Environmental Justice Case Study in the Des Moines Metropolitan Area

Adam Shell

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Presentation Overview

- Introduction & Objective
- Background on EJ
- EJ & Transportation
- Review of Methods
- Methodology
- Analysis & Results
- Conclusion
- Questions?

Introduction & Objective

Introduction & Objective

Introduction

- EJ = Unequal Human & Environmental Impacts
- Broad and Multifaceted
- Transportation Benefits and Burdens

Objective

- To analyze four transportation measures (accessibility, mobility, safety, and equity) and compare them between EJ and non-EJ areas.

Background of EJ

Background of EJ

- **Fundamental Principles of EJ…**
  1. Avoid, Minimize, Mitigate….effects
  2. Full & Fair Participation
  3. Prevent denial, reduction or delay in benefits
- **Who are the disadvantaged?**
- **History**
  - Research & Case Law
  - Policy (Civil Rights Act, NEPA, EO 12898)

Background of EJ

Two Sides of the EJ Debate

Advocates

- Lack of Awareness
- Deliberate exclusion from decision-making
- Limited political and economic power

Opponents

- Other pressing issues
- Industrial activity and settlement of majority before minority
- Racial motivation false and coincidental

EJ & Transportation

EJ & Transportation

Benefits

- Improved Accessibility
- Improved Travel Times to Selected Locations
- Provision & Quality of Transit Service
- Other: Proximity to Projects, User Characteristics, Asset Conditions

Burdens

- Community Disruption
- Economic
- Fiscal Decline
- Taxpayer Borne Costs
- Displacement
- Reductions in Safety and Security
- Noise & Air Pollution

Difficult to establish evidence of project impacts at system-wide level

Review of Methods

Review of Methods

- **Selecting the Spatial Unit**
  - Cover all bases (Scope, Scale, Data)
  - Small Spatial Units may lead to unreasonable results and suggest potential for little to no concern
  - U.S. Census Data
    - Most widely used
    - Common: TAZ's, block groups, & tracts
  - No-hard-and-fast-rule
    - Test Sensitivity of Results

Review of Methods

- **Identifying EJ Areas**
  - Standard
    - EJ Populations as percentage and select where exceed a percentage based threshold.
  - EPA
    - Low-Income by U.S. Census
    - Minority
      - >50% of affected area or,
      - “Meaningfully greater” (Analyst Judgment)
  - Unique Approach (Honglong Li et al.)

Review of Methods

- **Tools for Analysis**
  - No Single Method Exists
  - Qualitative & Quantitative Tools
  - Geographic Information Systems (GIS)
    - Primary Tool
    - EJ Identification & Analyses
  - Other
    - Travel Demand Model
    - Air Quality and Noise Models

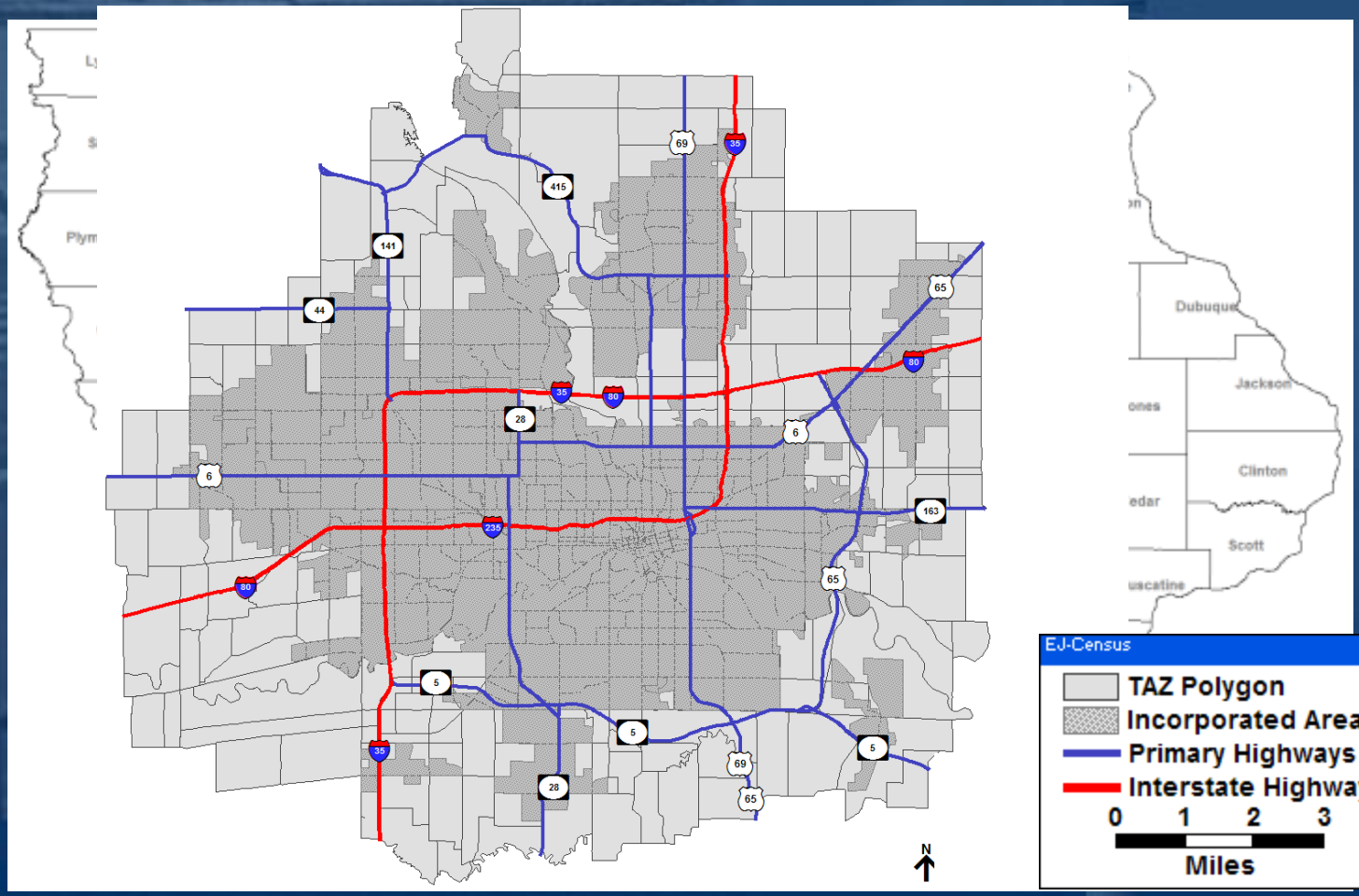
Review of Methods

- **MPO EJ Assessment**
  - Iowa MPO's – PPP, PTP, or Title VI
  - EJ Definition
    - Percentage Threshold
  - EJ Categories
    - Primarily Minority & Low-income
  - Tools
    - GIS
    - Some Travel Demand Model use

Methodology

Methodology

- Study Area



Methodology

- ***Environmental Justice Assessment in Racially Diverse Areas (Li et al.)***
- **Performance Measures**
  - Accessibility
  - Mobility (Temporal)
  - Safety
  - Equity
- **Modifications**
  - TDM, Safety, and Equity

