WORKING PAPER

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COMMUTER RAIL STATION MARKET ANALYSIS: SURVEY DESIGN

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This working paper covers the design of a small household interview travel survey to be used to evaluate the performance of CATS existing mode choice model in the Soo Line commuter rail corridor study. Before designing this survey, the following prerequisites were first identified:

1. The survey had to generate enough trip data to permit some limited mode choice model recalibration and restructuring, if warranted.

2. The 1980 census journey-to-work trip file and the 1980 census household and work summary data files would be the primary resource for establishing universe control figures and for eventual factoring of the survey trip data to the universe.

3. All data collection would be in the Soo Line corridor.

4. There are severe cost and time budgets for conducting the survey.

General Structure of the Survey

Past survey experience indicates that the best unit to sample travel from is the household. CATS and other transportation planning agencies have conducted numerous home interview travel surveys in the past and the methodology for this type of survey is well established. Secondly, many individual travel characteristics appear to depend on the attributes of the traveler's household. And finally, it is a relatively simple matter to construct samples of households compared with other sample units.

The cost and time considerations, however, dictate that little field work can be carried out. It would be too expensive to send interviewers to every sample household, therefore, the interviewing will be conducted by phone from CATS' offices. Each household interview will be preceded by an introductory letter and a simple travel log sent to the household. Two

hundred households is a rough estimate of the number of households that can be surveyed using such a phone survey under the budget and time limitations of the study.

Choice Stratification: The first prerequisite implies that the survey can not be a random sample of corridor households and their travel behavior. We need to gather enough existing commuter rail and bus trip data from the sampled corridor households to investigate questions of station choice, access mode choice, and alternative line-haul mode choice. This means that there has to be a fairly substantial "transit" travel data set, which can not be efficiently collected if the sample of households is randomly specified.

For this reason, the sample of households for the survey is to be stratified by current household mode choices. It will contain both a random component collected by random sampling of households in the corridor and two "mode choice" components obtained from households who are known commuter rail and bus users.

Geographic Stratification: The corridor is quite long, running from the built-up suburban fringe areas near Chicago to rural northern Lake County. Random sampling of households without respect to geography would tend to produce few sample households in the less developed areas of the corridor. Although low in population, the more distant parts of the Soo Line corridor may still be an important market due to the lack of transit alternatives and exceptional benefits from long distance commuter rail trips. By comparison, the closer-in parts of the corridor, even though heavily populated, feature more competing transit services and shorter trip lengths. It seems desirable then to also sample households on some sort of geographic basis to ensure

coverage of the range of different travel circumstances faced by corridor households.

The general survey design is, thus, to sample corridor households' travel behavior on both a choice and geographic attribute basis. The diagram in Figure 1 illustrates how the sample of households is structured. The top row is for the random choice component of the sample households stratified across the sampling areas, in this case townships. The bottom two rows are the mode choice components of the sample households. These households include known bus and commuter rail users also stratified by the same areas. Some cells in the commuter rail and bus choice rows will, however, possibly be empty due to the total absence of current commuter rail and/or bus users in some portions of the corridor. Recent research shows how such choice enriched samples can be used for calibration of discrete choice models (1), such as the type of logit model used by CATS.

Survey Area

The selection of the survey area within which sample households will be selected is based upon the following criteria:

1. The survey area should be large enough to contain the probable household market area for the proposed service, households with home-based trips that are likely to use the proposed commuter rail service on the Soo Line.

2. It has to be coincident with townships, the basic areal unit in the 1980 census files and CATS socioeconomic forecast files.

