## 3.4 Results of 1997 Traffic Surveys

### 3.4.1 Outline of Surveys

In order to analyze the present traffic condition and to obtain necessary data for updating the existing O-D (Origin-Destination) tables, two kinds of traffic surveys were conducted: One is "traffic count survey" and another is "roadside O-D interview". The outline of each survey is summarized as follows;

(1) Traffic Count Survey

1) Purpose

Traffic count survey was conducted in order to find the actual traffic volume at major road sections in and around Hanoi. The survey was carried out manually in accordance with the planned procedure; by direction, by vehicle type, by time period, as usual.

2) Classification of Vehicle Type

Though somewhat different classifications of vehicle type were applied depending on survey types, a classification with 11 categories of vehicle type was selected in this survey.

Non-motorized Vehicles

Bicycle and Cyclo.

Motorized Vehicles

Motorcycle, Passenger car, Taxi/Lam, Small bus, Bus, Small truck, Truck, Trailer, and Others.

3) Time Duration

Traffic count survey was carried out; in one weekday or for one week (continuous 7 days), depending on the survey points (refer to Figures 3.4.1 and 3.4.2).

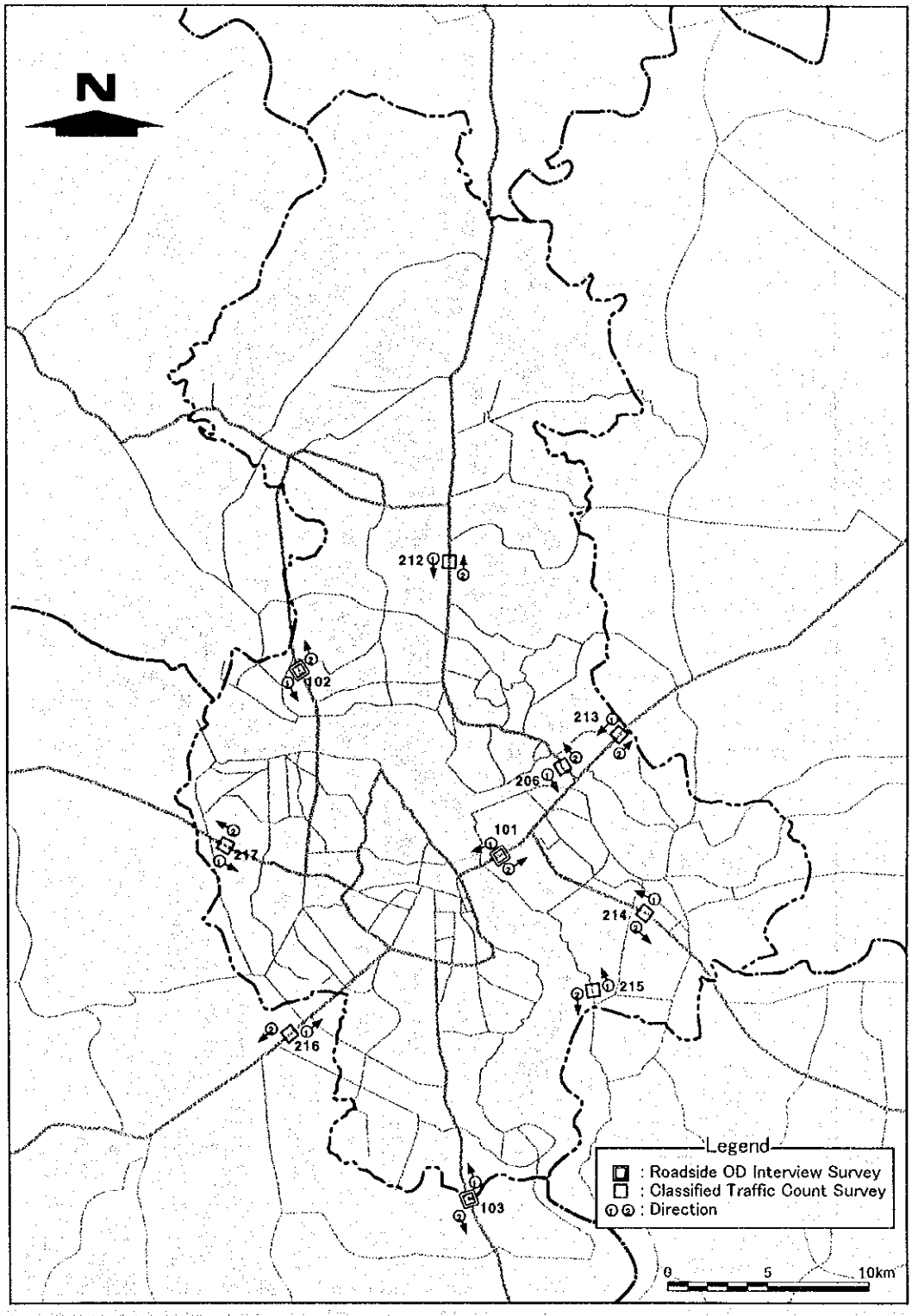



**Figure 3.4.1 Traffic Survey Stations (1)**

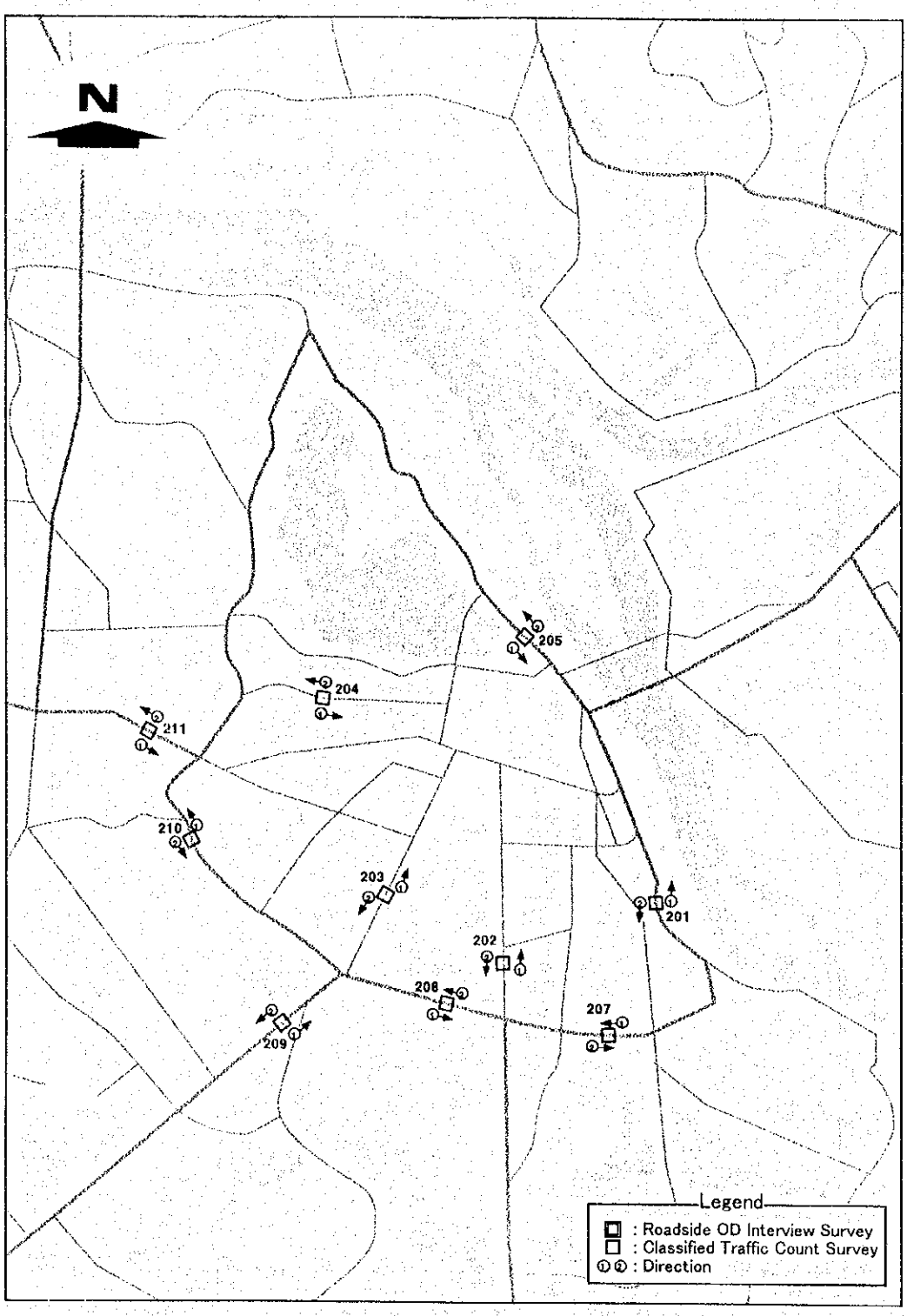



**Figure 3.4.2 Traffic Survey Stations (2)**

Time duration for one day was 12 hours; 07:00 to 19:00, and traffic volume by each quarter-hour was recorded. See Table 3.4.1 for the outline of traffic survey.

**Table 3.4.1 Outline of Traffic Survey**

| No. | Road Name (1) | Road Name (2) | Locatoin | Survey Date | Survey Hours | Remarks |
|---|---|---|---|---|---|---|
| 101 | NH No.1B | Nguyen Van Cu | Chuong Duong Br. | Oct. 07 (Tue) | 12 hrs. | with OD |
| 102 | Ring Road 3 | North Thang Long-Noi Bai | Thang Long Br. | Oct. 07 (Tue) | 12 hrs. | with OD |
| 103 | NH No.1A | Giai Phong | Van Dien | Oct. 07 (Tue) | 12 hrs. | with OD |
| 201 | Dike Rd. W-south | Tran Khanh Du | Tran Quang Khai | Sep. 18 (Thu) | 12 hrs. | |
| 202 | ext. of NH No.1A | Duong Giai Phong | Politechnic University | Sep. 17-23 | 12 hrs x 7 days | |
| 203 | ext. of NH No. 6 | Nguyen Luong Bang | Nguyen Luong Bang | Sep. 17 (Wed) | 12 hrs. | |
| 204 | Doi Can | Doi Can | Ngoc Ha | Sep. 18 (Thu) | 12 hrs. | |
| 205 | Dike Rd. W-north | Yen Phu | An Duong | Sep. 18 (Thu) | 12 hrs. | |
| 206 | NH No. 3 | NH No.3 | Xuan Du | Sep. 19 (Fri) | 12 hrs. | |
| 207 | Ring Road 2 | Minh Khai | Minh Khai | Sep. 18 (Thu) | 12 hrs. | |
| 208 | Ring Road 2 | Truong Chinh | Truong Chinh | Sep. 17 (Wed) | 12 hrs. | |
| 209 | NH No. 6 | Nguyen Trai | Nhan Chinh | Sep. 17 (Wed) | 12 hrs | |
| 210 | Ring Road 2 | Duong Lang | Trung Hoa | Sep. 18 (Thu) | 12 hrs. | |
| 211 | NH No. 32 | Cau Giay | Dich Vong | Sep. 17 (Wed) | 12 hrs. | |
| 212 | NH No. 3 | NH No.3 | Nguyen Khe | Sep. 22 (Mon) | 12 hrs. | |
| 213 | NH No. 1A | NH No.1A | Yen Vien | Sep. 19 (Fri) | 12 hrs. | |
| 214 | NH No. 5 | NH No.5 | Bay Bridge | Sep. 19 (Fri) | 12 hrs | under widening |
| 215 | Dike Rd. E-south | Dike Rd. E-south | Cu Khoi | Sep. 19 (Fri) | 12 hrs. | |
| 216 | NH No. 6 | NH No.6 | Ha Dong | Sep. 19 (Fri) | 12 hrs. | |
| 217 | NH No. 32 | NH No. 32 | Tai Tuu | Sep. 17 (Wed) | 12 hrs. | |

Source: JICA Study Team

4) Data Coding and Tabulation

The results of the survey recorded in the survey form B (refer to Appendix 1-1), were checked by supervisors and installed into computer following the prepared format, and tabulated as summarized in Appendix 1-3.

(2) Roadside O-D Interview

1) Purpose of the Survey

This survey aimed at the analysis of detail characteristics of the traffics across the river and at the southern border of Hanoi City. These data obtained by this survey were utilized to clarify the present features of traffic flow and to update the 1995 O-D tables, which were created in Hanoi Urban Transport Master Plan Study by JICA, into the 1997 O-D tables for the Study.

2) Survey Components

The survey consists of two parts; interview to the drivers and traffic count, and they

were carried out at same time.

i) Interview survey

Interviewers asked various items to the drivers of vehicles except for non-motorized vehicles such as bicycle and cyclo, in accordance with the prepared questionnaire, with necessary assistance of traffic polices at roadsides. This survey were done by sample basis at a sample rate of about 5% by each vehicle type (refer to survey form A in Appendix 1-1).

ii) Traffic count

At same time traffic count survey was also conducted during the whole period; 07:00 to 19:00. The same survey form B for traffic count survey was applied .

3) Survey Stations

i) National Highway 1A: near the southern border of Hanoi (south of Van Dien)
ii) Chuong Duong Bridge: near the gate of toll slip collection
iii) Thang Long Bridge: near the toll gate

4) Data Coding and Input

The results of the surveys were carefully checked by supervisors and were coded according to the coding manual. After coding, these data were installed into computer following the format (refer to Appendix 1-2).

### 3.4.2 Traffic Count Survey

The results of traffic count survey at 17 survey stations are tabulated in Appendix 1-3 of this report, together with the traffic count results at 3 roadside O-D interview stations. A summary is shown in Table 3.4.2 and Figure 3.4.3 and 3.4.4.

**Table 3.4.2 Summary of Traffic Count Survey Results**

12hrs. Traffic Volume

| Station | Survey Date | 1) Bicycle | 2) Cyclo | 3) Motor Cycle | 4) Passen-ger Car | 5) Taxi, Lan | 6) Small bus | 7) Bus | 8) Small truck | 9) Truck | 10) Trailer | 11) Others | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | Oct. 07 | 4,821 | 49 | 52,775 | 2,926 | 682 | 1,623 | 1,152 | 953 | 1,321 | 258 | 67 | 66,627 |
| 102 | Oct. 07 | 661 | 0 | 2,738 | 1,769 | 278 | 555 | 149 | 215 | 107 | 7 | 3 | 6,482 |
| 103 | Oct. 07 | 4,308 | 13 | 7,872 | 726 | 698 | 353 | 554 | 482 | 753 | 302 | 41 | 16,102 |
| 201 | Sep. 18 | 5,265 | 1,027 | 45,396 | 3,150 | 847 | 861 | 556 | 2,550 | 1,577 | 202 | 237 | 61,668 |
| 202 | Sep. 17-23 | 48,329 | 1,517 | 109,814 | 3,286 | 2,051 | 809 | 366 | 1,047 | 122 | 28 | 1 | 167,370 |
| 203 | Sep. 17 | 44,706 | 964 | 92,065 | 1,988 | 896 | 594 | 276 | 866 | 27 | 0 | 35 | 142,417 |
| 204 | Sep. 18 | 12,629 | 222 | 24,202 | 9 | 693 | 110 | 0 | 111 | 9 | 4 | 1 | 37,990 |
| 205 | Sep. 18 | 7,285 | 31 | 9,438 | 840 | 128 | 85 | 49 | 257 | 444 | 103 | 8 | 18,668 |
| 206 | Sep. 19 | 3,058 | 1 | 7,497 | 1,032 | 231 | 338 | 359 | 494 | 1,167 | 158 | 147 | 14,482 |
| 207 | Sep. 18 | 12,988 | 536 | 12,242 | 451 | 125 | 121 | 237 | 1,101 | 1,507 | 226 | 77 | 29,611 |
| 208 | Sep. 17 | 31,265 | 1,113 | 54,581 | 167 | 1,826 | 147 | 5 | 919 | 909 | 101 | 39 | 91,072 |
| 209 | Sep. 17 | 42,932 | 322 | 71,529 | 2,735 | 806 | 453 | 457 | 886 | 719 | 118 | 29 | 120,986 |
| 210 | Sep. 18 | 20,704 | 521 | 37,537 | 1,526 | 281 | 326 | 204 | 799 | 954 | 172 | 88 | 63,112 |
| 211 | Sep. 17 | 53,119 | 333 | 82,914 | 3,286 | 851 | 974 | 450 | 1,042 | 537 | 89 | 89 | 143,684 |
| 212 | Sep. 22 | 3,333 | 4 | 8,186 | 331 | 1,096 | 191 | 5 | 359 | 1,175 | 83 | 38 | 14,801 |
| 213 | Sep. 19 | 7,872 | 3 | 15,202 | 951 | 259 | 413 | 244 | 617 | 1,055 | 195 | 98 | 26,909 |
| 214 | Sep. 19 | 11,747 | 0 | 19,650 | 1,693 | 426 | 556 | 574 | 842 | 1,009 | 325 | 206 | 37,028 |
| 215 | Sep. 19 | 2,437 | 3 | 3,949 | 76 | 29 | 0 | 5 | 144 | 122 | 1 | 0 | 6,766 |
| 216 | Sep. 19 | 8,611 | 68 | 8,159 | 197 | 684 | 106 | 1 | 249 | 1,021 | 133 | 15 | 19,244 |
| 217 | Sep. 17 | 13,041 | 163 | 12,907 | 414 | 424 | 157 | 168 | 285 | 395 | 41 | 44 | 28,039 |

| Station | Non-motorized Vehicles | | Motorlized Vehicles | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NMV | Share to All Vehicles | Total | Motor Cycle | % | Passenger Vehicle | % | Cargo Vehicle | % |
| 101 | 4,870 | 7.3% | 61,757 | 52,775 | 85.5% | 6,383 | 10.3% | 2,532 | 4.1% |
| 102 | 661 | 10.2% | 5,821 | 2,738 | 47.0% | 2,751 | 47.3% | 329 | 5.7% |
| 103 | 4,321 | 26.8% | 11,781 | 7,872 | 66.8% | 2,331 | 19.8% | 1,537 | 13.0% |
| 201 | 6,292 | 10.2% | 55,376 | 45,396 | 82.0% | 5,414 | 9.8% | 4,329 | 7.8% |
| 202 | 49,846 | 29.8% | 117,524 | 109,814 | 93.4% | 6,512 | 5.5% | 1,197 | 1.0% |
| 203 | 45,670 | 32.1% | 96,747 | 92,065 | 95.2% | 3,754 | 3.9% | 893 | 0.9% |
| 204 | 12,851 | 33.8% | 25,139 | 24,202 | 96.3% | 812 | 3.2% | 124 | 0.5% |
| 205 | 7,316 | 39.2% | 11,352 | 9,438 | 83.1% | 1,102 | 9.7% | 804 | 7.1% |
| 206 | 3,059 | 21.1% | 11,423 | 7,497 | 65.6% | 1,960 | 17.2% | 1,819 | 15.9% |
| 207 | 13,524 | 45.7% | 16,087 | 12,242 | 76.1% | 934 | 5.8% | 2,834 | 17.6% |
| 208 | 32,378 | 35.6% | 58,694 | 54,581 | 93.0% | 2,145 | 3.7% | 1,929 | 3.3% |
| 209 | 43,254 | 35.8% | 77,732 | 71,529 | 92.0% | 4,451 | 5.7% | 1,723 | 2.2% |
| 210 | 21,225 | 33.6% | 41,887 | 37,537 | 89.6% | 2,337 | 5.6% | 1,925 | 4.6% |
| 211 | 53,452 | 37.2% | 90,232 | 82,914 | 91.9% | 5,561 | 6.2% | 1,668 | 1.8% |
| 212 | 3,337 | 22.5% | 11,464 | 8,186 | 71.4% | 1,623 | 14.2% | 1,617 | 14.1% |
| 213 | 7,875 | 29.3% | 19,034 | 15,202 | 79.9% | 1,867 | 9.8% | 1,867 | 9.8% |
| 214 | 11,747 | 31.7% | 25,281 | 19,650 | 77.7% | 3,249 | 12.9% | 2,176 | 8.6% |
| 215 | 2,440 | 36.1% | 4,326 | 3,949 | 91.3% | 110 | 2.5% | 267 | 6.2% |
| 216 | 8,679 | 45.1% | 10,565 | 8,159 | 77.2% | 988 | 9.4% | 1,403 | 13.3% |
| 217 | 13,204 | 47.1% | 14,835 | 12,907 | 87.0% | 1,163 | 7.8% | 721 | 4.9% |

