

2002
VEHICLE OCCUPANCY STUDY
FOR THE
KANSAS CITY METROPOLITAN AREA

FINAL REPORT

**2002 Vehicle Occupancy Study
For the Kansas City Metropolitan Region**

TECHNICAL MEMORANDUM

Introduction

Increasing **vehicle occupancy** (defined as the *average number of persons per vehicle*) during peak travel periods has been identified as a potential, low-cost solution to a number of current transportation problems including traffic congestion, energy consumption, and air pollution. Efforts to increase vehicle occupancy through carpooling, vanpooling, and transit use are widely accepted in the transportation field as important elements of a multi-faceted approach to improving the overall performance of the transportation system while avoiding the large capital investments associated with new or expanded roadway capacity. When successful, these methods may also result in substantial economic benefits to commuters and employers and improved air quality throughout the region.

This report presents the findings of the 2002 Vehicle Occupancy Study undertaken by the Mid-America Regional Council (MARC) as part of ongoing transportation planning and RIDESHARE (carpooling/vanpooling) efforts. The purpose of this study is to update vehicle occupancy data, to monitor impacts of agency efforts to increase occupancy, and to compare the results with common assumptions used in the long-range transportation planning process.

The study was designed to be as consistent as possible with previous MARC vehicle occupancy studies (completed in 1970, 1978, 1987, 1993, and 1997) so that direct comparisons can be made over time. In addition, the results can be compared with the present and historical vehicle occupancy rate for work trips determined by the U.S. Census Bureau for the Kansas City Metropolitan Statistical Area (MSA).

Prior to 1993, only the PM peak period (4:30-6:00) was sampled and used by MARC to estimate average vehicle occupancy. However, it is well known that non-work trips constitute a substantial proportion total automobile trips occurring during this period. As a result, sampling of the AM peak period (7:30-8:00) was introduced into the study in 1993, and has continued to be performed as part of each subsequent study. The AM peak period vehicle occupancy rate can now be compared across time and with the PM rate (1993 to Present).

Study Design and Data Collection

Data for the 2002 Vehicle Occupancy Study was collected by counting the total number of occupants in a sample of vehicles passing selected sites throughout the Kansas City region. The number of sample sites was increased from 26 in 1991 to 44 in 1992 with the purpose of obtaining a more representative sample of the metropolitan area. The same 44 sampling sites have been used in all subsequent studies for the purpose of making direct historical comparisons. The use of mechanical counters has allowed individual MARC staff to perform survey counts, reducing demands on time and resources while maintaining an appropriate level of accuracy. See the Appendix for a map showing the locations of the sample sites in the Kansas City metropolitan area.

The following parameters were kept in collecting and tabulating data:

1. The study focused on occupancy rates for work trips. Thus, sampling was performed during peak periods only. The PM peak period (4:30-6:30) and the AM peak period (7:00-8:30) are summarized in this study in a manner that is consistent with previous studies.
2. In an attempt to further focus the study on work trips, it distinguishes between private *passenger vehicles* used for commuting to work and other vehicles, such as semi-trailer trucks, delivery vans, police and emergency vehicles, etc. Although non-commute vehicles were counted, their occupants were not. Ultimately, occupancy rates were calculated only for commute vehicles, defined as automobiles, vans, minivans, pickup trucks, and motorcycles. A total of 43,471 passenger vehicles were sampled as part of the 2001 study.
3. Data were collected on Tuesdays, Wednesdays, and Thursdays only, as these days are considered most representative of average weekday travel behavior and commute conditions.
4. Sampling locations for data collection were selected in order that the data is equally representative of two geographical (inner and outer urbanized) areas¹, and of four functional classifications of roadways, as shown in Table 1.

¹ See Appendix for a map showing the count sites and the inner and outer urbanized areas.

TABLE 1 URBAN LOCATION OF SAMPLES SITES BY ROADWAY FUNCTIONAL CLASSIFICATION		
Functional Classification	Inner Urban Area	Outer Urban Area
Freeway / Expressway	5	6
Principal Arterial	6	5
Minor Arterial	5	6
Collector	5	6
<i>TOTAL</i>	<i>21</i>	<i>23</i>

TABLE 2 SAMPLE SITES BY COUNTY	
County	Number of Sites
Clay	6
Jackson	17
Johnson	13
Platte	2
Wyandotte	6

The available literature related to the design of private vehicle occupancy studies indicates that, for a regional study, the number of roadway sites sampled should be a function of data collection costs, the total number of roadway segments in the area's transportation system, and the desired confidence level for the calculated AVO. It also recommends that studies "randomly select collection sites and collection times," (Federal Highway Administration, 1997, vi). The 44 sites previously chosen by MARC appear to be weighted towards those areas in the Kansas City metro area that are greatest in terms of population and employment densities, VMT, traffic volumes, and roadway lane miles. Based on the reports of past occupancy studies, it is unclear whether or not the sample sites were chosen randomly. In the absence of a specified starting time for data collection events, it is reasonable to assume that collection times were selected at random for this study.

