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METROPOLITAN TORONTO AND REGION
TRANSPORTATION STUDY

An

Analysis Report

on the

1964 HOME INTERVIEW SURVEY

(CONDUCTED JOINTLY BY METROPOLITAN TORONTO AND REGION TRANSPORTATION
STUDY AND METROPOLITAN TORONTO PLANNING BOARD)

March, 1965

PREPARED FOR THE

METROPOLITAN TORONTO AND REGION TRANSPORTATION STUDY

BY

TRAFFIC RESEARCH CORPORATION LIMITED

TRAFFIC RESEARCH CORPORATION LIMITED

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March 31, 1965

Mr. Philip E. Wade, P. Eng.,
Study Director,
Metropolitan Toronto and Region
Transportation Study,
10 St. Mary Street, 3rd Floor,
TORONTO, Ontario.

Dear Mr. Wade:

We are pleased to submit herewith our report on an analysis of methods and results of the 1964 Home Interview Survey for Metropolitan Toronto and Region which was conducted jointly by Metropolitan Toronto and Region Transportation Study and Metropolitan Toronto Planning Board.

The work carried out during the course of this project was in accordance with the Memorandum of Agreement dated April 28, 1964, covering the collection of survey data and its analysis. In particular, this report describes the following steps:

1. Conduct of an O-D Survey in the Metropolitan Toronto Region;
2. Processing and analysis of the survey information to arrive at trip production, attraction and distribution formulae;
3. Design and organization of a data bank to serve as input for computer analysis of transportation.

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- 2 -

This work comprises an essential phase of the MTARTS Planning Process. Its importance in the Study ranks equally with the Economic Base Study, Community Characteristics Survey and the Traffic Volume and Speed Surveys, in providing the basic inventory of planning data.

A Home Interview Survey was conducted throughout the MTARTS Region, an area which includes Greater Metropolitan Toronto bounded by Hamilton and Guelph on the West, Bowmanville on the East and Barrie on the North. In this area, a total of 24,000 householders were interviewed and basic travel and population facts were obtained to represent the characteristics of the 2,800,000 people living in the area. When expanded, these survey facts indicated that close to 4,000,000 person trips were made daily by the residents of the Region. Special emphasis has been placed on reporting some of the overall travel patterns in the Region. Based on the findings of intensive validity checks we are confident that the Survey reports daily travel characteristics with more than 95 percent accuracy.

We are grateful to you, your staff, and to representatives of other cooperating agencies, especially the Metropolitan Toronto Planning Board, for the help received in carrying out this interesting and important project. We feel the results presented in this report represent a significant contribution to the art of travel movement forecasting.

Yours very truly,



H. G. von Cube,
Vice-President.

T/HGvC:nm
Encl.

LIST OF TABLES

TABLE NO.		PAGE
1. 1	Distribution of Travel By Purpose of Travel on an Average Weekday in the Spring of 1964	3
1. 2	Total Person Trips Made on an Average Week- day in the Spring of 1964, by the Residents of Metropolitan Toronto and Region : : :	4
1. 3	Percent of Daily Trips Made By Each Major Mode of Travel on an Average Weekday in the Spring of 1964 : : : :	5
1. 4	Total Person Trips Made By Each Mode on an Average Weekday in the Spring of 1964 By Residents of Metropolitan Toronto and Region	6
2. 1	Percent Distribution of Daily Person Trips By Each Purpose of Travel on an Average Weekday in the Spring of 1964 : : :	7
3	Trip Generation and Attraction Equations for Major Trip Purposes - Coefficients and Correlation Coefficients (R) : :	16 & 17
4	Number of Sample Households Surveyed in Comparison to 1964 Counts : :	28
5	Percentage of Households Surveyed on Each Weekday : : : : :	29
6.	Average Number of Trips Per Person Reported By Each Interview Technique : :	33
7	Percent Under-Reporting of Person Travel By Home Interview Survey : : :	39
8	Comparison Between 1964 Trip Rate and Rate Reported from Previous Surveys : :	43



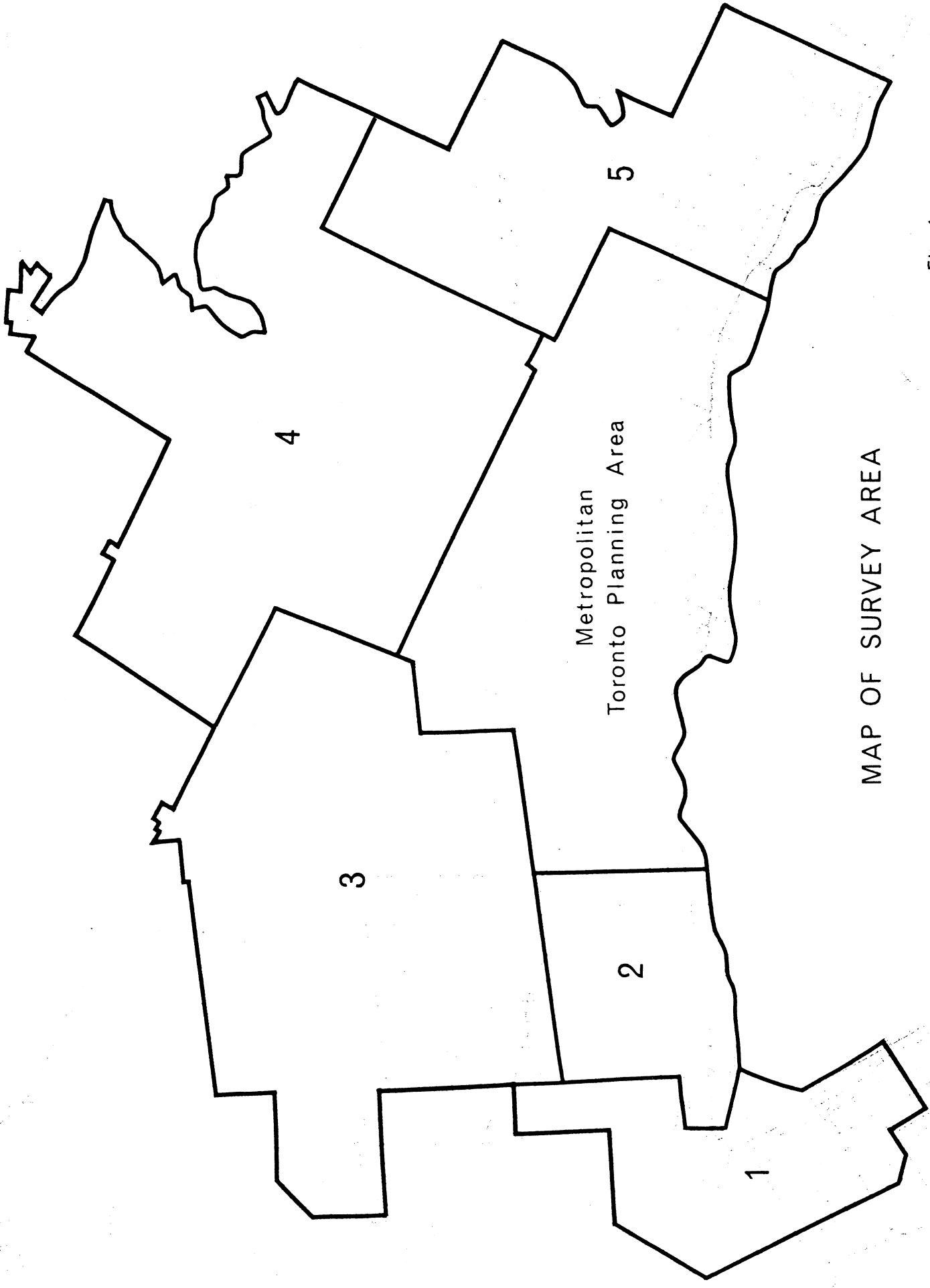
INTRODUCTION

INTRODUCTION

The Home Interview Survey reveals the movement of people associated with the many different population and employment centres in Metropolitan Toronto and Region (see Figure 1). As might be expected, an analysis of the results shows that travel is orderly and regular. The relationships between this order and the various factors prompting travel assist the planner in assessing present day transportation systems and in evaluating new or improved facilities.

It is the purpose of this report to present, in summary form, the findings of the 1964 Survey of Metropolitan Toronto and Region and to give evidence of the reliability of these results. In particular, the report will assess and refine the data to be used in the MTARTS Traffic Prediction Model. To this end the relationships between travel and the location and size of both population and employment centres will be reduced to a systematic and mathematical statement.

The format here is such that the pertinent findings of the Survey are first described along with the mathematical analysis of the results. It is this information which will have the greatest significance to the majority of the readers of this report. The procedure for the conduct



MAP OF SURVEY AREA

Fig.1

of the Home Interview Survey in the MTARTS Area is presented next. An analysis of the reliability of the survey data for application in the Planning Process follows last.

Detailed information on data processing, data sources and data analysis are contained in the Appendices following the final section.

1. Through the cooperation of the Metropolitan Toronto Planning Board, the findings of the MTPB Survey and the MTARTS Survey were combined to provide the summary statistics presented here. It was recognized that the MTARTS Planning Process comprised a Person Movement Study throughout the whole Metropolitan Toronto and Region. Accordingly, it was desirable that complete regional summary statistics of person travel be presented in this Report.

The detailed conduct of the Survey in the Metropolitan Toronto Planning Area is described in "An Analysis of Some Travel Trends Between 1956 and 1964 Based on Home Interview Surveys" prepared for the Metropolitan Toronto Planning Board by the Traffic Research Corporation Limited.

TRAVEL PATTERNS

Close to 4.0 million trips were made by over 2.8 million people living in Metropolitan Toronto and Region on an average weekday during the spring of 1964. Thus travel throughout the Region occurs at the rate of approximately one and four tenths (1.4) trips per person on an average weekday.

1. Purpose and Mode of Travel

The distribution of this daily travel by major travel purpose is shown in Table 1.1.

Table 1.1

Distribution of Travel by Purpose of Travel on an Average Weekday in the Spring of 1964

Purpose of Travel	1964 Survey
1. Btw. Home and Work	46%
2. Btw. Home and Shopping, School, Personal Business	29%
3. Btw. Home and Social and Recreational	14%
TOTAL HOME BASED	89%
4. Non-Home Based (No end at Home)	11%
TOTAL	100%

Note: Daily travel is based on trips which originate and terminate within the Study Area.

It will be noted that travel between home and work (i. e. to and from work) predominates and that 89% of all person trips have their origin or their destination in the home.

The total amount of travel by each major purpose is shown in Table 1. 2.

Table 1. 2

Total Person Trips Made on an Average Weekday
in the Spring of 1964, by Residents of
Metropolitan Toronto and Region

Purpose of Travel	Number of Trips in 1964
1. Btw. Home and Work	1,811,000
2. Btw. Home and Shopping, School, Personal Business	1,170,000
3. Btw. Home and Social and Recreational	537,000
TOTAL HOME BASED	3,518,000
4. Non-Home Based	444,000
TOTAL	3,962,000

Of all person trips in Metropolitan Toronto and Region approximately 77% were made in motor vehicles as automobile drivers or automobile, taxi, or truck passengers on an average weekday in the Spring of 1964. The distribution of motor vehicle

vehicle trips for each major purpose is shown in Table 1. 3 and the total number of such trips in Table 1. 4.

Approximately 70% of all person trips made by private motor vehicles were made as drivers and the remainder as passengers. The average number of persons per car was, therefore, 1. 4.

Table 1. 3

Percent of Daily Trips Made by Each Major Mode of Travel on an Average Weekday in the Spring of 1964

Major Trip Purpose	Motor Vehicle	Public Trnsp.	Walk to Work
1. Btw. Home and Work	70%	24%	6%
2. Btw. Home and Shopping, School, Personal Business	77%	23%	not rep.
3. Btw. Home and Social and Recreational	89%	11%	not rep.
TOTAL HOME BASED	75%	22%	3%
4. Non-Home Based	93%	7%	not rep.
TOTAL PURPOSES	77%	20%	3%

Note: not rep. means, Not Reported in Survey.

Table 1.4

Total Person Trips Made by Each Mode on an Average Weekday in the Spring of 1964 by Residents of Metropolitan Toronto and Region

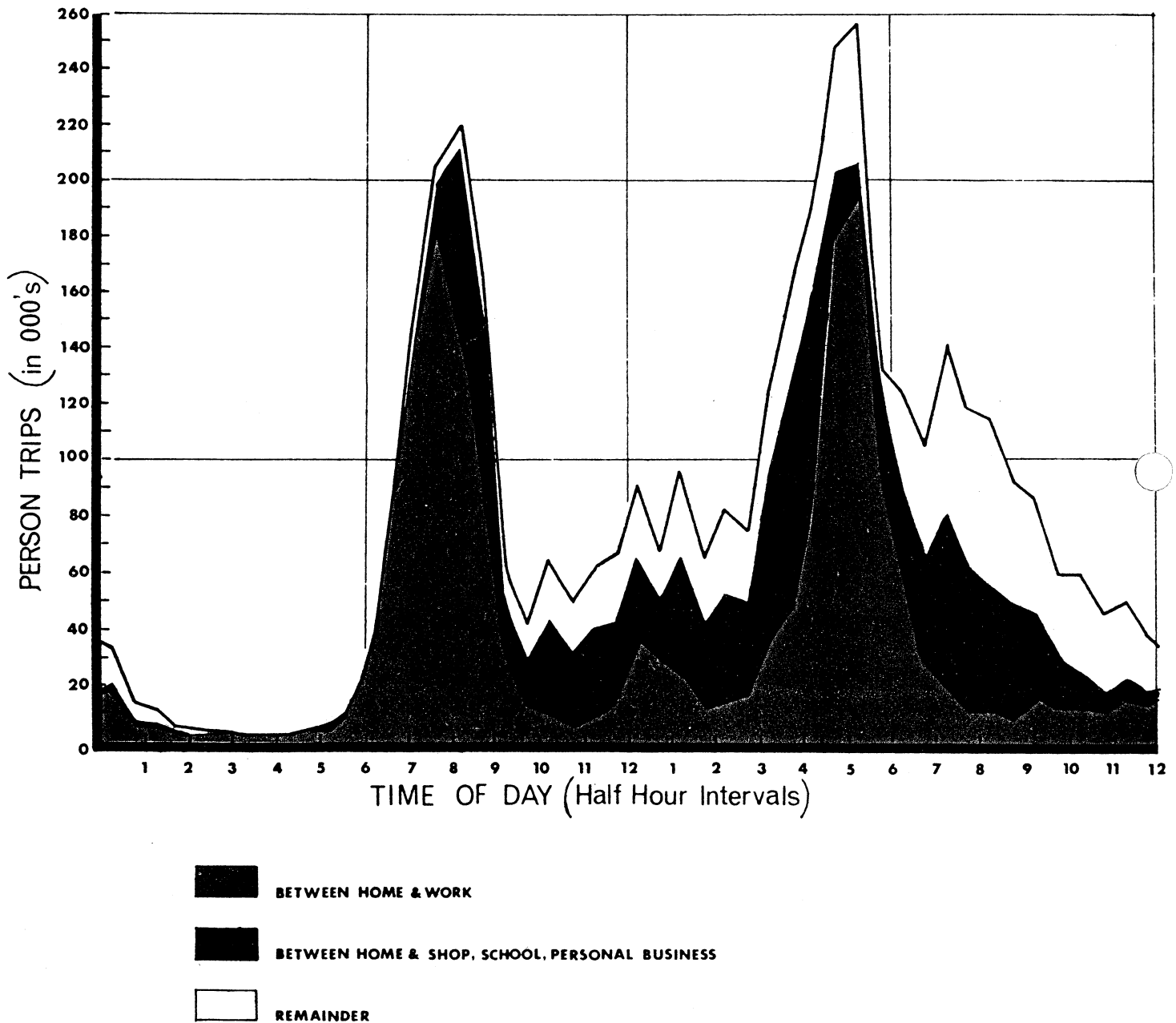
Purpose of Trip	Motor Vehicle	Public Transp.	Walk to Work
1. Btw. Home and Work	1,269,000	434,000	108,000
2. Btw. Home and Shopping, School, Personal Business	896,000	274,000	-
3. Btw. Home and Social and Recreational	479,000	58,000	-
TOTAL HOME BASED	2,644,000	766,000	108,000
4. Non-Home Based	413,000	31,000	-
TOTAL	3,057,000	797,000	108,000

2. Travel Patterns Over Time and Space

The great variation in travel observed throughout an average 24 hour weekday follows a regular cyclic pattern. Amount of travel during the peak morning rush hour is 2.5 times the average hourly travel rate. Again, during the evening rush hour the travel rate is 2.7 times the average hourly travel. The actual number of person trips undertaken during an average or typical weekday is shown in Figure 2.

The purposes for which travel is undertaken readily explain these observations. It is seen that travel to and from work largely

PEAKING OF TRAVEL WITHIN THE AVERAGE WEEKDAY IN METROPOLITAN TORONTO REGION



accounts for the major portions of the two peak periods. The patterns created by trips for other purposes tend to concentrate in off peak periods.

The survey results, as shown in Table 2.1, clearly show a directional symmetry for each major purpose of travel. During an average 24 hour period the number of trips destined for any given area equals the number of trips leaving that area.

Table 2.1

Percent Distribution of Daily Person Trips by Each Purpose of Travel on an Average Weekday in the Spring of 1964

Purpose at Trip Origin	Purpose at Trip Destination			
	Home	Work	Shop Schl. etc.	Social & Recrtnl.
1. Home	-	23%	15%	7%
2. Work	23%	3%	1%	-
3. Shopping, School, Personal Business	14%	1%	3%	1%
4. Social and Recreation	7%	-	1%	1%

Again, the importance of the home as either origin or destination is emphasized. Of all person trips, 45% originate at home and 44% are destined to home in the Metropolitan Region. It is recognized that slightly more travel is destined to shopping, school

and personal business than come home directly from these places.