Source: JICA Study Team

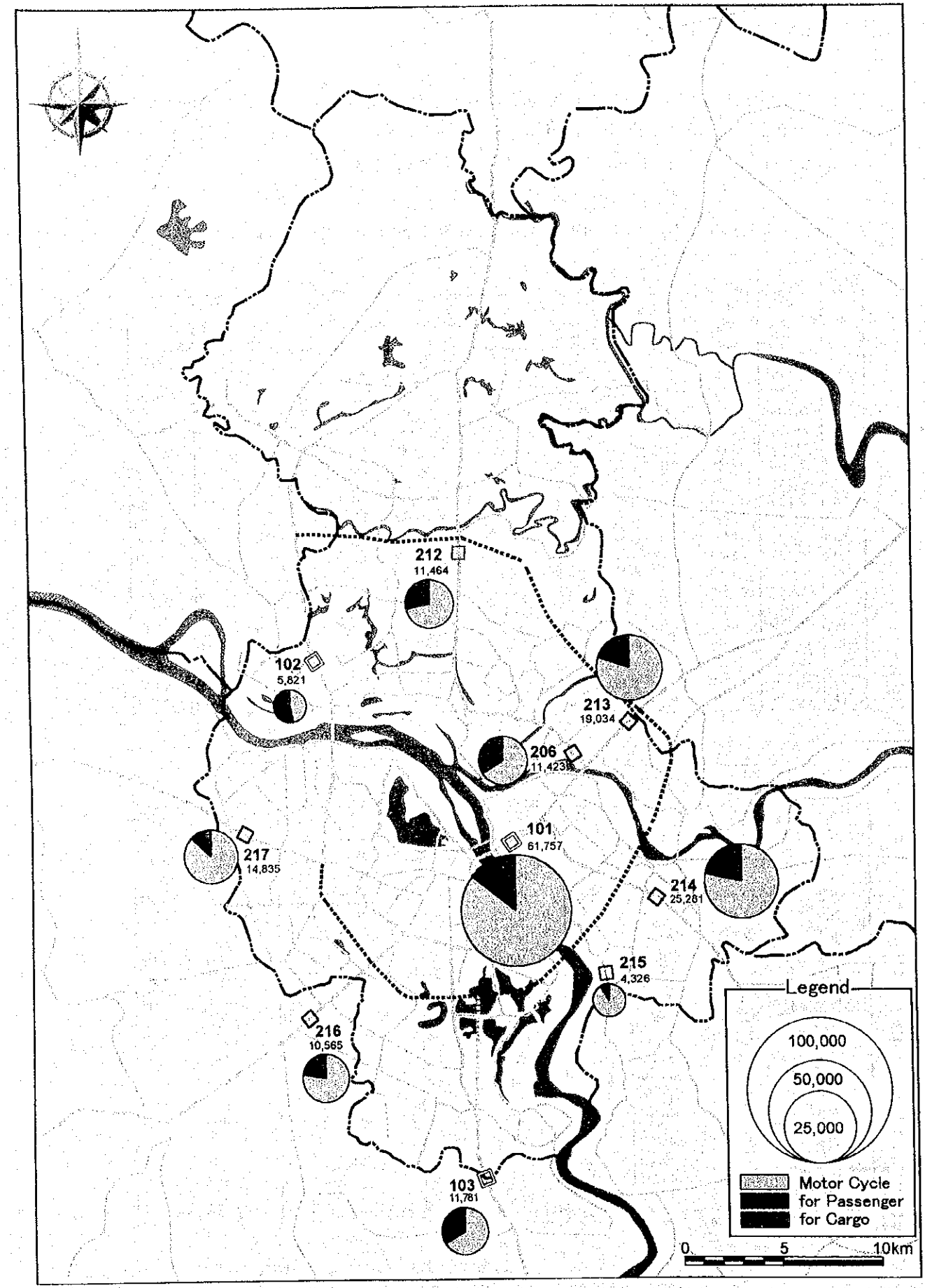



**Figure 3.4.3 12hrs. Traffic Count Results (1)**

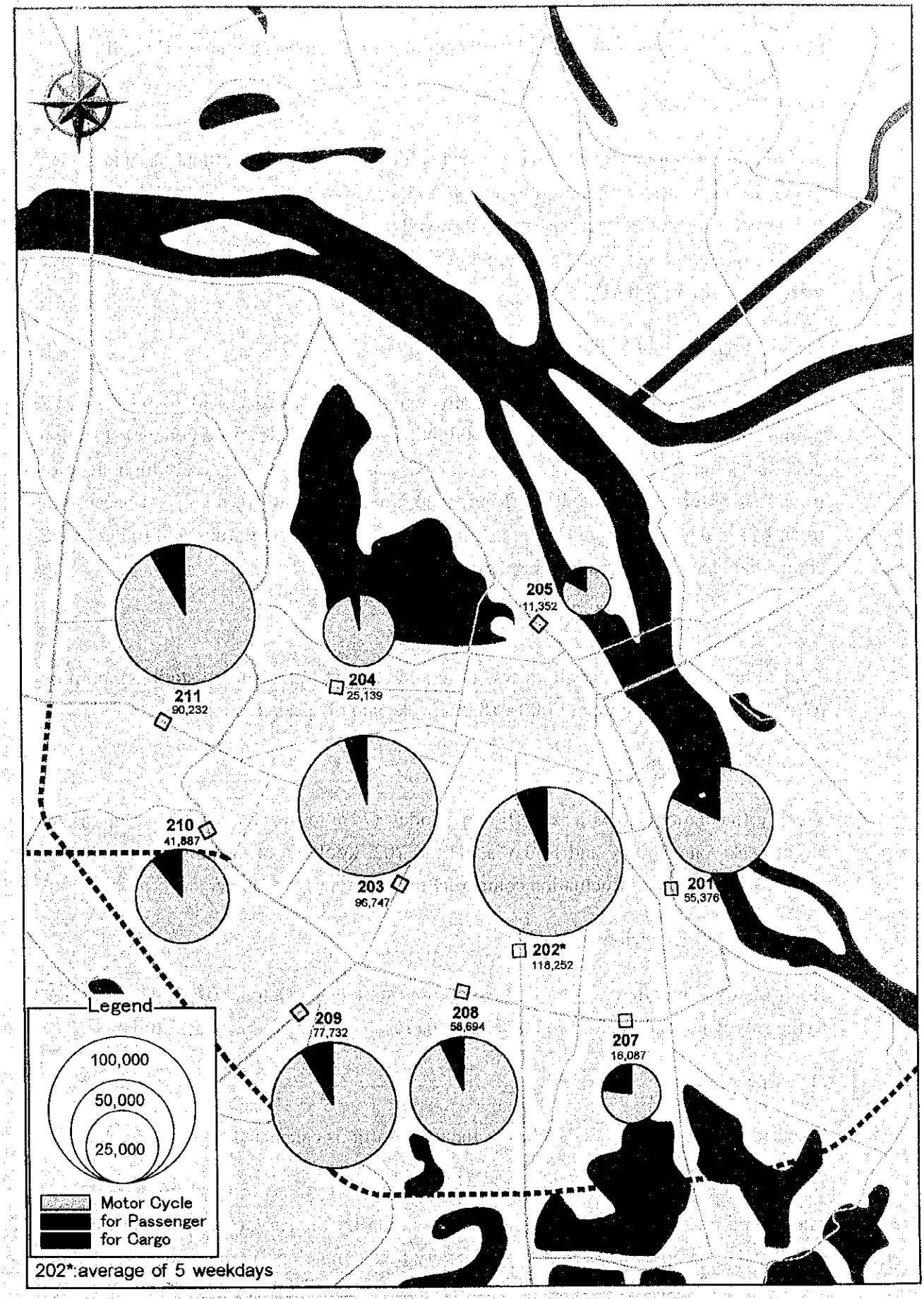



**Figure 3.4.4 12hrs. Traffic Count Results (2)**

Major findings by analysis of 1997 traffic count survey can be summarized as follows:

(1) Traffic Volume

As the traffic volume depends on each road condition such as route, function, width, etc., rather heavy traffic volumes, exceeding 50,000 motorized vehicles (MV, including motorcycle) for both directions, were observed at most of survey stations within urban districts of Hanoi. Meanwhile, volumes at major national highways in the suburban area were 10,000 to 30,000 MV.

(2) Composition of Vehicle Type

Motorcycle has dominant share especially within urban districts; 80 to 93% in MV number and 20 to 85% in PCU. Over 100 thousand motorcycles were counted at station 202, and 70 to 90 thousand at stations 203, 210 and 209. Comparatively high share of truck was observed along existing Ring Road No. 2 and southern dike road because of truck ban in daytime within the area. A certain volume of heavy truck and trailers were counted at NH No. 5 to/from Hai Phong.

(3) Hourly Fluctuation

Typical hourly fluctuation pattern was observed at most of the survey stations; morning (07:00 - 08:00) and evening (17:00 - 18:00) peaks and off-peak at noon.

(4) Weekly Fluctuation

Weekly fluctuation shows less traffic on Sunday (74% to average weekly volume) and slight peaks on Tuesday and Friday at station 202. Volume of passenger car indicates wider range of weekly fluctuation comparing to other types of vehicle.

### 3.4.3 Roadside O-D Interview

Roadside O-D interview was carried out at three stations on October 07, 1997, according to the survey manual mentioned before and the results are summarized as follows.

(1) Sample Rate

The sample rate of interview against to the total traffic is calculated by type of vehicle as tabulated in Table 3.4.3.

The sample rate varies in a wide range, depending on the survey location and type of vehicle. The sample rate of motorcycle is very low comparing to other vehicles, because

of ignorance/bad-manner of motorcycle drivers. Many samples are collected at station 102 (Thang Long - Noi Bai road) , better than expected.

**Table 3.4.3 Sample Rate of Roadside O-D Interview**

| Survey Station | | | | M/C | Pass. Car | Bus | Truck | Sub-total | |
|---|---|---|---|---|---|---|---|---|---|
| No. | Location | Dir. | | 1 | 2 | 3 | 4 | 2+3+4 | Total |
| 101 | Chuong Duong | 1 | Sample | 197 | 139 | 95 | 209 | 443 | 640 |
| | | | Traffic | 25,202 | 1,672 | 1,403 | 1,558 | 4,633 | 29,835 |
| | | | Ratio | 0.78 | 8.31 | 6.77 | 13.41 | 9.56 | 2.15 |
| | | 2 | Sample | 90 | 115 | 90 | 216 | 421 | 511 |
| | | | Traffic | 27,573 | 1,936 | 1,372 | 1,041 | 4,349 | 31,922 |
| | | | Ratio | 0.33 | 5.94 | 6.56 | 20.75 | 9.68 | 1.60 |
| | | 1+2 | Sample | 287 | 254 | 185 | 425 | 864 | 1,151 |
| | | | Traffic | 52,775 | 3,608 | 2,775 | 2,599 | 8,982 | 61,757 |
| | | | Ratio | 0.54 | 7.04 | 6.67 | 16.35 | 9.62 | 1.86 |
| 102 | Thang Long | 1 | Sample | 218 | 155 | 96 | 102 | 353 | 571 |
| | - Noi Bai | | Traffic | 1,562 | 1,043 | 358 | 153 | 1,554 | 3,116 |
| | | | Ratio | 13.96 | 14.86 | 26.82 | 66.67 | 22.72 | 18.32 |
| | | 2 | Sample | 149 | 191 | 44 | 92 | 327 | 476 |
| | | | Traffic | 1,176 | 1,004 | 346 | 179 | 1,529 | 2,705 |
| | | | Ratio | 12.67 | 19.02 | 12.72 | 51.40 | 21.39 | 17.60 |
| | | 1+2 | Sample | 367 | 346 | 140 | 194 | 680 | 1,047 |
| | | | Traffic | 2,738 | 2,047 | 704 | 332 | 3,083 | 5,821 |
| | | | Ratio | 13.40 | 16.90 | 19.89 | 58.43 | 22.06 | 17.99 |
| 103 | NH 1 (South) | 1 | Sample | 41 | 57 | 88 | 113 | 258 | 299 |
| | | | Traffic | 3,776 | 824 | 477 | 877 | 2,178 | 5,954 |
| | | | Ratio | 1.09 | 6.92 | 18.45 | 12.88 | 11.85 | 5.02 |
| | | 2 | Sample | 112 | 67 | 44 | 72 | 183 | 295 |
| | | | Traffic | 4,096 | 600 | 430 | 701 | 1,731 | 5,827 |
| | | | Ratio | 2.73 | 11.17 | 10.23 | 10.27 | 10.57 | 5.06 |
| | | 1+2 | Sample | 153 | 124 | 132 | 185 | 441 | 594 |
| | | | Traffic | 7,872 | 1,424 | 907 | 1,578 | 3,909 | 11,781 |
| | | | Ratio | 1.94 | 8.71 | 14.55 | 11.72 | 11.28 | 5.04 |
| All Stations | | | Sample | 807 | 724 | 457 | 804 | 1,985 | 2,792 |
| | | | Traffic | 63,385 | 7,079 | 4,386 | 4,509 | 15,974 | 79,359 |
| | | | Ratio | 1.27 | 10.23 | 10.42 | 17.83 | 12.43 | 3.52 |

Source: JICA Study Team

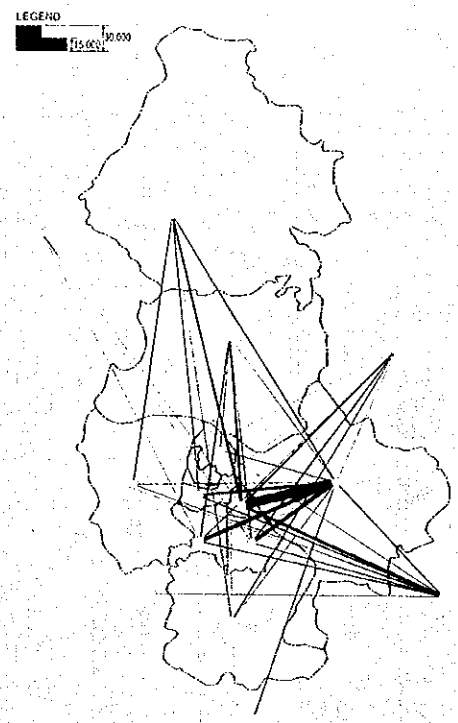
(2) O-D Distributions by Survey Station

O-D distribution by the results of interview survey is illustrated in the form of "desired lines" by survey station (Figures 3.4.5 to 3.4.7). This provides important information to update the existing 1995 O-D tables into 1997.

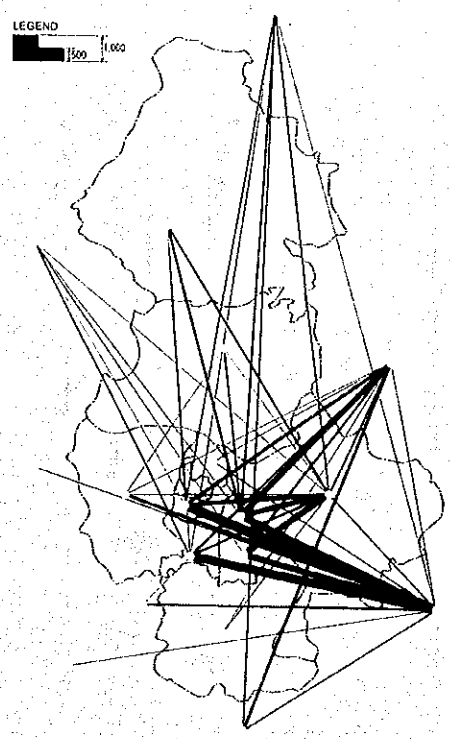
(3) Other Major Results

In addition to O-D distribution, other supplemental information, such as loading condition of trucks, trip purpose, average occupancy, etc., obtained from O-D interview is also summarized in Figures 3.4.8 to 3.4.10.

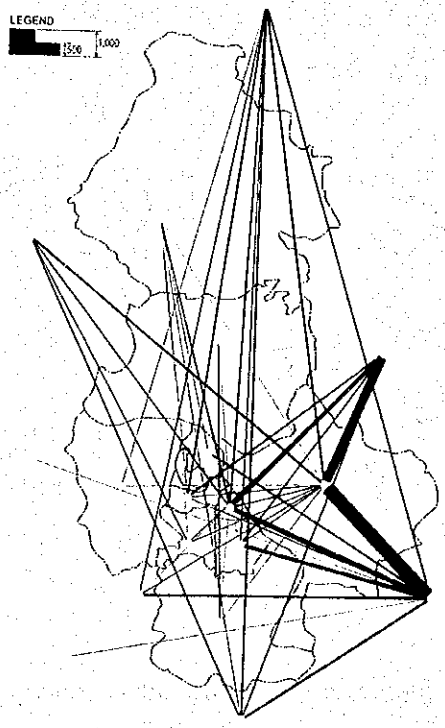
**Motorcycle**




**Passenger Car**




**Bus**




**Truck**

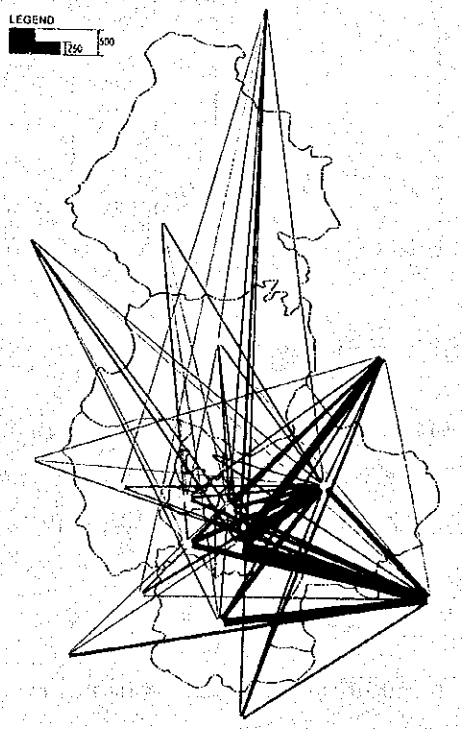
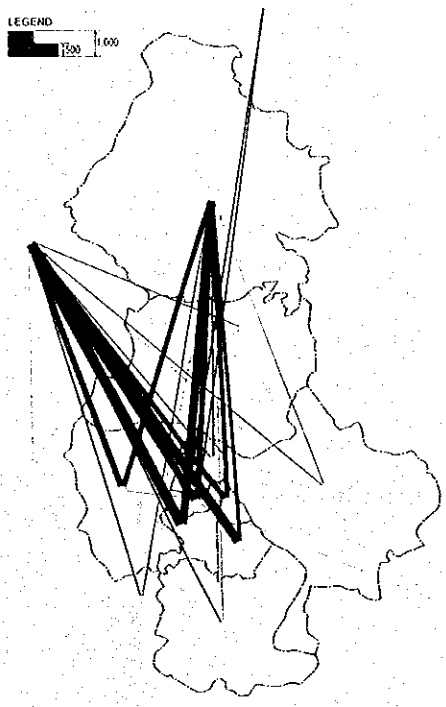
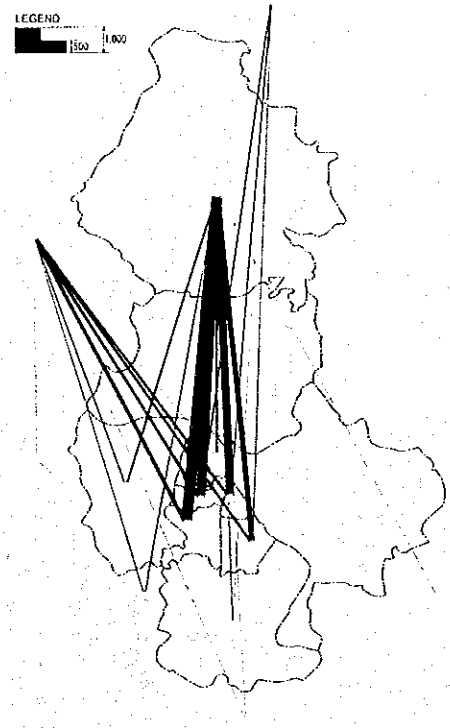



**Figure 3.4.5 Roadside O-D Result (Station 101)**

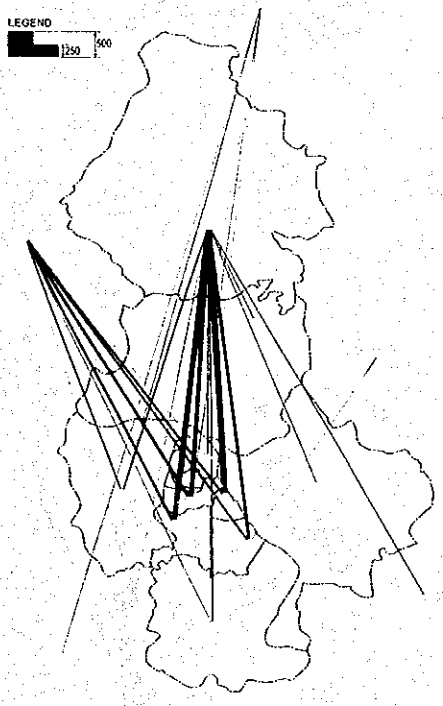
**Motorcycle**




**Passenger Car**




**Bus**




**Truck**

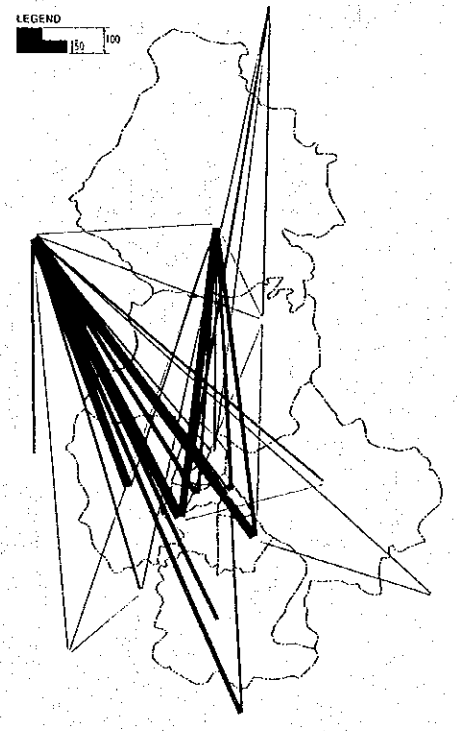
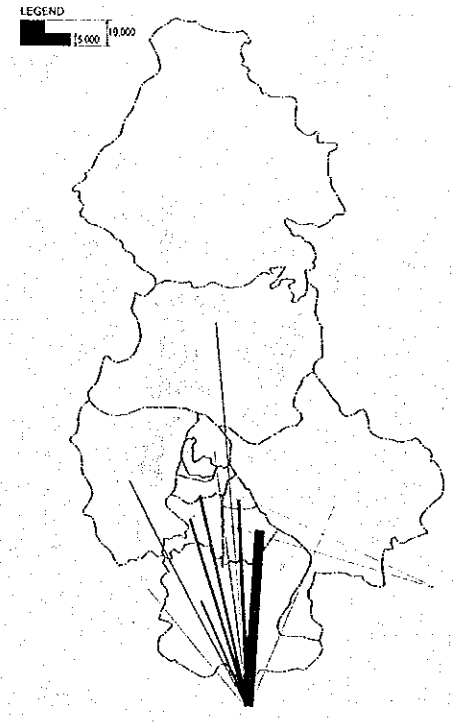
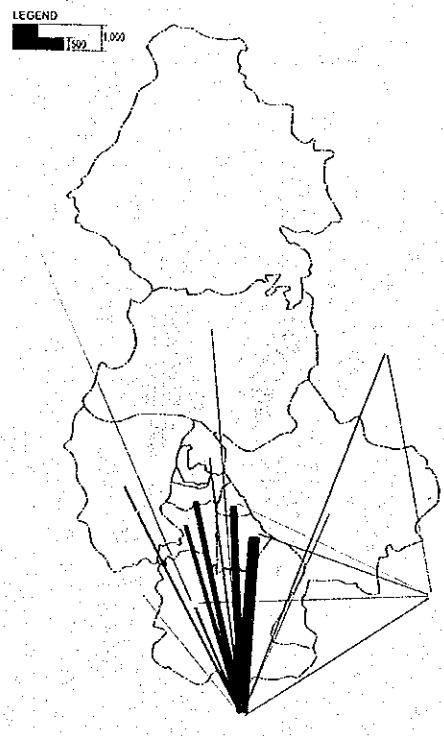