2002 Vehicle Occupancy Study Results

The data collected for the 2002 study determined that the average vehicle occupancy (AVO) rate for the Kansas City urbanized area is 1.22 during the PM peak period, and 1.16 during the AM peak period.

TABLE 3 ESTIMATED 2002 VEHICLE OCCUPANCY BY ROADWAY CLASSIFICATION PM PEAK PERIOD							
	Occupants per Vehicle (% of Total Sample)						
Functional Classification	1	2	3	4	5	6+	AVO
Freeway / Expressway	83.4%	13.1%	2.3%	0.4%	0.0%	0.0%	1.19
Principal Arterial	82.2%	14.7%	2.3%	0.6%	0.1%	0.0%	1.22
Minor Arterial	80.9%	15.8%	2.7%	0.6%	0.1%	0.0%	1.23
Collector / Local	76.7%	18.4%	3.9%	0.7%	0.2%	0.1%	1.29

TABLE 4 ESTIMATED 2002 VEHICLE OCCUPANCY BY ROADWAY CLASSIFICATION AM PEAK PERIOD							
	Occupants per Vehicle (% of Total Sample)						
Functional Classification	1	2	3	4	5	6+	AVO
Freeway / Expressway	89.9%	9.3%	0.7%	0.1%	0.0%	0.0%	1.14
Principal Arterial	88.1%	10.6%	1.0%	0.2%	0.0%	0.0%	1.13
Minor Arterial	89.7%	9.0%	1.0%	0.3%	0.0%	0.1%	1.14
Collector / Local	83.8%	13.4%	2.1%	0.6%	0.1%	0.0%	1.21

TABLE 5 HISTORICAL KCMR CONDITIONS – PM PEAK PERIOD							
	Occupants per Vehicle (% of Total Sample)						
Year	1	2	3	4	5	6+	AVO
2002	81.5%	15.0%	2.6%	0.6%	0.1%	0.0%	1.22
1997	82.3%	15.3%	1.8%	0.4%	0.1%	0.1%	1.21
1993	79.2%	16.9%	2.7%	0.9%	0.2%	0.1%	1.27
1992	78.5%	17.3%	2.9%	1.0%	0.2%	0.1%	1.28
1991	75.1%	20.1%	3.5%	1.0%	0.2%	0.1%	1.30
1990	74.6%	20.6%	3.6%	0.9%	0.2%	0.1%	1.31
1989	74.7%	21.3%	2.7%	0.9%	0.3%	0.1%	1.31

TABLE 6 HISTORICAL KCMR CONDITIONS – AM PEAK PERIOD							
	Occupants per Vehicle (% of Total Sample)						
Year	1	2	3	4	5	6+	AVO
2002	88.0%	10.5%	1.2%	0.3%	0.0%	0.0%	1.16
1997	87.8%	10.9%	0.9%	0.2%	0.1%	0.1%	1.14
1993	85.3%	12.5%	1.6%	0.4%	0.1%	0.1%	1.18

Specific values observed at individual sample sites range from 1.56 on Central Avenue at 10th Street (PM) in Kansas City, KS, to 1.04 on College Boulevard at Roe Avenue (AM) in Leawood, KS. Table 6 displays a historical comparison of the observed AVO rates for each sampling site, in descending magnitude of observed 2002 rates, during the PM peak period. Table 7 displays 2002 rates in a similar fashion for the AM peak period.

Statistical Analysis

In order to test the statistical significance of the average vehicle occupancy rates calculated for 2002, a two-sample paired t-test was performed on the data set for each period. For the PM peak period, the test results indicated that there is no significant difference between the average rates for 1997 and 2002. This supports the notion that the average vehicle occupancy is leveling out during the PM period.

However, when performed on the data for the AM peak period, the test results did indeed find a statistically significant (at the 0.05 level) difference between the mean AVO rates. This suggests that the occupancy rate during the AM period did increase slightly between 1997 and 2002.