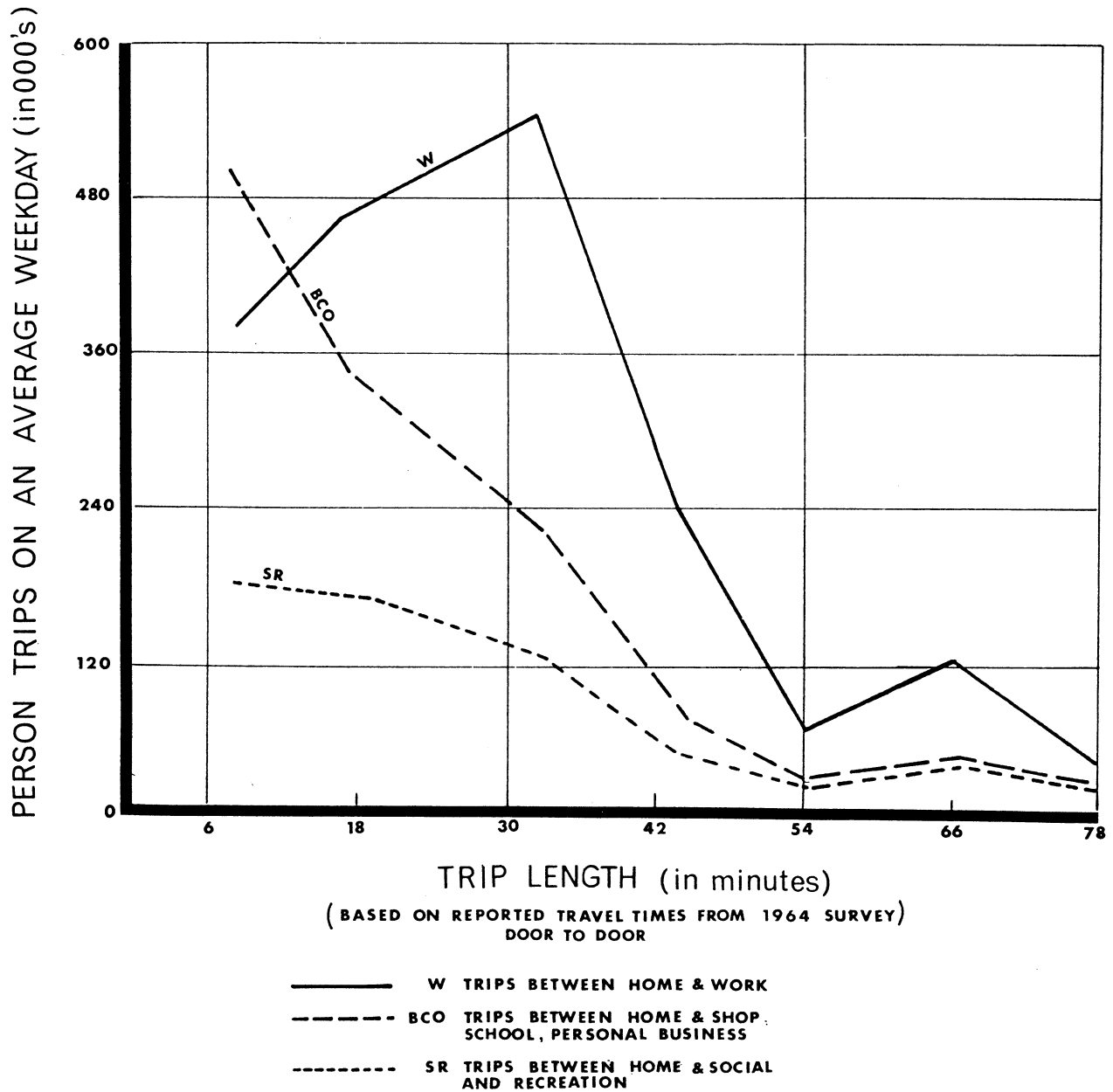
The demonstration of this directional symmetry is significant for the Planning Process in that it corroborates the expected return flow when traffic is estimated in one direction only.

The frequency of travel on an average weekday varies with the trip time. Generally, trips of long duration are made infrequently. The relationship between trip frequency and trip duration is shown in Figure 3. The relationships generally shown are based on the travel times recorded in the 1964 Survey.

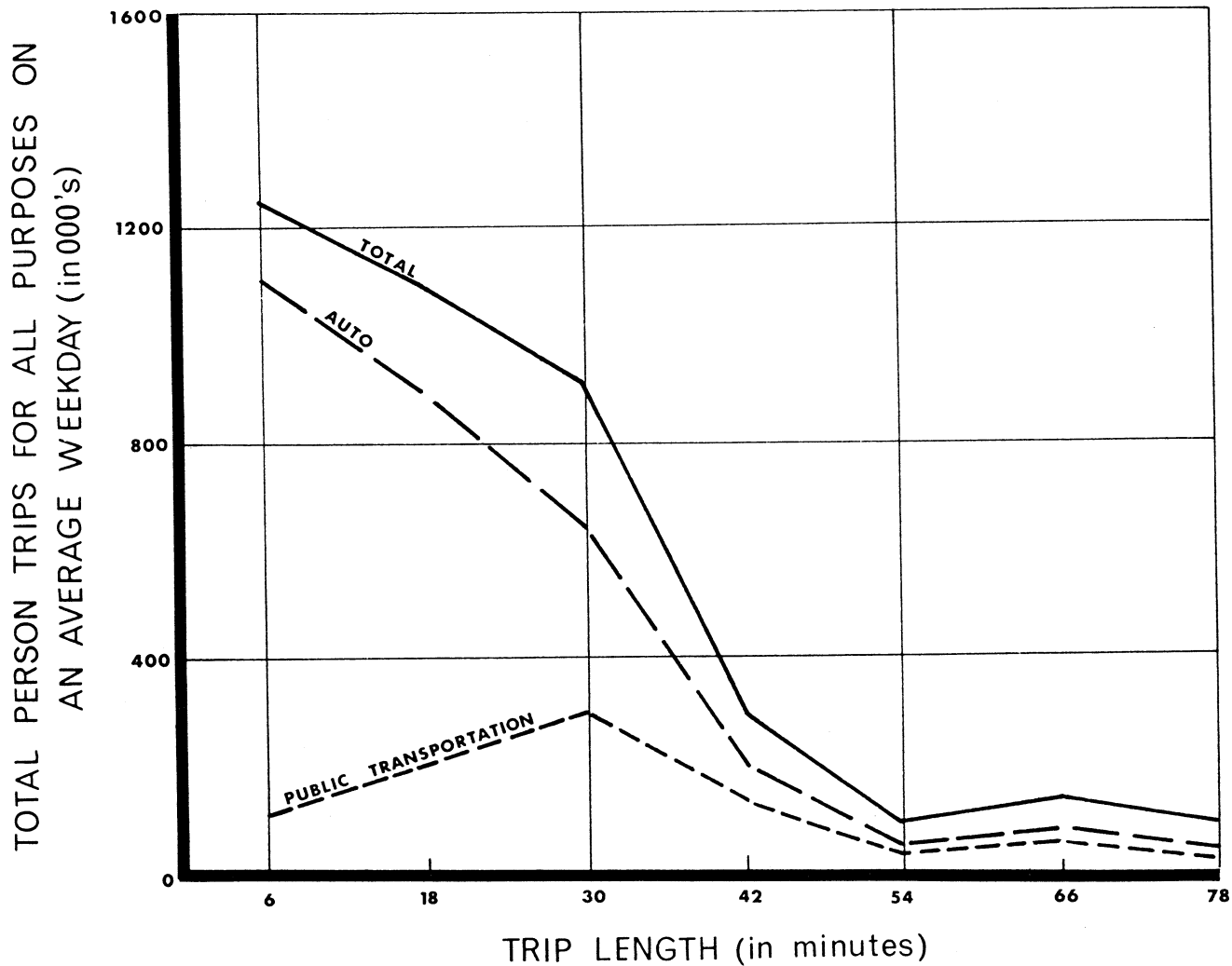
The influence of trip purpose can be seen in this relationship. The necessity of travel to work is shown by the fact that longer trips are made more frequently; the average trip time being 30 minutes. Shopping, school and personal business trips as well as social and recreational trips are of an average duration of approximately 15 minutes.

The method of travel may influence the relationship between trip frequency and trip time. Figure 4 shows the relationship between trip frequency and trip length for total person trips made by each method of travel. The average trip length is 20 minutes for motor vehicle trips and 30 minutes for transit trips to all purposes.

RELATIONSHIP BETWEEN TRIP FREQUENCY AND TRIP LENGTH ACCORDING TO PURPOSE OF TRAVEL



RELATIONSHIP BETWEEN TRIP FREQUENCY AND TRIP LENGTH FOR TRAVEL BY EACH MODE



BASED ON REPORTED TRAVEL TIMES FROM 1964 SURVEY
DOOR TO DOOR

Analysis to Establish



BASIC TRAVEL RELATIONSHIPS

There are five primary travel decisions common to all trips made in the Metropolitan Toronto Region.

<p style="text-align: center;">WHY?</p> <p>Purpose of Trip</p> <p style="text-align: center;">WHEN?</p> <p>Time of Day Trip Made</p>	<p>Trip Production</p>	<p><u>ESTABLISHES</u> the amount of total travel during a specified time for a given purpose.</p> <hr/> <p>VARIES WITH - Number of People/Area - People's Characteristics - Number of Work Places - Shopping and Recreational Opportunities</p>
<p style="text-align: center;">WHERE?</p> <p>Destination</p>	<p>Trip Distribution</p>	<p><u>ESTABLISHES</u> amount of travel from one area to another.</p> <hr/> <p>VARIES (a) Directly with opportunities in each area. (b) Inversely with the function of the travel time between the two areas.</p>
<p style="text-align: center;">HOW?</p> <p>Mode Used</p> <p style="text-align: center;">ROUTE?</p> <p>Route Followed</p>	<p>Travel Mode Split</p>	<p><u>ESTABLISHES</u> the diversion of total traffic to modes and routes.</p> <hr/> <p>VARIES WITH - Travel Time - Travel Cost - Travel Convenience - Socio-Economic Status - Trip Purpose</p>

These travel decisions are interrelated. The summary and preliminary analysis of the survey data with regard to these factors is described in Appendix C. A series of computer programs was prepared for the 1107 computer to assemble and summarize the survey data in a form useable for basic travel analysis. The detailed analysis to describe three of the five basic travel decisions by mathematical relationships is reported below. Analysis of how and by what route was carried out under a separate contract and is reported separately.

Trip Production - Why and When People Travel

The 1964 Home Interview Survey provided recent data on the frequency of travel. A summary of this information permitted the establishment of trip production rates (generation and attraction) for Metropolitan Toronto and Region. The amount of travel generated by each small geographical area (traffic zone) was related to the number of people, the number of households occupied, the number of cars owned by the resident population surveyed and employment statistics. By a statistical method known as "regression analysis" these relationships were reduced to mathematical equations. Because of their application to traffic prediction programs a consideration of two trip generation equations is made below. Separate equations were derived for off peak (i. e. all day except the two peak periods 7-9 AM and 4-6 PM), and for the morning peak hour travel (in particular 7-9 AM):

Equation 1:

		0.147 x Population
		+
<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p><u>Total Trips</u> Generated at Home on Average Weekday in 1964 to all Purposes <small>Off Peak</small></p> </div>	=	0.109 x Number of Households
		+
		0.529 x Number of Cars Owned

Equation 2:

		0.041 x Population
		+
<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p><u>Total Trips</u> Generated at Home during <u>7 - 9:00 AM</u> on Average Weekday in 1964 to all Purposes</p> </div>	=	0.596 x Number of Households
		+
		0.234 x Number of Cars Owned

Note: Trips generated at home are departing from the place of residence.

Both equations show the high degree of relationship between trips generated at home and the characteristics of the resident population. The correlation coefficients, a statistical reliability measure, substantiate this relationship and show it to be highly significant.

Equation 1: Correlation Coefficient is 0.96

Equation 2: Correlation Coefficient is 0.96

It is recognized that a perfect correlation would give a coefficient of 1.00.

Applying these equations to a summary of the population characteristics of residents of Metropolitan Toronto and Region estimates can be made of total traffic produced from home during an off peak period and during the 7-9 AM period.

Summary of Population Characteristics of Residents
of Metropolitan Toronto and Region

Number of People	2,820,000
Number of Households	732,000
Number of Cars Owned	727,000
Based on statistics available November, 1964	

Travel estimates are shown in the following Figure 5.1 and Figure 5.2:

Figure 5.1
(Equation 1)

Trips Generated at Home During Off Peak Period on an
Average Weekday in 1964 to All Purposes

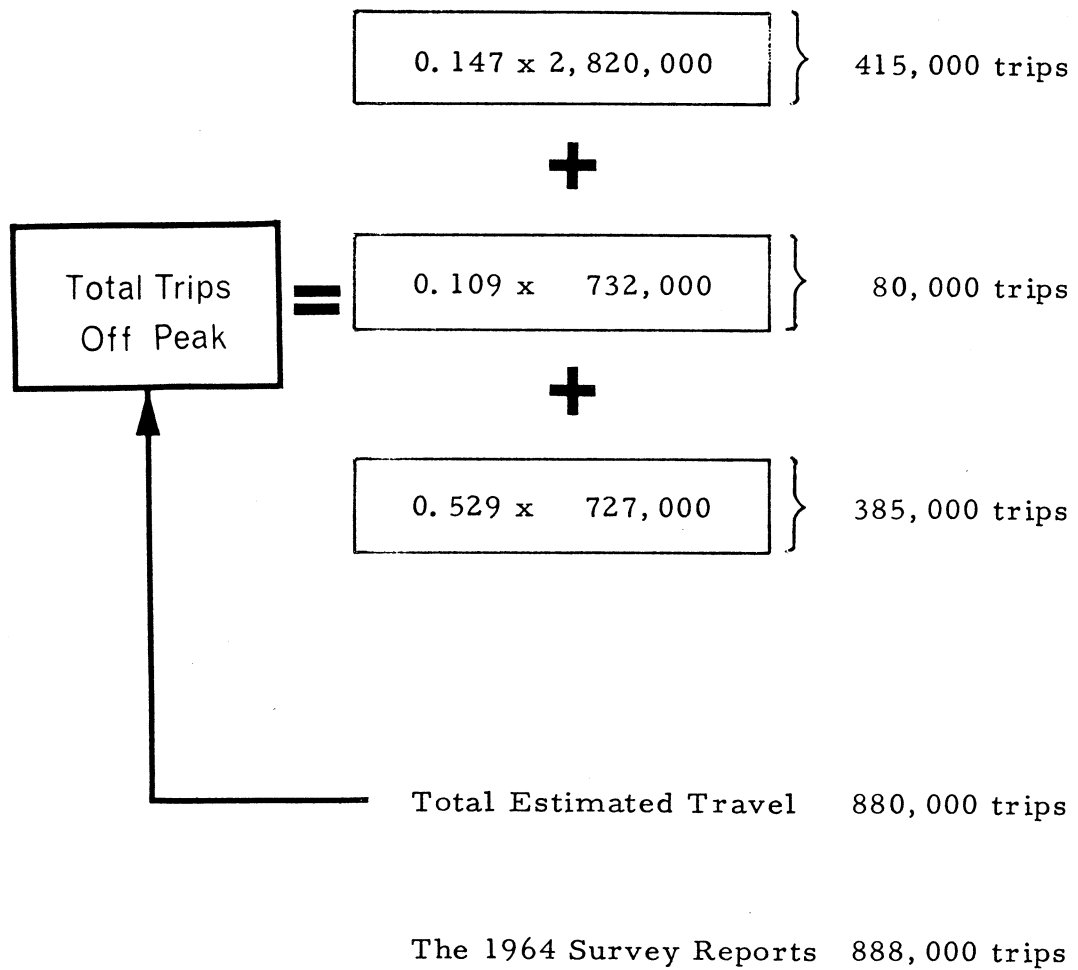
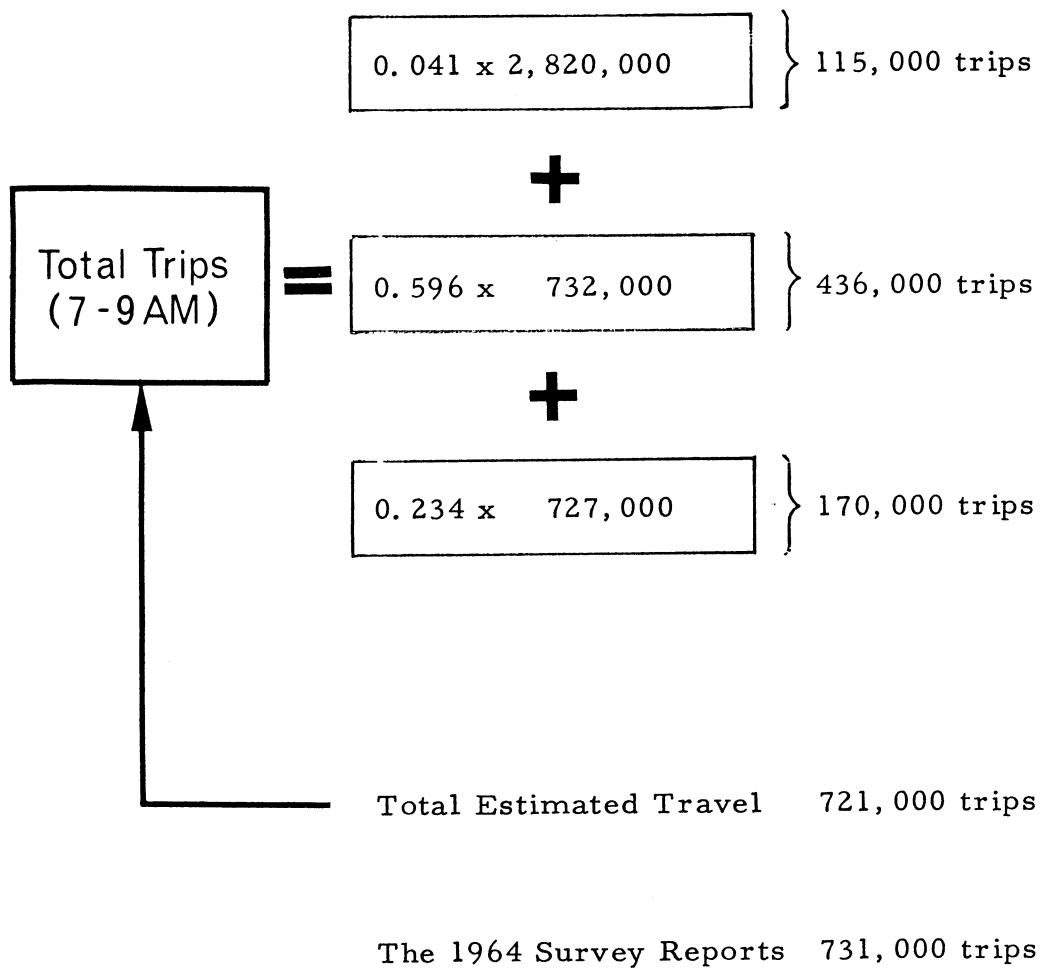


Figure 5.2
(Equation 2)

Trips Generated at Home During 7-9 AM on an Average
Weekday in 1964 Destined to All Purposes



Close agreement is observed between estimated traffic and traffic reported by the 1964 Home Interview Survey. The Off Peak difference is 0.9 percent and the AM Peak difference is 1.4 percent of the survey figures. These discrepancies were expected due to the design of the basic equations. Generally, differences are small and it is advisable to make minor adjustments to the equation coefficients to obtain perfect agreement between trips estimated and observed.