3. The survey area has to include some households that currently use commuter rail or bus transit services.

The proposed survey area is shown in Figure 2 along with the location of the Soo Line and the existing Northeast Illinois Railroad Corporation

Figure 1 STRUCTURE OF THE SURVEY SAMPLE HOUSEHOLDS

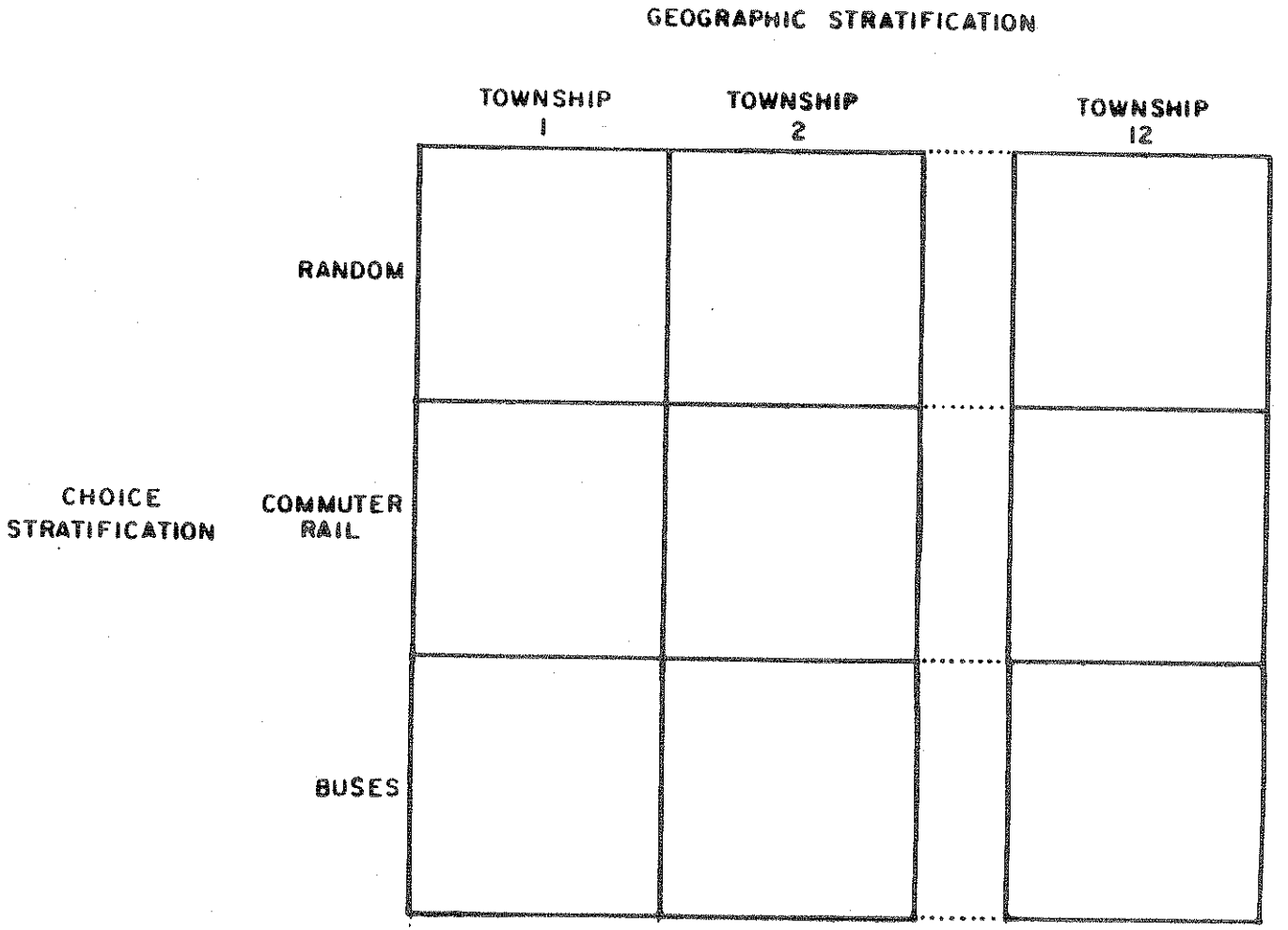