**Figure 3.4.6 Roadside O-D Result (Station 102)**

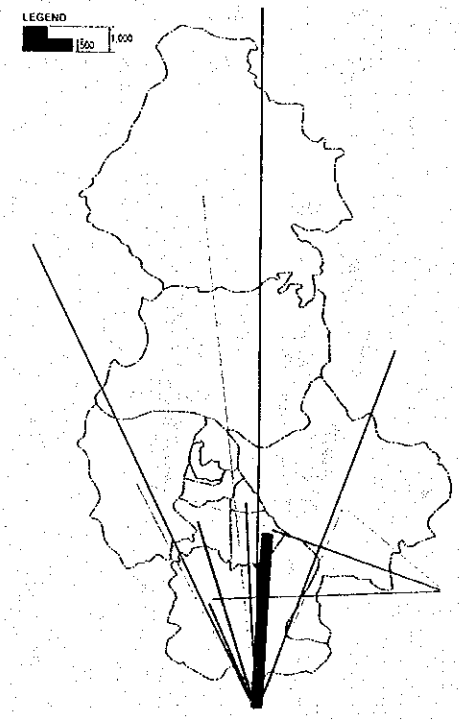
**Motorcycle**




**Passenger Car**




**Bus**




**Truck**

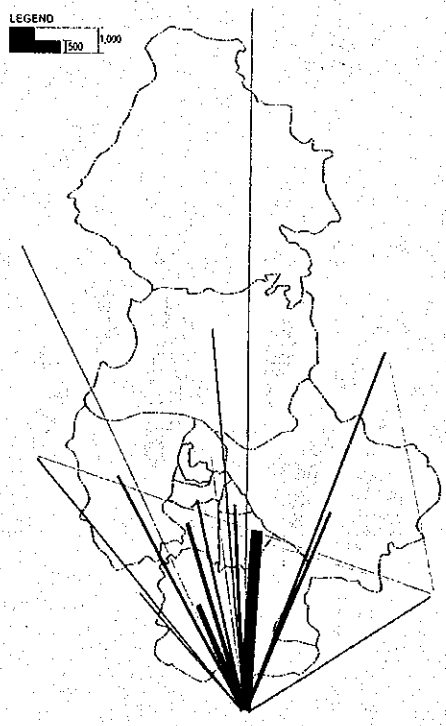



**Figure 3.4.7 Roadside O-D Result (Station 103)**

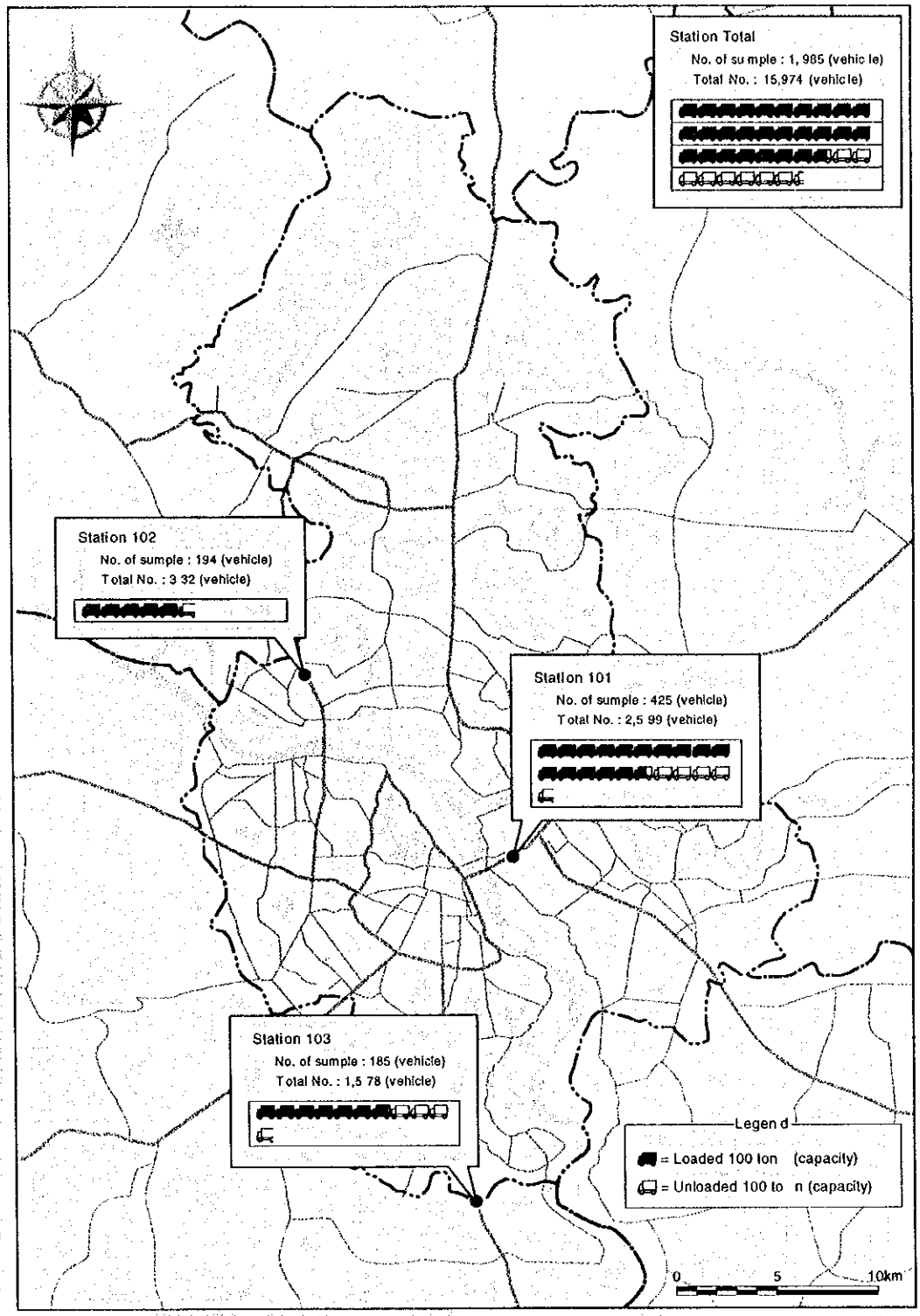



**Figure 3.4.8 Loading Condition of Roadside O-D**

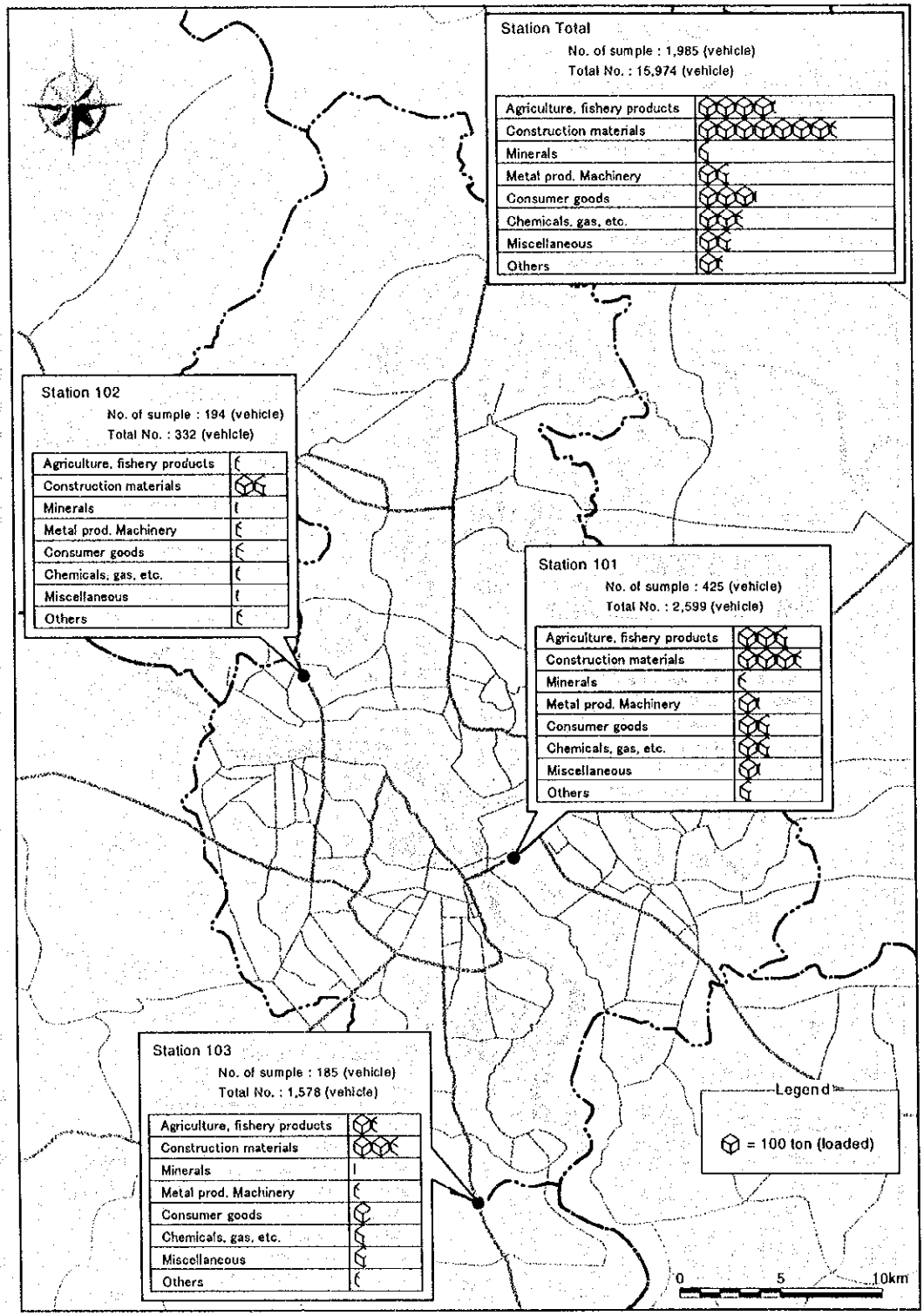



**Figure 3.4.9 Commodity Type of Roadside O-D**

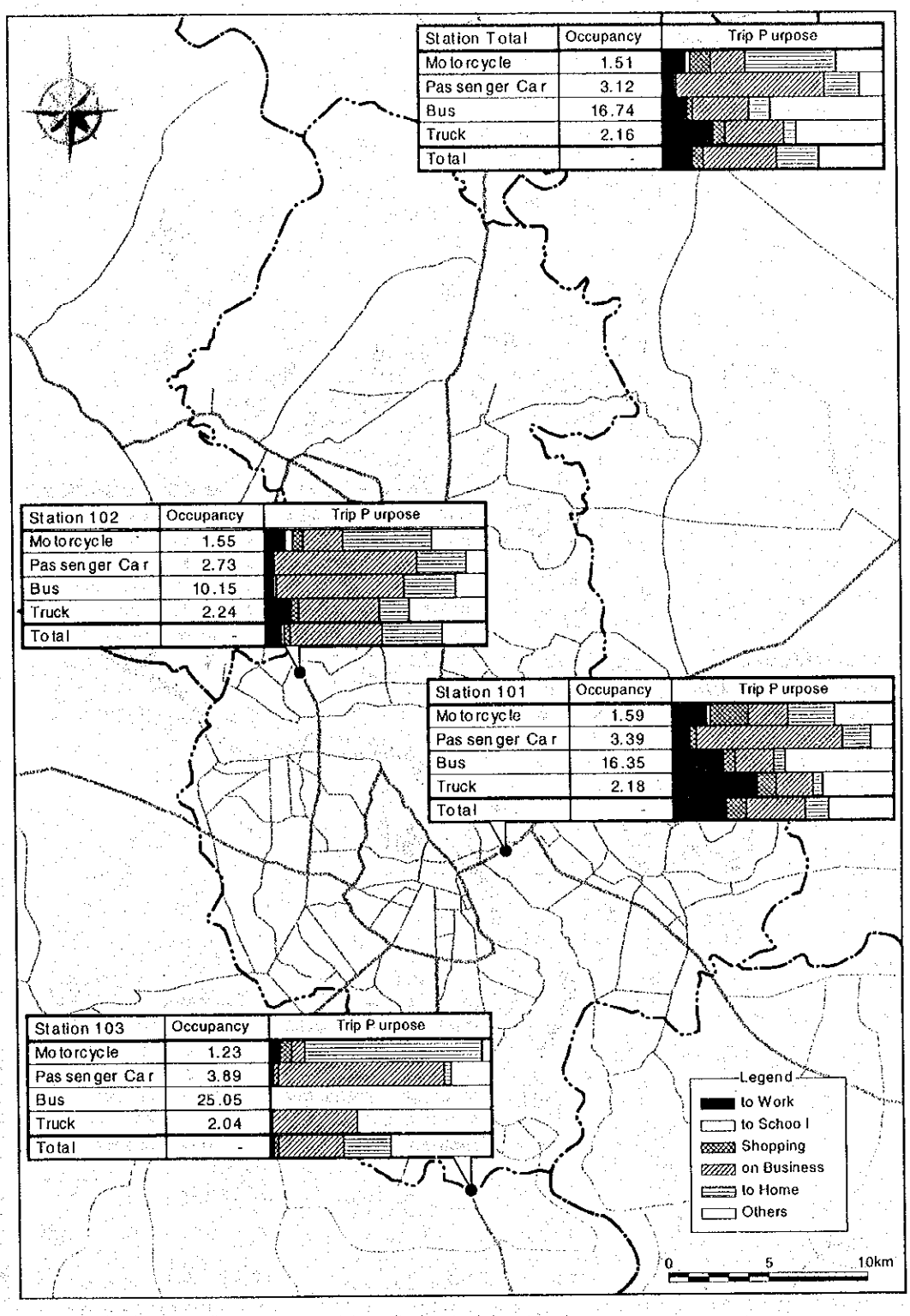



**Figure 3.4.10 Occupancy and Trip Purpose of Roadside O-D**

# CHAPTER 4
# TRAFFIC DEMAND FORECAST

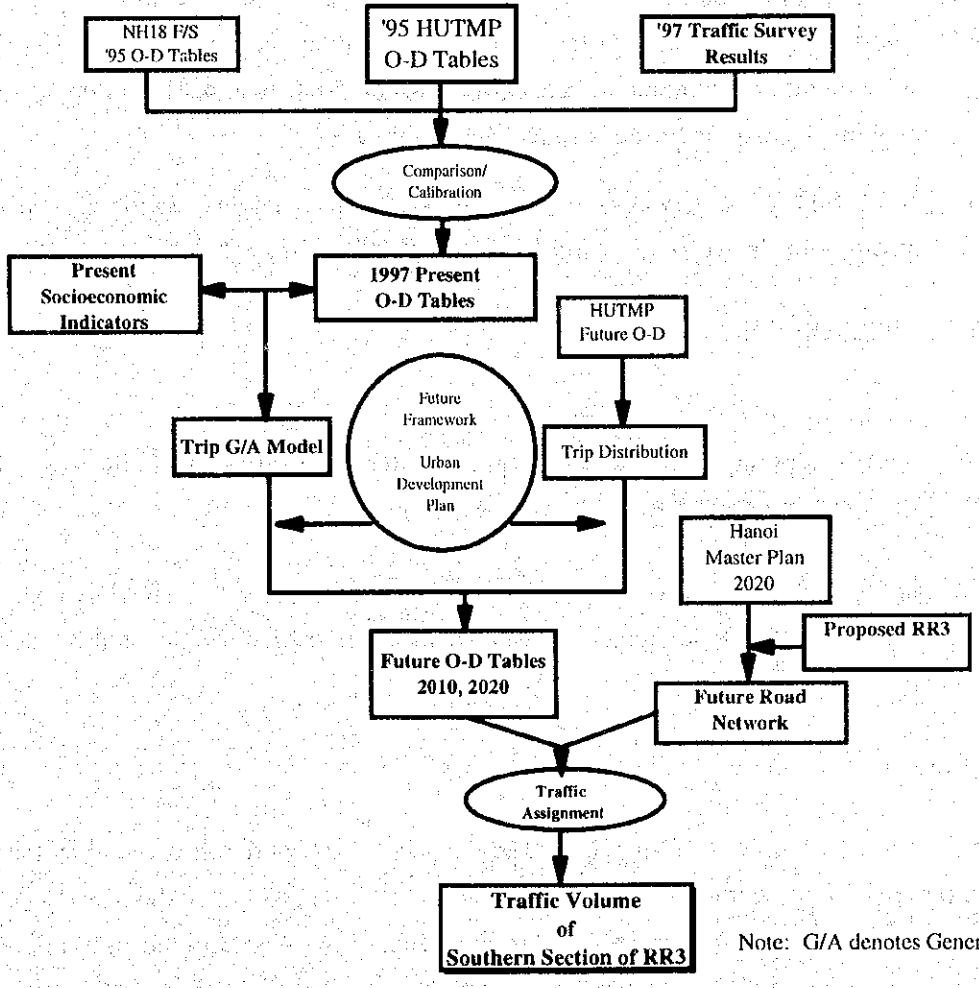
# CHAPTER 4 TRAFFIC DEMAND FORECAST

## 4.1 Methodology

The comprehensive Hanoi Urban Transport Master Plan Study (HUTMP) conducted by JICA from September 1995 to January 1997, has carefully analyzed future traffic demands based on "*person trip*" from various viewpoints. For the sake of consistency, and in consideration of the great amount of useful data obtainable from the results of HUTMP, practically the same methodology for traffic demand forecast is applied in the Study while considering possible future alternative conditions.

### 4.1.1 General

Overall methodology of traffic demand forecast in the Study is explained as shown in Figure 4.1.1.




Note: G/A denotes Generation/Attraction.

**Figure 4.1.1 General Flow Chart of Traffic Demand Forecast**

### 4.1.2 Basic Premises

The following conditions were set for traffic demand forecast of the proposed southern section of Hanoi Ring Road 3 (RR3).

i) Since the RR3 plays a significant role in the arterial road network of Hanoi metropolitan area, though the proposed section is a part of RR3, the traffic demand analysis should be conducted not as the independent road section but as a part of whole road network.

ii) Traffic demand is forecast in terms of vehicle volume in AADT (Average Annual Daily Traffic) by type of vehicle, that is, four (4) types; motorcycle, passenger car, bus and truck.

iii) Basic traffic movement in HUTMP, in the form of O-D tables, is used with the necessary modifications both at present and in the future.

iv) Though the official target year of the plan is the year 2010, additional supplementary demand forecast for the year 2020 was also conducted in order to provide a grasp of further future conditions.

v) JICA STRADA (System for Traffic Demand Analysis) model is fully utilized throughout the traffic demand forecast procedure in the Study.

### 4.1.3 JICA STRADA Model

This is the comprehensive traffic demand analysis model newly developed by JICA, which can be operated by the personal computer with CPU of 80,486 over, hard-disk (over 100MB), memory (over 8MB) and Windows.

The package of a traffic demand forecast model namely JICA STRADA consists of 25 modules of program package, and users can select each module at their demands of analysis.

## 4.2 Zoning

The HUTMP zoning system with 79 zones was converted into system with 59 zones taking into consideration the proposed route of RR3 and the newly confirmed administrative boundary in 1997. The area along RR3 was divided into smaller zones, while zone integration was conducted in other area. Table 4.2.1 summarizes the zoning systems of the Study; 14, 18 and 59-zone corresponding to the original 79 zoning system of HUTMP. Schematic zoning maps are illustrated in Figure 4.2.1.

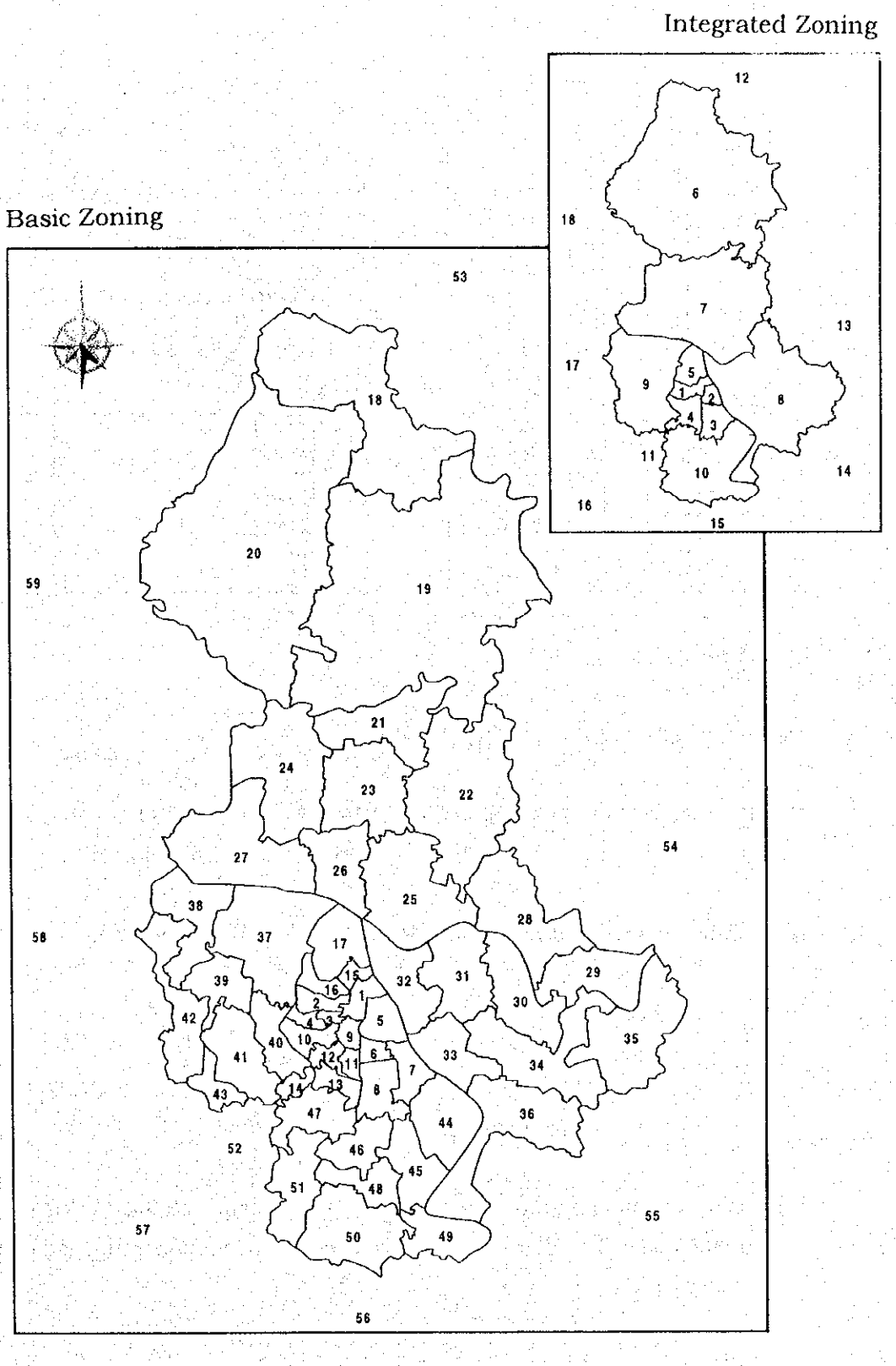



**Figure 4.2.1 Zoning Maps**

**Table 4.2.1 Zoning System**

| Categ. | F/S HTRR, JICA | | | HUTMP | NH18 |
|---|---|---|---|---|---|
| | 14 Block | District base | Basic Zoning | 79 Zone | SS 13 |
| Hanoi | 1 | 01 Ba Dinh | 1 - 4 | (4,5)*2/3*,3,7-9 | 1 |
| | 1 | 02 Hoan Kiem | 5 | 2*2/3*,6,10,11,15 | 1 |
| | 1 | 03 Hai Ba Trung | 6 - 8 | 24*2/3*,16-18,21-23,27,28 | 1 |
| | 1 | 04 Dong Da | 9 - 14 | 24*1/3*,12-14,19,20,25,26 | 1 |
| | 1 | 05 Tay Ho | 15 - 17 | (2,4,5)*1/3*,1,50 | 1 |
| | 2 | 06 Soc Son | 18 - 20 | 39*1/3*,40*1/4*,29-37 | 1 |
| | 3 | 07 Dong Anh | 21 - 27 | 39*2/3*,40*3/4*,38,40,41,43-4 | 1 |
| | 4 | 08 Gia Lam | 28 - 36 | 42,46-49,54,55,60 | 1 |
| | 5 | 09 Tu Liem | 37 - 43 | 51-53,56-59,67,68,70 | 1 |
| | 6 | 10 Thanh Tri | 44 - 51 | 61-66,69,71-73 | 1 |
| Ha Dong | 7 | 11 Ha Dong | 52 | 74 | - |
| Outside | 8 | 12 North | 53 | 76*0.4* | 7 |
| | 9 | 13 North-East | 54 | 76*0.6* | 2,6 |
| | 10 | 14 East | 55 | 75 | 3-5,13 |
| | 11 | 15 South | 56 | 79*0.6* | 12 |
| | 12 | 16 South-West | 57 | 79*0.4* | 11 |
| | 13 | 17 West | 58 | 78 | 10 |
| | 14 | 18 North-West | 59 | 77 | 8,9 |

## 4.3 Present O-D Tables

### 4.3.1 Procedure of Updating 1995 O-D Tables

Based on the 1995 O-D tables in HUTMP, the present 1997 O-D tables by vehicle type were created as a result of the following re-examination and adjustments:

i) Zone integration/disintegration in accordance with the new zoning system;

ii) Overall review of O-D distribution/flow;

iii) Examination of O-D traffic based on the results of roadside O-D interview conducted in October, 1997; and

iv) Comparison and calibration of basic traffic volume assumed from 1995 O-D table to the updated cordon-line and screen-line traffic volume estimated by traffic count survey results.