Although a "constant" coefficient, not related to any land characteristic, when placed in the equation would have produced perfect agreement, its use is not preferred. Estimating equations with constant terms predict some traffic even when all land use characteristics are zero. Furthermore, the size of such a constant factor is influenced by traffic zone size, land use characteristics and changes in traffic zone boundaries.

In summary, constant coefficients were not applied, and consequently the estimating equations require adjustment to ensure the desired agreement. Similar results were obtained for the estimating equations derived for the major trip purposes. Table 3 presents the relationships for trips generated and attracted for the individual trip purposes.

Trip Attraction describes the amount of travel destined to each small geographical area. As in the case of Trip Generation,

Table 3

Trip Generation and Attraction Equations
For Major Trip Purposes
- Coefficients and Correlation Coefficients (R) -

TRIP PURPOSE (From and to)	Household Characteristics				Population and Employment Characteristics						
	Population	Dwelling Units	Cars	R	Population	Manuf. Whlse. Constr.	Retail	Service	Other	R	
Off-Peak Period	TRIP GENERATION				TRIP ATTRACTION						
1. Home to all purposes	+0.147	+0.109	+0.529	0.96	+0.136	+0.379	+1.283	+0.165	+0.433	0.90	
2. Home to work	+0.135	+0.145	-0.253	0.91	+0.013	+0.349	+0.158	+0.107	+0.436	0.93	
3. Home to personal business or others	-0.006	+0.048	+0.137	0.83	+0.024	+0.000	+0.078	+0.080	+0.054	0.80	
4. Home to shopping	+0.021	-0.179	+0.413	0.89	+0.041	+0.000	+0.931	-0.090	+0.000	0.78	
5. Home to school	+0.003	-0.008	+0.015	0.43	+0.003	+0.000	+0.000	+0.008	+0.000	0.34	
6. Home to social and recreation	-0.006	+0.102	+0.217	0.89	+0.056	+0.000	+0.124	+0.058	+0.000	0.72	
	TRIP ATTRACTION				TRIP GENERATION						
7. All Purpose to home	+0.136	+0.037	+0.748	0.96	+0.161	+0.276	+1.296	+0.224	+0.337	0.89	
8. Work to home	+0.102	+0.102	-0.091	0.93	+0.020	+0.250	+0.216	+0.149	+0.329	0.94	
9. Personal business and others to home	-0.006	+0.060	+0.103	0.83	+0.022	+0.000	+0.099	+0.054	+0.055	0.79	
10. Shopping to home	+0.040	-0.274	+0.458	0.88	+0.048	+0.000	+0.827	-0.072	+0.000	0.75	
11. School to home →	+0.023	-0.029	+0.035	0.52	+0.020	+0.000	+0.000	+0.024	+0.000	0.32	
12. Social and recreation to home	-0.022	+0.178	+0.243	0.89	+0.060	+0.000	+0.176	+0.071	+0.000	0.74	
13. Non-home based to non-home based	TRIP GENERATION AND TRIP ATTRACTION				TRIP GENERATION AND TRIP ATTRACTION						
					+0.079	+0.087	+0.294	+0.171	+0.149	0.90	

continued.....

TRIP PURPOSE (from and to)	Household Characteristics			Population and Employment Characteristics							
	Population	Dwelling Units	Cars	R	Population	Manuf. Whlse. Constr.	Retail	Service	Other	R	
7-9 AM Peak Period	TRIP GENERATION			TRIP ATTRACTION							
14. Home to all purposes	+0.041	+0.596	+0.234	0.96	+0.039	+0.466	+0.600	+0.854	+0.382	0.97	
15. Home to work	+0.013	+0.620	+0.135	0.96	+0.005	+0.475	+0.507	+0.790	+0.412	0.98	
16. Home to personal business or others	-0.001	+0.014	+0.008	0.45	+0.002	+0.000	+0.023	+0.018	+0.000	0.71	
17. Home to shopping	+0.002	-0.005	+0.013	0.49	+0.000	+0.000	+0.072	+0.003	+0.000	0.81	
18. Home to school	+0.026	-0.044	+0.079	0.56	+0.029	+0.000	+0.000	+0.031	+0.000	0.35	
19. Home to social and recreation	+0.001	+0.001	-0.003	0.07	+0.002	+0.000	+0.003	+0.004	+0.000	0.30	
20. All purposes to home	TRIP ATTRACTION			TRIP GENERATION							
	Not sufficient data				+0.000	+0.027	+0.016	+0.010	+0.054	0.74	
21. Non-home based to non-home based	TRIP ATTRACTION AND ATTRACTION				TRIP GENERATION AND ATTRACTION						
					+0.010	+0.008	+0.008	+0.005	+0.015	0.61	

it is similarly related to population and employment statistics.
Consideration of two typical Trip Attraction equations is made
below for off peak and peak hour travel.

Equation 3:

		0.136 x Population
		+
		0.379 x Manufacturing and Wholesale Employment
		+
TOTAL TRIPS Attracted to All Purposes from Home During OFF PEAK Period on Average Weekday 1964	=	1.283 x Retail Employment
		+
		0.165 x Service Employment
		+
		0.433 x Other Employment

Equation 4:

$$\begin{array}{l} \boxed{\text{TOTAL TRIPS}} \\ \boxed{\text{Attracted to All}} \\ \boxed{\text{Purposes from Home}} \\ \boxed{\text{During 7-9 AM}} \\ \boxed{\text{on Average Weekday}} \\ \boxed{\text{1964}} \end{array} = \begin{array}{l} \boxed{0.039 \times \text{Population}} \\ + \\ \boxed{0.466 \times \text{Manufacturing and Wholesale}} \\ \boxed{\text{Employment}} \\ + \\ \boxed{0.600 \times \text{Retail Employment}} \\ + \\ \boxed{0.854 \times \text{Service Employment}} \\ + \\ \boxed{0.382 \times \text{Other Employment}} \end{array}$$

The correlation coefficients for these equations are respectively:

Equation 3 is 0.90

Equation 4 is 0.97

Trip Distribution - Where People Travel

The number of trips between any two zones for a particular trip purpose is dependent on the total number of trips generated for distribution at the trip origin (G_i), the total number of trips attracted to the destination (A_j), and the travel friction or impedance between the origin and destination as measured by the time factor (TF_{ij}).

The following formula is applied to describe this relationship, and hence to determine the trips distributed between each origin and destination zone:

$$J_{ij} = KG_i A_j TF_{ij} \quad i, j=1, \dots, N \text{ zones}$$

where: J_{ij} = number of trips leaving origin i for destination j for the purpose in question.

G_i = total trips generated at origin i for this purpose.

A_j = total trips attracted to destination j for this purpose.

TF_{ij} = time factor for trips made between origin i and destination j for this purpose, i. e. that is $e^{-BT_{ij}}$

where: B = parameter to be determined

e = 2.718

T_{ij} = travel time between i and j

The constant K is an adjustment factor so that the following equalities are satisfied:

(i) Total trips leaving origin i equals total trips generated there, i. e.

$$\sum_{j=1}^N J_{ij} = G_i$$

- (ii) Total trips arriving at destination j equals total trips attracted there, i. e.

$$\sum_{i=1}^N J_{ij} = A_j$$

The above formula is well known as "gravity formula" so called because of its similarity to the formula derived by Newton to describe gravitational attraction between two masses.

A detailed description of this gravity formula and its development is given in the Report 1 "Transportation Research Program, Appendix II" prepared by the Metropolitan Toronto Planning Board 1962. All necessary parameters associated with this formula were first derived from the 1956 Home Interview Survey in Metropolitan Toronto. During December of 1964, the basic gravity formula was re-established with the 1964 Home Interview Survey data of MTPB and MTARTS.

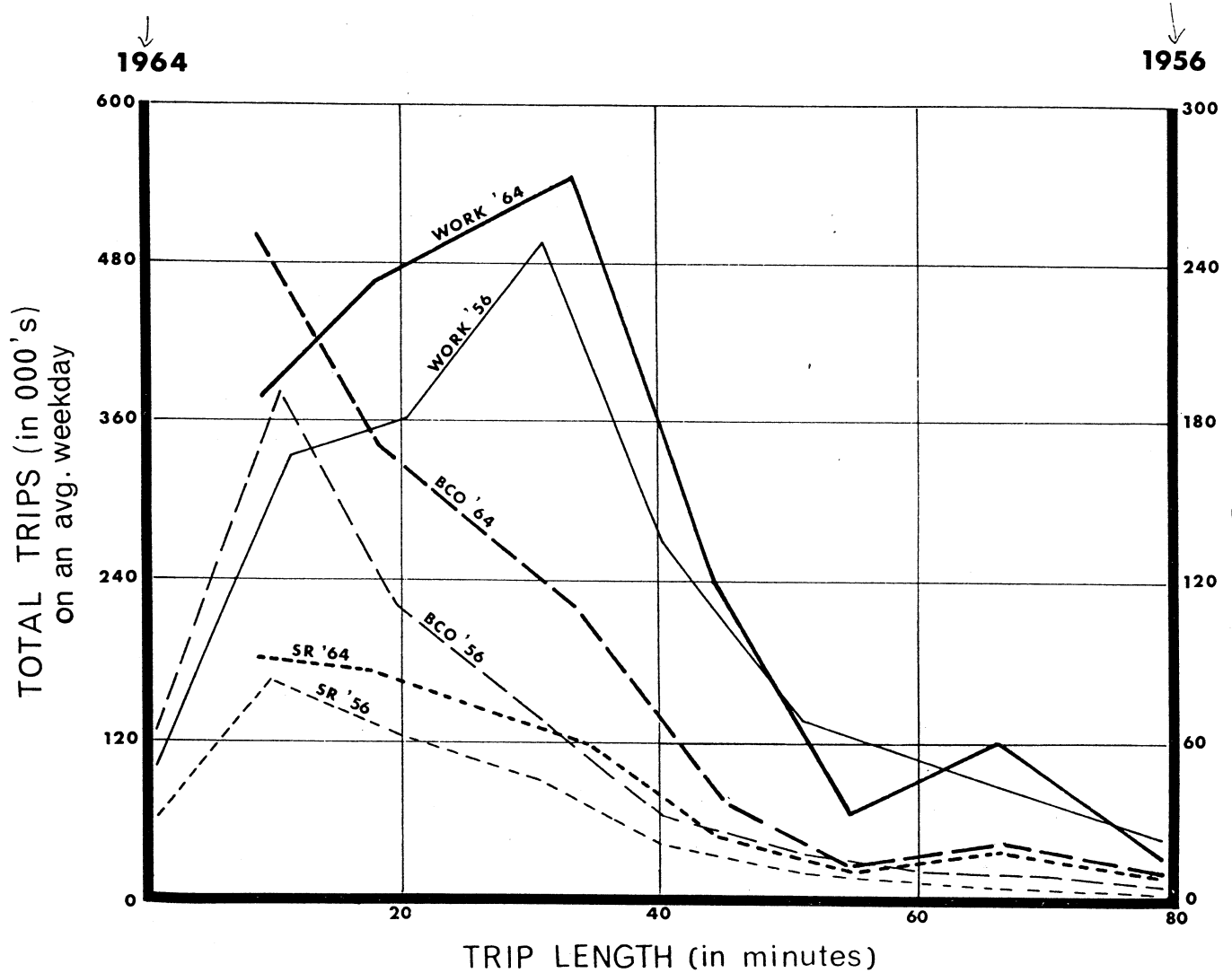
This basic formula was re-established for each of the major trip purposes.²

1. trips between home and work
 2. trips between home and shopping, school or personal business.
 3. trips between home and social recreation.
2. For comparability with the 1956 MTPB Gravity Model relationships, the 1964 relationships were derived for three main purpose groupings.

The principal relationship incorporated in the gravity formula is the relationship between the frequency of travel and the length of travel (in minutes). It is this relationship which describes the influence of travel friction on trip distribution and hence establishes the value of the parameter "B" of the gravity formula. This relationship is shown in Figures 6 and 7 for each major trip purpose, based on the 1964 survey data for MTARTS Region. Also, the relationships based on the 1956 survey data for Metropolitan Toronto Corporation Area are shown in the same figures for comparison. Figure 6 shows the relationship for trips made during an average weekday and Figure 7 shows it for the trips made during an average two hour peak period.

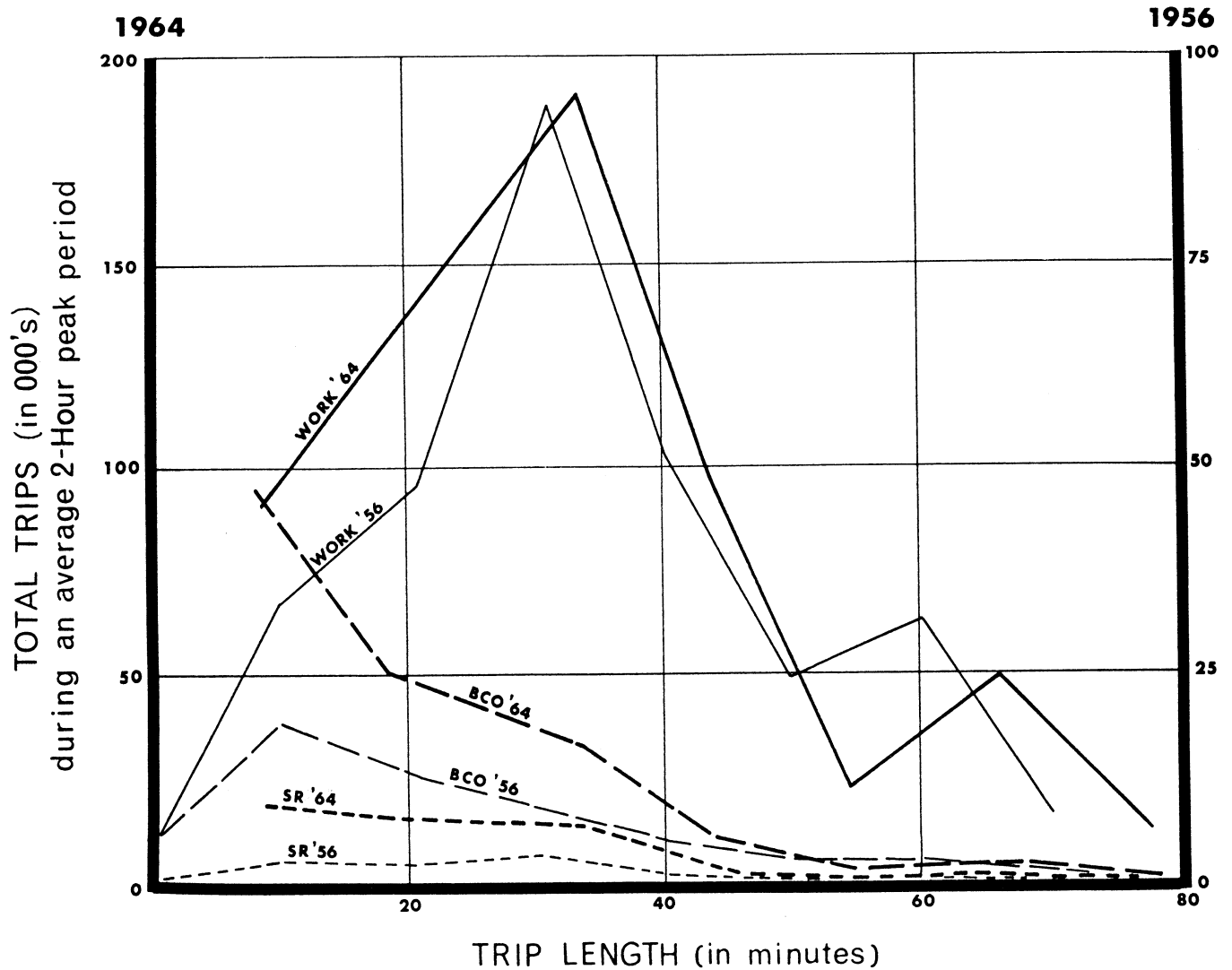
Investigation of the relationships between frequency of travel and the trip length as shown in Figures 6 and 7 discloses general agreement between the findings of the 1964 and ~~1964~~ 1956 surveys. People appear to spend approximately the same time travelling in 1964 as they did in 1956, as evidenced by the similarity in average trip lengths shown in the table below.

COMPARISON OF THE RELATIONSHIP BETWEEN TOTAL TRIPS MADE ON AN AVERAGE WEEKDAY AND TRIP LENGTH IN 1964 AND 1956



1964		1956
—————	WORK	—————
- - - - -	BCO SHOPPING, SCHOOL, PERSONAL BUSINESS	- - - - -
- · - · -	SR SOCIAL, RECREATION	- · - · -

COMPARISON OF THE RELATIONSHIP BETWEEN TOTAL TRIPS MADE DURING AN AVG. 2-HOUR PEAK PERIOD & TRIP LENGTH IN 1964 AND 1956



1964		1956
—————	WORK	—————
- - - - -	BCO SHOPPING, SCHOOL, PERSONAL BUSINESS	- - - - -
- · - · -	SR SOCIAL, RECREATION	- · - · -

Purpose of Travel	Average Trip Length	
	1964 (Minutes)	1956 (Minutes)
Btw. Home and Work	30	30
Btw. Home and Shopping, School or Personal Business	15	15
Btw. Home and Social or Recreation	15	15

On the basis of this evidence, it is concluded that the gravity formula established on the basis of the 1956 data is still applicable in the Planning Process. Consequently, the following recommendations are made:³

1. The time factor associated with travel to work be based on "B" parameter value of 0.04 as established from the 1956 survey.
2. Time factor associated with travel to other purposes be based on "B" parameter value of 0.08.

Minor adjustment to these "B" parameter values, if necessary can be made during the 1964 Calibration of the MTARTS Traffic Prediction Model.

3. Due to the agreement between 1964 and 1956 relationships, it was not necessary to conduct regression analysis for the parameter "B" in the gravity formula. The recommended → "B" parameter values were tested in the 1965 Traffic Model Calibration, July, 1965.

SURVEY PROCEDURE

In summary, the purpose of this survey was to collect information on the travel by people living and working throughout Metropolitan Toronto and Region.⁴ The data collected included information on household facts and travel facts about trip origins and destinations, method of travel used, and time of day during which trips are made.

The questionnaire adopted for the survey was designed to conform with the general questionnaire advocated by the National Committee on Urban Transportation. This was enlarged to permit the recording of additional information on length of residence and of employment, previous place of residence and employment, and public attitudes on method of travel and travel route used. A copy of the questionnaire is attached for perusal. In summary, the questionnaire was comprised of four types of forms:

1. Form 1: for the household report
2. Form 2: for special household facts
3. Form 3: for the travel or trip report
4. Form 4: for the special work trip report.