**Table 7
Historical Average Vehicle Occupancy Rates (PM)**

Site	Location	1989	1990	1991	1992	1993	1997	2001
43	Central Avenue @ 10th Street				1.72	1.54	1.32	1.56
30	Parallel Parkway @ 64th Terrace			1.32	1.37	1.48	1.51	1.51
38	64th Street @ North Antioch Road				1.42	1.51	1.25	1.47
18	US-24 (State Avenue) @ I-635	1.56	1.59	1.53	1.54	1.41	1.31	1.47
34	St. John Avenue @ Van Brunt Boulevard	1.48	1.54	1.42	1.43	1.51	1.38	1.40
28	Sterling Avenue @ Blue Ridge Boulevard	1.23	1.43	1.42	1.44	1.41	1.29	1.36
41	Hillcrest Road @ Bannister Road			1.43	1.43	1.21	1.35	1.32
15	US-69 (18th St. Expressway) @ I-35				1.23	1.27	1.16	1.31
21	US-24 (Independence Ave.) @ I-435				1.29	1.39	1.30	1.31
24	Charlotte St (PM) / Holmes St (AM) @ 12th St.	1.43	1.49	1.69	1.43	1.31	1.24	1.31
39	87th Street @ Antioch Road				1.36	1.27	1.30	1.29
29	N 72nd Street @ North Oak Trafficway			1.31	1.28	1.40	1.31	1.27
7	I-435 @ 87th Street	1.46	1.23	1.26	1.29	1.20	1.17	1.26
9	I-35 @ Antioch Road			1.12	1.29	1.11	1.21	1.25
36	43rd Street @ Broadway / J.C. Nichols Pkwy	1.40	1.33	1.27	1.29	1.34	1.21	1.25
40	Somerset Drive @ Mission Road	1.25	1.24	1.32	CLOSED	1.23	1.22	1.23
5	I-29 @ Barry Road		1.49	1.40	1.43	1.43	1.22	1.22
11	K-10 @ Ridgeview Road				1.30	1.24	1.22	1.22
42	College Boulevard @ Roe Avenue				1.11	1.26	1.15	1.22
8	I-435 @ Shawnee Mission Parkway				1.39	1.48	1.08	1.22
12	North Oak Trafficway @ 32nd Street			1.28	1.22	1.13	1.21	1.22
44	NW 68th Street @ US-169				1.30	1.26	1.36	1.22
25	Grand Avenue @ 14th Street	1.38	1.33	1.30	1.41	1.28	1.23	1.21
26	Broadway / J.C. Nichols Pkwy @ 43rd Street	1.20	1.23	1.24	1.18	1.23	1.19	1.21
16	US-40 @ I-70 (East)				1.42	1.35	1.26	1.20
33	College Boulevard @ Quivira Road				1.22	1.21	1.21	1.20
23	Waukomis Drive (Route AA) @ NW 56th St.			1.32	1.23	1.24	1.28	1.20
35	Lamar Avenue @ 51st Street			1.22	1.22	1.25	1.32	1.19
13	Southwest Trafficway @ 31st Street	1.17	1.16	1.19	1.21	1.19	1.20	1.19
20	M-78 (23rd Street) @ I-435			1.39	1.20	1.31	1.21	1.19
19	75th Street @ State Line	1.28	1.23	1.37	1.27	1.38	1.18	1.18
2	I-70 @ 18th Street Expressway	1.22	1.19	1.28	1.50	1.25	1.24	1.18
27	63rd Street @ Ward Parkway				1.26	1.26	1.26	1.18
14	31st Street @ Southwest Trafficway	1.20	1.21	1.19	1.21	1.16	1.14	1.18
17	M-350 @ I-435			1.39	1.21	1.23	1.19	1.18
1	I-70 @ 23rd Street	1.23	1.21	1.26	1.19	1.22	1.16	1.17
10	I-35 @ North Brighton			1.27	1.23	1.24	1.16	1.16
37	Oak Street @ Cleaver II Boulevard (47th St.)	1.24	1.30	1.26	CLOSED	CLOSED	1.17	1.16
22	US-169 (Metcalfe Avenue) @ College Blvd.				1.25	1.37	1.22	1.16
3	I-635 @ Metropolitan Avenue				1.43	1.24	1.19	1.15
32	College Boulevard @ US-69				1.12	1.22	1.21	1.14
6	I-435 @ State Line				1.19	1.24	1.13	1.13
4	I-29 @ I-35				1.22	1.28	1.37	1.12
31	College Boulevard @ Antioch Road	1.19	1.23	1.13	1.23	1.23	1.10	1.11

Table 8
Historical Average Vehicle Occupancy Rates (AM)

