2004-2005
Comprehensive Household Travel Data Collection Program

MI Travel Counts

Final Report

August 31, 2005

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Section 1: Program Summary

Background

The MI Travel Counts program was undertaken by the Michigan Department of Transportation (MDOT) and its partners to obtain information on statewide household travel characteristics. MDOT will use the data to update, develop, and calibrate statewide and urban travel demand models. The primary use of the models is to estimate future travel demand and travel patterns in determining project requirements and investment priorities for the State Long Range Plan, the shorter term Statewide Transportation Improvement Program (STIP), local Metropolitan Planning Organization (MPO) Long Range Plans (LRP), and the MPO Transportation Improvement Plans (TIP). Other uses include air quality conformity, alternatives analysis, and detour analysis.

MI Travel Counts is significant in its endeavor. There has never been a household travel data collection effort for the entire state. MDOT has not collected travel characteristics in urban areas since the 1970s. The only recent data collection effort in Michigan was conducted by Southeast Michigan Council of Governments (SEMCOG) in 1994.

In the design of MI Travel Counts, basic demographics and tour and travel characteristics were collected for every member (including children) of 14,315 households during a consecutive 48-hour travel period. MDOT and the MI Travel Counts consulting team developed and implemented eight key program and quality control components:

- Sample Design (Appendix 1)
- Work Plan and Data Collection Methodology (Appendices 2 and 3)
- Design of Materials and Instruments (Appendices 4-17)
- Public Awareness Plan (Appendices 18-21)
- Geocoding Procedures Manual (Appendix 22)
- Data Coding and Quality Control Manual and Codebook (Appendices 23 and 24)
- Pilot Study Report (Appendix 25)
- Interim Report and Data Delivery Schedule and Report Format (Appendices 26 and 27)

Development, testing, agreement, and follow-through on these eight program components were considered essential to the quality of data collection that would support the modeling efforts of MDOT.

All eight of these components are described in full in the following sections and appendices.

Sample Design

The sample design for MI Travel Counts divided the State of Michigan into seven geographic sample areas. Each sample area is defined by a collection of counties or other entities that are either geographically contiguous or similar, with respect to the

types of travel patterns and behaviors generated by households within those "sampling areas". The seven sample areas were the following:

1. SEMCOG (Seven counties of Detroit Area)
2. Small Cities (Population of 5,000-50,000 outside small urban and TMA areas)
3. Upper Peninsula Rural
4. Northern Lower Peninsula Rural
5. Southern Lower Peninsula Rural
6. Transportation Management Areas (TMAs) (Population over 200,000)
7. Small Urban Modeled Areas (Population between 50,000-200,000)

The MI Travel Counts Sampling Plan Technical Document is attached as Appendix 1; a map of the sampling areas is provided in Section 4.

To ensure nearly equal precision on data calculations within each area and when comparing across areas, the sample design required a minimum of 2,040 completed and accepted households within each of the seven sampling areas.[1]

Within sampling areas, the modeling rationale for the sample design was that auto sufficiency (the degree to which the number of autos available to a household matches the number of workers in the household), rather than auto ownership and household size is more highly correlated to travel behavior. While traditional household travel sampling designs rely on classification by household size and number of autos (or income), MI Travel Counts added an additional variable of interest—number of workers in the household to the sample design.

The stratification of households by household size, autos available, and number of workers identified 64 potential cells per geographic area (4 x 4 x 4). Upon inspection, improbable cells were removed from the tables where the number of workers was greater than household size. The first aggregation combined the cells where auto ownership was greater than the household size.

The next aggregation was to combine cells, having fewer than 30 households, within auto sufficiency categories. There are four levels of auto sufficiency: no autos, autos less than workers, autos greater than workers, and autos equal to workers. The first pass was to aggregate within auto sufficiency categories and household size. This was sufficient except for the zero auto households, which needed to be aggregated across household size. This is due to the rarity of zero-auto households outside of one-person households.

This stratification and re-aggregation process resulted in 169 data cell quotas across the seven sample areas. The target households were increased to 30 for those cells that

[1] Household with 5+ persons were considered complete if acceptable travel inventories were received from all but one member.

proportionally had less than 30 households. The summary number of households by sample area for MI Travel Counts is shown in Table 1.

Table 1. Summary of Households by Sample Area for MI Travel Counts

Sample Area	Targeted Households	Retrieved Households	Accepted Households
SEMCOG	2,040	2,539	2,249
Small Cities	2,044	2,760	2,369
Upper Peninsula Rural	2,051	2,306	2,044
Northern Lower Peninsula	2,054	2,353	2,090
Southern Lower Peninsula	2,043	2,258	2,084
TMAs	2,041	2,315	2,098
Small Urban Modeled Areas	2,042	2,222	2,062
Total	14,315	16,753	14,996

Note: 16,753 households were actually completed. By definition, a completed household was a household where two-day travel inventories and related information had been retrieved from every member. An accepted household, by definition, is a household that after thorough audit and review, the household's information was accepted by MDOT. The completed and accepted number of households may not be the same, as some households, for various reasons, were rejected by MDOT.

The design resulted in some data cell quotas for rare population households such as 2+ persons with zero autos in rural areas and 4+ person households with fewer autos than workers. For the most part, rare population households were also in the low-income category. Collecting travel inventories from these households proved challenging since early data analysis showed that even when these households were successfully recruited, they completed travel inventories at lower rates than more typical households (such as 2-person households with two autos and two workers).

In order to complete these rare population data cell quotas, MI Travel Counts implemented five responsive interviewing design[2] strategies over the course of the data collection period. Each of these strategies used a series of different or successive recruitment and response techniques. These modifications included:

- Adjusting recruitment sample targets based on the varying actual retrieval rates for different data cells.
- Introducing portions of low-income targeted Random-Digit-Dial (RDD) samples into the traditional RDD sampling frames.
- Introducing differential incentives ($20-$30 [not paid for by MDOT]) for zero-vehicle households and households with fewer autos than workers, if all members of the household completed the travel inventories.
- Introducing RDD listed sample targeted by income and household size.

[2] Steven Heeringa and Robert Groves, *"Responsive Design for Household Surveys"* in the 2004 Proceedings of the American Statistical Association, Survey Research Methods.

- Conducting refusal conversion interviews for all households recruited in rare population data cells that did not initially complete the travel inventories (retrievals).

The detailed sequencing and corresponding results of these modifications by phase is described in Section 8 of this report.

The final outcomes for MI Travel Counts were as follows:

14,996 households with a total of 37,475 persons were completed and accepted. However, 14% of the data cells were short of targeted household goals, by a total of 211 households spread across 24 cells. All sample areas met the minimum target of 2,040 households.

The 211 households short of specific targeted data cell goals were spread over 24 of the 169 data cell quotas. These data cells included households with 2+ persons and zero autos in the three rural sampling areas, 3+ person households with autos (more than zero) but less than workers in two sampling areas, and 4+ person households with the same number of autos and workers in five sampling areas including SEMCOG. All of these data cells represent rare populations (less than 5% of the household distribution), which are largely low income. These households proved difficult to reach by RDD phone methods since they are likely to be concentrated in small geographic areas or housing complexes and some may not have phones. Differential response rate analysis showed that they also are less likely to participate fully once recruited.

In terms of overall MI Travel Counts response rates, based on the American Association for Public Opinion Research's (AAPOR) Response Rate 3 (RR3) calculation method, the overall recruitment response rate for MI Travel Counts was 48.6%. The participation rate (retrievals/recruitments) overall was 57.6%. In comparison, the respective response rates for the 2001 National Household Travel Survey (NHTS) were 56.2% for the recruitment and 59.3% for the participation rate. The Council of American Survey Organizations (CASRO) method was used as the basis for calculating response rates for NHTS, which included ineligible pre-screened numbers (numbers removed as non-working from the RRD sample by the sample generating company, Genesys, before the sample was sent to data collection firms). Therefore, a direct comparison of the recruitment response rate cannot be made since MI Travel Counts did not include ineligible pre-screened numbers. Exclusion of the ineligible pre-screened numbers in the MI Travel Counts automatically lowers the recruitment response rate. However, the participation rate can be compared and is within 1.7% of the NHTS.

Work Plan and Data Collection Methodology

In the first three months of MI Travel Counts, extensive time was spent by MDOT and its partners developing a detailed work plan and delivery schedule for all facets of the data collection program. This program included the initial, interim, and final drafts of all required materials and manuals. The pilot and pilot report were scheduled as well as start-up of data collection and delivery of interim reports, after the completion of each

2,000 households. The delivery schedule was adhered to throughout the program. An exception was the delivery of the last set of completed households due to adjustments made at the end of interviewing to implement special methods to retrieve the rare population households.

In addition to a detailed Work Plan, a Data Collection Methodology Plan was developed that provided an overall blueprint for the MI Travel Counts data collection effort. The Data Collection Methodology Plan included protocols for recruitment of households and retrieval of travel inventories, with specific references to the Sampling Plan Document, Data Coding and Quality Control Manual, and the Geocoding Procedures Manual. These protocols defined criteria for determining whether a completed household would be accepted. All documents were approved prior to use in the Pilot by MDOT.

Additionally, the MI Travel Counts Data Collection Methodology Plan defined procedures for the long distance trip retrospective data collection component for each household member as well as for collection of travel inventories from any visitors staying overnight at a respondent household, within the 48-hour travel-recording period. The information from visitors to a household was included in order to capture travel characteristics from tourists, within and outside Michigan, who are staying overnight at residences rather than at hotels and motels.

Design of Materials and Instruments

The first four months of MI Travel Counts were also devoted to development of data collection materials and instruments. Subcommittees of MDOT staff, primary personnel from MORPACE, PBConsult, RLN Transportation Planning, Brogan & Partners, and international expert Peter Stopher, Ph.D., were involved in this task. There were a minimum of three iterations and reviews of each item before final drafts were approved.

In order to reduce respondent burden, particular attention was paid to the diary format to ensure that all modeling data requirements were met and that the flow and construction of questions and instructions were clear. The following materials and instruments can be found in the Appendices as cited below:

Final Pre-Recruitment Letter	Appendix 4
Person Information Sheet	Appendix 5
Diary Cover Letter	Appendix 6
Diary Labels	Appendix 7
Diary (Without Person Sheet)	Appendix 8
Final Diary with Person Sheet	Appendix 9
Reminder Call Script	Appendix 10
Initial Recruitment Script	Appendix 11
Recruitment Script after June 2, 2004	Appendix 12
Final Retrieval Script	Appendix 13
Summer Postcard	Appendix 14
Incentive Postcard	Appendix 15
Incentive Letter	Appendix 16

Retrieval Postcard Appendix 17

Section 5 of this report fully describes the design of MI Travel Counts data methodology plans, instruments, and procedures.

Public Awareness Plan and Program

The public awareness plan and program were designed and carried out by Detroit-based public relations firm Brogan & Partners in cooperation with MDOT, and consisted of six key elements:

- Development of a name and logo for the data collection program that would be immediately identifiable as to the project's intent and legitimacy.
- Pre-notification letters to legislators and affected state, regional, and local planning and transportation officials.
- Press releases to the media.
- A MI Travel Counts website (www.michigan.gov/mitravelcounts).
- A 1-800 number manned by MORPACE's phone room for respondent questions and follow-up.
- The phone number of the MDOT project director provided in the pre-recruitment letters and the diary cover letter for questions and concerns.

The Public Awareness Plan is described in Section 5 of this report.

The website had an average of 573 hits per month. The 1-800 number had a range of 2,000 to 4,000 calls per month over the data collection period, slightly higher than other recent travel inventory projects. The MI Travel Counts program received several positive news coverage spots on Michigan TV and radio stations and articles in the metropolitan Detroit and local newspapers. No negative coverage was encountered.

Respondent inquiries were mainly to verify the authenticity of MI Travel Counts, to learn who commissioned the study, and to learn the purpose of the study. Many respondents wanted clarification about the correct way to fill out their travel diaries, or to ask if the study was only for users of public transportation, or to ask if trips made during work needed to be reported. There were a few complaints about the length of the travel diary. The MDOT project director received many of the same types of calls, which were referred to MORPACE and resolved as quickly as was possible.

Respondents also called for reasons not related to the MDOT study. These included questions about local bus schedules, complaints about road conditions, and to request dial-a-ride pick-ups. Both MORPACE and the MDOT project director responded to these calls.

Geocoding Procedures

A fully detailed manual for geocoding was developed in consultation with MDOT staff. Geocoding was performed on a continuous basis. Address information for all origin and

destination points was downloaded continually by MORPACE. The geocoding procedures for MI Travel Counts are fully described in Section 10 of this report.

Table 2 summarizes the MI Travel Counts final geocoding results. The results exceeded or met the standard set in the Geocoding Procedures Manual. The minimum geocoding goal for home addresses and destinations was 99%, 95% for school and work addresses/destinations, and 90% for all trip origins and destinations.

Table 2. Geocoding Results for MI Travel Counts

Household Locations	Minimum Goal %	Total # Households Retrrieved	% of Retrieved Home Addresses Geocoded	Retrieved Home Addresses Not Geocoded % (N)	Total # Households Accepted	% of Accepted Home Addresses Geocoded	Accepted Home Adresses Not Geocoded % (N)
Household Home Address	99%	16,753	99.9%	0.04% (6)	14,996	100%	0% (0)
Person Locations	**Minimum Goal %**	**Total # of Worker/Student Locations Retrieved**	**% of Retrieved Worker/Student Locations Geocoded**	**Retrieved Worker/Student Locations Not Geocoded % (N)**	**Total # of Worker/Student Locations Accepted**	**% of Accepted Worker/Student Locations Geocoded**	**Accepted Worker/Student Locations Not Geocoded % (N)**
Person Primary Work Address	95%	18,927	97.6%	2.4% (453)	16,975	98.5%	1.5% (254)
Person Secondary Work Adddress	95%	898	96.2%	3.8% (34)	814	96.7%	3.3% (27)
Person School Address	95%	10,722	99.2%	0.8% (90)	9,488	99.4%	0.6% (59)
Primary Activity at Destination	**Minimum Goal %**	**Total # Retrieved Destinations**	**% of Retrieved Destinations Geocoded**	**Retrieved Destinations Not Geocoded % (N)**	**Total # Accepted Destinations**	**% of Accepted Destinations Geocoded**	**Accepted Destinations Not Geocoded % (N)**
Home for Paid Work or Other	99%	88,674	99.9%	0.01% (13)	78,728	100.0%	0% (2)
Work	95%	40,881	96.7%	3.3% (1,359)	36,679	98.2%	1.8% (662)
School	95%	19,086	98.8%	1.2% (228)	16,893	99.5%	0.5% (78)
Other Than Work/School	90%	147,283	95.6%	4.4% (6,476)	129,084	97.4%	2.6% (3,379)
Total Destinations	90%	295,924	97.3%	2.7% (8,076)	261,384	98.4%	1.6% (4,121)

For all trip origin and destination points of accepted households, only 1.6% were not geocoded. Only 16.2% of the geocoded points were geocoded to the nearest street intersection rather than to street address.

Data Coding and Quality Control

A full data coding book and quality control procedures were developed in consultation with MDOT staff before the start of the pilot. The quality control plan had four components:

1. Acknowledgement of the ethics and quality measures incumbent upon MORPACE as a member of the Council of American Survey Organizations (CASRO) and as a registered International Standards Organization 9000-200 firm.
2. Reliance on MORPACE's customized in-house Computer-Assisted Telephone Interviewing (CATI) system programmed logic checks and features.
3. A series of post-processing data checks performed by both MORPACE , PB and MDOT staff on an interim delivery basis.
4. Interim audit reviews of data by MORPACE, PB, and MDOT upon completion of the pilot, 2,000, 4,000, 6,000, 8,000, 10,000, 12,000, and 14,280, 16,000, 16,700, and 16,753 households.

Data quality control procedures and results are summarized in Section 11 of this report.

Pilot Study

The purpose of the pilot was to test the performance of the draft MI Travel Counts materials and procedures. Sixteen data collection instruments, procedures, and protocols for collecting the desired activity and travel data were tested and full retrieval interviews were conducted with all members of 126 households.

The pilot was considered successful. There were several changes that were made as a result of the pilot, which showed the value of the pilot survey process. The pilot helped to refine the final procedures and instruments and paved the way for a high quality program. The design and results of the pilot are summarized in Section 6 of this report.

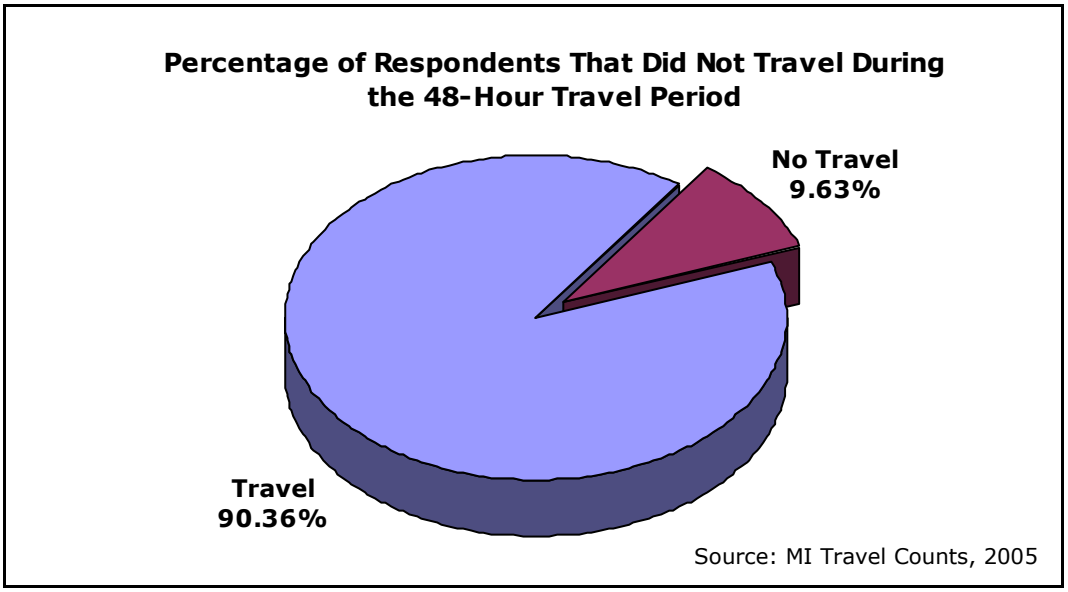
Interim Report and Data Delivery Formats and Schedule

A final element of the MI Travel Counts program was the interim delivery and review of data after the pilot, and at intervals of 2,000, 4,000, 6,000, 8,000, 10,000, 12,000, 14,280, 16,000, 16,700, and 16,753 household completions. At each of these intervals the interim datasets were reviewed and checked by MORPACE, and audited and reviewed by both PB and MDOT. Households, persons, or trips with missing or inconsistent data were flagged for further review and consideration of their acceptability.

Data Results

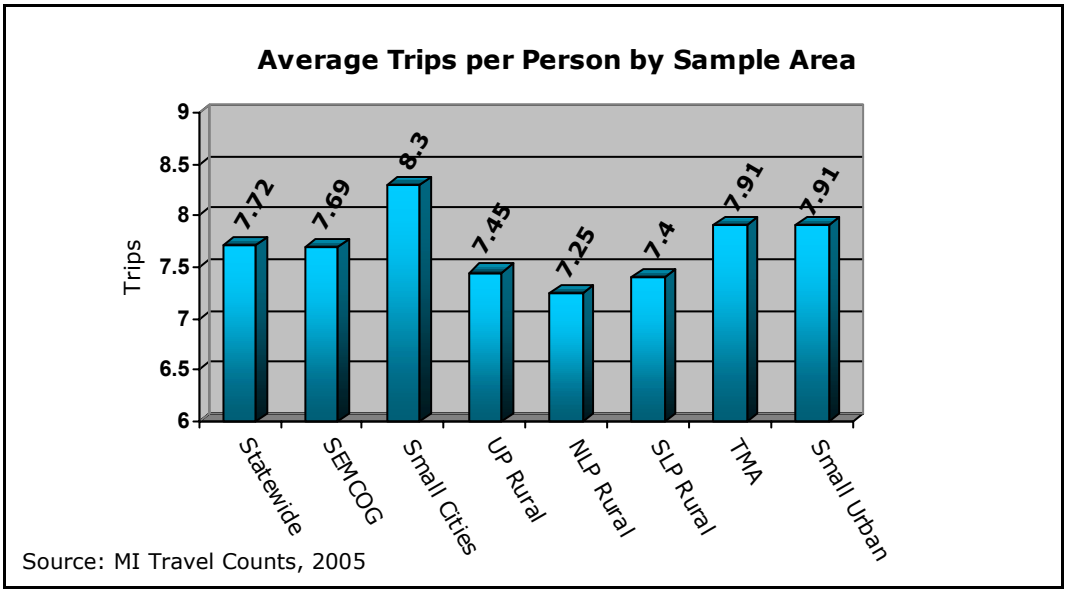
Figures 1 through 9 highlight travel characteristics for the 14,996 households that were completed and accepted by the MI Travel Counts data collection program.

Figure 1: Percentage of Respondents That Did Not Travel During the 48-Hour Travel Period



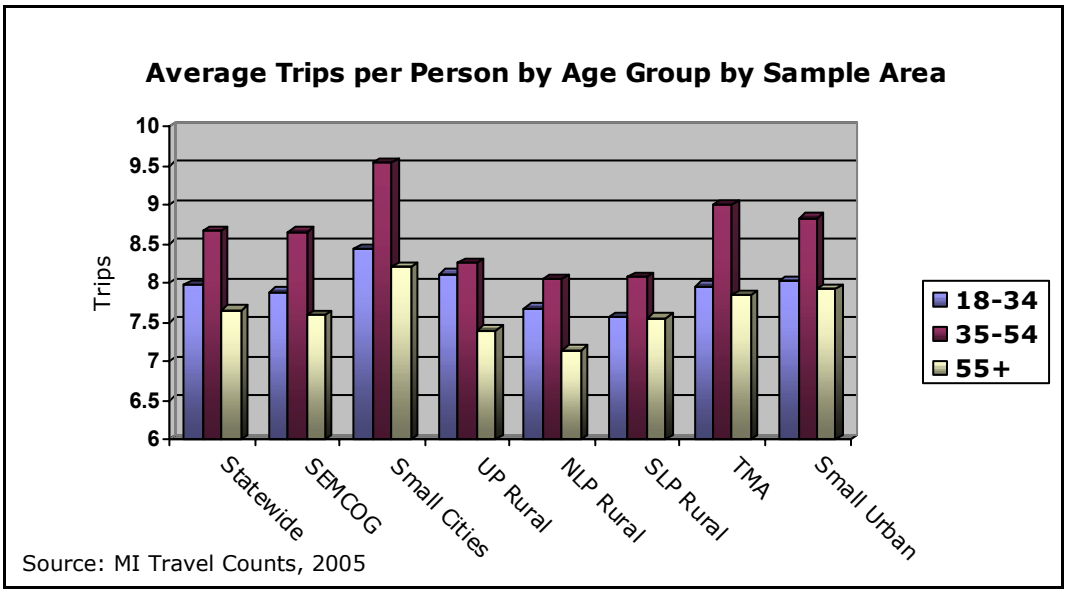
- *Figure 1:* (Unweighted) Less than 10% of respondents did not travel during the 48-hour assigned travel period.

Figure 2: Average Trips per Person by Sample Area (48 Hour Travel Period)



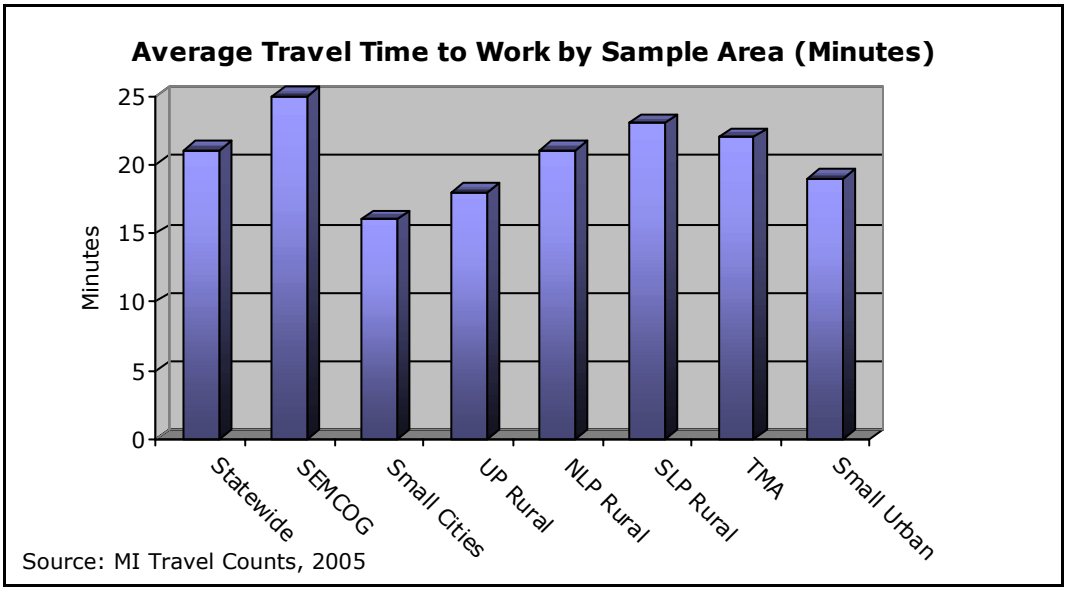
- *Figure 2:* (Unweighted) Average trips per person were highest in the Small Cities sample area (8.3), and lowest in the three rural areas (average 7.4).

Figure 3: Average Trips per Person by Age Group by Sample Area (48 Hour Travel Period)



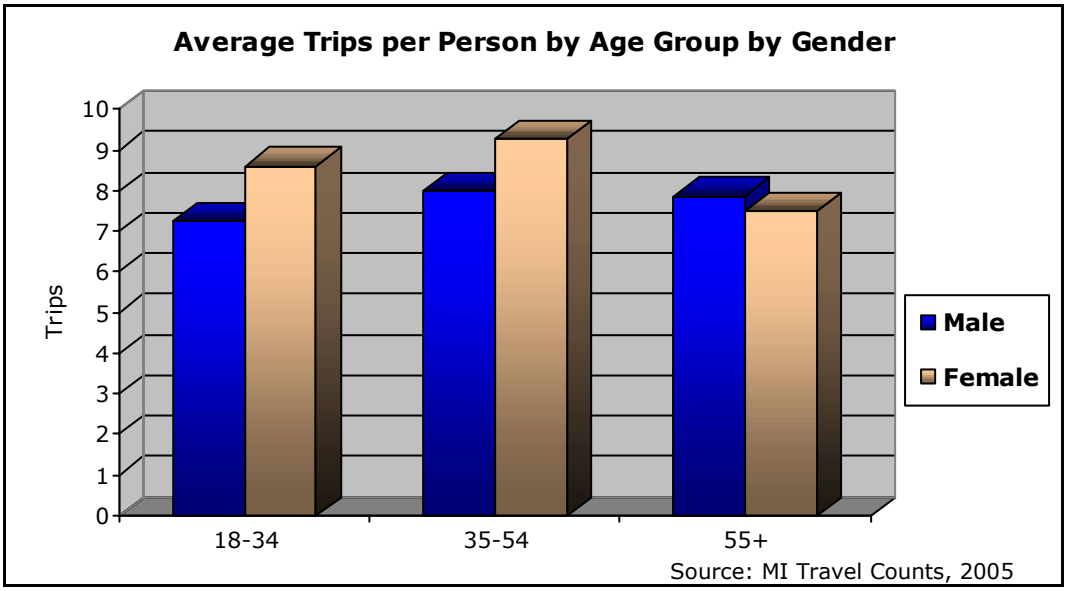
- *Figure 3:* (Unweighted) Across all sample areas, average trips rates were highest for those age 35-54. Average trip rates were considerably lower for those 55 years or older living in the rural areas of the Northern Lower Peninsula and Upper Peninsula.

Figure 4: Average Travel Time to Work by Sample Area (Minutes)



- *Figure 4:* (Unweighted) The average travel time to work in the urban/suburban SEMCOG area was 25 minutes; average travel time to work was shortest in the Small Cities area (16 minutes). Average travel time to work exceeded 20 minutes in the TMA and the rural areas of the Northern and Southern Lower Peninsula.

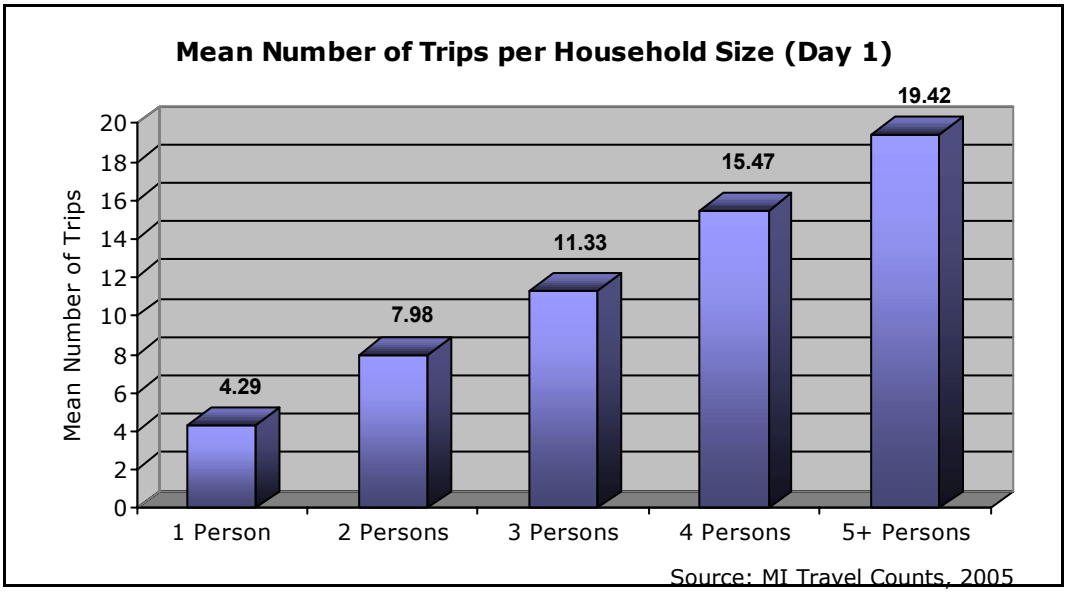
Figure 5: Average Trips per Person by Age Group by Gender (48 Hour Travel Period)



- *Figure 5:* (Unweighted) Females reported higher average trips than males for all age groups except 55 years and older where average trips for males were slightly higher than for females.

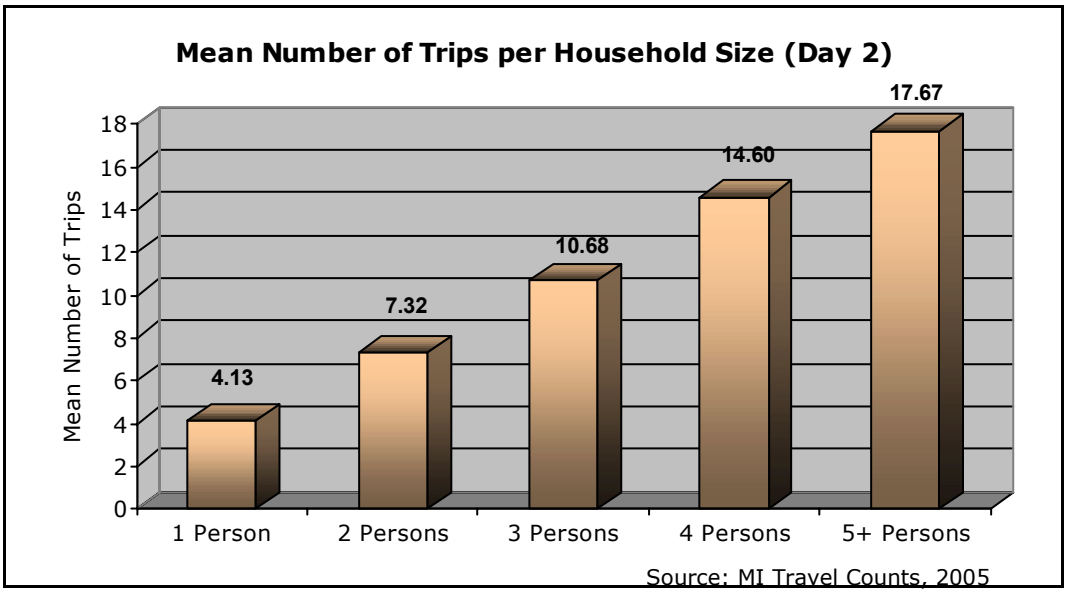
Figure 6 and Figure 7 below show the weighted (by household size) mean number of trips by household size for Day 1 and Day 2 travel respectively.

Figure 6: Mean Number of Trips per Household Size (Day 1)—Weighted



- *Figure 6:* (Weighted) On Travel Day 1, one person households averaged 4.29 trips while households with five or more persons averaged 19.42 trips per household. The mean weighted number of trips per household on Travel Day 1 was 9.99 trips.

Figure 7: Mean Number of Trips per Household Size (Day 2)—Weighted



- *Figure 7:* (Weighted) On Travel Day 2, the mean number of trips per household was 9.42, a decline of 5.7% in reported trips from Travel Day 1. The decline in average number of reported trips from Day 1 to Day 2 was 3.7% for one person households and 9.0% for households with five or more persons.

Figure 8 below shows the most frequent type of travel day trip pattern where "H" is home, "W" is work, "S" is school, and "O" is some other destination. A pattern is defined as a closed chain of trips that start and end at a base location, typically home. For example, the most frequent pattern is from home to work and then back to home. The exception in frequency of patterns is the "HWHOH" which is a frequently occurring double pattern.

HWH = Home-Work-Home

HSH = Home-School-Home

HOH = Home-Other-Home

HOOH = Home-Other-Other-Home

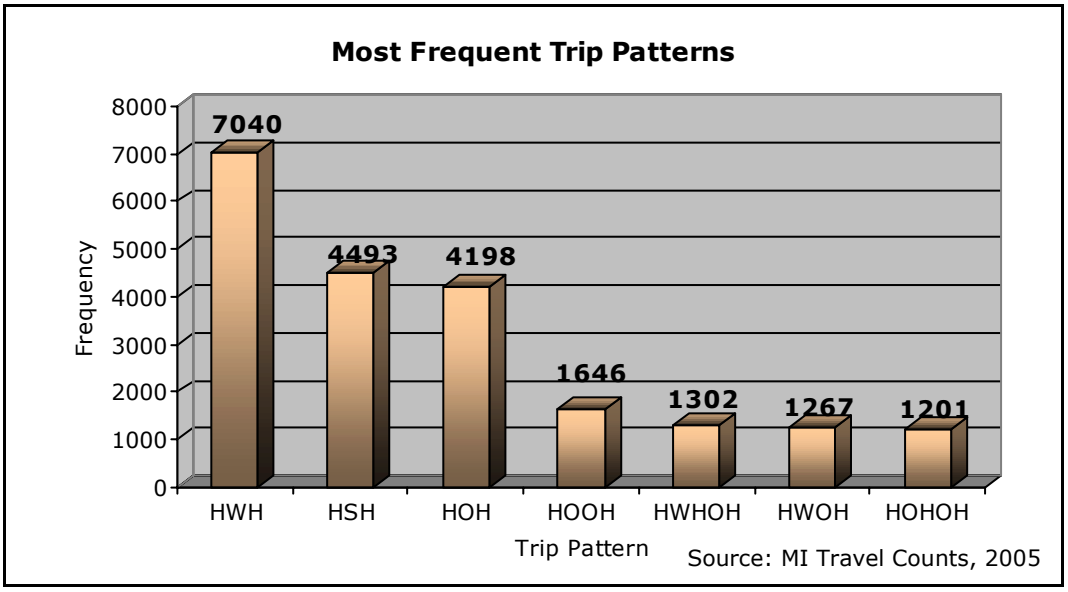
HWHOH = Home-Work-Home-Other-Home

HWOH = Home-Work-Other-Home

HOHOH = Home-Other-Home-Other-Home

HOOH = Home-Other-Other-Home

Figure 8: Most Frequent Trip Patterns

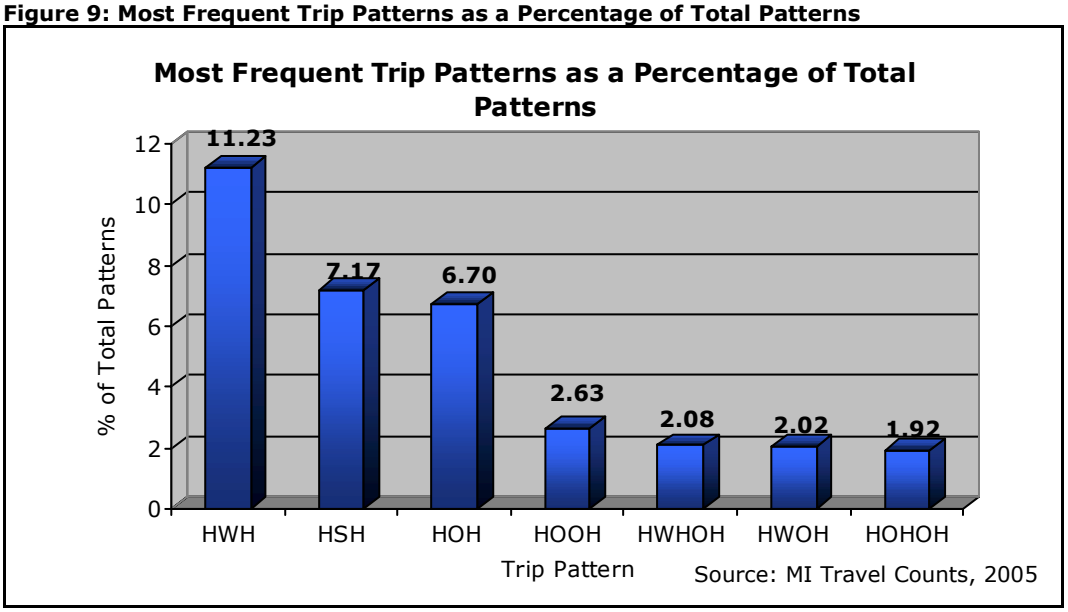


- *Figures 8:* (Weighted) Figure 8 shows the most frequent type of trip pattern (from one location to another and back).

There were 62,672 respondent travel days and 261,156 trips in the MI Travel Counts program from the 14,996 completed and accepted households. Figure 9 below shows the percent of each of these frequent trip patterns as a percent of total travel. The

figure illustrates approximately 33.74% of all patterns, the other trip patterns were each less than 1.5% of the total patterns.

Figure 9: Most Frequent Trip Patterns as a Percentage of Total Patterns



- *Figures 9:* (Weighted) Figure 9 shows that the traditional types of trip patterns (home/work/home, home/school/home, and home/other location/home) account for only one-fourth of all patterns.

A more detailed description of the approach and analysis of the data are contained in the body and appendices of this report.

Section 2. Project Background and Purpose of This Document

In Brief: *Section 2 provides information about the intended applications of MI Travel Counts data, identifies the project's principal goals, and states the objectives of this report.*

2a. Project Background

The purpose of MI Travel Counts was to obtain accurate information on statewide travel characteristics for the Michigan Department of Transportation (MDOT) to allow them to update, develop, and calibrate statewide and urban travel demand models. The models estimate future travel demand and travel patterns for use in determining project requirements and investment priorities for the Statewide Long Range Plan, the shorter term Statewide Transportation Improvement Program (STIP), local Metropolitan Planning Organization (MPO) Long Range Plans (LRP), and the MPO Transportation Improvement Plans (TIP). The MI Travel Counts data collection program was one component of the overall three-phase model improvement plan that MDOT is undertaking. MI Travel Counts 2004-2005 data will allow MDOT to move away from using national defaults in modeling since it has captured unique travel patterns that may exist within Michigan.

The model structure adopted in Phase I of the model implementation program is a tour-based model that requires extensive and appropriate information including, at a minimum: automobile availability, tour/stop generation, tour/stop destination choices, tour/stop time of day/departure time choices, and tour/stop mode choices. Thus, the primary organizing principle for the Phase II MI Travel Counts data collection phase was to capture tour-based travel characteristics for Michigan households. A tour is defined as a sequence of one or more away-from-home activity stops, such as for work, shopping, or recreation that begins and ends at the same location. An example of a tour might be from home to daycare to work and home, stopping back at the daycare on the way. The most prevalent type of tour is the home-based tour. A workplace type tour during lunch hour is a sub-tour within the larger home-based tour. For MI Travel Counts, tour and travel characteristics were to be collected for every member of 14,315 households, for a 48-hour consecutive period.

A supportive and essential principle for MI Travel Counts was to ensure that tour and travel characteristics data were collected from *a fully representative sample* of households within each of seven geographically defined sample areas of the state. Minimums of 2,040 household interviews were to be completed within each sample area. Equal precision sampling was utilized. This ensured equal precision data calculations within each geographic area and when comparing across areas.

Within sampling areas, the modeling rationale for the sample design was that auto sufficiency (the degree to which the number of autos available to a household matches the number of workers in the household), rather than auto ownership and household

size, is more highly correlated to travel behavior. Thus, the MI Travel Counts' sample design incorporated an additional level of stratification - the number of workers in a household. This more detailed stratification was also designed to minimize the need for weighting to Census proportions on key variables of interest, since weighting, in turn, reduces precision.

Within each sampling area, proportional data cell sample target counts by the three variables of interest (household size, number of vehicles, and number of workers) were determined by using 2000 Public Urban Microdata Sample (PUMS) data. Appendix 1 of this report fully display the sampling plan targets by data cell.

2b. Purpose of This Document

This report is intended for the use of current and future MDOT modeling staff or those of other planning agencies. It documents the methodology for carrying out MI Travel Counts, and focuses on the processes involved in data collection to achieve sample goals and produce a quality data set, including the techniques and resources used with corresponding outcomes. All of the materials used in MI Travel Counts are included as appendices to this report, and summary statistics and findings of the study are provided in Section 12: Data Collection Comparisons and Results.