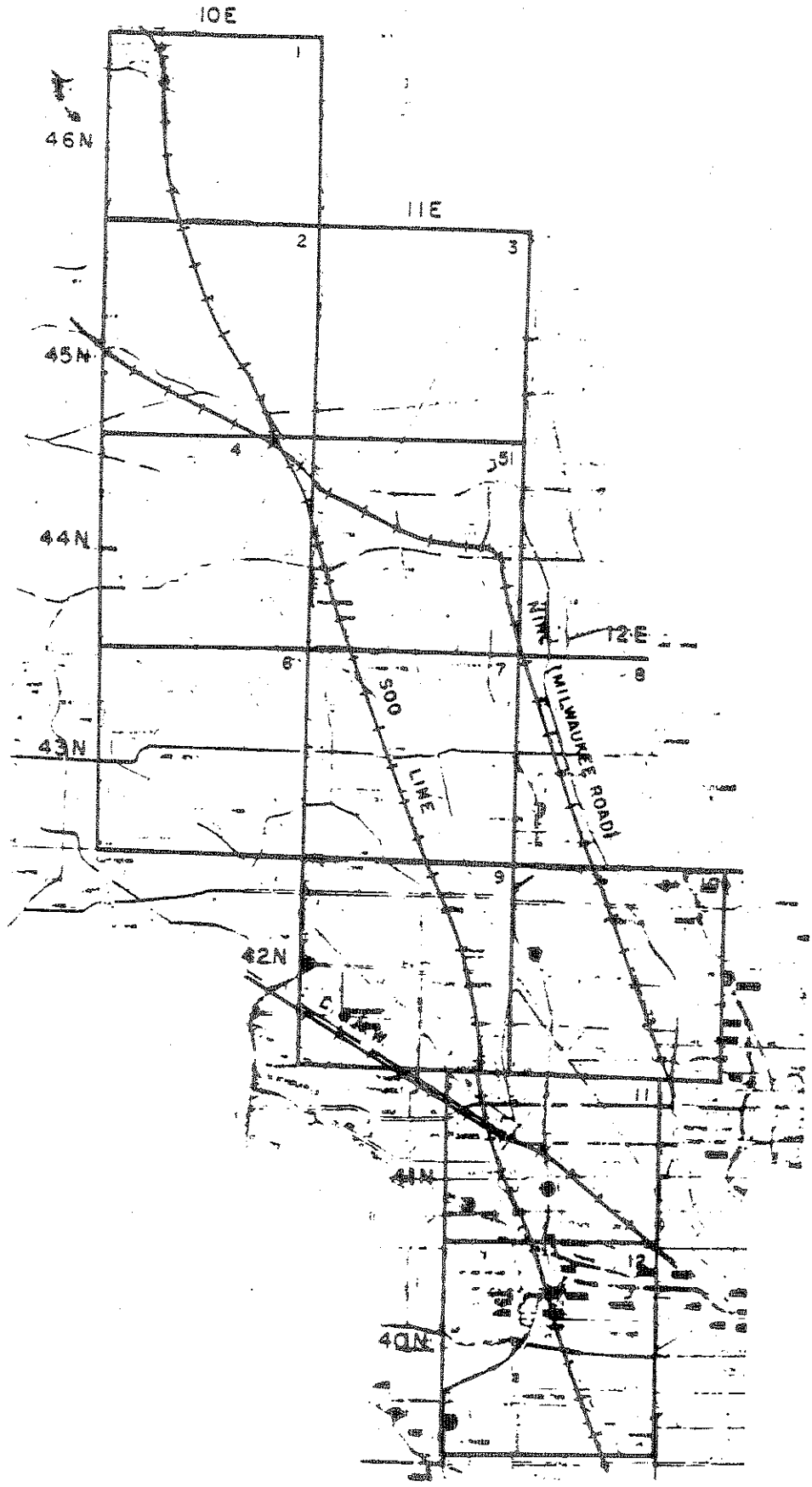


Figure 2 SOO LINE COMMUTER RAIL SURVEY AREA TOWNSHIPS



(Milwaukee Road north line) and Chicago and Northwestern (northwest line) commuter rail services. There are twelve townships included in the corridor survey area, eight in Lake County and four in northern Cook County. These townships cover an area of roughly 430 square miles.