These procedures are summarized in Figure 4.3.1.

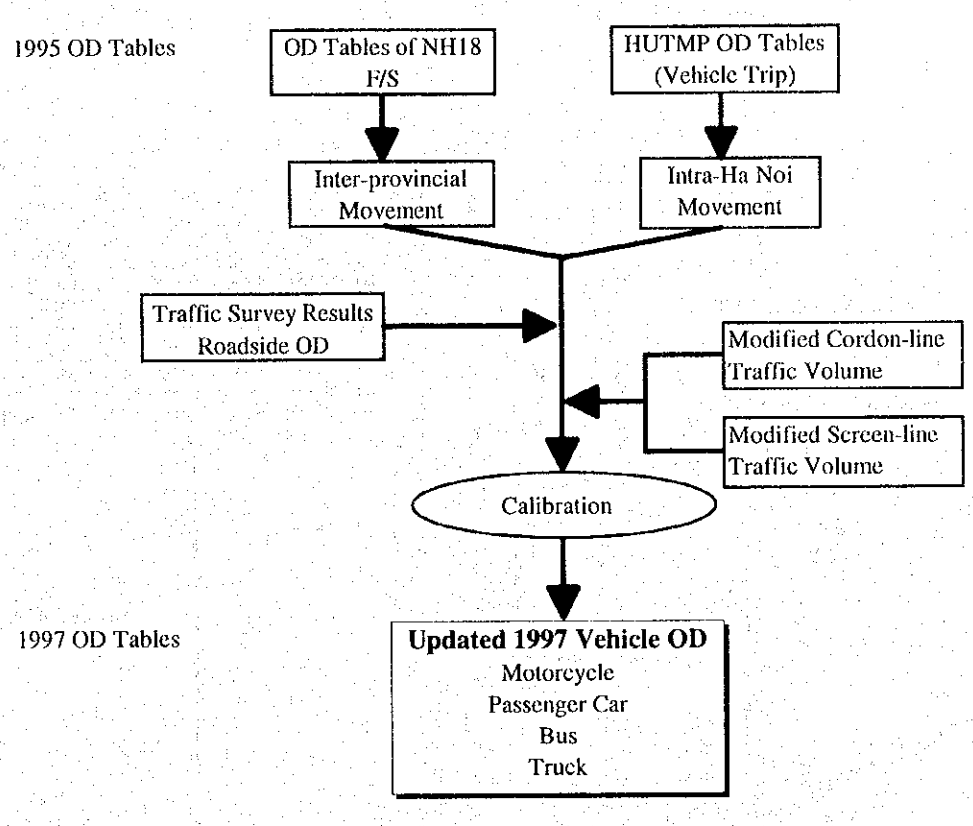



**Figure 4.3.1 Procedure of Confirmation of 1997 O-D Table**

Figure 4.3.2 shows major traffic volumes (vehicles/24hrs) at 7 cordon-line stations; NH1-north, NH5, NH1-south, NH6, NH32, NH2 and NH3, and 2 screen-line stations; Chuong Duong and Thang Long bridges.

### 4.3.2 1997 O-D Tables

The 1997 O-D tables obtained through the above procedure are tabulated in Table 4.3.1 and visual summaries in the form of 'desired lines' by 18-zone system are illustrated in Figure 4.3.3.

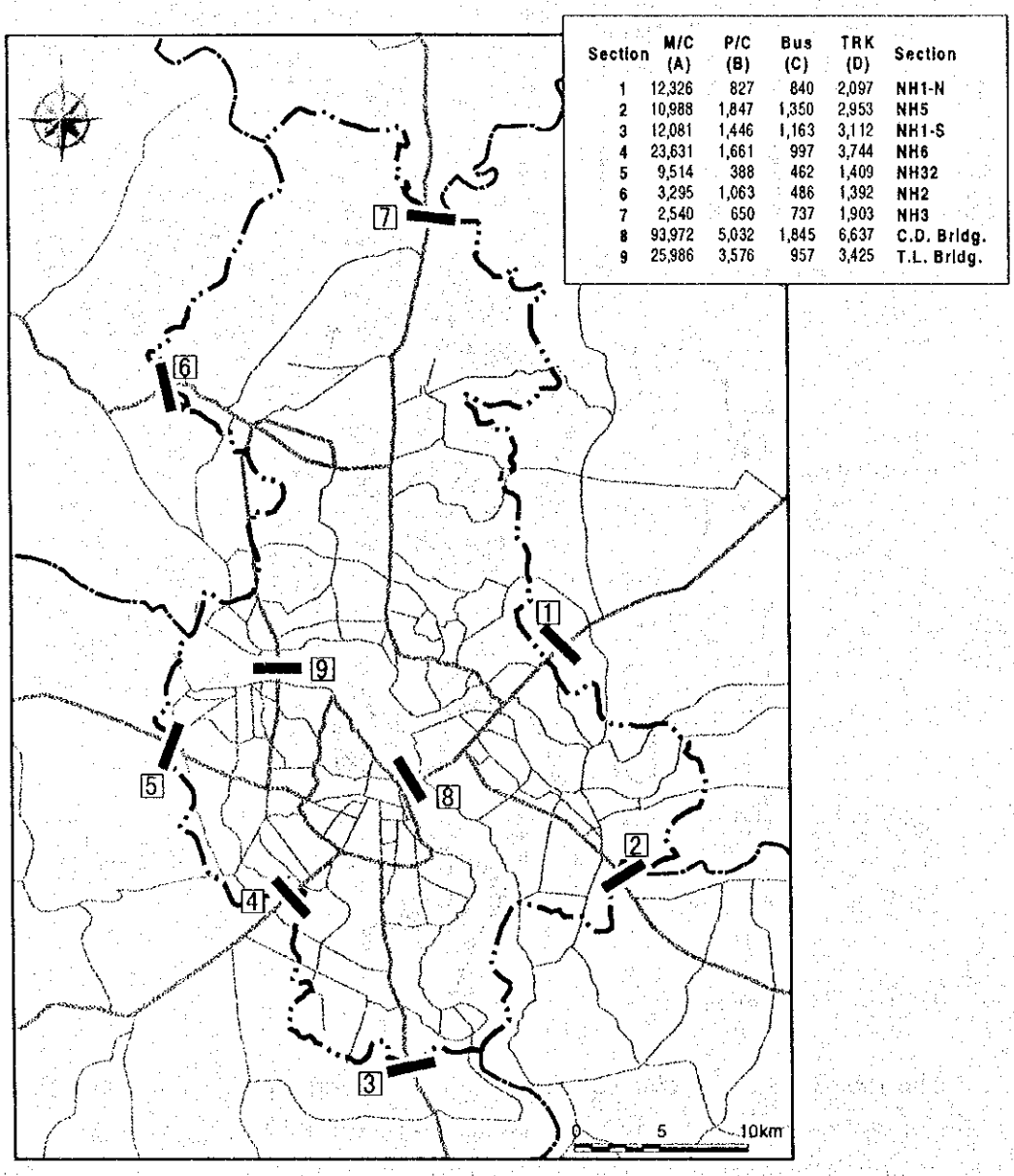
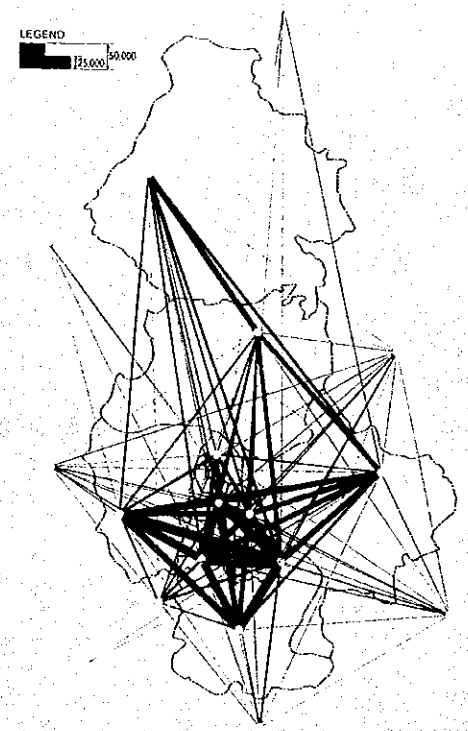



**Figure 4.3.2 Estimated 1997 Cordon/Screen-Line Traffic Volume**

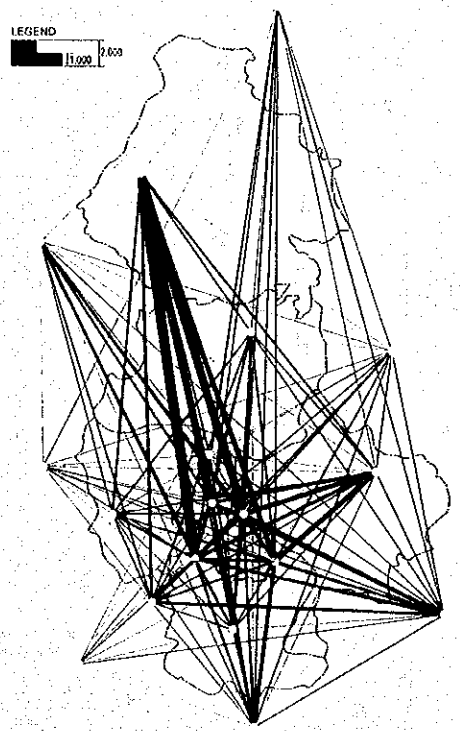
# Table 4.3.1 1997 O-D Tables

| Motorcycle | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | sub | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | sub | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7631 | 3839 | 7807 | 6740 | 2197 | 1023 | 1246 | 3027 | 5316 | 5030 | 43856 | 1285 | 61 | 439 | 479 | 414 | 13 | 535 | 127 | 3353 | 47209 |
| 2 | 3845 | 5898 | 6377 | 5392 | 1428 | 1492 | 1928 | 2353 | 4323 | 4044 | 37080 | 1043 | 121 | 409 | 461 | 414 | 12 | 264 | 229 | 2956 | 40038 |
| 3 | 7869 | 6410 | 19692 | 11825 | 2907 | 2367 | 3906 | 4868 | 9079 | 8505 | 77720 | 2234 | 174 | 603 | 622 | 2199 | 25 | 398 | 306 | 6562 | 84282 |
| 4 | 6792 | 5436 | 11844 | 15469 | 2581 | 1171 | 1618 | 4396 | 7784 | 7305 | 64596 | 1976 | 70 | 760 | 728 | 371 | 18 | 819 | 353 | 5094 | 69689 |
| 5 | 2182 | 1416 | 2958 | 2546 | 2987 | 420 | 489 | 1134 | 2084 | 1947 | 18161 | 451 | 34 | 124 | 255 | 61 | 3 | 161 | 41 | 1161 | 19323 |
| 6 | 1028 | 1695 | 2382 | 1158 | 485 | 24673 | 5436 | 2996 | 1247 | 474 | 41554 | 138 | 59 | 104 | 85 | 21 | 0 | 75 | 42 | 524 | 42078 |
| 7 | 1245 | 1895 | 3954 | 1923 | 593 | 5480 | 19782 | 3940 | 1602 | 1350 | 41764 | 330 | 65 | 227 | 184 | 43 | 2 | 175 | 105 | 1131 | 42895 |
| 8 | 3666 | 7564 | 5670 | 5213 | 1520 | 2885 | 4470 | 33095 | 3640 | 2676 | 70399 | 802 | 416 | 136 | 546 | 88 | 72 | 127 | 44 | 2232 | 72631 |
| 9 | 5258 | 4288 | 8929 | 7658 | 2080 | 1161 | 1546 | 3464 | 29047 | 6267 | 69698 | 1472 | 24 | 444 | 359 | 42 | 2 | 640 | 156 | 3139 | 72836 |
| 10 | 4902 | 3984 | 8347 | 7143 | 1935 | 421 | 1286 | 2535 | 6246 | 25841 | 62639 | 1376 | 5 | 229 | 186 | 124 | 1 | 145 | 35 | 2100 | 64739 |
| sub | 44410 | 42425 | 78137 | 65067 | 18793 | 41113 | 41907 | 61808 | 70383 | 63438 | 527467 | 11138 | 1029 | 3474 | 3908 | 3776 | 148 | 3339 | 1438 | 28251 | 555718 |
| 11 | 1312 | 1066 | 2273 | 2000 | 493 | 141 | 336 | 802 | 1613 | 1422 | 11358 | 1773 | 0 | 0 | 174 | 0 | 0 | 0 | 0 | 1947 | 13304 |
| 12 | 86 | 193 | 234 | 102 | 19 | 57 | 83 | 502 | 26 | 12 | 1314 | 0 | 3272 | 21 | 17 | 11 | 6 | 21 | 12 | 3362 | 4676 |
| 13 | 628 | 1372 | 1080 | 1123 | 177 | 151 | 325 | 288 | 854 | 715 | 6512 | 0 | 30 | 505 | 256 | 113 | 7 | 700 | 220 | 1831 | 8343 |
| 14 | 536 | 1139 | 699 | 872 | 143 | 121 | 264 | 156 | 624 | 266 | 4821 | 87 | 25 | 256 | 1135 | 92 | 6 | 569 | 176 | 2347 | 7168 |
| 15 | 223 | 255 | 419 | 406 | 81 | 19 | 40 | 511 | 145 | 358 | 2457 | 64 | 14 | 79 | 64 | 100 | 5 | 66 | 16 | 408 | 2864 |
| 16 | 61 | 63 | 77 | 59 | 7 | 1 | 9 | 358 | 10 | 5 | 649 | 0 | 10 | 13 | 10 | 4 | 0 | 0 | 0 | 37 | 686 |
| 17 | 486 | 459 | 667 | 835 | 137 | 86 | 193 | 209 | 469 | 253 | 3813 | 0 | 18 | 490 | 399 | 89 | 0 | 0 | 0 | 995 | 4808 |
| 18 | 126 | 108 | 168 | 205 | 33 | 50 | 114 | 66 | 157 | 64 | 1090 | 20 | 10 | 153 | 125 | 21 | 0 | 8 | 0 | 338 | 1428 |
| sub | 3458 | 4656 | 5616 | 5601 | 1090 | 625 | 1363 | 2892 | 3618 | 3095 | 32013 | 1944 | 3380 | 1518 | 2179 | 430 | 24 | 1364 | 424 | 11265 | 43278 |
| Total | 47867 | 47080 | 83754 | 70669 | 19883 | 41737 | 43270 | 64700 | 73988 | 66533 | 559480 | 13082 | 4409 | 4992 | 6088 | 4206 | 172 | 4703 | 1864 | 39515 | 598996 |
| Pass. Car | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | sub | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | sub | Total |
| 1 | 0 | 35 | 10 | 48 | 0 | 312 | 19 | 108 | 4 | 3 | 539 | 32 | 37 | 26 | 137 | 141 | 13 | 15 | 72 | 472 | 1012 |
| 2 | 35 | 32 | 80 | 127 | 15 | 376 | 67 | 96 | 51 | 49 | 929 | 63 | 47 | 63 | 84 | 125 | 15 | 11 | 24 | 431 | 1360 |
| 3 | 11 | 60 | 32 | 113 | 6 | 245 | 52 | 81 | 24 | 24 | 649 | 75 | 28 | 29 | 81 | 220 | 8 | 8 | 35 | 483 | 1132 |
| 4 | 48 | 127 | 113 | 182 | 25 | 497 | 80 | 108 | 76 | 75 | 1331 | 114 | 49 | 26 | 94 | 119 | 8 | 36 | 116 | 563 | 1894 |
| 5 | 0 | 15 | 6 | 25 | 0 | 33 | 13 | 11 | 4 | 3 | 110 | 16 | 9 | 15 | 24 | 34 | 3 | 8 | 23 | 131 | 241 |
| 6 | 214 | 217 | 113 | 268 | 53 | 30 | 49 | 115 | 57 | 31 | 1146 | 170 | 8 | 10 | 23 | 7 | 0 | 3 | 2 | 223 | 1369 |
| 7 | 19 | 83 | 52 | 80 | 13 | 49 | 40 | 60 | 79 | 54 | 529 | 38 | 25 | 4 | 7 | 8 | 3 | 3 | 11 | 99 | 627 |
| 8 | 196 | 247 | 314 | 159 | 11 | 38 | 40 | 130 | 43 | 49 | 1166 | 43 | 22 | 26 | 15 | 32 | 5 | 4 | 4 | 152 | 1318 |
| 9 | 4 | 51 | 24 | 76 | 4 | 106 | 57 | 67 | 26 | 23 | 439 | 36 | 11 | 17 | 82 | 11 | 3 | 8 | 10 | 178 | 617 |
| 10 | 3 | 49 | 23 | 75 | 3 | 43 | 55 | 30 | 23 | 16 | 320 | 36 | 8 | 12 | 5 | 19 | 3 | 10 | 5 | 95 | 415 |
| sub | 470 | 935 | 767 | 1152 | 130 | 1732 | 473 | 787 | 387 | 327 | 7159 | 621 | 241 | 228 | 552 | 716 | 58 | 108 | 303 | 2827 | 9986 |
| 11 | 32 | 63 | 75 | 114 | 16 | 47 | 38 | 43 | 36 | 36 | 498 | 0 | 0 | 41 | 94 | 0 | 0 | 0 | 31 | 167 | 665 |
| 12 | 35 | 29 | 42 | 35 | 10 | 8 | 16 | 23 | 1 | 10 | 209 | 0 | 247 | 14 | 24 | 32 | 3 | 10 | 9 | 339 | 548 |
| 13 | 67 | 63 | 45 | 61 | 20 | 15 | 6 | 31 | 12 | 4 | 324 | 0 | 20 | 39 | 29 | 23 | 2 | 21 | 20 | 153 | 477 |
| 14 | 119 | 118 | 106 | 144 | 54 | 30 | 10 | 54 | 34 | 16 | 685 | 141 | 34 | 29 | 69 | 39 | 47 | 35 | 33 | 447 | 1132 |
| 15 | 73 | 41 | 57 | 64 | 54 | 27 | 11 | 0 | 33 | 31 | 391 | 8 | 23 | 47 | 43 | 37 | 3 | 5 | 5 | 172 | 563 |
| 16 | 10 | 5 | 5 | 0 | 5 | 0 | 3 | 0 | 0 | 3 | 30 | 0 | 5 | 4 | 9 | 3 | 0 | 0 | 0 | 21 | 51 |
| 17 | 16 | 34 | 22 | 22 | 13 | 9 | 4 | 7 | 8 | 2 | 136 | 0 | 12 | 14 | 25 | 14 | 0 | 0 | 9 | 73 | 209 |
| 18 | 91 | 122 | 107 | 108 | 18 | 8 | 4 | 25 | 38 | 2 | 522 | 62 | 11 | 14 | 23 | 19 | 0 | 0 | 0 | 130 | 652 |
| sub | 443 | 474 | 459 | 548 | 190 | 145 | 92 | 182 | 161 | 103 | 2796 | 212 | 352 | 202 | 336 | 167 | 55 | 71 | 107 | 1501 | 4297 |
| Total | 913 | 1409 | 1226 | 1701 | 319 | 1876 | 564 | 969 | 549 | 429 | 9955 | 833 | 593 | 430 | 888 | 883 | 113 | 178 | 410 | 4328 | 14283 |
| Bus | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | sub | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | sub | Total |
| 1 | 4 | 7 | 30 | 18 | 0 | 19 | 0 | 1 | 0 | 0 | 79 | 53 | 11 | 23 | 48 | 37 | 2 | 34 | 20 | 229 | 308 |
| 2 | 7 | 1 | 14 | 16 | 2 | 19 | 2 | 4 | 0 | 0 | 65 | 49 | 23 | 47 | 30 | 26 | 5 | 20 | 38 | 238 | 303 |
| 3 | 32 | 14 | 18 | 34 | 11 | 50 | 2 | 2 | 1 | 0 | 164 | 80 | 29 | 20 | 48 | 181 | 0 | 46 | 29 | 432 | 596 |
| 4 | 18 | 16 | 34 | 10 | 7 | 34 | 1 | 6 | 0 | 0 | 126 | 30 | 14 | 27 | 28 | 104 | 0 | 23 | 21 | 248 | 374 |
| 5 | 0 | 2 | 12 | 8 | 0 | 7 | 0 | 0 | 0 | 0 | 29 | 23 | 2 | 5 | 13 | 3 | 0 | 7 | 3 | 58 | 86 |
| 6 | 20 | 20 | 50 | 34 | 6 | 18 | 23 | 234 | 15 | 25 | 446 | 35 | 7 | 1 | 4 | 17 | 0 | 1 | 1 | 65 | 511 |
| 7 | 0 | 0 | 2 | 1 | 0 | 15 | 0 | 29 | 1 | 7 | 55 | 3 | 4 | 1 | 3 | 0 | 0 | 0 | 0 | 10 | 66 |
| 8 | 4 | 2 | 5 | 2 | 0 | 223 | 29 | 17 | 5 | 3 | 290 | 16 | 114 | 170 | 219 | 16 | 26 | 9 | 68 | 639 | 929 |
| 9 | 0 | 0 | 1 | 0 | 0 | 16 | 1 | 3 | 0 | 1 | 22 | 0 | 7 | 11 | 14 | 2 | 0 | 7 | 9 | 50 | 72 |
| 10 | 0 | 0 | 0 | 0 | 0 | 25 | 4 | 4 | 1 | 0 | 35 | 0 | 8 | 12 | 15 | 23 | 0 | 17 | 11 | 86 | 121 |
| sub | 85 | 63 | 166 | 123 | 26 | 427 | 62 | 300 | 22 | 36 | 1311 | 289 | 219 | 316 | 421 | 410 | 33 | 163 | 201 | 2054 | 3365 |
| 11 | 53 | 49 | 80 | 30 | 23 | 35 | 3 | 3 | 0 | 0 | 277 | 0 | 21 | 0 | 159 | 0 | 0 | 0 | 0 | 180 | 457 |
| 12 | 22 | 29 | 24 | 11 | 2 | 3 | 4 | 117 | 2 | 1 | 213 | 21 | 204 | 13 | 18 | 69 | 6 | 12 | 8 | 352 | 565 |
| 13 | 71 | 47 | 45 | 35 | 7 | 2 | 2 | 46 | 15 | 16 | 286 | 36 | 19 | 28 | 16 | 43 | 2 | 21 | 11 | 176 | 462 |
| 14 | 46 | 101 | 66 | 40 | 38 | 7 | 4 | 81 | 26 | 22 | 431 | 64 | 25 | 16 | 63 | 57 | 32 | 28 | 15 | 299 | 730 |
| 15 | 18 | 20 | 132 | 82 | 1 | 7 | 4 | 5 | 16 | 47 | 332 | 0 | 67 | 30 | 40 | 12 | 4 | 16 | 36 | 204 | 536 |
| 16 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 23 | 0 | 0 | 28 | 0 | 4 | 2 | 2 | 3 | 0 | 0 | 0 | 10 | 39 |
| 17 | 28 | 24 | 21 | 22 | 5 | 2 | 2 | 12 | 10 | 14 | 141 | 0 | 14 | 15 | 19 | 33 | 0 | 0 | 0 | 81 | 221 |
| 18 | 25 | 29 | 13 | 43 | 6 | 1 | 0 | 17 | 15 | 10 | 158 | 13 | 9 | 8 | 10 | 25 | 0 | 0 | 0 | 64 | 223 |
| sub | 264 | 302 | 383 | 263 | 81 | 56 | 18 | 304 | 84 | 109 | 1866 | 134 | 363 | 112 | 327 | 241 | 44 | 78 | 69 | 1367 | 3233 |
| Total | 349 | 365 | 549 | 386 | 107 | 483 | 80 | 604 | 106 | 145 | 3177 | 424 | 582 | 430 | 747 | 651 | 77 | 241 | 270 | 3421 | 6599 |
| Truck | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | sub | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | sub | Total |
| 1 | 7 | 2 | 340 | 126 | 2 | 19 | 24 | 32 | 39 | 196 | 787 | 74 | 40 | 49 | 73 | 60 | 11 | 42 | 42 | 391 | 1178 |
| 2 | 2 | 0 | 158 | 4 | 0 | 8 | 28 | 62 | 14 | 34 | 308 | 7 | 48 | 31 | 52 | 49 | 14 | 19 | 37 | 257 | 565 |
| 3 | 340 | 156 | 742 | 922 | 48 | 181 | 265 | 328 | 715 | 753 | 4450 | 561 | 81 | 84 | 133 | 281 | 0 | 88 | 115 | 1343 | 5792 |
| 4 | 126 | 4 | 922 | 80 | 21 | 114 | 41 | 45 | 319 | 449 | 2121 | 87 | 63 | 57 | 101 | 215 | 6 | 71 | 63 | 682 | 2803 |
| 5 | 2 | 0 | 48 | 21 | 4 | 17 | 12 | 12 | 21 | 46 | 182 | 20 | 17 | 10 | 18 | 32 | 3 | 16 | 12 | 126 | 308 |
| 6 | 25 | 13 | 181 | 92 | 14 | 89 | 148 | 163 | 88 | 174 | 988 | 73 | 15 | 18 | 24 | 5 | 9 | 30 | 20 | 194 | 1181 |
| 7 | 20 | 12 | 265 | 42 | 12 | 148 | 60 | 131 | 62 | 134 | 886 | 40 | 19 | 24 | 35 | 20 | 3 | 37 | 24 | 202 | 1088 |
| 8 | 58 | 25 | 296 | 91 | 32 | 163 | 163 | 217 | 91 | 135 | 1270 | 141 | 250 | 33 | 93 | 101 | 78 | 23 | 39 | 759 | 2029 |
| 9 | 39 | 14 | 715 | 319 | 21 | 83 | 62 | 83 | 161 | 513 | 2010 | 195 | 14 | 23 | 32 | 30 | 0 | 39 | 43 | 377 | 2387 |
| 10 | 196 | 34 | 763 | 449 | 46 | 184 | 134 | 102 | 517 | 439 | 2864 | 272 | 43 | 60 | 110 | 86 | 3 | 19 | 52 | 645 | 3499 |
| sub | 815 | 259 | 4418 | 2147 | 200 | 1005 | 936 | 1175 | 2026 | 2873 | 15855 | 1470 | 590 | 388 | 669 | 881 | 126 | 384 | 463 | 4975 | 20830 |
| 11 | 74 | 7 | 561 | 87 | 20 | 73 | 40 | 68 | 135 | 272 | 1397 | 1 | 9 | 69 | 58 | 20 | 0 | 0 | 0 | 157 | 1553 |
| 12 | 20 | 45 | 36 | 10 | 16 | 6 | 27 | 175 | 7 | 37 | 378 | 3 | 1138 | 73 | 91 | 189 | 14 | 55 | 37 | 1598 | 1976 |
| 13 | 66 | 35 | 158 | 70 | 14 | 26 | 37 | 55 | 35 | 86 | 582 | 36 | 104 | 67 | 99 | 147 | 23 | 104 | 73 | 852 | 1234 |
| 14 | 74 | 44 | 163 | 138 | 36 | 32 | 43 | 80 | 52 | 129 | 792 | 58 | 131 | 99 | 151 | 185 | 234 | 131 | 92 | 1079 | 1871 |
| 15 | 47 | 60 | 150 | 135 | 17 | 4 | 14 | 101 | 89 | 201 | 817 | 20 | 96 | 103 | 130 | 98 | 7 | 58 | 41 | 552 | 1369 |
| 16 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 45 | 0 | 8 | 56 | 3 | 13 | 69 | 30 | 14 | 0 | 0 | 15 | 144 | 200 |
| 17 | 39 | 20 | 45 | 39 | 10 | 18 | 24 | 43 | 23 | 57 | 318 | 0 | 70 | 72 | 92 | 98 | 0 | 0 | 0 | 332 | 650 |
| 18 | 28 | 32 | 54 | 45 | 11 | 12 | 21 | 33 | 46 | 43 | 325 | 67 | 47 | 51 | 64 | 69 | 0 | 34 | 0 | 333 | 658 |
| sub | 349 | 243 | 1165 | 525 | 125 | 171 | 209 | 599 | 448 | 832 | 4665 | 187 | 1607 | 602 | 714 | 821 | 277 | 382 | 258 | 4847 | 9512 |
| Total | 1164 | 502 | 5583 | 2672 | 325 | 1176 | 1145 | 1774 | 2474 | 3705 | 20520 | 1657 | 2197 | 990 | 1382 | 1701 | 403 | 766 | 726 | 9822 | 30342 |