Methodology

Performance Measure	Definition	Question Asked	Procedure	Data Source
Accessibility	Ease of reaching opportunities by using surface transportation.	Will EJ areas have comparable access to specific groups of trip attractors as compared to non-EJ areas?	1. Identify major trip attractors. 2. Determine travel time thresholds. 3. Estimate number of EJ and non-EJ areas within travel time threshold. 4. Compare number of EJ and non-EJ areas within travel time threshold.	DMAMPO TDM; DMAMPO TAZ; TIP 2004-2006; & 2030 LRTP
Mobility	Ease of movement of people, goods, and services.	Will EJ areas experience a comparable time savings compared to non-EJ areas in the future transportation systems?	1. Calculate home-to-work trip travel time. 2. Calculate home-to-work trip travel time difference between the existing condition and transportation plans. 3. Compare travel time savings for EJ and non-EJ areas.	DMAMPO TDM; DMAMPO TAZ; TIP 2004-2006; & 2030 LRTP
Safety	Risk of crash or injury; safety improvement projects	Do EJ areas experience a comparable risk of crash or injury? Will the safety improvement projects in the TIP be allocated evenly between EJ and non-EJ areas?	1. Calculate annual crash rate. 2. Compare annual crash rate between EJ and non-EJ areas. 3. Determine safety improvement projects for each area. 4. Compare safety improvement projects for EJ and non-EJ areas.	Iowa DOT Crash Data 2001-2005; Iowa DOT Highway GIS Files, DMAMPO TAZ; & TIP 2004-2006
Equity	Distribution of transportation expenditure in transportation plans.	Are transportation plan expenditures allocated equitably between EJ and non-EJ block groups?	1. Estimate percentage of areas receiving transportation expenditure and average expenditure for EJ and non-EJ areas. 2. Compare these two indices between EJ and non-EJ areas.	TIP 2004-2006; & 2030 LRTP

Source: *Environmental Justice Assessment in Racially Diverse Areas*. Honglong Li et al.

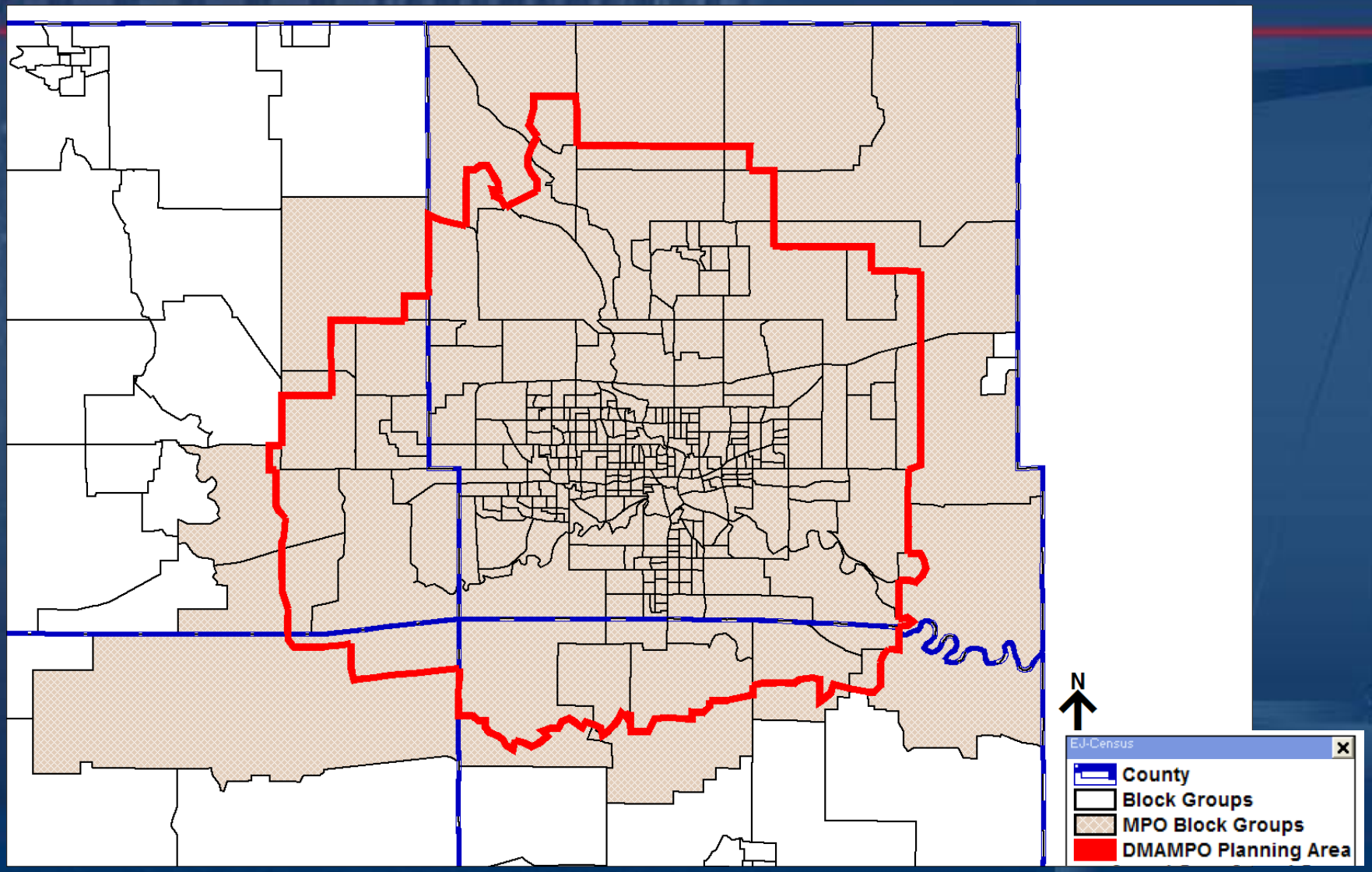
Methodology

- **Data Sources**
  - 2001 – 2005 Crash Data (InTrans)
  - Travel Demand Model (DMAMPO)
  - Planning Documents (DMAMPO)
  - GIS Shapefiles
    - Transportation Projects (DMAMPO)
    - Highway & Traffic Data (Iowa DOT)
    - Block Group TIGER files (U.S. Census Bureau)

Methodology

- **Selected Social Groups**
  - Minority (Sum of all non-White races and White Hispanics)
  - Low-Income (Population Below Poverty Level)
  - Elderly (Age 65 & Over)
  - Disabled (Physical Disability Only)
  - Zero Car Households (Owner Occupied)
- **Spatial Unit**
  - Block Group (EJ Identification)

Methodology



Methodology

- **Concentrations of Social Groups**
  - Threshold based on Li et al. Method

$$NC_{Minority} = \left(\frac{Minority\ Population_{Block\ Group}}{Total\ Population_{All\ Block\ Groups}}\right) - \left(\frac{Population_{Block\ Group}}{Total\ Population_{All\ Block\ Groups}}\right)$$

  - EJ Area if NC > Average plus 1 Std Deviation
  - General EJ Area if one or more category in block group