The survey area is shaped somewhat like a cone, narrow at the bottom where there are nearby adjacent competing transit services and wider at the top where competing commuter rail lines are widely spaced. On the southwest, the survey area is roughly bounded by the Chicago and Northwestern northwest commuter rail line that runs diagonally across southern Lake and northern Cook counties. In northern Lake County the survey area's western border is the "Chain of Lakes" area, a lightly populated area of lakes and park land. Toward the east, the survey area is limited by the NIRC commuter rail service (Milwaukee Road) mentioned earlier.

In terms of the above criteria, the survey area covers most of the households that logically would use the proposed Soo Line service for home based travel. Based on the market for existing commuter rail service in the region, it seems safe to anticipate that long distance home-to-work travel will be the principal market served by the Soo Line commuter rail service. The survey area is also totally compatible with existing CATS socioeconomic data files and the geography used in the special 1980 census Urban Transportation Planning Package (2), the journey-to-work data file for the northeastern Illinois region.

Most of the NIRC commuter rail line is included within the survey area. This means that it should be possible to find survey area households that currently use this commuter rail service. In other words, existing commuter rail users who are analogous to the principal market for the Soo Line

service. Also, some of the existing NIRC ridership from households located between the current NIRC and proposed Soo Line services would likely be diverted to the Soo Line..

The existing NORTRAN bus service is located in the southern set of townships in the survey area. It should also be possible to locate households from these survey area townships that use the existing Nortran express and feeder bus service

Sample Size

At this point, it is necessary to determine how many households should be interviewed in each township for the three components of the sample. It is fairly easy to show that the variance in the estimate of a population characteristic obtained through a stratified sample is minimized by sampling in each stratum proportionally according to the product of the fraction of the population in the stratum and the standard deviation of the characteristic within the stratum. Or:

$$N_s = \frac{W_s S_s}{\underset{s}{\text{SUM}}\ W_s S_s} N$$

Where: N_s = size of sample allocated to stratum s.

W_s = proportion of population in stratum s.

S_s = standard deviation of the population characteristic within stratum s.

N = population.

This means that townships with heterogenous households should be oversampled relative to the townships that have more uniform households.

Since we primarily want to estimate choice of mode by the sampled households, it seems obvious that the variance in mode choice in a township should be used for deciding how many households to sample within a township. It is argued, however, that this is not a good measure of the variety of households in a township. Some townships will exhibit low variance in choice of mode only because of the lack of reasonable alternatives to the private automobile, rather than due to uniform choice behavior within the township. In the calculations to allocate sample households across townships, it was finally decided to use the variance in household income as the measure of the spread of household types within a township, even though good arguments could be made for the use of other household characteristics.

Sample households were allocated among the random, commuter rail choice, and bus choice strata as follows, assuming a total sample of 200 households. Enough households were allocated to the random strata to obtain some coverage in every township. This requires approximately 100 to 130 households. Enough of the remaining households were then allocated to the commuter rail and bus choices to obtain reasonable coverage in the townships with existing commuter rail service and NORTRAN bus service. For the commuter rail strata, approximately 50 households are required, while a minimum of about 20 households are needed for the bus choice strata.

Summary of Sample Household Allocation: In Table 1, there are three separate sections for the calculations for the random, commuter rail, and bus choice allocation of sample households. The number of households assumed for each choice statum are 130, 60, and 20, respectively, for the random, commuter rail, and bus components of the sample. The township allocation for random

Table 1. Sample Households Within Townships

a. Allocation of Sample Random Choice Households: N=130.