Site	Location	1993	1997	2001
43	Central Avenue @ 10th Street	1.33	1.29	1.46
30	Parallel Parkway @ 64th Terrace	1.31	1.27	1.46
34	St. John Avenue @ Van Brunt Boulevard	1.26	1.27	1.43
11	K-10 @ Ridgeview Road	1.12	1.13	1.33
39	87th Street @ Antioch Road	1.23	1.09	1.31
38	64th Street @ North Antioch Road	1.37	1.12	1.29
18	US-24 (State Avenue) @ I-635	1.31	1.22	1.29
41	Hillcrest Road @ Bannister Road	1.25	1.20	1.26
40	Somerset Drive @ Mission Road	1.16	1.10	1.26
3	I-635 @ Metropolitan Avenue	1.13	1.14	1.24
8	I-435 @ Shawnee Mission Parkway	1.55	1.14	1.24
25	Grand Avenue @ 14th Street	1.22	1.14	1.23
28	Sterling Avenue @ Blue Ridge Boulevard	1.19	1.15	1.22
37	Oak Street @ Cleaver II Boulevard (47th St.)	CLOSED	1.07	1.21
23	Waukomis Drive (Route AA) @ NW 56th St.	1.13	1.15	1.20
36	43rd Street @ Broadway / J.C. Nichols Pkwy	1.13	1.12	1.18
2	I-70 @ 18th Street Expressway	1.13	1.18	1.18
9	I-35 @ Antioch Road	1.10	1.16	1.18
29	N 72nd Street @ North Oak Trafficway	1.13	1.20	1.18
6	I-435 @ State Line	1.21	1.09	1.18
19	75th Street @ State Line	1.22	1.13	1.17
20	M-78 (23rd Street) @ I-435	1.17	1.20	1.17
7	I-435 @ 87th Street	1.25	1.19	1.16
26	Broadway / J.C. Nichols Pkwy @ 43rd Street	1.11	1.09	1.16
21	US-24 (Independence Ave.) @ I-435	1.14	1.18	1.16
4	I-29 @ I-35	1.23	1.15	1.15
15	US-69 (18th St. Expressway) @ I-35	1.17	1.11	1.14
12	North Oak Trafficway @ 32nd Street	1.19	1.13	1.14
5	I-29 @ Barry Road	1.19	1.14	1.13
44	NW 68th Street @ US-169	1.26	1.32	1.12
35	Lamar Avenue @ 51st Street	1.19	1.12	1.11
16	US-40 @ I-70 (East)	1.19	1.17	1.11
14	31st Street @ Southwest Trafficway	1.09	1.17	1.11
10	I-35 @ North Brighton	1.22	1.16	1.10
27	63rd Street @ Ward Parkway	1.12	1.05	1.09
13	Southwest Trafficway @ 31st Street	1.09	1.20	1.09
17	M-350 @ I-435	1.14	1.13	1.09
1	I-70 @ 23rd Street	1.20	1.13	1.09
24	Charlotte St (PM) / Holmes St (AM) @ 12th St.	1.23	1.16	1.07
32	College Boulevard @ US-69	1.29	1.12	1.07
22	US-169 (Metcalf Avenue) @ College Blvd.	1.13	1.14	1.06
33	College Boulevard @ Quivira Road	1.16	1.06	1.06
31	College Boulevard @ Antioch Road	1.15	1.06	1.04
42	College Boulevard @ Roe Avenue	1.31	1.16	1.04

Comparison with Previous MARC Studies

Figures 1 and 2 depict historical, peak period AVO rates for the Kansas City metropolitan region. Please note that there are gaps in the PM period data for more recent years.

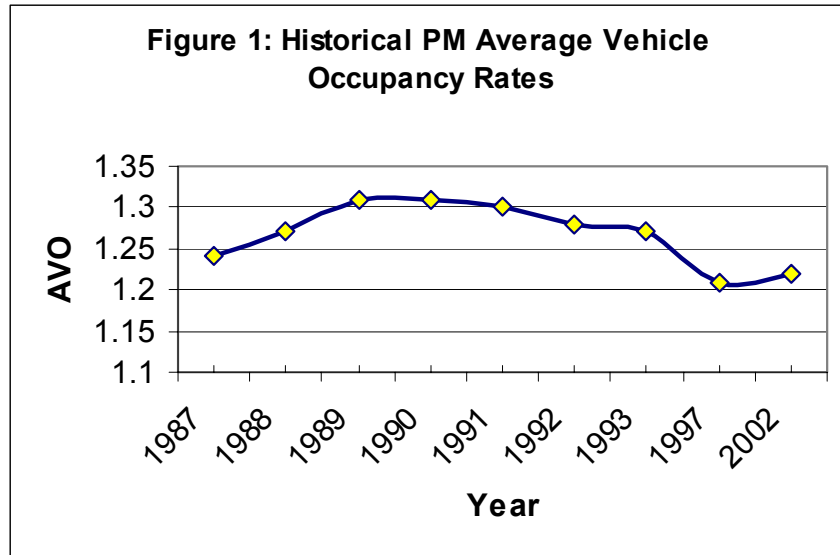


Figure 1 indicates that the AVO rate for the PM peak period rose throughout the late 1980s, declined during the 1990s, and currently appears to be leveling out.

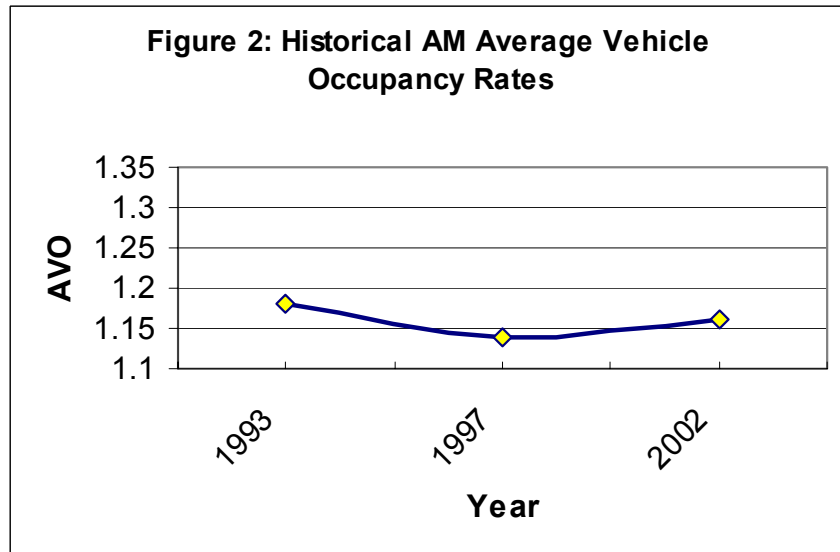


Figure 2 appears to indicate that, similar to the trend observed for the PM peak period, the regional AVO rate during the AM peak period decreased during the 1990s, but has actually increased slightly between 1997 and 2002.