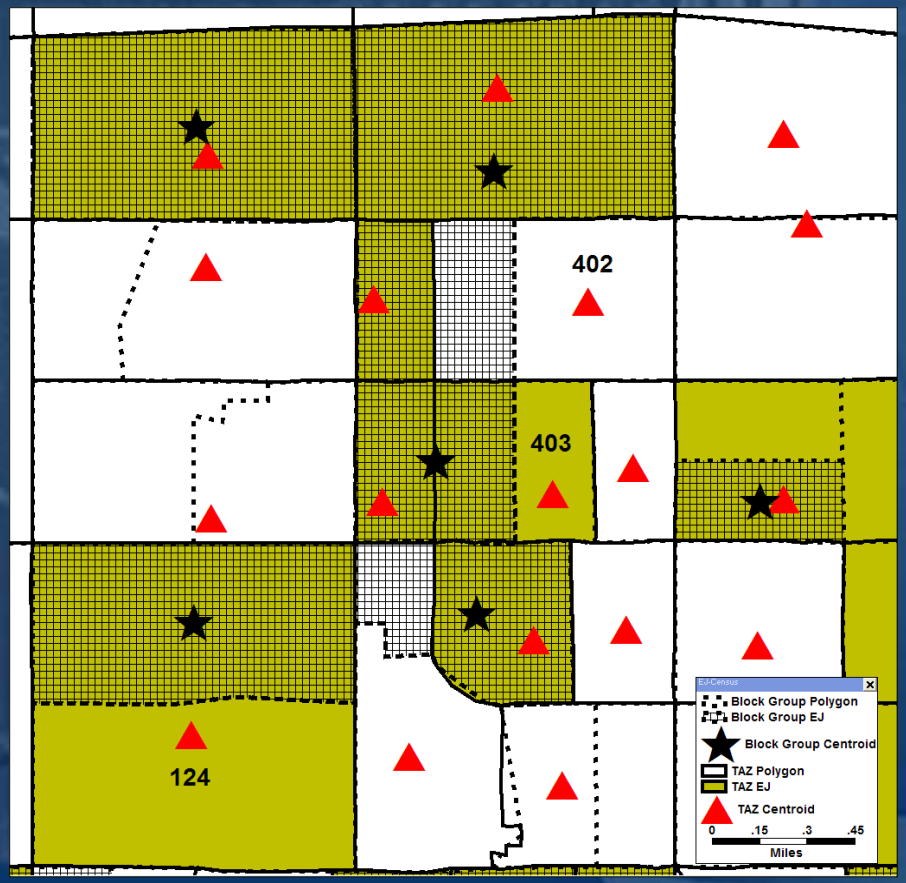
EJ Category	Block Groups
Minority	31
Low Income	35
Elderly	28
Physically Disable	42
Zero Car Households	43
Total EJ Block Groups	114

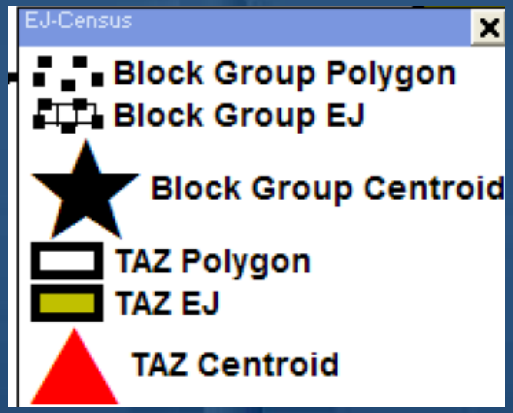
Methodology

- **Identify TAZ's as EJ or non-EJ**
  - Necessary in order to use the TDM
  - Iterative Process
    1. Overlay TAZ Polygon with Block Group Centroid
    2. Overlay TAZ Centroid with Block Group Polygon

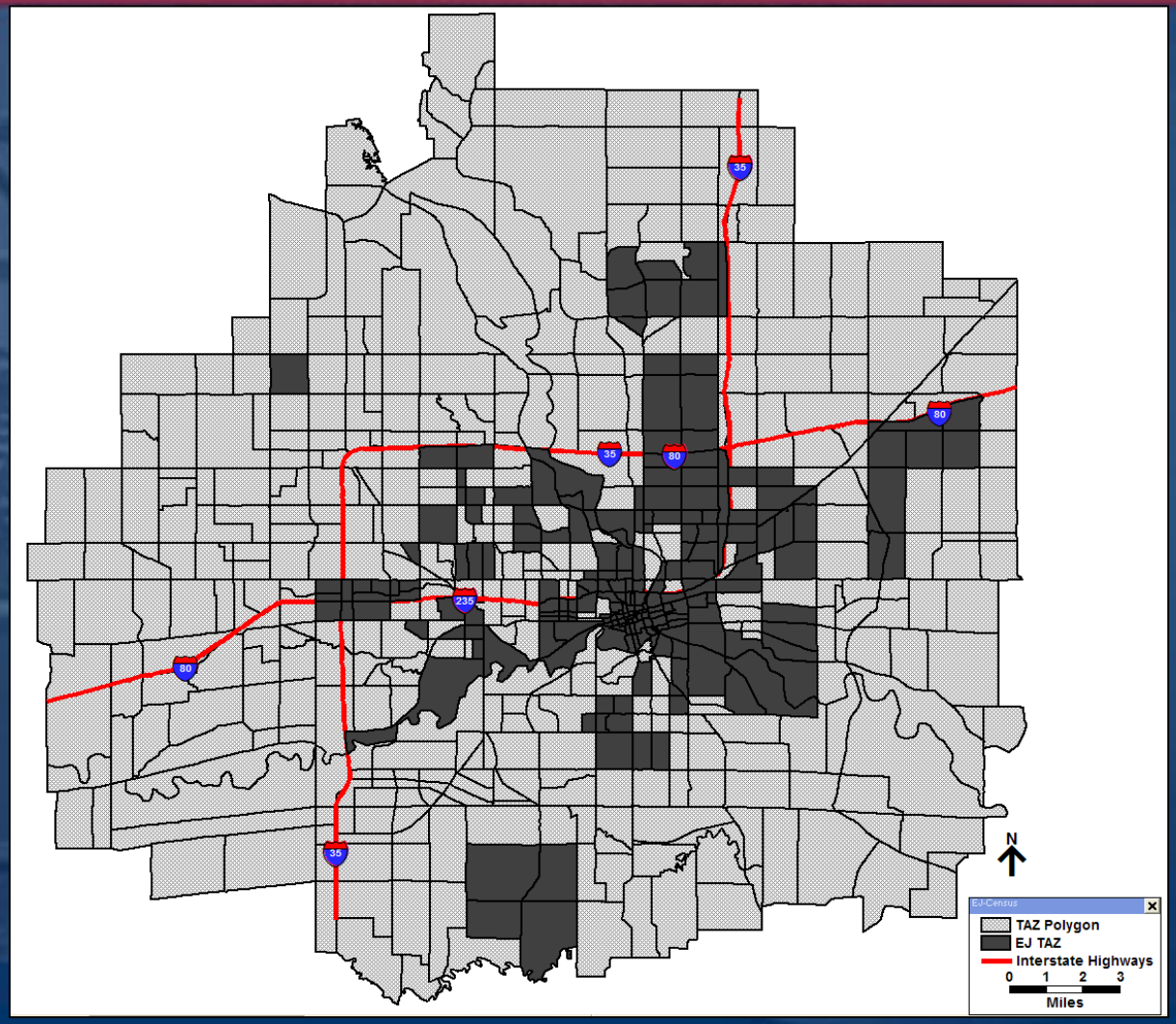
Methodology

- Identify TAZ's as EJ or non-EJ



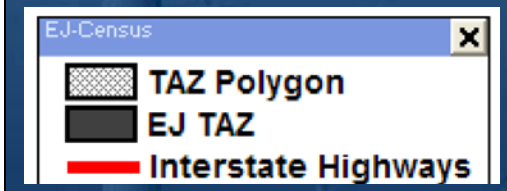


Methodology



Summary of EJ TAZ's

EJ Category	TAZ
Minority	39
Low Income	92
Elderly	57
Physically Disable	81
Zero Car Households	55
Total EJ TAZ's	213



Methodology

- **Travel Model**
  - Accessibility & Mobility Performance Measures
  - Assign TAZ Centroids as EJ or non-EJ
  - Calculate “Loaded” Travel Time
  - Scenarios
    - 2000, 2005, 2030
- **Safety Analysis (2001-2005)**
  - Crash Data: all crash types
  - 2003 Traffic (AADT) to calculate VMT
  - Excluded Freeway Crashes