Township	Households	Std. Dev. of Income	Fraction	Sample Households
1	4,331	$14,400	0.02	2
2	11,678	$13,100	0.04	5
3	7,799	$13,800	0.03	3
4	3,659	$15,200	0.01	2
5	11,051	$16,600	0.05	6
6	5,887	$17,300	0.03	3
7	10,331	$16,600	0.04	6
8	19,675	$19,000	0.09	12
9	44,577	$15,500	0.17	22
10	25,311	$18,300	0.11	15
11	51,534	$15,700	0.20	26
12	59,527	$14,600	0.22	28

b. Allocation of Sample Commuter Rail Choice Households: N=60.

Township	Commuter RR Work Trips	Std. Dev. of Income	Fraction	Sample Households
1	113	$14,400	0.00	0
2	756	$13,100	0.03	2
3	208	$13,800	0.01	0
4	220	$15,200	0.01	1
5	694	$16,600	0.03	2
6	486	$17,300	0.02	1
7	1,002	$16,600	0.04	3
8	4,083	$19,000	0.20	12
9	5,365	$15,500	0.22	13
10	3,374	$18,300	0.16	10
11	4,800	$15,700	0.20	12
12	2,239	$14,600	0.09	5

c. Allocation of Sample NORTRAN Bus Choice Households: N=20.

Township	Bus Work Trips	Std. Dev. of Income	Fraction	Sample Households
1	24	$14,400	0.02	2
2	50	$13,100	0.03	1
3	68	$13,800	0.04	1
4	8	$15,200	0.01	0
5	63	$16,600	0.05	1
6	39	$17,300	0.03	1
7	26	$16,600	0.02	0
8	295	$19,000	0.27	5
9	291	$15,500	0.21	4
10	372	$18,300	0.32	6

households is based on township households and township household income variance computed from the 1980 census journey-to-work file. In the case of the two mode choice strata, the allocation is based upon the number of workers in the township who use either of the two modes and the variance in township household income. Townships 11 and 12 were not allocated any bus choice households because of the number of households in the random sample component and the amount of competing transit services.

Selection of Sample

The random and choice portions of the sampled households will be developed from different sources. Random choice households will be sampled using a reverse address to number telephone directory (3). Mode choice component households will come from a list of monthly pass holders on the NIRC (Milwaukee Road) north line and from households solicited on corridor NORTRAN bus runs. The procedures to be followed in selecting the sample will be somewhat different, however, for the different sample household sources.

Random Sample: The following method will be used to select the random component of the sampled households.

1. The number of households to be sampled in the township is determined as outlined above in the sample size selection section.

2. A quarter-section within the township is randomly selected, probability of selection is based on the number of households in each quarter-section obtained from the 1980 census.

3. A location within the quarter-section, X and Y coordinates based upon air photos, is then randomly generated, and the nearest intersection to this point located.

4. One of the four or more approach streets to the intersection is randomly selected.

5. A range of street addresses (both sides of street) on the approach street between the intersection selected above and the nearest adjacent intersection is determined using the air photograph and the reverse telephone directory.

6. If no residences exist within the selected street addresses, then repeat steps 3 through 5 to generate another set of street addresses.

7. One of the addresses within the range of addresses is randomly selected.

8. If it appears that a residence is at the selected address include it in sample, otherwise, repeat step 7 until a residence is selected.

Choice Based Samples: A list of monthly pass holders on the NIRC commuter rail service in the corridor will first be obtained. This list will be for pass holders in the past spring since the sale of monthly passes declines in the summer due to vacations. Sample households from the list of monthly pass holders will be selected as follows:

1. The number of "choice" households in each township to be included in the sample is known from the previous calculations in Table 1.

2. A monthly pass holder is randomly selected from the list and the mailing address taken down.

3. The address is cross checked against the reverse listing directory.

4. If the address appears to be a residence and matches the pass holder include it in sample, providing there is room remaining in the number of households to be sampled in the township.