Comparison with U.S. Census Data

The “Journey to Work” data collected as part of the decennial U.S. Census reports travel behavior and characteristics for work trips throughout the country. This data is compiled and reported for every Metropolitan Statistical Area (MSA) in the United States, including the Kansas City MSA. Figure 3 shows a historical comparison between MARC (PM) and U.S. Census average vehicle occupancy rates.

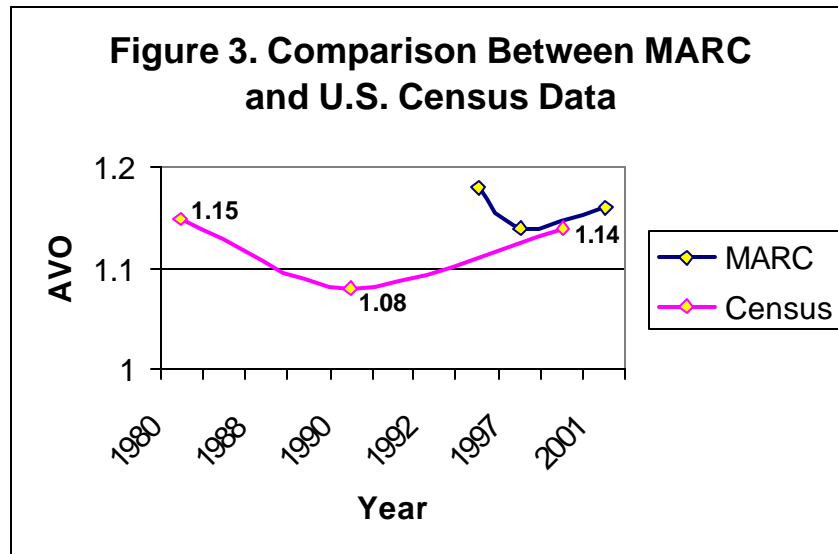


Figure 3 demonstrates that the historical Census AVO rates are significantly lower than those determined by MARC studies. This is likely due to the fact that, despite using data collection methods intended to minimize the number of non-work trips sampled, the MARC data unavoidably includes both work and non-work trips. In general, non-work trips are characterized as having higher vehicle occupancies. Another reason for the difference between the two rates may be the proximity of several MARC study sample sites to land uses such as schools, shopping centers, etc. Vehicles destined for these uses tend to have higher occupancies.

The Census AVO rate for the year 2000 was calculated using data that resulted from Census 2000 Supplementary Survey (C2SS). “The C2SS is designed to provide accurate estimates for the housing units and population for the 50 states and the District of Columbia,” (U.S. Census Bureau website). The values appearing in the C2SS Profiles and Summary Tables are estimates based on a sample survey of approximately 890,000 households throughout the United States, and are determined using a ratio estimation procedure.

Conclusion

The effectiveness of the regional RIDESHARE program, increasing traffic congestion and gasoline prices, and heightened environmental awareness and concern over air quality may begin to offer some explanation for increasing AVO rates during the 1980s in the Kansas City area. Conversely, extensive road and highway construction, widely dispersed development, increased vehicle miles traveled (VMT) and private automobile ownership rates, relatively low fuel costs and traffic congestion, abundant parking at little or no cost, and a booming economy in the 1990s are all likely reasons for the decrease in AVO for Kansas City. The results of an analysis performed by Charles River Associates Inc. for the Transit Cooperative Research Program (TCRP), which found that “development patterns, vehicle availability, and price and service levels are all important determinants of mode shares and occupancies,” (1998, 52), certainly support this notion.

The data collected for the **2002 Vehicle Occupancy Study** suggest that the average vehicle occupancy (AVO) for the Kansas City metropolitan region is no longer decreasing, but rather leveling out around 1.22 during the PM peak period, and slightly increasing to 1.15 during the AM peak period. The results of future studies will determine whether this is a long- or short-term trend. Some possible explanations for the observed changes may be increased participation in the RIDESHARE program—9707 successful matches were made among participants from 1997 to present—and significant increases in gasoline prices in recent years (See Appendix).

Higher automobile occupancy during peak periods can result in system wide benefits such as reduced traffic congestion, air pollution, fuel consumption, road maintenance costs, and capital investments for new roadway capacity. The individual benefits of carpooling include lower commuting costs and less automobile depreciation. Corporate benefits include reduced subsidies for employee parking, a potentially expanded labor market, and an improved public image. Although it is difficult to directly measure the success of the RIDESHARE program, it will continue to develop and implement strategies such as the Guaranteed Ride Home Program—working towards the goal of reducing the number of single-occupant vehicles in the Kansas City Region.

