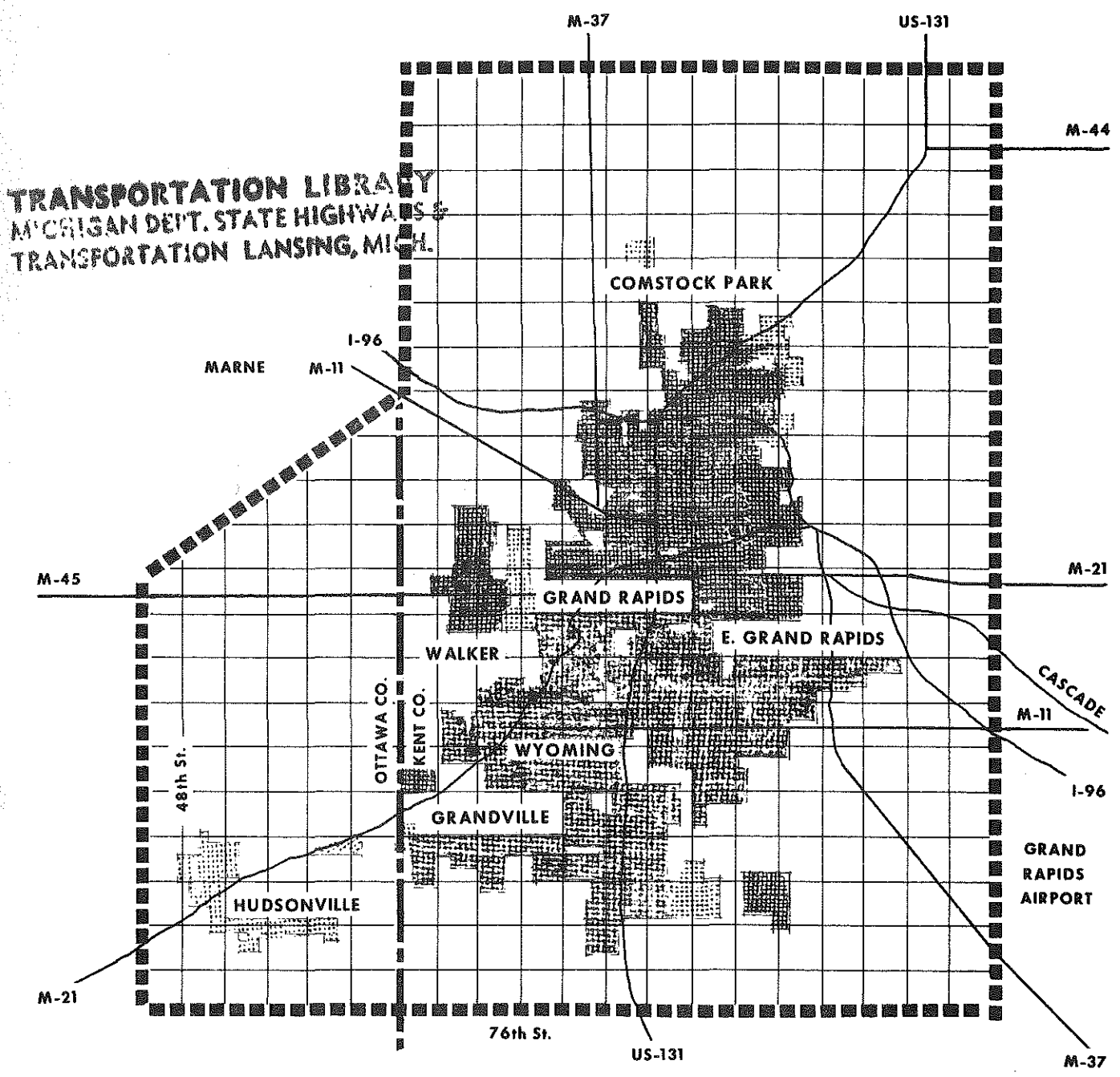


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GRAND RAPIDS AND ENVIRONS

TRANSPORTATION STUDY

ACCURACY CHECKS AND SCREENLINE ADJUSTMENT



MICHIGAN DEPARTMENT OF STATE HIGHWAYS

GRAND RAPIDS AND ENVIRONS
TRANSPORTATION STUDY

ACCURACY CHECKS AND SCREENLINE ADJUSTMENT

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PREPARED BY:

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INTRODUCTION

Interviewing in the GRETS Origin and Destination Survey was conducted between April and July of 1965 to obtain data representative of household characteristics and travel patterns in the area.