This report also has as objectives to present the overall rationale for the approaches and designs used, and to document:

- Designs and instruments.
- Problems that were encountered.
- Changes that were made during implementation to sampling procedures, the diary, public awareness plan, recruitment, retrieval, geocoding, and data quality checking to meet project objectives.
- Results of the above changes.
- Limitations of the approaches and changes implemented.
- Possible solutions or changes for future efforts.

Section 3. Objectives and Overall Approach

In Brief: *Section 3 states the key objectives of MI Travel Counts, describes the project consultant team, presents the conduct flow plan, and summarizes program components.*

3a. MI Travel Counts Key Objectives

The emphasis of the MI Travel Counts program was to produce a quality travel data set customized to the needs of MDOT for developing transportation models. Major requirements included:

- assuring the representativeness of the auto sufficiency sample and the appropriate structuring and filling of sampling data cells
- minimizing missing and incorrect data
- increasing the percentage of actual trips reported
- achieving the best possible geocoding results

The MI Travel Counts (program) Work Plan was documented as an approved final contract deliverable, dated November 25, 2003. The Work Plan served as a milestone document for the completion of the MI Travel Counts data collection effort. The Final Work Plan is included as Appendix 2.

Strategies used in addressing the objectives of MI Travel Counts included attention to detail in the designing of program conduct flow and corresponding program components including instruments and materials, a public awareness program, a detailed sample design, interviewer training, a pilot, sample and data collection monitoring, geocoding and data checking standards, and overall quality controls.

3b. Project Consultant Team and Roles

For the Phase II MI Travel Counts program MORPACE International, Inc. (MORPACE) served as the prime contractor. MORPACE previously completed large-scale household travel surveys for: the Metropolitan Transportation Commission (MTC) in the bay area of California, the add-on portion of the 2001 National Household Travel Survey for Battelle and FHWA, and various other locations including: Tucson, Arizona; Tyler-Longview, Texas; and Charlotte, North Carolina.

MORPACE was joined by Parsons-Brickerhoff (PB), forming the MORPACE-PB comprehensive household travel data collection project team for Phase II. PB had been the consultant for the Phase I development of data specifications for urban and statewide Michigan travel models and, therefore, was thoroughly familiar with the intricacies and details of the data requirements for Phase II of the study.

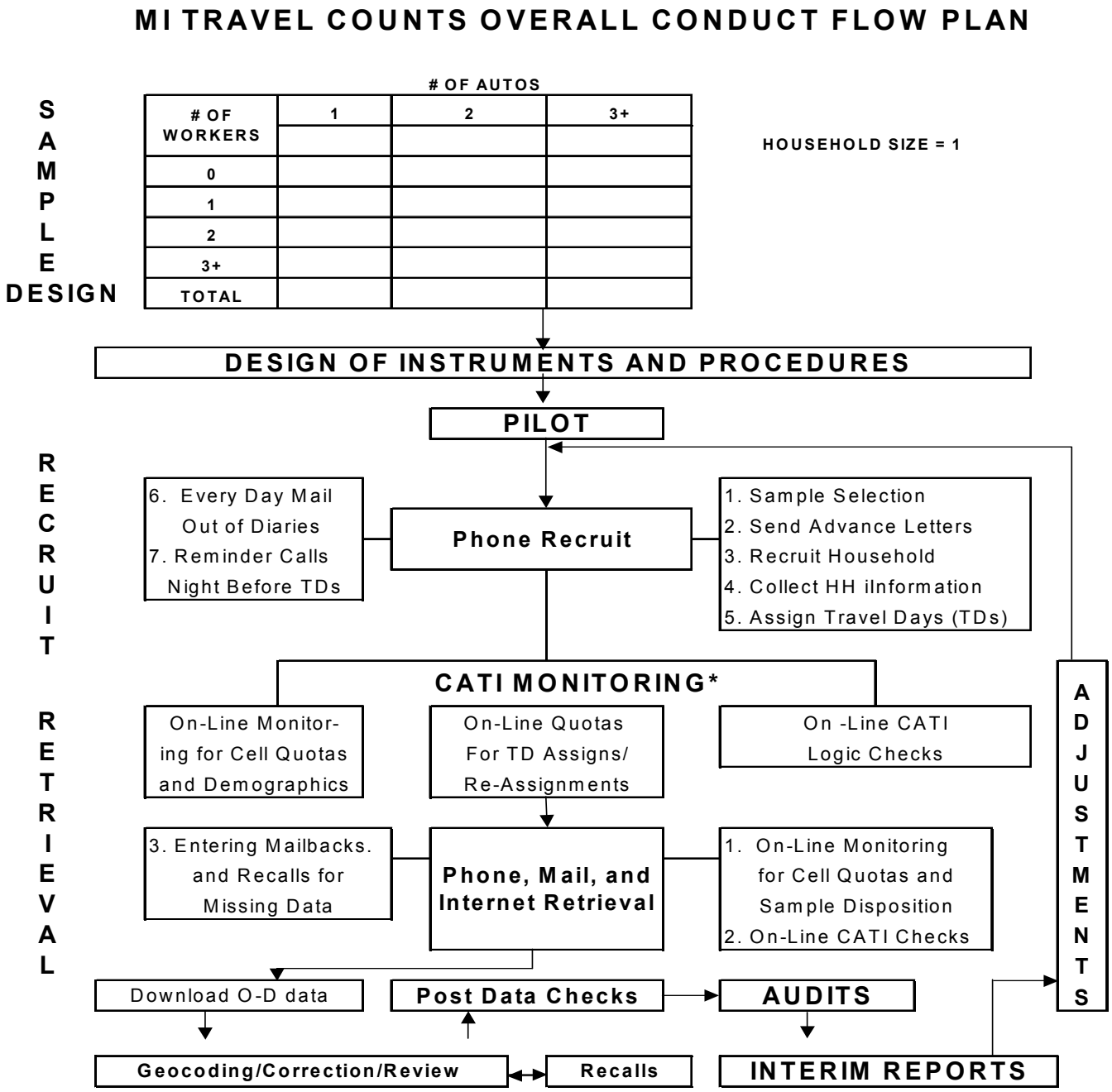
This MORPACE-PB project team was augmented by Peter Stopher, PhD, an internationally recognized travel inventory design expert. Peter Stopher helped to guide and review instrument and procedural manual development, reviewed quality control

measures, and assisted with the development of the final report. Brogan & Partners, a well-known and respected Detroit-based firm, conducted a public awareness program, which was essential for establishing the credibility of this large-scale data collection program. Finally Richard Nellett, a former MDOT travel modeling administrator, joined the team to assure the project's compliance with MDOT programmatic objectives and procedures, and to review written submissions and plans. Clarity of roles and depth of experience assured the responsiveness of this team.

3c. Overall Program Conduct Flow Plan

Figure 10 on the following page shows the integrated Conduct Flow Plan for MI Travel Counts from design, recruit and retrieval of households, data processing, and geocoding, through auditing, reporting, and correction.

Figure 10: MI Travel Counts Overall Conduct Flow Plan



** Computerized-Assisted Telephone Interviewing (CATI)*

3d. Program Components

There were eight program components to MI Travel Counts:

1. designing materials and instruments
2. sample design
3. public awareness program
4. interviewer training
5. pilot
6. data collection monitoring
7. geocoding, and
8. data checking and quality control.

The details of developing drafts and procedures for these components are presented in Section 5: Design of Data Collection Methodology Plans, Instruments, and Procedures. The effectiveness and results of these components are reviewed in Section 6 in regard to the pilot; Section 7 in regard to materials, the public awareness program, interviewer training, and data collection methods; Section 8 in regard to achieving sample goals; Section 9 in regard to interviewing response rates and refusal summary; Section 10 in regard to geocoding; and Section 11 in regard to data checking, quality control, and interim data reports. Data comparisons and results are presented in Section 12.

The following is an overview of MI Travel Counts program components.

Designing Materials and Instruments for MI Travel Counts: Three months were spent at the beginning of the project to design appropriate instruments and materials for MI Travel Counts. This process included extensive design and review input from MDOT staff committees and the full project consultant team. To meet quality requirements, consideration of respondent burden was essential, given the 48-hour activity and tour-based travel inventory design. While a 48-hour data collection period provides the richest and most varied dataset for travel modelers, a major concern was the amount of respondent time required. Respondent burden was also intrinsic in the redundancy of address questions and in the length of phone time taken to collect travel inventories from all members of a household. This led to agreement on a hybrid place-based or location based activity diary format rather than a full-blown activity time series approach.

This design captured only two types of activities within the home: (1) home-not working and (2) home–working. Primary and secondary activities at each location were collected; however, the timing of these activities at any one location was collected as a block without differentiating among activities. Activities and modes of travel were collected via closed-ended categories. Thus respondents were required to self-code their activities into pre-set categories using examples in the diary. The categories for activities and mode were based on those provided from the Phase I model improvement plan. The diary questions were designed to flow in conjunction with the Computerized

Assisted Telephone Interviewing (CATI), taking the respondents through their activities/locations and travel in chronological order.

The following instruments and materials were designed and extensively reviewed, and final versions are included in the appendices and are also described in this document:

1. Pre-Recruitment Letter (Appendix 4)
2. Recruitment Script (Appendix 12)
3. Reminder Call Script (Appendix 10)
4. Diary Cover Letter (Appendix 6)
5. Household Data Collection Instrument (Diary) (Appendix 9)
6. Data Retrieval Script (Appendix 13)
7. Follow-up Postcard Reminder (Appendix 17)

Generally, the information required for MI Travel Counts was in five categories as specified in the MDOT Request for Proposal (RFP)**:**

a. household characteristics (variables specified in Task 2.3 of the RFP),
b. person characteristics (variables specified in Task 2.2),
c. a travel inventory (activity-travel diary) for each member of the household with all of the information specified as needed in Task 2.1, including mode and vehicle questions for a 48-hour period, with home, work, school, and all stop locations geocoded,
d. a long-distance travel retrospective section (variables specified in Task 2.4), with home, work, school, and all stop locations geocoded, and
e. household, person, and travel inventory information from any persons who are visiting a sampled household overnight during the household's assigned travel days.

The inclusion of household visitors in the 48-hour travel inventory data collection provided a means of exploring home-based "tourism" within Michigan and its impact on household travel. This subset of Michigan visitors is otherwise difficult to reach. The addition of visitors to the data collection required questions in the recruit interview to determine whether visitors were expected during the assigned travel days. If so, travel diaries for visitors were provided in the mailing to the household. At the time of the household travel inventory interview, the computerized interviewing program had the ability to allow the addition of visitors if they were unanticipated (or to delete if they did not arrive).

Sample Design: An extensive sample design process was initiated starting with a project team workshop with MDOT on December 1, 2003. While an equal number of households were to be completed in each of the seven sampling areas, within each area the modeling requirements dictated an auto sufficiency sample proportional to Census data for the area by three variables: household size, number of autos, and number of workers. Aggregation across data cells occurred only when a proportional data cell was less than 30 households.

Public Awareness Program: A professional public awareness and information program was important to establish the credibility of MI Travel Counts. Public information included news releases, which led to articles in area newspapers. These articles helped inform the public about the need for the data being collected by MI Travel Counts and how it would be used. This was particularly important in the post 9/11 environment and given the sensitive activity and travel information that was collected from respondents (not just demographic questions such as income, but questions about their vehicles and when they are away from home, etc.).

The public awareness program was a cooperative effort between MDOT and the project team. Press releases and all public information materials were approved by MDOT and distributed using a list of local planning and governmental agencies developed in cooperation with MDOT. Additionally, the news media was periodically updated on the project's progress. The complexity of MI Travel Counts and the number of households that were to be reached, many of which are in rural areas where this type of extensive personalized research is rarely conducted, required a comprehensive public information program.

The MI Travel Counts public awareness program included developing an identifiable name (MI Travel Counts) and logo for the MDOT travel inventory data collection program the public could easily identify and connect with, and developing a fully functional website to assure the credibility of the project and to provide more detailed information (www.michigan.gov/mitravelcounts). Press releases and letter notifications to all planning and community agencies around the state preceded the pilot and data collection start-up. A dedicated toll-free number was manned by MORPACE throughout the data collection period to answer questions from respondents and the public. The following materials in the appendices document the MI Travel Counts public awareness program.

- Public Awareness Program Plan and developing a name and logo for the project (Appendix 18)
- Functional website specifications (Appendix 19)

Pilot: After the initial survey instruments were developed and the sample plan was approved, a pilot of the data collection was conducted. The purpose of the pilot was to test the performance of the materials and procedures developed for MI Travel Counts. The pilot was conducted from January 26 through February 10, 2004. A report of this pilot along with a pilot dataset was submitted to MDOT, with recommended changes in instruments, materials, and procedures included, for consideration and approval. A particular pilot goal was to evaluate whether respondent burden had been sufficiently reduced in the presentation of travel diary instructions and materials.

As an additional means of reducing respondent burden, multiple data collection techniques were used and piloted in MI Travel Counts, since different types of respondents choose to respond in different ways. For MI Travel Counts respondents were able to report their personal travel inventories by phone (when called or by calling

the toll-free project number), or by mail. An experienced interviewer was available during normal business hours to record travel inventory information by CATI from respondents choosing to call in. For mail-ins, recalls were made to collect missing information or for clarification. An Internet version was piloted in June of 2004 and introduced in September of 2004.

Interviewers and Training: The interviewers were Michigan-based and thus had a similar geographic frame of reference as respondents. Interviewers had experience interviewing on the firm's customized computer interviewing system before they were selected to conduct travel inventories, which is considered advanced survey work. Project-specific training included interactive practice with the customized interviewing computer script in test mode. Interviewer instructions and training guides are documented in the MI Travel Counts Interviewer Training Manual. Both MDOT and project consultant team members attended the briefing sessions for both the pilot and full study start-up recruitment and retrieval sessions. Project team members also closely monitored the interviews remotely at start-up and at times throughout the data collection period. Debriefings to get interviewer feedback were also conducted.

Data Collection Monitoring: MI Travel Counts required detailed, real-time monitoring to achieve the auto-sufficiency sample design, which was dictated by Census proportionality *within* each of the seven geographic sampling areas by: household size, number of household vehicles (autos), and number of workers. It was also important to achieve Census proportionality by age and household income. As the pilot showed, if left unmonitored, smaller households and retirees were more likely to complete the project, while larger and younger households were less likely. Likewise, zero vehicle households were less likely to complete the interview, as were lower income households, or larger households with at least one auto, but fewer autos than workers. As the data collection progressed, corrective actions and responsive interviewing strategies in the form of higher numbers of callbacks to households for difficult to fill data cells, rescheduling of underrepresented recruited households, refusal conversion techniques for households completing the recruit but not the travel retrieval data, and increased use of targeted and modified Random Digit Dial (RDD) sampling frames were all needed to achieve near perfect Census proportionality within areas. This achievement is documented by the significant degree to which results meet the requirements of the auto sufficiency sampling design.

The computer assisted telephone interviewing (CATI) and sample control systems were integrated with real-time monitoring technologies to assure transparency to MDOT in regard to the on-going status of the data collection and its progress in meeting MDOT's expectations. These systems assured timely reporting of household sample disposition.

Data Checking: The customized computer programming is designed to be able to perform a series of real-time logic checks. An extensive post-processing list of data checks that were performed can be found in the Data Coding and Quality Control Procedures Manual (Appendix 23). Customized computer system controls assured such things as not allowing an auto passenger to travel alone (without a driver), not allowing

someone under 14 to be the driver, assuring that the number of person completes matched household size, etc. Post-processing checks uncovered errors in the tour-based records such as when the time and distance of travel between two points were not within reasonable parameters. Also checks were made for missing data items that affected the "complete" status of a household. Since this was a continuous checking process, attempts were made to re-contact respondents within four days to clarify mode/trip/stop/location information and/or obtain important missing information.

In addition to the pilot report, nine fully automated interim reports and datasets were submitted to MDOT after the completion of 2,000; 4,000; 6,000; 8,000; 10,000; 12,000; 14,280; 16,000; 16,700; and 16,753 completed households. PB, in turn, audited each interim dataset for problems with time and distance testing of trips to identify outliers for further review. This auditing process involved checking the distance and time between origin and destination points by using TransCAD and the MDOT Statewide Model Network (taking into account average speeds and the distance between points) to calculate reasonable trip duration times. These calculated times were then compared with respondent reported trip time duration All identified trip time/distance discrepancies were flagged in the data set for callbacks to respondents, review, correction, or eventual designation as incompletes. These interim reports are further described in Section 11 and an example is included as Appendix 27.

Geocoding Standards: The geocoding rates to latitude/longitude (the street address or street intersection level) exceeded 99% for home addresses, 95% or better for work and school addresses, and 90% for all other trip locations. In addition, all households with 25% or more of their origin or destination travel points not geocoded were thoroughly reviewed for correction and if not corrected, were candidates for deletion from the data set based on MDOT review. For geocoding, the Michigan Geographic Information Center's MI geographic Framework V3 (MGFv3), was fully integrated with ArcView software. Trip files have a designated geocoding results code confirming the record was coded to Framework V3, MapMarker GDT files, or manually geocoded to a location using Maptitude software. A tiered geocoding approach was implemented that ranked different methods of location. Full details are available in Section 10.

Summary of Quality Control Features: Final key quality control features of the management plan were: (1) meeting all contract requirements, (2) frequent communication and meetings with MDOT in Lansing and on-site at the phone room,
(3) the provision of real-time and timely electronic status reports, and (4) nine periodic interim deliveries of data fully audited and checked with interim reports. The following manuals, included as Appendix 22 and Appendix 23, describe in detail the MI Travel Counts geocoding procedures and data checking and quality control processes employed.

- Geocoding Procedures Manual
- Data Coding and Quality Control Manual

Section 4: Sample Design, Methodology, and Procedures

In Brief: *Section 4 provides background and the rationale for the auto sufficiency sample approach that was selected and implemented for MI Travel Counts. It also provides a full explanation of the stratification plan, how proportional counts were developed for the three variables of interest (household size, number of autos, and number of workers) within each of the seven sampling areas, and finally how the sample was selected and how it was monitored. As an example, Table 6 through Table 8 (p. 33-35) display the actual sample target plan for the Small Urban Modeled Areas stratum. The results and additional methods used to achieve sample plan requirements are described in Section 8 of this report.*

4a. Introduction and Background

Practical sample design consists of balancing precision and economics and the diminishing returns associated with increased sample size. Sampling theory shows that the precision of a given design increases as the sample size increases (largely independent of the population size). However, a particular design's associated data collection costs also increase with increases in sample size. Therefore, sample design often begins by asking the following two questions:

1. How much precision is needed?
2. How much precision can we afford?

The answer to the first question depends on the specific goals and objectives of a study. In contemporary travel research this generally refers to estimating the parameters of specific travel models - models that capture the travel patterns and behaviors of households within a given geographic locale. The answer to the second question will depend, of course, on one's budget.

Stratification is one of the primary methods used in sampling to increase the overall precision of a survey without increasing the sample size. Stratification refers to the process whereby a population is divided into a number of separate 'bins' and independent random samples are drawn from those bins. The effectiveness of stratification on reducing sampling error depends on the degree of relationship between the variables used to define the strata and the parameters being measured in the survey. The greater the relationship, the greater the potential decrease in sampling error. Variables commonly used to stratify household travel research samples are the following:

- Geography
- Household size, and
- Number of vehicles in the household.

Each of these variables has been shown to have an effect on the number of trips, the type of trips (purpose), and in some localities, the modes used for the trips generated by a given household.

The sample design for many travel surveys begins with obtaining estimates of the distribution of households by household size and the number of vehicles in specific geographic areas (e.g., cities, counties, or metro areas). These estimates usually come from the U.S. Census Bureau 6and are then used to determine some type of proportional allocation of the sample.

If it is decided to maximize the efficiency of the sample design, a strict proportional allocation across the cells of the design may be made, i.e., the desired sample size within a given cell will correspond to its relative proportion of the population across all the cells. However, if variance estimates for key parameters in the survey are available, the allocation may be weighted by these estimates as a further strategy for reducing overall sampling error.

In most cases, the reliability of a sample (the amount of sampling error) is a function of the size of the sample, not the size of the population being sampled. Therefore, different estimates of error are associated with different levels of stratification within a survey. At the overall sample level, one has the largest sample size and, correspondingly, the smallest amount of error. As the sample size for any given cell in a stratified design gets smaller, the corresponding error for that cell increases. However, the key parameters of interest in most travel models are estimated using an aggregation of cells across a design.

> *For example, within a stratum, we would rarely be interested in the trip rates in cross-classification tables for households with three members, one auto, and two workers, versus households with three members, one auto, and three or more workers. To find and interview a sufficient number of households (for statistically reliable results) within both of these data cells would require disproportional sampling, resulting in high costs for the value of returns.*

4b. Stratification and MI Travel Counts

The sample design for MI Travel Counts divided the State of Michigan into seven geographic strata. Each stratum is defined by a collection of counties or other geographically defined entities that are either geographically contiguous, or similar with respect to the types of travel patterns and behaviors generated by households within those "sampling areas". The seven strata were the following:

1. SEMCOG (Seven Counties of Detroit Area)
2. Small Cities (Population of 5,000-50,000 outside small urban and TMA areas)
3. Upper Peninsula Rural
4. Northern Lower Peninsula Rural
5. Southern Lower Peninsula Rural
6. Transportation Management Areas (TMAs) (Population over 200,000)
7. Small Urban Modeled Areas (Population between 50,000-200,000)

Figure 11: Data Collection Sample Area- Small Cities

Figure 12: Data Collection Sample Area- Model Areas

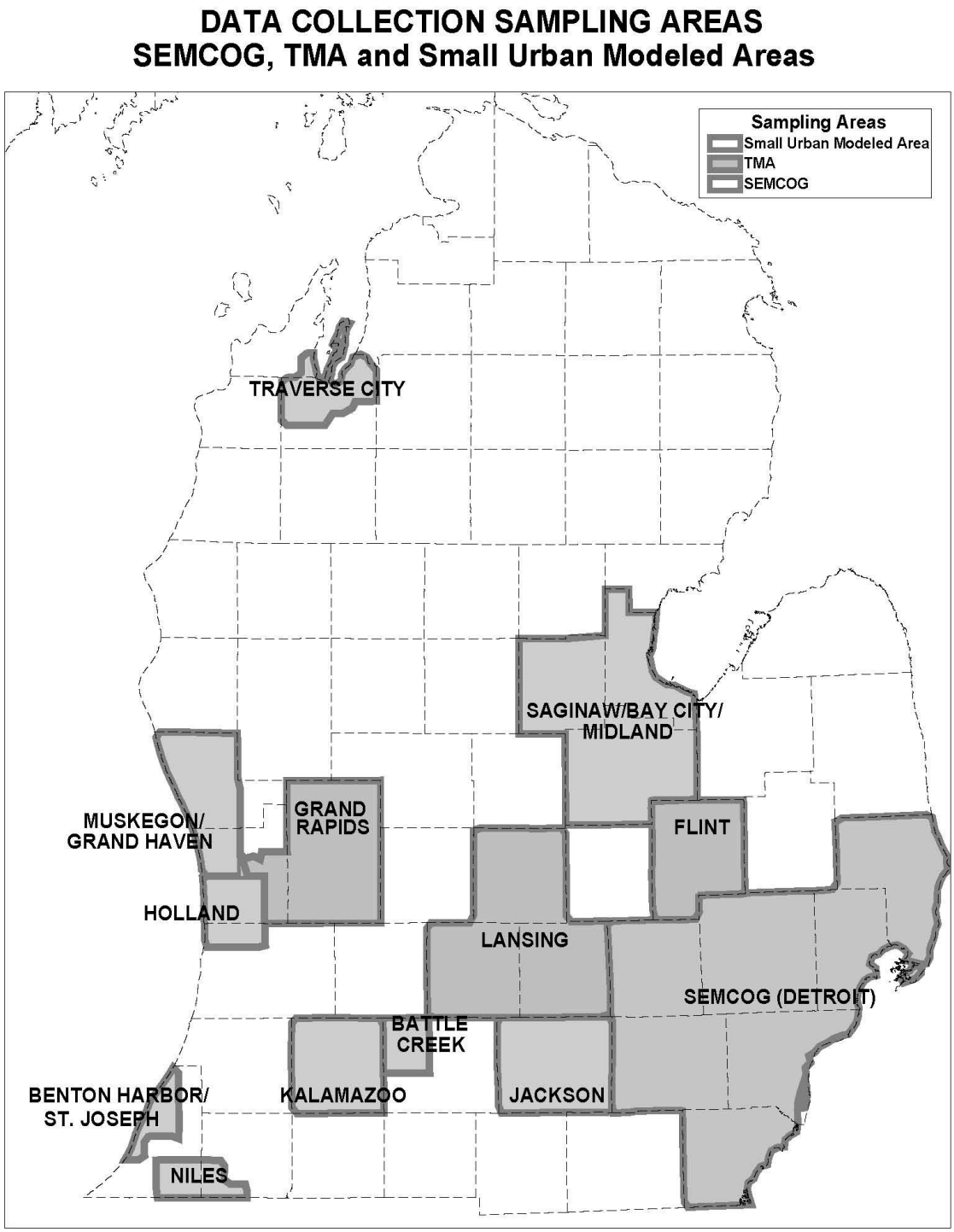
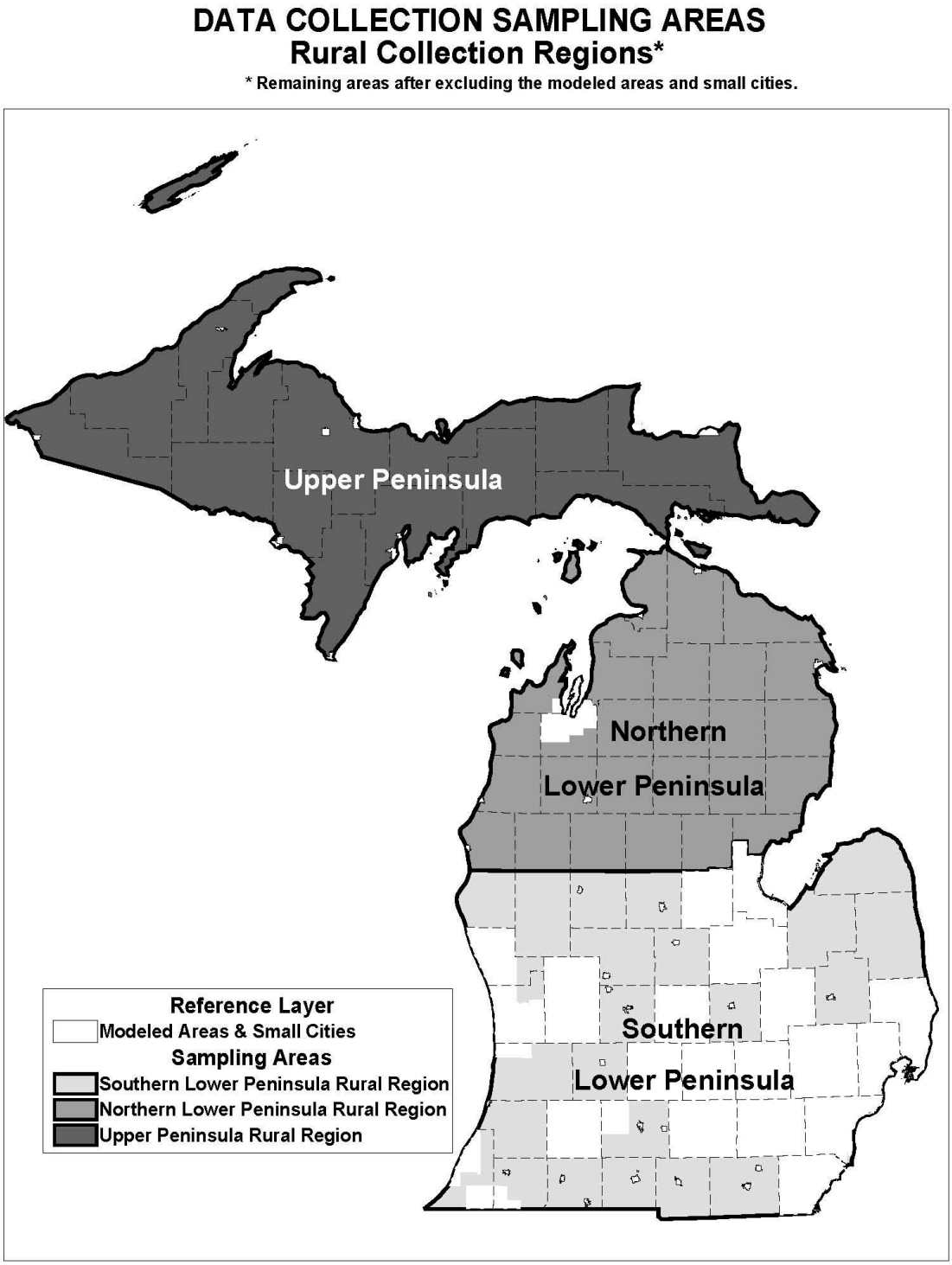


Figure 13: Data Collection Sample Area- Rural Areas



A total of 2,040 completed households were allocated to each of the geographic strata. (A "completed" household was a household where travel diary information was obtained for every member of the household.) This means that all models generated for the various geographic strata of the State of Michigan will be estimated with approximately the same level of precision. It also means that, at the modeling stage, weights to account for the proportional number of households in each stratum may need to be applied when data are aggregated across strata, or to a statewide level, in order to adjust for unequal probabilities of selection. Section 14 provides anticipated weights by stratum using 2000 5% Public Use Microdata Sample (PUMS) data for the number of households within each stratum. PUMS files have state-level Census 2000 data containing individual records of the characteristics for a 5% sample of people and housing units. While preserving confidentiality (by removing identifiers), these microdata files permit users to prepare tabulations that meet special data needs.

As in traditional travel inventory studies, household size and the number of vehicles in the household were used to further divide each geographic stratum. (Sometimes auto ownership has been replaced by household income since these two variables are highly correlated.) This two-way classification is generally undertaken to insure that the final sample is as representative as possible. These variables are not only highly correlated with various travel characteristics of a household, but they are also highly correlated with household response rates.

The MI Travel Counts sample design incorporated an additional level of classification – the number of workers in a household. The strong relationships of auto ownership and household size variables to travel behavior are not ignored when a third variable of importance to travel behavior (number of workers) is added to the stratification, providing the auto sufficiency design.

The rationale behind using this additional level of stratification is that auto sufficiency (the degree to which the number of autos available to a household matches the number of workers in the household), rather than auto ownership and household size, is more highly correlated to travel behavior. For the development of activity and tour models, especially when considering joint household travel behavior, the availability of an auto to every worker changes the dynamics of travel behavior for all persons within a household. If it is assumed that workers have priority over auto availability, and if there are fewer autos than workers, then the other people in the household have to share a ride or find alternative modes of travel. Likewise, if non-workers in the household have priority over auto availability, and if there are fewer autos than workers, the workers will have to find other means for traveling to work outside the home, other than by driving an auto alone.

Three-way classification results in a four-fold increase from 16 cells to 64 cells compared to the 'typical' design. Therefore, under any allocation procedure, the sample sizes in the cells of this design are smaller than those obtained in designs that are stratified using only household size and number of vehicles.

For MI Travel Counts, a proportional allocation of households to the cells of the design was made within each geographic stratum. This allocation was based on U.S. Census 2000 PUMS 5% data. Proportional allocation had two advantages. The first advantage was economic in nature. Proportional allocation was most efficient for data collection since sample households are in proportion to their incidence in the population with no over-sampling required. The second advantage was analytic. Models generated within a geographic stratum are self-weighting for that stratum and there is no accompanying loss of precision due to weighting. Only aggregation of data to the statewide level (or across strata) requires weighting.

The value ranges used for each of the household characteristics were:

- Household size: 1 – 4+ persons
- Auto Ownership: 0 – 3+ autos
- Workers: 0 – 3+ persons.

This identified 64 potential cells per geographic area (4 x 4 x 4). The household size was limited to four-plus as households greater than five broken down by the other two variables become increasingly rare. Table 3 shows the data cells in the sample design.

Table 3. MI Travel Counts Sample Design - Household Size by Number of Workers by Number of Vehicles for A Given Piece of Geography

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers				
1 worker				
2 workers				
3+ workers				
2 PERSON HOUSEHOLDS				
0 workers				
1 worker				
2 workers				
3+ workers				
3 PERSON HOUSEHOLDS				
0 workers				
1 worker				
2 workers				
3+ workers				
4+ PERSON HOUSEHOLDS				
0 workers				
1 worker				
2 workers				
3+ workers				

4c. Sample Development and MI Travel Counts

A proportional allocation of households to the cells of the sample design was made within each sample area. This allocation was based on U.S. Census 2000 Public Use Microdata Sample Area (PUMA) 5% data. For each PUMA the number of households was broken out by size, auto ownership, and the number of workers. Then the percentage of households by sample area was determined for each PUMA. With the percentages of households by sample area for each PUMA determined the number of households per cell for each sample area within each PUMA was calculated. Finally, the number of households per cell for each sample area by PUMA was added together.

For MI Travel Counts, a goal of 30 completed households was established for each cell. *(A sample size of 30 provides a sampling margin of error of ± 15% at the 90% confidence level, at the worst case scenario of a 50/50 percentage split.)* To achieve 30 completed households per cell, some aggregation was necessary as certain combinations of household characteristics are very rare and need to be aggregated with similar types of cells in order to provide statistically valid results. A sampling design was required that allowed cells to be aggregated, yet maintained distinctive characteristics of travel behavior.

The first aggregation was to combine the cells where both auto ownership and number of workers are greater than the household size. This is a logical collapse of cells, as each household member can use only one vehicle at a time, and any increase in auto ownership will not affect their travel behavior. Also the number of workers cannot be greater than household size. This reduces the total number of cells to 45. (See Table 4)

Table 4. Aggregation of Data Cells

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers				
1 worker				
2 PERSON HOUSEHOLDS				
0 workers				
1 worker				
2 workers				
3 PERSON HOUSEHOLDS				
0 workers				
1 worker				
2 workers				
3+ workers				
4+ PERSON HOUSEHOLDS				
0 workers				
1 worker				
2 workers				
3+ workers				

A logical and systematic aggregation scheme that retains travel behavior characteristics was considered to be the most desirable method to combine cells. Table 5 shows the design used for cell combination. The design is based on 'auto sufficiency' rather than auto ownership. Auto sufficiency is based on sufficient autos per workers and is derived from the available household characteristics. There are four levels of auto sufficiency: no autos, autos less than workers, autos greater than workers, and autos equal to workers. The blue cells in Table 5 represent households with no autos available. The green cells represent households where the number of autos is less than the number of workers. The yellow cells represent households where the number of autos is equal to the number of workers. Finally the pink cells are for households where the number of autos is greater than the number of workers (see Table 5).

Table 5. Auto Sufficiency Design

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers				
1 worker				
2 PERSON HOUSEHOLDS				
0 workers				
1 worker				
2 workers				
3 PERSON HOUSEHOLDS				
0 workers				
1 worker				
2 workers				
3+ workers				
4+ PERSON HOUSEHOLDS				
0 workers				
1 worker				
2 workers				
3+ workers				

**Blue: No Autos Available; Green: Autos<Workers; Yellow: Autos=Worker; Pink: Autos>Workers*

As an example, Table 6 shows the percentage of population for the Small Urban Modeled Areas stratum, broken down into the three household characteristics of household size, auto ownership, and number of workers.

Table 6 **SMALL URBAN MODELED AREAS Auto Sufficiency Design: Percentages of Population by Household Size, Autos Available, and Number of Workers**

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers	*3.00%*	*9.77%*		
1 worker	*0.72%*	*11.46%*		
2 PERSON HOUSEHOLDS				
0 workers	*0.58%*	*3.87%*	*6.47%*	
1 worker	*0.46%*	*3.34%*	*6.89%*	
2 workers	*0.25%*	*1.46%*	*11.51%*	
3 PERSON HOUSEHOLDS				
0 workers	*0.18%*	*0.57%*	*0.45%*	*0.17%*
1 worker	*0.27%*	*1.87%*	*2.06%*	*0.90%*
2 workers	*0.14%*	*0.81%*	*3.82%*	*2.19%*
3+ workers	*0.04%*	*0.14%*	*0.50%*	*1.70%*
4+ PERSON HOUSEHOLDS				
0 workers	*0.15%*	*0.43%*	*0.43%*	*0.23%*
1 worker	*0.24%*	*1.47%*	*3.72%*	*1.24%*
2 workers	*0.19%*	*1.09%*	*6.84%*	*3.46%*
3+ workers	*0.10%*	*0.30%*	*0.99%*	*3.52%*

**Blue: No Autos Available; Green: Autos<Workers; Yellow: Autos=Worker; Pink: Autos>Workers*

These percentages were then used to determine how many households were required for proportional representation in each cell, in order to meet the required total of 2,040 households to be represented in each stratum.

Table 7 shows the actual number of households targeted by sample cell, without aggregation, for a proportional sample within the Small Urban Modeled Areas stratum.

Table 7 SMALL URBAN MODELED AREAS: Number of Households Targeted by Household Size, Autos Available, and Number of Workers, Without Aggregation

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers	61	199		
1 worker	15	234		
2 PERSON HOUSEHOLDS				
0 workers	12	79	132	
1 worker	9	68	141	
2 workers	5	30	235	
3 PERSON HOUSEHOLDS				
0 workers	4	11	9	3
1 worker	5	38	42	18
2 workers	3	17	78	45
3+ workers	1	3	10	35
4+ PERSON HOUSEHOLDS				
0 workers	3	9	8	5
1 worker	5	30	76	25
2 workers	4	22	140	71
3+ workers	2	6	20	72

Table 8 contains the actual number of households required for Small Urban Modeled Areas by sample cell, with aggregation. This table also shows the required target sample design aggregation scheme using the minimum 30 households per cell rule.

Table 8 SMALL URBAN MODELED AREAS: Number of Households Targeted by Household Size, Autos Available, and Number of Workers, With Aggregation

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers	76	199		
1 worker		234		
2 PERSON HOUSEHOLDS				
0 workers	53	79	132	
1 worker		68	141	
2 workers		30	235	
3 PERSON HOUSEHOLDS				
0 workers	↓	42		
1 worker		38	42	
2 workers		30	78	45
3+ workers				35
4+ PERSON HOUSEHOLDS				
0 workers	↓	48		
1 worker		30	76	
2 workers		48	140	71
3+ workers				72

**Blue: No Autos Available; Green: Autos<Workers; Yellow: Autos=Worker; Pink: Autos>Workers*

In general, if any aggregation was required, the first pass was to aggregate within the auto sufficiency variable within a specific household size. This was sufficient except for the zero auto households. The zero-auto households needed to be aggregated across household size. This is due to the rarity of zero-auto households outside of one-person households.

Aggregation occurred only as often as necessary to achieve the required 30 households per cell. Where a combined total was less than 30, a minimum target cell size of 30 was established. No collapsing occurred either across auto sufficiency categories or "diagonally" within the autos equal workers category. The auto sufficiency sample designs for the remaining six geographic strata are presented in detail in the MI Travel Counts Sample Design Technical Document attached as Appendix 1.

Deviations from targeted sampling data cells within strata were considered out of the norm for progress. These deviations were reviewed in full as part of the weekly and interim reports, and targeted corrective actions were specified. Corrective actions and responsive interviewing techniques are discussed in full in Section 8. They include the following: additional recruit and retrieval calls, rescheduling of travel days for households recruited within deviation cells that did not complete diaries for all members, use of targeted low income random-digit-dial (RDD) sampling frames, non-response/refusal conversion interviewing, and use of listed RDD samples targeted by household size and income for cells that deviated from design.

Approximate estimates for the sample margins of error for various data cell sizes are presented in Table 9 below. These estimates are based on the SRS (simple random sample) formula for estimating the error of a dichotomous variable where the population parameter equals 50% and the confidence level is 90%.

This means that if 50% of sample households in a sample area say they have 1 or less vehicles and 50% of sample households in the same sample area say they have 2 or more vehicles, when this sample information is used to represent the entire sample area, there is a possible error from the 50%-50% sample statistic of up to ± 15%, if the sample size is only 30. (Thus the percent of sample area households with 1 or less vehicles could actually be anywhere from 35% to 65%). Likewise, if the sample statistic was the same, but the sample size within the sample area was 2,040; then the percent of sample area households with 1 or less vehicles can be expected to range from only 48.2% to 51.8% (± 1.8%). The 90% confidence level means that if the survey were repeated an infinite number of times, 9 out of 10 times the true value of a parameter would fall within the sampling margin of error.

Table 9. Sample Size versus Sampling Error

Sample Size	Error
30	± 15.0%
70	± 10.0%
100	± 8.2%
130	± 7.2%
170	± 6.3%
200	± 6.8%
250	± 5.2%
300	± 4.7%
350	± 4.4%
400	± 4.1%
450	± 3.9%
500	± 3.7%
550	± 3.5%
600	± 3.3%
650	± 3.2%
700	± 3.1%
800	± 2.9%
900	± 2.7%
1000	±2.6%
2040	± 1.8%

4d. Sample Selection and Monitoring Plans

Obtaining the Sample

A stratified, list-assisted Random-Digit-Dialing (RDD) sample was purchased for the MI Travel Counts project from GENESYS Sampling System, a division of Marketing Systems Group (MSG) in Fort Washington, Pennsylvania. Founded in 1987, GENESYS Sampling Systems is a full-service sampling company that provides a wide variety of services to the research community. GENESYS has a highly effective ID Plus screening process that works to eliminate non-working numbers from the sampling frame.

List-assisted is a commercial list of directory-listed telephone numbers, which increases the likelihood of dialing household residences. When this method is used, unlisted telephone numbers and directory-listed telephone numbers have the same probability of selection.

