158	54,626	51,020	61,679	63,148	59,541	71,279	72,748	69,141
	Net growth in urban HU	8,141	9,609	6,003	16,662	18,131	14,524	26,262	27,731	24,124
	New low density HU	4,070	961	4,802	8,331	1,813	11,619	13,131	2,773	19,299
	New vacant site medium density HU	1,832	2,402	1,129	3,749	4,533	2,732	5,909	6,933	4,538
	New med. density HU by Infill	204	2,402	11	417	4,533	28	657	6,933	46
	New vacant site high density HU	611	384	42	1,250	725	102	1,970	1,109	169
	New re-developed site high density HU	1,425	3,459	18	2,916	6,527	44	4,596	9,983	72
	Urban acres needed for new single fam	509	80	960	1,041	151	2,324	1,641	231	3,860

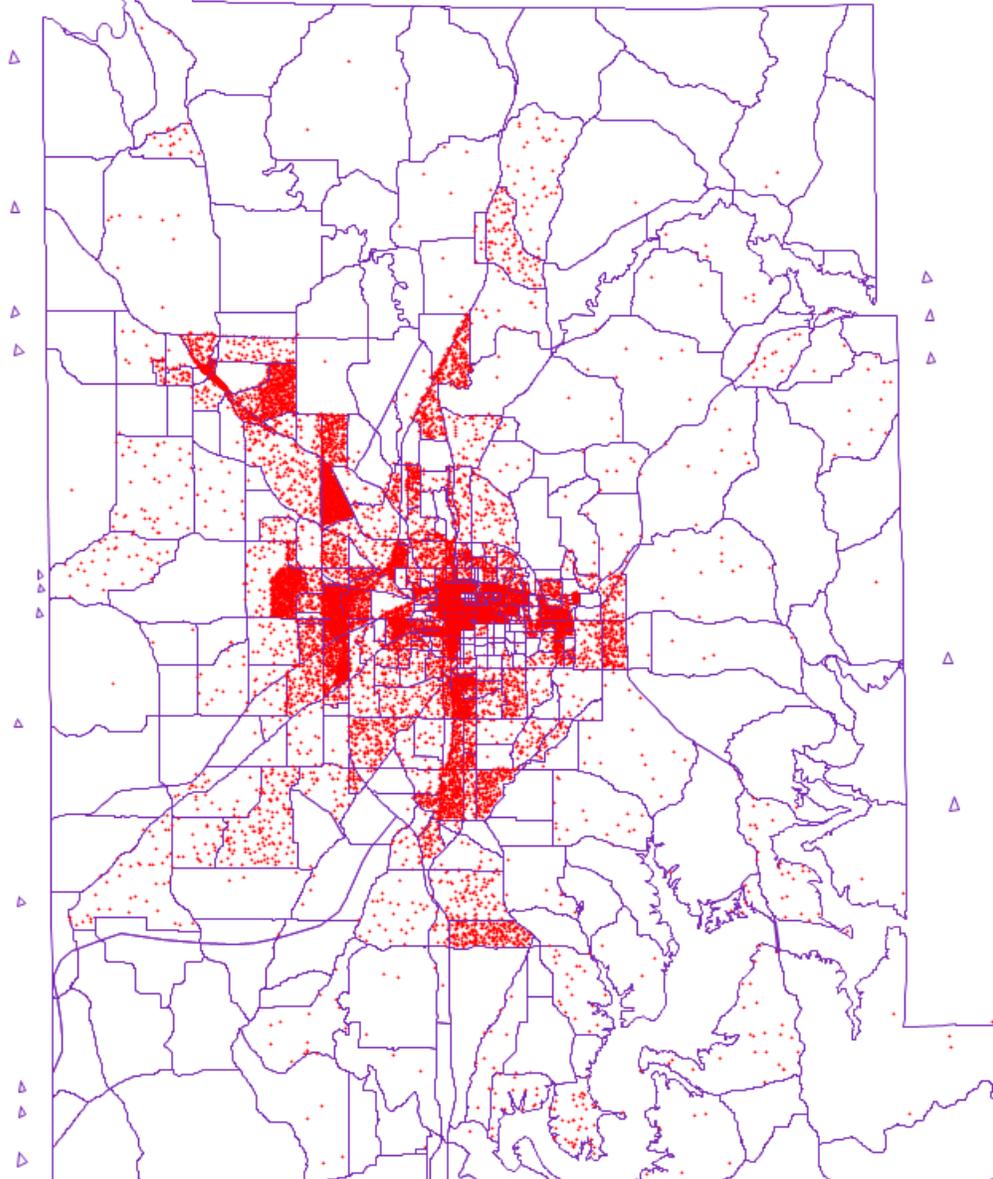
# Forecast Allocation

## Housing

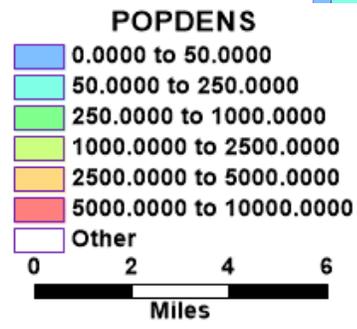
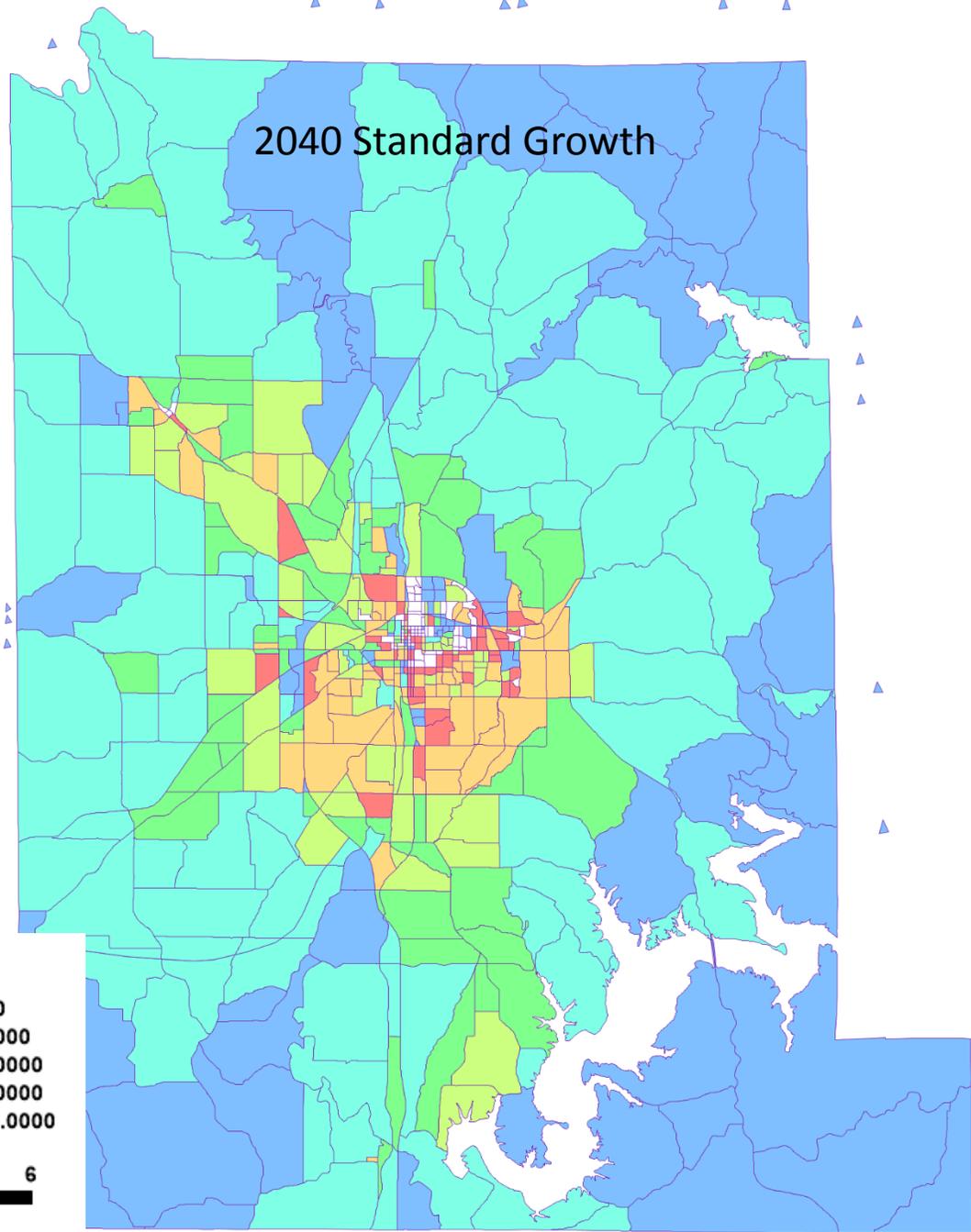
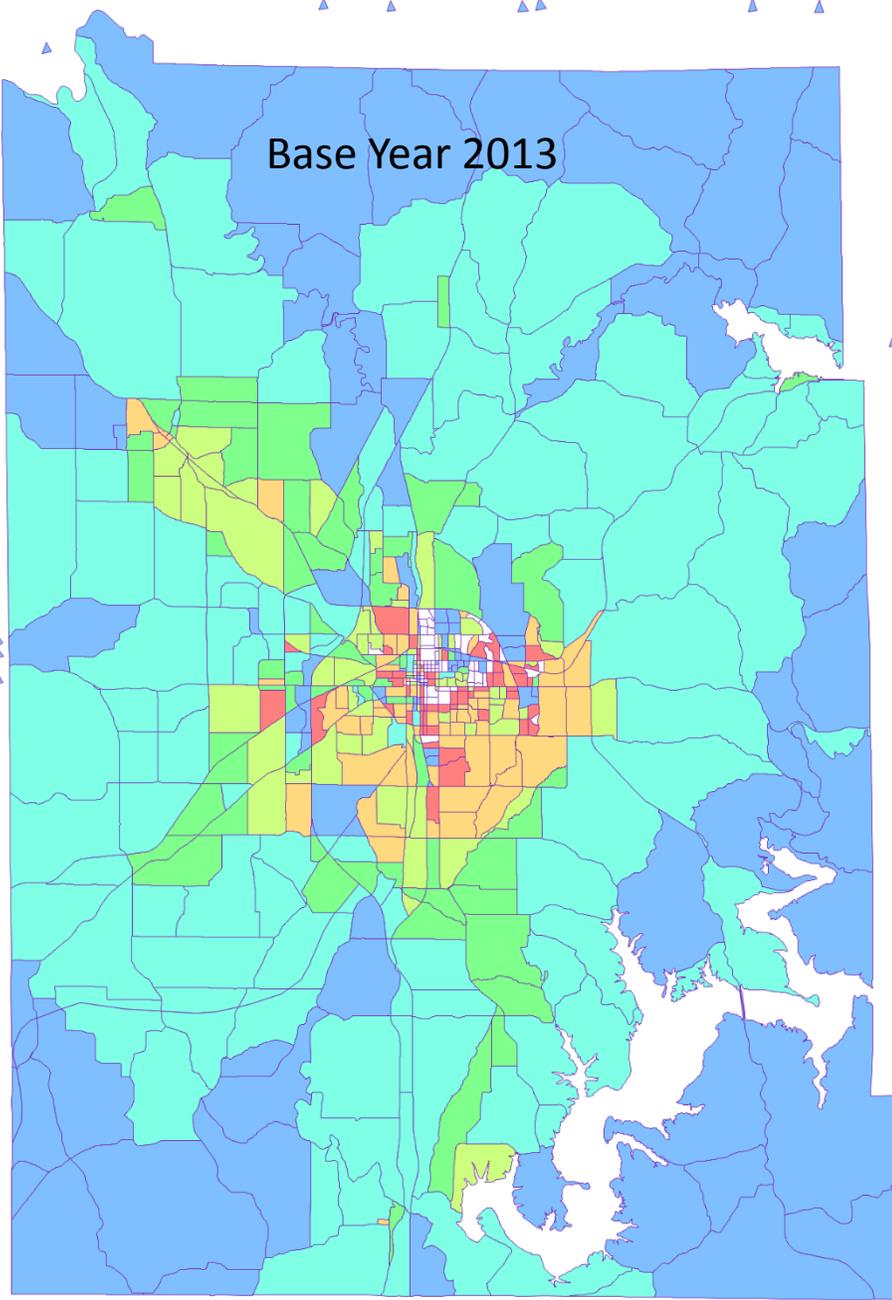