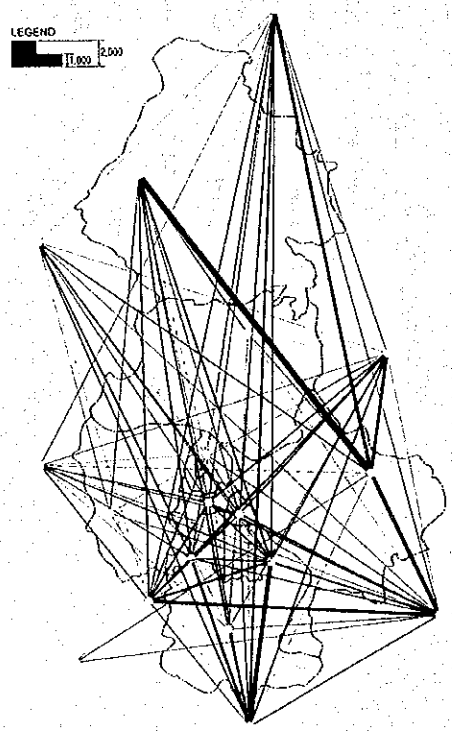
Motorcycle




Passenger Car




Bus




Truck

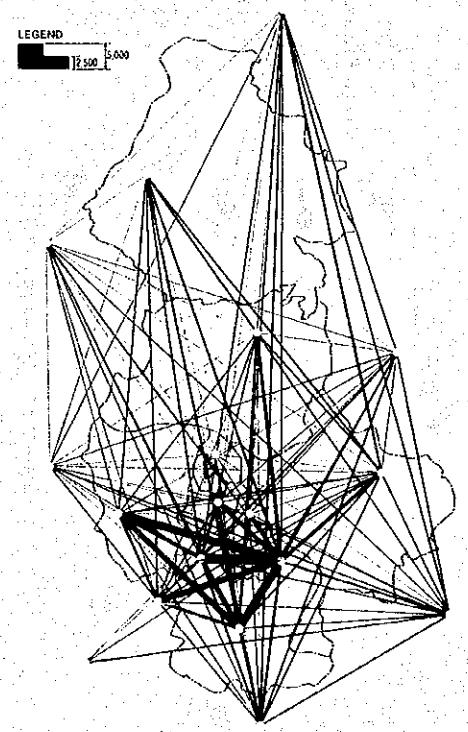



**Figure 4.3.3 1997 Desired Lines**

## 4.4 Future O-D Tables

Future O-D tables are the essential data for traffic volume forecast of the proposed RR3 section, and both O-D tables for the year 2010 and 2020 were estimated by considering the following three steps; traffic generation/attraction analysis, O-D distribution and modal split.

As future O-D tables for 2005 and 2015 had been estimated in HUTMP, each procedure and assumption applied were carefully reviewed and necessary updated information and alternative scenarios were prepared to estimate future O-D data, in 2010 and 2020, for this study.

### 4.4.1 Traffic Generation/Attraction Analysis

Generation/attraction model of vehicle trip was created, following almost the same procedure of traffic demand model analyses in HUTMP.

(1) Hanoi City

Population, number of workers and employment, etc., were estimated by traffic zone from the latest collected data as necessary data to update the model from 1995 to 1997. Furthermore, generation/attraction models by vehicle type were determined after correlation analysis between the socio-economic indicators and the generation/attraction volume of the 1997 O-D table. At the same time, the estimated growths of total generation/attraction volume in HUTMP were also reviewed for reference of future control total volume.

(2) Outside of Hanoi

Since there were not sufficient data for the area outside of Hanoi, the elasticity between the growth of traffic volume and those of socio-economic factors by province such as population, employment, GRDP, etc. were examined from the 2005 and 2015 O-D tables in HUTMP.

**Table 4.4.1 Parameters of Generation/Attraction Model**

| Mode | Correlation Coefficient | Constant Value | Population | | Employment | |
|---|---|---|---|---|---|---|
| | | | Coefficient | t-value | Coefficient | t-value |
| Generation | | | | | | |
| Motorcycle | 0.9213 | 3.6645E+03 | 1.1636E-01 | 6.932 | 8.8588E-02 | 4.903 |
| Pass. Car | 0.8800 | -6.1064E+00 | 2.7292E-03 | 4.417 | 3.7231E-03 | 4.838 |
| Bus | 0.8489 | -5.3528E+00 | 7.6569E-04 | 3.652 | 8.3323E-04 | 3.759 |
| Truck | 0.6147 | 5.4893E+01 | 3.6898E-03 | 1.551 | 1.2256E-02 | 3.777 |
| Attraction | | | | | | |
| Motorcycle | 0.9373 | 3.2733E+03 | 1.1817E-01 | 7.009 | 1.1706E-01 | 6.450 |
| Pass. Car | 0.9171 | -5.1762E+00 | 2.1807E-03 | 4.190 | 4.6937E-03 | 7.242 |
| Bus | 0.8741 | -4.2590E+00 | 7.5494E-04 | 3.484 | 1.1008E-03 | 4.805 |
| Truck | 0.6003 | 6.2407E+01 | 3.5308E-03 | 1.439 | 1.2309E-02 | 3.679 |

### 4.4.2 Future Socio-Economic Indicators

Future socio-economic indicators by zone to apply the traffic generation/attraction model were forecast based on the results in HUTMP and newly proposed Hanoi Master Plan 2020. The results are summarized in Table 4.4.2.

### 4.4.3 O-D Distribution and Modal Split

(1) O-D Distribution

For the year 2010, the distribution pattern obtained as the intermediate case between the 2005 and 2015 O-Ds in HUTMP was selected, after comparison with the present pattern O-D. Meanwhile, 2015 O-D distribution pattern in HUTMP was applied for 2020, as conceptual future land use plan in 2015 (HUTMP) is quite similar to the land use of new Hanoi Master Plan 2020.

(2) Modal Split

As a modal split, especially transfer from motorcycle to passenger car in the future, was also carefully examined in HUTMP, additional alternative cases were examined both for 2010 and 2020.

## Table 4.4.2 Estimated Socio-Economic Indicators, 2010 and 2020

| | 1997 | | | 2010 | | | 2020 | | |
|---|---|---|---|---|---|---|---|---|---|
| Zone | Population | Workers* | Employment | Population | Workers* | Employment | Population | Workers* | Employment |
| 1 | 60,106 | 27,450 | 67,990 | 51,070 | 22,762 | 68,442 | 42,034 | 18,075 | 68,894 |
| 2 | 43,557 | 19,892 | 18,231 | 52,831 | 23,298 | 15,624 | 62,105 | 26,705 | 13,017 |
| 3 | 43,208 | 19,732 | 14,052 | 33,394 | 14,936 | 23,926 | 23,581 | 10,140 | 33,800 |
| 4 | 32,530 | 14,856 | 4,412 | 29,655 | 13,185 | 17,883 | 26,779 | 11,515 | 31,355 |
| 5 | 181,000 | 82,660 | 169,945 | 144,850 | 64,700 | 201,367 | 108,700 | 46,741 | 232,789 |
| 6 | 71,798 | 32,789 | 27,645 | 46,010 | 20,742 | 35,289 | 20,223 | 8,696 | 42,933 |
| 7 | 77,497 | 35,392 | 82,947 | 59,597 | 26,661 | 76,348 | 41,697 | 17,930 | 69,750 |
| 8 | 183,805 | 83,941 | 59,805 | 183,543 | 81,376 | 44,636 | 183,280 | 78,811 | 29,467 |
| 9 | 92,925 | 42,438 | 10,794 | 71,310 | 31,903 | 10,635 | 49,695 | 21,369 | 10,476 |
| 10 | 67,792 | 30,960 | 60,800 | 71,866 | 31,807 | 73,354 | 75,939 | 32,654 | 85,907 |
| 11 | 41,194 | 18,813 | 5,173 | 33,093 | 14,780 | 3,391 | 24,993 | 10,747 | 1,609 |
| 12 | 57,216 | 26,130 | 19,985 | 59,086 | 26,170 | 20,330 | 60,956 | 26,211 | 20,675 |
| 13 | 54,620 | 24,944 | 27,465 | 63,653 | 28,099 | 20,294 | 72,686 | 31,255 | 13,122 |
| 14 | 60,453 | 27,608 | 20,504 | 50,142 | 22,368 | 17,187 | 39,831 | 17,128 | 13,869 |
| 15 | 25,029 | 11,431 | 3,397 | 24,144 | 10,716 | 2,463 | 23,258 | 10,001 | 1,529 |
| 16 | 35,231 | 16,090 | 8,979 | 32,927 | 14,629 | 7,695 | 30,624 | 13,168 | 6,411 |
| 17 | 22,339 | 10,202 | 6,951 | 23,829 | 10,544 | 4,053 | 25,318 | 10,887 | 1,155 |
| 18 | 30,510 | 2,961 | 2,098 | 27,602 | 2,458 | 1,632 | 24,694 | 1,956 | 1,166 |
| 19 | 120,507 | 11,695 | 10,570 | 135,260 | 21,780 | 50,059 | 150,013 | 31,864 | 89,549 |
| 20 | 80,283 | 7,791 | 5,525 | 73,288 | 6,771 | 11,681 | 66,294 | 5,751 | 17,838 |
| 21 | 26,908 | 3,917 | 1,790 | 23,975 | 2,854 | 1,392 | 21,041 | 1,791 | 995 |
| 22 | 60,978 | 8,877 | 4,056 | 54,330 | 7,183 | 3,154 | 47,683 | 5,489 | 2,253 |
| 23 | 36,127 | 5,259 | 10,369 | 70,340 | 20,237 | 52,671 | 104,553 | 35,215 | 94,972 |
| 24 | 34,084 | 4,962 | 2,268 | 30,762 | 3,785 | 1,782 | 27,441 | 2,608 | 1,297 |
| 25 | 40,706 | 5,926 | 3,845 | 36,269 | 4,318 | 2,674 | 31,831 | 2,710 | 1,503 |
| 26 | 13,650 | 1,987 | 907 | 12,162 | 1,448 | 705 | 10,674 | 909 | 503 |
| 27 | 32,148 | 4,680 | 2,138 | 65,062 | 19,070 | 51,893 | 97,977 | 33,460 | 101,647 |
| 28 | 52,929 | 12,841 | 3,776 | 48,664 | 11,535 | 2,937 | 44,400 | 10,228 | 2,097 |
| 29 | 14,713 | 3,570 | 1,049 | 13,528 | 3,206 | 816 | 12,342 | 2,843 | 583 |
| 30 | 18,964 | 4,601 | 4,767 | 32,498 | 11,061 | 3,471 | 46,032 | 17,522 | 2,175 |
| 31 | 48,880 | 11,859 | 9,121 | 108,678 | 37,444 | 40,233 | 168,476 | 63,029 | 71,346 |
| 32 | 29,566 | 7,173 | 8,900 | 27,511 | 6,212 | 5,636 | 25,456 | 5,251 | 2,372 |
| 33 | 29,566 | 7,173 | 8,900 | 27,511 | 6,212 | 5,636 | 25,456 | 5,251 | 2,372 |
| 34 | 44,630 | 10,828 | 21,391 | 41,206 | 9,238 | 64,897 | 37,781 | 7,649 | 108,403 |
| 35 | 32,535 | 7,894 | 2,321 | 29,914 | 7,090 | 1,805 | 27,292 | 6,287 | 1,289 |
| 36 | 36,316 | 8,811 | 2,592 | 33,391 | 7,915 | 2,016 | 30,465 | 7,018 | 1,439 |
| 37 | 87,814 | 25,566 | 7,671 | 153,009 | 52,931 | 49,946 | 218,205 | 80,295 | 92,221 |
| 38 | 25,902 | 7,541 | 1,926 | 60,873 | 22,381 | 3,667 | 95,844 | 37,221 | 5,408 |
| 39 | 41,522 | 12,089 | 5,362 | 121,303 | 46,078 | 9,523 | 201,083 | 80,067 | 13,684 |
| 40 | 32,070 | 9,337 | 6,369 | 40,920 | 12,898 | 5,830 | 49,769 | 16,459 | 5,291 |
| 41 | 27,674 | 8,057 | 3,766 | 176,095 | 71,667 | 32,601 | 324,516 | 135,277 | 61,436 |
| 42 | 28,054 | 8,168 | 7,778 | 24,941 | 6,615 | 4,505 | 21,829 | 5,063 | 1,232 |
| 43 | 10,463 | 3,046 | 778 | 21,159 | 7,566 | 1,287 | 31,855 | 12,085 | 1,797 |
| 44 | 42,765 | 10,376 | 6,577 | 36,958 | 7,766 | 4,167 | 31,151 | 5,157 | 1,757 |
| 45 | 11,771 | 2,856 | 4,285 | 10,173 | 2,138 | 2,384 | 8,575 | 1,420 | 484 |
| 46 | 17,103 | 4,150 | 2,403 | 77,038 | 29,876 | 6,076 | 136,972 | 55,603 | 9,750 |
| 47 | 29,114 | 7,064 | 6,704 | 85,432 | 31,204 | 7,351 | 141,750 | 55,344 | 7,997 |
| 48 | 26,287 | 6,378 | 5,358 | 119,456 | 46,371 | 27,621 | 212,625 | 86,365 | 49,884 |
| 49 | 17,453 | 4,234 | 1,291 | 15,083 | 3,360 | 1,004 | 12,713 | 2,486 | 717 |
| 50 | 41,246 | 10,007 | 3,054 | 35,646 | 7,942 | 2,374 | 30,046 | 5,876 | 1,694 |
| 51 | 24,060 | 5,837 | 4,055 | 48,264 | 17,269 | 4,072 | 72,467 | 28,700 | 4,089 |
| Total | 2,397,600 | 782,835 | 782,835 | 2,949,300 | 1,014,556 | 1,110,418 | 3,501,000 | 1,246,279 | 1,438,000 |

Note: * = Excluding primary sector

### 4.4.4 Future O-D Tables

Though five (5) O-D tables in total were examined in the course of the study, each one O-D table was selected as the base case; case 2 for 2010 and case 4 for 2020 respectively. (Table 4.4.3)

**Table 4.4.3 Alternatives of Future O-D Tables**

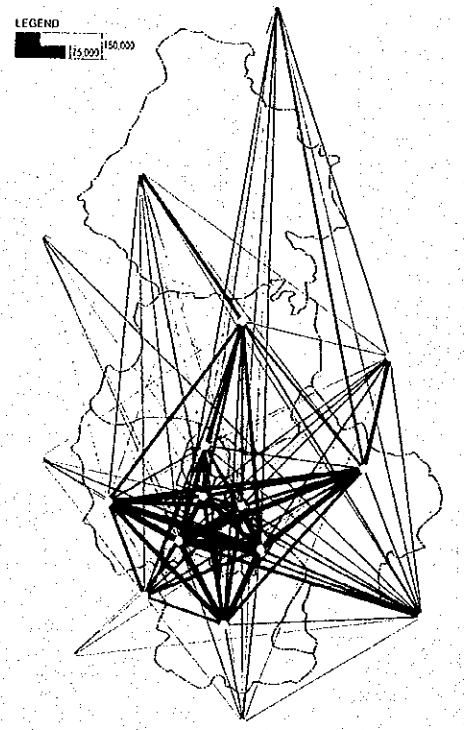
| Case | Year | | O-D Distribution | Modal Split | Total Volume (thousand) | |
|---|---|---|---|---|---|---|
| 1 | 2010 | 1 | Present Pattern | General Trend | Motorcycle | 1,545 |
| | | | | | Pass. Car | 69 |
| | | | | | Bus | 31 |
| | | | | | Truck | 107 |
| **2** | 2010 | 2 | 2005/2015 Pattern | General Trend | Motorcycle | 1,732 |
| | | | | | Pass. Car | 75 |
| | | | | | Bus | 36 |
| | | | | | Truck | 117 |
| 3 | 2010 | 3 | 2005/2015 Pattern | Additional Shift from M/C to Pass. Car | Motorcycle | 1,212 |
| | | | | | Pass. Car | 326 |
| | | | | | Bus | 36 |
| | | | | | Truck | 117 |
| **4** | 2020 | 1 | 2015 Pattern | General Trend | Motorcycle | 1,442 |
| | | | | | Pass. Car | 857 |
| | | | | | Bus | 64 |
| | | | | | Truck | 244 |
| 5 | 2020 | 2 | 2015 Pattern | Additional Shift from M/C to Bus | Motorcycle | 865 |
| | | | | | Pass. Car | 857 |
| | | | | | Bus | 116 |
| | | | | | Truck | 244 |

Each base case of future O-D tables is summarized both in the form of O-D matrix and desired lines in 18-zone system (Table 4.4.4/Figure 4.4.1 for 2010 and Table 4.4.5/Figure 4.4.2 for 2020).

