2000 Travel Behavior Inventory

Home Interview Survey: Data and Methodology

Metropolitan Council

August 2003

Metropolitan Council
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Publication no. 35-03-032

Printed on recycled paper with at least 20% post-consumer waste.

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Introduction

The 2000 Twin Cities Metropolitan Area Travel Behavior Inventory (TBI) is the first major travel survey in the region since 1990. As in 1990, the 2000 TBI includes a *Home Interview Survey*, *External Station Traffic Counts*, an *External Station Origin/Destination Survey, and a Highway Speed Survey*. This technical report presents an overview of the Home Interview Survey (HIS), including survey design and the procedures used in conducting the survey. As the cornerstone of the 2000 TBI, the results of the HIS will be used to achieve five main goals:

1. Update the regional travel models;
2. Discover the travel needs of citizens and businesses;
3. Enhance the credibility of regional transportation plans;
4. Evaluate the effects of transportation policy; and
5. Plan and design needed transportation improvements.

The HIS measured person trips by motorized and nonmotorized means within the seven-county metropolitan area and within the 13 counties in Minnesota and Wisconsin that surround the seven-county area. A person trip is a one-way journey between two addresses by one person. In addition to data on trips in motor vehicles, the HIS collected data on such nonmotorized modes as walking and bicycling.

The scope of the HIS involved the collection of 24-hour weekday travel characteristics and socioeconomic data from a sample of households in the study area. The data will be primarily used for validation and/or recalibration of regional trip-generation, trip-distribution, and mode-choice models and the trip-assignment process. Data from the HIS are specifically used to describe the relationships between demographics and travel behavior. The primary users of the data are the Metropolitan Council and the Minnesota Department of Transportation. However, other local agencies, consultants and the public will have access to the data through the Metropolitan Council.

Methodology

Study Sample

The Household Inventory Survey was conducted with randomly selected households between April 2001 and September 2001. The study area included the seven counties of the regional Metropolitan Planning Organization (MPO) and 13 adjacent counties. The 20 counties within the study area are listed in Table 1.

Table 1
Study Area Counties

MPO Core	Minnesota	Wisconsin
Anoka	Chisago	Pierce
Carver	Goodhue	Polk
Dakota	Isanti	St. Croix
Hennepin	Le Sueur	
Ramsey	McLeod	
Scott	Mille Lacs	
Washington	Rice	
	Sherburne	
	Sibley	
	Wright	

A total of 8,961 households were successfully recruited to participate in the survey. Those households provided both household- and person-level socioeconomic data, including among other items, household size, number of vehicles, household income, dwelling type, age, gender, and employment/school status and address.

Following the demographic interviews, 6,386 households (71%) completed 24-hour travel logs. Household members (5+ years of age) recorded trip origin and destination locations, travel mode, trip start/end times, and activities at trip destinations. After data were processed, it was determined that 6,219 households (69%) provided complete data. The data reported in this report are based upon those households. Figure 1 presents the locations of the households providing complete data.

The 2000 HIS employed a probability sample to survey households within the universe of 1,226,229[1] households in the 20-county study area. Before surveying, the study area was stratified by geography to ensure a proper distribution of samples. The seven counties within the core study area were sampled independently and proportionally to 1990 Census household population counts. The 13 adjacent counties were clustered and sampled together with no county distribution requirements. Table 2 presents a comparison of sample households and population households by county. The survey resulted in a 0.5% sample of all households within the universe.