Using sampling procedures recommended by the U.S. Bureau of Public Roads, an internal sample of dwelling units was selected at a rate of 1 in 15, to include six and two-thirds percent of the total households in the study area. Of 7,233 addresses selected for sampling, completed interviews were obtained from 6,617 households. Not including permanently vacant dwellings, complete and usable interviews were obtained at a rate of 95%. The internal sample data was then expanded to the universe on a tract basis.

A sample of 1 in 8, or twelve and one half percent, was selected for commercial vehicles, as drawn from the registration files of the Michigan Department of State in Lansing. Interviews for 2930 vehicles garaged within the area were obtained. Fifty percent of all taxicabs in the area were also sampled, yielding 53 completed samples.

At the 41 external stations, of the 114,500 vehicles classified, interviews were obtained for 76% of all cars and 71% of all commercial vehicles.

After the survey data was expanded to the sampling universe some evaluation of its completeness and accuracy was required. This was necessary before continuing the transportation study under the assumption that the household and travel characteristics of the GRETS area had been reproduced by the survey data.

Therefore accuracy checks were made on household socio-economic characteristics at the zonal level and on trip data comparisons for the study area.

OCCUPIED DWELLING UNIT
ACCURACY CHECK

One of the best checks of the completeness of the home interview sample is a comparison between total occupied dwellings as recorded by the survey and counts of occupied dwelling units obtained from other sources. This check is necessary to determine if the total universe of trip producing dwelling units was sampled.

The primary source for this check was an independent land use survey compiled in 1965-66 by the Kent County Planning Department and the City of Grand Rapids. Inventory sheets were prepared for each traffic analysis zone within the Transportation Study area. Besides land use acreages, these sheets contained information on the number and type of dwelling units within each zone. This information was supplemented by a 1965 school census and the 1960 U.S. Census of Population. These additional sources were used whenever the land use survey data was incomplete or when it appeared to be inconsistent with land use acreages.

In order to determine the number of occupied dwelling units it was necessary to estimate the number of vacant units per zone. A comparison of area wide vacancy rates for 1960 and 1965 showed no significant changes had occurred in the five year period. It was assumed that census tract vacancy rates given in the 1960 census would apply in 1965 to all zones falling within each particular tract. In areas which were not included

in census tract statistics a vacancy rate of 2.5 percent was used. This is the approximate rate for tracted suburban areas around Grand Rapids.

The total number of vacant units by zone was then determined and subtracted from the total dwelling unit count.

The summarized results of this check are given below:

	<u>O-D</u>	<u>CHECK</u>	<u>ACCURACY</u>
City of Grand Rapids	51,670	52,036	99.3%
Kent County (partial)	47,522	44,903	105.8%
Ottawa County (partial)	4,926	4,969	99.1%
Total GRETS area	104,118	101,908	102.2%

The results show that the comparison was consistently good for the study area and for three major area breakdowns. Kent County (partial) includes the area between the Grand Rapids city limits and the cordon line while Ottawa County (partial) contains a portion of that county adjacent to the Grand Rapids urban area.

The largest discrepancies in the comparison for individual zones resulted from differences in the counting of institutional dwellings in six zones. These zones contained nursing homes and educational group quarters.

However, since the discrepancies were not consistently in favor of the O-D survey or the accuracy check data, the exclusion of these zones would not have affected the accuracy of the comparison.

POPULATION ACCURACY CHECK

Two sources were available to provide independent estimates of population for the GRETS area in the study year, 1965. The first was Working Paper No. 9, prepared by the State Resource Planning Division, Office of Economic Expansion, Michigan Department of Commerce, dated November, 1966. This paper provided 1965-1990 estimates of population updated from the census for the cities of Grand Rapids, Grandville and Wyoming, and for the remaining townships comprising the study area. In preparing these estimates, county projections were used as control totals for the sub-county units. Thus the smaller units are distributions of total county populations.

The second group of estimates were provided by the local planning agency, the Kent County Planning Commission. These estimates have been published previously and were developed in conjunction with a land use development plan for the area. Population was projected in five year increments to 1990 for all areas in Kent County and for two adjoining townships in Ottawa County.

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POPULATION ACCURACY CHECK SUMMARY

	<u>O-D</u>	<u>W.P. #9</u>	<u>ACC.</u>	<u>K.C.P.C.</u>	<u>ACC.</u>
City of Grand Rapids, Grand Rapids Twp., City of Kentwood, Paris Township, City of Walker	247,402	243,570	101.6%	243,017	101.8%
Cities of Wyoming, Grandville	67,128	57,088	117.6%	64,217	104.5%
Kent Cty. (partial)	27,879	22,656	123.1%	28,173	99.0%
Ottawa Cty.(partial)	20,655	15,100	136.8%	20,490	100.8%
Total GRETS Area	363,064	338,414	107.3%	355,897	102.0%

In order to compare areas with compatible boundaries it was first necessary to consolidate some sub-areas. This was necessary because the two independent estimates were prepared using municipal boundaries which existed in different years.