Methodology

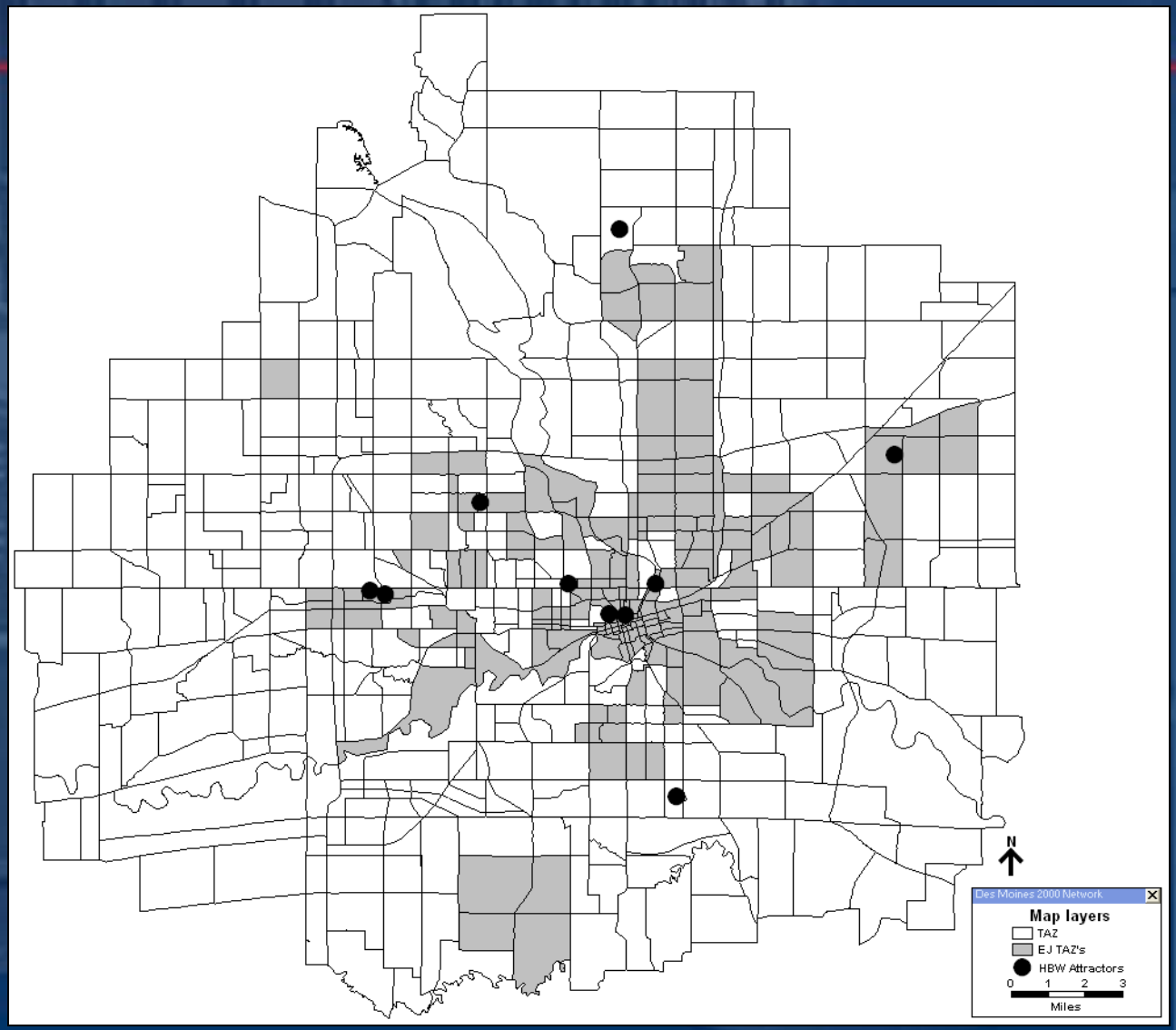
- **Equity Analysis**
  - MPO Planning Documents
    - 2030 LRTP
    - FFY 2004-2006
  - Transportation Projects
    - Project expenditures in plans to GIS files
    - Summarize Project Expenditures by EJ & non-EJ
      - Allocated expenditures by percentage of length
    - Emphasis on Highway Funding
      - Transit funding lacked detail and improvements weren't geographic specific

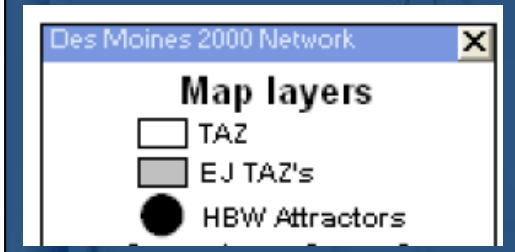
Analysis and Results

Analysis and Results

- **Accessibility**
  - Ease of reaching opportunities
    - Opportunities = trips to work, school, shopping, etc
  - Determine if EJ and non-EJ areas have comparable access to the top destinations
    - Top 10 HBW & HBO (Internal) Attractors
      - Hospitals
      - Shopping Malls
      - Casino
      - University

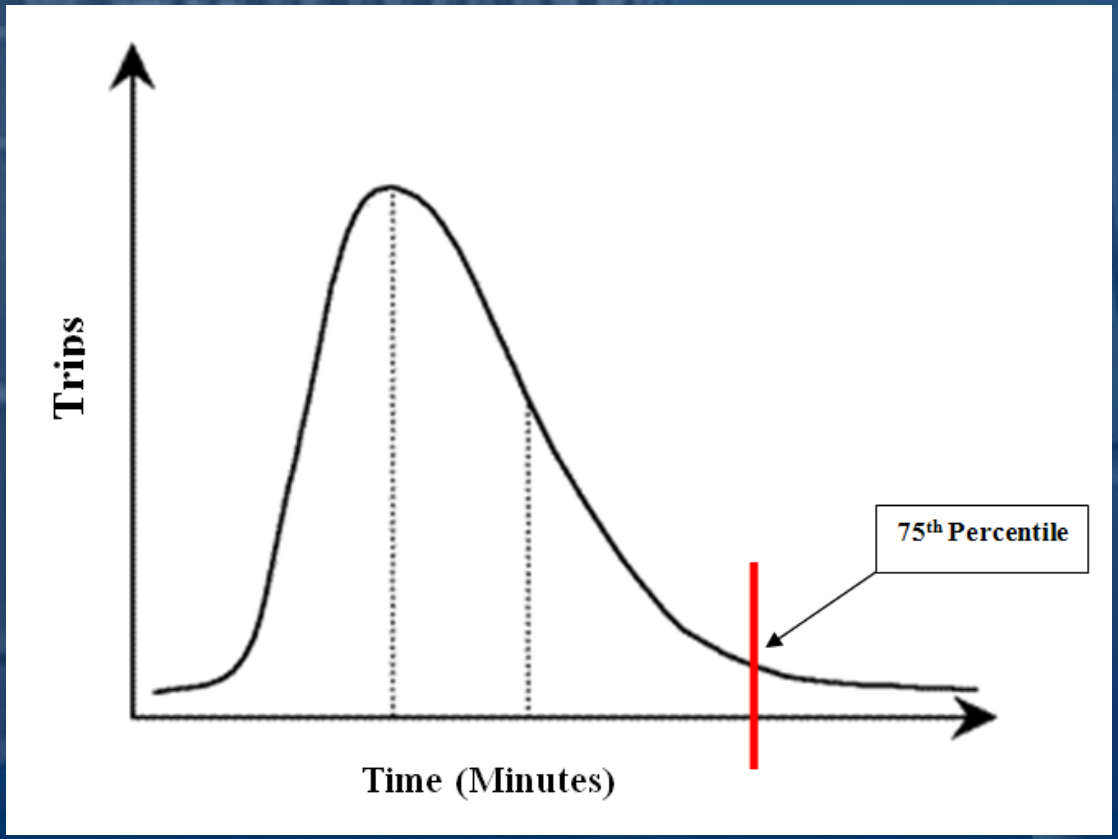
Analysis and Results





Analysis and Results

- **Travel Time Thresholds (TTT)**
  - 75th Percentile from all TAZ's to all TAZ's.



