TRAVEL DEMAND FORECASTS

A. Introduction

1. The purpose of the travel demand forecasts is to assess the impact of the project components on the performance of the urban transport system in Ji'an. The results of the analysis will provide the forecasts of future travel demand, travel patterns, transport system performance, and public transport ridership which will be used to assess the economic viability of each transport project component. The information from the travel model will be used for estimating travel time and vehicle operating cost savings, emissions, and traffic safety impacts.

B. The scope of the analysis

2. The analysis area covers the existing Ji'an Urban Center Area (JUCA) and its surrounding area (see Figure 1):

(i) Jizhou District
(ii) Qinyuan District
(iii) Jingangshan Economic Development District
(iv) Jiangshan New District
(v) City West New District
(vi) Southwest New District
(vii) Binjiang New District

3. The project components included in the travel demand model are (see Figure 2):

(i) Public transport component – including an 6.9-km bus priority corridor with associated improvement of bus stop bays and waiting areas.
(ii) Urban road development component with traffic management – including five new arterial roads in the JUCA including improved traffic management measures and an advanced traffic monitoring and control system.

4. Traffic data on existing roads, socio-economic forecasts, urban development plans, and vehicle fleet forecasts were used to develop the travel demand model and to support scenario analysis (see Figure 3).

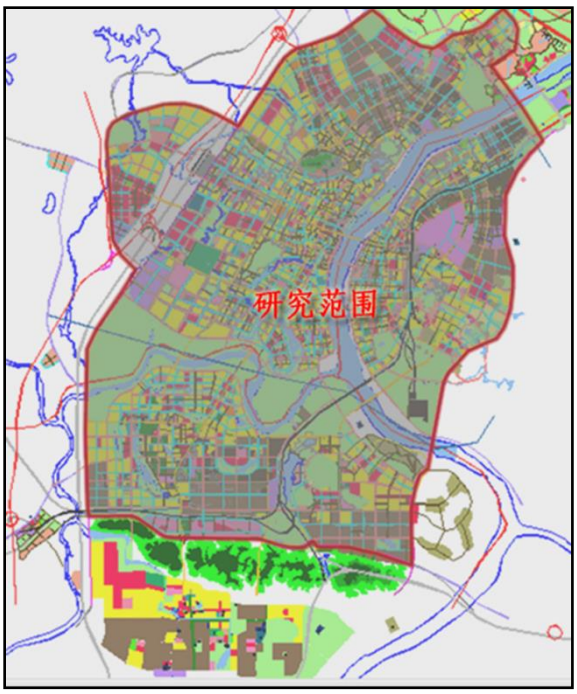

Figure 1: Analysis Area

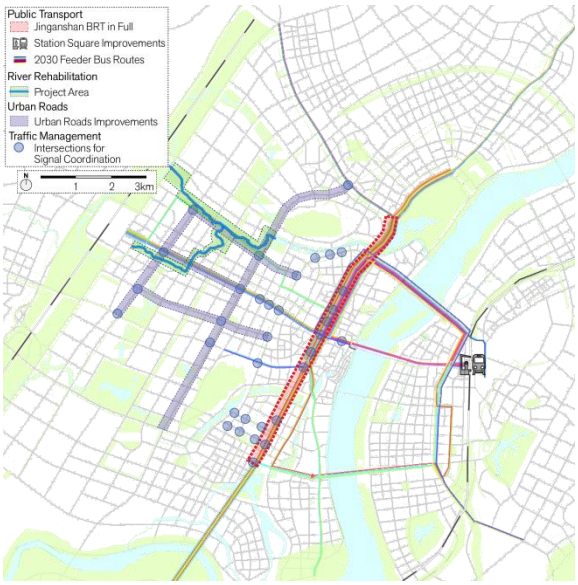

Figure 2: Project Components

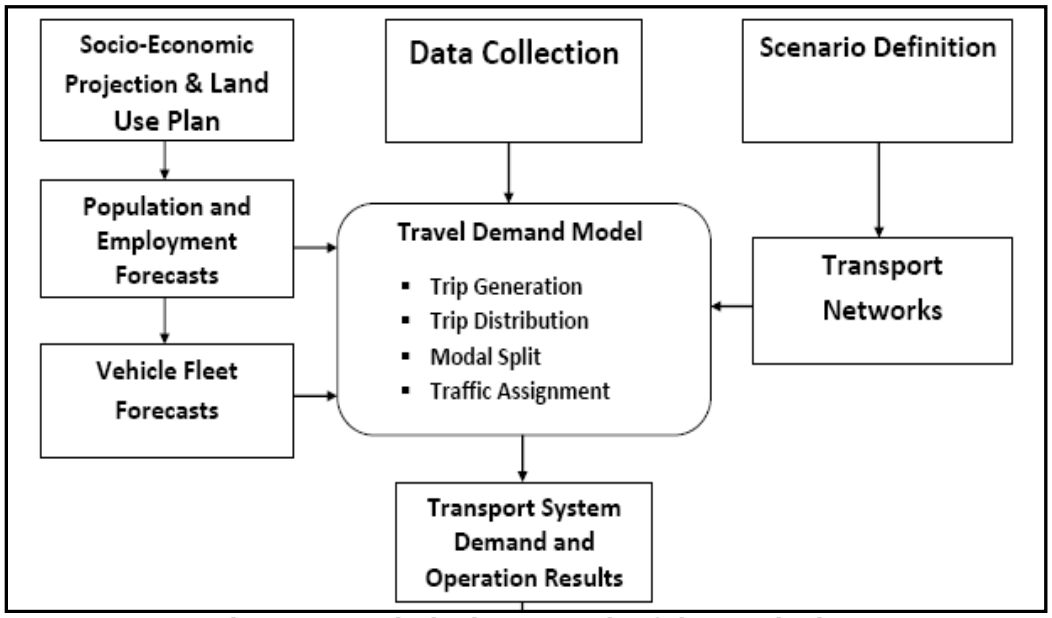

Figure 3: Technical Approach of the Analysis

C. Data Collection and Forecasts

1. Socioeconomic and land use data

5. The current population, economic development and land use pattern are the fundamental factors which generate current travel demand. Those data have been collected for the base year to associate those data to the travel demand and patterns within the study area. The population in the study area has been growing 0.7% per annum during the last 7 years. According to the master plan for the area included in the travel demand model, the population in

2013 was 480,000 and expected to increase to 730,000 in 2020 and 1,040,000 in 2030. Future numbers of employees were also forecasted on the basis of population and land use plans.

Table 1: Population of Various Residential Districts

Residential District	Year 2013	Year 2020	Year 2030
City North District	21,000	35,000	55,000
Central District	190,000	220,000	250,000
Houhe District	75,000	115,000	160,000
City West	-	62,500	187,500
City East	42,000	47,500	60,000
Binjiang	21,000	60,000	80,000
Dunhou	99,000	135,000	160,000
JGS Economic Devel. Dist	17,000	55,000	87,500
Total	**480,000**	**730,000**	**1,040,000**