During this process, banks of 100 consecutive telephone numbers (e.g., 910-341-5800 to 910-341-5899) were constructed and compared to a database containing the count of directory-listed residential telephone numbers in each bank. The banks that contain zero directory-listed telephone numbers were deleted from the sampling frame. This greatly increased the chance of dialing residential households. While, the deleted banks contained some residential telephone numbers, recent research has shown that less than two percent of the residential telephone numbers nationally are located in 100-banks with zero directory-listed numbers.

Monitoring the Sample

A customized computer call and scheduling system controlled the distribution of sample numbers to the interviewers. Predictive dialers were not used; interviewers manually dialed the phone numbers for this project. Replicates of numbers were released one at a time until all households receive a minimum of six calls. (Replicates are randomly selected subsamples of the main sampling frame so they are by definition identical to the main frame) Replicates were used so that potential respondents would not receive pre-recruitment letters too far in advance of their recruitment call. A maximum of two calls were made to each number (one hour apart) in any one evening. Daytime and weekend attempts were made before numbers were retired. Only one-fourth of the sample was ordered at a time since GENESYS updates its files quarterly to include new numbers. Thus, the sample numbers were ordered in segments spread out over the data collection year, both to assure the inclusion of new household numbers and to adjust the sample in accordance with varying response rates per sample area and by data cell as the data collection progressed

Real-time sample disposition reports could be accessed by MDOT via modem throughout the survey. These reports included counts of ineligible numbers, uninformed and informed refusals, non-contacts (busy, answering machines) and completes. (Uninformed refusals are those where the respondent terminated before the interviewer could get through the introduction; informed refusals are those were the respondent heard the introduction, and then chose to terminate.) The reports also contained counts of recruited and retrieved households by sample data cells within sample areas. A copy of the computerized tally was e-mailed with the weekly status reports to MDOT.

The sampling process was monitored for the key variables of interest by geographic sampling area throughout the survey. The key variables by stratum were household size, number of vehicles, number of workers, and income category. Missing item responses for these variables were also tracked and reviewed as a part of the interim reports. Monitoring was tailored to the individual needs and concerns of MDOT, the modeling requirements, and the results of the Pilot.

In addition to data cell monitoring within strata, attention was given to monitoring the representation of recruited and completed households by sub-geographic areas within strata. For this purpose, an allocation guide for both the recruit and retrieval data collection efforts was developed and shown in tables. These tables showed the expected proportional breakdown of each stratum by its relevant sub-geographic components, i.e. counties, cities, or townships. Corresponding 2000 Census household counts were converted to proportional percents and the number of expected recruited/completed households per sub-geography was calculated. The in-stratum sample monitoring was maintained on a continuous basis and progress results were part of each interim monthly report. The goal was approximate proportional sub-geographic representation.

Response Rates and Sample Disposition

Generally recruitment response rates that include all non-contact and contact numbers in the sampling frame are over 40% for the recruitment interview, based on USDOT/Westat developed criteria for the 2001 National Household Travel Survey (NHTS). Reporting of response rates for both the recruit and retrieval interview were included in the monthly and interim reports to MDOT. The method of calculation for response rates for MI Travel Counts, along with sample disposition results, are provided in Section 9 of this report.

The dispositions of all calls were tracked and documented throughout the survey. Refusals were recorded as uninformed refusals (which are considered "soft refusals") and "hard refusals" (where the respondent asked never to be called again or was hostile or belligerent). Uninformed (soft) refusal numbers were households where the respondent hung-up before the interviewer was able to get through the introduction. These numbers were "rested" for a 10-day period and then retried until a minimum of 6 calls were made over different days of the week and at different times, or a refusal or complete was secured. Soft refusals were referred to a refusal conversion process. This process consisted of having a more senior, specially trained interviewer recontact the household on a different day and attempt to complete the interview. Hard refusals were not called back. These were incidents where the respondent specifically asked to be removed from the sample list, or the respondent was threatening or abusive in their refusal.

Final monitoring of households to stratum were based on geocoding of completed home addresses, while interim real-time tracking was based on respondents' self-identification of their county, city, and where relevant, their township. Periodic meetings with the MDOT project staff included discussion of cell target success and sampling quality control.

Section 8 of this report (Responsive Design Interviewing and Achieving Sample Goals) reports the degree to which the MI Travel Counts data collection effort achieved sample design requirements. It also documents all specialized efforts taken to achieve sampling goals, the outcomes of these efforts for specific phases, and a full discussion of the few cases where data cell targets were not met.

Section 5: Design of Data Collection Methodology Plans, Instruments, and Procedures

In Brief: *This section describes in detail the design and content of methodology plans, instruments, and procedures developed to guide MI Travel Counts.*

Nine different plans, instruments, or manuals were developed to guide MI Travel Counts, in addition to the Sample Design Technical Document described in Section 4 and in Appendix 1 of this report. These elements were:

1. Public awareness plan
2. Data collection methodology plan
3. Pre-recruitment letter
4. Interviewer training manual and household recruit instrument
5. Activity/travel diary and cover letter
6. Reminder call script
7. Retrieval interview phone and Internet script
8. Geocoding Procedures Manual
9. Data Coding and Quality Procedures Manual

Each of these is summarized below. All of the relevant MI Travel Counts plans, instruments, and manuals can also be found in the appendices to this report.

5a. Element 1: PUBLIC AWARENESS PLAN

A full public awareness plan was developed and implemented by Brogan & Partners, a Detroit-based public relations firm and MDOT. Prior to the collection process, a public information campaign was necessary to secure the public's confidence that the study was valid and necessary, and to increase the ease with which interviewers could secure study participants. This public information campaign was intended to overcome the general public's frustration with, and negative response to, telemarketers and the public's growing concern over identity theft and providing personal information over the phone or via the Internet.

The public information campaign began before the pilot data collection program was launched and was an ongoing effort to inform potential interview candidates of the program. The objectives of the public information campaign included the following:

1. Addressing any public concerns about the program or how the data would be collected, processed, and handled by informing government officials and public information departments at the city, county, regional, and state level and soliciting their support.
2. Gaining the public's confidence that the study was legitimate, valid, and critical.

3. Informing the public that the information collected would be used to update statewide and urban travel demand models, which are used to estimate where future travel will occur over the next 20 years.
4. Educating the target audiences on the long-range, consumer-level benefits of the study, such as easier and safer travel, less congestion, and a better-integrated transportation system.

Media outlets across the state, including wire services, daily, weekly and community newspapers, radio, television, and trade publications were instrumental in spreading the word of the pending study and confirming its legitimacy and the benefits of participation. A name (MI Travel Counts) and logo was developed for the data collection effort.

Target Audiences:

- Michigan residents
- Michigan State Government offices including city officials, county commissioners, county road commissioners, city/village/township/county planners, township/village supervisors and trustees, and the Legislature. (The Legislature was the first target audience to receive notification of the program and city/village/township/county planners were the second target audience to receive notification of the program)
- Planning agencies including Metropolitan Planning Organizations (MPOs) and Regional Planning Organizations (RPOs)
- Michigan public information departments including state and local police, and Secretary of State.
- MDOT Regional offices and Transportation Service Center (TSC) offices and all MDOT facilities through a Monday Memo, MDOT Today, and the Multi-Modal Bureau newsletter
- Print media including wire services, major daily and weekly papers, and all local and community papers statewide
- Television and radio media with news departments statewide

Major Plan Components Included:

- Developing comprehensive media and target audience lists
- Developing informational letters to target audiences
- Developing and launching press releases
- Developing a recognizable name (MI Travel Counts) and logo for the data collection effort
- Developing website content and launching and promoting use of the website (www.michigan.gov/mitravelcounts/)
- Establishing a 1-800 number and email address for information and help
- Evaluating of public awareness plan effectiveness. (See Section 7 for more information)

The existing project name, "MDOT Comprehensive Household Travel Data Collection Work Program" was considered bureaucratic, boring, long, and vague. Concern was that no one would remember it, understand what it meant, or why they should participate in the study. Brogan & Partners' goal in developing a new name and logo for the project was to create "a buzz" about the travel study and its benefits. The objective was to give residents the idea that this was a positive thing for their local communities, and to link positive aspects and a sense of the legitimacy to the travel study pre-recruitment letter and the recruitment phone call that followed the letter.

Residents were encouraged to visit the MI Travel Counts mini-website that was designed to further legitimize the study and to ease resistance to participating. The sections of the website that were developed were:

- Please Participate
- Program Benefits
- Media FAQ's
- Contact Us
- Program Privacy
- Results

Residents were also provided in the pre-recruitment and diary cover letters with a single MDOT project director contact they could communicate with in case of concerns.

The purpose of notification letters to Michigan organizations/officials was to make them aware of the study, and to provide understanding of the benefits of the travel study to their communities, so they could provide participants reassurance should they be called by concerned residents. Organizations and officials were encouraged to motivate their residents to participate. Michigan Media outlets were asked to broadcast the benefits and legitimacy of this study.

A detailed tactical plan for the MI Travel Counts public awareness program and copies of example informational letters, press releases, and the MI Travel Counts website content can be found in Appendices 19-22.

5b. Element 2: DATA COLLECTION METHODOLOGY PLAN

As a pre-plan activity, an overall data methodology plan was developed by the project team and approved by MDOT before start-up of the pilot. This document describes the stages of MI Travel Counts in relation to project goals and requirements, as documented in the MDOT RFP and in the MI Travel Counts documents, also developed and approved before the pilot. These documents are listed below:

- Sample design technical document
- Public awareness plan
- Functional website specifications

- Documented toll free telephone line for respondents' questions
- Pre-recruitment letter
- Recruitment script
- Diary cover letter
- Household data collection instrument (diary)
- Data retrieval script for data collection
- Interviewer training manual
- Geocoding procedures manual
- Data checking and quality control manual

A final copy of the MI Travel Counts Data Methodology Plan is included as Appendix 3.

5c. Element 3: PRE-RECRUITMENT LETTER

A pre-recruitment informational letter was developed and released to replicates (randomly selected portions) of the sample on a scheduled basis. This was done so that respondents did not receive the letter too far in advance of the recruitment phone call.

The households that received pre-recruitment letters were flagged in the data file. The letters were subjected to MORPACE's internal ISO check-off process, and the project director or her designee was present to audit the mailing process and check the appearance and stuffing of envelopes. All undeliverable mailing was monitored and flagged in the data file. An attempt was made to correct the address through the United States Postal Service (USPS) website. A log was also kept of phone calls to the 1-800 number, to Internet help, and of any mail responses. Any non-routine responses were referred to MDOT. Undeliverable mailings were monitored, logged, and flagged in the data file.

5d. Element 4: INTERVIEWER TRAINING AND HOUSEHOLD RECRUIT INSTRUMENT

Interviewers were thoroughly trained as to the specific requirements of the MI Travel Counts data collection program before the pilot and again before the final start-up of the recruit interviewing. Initially, all interviewers on the recruit and retrieval had extensive interviewing experience on other household travel surveys. New interviewers were added to the recruit only as time allowed for extensive training. Activity/travel interviewing is considered advanced work and each interviewer was trained and provided with an extensive MI Travel Counts training notebook with all written instruments and instructions. Each interviewer completed and practiced one-on-one mock and monitored interviews before they were allowed to recruit for MI Travel Counts.

The sample disposition was tracked, including the number and type of data cell counts with socioeconomic attributes for the completed sample. Partial completes were assigned as callbacks by the scheduler system. As described elsewhere, refusals were coded as uninformed/soft or hard refusals.

Two-consecutive travel days were randomly assigned to a household by the CATI system, which kept travel day assignments even by eligible days over the interviewing period. At the end of every interviewing evening the supervisor wrote a project note in the system to the senior project manager reporting on progress in meeting objectives, and to relay any non-routine issues that arose with respondents. Interviews were monitored remotely throughout the survey by MORPCAE management. This capability was also available to MDOT as well as the rest of the project team.

The CATI screens displayed counts of recruited and retrieved households by data cells within sample areas and by socioeconomic attributes, which were then compared with the MI Travel Counts Sample Design Tables 8.1 through 8.7 (in Appendix 1) on a weekly basis.

5e. Element 5: ACTIVITY/TRAVEL DIARY AND COVER LETTER

A three-month period was spent by MDOT and the consultants on developing the diary cover letter, instructions, and the main diary instrument. MDOT's staff subcommittee on diary development was fully engaged in the design and finalization of these important data collection instruments. The diary developed was a hybrid place-based or location-based model, where the respondent was carefully taken chronologically through their travel days from location to location, recording both their activities at locations and their detailed travel information between locations. Much attention was placed on reducing respondent burden by making the diary easily understood. Included with the diary was a Person Information Sheet for each member of the household. This information was not included in the recruit since data requested for each member about work and school were extensive. The diary, cover letter, instructions, and Person Information Sheet were thoroughly tested in the pilot, which was conducted in February and March of 2004. Final copies of the diary cover letter, the diary, and person information sheet can be found in Appendices 7 and 10 respectively.

The activity-travel diary (retrieval interview) format consisted of five parts:

1. Collecting any changes in, or missing data, in regard to household socioeconomic attributes
2. Collecting person attributes in regard to school and/or work activities
3. Activity-travel diary
4. Long-distance travel retrospective
5. Visitor travel inventory (if applicable)

For easy reporting by both the respondents and the interviewers, a.m./p.m. times appeared in the CATI program and in the diaries. Coding in the data file is in military time.

The diaries were mailed out daily using MORPACE's full sign-off procedures which require that responsible staff sign a check-off form documenting that they have

reviewed each mailing packet for the appropriate number of materials, the appearance of materials, appropriate addresses and labels, and postage requirements. Personal labels were applied to diaries with the name, ID #, and the travel days for each respondent. A business reply envelope was included with the household packet. A full mailing log was electronically maintained in the database. In total, diary packets were sent to 29,272 recruited households. Any undeliverable mailings were fully explored and the household was re-contacted by phone for corrected information. The data file was continually edited with these changes by an assigned assistant programmer.

Diary materials and cover letter information were mailed U.S. Priority Mail, in official priority mail envelopes, approximately seven days prior to the travel date. This expense was justified because it cut down on re-mailings and reassignment of travel days, and it strengthened the respondent's perception of the importance and credibility of the study.

5f. Element 6: REMINDER CALL SCRIPT

The evening before the first assigned household travel day, the recruited household was called to remind household respondents to start recording their locations and travel at 3:00 a.m. A copy of the reminder script is included as Appendix 10. Any questions regarding the process or the diaries were answered. Re-mailings and rescheduling of travel dates were edited into the data file on a daily basis by the assistant programmer. Hard refusals at this point were recorded and reviewed by a supervisor for possible refusal conversion.

5g. Element 7: RETRIEVAL PHONE AND INTERNET SCRIPTS

Household retrieval phone interviews were automatically scheduled by the Computer Assisted Telephone Interviewing (CATI) system for the evening following the assigned travel days. Retrieval interviews continued to be scheduled automatically for the following five days until the CATI recorded that all members had completed the travel inventory. Phone messages were left with persons or on answering machines. Respondents were asked for the most convenient time to call them back, and the CATI scheduler automatically brought the call up at this time for an available interviewer. Attempts were also made during the day and on weekends.

Respondents who were reluctant to complete the person information sheet and activity/travel inventories by phone were asked if they would do so by either mail or for the fall by Internet. If mail was indicated, the household was reminded that a postage-paid envelope was provided with the diary package for the return of all completed materials. If Internet was preferred, the household respondents were referred to the login and password information printed on the label of their diary. Those who indicated they would complete by Internet were automatically called on a succeeding night, if their interviews were not recorded in the database as a total household complete. Difficult to reach respondents were asked to mail in their diaries or to call the toll-free number provided. The CATI

system provided all of the real-time tallies specified for the recruit, by person and household as appropriate. The data file was edited daily with any corrected information that was received from respondents.

Throughout the project duration, a toll free telephone number was available for answering questions and was manned from 9.a.m. to 10 p.m. on weekdays, from 10 a.m. to 2:30 p.m. on Saturdays, and from 6 p.m. to 10 p.m. on Sundays. Messages were accepted during unmanned hours and were responded to promptly. During manned hours, the 1-800 service was able to connect callers directly to experienced interviewers who could collect their activity/travel inventory and other required information using the Computer Assisted Telephone Interviewing (CATI) system. Respondents were also provided, in the pre-recruitment and diary cover letters, with the phone number of the MDOT project director. A web-based (Internet URL) survey-help address was also provided in the pre-recruitment and diary cover letters, along with link information to the MI Travel Counts website. E-mailed responses to Internet inquiries were sent within 24-hours.

The travel inventories were reported for all household and visitor members on the same consecutive days. If a problem arose, the household was re-assigned another travel period. Reminder calls were made on the evening before the first assigned travel day.

Mailed in travel diaries were manually reviewed for completeness and callbacks were made to respondents to collect missing information. The completed inventories were then entered into the CATI system. Recalls were also made to clarify or collect missing data that was discovered when performing computer checks of completed CATI or Internet travel inventories. Finally, callbacks were made for address information when an address was found to be non-geocodable to latitude and longitude. All corrected information was entered into or edited into the CATI data file.

5h. Element 8: GEOCODING PROCEDURES MANUAL

A full Geocoding Procedures Manual was developed by the project team before pilot start-up, with extensive input from the MDOT subcommittee on geocoding for MI Travel Counts. The geocoding process took place concurrently with the data collection task, and on a continuous basis. This allowed a higher level of quality control and for callbacks to respondents as needed within a five business-day window. The geocoding manual specified that geocoding rates to latitude/longitude (the street address or street intersection level) would be 99% or better for home addresses, 95% or better for work and school addresses, and 90% or better for all other trip locations. The complete geocoding process and results are described in Section 10. The final Geocoding Procedures Manual is included as Appendix 22.

Extensive efforts described in Section 8: Responsive Design Interviewing and Achieving Sample Goals were made to replace households not meeting geocoding criteria. Review with MDOT personnel determined whether the household should be removed from the data file, or whether the household's overall demographic and trip/activity information were sufficient to warrant keeping the household in the final data file, since the trade-off might be a less representative overall household sample base.

Interim reports and data files were submitted for audit review and to MDOT after completion of each 2,000 additional households. These interim reports indicated the status of individual households in terms of meeting geocoding standards. The audit process involved geocoding and time and distance testing and was submitted by Parsons-Brinkerhoff (PB) with recommendations for corrective actions. The interim auditing process identified outliers, which were flagged and set aside for further review and correction, either through review of geocoded points or a review of respondent reported times. These audit procedures are more thoroughly explained in Section 11 of this report and in Appendix 23.

5i. Element 9: DATA CODING AND QUALITY PROCEDURES MANUAL

A full Data Coding and Quality Control Manual was developed by the project team before the pilot with extensive input from the MDOT subcommittee on quality control for MI Travel Counts. This manual consisted of five parts:

1. Commitment to quality through MORPACE-PB ISO 9001-2000 process and standards and compliance with Council of American Survey Research Organizations standards
2. Project specific quality control measures
3. Requirements for the pilot
4. Specific data checking procedures
5. Data codebook and coding specifications

A copy of the MI Travel Counts Data Coding and Quality Control Manual is included as Appendix 23.

An electronic program was developed for the interim reports reviewing all collected information at intervals of 2,000, 4,000. 6,000, 8,000, 10,000, 12,000, 14,280, 16,000, and 16,700 completed households for missing data that would cause the household interview to be considered incomplete. Households with missing geocoding data were referred to the phone room for recall. Corrected data were edited into the file. Households with substantial missing data, reporting no trips without substantial reasons, or failing to meet geocoding or time and distance testing criteria were flagged in the data file for further review and consideration.

The sample disposition for all recruit and retrieval interviews was reviewed with every interim report to assure that the maximum number of call attempts were being made within the time period allowed. The comparative outcomes of phone,

Internet, Toll-free number, and mailed interviews are reported in Section 12: Data Collection Comparisons and Results.

The full and specific post-processing data checks based on criteria established in the Data Coding and Quality Control Manual were performed and results were reported in each MI Travel Counts interim report. Section 11: Data Checking and Interim Data and Report Delivery documents these results.

The MI Travel Counts data checking emphasis was on:

- producing a high quality dataset that accurately reflected the responses provided by household members, and
- capturing tours and sub-tours with all the required information in a consistent manner.

The customized computer programming and post-processing data checks were extensively designed to assure delivery of complete household data. These specific data checks are listed in the Data Coding & Quality Control Manual in Appendix 23. With household activity/travel inventories there are always possible trade-offs between the level of completeness of individual records within households and overall response bias. In making the decisions as to which households were excluded, the following two factors were taken into account:

1. The comprehensive quality of the household's information in terms of meeting the criteria delineated in the MI Travel Counts procedural documents listed on the following page
2. The bias effects on proportional sampling.

Section 6: Pilot and Interim Design Changes

6a. Pilot Parameters and Criteria

The purpose of the pilot was to test the performance of the draft MI Travel Counts materials and procedures. The following draft and initial data collection instruments, procedures, and protocols for collecting the desired activity and travel data were developed in conjunction with MDOT from November 6th of 2003 until January 23rd of 2004:

1. Public Awareness Plan
2. Toll-Free Information Number
3. Functional Website
4. Sample Design Technical Document and Procedures
5. Data Collection Methodology Plan
6. Pre-Recruitment Letter
7. A Recruitment Instrument and Computer Assisted Telephone Interview (CATI) recruitment script and system
8. Diary Cover Letter
9. Diary
10. Person Information Sheet
11. Reminder Script
12. Data Retrieval Instrument and CATI script and system
13. Interviewer Training Manual
14. Data Coding Structure
15. Quality Control Manual
16. Geocoding Procedures Manual

A pilot of the data collection effort was conducted from January 26th to February 10th of 2004. The above sixteen task elements were tested with the following exceptions:

1. The contract proposal specified a Pilot sample size of 100 completed households; 126 households were actually completed. The pilot sample size was insufficient to evaluate data cell filling difficulties on an in-area basis.
2. Due to time constraints, the Internet retrieval was not tested for the pilot. Implementation of the Internet retrieval was delayed so that any minor retrieval issues could be resolved prior to launching the Internet version.

6b. Pilot Findings and Recommendations

Pilots of travel inventories are traditionally conducted within the limits of short time periods and intentionally without the benefits of such corrective techniques as sample monitoring or redirection of sampling effort. Also, they are conducted without benefit of such corrective procedures as refusal conversion techniques, which require recontacts over an extended period of several weeks to be effective. The objective of the MI Travel Counts pilot was to test the efficacy of instruments and procedures in reducing respondent confusion and burden, as well as in producing the required complete and quality dataset. The pilot also had as its objective to expose those aspects of the data collection process that would require the most attention and the most detailed corrective recommendations and strategies. The project team and MDOT staff were present at the

phone room for interviewer training and to monitor the start up of both the pilot recruitment and the separate pilot retrieval.

Quoting from a review of the Pilot by Peter Stopher, Ph.D., a MI Travel Counts subconsultant and an internationally recognized expert in travel survey design and execution:

"This appears to have been a successful pilot that promises well for the full data collection effort. The few changes that have been made are useful and show the value of the pilot survey process. (The Pilot) has helped to refine the final procedures in important ways, and that paves the way for a high quality program."

The pilot report evaluated the effectiveness of the sixteen different task elements. The general outcomes of these evaluations, as documented in the Pilot report (Appendix 25), were:

1. Public Awareness Plan

   The Plan was implemented and responses to notification letters to the legislature and local planning agencies and to press releases were positive. No complaints were received. No changes in the Public Awareness Plan were recommended.

2. Toll-Free Information Number

   As a result of the pilot, no changes were recommended to the toll-free number protocol. No complaints were received.

3. Functional Website

   No changes to the MI Travel Counts website were recommended after the pilot. The website was considered to be a significant asset for encouraging participation in the study. A copy of the final website content is included as Appendix 19 to this final report.

4. Sample Design Technical Document and Procedures

   The pilot response rates were adequate to very good. The pilot participation rate (retrieved households to recruited households) of 55% was well above the 50% expected average rate obtained by other travel inventories conducted within recent years. The pilot CATI sample tallies for both the recruit and the retrieval are located in the appendix of the pilot report (Appendix 25).

   In regard to achieving the representativeness of the sample, the pilot documented that close, real-time monitoring would be necessary to achieve

Census proportionality within sampling area, household size, number of household vehicles, number of workers, and household income. Corrective actions in the form of a higher number of callbacks to households in difficult-to-fill data cells, rescheduling of underrepresented recruited households, and increased or targeted sampling frames would most likely be required.

As a result of the pilot, no changes were recommended to the Sample Design Technical Document.

5. Data Collection Methodology Plan

No recommendations for changes in the Data Collection Methodology Plan were considered necessary as a result of the pilot.

6. Pre-Recruitment Letter

The pre-recruitment letter significantly increased the participation of households in the project. Only minor revisions in wording were recommended as a result of the pilot, including a change in the MDOT project director's phone number. The final pre-recruitment letter is included as Appendix 4 to this report.

7. Recruitment Instrument and CATI recruit script and system

A primary goal of the MI Travel Counts pilot was to use the full benefits of the customized in-house computer system to ensure improved consistency of the data collected. No off the shelf or licensed software was used. As a result of either monitoring of pilot recruitment interviews or post processing data checks, a few minor changes in the recruitment instrument were recommended and include:

- Adding "bus or" transit to the transit pass question for greater respondent understanding ("Do you have a bus or transit pass?")
- If the respondent has a transit pass, adding a question as to how much they pay for the pass in dollars and cents, and then on what basis (annual, monthly, weekly, etc.)
- Adding "nearest" to the cross streets question ("What are the nearest cross streets?")
- For both household members and visitors, adding "16 years or older" and "currently" to the employment question ("Including yourself, how many of the people**,** *16 years of age or older***,** living in your household are currently employed?")
- Combining the city and township questions for easier sample area identification ("What city or township do you live in?")

- For both household members and visitors, asking age, first as an open-ended question to save interviewing time, and then reading age response categories for those who refuse or don't know household member's exact age.
- If CATI monitoring by age within *sampling areas* indicates that Census targets have been reached for persons age 65 or older, the following question was added to the beginning of the recruit: "Is anyone in you household under age 65?" If not, the household was terminated.

Recommended changes made to the recruitment instrument are detailed further in Appendix C of the pilot report. The initial recruitment instrument (incorporating changes made as a result of the pilot) can be found as Appendix 11 to this report. A few minor additional changes to the recruitment script were made for clarification as a result of the first interim report and are included in the Final Recruitment Script (Appendix 12).

The pilot recruitment interview took an average of 9.4 minutes per household to complete. This was considered an average length since the National Household Travel Survey (NHTS) recruitment interview took on average 8 minutes, while the Bay Area Travel Survey took 13 minutes on average.

8. Diary Cover Letter

After the pilot, a sentence about confidentiality in the diary cover letter was modified as follows: "The information you provide will only be used for the statistical purposes of this study. It will be kept *confidential* and *secure.*" The MDOT project director's phone number was also revised. The revised Diary cover letter is Appendix 6 to this report.

9. Diary

A review of the 50 pilot diaries received by mail indicated that respondents fully understood the instructions, content, format, and flow. The following minor changes were recommended and made in the diary format as a result of the pilot:

- In the Activity Choices definitions, the following explanation was given for Work: Work (employment and job-related activities)
- A minor change in format was made to the "Start Recording Here" box to make it more prominent.
- To meet modeling requirements, a global change was made to the coding placement of mopeds. "Mopeds" were moved from the "Bicycle/Moped" category to the "Motorcycle/Moped" category; thus, the two categories became "Bicycle" and "Motorcycle/Moped".

- Other minor changes were made in the bulleted instructions on page 1 of the diary.

Additional recommended changes to the diary are detailed further in Appendix C of the Pilot Report. A copy of the final diary (including all changes made as a result of the pilot and all additional changes made as a result of an interim review conducted in July 2004) is presented in Appendix 8 to this report. The changes made as a result of the July interim review are documented in Section 7.

10. Person Information Sheet

The purpose of the Person Information Sheet was to let respondents know and think about the questions related to their school and work activities and particularly about their long distance travel within the past three months. It allowed respondents to fill out the form and mail it back with their activity/travel diary information, if they chose this mode of responding to the inventory. During the pilot, respondents understood the instructions, content, format, and flow. The following minor changes were recommended and made to the Person Information Sheet as a result of the pilot:

- The first answer category for work flexibility was changed to: "I have no flexibility in my work schedule."
- Moped was moved from the "Bicycle/Moped" category to the "Motorcycle" category.
- For clarity, the industry question wording was changed to: "What is (your/NAME's) *employer's* industry?"

A copy of the final Person Information Sheet (incorporating changes made after the pilot) can be found in Appendix 5 to this report. Section 7 of this report describes a further change made to the Person Information Sheet (namely, incorporating it into the diary). This change was made as a result of the July 2004 interim review. The final combined Person Information Sheet and Diary are presented in Appendix 9.

11. Reminder Call script

No changes were made to the reminder script as a result of the pilot. The reminder script is attached as Appendix 10.

12. Data Retrieval Instrument and CATI retrieval CATI script and system

Confusing questions, long interview length, and worries about confidentiality are taxing to the respondent in travel inventories. Minimizing respondent burden while still obtaining the desired information was an important goal. The major sources of respondent burden tested by the pilot were:

- Interview length
- Clarity; confusing questions, order, or formats that are frustrating to respondents
- Degree of flexibility provided to respondents in how and when they respond
- Appropriate attention to confidentiality and privacy concerns

The pilot retrieval phone interview averaged 13.7 minutes per person. This was considered at the upper limits of acceptability for respondent burden, since the Bay Area Travel Survey 48-hour activity/travel inventory took an average of 14 minutes.

The length of the retrieval interview per person and per household for the pilot was at the outside limits of average lengths for household travel inventories, but there were less than five mid-interview household terminates. Offering mail back and Internet options for data retrieval were recommended and implemented to reduce respondent burden, especially for 3+ person households. Minor changes in the data retrieval instrument recommended and made after the pilot in order to improve clarity included the following:

- Deleting the "at this location" at the end of the question: "What time did (you/NAME) ARRIVE?"
- Adding additional city names.
- Adding text to the question and an interviewer note: "Are you/Is NAME currently attending *any level of* school?
- To match the updated person information sheet, changing the fist answer category for work flexibility to: "I have no flexibility in my work schedule."
- For clarity, changing the industry question to: "What is (your/NAME's) *employer's* industry?" Also adding the following interviewer note:
  (IF NEEDED: By industry, we mean the employer's principal business or activity.)
- Moving moped from the "Bicycle/Moped" category to the "Motorcycle" category.
- Making minor wording changes in questions regarding bus, dial-a-ride, and taxi/shuttle provider and payment questions.

- Deleting the probe of "Did you stop anywhere along the way?" per discussions at the MDOT project meeting on February 26, 2004.
- Assuring times come up for the accompanying household member when a trip was previously reported by another member.

Additional minor changes to the retrieval script are described in Appendix C of the Pilot Report. The final retrieval script (incorporating changes made as a result of both the pilot and the July, 2004 interim review) is included as Appendix 13.

13. Interviewer Training Manual

All changes made to project instruments and materials were updated in the MI Travel Counts Interviewer Training Manual. A handout was added to the Interviewer Guidebook with additional information on the activity codes.

14. Data Coding Structure

As a result of MDOT review at a February 26, 2004 meeting, minor changes were made to the code lists including expansion of column width to accommodate TAZ numbers and adding fields for the original respondent reported location address, as well as any corrected address information used for geocoding. Complete revised variable code lists were provided in Excel file format as Appendix 24.

15. Data Coding and Quality Control Manual and Procedures

Missing data is a problem in any data collection research effort. The pilot results were expected to be the basis for determining missing data tolerances, i.e., what constitutes a completed household interview? Such a process always involves some trade-offs. For MI Travel Counts, data variables considered essential were household size, number of vehicles, employment status of each person, household income, age of persons, and the address (or nearest street intersection). While researchers would like to have complete data cells for all items, eliminating whole households due to minimum missing or refused information from one member can introduce considerable research bias. In the real world, respondents may legitimately not know the answer or refuse to answer questions.

The pilot was a source for examining the reasonableness, or acceptable circumstances, for missing data. Before the pilot, as part of the Data Coding and Quality Control Manual, post-processing data checks were developed. As a result of the pilot, additional checks were added and some were revised. The final Data Coding and Quality Control Manual, which incorporates changes

made as a result of the pilot, is attached as Appendix 23. The data check lists included benchmarks that were used to judge data quality. This Data Coding and Quality Control Manual includes a list of post-processing audit checks, which is also provided as Appendix G to the pilot report (Appendix 25).

Pilot frequency results (Appendices H_1 through H_4 of the pilot report) and post processing data checks showed that data were consistent, missing data were minimal, and an appropriate level of data detail had been collected. To accomplish completed data information objectives and reach sampling targets, a detailed sampling in-area allocation guide was developed to assure proportional geographic representation and filling of sampling data cells. This monitoring was also required to assure sampling representation by household size and age of persons and to determine whether declining rates in reported Day 2 trips were acceptable. Results of the pilot, while acceptable, indicated that the following specialized strategies were needed in order for MI Travel Counts to meet its final sampling and data quality targets:

1. Increasing callbacks to difficult to reach data cell households for both the recruit and the retrieval (including day time retrieval interviewing).
2. Increasing sample replicates and/or ordering targeted sampling frames (such as supplemental income targeted RDD samples within areas).
3. Rescheduling recruited households who fail to complete the retrieval for all household members on their assigned travel days.
4. Developing and implementing special techniques to assure acceptable Day 2 trip rates. Such techniques used included an interviewer script when 3 a.m. at the end of the first travel day was reached to the effect that "it is very important to the results of this study that you report as much detail about <u>all</u> of your locations and travel for this next 24 hours as you did for the last 24 hours."

For the pilot, Parsons Brinckerhoff (PB) conducted audit checks of pilot data as specified in the Data Coding and Quality Control Manual. Inconsistencies in data found were minor and correctable. Using TransCAD, time and speed checks were conducted between trip origin and destination points and a list of questionable trips was developed based on the results. Additionally, a table was constructed for review of possible non-geocodable errors or corrections. These two trip audit tables and data for questionable households were comprehensively reviewed as specified in the Manual. Based on findings, 11 households (8.7%) were deleted from the final Pilot dataset (9 due to time and distance problems that could not be corrected and 2 based on missing more than one geocoded location).

To minimize time and distance problems for MI Travel Counts, the following changes were recommended and implemented as a result of the pilot:

1. Due to the number of short trips identified by time and distance checks, criteria for speed checks were modified as follows: "Trips less than 2 miles in length and also 30 minutes in time were considered acceptable due to short distance and time. Trips that are flagged will have 10 minutes added or subtracted from the trip length and new speed computed. If the new speed is still not within the speed parameters, the record will be flagged and reviewed."
2. Adding a programmed question to the CATI to confirm with the respondent that a trip took over one hour to complete, when this was recorded.
3. Increasing emphasis on phone room supervisor and interviewer training in regard to time recording.
4. Adding two questions at the end of the daily travel collection which are (if the respondent reported any trips over one hour during their travel period):

   Did any of the trips you've reported take significantly longer than usual? (Yes/No)

   (IF YES)

   Was this due to: (READ LIST)

   01 Weather (rain or snow)
   02 Construction
   03 An accident
   04 Traffic congestion

A copy of the final Data Coding and Quality Control Manual (incorporating all changes made as a result of the pilot and July 2004 interim review) is included as Appendix 23 to this report.

16. <u>Geocoding Manual</u>

MI Travel Counts was designed to collect travel information from all members of selected households over a 48-hour period. This is an extensive requirement in itself, but in addition, there also is the need to obtain the address information for all locations visited along the way. The question is always whether sufficient information is being collected to both accurately detail travel and for geocoding all or most origin and destination points.

For the pilot, all locations (home, school, work, and trip locations) were put through an extensive geocoding process according to the MI Travel Counts Geocoding Procedures Manual, which detailed the requirements and steps for geocoding. Pilot geocoding results are shown in Table 7 of the pilot report. The pilot met the specified requirements of the Geocoding Procedures Manual. There were no additional recommendations to the specifications in the Manual. A copy of the final Geocoding Manual is included as Appendix 22.

The one geocoding problem encountered during the pilot was difficulty in integrating MDOT's Framework v3 file with MapInfo MapMarker Plus (GTD) system as required. This was not achieved until March 18, 2004. Additionally, pilot files needed to be re-geocoded on April 2, 2004 to correct MapMarker offsets to 25 feet. Revised pilot files were sent to MDOT with the April 7, 2004 revised final Pilot report.

The independent reviews of pilot results by Parsons Brinckerhoff (PB) and Peter Stopher can be found in section D of the pilot report. Additional changes made to instruments and procedures manuals as a result of the July 2004 interim review are documented in Section 7 of this report.

Section 7: Data Collection Program Implementation, Evaluation, and Changes

In Brief: *The first part of this section provides a detailed account of the schedule for MI Travel Counts. The remainder of this section provides an evaluation of the effectiveness of the public awareness program and individual data collection instruments.*

7a. Schedule

MI Travel Counts began with a work program meeting on November 12, 2003, with MDOT and the project consultant team present to kickoff the project, and to distribute and review an initial draft work plan. Copies of general travel inventory diary format types used elsewhere were distributed. A follow-up meeting was held during November and a revised Final Work Plan was approved on November 24, 2003. A copy of the Final Work Plan is submitted as Appendix 2.

Also during November of 2003, the following items were submitted:

- A memorandum from PBConsult and Peter Stopher regarding recommendations on the general format for the diary required to meet MDOT travel demand modeling objectives
- Draft Initial Pre-Recruitment Letter
- Draft Initial Recruitment Instrument
- Draft Initial Reminder Call Script
- Draft Initial Diary Cover Letter
- Draft Initial Diary

A meeting was held on November 25, 2003 to explain, review, and clarify the diary format memorandum and Draft Initial Pre-Recruitment Letter, Recruitment Instrument, and Reminder Script. A revised initial Draft Diary, the Draft Retrieval Instrument, and the Person Information Sheet were submitted in early January of 2004. Final drafts of these documents were submitted and approved by MDOT by January 23, 2004. Each of these documents flowed through three rounds of review by MDOT and corresponding revisions by the project team. Thus there was an initial draft, a draft, and a final draft submission to MDOT for each document within an approximately 70-day period from early November 2003 to late January of 2004. Final documents were submitted to MDOT after the pilot.

The Diary format and specific question wording were extensively reviewed by MDOT's subcommittee on Diary development and a workshop at MDOT was conducted December 2, 2003 on diary format and question wording, with the full consultant project team participating. The major issues of concern were to ensure that the diary information collected met MDOT's modeling needs, to reduce respondent burden given the 48-hour activity travel data collection task, and to ensure clarity of instructions and smooth diary flow.

At the three-topic (diary, public awareness plan, and sample design) workshop held December 1-2, 2003, The Public Awareness Plan and approach were discussed, reviewed and clarified. In early January of 2004, the Initial Public Awareness Program Plan was submitted for review. The design and content of the MI Travel Counts website, pre-recruitment letters to government and community agencies, and press releases were completed and approved by MDOT in late January 2004. Also a part of the Public Awareness plan was arriving at a name for the data collection effort. Brogan & Partners suggested a list of names and MDOT chose "MI Travel Counts" in January of 2004. Website content was proposed by Brogan, reviewed by MDOT, and submitted in final format.

The sole topic of the workshop at MDOT on day 1 (December 1, 2003), was sample design. The geographic sampling areas had previously been designated as a part of Phase One *"Travel Demand Model Research and Development of Model Specifications"* and there was unanimous agreement on using the auto sufficiency sample design approach as described in Section 4: Sample Design, Methodology, and Procedures, of this report. However, there was much discussion regarding the aggregation of data cells within household size. The final MI Travel Counts Sample Design Technical Document was approved by MDOT in January 2004 after draft and final submissions.

The last phase of the design of MI Travel Counts, which was conducted concurrently with instrument and materials design, public awareness plan design, and sample design, was development of four key manuals to guide implementation of MI Travel Counts. These documents were:

1) Data Methodology Plan
2) Interviewer Training Manual
3) Data Coding and Quality Control Manual
4) Geocoding Procedures Manual

These manuals also went through several iterations and with major input from MDOT staffed subcommittees for data methodology (documenting the overall approach), quality control, and geocoding. These manuals were initially approved by MDOT on January 23, 2004.

The pilot of approved design procedures, plans, instruments, and materials began with mailing of pre-recruitment letters to the first RDD pilot sample replicate in January of 2004. A pilot of the data collection effort was conducted from January 26th to February 10th of 2004. The initial pilot report was submitted to MDOT March 9, 2004. The pilot recommended revisions were made (see Section 6) and the full data collection effort started with the release of a replicate of pre-recruitment letters to sample households on March 18, 2004. Recruitment calls began the evening of March 22, 2004. MDOT and the project team were present at the phone room for training and debriefing of the interviewers and to monitor the first evening effort of both the recruitment and the travel inventory retrieval.

The recruitment and retrieval ran continuously with consecutive 48-hour travel days assigned Mondays through Thursdays from April 4, 2004 through June 10, 2004, when data collection was halted at the end of the public school year. During this spring 2004 data collection period MI Travel Counts recruitment continued with approximately 1,267 households recruited per week. Complete Person Information Sheet and diary data for 48-hours were collected from approximately 570 households per week.

The following Table 10 provides the MI Travel Counts schedule for planned and delivered interim reports.

Table 10. Revised Schedule for Monthly and Interim Reporting

All data delivery dates were required to be within the 5-day grace period of the milestone dates listed in the contract and Final Work Plan (Appendix 2).