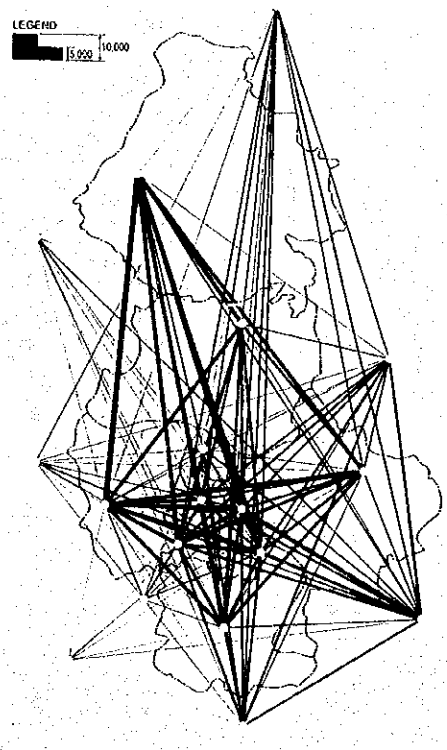
# Table 4.4.4 2010 O-D Tables

| Motorcycle | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | sub | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | sub | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19803 | 7423 | 13636 | 13399 | 4476 | 1026 | 6647 | 9076 | 10681 | 9443 | 95660 | 5278 | 1288 | 2128 | 4066 | 258 | 90 | 1197 | 764 | 15069 | 110729 |
| 2 | 6732 | 18120 | 10969 | 10359 | 2839 | 817 | 5864 | 7819 | 9511 | 8611 | 81641 | 4217 | 1325 | 2190 | 3595 | 292 | 84 | 658 | 358 | 12619 | 94260 |
| 3 | 14331 | 12768 | 48751 | 23535 | 5728 | 774 | 9498 | 15715 | 18746 | 18222 | 166166 | 8368 | 1879 | 3110 | 5239 | 850 | 164 | 834 | 529 | 20973 | 187139 |
| 4 | 13772 | 11861 | 23131 | 49154 | 5420 | 998 | 9499 | 15016 | 17432 | 15095 | 161378 | 8304 | 1513 | 2512 | 7198 | 795 | 136 | 1604 | 1021 | 23083 | 184461 |
| 5 | 4812 | 3418 | 6010 | 5817 | 9202 | 579 | 3116 | 4051 | 4657 | 3954 | 45616 | 2037 | 792 | 1311 | 1165 | 206 | 22 | 369 | 230 | 6135 | 51751 |
| 6 | 1061 | 895 | 766 | 1044 | 554 | 74021 | 10398 | 1054 | 1761 | 165 | 91719 | 974 | 857 | 1424 | 1164 | 23 | 1 | 265 | 166 | 4874 | 96593 |
| 7 | 6875 | 6640 | 9403 | 9630 | 2960 | 10855 | 83520 | 6064 | 8621 | 3098 | 147666 | 4066 | 985 | 1634 | 3171 | 85 | 23 | 772 | 492 | 11228 | 158894 |
| 8 | 9453 | 6960 | 15632 | 15236 | 3877 | 1107 | 6016 | 103377 | 9729 | 8238 | 181625 | 5487 | 5725 | 9479 | 1530 | 241 | 427 | 248 | 151 | 23288 | 204913 |
| 9 | 11274 | 10957 | 19022 | 18133 | 4521 | 1784 | 8722 | 9795 | 106845 | 12606 | 203639 | 8797 | 601 | 997 | 4556 | 260 | 18 | 1611 | 1021 | 17859 | 221498 |
| 10 | 10299 | 10265 | 17075 | 16319 | 3960 | 166 | 3192 | 8533 | 12939 | 85033 | 168721 | 7443 | 120 | 195 | 2293 | 620 | 10 | 353 | 225 | 11259 | 179980 |
| sub | 98412 | 91247 | 164445 | 162726 | 43535 | 92107 | 146472 | 180500 | 200922 | 163465 | 1343831 | 54971 | 15085 | 24986 | 33980 | 3630 | 973 | 7811 | 4957 | 146387 | 1490218 |
| 11 | 5549 | 4398 | 8624 | 8519 | 2005 | 997 | 4139 | 5927 | 8960 | 7251 | 56369 | 10869 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10869 | 67238 |
| 12 | 1761 | 2041 | 2480 | 2158 | 403 | 848 | 1252 | 7154 | 609 | 293 | 18999 | 0 | 1424 | 2354 | 923 | 344 | 262 | 296 | 189 | 5792 | 24791 |
| 13 | 2921 | 3375 | 4103 | 3582 | 664 | 1402 | 2063 | 11837 | 1018 | 470 | 31435 | 0 | 2354 | 3895 | 1529 | 570 | 435 | 491 | 312 | 9586 | 41021 |
| 14 | 6818 | 5042 | 7415 | 10232 | 1599 | 1693 | 4486 | 2270 | 6392 | 3190 | 48137 | 0 | 1321 | 2183 | 11005 | 1611 | 129 | 4234 | 2691 | 23174 | 71311 |
| 15 | 981 | 982 | 2054 | 1781 | 369 | 151 | 446 | 579 | 439 | 639 | 8415 | 0 | 488 | 772 | 1127 | 345 | 36 | 226 | 146 | 3120 | 11535 |
| 16 | 394 | 386 | 487 | 400 | 45 | 16 | 113 | 1284 | 84 | 38 | 3247 | 0 | 407 | 670 | 221 | 30 | 0 | 0 | 0 | 1328 | 4575 |
| 17 | 1068 | 948 | 1387 | 1920 | 300 | 312 | 846 | 426 | 1195 | 595 | 9017 | 0 | 248 | 411 | 2962 | 304 | 0 | 0 | 0 | 3925 | 12942 |
| 18 | 697 | 601 | 880 | 1220 | 193 | 199 | 534 | 264 | 759 | 382 | 5729 | 0 | 159 | 261 | 1886 | 194 | 0 | 0 | 0 | 2500 | 8229 |
| sub | 19209 | 17773 | 27430 | 29822 | 5578 | 5618 | 13873 | 29741 | 19456 | 12849 | 181348 | 10869 | 6381 | 10546 | 19653 | 3398 | 862 | 5247 | 3338 | 60294 | 241642 |
| Total | 117621 | 109020 | 191875 | 192548 | 49113 | 97725 | 160345 | 210241 | 220378 | 176313 | 1525179 | 65840 | 21466 | 35526 | 53633 | 7028 | 1835 | 13058 | 8295 | 206681 | 1731860 |
| Pass. Car | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | sub | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | sub | Total |
| 1 | 206 | 317 | 338 | 376 | 56 | 526 | 281 | 316 | 445 | 285 | 3144 | 51 | 201 | 326 | 346 | 513 | 32 | 77 | 46 | 1592 | 4736 |
| 2 | 298 | 185 | 459 | 509 | 83 | 670 | 313 | 424 | 622 | 436 | 3999 | 104 | 248 | 416 | 612 | 465 | 44 | 55 | 36 | 1980 | 5979 |
| 3 | 352 | 521 | 456 | 676 | 87 | 737 | 431 | 496 | 665 | 419 | 4740 | 120 | 173 | 287 | 446 | 593 | 30 | 57 | 41 | 1747 | 6487 |
| 4 | 406 | 587 | 590 | 518 | 88 | 834 | 444 | 571 | 697 | 443 | 5178 | 166 | 252 | 423 | 365 | 594 | 35 | 134 | 83 | 2052 | 7230 |
| 5 | 66 | 101 | 95 | 98 | 10 | 185 | 83 | 83 | 120 | 74 | 915 | 20 | 52 | 85 | 236 | 292 | 7 | 46 | 32 | 770 | 1685 |
| 6 | 424 | 555 | 573 | 626 | 130 | 561 | 559 | 551 | 857 | 552 | 5488 | 44 | 65 | 109 | 221 | 30 | 1 | 21 | 12 | 503 | 5991 |
| 7 | 300 | 358 | 442 | 446 | 77 | 899 | 288 | 433 | 620 | 411 | 4272 | 56 | 151 | 241 | 81 | 0 | 8 | 23 | 10 | 570 | 4842 |
| 8 | 342 | 486 | 520 | 582 | 83 | 737 | 451 | 458 | 757 | 497 | 4913 | 51 | 148 | 235 | 147 | 189 | 23 | 26 | 15 | 833 | 5746 |
| 9 | 518 | 753 | 748 | 770 | 120 | 1220 | 674 | 797 | 860 | 649 | 7109 | 140 | 107 | 194 | 203 | 35 | 18 | 99 | 69 | 865 | 7974 |
| 10 | 341 | 539 | 486 | 505 | 79 | 807 | 454 | 546 | 666 | 338 | 4763 | 110 | 83 | 117 | 116 | 55 | 19 | 48 | 32 | 579 | 5342 |
| sub | 3253 | 4402 | 4709 | 5005 | 813 | 7175 | 4078 | 4675 | 6309 | 4104 | 44521 | 862 | 1480 | 2433 | 2772 | 2766 | 217 | 585 | 376 | 11491 | 56012 |
| 11 | 49 | 109 | 115 | 171 | 17 | 39 | 58 | 67 | 142 | 99 | 866 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 866 |
| 12 | 212 | 159 | 257 | 190 | 51 | 59 | 65 | 157 | 14 | 65 | 1269 | 0 | 110 | 180 | 248 | 241 | 9 | 52 | 34 | 874 | 2143 |
| 13 | 353 | 259 | 425 | 314 | 68 | 92 | 131 | 265 | 17 | 150 | 2094 | 0 | 180 | 299 | 411 | 401 | 13 | 66 | 54 | 1444 | 3538 |
| 14 | 506 | 909 | 843 | 580 | 275 | 277 | 123 | 223 | 266 | 158 | 3960 | 0 | 354 | 584 | 858 | 496 | 12 | 332 | 210 | 2846 | 6806 |
| 15 | 398 | 280 | 220 | 276 | 247 | 242 | 53 | 0 | 0 | 286 | 2002 | 0 | 177 | 290 | 346 | 127 | 25 | 36 | 24 | 1025 | 3027 |
| 16 | 28 | 16 | 25 | 17 | 13 | 3 | 6 | 10 | 1 | 16 | 136 | 0 | 13 | 23 | 38 | 24 | 0 | 0 | 0 | 98 | 234 |
| 17 | 91 | 169 | 118 | 103 | 64 | 54 | 29 | 36 | 51 | 30 | 735 | 0 | 66 | 109 | 230 | 94 | 0 | 0 | 0 | 499 | 1234 |
| 18 | 60 | 105 | 70 | 86 | 31 | 32 | 16 | 21 | 27 | 19 | 447 | 0 | 41 | 69 | 148 | 59 | 0 | 0 | 0 | 315 | 762 |
| sub | 1697 | 2005 | 1873 | 1717 | 776 | 798 | 501 | 779 | 518 | 845 | 11509 | 0 | 941 | 1554 | 2277 | 1442 | 59 | 506 | 322 | 7101 | 18610 |
| Total | 4950 | 6407 | 6582 | 6722 | 1589 | 7973 | 4577 | 5454 | 6827 | 4949 | 56030 | 862 | 2421 | 3987 | 5049 | 4208 | 276 | 1091 | 698 | 18592 | 74622 |
| Bus | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | sub | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | sub | Total |
| 1 | 67 | 88 | 74 | 83 | 20 | 199 | 58 | 20 | 35 | 17 | 659 | 35 | 30 | 45 | 247 | 161 | 10 | 85 | 58 | 674 | 1333 |
| 2 | 93 | 121 | 145 | 93 | 15 | 251 | 65 | 25 | 40 | 24 | 872 | 37 | 64 | 106 | 336 | 84 | 26 | 75 | 47 | 775 | 1647 |
| 3 | 96 | 183 | 289 | 160 | 7 | 504 | 323 | 82 | 68 | 49 | 1761 | 61 | 86 | 147 | 316 | 1104 | 6 | 180 | 113 | 2013 | 3774 |
| 4 | 88 | 99 | 132 | 148 | 14 | 313 | 169 | 60 | 45 | 25 | 1093 | 30 | 45 | 69 | 304 | 489 | 4 | 79 | 45 | 1066 | 2159 |
| 5 | 20 | 17 | 6 | 14 | 2 | 65 | 15 | 6 | 10 | 3 | 158 | 14 | 4 | 8 | 77 | 16 | 1 | 19 | 11 | 150 | 308 |
| 6 | 245 | 317 | 476 | 369 | 77 | 11 | 45 | 241 | 505 | 265 | 2551 | 553 | 23 | 35 | 19 | 56 | 0 | 4 | 3 | 693 | 3244 |
| 7 | 64 | 80 | 270 | 172 | 16 | 42 | 2 | 149 | 173 | 270 | 1238 | 454 | 16 | 52 | 52 | 0 | 1 | 0 | 0 | 575 | 1813 |
| 8 | 20 | 26 | 63 | 61 | 6 | 329 | 225 | 1365 | 440 | 221 | 2776 | 118 | 343 | 582 | 139 | 58 | 92 | 32 | 17 | 1381 | 4157 |
| 9 | 39 | 45 | 65 | 49 | 12 | 473 | 185 | 372 | 94 | 83 | 1418 | 16 | 0 | 8 | 312 | 26 | 0 | 63 | 28 | 453 | 1871 |
| 10 | 17 | 32 | 43 | 26 | 3 | 247 | 278 | 181 | 81 | 47 | 955 | 10 | 12 | 39 | 254 | 142 | 0 | 75 | 51 | 583 | 1538 |
| sub | 749 | 1009 | 1563 | 1175 | 172 | 2434 | 1363 | 2521 | 1491 | 1004 | 13481 | 1331 | 624 | 1091 | 2056 | 2136 | 140 | 612 | 373 | 8363 | 21844 |
| 11 | 37 | 37 | 62 | 31 | 15 | 581 | 498 | 140 | 13 | 11 | 1425 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1425 |
| 12 | 24 | 83 | 73 | 36 | 6 | 7 | 15 | 358 | 14 | 0 | 616 | 0 | 87 | 144 | 133 | 288 | 12 | 32 | 22 | 718 | 1334 |
| 13 | 42 | 139 | 115 | 64 | 13 | 17 | 26 | 595 | 26 | 9 | 1046 | 0 | 144 | 239 | 221 | 479 | 22 | 54 | 34 | 1193 | 2239 |
| 14 | 389 | 486 | 447 | 438 | 77 | 30 | 66 | 211 | 348 | 329 | 2821 | 0 | 191 | 317 | 614 | 759 | 32 | 237 | 150 | 2300 | 5121 |
| 15 | 86 | 119 | 344 | 231 | 5 | 22 | 45 | 30 | 162 | 49 | 1093 | 0 | 278 | 458 | 531 | 41 | 60 | 72 | 45 | 1485 | 2578 |
| 16 | 4 | 20 | 15 | 5 | 1 | 1 | 3 | 88 | 2 | 1 | 138 | 0 | 12 | 21 | 20 | 40 | 0 | 0 | 0 | 93 | 231 |
| 17 | 80 | 93 | 84 | 85 | 14 | 8 | 14 | 43 | 56 | 68 | 545 | 0 | 38 | 60 | 164 | 145 | 0 | 0 | 0 | 407 | 952 |
| 18 | 49 | 58 | 56 | 52 | 11 | 4 | 0 | 23 | 35 | 38 | 326 | 0 | 24 | 40 | 105 | 93 | 0 | 0 | 0 | 262 | 588 |
| sub | 711 | 1035 | 1196 | 942 | 142 | 670 | 667 | 1488 | 656 | 505 | 8010 | 0 | 774 | 1279 | 1788 | 1845 | 126 | 395 | 251 | 6458 | 14468 |
| Total | 1460 | 2044 | 2759 | 2117 | 314 | 3104 | 2030 | 4007 | 2147 | 1509 | 21491 | 1331 | 1398 | 2370 | 3844 | 3981 | 266 | 1007 | 624 | 14821 | 36312 |
| Truck | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | sub | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | sub | Total |
| 1 | 312 | 71 | 1213 | 551 | 128 | 396 | 677 | 738 | 638 | 620 | 5374 | 90 | 273 | 455 | 412 | 238 | 31 | 125 | 74 | 1698 | 7072 |
| 2 | 81 | 12 | 328 | 77 | 34 | 102 | 212 | 194 | 180 | 118 | 1338 | 12 | 216 | 361 | 187 | 233 | 23 | 41 | 21 | 1094 | 2432 |
| 3 | 1294 | 310 | 1440 | 2173 | 237 | 629 | 1306 | 1255 | 2020 | 1140 | 11704 | 505 | 349 | 577 | 378 | 1119 | 4 | 171 | 110 | 3213 | 14917 |
| 4 | 586 | 69 | 2050 | 404 | 180 | 407 | 727 | 569 | 1332 | 932 | 7256 | 101 | 293 | 477 | 409 | 1096 | 13 | 187 | 121 | 2697 | 9953 |
| 5 | 125 | 29 | 221 | 176 | 48 | 144 | 194 | 251 | 206 | 185 | 1579 | 29 | 101 | 172 | 101 | 153 | 7 | 50 | 26 | 639 | 2218 |
| 6 | 399 | 91 | 504 | 406 | 148 | 455 | 672 | 894 | 606 | 436 | 4611 | 94 | 117 | 189 | 262 | 16 | 1 | 116 | 74 | 869 | 5480 |
| 7 | 676 | 187 | 1238 | 721 | 197 | 664 | 663 | 1470 | 772 | 579 | 7167 | 228 | 107 | 181 | 277 | 77 | 4 | 125 | 72 | 1071 | 8238 |
| 8 | 735 | 173 | 1196 | 584 | 255 | 679 | 1468 | 1153 | 1086 | 655 | 8166 | 62 | 1136 | 1888 | 272 | 259 | 86 | 49 | 36 | 3787 | 11953 |
| 9 | 645 | 164 | 1927 | 1343 | 211 | 606 | 778 | 1104 | 1178 | 1271 | 9227 | 239 | 70 | 122 | 219 | 139 | 3 | 98 | 56 | 946 | 10173 |
| 10 | 822 | 104 | 1079 | 932 | 186 | 435 | 583 | 663 | 1260 | 469 | 6333 | 222 | 134 | 217 | 350 | 207 | 5 | 32 | 24 | 1191 | 7524 |
| sub | 5475 | 1210 | 11196 | 7377 | 1624 | 4617 | 7260 | 8291 | 9280 | 6405 | 62755 | 1582 | 2796 | 4639 | 2867 | 3537 | 177 | 994 | 613 | 17205 | 79960 |
| 11 | 91 | 12 | 504 | 102 | 28 | 95 | 220 | 66 | 238 | 217 | 1573 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1577 |
| 12 | 146 | 201 | 148 | 50 | 102 | 49 | 132 | 909 | 31 | 134 | 1902 | 0 | 511 | 844 | 780 | 1216 | 29 | 164 | 106 | 3650 | 5552 |
| 13 | 239 | 334 | 241 | 75 | 163 | 89 | 213 | 1504 | 56 | 215 | 3129 | 0 | 844 | 1398 | 1289 | 2008 | 51 | 275 | 173 | 6038 | 9167 |
| 14 | 590 | 280 | 542 | 661 | 145 | 365 | 397 | 444 | 322 | 488 | 4224 | 0 | 1117 | 1846 | 1486 | 1710 | 87 | 565 | 359 | 7150 | 11374 |
| 15 | 149 | 95 | 339 | 470 | 107 | 17 | 25 | 214 | 71 | 497 | 1984 | 0 | 617 | 1020 | 1199 | 337 | 40 | 189 | 121 | 3523 | 5507 |
| 16 | 4 | 6 | 0 | 0 | 1 | 0 | 8 | 45 | 0 | 11 | 75 | 0 | 27 | 45 | 43 | 85 | 0 | 0 | 0 | 200 | 275 |
| 17 | 110 | 45 | 85 | 102 | 30 | 71 | 72 | 83 | 60 | 90 | 748 | 0 | 209 | 348 | 397 | 323 | 0 | 0 | 0 | 1276 | 2023 |
| 18 | 70 | 28 | 52 | 68 | 12 | 43 | 48 | 47 | 37 | 57 | 462 | 0 | 134 | 220 | 251 | 204 | 0 | 0 | 0 | 809 | 1271 |
| sub | 1399 | 1001 | 1911 | 1518 | 588 | 729 | 1115 | 3312 | 815 | 1709 | 14097 | 4 | 3459 | 5719 | 5425 | 5883 | 207 | 1193 | 759 | 22649 | 36746 |
| Total | 6874 | 2211 | 13107 | 8895 | 2212 | 5346 | 8395 | 11603 | 10095 | 8114 | 76852 | 1586 | 6255 | 10358 | 8292 | 9420 | 384 | 2187 | 1372 | 39854 | 116706 |

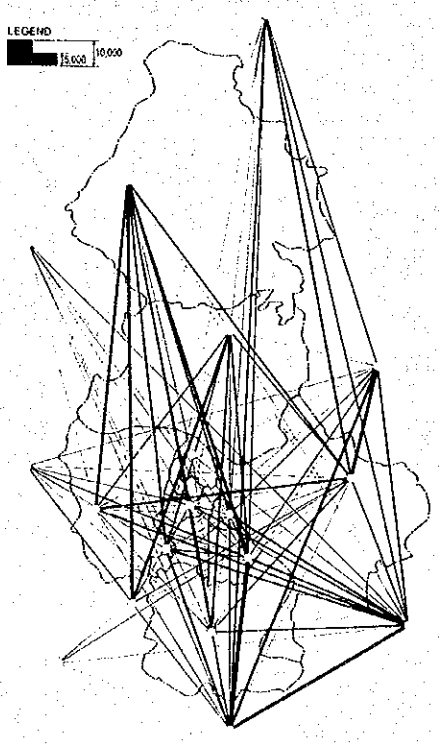
Motorcycle




Passenger Car




Bus




Truck

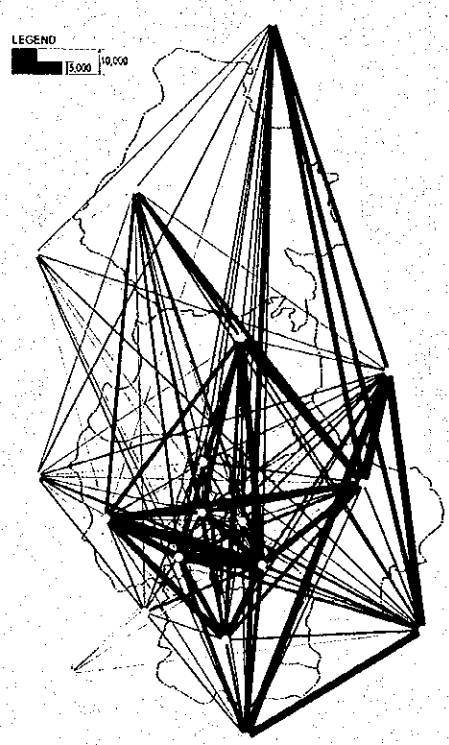
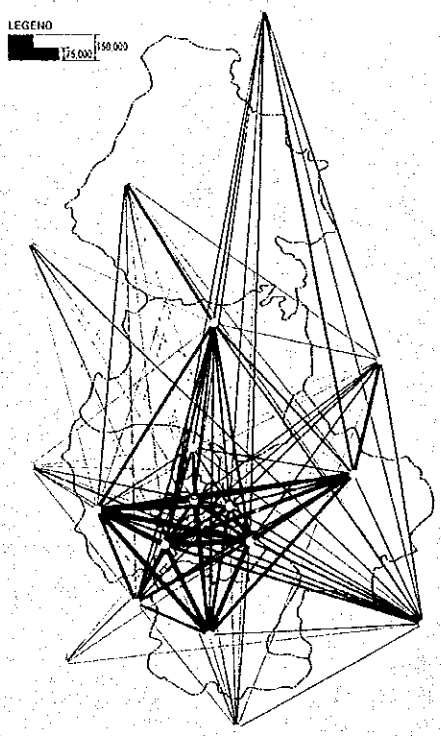