4. Requirements of Survey were described in Submission No. 1 to MTARTS prepared by Traffic Research Corporation Limited, 1964.

Specifications of MTPB Survey are reported in "Proposal to Conduct Home Interview Survey in the Metropolitan Toronto Planning Area", prepared for the Metropolitan Toronto Planning Board by Traffic Research Corporation Limited, March, 1964.

1
HOUSEHOLD
REPORT

METROPOLITAN TORONTO AND REGION TRANSPORTATION STUDY
TRANSPORTATION SURVEY 1964

Zone No.

Sample No.

MEMBERS OF THE HOUSEHOLD are requested to complete this form.
YOUR ANSWERS WILL BE CONFIDENTIAL AND WILL BE USED FOR STATISTICAL PURPOSES ONLY. No name or signature is needed.

- A. How many persons live at this address? (Do not include visitors.)

- B. How many are children under 5 years of age?

- C. How many are servants living in, or roomers?

- D. How many passenger cars are owned by persons at this address? (Include station wagons, jeeps)

- E. How many company or leased cars are used and garaged here? (Include station wagons, jeeps)

- F. How many trucks or vans are used and garaged here?

- G. List the persons 5 years of age and older who live at this address. Include servants who live in or roomers. List visitors who live outside the survey area but are temporarily staying at this address.

Person Identification Number	Person Identification (For example, father, mother, son-John, daughter-Mary)	Check (✓) if Interviewed	Sex (✓)		Age Group (use code shown below)	Driver's Licence? (✓)		Did You Make Trips? (SEE FORM 3) (✓)			Occupation What do you do? (clerk, machine operator, cook, agent, retired, housewife, student, unemployed, etc.)	Industry In what type of business or industry do you work? (car manufacturing, bakery, hotel, fire dep't, etc.)
			1 M	2 F		1 Yes	2 No	1 Yes	2 No	3 Not known		
1	Head of Household											
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
98	Visitor											
99	Visitor											

Age Groups Code 5-10 **1** 11-15 **2** 16-20 **3** 21-25 **4** 26-35 **5** 36-45 **6** 46-55 **7** 56-65 **8** over 65 **9**

PLEASE SEE OVER

TRIP REPORT

EACH PERSON 5 YEARS OF AGE AND OLDER REPORT ALL TRIPS FOR A 24-HOUR PERIOD BEGINNING 4 A.M. ON

Members of household, servants who live in, roomers and visitors who live outside survey area, each complete a separate form. If more than 6 trips use additional forms. "TRIP" is the one way travel from one point to another for a particular purpose. Stop-overs are regarded as the end of one trip and the beginning of another. Do not include stops made for relatively unimportant purposes, for example, drop a letter in a mailbox, purchase gasoline, parking your automobile, transferring from one public transportation vehicle to another. Do not report walking trips, except walking from Home to Work and from Work to Home.

Person Identification

(Please use same identification as on Household Report 1)

Zone No. _____
 Sample No. _____
 Person No. _____

For AUTO DRIVER ONLY

Trip No.	I STARTED THIS TRIP AT			I ENDED THIS TRIP AT			Minutes walked at start of trip	Minutes walked at end of trip	TYPE OF PROPERTY at TRIP END (store, school, factory, house, roadside, playground, etc.)	PURPOSE of TRIP (Circle one from and to purpose for each trip (see pamphlet))	METHOD of TRAVEL (Circle one code per trip)	For Passenger of Public Transit (Number of Transfers)	For No. Persons in Car (include Driver)	VEHICLE PARKING AT TRIP END					
	Number, Street, or Municipality (if unknown describe location)			Number, Street, or Municipality (if unknown describe location)										Type of Parking (Circle one code per trip)	Duration of Parking (Hrs., Min., Sec.)	Fee	Method of Payment (Circle code)		
	Time (Hrs., Min., P.M.)	Time (Hrs., Min., P.M.)	Time (Hrs., Min., P.M.)	Time (Hrs., Min., P.M.)	Time (Hrs., Min., P.M.)	Time (Hrs., Min., P.M.)													
										1 Work	1 Auto driver	4	1	Street free	1	Monthly			
										2 Personal business	2 Auto/Truck passenger	2	2	Street meter	2	Monthly			
										3 Shopping	3 Taxi passenger	3	3	Lot free	3	Daily			
										4 Social	4 Public Transit (TTC, Gray Coach etc.)	4	4	Lot paid	4	Daily			
										5 Recreation	5 (TTC, Gray Coach etc.)	5	5	Garage free	5	Daily			
										6 School	6 Railway	6	6	Garage paid	6	Duration of parking			
										7 Serve passenger	7 School bus	7	7	Service, Repair	7	Duration of parking			
										8 Change travel method	8 Other	8	8	Residential	8	Duration of parking			
										9 Home	9 Walk between home-work	9	9	Cruised	9	Duration of parking			
										1 Work	1 Auto driver		1	Street free	1	Monthly			
										2 Personal business	2 Auto/Truck passenger		2	Street meter	2	Monthly			
										3 Shopping	3 Taxi passenger		3	Lot free	3	Daily			
										4 Social	4 Public Transit (TTC, Gray Coach etc.)		4	Lot paid	4	Daily			
										5 Recreation	5 (TTC, Gray Coach etc.)		5	Garage free	5	Duration of parking			
										6 School	6 Railway		6	Garage paid	6	Duration of parking			
										7 Serve passenger	7 School bus		7	Service, Repair	7	Duration of parking			
										8 Change travel method	8 Other		8	Residential	8	Duration of parking			
										9 Home	9 Walk between home-work		9	Cruised	9	Duration of parking			
										1 Work	1 Auto driver		1	Street free	1	Monthly			
										2 Personal business	2 Auto/Truck passenger		2	Street meter	2	Monthly			
										3 Shopping	3 Taxi passenger		3	Lot free	3	Daily			
										4 Social	4 Public Transit (TTC, Gray Coach etc.)		4	Lot paid	4	Daily			
										5 Recreation	5 (TTC, Gray Coach etc.)		5	Garage free	5	Duration of parking			
										6 School	6 Railway		6	Garage paid	6	Duration of parking			
										7 Serve passenger	7 School bus		7	Service, Repair	7	Duration of parking			
										8 Change travel method	8 Other		8	Residential	8	Duration of parking			
										9 Home	9 Walk between home-work		9	Cruised	9	Duration of parking			
										1 Work	1 Auto driver		1	Street free	1	Monthly			
										2 Personal business	2 Auto/Truck passenger		2	Street meter	2	Monthly			
										3 Shopping	3 Taxi passenger		3	Lot free	3	Daily			
										4 Social	4 Public Transit (TTC, Gray Coach etc.)		4	Lot paid	4	Daily			
										5 Recreation	5 (TTC, Gray Coach etc.)		5	Garage free	5	Duration of parking			
										6 School	6 Railway		6	Garage paid	6	Duration of parking			
										7 Serve passenger	7 School bus		7	Service, Repair	7	Duration of parking			
										8 Change travel method	8 Other		8	Residential	8	Duration of parking			
										9 Home	9 Walk between home-work		9	Cruised	9	Duration of parking			

IF REPORT INCLUDES AT LEAST ONE WORK TRIP AS CAR DRIVER, BY PUBLIC TRANSIT OR BY RAILWAY SEE REVERSE SIDE

1. Conduct of Survey

Over 24,700 households in the survey area were interviewed for household and travel facts, from which close to 24,000 useable questionnaires were obtained. Those households which completed questionnaires comprised a representative sample of 3.3 percent of all households in the survey area and were distributed geographically throughout the area in the same proportion as the population centres. Additional households located in the Brampton Transportation Study Area were interviewed, to increase the sample size to approximately 10 percent of the total. This intensified sample was to document more accurately the travel habits of residents in this area than it was possible to reveal in the standard sample. However, fewer households were interviewed in the Hamilton Area. (See Appendix A for explanation.) Table 4 shows the approximate number of sample households in each area of the Region with completed questionnaires. The number of samples is presented with recent counts of 1964 households in each municipality. A constant sample rate in areas other than Brampton and Hamilton was difficult to maintain due to the lack of accurate household counts at the time of the survey. Accurate counts were only available by November, 1964.

In particular, close to 90 percent of the traffic zones (more than 800 of the 914 official zones), were covered by the survey. The remaining 10 percent accounted for approximately 1 percent of the

Table 4

Number of Sample Households Surveyed in Comparison
to 1964 Household Counts

AREA (Sections of Counties in MTARTS Region)	Number of Sample Households in Survey	*Count of Households in 1964 (rounded to nearest 1000)	Percent Sample
Metropolitan Toronto	13,390	479,000	2.8%
Fringe Municipalities	1,450	47,000	3.1%
TOTAL PLANNING AREA	14,840	526,000	2.8%
1. Wentworth County	2,490	90,000	2.8%
2. Townships of Oakville and Burlington in Halton County	1,180	25,000	4.7%
3. Remainder of Halton County, Wellington and Peel Counties	2,240	32,000	7.0%
4. York - North, Simcoe and part of Simcoe North Counties	1,430	26,000	5.5%
5. Ontario and Durham Counties	1,570	33,000	4.7%
TOTAL REMAINDER REGION	8,910	206,000	4.3%
TOTAL STUDY AREA	23,750	732,000	3.3%

* 1964 Counts of Households were reported by the Department of Municipal Affairs, Community Planning Branch in the "Report on Population, Households, Employment", Nov. 1964.

Also, Counts for the Planning Area were obtained from Metropolitan Toronto Planning Board, November, 1964.

regional dwelling units. Accordingly, their omission from the Survey did not significantly affect the Survey findings. Regretably, it was not possible to guarantee complete coverage of all traffic zones, as sample households were selected from Hydro records. In cases of rural communities (with less than 100 dwelling units) it was probable that no samples would be chosen.

Number of Zones	Number of Dwellings
12 (Metro Toronto)	Less than 5
38 (Remainder Region)	Less than 10
43	10 - 100
15	100 - 200
5	200 - 600
1	800 - 1500

The number of zones not surveyed are itemized in the above table in accordance with number of recorded dwelling units.

The sample of households selected for the Survey was obtained from special listings of customers of municipal Hydro Commissions and of the Ontario Hydro Commission for rural districts.⁵ Each Hydro

5. The Metropolitan Toronto and Region Transportation Study, Metropolitan Toronto Planning Board and their Consultant, Traffic Research Corporation Limited acknowledge the generous assistance and cooperation given by all Hydro Commissions in the Survey Area in providing sample lists of Hydro customers.

Commission provided a list of 10 (every 10th) or 20 (every 5th) percent of all customers (a few commissions provided a 100 percent list), itemizing the addresses and municipality names of the selected households (surnames of householders were generally omitted, unless required for positive identification, so as to avoid full disclosure of information). A sample of the Hydro listings was chosen for the Survey. This source of sample households gave a representative coverage of all households, since over 99.5 percent of households were serviced by Hydro, and less than 1 percent of these were on bulk meters (several households on one meter). In comparison, the Bell Telephone reported 96 percent coverage of regional households of which 5 to 20 percent, varying by the district, were with unlisted coverage (no listing in telephone book). Other methods of selecting households, by observation and on-the-street counting, were not preferred due to the probability of erroneous counts occasioned by the high percentage of multiple housing developments in some areas.

The method of selecting households through the use of Hydro records was highly successful. It is recommended for all future surveys in the Region.

The selected households were surveyed during the period beginning on April 28, 1964, and ending on June 30, 1964. Approximately equal numbers of households were interviewed on each weekday.

Monday through Friday. This was necessary as the frequency of travel is known to vary throughout the week, i. e. Monday travel is approximately 10 percent below the average and Friday travel is 10 percent above the average. Table 5 shows the number of households surveyed throughout the week as a percentage of total households surveyed.

Table 5

Percentage of Households Surveyed on Each Weekday

Area	Mon. *	Tues.	Wed.	Thurs.	Frid.
Planning Area (Metro)	19	21	19	21	20
1. Wentworth County	20	21	19	17	22
2. Townships of Oakville and Burlington in Halton County	21	20	24	19	16
3. Remainder of Halton County, Wellington and Peel Counties	20	19	20	19	20
4. York - North, Simcoe and part of Simcoe North Counties	19	20	20	17	24
5. Ontario and Durham Counties	15	20	19	21	25
AVERAGE	19	21	19	21	20

* The proportion of interviews conducted on Monday were less than other days due to the May 24th holiday weekend interrupting normal survey procedure. Consequently, more interviews were obtained for the Friday preceding the Monday holiday.

Normal interviewing in the Oshawa and Whitby areas (5) was particularly upset by the holiday weekend.

Initial contact, with the householders selected, was made by mailing post cards which informed them that they had been chosen to participate in the Survey. A few days later, the householders were telephoned and asked for their cooperation in the Survey. On agreeing to participate in the Survey, the householders were interviewed by one of three survey procedures:

1. Mail-Telephone procedure
2. Telephone procedure
3. Face-to-Face procedure

Each technique is briefly described below.⁶

1. Mail-Telephone Procedure

Under this procedure, the initial telephone call was used to obtain preliminary household information in order to determine how many questionnaire forms of each type should be mailed to the households. Following the telephone agreement the questionnaires were mailed with the required travel day clearly specified. A few days later the householder received a second call as a reminder to complete the forms and return them by mail, or as an offer of assistance by one of the other interview procedures, if so desired.

6. Detailed procedure of the Home Interview Origin and Destination Survey is presented in the report "Instruction Manual" prepared for Metropolitan Toronto Planning Board and Metropolitan Toronto and Region Transportation Study by Traffic Research Corporation Limited.

2. Telephone Procedure

Under this procedure some of the initial household information was obtained over the telephone. If it appeared that the interview could be completed by telephone, as the number of occupants in the household was small and the householders were anxious to complete the interview, the questionnaire was completed at the time. Otherwise, a telephone appointment was made for a later call when all members of the household would be present, or a face-to-face interview was arranged.

3. Face-to-Face Procedure

Lastly, under this procedure, interviews were obtained by personal contact with the householders. Face-to-Face home interviews at the householder's residence were of two types: those which were pre-arranged following an initial telephone contact, and those which were carried out as a result of not being able to contact the householder by any other means.

The distribution of interviews in the Metropolitan Toronto Corporation Area between the three interview procedures is shown below:

-	Mail	22%
-	Telephone	36%
-	Face-to-Face	<u>42%</u>
		<u>100%</u>

It was recognized at the half way point of the Survey that the Mail procedure would not produce sufficient numbers of interviews by the deadline date of June 29, 1964. Accordingly, this procedure was abandoned completely in favour of the Telephone and Face-to-Face procedures for interviewing in the remainder of the MTARTS Region. While the Mail procedure appeared to be more economical to execute, it did necessitate a long delay between the mailing of the questionnaires to the householder and the final return of the completed questionnaires. Consequently, this procedure was considered unattainable in relation to the tight scheduling of the Survey. The distribution of interviews for the remainder of the Region between the two interview procedures is shown below:

-	Telephone	45%
-	Face-to-Face	<u>55%</u>
		<u>100%</u>

Minor differences were observed between the survey reports of households interviewed by the Telephone and by Face-to-Face technique. The number of reported trips per person is summarized in Table 6. The average trip rates are calculated for each method of interview. The largest difference occurs for the Hamilton Area (1), but it is still less than fifteen percent of the face-to-face trip rate. Notable differences were observed between the reported results of the Mail interviews and the other two procedures. The householders who cooperated

fully in the Mail procedure by returning their completed questionnaires, belonged to a special class of people. It was observed that these households were comprised of one or two people who also appeared to travel frequently.

Table 6

Average Number of Trips per Person Reported by
Each Interview Technique

Area	Number of Trips per Person		
	Telephone Technique	Face-to-Face Technique	Mail
Planning Area (Metro)	1.3	1.3	1.6
1. Wentworth County	1.3	1.5	Not Conducted
2. Townships of Oakville and Burlington in Halton County	1.7	1.7	
3. Remainder of Halton County, Wellington and Peel Counties	1.7	1.7	
4. York - North, Simcoe and part of Simcoe North Counties	1.6	1.5	
5. Ontario and Durham Counties	1.5	1.5	
Average Remainder Region	1.5	1.5	
Average Study Area	1.4	1.4	

2. Editing, Coding and Checking of Survey

The coding, manual editing and checking of the survey data were completed by August, 1964. Several check and control procedures were followed in the conduct of this work, such as:

- (a) Crosschecks of interviewer's work
- (b) Complete editing of questionnaires
- (c) Complete coding of questionnaires
- (d) Key punching of questionnaires and punch card verification
- (e) Sorting and tabulation of card file
- (f) Visual checks of tabular listings

Details of these operations are reported in Appendix C.

During September and October 1964, all survey data were transferred to Univac 1107 magnetic tapes. Once the data were transferred to magnetic tapes, the tapes were integrated into the MTARTS Data Bank.⁷ The tapes are available for inspection. All survey data have been copied onto a single Univac 1107 magnetic tape in an integrated household trips format. Details of this operation are described in special memoranda of TRC files.⁸

- 7. The MTARTS Data Bank is described in Appendix B.
- 8. Special memoranda on Data and Program Format are presented in a separate report, "Program and Data Format File" prepared for Metropolitan Toronto and Region Transportation Study, by Traffic Research Corporation Limited, March, 1965.

Computer Programs were written and applied during October, November and December, 1964 to complete the following operations:

1. Final computer screening of the data to provide a 99% clean file for derivation of travel relationships.
2. Trip linking whereby individual trips for serve passenger change of mode purposes are linked to represent a combined trip for the primary trip purpose.
3. Assignment of detailed address codes where addresses are approximately specified or not specified at all.
4. Sorting of Master Trip File
5. Summary of survey data

Details of this work are presented in Appendix C.

3. Expansion of Survey

It has been mentioned previously that the sample households were selected to be representative of all households in the Region. To do so, it was necessary to expand the survey report of these representative households. For each data zone the number of survey households was compared with total household counts received for the Region, and the basic expansion factor was based on the ratio of actual households to the number of sample households. Further, special adjustments were made to account first for people who made trips but were not recorded in the survey (i. e. Not Known), and second for the expected under-reporting of trips. Mathematically,

the procedure for expanding the trip file was as follows:

- Household expansion factor = $\frac{\text{household counts by data zone}}{\text{sample households}}$
- Trip expansion factor = household factor x $\frac{(100 + UT)}{100} \times \frac{(100 + UR)}{100}$

where: UT means that for each 100 persons who report trips, a small number UT make trips for which details are not known.

UR means that for each 100 persons who report trips a small number UR made trips but did not report them (see next section on Accuracy Checks).

An average zonal expansion factor of approximately 30 was applied to factor travel reported in the survey to total travel throughout the Planning Area. The zonal factors varied between 10 and 50 with an average of 30.