Items Due to MDOT	Number of Scheduled Completed Households to be Delivered	Number of Completed Households Delivered by MORPACE	Scheduled Dates for Submission of MORPACE Reports to MDOT *(PB Audit Reports Due 10-14 Days Later)*	Date Delivered by MORPACE
Submission and Approval of Initial, Draft, and Final Instruments and Procedures Manuals (See Final Work Plan: Appendix 2)	NA	NA	November 6, 2003—January 23, 2004	Final Delivery 1/23/04
Monthly Progress Report and Drafts	NA	NA	January 31, 2004	1/31/2004
Conduct of Pilot	100	110	January 26, 2004—February 10,2004	NA
Pilot Report and Pilot Data	110	110	February 24, 2004	3/9/04 (Initial)
Monthly Progress Report	NA	NA	March 5, 2004	3/9/04
Monthly Progress Report	NA	NA	April 9, 2004	4/9/04
1st Interim and Monthly Progress Report and Interim Data (including geocoding)	2,000	2,047	Initial Due Date: 5/21/04 Revised Date: 6/2/04 for 1st Interim and Monthly Report and Interim Data File (fully geocoded)	5/24/04 (Initial) 6/2/04 (Final)
2nd Interim and Monthly Progress Report and Interim Data	4,000	4,047	June 23, 2004 – MORPACE 2nd Interim and Monthly Report and Data File	6/23/04
3rd Interim and Monthly Progress Report and Interim Data	6,000	6,026	July 22, 2004 – MORPACE 3rd Interim Report and Data File	7/26/04
4th Interim and Monthly Progress Report and Interim Data	8,000	8,088	October 26, 2004 – MORPACE 4th Interim and Monthly Report and Data File	10/26/04
5th Interim and Monthly Progress Report and Interim Data	10,000	10,051	November 24, 2004 – MORPACE 5th Interim and Monthly Report and Data File	11/24/04
6th Interim and Monthly Progress Report and Interim Data	12,000	12,053	December 22, 2004 – MORPAC E 6th Interim and Monthly Report and Data File	12/28/04

Revised Schedule for Monthly and Interim Reporting *(Continued)*				
7th Interim and Monthly Progress Report Interim Data	14,315	14,297	January 19, 2005 – MORPACE 7th Interim and Monthly Report and Data File	1/26/05
8th Interim and Monthly Report and Draft Initial Data Files	14,315	16,048	February 24, 2005 – MORPACE Draft Initial and Monthly Report and Draft Initial Data Files	2/24/05
Final Interim Report and Monthly Report and Draft Final Interim Data Files	14,315	16,741	March 20, 2005 – MORPACE Final Interim and Monthly Report and Final Interim Data Files	3/24/05
Monthly Progress Report and Draft Final Report and Draft Final Data Files	14,315	16,751	Initial Due Date: 4/25/05 Revised Due Date: 6/17/05 for MORPACE Monthly Progress Report and Draft Final Report and Draft Final Data Files	4/24/05
Monthly Progress Report and Draft Final Report and Final Data Files	14,315	16,753	Initial Due Date: 4/14/05 Revised Due Date: 6/24/05 for MORPACE Monthly Progress Report and Draft Final Report and Final Data Files	6/24/05
Final Report Delivery	14,315	Retrieved: 16,753 Accepted: 14,996	Initial Due Date: 5/31/05 Revised Due Date: 8/22/05 for Final Report	8/25/05
Monthly Progress Report and Final Copies of Project Report	14,315	Retrieved: 16,753 Accepted: 14,996	Initial Due Date: 5/31/05 Revised Due Date: 8/31/05 for MORPACE Monthly Report and Final Copies of Project Report Final Weighted Data Files	8/31/05

The first interim report was submitted on June 2, 2004 and included complete data checks and report on 2,047 completed households with travel days through May 11, 2004. The second interim report included data on 4,047 completed households with travel days through May 27 ,2004, and the third and final spring 2004 interim report included data checks and results from 6,026 households with travel days through June 10 ,2004

A small test of the Internet version of the retrieval was implemented on June 11, 2004 running through June 21, 2004. Only three of 29 households recruited to complete the travel diaries by Internet actually did so. When data collection resumed in the fall, the Internet retrieval option was offered only to those respondents not wanting to complete by phone.

A postcard was mailed to 3,090 households on June 17, 2004 informing them of the break in the project during the summer months. The postcard was mailed to households that were sent a pre-recruitment letter, but were not contacted (no answer/busy) during the recruit after one call attempt. The purpose of the postcard was to let potential

respondents who received a letter know why they would not be called again until start-up of the project again in the fall of 2004.

During July and August of 2004 meetings were held with MDOT for the purpose of an interim review, and as a result several changes were made in the Person Information Sheet, the Dairy, recruit sampling quotas, and geocoding processes. These changes are documented in section 7b below.

The fall recruitment was re-started on August 23, 2004, with the last scheduled travel days for December 20-21, 2004. There were 8,088 retrieved households included in the 4th interim report with travel days through October 4, 2004. The fifth interim report submitted on November 24, 2004 included reports and checks on 10,051 completed households with travel days through November 4, 2004. The 6th interim report (December 28, 2004) included checked results from 12,053 completed households with travel days through December 1, 2004; the 7th interim report, submitted as scheduled on January 26, 2005, included checked results on 14,297 completed households with travel days through January 5, 2005.

The desired goal of 14,315 completed sample households, and each of the interim report goals, were met within five business days of each scheduled delivery date, with the exception of the final January 16, 2005 delivery which was extended through the spring of 2005 to fill remaining data cell quotas and replace households that were not accepted by MDOT. As Section 8: Responsive Design Interviewing and Achieving Sample Goals describes, additional effort was needed to achieve goal targets in certain difficult-to-fill (rare population) data cells, particularly 2+ person households with zero vehicles in rural areas and 3+ person households with autos less than workers. Also lagging was 4+ person households of completes due to the increased amount of household respondent burden in requiring all members to complete a 48-hour activity/travel inventory. As described in Section 8, a series of incentives and targeted RDD sampling methods were implemented in the fall of 2004 and continued into March of 2005, to obtain completes within rare population data cells.

Recruitment for data cells where completes exceeded sample targets was suspended as data cells were "closed"; however, once a household was recruited, all normal attempts needed to be made to retrieve the household's activity/ travel inventory information by phone were continued. Additionally, retrievals in the form of mailed back diaries continued to come in. Thus by the 8th interim report, submitted February 24, 2005, 16,048 households had been completed with travel days through January 25, 2005. In February 2005, non-response interviewing in the form of callbacks to recruited households in under goal data cells, who failed to respond to retrieval calls, were made, new travel days were assigned, and retrievals were reattempted with up to ten callback attempts. In March, a final attempt was made to recruit households within the rare population data cells, using RDD listed sample targeted by household size and income and with the use of incentives. A full description of methods and results are included in Section 8.

Review of households with no trips or geocoding and/or time and distance problems that had been identified throughout the data collection effort were thoroughly reviewed from February through May of 2005. A draft final report was submitted to MDOT on April 15 and again on April 25, 2005 and May 26, 2005. The final draft approved report and dataset were delivered on August 2, 2005.

7b. Evaluation by Element

7b.1. Public Awareness Program

The public awareness program was considered very successful as there were no concerns reported about MI Travel Counts among legislative, regional, or local government officials and agencies. Also, all media articles and attention were positive and encouraging in terms of MDOT's image. The website and toll-free number were heavily used, but complaints were very minor and concerns about MI Travel Counts validity appeared to be greatly reduced.

7b.2. Website and Hits

The MI Travel Counts website designed to aid respondents of the MI Travel Counts study, was considered a success. The website (http://www.michigan.gov/mitravelcounts) consists of a homepage with six main subpages:

- Please Participate
- Program Benefits
- Media FAQ's
- Contact Us
- Program Privacy
- Results

Table 11. Number of Web Hits per Month

Month	Page Views	Percent	Month	Page Views	Percent
Jan 2004	1,230	10.7	Sep 2004	616	5.4
Feb 2004	634	5.5	Oct 2004	605	5.3
Mar 2004	2,992	26.1	Nov 2004	581	5.1
Apr 2004	934	8.1	Dec 2004	962	8.3
May 2004	556	4.8	Jan 2005	398	3.5
Jun 2004	436	3.8	Feb 2005	276	2.4
Jul 2004	358	3.1	Mar 2005	317	2.8
Aug 2004	297	2.6	Apr 2005	290	2.5
			Total	**11,482**	**100%**

The website had an average of 718 hits per month. The most frequent hits were at data collection start-up in March of 2004 continuing steadily (with the exception of the 2004 summer months when the project was temporarily halted) tapering off in early 2005 as efforts were concentrated on reaching and

completing the rare populations. The most frequently visited page was the home page with an average of 205 hits per month. The page entitled "Please Participate" was the second most visited site with an average of 71 hits per month. A full copy of the MI Travel Counts website content can be found in Appendix 19.

7b.3. 1-800 Number

A toll free telephone number (1-800-566-6262) was established for MI Travel Counts, to allow respondents to call with any questions or concerns about their participation. During periods when the project was fully active, this phone number received approximately 2,000-4,000 calls per month. This is slightly above average as compared to both the Bay Area Household Travel Survey and to the National Household Travel Survey (NHTS).

Anecdotal information from the staff responsible for fielding these calls showed that respondents called mainly for reassurance and clarification. Most respondents called with questions intended to verify the authenticity of the study, to learn who commissioned the study, and to learn the purpose of the study. Other common respondent calls were to get clarification as to the correct way to fill out their travel diaries, to ask if the study was only for users of public transportation, and to ask if trips made during work needed to be reported (the stops made by a delivery driver, for example).

Some respondents called to complain about the length of the diary and about respondent burden, and there were some complaints about not being called back for retrieval (although research of the phone file showed that an attempt had been made). These latter complaints were quickly and individually resolved. There were relatively few complaints about privacy concerns. The MDOT project director received many of the same types of calls, which were referred to MORPACE and resolved as quickly as was possible.

Respondents also called for reasons not related to the MDOT study. These included questions about local bus schedules, complaints about road conditions, and to request dial-a-ride pick-ups. Both MORPACE and the MDOT project director responded to these calls.

7b.4 Pre-Recruitment Letter

During the summer break from interviewing during July and August of 2004, a thorough review was conducted of all materials, instruments and procedures. No changes were required in the pre-recruitment letter itself. However, procedures did have to change between the end of the spring 2004 recruitment and the start-up recruitment again in the fall of 2005. This was because replicate sample numbers were at first sent to Acxiom for address matching (from April to June of 2004). Acxiom is a company that maintains a database service for matching USA phone numbers to addresses, and vice versa. Acxiom was able to provide addresses for some unlisted numbers since its database includes information from additional marketing sources such as magazine subscriptions. A match yield rate averaging 62% was obtained from Acxiom from April to June of 2004. However, due to privacy litigation against Acxiom unrelated to MI Travel Counts, Acxiom was unable to provide address matching for random-digit-dial numbers after July 1, 2004. Therefore, from this date on for the remainder of MI Travel

Counts, address matching was only provided by GENESYS (MRG), and only listed numbers could be matched. The match rate for the RDD sample from this point on averaged only 51%. While match rates often vary by state, the telephone to address match rate nationally is approximately 52%.

7b.5 Recruitment Instrument

The only change made was to add a short sentence to terminate recruitment gracefully at the beginning of the interview, when CATI programming determined that--taking into account household size, number of vehicles, and number of workers--the household was in a data cell where sample goals had already been met. Once interviewers gained experience, the average length of the recruitment interview over the data collection period dropped from the pilot average of 9.4 minutes per household to 9.0 minutes per household.

7b.6 Diary Cover Letter

No changes were required.

7b.7 Reminder Script

No changes were required.

7b.8 Person Information Sheet and the Diary

The following observations and corrections were made as a result of the July 2004 interim review in regard to the Person Information Sheet and the Diary:

1. Many households mailed back diaries that were missing some or all of the Person Information Sheets for their members. (A separate sheet for each member was included in the diary mail packet.)
2. Many households or members mailed back diaries that reported only one day (24 hours) of travel and then they were stopping.

The need for these revisions was not apparent during the pilot, because only eight households mailed in their pilot diaries, an insignificant sample size. The difficulties became noticeable as 500+ households mailed in their diaries during the initial data collection period.

With MDOT's approval, the following interim corrective actions were taken during the spring 2004 data collection:

- A label was placed on the "START HERE" page of the diary as a reminder that travel is to be recorded for 48-hours.
- A label was also placed on the back of the postage-paid return envelope to advise respondent households not to mail back their diaries until they have spoken with a MORPACE representative.
- The label on the back of the return envelope also reminded respondents that, when mailing, Person Information Sheets must be completed and included for each household member.

These actions reduced the number of incomplete diaries being mailed in, but project staff was still spending significant time on callbacks to collect missing information, particularly affecting the rate of four-plus person households being completed.

Prior to the restart of the interviewing in the fall of 2004, changes were made to the diary and it was reprinted. The alterations included:

- Incorporated Personal Information Sheet into diary
- Shortened the example
- Added a checkbox for Day 1/Day 2 – The Day1/Day2 check box was moved next to the time (Diary Item #4) rather than at the top of the page.
- The instruction to record any additional long distance trips was moved below the Activity and Travel Codes on page 2 to accommodate the Person Information Sheet.
- The Personalized Diary Label – was changed to say Day 1 and Day two, with the travel dates, and the optional Internet retrieval password was incorporated.
- The Businesses Reply Envelope was changed to remind respondents to fill in the person information within the Diary.
- The Diary Cover Letter – was changed to remind respondents to fill in the person information within the Diary, rather than Person Information Sheet.

The reprinted, final diary with integrated Person Information Sheet is included as Appendix 9.

These later revisions significantly improved the quality of mailed in diaries and, reduced respondent burden and confusion even for those respondents reporting diary results by phone. The mail processing staff, however, still reported that there was often lack of clarity (which had to be resolved by recalls) as to when Day 1 finished and when Day 2 began, as many respondents stopped checking the repetitive "Day 1" after each time, before beginning Day 2. It is recommended that, in the future, for two-day diaries, instructions at the bottom of each diary page state clearly to check if Day 1 is finished, and to start Day 2 at the top of the next page. Another successful approach that has been tested is to provide respondents with a sticker to be placed at the end of Day 1.

No other significant changes were made in any of the other recruitment scripts or materials for MI Travel Counts.

7b.9. Retrieval Instruments and Modes

MI Travel Counts allowed retrievals by phone, mail, and Internet in order to suit the preferences of different households.

Statewide, not taking into account weighting, 10,530 persons (25%) chose to return their diaries by mail, only 180 (less than 1%) chose to return activity/travel and person information by Internet. Respondent households, and

members within a household, were immediately encouraged to complete the interview either by Internet or mail, if they did not want to proceed with the retrieval of information by phone. The Internet version for MI Travel Counts was designed and managed by Resource Systems Group Inc. of White Junction, Vermont. The format was very attractive and once respondents had recorded a few activities and trips, it easily navigated them through their 48-hour recording period, allowing them to edit responses as they proceeded. Addresses visited more than once did not have to be re-recorded.

Only 5% of those who agreed to complete the household's activity and travel inventories by Internet actually did so. This is most likely because the Internet retrieval option was only offered after the household had expressed reluctance to complete the inventories by phone. Thus, the agreement to complete by Internet was likely in essence, a soft refusal to begin with.

However, based on MORPACE's experience of conducting over 200,000 Internet interviews annually, it has been determined that Internet response rates decrease as the length of the questionnaire and number of open ended responses increase. The very low Internet response rates for MI Travel Counts may also be due to the long length of the MI Travel Counts retrieval questionnaire, especially when multiple household members' 48-hour activity/travel data had to be entered. Additionally, MI Travel Counts required many open-ended responses to enter unique addresses of trip destinations.

Once interviewers gained experience, the average length of the retrieval interview dropped from the pilot average of 13.7 minutes per person to 10.4 minutes per person, over the duration of the data collection period.

Section 8: Responsive Design Interviewing and Achieving Sample Goals

In Brief: *Section 8 provides a description of the problems encountered in obtaining the auto sufficiency sample goals of MI Travel Counts by sampling area for the difficult-to-fill data cells (rare populations). Once the problems were identified, techniques recently proposed by experts at the University of Michigan's Institute for Social Research were implemented in phases, starting with the fall 2004 recruitment for MI Travel Counts. This section describes and documents the approaches used for correction, and the results obtained at each phase of data collection.*

8a. Background

Section 4: Sample Design, Methodology, and Procedures provides a full description of the auto-sufficiency sampling plan developed for MI Travel Counts. The Sample Design Technical Document included as Appendix 1 to this report provides sample goals by data cells for each of the seven defined geographic areas of Michigan. Sample goals are proportional to 2000 Public Use Microdata Sample Area (PUMA) counts within each area by household size, and within household size, by the number of autos and the number of workers. Total sample size for each area was set at 2,040 completed households. Where proportional representation resulted in a data cell falling below 30 completed households (1.47% of the area sample), data cell targets were aggregated with an adjacent data cell(s) within the same auto sufficiency category [i.e. zero vehicles, autos are (>0) fewer than workers, autos are equal to workers, and autos are greater than workers]. Only the autos=0 category required aggregation across household size (for 2+ person households) due to small proportional data cell sizes. As shown in Appendix 1, after aggregation, the SEMCOG sampling area had 25 targeted data cells and each of the other areas had 24 targeted cells for a total of 169 targeted sample data cells.

As the Sample Design Technical Document developed, one of the goals of the project became precisely meeting proportional data cell sampling targets within sampling areas. This would limit the need for weighting data by the key modeling variables of household size, number of autos, and number of workers. The contracted methodology for reaching sample goals was Random-Digit-Dialing (RDD) with no additional budget for supplemental on-site or in-person interviewing.

8b. Phase 1 Progress Toward Sample Design Achievement

The interviewing began in March of 2004 with a traditional RDD sampling frame and methods, including pre-recruitment letters and at least six recruitment callback attempts to every household in a sample replicate, before proceeding to a new replicate of RDD numbers. No incentives were offered. Data collection continued in this fashion through the spring until June 10, 2004, when the data collection was suspended for the summer at the end of the public school year. Recruitment goals for the spring were set at double retrieval rates for each of the 169 targeted data cells, since a minimum participation rate (retrievals/recruitments) of 50% was anticipated, based on MORPACE's experience in conducting the Bay Area Travel Survey, the National Household Travel Survey Add-on

Program, and travel inventories at other sites since 2000. Table 12 and Table 13 show the results of MI Travel Count sample recruitment and retrieval at the end of June 2004 for the Small Urban Modeled Areas (one of the seven geographic strata), using traditional RDD sampling and data collection procedures.

Table 12. Recruitment by Data Cells as of 6/02/04
Small Urban Modeled Areas

Note: *Recruited Households as of 6/02/04***/***Total Recruitment Goal* **(***% Complete***)**

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers	23/152 (15%)	164/398 (41%)		
1 worker		172/468 (37%)		
2 PERSON HOUSEHOLDS				
0 workers	9/106 (8%)	63/158 (40%)	200/264 (76%)	
1 worker		41/136 (30%	167/282 (59%)	
2 workers		12/60 (20%)	272/470 (58%)	
3 PERSON HOUSEHOLDS				
0 workers	↓	40/84 (48%)		
1 worker		18/76 (24%)	34/84 (40%)	
2 workers		14/60 (23%)	58/156 (37%)	56/90 (62%)
3+ workers				47/70 (67%)
4+ PERSON HOUSEHOLDS				
0 workers	↓	38/96 (40%)		
1 worker		17/60 (28%)	84/152 (55%)	
2 workers		15/96 (16%)	119/280 (43%)	87/142 (61%)
3+ workers				98/144 (68%)

Findings:

- As of June 2004 overall recruitment for Small Urban Modeled Areas was at 45% (1,848 of 4,080).
- However, recruitment for some data cells was more than 60% complete while recruitment for other data cells (vehicles=0 or autos are fewer than workers) was less than 25% complete.

Table 13. **Retrieval by Data Cells as of 6/22/04**
Small Urban Modeled Areas

Note: *Households as of 6/22/04***/***Total Retrieval Goal* **(***% Complete***)**

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers	11/76 (14%)	125/199 (63%)		
1 worker		121/234 (52%)		
2 PERSON HOUSEHOLDS				
0 workers	1/53 (2%)	45/79 (57%)	157/132 (119%)	
1 worker		23/68 (34%)	105/141 (74%)	
2 workers		5/30 (17%)	178/235 (76%)	
3 PERSON HOUSEHOLDS				
0 workers	↓	25/42 (60%)		
1 worker		9/38 (24%)	18/42 (43%)	
2 workers		3/30 (10%)	21/78 (27%)	29/45 (64%)
3+ workers				28/35 (80%)
4+ PERSON HOUSEHOLDS				
0 workers	↓	19/48 (40%)		
1 worker		7/30 (23%)	44/76 (58%)	
2 workers		2/48 (4%)	59/140 (42%)	33/71 (46%)
3+ workers				31/72 (43%)

Findings

- Overall, retrieval for Small Urban Modeled Areas was at 54% (1,099 of 2,040) in June of 2004. The participation rate (retrievals/recruits) was 59.5%, higher than expected for this stratum.
- Moreover, the participation rate for 2-person households with 2+ autos and zero workers was 119% (157/132)--completed retrievals had already exceeded the target; while the participation rate for 2+ person households with zero autos was only 2% (1/53), in a data cell with only an 8% recruit rate (Table 12).

If the data collection were to continue in this traditional RDD manner the result would have been:

- Either a very disproportional sample, or
- Dramatically rising costs of interviewing as recruitment for data cells with both high recruitment and high participation rates were completed and data collection efforts were concentrated on the difficult to fill and rare population data cells, with very high calls-to-completes ratios.

This pattern is inherent in all RDD household travel surveys and, in fact, is intrinsic to all RDD data collection efforts where a proportionally representative sample is sought by key population variables of interest such as household size, number of autos, and number of workers.

8c. Explanation of Responsive Design Interviewing

Steven Heeringa and Robert Groves from the University of Michigan's Institute for Survey Research and the Joint Program in Survey Methodology have recently presented some new ideas on survey management[2] that had a significant impact on how nonresponse issues were addressed in MI Travel Counts.

- According to Heeringa and Groves, the computerization of the survey process allows researchers to capture both sample monitoring data and paradata that can be used to conduct cost/benefit tradeoff analyses in real time. 'Paradata' refers to process measures of interviewer effort and cost. This real-time access to survey responses and interviewing efforts provides one with the opportunity to make mid-course corrections and design alterations. Responsive designs use sample monitoring and paradata to guide changes in features of the data collection in order to maximize the quality of estimates per unit cost and to reach the goal of achieving a representative sample on key population variables of interest.

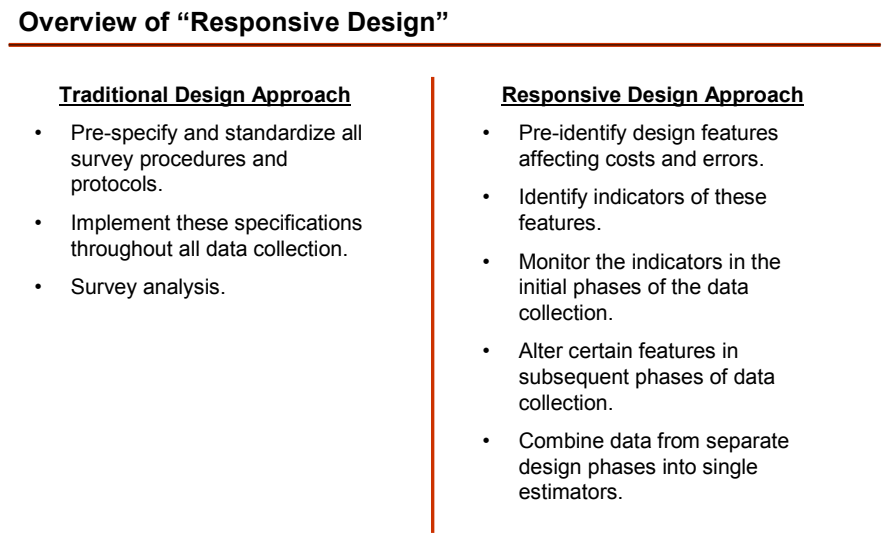
The primary motivations behind the use of responsive designs in household travel surveys are:

1. Cost inflation that commonly occurs during the later stages of data collection can be reduced. This, in turn, results in savings that provide additional budgetary resources for nonresponse conversions and other modeling tasks.
2. Reducing the nonresponse rates leads to more representative samples.

Figure 14 on the following page provides a comparison of the features of Traditional and Responsive Design data collection.

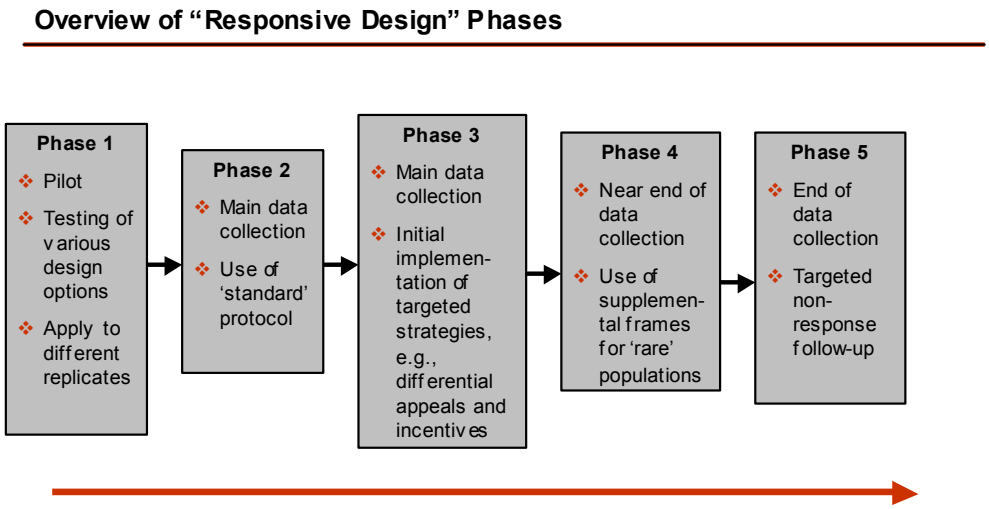
[2] Steven Heeringa and Robert Groves, *"Responsive Design for Household Surveys"* in the 2004 Proceedings of the American Statistical Association, Survey Research Methods.

Figure 14: Overview of "Responsive Design"



Responsive design is characterized by phases of the data collection where differing sets of sampling frames, data collection modes, recruitment protocols, etc. are in force. Figure 15 presents an overview of the five phases of responsive design interviewing for MI Travel Counts. Phase 1 was the pilot followed by Phase 2, the main data collection period using standard sampling frames and protocols. In Phase 3, the main data collection was continued with progressive implementation of targeted strategies and differential incentives for identified rare populations. In Phase 4, near the end of the data collection, supplemental sampling frames for rare populations were employed. Finally, Phase 5 concentrated on nonresponse follow-up.

Figure 15: Overview of "Responsive Design" Phases



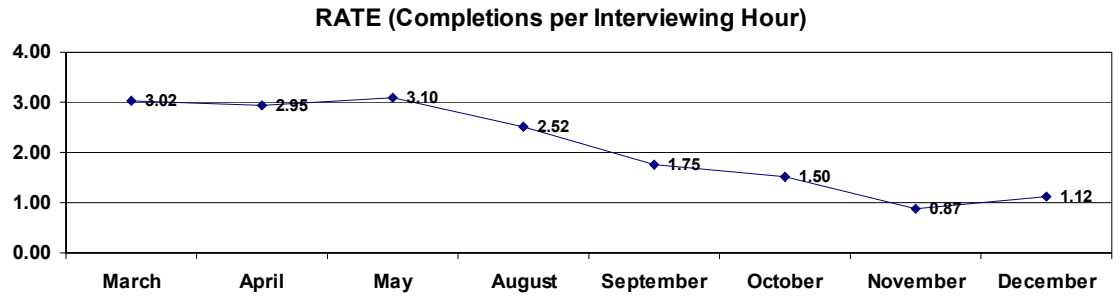
The responsive design interviewing approach is particularly appropriate for household travel surveys because they involve:

- Large samplings with extended periods of data collection
- Highly stratified designs that have pushed up the costs of data collection
- Multi-stage data collection protocols, e. g., recruitment followed by diary completion followed by data collection/submission
- Increased respondent burden – particularly with multiple travel day diary completion, geographic specification, and stringent household member participation requirements

A pre-test and five phases of data collection were used in the MI Travel Counts survey. Phase 1 started with the main data collection effort in the spring of 2004 using standard RDD protocol and ended in June of 2004 when the results of the standard protocol could be fully assessed. Phases 2 through 4 were implemented as will be described below during the fall of 2004 until January of 2005. Phase 5 of data collection was conducted in February and March of 2005, when the data collection ended.

Paradata measures examined for MI Travel Counts from March of 2004 to December of 2004 showed the effect of unequal recruitment and retrieval rates by data cell on key measures of interviewing effort. A common measure of survey response is the number of completions per interviewer hour as shown in Figure 16.

Figure 16: RATE (Completions per Interviewing Hour)

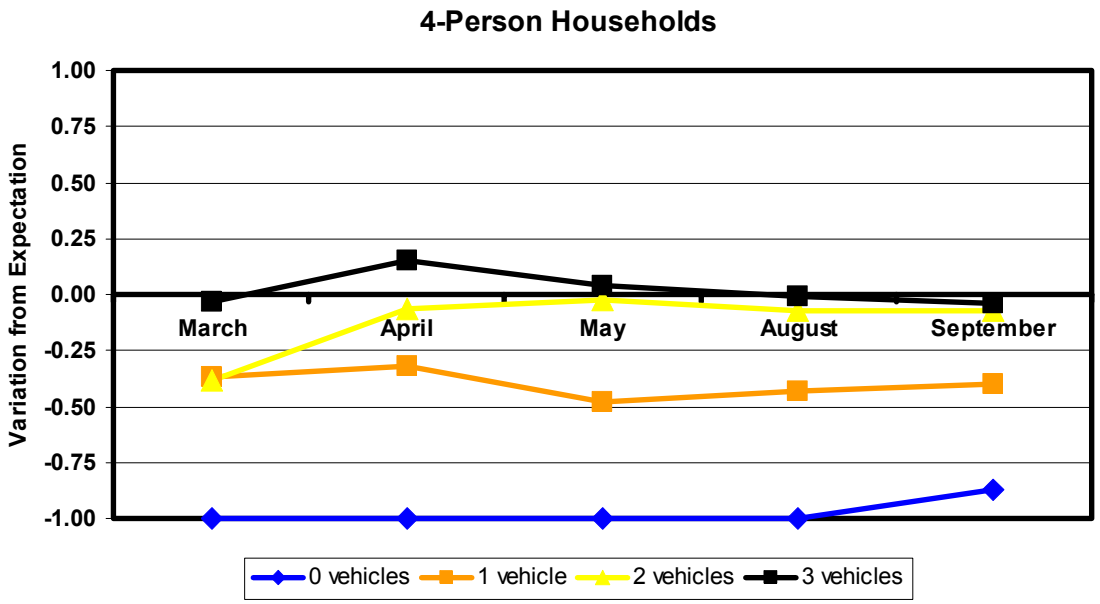


In March of 2004, the rate of household completes was 3.02 per interviewing hour and this rate remained fairly constant until mid-May 2004, when, as predicted, the production rate for recruits per hour began and continued to decline dramatically. This was because the recruitment for easy to fill and proportionally large data cells was being halted since retrieval targets had been met, and the survey effort was increasingly concentrated on recruiting households in rare population data cells. In effect, the interviewers were beginning to have to look for rare populations that are only 2.4% of households within Michigan, or within a sample area.

Figure 17 plots a monthly index of 'yield' observed for one of the geographic strata for 4+ person households by the number of household vehicles (March through September

of 2004). The 'yield' is the observed number of recruitment completions divided by an expected number of completions assuming no differences in response rates.

Figure 17: Example- Small Urban Modeled Areas



A similar pattern was observed for all strata for all household size categories - zero vehicle households are much more difficult to recruit from an RDD sample than are households with vehicles.

The implications for household travel data collection efforts are:

1. There is a need to explicitly incorporate a multi-phase survey design where planned assessments of sample and paradata occur between phases and changes to design elements are considered.
2. During the initial design phase testing of various design options that may impact nonresponse should be implemented.
3. Real-time paradata indices of nonresponse (e.g., recruitment success against a detailed population model) should be tracked.

The Responsive Design options to correct for nonresponse that were implemented for MI Travel Counts included:

- Adjustments between phases to the recruitment quotas based on differential response rates in the second stage data collection.
- Implementation of differential incentives (for different subpopulations) in the second stage data collection (retrieval) across phases.

- Use of supplemental sample frames for subgroups with less than 10% incidence (our 'rare' populations) as the data collection progressed.

The remainder of this section documents the responsive design changes that were made in each phase of the data collection and the corresponding results.

8d. Evaluation of Responsive Design Options and Results by Phase

This section reviews data collection Phases 2 through 5

Phase 2

Phase 2 commenced with the resumption of data collection in the fall of 2004. The first option/technique used in Phase 2 was to adjust recruitment targets/quotas by data cell to reflect actual Phase 1 experience with recruitment response rates and retrieval participation rates by data cell. This adjustment of recruitment quotas based on actual data cell experience continued throughout the remaining phases of data collection.

The second adjustment in Phase 2 involved phasing into the main RDD sample a targeted low-income RDD sampling frame. This was justified by Phase 1 paradata which showed that both recruitment response rates and retrieval participation rates within all sampling areas were low for households with zero autos and for households with autos fewer than workers. A review of Phase 1 data for these cells revealed that these households on average have low incomes. Genesys prepared the targeted low income RDD sample for each sampling area, selecting those geographic areas (exchanges) where 2000 Census data showed a concentration of households with incomes less than $25,000.

At the start of Phase 2 (with the resumption of data collection in the fall of 2004), this targeted low-income sample was released at a ratio of 1 to 4 with the main RDD sample. As the data cells with autos equal to or greater than workers achieved goals, the low-income sample ratio to RDD main sample was increased to 1:3.

Tables 14 and 15 show early October results from the Phase 2 data collection.

Table 14. Recruitment by Data Cells as of 9/28/04
Small Urban Modeled Areas

Note: *Recruited Households as of 9/28/04* **/** *Total Recruitment Goal* **(***% Complete***)**

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers	48/158 (30%)	244/259 (94%)		
1 worker		231/326 (71%)		
2 PERSON HOUSEHOLDS				
0 workers	21/482 (4%)	102/111 (92%)	200/200 (100%)	
1 worker		62/116 (53%	218/218 (100%)	
2 workers		19/72 (26%)	347/346 (100%)	
3 PERSON HOUSEHOLDS				
0 workers	↓	58/65 (89%)		
1 worker		28/76 (37%)	61/71 (86%)	
2 workers		21/143 (15%)	83/205 (40%)	77/81 (95%)
3+ workers				56/55 (102%)
4+ PERSON HOUSEHOLDS				
0 workers	↓	51/96 (53%)		
1 worker		27/68 (40%)	113/146 (77%)	
2 workers		24/361 (7%)	172/269 (64%)	122/182 (67%)
3+ workers				124/213 (58%)

Findings:

- As of September 28, 2004 overall recruitment for Small Urban Modeled Areas was 58% (2,510 of 4,319).
- Recruitment was high (meeting goals) for 1 and 2-person households with autos equal to or greater than workers while recruitment of zero vehicle households overall increased from 32 to 69, or by 116%. However recruitment overall for the lower income household data cells was still lower than needed to achieve targets, especially given low participation (retrieval) rates for these households.

Table 15. Retrieval by Data Cells as of 10/04/04
Small Urban Modeled Areas

Note: *Households as of 10/04/04* **/** *Total Retrieval Goal* **(***% Complete***)**

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers	25/76 (33%)	177/199 (89%)		
1 worker		150/234 (64%)		
2 PERSON HOUSEHOLDS				
0 workers	2/53 (4%)	64/79 (81%)	162/132 (123%)	
1 worker		29/68 (43%)	133/141 (94%)	
2 workers		7/30 (23%)	226/235 (96%)	
3 PERSON HOUSEHOLDS				
0 workers	↓	31/42 (74%)		
1 worker		11/38 (29%)	29/42 (69%)	
2 workers		3/30 (10%)	29/78 (37%)	37/45 (82%)
3+ workers				35/35 (100%)
4+ PERSON HOUSEHOLDS				
0 workers	↓	24/48 (50%)		
1 worker		9/30 (30%)	52/76 (68%)	
2 workers		2/48 (4%)	76/140 (54%)	39/71 (55%)
3+ workers				40/72 (56%)

Findings

- Retrieval for Small Urban Modeled Areas was at 68% (1,392 of 2,040). Retrievals have achieved goals for four 2 and 3 person household data cells.
- However, while retrieval of zero vehicle households increased from 12 to 27 (125%), retrievals for zero auto households and households with fewer autos than workers were still well below goal.

Conclusions from the Phase 2 data collection were that, while the responsive design techniques implemented made significant progress towards obtaining a fully proportional sample within strata, the progress was not sufficient to achieve the overall survey goals within the time and budget allowed.

Phase 3

Phase 3 developed a more specifically targeted approach consisting of implementation of differential incentives for zero vehicle households. MORPACE accepted the sponsorship and budgetary responsibility for incentives, so offering the incentive and the letter accompanying the incentives came from MORPACE instead of the Michigan Department of Transportation. During the recruitment, an incentive of $20 was offered to 1-person households with zero autos if they completed the retrieval; this incentive was increased to $30 for 2+-person households with zero vehicles completing the retrieval. Checks and a thank-you letter were mailed using MORPACE letterhead within 10 to 14 days after receiving the entire households' activity/travel inventories. The differential incentives for zero auto households were implemented on October 29, 2004.

Later in Phase 3 (on December 2, 2004) $20 incentives were also implemented on the same basis for households with at least one auto, but with autos fewer than workers. Also, $20 incentives were offered for 2+ person households where autos equal one and workers equal one. Households targeted for incentives were for the most part low-income households.

Table 16 shows the results of Phase 3 data collection where differential incentives were introduced. The introduction of incentives for household size 1 and 2+ with zero autos increased the number of retrieved households respectively by 188% and 850%; however the retrieval of rare population households was still significantly below goal.

Table 16. Retrieval by Data Cells as of 01/05/05
Small Urban Modeled Areas

Note: *Households as of 01/05/05***/***Total Retrieval Goal* **(***% Complete***)**

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers	72/76 (95%)	206/199 (104%)		
1 worker		237/234 (101%)		
2 PERSON HOUSEHOLDS				
0 workers	19/53 (36%)	85/79 (108%)	163/132 (123%)	
1 worker		59/68 (87%)	140/141 (99%)	
2 workers		18/30 (60%)	238/235 (101%)	
3 PERSON HOUSEHOLDS				
0 workers	↓	43/42 (102%)		
1 worker		27/38 (71%)	45/42 (107%)	
2 workers		9/30 (30%)	74/78 (95%)	45/45 (100%)
3+ workers				38/35 (109%)
4+ PERSON HOUSEHOLDS				
0 workers	↓	57/48 (119%)		
1 worker		18/30 (60%)	76/76 (100%)	
2 workers		8/48 (17%)	135/140 (96%)	83/71 (117%)
3+ workers				70/72 (97%)

Findings

- Overall, Small Urban Modeled Areas retrieval was at 96% (1,965 of 2,040).
- 1-person zero auto household retrieval increased from 25 to 72, or 188%; 2+-person zero auto retrieval increased from 2 to 19 or 850%, however, this was still significantly below the goal, as were 2+-person households with autos fewer than workers.

Phase 4

By late December of 2004, over 12,900 households had been retrieved for MI Travel Counts and only the difficult-to-fill, rare population data cells remained to be retrieved, representing less than 10% of the overall sample goal. At this point, Phase 4 data collection was implemented. After the RDD and targeted low income sample was depleted with over four callback attempts to each number, an RDD listed sample targeted to unfilled data cells by both household size and income was developed by Genesys.

For most data cells, this sample was targeted by household size and (low) income categories. Moving to a listed sample allowed targeting by these key variables and was further justified by an analysis of MI Travel Counts sample dispositions that showed that 91% of retrieval completes were from households who had received a pre-recruitment letter. These are in fact the listed households for whom addresses could be matched with phone numbers. Unlisted numbers, for the most part, turn out to be non-working/non-assigned numbers, fax numbers, business numbers or otherwise ineligible numbers, or numbers for which eligibility is unknown.

The rare population status of the difficult-to–fill data cells is confirmed by 2000 PUMS data which shows that for the Small Urban Modeled Areas, 2+ person households with zero vehicles are only 2.59% of the areas' households, 4+ person households with autos fewer than workers are only 2.38% of total, while 3+ person households with autos fewer than workers are only 1.45% of total households.

Deviations from modified Random-Digit-Dialing (RDD) sampling such as more qualitative "bootstrapping" or in-person interviewing methods were not considered since MDOT's modeling requirements were for a statistically valid sample, and thus an RDD dependent frame. In addition the project contract did not provide for methodologies outside RDD.

The results at the end of January 2005 shown in Table 17 display the impact of using a listed RDD sample targeted by household size and income, along with Phase 3 differential incentives.

Table 17. **Retrieval by Data Cells as of 01/25/05**
Small Urban Modeled Areas

Note: *Households as of 01/25/05***/***Total Retrieval Goal* **(***% Complete***)**

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers	94/76 (124%)	206/199 (104%)		
1 worker		240/234 (103%)		
2 PERSON HOUSEHOLDS				
0 workers	42/53 (79%)	86/79 (109%)	163/132 (123%)	
1 worker		87/68 (128%)	141/141 (100%)	
2 workers		24/30 (80%)	239/235 (102%)	
3 PERSON HOUSEHOLDS				
0 workers	↓	44/42 (105%)		
1 worker		36/38 (95%)	48/42 (114%)	
2 workers		15/30 (50%)	98/78 (126%)	47/45 (104%)
3+ workers				39/35 (111%)
4+ PERSON HOUSEHOLDS				
0 workers	↓	60/48 (125%)		
1 worker		34/30 (113%)	83/76 (109%)	
2 workers		18/48 (38%)	146/140 (104%)	83/71 (117%)
3+ workers				71/72 (99%)

Findings

- Small Urban Modeled Areas retrieval was at 105% (2,144 of 2,040).
- Zero-vehicle household retrieval when household size=2+ was still under goal as were 3+ household size retrievals where autos are fewer than workers.

