# Ⅲ. MASTER PLAN

# CHAPTER 3

# TRAFFIC DEMAND

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## 3.1 Introduction

The main objective of this chapter is to describe the Study's traffic survey and survey results, how these were applied to build a traffic demand model, and the results of the traffic demand model. The results of the traffic demand model are to assist the economist of the Study in the Master Plan i.e., prioritization and recommendation of road improvement projects for the Study Area (i.e., Champasack, Saravan, Attapeu, Sekong, and the area around Route 1G in Savannakhet). Indices such as travel time and vehicle-kilometers, which are outputs of the model, are used in this process.

## 3.2 Traffic Survey

The traffic survey was carried out on weekdays in order to measure traffic flows for a "typical day". There is little existing information on traffic flows for roads in the southern part of Lao P.D.R. For this reason, the Study decided to execute a traffic survey. The scope of the traffic survey basically consists of carrying out the following fieldwork in order to eventually model intercity traffic flows:

- Roadside origin-destination (OD) passenger and goods vehicle survey
- Traffic volume survey
- Axle-load survey
- Travel speed survey

Below, a description of the locations and the methodology of each of the surveys are given.

### 3.2.1 Roadside OD Survey, Traffic Volume Survey, Bus Passenger Volume Survey

The roadside OD survey is important for gathering the basic data necessary to model and simulate patterns of trip making via the creation of OD tables, which are one of the key components of the traffic demand model, while the traffic volume survey is important for providing vehicle volume data used to validate the traffic assignment model. In addition, a simple bus passenger volume survey, which gauges the number of passengers riding a bus, was carried out to grasp the demand for public transit.

The locations of these surveys are as shown in Figure 3.2.1.

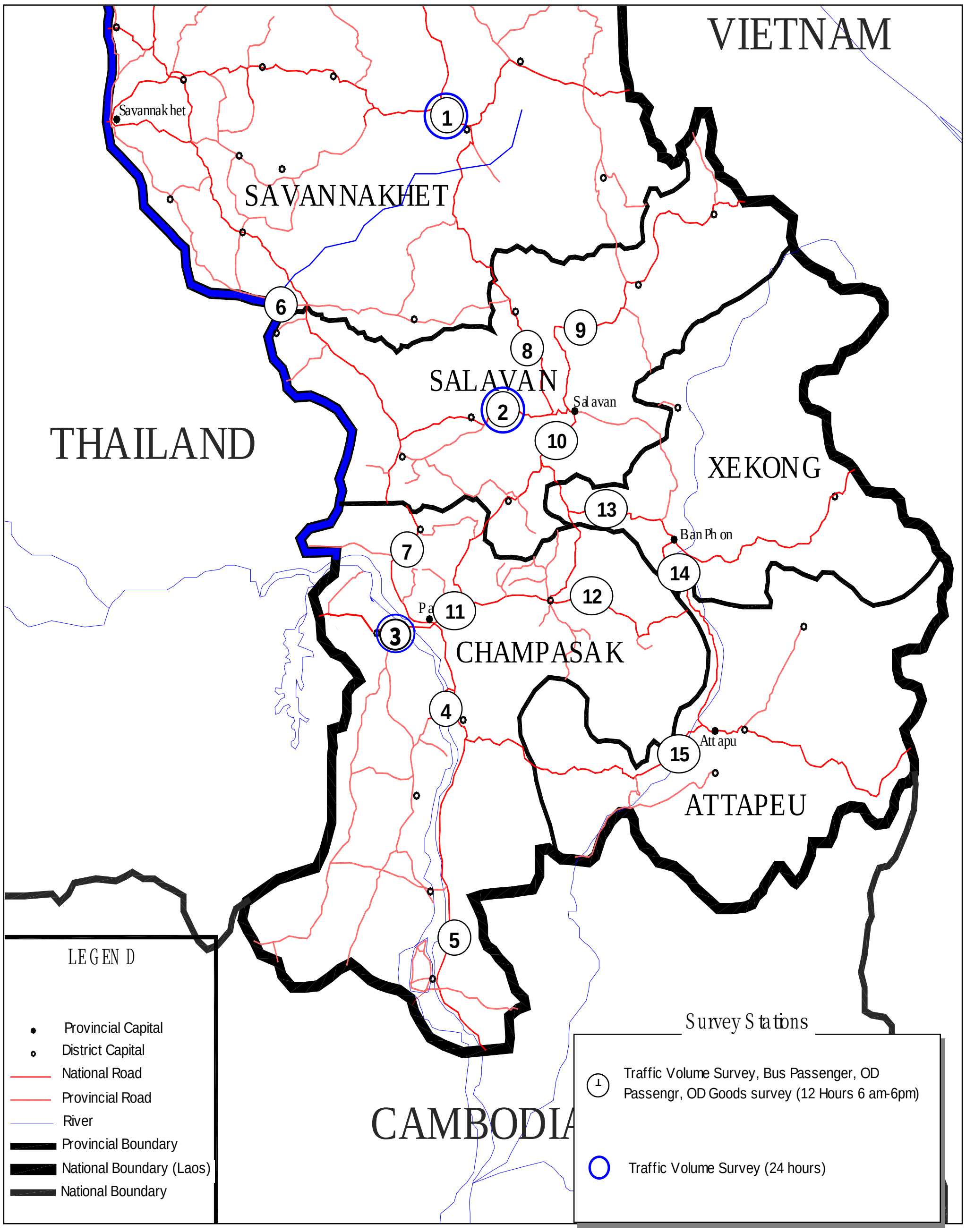


**Figure 3.2.1 Survey Stations for the OD Passenger/Goods Survey, Traffic Volume Survey, & Bus Passenger Volume Survey**

**1) Roadside OD Interview Survey**

- Survey Time: 12 hours (6 am – 6 pm) for a single weekday.
- Survey Items:

For Passenger Vehicles: Place of origin/destination, mode of transport, purpose of trip,

no. of vehicle occupants, bus usage per week, private vehicle ownership.
For Goods Vehicles: Place of origin/destination, type of goods vehicle, types of goods carried, weight of goods, capacity of goods vehicle.

- No. of Survey Stations: 15 stations located on the major national routes of the Study area.
- Survey Methodology: Drivers were interviewed for both directions and their answers recorded on-site. For statistical purposes, a minimum sampling rate of 10% was aimed for.

**2) Traffic Volume Survey**

- Survey Time: 12 hours (6 am – 6 pm) for two separate weekdays at 12 locations and 24 hours for two weekdays at 3 locations.
- Measurement Intervals: 30 minutes.
- No. of Survey Stations: 15 stations (same as that of the OD survey).
- No. of Vehicle Classes: 13 classes.
- Survey Methodology: Manual counting and classification.

**3) Bus Passenger Volume Survey**

- Survey Time: 12 hours (6 am – 6 pm) for a single day.
- No. of Survey Stations: Same 15 stations as those for the OD survey.
- Bus Classification: Divided into private and public buses, intra- and inter-provincial routes, and bus size (below 20 seats, 20-29 seats, 30-39 seats, and 0ver 4 seats).
- Survey Methodology: Non-intrusive visual inspection.

### 3.2.2 Axle-Load Survey

An axle-load survey was carried out to measure the loads that roads are subjected to by trucks. Because of the significant impact that overloaded trucks can have on the condition of roads, this survey is important for determining the potential effects on road maintenance costs. The locations for the axle-load survey are as shown in Figure 3.2.2. The details of the execution are described below.

- Survey Time: 1 day for 24 hours.
- No. of Measurements: 3 locations for a sample of heavy vehicles of at least 10%.
- Survey Methodology: A portable axle-load weighing machine is used to measure the axle loads of goods vehicles.

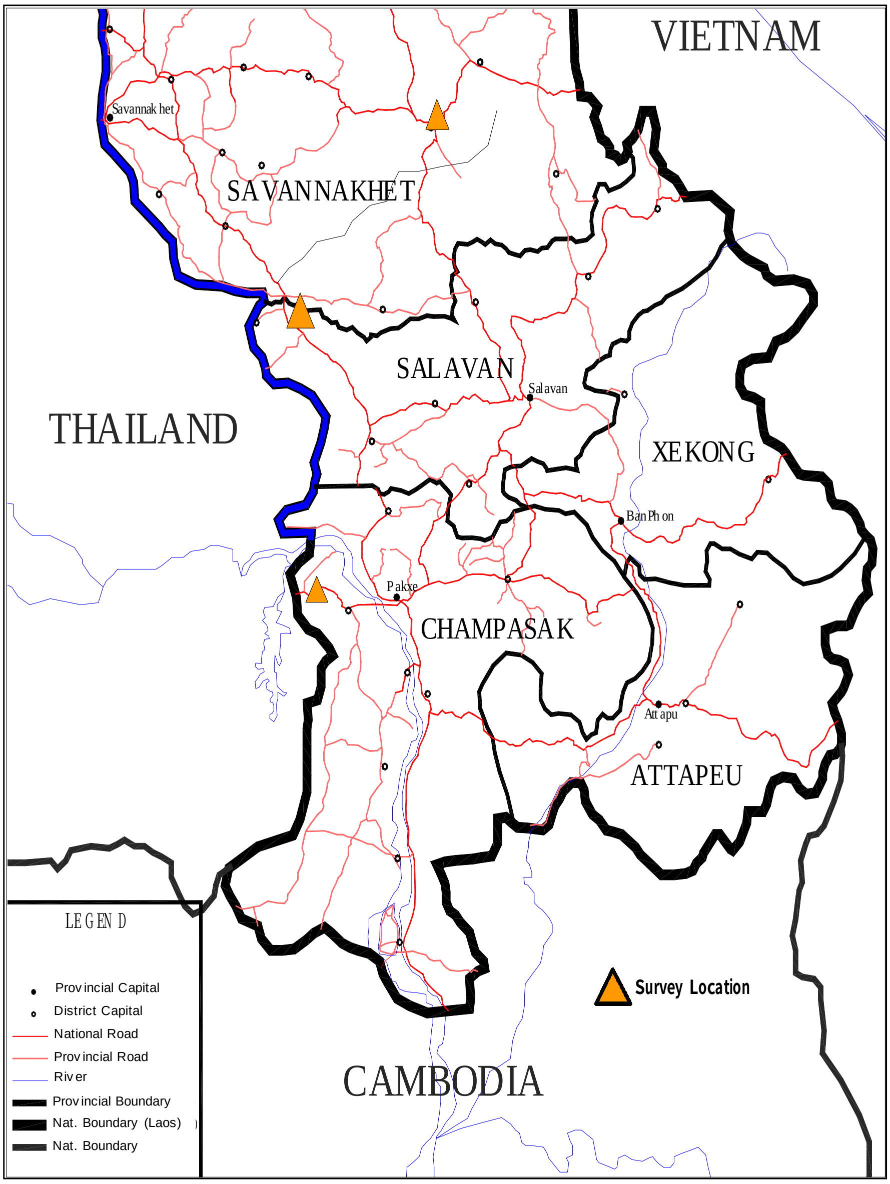


**Figure 3.2.2 Axle-Load Survey Stations**

### 3.2.3 Travel Speed and Traffic Rolling Count Survey

The travel speed survey is important in that it provides observed travel speed data that can be directly compared with modeled travel speeds in the calibration of the traffic demand model. The routes where this survey was carried out are shown in Figure 3.2.3. In addition, a traffic rolling count was carried out simultaneously to take into account the effects of traffic volume.

- Survey Time: For a single weekday (required travel time between designated origin and destination for pre-determined routes).
- No. of Measurements: 1 time on a weekday for the 36 routes indicated in Figure 3.2.3,

with speeds recorded in principal at 5-mile intervals along each route. Measurement intervals vary depending on whether or not there are major changes in the road surface (such as from paved to unpaved), road configuration (such as major junctions), terrain (such as from a flat to a mountainous area), etc.

- Survey Methodology: A test car is used and average travel speeds for the different locations along the survey routes obtained by traveling along with the traffic flow (average car method) or at free-flow speeds.
- Misc: The traffic rolling count survey will count the number of vehicles (i.e., motorcycles, 3-wheelers, buses, and trucks) that pass the test car from the opposite direction, as well as the same direction, and the number of vehicles that the test car passes.

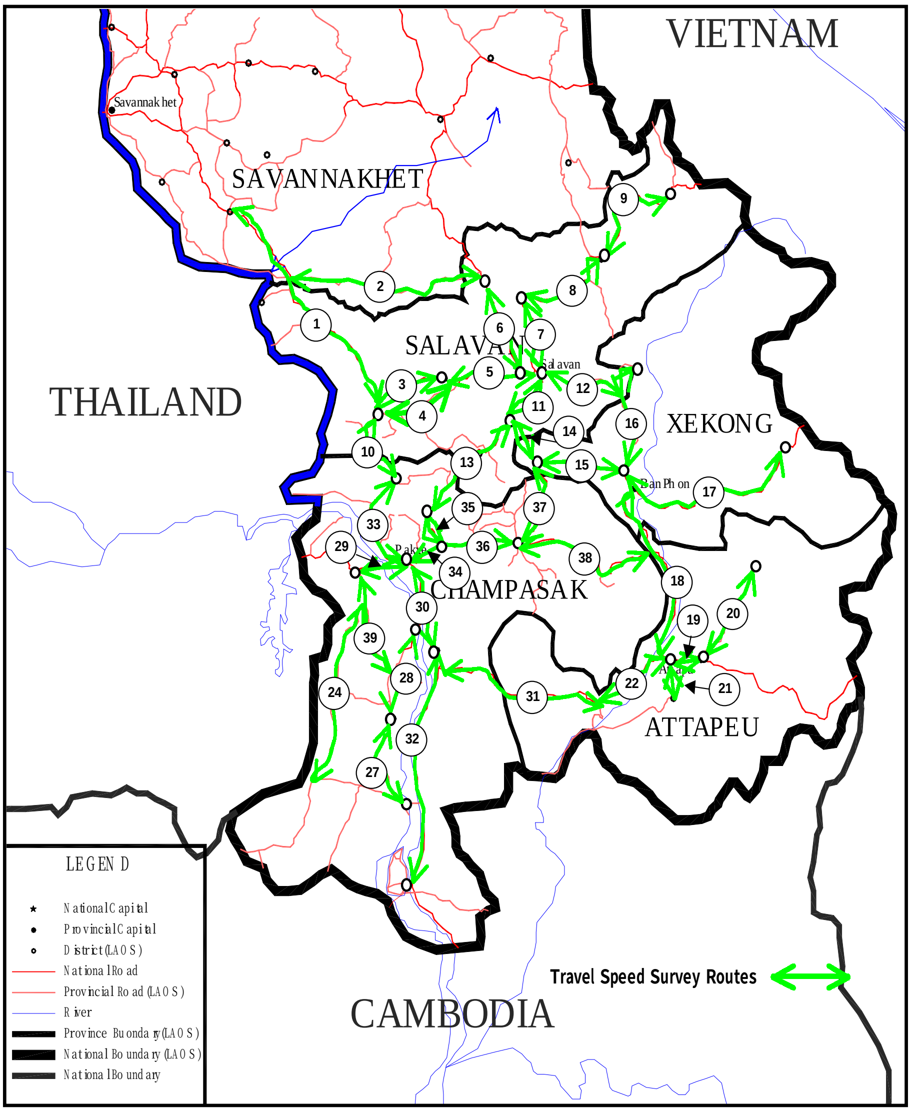


**Figure 3.2.3 Travel Speed Survey Roads**

(Note: Due to elimination of some inaccessible roads only 36 roads were observed and not 39)

## 3.3 Traffic Survey Results

### 3.3.1 Roadside OD Survey

**Sampling Rate**

The number of vehicles that were sampled and the sampling rates for the 15 OD survey points illustrated in Figure 3.2.1 are noted in Table 3.3.1. As the table indicates, the average sampling rate for passenger vehicles was 27.4% and for freight vehicles 70.1%. The goal to achieve a minimum sampling rate of 10% was therefore realized. The sampling rate for goods vehicles is much larger due to the much smaller number of goods vehicles.