Households with NORTRAN bus riders will be obtained by an on-board solicitation shortly before the survey is to be taken. A description of the survey will be distributed to NORTRAN riders including a mailback form for households willing to participate in the survey. After the names of bus

choice sample households are obtained, the procedure followed for creating the sample is the same as for commuter rail choice based households.

Principal Survey Instruments

This final section of the working paper contains drafts of the different survey instruments that will be used in gathering travel data from the households. To recapitulate, all sample households will receive an introductory letter plus a simple form to keep track of the trips made by the household on the designated travel day. During the following evening, a member of the household will be interviewed over the phone and the trip and household data recorded.

The interviewing is to be usually carried out during the early evening hours of 6:00 PM to 9:00 PM on Tuesdays through Thursdays. Friday evening interviewing is undesirable because interviewees are more likely to be away from the household on this evening. Also, it is difficult to find interviewers willing to work on this evening of the weekend. Since travel is surveyed from the previous day, Monday evening interviews can only be used for call backs to sampled households that could not be contacted on the scheduled interview day.

Introductory Letter: Appendix 1 is a draft of the letter to be sent to each household in advance of the phone interview. Its content is self-explanatory and it just gives the interviewee: (1) some information on the purpose of the survey; (2) what will be expected of the interviewee; (3) some preliminary instructions to follow; and (4) some assurances that his responses will be confidential and used appropriately.

The same letter can be sent to both the random and choice households in the sample with only a few minor changes. For example, the paragraph regarding nonusers of commuter rail service can be eliminated for sample households from the monthly ticket list on the NIRC commuter rail line.

Household Trip Diary: Appendix 2 shows the household trip diary and instructions to be sent to the sample households along with the introductory letter. Its purpose is to help the interviewee recall travel made by the household that took place during the day preceding the interview. The form and instructions are intended to be as simple as possible, and it will be the responsibility of the interviewer to get the trips into the final format. The interviewer, for example, will have to disentangle multipurpose, multidestination trips into separate trip record for each leg of the trip.

Home Interview Tally Sheet: Appendix 3 reproduces the tally sheet to be employed by the interviewer for recording the travel data gathered during the telephone interview. An attempt was made to also keep this form simple; in many cases, the interviewer only has to circle posible multiple choice responses.

The tally sheet contains three major sections for a description of the household, some general household travel information, and the daily trip log. The work travel information picked up in the second part of the form is similar to the that obtained in the census. This data should be useful for factoring the sample and also provide some cross reference between the work trip reporting in the census and actual daily work travel.

Household income data is intentionally not requested. It is felt that adequate household income data is available from the census files, and that

responses to income questions are unreliable unless broad income categories are used.

References

1. Moshe Ben-Akiva and Steven R. Lerman (1985). Discrete Choice Analysis: Theory and Application to Predict Travel Demand. M.I.T. Press.

2. U. S. Bureau of the Census (1983). Urban Transportation Planning Package, 1980 Census: Technical Documentation for Summary Tape. Journey-to-Work and Migration Branch, Population Division, Washington, D.C.

3. Reuben H. Donnelley Corportation (1985). Chicago North Suburban Street Address Telephone Directory. Chicago, Illinois.

Appendix 1: Introductory Letter for Survey

Date

Inside Address
From Reverse
Phone Directory

Dear Name as in Directory:

Village governments and your neighbors in northern Cook and Lake Counties have supported adding commuter rail service to downtown on the Soo Line tracks between Antioch and Des Plaines. You and the other members of your household can now help determine the amount of commuter rail service that should be provided by participating in a travel survey of persons who live in the vicinity of the Soo Line. This Soo Line commuter rail feasibility study is sponsored by METRA, the commuter rail operating board for northeastern Illinois, in cooperation with the North Suburban Mass Transit District, the Regional Transportation Authority, the Chicago Area Transportation, and local village governments.