Phase 5

In the final and last Phase of data collection (Phase 5), non-response, refusal conversion was attempted for all data cells in all sampling areas where retrievals did not meet goals. This involved senior interviewers making up to six callback attempts to recruited households in the targeted cells that failed to complete the retrieval for all household members. An attempt was made to re-recruit these households for new assigned travel days. These households were offered an incentive of $20 if all members completed the retrieval.

Table 18 documents the results of the non-response interviewing for Small Urban Modeled Areas. In addition, as a last attempt to document the ineffectiveness of attempting to recruit 2+ person households with zero vehicles in the three rural areas (Upper Peninsula Rural, Northern Lower Peninsula Rural, and Southern Lower Peninsula Rural) as well as 4+ person households with autos fewer than workers in the sampling areas of SEMCOG, TMAs, and Small Urban Modeled Areas through even modified RDD methods, recruitment for the targeted data cells was retried with an additional listed RDD sample. However, given the small percentages of the general population that these subgroups represent (2.59% and 1.45% to 2.38%, respectively), only four additional

households for these cells could be recruited and interviewer call to complete ratios exceeded 200:1.

An MDOT review of 2+-person households with zero autos in the Upper Peninsula Rural Area using Census block data showed unexplainable concentrations of zero vehicle households leading to a possible conclusion that there may be anomalies in the 2000 Census data in regard to this variable in these rural locations. In concluding the MI Travel Counts data collection effort it was agreed with MDOT that no further efforts were warranted to reach the 24 unmet data cell goals.

Table 18 shows the final results for sample goal achievement in the Small Urban Modeled Areas.

Table 18. Final Retrieval by Data Cells
Small Urban Modeled Areas

Note: *Final Households Retrieved* **/** *Total Retrieval Goal* **(***% Complete***)**

NUMBER OF WORKERS	***0 VEHICLES***	***1 VEHICLE***	***2 VEHICLES***	***3+ VEHICLES***
1 PERSON HOUSEHOLDS				
0 workers	98/76 (129%)	206/199 (104%)		
1 worker		243/234 (104%)		
2 PERSON HOUSEHOLDS				
0 workers	51/53 (96%)	89/79 (113%)	163/132 (123%)	
1 worker		91/68 (134%)	144/141 (102%)	
2 workers		29/30 (97%)	242/235 (103%)	
3 PERSON HOUSEHOLDS				
0 workers	↓	44/42 (105%)		
1 worker		48/38 (126%)	48/42 (114%)	
2 workers		19/30 (63%)	106/78 (136%)	48/45 (107%)
3+ workers				40/35 (114%)
4+ PERSON HOUSEHOLDS				
0 workers	↓	60/48 (125%)		
1 worker		40/30 (133%)	85/76 (112%)	
2 workers		23/48 (48%)	150/140 (107%)	86/71 (121%)
3+ workers				73/72 (101%)

Findings

- Small Urban Modeled Areas retrieval is at 109% (2,226 of 2,040).
- Zero-vehicle household retrieval when household size=2+ almost reached goal (96%); 3+ household retrieval where autos>0 but fewer than workers is on average 54% complete.

Phase 5 results and final completion to goal rates by data cell for other MI Travel Counts strata followed similar patterns. A final summary of data cells that did not reach goal 100% of goal is provided by sample area in Table 19.

Table 19. Final Summary of Under Target Data Cells By Sample Area and Percent Under Goal (Data Cells with Less than 100% of Goal Achieved in Any Sample Area)

	Data Cell Description									
	HH Size=1	**HH Size=2**		**HH Size=3**				**HH Size=4+**		
Region	*Autos=0*	*HH Size=2+ Autos=0*	*Autos=1 Workers=2*	*Autos=1 Workers=1*	*Autos=3+ Workers=3+*	*Autos < Workers*	*Autos=3+ Workers=3*	*Autos=1 Workers=1*	*Autos < Workers*	*Autos=3+ Workers=2*
SEMCOG	AG	AG	AG	AG	AG	AG	AG	95%	62%	AG
Small Cities	AG	AG	AG	AG	AG	AG	AG	AG	94%	AG
Upper Peninsula Rural	96%	51%	AG	91%	93%	AG	AG	AG	73%	98%
Northern Lower Peninsula Rural	89%	71%	90%	AG	AG	57%	97%	AG	81%	AG
Southern Lower Peninsula Rural	AG	54%	AG	AG	AG	87%	AG	AG	92%	AG
TMAs	AG	AG	94%	AG	AG	87%	AG	AG	61%	AG
Small Urban Modeled Areas	AG	96%	97%	AG	AG	63%	AG	AG	48%	AG

AG= Achieved Goal

At the end of the data collection and review period, using the responsive design phased approach, 85.2% of the 169 data cells had reached 100% of the completed and accepted household goals; 95% of data cells (160) had achieved more than 80% of goals. Only one cell was under 50% complete (Small Urban Areas: HH Size=4+ Autos > 0 but less than Workers was 48% complete).

Of the nine data cells where less than 80% of target was completed, over half (5) were rare populations (under 2.5% of households in the Sample Area) for which MORPACE was unable to recruit a sufficient number for completion. An analysis by MDOT of 2000 Census data in the three rural strata showed small geographic concentrations of 2+ person households with zero vehicles. These concentrations were not accessible for recruitment through RDD sampling methods.

The remaining four data cells in the urban areas of SEMCOG, TMAs, and Small Urban Modeled Areas had sufficient recruitments but low participation (retrieval) rates, and incentives and nonresponse interviewing efforts employed were insufficient to overcome this participation deficit. However, nearly representative samples within each sample area were achieved using the responsive design approach.

Section 9: Response Rates and Interview Refusal Summary

In Brief: *Section 9 presents the recruitment response rates for MI Travel Counts and describes the refusal conversion techniques that were used.*

RECRUITMENT RESPONSE RATE

Table 20 shows the number of pre-recruitment letters sent per sample area and the final disposition of sample numbers.

MI Travel Counts used a two-stage interviewing process: (1) recruit households from an RDD sample, and (2) retrieve information from all members of the recruited households. The two response rates are determined separately and are called, respectively, the recruitment response rate and the participation rate.

The customized computer system recorded a disposition (or outcome) for each of the 321,858 phone numbers in the sample over the full course of the project. Call attempts yielded three types of dispositions: (1) eligible (a residence within Michigan), (2) ineligible (business, government, non-working number, fax, etc.), and (3) unknown eligibility (no answer, busy, etc.). Subcategories for each of these dispositions are shown above in Table 20.

The sample classified as unknown eligibility is mostly households, or perhaps small businesses or organizations, which are just not picking up the phone, or a person hangs up before the interviewer can get through the project introduction. The exact outcome for this portion of the sample is unknown.

Based on the American Association for Public Opinion Research's (AAPOR) Response Rate 3 (RR3) method, the assumption that 20% of unknown eligibility cases are actually eligible was used. Using this approach, we assumed that 20% of the unknown eligibility sample is eligible (0.20 x 115,082 = 23,016). Adding this to the known eligible sample (37,259), we assumed there were 60,275 eligible numbers (23,016 + 37,259 = 60,275). In calculating a recruitment response rate this way, 48.6% of all assumed eligible households were recruited (29,272/60,275 = 48.6%).

Using the CASRO method of estimating response rates, we assumed, based on our experience to date, that the percent of unknown numbers that will be found to be eligible will be eligible/(eligible+ineligible). The eligible count is 37,259 and the ineligible count is 169,517, as shown in Table 20. The percent of unknown numbers that will be found to be eligible is 18.0% [37,259/(37,259+169,517) or 37,259/206,776=18.0%]. Thus, the total eligible numbers would be estimated at 37,259 +(115,082*0.18 or 20,715) = 57,974. The response rate using this formula then would be estimated at 46.8% (29,272/57,974) = 50.49%). The fact that these two different formulas support similar response rate result confirms the reliability of the estimate.

Table 20. Count of Pre-Recruitment Letters and Sample Disposition

Region	Statewide	SEMCOG Not Detroit	Detroit	Small Cities	UP Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMA's	Urban Modeled Areas
Pre-Recruitment Letters Sent	221981	31426	18138	52383	20210	28354	19604	28318	23548
Pre-Recruitment Letters Undeliverable	23508	2923	1904	2514	4881	6949	2354	2105	1982
Pre-Recruitment Letters Delivered	198473	28503	16234	49869	15329	21405	17250	26213	21566
Pre-Recruitment Letters Deliverd as a Percent of Total Sample	62%	67%	74%	82%	44%	52%	53%	58%	52%
Total Sample	321858	42431	22019	61134	35134	41392	32659	45412	41677
Eligible	37259	5309	2308	5879	4439	4705	4557	5231	4831
Completed Recruit Interviews	29272	3816	1551	4504	3770	3859	3840	4075	3857
Refused	4185	748	255	781	351	527	395	602	526
Never call us again / Remove from Listings	2000	356	94	397	151	247	194	291	270
Party Terminated - Qualified / Refused	858	158	90	179	65	105	70	108	83
Do Not Call Now / Not Dialed	1327	234	71	205	135	175	131	203	173
Terminated Mid-Interview	1577	181	162	302	163	202	153	201	213
Party Terminated Mid-Survey-Qualified	1536	177	161	292	161	199	147	197	202
Cancelled Respondent	15	0	0	2	1	2	3	2	5
Deleted Complete	26	4	1	8	1	1	3	2	6
Language Barrier / Deaf	2225	564	340	292	155	117	169	353	235
Ineligible	169517	21523	10633	32806	19784	21575	17433	23392	22371
Question Terminate - Did Not Qualify	63603	8899	4293	12646	6415	7966	6278	9071	8035
Disconnected / Changed / New / Not Working	43558	4615	3221	6881	6742	5440	4563	5984	6112
Fax Machine / Data Line Terminate	8334	1611	503	1308	696	929	797	1392	1098
Wrong / Business	14676	2649	830	2945	1214	1524	1070	2255	2189
Wrong	4066	737	277	783	334	422	263	711	539
Business /Government	10502	1900	546	2143	871	1081	794	1528	1639
Party Not Available - Never Will Be / Dead	108	12	7	19	9	21	13	16	11
Quota Terminate - Qualified / Quota Filled	39346	3749	1786	9026	4717	5716	4725	4690	4937
Unknown	115082	15599	9078	22449	10911	15112	10669	16789	14475
No Answer/Busy	32737	4272	2728	5520	3394	5310	2894	4720	3899
No Answer	29388	3680	2462	5035	3071	4922	2566	4149	3503
Busy	2325	381	175	338	225	304	262	372	268
New / Changed	1024	211	91	147	98	84	66	199	128
Answering Machine	38393	5217	2476	8530	3125	4884	3510	5705	4946
Scheduled For A Callback	8277	1160	1172	1548	651	646	610	1410	1080
Party Terminated (Would Not Speak)	35675	4950	2702	6851	3741	4272	3655	4954	4550

Throughout the data collection, sample numbers where the party hung up before the interviewer could get through the introduction were flagged by the interviewer as "soft or uninformed refusals." These numbers were put back into the system after a period of 7 to 10 days to retry the recruit before the numbers were retired. Interviewers immediately classified as refusals those households where the respondent stated not to call again or when strong or abusive language was used.

The percent of retrievals to recruits is called the participation rate. Table 21 shows the participation rate by stratum:

Table 21. Participation Rates by Stratum

Stratum	Number of Recruits	Number of Retrievals	Participation Rate
SEMCOG	5,367	2,534	47.2%
Small Cities	4,504	2,760	61.3%
Upper Peninsula Rural	3,770	2,306	61.2%
Northern Lower Peninsula Rural	3,859	2,352	60.9%
Southern Lower Peninsula Rural	3,840	2,261	58.9%
TMAs	4,074	2,312	56.8%
Small Urban Modeled Areas	3,858	2,226	57.7%
	29,272	16,753	57.2%

The completed sample was well over target in each of the 7 strata (target=2040 per stratum) because even with all of the efforts to micro-manage recruitment quotas per data cell, many data cells had higher than anticipated participation rates, and once a household was recruited for the travel inventory, reasonable effort had to be expended to retrieve the household's information.

As previously stated, the contracted method for MI Travel Counts was Random-Digit-Dialing (RDD). Additional budget for qualitative approaches, such as sending interviewers out to Census identified clusters of zero vehicle households in the Upper Peninsula or searching for 3+ person households with autos>0 but fewer than workers through social service agencies, was not available. Additionally, such qualitative approaches would have reduced the overall statistical reliability of the sample. The trade-off of using scientific RDD sampling is that households with only cell phones (mostly single young adults) and households without phones were excluded from the recruitment. Cell phone sampling methodology and permission to contact cell phones does not yet exist. Households in Michigan without phones are estimated at approximately 3% while the percent of adults (not households) with cell phones only is estimated at 5.5% nationally. While we do not know if there are any differences in travel characteristics between land/and non-land phone holders, recent research has shown that individuals/households come in and out of land phone access, so that demographically they are similar to those who recently obtained a land phone and who were, therefore, included in the MI Travel Counts sample. Also, retrieval of travel inventories for one-person households with one auto exceeded data cell goals for all sample areas. The RDD sampling frame was updated every four months to insure that new numbers were included in the sample over the course of the year of data collection.

Section 10: Geocoding

In Brief: *Section 10 presents the details of the MI Travel Counts geocoding process, the problems encountered, solutions implemented, and the corresponding geocoding results.*

10a. Process

As stated in Section 5 of this report, the geocoding process took place concurrently with the data collection task. The geocoding process for MI Travel Counts followed a "Geocoding Hierarchy" developed by MDOT's Geocoding Team.

Figure 18 shows a flowchart of the Geocoding Process for MI Travel Counts. The steps below explain the geocoding process.

Step 1: Data Processing Generated Files for Geocoding

- The Data Processing Department prepared home, start, work, school, and trip.csv files.

Step 2: Geocoding Files Cleaned and Prepared

The Research Team prepared files for geocoding -using the geographic Framework v3 files supplied by the Michigan Geographic Information Center. Framework v3 was integrated with ArcView to geocode files to Framework street-level.

- A customized in-house process of address cleaning to prepare files to be geocoded was developed. This process is described in further detail in the MI Travel Counts Geocoding Manual, which is included as Appendix 22, page 23.

Step 3: First Automatic to Street Level using ArcView

- Files were automatically geocoded to Framework v3 street-level (First Automatic) using ArcView.
- Records were matched to a minimum 90% accuracy and had an offset of 25 feet.

Step 4: First Interactive to Street Level using MapMarker

- Records that could not be automatically geocoded to Framework v3 street level in Step 3 were interactively geocoded to MapMarker Plus (GDT enhanced) street-level (First Interactive). If there was a non-geocodable address listed in the Home File, the respondent was re-contacted for the correct home address. No geocoding other than to street-level was done during this step.

Step 5: Internet & Map Investigations

- Research staff identified all locations that were not yet geocoded to street-level.
- Internet searching of all locations not yet geocoded to this level was performed in Step 5.

Step 6: Second Automatic to Street-Level using ArcView

- A second automatic geocoding process was performed (Second Automatic) as described in Step 3 to Framework v3 street level using ArcView.

Step 7: Final Interactive to Street-Level and Street-Intersection using MapMarker

- All addresses not geocoded to Framework v3 in Step 6, were interactively geocoded to MapMarker Plus (GDT enhanced) street-level using MapMarker.
- During this process, a final interactive process was performed (Final Interactive), again looking at every record individually as described in Step 4.
- As many locations as possible were geocoded to street-level. The majority of street-level locations at this stage were MapMarker street-level. If a location could not be geocoded to street-level, then it was geocoded to Framework Intersection and then to MapMarker Intersection.

Step 8: Final Automatic to Street-Level using ArcView

- A final automatic geocoding process was performed (Final Automatic) as described in Step 3, when necessary.

Step 9: Review of Non-Geocodables

- The remaining non-geocodables were reviewed. Attempts were made through Internet sites and other resources to get these last locations to street-intersection. When necessary, an attempt was made with Maptitude to manually geocode trip locations for households that had more than 24% of their total trip origins and destinations either non-geocodable or with time and distance issues.

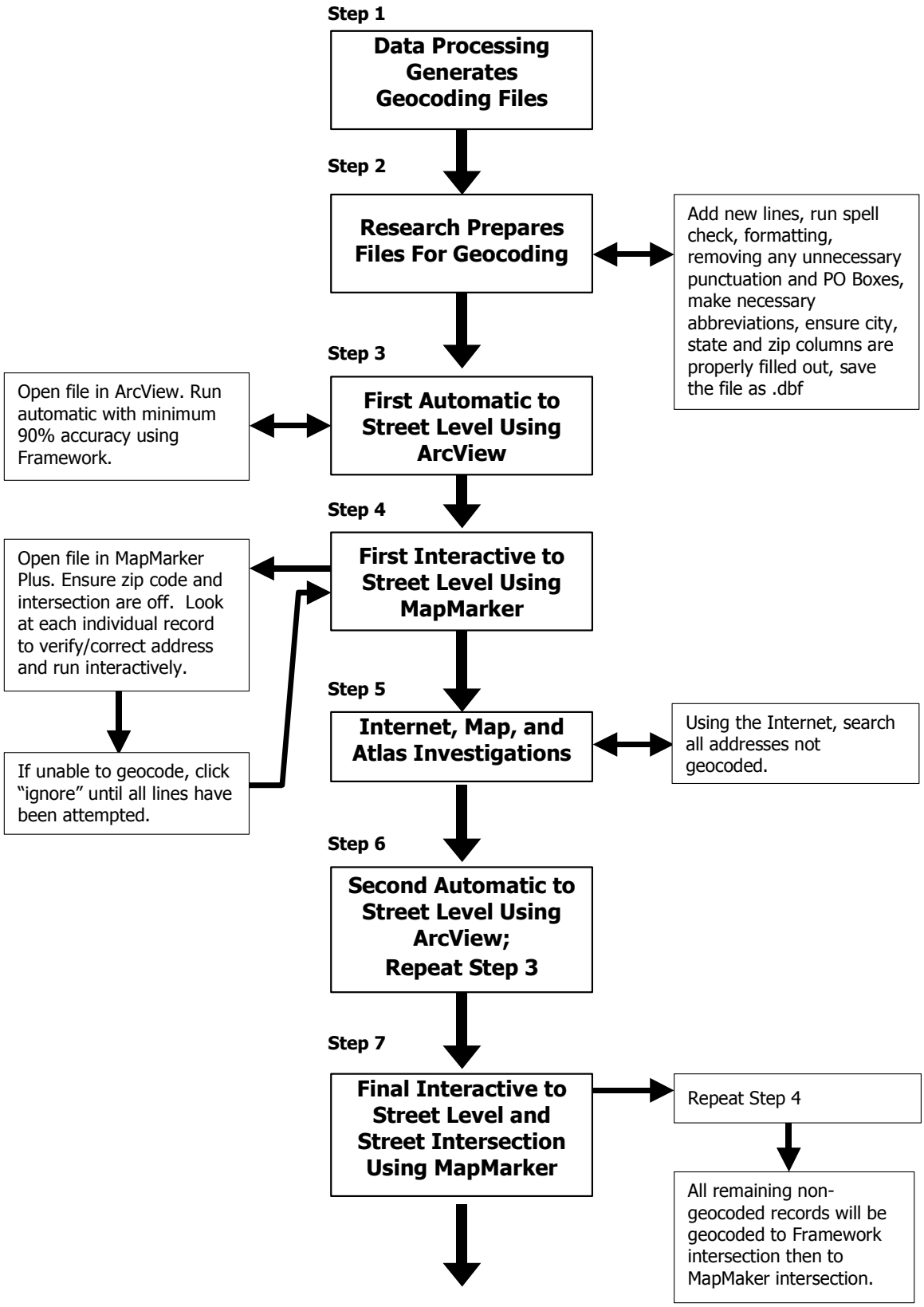
Step 10: Assignment of Sample Areas using Maptitude

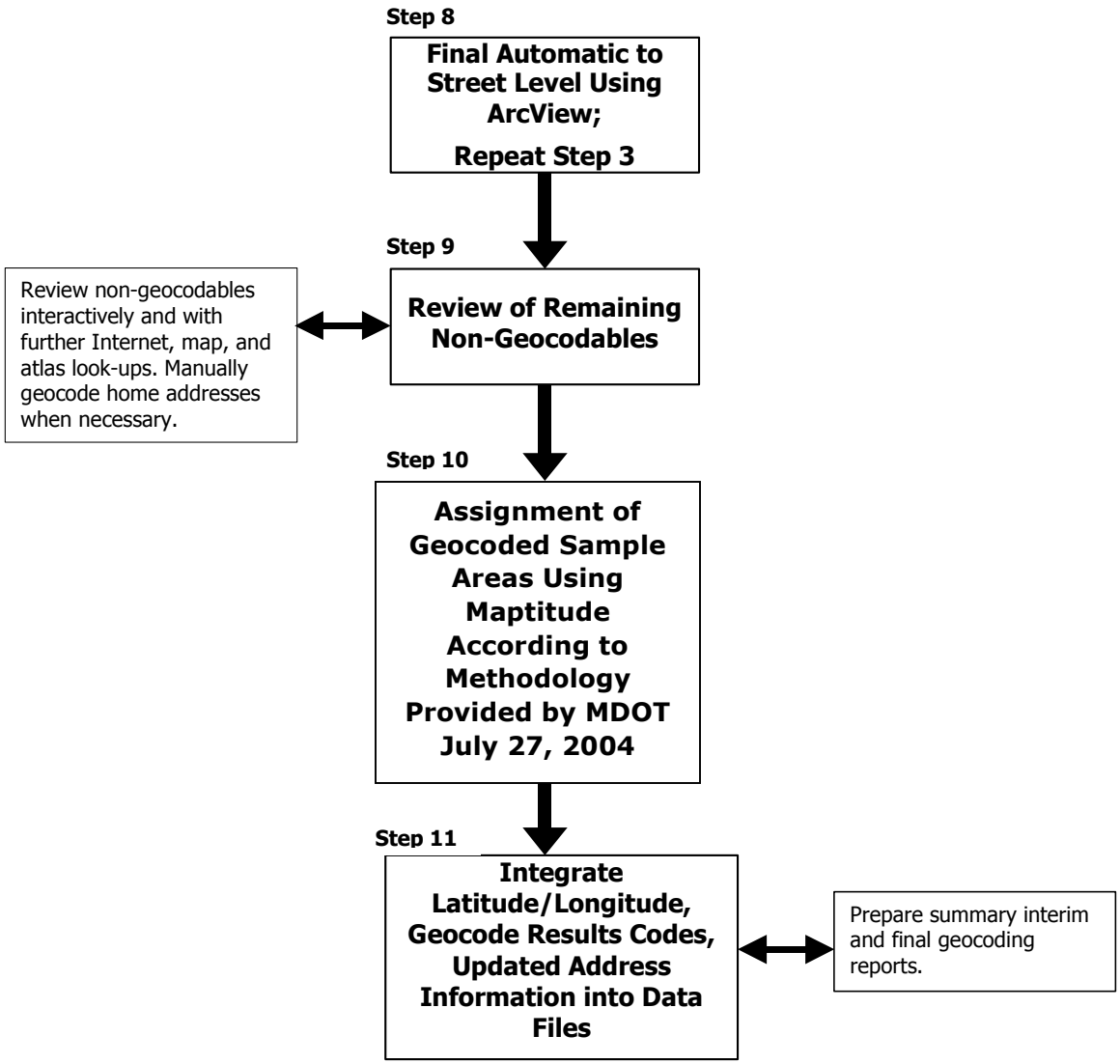
- Sample Areas were assigned to home locations using the geocoded information according to the methodology provided by MDOT, July 27, 2004.

Step 11: Integrate Latitude/Longitude, Geocoding Results Codes, and Updated Address Information into Data Files

- Latitudes, longitudes, the geocode result, and corrected address information were entered into fields of the project data files.

Figure 18: MI Travel Counts Geocoding Procedures Flowchart





10b. Traffic Analysis Zone (TAZ) Assignment

Traffic Analysis Zone (TAZ) assignments were completed by Parsons Brinckerhoff (PB). Detailed procedures of the TAZ assignment are described in Appendix 22.

10c. Quality Control

Parsons Brinckerhoff (PB) conducted audit checks on all geocoded points for MI Travel Counts. Files were submitted for audit on an interim basis starting with the pilot report, then after the completion of each additional 2000 households (Interim Reports). With the use of MI Geographic Framework V3 (MGFv3), ArcGIS 8.x, and the TransCAD statewide model network from MDOT, the auditor was successfully able to complete geocoding checks. A detailed explanation of the process is described in further detail in Appendix 22, Page 12. The auditor then provided a written report of the findings. In addition to geocoding checks, the auditor also conducted time and distance checks as

described in Section 11: Data Checking and Interim Data and Report Delivery. The MDOT Geocoding Team developed a Geocoding Hierarchy to follow for all household, work, school and trip locations. This process was discussed at the February 26, 2004 meeting and approved by MDOT on March 4, 2004. The hierarchy is described in the geocoding procedures above and is listed in the Geocoding Manual in Appendix 22. It was agreed that households not meeting the criteria of having no more than 24% of their trip origins and destinations nongeocodable would be thoroughly reviewed for possible correction.

10d. Problems & Solutions

Households not meeting the geocoding criteria established by MDOT (25% or less nongeocodable records per household) were further reviewed. The households were examined using manual Internet or map searches, followed by manual geocoding using Maptitude software with MI Geographic Framework v3.

Additional information for nongeocodable records was provided by MDOT and Parsons Brinckerhoff (PB) as auditor, and flagged in the dataset after each interim report. However, the intense data collection schedule of completing 2,000 households per month, along with the need to keep up with geocoding and recalls to respondents, and the 30% increase in geocoding time required by integrating and giving preference to geocoding to Michigan's Framework files, made it impossible to review geocoding and time and distance problem cases identified and flagged during the interim report processes, until data collection slowed down in February of 2005. All households not meeting geocoding or time and distance testing were reviewed and corrected, to the extent possible, by the April 2005 draft dataset submission. The information was reviewed and then integrated in the appropriate data file for MI Travel Counts.

Problems were also encountered while integrating MI Geographic Framework v3 with MapMarker. It took several weeks during the pilot for the MapMarker support staff to assist in successfully integrating MGFv3 with the MapMarker software. While the MGFv3 was integrated into MapMarker, resulting street-level latitude and longitude values using Framework would sometimes be located on the incorrect side of the street. This occurred in roughly 50% of the Framework Street-Level points. It was determined that using ArcView to geocode these locations provided the correct latitude and longitude values. An interim process consisted of sending all Framework street-level points identified by MapMarker to the auditor for re-geocoding in ArcView. While this solution served a purpose, it was not the optimum solution. Therefore, the consultant project team purchased a license to use ArcView and incorporated it as the first step in the new geocoding process (following file preparation). This was implemented during May of 2004. MDOT provided technical assistance to MORPACE in order to run Framework using ArcView. MDOT trained MORPACE geocoding staff on how to properly set up ArcView address locators in order to geocode. Once trained, MORPACE was able to complete geocoding files and rerun to correct problems.

10e. Results

Geocoding targets to latitude/longitude (street address or street intersection level) were to be 99% or better for home addresses, 95% or better for work and school addresses, and 90% or better for all other trip locations according to the MDOT approved Geocoding Manual. Results for these locations are shown in Table 2 of the Executive Summary.

Table 22 shows geocoding results for all destinations including the minimum goals, geocoding rates achieved for retrieved trips, and geocoding rates achieved for trips of completed and accepted households. The table illustrates that the achieved percentage exceeds the target percentage for each destination category—home, work, school, and all other destinations.

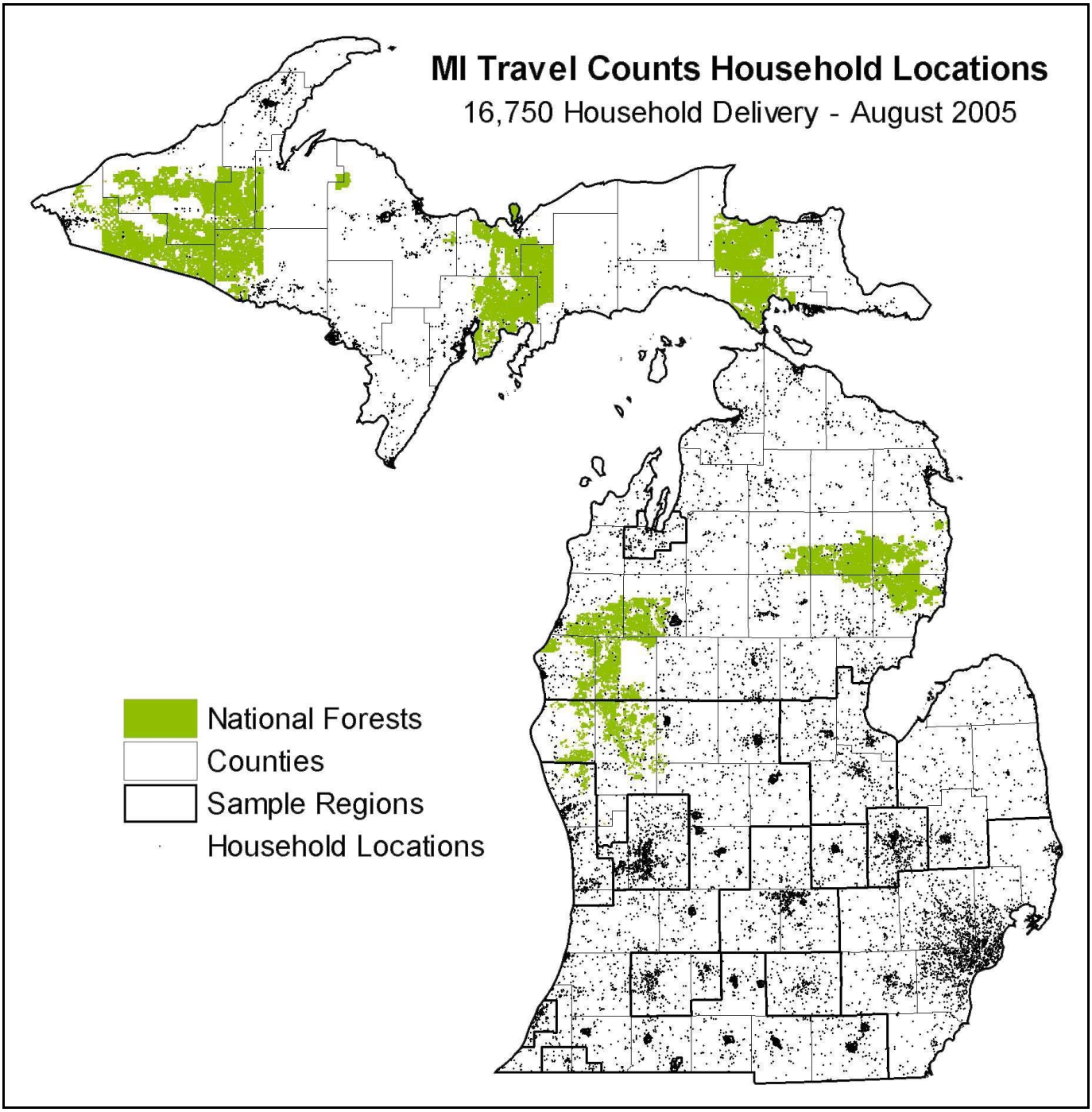
Table 22. Geocoding Results for MI Travel Counts by Destination Types

Household Locations	Minimum Goal %	Total # Households Retrrieved	% of Retrieved Home Addresses Geocoded	Retrieved Home Addresses Not Geocoded % (N)	Total # Households Accepted	% of Accepted Home Addresses Geocoded	Accepted Home Adresses Not Geocoded % (N)
Household Home Address	99%	16,753	99.9%	0.04% (6)	14,996	100%	0% (0)
Person Locations	**Minimum Goal %**	**Total # of Worker/Student Locations Retrieved**	**% of Retrieved Worker/Student Locations Geocoded**	**Retrieved Worker/Student Locations Not Geocoded % (N)**	**Total # of Worker/Student Locations Accepted**	**% of Accepted Worker/Student Locations Geocoded**	**Accepted Worker/Student Locations Not Geocoded % (N)**
Person Primary Work Address	95%	18,927	97.6%	2.4% (453)	16,975	98.5%	1.5% (254)
Person Secondary Work Adddress	95%	898	96.2%	3.8% (34)	814	96.7%	3.3% (27)
Person School Address	95%	10,722	99.2%	0.8% (90)	9,488	99.4%	0.6% (59)
Primary Activity at Destination	**Minimum Goal %**	**Total # Retrieved Destinations**	**% of Retrieved Destinations Geocoded**	**Retrieved Destinations Not Geocoded % (N)**	**Total # Accepted Destinations**	**% of Accepted Destinations Geocoded**	**Accepted Destinations Not Geocoded % (N)**
Home for Paid Work or Other	99%	88,674	99.9%	0.01% (13)	78,728	100.0%	0% (2)
Work	95%	40,881	96.7%	3.3% (1,359)	36,679	98.2%	1.8% (662)
School	95%	19,086	98.8%	1.2% (228)	16,893	99.5%	0.5% (78)
Other Than Work/School	90%	147,283	95.6%	4.4% (6,476)	129,084	97.4%	2.6% (3,379)
Total Destinations	90%	295,924	97.3%	2.7% (8,076)	261,384	98.4%	1.6% (4,121)

For all trip origin and destination points of accepted households, only 1.7% were non-geocodable to latitude/longitude, and only 15.7% were geocoded to the nearest street intersection rather than to street address.

Figure 19 on the following page shows the geocoded locations of 16,750 households in Michigan.

Figure 19: MI Travel Counts Household Locations



Section 11: Data Checking and Interim Data and Report Delivery

In Brief: *Section 11 provides the details of customized computer system controls, post-processing data checks, audit reviews, and interim data and report deliveries that were employed in MI Travel Counts to ensure quality.*

11a. Computer System Customization and Quality Control Features

MORPACE had considerable experience in customizing its advanced Computerized-Assisted Telephone Interviewing (CATI) data collection system for household travel inventories. Sophisticated, in-house CATI systems allowed for on-line clarification of inconsistent respondent information and multiple data checks. Logic errors were avoided because the appropriate programmed skip patterns and valid answer ranges were programmed into the system. Innovative and standard CATI features employed for MI Travel Counts included:

- *Household information was linked for the retrieval interview.* Since it would often take more than one evening to collect all needed information for each requested household member. The electronically controlled system allows interviewers to view the name, age of each household member, and their interviewing status. When all appropriate data were collected for all household members, the household disposition automatically shows as complete, and did not come up again for interviewing.

- *On-line time checks were performed.* Respondents could not provide an end time that was before a start time, or a start time that was before the previous end time.

- *City lists were compiled.* Complete city lists for the inventory area were developed and provided to the interviewers in alphabetical order. The interviewer simply typed the city number into the CATI system, saving time and avoiding common spelling mistakes. (The other-specify option was always allowed.)

- *Previously reported locations were automatically recorded.* If a respondent goes to work, then goes out for lunch, and then returns to work, the respondent is very frustrated if the work location information must be recorded twice. The CATI system allowed the interviewer to select the previously reported location and move forward with the interview, relieving the respondent of duplicating information.

- *Trips and locations reported by other household members were automatically confirmed and recorded.* If multiple household members go to lunch before coming home together from church, they would be understandably frustrated if the trip and location information had to be recorded multiple times.

- *Many other checks were either automatic or customized within the CATI system.* For example, not allowing inconsistent answers such as an under 14 year old driving alone, an unemployed person reporting work trips, consistency

between number of vehicles available to the household and number of vehicles used on a travel day, and consistency in mode changes.

- *Person counts always matched reported household size.* When individual person information was collected, the CATI ensured that the number of people for whom information was reported matched the reported household size. If it did not, the interviewer was prompted to review the persons in the household with the respondent/contact person and to add or subtract from the reported household size as appropriate.

- *Client remote and on-site access to the CATI system and reports assured quality control.* Using a modem and standard remote connection software, MDOT could access the CATI system. MDOT could personally test the project's questionnaires, seeing the questionnaires as they appeared on the screen to the interviewer. MDOT was also welcome to personally visit the interviewing location in Sterling Heights, MI and/or monitor interviewing via telephone. MDOT was on-site for the pilot start and the first interview night of recruiting and retrieval.

All of the In-Computer Data Logic Checks can be found in the Data Coding and Quality Control Manual attached as Appendix 23. It is important to emphasize that all of these logic data checks were customized within the Computer Assisted Telephone Interviewing (CATI) system to avoid the possibility of these problems occurring during phone interviewing. These were not post-processing checks or edits made after the problem had occurred. The Internet version of the retrieval was also customized to incorporate these innovative CATI techniques.

Throughout the MI Travel Counts program, the emphasis was on the accessibility of real-time monitoring information to the project consultant team and MDOT. The more quickly on going results were available in a readable format, the less disruptive were any corrective measures that were required. It was essential that MDOT know the status of data collection, both in terms of progress on completing sampling cells and in regard to the quality of the data being collected.

11b. Households That Did Not Travel on Assigned Days

If a person reported that no trips were taken on an assigned travel day, the CATI skipped the interviewer to a question asking the respondent for additional clarification about the reasons or circumstances for not taking any trips on that day. The records of all persons reporting no trips were reviewed as a part of the interim reports to determine whether the reasons/circumstances were valid. The report data on no trip households included such variables as households' sample area, age, work status and reasons given for no trips. If it was determined by MDOT that a response was not reasonable, the entire household was considered non-responsive and another household was substituted.

11c. Audit Reviews and the Interim Report and Data Delivery Process

Parsons Brinckerhoff (PB) as the modeling consultant for the Phase 1 Model Improvement Program contributed significantly to the design of the sample and data collection instruments for MI Travel Counts. During the data collection phase, PB served as an auditor of data to ensure that results met or exceeded modeling requirements.

Complete interim data files were submitted for audit review and then to MDOT after the pilot, after 2,000 completes; 4,000 completes; 6,000 completes; 8,000 completes; 10,000 completes; 12,000 completes; 14,280; 16,000; 16,700; and 16,753 households. Appendix 26 shows a detailed schedule for submission of monthly and final reports, interim and final data.

A copy of an interim report is included as an example as Appendix 27.

11d. Quality Control Steps

The audit flagged a total of 1,796 trips for problems relating to errors in time and distance reporting, through the 8th and final Interim Report (16,048 households with 282,632 trips). This task was accomplished by comparing the expected amount of time needed to complete a trip between a geocoded origin and destination using TransCAD and the MDOT Statewide Model network, to the departure and arrival times provided by the respondent. Errors were identified for trips that had a large difference between the reported and expected times. Respondents were asked if any unusual circumstances, such as inclement weather or auto accidents, contributed to a longer than expected travel time. If a respondent answered yes to this question, that particular trip was not marked for a time and distance problem. A detailed description of procedures for time and distance checking is listed in the Geocoding Manual in Appendix 22.

Flagged trips were marked with one of eight problem codes: four codes pertained to geocoding problems, three to time reporting problems, and one to transportation mode reporting problems. The large majority of flagged records fell into the first two categories: possible geocoding errors (≈56.5%) and possible time reporting errors (≈41.5%). See Figure 11.B.i of Appendix 27. All trip records flagged were examined individually to determine the cause of the error.

Trips flagged for geocoding errors were examined in the context of the other trips made by the same household. This process yielded the cities most likely to contain the address originally listed by the respondent. Using the description of the location, and the cities most frequented by the household, a new candidate address was chosen. The new address was then checked to be certain it fell within the time and distance parameters set by the audit.

An example of a typical geocoding time and distance problem is as follows: the data show a respondent traveling from Escanaba to a specific street address with no city listed. The geocoding process found a street address match in Flint and accepted it.

The time and distance testing thus showed the respondent traveling in 15 minutes to go to a restaurant at 1812 Main Street in Flint. This trip is about 370 miles, meaning the respondent would have had to travel at 1,480 mph. In this case, either the origin or destination is incorrect. If all of the other trips made by the household are to Escanaba, Wells, and Gladstone, then it is clear that the Flint address is probably in error. In fact, the street name and address given by the respondent was found in a town very close to the others frequented by the household in question.

Trips flagged for a time reporting problem were examined for errors in the reported travel day, and for problems with military time conversion.

11e. Problems and Solutions

Twenty-seven percent of the flagged trips (485 of 1796) were updated with new information (477 geocoding problems and 8 time problems corrected). The major impediments to correction of time and distance issues were as follows:

Some records that indicated a geocoding error did not contain enough specific information to choose a new address. For example, a respondent reports traveling 200 miles in 5 minutes (average speed of 240 mph) to go to a gas station. After examining the other trips made by that respondent, a new city is selected as the likely location of the gas station. However, the description of the gas station and address information are not accurate enough to decide on a new location for the gas station. In these cases, we are aware that the original geocoding is incorrect, but were unable to select a new point, so the location was left un-geocoded.

Records with time reporting problems were far more difficult to correct than records with geocoding errors. If a trip with a time reporting problem had no obvious mistakes in the reported travel day, or could not be easily be explained otherwise, there was little that could be done. Any change to the arrival or departure time listed by a respondent would be not much more than a guess. In these cases no respondent information was changed, but a column was added to the dataset for the computed travel time.

Table 23 below shows a sample of time and distance checking and results taken from approximately 14,000 household records.

Table 23: Example: Records Flagged and Corrected for Time and Distance Problems.

Code	Description	Type	Count	Percentage	Corrected	% Corrected
2	Check arrival or departure time	Time	131	7.29%	6	4.58%
3	Check for either origin/destination	Geocoding	38	2.12%	7	18.42%
4	Trip time is too long compared to TransCAD (not sure of problem)	Time	518	28.84%	2	0.39%
5	Trip time is too short compared to TransCAD (not sure of problem)	Time	95	5.29%	0	0.00%
6	Check geocoding of either the origin or destination, trip time makes sense compared to OD but TransCAD doesn't	Geocoding	71	3.95%	39	54.93%
7	Check location of destination	Geocoding	473	26.34%	221	46.72%
8	Check location of origin	Geocoding	432	24.05%	210	48.61%
9	Check transportation mode, may involve a school trip or air/train/walk	Trans Mode	38	2.12%	0	0.00%
		Total	**1796**	**100.00%**	**485**	**27.00%**

11f. Final Data Collection Status

Final MI Travel Counts retrieval results are presented below in Table 24 by the sample design data cells (household size, number of vehicles, and number of workers) for each of the seven MI Travel Counts sampling areas. The "TARGET" column shows the sample plan targeted number of households for the data cell; the "RETRIEVED" column shows the number of completed households for the data cell; the "RETRIEVED %" shows the percent of retrieved to target households; the "ACCEPTED" column shows the number of completed households accepted by MDOT, based on pre-established geocoding and time and distance testing criteria; the "ACCEPTED %" is the percent of accepted to target households.