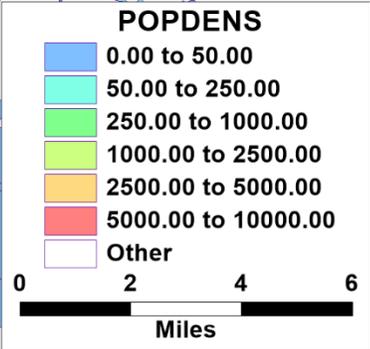
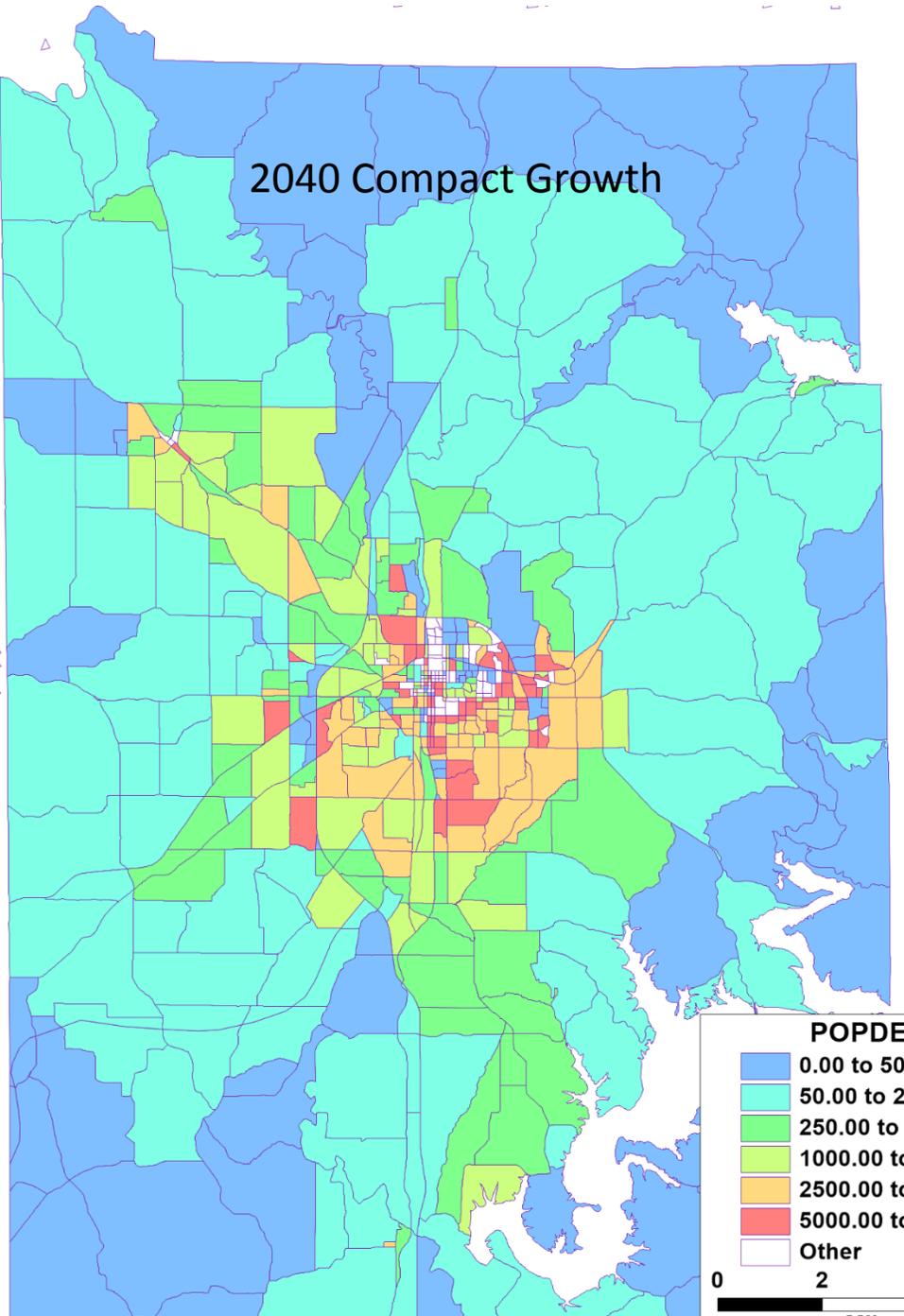