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Sources Cited

Charles River Associates Incorporated, "Trends in Single Occupant Vehicle and Vehicle Miles of Travel Growth in the United States," *TCRP Web Document 5 (Project H13-B)*, April 1998: 52.

Heidtman, K., B. Skarpness, & C. Tornow, "Improved Vehicle Occupancy Data Collection Methods," Federal Highway Administration: Office of Highway Information Management, 1997: *vi*.

U.S. Census Bureau website:

<http://www.census.gov/c2ss/www/Methodology/Accuracy.htm>

APPENDIX

List of 2002 Vehicle Occupancy Study Count Locations

I. Freeway and Expressway (F/E)

1	I-70	@	23rd Street
2	I-70	@	18th Street Expressway
3	I-635	@	Metropolitan Avenue
4	I-29	@	I-35
5	I-29	@	Barry Road
6	I-435	@	State Line
7	I-435	@	87th Street
8	I-435	@	Shawnee Mission Parkway
9	I-35	@	Antioch Road
10	I-35	@	North Brighton
11	K-10	@	Ridgeview Road

II. Principal Arterial (PA)

12	North Oak Trafficway	@	32nd Street
13	Southwest Trafficway	@	31st Street
14	31st Street	@	Southwest Trafficway
15	US-69 (18th St. Expressway)	@	I-35
16	US-40	@	I-70 (East)
17	M-350	@	I-435
18	US-24 (State Avenue)	@	I-635
19	75th Street	@	State Line
20	M-78 (23rd Street)	@	I-435
21	US-24 (Independence Ave.)	@	I-435
22	US-169 (Metcalf Avenue)	@	College Boulevard

III. Minor Arterial (MA)

23	Waukomis Drive (Route AA)	@	NW 56th Street
24	Charlotte Street	@	12th Street
25	Grand Avenue	@	14th Street
26	Broadway / J.C. Nichols Parkway	@	43rd Street
27	63rd Street	@	Ward Parkway
28	Sterling Avenue	@	Blue Ridge Boulevard
29	N Oak Trafficway	@	N 72nd Street
30	Parallel Parkway	@	64th Terrace
31	College Boulevard	@	Antioch Road
32	College Boulevard	@	US-69
33	College Boulevard	@	Quivira Road

IV. Collector

34	St. John Avenue	@	Van Brunt Boulevard
35	Lamar Avenue	@	51st Street
36	43rd Street	@	Broadway / J.C. Nichols Parkway
37	Oak Street	@	Cleaver II Boulevard (47th Street)
38	64th Street	@	North Antioch Road
39	87th Street	@	Antioch Road
40	Somerset Drive	@	Mission Road
41	Hillcrest Road	@	Bannister Road
42	College Boulevard	@	Roe Avenue
43	Central Avenue	@	10th Street
44	NW 68th Street	@	US-169