Table 24. By Sample Area

MI TRAVEL COUNTS

HOUSEHOLD CELL TARGETS, RETRIEVALS, AND NUMBER ACCEPTED

SEMCOG	TARGET	RETRIEVED	RETRIEVED %	ACCEPTED	ACCEPTED %
HH Size=1 Autos=0 Workers=0,1	100	140	140%	125	125%
HH Size=1 Autos=1+ Workers=0	185	204	110%	185	100%
HH Size=1 Autos=1+ Workers=1	273	339	124%	298	109%
HH Size=2 Autos=0 Workers=0,1,2	36	61	169%	44	122%
HH Size=2 Autos=1 Workers=0	73	94	129%	80	110%
HH Size=2 Autos=1 Workers=1	75	104	139%	89	119%
HH Size=2 Autos=1 Workers=2	30	33	110%	30	100%
HH Size=2 Autos=2+ Workers=0	89	99	111%	89	100%
HH Size=2 Autos=2+ Workers=1	121	139	115%	122	101%
HH Size=2 Autos=2+ Workers=2	211	228	108%	211	100%
HH Size=3,4 Autos=0 Workers=0,1,2,3+	47	77	164%	64	136%
HH Size=3 Autos=1,2,3+ Workers=0	30	35	117%	33	110%
HH Size=3 Autos=1 Workers=1	41	43	105%	41	100%
HH Size=3 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	30	31	103%	30	100%
HH Size=3 Autos=2,3+ Workers=1	68	115	169%	99	146%
HH Size=3 Autos=2 Workers=2	78	119	153%	102	131%
HH Size=3 Autos=3+ Workers=2	40	44	110%	41	103%
HH Size=3 Autos=3+ Workers=3	32	32	100%	32	100%
HH Size=4 Autos=1,2,3+ Workers=0	31	33	106%	31	100%
HH Size=4 Autos=1 Workers=1	38	36	95%	36	95%
HH Size=4 [Autos=1 Workers=2,3+] and [Autos=2 Workers=3+]	50	32	64%	31	62%
HH Size=4 Autos=2 Workers=1	87	145	167%	127	146%
HH Size=4 Autos=2 Workers=2	124	137	110%	127	102%
HH Size=4 Autos=3+ Workers=1,2	82	115	140%	96	117%
HH Size=4 Autos=3+ Workers=3+	69	104	151%	86	125%
SEMCOG TOTALS	2040	2539	124%	2249	110%

SMALL CITIES	TARGET	RETRIEVED	RETRIEVED %	ACCEPTED	ACCEPTED %
HH Size=1 Autos=0 Workers=0,1	86	125	145%	118	137%
HH Size=1 Autos=1+ Workers=0	216	245	113%	217	100%
HH Size=1 Autos=1+ Workers=1	229	313	137%	259	113%
HH Size=2,3,4 Autos=0 Workers=0,1,2,3+	47	48	102%	47	100%
HH Size=2 Autos=1 Workers=0	87	99	114%	88	101%
HH Size=2 Autos=1 Workers=1	68	105	154%	90	132%
HH Size=2 Autos=1 Workers=2	32	37	116%	32	100%
HH Size=2 Autos=2+ Workers=0	150	168	112%	150	100%
HH Size=2 Autos=2+ Workers=1	147	192	131%	153	104%
HH Size=2 Autos=2+ Workers=2	224	254	113%	230	103%
HH Size=3 [Autos=1,2,3+ Workers=0] and [Autos=3+ Workers=1]	46	85	185%	70	152%
HH Size=3 Autos=1 Workers=1	37	51	138%	40	108%
HH Size=3 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	30	39	130%	35	117%
HH Size=3 Autos=2 Workers=1	42	67	160%	56	133%
HH Size=3 Autos=2 Workers=2	75	138	184%	117	156%
HH Size=3 Autos=3+ Workers=2	45	70	156%	57	127%
HH Size=3 Autos=3+ Workers=3	31	55	177%	44	142%
HH Size=4 [Autos=1,2,3+ Workers=0] and [Autos=3+ Workers=1]	46	66	143%	53	115%
HH Size=4 Autos=1 Workers=1	30	37	123%	34	113%
HH Size=4 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	47	45	96%	44	94%
HH Size=4 Autos=2 Workers=1	70	120	171%	105	150%
HH Size=4 Autos=2 Workers=2	129	222	172%	182	141%
HH Size=4 Autos=3+ Workers=2	68	95	140%	79	116%
HH Size=4 Autos=3+ Workers=3+	62	84	135%	69	111%
SMALL CITIES TOTAL	2044	2760	135%	2369	116%

UPPER PENINSULA RURAL	TARGET	RETRIEVED	RETRIEVED %	ACCEPTED	ACCEPTED %
HH Size=1 Autos=0 Workers=0,1	108	104	96%	104	96%
HH Size=1 Autos=1+ Workers=0	246	277	113%	247	100%
HH Size=1 Autos=1+ Workers=1	218	264	121%	219	100%
HH Size=2,3,4 Autos=0 Workers=0,1,2,3+	47	24	51%	24	51%
HH Size=2 Autos=1 Workers=0	99	111	112%	100	101%
HH Size=2 Autos=1 Workers=1	69	90	130%	69	100%
HH Size=2 Autos=1 Workers=2	31	33	106%	31	100%
HH Size=2 Autos=2+ Workers=0	171	172	101%	171	100%
HH Size=2 Autos=2+ Workers=1	152	170	112%	153	101%
HH Size=2 Autos=2+ Workers=2	198	205	104%	198	100%
HH Size=3 [Autos=1,2,3+ Workers=0] and [Autos=3+ Workers=1]	49	61	124%	49	100%
HH Size=3 Autos=1 Workers=1	35	32	91%	32	91%
HH Size=3 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	30	33	110%	32	107%
HH Size=3 Autos=2 Workers=1	42	60	143%	46	110%
HH Size=3 Autos=2 Workers=2	71	92	130%	76	107%
HH Size=3 Autos=3+ Workers=2	43	46	107%	43	100%
HH Size=3 Autos=3+ Workers=3	30	29	97%	28	93%
HH Size=4 [Autos=1,2,3+ Workers=0] and [Autos=3+ Workers=1]	39	49	126%	41	105%
HH Size=4 Autos=1 Workers=1	30	37	123%	30	100%
HH Size=4 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	44	32	73%	32	73%
HH Size=4 Autos=2 Workers=1	62	75	121%	64	103%
HH Size=4 Autos=2 Workers=2	120	171	143%	138	115%
HH Size=4 Autos=3+ Workers=2	60	61	102%	59	98%
HH Size=4 Autos=3+ Workers=3+	57	78	137%	58	102%
UPPER PENINSULA RURAL TOTALS	2051	2306	112%	2044	100%

NORTHERN LOWER PENINSULA RURAL	TARGET	RETRIEVED	RETRIEVED %	ACCEPTED	ACCEPTED %
HH Size=1 Autos=0 Workers=0,1	81	72	89%	72	89%
HH Size=1 Autos=1+ Workers=0	245	285	116%	246	100%
HH Size=1 Autos=1+ Workers=1	207	235	114%	212	102%
HH Size=2,3,4 Autos=0 Workers=0,1,2,3+	42	30	71%	30	71%
HH Size=2 Autos=1 Workers=0	110	128	116%	111	101%
HH Size=2 Autos=1 Workers=1	63	87	138%	71	113%
HH Size=2 Autos=1 Workers=2	30	28	93%	27	90%
HH Size=2 Autos=2+ Workers=0	189	231	122%	189	100%
HH Size=2 Autos=2+ Workers=1	148	161	109%	149	101%
HH Size=2 Autos=2+ Workers=2	206	208	101%	206	100%
HH Size=3 [Autos=1,2,3+ Workers=0] and [Autos=3+ Workers=1]	47	77	164%	55	117%
HH Size=3 Autos=1 Workers=1	34	41	121%	35	103%
HH Size=3 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	30	17	57%	17	57%
HH Size=3 Autos=2 Workers=1	45	57	127%	47	104%
HH Size=3 Autos=2 Workers=2	69	78	113%	73	106%
HH Size=3 Autos=3+ Workers=2	46	56	122%	49	107%
HH Size=3 Autos=3+ Workers=3	30	29	97%	29	97%
HH Size=4 [Autos=1,2,3+ Workers=0] and [Autos=3+ Workers=1]	47	66	140%	52	111%
HH Size=4 Autos=1 Workers=1	30	37	123%	35	117%
HH Size=4 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	43	35	81%	35	81%
HH Size=4 Autos=2 Workers=1	66	89	135%	80	121%
HH Size=4 Autos=2 Workers=2	122	170	139%	144	118%
HH Size=4 Autos=3+ Workers=2	66	75	114%	67	102%
HH Size=4 Autos=3+ Workers=3+	58	61	105%	59	102%
NORTHERN LOWER PENINSULA RURAL TOTALS	2054	2353	115%	2090	102%

SOUTHERN LOWER PENINSULA RURAL	TARGET	RETRIEVED	RETRIEVED %	ACCEPTED	ACCEPTED %
HH Size=1 Autos=0 Workers=0,1	73	74	101%	73	100%
HH Size=1 Autos=1+ Workers=0	194	196	101%	194	100%
HH Size=1 Autos=1+ Workers=1	233	261	112%	234	100%
HH Size=2,3,4 Autos=0 Workers=0,1,2,3+	50	27	54%	27	54%
HH Size=2 Autos=1 Workers=0	76	84	111%	76	100%
HH Size=2 Autos=1 Workers=1	66	66	100%	66	100%
HH Size=2 Autos=1 Workers=2	32	33	103%	32	100%
HH Size=2 Autos=2+ Workers=0	131	182	139%	158	121%
HH Size=2 Autos=2+ Workers=1	145	156	108%	149	103%
HH Size=2 Autos=2+ Workers=2	237	242	102%	237	100%
HH Size=3 [Autos=1,2,3+ Workers=0] and [Autos=3+ Workers=1]	45	54	120%	46	102%
HH Size=3 Autos=1 Workers=1	38	44	116%	42	111%
HH Size=3 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	30	27	90%	26	87%
HH Size=3 Autos=2 Workers=1	42	54	129%	48	114%
HH Size=3 Autos=2 Workers=2	79	121	153%	95	120%
HH Size=3 Autos=3+ Workers=2	47	49	104%	48	102%
HH Size=3 Autos=3+ Workers=3	35	36	103%	35	100%
HH Size=4 [Autos=1,2,3+ Workers=0] and [Autos=3+ Workers=1]	50	71	142%	61	122%
HH Size=4 Autos=1 Workers=1	31	35	113%	31	100%
HH Size=4 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	48	44	92%	44	92%
HH Size=4 Autos=2 Workers=1	77	86	112%	77	100%
HH Size=4 Autos=2 Workers=2	138	157	114%	138	100%
HH Size=4 Autos=3+ Workers=2	76	85	112%	77	101%
HH Size=4 Autos=3+ Workers=3+	70	74	106%	70	100%
SOUTHERN LOWER PENINSULA RURAL TOTALS	2043	2258	111%	2084	102%

TMAs	TARGET	RETRIEVED	RETRIEVED %	ACCEPTED	ACCEPTED %
HH Size=1 Autos=0 Workers=0,1	77	95	123%	80	104%
HH Size=1 Autos=1+ Workers=0	172	184	107%	173	101%
HH Size=1 Autos=1+ Workers=1	258	270	105%	259	100%
HH Size=2,3,4 Autos=0 Workers=0,1,2,3+	56	63	113%	58	104%
HH Size=2 Autos=1 Workers=0	67	79	118%	67	100%
HH Size=2 Autos=1 Workers=1	72	95	132%	80	111%
HH Size=2 Autos=1 Workers=2	31	29	94%	29	94%
HH Size=2 Autos=2+ Workers=0	100	112	112%	100	100%
HH Size=2 Autos=2+ Workers=1	128	140	109%	130	102%
HH Size=2 Autos=2+ Workers=2	245	273	111%	246	100%
HH Size=3 [Autos=1,2,3+ Workers=0] and [Autos=3+ Workers=1]	43	53	123%	46	107%
HH Size=3 Autos=1 Workers=1	39	47	121%	44	113%
HH Size=3 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	30	27	90%	26	87%
HH Size=3 Autos=2 Workers=1	43	61	142%	56	130%
HH Size=3 Autos=2 Workers=2	85	116	136%	95	112%
HH Size=3 Autos=3+ Workers=2	45	48	107%	45	100%
HH Size=3 Autos=3+ Workers=3	35	40	114%	36	103%
HH Size=4 [Autos=1,2,3+ Workers=0] and [Autos=3+ Workers=1]	52	71	137%	62	119%
HH Size=4 Autos=1 Workers=1	36	44	122%	39	108%
HH Size=4 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	51	31	61%	31	61%
HH Size=4 Autos=2 Workers=1	85	97	114%	86	101%
HH Size=4 Autos=2 Workers=2	144	159	110%	146	101%
HH Size=4 Autos=3+ Workers=2	71	85	120%	76	107%
HH Size=4 Autos=3+ Workers=3+	76	96	126%	88	116%
TMA TOTALS	2041	2315	113%	2098	103%

SMALL URBAN MODEL AREAS	TARGET	RETRIEVED	RETRIEVED %	ACCEPTED	ACCEPTED %
HH Size=1 Autos=0 Workers=0,1	76	98	129%	91	120%
HH Size=1 Autos=1+ Workers=0	199	206	104%	199	100%
HH Size=1 Autos=1+ Workers=1	234	243	104%	234	100%
HH Size=2,3,4 Autos=0 Workers=0,1,2,3+	53	51	96%	51	96%
HH Size=2 Autos=1 Workers=0	79	88	111%	81	103%
HH Size=2 Autos=1 Workers=1	68	91	134%	80	118%
HH Size=2 Autos=1 Workers=2	30	29	97%	29	97%
HH Size=2 Autos=2+ Workers=0	132	163	123%	137	104%
HH Size=2 Autos=2+ Workers=1	141	144	102%	141	100%
HH Size=2 Autos=2+ Workers=2	235	242	103%	235	100%
HH Size=3 [Autos=1,2,3+ Workers=0] and [Autos=3+ Workers=1]	42	44	105%	42	100%
HH Size=3 Autos=1 Workers=1	38	48	126%	41	108%
HH Size=3 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	30	19	63%	19	63%
HH Size=3 Autos=2 Workers=1	42	47	112%	43	102%
HH Size=3 Autos=2 Workers=2	78	105	135%	89	114%
HH Size=3 Autos=3+ Workers=2	45	48	107%	45	100%
HH Size=3 Autos=3+ Workers=3	35	40	114%	36	103%
HH Size=4 [Autos=1,2,3+ Workers=0] and [Autos=3+ Workers=1]	48	60	125%	50	104%
HH Size=4 Autos=1 Workers=1	30	40	133%	34	113%
HH Size=4 [Autos=1 Workers=2,3] and [Autos=2 Workers=3]	48	23	48%	23	48%
HH Size=4 Autos=2 Workers=1	76	85	112%	77	101%
HH Size=4 Autos=2 Workers=2	140	150	107%	141	101%
HH Size=4 Autos=3+ Workers=2	71	85	120%	71	100%
HH Size=4 Autos=3+ Workers=3+	72	73	101%	73	101%
SMALL URBAN MODEL AREA TOTALS	2042	2222	109%	2062	101%

SUMMARY:

Sampling Target Total = 14,315
Retrieved Households = 16,753
Accepted Households = 14,996

Total number household short of below target households=211 (211/14,315= 1.47%)
98.5% of data cell goals were met

Note that several cells have more than 100% of their targets retrieved. This is due to:

- allowing for a margin of completed households that do not meet acceptable standards, and
- because quotas can only be enforced on the recruitment, and some data cells had much higher than expected retrieval rates. Quotas on recruitment were carefully monitored after the first 6,000 households were retrieved to ensure that resources were not wasted collecting information from households in already completed cells. However, once a household is recruited it must be retrieved, so some exceeding of retrieval targets is unavoidable.

Section 12: Data Comparisons and Results

In Brief: *Section 12 of the report provides an overview of travel characteristic results for MI Travel Counts.*

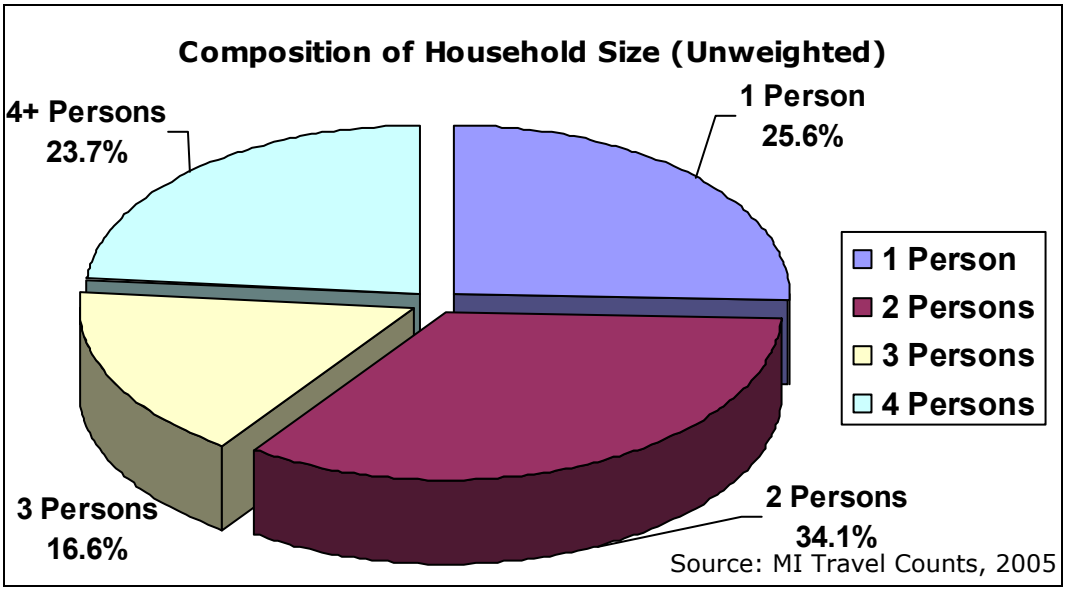
MI Travel Counts comparison to National Household Travel Survey (NHTS)

Tables 25 through 29 and Figures 20 through 22 below provide basic demographics for MI Travel Counts *accepted* households, and household members (persons). Unweighted MI Travel Counts data is compared with published unweighted National Household Travel Survey (NHTS) 2001 data, as documented in the NHTS control table released in January 2004 (see Appendix 29 of that report). When both data sets are weighted, both sets will have been corrected to their respective proportional 2000 U.S. Census Bureau geography and classifications.

Table 25. Comparison of MI Travel Counts and NHTS Unweighted Data on Basic Demographic Characteristics for Accepted Households

Variable	MI Travel Counts	NHTS
Total Number of Households	14,996	69,817
Total Person (Household Members) Interviewed	37,475	160,758
Average Number of People per Household	2.5	2.3
Percent 1-Person Household	25.60%	Not available
Percent 2-Person Household	34.10%	Not available
Percent 3-Person Household	16.60%	Not available
Percent 4-Person Household	23.70%	Not available
People Who Did Not Travel on Travel Day 1	3617	19,843
Percent Non-Travelers	9.60%	12.30%

Figure 20: MI Travel Counts - Composition of Household Size



The higher average number of people per household for MI Travel Counts in comparison to the 2001 NHTS may be partially due to the more rural unweighted sample of MI Travel Counts. However the unweighted percent of 4+ person households for MI Travel Counts, though not available for NHTS, is considerably higher than for most other household travel inventories that have often had unweighted 4+ person household percentages lower than 20%. (See the Bay Area Travel Survey Report and the State of California Household Travel Survey Report for unweighted comparisons). This is an indication that the more highly stratified auto sufficiency sample plan for MI Travel Counts, coupled with responsive design interviewing techniques, was effective in producing a representative sample by household size.

The percent of persons reporting no travel on assigned travel days is often considered a possible measure of nonresponse bias, as a high percent of respondents self-reporting no travel can be viewed as actual "soft refusals" to report travel. The relatively low percent of "non-travelers" for MI Travel Counts is an indication that the project's extensive quality control and review measures for this incidence were effective.

Table 26. Comparison of MI Travel Counts and NHTS Unweighted Data on Person Characteristics for Accepted Households

Variable	MI Travel Counts	NHTS
Number of Persons Age 16+	28,932	124,477
Percent of Persons Age 16+	77.10%	77.40%
Number of Persons Age 16 or 17	1,119	4,145
Percent of Persons Age 16 or 17	3.00%	2.60%

Household travel inventory participation rates for 16 and 17 years olds are often quite low since this group is highly mobile. Comparisons with NHTS show that MI Travel Counts was relatively successful in obtain travel information from this age group.

Table 27. Comparison of MI Travel Counts and NHTS Unweighted Data on Worker Characteristics for Accepted Households

Variable	MI Travel Counts	NHTS
Number of Full-Time and Part-Time Workers	17,488	85,350
Percent Persons (Age 16+) Who Worked	60.4%	68.6%
Percent Households with Income not Reported	3.80%	9.30%

The MI Travel Counts percent of workers among persons age 16+ was somewhat lower that for the 2001 NHTS. This could be due to changes in the economy since 2001 and the relatively high 2004-2005 unemployment rate in Michigan versus the nation. The more rural character of MI Travel Counts unweighted data could also have an impact on this measure. However, it does not appear to be due to an oversampling of retired adults, as the percent of persons age 65+ among completed and accepted households for MI Travel Counts is equivalent to 2000 Census data.

Figure 21: MI Travel Counts – Composition of Workers in the Household (Unweighted)

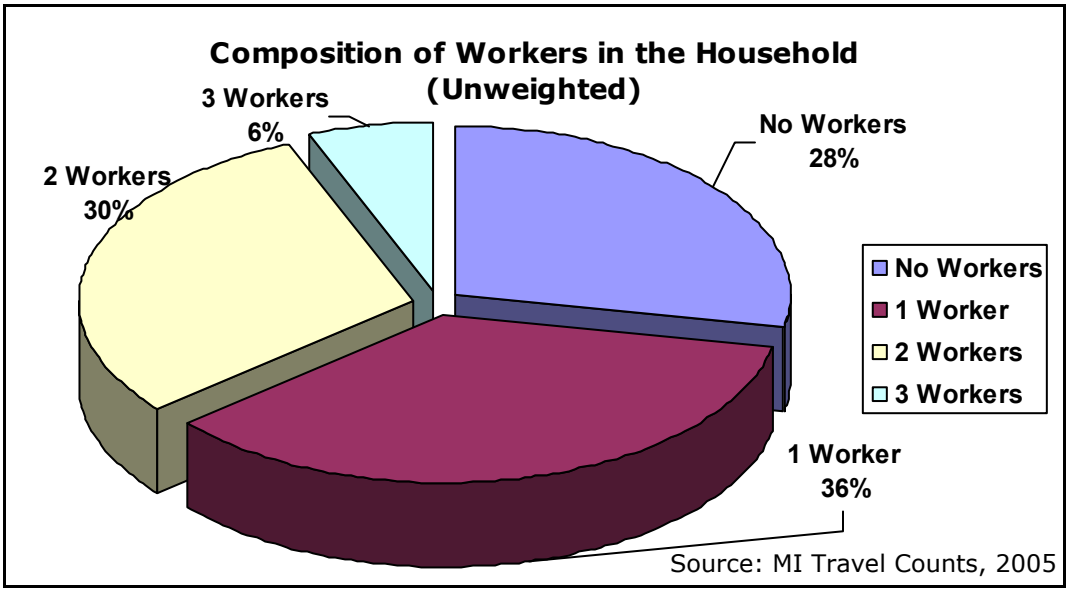
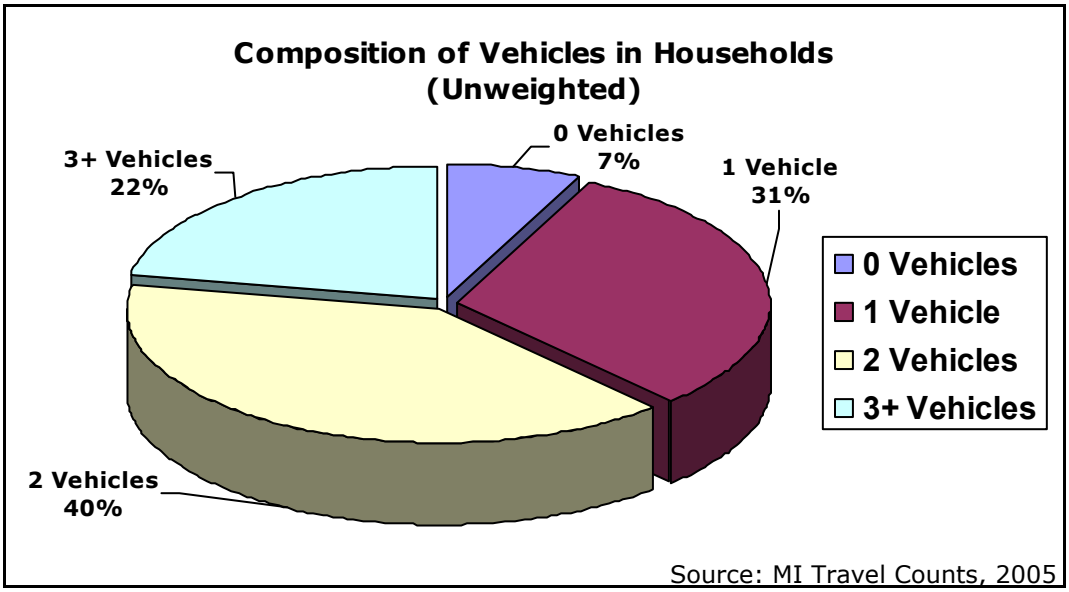


Table 28. Comparison of MI Travel Counts and NHTS Unweighted Data on Vehicle Characteristics for Accepted Households

Variable	MI Travel Counts	NHTS
Number of Vehicles	28,676	139,382
Average Number of Vehicles Per Household	1.90	2.00
Number of Zero Vehicle Households	1,008	Not Available
Percent Households with Zero Vehicles	6.70%	Not Available
Percent Households with Fewer Autos Than Workers	5.90%	Not Available
Average Number of Vehicles per Worker	1.60	1.60

The percent of MI Travel Counts zero vehicle households is nearly representative of zero vehicle households reported for Michigan in the 2000 U.S. Census Bureau data. As previously reported, 2+-person households with zero vehicles were somewhat underreported for the rural areas of the Upper Peninsula and the Northern and Lower Peninsula.

Figure 22: MI Travel Counts – Composition of Vehicles in Households (Unweighted)



The percent of MI Travel Counts zero vehicle households is nearly representative of zero vehicle households reported for Michigan in the 2000 Census data. As previously reported, 2+-person households with zero vehicles were somewhat underreported for the rural areas of the Upper Peninsula and the Northern and Lower Peninsula.

Table 29. Comparison of MI Travel Counts and NHTS Unweighted Data on Person Trip Characteristics for Accepted Households

Variable	MI Travel Counts	NHTS
Total Person Trips: Day 1	136,897	642,292
Total Person Trips: Day 2	124,259	Not Available
Average Number of Trips per Person: Day 1	3.60	4.00
Average Number of Trips per Person: Day 2	3.30	Not Available
Average Number of Trips per Household: Day 1	9.10	9.20

Travel versus No Travel

In assessing average trips per person or per household, it should be noted that MI Travel Counts unweighted total data is heavily skewed towards rural households since equal precision sampling across sampling areas resulted in 43% of households being from rural areas outside cities or towns with populations over 50,000. As Figure 24 on page 109 shows, trips per person and per household are higher in the urban sampling areas (SEMCOG, Small Cities, TMAs, and Small Urban Areas) than they are in the three rural areas: Upper Peninsula Rural, Northern Lower Peninsula Rural, and Southern Lower Peninsula Rural.

Thus, while unweighted trips per household for MI Travel Counts as shown in Table 29 are nearly equivalent to average number of trips per household for 2001 NHTS, per person average number of trips on Day 1 are somewhat lower, since trips per person are lower in rural areas of Michigan than in urban or suburban areas. In addition, average

household size for MI Travel Counts is higher than for 2001 NHTS. As household size increases, the number of trips per person generally decreases as one household member runs errands or conducts personal business for other members.

MI Travel Counts Basic Travel and Retrieval Statistics

The data presented in the figures and tables below are based on the 14,996 completed and accepted households delivered in the final data file to MDOT. Again, no weights have been applied to the statewide totals; however, most results are presented by sampling area.

Figure 23 provides the unweighted percent of households reporting no trips during the 48-hour assigned travel period.

Figure 23: Percentage of Respondents That Did Not Travel During the 48-Hour Travel Period

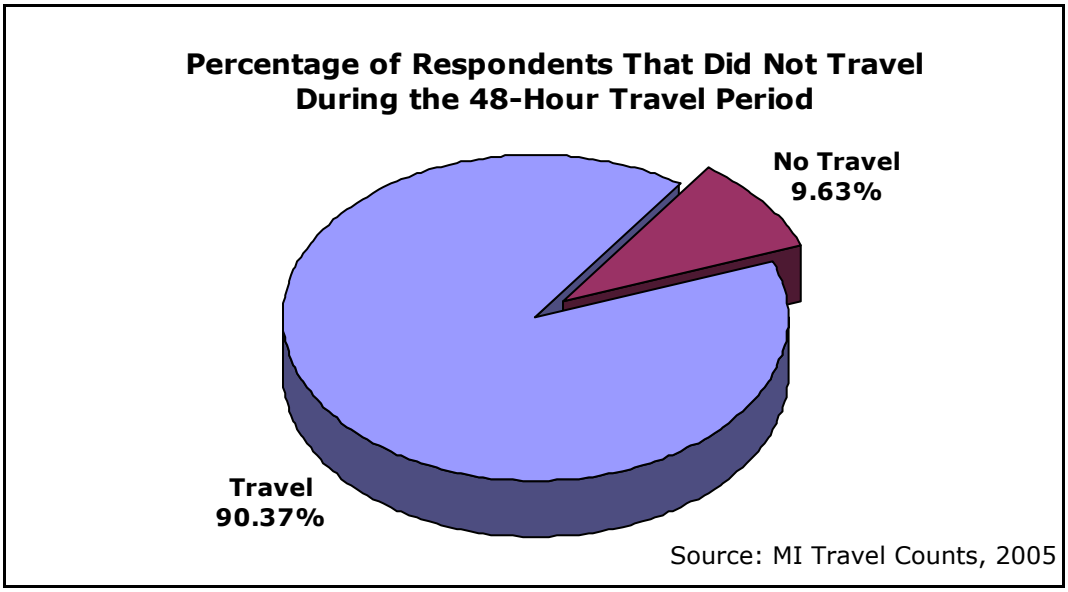


Table 30: Respondents with No Travel and Trips by Sample Area (Day 1 and Day 2 Combined)

Sample Area	Statewide	SEMCOG	Small Cities	UP Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMA's	Small Urban Modeled Areas
Total	264,994	39,643	45,231	33,461	33,232	36,235	39,783	37,409
Freq – No Travel	3,610	603	591	482	626	468	396	444
Freq – Travel	33,865	5,074	5,381	4,424	4,495	4,834	4,981	4,676

Less than 10% of respondents did not travel during the 48-hour assigned travel period. Reported "no travel" was lowest in the TMAs and Small Urban Modeled Areas and highest within the Northern Lower Peninsula rural sampling area.

Table 31 contains some respondent retrieval characteristics for those reporting no travel.

Table 31: Respondents without Travel - Retrieval Methods and Age by Sample Area (Day 1 and Day 2 Combined)

Sample Area	Statewide	SEMCOG	Small Cities	UP Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMA's	Small Urban Modeled Areas
Freq – No Travel	3,610	603	591	482	626	468	396	444
Phone Respondents	1,320	208	210	197	234	166	142	163
Proxy	1,832	313	320	221	313	242	206	217
Age < 18	616	90	121	77	107	79	66	76
Age >= 18	1,216	223	199	144	206	163	140	141
Mailed Diary	458	82	61	64	79	60	48	64
Internet	0	0	0	0	0	0	0	0
% Phone Respondents	37%	34%	36%	41%	37%	35%	36%	37%
% Proxy	51%	52%	54%	46%	50%	52%	52%	49%
Age < 18	17%	15%	20%	16%	17%	17%	17%	17%
Age >=18	34%	37%	34%	30%	33%	35%	35%	32%
% Mailed Dairy	13%	14%	10%	13%	13%	13%	12%	14%
% Internet	0	0	0	0	0	0	0	0

The retrieval characteristics of respondents with "no travel" are fairly consistent across the various sampling areas. This includes the percentage completing the interview by phone and by proxy. It also includes the distribution of proxy interviews by age and the percentage that mailed in a diary. The only exception was in the Upper Peninsula Rural sampling area where the percent of "no travel" respondents retrieved by phone is slightly higher than in other sampling areas, and the percent retrieved by proxy is slightly lower than in the other sampling areas.

Table 32: Respondents who Travel - Retrieval Methods and Age by Sample Area (Day 1 and Day 2 Combined)

Sample Area	Statewide	SEMCOG	Small Cities	UP Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMA's	Small Urban Modeled Areas
Freq – Travel	33,865	5,074	5,381	4,424	4,495	4,834	4,981	4,676
Phone Respondents	12,014	1,728	1,904	1,648	1,617	1,732	1,716	1,678
Proxy	12,932	1,956	2,160	1,627	1,703	1,895	1,869	1,722
Age < 18	6,188	964	1,041	742	816	918	902	805
Age >= 18	6,744	992	1,119	885	887	977	967	917
Mailed Diary	8,748	1,365	1,282	1,129	1,156	1,198	1,360	1,258
Internet	171	25	35	20	19	18	36	18
% Phone Respondents	35%	34%	35%	37%	36%	36%	34%	36%
% Proxy	38%	52%	54%	46%	50%	52%	52%	49%
Age < 18	18%	19%	19%	17%	18%	19%	18%	17%
Age >=18	20%	20%	21%	20%	20%	20%	19%	20%
% Mailed Dairy	26%	27%	24%	26%	26%	25%	27%	27%
% Internet	1%	0	1%	0	0	0	1%	0

Overall, 35% of persons with travel reported their activity/travel information by phone, 38% was reported by proxy, 25% by mail and less than 1% by Internet. The retrieval characteristics of respondents with travel are fairly consistent across the various sampling areas. This includes the percentage completing the interview by phone and by proxy. It also includes the distribution of proxy interviews by age and the percentage that mailed in a diary.

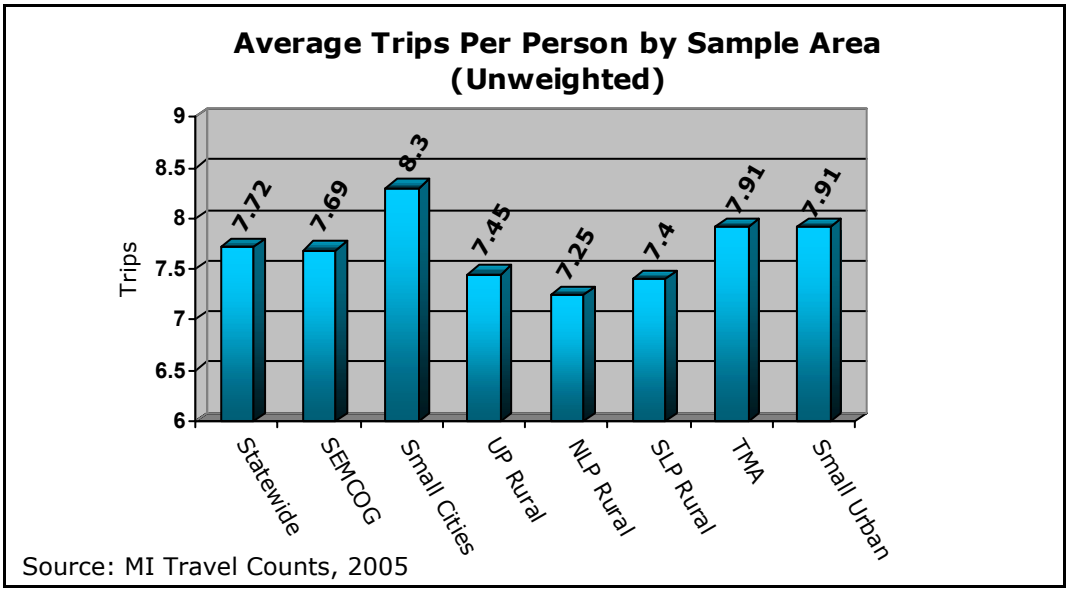
Table 33 shows the average number of person trips by trip purpose.

Table 33. Average Number of Trips by Purpose Per Person (Day 1 and Day 2 Combined) **Sample Area**	**Statewide**	**SEMCOG**	**Small Cities**	**UP Rural**	**Northern Lower Peninsula**	**Southern Lower Peninsula**	**TMA's**	**Small Urban Modeled Areas**
Total	**7.72**	**7.69**	**8.30**	**7.45**	**7.25**	**7.40**	**7.91**	**7.91**
Home- Paid Work	**0.03**	**0.03**	**0.03**	**0.02**	**0.03**	**0.03**	**0.03**	**0.03**
Home - Other	**2.30**	**2.33**	**2.58**	**2.20**	**2.07**	**2.14**	**2.34**	**2.36**
Work	**1.08**	**1.06**	**1.13**	**1.01**	**1.05**	**1.09**	**1.14**	**1.09**
Attend Childcare	**0.05**	**0.04**	**0.05**	**0.05**	**0.05**	**0.05**	**0.06**	**0.06**
Attend School	**0.41**	**0.45**	**0.42**	**0.40**	**0.42**	**0.40**	**0.42**	**0.38**
Attend College	**0.03**	**0.05**	**0.03**	**0.03**	**0.02**	**0.02**	**0.04**	**0.03**
Eat Out	**0.34**	**0.36**	**0.34**	**0.29**	**0.29**	**0.34**	**0.37**	**0.40**
Personal Business	**0.95**	**0.86**	**0.99**	**1.00**	**0.98**	**0.93**	**0.93**	**0.99**
Everyday Shopping	**0.69**	**0.67**	**0.69**	**0.72**	**0.68**	**0.66**	**0.72**	**0.72**
Major Shopping	**0.06**	**0.06**	**0.05**	**0.06**	**0.05**	**0.06**	**0.06**	**0.07**
Religious/Community	**0.12**	**0.12**	**0.13**	**0.13**	**0.09**	**0.11**	**0.12**	**0.13**
Social	**0.28**	**0.25**	**0.28**	**0.35**	**0.29**	**0.28**	**0.27**	**0.28**
Recreation– Participate	**0.21**	**0.20**	**0.25**	**0.22**	**0.18**	**0.18**	**0.21**	**0.24**
Recreation- Watch	**0.07**	**0.06**	**0.07**	**0.07**	**0.06**	**0.07**	**0.07**	**0.07**
Accompany Another Person	**0.41**	**0.43**	**0.50**	**0.37**	**0.38**	**0.40**	**0.39**	**0.38**
Pick-Up/Drop-Off Passenger	**0.60**	**0.67**	**0.70**	**0.49**	**0.54**	**0.55**	**0.65**	**0.60**
Turn Around	**0.07**	**0.07**	**0.06**	**0.06**	**0.07**	**0.07**	**0.09**	**0.08**

While the average number of trips per person statewide (without weighting) was 7.72, trips rates were highest in the Small Cities areas and lowest in the UP and the Southern Lower Peninsula rural areas. Work trips had the highest reported frequency following by personal business trips, everyday shopping trips, and picking up or dropping off passengers.

The highest rates of work trips were generated in the TMA's and Small Cities sampling areas while the lowest rate was generated in the UP Rural area.

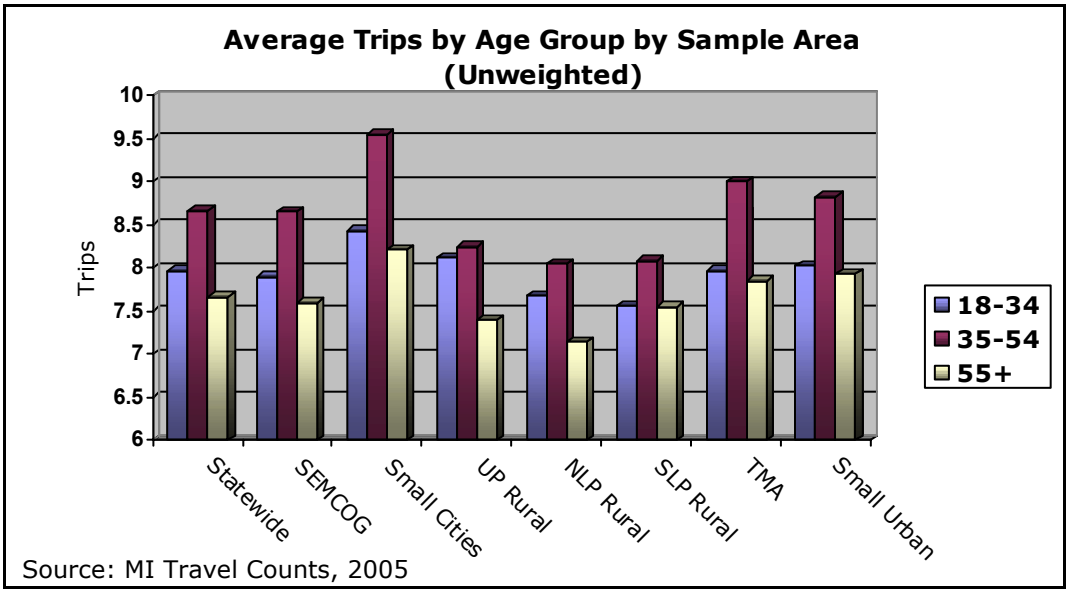
Figure 24: Average Trips per Person by Sample Area (Unweighted)



Average trips per person were highest in the Small Cities sampling area (8.3), and lowest in the three rural areas (average 7.4).