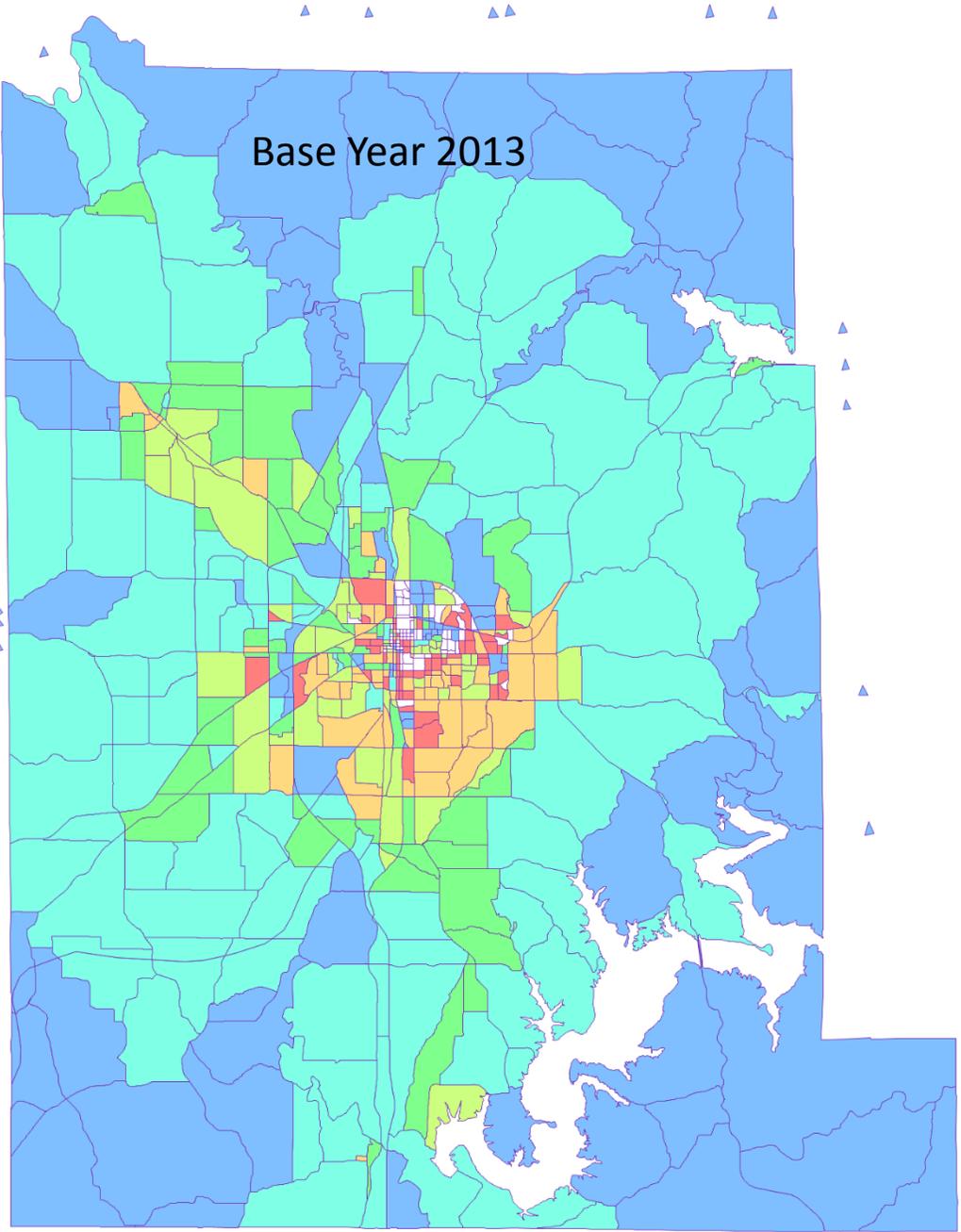
2013-2040 New Housing Units  
= 1 HH Growth