**Table 3.3.1 OD Survey Sampling Rates (12 hours)**

| Survey Station | Total No. of Pass. Veh. Sampled | Sampling Rate for Pass. Veh. | Total No. of Freight Veh. Sampled | Sampling Rate for Freight Veh. |
|---|---|---|---|---|
| 1 | 1016 | 10.7% | 183 | 58.1% |
| 2 | 348 | 42.8% | 20 | 45.0% |
| 3 | 2807 | 12.9% | 65 | 61.9% |
| 4 | 1070 | 21.9% | 21 | 90.5% |
| 5 | 502 | 33.7% | 13 | 61.5% |
| 6 | 399 | 57.9% | 90 | 53.3% |
| 7 | 465 | 48.6% | 87 | 71.3% |
| 8 | 89 | 83.1% | - | -. |
| 9 | 117 | 94.9% | - | - |
| 10 | 960 | 35.9% | 33 | 100.0% |
| 11 | 1726 | 13.0% | 115 | 77.4% |
| 12 | 256 | 53.9% | 11 | 100.0% |
| 13 | 584 | 28.1% | 53 | 100.0% |
| 14 | 382 | 31.4% | 33 | 78. 8% |
| 15 | 559 | 25. 8% | 14 | 85.7% |
| Average | 752 | 24. 8% | 57 | 70.1% |

**Vehicle Trip Characteristics**

Passenger vehicle trips by purpose were categorized into 3 types: home-based work trips, home-based other trips, and non-home-based trips. As Figure 3.3.1 indicates, home-based work trips accounted for the largest proportion of trips at approximately 46%, with home-based other trips being next at 33% and non-home-based trips the smallest at 21%. Note that school trips are included in home-based work trips.

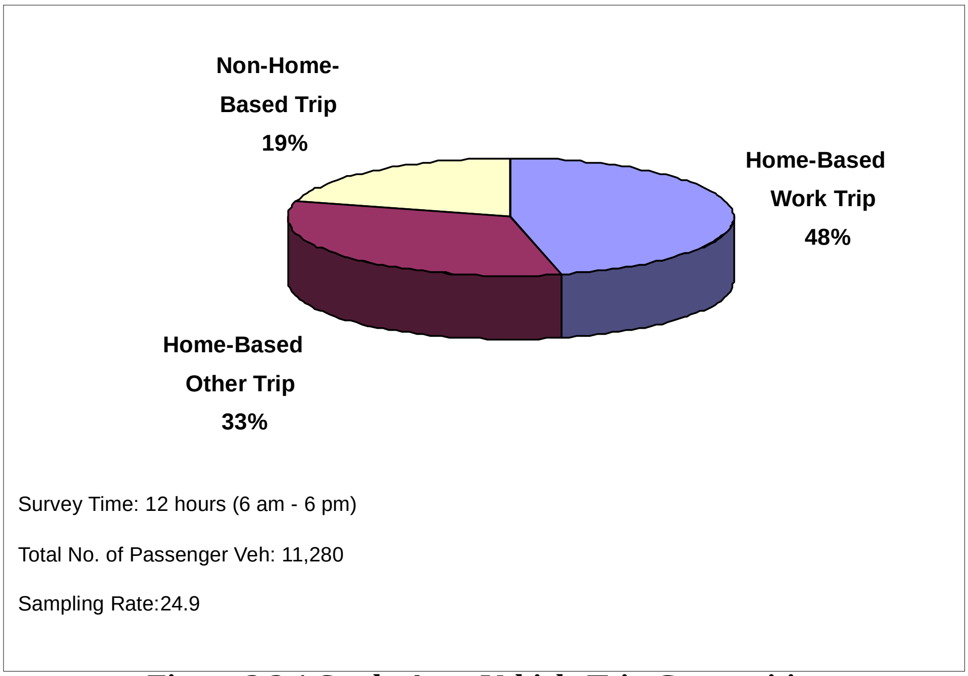


**Figure 3.3.1 Study Area Vehicle Trip Composition**

As for the trips of goods vehicles, excluding those trucks that were empty (39%), the most ferried items according to those vehicles surveyed were construction materials (21%), industrial products (8%), and agricultural products (6%). The proportion of vehicles that were carrying other types of commodities were 5% or less and were about 17% of the total goods vehicles interviewed (see Figure 3.3.2).

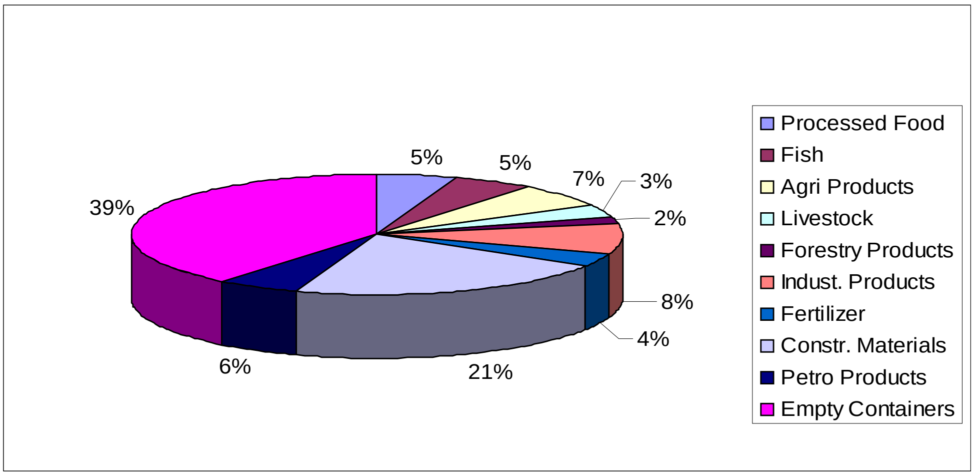


**Figure 3.3.2 Study Area Vehicle Goods Composition**

As for total vehicle trip movements, Figure 3.3.3 shows that the vast majority of vehicles surveyed (or 85.7%) travel within southern Laos (or Champasack, Saravan, Attapeu, Sekong, and Savannakhet). As for vehicle trips with one trip end outside this area, these account for 14.3% of the vehicles surveyed, while none of the vehicles interviewed answered affirmatively to making a through trip (e.g., trips from Vietnam to Thailand or vice versa).

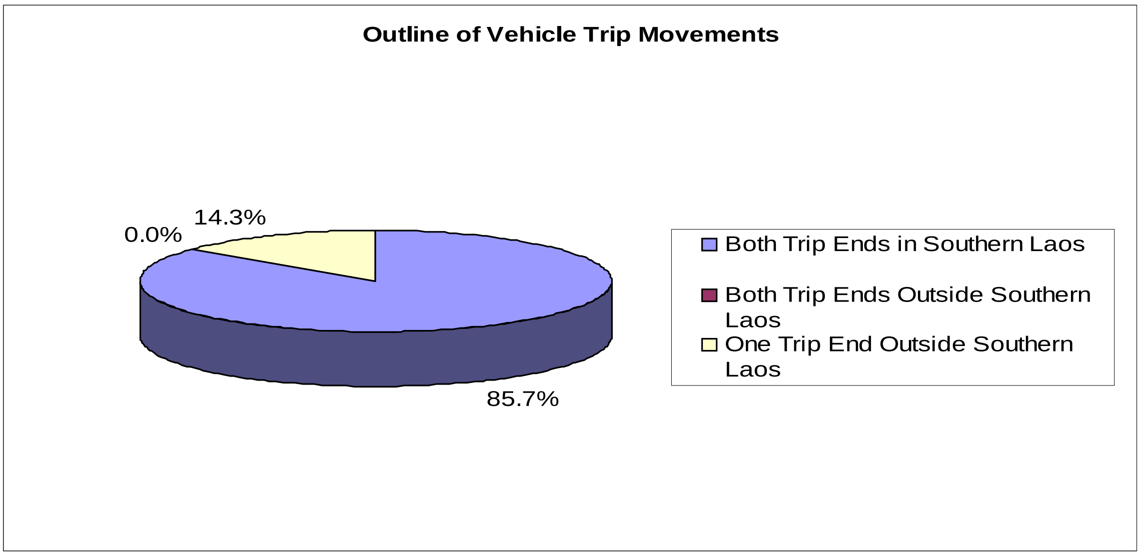


**Figure 3.3.3 Outline of Vehicle Trip Movements**

## 3.3.2 Traffic Volume Survey

The composition of traffic, as determined by the traffic volume survey, is as shown in Figure 3.3.4. As the figure indicates, motorcycles account for the largest number of vehicles on the road at 36% of the total share, with bicycles being next at 30%. Other vehicle types account individually for less than 5% of the total with the combined aggregate totaling 34%.

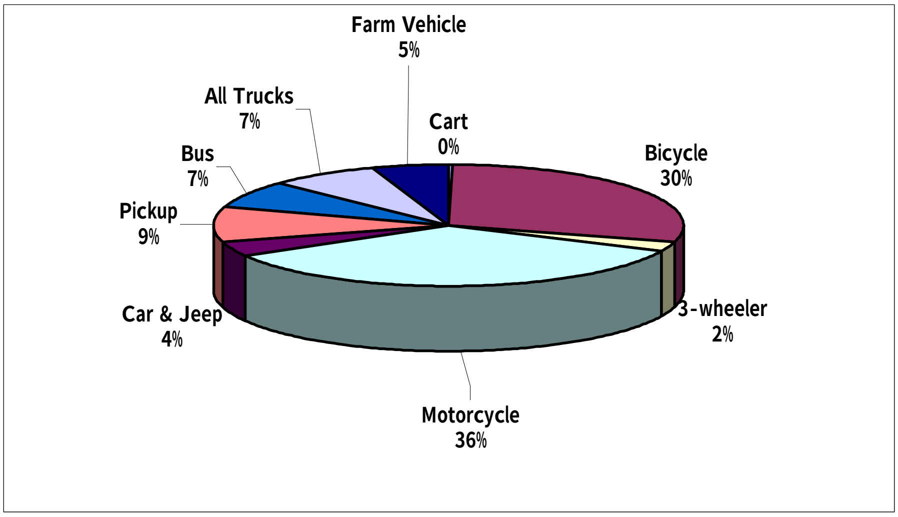


**Figure 3.3.4 Study Area Traffic Composition**

As for the actual traffic volumes that were surveyed on-site, the average 12-hour (6 am – 6 pm) bi-directional values for the two-day survey period for motorized traffic are as shown in Figure 3.3.5 below. The maximum average 12-hour flow for motorized vehicles (i.e., bicycles and carts are excluded) was 1758 vehicles near Pakse bridge, while the minimum average 12-hour flow for motorized vehicles was 31 on Rt. 1G north of Saravan. The overall 12-hour average flow for motorized vehicles for the Study area is approximately 525 vehicles.