VALIDITY CHECKS

In order to check the accuracy of the Home Interview Origin and Destination Survey, special investigations were conducted. It was the objective of these investigations to establish the reliability of the Survey to document person travel and householder characteristics in the Survey Area. Special screenline checks of observed travel and reported travel in the Survey at the intermediate cordons (see Figure 8) present findings on the symmetry of travel. Comparisons between reported travel of the 1964 Survey and that of previous surveys conducted by several Traffic Consultants on behalf of the Department of Highways of Ontario, further demonstrated the accuracy of survey results. Other comparisons between reported work trip destinations and centres of employment activity were evidence of the accuracy of the Survey to disclose people's places of work. Lastly, the accuracy of the Survey to report householder characteristics was shown by comparisons with documented findings of the Metropolitan Toronto Planning Board and the Department of Municipal Affairs.⁹ Each of the accuracy checks and the findings are described below:

1. Summary of Re-Interviews of Householders in Depth

It was normal practice during the conduct of the Survey to

9. Separate reports on Population; Household; Employment. November, 1964, for Planning Area and Remainder of Region.

check interviewers on the quality and accuracy of their work. Such checks were to ensure the completeness of the Survey interviews with regard to accuracy of the household and travel reports. Such checks ensured the highest possible accuracy in the reporting of people's travel. In spite of such careful checks, a consistent under-reporting of person travel is expected in origin-destination surveys in large metropolitan areas. ¹⁰ In anticipation of the possible under-reporting of travel, special depth interviews were conducted with approximately 850 of the survey householders, (550 in Planning Area and 300 in remainder of Region). These householders were questioned again about their regular and irregular travel, (i. e. work and non-work respectively). During this depth interview the householder described again his travel for a typical or average weekday, but without reference to any specified date or day. Accordingly, each household was assessed for the under-reporting of trips, by comparison with the original trip reports.

The findings of the depth interviews confirmed the published results from other transportation studies. Travel on the average was 10 percent under-reported by the Survey. Work travel was most accurately reported with approximately 94 percent coverage by the

10. The official report of the Chicago Area Transportation Study reports that expanded survey trips accounted for 87.6 percent of automobile driver trips intercepted at the cordon. These were reported as "better than average results for an origin-destination survey in a large city" Volume 1, Page 31.

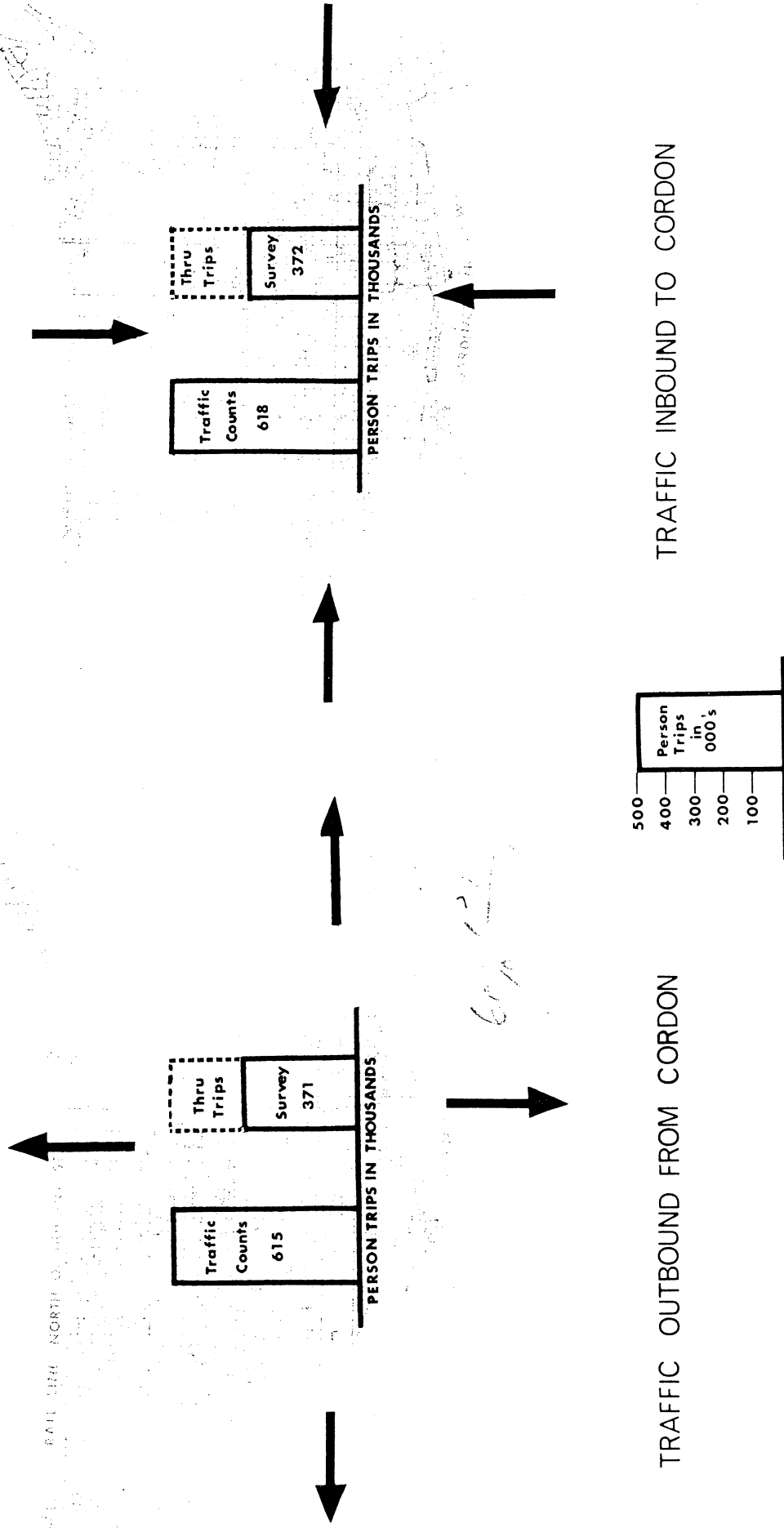
Survey. However, travel for the other purposes was less accurately reported with an approximate 88 percent coverage. The findings shown in Table 7 by Area were incorporated in the expansion of survey results to provide a complete report of people's travel in the Region, as mentioned in the previous chapter.

2. Screenline Check

A comparison between summaries of expanded survey trips and traffic counts at the major Intermediate Cordon in Metropolitan Toronto was conducted. This Intermediate Cordon is bounded on the North by the CPR tracks which are just north of Dupont Street (North Toronto Line), on the East by the Don Valley, on the South by Lake Ontario and on the West by the CNR railway right-of-way to Malton (Allendale Line). All trips reported in the Survey with trip origins outside the cordon and with trip destinations within the cordon and vice versa were summarized.¹¹ These trip summaries for all day travel were compared with 1964 counts of traffic inbound and outbound across the cordon. The findings of these comparisons are shown in Figure 8. As expected,

11. These findings of the Cordon Check are copied from the Report on MTPB 1964 Home Interview Survey. The 1964 Home Interview Survey of MTPB and MTARTS plus Roadside Surveys of the Department of Highways of Ontario (at the MTARTS External Cordon) provided summaries of person trip origins and destinations.

COMPARISON BETWEEN SURVEY TRAVEL ORIGINATING AND DESTINED WITHIN THE INTERMEDIATE CORDON AND ACTUAL TRAFFIC COUNTS AT CORDON



TRAFFIC COUNTS BASED ON 17 HOUR COUNT IN 1963

the survey counts are considerably less than the 1964 traffic counts. The difference is probably attributable to the extra traffic which passes through the cordons to destinations outside. Due to the influence of this through traffic, 1964 traffic counts are inflated for this comparison.

Summaries of through traffic should be prepared from the Survey, and combined with the trip end summaries outlined above. Accordingly, this combined summary of survey trips can be made comparable with the actual cordon traffic counts. This check is more easily conducted in connection with future tests associated with the Calibration of the Traffic Prediction Model to be carried out during 1965. Hence the complete cordon check is deferred until a more suitable opportunity for its conduct.

It is important to note that the Survey results reflect the apparent symmetry of directional traffic. The total inbound traffic and outbound traffic is approximately equal, as previously mentioned in the opening chapter of the report.

3. Checks on Present and Previous Travel

Several surveys were conducted in the Region and were used as a check against the reported travel rate per capita from the 1964 Survey. A Home Interview Survey was conducted throughout the Metropolitan Toronto Corporation Area in 1956. Several surveys were conducted on behalf of the Department of Highways of Ontario

for specific areas in the MTARTS Region (Hamilton Study Area, Oakville and Burlington Area and the Area North and East of Toronto). These surveys were valuable in that they provided a cross check on the total travel in different sections of the Region. The travel rates per capita during the average weekday were established from the 1964 and previous surveys. A comparison of these trip rates is shown in Table 8. The total travel rate reported from the 1964 Survey agrees reasonably well with those rates obtained from previous surveys.

4. Comparison Between Survey Work Trip Destinations and Employment Counts

Since the Home Interview Survey is conducted at the household's residence, one naturally expects that home-based travel, and population and socio-economic facts are accurately described. Sections 1, 3, and the final section 5 to follow, are devoted to accuracy checks of this nature. This section describes the accuracy of the Survey to reveal non-residential travel information. Total work trips were summarized from the survey by area of work place. These summaries of work trip destinations were compared with total employment counts¹² for 1964. Considering that the Survey was based on home interviews and not on interviews at

12. Employment counts were obtained from Metropolitan Toronto Planning Board and Department of Municipal Affairs, Nov. 1964.

Table 8

Comparison Between 1964 Trip Rate and Rate
Reported from Previous Surveys

AREA	MTARTS 1964 SURVEY (Trips per Person)	PREVIOUS SURVEYS
MTARTS Region (including MTPB Planning Area)	1.4	
MTPB Corporation Area	1.4*	1.3 (1956 MTPB Survey)*
1. Wentworth County	1.4	1.8 (1961 HATS Survey)**
2. Townships of Oakville and Burlington in Halton County	1.7	1.8 (1963 Oak/Burl. Survey) ***
3. Remainder of Halton County, Wellington and Peel Counties	1.7	No Record
4. York - North, Simcoe and part of Simcoe North Counties	1.6 (2.0 for City of Barrie)	2.0**** (1961 City of Barrie Survey)
5. Ontario and Durham Counties	1.5	1.4***** (1963 North and East Fan Area Survey)

* Figures published in Report on MTPB 1964 Home Interview Survey.

** Figure published in official report of the Hamilton Area Transportation Study for internal traffic, 1961. This figure is based on a small and very selective sample of Urban Households. Therefore, it may not necessarily be representative of Urban and Rural Households in Area 1.

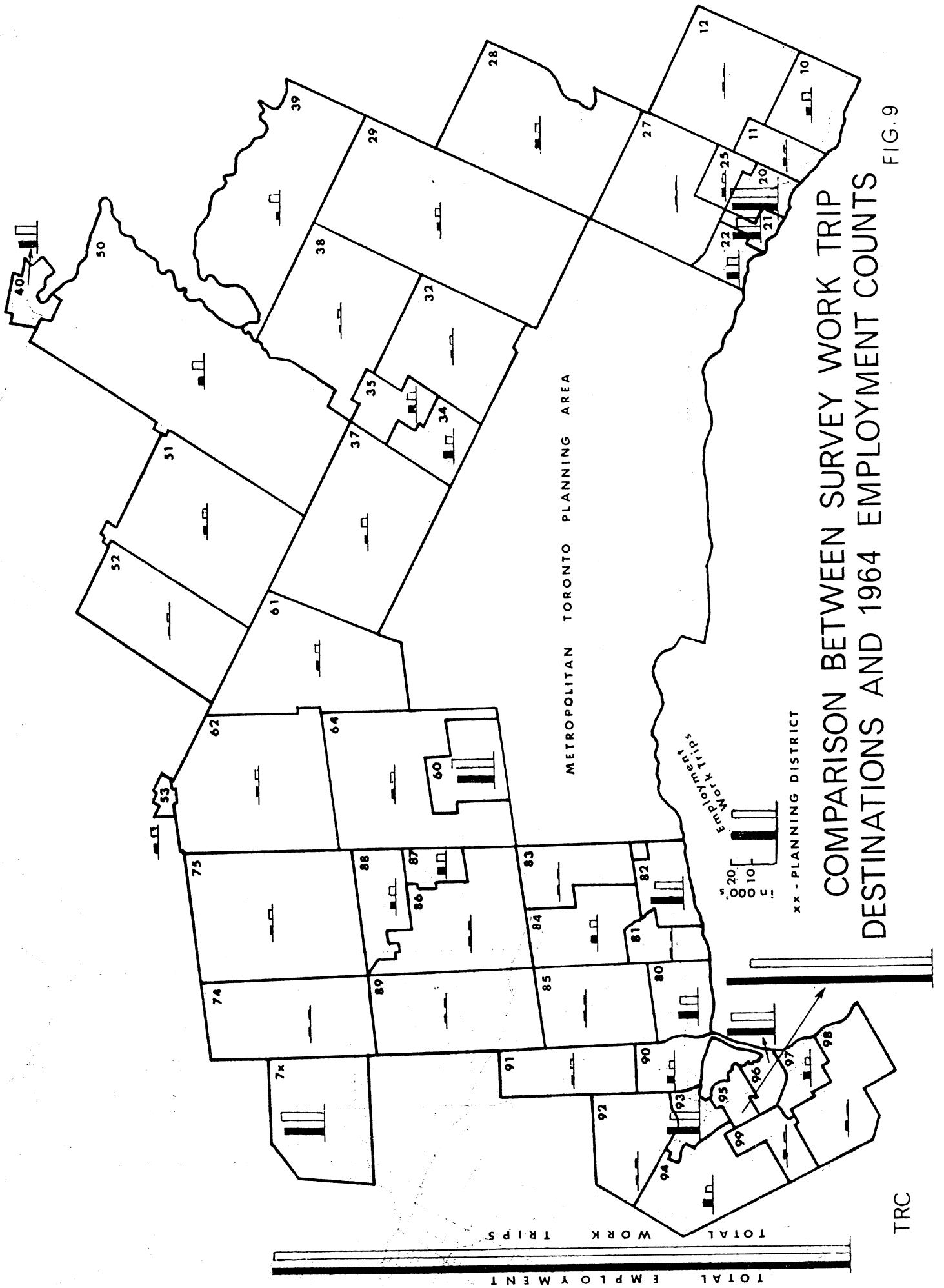
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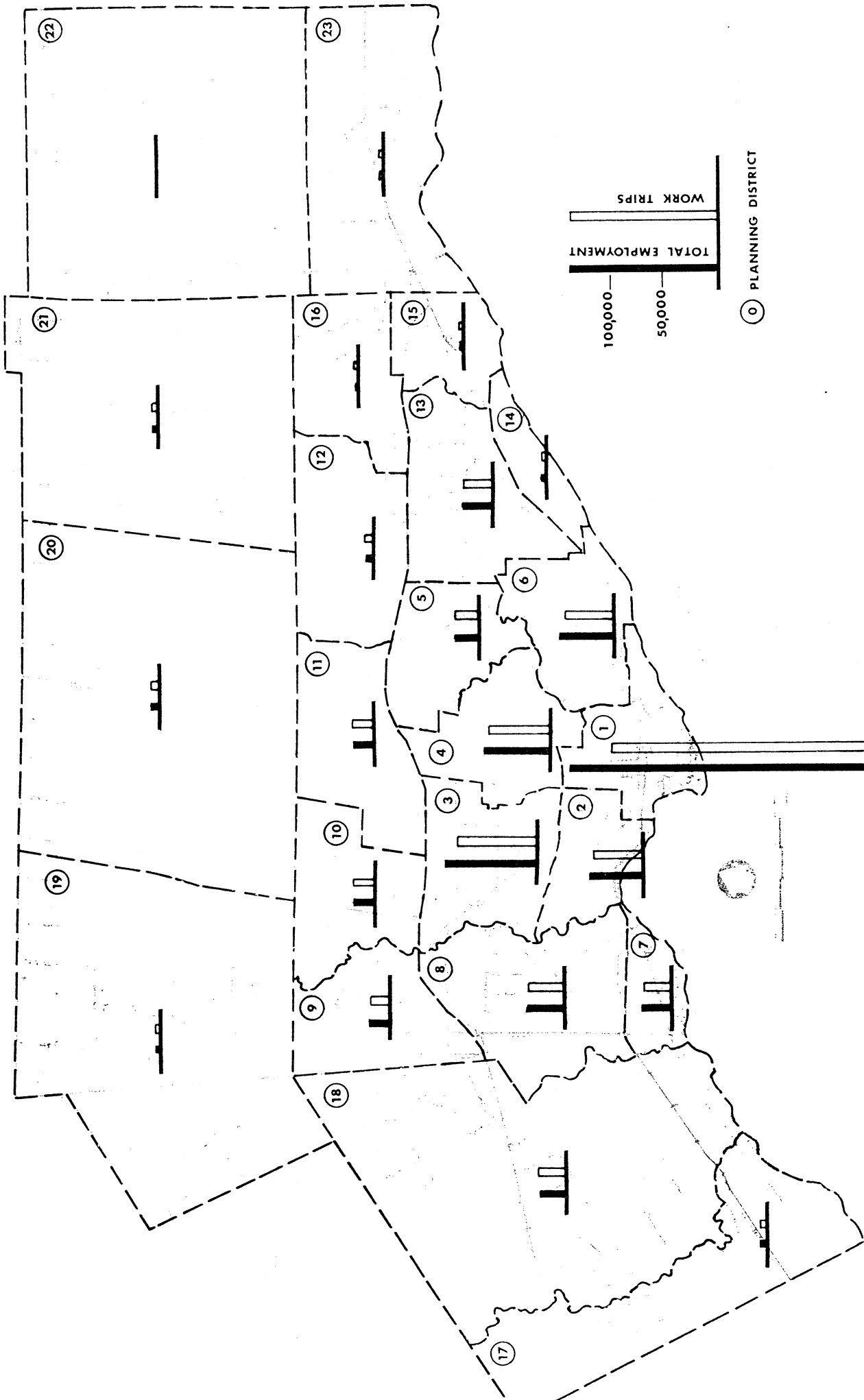
- *** Figure based on unpublished records in the files of the Joint Consulting Firm, Damas-Smith and Traffic Research Corporation Limited.
- **** Trip rate per capita of City of Barrie in 1961, is derived from data of the City of Barrie Traffic and Transportation Survey (see report by Laughlin, Wylie and Ufnal).
- ***** Trip rate per capita for Oshawa and Whitby in 1963, is reported by Traffic and Planning Studies Section of DHO, January 1965. This figure is tentative and may be subject to change by DHO.

place of employment, there was remarkable agreement between survey work trip destinations and the employment counts by area. Figures 9 and 9A demonstrate the close agreement between work trips and employment for survey districts in the Survey Area. Close agreement was also obtained for the fine areal units (traffic zones).