## Jobs

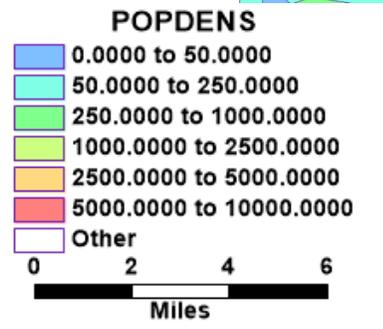
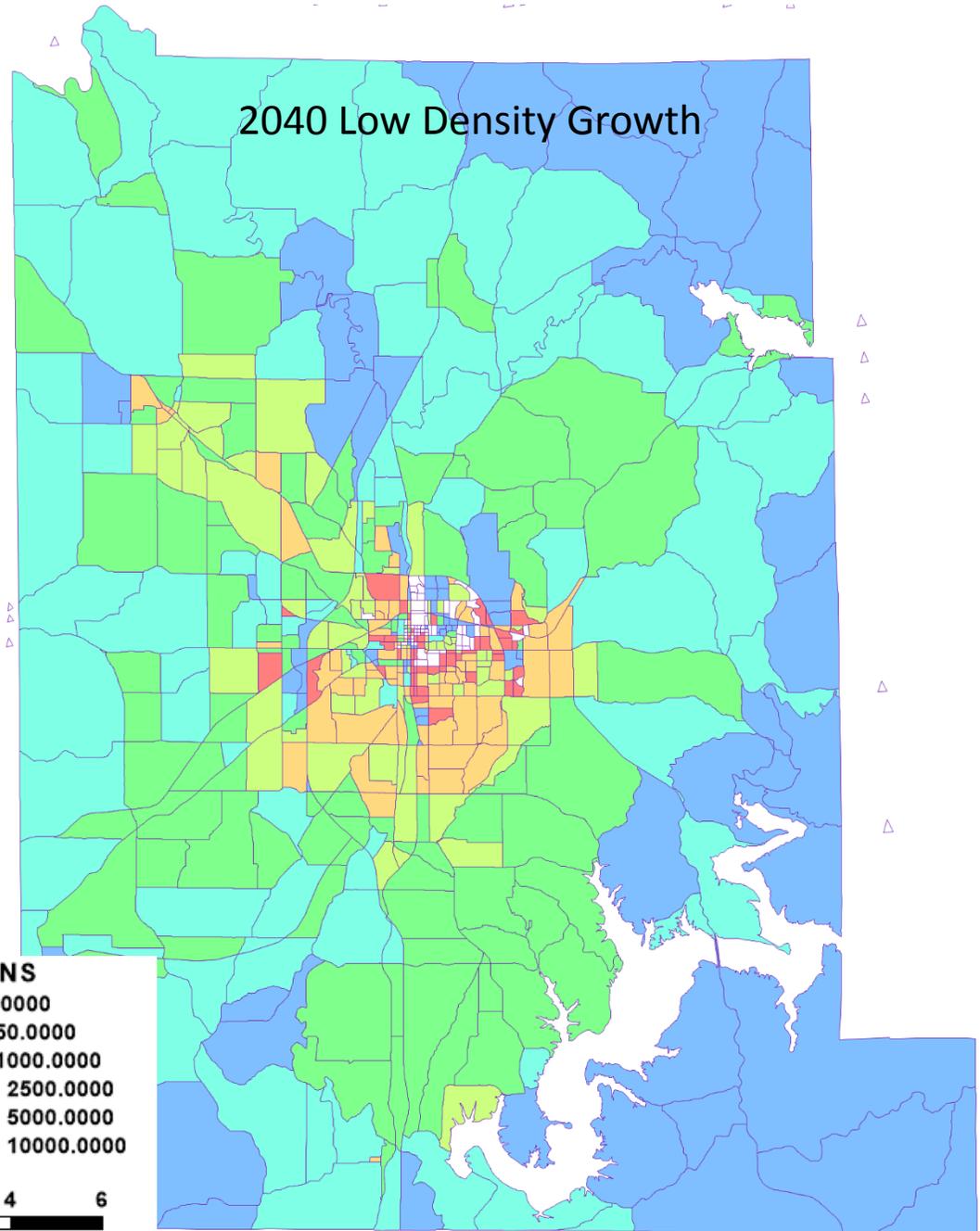
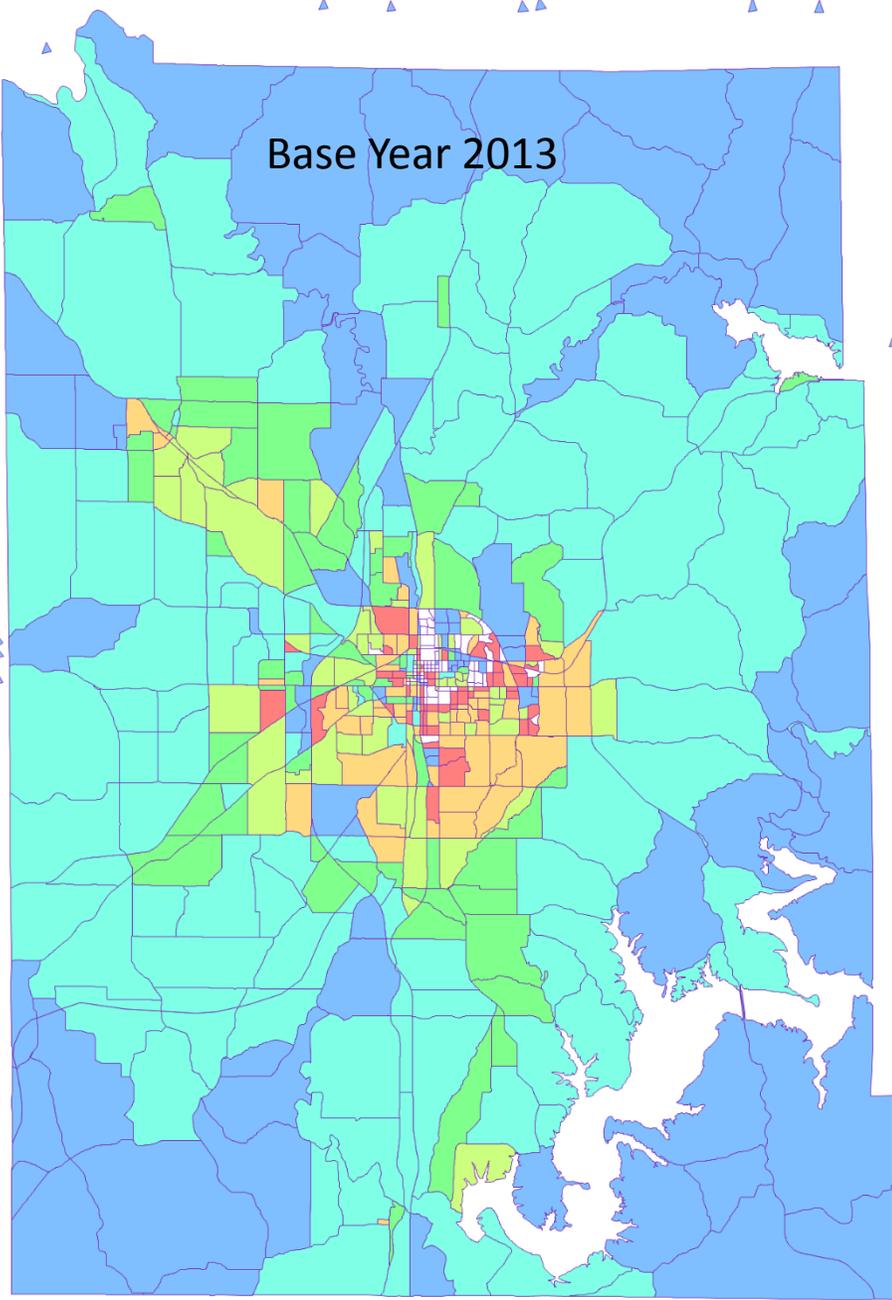