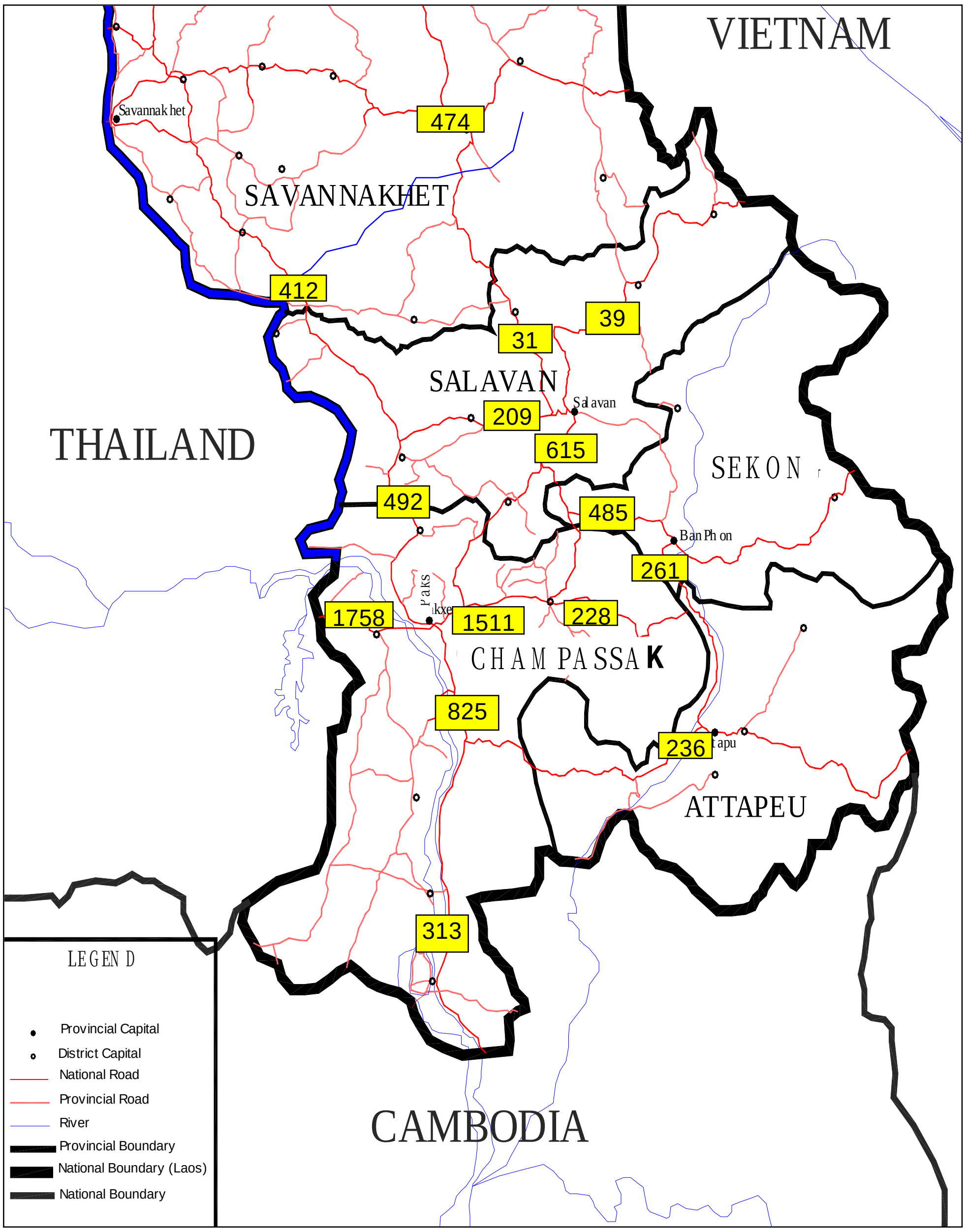


**Figure 3.3.5 Average Bi-Directional 12-hour Traffic Volumes (Motorized Traffic Only)**

### 3.3.3 Axle-Load Survey

As Table 3.3.2 shows, the average total axle load for goods vehicles varies from 14.4 tons to 17.4 tons. The percentage of overloaded trucks was least at Survey Station 1 on Rt. 9 near the town of Phine, which is probably due to strict police enforcement. The highest value of 30.6 percent was on Rt. 13 near the Savannakhet-Saravan provincial border, while the percentage of overloaded trucks was about 10% at Survey Station 3 near the Pakse Bridge.

**Table 3.3.2 Average Total Axle-Load and % of Overloaded Trucks**

| Survey Station | Trucks Weighed | Sampling Rate | Average Total Axle-Load | % of Trucks Overloaded |
|---|---|---|---|---|
| 1 | 142 | 77.6% | 14.4 | 4.3 |
| 3 | 70 | 52.2% | 17.4 | 10.0 |
| 6 | 56 | 35.9% | 16.0 | 30.6 |

### 3.3.4 Travel Speed Survey

Average travel speed on the roads in the Study area varies greatly, from a low of 17.7 to a high of about 70 km/h. This was due mostly to road conditions, although there were cases of road construction having a significant impact (such as that on Rt. 13). As Figure 3.3.6 below shows, road conditions are strongly correlated with average travel speed. The average travel speeds for all of the 36 roads surveyed by the Study are shown in Figure 3.3.7.

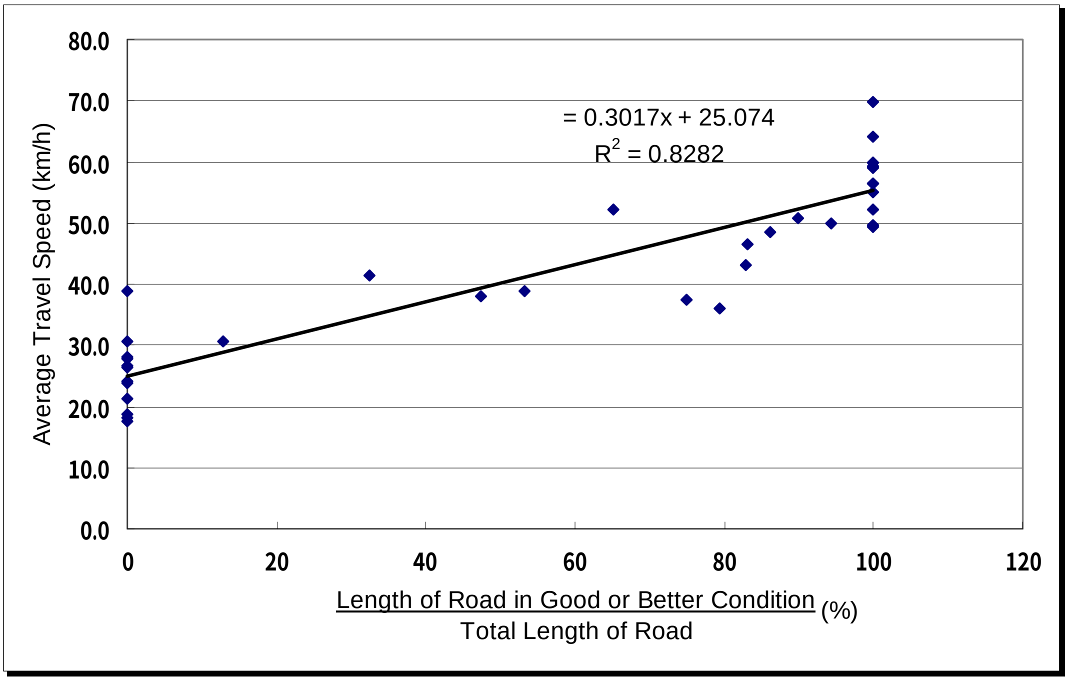


**Figure 3.3.6 Road Condition & Average Travel Speed**

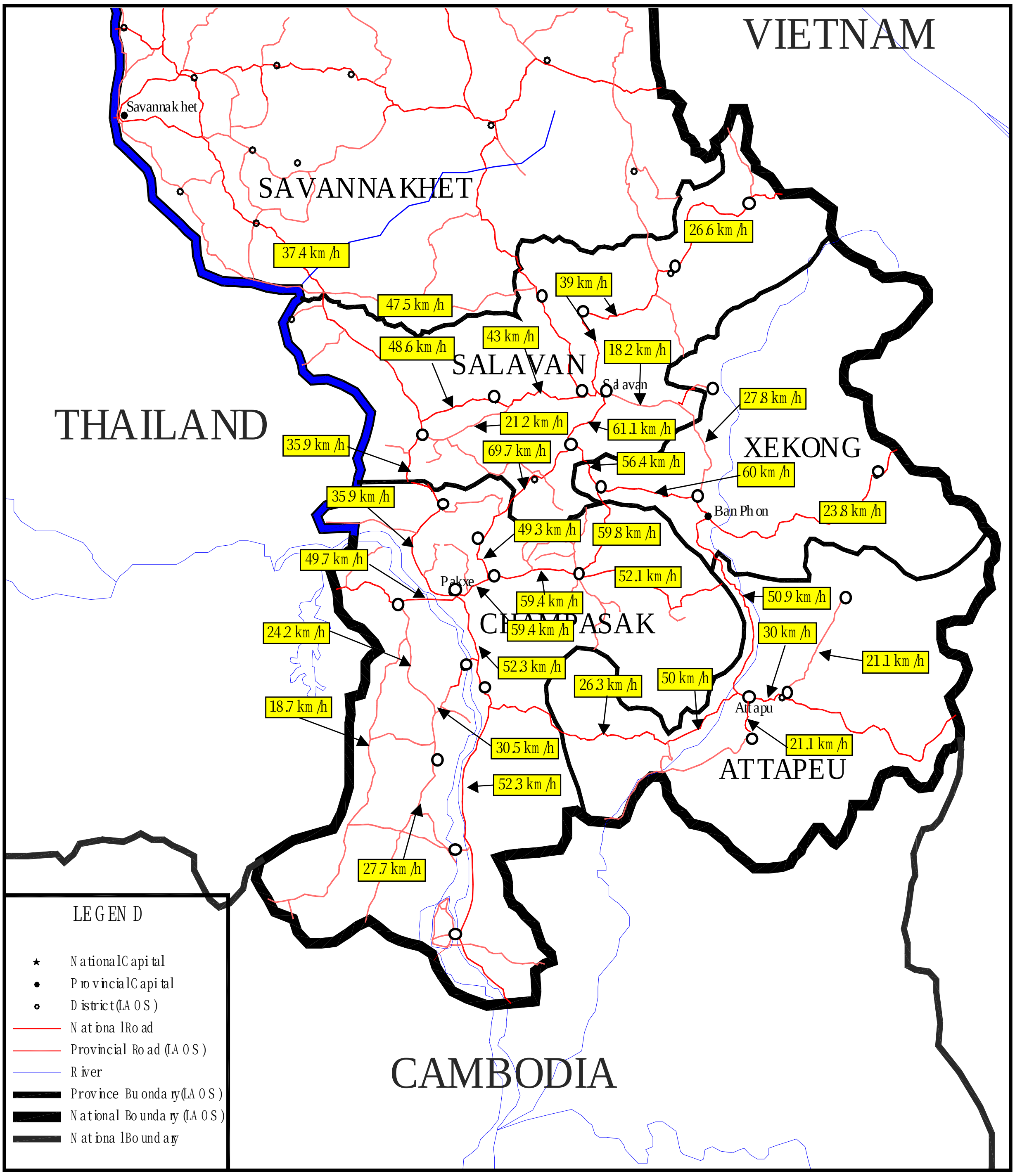


**Figure 3.3.7 Average Road Travel Speed**

## 3.4 Traffic Demand Model

The above results from the traffic survey are applied to a demand model employing the traditional 4-step estimation method contained in the JICA STRADA (System for Traffic Demand Analysis) package, which consists of the steps of trip generation/attraction, trip distribution, modal split, and traffic assignment, to calculate traffic demand for southern Lao. The forecast years for the Study are 2007 and 2020. An overall workflow for estimating traffic demand is shown Figure 3.4.1.

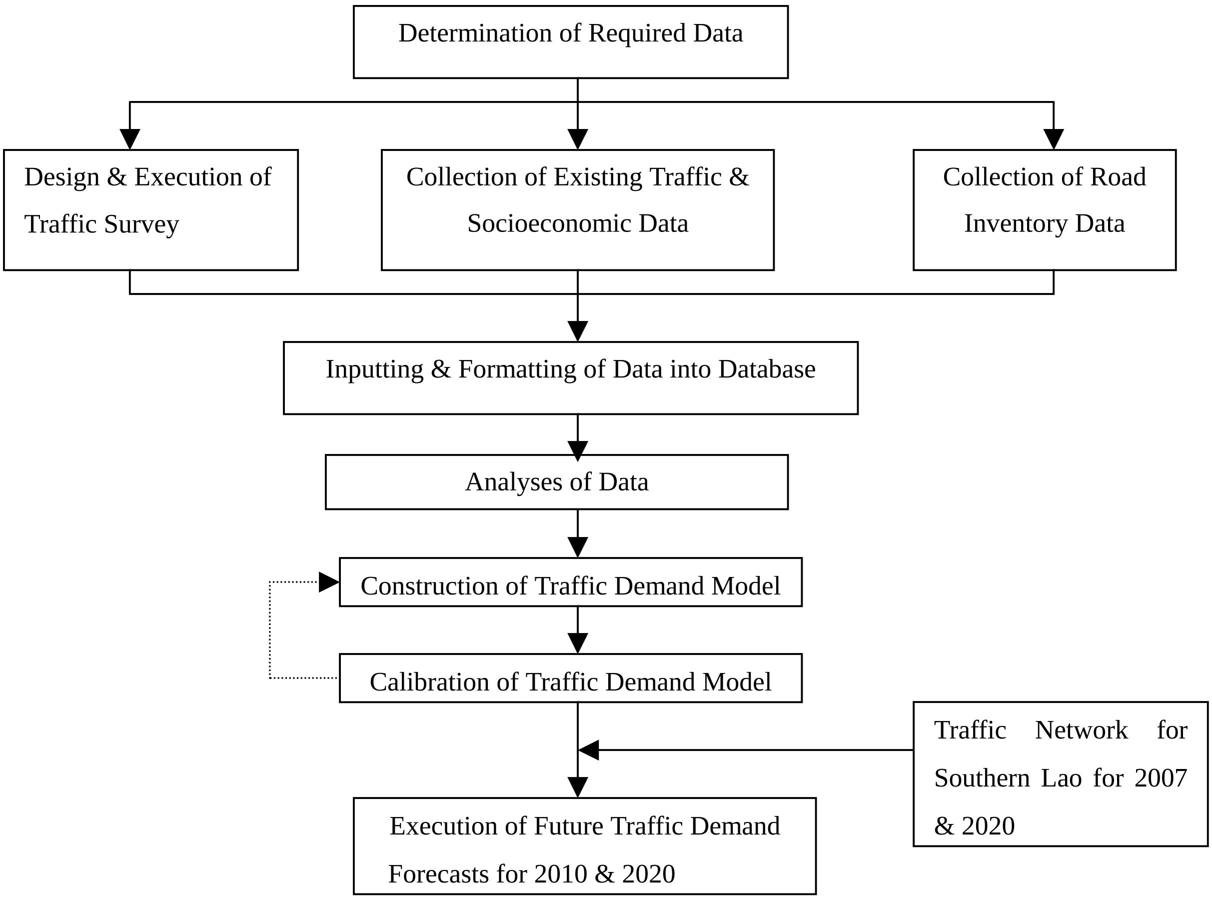


**Figure 3.4.1 Overall Workflow for Estimating Future Traffic Demand**

Below, the construction of each of the four steps of the traffic demand model is described in detail.

### 3.4.1 Trip Generation/Attraction

#### 1) Trip Control Totals

Vehicle trip control totals for the Study area of southern Lao, which serve as upper-boundary values to ensure realistic estimates of future traffic demand, were established via regression analysis using the relationship of GDP and total vehicle trips for districts. The number of inter-zonal vehicle trips calculated to originate and terminate within the Study area for the year 2001 and the planning years of 2007 and 2020 are as shown in Table 3.4.1. As this table indicates, traffic is forecast to grow at a rate of approximately 7.3% between 2001and 2020.

**Table 3.4.1 Total Future Daily Trips for Study Area**

| Year | Daily Trips |
|---|---|
| 2001 | 5,500 |
| 2007 | 7,700 |
| 2020 | 21,000 |

Note that if vehicle trips with a trip end outside the Study area are included, the total number of vehicle trips becomes approximately 7,300, 10,300, and 27,700 for the years 2001, 2007, and 2020, respectively, or about 1.33 times the total of inter-zonal trips originating and terminating in the Study area.