In the MTPB Planning Area, work trip arrivals were generally 10 to 15 percent less than the stated employment count. This disagreement was expected. At least 10 to 15 percent of the employment labour force are usually absent from work, due to illness, holidays, or for other reasons. The largest difference occurred in District 1, the downtown area, where no doubt seasonal and part time employment is more prevalent for retail and office firms, and where staffs, although registered as employed by downtown companies, are actually engaged in other areas.

In the remainder of the Region, work trip arrivals were equal to or greater than the stated employment count, except for cities and towns on the boundary of the M. T. A. R. T. S. Region. This over-estimate, at first glance, was surprising. It was expected that 10 to 15 percent of the employed labour force would be absent from work, due to illness, holidays, or other reasons, and hence the survey work trips should be less than the employment counts. On consideration, however, it was noted that disagreements between work trip destinations and employment counts occurred in





○ PLANNING DISTRICT

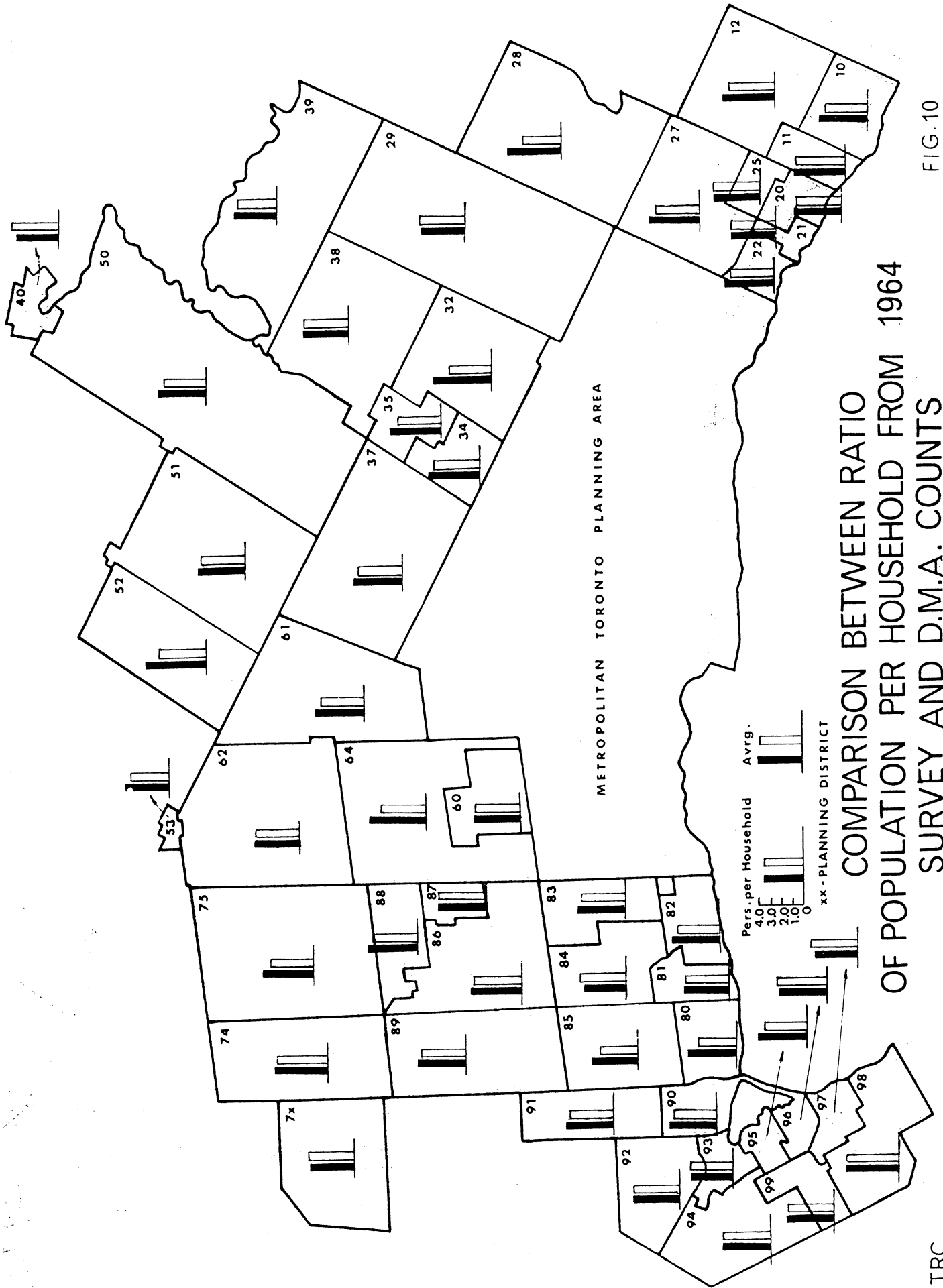
COMPARISON BETWEEN SURVEY WORK
TRIP DESTINATIONS & 1964 EMPLOYMENT
COUNTS

the new and rapidly developing districts. In such cases the Home Interview Survey probably reported more accurately the locations of work for construction and agriculture employment. It was recognized that construction employment was recorded at the location of construction office which was often at a different location from the actual construction site(s). Agriculture employment would not be recorded. Hence reported work trip arrivals should equal or exceed employment counts for construction and agriculture areas.

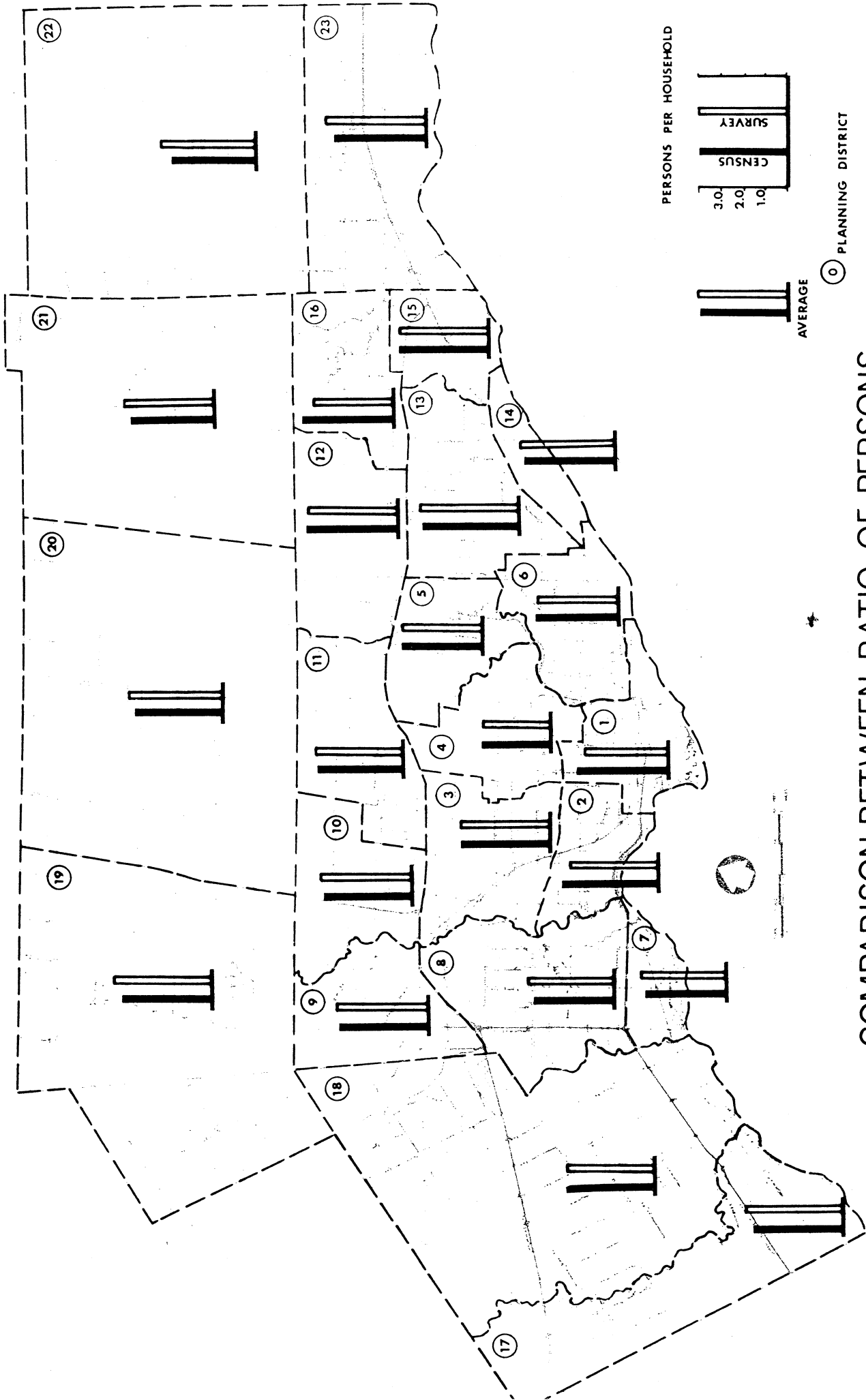
5. Comparison Between Household Characteristics from Survey and from the 1961 Decennial Census

The 1961 Government Census is the base inventory of household characteristics for the Region. Recent household and population counts are generally based on the updating of Census information (see footnote, bottom of Table 4). The 1964 Survey provides now a new inventory of household facts. Accordingly, it is important that one establishes its reliability for application in the planning process. It must be recognized that the Census is based on a 100 percent interview of households for basic facts and a 20 percent interview for special socio-economic facts as opposed to an average Home Interview Survey rate of 3.3 percent. Comparisons between the survey summaries of household facts and updated Census information reveal considerable agreements. Noteworthy disagreements occur for newly developed

areas for which the updated 1961 Census may no longer accurately reflect characteristics. Figures 10 and 10A show the comparison between population per household for each survey district obtained from the 1964 Survey, and the ratios from the data of the Department of Municipal Affairs and Metropolitan Toronto Planning Board.



COMPARISON BETWEEN RATIO
OF POPULATION PER HOUSEHOLD FROM 1964
SURVEY AND D.M.A. COUNTS



COMPARISON BETWEEN RATIO OF PERSONS PER HOUSEHOLD FROM 1964 SURVEY AND 1961 CENSUS

APPENDICES

APPENDIX A

SAMPLING RATES FOR HOME INTERVIEW SURVEY

1. Sampling Rates for Home Interview Survey

The sample sizes listed below were recommended for the Home Interview Survey throughout the M. T. A. R. T. S. Region.

	Area	No. of Interviews	Sampling Rate
1.	Metro Toronto Planning Area	15, 000	3%
2.	City of Hamilton and Area Surrounding Hamilton	3, 000	2%
3.	Brampton and Vicinity	1, 000	10%
4.	Remainder of the Region	5, 000	5%

The sample size for the Metropolitan Toronto Planning Area is in accordance with the recommendations of the U. S. Bureau of Public Roads (BPR). This is also true of the City of Brampton. Urban transportation studies are underway for both areas in 1964 and the sampling rates are designated accordingly.

The sampling rates for Hamilton and the remainder of the Region are approximately one third those recommended by BPR for urban studies of areas the size of Hamilton and other urban parts of the Region. This lower rate is possible for the following reason:

The areal units which would form the basic zones (section 2 describes zoning) of the regional study would be generally three times as large as the "Traffic Zones" which would form the basis of individual urban studies. For small percentage samples, the sampling rate required to maintain the sampling error below a given level is approximately inversely proportional to zone size (i. e. zonal population size). Thus, the BPR recommendations apply to the detail required for urban studies and not for a regional study such as M. T. A. R. T. S.

The sampling rate for Hamilton is particularly low (2%) because of the dense population in Hamilton zones. The sampling rate in the remainder of the Region (5%) is higher than for the Metropolitan Toronto Planning Area (3%) because of the low population in these zones; i. e. there is a certain maximum geographical size for zones which only permits a small population to be included in many cases and thus requires a higher rate to keep the percentage sampling error within bounds.

2. M. T. A. R. T. S. Zoning.

The regional travel pattern consists of many trips between a theoretically infinite set of origins and destinations. The purpose of zoning is to reduce the number of origins and destinations to a manageable figure for analysis. Since a set of trips to or from each zone is treated as a homogeneous group it is important that

the community characteristics of the zone be reasonably homogeneous so that they may be related to the characteristics of these trips in a meaningful way. Another criterion for zoning is that each zone be composed of integral number of areas which are used as units for the collection of community characteristics by government agencies. The zone size must be consistent with the degree of detail required for study purposes; in general it is best to collect data and code it for small subdivisions since these are easily aggregated if small zones are not required. The shape of the zone is also important; for a given zone size, the more elongated a zone, the more misleading is the (necessary) assumption of a point as traffic origin or destination. It is also important that traffic barriers, such as rivers, ravines, railroad tracks, not traverse a zone but that they serve rather as zonal boundaries.

In summary, the following criteria should be considered in zoning:

1. Homogeneity of community characteristics
2. Composed of integral statistical areas
3. Small basic size with provisions for aggregation
4. Shape not long or irregular
5. Not traversed by traffic barriers

All of the above requirements cannot of course always be met, so a certain amount of judgment was exercised in arriving at appropriate compromises in the following zoning system for

the M. T. A. R. T. S. Area.

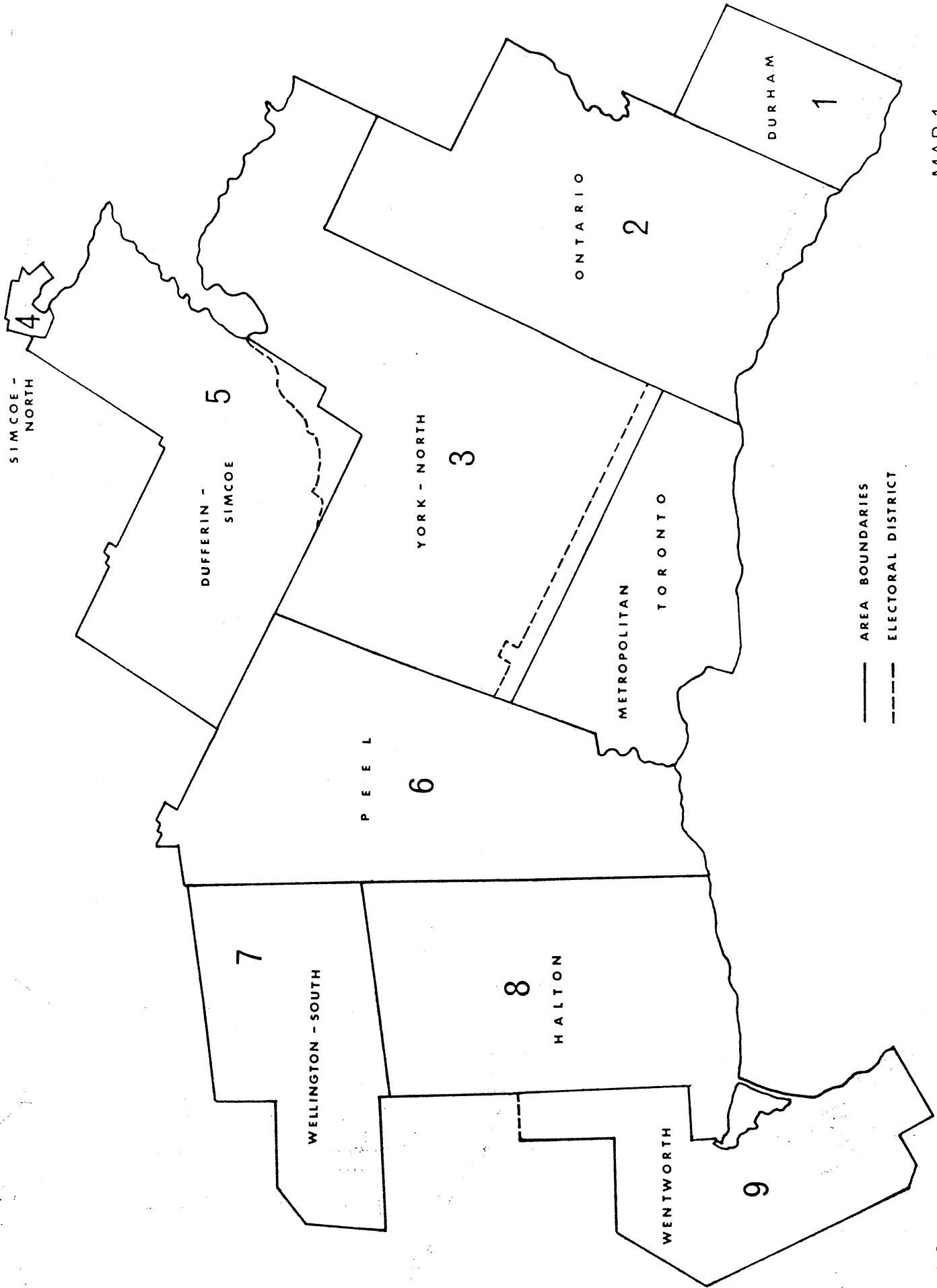
The system is composed of the following four types of zones in decreasing order of size so that each zone is entirely within the immediately larger type:

- AREAS
- DISTRICTS
- SUBDISTRICTS
- TRAFFIC ZONES

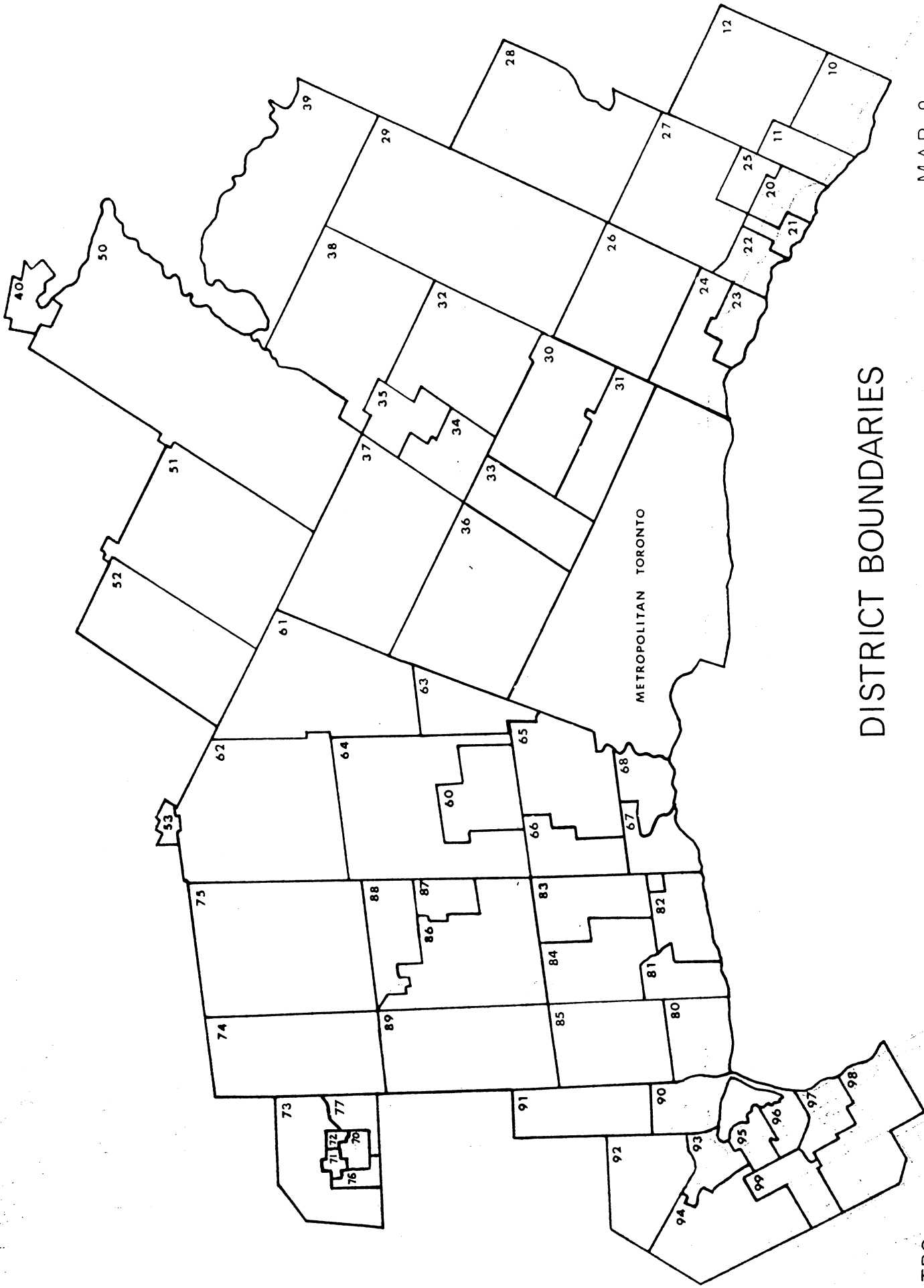
The ten "Areas" shown in Map 1 correspond generally to the electoral districts with several exceptions. The Areas are as follows:

Area	0	Metropolitan Toronto
	1	Electoral Districts of Durham
	2	Electoral Districts of Ontario
	3	Electoral Districts of York
		North and northern strip of Electoral District of Metropolitan Toronto and a corner of Electoral District of Simcoe.
	4	City of Barrie, which is located in Electoral District of Simcoe North.
	5	Eastern portion of Electoral District of Dufferin-Simcoe
	6	Electoral District of Peel
	7	Majority of Electoral District of Wellington South
	8	Electoral District of Halton
	9	Eastern portion of Electoral District of Wentworth.

Each Area is divided into at most ten Districts, as shown in Map 2. Metropolitan Toronto has not yet been divided into Districts, but has been divided into Traffic Zones. District boundaries will be delineated later in collaboration with



— AREA BOUNDARIES
 - - - ELECTORAL DISTRICT



DISTRICT BOUNDARIES

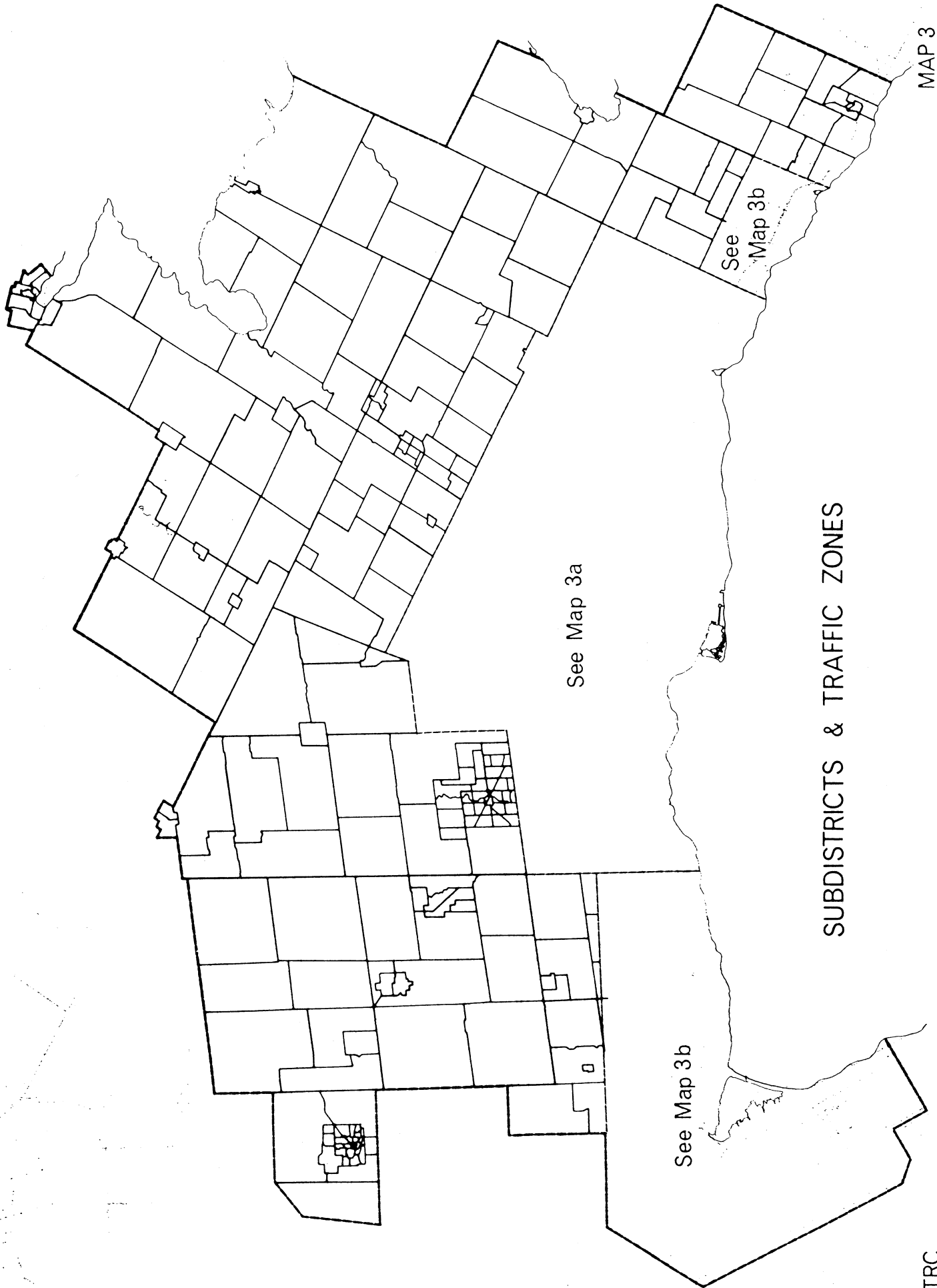
Metropolitan Toronto Planning Board. The present subdivision of Metropolitan Toronto into Traffic Zones and of the rest of the Region into Districts may be useful in "corridor analyses", i. e. relatively coarse analysis of major travel movements to and from Metropolitan Toronto.

The Subdistrict is a finer subdivision designed for more detailed analysis. Large communities comprise more than one Subdistrict, while smaller communities consist of a single Subdistrict.

Traffic Zones are divisions of Subdistricts. In urban areas a typical traffic zone covers approximately 25 city blocks. Boundaries are generally along the centres of streets and are designated according to the five criteria listed above. The Traffic Zone subdivision is generally too fine for regional transportation analysis except in Metropolitan Toronto. Subdistrict and traffic zone boundaries are shown in Map 3, 3A and 3B.

The Traffic Zones used in the following D. H. O. past studies have been adopted without change:

1. 1963 D. H. O. North and East Toronto Fan (excluding Metropolitan Toronto).
2. 1963 Oakville Burlington Study (excluding Metropolitan Toronto and areas to the east)
3. 1961 Hamilton Area Transportation Study.

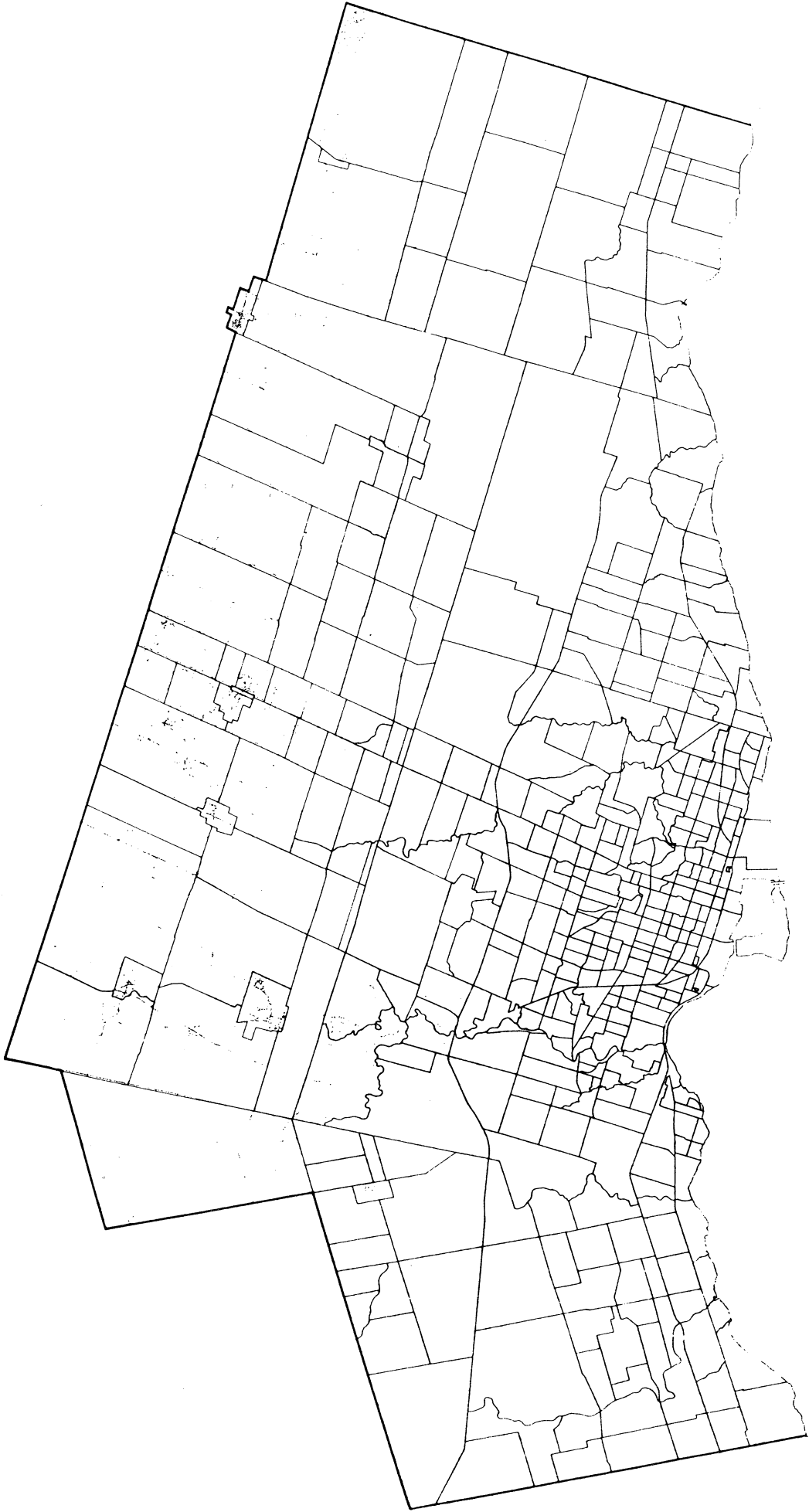


See Map 3a

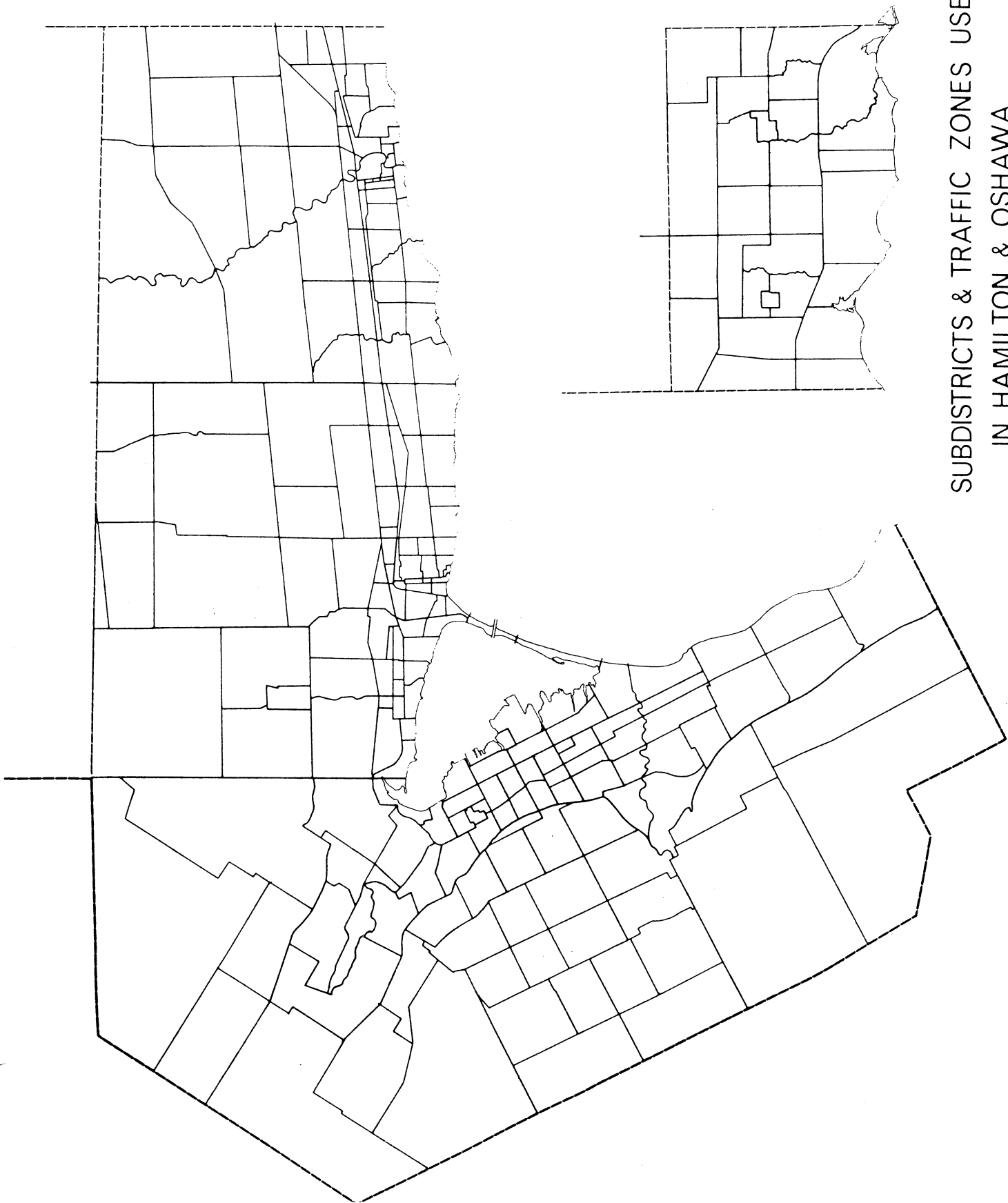
See
Map 3b

See Map 3b

SUBDISTRICTS & TRAFFIC ZONES



SUBDISTRICTS & TRAFFIC ZONES USED IN METRO TORONTO



SUBDISTRICTS & TRAFFIC ZONES USED
IN HAMILTON & OSHAWA

4. 1964 Brampton Transportation Study.

The zones in the above areas have been renumbered.

The Traffic Zones for Metropolitan Toronto are coincident with census tracts and are assigned census tract numbers. The remaining portions of the Region are subdivided into Traffic Zones according to 1961 DBS Enumeration Areas and, where available, Census Tract boundaries. In some instances Traffic Zones violate these boundaries in order to eliminate elongated zones. Traffic Zones often comprise more than one enumeration area. The zones of the Barrie Transportation Study of 1961 were not adopted since they do not follow city streets. Also the zones of the Guelph Study of 1959 were abandoned in favour of the more permanent census tract system.



APPENDIX B



APPENDIX B

METROPOLITAN TORONTO AND REGION TRANSPORTATION DATA BANK

1. Introduction

It is the purpose of this memorandum to describe the establishment of the MTARTS Data Bank. This Data Bank comprises a "computer" oriented reference library of land use and transportation statistics which are considered useful in transportation studies. The Bank is designed to permit the rapid filing of data, convenient updating of data already "banked", the combination of data by different geographical units or zones and the retrieval and tabulation of stored information.

The design of the Data Bank permits the storage of many categories of data considered essential in transportation studies. The Bank is expandable and contractable in the types of data which can be stored.

2. Data Categories

Several classes of data should be considered for incorporation into the Data Bank. In summary, these classes are the following:

(a) Community Characteristics

1. Dwelling Units
2. Population

3. Employment
4. Number of Cars
5. Household Income, Wages and Salaries

(b) Travel Demand

1. Person trip summaries by data zone
2. Origin-Destination trip summaries
3. Traffic volumes on roads, transit and commuter railroad

(c) Transportation Facilities

1. Road capacity and physical description
2. Road speeds and travel times
3. Characteristics of urban transit service
4. Characteristics of intercity bus service
5. Characteristics of rail service
6. Parking inventory

In order to "Bank" these data it is necessary to assign geographical identification.

3. Geographic Identification

Nearly all of the statistics mentioned have some geographic association whether it is pertinent to a certain point (e. g. intersection), a line (e. g. highway) or area (e. g. zone). Thus it is convenient to have some sort of reference coordinate system to identify points, or delineate lines and perimeters of areas.

This would make it possible to find rapidly the location to which any statistic pertains. Since each group of municipalities has a particular orientation of its road grid it may be more convenient to use several coordinate systems tied together by reference points. Consideration must be given to the most convenient form for storage, data processing and presentation.

If the Planning Region is subdivided into a fine set of geographic zones and detailed pattern of links in its transportation grid, then the problem of incompatibility in future zoning systems for transportation studies would be minimized. Any future study could select its zones in some area as simple units of the Planning Region subdivision and could aggregate their subdivisions into larger zones where detail is not necessary. Data Bank statistics, where possible, should pertain to the smallest possible link or zone unless it becomes impractical or inaccurate to collect statistics in such detail.