2013-2040 Job Growth  
= 1.0000 Emp Growth





I-Mon



# Vision and Performance Measures

Performance Measure Categories	MTP Vision				
	<i>Mobility and Accessibility</i>	<i>Transit</i>	<i>Community</i>	<i>Safety</i>	<i>Rebuild and Renew</i>
<i>Travel Demand</i>	●	●			
<i>System Efficiency</i>	●	●	●		
<i>System Condition</i>					●
<i>Safety</i>				●	
<i>Environmental Concerns</i>			●		
<i>System Investment &amp; Economics</i>		●	●		

# Vision and Performance Measures

## Travel Demand

- Person trips per day
- Daily vehicle trips
- Daily vehicle miles
- Daily vehicle hours
- Daily transit boarding's
- Mode shares

## Safety

- Predicted number of accidents
  - Fatal, Injury, Property Damage

## Travel Efficiency

- Vehicle hours of delay
- Accessibility by mode
  - Number of jobs within X minutes
  - Shopping within X minutes
- Transit person hours
- Weighted average transit walk distance
- Weighted average transit headway
- 5D Variables

## Economic

- Infrastructure costs
- Monetized System User benefits (time, cost, etc.)
- Potential jobs impacts
- Prosperity index

## Environmental

- Greenhouse gas emission tonnage
- GHG per trip
- GHG per capita

# Aggregate Statistics

Urban Design Variables					
Elements	Variables		Data Source		Units
<b>Density</b>					
DENS1	Households Densiity		No. Households from TAZ data	TAZ land area in sq.mi	households per sq. mi.
DENS2	Employment Density		No. of Jobs from TAZ data	TAZ land area in sq.mi	jobs per sq.mi.
<b>Diversity</b>					
DIVERS	Jobs/Housing Ratio		No. of Jobs within 1 mile radius	No. Households within 1 mile radius	Jobs per household ratio
<b>Design</b>					
DESGN1	Walkability		Pct. Of TAZ streets that are walkable		miles walkable per total centerline miles
DESGN2	Average Blockface (miles)		Centerline miles of road (non-freeway)	Number of links (non-freeway)	Miles per link
DESGN3	Street Density		Centerline miles of road (non-freeway)	Land area of TAZ	road miles/square mile
<b>Destinations</b>					
DEST1	Commercial establishments within 10 min walk		Selection set of commercial parcels	Count parcels within 0.1667 mi	Number of establishments
DEST2	Retail jobs within 10 min walk		No. of Retail jobs from TAZ data	Count jobs within 0.1677 mi	Number of retail jobs
<b>Distance to Transit</b>					
DTT1	Street Coverage within 10min. Walk to Transit Stop		Street miles within a 10 min walk of transit stops		Pct. Of Centerline Miles
DTT2	Access to destinations via transit		Number of stops within 5 miles via transit		Number of stops