#### 2) Zonal Trip Generation/Attraction

In order to model vehicle trip generation and attraction, the Study area was divided into 30 zones (see Figure 3.4.2). This division was based on the administrative boundaries for districts. Then, the correlation between various socioeconomic factors and vehicle trip generation/attraction by vehicle type were checked and models constructed. Trip purpose, which is usually taken into account, was not considered due to the low traffic volumes. That is, further disaggregation would have produced extremely low and therefore invalid samples.

The socioeconomic factors that were considered for trip generation/attraction modeling consisted of employment, population, vehicle ownership, and GDP. The vehicle types considered were light vehicles (i.e., cars, jeeps, and pickups), buses, motorcycles, medium trucks, and heavy trucks. As for tractors and 3-wheelers, they were not modeled since their use is almost exclusively intra-zonal. The final trip generation/attraction models provide daily (24-hour) trip generation/attraction figures for a typical weekday.

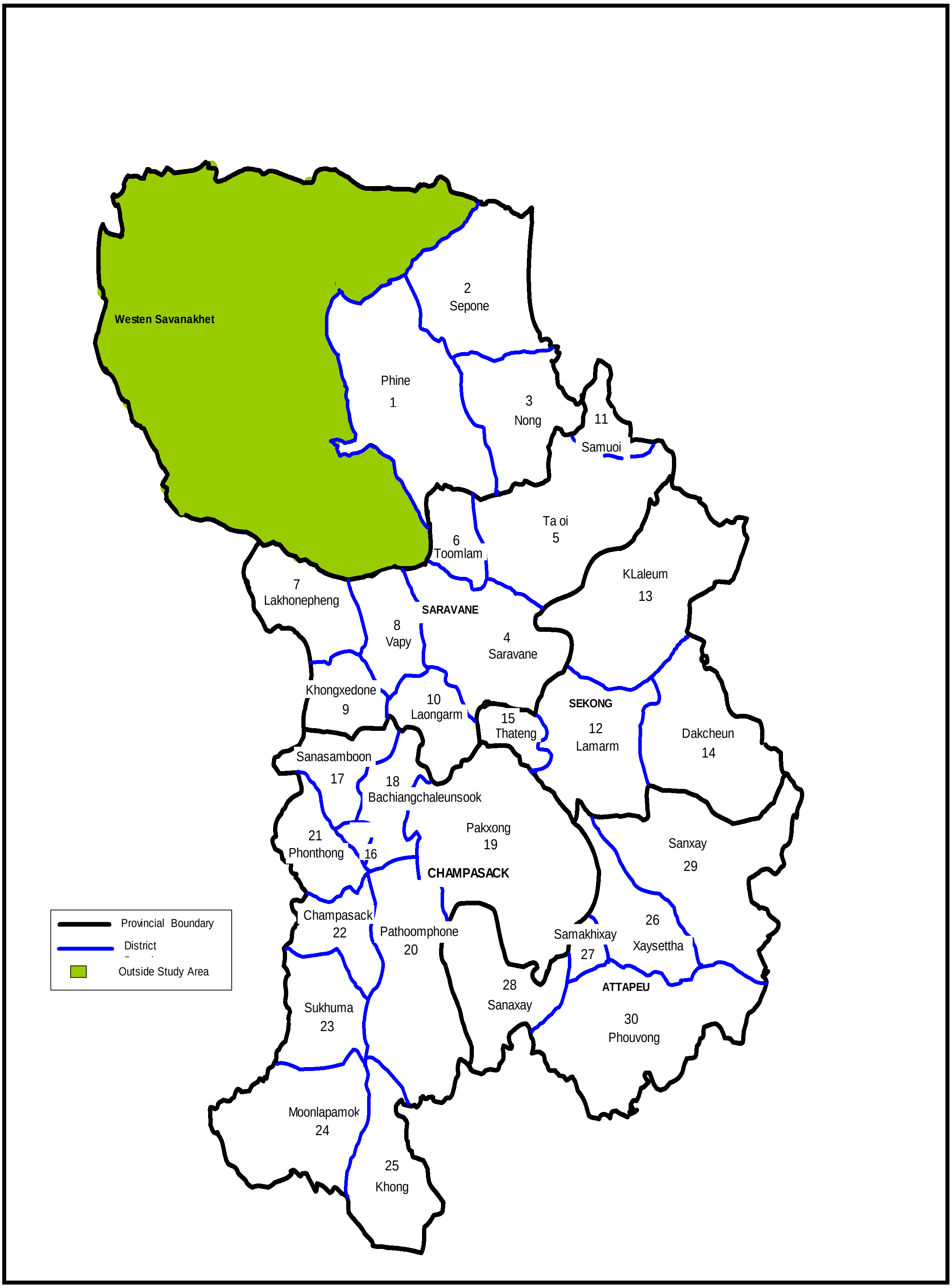


**Figure 3.4.2 Zoning Map for Study Area**

**Table 3.4.2 Trip Generation Models**

| Trip Type | Variable | $R^2$ |
|---|---|---|
| 1. Light-Vehicle Trip | Total No. of Vehicles | 0. 94 |
| 2. Bus Trip | Total No. of Vehicles | 0. 82 |
| 3. Motorcycle Trip | Total No. of Vehicles | 0.75 |
| 4. Heavy Truck Trip | GDP | 0.78 |
| 5. Medium Truck Trip | GDP | 0.73 |

**Table 3.4.3 Trip Attraction Models**

| Trip Type | Variable | $R^2$ |
|---|---|---|
| 1. Light-Vehicle Trip | GDP | 0.77 |
| 2. Bus Trip | GDP | 0.75 |
| 3. Motorcycle Trip | GDP | 0.71 |
| 4. Heavy Truck Trip | GDP | 0.87 |
| 5. Medium Truck Trip | GDP | 0.88 |

Excluding the model for Motorcycle Trip generation, Tables 3.4.2 and 3.4.3 indicate that the vehicle trip generation/attraction models all have an $R^2$ (i.e., coefficient of determination) that exceeds 0.75 and therefore sufficiently explain trip making. Note that due to the small number of zones only a single explanatory variable was used in the models for statistical reasons.

As for trips with a trip end outside of the Study area (i.e., traffic to northern and central Laos and international traffic to Thailand, Vietnam, etc.), these are factored up as follows:

- In addition to the natural growth in traffic, it is assumed that a further 3 times increase in trips from Savannakhet towards Pakse on Rt. 13 will occur after the construction of the Second Mekong Bridge. This means that inter-zonal traffic on this link will grow from about 840 vehicles per day in 2001 to about 3320 vehicles per day in 2020. This increase is based on two factors: the improvement of Rt. 13 and the generation of new trips as a result of bridge construction. For example, daily traffic before and after the construction of the Pakse Bridge more than trebled, going from 596 vehicles in 1996 when there was only ferry service to 2060 vehicles in 2001 after the bridge's completion in that same year.
- Traffic from Cambodia for the planning year of 2007 is assumed to be non-existent. As for the year 2020, it is assumed that two cross-border corridors will exist at that time and will connect up with Rt. 13 and Rt. 1J in Lao P.D.R. Since there are no existing traffic flows and no information on future traffic flows for these corridors, future traffic for these corridors is derived by comparing and extrapolating from international flows for other cross-border corridors in this region. Flows on these corridors in 2020 are about 170 and

120 vehicles per day, respectively.

- Traffic entering southern Lao from Chong Mek, Thailand is assumed to grow by more than 3.2 times between 2001 and 2020 and is based on future economic growth. This means that daily traffic will grow from the present 115 vehicles per day to about 370 vehicles per day in 2020. However, the increase could be even more dramatic if procedural barriers to cross-border traffic are removed or reduced. Since this is impossible to predict, it was not considered by the Study.
- Traffic from Vietnam is assumed to increase by more than 6 times by the year 2020 to a total of about 1000 vehicles per day for the combined routes of 9, 15 East, 16, and 18B. The following materials and data were used in obtaining this derivation:
    - The January 1999 publication "Sub-Regional Seminar on the East-West Transport Corridor Development" by the Japan Transport Cooperation Assoc. and the Transport Development and Strategy Institute of Vietnam.
    - The January 2001 "Rural Access Roads Improvement Project (Draft Economic Report)" financed by the Asian Development Bank.
    - Economic and vehicle ownership trends for Vietnam derived by the Study Team.
    - Time series traffic count data from the Transport Planning Unit of MCTPC (April 1997).

Another factor that could affect the number of vehicle trips is average vehicle occupancy. Present vehicle occupancy is as shown in Figure 3.4.3 below.

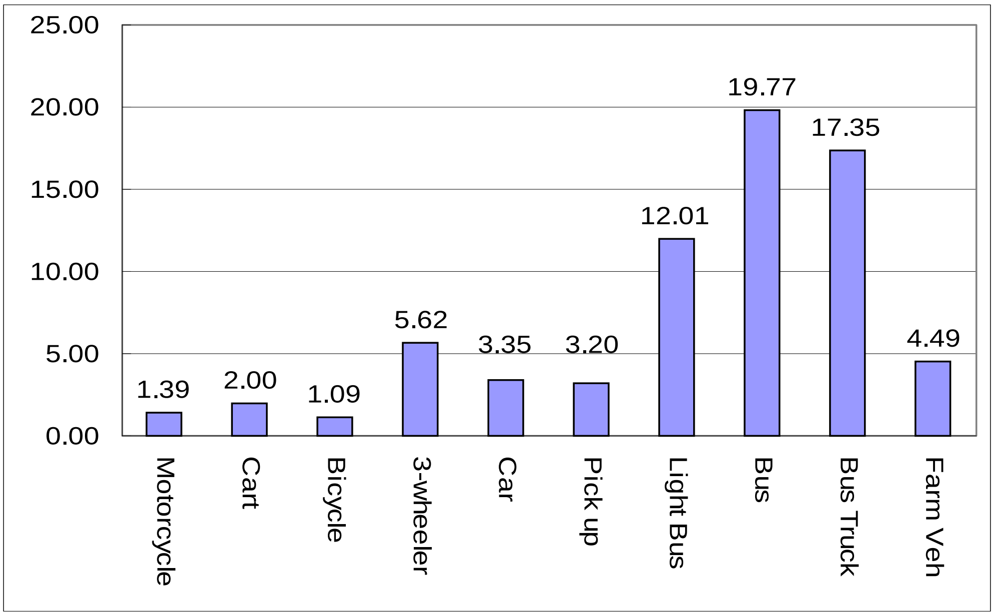


**Figure 3.4.3 Average Vehicle Occupancy**

With an increase in income there is usually a decline in the number of vehicle occupants. However, given the low ownership and income levels of southern Lao, it is assumed for the purposes of this Study that these figures will remain constant for the foreseeable future. Freight truck use also affects traffic levels. Unfortunately, however, it was not possible to grasp the actual amount of loads carried by trucks. Given the present stage of Lao's development, it can be safely said that the weight of an average load will probably increase, so there will be no increase in the number of trucks due to such phenomenon as just-in-time delivery systems, etc.

### 3.4.2 Trip Distribution

#### 1) Construction of OD Tables

In order to model the daily vehicle trips generated/attracted in the Study area, it was necessary to grasp the trip patterns of the Study area by using the data collected from the roadside OD interview survey and to construct origin-destination tables for each mode of travel. The process used to construct daily OD vehicle-type trip tables is as shown in Figure 3.4.4.

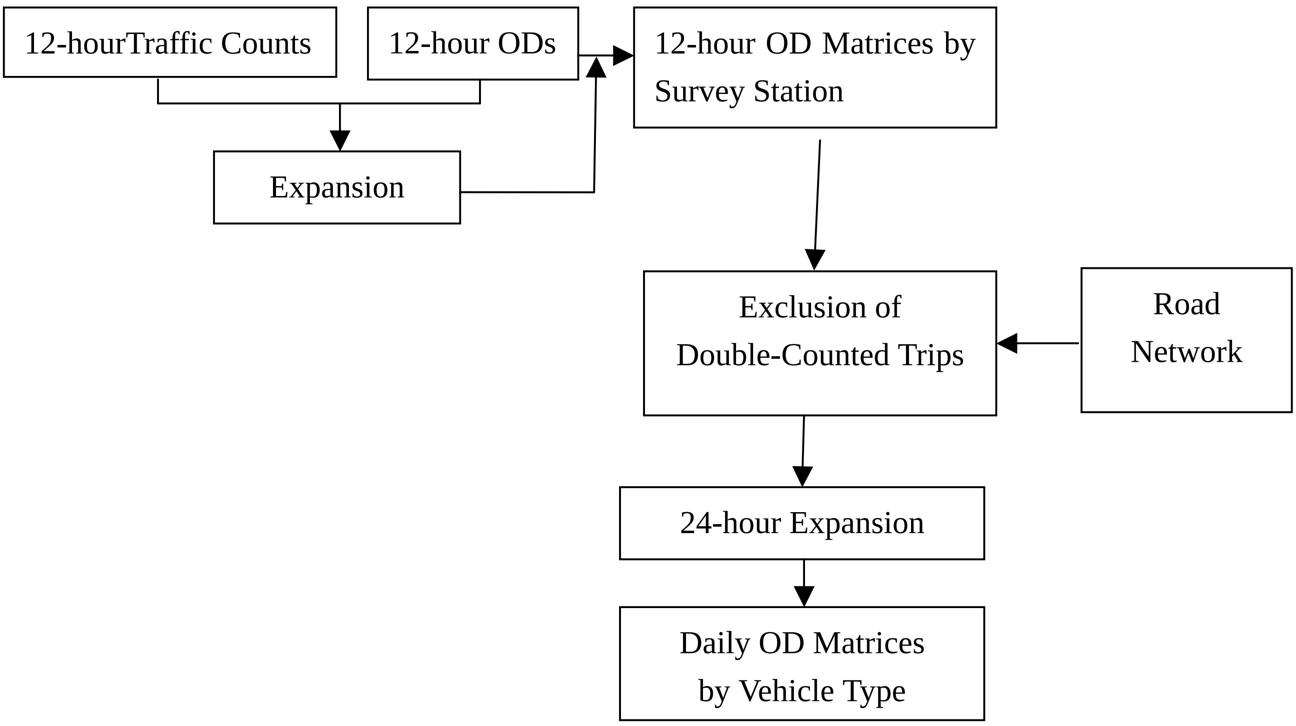


**Figure 3.4.4 Flow for Building of Daily OD Matrices**

### 2) Deterrence to travel & model type

Trip distribution simulates the patterns of travel by applying the concept of ease of movement. Ease of, or deterrence to, movement is usually defined either in terms of cost, time, or distance. For the Study area, a great deterrence to travel is the large distances between populated areas. Another characteristic of the Study area is that populated areas are quite distinct from one another. Given this, it was decided a type of gravity model would be applied to model the distribution of trips. The model that was deemed as best for determining the trip distribution for light vehicles, buses, and motorcycles is the conventional gravity model and it is as follows:

$$t_{ij} = k \cdot \frac{T_i \, U_j}{f(d_{ij})}$$

Where,

$t_{ij}$ = trips from zone i to zone j
$T_i$ = vehicle trips generated
$U_j$ = vehicle trips attracted
$d_{ij}$ = distance between zones
$f(d_{ij})$ = function expressing the travel impedance between zones in terms of distance
$f(d_{ij}) = d_{ij}^{-b}$ where b is an impedance parameter

As for heavy and medium trucks, it was deemed that a modified gravity model or the Voorhees model is best and it is as follows:

$$t_{ij} = T_i \frac{U_j f(d_{ij})}{\sum_{k=1}^{n} U_k f(d_{ik})}$$

Below the construction of OD Matrices using these models is described.