Analysis and Results

- **Travel Time Thresholds (TTT)**
  - 75th Percentile from all TAZ's to all TAZ's.

2000 TTT	Home-Based Work Trips	Home-Based Other Trips
Average Travel Time (min)	19.9	15.4
Travel Time Threshold (min)	28.1	23.7

2005 TTT	Home-Based Work Trips	Home-Based Other Trips
Average Travel Time (min)	21.3	16.8
Travel Time Threshold (min)	29.9	27.2

2030 TTT	Home-Based Work Trips	Home-Based Other Trips
Average Travel Time (min)	30.4	27.5
Travel Time Threshold (min)	39.3	38.3

Analysis and Results

- **Accessibility**
  - Accessibility Ratio (AR)

$$AR = \frac{\sum_{n=1}^{N} \left(\frac{PT_n}{\sum_{n=1}^{N} PT_n} A_n \right)}{N}$$

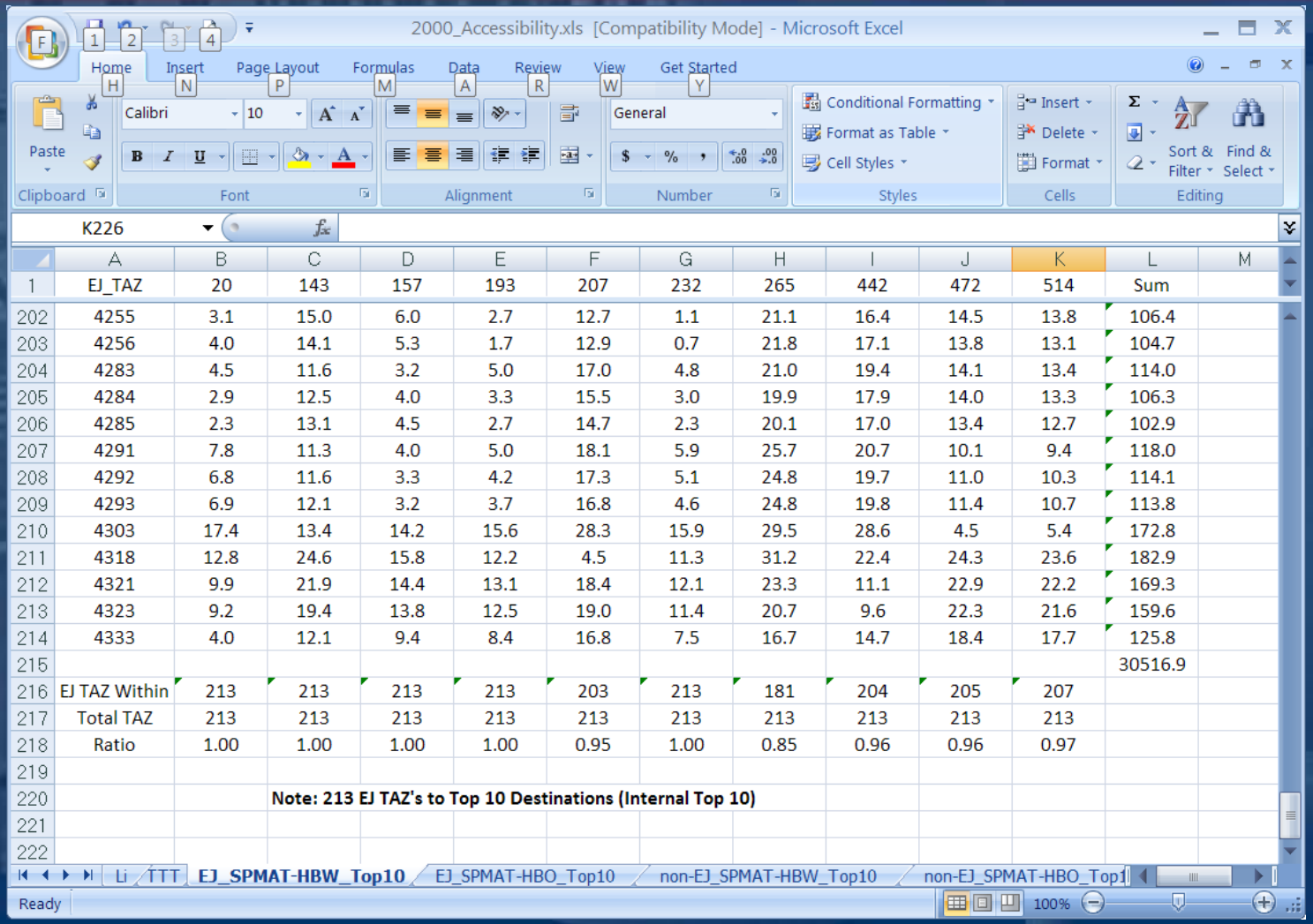
Where:

N = total number of trip attractor zones for HBW and HBO
n = number of trip attractor zones
PT = number of auto-trips by trip purpose

$$A_n = \left[\frac{(\text{\# EJ TAZ's within TTT/total \# of EJ TAZ's})}{(\text{\# of non-EJ TAZ's within TTT/total \# of non-EJ TAZs'})} \right]$$

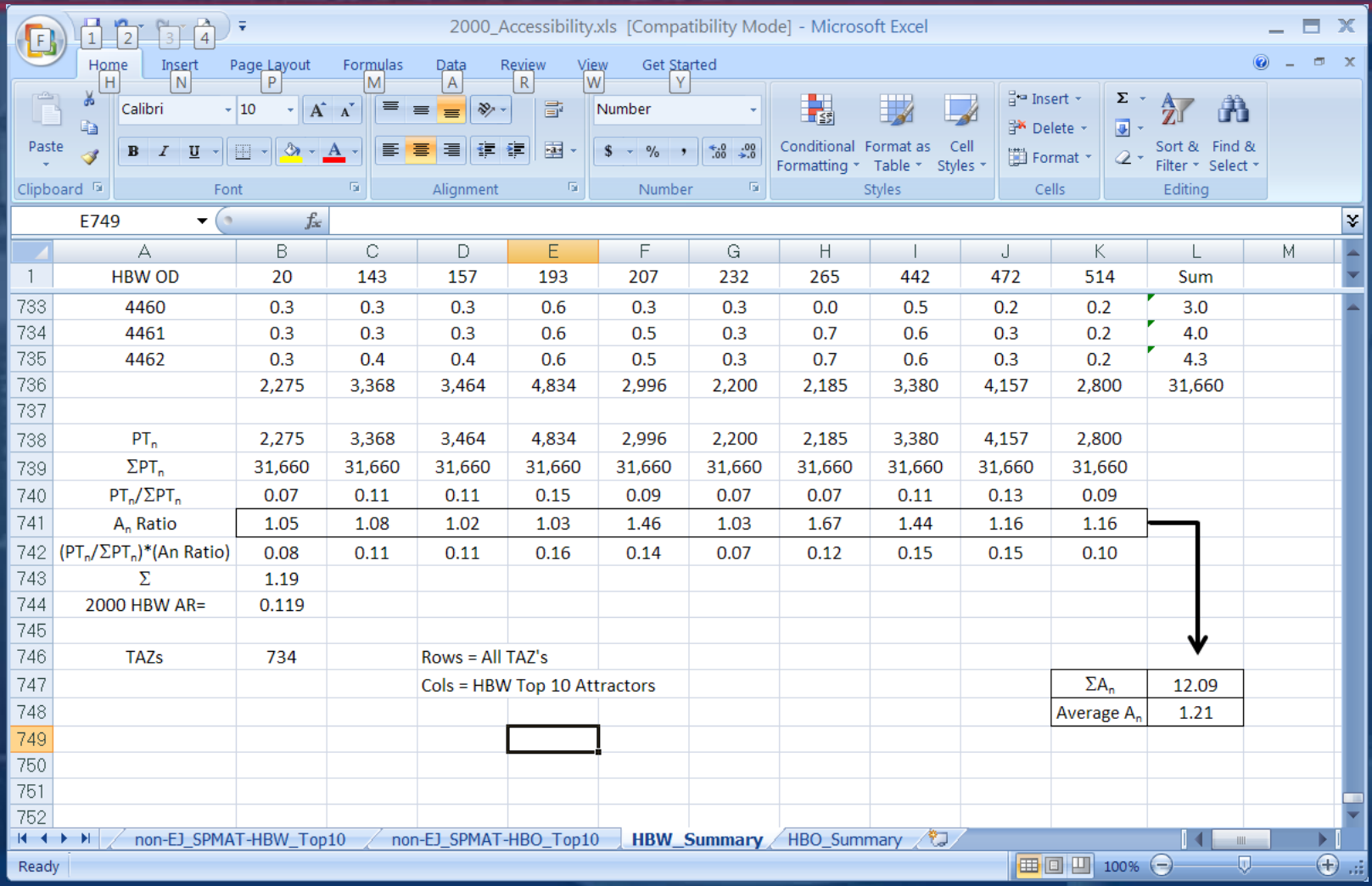
- **AR < 1; EJ lower accessibility**
- **AR = 1; Equity**
- **AR > 1; EJ better accessibility**