**Figure 4.4.1 Desired Lines, 2010**

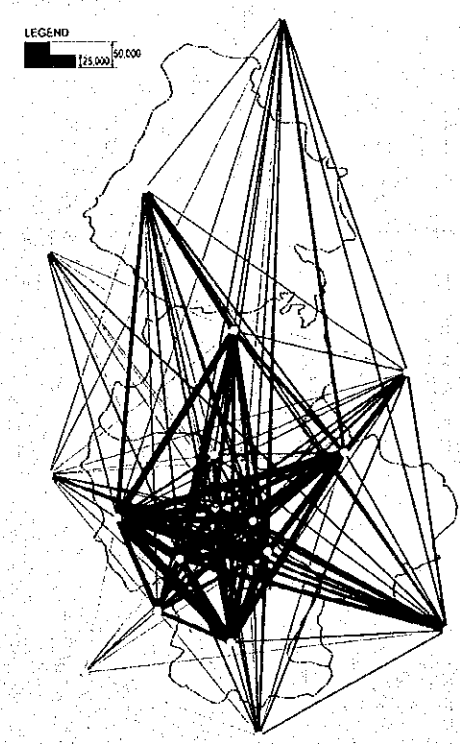
# Table 4.4.5 2020 O-D Tables

| Motorcycle | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | sub | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | sub | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14213 | 4773 | 8119 | 8380 | 2962 | 660 | 4773 | 6746 | 9411 | 7599 | 67636 | 4621 | 1136 | 1877 | 3508 | 228 | 87 | 1178 | 685 | 13420 | 81056 |
| 2 | 4254 | 11780 | 6208 | 6279 | 1719 | 500 | 3930 | 5371 | 8203 | 8718 | 54962 | 3609 | 1135 | 1874 | 3077 | 250 | 78 | 524 | 306 | 10853 | 65815 |
| 3 | 8683 | 7501 | 27923 | 13565 | 3256 | 438 | 6095 | 10794 | 14954 | 11665 | 104874 | 6932 | 1567 | 2593 | 4350 | 712 | 150 | 763 | 441 | 17508 | 122382 |
| 4 | 6731 | 7402 | 13151 | 31577 | 3247 | 605 | 6525 | 10949 | 14521 | 11472 | 103177 | 7127 | 1279 | 2121 | 6041 | 571 | 126 | 1462 | 850 | 19677 | 127854 |
| 5 | 3225 | 2143 | 3427 | 3524 | 8148 | 372 | 2210 | 2946 | 3844 | 3021 | 30860 | 1749 | 681 | 1127 | 1004 | 178 | 21 | 349 | 198 | 5307 | 36167 |
| 6 | 670 | 543 | 419 | 620 | 337 | 59342 | 7483 | 843 | 1547 | 131 | 71935 | 881 | 786 | 1305 | 1086 | 21 | 1 | 271 | 155 | 4506 | 76441 |
| 7 | 4823 | 4413 | 5776 | 6380 | 2008 | 7931 | 78142 | 4798 | 8394 | 2845 | 125510 | 3824 | 855 | 1418 | 3015 | 74 | 22 | 790 | 459 | 10457 | 135967 |
| 8 | 6916 | 6184 | 10335 | 10763 | 2716 | 904 | 4793 | 86410 | 9548 | 7656 | 146325 | 5063 | 4947 | 8187 | 1334 | 216 | 415 | 230 | 130 | 20522 | 166847 |
| 9 | 9981 | 9609 | 14973 | 15005 | 3667 | 1571 | 8589 | 9315 | 124971 | 13109 | 211390 | 9136 | 627 | 1039 | 4520 | 270 | 17 | 1771 | 1025 | 18405 | 229795 |
| 10 | 8354 | 8113 | 12137 | 12349 | 2988 | 135 | 3009 | 8083 | 13538 | 91404 | 160108 | 7421 | 118 | 190 | 2170 | 616 | 11 | 366 | 213 | 11105 | 171213 |
| sub | 69950 | 62461 | 102468 | 108442 | 29045 | 72458 | 125649 | 146752 | 209031 | 155820 | 1081777 | 50363 | 13131 | 21731 | 30205 | 3036 | 928 | 7704 | 4462 | 131760 | 1213537 |
| 11 | 4859 | 3789 | 7089 | 7275 | 1706 | 908 | 3519 | 5516 | 9317 | 7209 | 51587 | 11733 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11733 | 63320 |
| 12 | 1569 | 1759 | 2040 | 1827 | 342 | 809 | 1097 | 6233 | 622 | 276 | 16574 | 0 | 1538 | 2541 | 996 | 371 | 311 | 351 | 204 | 6312 | 22886 |
| 13 | 2602 | 2908 | 3374 | 3019 | 584 | 1339 | 1809 | 10311 | 1040 | 455 | 27421 | 0 | 2541 | 4205 | 1651 | 618 | 515 | 581 | 337 | 10446 | 37867 |
| 14 | 5193 | 4344 | 6116 | 6532 | 1364 | 1590 | 4286 | 1973 | 6332 | 3010 | 42740 | 0 | 1428 | 2356 | 11881 | 1739 | 152 | 5009 | 2905 | 25468 | 68208 |
| 15 | 865 | 846 | 1691 | 1462 | 315 | 138 | 435 | 500 | 456 | 593 | 7301 | 0 | 505 | 834 | 1217 | 372 | 43 | 267 | 157 | 3395 | 10696 |
| 16 | 386 | 365 | 440 | 366 | 42 | 15 | 112 | 1253 | 92 | 41 | 3112 | 0 | 461 | 793 | 262 | 35 | 0 | 0 | 0 | 1571 | 4683 |
| 17 | 1065 | 895 | 1255 | 1755 | 280 | 323 | 884 | 407 | 1297 | 814 | 8775 | 0 | 293 | 486 | 3505 | 359 | 0 | 0 | 0 | 4643 | 13418 |
| 18 | 622 | 518 | 726 | 1016 | 164 | 186 | 512 | 230 | 754 | 361 | 5089 | 0 | 172 | 282 | 2036 | 209 | 0 | 0 | 0 | 2699 | 7788 |
| sub | 17181 | 15424 | 22731 | 25252 | 4777 | 5308 | 13054 | 26423 | 19910 | 12559 | 162599 | 11733 | 6958 | 11497 | 21548 | 3701 | 1021 | 6208 | 3603 | 68267 | 298866 |
| Total | 87011 | 77885 | 125199 | 133694 | 33823 | 77766 | 138703 | 173175 | 228941 | 168379 | 1244376 | 62096 | 20087 | 33228 | 51753 | 6937 | 1949 | 13912 | 8065 | 198027 | 1442403 |
| Pass. Car | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | sub | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | sub | Total |
| 1 | 7214 | 2826 | 4400 | 4616 | 1510 | 1248 | 2936 | 3916 | 5582 | 4343 | 38991 | 2336 | 961 | 1574 | 2432 | 1165 | 118 | 740 | 424 | 9750 | 48441 |
| 2 | 2530 | 5987 | 3597 | 3781 | 942 | 1355 | 2563 | 3349 | 5539 | 4254 | 33877 | 1954 | 1041 | 1733 | 2704 | 1045 | 134 | 374 | 221 | 9206 | 43083 |
| 3 | 4700 | 4334 | 14033 | 7272 | 1673 | 1292 | 3762 | 6055 | 8640 | 6462 | 58223 | 3576 | 1080 | 1787 | 2934 | 1449 | 132 | 484 | 286 | 11728 | 69951 |
| 4 | 4838 | 4443 | 7088 | 15965 | 1687 | 1698 | 4089 | 6327 | 8642 | 6489 | 61266 | 3770 | 1098 | 1831 | 3591 | 1344 | 131 | 970 | 558 | 13293 | 74559 |
| 5 | 1653 | 1184 | 1770 | 1832 | 2988 | 443 | 1233 | 1594 | 2116 | 1614 | 16427 | 884 | 428 | 706 | 931 | 633 | 24 | 264 | 156 | 4026 | 20453 |
| 6 | 1073 | 1174 | 1026 | 1331 | 336 | 29824 | 5000 | 1857 | 3108 | 1461 | 45968 | 521 | 525 | 874 | 1011 | 79 | 3 | 185 | 102 | 3300 | 49268 |
| 7 | 2988 | 2878 | 3587 | 3982 | 1115 | 5668 | 38581 | 3536 | 6184 | 2682 | 71201 | 1975 | 712 | 1156 | 1634 | 36 | 29 | 436 | 242 | 6220 | 77421 |
| 8 | 4054 | 3873 | 5856 | 6237 | 1462 | 2098 | 3597 | 42876 | 6988 | 5108 | 82151 | 2564 | 2675 | 4407 | 913 | 438 | 248 | 162 | 90 | 11497 | 93648 |
| 9 | 6174 | 6611 | 8835 | 9040 | 2024 | 4152 | 6571 | 7249 | 83590 | 8611 | 122857 | 4775 | 558 | 969 | 2648 | 218 | 54 | 1131 | 666 | 11020 | 133877 |
| 10 | 4870 | 5212 | 6837 | 7059 | 1596 | 2158 | 2959 | 5496 | 8894 | 45269 | 90348 | 3654 | 248 | 362 | 1302 | 430 | 56 | 267 | 159 | 6678 | 97026 |
| sub | 40094 | 38522 | 57029 | 61095 | 15333 | 49934 | 71291 | 82057 | 119381 | 86293 | 621029 | 26210 | 9326 | 15399 | 20100 | 6837 | 929 | 5013 | 2904 | 86718 | 707747 |
| 11 | 2453 | 2053 | 3644 | 3848 | 857 | 524 | 2327 | 2817 | 4864 | 3718 | 26805 | 5679 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5679 | 32484 |
| 12 | 1190 | 1173 | 1462 | 1246 | 261 | 528 | 695 | 3287 | 339 | 347 | 10528 | 0 | 982 | 1618 | 1017 | 699 | 173 | 292 | 172 | 4953 | 15481 |
| 13 | 1974 | 1931 | 2419 | 2063 | 436 | 860 | 1122 | 5450 | 548 | 698 | 17401 | 0 | 1618 | 2680 | 1686 | 1163 | 279 | 484 | 281 | 8191 | 25592 |
| 14 | 3535 | 3938 | 4151 | 5198 | 1171 | 1387 | 2347 | 1348 | 3663 | 1781 | 28519 | 0 | 1454 | 2402 | 7603 | 1912 | 102 | 3209 | 1859 | 18541 | 47060 |
| 15 | 1301 | 975 | 1219 | 1286 | 596 | 632 | 307 | 244 | 221 | 997 | 7778 | 0 | 627 | 1029 | 1337 | 455 | 80 | 215 | 126 | 3871 | 11649 |
| 16 | 251 | 210 | 263 | 212 | 47 | 14 | 66 | 526 | 48 | 73 | 1810 | 0 | 263 | 438 | 218 | 75 | 0 | 0 | 0 | 994 | 2804 |
| 17 | 717 | 808 | 848 | 1054 | 246 | 287 | 501 | 269 | 753 | 363 | 5846 | 0 | 297 | 492 | 2241 | 397 | 0 | 0 | 0 | 3427 | 9273 |
| 18 | 422 | 463 | 482 | 615 | 136 | 161 | 285 | 149 | 428 | 214 | 3355 | 0 | 171 | 265 | 1301 | 229 | 0 | 0 | 0 | 1966 | 5341 |
| sub | 11843 | 11551 | 14488 | 15522 | 3750 | 4393 | 7350 | 14190 | 10864 | 8091 | 102042 | 5679 | 5412 | 8944 | 15403 | 4930 | 634 | 4200 | 2440 | 47642 | 149684 |
| Total | 51937 | 50073 | 71517 | 76617 | 19083 | 54327 | 78641 | 96247 | 130245 | 94384 | 723071 | 31889 | 14738 | 24343 | 35503 | 11767 | 1563 | 9213 | 5344 | 134360 | 857431 |
| Bus | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | sub | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | sub | Total |
| 1 | 128 | 149 | 98 | 136 | 23 | 228 | 76 | 28 | 99 | 31 | 996 | 66 | 51 | 79 | 446 | 298 | 18 | 168 | 103 | 1229 | 2225 |
| 2 | 151 | 214 | 189 | 130 | 28 | 276 | 96 | 42 | 90 | 56 | 1271 | 64 | 110 | 184 | 582 | 145 | 49 | 142 | 82 | 1358 | 2629 |
| 3 | 128 | 250 | 402 | 203 | 18 | 514 | 431 | 112 | 111 | 122 | 2291 | 100 | 141 | 240 | 519 | 1337 | 10 | 324 | 186 | 3357 | 5648 |
| 4 | 142 | 142 | 163 | 212 | 17 | 340 | 212 | 78 | 116 | 65 | 1487 | 49 | 77 | 116 | 488 | 817 | 8 | 142 | 71 | 1769 | 3255 |
| 5 | 25 | 29 | 14 | 18 | 3 | 67 | 19 | 8 | 32 | 10 | 225 | 23 | 7 | 13 | 130 | 25 | 1 | 34 | 18 | 251 | 476 |
| 6 | 275 | 340 | 456 | 385 | 76 | 13 | 60 | 294 | 1045 | 521 | 3465 | 997 | 44 | 68 | 38 | 90 | 0 | 8 | 7 | 1252 | 4737 |
| 7 | 85 | 110 | 341 | 219 | 18 | 73 | 11 | 276 | 447 | 687 | 2267 | 887 | 25 | 96 | 97 | 0 | 2 | 0 | 0 | 1107 | 3374 |
| 8 | 41 | 79 | 106 | 93 | 6 | 365 | 394 | 1833 | 881 | 344 | 4133 | 223 | 546 | 930 | 223 | 104 | 163 | 63 | 30 | 2282 | 6415 |
| 9 | 112 | 102 | 103 | 132 | 32 | 1021 | 473 | 787 | 290 | 211 | 3263 | 35 | 0 | 19 | 611 | 59 | 0 | 153 | 62 | 939 | 4202 |
| 10 | 35 | 66 | 102 | 68 | 9 | 504 | 723 | 312 | 210 | 105 | 2135 | 18 | 26 | 84 | 502 | 285 | 0 | 144 | 87 | 1146 | 3281 |
| sub | 1122 | 1472 | 1973 | 1597 | 230 | 3401 | 2515 | 3770 | 3321 | 2152 | 21553 | 2462 | 1027 | 1829 | 3636 | 3660 | 251 | 1178 | 646 | 14689 | 36242 |
| 11 | 64 | 84 | 99 | 49 | 23 | 1044 | 987 | 270 | 27 | 19 | 2646 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2646 |
| 12 | 42 | 144 | 118 | 60 | 10 | 13 | 24 | 558 | 29 | 0 | 998 | 0 | 189 | 310 | 288 | 623 | 28 | 76 | 47 | 1561 | 2557 |
| 13 | 73 | 240 | 185 | 107 | 20 | 32 | 40 | 927 | 54 | 18 | 1696 | 0 | 310 | 515 | 476 | 1034 | 51 | 127 | 73 | 2586 | 4282 |
| 14 | 704 | 840 | 721 | 700 | 124 | 60 | 126 | 335 | 669 | 621 | 4900 | 0 | 412 | 684 | 1328 | 1639 | 76 | 561 | 324 | 5022 | 9922 |
| 15 | 150 | 205 | 559 | 361 | 9 | 40 | 70 | 55 | 350 | 102 | 1921 | 0 | 599 | 989 | 1146 | 88 | 143 | 171 | 97 | 3233 | 5154 |
| 16 | 6 | 39 | 27 | 9 | 1 | 2 | 4 | 149 | 4 | 3 | 244 | 0 | 28 | 49 | 48 | 94 | 0 | 0 | 0 | 219 | 463 |
| 17 | 157 | 175 | 149 | 149 | 24 | 16 | 30 | 79 | 114 | 137 | 1030 | 0 | 90 | 142 | 389 | 342 | 0 | 0 | 0 | 963 | 1993 |
| 18 | 86 | 109 | 89 | 85 | 17 | 7 | 0 | 35 | 67 | 71 | 557 | 0 | 52 | 86 | 226 | 200 | 0 | 0 | 0 | 564 | 1121 |
| sub | 1282 | 1807 | 1945 | 1540 | 228 | 1214 | 1281 | 2408 | 1314 | 971 | 13990 | 0 | 1680 | 2775 | 3899 | 4020 | 298 | 935 | 541 | 14148 | 28138 |
| Total | 2404 | 3279 | 3918 | 3137 | 458 | 4615 | 3796 | 6178 | 4635 | 3123 | 35543 | 2462 | 2707 | 4604 | 7535 | 7680 | 549 | 2113 | 1187 | 28837 | 64380 |
| Truck | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | sub | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | sub | Total |
| 1 | 537 | 141 | 1490 | 971 | 187 | 855 | 1495 | 1566 | 1588 | 1391 | 10221 | 189 | 529 | 884 | 869 | 487 | 64 | 284 | 154 | 3460 | 13681 |
| 2 | 144 | 26 | 397 | 126 | 49 | 216 | 494 | 437 | 440 | 234 | 2563 | 23 | 436 | 727 | 377 | 468 | 52 | 91 | 42 | 2216 | 4779 |
| 3 | 1717 | 439 | 1416 | 2567 | 262 | 922 | 2520 | 2264 | 4034 | 2067 | 18208 | 906 | 634 | 1046 | 685 | 2008 | 6 | 338 | 195 | 5818 | 24026 |
| 4 | 978 | 126 | 2230 | 526 | 228 | 779 | 1473 | 1137 | 3026 | 1884 | 12387 | 198 | 532 | 867 | 751 | 2049 | 27 | 375 | 221 | 5019 | 17405 |
| 5 | 183 | 46 | 227 | 223 | 57 | 263 | 342 | 409 | 404 | 312 | 2463 | 52 | 185 | 312 | 185 | 281 | 12 | 100 | 49 | 1176 | 3639 |
| 6 | 856 | 210 | 832 | 777 | 266 | 1155 | 1276 | 2078 | 1691 | 1057 | 10698 | 197 | 258 | 411 | 604 | 35 | 3 | 293 | 171 | 1972 | 12670 |
| 7 | 1499 | 484 | 2257 | 1461 | 350 | 1774 | 1744 | 3879 | 2354 | 1578 | 17380 | 562 | 208 | 353 | 549 | 139 | 8 | 262 | 135 | 2216 | 19596 |
| 8 | 1562 | 426 | 2047 | 1135 | 411 | 2071 | 3880 | 2448 | 2967 | 1492 | 18439 | 137 | 2116 | 3521 | 505 | 485 | 174 | 97 | 63 | 7098 | 25537 |
| 9 | 1532 | 445 | 3547 | 3067 | 421 | 1676 | 2412 | 3046 | 4010 | 4132 | 24288 | 577 | 152 | 271 | 475 | 340 | 8 | 245 | 129 | 2198 | 26586 |
| 10 | 1408 | 230 | 1826 | 1900 | 316 | 1065 | 1591 | 1511 | 4119 | 1104 | 15072 | 489 | 276 | 449 | 776 | 482 | 13 | 73 | 46 | 2610 | 17682 |
| sub | 10516 | 2573 | 16269 | 12753 | 2549 | 10773 | 17727 | 18775 | 24633 | 15251 | 131819 | 3330 | 5328 | 8841 | 5778 | 6773 | 367 | 2159 | 1207 | 33783 | 165602 |
| 11 | 193 | 25 | 870 | 202 | 52 | 200 | 545 | 145 | 579 | 476 | 3287 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 3296 |
| 12 | 290 | 425 | 261 | 94 | 188 | 116 | 285 | 1722 | 76 | 306 | 3763 | 0 | 1103 | 1823 | 1685 | 2625 | 69 | 388 | 229 | 7922 | 11685 |
| 13 | 473 | 705 | 425 | 139 | 301 | 206 | 463 | 2849 | 135 | 492 | 6188 | 0 | 1823 | 3019 | 2782 | 4336 | 120 | 650 | 373 | 13103 | 19291 |
| 14 | 1248 | 593 | 939 | 1194 | 264 | 844 | 794 | 820 | 702 | 1080 | 8478 | 0 | 2412 | 3985 | 3166 | 3693 | 205 | 1338 | 776 | 15575 | 24053 |
| 15 | 307 | 201 | 593 | 864 | 200 | 41 | 45 | 382 | 172 | 1141 | 3946 | 0 | 1333 | 2201 | 2588 | 728 | 94 | 447 | 262 | 7653 | 11599 |
| 16 | 7 | 13 | 0 | 0 | 2 | 0 | 19 | 97 | 0 | 30 | 168 | 0 | 64 | 107 | 101 | 202 | 0 | 0 | 0 | 474 | 642 |
| 17 | 255 | 105 | 180 | 204 | 60 | 180 | 158 | 172 | 143 | 219 | 1656 | 0 | 496 | 818 | 939 | 765 | 0 | 0 | 0 | 3018 | 4674 |
| 18 | 148 | 80 | 89 | 125 | 22 | 99 | 99 | 86 | 84 | 130 | 942 | 0 | 289 | 476 | 542 | 441 | 0 | 0 | 0 | 1748 | 2690 |
| sub | 2921 | 2127 | 3337 | 2822 | 1089 | 1686 | 2408 | 6273 | 1891 | 3874 | 28428 | 9 | 7520 | 12429 | 11803 | 12790 | 488 | 2823 | 1640 | 49502 | 77930 |
| Total | 13437 | 4700 | 19606 | 15575 | 3638 | 12459 | 20135 | 25048 | 26524 | 19125 | 160247 | 3339 | 12848 | 21270 | 17581 | 19563 | 855 | 4982 | 2847 | 83285 | 243532 |

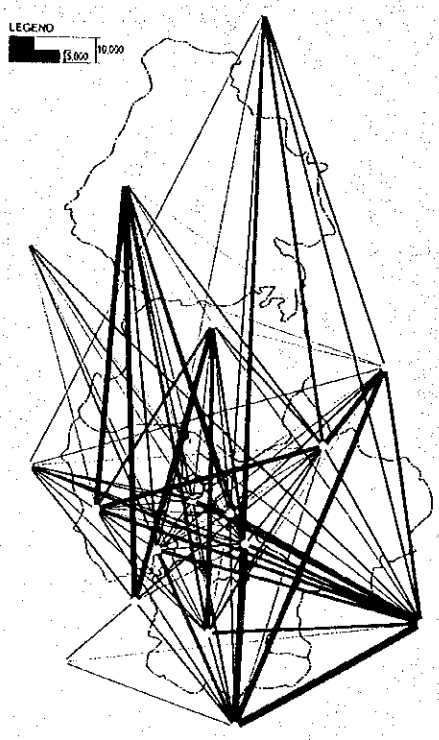
Motorcycle




Passenger Car




Bus




Truck

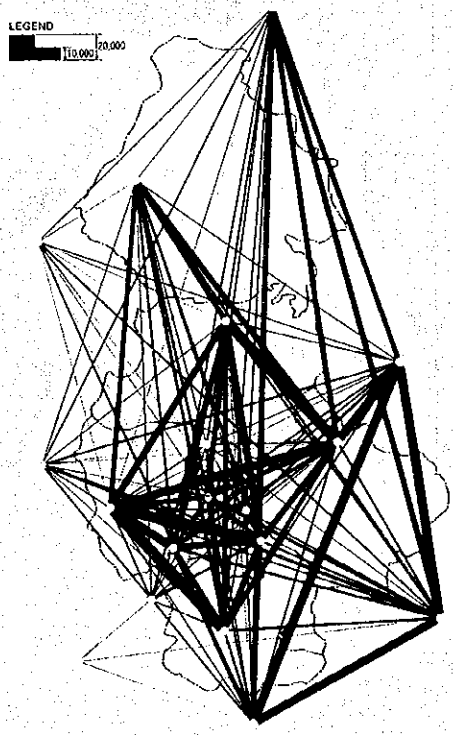



**Figure 4.4.2 Desired Lines, 2020**

## 4.5 Future Traffic Demand of Southern Section of Hanoi Third Ring Road (SHTRR)

The future traffic demand along the proposed SHTRR was forecast through traffic assignment simulation based on the future O-D tables estimated in the previous step and future road network.