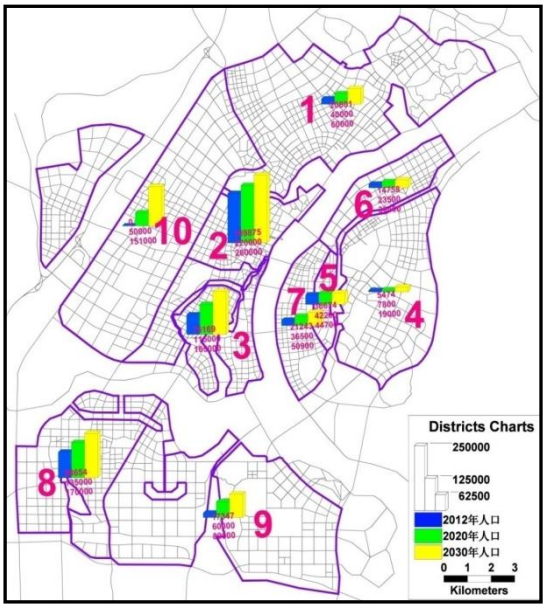

Figure 4: Population Growth

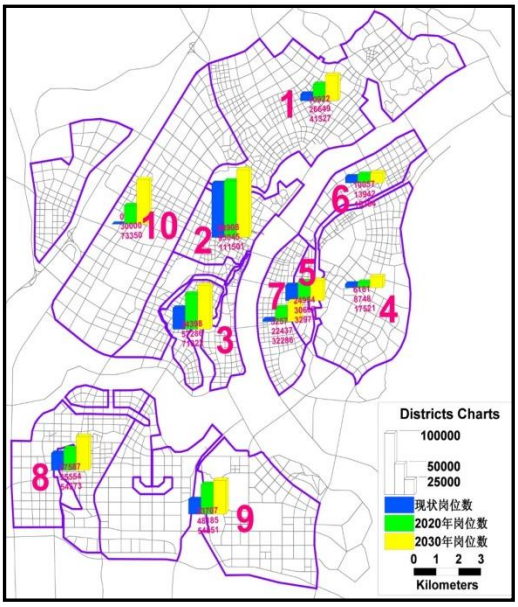

Figure 5: Employment Growth

6. The current land use data and projections are shown in Figure 5 and Figure 6. Existing urban areas that have been substantially developed include: Jizhou District to the West of river, Qinyuan to the East and Jingangshan Economic development Zone to the South of existing city center. By 2020, the urban area is expected to expand in all directions from the city center.

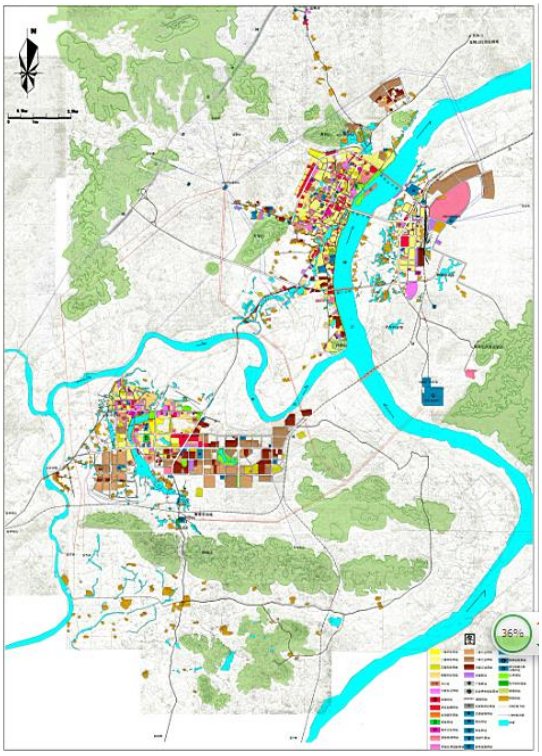

Figure 6: Existing Urban Land Use Pattern

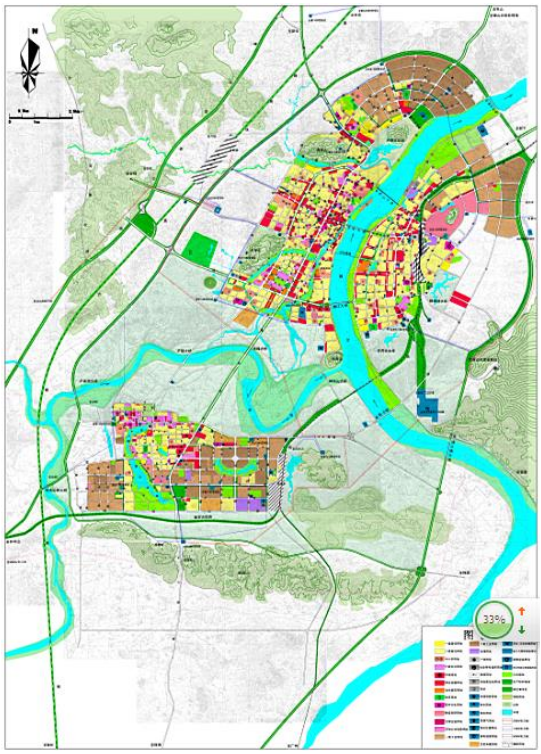

Figure 7: Planned Urban Land Use Plan (2020)

Source: Ji'an Municipal Government. Ji'an Urban Master Plan (2007–2020).