[1] 2000 Census

Figure 1
Locations of Survey Households

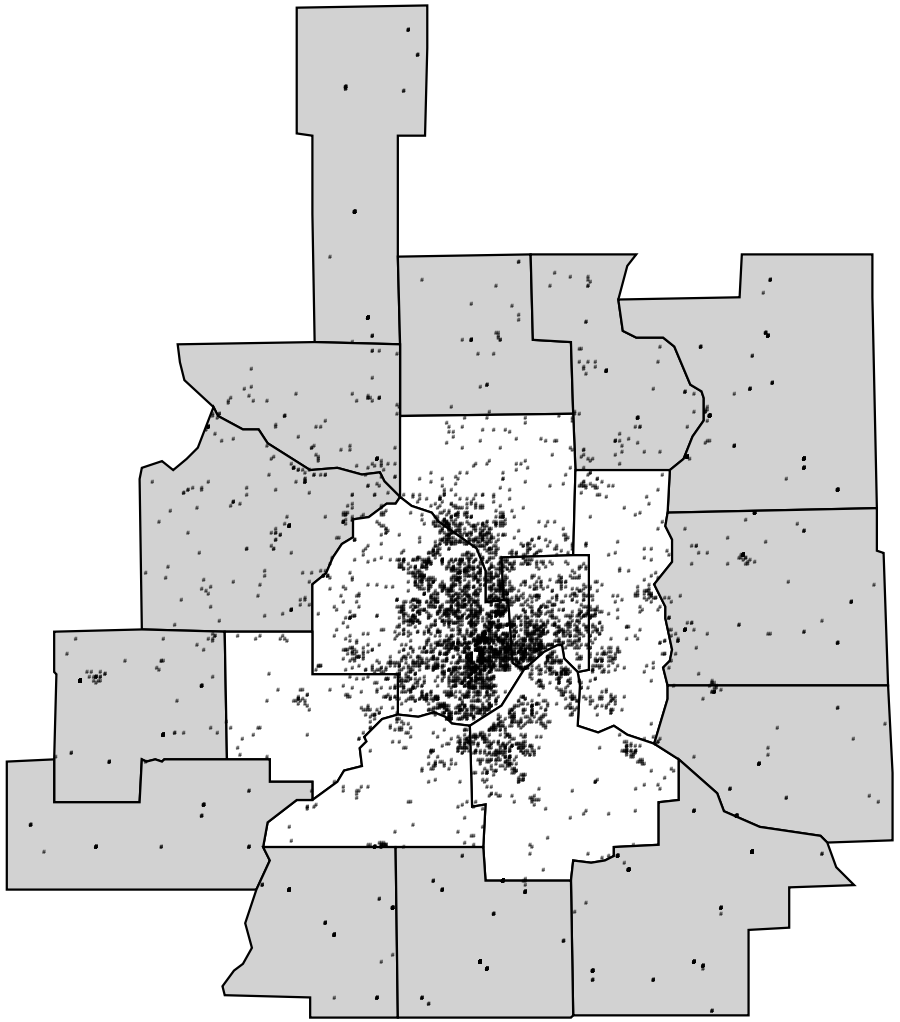

Table 2
Sample Households and Population Households by County

County	2001 HIS	Sample Percent	2000 Census	Census Percent	Percent Sample
Anoka	520	8.4%	106,428	8.7%	0.5%
Carver	103	1.7%	24,256	2.0%	0.4%
Dakota	655	10.5%	131,151	10.7%	0.5%
Hennepin (excl. Mpls.)	1,709	27.5%	293,777	24.0%	0.6%
Minneapolis	885	14.2%	162,352	13.2%	0.5%
Ramsey (excl. St. Paul)	332	5.3%	89,127	7.3%	0.4%
St. Paul	414	6.7%	112,109	9.1%	0.4%
Scott	140	2.3%	30,692	2.5%	0.5%
Washington	274	4.4%	71,462	5.8%	0.4%
Seven-County Region Total	5,032	80.9%	1,021,454	83.3%	0.5%
Ring Counties	1,187	19.1%	204,766	16.7%	0.6%
Total	6,219	100.0%	1,226,220	100.0%	0.5%

During the survey, the collection of households was controlled through sample management to ensure an adequate representation of all households with respect to household size and vehicle ownership. The following strata were monitored throughout the survey:

- Household Size – Total number of persons in the household (1, 2, 3, 4+ persons), and
- Vehicle Ownership – Total number of motorized vehicles owned (0, 1, 2, 3+ vehicles).