## Aggregate Statistics

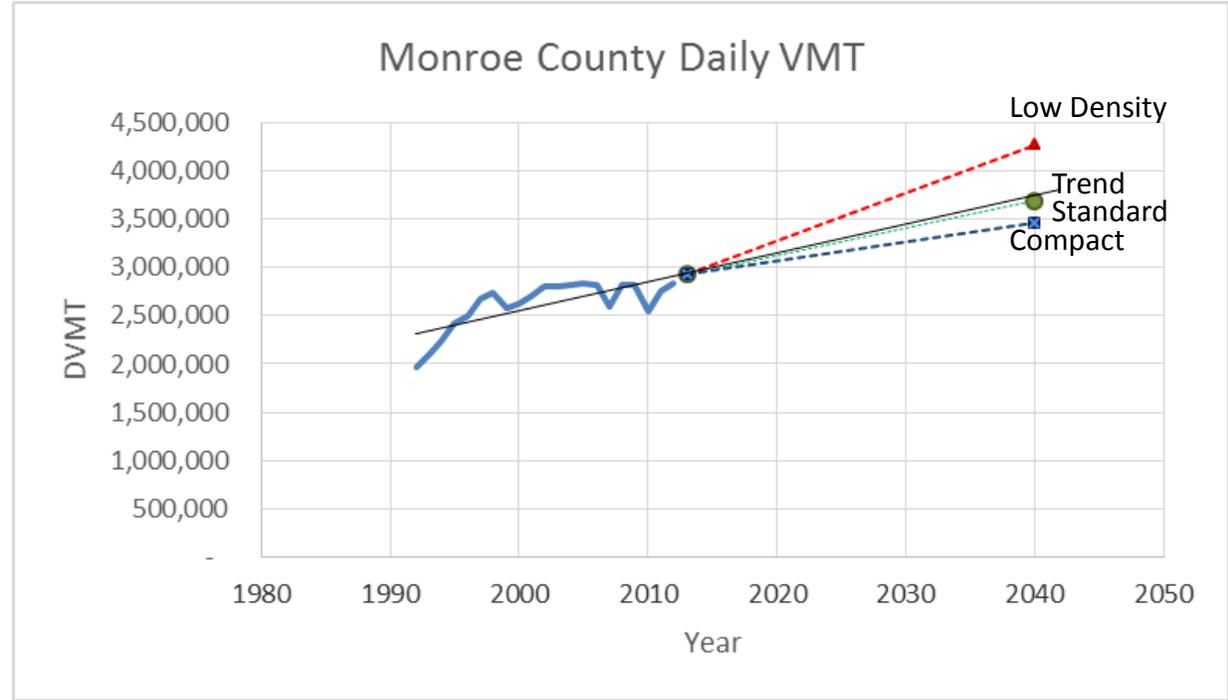
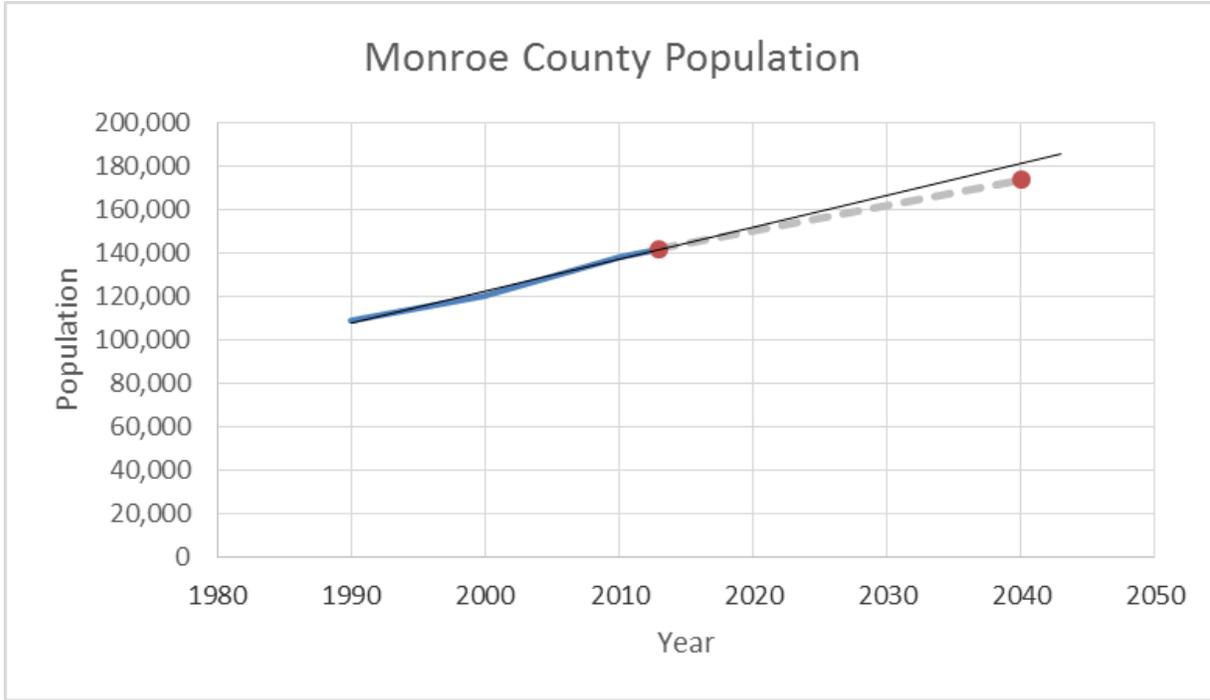
<b>Vehicle Trip Elasticity by 5D Variable</b>		
<b>5D Variable</b>	<b>Cervero and Ewing</b>	<b>EPA Doc</b>
Density1	-0.011	
Density2	-0.005	-0.040
Diversity	-0.026	-0.060
Design1	-0.054	
Design2	-0.054	
Design3	-0.054	-0.020
Destinations1	-0.022	
Destinations2	-0.034	-0.030
DistancetoTransit1	-0.027	
DistancetoTransit2	0.000	N/A

<b>VMT Elasticity by 5D Variable</b>		
<b>5D Variable</b>	<b>Cervero and Ewing</b>	<b>EPA Doc</b>
Density1	-0.040	
Density2	0.000	-0.050
Diversity	-0.020	-0.050
Design1	-0.120	
Design2	-0.120	
Design3	-0.120	-0.040
Destinations1	-0.200	
Destinations2	-0.200	-0.200
DistancetoTransit1	-0.050	
DistancetoTransit2	-0.050	N/A

## **Current Scenarios Being Evaluated**

- Standard Forecast - 2040 growth allocation (mid-range growth, standard policies), No new projects
- Standard Forecast, but delete I-69 to illustrate impact
- Standard Forecast, but allow auto operating costs to increase faster than inflation
- Standard Forecast, but add E-W BRT