The results of the check show a good comparison of independent population data with the O-D survey data. The best results were achieved by the Planning Commission estimates, while the worst comparisons were between the Working Paper and the O-D survey in the rural areas. This was expected however, since the Working Paper is conservative in distributing county populations to the suburban areas surrounding large cities. For these areas in the present study, the Planning Commission estimates are thought to be more appropriate.

HOUSEHOLD INCOME ACCURACY CHECK

Household income information, representing incomes received during 1959, was available by census tract from the 1960 census. An attempt was made to update this data to 1965. A rate of increase of 29% for household incomes in the study area during the 1959-1965 period was calculated from small area income estimates published by Sales Management Magazine. This source has regularly published similar estimates. This rate was then used to produce updated census tract estimates of income. O-D survey zones were aggregated to create units with boundaries compatible to census tracts for comparison purposes. The following table lists the tracts which are the most compatible with O-D survey units.

HOUSEHOLD INCOME ACCURACY

<u>CENSUS TRACT</u>	<u>1959 CENSUS HOUSEHOLD INCOME</u>	<u>1965 UPDATE¹ HOUSEHOLD INCOME</u>	<u>1965 O-D HOUSEHOLD INCOME</u>
1	7,406	9,553	9,375
2	6,774	8,738	9,260
4	4,961	6,399	7,394
5	5,228	6,744	7,916
6	4,859	6,268	7,094
18	5,126	6,612	6,875
19	5,829	7,519	7,408
21	3,711	4,787	5,692
26	3,375	4,343	6,109
27	4,752	6,130	7,523
32	6,097	7,865	7,500
33	6,788	8,756	9,094
34	6,884	8,880	8,795
TOTALS	5,940 ²	7,662 ²	8,034 ³

1. Census update for 1965=1.29 (1959 Income)
2. Figure for tracted area only.
3. Figure for entire GRETS area.

The home interview totals from the O-D survey show a household income of \$8,034 for the entire GRETS area. Household income as derived from the census update for tracted areas was \$7,662, providing an accuracy check of the O-D survey data of 104.9%.

The disparity in individual tracts appears to be due to the variability of the area wide update figure and to the wider sampling of group quarters and institutional dwellings achieved by the census. In areas where these exist the census reports larger numbers of low incomes than the O-D survey.

AUTOMOBILE ACCURACY CHECK

From Michigan Secretary of State publications on automobile registration, it was found that auto ownership increased 11.6% during the period 1960-1965 in Kent and Ottawa counties. This area wide rate was used to update census tract information on auto ownership, which was only available for the cities of Grand Rapids and Wyoming, containing approximately 45% of the automobiles in the area.

AUTOMOBILE ACCURACY CHECK SUMMARY

	<u>O-D</u>	<u>Census Update</u>	<u>Accuracy</u>
City of Grand Rapids	53,707	58,886	91.2%
City of Wyoming	<u>20,878</u>	<u>17,186</u>	<u>121.5%</u>
TOTAL	74,585	76,072	98.0%

Although only a general check, the comparison does show that auto ownership increased at a higher than average rate in a suburban area - the city of Wyoming, and at a lower rate in the most urbanized area - the City of Grand Rapids.

RATE COMPARISONS

In addition to accuracy checks where independent estimates were available, general rates developed in the GRETS area were also compared with previous transportation studies conducted in western Michigan. These studies, taken in Battle Creek, Muskegon, and Kalamazoo, should have household and travel characteristics similar to the GRETS area.

As is shown on the following page, the rates developed in the GRETS area appear to be consistent with the results of the other studies taken in the area. This should indicate a general survey accuracy.

The rate comparison with a previous study in the Grand Rapids area, conducted in 1947, also shows the changes in auto ownership and trip generation rates that have occurred in the area since that date.

GRETS AREA RATE COMPARISONS

	<u>BATTLE CREEK</u>	<u>MUSKEGON</u>	<u>KALAMAZOO</u>	<u>GRETS</u>	<u>GRAND RAPIDS</u>
Year	1961	1964	1966	1965	1947
Population	79,391	115,311	163,391	363,088	220,977
Persons/ D.U.	3.06	3.24	3.14	3.49	3.39
Cars/D.U.	1.11	1.18	1.28	1.24	.81
Cars/Person	.363	.363	.408	.356	.239
Internal Trips/Person	4.46	3.36	4.10	3.42	2.57
Internal Trips/D.U.	13.66	10.89	12.89	11.94	8.72
Internal Auto-Driver Trips/D.U.	8.05	7.20	8.25	7.50	4.77

CONCLUSIONS

The four accuracy checks made on expanded socio-economic data from the GRETS Internal Survey indicate that the basic data is reliable. In each check, expanded sample data corresponded well with independent estimates of the same information. The geographic area breakdowns in each check also indicated that no significant geographic bias exists in the sampling procedures or the data.