Sampling Frame

A sampling frame is the list of elements from which a sample is selected. Properly drawn samples provide information appropriate for describing the population of elements that comprise the sampling frame. The HIS sampling frame was listed and unlisted residential telephone numbers of households within the study area. Telephone numbers were considered listed if they were included in a public database and unlisted if they were not.

Sample Generation

Both listed and unlisted telephone numbers were generated using slightly modified random digit dial (RDD) procedures. Using the working telephone exchanges and blocks in the study area, every possible telephone number was generated into a list. The list was stratified by county and 100,000 numbers randomly drawn. Following the selection of numbers, an automated dialer was used to screen for non-working numbers. A database of listed numbers was then used to screen for nonresidential numbers. The remaining numbers were then placed into replicates for dialing. A replicate is a systematically selected subset of the entire set of selected numbers. In other words, if 25% of all selected numbers are located within the 651 area code, one out of every four numbers in each replicate is also located within the 651 area code. Replicates are used to help manage sample during the survey.

Materials

Because of the complexity of the HIS and the known burden placed on respondents by similar surveys, materials were designed to not only collect data elements needed for modeling, but to provide ample information to participants so that fear and perceptions of burden could be minimized. The following sections describe the materials used during the survey.

Advance Letter/Brochure

The combination of an advance letter and brochure was used to inform prospective respondents that they had been selected to participate in the survey. The advance letter was written on the Metropolitan Council's letterhead to reinforce the survey's legitimacy. The brochure provided more detail on what was being asked of the household. Both provided contact information for NuStats and the Metropolitan Council. A copy of these materials can be found in Appendix A.

Questionnaire

The survey questionnaire was a combination of two telephone interview scripts and a travel diary. The first telephone interview, Recruitment Questionnaire, was used to collect household and person-level socioeconomic data. Data items included:

- Household size, income, residence type, owner/renter status
- Number of vehicles, vehicle year, make, model, and number of cylinders
- Person age, gender, employment/student status, driver's license status

The complete Recruitment Questionnaire is available on request.

The second telephone interview, Retrieval Questionnaire, was used to collect the trip information of household members age 5 years and older. The questionnaire collected the following information:

- Origin and destination addresses
- Travel mode
- Departure/arrival times
- Destination activity
- Vehicle used
- Size of travel party

The complete Retrieval Questionnaire is available on request. A list of all data items can be found in Appendix B.

Travel Diary

The HIS used a modified version of the travel diary used during the 1990 survey. The consultant conducting the HIS, NuStats, incorporated the results of research focused on materials design from similar travel surveys in preparing the Twin Cities travel diary. The travel diary was designed to be more user-friendly in order to improve record-keeping. The diary, a four-page booklet with a foldout flap, provided respondents with easier to understand directions and contact information in case they needed help. An example page corresponding to a graphically illustrated sample travel day was included to minimize underreporting of non-motorized trips and quick vehicle stops (ATM, gas station, etc.). A copy of the travel diary can be found in Appendix C.

Pre-Test

During September of 2000, NuStats conducted a small pre-test with 86 households within the core counties of the study area. The main objective of the pre-test was to test all aspects of survey design, including sampling methodology, survey instruments, and the data collection procedures. In addition, the pilot gave NuStats the opportunity to estimate and assess non-response, non-contact, and completion rates. Through this testing, NuStats gained the required information to adjust its methodology and procedures to ensure a successful full-study of household travel behavior in the Minneapolis-St. Paul metropolitan region.

The following changes were recommended after an evaluation of the pre-test:

- Diaries are to be mailed earlier, giving ample time for each respondent household to receive them.
- Introduction script for retrieval interview should identify both the Metropolitan Council and the Minnesota Department of Transportation.
- The follow-up question to the walk/bike loop trips item was ambiguously worded: “how many?”
- The CATI script needs to have new probes to ensure that we capture incidental trips for lunch and stops to and from home.
- Drop Internet Use questions from the Recruitment Questionnaire in order to decrease the length of the interview.