### 4.5.1 Traffic Assignment

Basic road network for traffic assignment, of the years 2010 and 2020, were prepared as follows:

i) Fundamental network information within Hanoi City; such as length, width and location (x, y) of each link, was provided from that of HUTMP.

ii) Since most of the small urban streets in CBD are utilized by short-trips (intra-zone trips), they were integrated and represented by arterial roads, taking into consideration a balance between zoning system and density of network.

iii) Though the network of HUTMP included even small service-roads in the urbanized area of Hanoi, they were neglected or simplified and the arterial road network was formulated to cope with the purpose of the Study.

iv) Major highway projects related to the Study Area were considered in the future network as follows: Hanoi Third Ring Road (RR3), Duong Lang - Hoa Lac expressway (New City Road), New National Highway No.1 (North and South), National Highway No.18, etc. (Figure 4.5.1 and Table 4.5.1).

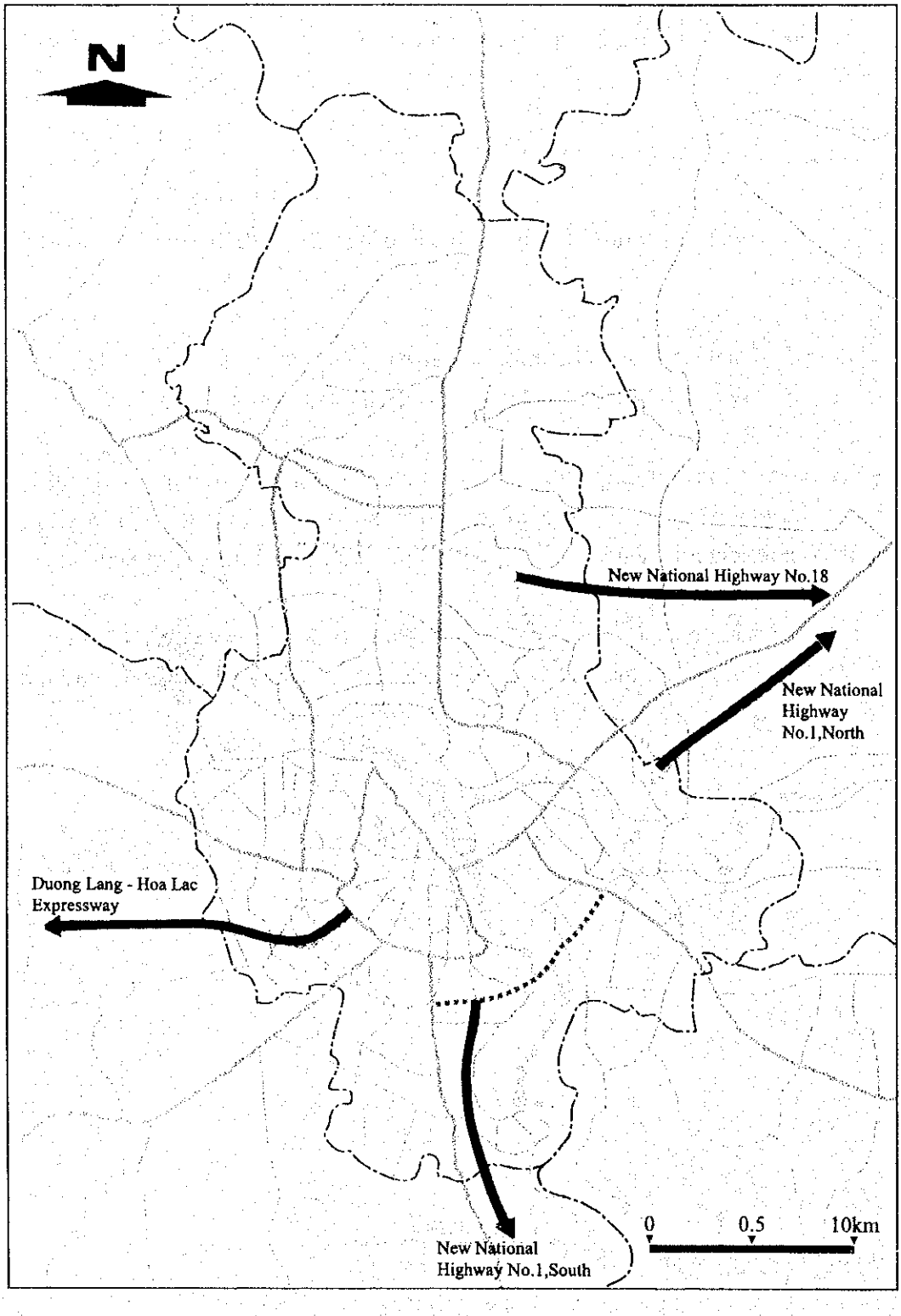



**Figure 4.5.1 Major Highway Projects**

**Table 4.5.1 Major Highway Projects**

| Name of Highway | Section | Approx. Length | Free/ Toll | 2010 No. of Lanes | 2020 No. of Lanes |
|---|---|---|---|---|---|
| Hanoi Third Ring Road (RR3) | A: NH2 - NH32 | 16Km | Toll | 4 (+ 2WV) | 4 |
| | B: NH32 - NH1 | 11Km | Toll | 4 (+ 2WV) | 6 |
| | C: NH1s - NH5 | 12Km | Toll | 4 (+ 2WV) | 6 |
| | D: NH5 - NH1n | 10Km | Toll | 4 | 6 |
| | D: NH1n - NH2 | 20Km | Toll | X | 4 |
| Duong Lang - Hoa Lac Expressway (New City Road) | | (32Km) | Toll | 4 | 6 |
| New National Highway No.1 North (ADB) | RR3 - NH1 | (30Km) | Toll | 4 | 4 |
| New National Highway No.1 South (WB, OECF) | NH1 - RR3 | (30Km) | Toll | 4 | 6 |
| New National Highway No.18 | RR3 - NH1 | (25Km) | Toll | X | 4 |

Source: Related Agencies

## 4.5.2 Results

(1) Summary

Though the purpose of the study is not to analyze overall traffic demand in Hanoi but to forecast the demand of SHTRR, some significant characteristics in general traffic demand flow can be observed by the results. They are;

i) Importance of RR3

Traffic assignment results can reveal a quite significant role of RR3 as an essential road of the arterial network in Hanoi as illustrated in Figure 4.5.2. The importance of RR3 might be immutable even in the case of incomplete circumferential network (without a northern portion) in 2010. Moreover, the figure suggests the traffic dispersal function of RR3 to and from NH1 south, NH5 and NH1 north.

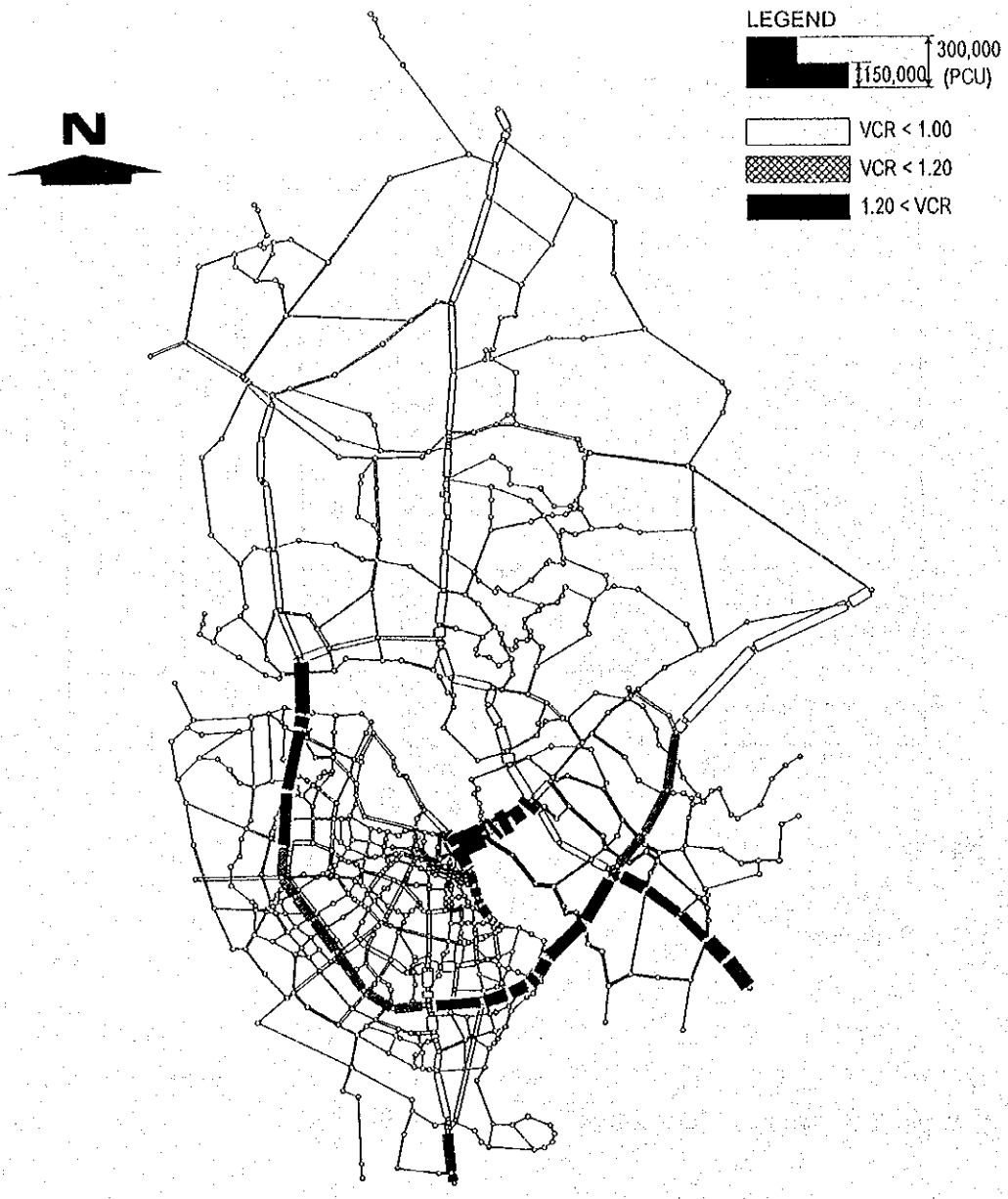



**Figure 4.5.2 Overall Traffic Demand in 2010**

ii) Increasing Traffic Demand across Red River

Total traffic demand across the Red River in 2010 is estimated in 300 thousand PCU, that is over 4 times comparing with 71 thousand in 1997. The demand will continue to concentrate to Chuong Duong bridge because of its advantageous location. This shows the necessity of the improvement of Chuong Duong bridge to increase its capacity as well as urgent construction of new Thanh Tri bridge.

(2) Traffic Volume of SHTRR

The total traffic demand of SHTRR is forecast to reach to 58 to 73 thousand PCU in 2010; that is, almost the same volume as the existing traffic volume at Chuong Duong bridge. It will reach to 86 to 112 thousand PCU (1.5 times of that in 2010) in 2020.

The composition by vehicle type in 2010 shows a dominant share by motorcycle even in PCU; 40 % by motorcycle, 10 % by passenger car, 15 % by bus and 35 % by truck. It is, therefore, desirable to provide a priority/exclusive lane for motorcycle separate from 4-wheel vehicles, in 2010.

(3) Traffic Volume of RR3 by Section

SHTRR is divided into two sections by the junction connected with New National Highway No. 1 South. The estimated traffic volumes by section are summarized in Table 4.5.2. The traffic demands of the proposed section are quite larger than those of the connecting sections (especially section 2 and B) in 2010. The volume of section 2 is largest and this reveals a certain traffic flow between New National Highway No. 1 South, Thanh Tri bridge and NH5.

**Table 4.5.2 Summary of Traffic Demand by Section, 2010**

| | | Section A | **Section 1** | **Section 2** | Section B |
|---|---|---|---|---|---|
| | | NH6 - NH1 south | **NH1 south- NH1 BP** | **NH1 BP - NH5** | NH5 - NH1 BP |
| 2010 | | | | | |
| | Motorcycle | 64,050 | **88,620** | **94,320** | 46,380 |
| | Pass. Car | 5,550 | **5,960** | **7,480** | 5,670 |
| | Bus | 4,180 | **3,910** | **5,520** | 3,200 |
| | Truck | 9,440 | **8,610** | **13,160** | 12,170 |
| | Total | 83,220 | **107,090** | **120,480** | 67,420 |
| | Total in PCU | 52,010 | **57,580** | **73,130** | 50,320 |

Detailed results of traffic demand in 2010 are shown in Figure 4.5.3; traffic volume of RR3 by section in PCU and number of vehicle, together with the volumes of the crossing road sections with RR3.

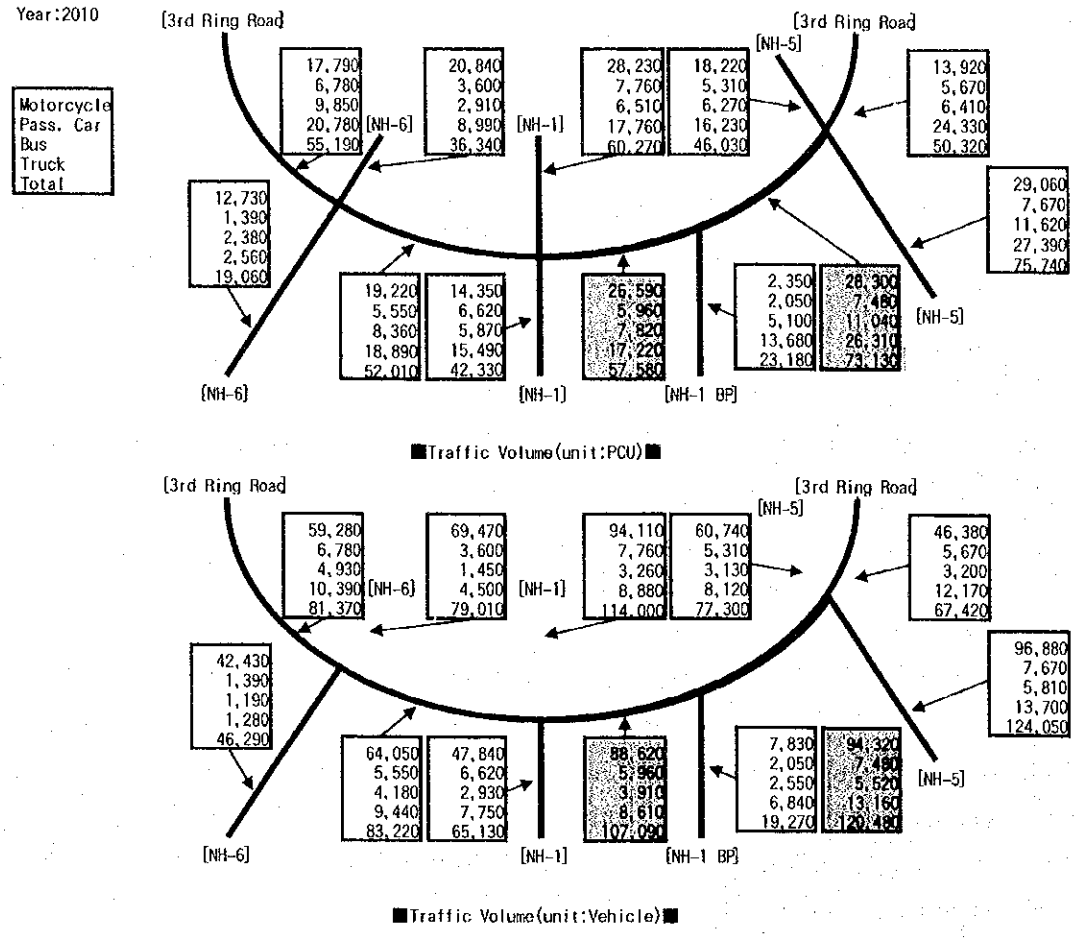



**Figure 4.5.3 Traffic Demand by Section, 2010**

(4) Traffic Volume at Junction and Interchange

Estimated traffic by each direction at junction with New NH1 South and two interchanges at NH1 and NH5 are illustrated in Figure 4.5.4. Major features of traffic flows are summarized as follows:

i) NH1 Interchange

Through traffic along both RR3 and NH1 are heaviest. Traffic between NH1-north and RR3-east are also heavier than other directions.

ii) New NH1 South Junction

Traffic between RR3-west and New NH1-south is significantly less than the other two directions.

iii) NH5 Interchange

The heaviest traffic flow (45 thousand PCU) is observed between RR3-west and NH5-east. The three other directional flows are almost the same volume of 20 thousand PCU; two through traffics and the traffic between RR3-east and NH5-west.

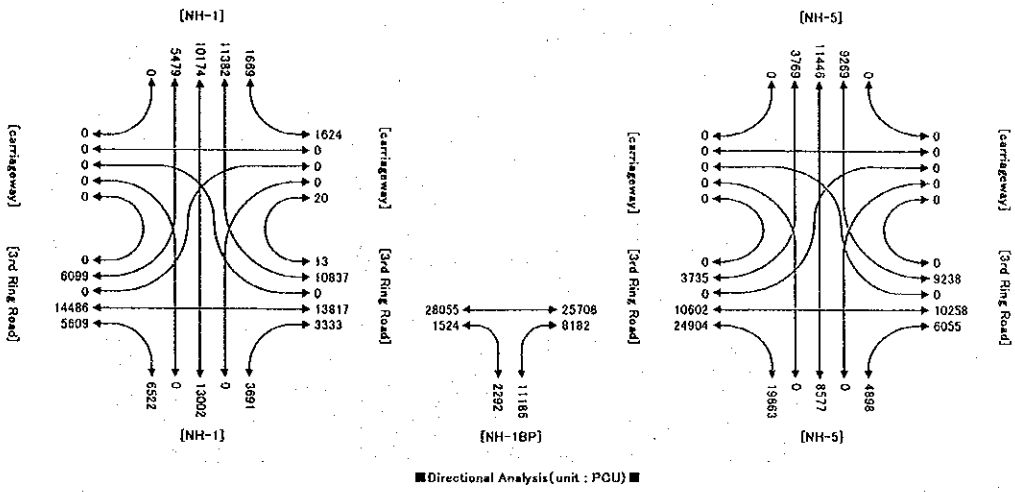



**Figure 4.5.4 Traffic Demand at Junction/Interchange, 2010**

(5) Traffic Demand in 2020

Though the target year of the study is 2010, an additional traffic demand for 2020 was also forecast as supplemental purposes, since the traffic demand structure in and around Hanoi might be changed to a certain extent after 2010.

Major results are as follows:

- The increased traffic demands for RR3, especially its southeast and west portions, are observed;
- Demands of 1.5 to 2.0 times of 2010, 86 to 112 PCU, are forecast along the SHTRR; and
- The composition by vehicle type is drastically changed from the dominant share by motorcycle in 2010; 15 % of motorcycle, 34 % of passenger car, 14% of bus and 37 % of truck (in PCU) in 2020, respectively.

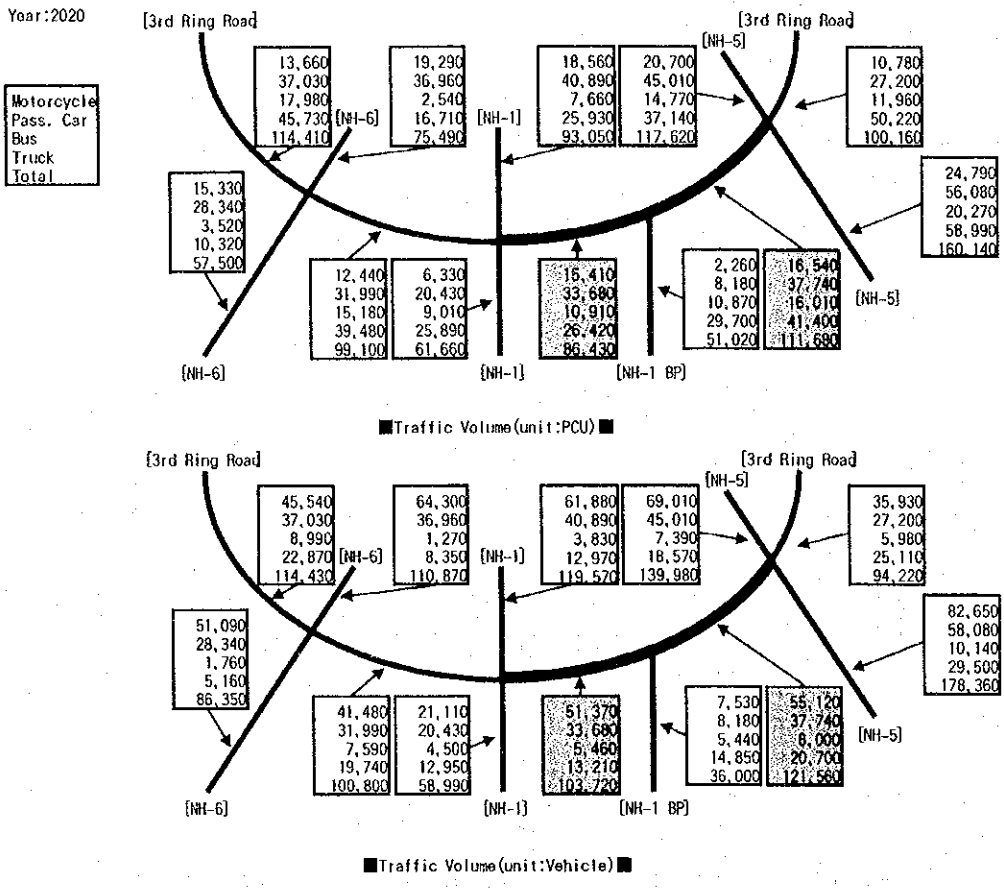



**Figure 4.5.5 Traffic Demand by Section, 2020**

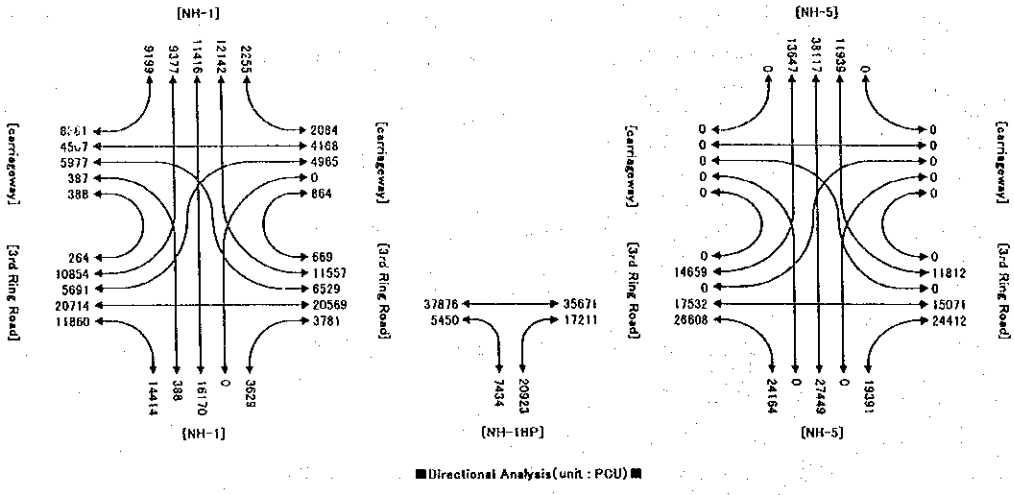



**Figure 4.5.6 Traffic Demand at Junction/Interchange, 2020**