The results of the comparisons at the study area level are summarized here:

<u>ACCURACY CHECK</u>	<u>ACCURACY RATIO</u>
Occupied Dwelling Units	102.2%
Population	107.3%, 102.0%
Household Income	104.9%
Automobile	98.0%

TRAVEL CHECKS

In addition to accuracy checks made upon the socio-economic data of the O-D survey, checks were also made to determine the completeness of the trip data reported in the survey. These consisted of a screenline comparison check and a vehicle miles of travel comparison check.

THE SCREENLINE COMPARISON CHECK

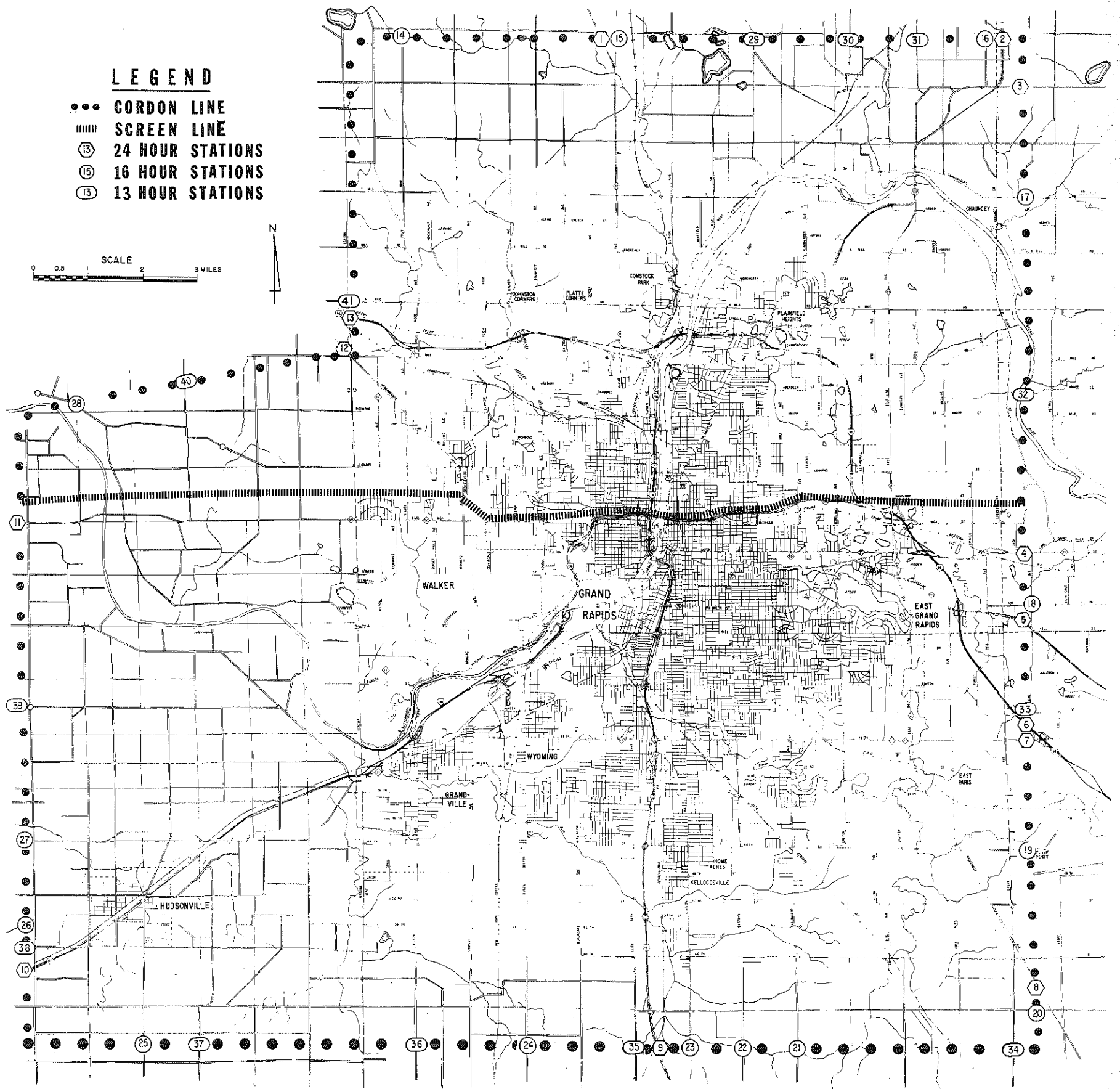
The GRETS Screenline, as shown on the following page, runs from cordon to cordon in an east to west direction. In the less urbanized areas, the lack of a definite geographical boundary produces a large number of screenline crossing points. However, in the downtown section the screenline follows to the north of a limited access interstate facility, I-196, and the frequency of screenline crossings is reduced. This location of the screenline was chosen to maximize the interception of major traffic movements in the area, while attempting to minimize the number of multiple crossings of the screenline.