In addition to these changes, an expert panel consisting of members from NuStats, Parsons-Brinkerhoff, the Metropolitan Council, and Mn/DOT recommended changing the pre-test Destination Activity list in order to provide an improved description of Trip Purpose. The revised list included new activities such as "Change mode of transportation," "With another person at their activity," and "Quick Stop," while combing "Civic" and "Church" into one activity as well as combining "Shopping Incidental" and "Shopping Major" into one activity. Table 3 on the following page compares the activity lists used in the pre-test and full-study.

Table 3
Destination Activity List

Pre-Test	Full-Study
Personal Activities at Home	At-Home Activities
Internet Use at Home	Working at Home
Work at Home	Work
Work (other than at home)	Work-Related
Internet Use at Work	Attending School
Telecommunications at Work instead of Travel	Other School Activities
School (through HS)	Child Care, Day Care, After School Care
School (post HS)	Quick Stop (gas, ATM, coffee)
Shopping Incidental	Shopping
Shopping Major	Visit Friends/Relatives
Personal Business	Personal Business
Medical	Eat Meal outside of Home
Eat Meal outside of Home	Entertainment/Recreational/Fitness
Social/Recreational	Civic/Religious
Civic	Pick up/Drop off Passenger
Church	With Another Person at their Activity
Pick up/Drop off Passenger	Change Mode of Transportation

Data Collection

The survey conformed to standard procedures for conducting a household travel behavior survey and included the following nine stages:

1. Geocode Home Addresses,
2. Advance Mailing,
3. Recruitment Telephone Interview,
4. Geocode Habitual Addresses,
5. Respondent Packet Mailing,
6. Reminder Call,
7. Travel Day,
8. Data Retrieval Telephone Interview, and
9. Geocode Trip-ends.

Geocode Home Addresses

Prior to dialing, a first attempt was made to geocode households with a known home address. Geocoding of households with an unknown or ungeocodable address was attempted following the recruitment telephone interview. This initial step provided the best opportunity to geocode all households.

Advance Mailing

Households with a known address were mailed a packet containing an advance letter and brochure prior to first telephone contact. All households with an unknown address were given the option of receiving this packet during the recruitment interview.

The advance letter and brochure provided a brief introduction to the study and the sponsor, written in simple language, and focused on explaining the relevance of the survey to individuals' daily lives. As such, they identified the benefits at the local level and provided a toll-free number to obtain additional information.

Recruitment Telephone Interview

The recruitment interview, the first telephone contact, was comprised of two components, the screening interview and the scheduling interview. Because of the recent trend of decreased contact rates, these two interviews were combined into one telephone call. However, there was an option for a respondent to request a callback once the screening interview portion of the call was completed. Most households preferred to continue with the interview following the screening component.

The *screening interview* was an expansion of the traditional advance call concept. Whereas the advance call served to elicit a home address from unlisted telephone numbers and verify the address for listed numbers, the screening interview also collected vehicle information as well as household and respondent (person) demographics.

The purpose of the *scheduling interview* was to secure the household's participation by assigning a travel day. The interview was also used to obtain demographic information from the remaining household members. This allowed the respondent to focus on completing the travel log from this point on in the survey process, thereby reducing the perception of "burden" of the survey.

During the scheduling interview, work and school addresses were collected. This permitted an attempt to geocode these addresses prior to the retrieval interview. If the address was insufficient for geocoding, it was corrected at the time of travel-data retrieval. Since these addresses typically form the substance of the respondent's travel, it also helped to reduce the retrieval interview length.

All interviews were conducted using Council of American Survey Research Organizations (CASRO) standards, of which NuStats is a member. They were administered using computer-assisted telephone interviewing (CATI) technology. NuStats used *Info Zero Un*, a software application that has proven to be excellent for efficient recruitment, with built in "wild" code checking, consistency checks, and reporting systems. The latter was valuable for the continuous assessment of sample productivity.