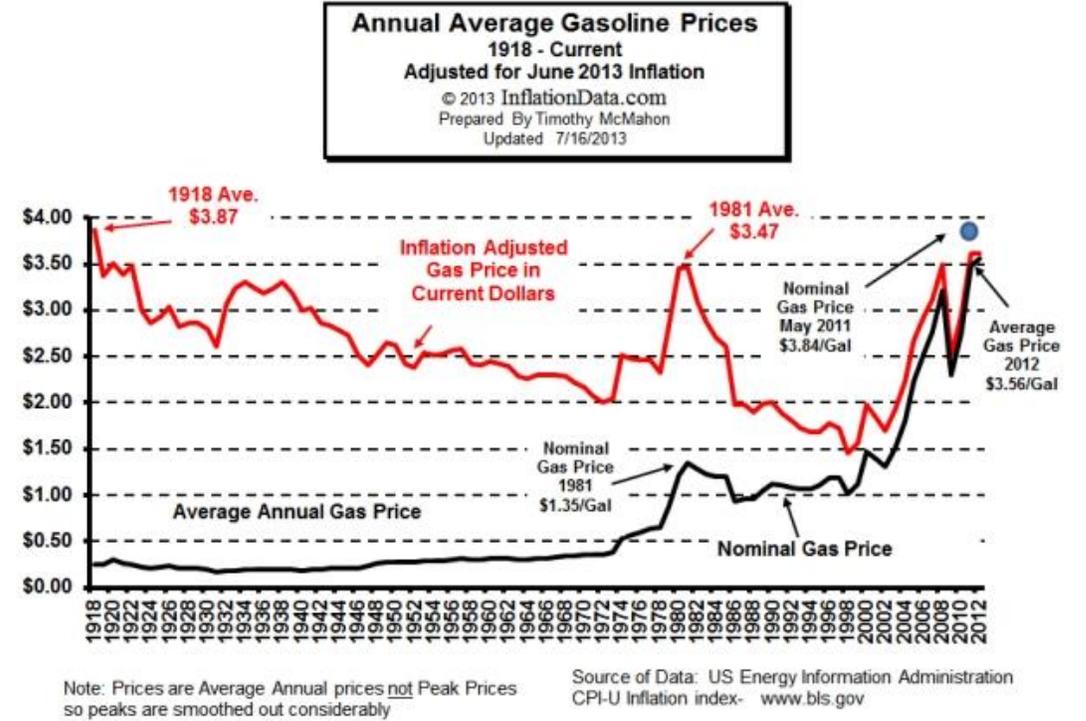
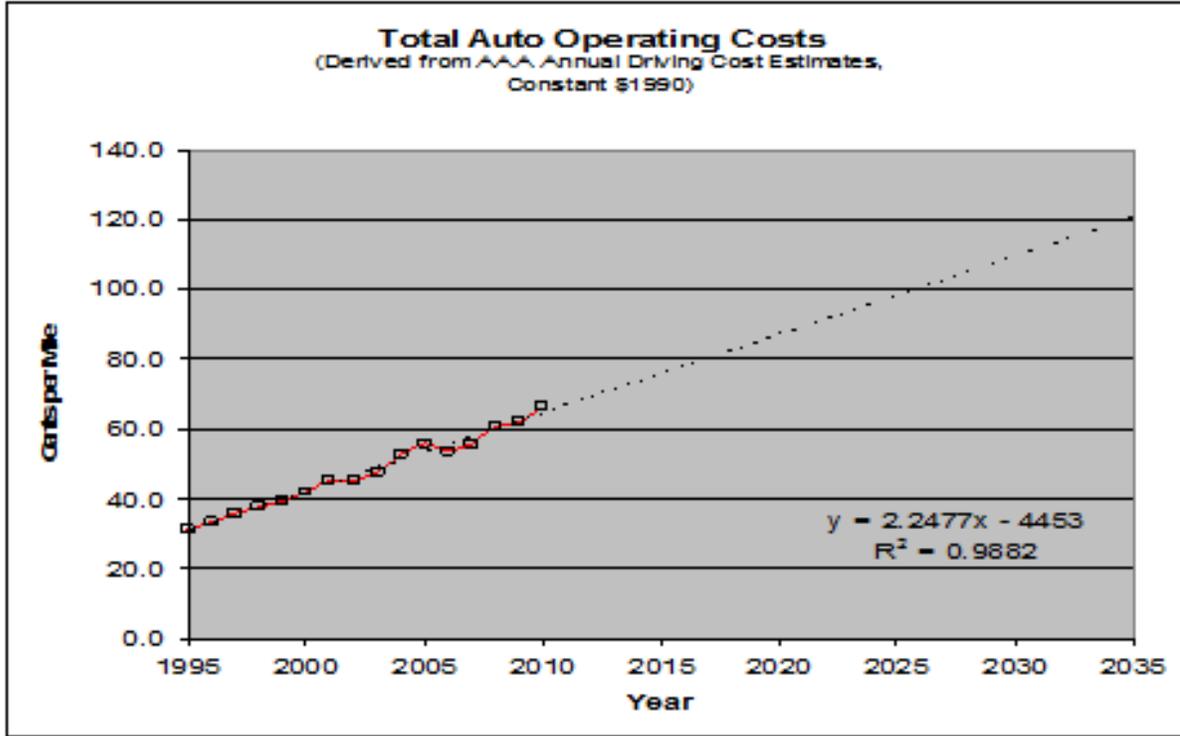
# Development Style Impact on VMT



## I-69 Impact on Travel Demand

- Contributes 300,000 vehicle miles per day in 2040
- I-69 VMT makes up 8% of vehicle travel
- Positive impact on safety
- Improves auto travel times
- No impact on mode share
- Positive impact on GHG

# Increasing Driving Cost's Impact on Travel Demand



## Increasing Driving Cost's Impact on Travel Demand

### Auto Cost Per Mile of Travel

	2014		2040	
Operating Cost	\$	0.59	\$	1.32
Time Cost	\$	0.55	\$	0.55
Total Cost	\$	1.14	\$	1.87

Estimated Mode Share						
2040	Auto - Driver	Auto - Passenger	Rode a bike	Transit, drove to bus	Transit, walked to bus	Walked
Standard	52.6%	4.3%	17.0%	0.2%	5.2%	20.7%
Higher Auto Costs	42.1%	5.3%	20.7%	0.3%	6.4%	25.2%

## E-W BRT Impact on Travel Demand

- Too early to say
- We now know that it can't replace BT Route 3

## Initial Summary

Scenario	HH	Person Trips	VMT	Auto Trip Length
Base	54,038	432,304	2,929,216	6.776
Standard	72,507	580,056	3,690,813	6.363
Low Density	72,507	580,056	4,270,797	7.363
Compact	72,507	580,056	3,453,546	5.954
Higher Gas	72,507	580,056	3,304,385	5.697
No I-69	72,507	580,056	3,390,763	5.846