GRAND RAPIDS AND ENVIRONS TRANSPORTATION STUDY

LEGEND

- CORDON LINE
- ||||| SCREEN LINE
- Ⓜ 24 HOUR STATIONS
- Ⓟ 16 HOUR STATIONS
- Ⓝ 13 HOUR STATIONS

SCALE
0 0.5 2 3 MILES



MICHIGAN STATE HIGHWAY DEPARTMENT

Classification counts at the 54 screenline stations were made twice during the study and averaged. The results of the comparison of these counts with the trips reported crossing the screenline from the survey are shown in the following table:

SCREENLINE ACCURACY CHECK

<u>CHECK</u>	<u>GROUND COUNT</u>	<u>REPORTED TRIPS</u>	<u>ACCURACY</u>
Passenger Cars	171,065	131,722	77.0%
All Trucks	21,428	21,591	100.8%
Single Unit Trucks	18,778	19,054	101.5%
Combination Trucks	2,650	2,537	95.7%
ALL VEHICLES	192,493	153,313	79.6%

The results show that the greatest deficiency of trip reporting occurred for passenger cars. However, the accuracy here was felt to be acceptable and comparable with other studies of similar size. The truck comparison was very good. The slight overreporting should be due to the daily fluctuation of classification counts, which exceeds 1 percent.

The 153,313 trips reported crossing the screenline represented 21% of all trips made within the area. Using these trips as sample data for the study area, the trip file was then adjusted for underreporting thru the screenline adjustment procedure.

SCREENLINE ADJUSTMENT PROCEDURE

The screenline accuracy check for the GRETS area provided a 77% check of auto driver trips. As far as could be determined, multiple screenline crossings and nonreported trips were not important factors in this comparison.

Multiple crossings as a percent of ground counts were assumed to be 3%. A later traffic assignment of adjusted trips indicated that this percentage may be even lower. Adjusted crossings from the survey matched closely with assigned crossings, indicating that few logical traffic movements would cross the screenline twice. Other multiple crossings, not shown in the assignment, could be created by circulating traffic.

Nonreported trips made by nonresidents of the study area are most often a serious problem in Michigan cities which serve as attractors for vacation and social recreation trips. Tourists, interviewed at the external stations, are recorded only as entering and leaving the the study area. Additional internal to internal trips generated by these persons while in the study area are not disclosed by present interviewing methods. A higher incidence of double crossings in these nonreported trips - due to the lack of familiarity with the area, adds to the poor comparison of crossings and ground counts.

Rather than being an attractor of such trips, the GRETS area is known to be a large producer of recreational trips which are attracted to areas west of the study area. Therefore, the nonreporting of trips made by nonresidents should not be a serious problem in the GRETS area.

The deficiency remaining in the auto driver check should be due to the under reporting of trips. To compensate for under reporting, auto driver trips were adjusted to 97% of the screenline ground counts. No adjustment of truck trips was necessary.

The total number of auto driver trips reported in the GRETS Internal Survey was 531,735. Of these, 102,515 crossed the screenline, while 429,220 did not. The purpose breakdown of these trips is shown in the following table:

INTERNAL UNFACTORED AUTO-DRIVER TRIPS

TRIP PURPOSE	CROSSINGS		NON-CROSSINGS		TOTAL	
	No.	%	No.	%	No.	%
Work	43,576	42.5%	124,599	29.0%	168,175	31.6%
Shop	11,548	11.3%	89,057	20.8%	100,605	18.9%
Pers.Bus.	6,883	6.7%	34,065	8.0%	40,948	7.8%
Serve P.	15,179	14.8%	72,156	16.8%	87,335	16.4%
Soc.Rec.	19,388	18.9%	83,413	19.4%	102,801	19.3%
Other	<u>5,941</u>	<u>5.8%</u>	<u>25,930</u>	<u>6.0%</u>	<u>31,871</u>	<u>6.0%</u>
TOTAL	102,515	100.0%	429,220	100.0%	531,735	100.0%