### 3) Construction OD Matrices

OD matrices for the five vehicle types are constructed applying the above-mentioned models. As for their goodness of fit, it is confirmed taking into account the following:

- Observed and modeled vehicle trip distribution lengths
- Observed and modeled trip patterns
- Comparison of trips observed and modeled trips over a screen line

As the correlation coefficients for vehicle trip distribution and trip length in Table 3.4.4 indicate, the trip distribution models sufficiently simulate the travel patterns for the Study area for light vehicles, buses, motorcycles, heavy trucks, and medium trucks.

**Table 3.4.4 Trip Distribution Models**

| Trip Type | Estimated Parameter | Correlation Coefficient for Trips | Correlation Coefficient for Trip Length |
|---|---|---|---|
| 1. Light Vehicle | -0.566 | 0.78 | 0.87 |
| 2. Bus | -0.525 | 0.74 | 0.81 |
| 3. Motorcycle | -0. 839 | 0.73 | 0.84 |
| 4. Heavy Truck | 0.147 | 0. 73 | 0.87 |
| 5. Medium Truck | 0.132 | 0. 82 | 0.95 |

The screen line established in this Study was the Pakse Bridge, which crosses over the Mekong River. As Figure 3.4.5 indicates, the modeled and observed 24-hour traffic volumes are also close, with the modeled value being about 6% less than the observed value.

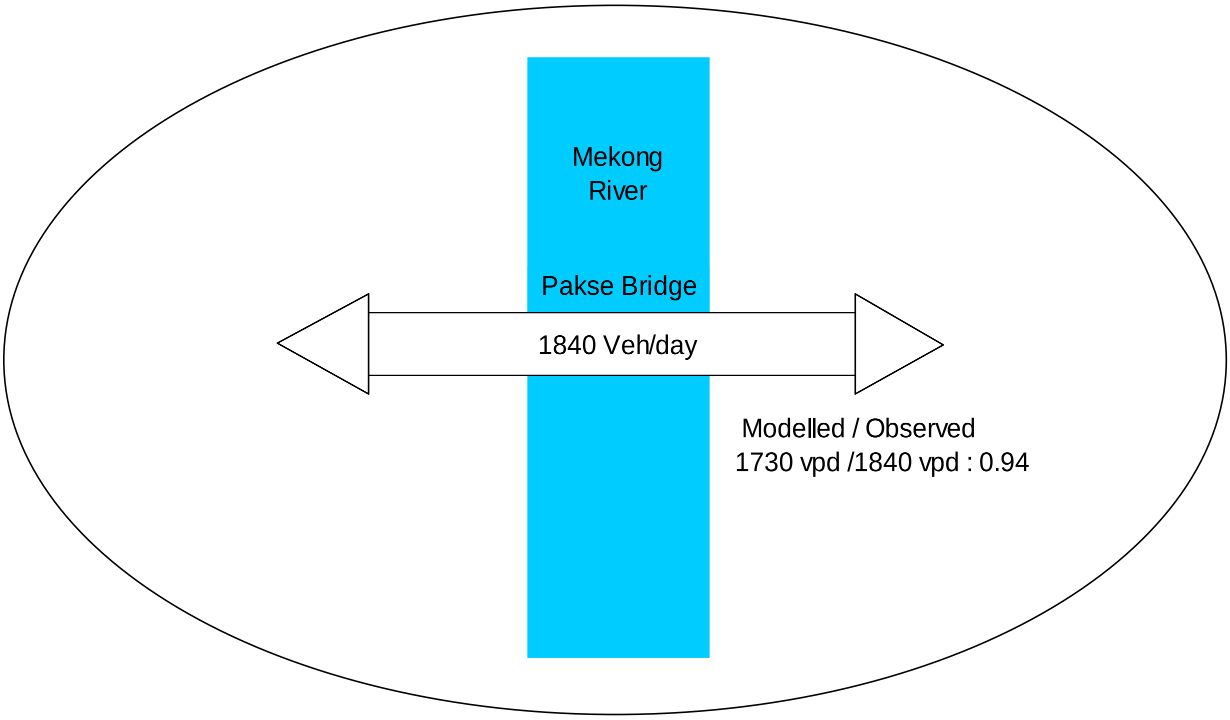


**Figure 3.4.5 Average Daily Traffic Volume at Screen Line (2001)**

Based on the trip patterns derived from the above trip distribution models, the trips that are generated/attracted in the Study area are distributed.

The results of this work are represented by desire line charts constructed for the years 2001, 2007, and 2020 (for more details refer to the OD matrices contained in the ANNEX M-1 in the Report). As these charts clearly show, **Pakse is the center of activity**, with the majority of trip activity taking place between Pakse and the following locations:

- Phonthong (an area near Pakse Bridge west of the Mekong River)
- Paksong (a district east of Pakse on Rt. 16)
- Bachingchaleunsook (a district on Rt. 20)
- Saravan (a town at the junction of Rt. 15 and Rt. 20 in central southern Lao)
- Khong (a town south of Pakse on Rt. 13 going towards the Cambodian border)

The above-mentioned patterns of predominant trip making are also indicative of the economic centers of southern Lao, with the main axes of activity running in an east-west direction between the area west of Pakse Bridge (which includes the Champasack area) to Paksong and between Pakse to towns along Rt. 20 to Saravan. A secondary axis of economic importance runs in a north-south direction between Khongxedone north of Pakse to Khong near the Cambodian border in the south.

LEGEND

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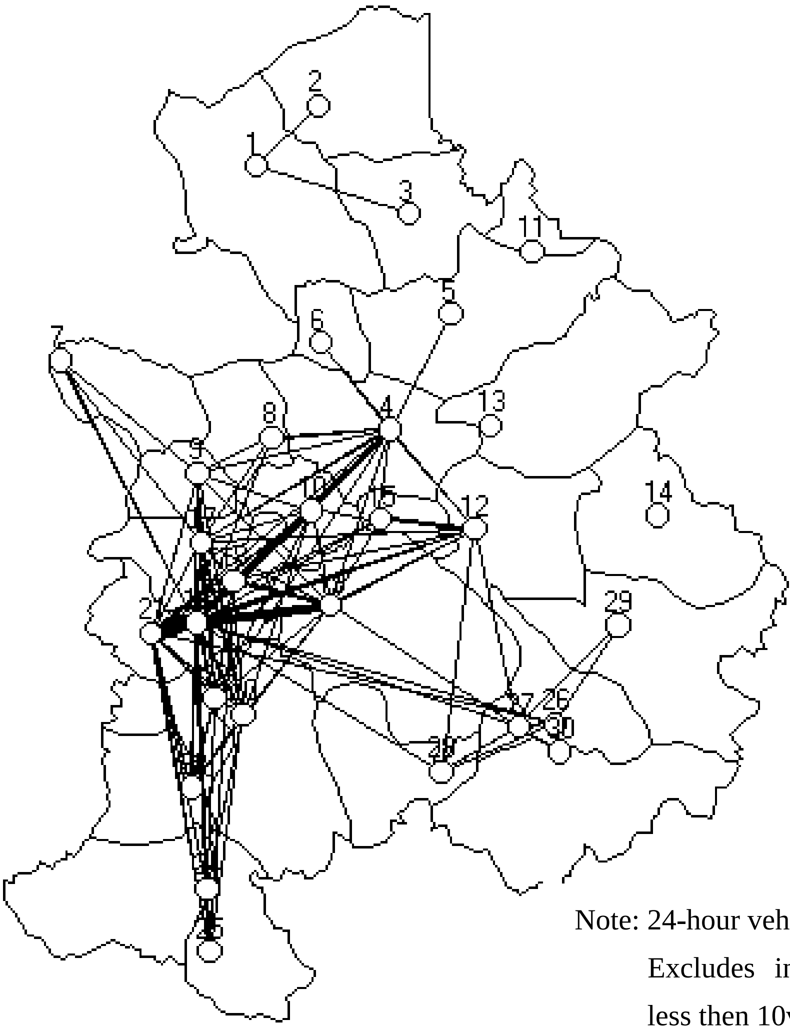


Note: 24-hour vehicle flows,
Excludes inter-zonal flows of less then 10vpd

**Figure 3.4.6 Desire Line Chart for Study Area (for 2001)**

LEGEND

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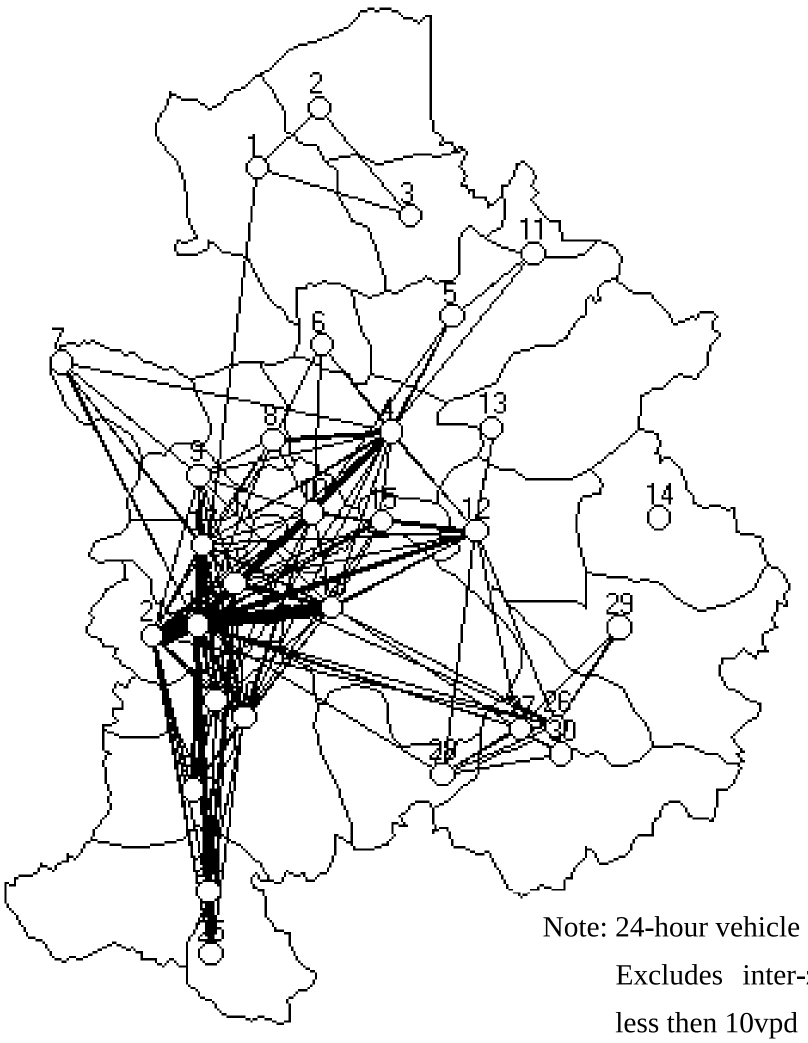


Note: 24-hour vehicle flows,
Excludes inter-zonal flows of less then 10vpd

**Figure 3.4.7 Desire Line Chart for Study Area**
**(for 2007)**

LEGEND

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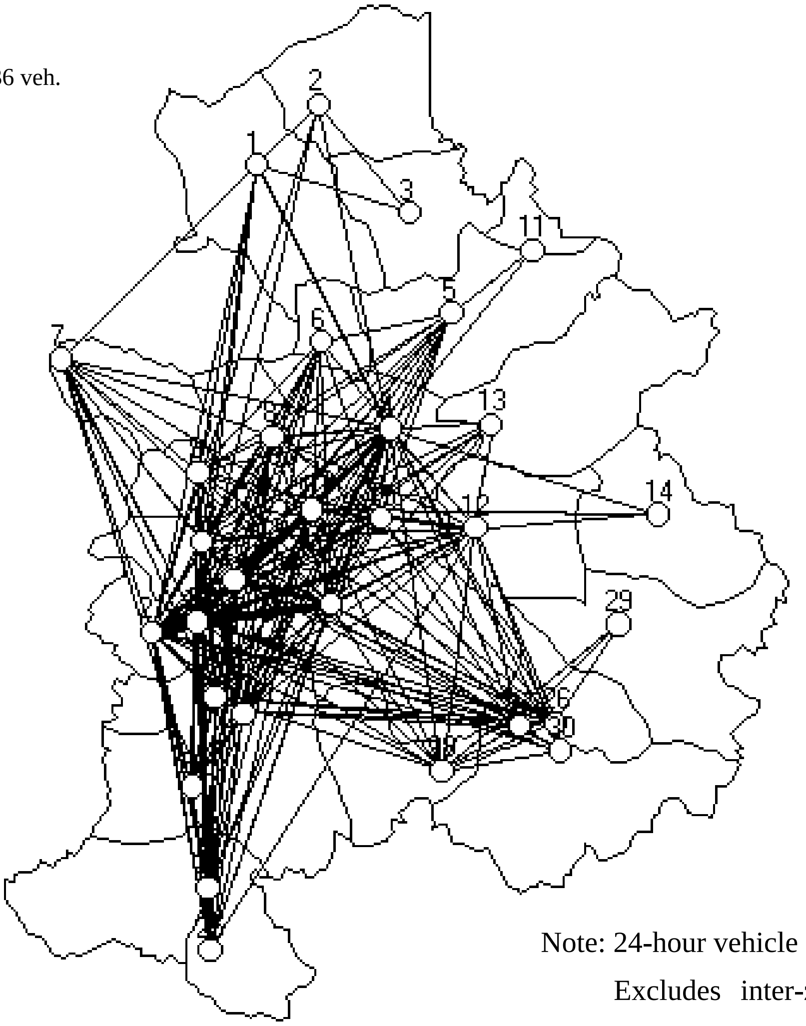


Note: 24-hour vehicle flows,
Excludes inter-zonal flows of less then 10vpd

**Figure 3.4.8 Desire Line Chart for Study Area**
**( for 2020 )**

### 3.4.3 Modal Split

The purpose of a modal split model is to simulate the selection process that travelers go through in choosing a mode of transport by which to travel. In the Study, it was decided that a modal split model would not be constructed for the following two reasons:

- There is very little public transit so in reality the potential for private-vehicle users to switch modes is small.
- Most riders of public transit who were questioned stated that they had no access to a private vehicle. That is, public transit users are captive users and are unable to switch to private transport.