Figure 25 shows the average number of trips by age group.

Figure 25: Average Trips by Age Group by Sample Area (Unweighted)



Across all sampling areas, the average trips were highest for those ages 35-54. The average number of trips was considerably lower for those 55 years or older living in the rural areas of the Northern Lower and Upper Peninsulas.

Table 34. Average Number of Trips by Person by Age and Gender (Day 1 and Day 2 Combined)

Sample Area	Statewide	SEMCOG	Small Cities	UP Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMA's	Small Urban Modeled Areas
Total	**7.72**	**7.69**	**8.30**	**7.45**	**7.25**	**7.40**	**7.91**	**7.91**
Age 18-34	**7.97**	**7.89**	**8.43**	**8.12**	**7.68**	**7.56**	**7.96**	**8.02**
Age 35-54	**8.66**	**8.65**	**9.54**	**8.25**	**8.05**	**8.08**	**9.00**	**8.83**
Age 55+	**7.66**	**7.59**	**8.21**	**7.40**	**7.14**	**7.55**	**7.85**	**7.93**
Male	**7.39**	**7.20**	**8.03**	**7.26**	**6.97**	**7.08**	**7.48**	**7.61**
Age 18-34	**7.42**	**6.68**	**7.75**	**7.59**	**7.04**	**7.00**	**7.14**	**7.43**
Age 35-54	**7.99**	**7.83**	**8.90**	**7.59**	**7.46**	**7.39**	**8.24**	**8.31**
Age 55+	**7.86**	**7.61**	**8.69**	**7.73**	**7.25**	**7.64**	**8.07**	**8.09**
Female	**8.02**	**8.13**	**8.53**	**7.64**	**7.52**	**7.70**	**8.30**	**8.18**
Age 18-34	**8.60**	**8.86**	**9.02**	**8.57**	**8.22**	**8.09**	**8.65**	**8.52**
Age 35-54	**9.26**	**9.33**	**10.11**	**8.84**	**8.57**	**8.73**	**9.65**	**9.31**
Age 55+	**7.50**	**7.57**	**7.81**	**7.08**	**7.03**	**7.46**	**7.68**	**7.81**

Across all sampling areas, females tend to generate more trips than males. Females reported higher average trips than males for two of the three age groups, 55 years and older average trips for males were slightly higher than for females. The trip generation rate was highest among females ages 35 to 54, and lowest among males ages 18 to 34.

Figure 26: Average Trips by Age by Gender (Unweighted)

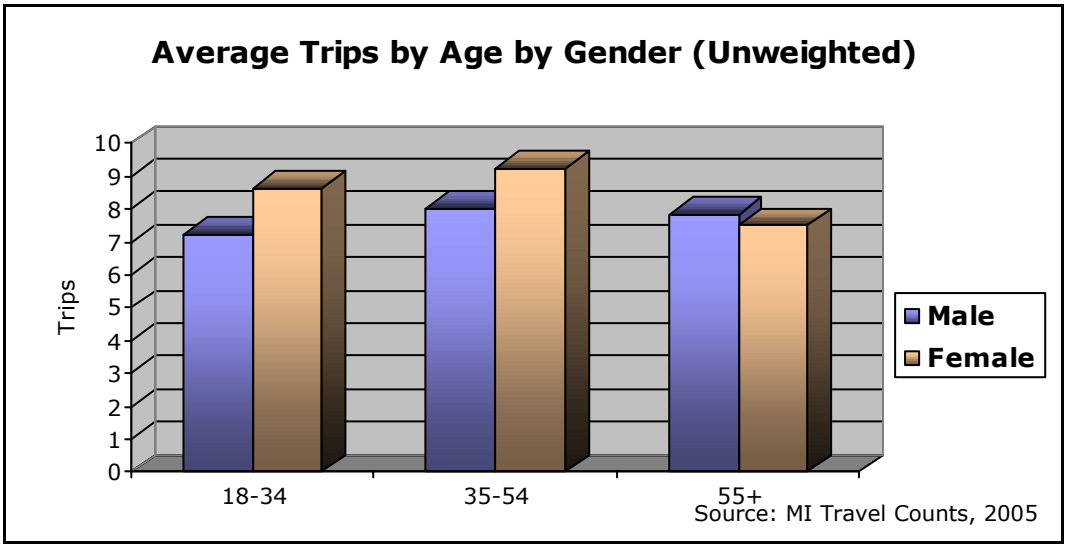


Figure 27: Average Trips for Females by Age Group by Sample Area (Unweighted)

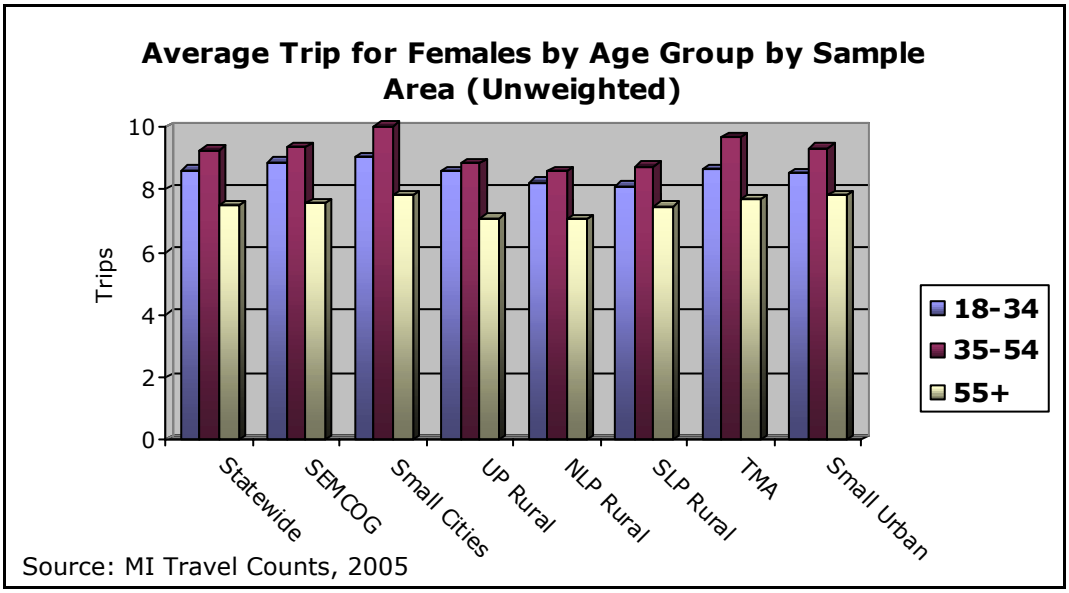


Figure 28: Average Trips for Males by Age Group by Sample Area (Unweighted)

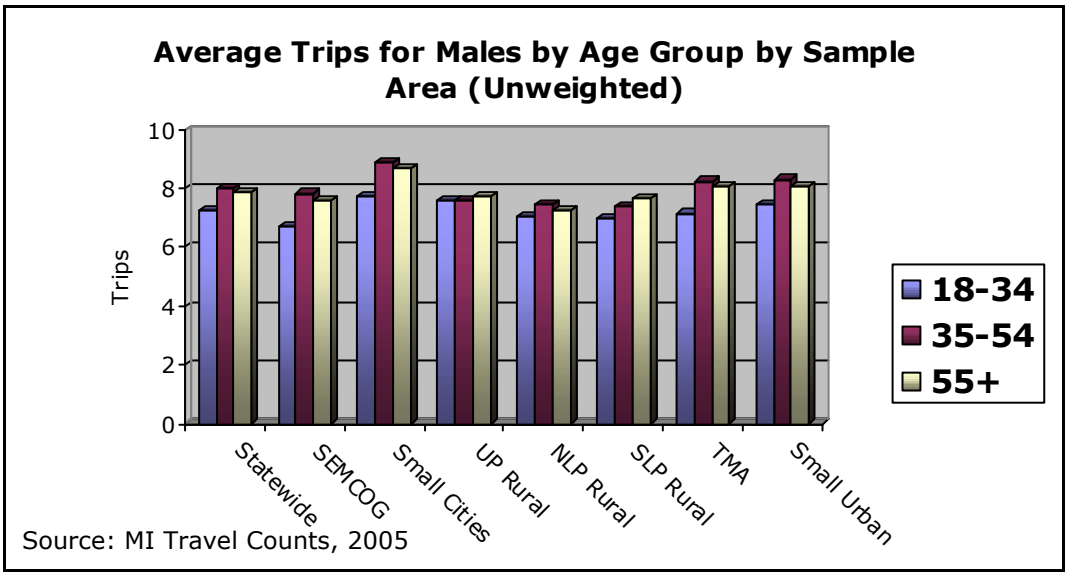
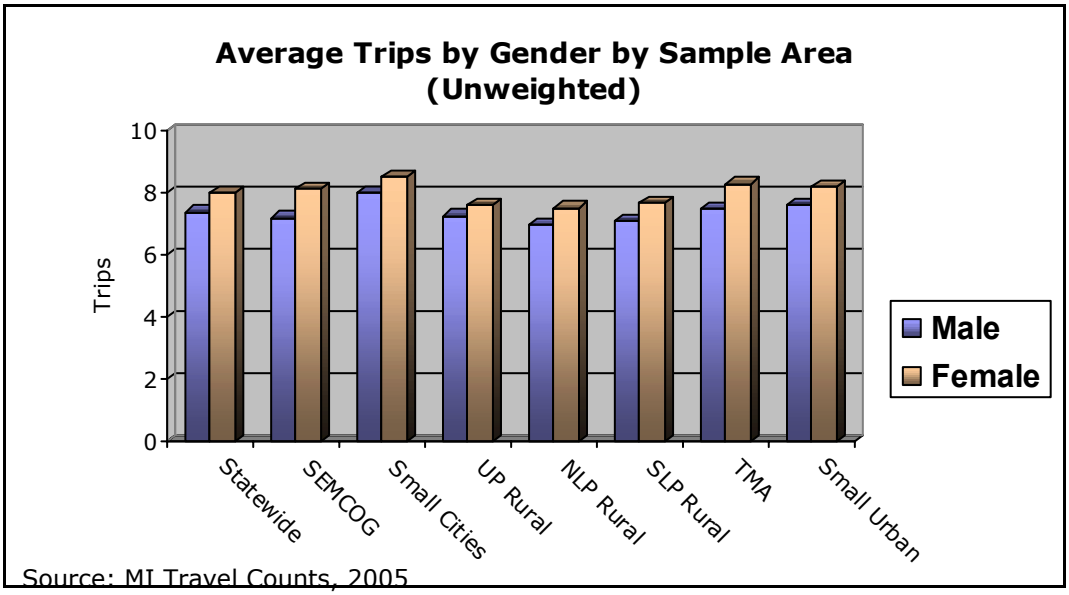


Figure 29: Average Trips by Gender by Sample Area (Unweighted)



Trips by Retrieval Method

Table 35 shows the average trips per person by sampling area by method of respondent retrieval. Tables 36 through 39 show average trips by sample area, by age and gender characteristics for each retrieval method.

Table 35: Average Number of Trips by Person by Retrieval Method (Day 1 and Day 2 Combined)

Sample Area	Statewide	SEMCOG	Small Cities	UP Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMA's	Small Urban Modeled Areas
Total	**7.72**	**7.69**	**8.30**	**7.45**	**7.25**	**7.40**	**7.91**	**7.91**
Phone Respondents	**8.48**	**8.47**	**9.21**	**8.17**	**7.78**	**8.03**	**8.77**	**8.79**
Proxy	**6.92**	**6.80**	**7.35**	**6.67**	**6.57**	**6.82**	**7.07**	**7.06**
Mailed Diary	**7.83**	**7.98**	**8.50**	**7.55**	**7.48**	**7.39**	**7.92**	**7.90**
Internet	**8.77**	**8.20**	**9.60**	**7.45**	**10.21**	**7.83**	**9.94**	**6.50**

Trip rates were the highest for Internet respondents followed closely by phone respondents. Those who mailed their travel inventories in had the lowest number of trips.

Table 36: Average Number of Trips by Phone Respondents by Age and Gender Characteristics (Day 1 and Day 2 Combined)

Sample Area	Statewide	SEMCOG	Small Cities	UP Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMA's	Small Urban Modeled Areas
Phone Respondents	8.48	8.47	9.21	8.17	7.78	8.03	8.77	8.79
Age 18-34	8.71	8.75	9.08	8.65	7.99	8.24	8.86	9.08
Age 35-54	9.04	8.91	10.07	8.79	8.19	8.35	9.42	9.32
Age 55+	7.84	7.9	8.29	7.5	7.36	7.60	8.02	8.21
Male	8.08	7.83	8.93	8.00	7.39	7.55	8.20	8.52
Age 18-34	7.61	6.75	7.80	7.71	6.72	7.56	8.21	8.20
Age 35-54	8.22	8.04	9.34	8.07	7.57	7.58	8.07	8.61
Age 55+	8.10	7.99	8.85	8.01	7.42	7.51	8.40	8.58
Female	8.69	8.77	9.36	8.27	8.00	8.29	9.06	8.93
Age 18-34	9.18	9.52	9.65	9.04	8.55	8.53	9.17	9.48
Age 35-54	9.49	9.33	10.49	9.21	8.53	8.79	10.12	9.74
Age 55+	7.69	7.85	7.96	7.17	7.32	7.64	7.82	8.03

Table 37: Average Number of Trips by Proxy by Age and Gender Characteristics (Day 1 and Day 2 Combined)

Sample Area	Statewide	SEMCOG	Small Cities	UP Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMA's	Small Urban Modeled Areas
Proxy	6.92	6.80	7.35	6.67	6.57	6.82	7.07	7.06
Age 18-34	7.30	6.73	7.87	7.60	7.44	7.17	7.11	7.25
Age 35-54	7.67	7.61	8.37	7.10	7.18	7.32	8.10	7.75
Age 55+	7.22	6.93	7.68	7.03	6.61	7.45	7.30	7.55
Male	6.93	6.69	7.41	6.76	6.55	6.90	7.00	7.12
Age 18-34	7.02	6.19	7.57	7.63	7.18	6.71	6.66	7.29
Age 35-54	7.56	7.24	8.24	7.02	7.05	7.40	7.91	7.86
Age 55+	7.56	7.07	8.33	7.30	7.04	7.83	7.71	7.72
Female	6.91	6.96	7.28	6.53	6.59	6.70	7.16	6.98
Age 18-34	7.73	7.44	8.36	7.55	7.81	7.92	7.74	7.19
Age 35-54	7.90	8.34	8.58	7.25	7.43	7.10	8.52	7.55
Age 55+	6.54	6.67	6.63	6.41	5.58	6.59	6.62	7.22

Proxy respondent trips were lower than for respondents as a whole; 6% lower for males and 14% lower for females.

Table 38: Average Number of Trips by Mailed Diary Respondents by Age and Gender Characteristics (Day 1 and Day 2 Combined)

Sample Area	Statewide	SEMCOG	Small Cities	UP Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMA's	Small Urban Modeled Areas
Mailed Diary	7.83	7.98	8.50	7.55	7.48	7.39	7.92	7.90
Age 18-34	7.96	8.32	8.38	8.20	7.51	7.43	7.91	7.78
Age 35-54	8.91	9.18	9.80	8.36	8.55	8.25	8.98	9.10
Age 55+	7.67	7.47	8.58	7.55	7.10	7.54	8.02	7.51
Male	7.49	7.50	8.23	7.33	7.23	6.96	7.60	7.54
Age 18-34	7.30	7.30	8.09	7.41	7.00	7.25	6.95	7.06
Age 35-54	8.21	8.33	9.13	7.70	7.74	7.11	8.74	8.52
Age 55+	7.82	7.72	8.84	7.81	7.23	7.61	7.97	7.63
Female	8.17	8.45	8.76	7.79	7.73	7.84	8.23	8.25
Age 18-34	8.54	9.25	8.59	8.85	7.94	7.61	8.80	8.34
Age 35-54	9.56	9.96	10.43	8.97	9.30	9.32	9.19	9.64
Age 55+	7.50	7.16	8.28	7.23	6.95	7.46	8.09	7.38

Table 39: Average Number of Trips by Internet Respondents by Age and Gender Characteristics (Day 1 and Day 2 Combined)

Sample Area	Statewide	SEMCOG	Small Cities	UP Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMA's	Small Urban Modeled Areas
Internet	8.77	8.20	9.60	7.45	10.21	7.83	9.94	6.50
Age 18-34	9.19	12.25	10.17	6.40	12.00	3.50	9.00	0
Age 35-54	10.47	8.86	11.79	10.50	11.38	10.00	12.75	6.60
Age 55+	7.67	8.33	9.67	4.00	0	0	5.50	0
Male	8.61	8.60	9.80	6.63	10.43	7.00	9.15	7.50
Age 18-34	8.80	12.00	8.00	7.00	9.00	3.00	13.00	0
Age 35-54	10.73	10.33	14.20	10.00	13.00	8.00	10.40	8.40
Age 55+	7.71	6.50	9.67	4.00	0	0	8.00	0
Female	8.91	7.93	9.45	8.00	10.08	8.67	10.94	5.25
Age 18-34	9.44	12.50	11.25	6.00	18.00	4.00	8.20	0
Age 35-54	10.28	7.75	10.44	11.00	10.40	11.50	14.43	4.80
Age 55+	7.5	12.00	0	0	0	0	3	0

Internet and mail respondents were less likely to report "no trips" for the assigned travel days. Mail respondent reported trips were significantly higher for females 35-54 (9.56). Only 13% of the 3,610 persons reporting no trips on the travel days were mail respondents. None of the 171 Internet respondents reported zero trips and Internet

reported per person trips were considerably higher (8.77). Trips per person were significantly higher for females age 35-54 (9.26).

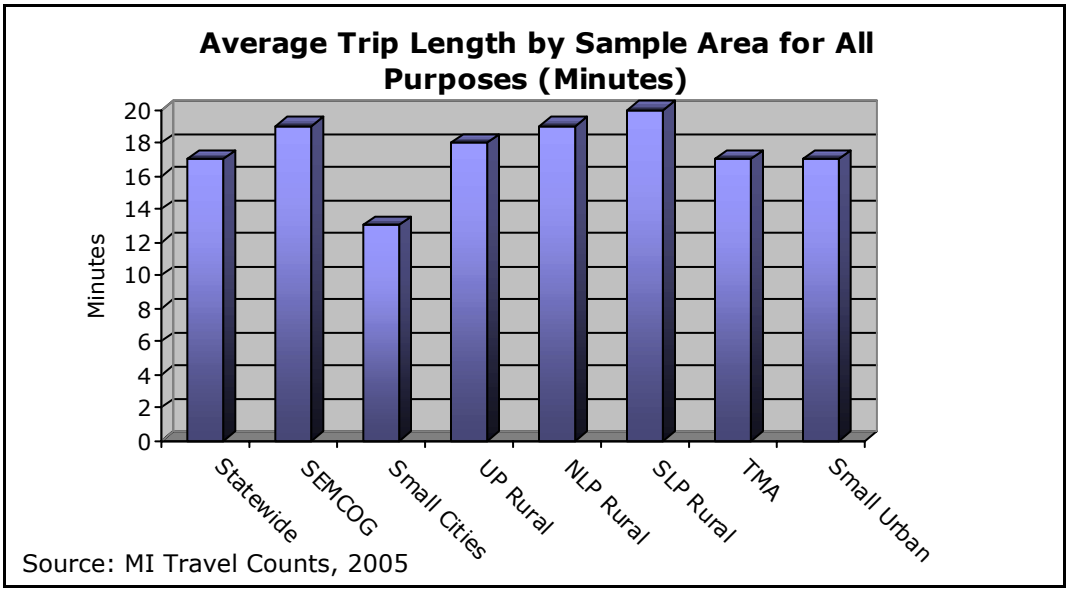
Travel Time

Table 40. Average Trip Duration in Minutes by Purpose (Reported Times)

Sample Area	Statewide	SEMCOG	Small Cities	UP Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMA's	Small Urban Modeled Areas
Average	**17**	**19**	**13**	**18**	**19**	**20**	**17**	**17**
Work	**21**	**25**	**16**	**18**	**21**	**23**	**22**	**19**
Attend Childcare	**14**	**14**	**13**	**15**	**15**	**14**	**14**	**15**
Attend School	**19**	**17**	**13**	**21**	**23**	**22**	**19**	**19**
Attend College	**26**	**27**	**18**	**29**	**31**	**33**	**24**	**27**
Eat Out	**14**	**14**	**12**	**16**	**17**	**16**	**13**	**14**
Personal Business	**17**	**18**	**13**	**18**	**18**	**18**	**16**	**16**
Everyday Shopping	**13**	**14**	**11**	**14**	**14**	**14**	**13**	**13**
Major Shopping	**19**	**17**	**18**	**22**	**21**	**23**	**16**	**17**
Religious/Community	**14**	**15**	**10**	**12**	**15**	**16**	**13**	**15**
Social	**19**	**20**	**15**	**18**	**20**	**19**	**20**	**20**
Recreation-Participate	**19**	**19**	**16**	**21**	**21**	**21**	**18**	**19**
Recreation-Watch	**19**	**18**	**14**	**17**	**20**	**21**	**19**	**20**
Accompany Another Person	**15**	**15**	**12**	**17**	**17**	**16**	**15**	**16**
Pick-Up/Drop-Off Passenger	**14**	**14**	**10**	**14**	**15**	**16**	**14**	**14**
Turn Around	**20**	**20**	**17**	**27**	**20**	**18**	**20**	**22**

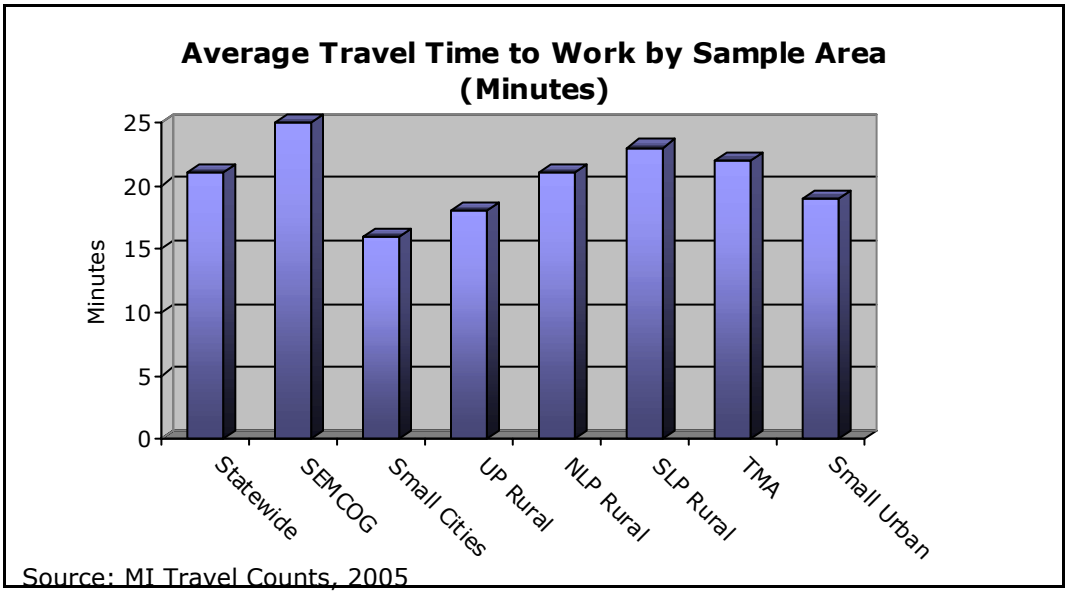
The average trip duration for work trips was 21 minutes statewide (on an unweighted basis). The SEMCOG sampling area had the longest average work trip duration; the shortest average work trip duration was in the Small Cities sampling area. Other trip purposes with longer duration times are to attend college and for major shopping (particularly in rural areas).

Figure 30: Average Trip Length by Sample Area for All Purposes (Minutes)



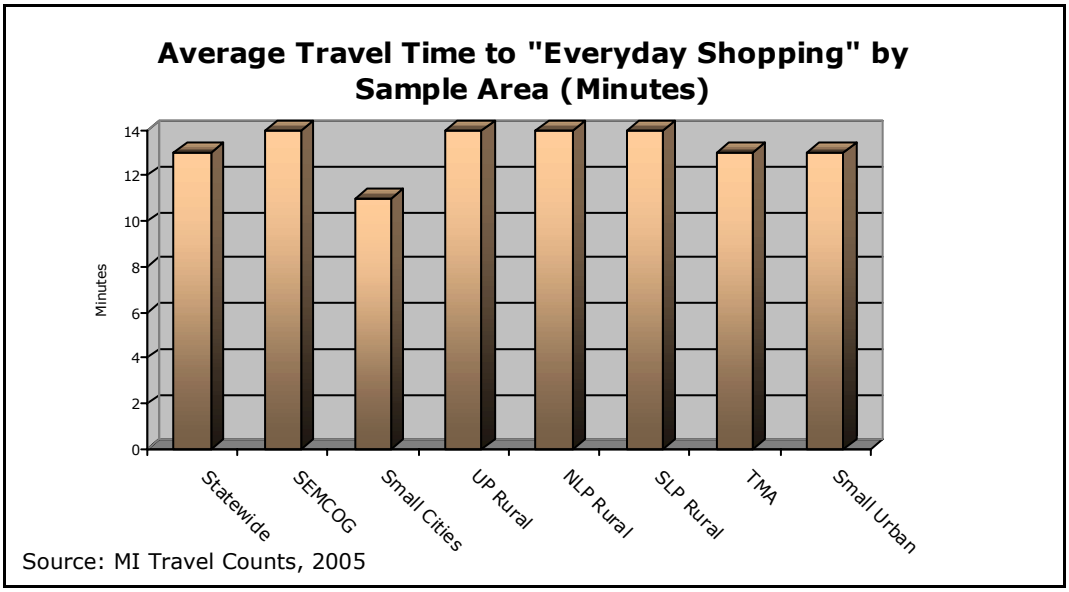
The average trip length was 17 minutes. The averages across the sampling areas ranged from 13 minutes in the Small Cities sampling area to 20 minutes in the Southern Lower Peninsula Rural sampling area.

Figure 31: Average Travel Time to Work by Sample Area (Minutes)



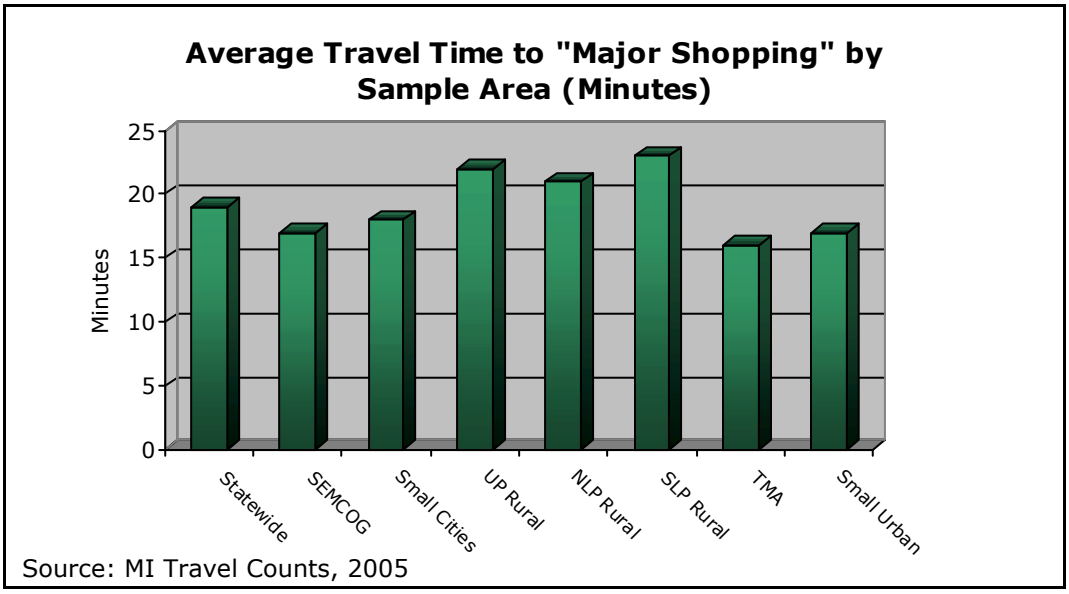
The average travel time to work in the urban/suburban SEMCOG sampling area was 25 minutes; average travel time to work was shortest in the Small Cities area (16 minutes). Average travel time to work exceeded 20 minutes in the TMA and the rural areas of the Northern and Southern Lower Peninsula.

Figure 32: Average Travel Time to "Everyday Shopping" by Sample Area (Minutes)



The average travel time for "everyday shopping" was 13 minutes. The shortest average travel time was reported for the Small Cities sampling area (11 minutes). Average travel times for "everyday shopping" for all other sampling areas was 13 or 14 minutes.

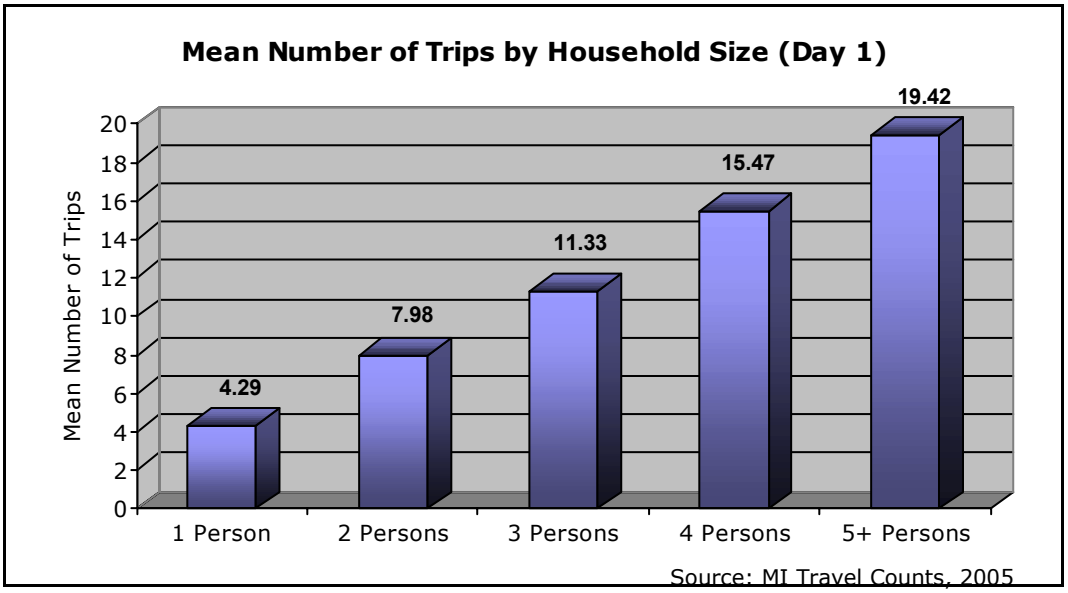
Figure 33: Average Travel Time to "Major Shopping" by Sample Area (Minutes)



The average travel time for "major shopping" was 19 minutes. The shortest average travel times were reported for the SEMCOG sampling area and the Small Urban Modeled Areas (17 minutes each). The longest average travel times for "major shopping" were reported for the rural sampling areas of the Upper and Lower Peninsula (22 and 23 minutes, respectively).

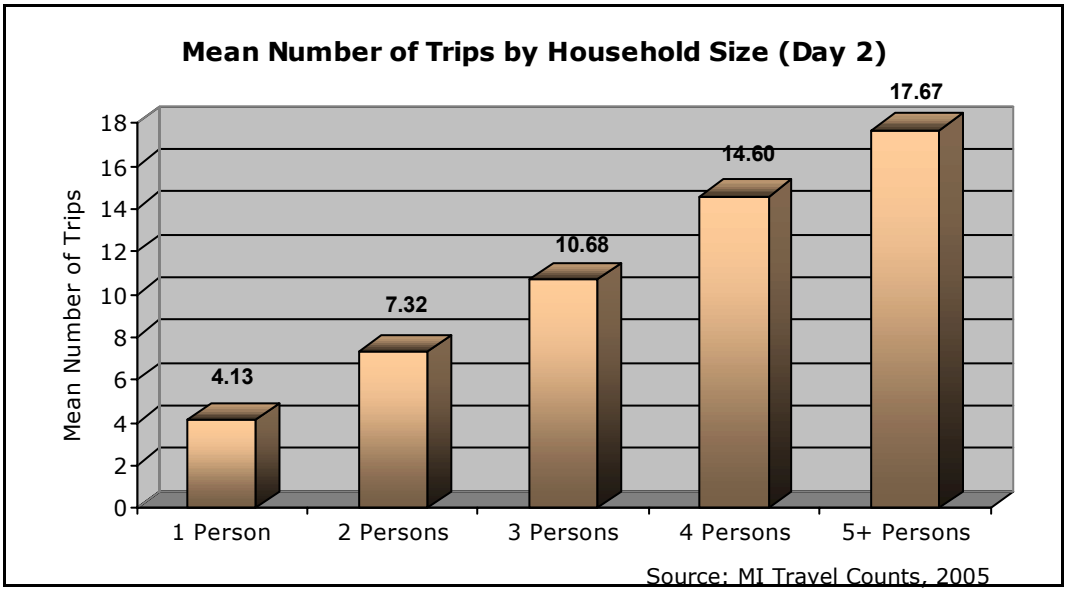
Average Trips-- Weighted

Figure 34: Mean Number of Trips by Household Size (Day 1)—Weighted



On Travel Day 1, one person households averaged 4.29 trips while households with five or more persons averaged 19.42 trips per household. The mean weighted number of trips per household on Travel Day 1 was 9.99 trips.

Figure 35: Mean Number of Trips by Household Size (Day 2)—Weighted



On Travel Day 2, the mean number of trips per household was 9.42, a decline of 5.7% in reported trips from Travel Day 1.

The average Trips per Household currently used for TMA Models is 9.00 and for Small Urban Area Models is 9.20.

Travel Patterns

Figure 36 shows the most frequent types of daily travel patterns where "H" represents home, "W" represents work, "S" represents school, and "O" is some other destination.

HWH = Home-Work-Home

HSH = Home-School-Home

HOH = Home-Other-Home

HOOH = Home-Other-Other-Home

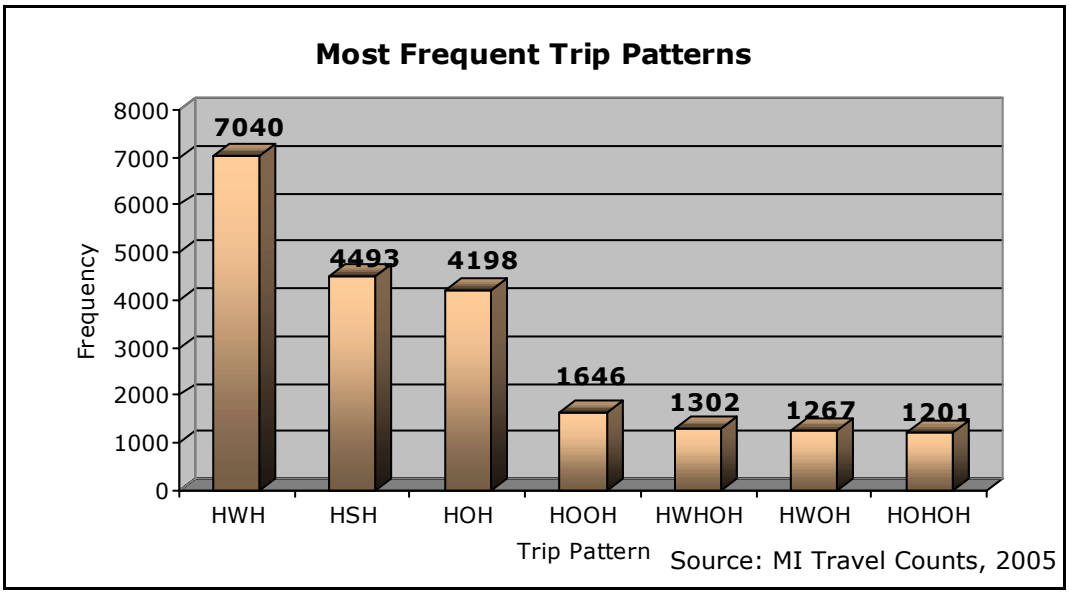
HWHOH = Home-Work-Home-Other-Home

HWOH = Home-Work-Other-Home

HOHOH = Home-Other-Home-Other-Home

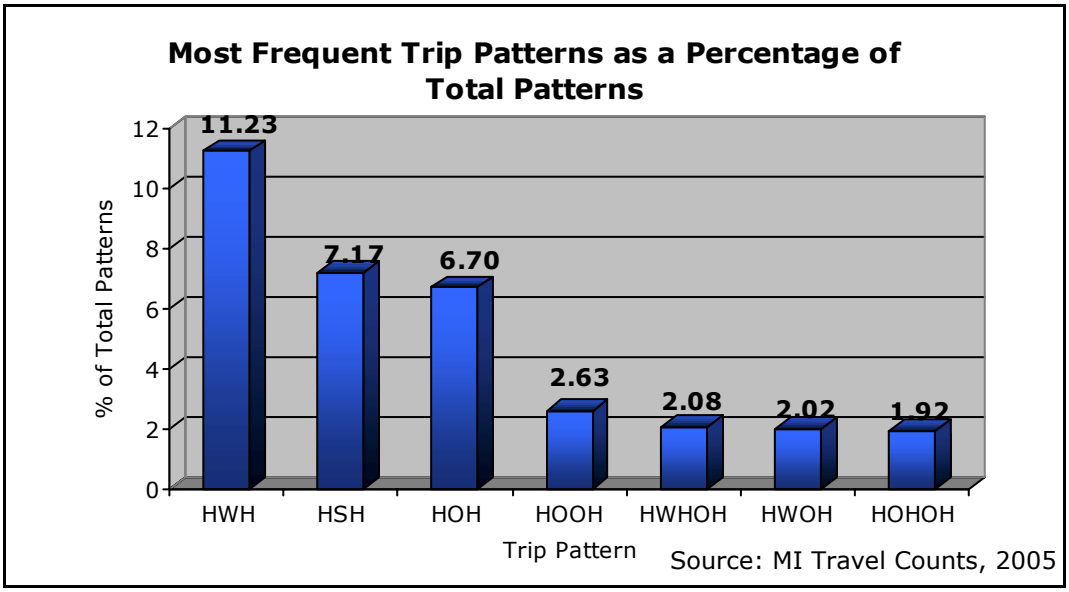
HOOH = Home-Other-Other-Home

Figure 36: Most Frequent Trip Patterns



There were 62,672 respondent travel days and 259,684 trips in the MI Travel Counts program from the 14,996 completed and accepted households. The percent of each of these frequent travel patterns as a percent of total travel is presented in Figure 37. The figure illustrates approximately 33.7% of all travel patterns. No other daily trip pattern represented more than 1.5% of the total patterns.

Figure 37 Most Frequent Trip Patterns as a Percentage of Total Patterns



Long Distance and Visitors

For the long distance retrospective component, 37,320 long-distance trips (over 100 miles taken in the last 3 months) were reported by 22,966 persons (61.3% of all MI Travel Counts reporting household members).

For the visitor portion of MI Travel Counts, 818 trips were collected from 156 visitors, or 5.25 trips per residential visitor.

Section 13: Data Weighting and Expansion

In Brief: *Section 13 describes the procedures, calculations, and factors that were used to weight and expand the data.*

Expansion Factors by Geographic Sample Area

The final step in MI Travel Counts was to calculate the expansion factors in order to properly weight each observation of the sample. For MI Travel Counts, households were to be sampled in proportion to their distribution by size, number of autos available, and the number of workers in the household. In addition, the state was divided into seven distinct sampling areas.

The number of households to be sampled per Area was determined to be 2040, based on 68 household types times 30 minimum observations per type. (While an additional 35 households were part of the sampling plan targets to bring collapsed data cells to a minimum of 30, the actual proportional Census based distribution by cell for weighting is based on the actual proportional distributions by area of 2,040 households.) The expansion factor for each household by area would then be calculated by taking the total number of sample area households and dividing it by the total number of households surveyed.

The Sampling Plan Technical Document (Appendix 1) and Table 41A through 41G below show the total number of households that were to be surveyed for each sample area stratified by autos and workers. These totals were determined by the distribution of households from the 2000 PUMS data. In some cases these cells were collapsed; hence, there are no longer 68 combinations per sample area. This was done where the number of autos is greater than the household size; such cells were combined with the number of autos equal to the household size. This was based on the assumption that a person can only drive one vehicle at a time, so once the auto sufficiency was met, it no longer matters how many more vehicles the household owns. Certain cells were collapsed because the cell was so unique, it would have been almost impossible to find representative households to survey. For example, households with four or more persons and no autos or workers were often combined with smaller household sizes.

To be expected, some sampling areas and distributions had extra surveys while other sampling areas and distributions did not have enough or were completely missing. (While the sampling plan collapsed rare population cells for data collection efficiency, the weighting plan correctly bases weights on uncollapsed cells, since future data users may want to aggregate and weight a certain data cell across sample areas, etc.) Therefore, the expansion factors must reflect these variations in the actual number of surveys collected. Otherwise, the total households will not be represented properly and could bias any results produced from using the expanded observations.

Tables 41A through 41G show, for each sample area separately, the number of surveys targeted and the number of surveys collected by household size, workers and autos.

Additionally, the ratio of surveys targeted to surveys collected is shown in the last column. If the ratio of targeted surveys to collected surveys is equal to 1.0, then the collected surveys exactly equals the number of targeted surveys. If the ratio is less than 1.0, then that cell was over-sampled and the number of collected surveys is greater than the number of targeted surveys. If the ratio is greater than 1.0, then that cell was under-sampled and the number of collected surveys is less than the number of targeted surveys.