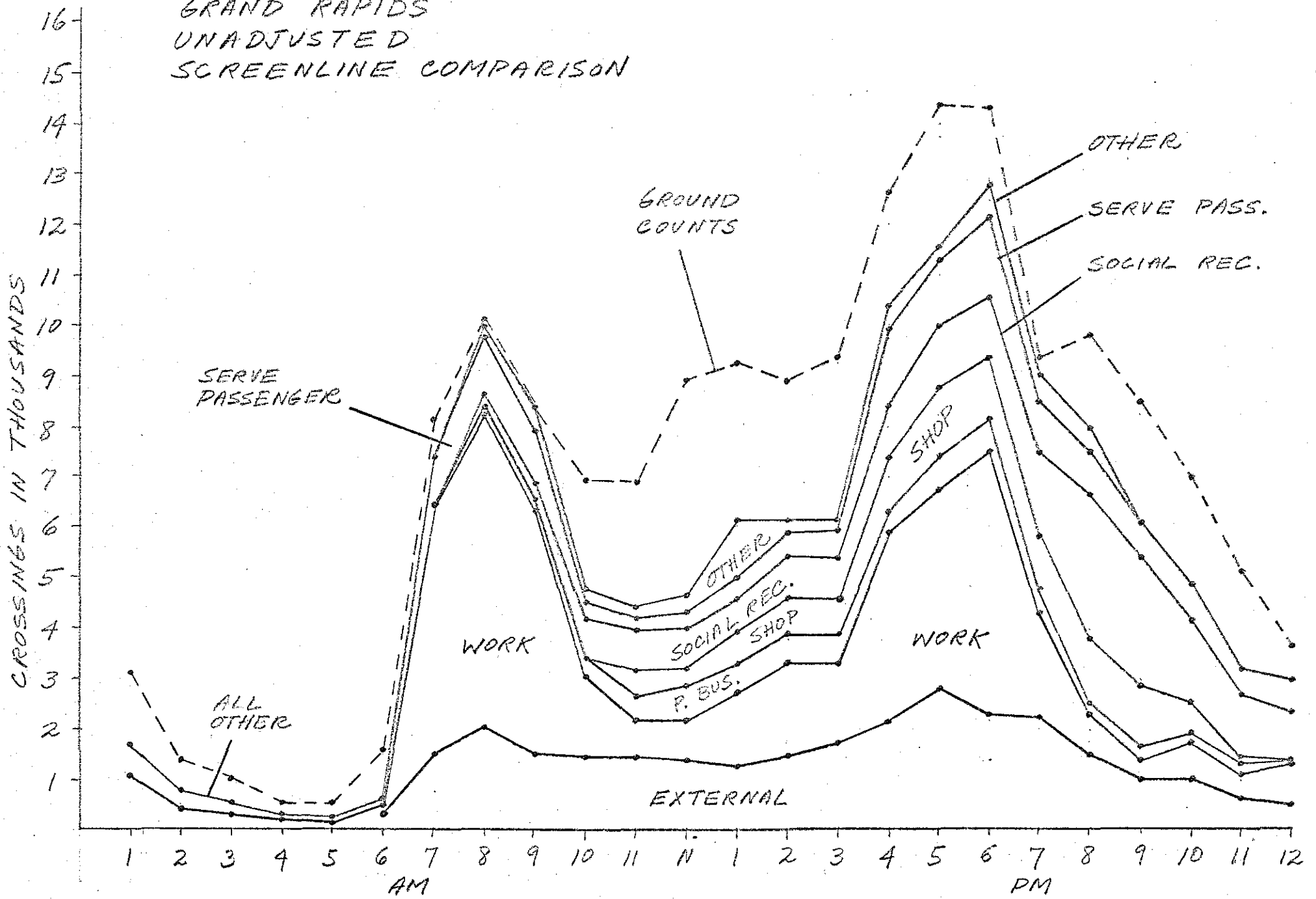
The screenline intercepted a higher percentage of work trips and a lower percentage of shop trips than occurred for the rest of the study area.

Another 29,207 auto driver trips from the external survey crossed the screenline. These were excluded from adjustment since they had been expanded to ground counts during external expansion.