Given the above, it was decided not to construct a modal split model. As a result of this decision, modal split follows automatically from the trip generation and attraction stage.

### 3.4.4 Traffic Assignment

Traffic assignment is the last stage of the traffic demand model and produces outputs (such as vehicle-km, vehicle-hours, travel speed, and congestion rates) that are used to assist in the prioritization of the Study routes. In this study, due to the large under utilization of road capacity and the small number of alternative routes, it was deemed that either the incremental or equilibrium traffic assignment models could be effectively applied. Here, the former methodology is selected as it is easier to check directional movements. In the incremental traffic assignment model, the principle of equal travel times is used. That is, traffic will switch to another route with shorter travel times and this process continues until there are no alternatives. Here, the calculation of travel time is important. To calculate travel time, the following information for the different types of road links is required: capacity, design speed, and speed-flow (QV) functions.

Three parameters that greatly affect the design speed and capacity of a road are geometry, terrain, and land use. Information on road capacity and design speed by road class and terrain was obtained by the Study Team. This information, along with design information from Japan, was the major factor for setting the maximum daily design capacity for the existing links of the road network (see Table 3.4.5). Capacity was then adjusted as necessary for narrowness using an adjustment factor (see Table 3.4.6). As for design speed, free-flow speeds from the travel speed survey carried out by the Study Team were used.

**Table 3.4.5 Design Capacity and Free-Flow Speeds for Road Network Links**

| Type of Road | Land Use | Max. Daily Design Capacity (vpd) | Carriageway (m) | Free-Flow Speeds (km/h) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Very Good | Good | Poor | Very Poor |
| 1-Lane Unpaved | Rural | 600 | Less than 5.5 | 55 | 50 | 30 | 20 |
| 2-Lane Unpaved | Rural | 1000 | 5.5 or > | 55 | 50 | 30 | 20 |
| 2-Lane Paved | Urban | 8000 | 7.0 or > | 50 | 50 | 30 | - |
| | Suburban/Rural | | | 70 | 70 | 50 | - |
| 4-Lane Paved | Urban | 20000 | 14.0 or > | 50 | 50 | - | - |
| | Suburban/Rural | | | 80 | 80 | - | - |

Source: Based on MCTPC standard & Study Team survey

**Table 3.4.6 Capacity Adjustment Factor for Shoulder Width**

| Shoulder Width (m) | Adjustment Factor | |
|---|---|---|
| | One Side Insufficient | Both Sides Insufficient |
| > 0.75 | 1.00 | 1.00 |
| 0.5 | 0.98 | 0.95 |
| 0.25 | 0.95 | 0.91 |
| 0 | 0.93 | 0.86 |

Source: Based on Japanese Engineering Textbook: Traffic Engineering, Asakura Shoten, Tokyo, April 1994.

As for selecting appropriate Quantity-Velocity (QV) functions for the above road types, it was decided after an examination of the data gathered by the Study Team that a function for paved and unpaved roads would be applied. The function shown in Figure 3.4.9 is for paved roads and the function in Figure 3.4.10 for unpaved roads, respectively. The logic behind this selection is that better designed or higher-grade roads are able to sustain higher speeds at larger volumes. For example, on unpaved roads in the dry season, dust from these roads kicked up by vehicles results in drastic drops in running speed with even just a little traffic. During the wet season, unpaved roads become quickly rutted, resulting in low travel speeds.

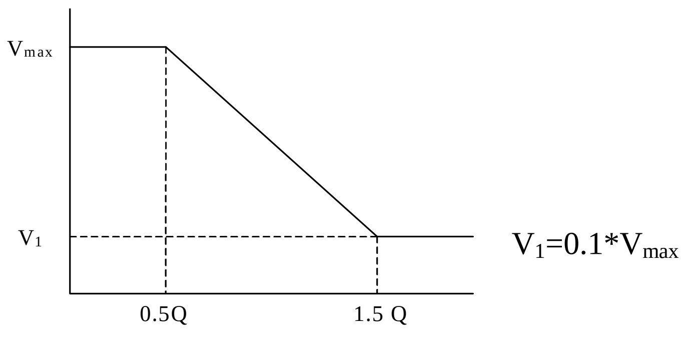


**Figure 3.4.9 QV for Paved Roads**

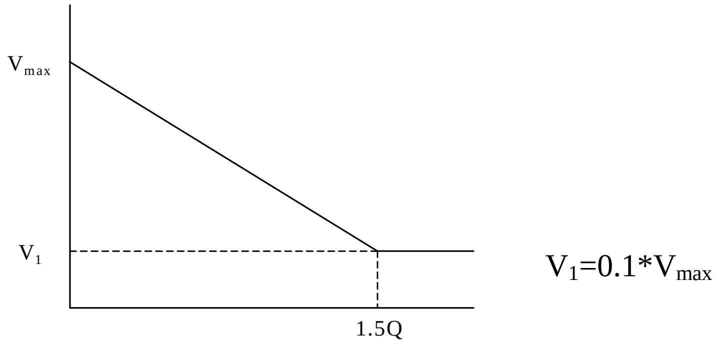


**Figure 3.4.10 QV for Unpaved Roads**

The validation of the traffic assignment model was carried out comparing modeled and observed daily traffic flows at sites where traffic volume counts were executed (see Table 3.4.7). As the table indicates, the average deviation between estimated and observed flows is about 3%, which is acceptable from the strategic level of analysis that is being carried out for this study. Traffic flows at Survey Stations 8 and 9 were not considered because of their extremely small values. Generally, however, the modeled and observed traffic flows for each site are acceptable.

**Table 3.4.7 Comparison of Model Estimates with Observed Traffic Volumes**

| Survey Station | Model Total (vehicles) | Observed Total (vehicles) | Model/Observed |
|---|---|---|---|
| 1 | 528 | 595 | 0.89 |
| 2 | 294 | 220 | 1.34 |
| 3 | 1731 | 1840 | 0.94 |
| 4 | 890 | 955 | 0.93 |
| 5 | 336 | 350 | 0.96 |
| 6 | 689 | 603 | 1.14 |
| 7 | 835 | 670 | 1.25 |
| 8 | 126 | 35 | * |
| 9 | 97 | 45 | * |
| 10 | 652 | 720 | 0.91 |
| 11 | 2078 | 1770 | 1.17 |
| 12 | 171 | 255 | 0.67 |
| 13 | 524 | 545 | 0.96 |
| 14 | 244 | 290 | 0.84 |
| 15 | 171 | 264 | 0.65 |
| Average | | | 0.97 |

### 3.5 Future Traffic Demand

By applying the calibrated traffic assignment model above, future traffic forecasts for the years of 2007 and 2020 are carried out for scenarios as requested by the economist for his work in the economic prioritization of the Study roads (see Location Map). Those scenarios are as follows:

- 2007 Base Case: Where the improvement of Rt. 1I, 9, 15 East, 16, and 18B is assumed and is held true for all cases.
- 2007 Scenario 1: Improvement of Rt. 16A, 1H, 1J, and 1G
- 2007 Scenario 2: Improvement of Rt. 18A, 1J, and 15
- 2007 Scenario 3: Improvement of Rt. 14B from junction with Rt. 16 to 14A1 and improvement of 14A1.
- 2007 Scenario 4: Construction of missing link on Rt. 14A north of Champasack
- 2007 Scenario 5: Improvement of all Study roads
- 2020 Scenario 1: Improvement of all Study roads
- 2020 Scenario 2: Improvement of Rt. 14A1 to 14 C1 (including missing link), 16A, 15, 1H, 1G, and 1J

Based on the results of the above traffic assignments, which are contained in the next nine pages (present flows are included for reference), the following conclusions from a traffic viewpoint can be drawn:

- Routes 16A and 18A are highly similar in the role that they play in the road transport network and therefore directly compete with each other. Accordingly, scarce resources should only be used for one of these routes. Either of these routes would serve as an important east-west corridor connecting the province of Attapeu and Vietnam with the more populous and richer western part of southern Lao. According to the July 2000 “Study on the National Transport Development Strategy in the Socialist Republic of Vietnam,” which was financed by JICA, this is becoming especially important as Vietnam puts more emphasis on its links with southern Lao via Attapeu.
- Note that although Rt. 16A is a little longer than Rt. 18A in terms of length, its improvement would also provide better access to markets for the coffee-rich Boloven Plateau, while improving Rt. 18A would have little commercial value and could potentially be destructive environmentally.
- From the perspective of traffic demand and time savings, construction of the missing link on Rt. 14A is desirable. For example, vehicles that currently use the

ferry to cross the Mekong River at Champasack would divert to this route for significant reductions in travel times. The construction of this link would also promote tourism and encourage agriculture activity by providing improved access.

- From the perspective of linking up central southern Laos with the north-south Rt. 13, the improvement of Rt. 15 can be said to be desirable. This would also provide better access between Savannakhet, Pakse and Saravan, which already form an important trip-making axis. In addition, the population density along this route is relatively high; thereby, ensuring sufficient demand.
- Even with the improvement of Rt. 1G and the construction of its missing link, there will be little traffic on this road. This is because most of the traffic on Rt. 9, which has a high proportion of goods vehicles and traffic from Vietnam, is headed for Savannakhet and the northern part of Laos. In addition, Rt. 1G competes with Rt. 15 East for traffic from Vietnam and careful consideration should be given to whether or not both require improvement.
- The improvement of the portion of Rt. 1H under study has merit in that it connects two of the most important routes in southern Lao (i.e., Rt. 16 and Rt. 20) and should be carried out in the near future.
- In terms of traffic flows and economic interconnectivity, improvements to the road network in southern Lao should focus more on east-west connections rather than north-south connections.
- Although these are not Study roads, access to seven of the 30 district capitals of the Study area do not have an all-weather road (i.e., basic access) and should be considered in a future study.

LEGEND :

Traffic volume (1 car)