A_n Ratio



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	EJ_TAZ	20	143	157	193	207	232	265	442	472	514	Sum	
202	4255	3.1	15.0	6.0	2.7	12.7	1.1	21.1	16.4	14.5	13.8	106.4	
203	4256	4.0	14.1	5.3	1.7	12.9	0.7	21.8	17.1	13.8	13.1	104.7	
204	4283	4.5	11.6	3.2	5.0	17.0	4.8	21.0	19.4	14.1	13.4	114.0	
205	4284	2.9	12.5	4.0	3.3	15.5	3.0	19.9	17.9	14.0	13.3	106.3	
206	4285	2.3	13.1	4.5	2.7	14.7	2.3	20.1	17.0	13.4	12.7	102.9	
207	4291	7.8	11.3	4.0	5.0	18.1	5.9	25.7	20.7	10.1	9.4	118.0	
208	4292	6.8	11.6	3.3	4.2	17.3	5.1	24.8	19.7	11.0	10.3	114.1	
209	4293	6.9	12.1	3.2	3.7	16.8	4.6	24.8	19.8	11.4	10.7	113.8	
210	4303	17.4	13.4	14.2	15.6	28.3	15.9	29.5	28.6	4.5	5.4	172.8	
211	4318	12.8	24.6	15.8	12.2	4.5	11.3	31.2	22.4	24.3	23.6	182.9	
212	4321	9.9	21.9	14.4	13.1	18.4	12.1	23.3	11.1	22.9	22.2	169.3	
213	4323	9.2	19.4	13.8	12.5	19.0	11.4	20.7	9.6	22.3	21.6	159.6	
214	4333	4.0	12.1	9.4	8.4	16.8	7.5	16.7	14.7	18.4	17.7	125.8	
215												30516.9	
216	EJ TAZ Within	213	213	213	213	203	213	181	204	205	207		
217	Total TAZ	213	213	213	213	213	213	213	213	213	213		
218	Ratio	1.00	1.00	1.00	1.00	0.95	1.00	0.85	0.96	0.96	0.97		
219													
220			Note: 213 EJ TAZ's to Top 10 Destinations (Internal Top 10)										
221													
222													

A_n Ratio…cont



2000_Accessibility.xls [Compatibility Mode] - Microsoft Excel

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E749

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	HBW OD	20	143	157	193	207	232	265	442	472	514	Sum	
733	4460	0.3	0.3	0.3	0.6	0.3	0.3	0.0	0.5	0.2	0.2	3.0	
734	4461	0.3	0.3	0.3	0.6	0.5	0.3	0.7	0.6	0.3	0.2	4.0	
735	4462	0.3	0.4	0.4	0.6	0.5	0.3	0.7	0.6	0.3	0.2	4.3	
736		2,275	3,368	3,464	4,834	2,996	2,200	2,185	3,380	4,157	2,800	31,660	
737													
738	PT_n	2,275	3,368	3,464	4,834	2,996	2,200	2,185	3,380	4,157	2,800		
739	ΣPT_n	31,660	31,660	31,660	31,660	31,660	31,660	31,660	31,660	31,660	31,660		
740	$PT_n/\Sigma PT_n$	0.07	0.11	0.11	0.15	0.09	0.07	0.07	0.11	0.13	0.09		
741	A_n Ratio	1.05	1.08	1.02	1.03	1.46	1.03	1.67	1.44	1.16	1.16		
742	$(PT_n/\Sigma PT_n)$*(An Ratio)	0.08	0.11	0.11	0.16	0.14	0.07	0.12	0.15	0.15	0.10		
743	Σ	1.19											
744	2000 HBW AR=	0.119											
745													
746	TAZs	734		Rows = All TAZ's									
747				Cols = HBW Top 10 Attractors									
748													
749													
750													
751													
752													