The response rate for the recruitment interview stage was 38%. This was calculated using the following formula as prescribed by the American Association for Public Opinion Research (AAPOR) for RDD telephone surveys.

$$RR = \frac{C}{[((E \div (E + IE)) \times UE) + E]}$$

Where:
RR = Response Rate
C = Completes
E = Eligible Units
IE = Ineligible Units
UE = Eligibility Unknown Units

An "Eligible" unit was a telephone attempt made to a household identified as qualifying for inclusion in the survey. An "Ineligible" unit was a telephone attempt made to a nonqualifying household (over quota) or to businesses, bad numbers (disconnects), and computer and fax lines. Telephone attempts resulting in no answer, busy signal, etc., were considered "Eligibility Unknown" units because no definitive determination could be made as to the qualifying status of the telephone number. When calculating the response rate, the assumption was made that, had "Eligibility

Unknown" units been contacted, the proportion of those units that would have qualified for the study would have been consistent with the occurring ratio of "Eligible" to "Ineligible" units. Table 4 presents final call outcomes for the recruitment interview.

Table 4
Recruitment Call Outcomes

Call Outcome	Frequency
Eligible Units	
Recruited	8,961
Refused to participate	9,453
Subtotal Eligible	**18,414**
Ineligible Units	
Disconnected number	6,522
Business /Government	3,116
Computer /Fax line	4,041
Language Barrier	1,031
Out of area/Over Quota	256
Subtotal Ineligible	**14,966**
Eligibility Unknown Units	
No answer/Blocked Call	5,882
Call Back	150
Answering machine	2,617
Busy	576
Subtotal Eligibility Unknown	**9,225**
TOTAL	**42,605**

Geocode Habitual Addresses

Following the recruitment interview, NuStats attempted to geocode all home addresses as well as other habitual addresses (work, school, volunteer). Every effort was made to collect additional information during subsequent interviews for addresses not matching to an X/Y coordinate.

Respondent Mailing Packet

Shortly after recruitment, each household was mailed a packet containing a cover letter, personalized travel diaries, and instructions. The materials referenced a toll-free number for additional help in completing the travel diary.

Reminder Call

NuStats conducted a reminder call to each household the day before the assigned travel day. This call served four purposes. First, it raised the likelihood that respondents would follow all the instructions and complete the travel log in a timely manner. Second, it provided an opportunity to reinforce legitimacy and to answer any questions participants may have had. Third, the reminder call served as a data-item completion or correction process (for example, to clarify work or school addresses). Fourth, the respondent was given the opportunity to schedule a retrieval call at a time that was convenient for the household.

Travel Day

Travel days—3 a.m. to 3 a.m.—were held on weekdays (Monday through Friday) starting Tuesday, April 10 and ending Friday, August 24. Holidays, including July 3 through 5, were excluded as valid travel days. An average of 65 households traveled per day over 95 valid travel days. Table 5 shows how households were distributed among travel days by day of week and by month.

Table 5
Distribution Households Travel Days

Day of Week	Frequency	Percent
Monday	1,562	25%
Tuesday	1,396	22%
Wednesday	1,170	19%
Thursday	1,149	19%
Friday	942	15%
TOTAL	6,219	100%
Month	**Frequency**	**Percent**
April	396	6%
May	1,107	18%
June	2,350	38%
July	1,249	20%
August	1,117	18%
TOTAL	6,219	100%

Data Retrieval Telephone Interview

On the day following the travel day (or at the appointed time), a NuStats interviewer contacted the household to collect the travel data. The average retrieval interview took approximately 35 minutes to complete. Table 6 presents call outcomes for all retrieval interviews. The response rate for the retrieval interview stage was 71%. This was calculated by dividing the number of completes (6,386) by the number of recruited households (8,961).

Table 6
Retrieval Call Outcomes

Call Outcome	Frequency
Eligible Units	
Completed	6,386
Pending (no answer, call backs, etc.)	1,587
Refused to participate	942
TOTAL	**8,915**

The overall response rate for the 2001 Home Inventory Survey is 27%. This was calculated by multiplying the response rates from the two stages together (38% * 71% = 27%). Although response rates are declining throughout the survey research industry, the HIS response rate is within the industry's acceptable range for household travel surveys (22% to 27%).