Table 41A. SEMCOG, Targeted and Collected Surveys

Household Size	*# of Workers*	*Autos Available*	*Targeted # Surveys*	*Actual # Surveys*	*Ratio*
1	0	0	77	111	0.694
1	1	0	23	14	1.643
2	0	0	18	26	0.692
2	1	0	12	16	0.750
2	2	0	6	2	3.000
3	0	0	6	16	0.375
3	1	0	8	17	0.471
3	2	0	3	3	1.000
3	3	0	1	0	0.000
4	0	0	10	7	1.429
4	1	0	11	20	0.550
4	2	0	5	0	0.000
4	3	0	3	1	3.000
1	0	1	185	185	1.000
1	1	1+	273	297	0.919
2	0	1	73	79	0.924
2	1	1	75	89	0.843
2	2	1	30	30	1.000
3	0	1	14	14	1.000
3	1	1	41	41	1.000
3	2	1	16	15	1.067
3	3	1	3	1	3.000
4	0	1	15	11	1.364
4	1	1	38	36	1.056
4	2	1	24	13	1.846
4	3	1	7	3	2.333
2	0	2	89	89	1.000
2	1	2	121	122	0.992
2	2	2+	211	211	1.000
3	0	2	12	17	0.706
3	1	2	48	71	0.676
3	2	2	78	101	0.772
3	3	2	11	14	0.786
4	0	2	11	12	0.917
4	1	2	87	127	0.685
4	2	2	124	127	0.976
4	3	2	19	15	1.267
3	0	3+	4	2	2.000
3	1	3+	20	28	0.714
3	2	3+	40	40	1.000
3	3	3+	32	32	1.000
4	0	3+	5	8	0.625
4	1	3+	26	28	0.929
4	2	3+	56	67	0.836
4	3	3+	69	86	0.802

Table 41B. Northern Lower Peninsula Rural, Targeted and Collected Surveys

Household Size	*# of Workers*	*Autos Available*	*Targeted # Surveys*	*Actual # Surveys*	*Ratio*
1	0	0	67	71	0.944
1	1	0	14	1	14.000
2	0	0	10	18	0.556
2	1	0	8	5	1.600
2	2	0	4	1	4.000
3	0	0	2	2	1.000
3	1	0	4	0	0.000
3	2	0	3	0	0.000
3	3	0	1	0	0.000
4	0	0	2	0	0.000
4	1	0	3	2	1.500
4	2	0	3	1	3.000
4	3	0	2	1	2.000
1	0	1	245	245	1.000
1	1	1	207	212	0.976
2	0	1	110	110	1.000
2	1	1	63	71	0.887
2	2	1	27	27	1.000
3	0	1	11	8	1.375
3	1	1	34	35	0.971
3	2	1	14	2	7.000
3	3	1	3	0	0.000
4	0	1	10	1	10.000
4	1	1	27	35	0.771
4	2	1	23	17	1.353
4	3	1	4	0	0.000
2	0	2	189	189	1.000
2	1	2	148	148	1.000
2	2	2	206	205	1.005
3	0	2	11	14	0.786
3	1	2	45	45	1.000
3	2	2	69	73	0.945
3	3	2	8	15	0.533
4	0	2	9	11	0.818
4	1	2	66	80	0.825
4	2	2	122	144	0.847
4	3	2	16	18	0.889
3	0	3	4	7	0.571
3	1	3	21	26	0.808
3	2	3	46	49	0.939
3	3	3	28	29	0.966
4	0	3	4	2	2.000
4	1	3	24	38	0.632
4	2	3	66	67	0.985
4	3	3	58	58	1.000

Table 41C. Southern Lower Peninsula Rural, Targeted and Collected Surveys

Household Size	*# of Workers*	*Autos Available*	*Targeted # Surveys*	*Actual # Surveys*	*Ratio*
1	0	0	56	68	0.824
1	1	0	16	5	3.200
2	0	0	11	13	0.846
2	1	0	9	5	1.800
2	2	0	5	3	1.667
3	0	0	3	2	1.500
3	1	0	5	0	0.000
3	2	0	2	0	0.000
3	3	0	1	0	0.000
4	0	0	3	2	1.500
4	1	0	5	2	2.500
4	2	0	3	0	0.000
4	3	0	2	0	0.000
1	0	1	194	194	1.000
1	1	1	233	233	1.000
2	0	1	76	76	1.000
2	1	1	66	66	1.000
2	2	1	32	32	1.000
3	0	1	11	7	1.571
3	1	1	38	42	0.905
3	2	1	16	10	1.600
3	3	1	3	1	3.000
4	0	1	9	2	4.500
4	1	1	31	31	1.000
4	2	1	21	20	1.050
4	3	1	6	2	3.000
2	0	2	131	158	0.829
2	1	2	145	149	0.973
2	2	2	237	237	1.000
3	0	2	10	10	1.000
3	1	2	42	48	0.875
3	2	2	79	95	0.832
3	3	2	10	15	0.667
4	0	2	8	5	1.600
4	1	2	77	77	1.000
4	2	2	138	137	1.007
4	3	2	21	22	0.955
3	0	3	4	6	0.667
3	1	3	20	22	0.909
3	2	3	47	47	1.000
3	3	3	35	35	1.000
4	0	3	5	5	1.000
4	1	3	28	49	0.571
4	2	3	76	76	1.000
4	3	3	70	70	1.000

Table 41D. Upper Peninsula, Targeted and Collected Surveys

Household Size	*# of Workers*	*Autos Available*	*Targeted # Surveys*	*Actual # Surveys*	*Ratio*
1	0	0	87	90	0.967
1	1	0	21	14	1.500
2	0	0	14	15	0.933
2	1	0	8	3	2.667
2	2	0	5	1	5.000
3	0	0	2	0	0.000
3	1	0	5	2	2.500
3	2	0	2	0	0.000
3	3	0	1	0	0.000
4	0	0	2	1	2.000
4	1	0	4	1	4.000
4	2	0	3	1	3.000
4	3	0	1	0	0.000
1	0	1	246	247	0.996
1	1	1	218	219	0.995
2	0	1	99	99	1.000
2	1	1	69	69	1.000
2	2	1	31	31	1.000
3	0	1	10	6	1.667
3	1	1	35	32	1.094
3	2	1	12	15	0.800
3	3	1	4	5	0.800
4	0	1	8	10	0.800
4	1	1	30	30	1.000
4	2	1	21	17	1.235
4	3	1	6	2	3.000
2	0	2	171	171	1.000
2	1	2	152	153	0.993
2	2	2	198	198	1.000
3	0	2	13	9	1.444
3	1	2	42	46	0.913
3	2	2	71	76	0.934
3	3	2	10	11	0.909
4	0	2	8	3	2.667
4	1	2	62	63	0.984
4	2	2	120	138	0.870
4	3	2	17	13	1.308
3	0	3	5	6	0.833
3	1	3	21	28	0.750
3	2	3	43	43	1.000
3	3	3	27	28	0.964
4	0	3	2	1	2.000
4	1	3	21	27	0.778
4	2	3	60	59	1.017
4	3	3	57	58	0.983

Table 41E. TMA, Targeted and Collected Surveys

Household Size	*# of Workers*	*Autos Available*	*Targeted # Surveys*	*Actual # Surveys*	*Ratio*
1	0	0	58	67	0.866
1	1	0	19	12	1.583
2	0	0	12	26	0.462
2	1	0	9	7	1.286
2	2	0	4	0	0.000
3	0	0	5	6	0.833
3	1	0	5	5	1.000
3	2	0	2	1	2.000
3	3	0	1	0	0.000
4	0	0	4	4	1.000
4	1	0	6	8	0.750
4	2	0	3	1	3.000
4	3	0	2	0	0.000
1	0	1	172	172	1.000
1	1	1	258	258	1.000
2	0	1	67	67	1.000
2	1	1	72	80	0.900
2	2	1	31	29	1.069
3	0	1	13	11	1.182
3	1	1	39	44	0.886
3	2	1	13	11	1.182
3	3	1	4	0	0.000
4	0	1	11	7	1.571
4	1	1	36	39	0.923
4	2	1	23	13	1.769
4	3	1	7	2	3.500
2	0	2	100	100	1.000
2	1	2	128	128	1.000
2	2	2	245	245	1.000
3	0	2	9	6	1.500
3	1	2	43	56	0.768
3	2	2	85	95	0.895
3	3	2	11	15	0.733
4	0	2	9	4	2.250
4	1	2	85	86	0.988
4	2	2	144	144	1.000
4	3	2	21	16	1.313
3	0	3	3	6	0.500
3	1	3	18	23	0.783
3	2	3	45	45	1.000
3	3	3	35	36	0.972
4	0	3	4	2	2.000
4	1	3	28	49	0.571
4	2	3	71	76	0.934
4	3	3	76	88	0.864

Table 41F. Small Urban Modeled Areas, Targeted and Collected Surveys

Household Size	*# of Workers*	*Autos Available*	*Targeted # Surveys*	*Actual # Surveys*	*Ratio*
1	0	0	61	79	0.772
1	1	0	15	12	1.250
2	0	0	12	23	0.522
2	1	0	9	8	1.125
2	2	0	5	1	5.000
3	0	0	4	8	0.500
3	1	0	5	3	1.667
3	2	0	3	0	0.000
3	3	0	1	0	0.000
4	0	0	3	3	1.000
4	1	0	5	3	1.667
4	2	0	4	1	4.000
4	3	0	2	1	2.000
1	0	1	199	199	1.000
1	1	1	234	234	1.000
2	0	1	79	82	0.963
2	1	1	68	80	0.850
2	2	1	30	29	1.034
3	0	1	12	6	2.000
3	1	1	38	41	0.927
3	2	1	17	11	1.545
3	3	1	3	2	1.500
4	0	1	9	6	1.500
4	1	1	30	34	0.882
4	2	1	22	19	1.158
4	3	1	6	0	0.000
2	0	2	132	137	0.964
2	1	2	141	141	1.000
2	2	2	235	235	1.000
3	0	2	9	6	1.500
3	1	2	42	42	1.000
3	2	2	78	89	0.876
3	3	2	10	6	1.667
4	0	2	9	8	1.125
4	1	2	76	77	0.987
4	2	2	140	141	0.993
4	3	2	20	4	5.000
3	0	3	3	8	0.375
3	1	3	18	22	0.818
3	2	3	45	45	1.000
3	3	3	35	35	1.000
4	0	3	5	3	1.667
4	1	3	25	33	0.758
4	2	3	71	72	0.986
4	3	3	72	72	1.000

Table 41G. Small Cities, Targeted and Collected Surveys

Household Size	*# of Workers*	*Autos Available*	*Targeted # Surveys*	*Actual # Surveys*	*Ratio*
1	0	0	68	103	0.660
1	1	0	18	15	1.200
2	0	0	12	19	0.632
2	1	0	8	11	0.727
2	2	0	5	2	2.500
3	0	0	3	2	1.500
3	1	0	5	7	0.714
3	2	0	2	0	0.000
3	3	0	1	0	0.000
4	0	0	2	5	0.400
4	1	0	4	1	4.000
4	2	0	3	0	0.000
4	3	0	1	0	0.000
1	0	1	216	216	1.000
1	1	1	229	259	0.884
2	0	1	87	87	1.000
2	1	1	68	90	0.756
2	2	1	32	32	1.000
3	0	1	10	12	0.833
3	1	1	37	40	0.925
3	2	1	15	16	0.938
3	3	1	3	2	1.500
4	0	1	9	8	1.125
4	1	1	30	34	0.882
4	2	1	22	20	1.100
4	3	1	6	4	1.500
2	0	2	150	150	1.000
2	1	2	147	153	0.961
2	2	2	224	230	0.974
3	0	2	11	19	0.579
3	1	2	42	56	0.750
3	2	2	75	117	0.641
3	3	2	9	17	0.529
4	0	2	8	9	0.889
4	1	2	70	105	0.667
4	2	2	129	182	0.709
4	3	2	19	20	0.950
3	0	3	5	7	0.714
3	1	3	20	32	0.625
3	2	3	45	57	0.789
3	3	3	31	44	0.705
4	0	3	4	2	2.000
4	1	3	25	34	0.735
4	2	3	68	79	0.861
4	3	3	62	69	0.899

The first step to determine the correct expansion factor is to calculate the average expansion factor per sample area based on the total households in the sample area and the number of surveys expected or targeted. For example, in the SEMCOG area, there are 1,823,128 households and 2,040 targeted surveys. This calculates to an average factor of 894. Table 42 shows the average expansion factor for each sample area.

Table 42. Average Estimated Expansion Factors by Sample Area

Sample Area	***Total Households***	***Expected Surveys***	***Average Expansion Factor***
SEMCOG	1,823,128	2040	893.7
NLP	220,273	2040	108.0
SLP	429,448	2040	210.5
UP	94,109	2040	46.1
TMA	578,786	2040	283.7
SUMA	532,161	2040	260.9
Small Cities	106,900	2040	52.4

The average expansion factor would be sufficient as a final expansion factor if the number of collected surveys by cell exactly matched the number of expected or targeted surveys. This was because the number of surveys targeted was originally based on the actual distribution of households by size, workers and autos. Since the targeted and actual number of surveys differs, the expansion factors can then be multiplied by the ratio calculated in Tables 41A through 41G to individualize each cell according to the actual survey results. If a cell was under-sampled, then the expansion factor should be greater than the average estimated factor to reflect the lower sample. Conversely, if a cell was over-sampled, then the expansion factor should be lower than the estimated average factor for the area.

Tables 43A through 43G show the adjusted expansion factors based on the average estimated values times the ratio of actual to estimated surveys by household variables and geographic area.

Example Calculation:

Using the SEMCOG area, and the first cell of household size 1, 0-workers and 0-autos:

Targeted Surveys: 77
Collected Surveys: 111
Ratio of Targeted to Collected Surveys: 77 / 111 = 0.6937 (< 1.0 : Over-sampled)
Average Expansion Factor: 893.7
Adjusted Expansion Factor: 893.7 x 0.6937 = 619.95
Ratio of Actual HHs to Total Households: 1.0029
Final Expansion Factor: 619.95 x 1.0029 = 621.78

Table 43A. SEMCOG, Adjusted Expansion Factor

Household Size	*# of Workers*	*Autos Available*	*Ratio*	*Adjusted Factor*
1	0	0	0.694	619.95
1	1	0	1.643	1468.21
2	0	0	0.692	618.71
2	1	0	0.750	670.27
2	2	0	3.000	2681.07
3	0	0	0.375	335.13
3	1	0	0.471	420.56
3	2	0	1.000	893.69
3	3	0	0.000	0.00
4	0	0	1.429	1276.70
4	1	0	0.550	491.53
4	2	0	0.000	0.00
4	3	0	3.000	2681.07
1	0	1	1.000	893.69
1	1	1+	0.919	821.47
2	0	1	0.924	825.82
2	1	1	0.843	753.11
2	2	1	1.000	893.69
3	0	1	1.000	893.69
3	1	1	1.000	893.69
3	2	1	1.067	953.27
3	3	1	3.000	2681.07
4	0	1	1.364	1218.67
4	1	1	1.056	943.34
4	2	1	1.846	1649.89
4	3	1	2.333	2085.28
2	0	2	1.000	893.69
2	1	2	0.992	886.36
2	2	2+	1.000	893.69
3	0	2	0.706	630.84
3	1	2	0.676	604.18
3	2	2	0.772	690.18
3	3	2	0.786	702.19
4	0	2	0.917	819.22
4	1	2	0.685	612.21
4	2	2	0.976	872.58
4	3	2	1.267	1132.01
3	0	3+	2.000	1787.38
3	1	3+	0.714	638.35
3	2	3+	1.000	893.69
3	3	3+	1.000	893.69
4	0	3+	0.625	558.56
4	1	3+	0.929	829.86
4	2	3+	0.836	746.97
4	3	3+	0.802	717.03

Table 43B. Northern Lower Peninsula Rural, Adjusted Expansion Factor

Household Size	*# of Workers*	*Autos Available*	*Ratio*	*Adjusted Factor*
1	0	0	0.944	101.84
1	1	0	14.000	1510.94
2	0	0	0.556	59.96
2	1	0	1.600	172.68
2	2	0	4.000	431.70
3	0	0	1.000	107.92
3	1	0	0.000	0.00
3	2	0	0.000	0.00
3	3	0	0.000	0.00
4	0	0	0.000	0.00
4	1	0	1.500	161.89
4	2	0	3.000	323.77
4	3	0	2.000	215.85
1	0	1	1.000	107.92
1	1	1	0.976	105.38
2	0	1	1.000	107.92
2	1	1	0.887	95.76
2	2	1	1.000	107.92
3	0	1	1.375	148.40
3	1	1	0.971	104.84
3	2	1	7.000	755.47
3	3	1	0.000	0.00
4	0	1	10.000	1079.24
4	1	1	0.771	83.26
4	2	1	1.353	146.02
4	3	1	0.000	0.00
2	0	2	1.000	107.92
2	1	2	1.000	107.92
2	2	2	1.005	108.45
3	0	2	0.786	84.80
3	1	2	1.000	107.92
3	2	2	0.945	102.01
3	3	2	0.533	57.56
4	0	2	0.818	88.30
4	1	2	0.825	89.04
4	2	2	0.847	91.44
4	3	2	0.889	95.93
3	0	3	0.571	61.67
3	1	3	0.808	87.17
3	2	3	0.939	101.32
3	3	3	0.966	104.20
4	0	3	2.000	215.85
4	1	3	0.632	68.16
4	2	3	0.985	106.31
4	3	3	1.000	107.92

Table 43C. Southern Lower Peninsula Rural, Adjusted Expansion Factor

Household Size	*# of Workers*	*Autos Available*	*Ratio*	*Adjusted Factor*
1	0	0	0.824	173.36
1	1	0	3.200	673.64
2	0	0	0.846	178.13
2	1	0	1.800	378.92
2	2	0	1.667	350.86
3	0	0	1.500	315.77
3	1	0	0.000	0.00
3	2	0	0.000	0.00
3	3	0	0.000	0.00
4	0	0	1.500	315.77
4	1	0	2.500	526.28
4	2	0	0.000	0.00
4	3	0	0.000	0.00
1	0	1	1.000	210.51
1	1	1	1.000	210.51
2	0	1	1.000	210.51
2	1	1	1.000	210.51
2	2	1	1.000	210.51
3	0	1	1.571	330.81
3	1	1	0.905	190.46
3	2	1	1.600	336.82
3	3	1	3.000	631.54
4	0	1	4.500	947.31
4	1	1	1.000	210.51
4	2	1	1.050	221.04
4	3	1	3.000	631.54
2	0	2	0.829	174.54
2	1	2	0.973	204.86
2	2	2	1.000	210.51
3	0	2	1.000	210.51
3	1	2	0.875	184.20
3	2	2	0.832	175.06
3	3	2	0.667	140.34
4	0	2	1.600	336.82
4	1	2	1.000	210.51
4	2	2	1.007	212.05
4	3	2	0.955	200.94
3	0	3	0.667	140.34
3	1	3	0.909	191.38
3	2	3	1.000	210.51
3	3	3	1.000	210.51
4	0	3	1.000	210.51
4	1	3	0.571	120.29
4	2	3	1.000	210.51
4	3	3	1.000	210.51

Table 43D. Upper Peninsula Rural, Adjusted Expansion Factor

Household Size	*# of Workers*	*Autos Available*	*Ratio*	*Adjusted Factor*
1	0	0	0.967	44.51
1	1	0	1.500	69.06
2	0	0	0.933	42.97
2	1	0	2.667	122.78
2	2	0	5.000	230.21
3	0	0	0.000	0.00
3	1	0	2.500	115.10
3	2	0	0.000	0.00
3	3	0	0.000	0.00
4	0	0	2.000	92.08
4	1	0	4.000	184.17
4	2	0	3.000	138.12
4	3	0	0.000	0.00
1	0	1	0.996	45.86
1	1	1	0.995	45.83
2	0	1	1.000	46.04
2	1	1	1.000	46.04
2	2	1	1.000	46.04
3	0	1	1.667	76.74
3	1	1	1.094	50.36
3	2	1	0.800	36.83
3	3	1	0.800	36.83
4	0	1	0.800	36.83
4	1	1	1.000	46.04
4	2	1	1.235	56.87
4	3	1	3.000	138.12
2	0	2	1.000	46.04
2	1	2	0.993	45.74
2	2	2	1.000	46.04
3	0	2	1.444	66.50
3	1	2	0.913	42.04
3	2	2	0.934	43.01
3	3	2	0.909	41.86
4	0	2	2.667	122.78
4	1	2	0.984	45.31
4	2	2	0.870	40.04
4	3	2	1.308	60.21
3	0	3	0.833	38.37
3	1	3	0.750	34.53
3	2	3	1.000	46.04
3	3	3	0.964	44.40
4	0	3	2.000	92.08
4	1	3	0.778	35.81
4	2	3	1.017	46.82
4	3	3	0.983	45.25

Table 43E. TMA, Adjusted Expansion Factor

Household Size	*# of Workers*	*Autos Available*	*Ratio*	*Adjusted Factor*
1	0	0	0.866	246.09
1	1	0	1.583	450.10
2	0	0	0.462	131.20
2	1	0	1.286	365.50
2	2	0	0.000	0.00
3	0	0	0.833	236.90
3	1	0	1.000	284.28
3	2	0	2.000	568.55
3	3	0	0.000	0.00
4	0	0	1.000	284.28
4	1	0	0.750	213.21
4	2	0	3.000	852.83
4	3	0	0.000	0.00
1	0	1	1.000	284.28
1	1	1	1.000	284.28
2	0	1	1.000	284.28
2	1	1	0.900	255.85
2	2	1	1.069	303.88
3	0	1	1.182	335.96
3	1	1	0.886	251.97
3	2	1	1.182	335.96
3	3	1	0.000	0.00
4	0	1	1.571	446.72
4	1	1	0.923	262.41
4	2	1	1.769	502.95
4	3	1	3.500	994.97
2	0	2	1.000	284.28
2	1	2	1.000	284.28
2	2	2	1.000	284.28
3	0	2	1.500	426.41
3	1	2	0.768	218.28
3	2	2	0.895	254.35
3	3	2	0.733	208.47
4	0	2	2.250	639.62
4	1	2	0.988	280.97
4	2	2	1.000	284.28
4	3	2	1.313	373.11
3	0	3	0.500	142.14
3	1	3	0.783	222.48
3	2	3	1.000	284.28
3	3	3	0.972	276.38
4	0	3	2.000	568.55
4	1	3	0.571	162.44
4	2	3	0.934	265.57
4	3	3	0.864	245.51

Table 43F. Small Urban Modeled Areas, Adjusted Expansion Factor

Household Size	*# of Workers*	*Autos Available*	*Ratio*	*Adjusted Factor*
1	0	0	0.772	201.23
1	1	0	1.250	325.76
2	0	0	0.522	135.97
2	1	0	1.125	293.18
2	2	0	5.000	1303.04
3	0	0	0.500	130.30
3	1	0	1.667	434.35
3	2	0	0.000	0.00
3	3	0	0.000	0.00
4	0	0	1.000	260.61
4	1	0	1.667	434.35
4	2	0	4.000	1042.43
4	3	0	2.000	521.22
1	0	1	1.000	260.61
1	1	1	1.000	260.61
2	0	1	0.963	251.07
2	1	1	0.850	221.52
2	2	1	1.034	269.59
3	0	1	2.000	521.22
3	1	1	0.927	241.54
3	2	1	1.545	402.76
3	3	1	1.500	390.91
4	0	1	1.500	390.91
4	1	1	0.882	229.95
4	2	1	1.158	301.76
4	3	1	0.000	0.00
2	0	2	0.964	251.10
2	1	2	1.000	260.61
2	2	2	1.000	260.61
3	0	2	1.500	390.91
3	1	2	1.000	260.61
3	2	2	0.876	228.40
3	3	2	1.667	434.35
4	0	2	1.125	293.18
4	1	2	0.987	257.22
4	2	2	0.993	258.76
4	3	2	5.000	1303.04
3	0	3	0.375	97.73
3	1	3	0.818	213.22
3	2	3	1.000	260.61
3	3	3	1.000	260.61
4	0	3	1.667	434.35
4	1	3	0.758	197.43
4	2	3	0.986	256.99
4	3	3	1.000	260.61

Table 43G. Small Cities, Adjusted Expansion Factor

Household Size	*# of Workers*	*Autos Available*	*Ratio*	*HH Adjusted Factor*
1	0	0	0.660	34.60
1	1	0	1.200	62.88
2	0	0	0.632	33.10
2	1	0	0.727	38.11
2	2	0	2.500	131.01
3	0	0	1.500	78.60
3	1	0	0.714	37.43
3	2	0	0.000	0.00
3	3	0	0.000	0.00
4	0	0	0.400	20.96
4	1	0	4.000	209.61
4	2	0	0.000	0.00
4	3	0	0.000	0.00
1	0	1	1.000	52.40
1	1	1	0.884	46.33
2	0	1	1.000	52.40
2	1	1	0.756	39.59
2	2	1	1.000	52.40
3	0	1	0.833	43.67
3	1	1	0.925	48.47
3	2	1	0.938	49.13
3	3	1	1.500	78.60
4	0	1	1.125	58.95
4	1	1	0.882	46.24
4	2	1	1.100	57.64
4	3	1	1.500	78.60
2	0	2	1.000	52.40
2	1	2	0.961	50.35
2	2	2	0.974	51.04
3	0	2	0.579	30.34
3	1	2	0.750	39.30
3	2	2	0.641	33.59
3	3	2	0.529	27.74
4	0	2	0.889	46.58
4	1	2	0.667	34.93
4	2	2	0.709	37.14
4	3	2	0.950	49.78
3	0	3	0.714	37.43
3	1	3	0.625	32.75
3	2	3	0.789	41.37
3	3	3	0.705	36.92
4	0	3	2.000	104.80
4	1	3	0.735	38.53
4	2	3	0.861	45.11
4	3	3	0.899	47.09

Finally, due to the lack of any collected surveys in certain cases, there are cells where the adjusted expansion factors are zero. Since the overall number of households has to be maintained, one more adjustment is necessary in order to preserve the total number of households. Table 44 shows the reported number of households by sample area compared to the estimated number of households.

Table 44. Ratio of Actual to Estimated Households

Sample Area	Actual Households	Estimated Households	Ratio of Actual to Estimated Households
SEMCOG	1,823,128	1,817,766	1.0029
NLP	220,273	218,439	1.0084
SLP	429,448	426,711	1.0064
UP	94,109	93,833	1.0029
TMA	578,786	575,659	1.0054
SUMA	532,161	529,555	1.0049
Small Cities	106,900	106,534	1.0034

The estimated number of households was calculated by multiplying the number of surveys by the adjusted expansion factor and then summarizing for each sample area. An adjustment factor for each sample area is then calculated based on the ratio of actual to estimated households. This ratio is then multiplied with the adjusted expansion factors which results in the final expansion factors. Table 45 shows a sample calculation using the SEMCOG area with a household size of 1, 0 workers, and 0 autos is below:

Table 45. Final Expansion Factor Sample Calculation

Targeted Surveys	Collected Surveys	Ratio	Average Expansion Factor	Adjusted Expansion Factor	Actual HH to Total HH	Final Expansion Factor
77	111	0.6937	893.7	619.95	1.0029	621.78

Tables 46A through 46G show the final expansion factors by household variables for each sample area.

Table 46A. SEMCOG, Final Household Expansion Factor

Household Size	# of Workers	Autos Available	Adjusted Factor	Final Expansion Factor
1	0	0	619.95	621.78
1	1	0	1468.21	1472.54
2	0	0	618.71	620.53
2	1	0	670.27	672.24
2	2	0	2681.07	2688.98
3	0	0	335.13	336.12
3	1	0	420.56	421.80
3	2	0	893.69	896.33
3	3	0	0.00	0.00
4	0	0	1276.70	1280.47
4	1	0	491.53	492.98
4	2	0	0.00	0.00
4	3	0	2681.07	2688.98
1	0	1	893.69	896.33
1	1	1+	821.47	823.90
2	0	1	825.82	828.25
2	1	1	753.11	755.33
2	2	1	893.69	896.33
3	0	1	893.69	896.33
3	1	1	893.69	896.33
3	2	1	953.27	956.08
3	3	1	2681.07	2688.98
4	0	1	1218.67	1222.26
4	1	1	943.34	946.12
4	2	1	1649.89	1654.76
4	3	1	2085.28	2091.43
2	0	2	893.69	896.33
2	1	2	886.36	888.98
2	2	2+	893.69	896.33
3	0	2	630.84	632.70
3	1	2	604.18	605.97
3	2	2	690.18	692.21
3	3	2	702.19	704.26
4	0	2	819.22	821.63
4	1	2	612.21	614.02
4	2	2	872.58	875.15
4	3	2	1132.01	1135.35
3	0	3+	1787.38	1792.65
3	1	3+	638.35	640.23
3	2	3+	893.69	896.33
3	3	3+	893.69	896.33
4	0	3+	558.56	560.20
4	1	3+	829.86	832.30
4	2	3+	746.97	749.17
4	3	3+	717.03	719.15

Table 46B. Northern Lower Peninsula Rural, Final Household Expansion Factor

Household Size	# of Workers	Autos Available	Adjusted Factor	Final Expansion Factor
1	0	0	101.84	102.70
1	1	0	1510.94	1523.63
2	0	0	59.96	60.46
2	1	0	172.68	174.13
2	2	0	431.70	435.32
3	0	0	107.92	108.83
3	1	0	0.00	0.00
3	2	0	0.00	0.00
3	3	0	0.00	0.00
4	0	0	0.00	0.00
4	1	0	161.89	163.25
4	2	0	323.77	326.49
4	3	0	215.85	217.66
1	0	1	107.92	108.83
1	1	1	105.38	106.26
2	0	1	107.92	108.83
2	1	1	95.76	96.57
2	2	1	107.92	108.83
3	0	1	148.40	149.64
3	1	1	104.84	105.72
3	2	1	755.47	761.81
3	3	1	0.00	0.00
4	0	1	1079.24	1088.31
4	1	1	83.26	83.96
4	2	1	146.02	147.24
4	3	1	0.00	0.00
2	0	2	107.92	108.83
2	1	2	107.92	108.83
2	2	2	108.45	109.36
3	0	2	84.80	85.51
3	1	2	107.92	108.83
3	2	2	102.01	102.87
3	3	2	57.56	58.04
4	0	2	88.30	89.04
4	1	2	89.04	89.79
4	2	2	91.44	92.20
4	3	2	95.93	96.74
3	0	3	61.67	62.19
3	1	3	87.17	87.90
3	2	3	101.32	102.17
3	3	3	104.20	105.08
4	0	3	215.85	217.66
4	1	3	68.16	68.74
4	2	3	106.31	107.21
4	3	3	107.92	108.83

Table 46C. Southern Lower Peninsula Rural, Final Household Expansion Factor

Household Size	# of Workers	Autos Available	Adjusted Factor	Final Expansion Factor
1	0	0	173.36	174.48
1	1	0	673.64	677.96
2	0	0	178.13	179.27
2	1	0	378.92	381.35
2	2	0	350.86	353.11
3	0	0	315.77	317.80
3	1	0	0.00	0.00
3	2	0	0.00	0.00
3	3	0	0.00	0.00
4	0	0	315.77	317.80
4	1	0	526.28	529.66
4	2	0	0.00	0.00
4	3	0	0.00	0.00
1	0	1	210.51	211.86
1	1	1	210.51	211.86
2	0	1	210.51	211.86
2	1	1	210.51	211.86
2	2	1	210.51	211.86
3	0	1	330.81	332.93
3	1	1	190.46	191.69
3	2	1	336.82	338.98
3	3	1	631.54	635.59
4	0	1	947.31	953.39
4	1	1	210.51	211.86
4	2	1	221.04	222.46
4	3	1	631.54	635.59
2	0	2	174.54	175.66
2	1	2	204.86	206.18
2	2	2	210.51	211.86
3	0	2	210.51	211.86
3	1	2	184.20	185.38
3	2	2	175.06	176.18
3	3	2	140.34	141.24
4	0	2	336.82	338.98
4	1	2	210.51	211.86
4	2	2	212.05	213.41
4	3	2	200.94	202.23
3	0	3	140.34	141.24
3	1	3	191.38	192.60
3	2	3	210.51	211.86
3	3	3	210.51	211.86
4	0	3	210.51	211.86
4	1	3	120.29	121.06
4	2	3	210.51	211.86
4	3	3	210.51	211.86

Table 46D. Upper Peninsula Rural, Final Household Expansion Factor

Household Size	# of Workers	Autos Available	Adjusted Factor	Final Expansion Factor
1	0	0	44.51	44.64
1	1	0	69.06	69.27
2	0	0	42.97	43.10
2	1	0	122.78	123.14
2	2	0	230.21	230.89
3	0	0	0.00	0.00
3	1	0	115.10	115.44
3	2	0	0.00	0.00
3	3	0	0.00	0.00
4	0	0	92.08	92.35
4	1	0	184.17	184.71
4	2	0	138.12	138.53
4	3	0	0.00	0.00
1	0	1	45.86	45.99
1	1	1	45.83	45.97
2	0	1	46.04	46.18
2	1	1	46.04	46.18
2	2	1	46.04	46.18
3	0	1	76.74	76.96
3	1	1	50.36	50.51
3	2	1	36.83	36.94
3	3	1	36.83	36.94
4	0	1	36.83	36.94
4	1	1	46.04	46.18
4	2	1	56.87	57.04
4	3	1	138.12	138.53
2	0	2	46.04	46.18
2	1	2	45.74	45.88
2	2	2	46.04	46.18
3	0	2	66.50	66.70
3	1	2	42.04	42.16
3	2	2	43.01	43.14
3	3	2	41.86	41.98
4	0	2	122.78	123.14
4	1	2	45.31	45.44
4	2	2	40.04	40.15
4	3	2	60.21	60.39
3	0	3	38.37	38.48
3	1	3	34.53	34.63
3	2	3	46.04	46.18
3	3	3	44.40	44.53
4	0	3	92.08	92.35
4	1	3	35.81	35.92
4	2	3	46.82	46.96
4	3	3	45.25	45.38

Table 46E. TMA, Final Household Expansion Factor

Household Size	# of Workers	Autos Available	Adjusted Factor	Final Expansion Factor
1	0	0	246.09	247.43
1	1	0	450.10	452.55
2	0	0	131.20	131.92
2	1	0	365.50	367.48
2	2	0	0.00	0.00
3	0	0	236.90	238.18
3	1	0	284.28	285.82
3	2	0	568.55	571.64
3	3	0	0.00	0.00
4	0	0	284.28	285.82
4	1	0	213.21	214.37
4	2	0	852.83	857.46
4	3	0	0.00	0.00
1	0	1	284.28	285.82
1	1	1	284.28	285.82
2	0	1	284.28	285.82
2	1	1	255.85	257.24
2	2	1	303.88	305.53
3	0	1	335.96	337.79
3	1	1	251.97	253.34
3	2	1	335.96	337.79
3	3	1	0.00	0.00
4	0	1	446.72	449.15
4	1	1	262.41	263.83
4	2	1	502.95	505.68
4	3	1	994.97	1000.37
2	0	2	284.28	285.82
2	1	2	284.28	285.82
2	2	2	284.28	285.82
3	0	2	426.41	428.73
3	1	2	218.28	219.47
3	2	2	254.35	255.73
3	3	2	208.47	209.60
4	0	2	639.62	643.10
4	1	2	280.97	282.50
4	2	2	284.28	285.82
4	3	2	373.11	375.14
3	0	3	142.14	142.91
3	1	3	222.48	223.69
3	2	3	284.28	285.82
3	3	3	276.38	277.88
4	0	3	568.55	571.64
4	1	3	162.44	163.33
4	2	3	265.57	267.02
4	3	3	245.51	246.84

Table 46F. Small Urban Modeled Areas, Final Household Expansion Factor

Household Size	# of Workers	Autos Available	Adjusted Factor	Final Expansion Factor
1	0	0	201.23	202.22
1	1	0	325.76	327.36
2	0	0	135.97	136.64
2	1	0	293.18	294.63
2	2	0	1303.04	1309.45
3	0	0	130.30	130.95
3	1	0	434.35	436.48
3	2	0	0.00	0.00
3	3	0	0.00	0.00
4	0	0	260.61	261.89
4	1	0	434.35	436.48
4	2	0	1042.43	1047.56
4	3	0	521.22	523.78
1	0	1	260.61	261.89
1	1	1	260.61	261.89
2	0	1	251.07	252.31
2	1	1	221.52	222.61
2	2	1	269.59	270.92
3	0	1	521.22	523.78
3	1	1	241.54	242.73
3	2	1	402.76	404.74
3	3	1	390.91	392.84
4	0	1	390.91	392.84
4	1	1	229.95	231.08
4	2	1	301.76	303.24
4	3	1	0.00	0.00
2	0	2	251.10	252.33
2	1	2	260.61	261.89
2	2	2	260.61	261.89
3	0	2	390.91	392.84
3	1	2	260.61	261.89
3	2	2	228.40	229.52
3	3	2	434.35	436.48
4	0	2	293.18	294.63
4	1	2	257.22	258.49
4	2	2	258.76	260.03
4	3	2	1303.04	1309.45
3	0	3	97.73	98.21
3	1	3	213.22	214.27
3	2	3	260.61	261.89
3	3	3	260.61	261.89
4	0	3	434.35	436.48
4	1	3	197.43	198.40
4	2	3	256.99	258.25
4	3	3	260.61	261.89

Table 46G. Small Cities, Final Household Expansion Factor

Household Size	# of Workers	Autos Available	Adjusted Factor	Final Expansion Factor
1	0	0	34.60	34.71
1	1	0	62.88	63.10
2	0	0	33.10	33.21
2	1	0	38.11	38.24
2	2	0	131.01	131.46
3	0	0	78.60	78.87
3	1	0	37.43	37.56
3	2	0	0.00	0.00
3	3	0	0.00	0.00
4	0	0	20.96	21.03
4	1	0	209.61	210.33
4	2	0	0.00	0.00
4	3	0	0.00	0.00
1	0	1	52.40	52.58
1	1	1	46.33	46.49
2	0	1	52.40	52.58
2	1	1	39.59	39.73
2	2	1	52.40	52.58
3	0	1	43.67	43.82
3	1	1	48.47	48.64
3	2	1	49.13	49.30
3	3	1	78.60	78.87
4	0	1	58.95	59.16
4	1	1	46.24	46.40
4	2	1	57.64	57.84
4	3	1	78.60	78.87
2	0	2	52.40	52.58
2	1	2	50.35	50.52
2	2	2	51.04	51.21
3	0	2	30.34	30.44
3	1	2	39.30	39.44
3	2	2	33.59	33.71
3	3	2	27.74	27.84
4	0	2	46.58	46.74
4	1	2	34.93	35.06
4	2	2	37.14	37.27
4	3	2	49.78	49.95
3	0	3	37.43	37.56
3	1	3	32.75	32.86
3	2	3	41.37	41.51
3	3	3	36.92	37.05
4	0	3	104.80	105.17
4	1	3	38.53	38.66
4	2	3	45.11	45.26
4	3	3	47.09	47.25

Section 14: Lessons Learned and Future Recommendations

In Brief: *Section 14 presents bulleted points of specific lessons learned and future recommendations for the MI Travel Counts project.*

- For auto sufficiency sample designs, further aggregation of cells should be allowed so that data cell representation does not fall below a minimum of 5%. MI Travel Counts documents that, even with RDD responsive design techniques, the budget and time required to recruit and retrieve rare populations below this level of incidence have diminishing benefits and returns. Rare population (mostly low income) households had low participation rates even when successfully recruited. Data cells need to be further collapsed, or interviewing strategies other than RDD must be employed.

- Responsive design techniques as used in MI Travel Counts were very effective in recruiting rare population households. However, responsive designs need further analysis and research to determine more precise plans for implementation as to when and in what combination, RDD modified strategies, such as incentives and targeted RDD samples, should be introduced.

- For a 48-hour diary, adding Day 1 and Day 2 checkboxes by the times questions in the diary helped respondents record accurate travel information. The checkboxes were added to the diary before the Fall 2004 travel periods. This also helped the phone room more clearly enter mailed-in diary information. However, there were still problems with respondents not making a clear distinction as to when Day 1 stopped and Day 2 began. A more distinctive way of marking the break between days in a 48-hour travel inventory is needed, perhaps by having the participant remove or place a sticker at the beginning of Day 2.

- Before the person information sheet was combined with the diary, many respondents did not fill out the sheet, or did not include it when mailing in the diary. Separate return sheets included with a diary tended to be ignored. Adding the Person Information sheet to the diary helped to obtain complete information from the households.

- Extensive preplanning was required in order to use the Michigan Geographic Information Center's MI Geographic Framework Version 3 (MGFv3). This process should have taken place prior to the pilot of MI Travel Counts. Additional preplanning time would have reduced problems with integrating the software.

- Requirements for acceptable geocoding by household should have been agreed upon at the onset of the geocoding process and should have been more prescriptive. Extensive time was required of MORPACE staff in order to maintain

geocoding standards. More budgeted staff hours than predicted were necessary to obtain required geocoding completes.

- Decreasing the number of interim reports would have allowed for more extensive data checking and cleaning between report periods. Given the deliverable dates of the reports, it was difficult to report errors to MORPACE in time for them to be fixed in the next deliverable. A lot of time was spent on the reporting. The same result could have been accomplished with fewer reports. It is recommended that interim reports be completed for 2,000 household completes, then 4,000 completes, and, thereafter, after every 4,000 completes. Alternatively, the reports could have been pared down for selected interim reporting periods, since MDOT greatly valued data deliveries for every 2,000 completes.

- The audits and reviews conducted by PB and MDOT through the interim data sets were very helpful in identifying data issues, eliminating the need to conduct all the data checks at the end of the project.

- The public relations program, press releases, and pre-notification letters were very helpful in validating the study.