ΣA_n	12.09
Average A_n	1.21

non-EJ_SPMAT-HBW_Top10 | non-EJ_SPMAT-HBO_Top10 | HBW_Summary | HBO_Summary

Ready

100%

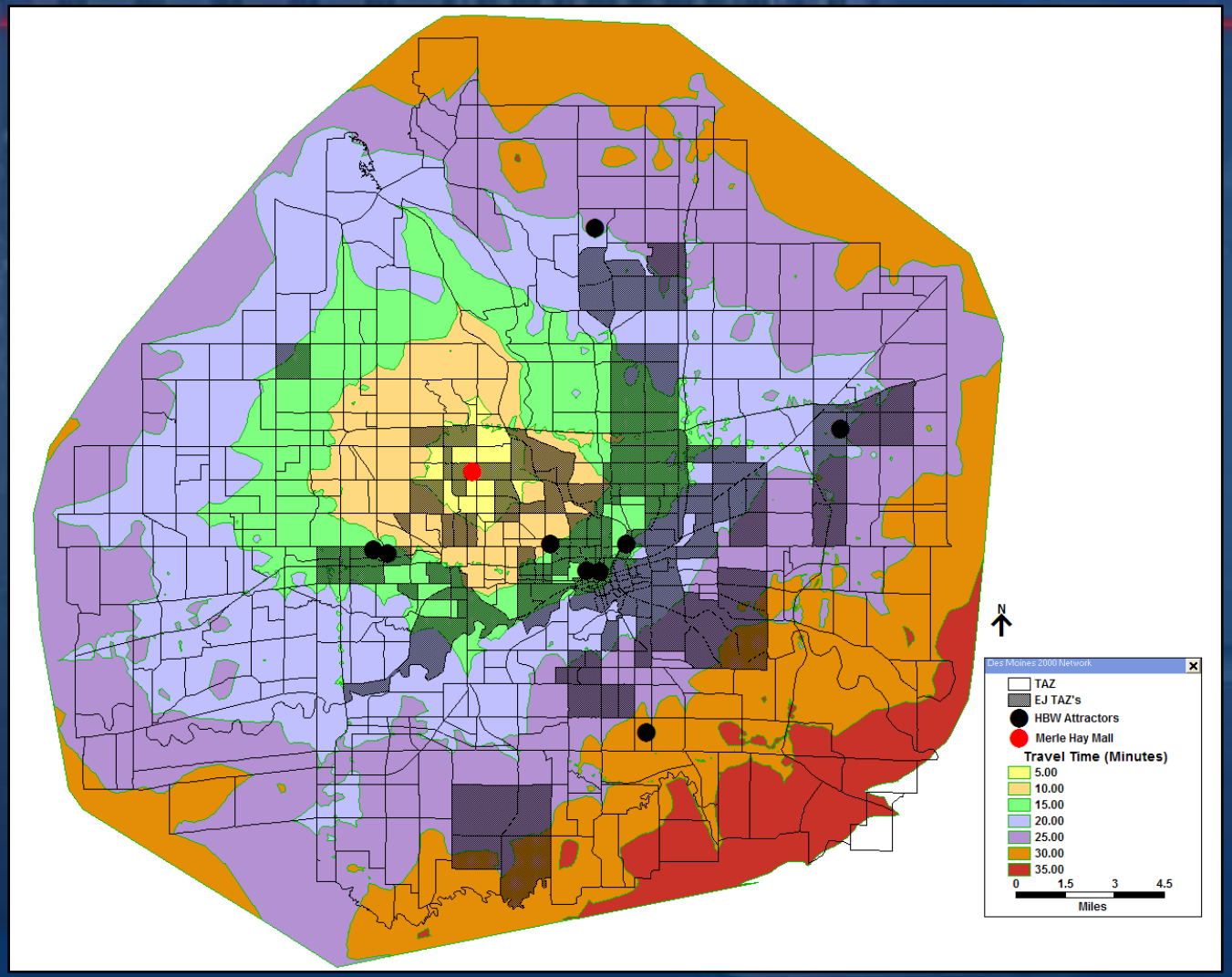
Analysis and Results

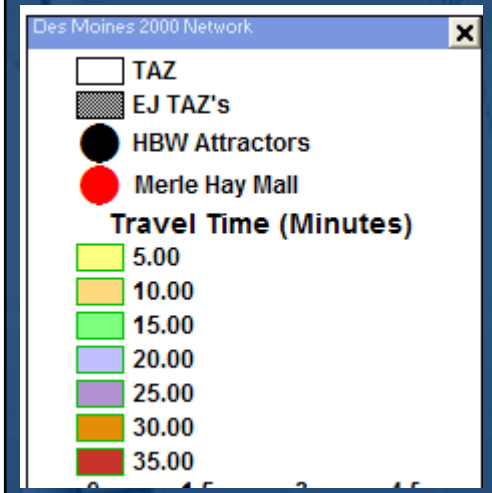
- **Accessibility**
  - Results
    - Summary of Average A_n (Ratio EJ / Ratio non-EJ within)

	HBW	HBO
2000	1.21	1.57
2005	1.14	1.35
2030	1.12	1.22

    - Analysis determined EJ areas have better overall accessibility
    - Isochronal Map (Merle Hay Mall Only!)

Results and Analysis





Analysis and Results

- **Mobility (Temporal)**
  - Ease of movement of people, goods, and services
  - Transportation to work top priority…
    - …Given employment most effective way to improve disadvantaged status of EJ
  - Determine if EJ and non-EJ areas have comparable time savings in the future transportation systems

Analysis and Results

- **Mobility**
  - 75th Percentile HBW Travel Time
    - From EJ areas….to all TAZ's
    - From non-EJ areas….to all TAZ's
  - Results
    - EJ areas greater travel time increase, however
    - EJ Areas experience lower absolute travel time

HBW Trips – 75th Percentile Travel Time & Change

	75th percentile Travel Time (min)		Travel Time Change	
	EJ	non-EJ	EJ	non-EJ
2000	23	27.5	-	-
2005	24.6	29.1	7.0%	5.8%
2030	34.5	39.1	50.0%	42.2%

Analysis and Results

- **Safety**
  - Goal of Safety Improvements: To reduce the risk of crash and injury
  - Crash rate used to determine risk

Crash Rate (100 MVM) =(Average Annual Crashes*100,000,000)/(VMT*365)

Where: VMT=AADT*Segment Length

AADT=Annual Average Daily Traffic

  - Compare crash rate between EJ and non-EJ
  - Compare distribution of safety improvements between EJ and non-EJ
  - Excluded Freeways (Crashes & VMT)

Analysis and Results

- **Safety**

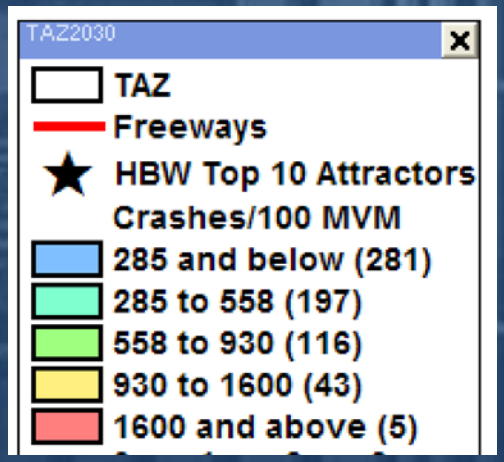
Crash Rate Summary for EJ and non-EJ Areas

Variable	EJ Areas	Non-EJ Areas	DMAMPO
TAZ's	213	429	642
VMT_2003	1,874,316,672	2,600,015,142	4,474,331,814
Crash_2001	10,405	8,760	19,165
Crash_2002	10,396	9,250	19,646
Crash_2003	10,861	9,206	20,067
Crash_2004	10,480	9,620	20,100
Crash_2005	10,564	10,053	20,617
Crash_Avg	10,541	9,378	19,919
Crash Rate	562.4	360.7	445.2

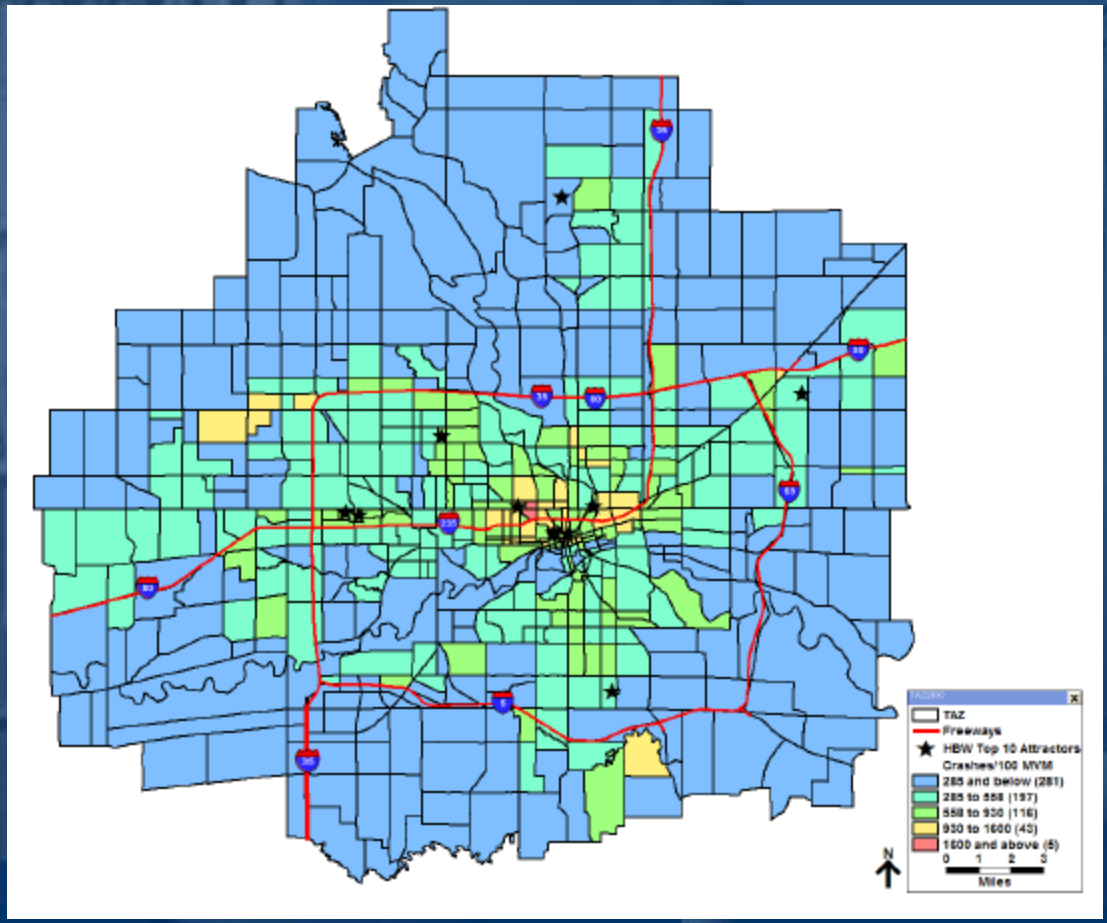
Note: Crash Rate per 100 MVM

Results and Analysis

- **Safety**



Crash Rate by Traffic Analysis Zone



Analysis and Results

- **Safety**
  - Improvements outlined in TIP only!