Geocode Trip-ends

Trip-ends were geocoded promptly following the retrieval interview. The quick turn-around allowed for clarification interviews with respondents providing unmatchable addresses. All addresses were geocoded using ESRI's ArcView software with coverage files provided by the Metropolitan Council. Table 7 presents the final geocoding match rates for each location type.

Table 7
Geocode Match Rates (Addresses Traveled To)

Location Type	X/Y Coordinate	Zip Code	City/County	Out of Area	Unmatched
Home	85%	12%	3%	0%	0%
Work	73%	4%	8%	1%	15%
School	62%	6%	12%	3%	18%
Trip-ends	83%	1%	15%	<1%	<1%

As Table 7 shows, all home addresses were matched to some level of geography. Work and school addresses were the most difficult to geocode due to the high refusal rate of these addresses. Less than 1% of all trip-end addresses were not geocoded.

Data Processing and Quality Control

Data were evaluated between each of the survey stages for accuracy and completeness. Research for households not meeting delivery standards was conducted during subsequent telephone contacts as well as with research callbacks after the conclusion of the survey. Routine and customized edit-checks were performed on master data files. Routine checks included such items as:

- Checks for out-of-range data.
- Checks for missing data. This was performed through a combination of queries and viewing of internal delivery files.
- Checks for proper data skips.
- Checks to ensure the deliverable files include all data items specified by the Data Items Matrix.
- Checks for high-frequency of item non-responses (checked throughout various stages).

Development of Expansion Factors

Expansion factors were developed based on the ratio of TBI-surveyed households versus Census-surveyed households. The purpose of the expansion was to provide a data picture of travel region-wide based on the TBI sample.

Households were aggregated by geographic location, household size, and vehicle availability. The geographic level used consisted of the two central cities (Minneapolis and St. Paul), the remainder of Hennepin County, the remainder of Ramsey County, Anoka County, Carver County, Dakota County, Scott County, Washington County, and the region's Minnesota/Wisconsin ring counties.

The data for the counties were acquired from the American Association of State Highway and Transportation Officials' initial release of the data from the Census for Transportation Planning Package (CTPP). Data for the two central cities were acquired directly from the U.S. Census Bureau. It was found that when these data were aggregated to household size and vehicle availability, households were lost due to insufficient data. Therefore, an adjustment was made to inflate the CTPP distribution to match the basic Census household count for each county and the two central cities. See the appendix for the weighting factors developed. Due to the limited sample size, data in some table cells were combined to develop credible values. Final household expansion factors are shown in Table 8.

A second adjustment was made to account for the discrepancy between all trip records collected by the HIS and those that had sufficient location information to be able to be geocoded to Transportation Analysis Zones (TAZs). The HIS collected 58,345 trip records, of which 44,397 could be coded to TAZs. The ratio of these two numbers provided an expansion factor of 1.31417, which was applied to the trip records for households in the seven-county metropolitan area. Geocoding trip-ends was found to be more difficult in the ring counties and the resulting discrepancy between total trips and geocodable trips was greater in that area. Therefore, the expansion factors for trips by households in the ring counties were adjusted by 2.83664. As a result of these adjustments, the 2000 TBI HIS has different expansion factors for household and person data and for trip data.

Auto Trips

The expanded trip records were converted to a daily vehicle-trip table and broken down to the six time periods for which the travel demand model makes highways assignments. These trip tables were built to include only trips that began and ended inside the seven-county region, including those trips that were made by residents by households from the 13 "ring" counties outside the region. Trips starting or ending outside the region were built from data from the External Station Survey. These trips were also broken down to the six time periods and then combined with the trip tables developed from the HIS data. The resulting trip tables were assigned to the highway network.