Enclosed with this letter is a form for keeping track of <u>all</u> trips made by <u>all</u> members of your household on the day and date stamped on the form. Please read and follow carefully the instructions on this form and record only travel for the date specified. You will then be called the following evening, or at a later date if no one is at home to answer the phone, for a brief telephone interview.

This interview will be conducted by an employee of the Chicago Area Transportation Study and should last no more than ten minutes or so. The primary purpose of the interview is to review the travel noted on your form so that it can be coded in a standard format for data processing with travel reported by other households. The interviewer will also ask a few general questions about the members of your household so that your household's travel can be grouped with travel from similar households for statistical analysis.

Please note that all interviews will be conducted <u>only</u> by phone, no person representing any of the above agencies will contact you in person or ask to enter your home in regard to this survey. The data that is collected will be used only to forecast ridership on the proposed Soo Line commuter rail line. Your name and address will not be permanently recorded on any survey form in our office and the lists of households participating in the survey will be destroyed at the completion of the survey.

If you have questions about the instructions for completing the travel form or would like to discuss the purpose and use of this survey, please call Ronald Eash of the Chicago Area Transportation Study at 793-3638 during normal weekday working hours. Thank you for your help.

Sincerely,

Somebody

Appendix 2. Instructions and Household Trip Diary

INSTRUCTIONS FOR RECORDING TRAVEL ON HOUSEHOLD TRAVEL RECORD FORM

1. Record trips made by all family and nonfamily members of household including temporary residents, except for short neighborhood walking trips and trips made by infants less than 5 years of age.

2. Record all trips that leave or return home during the entire 24 hours of the designated survey day.

3. If two or more household members travel together, record each tripmaker as a separate trip.

4. Record multiple destinations in order reached; for example, a trip from home to the drug store and then to the grocery store before returning home would have drug store coded as Destination No. 1 and grocery store coded as Destination No. 2.

5. For each destination, note approximate location such as street address or nearby street intersection.

6. Under Traveled By record travel modes used, such as drove own automobile, rode with other person, rode in carpool, school bus, bus, bicycle, commuter rail, etc.

7. If more than one travel mode is used, such as driving to a commuter rail station and then boarding a train, record all modes used.

8. If unsure how to record unusual trip, make notes on form and discuss with interviewer during phone interview.

HOUSEHOLD TRAVEL RECORD FOR TUESDAY SEPTEMBER 19, 1985

Trip No.	Person Traveling	Time Left Home	Destination No. 1	Destination No. 2	Destination No. 3	Time Returned Home	Traveled By
1							
2							
3							
4							
5							

Appendix 3. Home Interview Tally Form

HOME INTERVIEW TALLY SHEET

Household Number: _____ Interviewer: _____ Date: _____

Part I: Household Members

1. Head of Household

Sex	Employment Status	Driver	Elderly (Plus 65)	Public Transp. Handicapped
M F	Full-Time Employed Part-Time Employed Full-Time Student Part-Time Student Not Employed Retired	Yes No	Yes No	Yes No

2. Adult No. 2 (16 years or older)

Sex	Relationship To Head	Employment Status	Driver	Elderly (Plus 65)	Public Transp. Handicapped
M F	Spouse Son Daughter Father Mother Relative Unrelated	Full-Time Employed Part-Time Employed Full-Time Student Part-Time Student Not Employed Retired	Yes No	Yes No	Yes No

3. Adult No. 3 (16 years or older)

Sex	Relationship To Head	Employment Status	Driver	Elderly (Plus 65)	Public Transp. Handicapped
M F	Spouse Son Daughter Father Mother Relative Unrelated	Full-Time Employed Part-Time Employed Full-Time Student Part-Time Student Not Employed Retired	Yes No	Yes No	Yes No