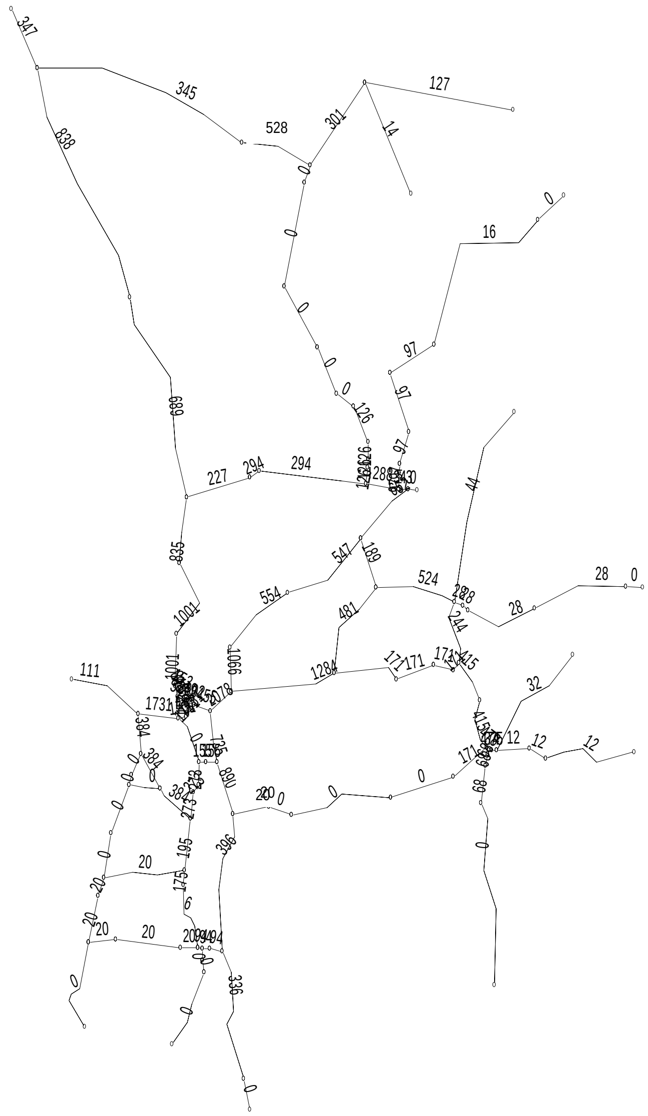


**Figure 3.5.1 Present Traffic Flows (2001)**

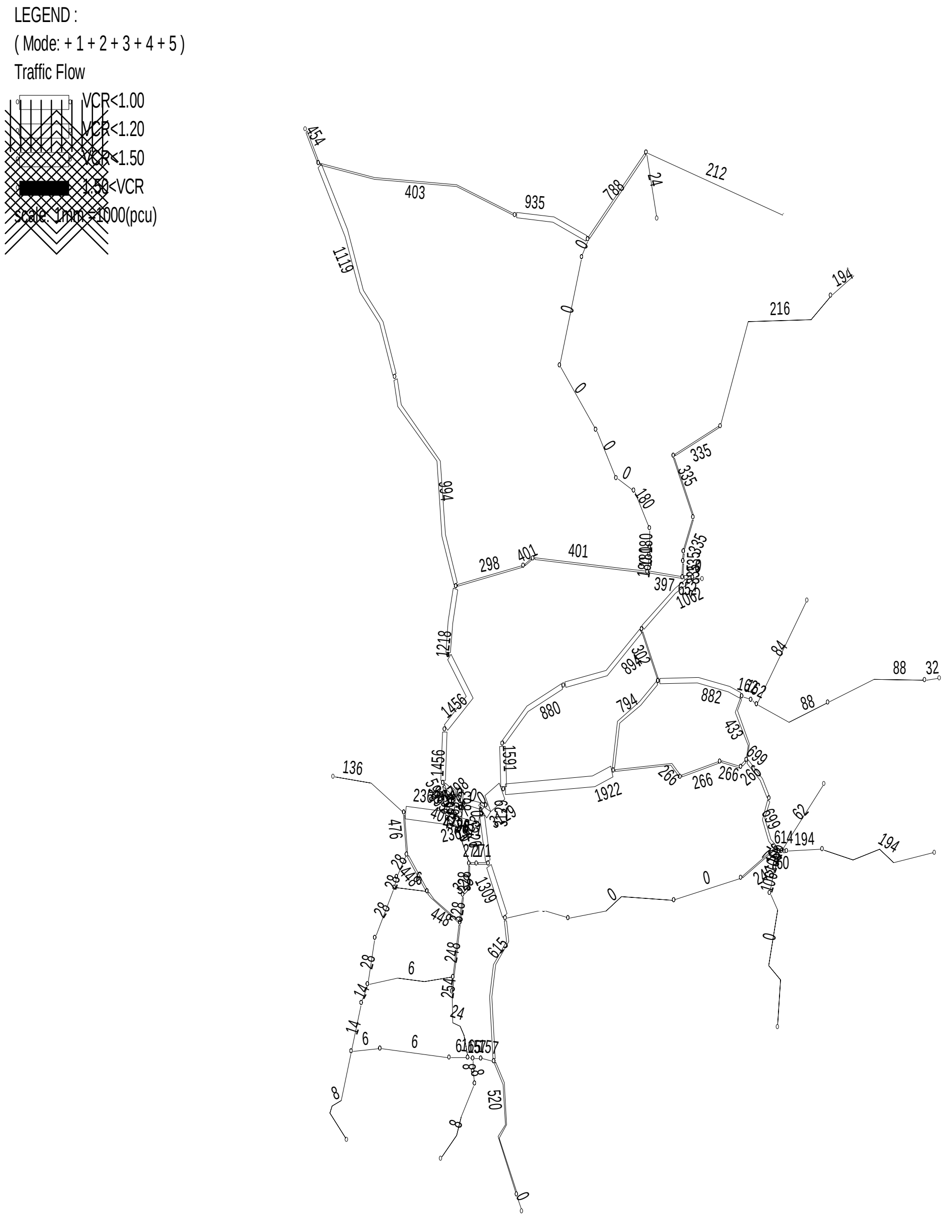


**Figure 3.5.2 2007 Base Case**

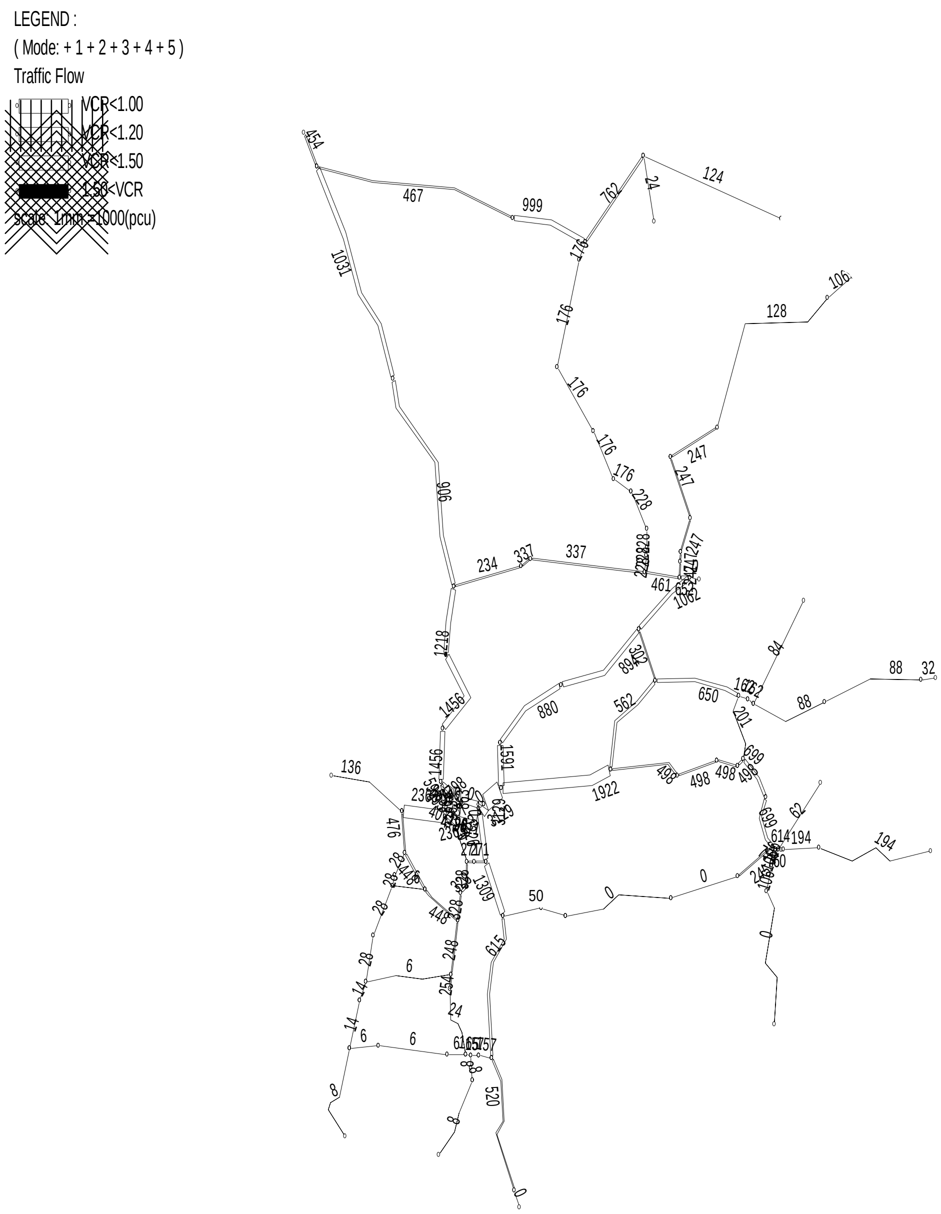


**Figure 3.5.3 2007 Scenario 1**

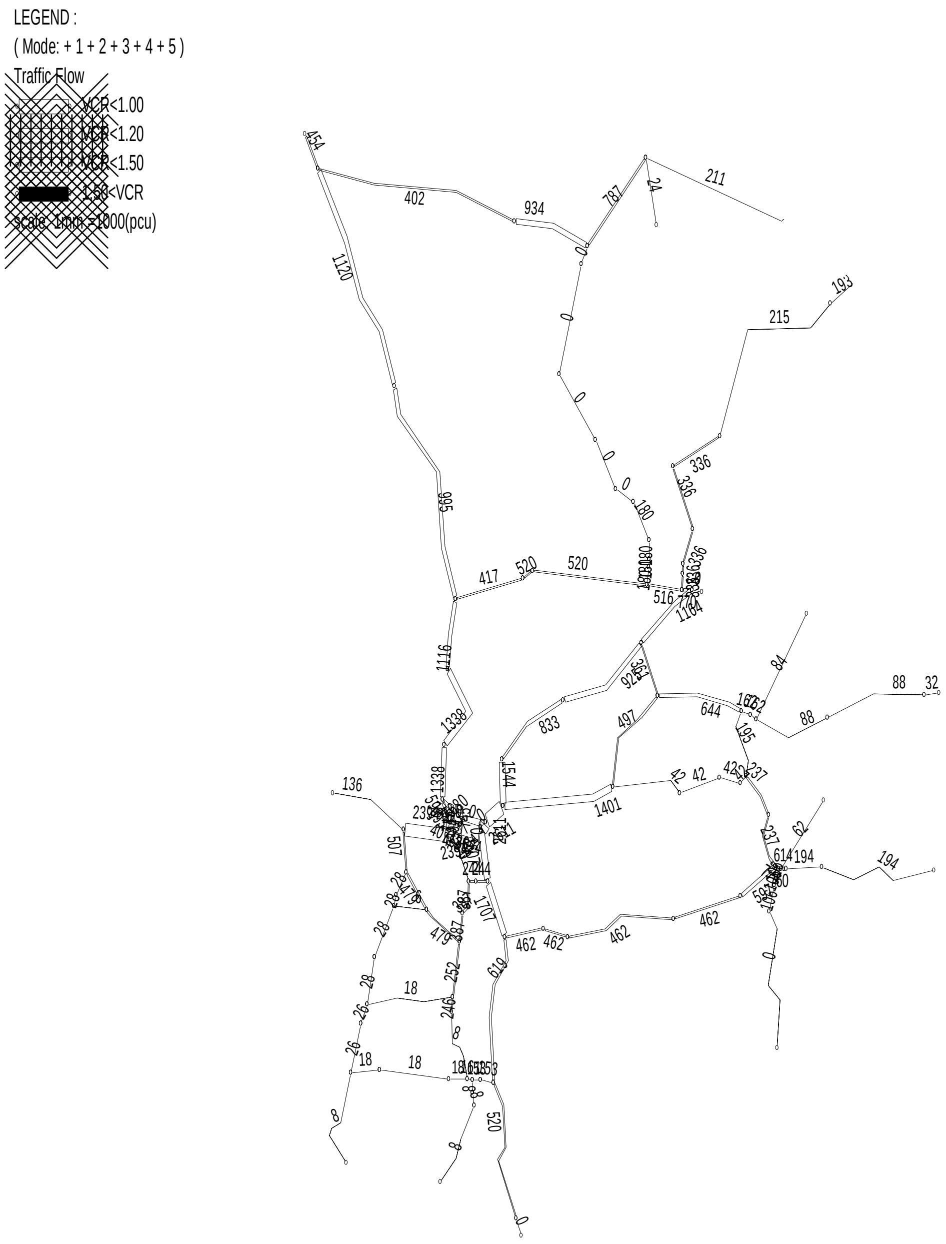


**Figure 3.5.4    2007 Scenario 2**

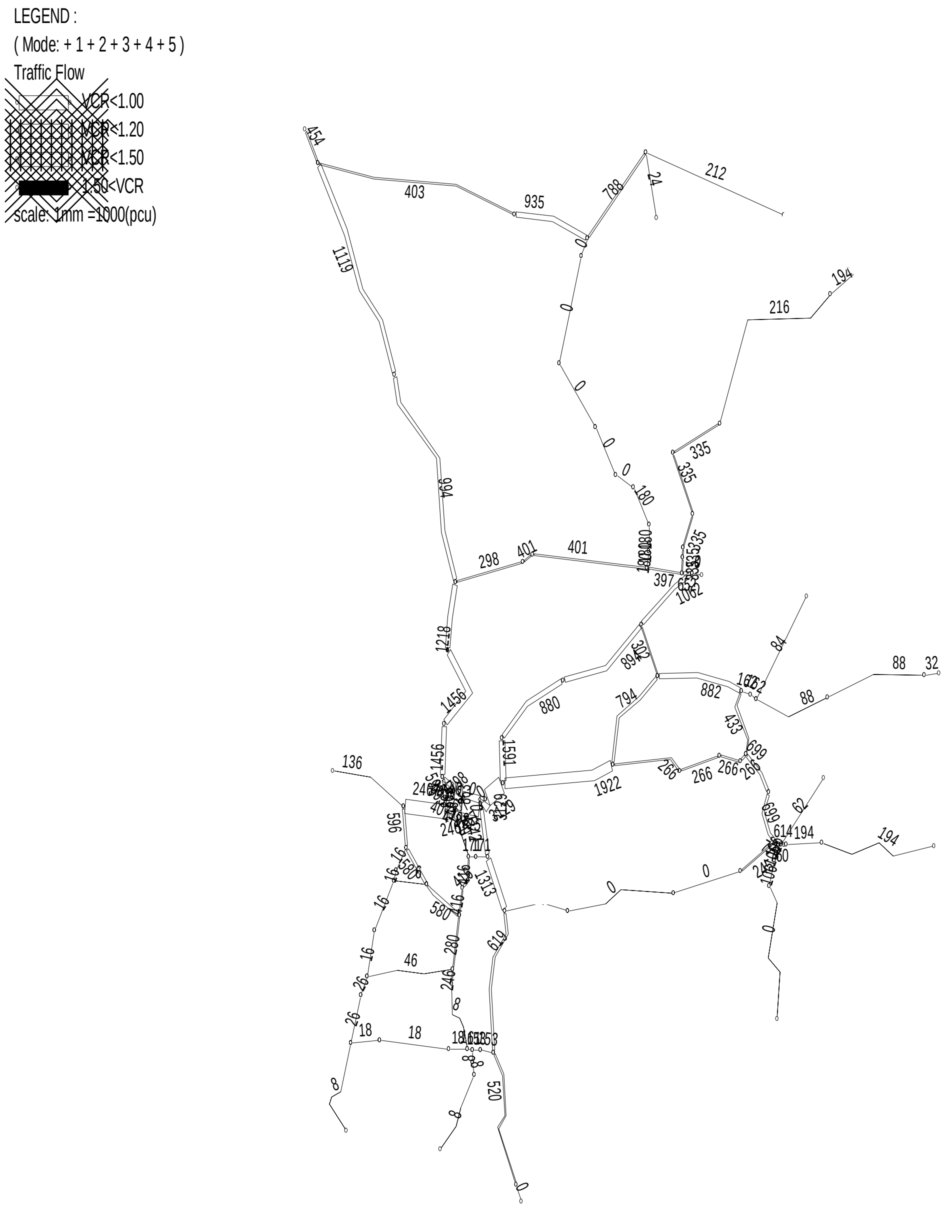