Note: Projects included Bridge Rehab, Signals, Capacity

TAZ's with a Crash Rate that exceed MPO Average and Receive a SIP

Category	Crash Rate >= 445	Crash Rate >= 445 and receiving a SIP
EJ	126	8
Non-EJ	99	9

Note: Crash Rate per 100 MVM

Safety Improvement Expenditures for EJ and non-EJ

Category	# TAZ's	% TAZs	Safety Expenditures (Million $)	Percent of TIP
EJ	14	2%	$7.02	2%
Non-EJ	45	7%	$38.84	11%

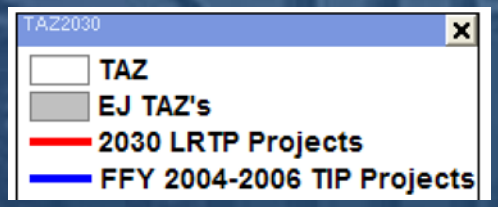
Note:
1. The total costs of the TIP for years 2004-2006 is $361,162,881.
2. Interstate safety expenditures are not included.

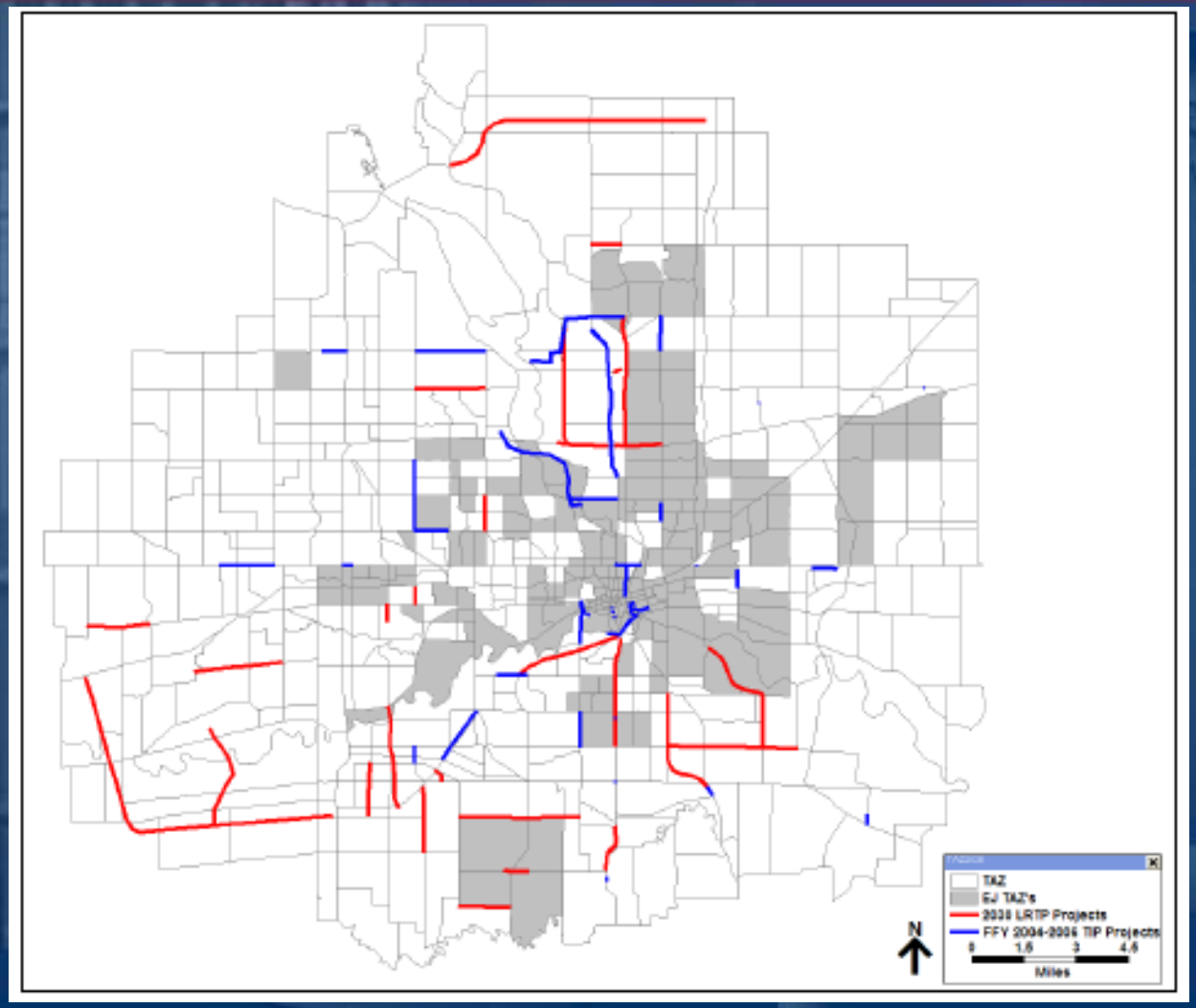
Analysis and Results

- **Equity**
  - Distribution of transportation expenditures
    - TIP & LRTP
  - Determine if plan expenditures are equitable between EJ and non-EJ
  - Included only projects if provided local benefits
    - Excluded Interstate Capacity and Interchange Improvements

Analysis and Results

- Equity





Analysis and Results

- **Equity**

Category	Number of TAZ's Receiving a Transportation Expenditure		Percent of TAZ's Receiving a Transportation Expenditure		Total Transportation Expenditure (millions $)		Average Transportation Expenditure per TAZ (millions $)		Expenditure Per Capita (millions $)	
	TIP	LRTP	TIP	LRTP	TIP	LRTP	TIP	LRTP	TIP	LRTP
EJ	33	16	5%	3%	$37.95	$34.38	$1.15	$2.15	$1,361	$1,623
non-EJ	66	86	10%	13%	$45.71	$268.76	$0.69	$3.13	$1,040	$5,858

Note:

1) The total costs of the TIP for years 2004-2006 is $361,162,881.
2) The total cost of the LRTP between 2020 and 2030 is $650,224,000.
3) Interstate investment for the TIP and LRTP is not included.
4) 2000 Population was used to determine expenditures per capita

- Greater share of overall expenditures to non-EJ
- However….on a per TAZ and per capita basis, non-EJ receive less in the TIP

Conclusion

Conclusion

- **Unique Approach to define EJ areas**
- **System-Wide EJ Analysis**
  - Importance of Performance Measures & Merits to Trade-Offs
- **Limitations**
  - Travel Demand Model
    - Lack of Mode Split (Transit)
  - Socially Disadvantaged Groups (Elderly?)
- **Recommendations?**


Questions?