A graphical comparison of the hourly distribution of crossings and ground counts provided the rationale for developing adjustment factors. Trip purpose factors were chosen which would decrease the large deficiency in the 10 AM to 3 PM period while retaining the good comparison for the AM and PM peak hours. As a result, trip purposes with few peak hour trips received the highest factors. After trial and error, the following factors were found to provide the "best fit" with the hourly count line.

a. Work	1.0
b. Shop	1.6
c. Personal Business	2.5
d. Serve Passenger	1.1
e. Social Recreation	1.3
f. Other	2.5

GRAND RAPIDS
UNADJUSTED
SCREENLINE COMPARISON



In preparing these factors, an attempt was also made to provide a logical explanation of underreporting during the midday period. Work trips, accepted as being well reported-as is shown in the good AM peak hour comparison, were left unadjusted. No other factors over 2.5 were used. Serve passenger trips, usually similar to work trips in origin, also received a low adjustment factor, 1.1. Shopping and social recreation trips were felt to be fairly well represented in the unadjusted data during the midday period and received factors of 1.6 and 1.3, respectively. The largest adjustment for underreporting was applied to personal business and other trips-trips commonly underreported during the lunch break and midday period. The "other" purpose category includes school, mode-change, eat-meal, unknown and medical-dental trip purposes, of which eat-meal is the largest.

After the application of these factors, a graphical comparison of the adjusted crossings and ground counts shows that most of the underreporting during the midday period has been eliminated. Some underreporting remains for the hours 10AM to 12 NOON. However, this period could not be adjusted further without using factors over 2.5 or worsening the peak hour comparisons. The difference remaining may be due to circulating traffic in the downtown area for these hours in which personal business and shopping trips predominate.

GRAND RAPIDS
ADJUSTED
SCREENLINE COMPARISON

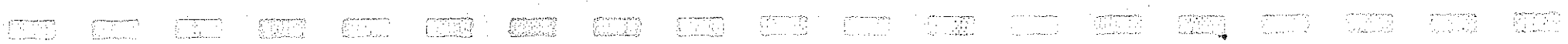
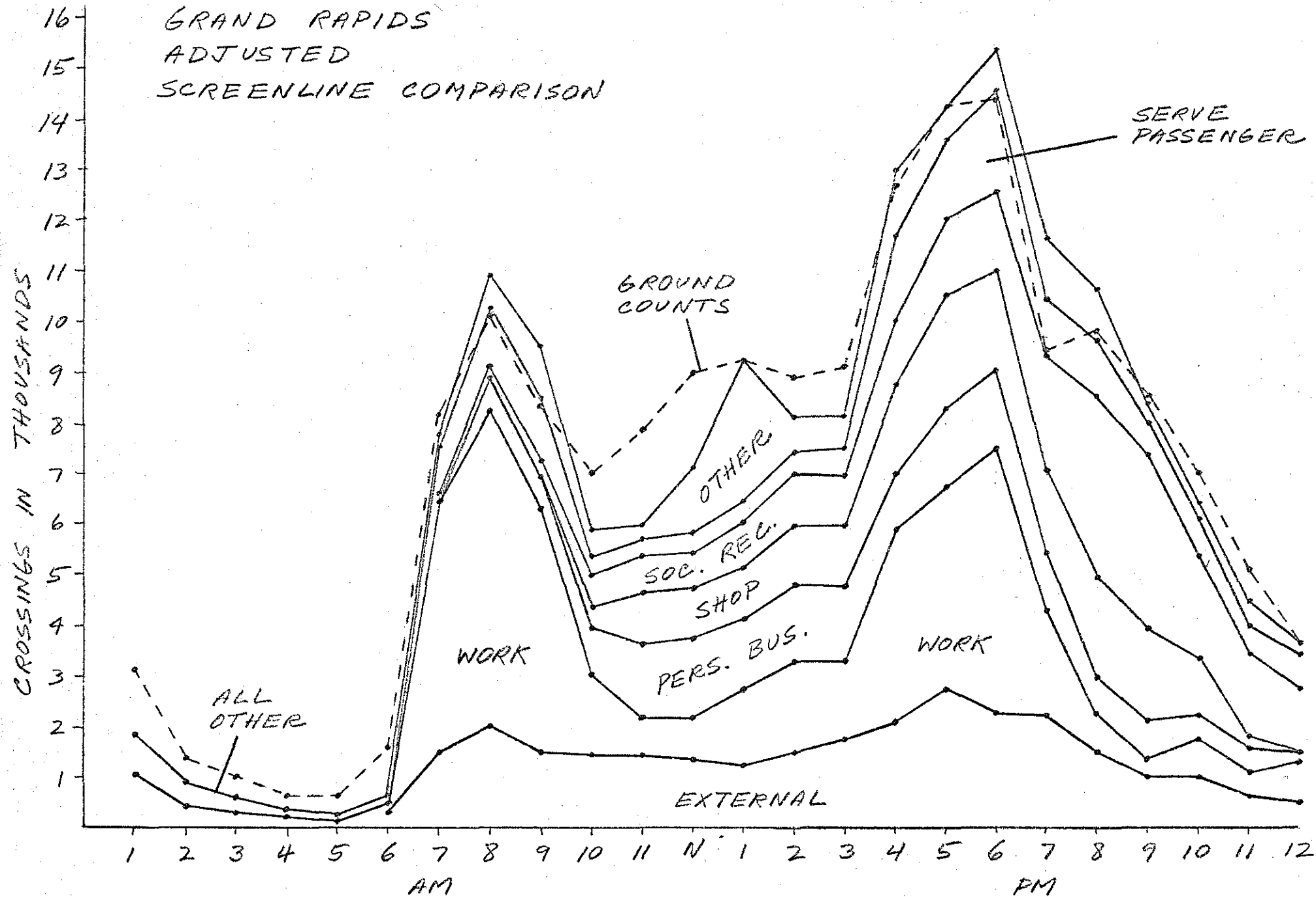