**Figure 3.5.5 2007 Scenario 3**

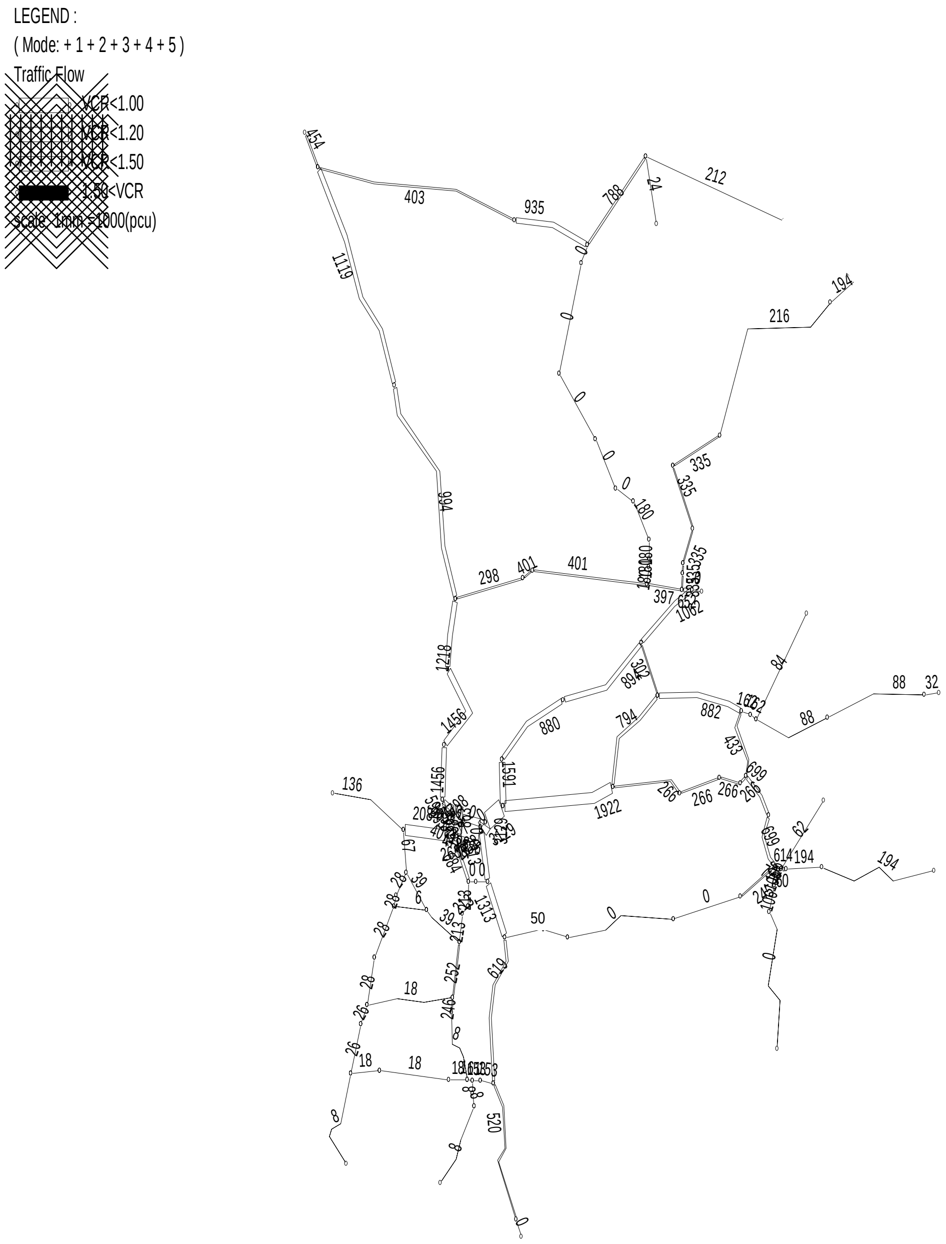


**Figure 3.5.6 2007 Scenario 4**

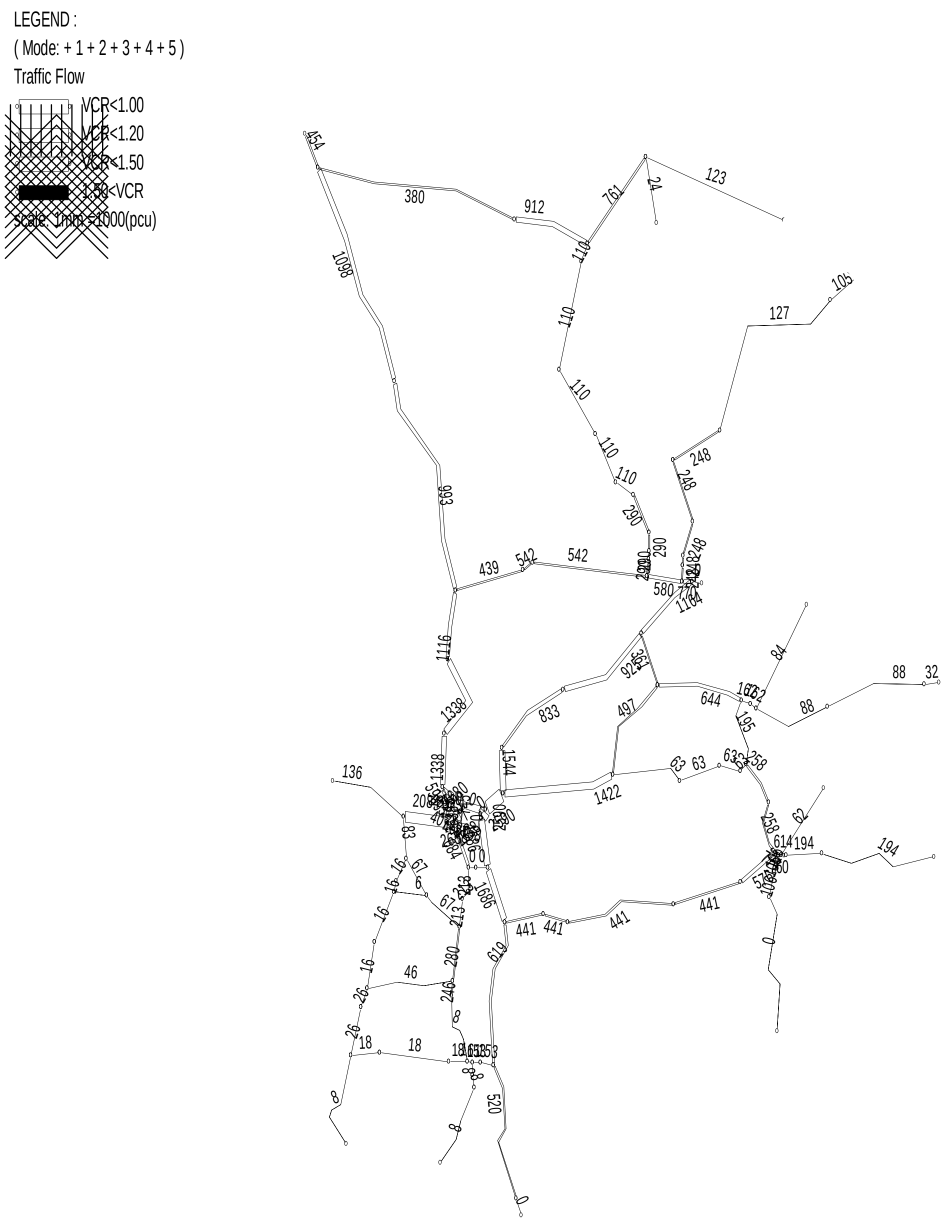


**Figure3.5.7 2007 Scenario 5**

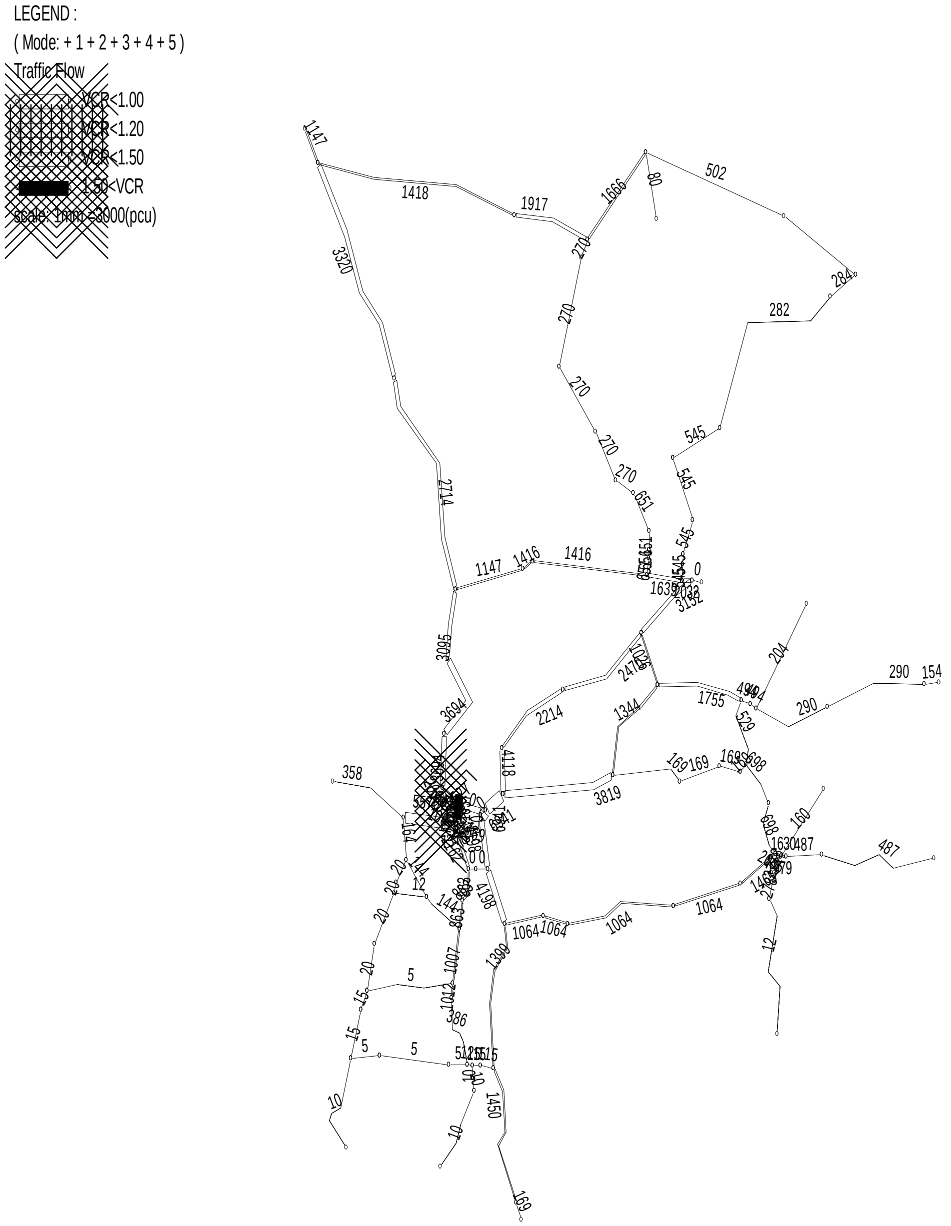


**Figure 3.5.8 2020 Scenario 1**

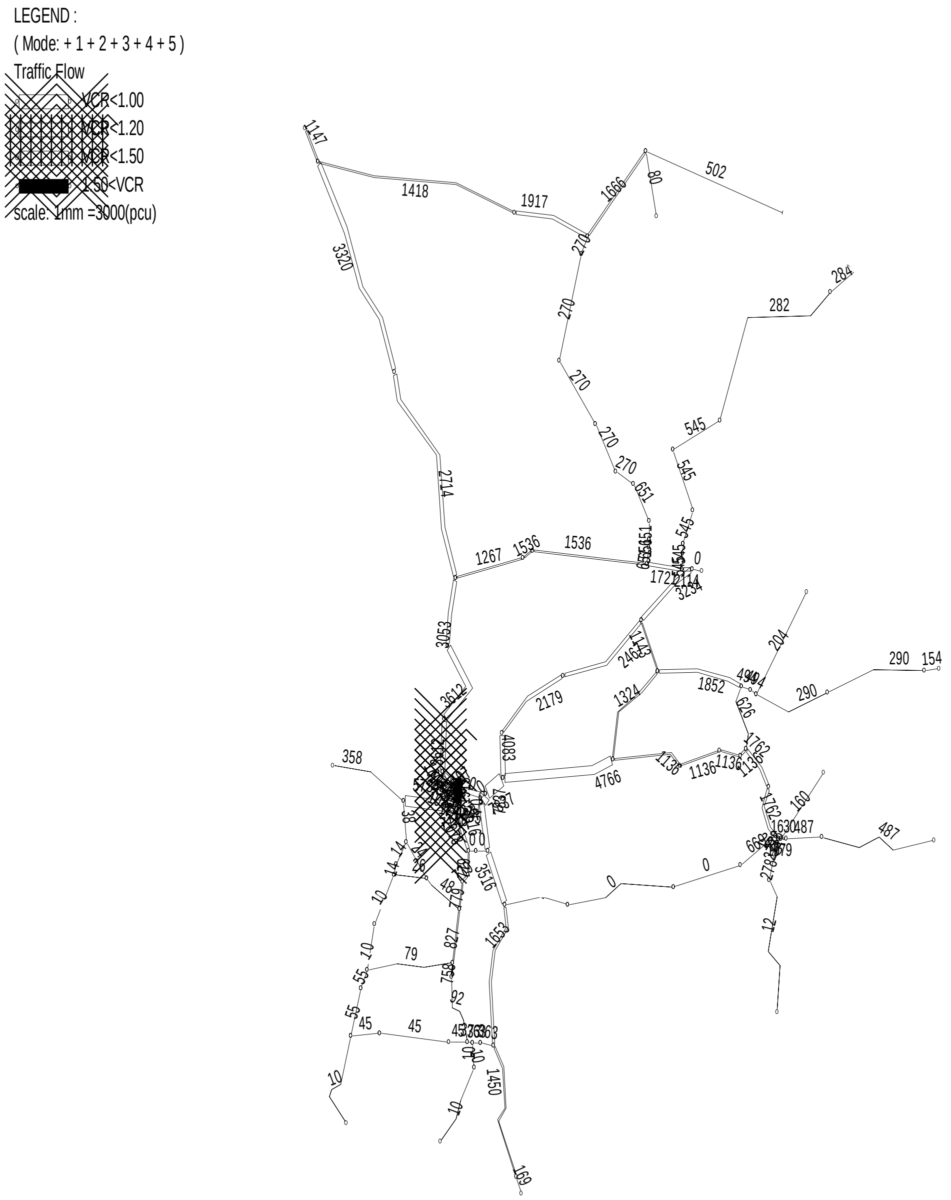


**Figure 3.5.9 2020 Scenario 2**