Part I: Continued

4. Adult No. 4 (16 years or older)

Sex	Relationship To Head	Employment Status	Driver	Elderly (Plus 65)	Public Transp. Handicapped
	Spouse	Full-Time Employed			
M	Son	Part-Time Employed	Yes	Yes	Yes
F	Daughter	Full-Time Student	No	No	No
	Father	Part-Time Student			
	Mother	Not Employed			
	Relative	Retired			
	Unrelated				

5. Adult No. 5 (16 years or older)

Sex	Relationship To Head	Employment Status	Driver	Elderly (Plus 65)	Public Transp. Handicapped
	Spouse	Full-Time Employed			
M	Son	Part-Time Employed	Yes	Yes	Yes
F	Daughter	Full-Time Student	No	No	No
	Father	Part-Time Student			
	Mother	Not Employed			
	Relative	Retired			
	Unrelated				

6. Adult No. 6 (16 years or older)

Sex	Relationship To Head	Employment Status	Driver	Elderly (Plus 65)	Public Transp. Handicapped
	Spouse	Full-Time Employed			
M	Son	Part-Time Employed	Yes	Yes	Yes
F	Daughter	Full-Time Student	No	No	No
	Father	Part-Time Student			
	Mother	Not Employed			
	Relative	Retired			
	Unrelated				

Part I: Continued

7. Child No. 1 (15 years or less)

Sex	Age	Relationship To Head
M	6 to 15	Son
F	5 or Less	Daughter
		Unrelated

8. Child No. 2 (15 years or less)

Sex	Age	Relationship To Head
M	6 to 15	Son
F	5 or Less	Daughter
		Unrelated

9. Child No. 3 (15 years or less)

Sex	Age	Relationship To Head
M	6 to 15	Son
F	5 or Less	Daughter
		Unrelated

10. Child No. 4 (15 years or less)

Sex	Age	Relationship To Head
M	6 to 15	Son
F	5 or Less	Daughter
		Unrelated

11. Child No. 5 (15 years or less)

Sex	Age	Relationship To Head
M	6 to 15	Son
F	5 or Less	Daughter
		Unrelated

12. Child No. 6 (15 years or less)

Sex	Age	Relationship To Head
M	6 to 15	Son
F	5 or Less	Daughter
		Unrelated

13. Child No. 7 (15 years or less)

Sex	Age	Relationship To Head
M	6 to 15	Son
F	5 or Less	Daughter
		Unrelated

14. Child No. 8 (15 years or less)

Sex	Age	Relationship To Head
M	6 to 15	Son
F	5 or Less	Daughter
		Unrelated

Part II: Household Work Travel Characteristics

1. Number of Automobiles Available to Household: _____
2. Number of Trucks and Vans Available to Household: _____
3. Usual Work Travel by Full and Part-Time Employed Household Members

Adult No.	Employer and Location	Average Travel Time	Usual Travel Mode	If Commuter Rail is Usual Work Travel Mode	
				Station Used	Usual Access Mode
					Walk Drive and Park Driven Carpool Bus Other
					Walk Drive and Park Driven Carpool Bus Other
					Walk Drive and Park Driven Carpool Bus Other

Part II: Continued

Adult No.	Employer and Location	Average Travel Time	Usual Travel Mode	If Commuter Rail is Usual Work Travel Mode	
				Station Used	Usual Access Mode
					Walk Drive and Park Driven Carpool Bus Other
					Walk Drive and Park Driven Carpool Bus Other
					Walk Drive and Park Driven Carpool Bus Other

Part III: Household Trip Log

Traveler	FROM Origin Location	FROM Start Time	TO Destination Location	TO End Time	Trip Purpose	Mode	Out-of-Pocket Cost
Head __ A. No. __ C. No. __							
Head __ A. No. __ C. No. __							
Head __ A. No. __ C. No. __							
Head __ A. No. __ C. No. __							
Head __ A. No. __ C. No. __							
Head __ A. No. __ C. No. __							