4. General Purpose Computer Program System

A system of computer programs was written which permits the following operations in connection with the Data Bank.*

* The program system was written under contract with the Metropolitan Toronto and Region Transportation Study by Traffic Research Corporation Limited, 1964. This work was in accordance with Contract No. 1 between M. T. A. R. T. S. and TRC, March, 1964.

corresponding data to an existing Data Bank file.

(4) Town Aggregation Block-AGTWN

In some cases data are available only on the basis of data zones. Alternatively, we may wish to test the performance of the Traffic Model if the 914 data collection zones in the MTAR TS Region are aggregated into a smaller number of zones. AGTWN aggregates the data on a geographical basis.

(5) Data Combination Block (Combined Variable Block)-
COMVAR

COMVAR is the nerve centre of the Data Bank. It uses any combination of the arithmetic processes to aggregate or generate variable categories from the raw data. Each process specified is repeated identically for everyone of the data zones. Initially, COMVAR is used to alter incompatible categories or generate missing ones. Later, the analyst specifies which variables are to be combined, and COMVAR is now used to generate the significant "super"-variables which form the structure of the planning work, i. e. density, ratios, etc.

(6) Data Difference Block-DIFF

To obtain trends of variable categories, the values of corresponding categories of the historical year must be subtracted from those of the current year. DIFF subtracts data on two tapes (one for each year) and writes a third difference tape.

As an extra merge feature, it can also add two tapes and create a third sum tape.

5. Data Categories in Bank

The following data items have been summarized by data zones (census tracts in the Metropolitan Toronto Corporation Area and traffic zones in the remainder of the M. T. A. R. T. S. Region) and are stored in the M. T. A. R. T. S. Region Data Bank.

(a) Community Characteristics

1. Dwelling Units
2. Population and population 5 years of age and older
3. Number of cars owned and garaged at home
4. Average worker income (household income divided by number of workers)
5. Employment by nine categories in the Metropolitan Toronto Planning Area:
 - primary
 - manufacturing
 - construction
 - transportation, storage and communication
 - wholesale trade
 - retail trade
 - finance, insurance, real estate
 - recreation and personal service
 - other services

Employment by eight categories in Hamilton:

- manufacturing
- industrial and wholesale
- wholesale trade and contracting
- retail
- service
- public building
- transportation and public utilities
- agriculture and open space

Employment by five categories in the remainder of the Region:

- manufacturing
- wholesale
- retail
- service
- other

(b) Travel Demand

1. Person trip summaries by data zone for the AM peak (7-9 AM), PM Peak (4-6 PM) and Off-Peak (remaining 20 hours) periods for each of the following trip purposes:

- 1.1 Trip Departures (trip starts)

- from home to all purposes and vice versa
- from home to work and vice versa
- from home to personal business and others and vice versa
- from home to shopping and vice versa
- from home to school and vice versa
- from home to social and recreation and vice versa
- from all purposes except home to all purposes except home

- 1.2 Trip Arrivals (trip ends)

- at all purposes from home and vice versa
- at work from home and vice versa

- at personal business and others from home and vice versa
- at shopping from home and vice versa
- at school from home and vice versa
- at social and recreation from home and vice versa
- at all purposes except home from all purposes except home

2. Origin-Destination summaries of person trips by mode.

6. Data Categories Recommended for Banking

The following data categories are available or could be assimilated and are deemed suitable for incorporation in the Data Bank.

(a) Community Characteristics

1. Miscellaneous household and population characteristics.
2. Land Use Statistics, i. e. acreage by each classification of land use.
3. Data Summaries of the Metropolitan Toronto Assessment Department.

(b) Travel Demand

1. Miscellaneous zonal summaries of person traffic and origin-destination summaries.

(c) Transportation Facilities

1. MTARTS Road and Transit Inventories
2. MTARTS Parking Inventory

Note: Special purpose Summary Programs such as those described in Appendix C. 5 must be prepared. These programs will be necessary to summarize detailed data for (a) and (b) above by suitable geographical units or data zones. Once the data is summarized by data zones it can be easily banked.

APPENDIX C

APPENDIX C

CHECKS, SUMMARY AND PRELIMINARY ANALYSIS OF SURVEY DATA

1. Checks of Survey Data

Details of the check and control procedures are as

follows:

- (a) Interviewers were instructed to review all completed questionnaires prior to submitting them for editing.
- (b) All questionnaires were completely edited. Editing was necessary to ensure maximum quality of report. Errors and omissions discovered were corrected either by telephone or by personal visit with the household. Further, the questionnaires were organized into batches of 100 forms. At least 50 forms in each batch were re-edited. If the error rate in the 50 forms exceeded our control figure (5%) all forms were re-edited in the batch.
- (c) All questionnaires were completely coded. Further, 50 forms in each batch of 100 were re-coded and errors were corrected. If the error rate exceeded our control figures (5%) all forms of the batch were re-coded. Lastly, a special review was conducted and the findings are reported below.
- (d) All data from the questionnaires were keypunched. The keypunching was completely verified by duplicate punching. A different operator verified the cards from the operator who punched the cards. Further, 5 forms out of 100 were reverified. When the error rate exceeded the acceptable control value (1%) all forms were reverified. Key punching of approximately eighty thousand (80,000) punched cards (9 per household) was completed during September, 1964.

- (e) All household and trip data on punch cards were sorted by zone, sample and person number and were tabulated on listings. A visual check for missing cards and obvious errors was conducted with all listings. Missing cards were replaced in the card decks and errors in the data were corrected.

2. Special Coding Review

The review of the coded questionnaires resulting from the survey was carried out for seven lots, each lot corresponding to a well-defined area in the Region covered by the Survey. The seven areas so defined comprise the whole survey region. The numbers of questionnaires in the lots and the areas represented are tabulated below:

Lot	Number of Questionnaires	Area Represented (See Map Survey Area)
1	13,390	Metropolitan Planning Area
2	1,450	The Fringe of the Planning Area
3	2,490	Hamilton and Hamilton Area
4	1,180	Oakville - Burlington
5	2,240	Guelph and Guelph Area
6	1,430	Barrie and Barrie Area
7	1,570	Oshawa - Bowmanville

Four batches of 49 or 50 questionnaires each were selected from each lot. The selection procedure for any batch can be illustrated by an example. To select a single batch from lot 1, we divide 13,390 by 50 and round the result to the integer just below the result; we get the answer 267. A random number in the range 1 to 267 was then chosen. The 13,390 questionnaires were sequenced and the first selection was the questionnaire with serial number equal to the random

number chosen. Thereafter, every 267'th questionnaire was chosen until the batch was complete. Thus the members of each batch were distributed uniformly over the questionnaires in the lot and all the questionnaires in the lot had essentially the same chance of being selected.

The codes recorded on the selected questionnaires were carefully checked and all errors recorded for the 4 batches in each lot for Home Zone Codes and for at least 2 batches from each lot in the case of the other codes.

The results are shown in the attached table.

1. Analysis of Results

For each of the five (5) types of codes:

- Home Zone Codes
- Non-Home Zone Codes
- Occupation Codes
- Industrial Codes
- Property Codes

a sample error rate by batch was calculated. From these error rates by batch, error rates by lot (or area) and in total were calculated.

Statistical procedures were then applied to check:

- (a) The consistency of error rates between batches from the same lot (or area).
- (b) The consistency of error rates among lots.

The results of this analysis are discussed below.

Home Zone Codes

For home zone codes, the error rate is uniformly low over all batches and in all areas. Out of a total of 1,396 home zone codes checked in the complete sample, only 6 were found to be in error. This corresponds to an average sample error rate of 0.43 percent. On this basis it is calculated that, in the complete survey, there is less than one chance in twenty that the error rate for home zone codes is as high as 0.83 percent. The true error rate for home zone codes applicable to the whole survey is almost certainly less than this upper limit; the most probable value for this error rate is 0.43 percent and there is better than an even chance that its value is less than 0.5 percent.

Non-Home Zone Codes

The average error rate for the complete sample was found to be 3.3 percent for non-home zone codes. This is considerably higher than for any of the other codes. Moreover, there is some evidence that the error rate for this type of coding varies somewhat from area to area. If the batches corresponding to the several areas were all taken from a common source having a 3.3 percent error rate, we can calculate limits R_1 and R_2 ($R_1 < R_2$), between which the observed error rate for any area should lie in 19 out of 20 trials. The observed error rate for area 1 (1.9 percent) is less than R_1 , while that for area 2 (4.5 percent) is only slightly less than R_2 . Thus there is some evidence to support the view that the true error

rate in area 1 is definitely lower, while that in area 2 is higher than in the other areas.

Area 1 is, for the most part, a well settled area for which up-to-date maps and manuals are available; area 2, on the other hand, is one in which rapid growth is taking place and for which maps and manuals may be somewhat inaccurate. This fact alone may be responsible for most of the difference observed in the error rates for these two areas.

For each of the seven (7) areas, we have reported error rates for two distinct batches. The observed error rates for the two batches from the same area do not agree; however, the difference between them is, with the exception of area 5, well within the limits calculated for two batches drawn at random from a common source. For area 5, the two error rates are 5.2 percent for one batch and 1.5 percent for the other. For two samples drawn from a common source, error rates differing by this amount or more could be expected to occur less frequently than once in twenty trials. Too much importance should not be attached to the fact that one such large difference occurred among the seven (7) independent pairs that were examined.

In view of the fact that the error rate may have varied somewhat from area to area, a weighted average error rate is to be preferred to a simple arithmetic average. Since area 1, with the

TABLE OF RESULTS

Lot or Area	Home Zone Codes - Errors			Non-Home Zone Codes - Errors			Occupation Codes - Errors			Industrial Codes - Errors			Property Codes - Errors		
	Batch	No. of Codes	%	Batch	No. of Codes	%	Batch	No. of Codes	%	Batch	No. of Codes	%	Batch	No. of Codes	%
1	1-4	200	1 0.5	1	360	4 1.1	1	168	0	1	168	0	1	304	0
				2	313	9 2.9	2	168	1 0.6	2	168	2 1.2	2	275	0
				1,2	673	13 1.9	1,2	336	1 0.3	1,2	336	2 0.6	1,2	579	0
2	1-4	197	2 1.0	3	480	25 5.2	3	191	3 1.6	3	191	2 1.0	3	311	10 3.2
				4	335	12 3.6	4	192	0	4	192	1 0.5	4	290	3 1.0
				3,4	815	37 4.5	3,4	383	3 0.8	3,4	383	3 0.8	3,4	601	13 2.2
3	1-4	200	1 0.5	1	230	8 3.5	1	171	5 2.9	1	171	0	1	211	4 1.9
				2	278	10 3.6	2	160	5 3.1	2	160	3 1.9	2	244	1 0.4
				1,2	508	18 3.5	1,2	331	10 3.0	1,2	331	3 0.9	1,2	455	5 1.1
4	1-4	200	2 1.0	1	385	16 4.2	1	192	0	1	192	1 0.5	1	334	5 1.5
				2	391	8 2.0	2	173	1 0.6	2	173	2 1.2	2	330	4 1.2
				1,2	776	24 3.1	1,2	365	1 0.3	1,2	365	3 0.8	1,2	664	9 1.4
5	1-4	199	0	2	392	22 / 5.6	2	176	1 0.6	2	176	1 0.6	2	234	0
				4	390	6 • 1.5	4	155	4 2.6	4	155	0	4	348	3 0.9
				2,4	782	28 3.6	2,4	331	5 1.5	2,4	331	1 0.3	2,4	582	3 0.5
6	1-4	200	0	2	341	16 4.7	2	163	1 0.6	2	163	1 0.6	2	295	1 0.3
				4	316	8 2.5	4	167	2 1.2	4	167	3 1.8	4	278	4 1.4
				2,4	657	24 3.7	2,4	330	3 0.9	2,4	330	4 1.2	2,4	573	5 0.9
7	1-4	200	0	2	313	13 4.2	2	152	5 3.3	2	152	0	2	272	1 0.4
				4	281	6 2.1	4	161	1 0.6	4	161	1 0.6	4	253	1 0.4
				2,4	594	19 3.2	2,4	313	6 1.9	2,4	313	1 0.3	2,4	525	2 0.4

lowest observed error rate, contributes over half the total number of questionnaires, it is clear that the expected error rate for the whole survey will be less than the average sample rate of 3.3 percent. When the error rate in each area is weighted in proportion to the number of survey questionnaires from that area, a weighted average error rate of approximately 2.6 percent is obtained. This result has been obtained as a result of checking nearly 5000 individual non-home zone codes. It is extremely unlikely therefore, that an error rate of as much as 3 percent remains in the survey coding pertaining to non-home zone codes.

Occupation, Industrial and Property Codes

For the most part, error rates for occupation, industrial and property codes are uniformly low over all areas. The most notable exceptions appear to be occupation codes in area 3 and property codes in area 2. Occupational coding for area 3 was done locally using abbreviated manuals; property coding in area 2 presented a few unusual problems.

The average error rates over the complete sample are 1.2 percent for occupation codes, 0.7 percent for industrial codes, and 0.9 percent for property codes. In view of these low average error rates and the partial explanation of the two higher than average rates, it would appear that the accuracy achieved in these codes is quite satisfactory.

2. Conclusions

The sample check of the coding for the 1964 Traffic Survey appears to have been carefully and correctly conducted. The results indicate a very low error rate in home zone codes and quite low error rates for occupation, industrial and property codes. For non-home zone codes, the error rate is considerably higher than for the other codes. A weighted average of the results indicates an error rate of about 2.6 percent in the total data for non-home zone codes.

In view of the inevitable uncertainty that attaches to surveys of this kind and the application of the results to traffic forecasting and also due to the fact that such coding errors as do remain can be expected to partially compensate one another, it would seem difficult to justify the expense of further checks.

3. Summary and Preliminary Analysis of Survey Data

The summary and preliminary analysis of the 1964 Survey information to permit the derivation of travel relationships is described below.

Computer programs were written for the Univac 1107 computer to carry out each of these tasks. Details of these programs are presented below:

1. Final Screening of Data

In spite of quality control and intensive manual editing procedures, a number of errors remained undetected in the data file. A small error

rate was expected with such a large number of survey interviews (close to 24,000) and with a questionnaire of such complexity as the M. T. A. R. T. S. form. The errors which existed in this file were of the following type:

- Interviewer errors, i. e. basic data inconsistencies exist, etc.
- Coder errors, i. e. invalid address codes outside the range of designated numbers were assigned, etc.
- Editor errors, i. e. duplicate household numbers were assigned, etc.
- Key punch/verifier errors, i. e. wrong codes were punched, etc.
- Data processing errors, i. e. household and trip cards were misplaced, etc.
- Miscellaneous errors created by computer operators or malfunction of computer, etc.

All M. T. A. R. T. S. Survey data was initially screened to remove these errors during October. A second and third computer screening of error data were accomplished during the first week in November. This screening was vital to the analysis of the survey data. Otherwise serious errors in the data could present a biased picture of travel behaviour. In conclusion, 99% of the detectable type of errors were removed from the file by this screening process.

2. Trip Linking

In certain aspects of investigating travel behaviour, it is desirable to break a trip which involves one or more changes in mode

and/or a diversion to serve a passenger, into several simpler trips (for Travel Mode and Route Choice Analysis). However, for the analysis of the Production of trips and the Distribution of trips to work and other purposes, it is desirable to recombine the individual simple trips, into a single trip record, for which the origin of the combined trip is the origin of the first simple trip, and the destination, is the destination of the last simple trip. This combined trip refers to only one person of course. Also, the period of the combined trip should be for a continuous duration of travelling. Approximately 13% of the total reported trips would be so affected.

Trip linking was achieved by an 1107 computer program. The programming was completed during October and testing was completed during the first week in November. Production runs with this program were carried out during November.

3. Assignment of Detailed Addresses

The survey questionnaire required the householder to report the street address and municipality for the following locations:

- origin zones of all trips
- destination zones of all trips
- address lived previously
- address worked now
- address worked previously

Regretably, at least 3 to 5 percent of the householders were either unwilling to or unable to specify exactly these locations. Rather than permitting coders to randomly assign address codes (at the data zone

level of detail), they were instructed to pinpoint the district or municipality in the Planning Area where possible. It is our practice to handle this problem in the manner described below, using a special 1107 computer program.

It was the purpose of the Zonal Code Distribution Program to assign precise address codes (at the data zone level of detail) by a mathematical (Monte Carlo) Assignment technique. The codes were assigned to a traffic zone in the designated district, or municipality, according to the employment opportunities enumerated in each traffic zone. This work was completed during December, 1964.

4. Sort of Master File

An important program for the 1107 System was the Sort-Merge Program. This program sorted in order, household or trip records by zone, sample, person and trip number. The file could, of course, be sorted by this program in order on any other field of the data file. This operation was completed during November, 1964.

5. Summary of Survey Data

For analysis work during 1964, three special summary programs were written during November, 1964. It is our standard practice that the summary of data be accomplished by such computer programs. Details of the programs and their summary outputs are described below:

- Home to Work
- Home to Business, Commercial,
Social, Recreation
- Home to School

In addition, the following data was also tabulated for each study zone interchange and for each of the above trip purpose categories for special time periods:

- Total automobile person trips
- Total auto drivers who need a car to do one's work
- Total transit trips
- Total railway trips
- Total transit trips made by people with no driver's licence or no cars owned
- Average door-to-door time by auto
- Average door-to-door time by transit
- Average number of transfers by transit
- Average number of riders by auto

Lastly, for each origin and destination interchange the following data was tabulated:

- Average walking time by transit
- Average walking time by auto
- Average parking cost
- Frequency of parking by: free, street meter, pay.

The application of these summary data to investigate why, when and where people travel is described in the opening chapter.

(i) Summary Program No. 1

This program summarized the basic data of the Survey data file, which was sorted previously by home zone number, sample number, etc. The following data was summarized on a home zone basis:

- Population
- Population 5 years of age and older
- Number of dwelling units
- Number of passenger cars
- Average worker income

General trip data was also summarized by this program. This information consisted of trip summaries categorized by specified trip purposes and by trip start time in half hour intervals over the day. Further, summaries were prepared on frequency of travel versus trip length for specified trip purposes and travel modes for the following time periods:

- i. e. AM 2 hour peak, PM 2 hour peak,
All day.

(ii) Summary Program No. 2

This program summarized the data file once sorted by origin zone and/or destination. For each origin (or destination) zone the number of trips by specified trip purposes was summarized.

(iii) Summary Program No. 3

The program was primarily intended to extract the information from the data file that would be required for investigation of where and how people travel. For selected origin and destination interchanges the number of expanded trips by the following trip purpose was tabulated:

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