TABLE 1

ADJUSTED AUTO DRIVER TRIPS CROSSING SCREENLINE

<u>PURPOSE</u>	<u>UNFACTORED TRIPS</u>	<u>%</u>	<u>FACTORED TRIPS</u>	<u>%</u>
Work	43,576	42.5	43,576	32.0
Shop	11,548	11.3	18,477	13.6
Pers. Bus.	6,883	8.7	17,208	12.7
Serve Pass.	15,179	14.8	16,697	12.3
Soc. Rec.	19,388	18.9	25,204	18.5
Other	<u>5,941</u>	<u>5.8</u>	<u>14,853</u>	<u>10.9</u>
TOTAL	102,515	100.0%	136,015	100.0%

TABLE 2

ADJUSTED SCREENLINE CHECK

Internal Auto-Driver	+	External Auto-Driver	
136,015		29,207	
<hr/>			= 96.6%
Counts			
171,065			

TABLE 3

ADJUSTED INTERNAL AUTO DRIVER TRIPS

<u>PURPOSE</u>	<u>UNFACTORED TRIPS</u>	<u>%</u>	<u>FACTOR</u>	<u>FACTORED TRIPS</u>	<u>%</u>
Work	168,175	31.6	1.0	168,175	22.7
Shop	100,605	18.9	1.6	160,968	21.7
Pers. Bus.	40,948	7.7	2.5	102,370	13.8
Serve Pass.	87,335	16.4	1.1	96,069	13.0
Soc. Rec.	102,801	19.3	1.3	133,641	18.0
Other	<u>31,871</u>	<u>6.0</u>	2.5	<u>79,678</u>	<u>10.8</u>
TOTAL	531,735	100.0%		740,901	100.0%

TABLE 4

TOTAL AREA TRIPS

	<u>UNADJUSTED</u>	<u>ADJUSTED</u>
Auto Driver	531,735	740,901
Truck & Taxi	99,228	99,228
External	<u>106,301</u>	<u>106,301</u>
TOTAL	737,264	946,430

SUMMARY AND CONCLUSIONS

Trip adjustment thru the use of five 24-hour trip purpose factors provided results which compared well with the hourly distribution of screenline ground counts. These factors provided an additional 209,000 internal auto driver trips and increased the total area trips from 737,264 to 946,430.

At the time the adjustments were made the data was not yet available in a home-based and non-home-based breakdown, which usually provides additional factoring in the non-home-based purpose categories. However, it is felt that satisfactory results were obtained from the factors presented here.

After these adjustments, the trip data should represent the existing travel patterns of the GRETS base year and provide the input for traffic assignments to the base year network.

VEHICLE MILES OF TRAVEL COMPARISON CHECK

To check for geographic bias in the screenline factoring, the factored trips were assigned to the existing street network and a comparison was made of vehicle miles of travel by geographic area for the assignment versus the ground counts.

VMT CHECK OF FACTORED TRIPS

<u>AREA</u>	<u>COUNT VMT</u>	<u>ASSIGNED VMT</u>	<u>ACCURACY</u>
1 - Southeast	203,783	222,166	1.09
2 - South	548,217	563,239	1.03
3 - West	651,154	686,096	1.05
4 - North	328,892	311,842	.95
5 - Downtown	542,486	517,193	.95
6 - North Central	487,240	472,991	.97
7 - South Central	<u>746,197</u>	<u>759,072</u>	1.02
TOTAL	3,507,996	3,532,599	1.01

The results show that the factoring of the trip data based upon the characteristics of trips reported crossing the screenline did not produce any discernible geographic bias in the trip data.

GRAND RAPIDS

VMT

COMPARISON AREAS