The resulting loaded networks were recombined to create a daily loading and compared to Mn/DOT AADT flow maps. Over 460 highway links were compared, primarily on the principal arterial system and the "A" Minor Arterial system inside the I-494/I-694 ring. The average difference between the HIS assigned load and the Mn/DOT flow maps was 2.8% with a Pearson R value of 0.95. The percentage difference improved to 0.5% when the heavy commercial trucks counts were deducted from the Mn/DOT AADT. This was a reasonable reduction to make, as the Home Interview Survey was not designed to capture trips by heavy commercial vehicles. Given these results, the expansion factors developed are valid. Figure 2 illustrates the relationship between the HIS assignments and the Mn/DOT AADT for each link.

Transit Trips

The recorded transit ridership reported by the TBI after initial household expansion and adjustment for non-geocodable trips was 181,346. In 2001, Metro Transit reported an average daily ridership of 243,392. An adjustment procedure was developed to make the TBI-reported transit ridership consistent with observed transit ridership. Because the TBI HIS was conducted over several months, during which a fare change occurred, the monthly average ridership figures reported by Metro Transit were weighted by the percentage of HIS transit rides recorded in that month. The five months were then summed to reach an average daily ridership.

This figure was then further adjusted to more closely match the annual average daily ridership reported by Metro Transit. Because there are more transit riders than are carried by Metro Transit alone (that is, by opt-outs, contracted service, community-based providers and Metro Mobility/ADA), the ratio of total 2001 transit riders to Metro Transit riders was used to further adjust the expansion factors for transit riders.

Table 8
Final Household Expansion Factors

	Household Size	Vehicles Available			
		0	1	2	3+
Anoka	1	161.8208	161.8208	159.2375	56.3015
	2	262.7241	262.7241	225.6866	152.5810
	3	288.9167	288.9167	210.0198	178.4537
	4+	291.8750	291.8750	291.8750	210.2315
Carver	1	343.0087	343.0087	90.5660	40.9008
	2	320.0485	320.0485	171.3601	230.0668
	3	352.7691	352.7691	352.7691	301.6431
	4+	273.1587	273.1587	273.1587	285.1692
Dakota	1	388.0747	184.6696	141.8307	71.8447
	2	283.5160	283.5160	185.7833	100.9107
	3	401.1991	401.1991	229.1112	181.6746
	4+	368.6144	368.6144	229.4136	238.6214
Hennepin (excl. Mpls.)	1	173.4973	173.4973	131.9141	122.7122
	2	481.3578	218.4657	206.6867	119.3444
	3	394.4701	267.3658	157.1219	202.6221
	4+	175.2614	175.2614	175.2614	150.9346
Minneapolis	1	281.1110	136.3500	150.6522	330.0000
	2	352.6667	145.7759	188.2937	109.4828
	3	415.8333	204.8148	144.1818	322.3077
	4+	309.6479	309.6479	309.6479	190.3448

Table 8
Final Household Expansion Factors

	Household Size	Vehicles Available			
		0	1	2	3+
Ramsey (excl. St. Paul)	1	302.8629	302.8629	259.9394	153.2163
	2	295.8127	295.8127	295.8127	200.7662
	3	314.1280	314.1280	314.1280	314.1280
	4+	262.4265	262.4265	262.4265	262.4265
St. Paul	1	239.8701	239.8701	171.2500	92.5000
	2	273.0357	273.0357	273.0357	127.5000
	3	300.6098	300.6098	300.6098	155.7895
	4+	458.3750	458.3750	458.3750	625.000
Scott	1	214.3971	210.6452	160.5406	41.1643
	2	223.6220	223.6220	223.6220	155.2235
	3	330.6004	330.6004	330.6004	205.2495
	4+	281.2891	281.2891	281.2891	240.2320
Washington	1	252.7120	252.7120	78.8232	85.8397
	2	365.6771	347.0565	220.2156	201.9492
	3	406.8801	406.8801	406.8801	228.9344
	4+	383.8322	383.8322	383.8322	455.0513
Ring Counties	1	211.0912	211.0912	194.2222	187.3176
	2	214.6689	214.6689	117.1680	150.2676
	3	273.8819	273.8819	199.2461	230.8788
	4+	333.4617	333.4617	195.8066	417.3433

Figure 2
HIS Assignment vs. Mn/DOT AADT