Figure 4. Count Locations for 2001 Vehicle Occupancy Study

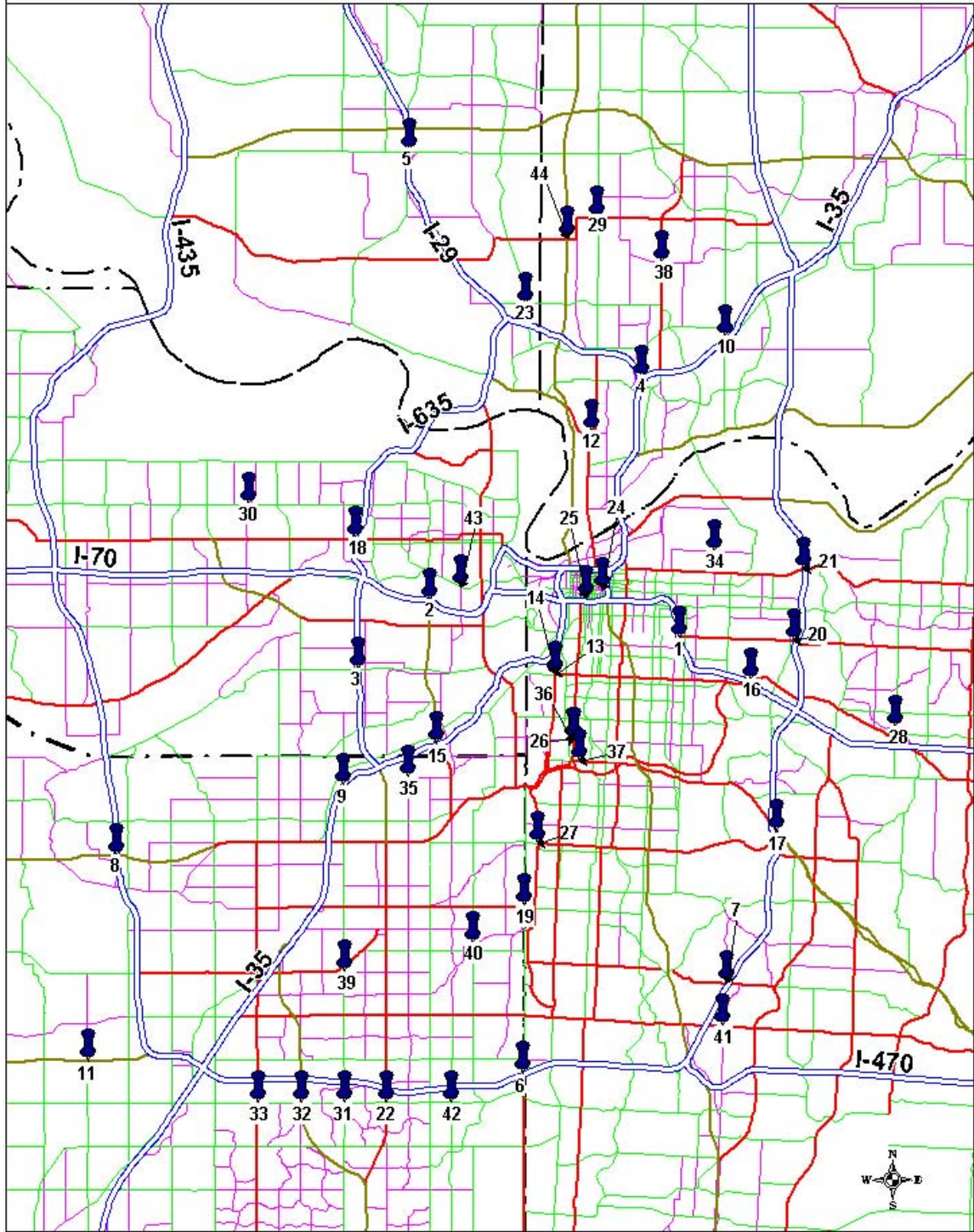
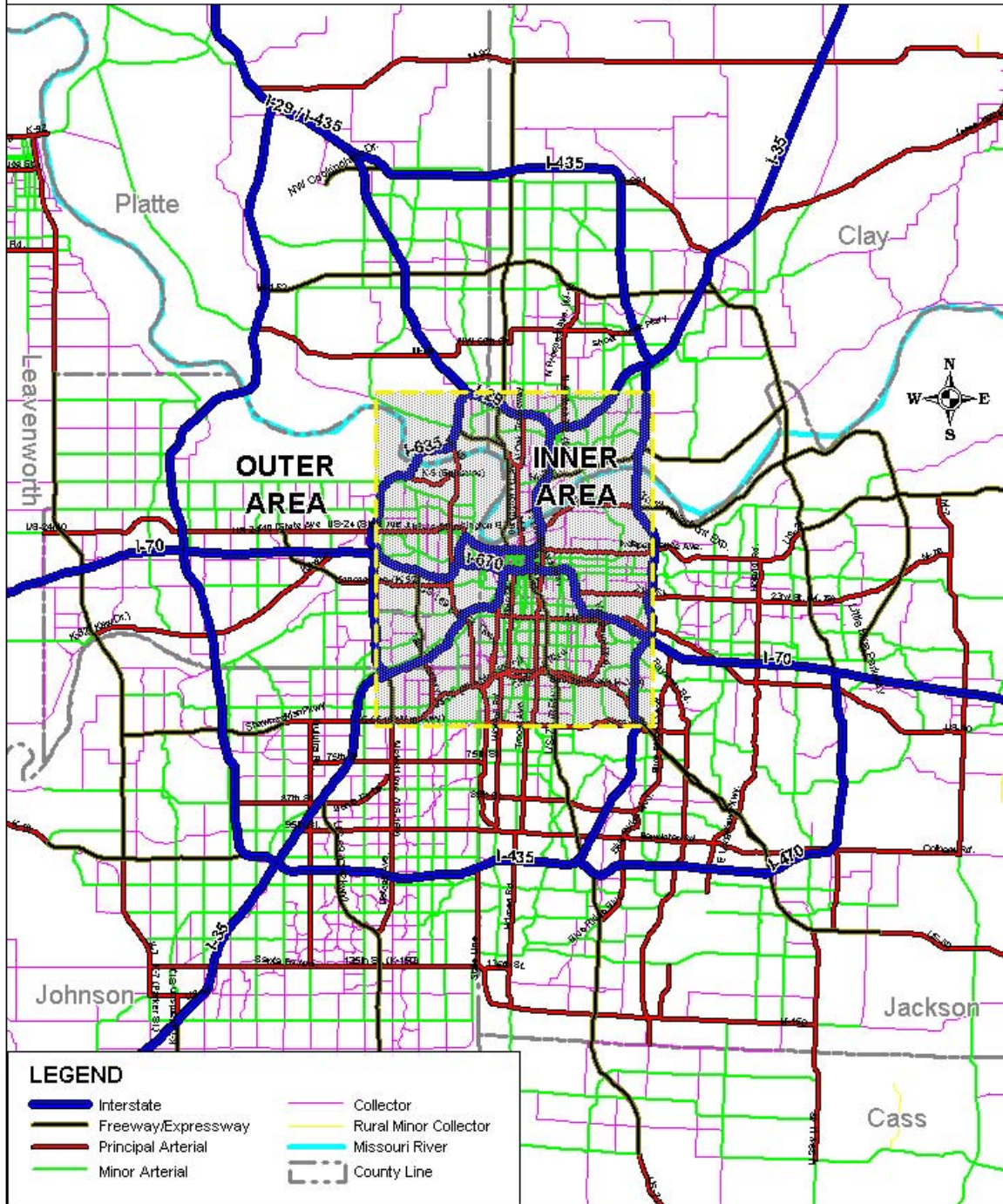


Figure 5
Inner and Outer Urbanized Areas
for the Metropolitan Region



Sample Data Collection Sheet

ROUTE _____ AT _____ DIRECTION _____ DATE _____

FUNCTIONAL CLASS _____ RECORDED BY _____ TIME _____

NUMBER OF OCCURRENCES

1	2	3	4	5	6+	Buses	Trucks	Other

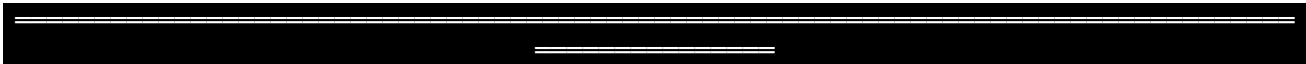


ROUTE _____ AT _____ DIRECTION _____ DATE _____

FUNCTIONAL CLASS _____ RECORDED BY _____ TIME _____

NUMBER OF OCCURRENCES

1	2	3	4	5	6+	Buses	Trucks	Other



ROUTE _____ AT _____ DIRECTION _____ DATE _____

FUNCTIONAL CLASS _____ RECORDED BY _____ TIME _____

NUMBER OF OCCURRENCES

1	2	3	4	5	6+	Buses	Trucks	Other

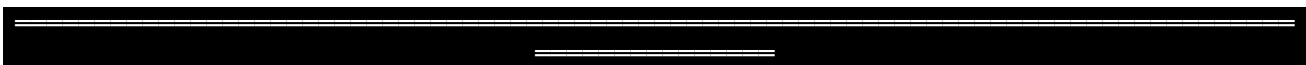


ROUTE _____ AT _____ DIRECTION _____ DATE _____

FUNCTIONAL CLASS _____ RECORDED BY _____ TIME _____

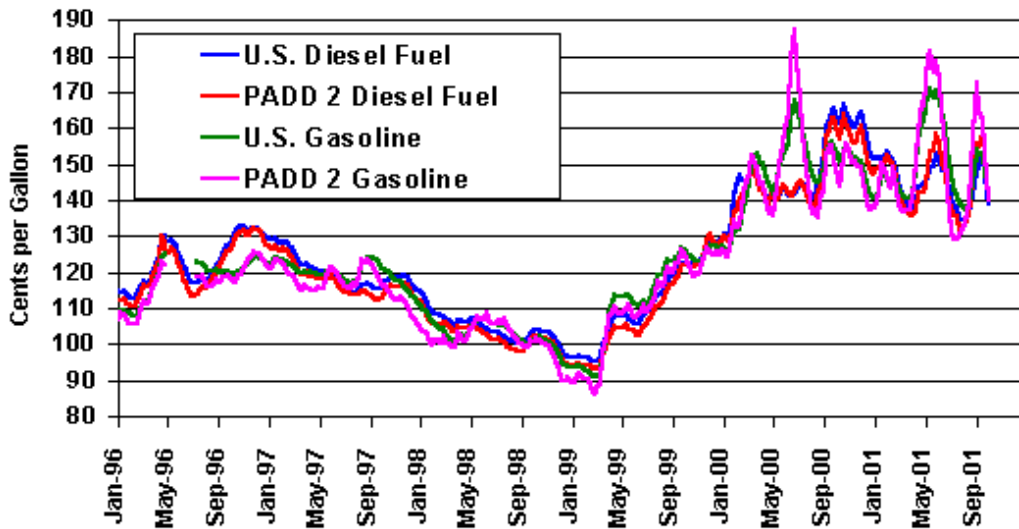
NUMBER OF OCCURRENCES

1	2	3	4	5	6+	Buses	Trucks	Other



Recent Trends in Auto Fuel Prices

Figure 6. Midwest vs U.S. Gasoline and Diesel Fuel Prices



Source: *Weekly Petroleum Status Report*
http://www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/2001/midwest_outlook/midwest.html#N_1_

*PADD = Petroleum Administration Defense District (designated by the Energy Information Administration of the U.S. Department of Energy); PADD 2 is the Midwest district comprising Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, Wisconsin.