7. The annual growth rates of automobiles have been more than 30% for the last 10 years. As shown in Table 2, the number of automobiles is forecast to grow from 35,000 in 2013 to 109,500 in 2020, and to 187,000 in 2030. In 2030, vehicle ownership is expected to reach the level of 180 cars/1000 people.

Table 2: Forecast Motorized Vehicle Fleet Sizes

	2012	2020	2030
Number of Passenger Vehicles	35,519	109,500	187,200
Population (1000s)	48	73	104
Vehicles/1000 People	74	150	180

2. Traffic and travel data survey

8. A number of surveys were carried out to collect data for this study. The purposes of these surveys are to acquire necessary information on travel and traffic conditions on the road network and public transport system. The data collected in the surveys were used to calibrate or adjust the parameters of the travel demand model. These include:

Table 3: Traffic and Travel Survey Items

Survey Type	Details
Road traffic volume count study	33 road segments within the city center and 6 external highway segments. classified vehicle count data (including bicycles and electric bicycles) 12-hour period from 07:00 to 19:00 major external highways connecting to Ji'an Center City : routes G105, S318 (Ji'an North Avenue), S224 (Ji'an South Avenue) and S335
Bus routes on-board ridership survey	passengers boarding and alighting at stops 12-hour period from 07:00 to 19:00 16 bus routes (out of 20 routes in operation) with daily ridership more than 500 passengers
Jingangshan avenue screenline bus passenger volume survey	7 locations along the BRT corridor 12-hour period from 07:00 to 19:00
External transport terminal passenger survey	Gender split of passengers Percentages of people picking up/dropping off passengers Split of Ji'an residents and visitors Purpose split of the out of city trips Destinations of the out of city trips Mode use for visitor coming to Ji'an

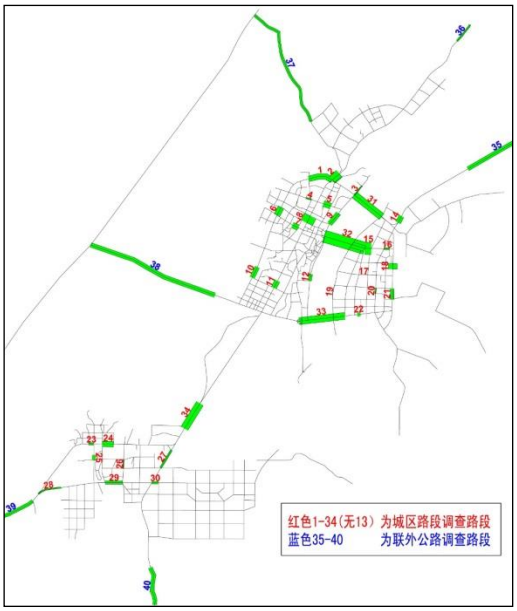

Figure 8: Locations of Traffic Volume Count Survey

Figure 9: Locations of screen-line bus passenger volume survey

D. Travel Demand Model Development

1. 4-stage Modelling Process

9. The model used in this study is a traditional 4-step trip based model implemented in TransCAD. The model included the following four elements:

(i) Trip generation – estimating trips generated from/to each traffic zone
(ii) Trip distribution – estimating trips among and within traffic zones

(iii) Modal split – estimating trips among traffic zones by various travel modes
(iv) Traffic assignment – "assigning" trips onto the transport network to estimate the traffic volume on the road network and public transport network

10. The model considers trips of following travel modes:
(i) Non-motorized person trips – walk, bicycle, moped, etc.
(ii) Transit trips – bus and BRT
(iii) Personal motorized trips – auto, motorcycle, etc.
(iv) Trucks – small trucks and large trucks

11. The model process basically generates a set of trip tables for various travel modes, which describe trips between individual traffic zone pairs. These trip tables are then "assigned" to the transport network to predict the vehicle volumes on the road network and passenger volumes on the transit network. The model can also estimate the service level (e.g., travel speeds, delay) on the transport system.

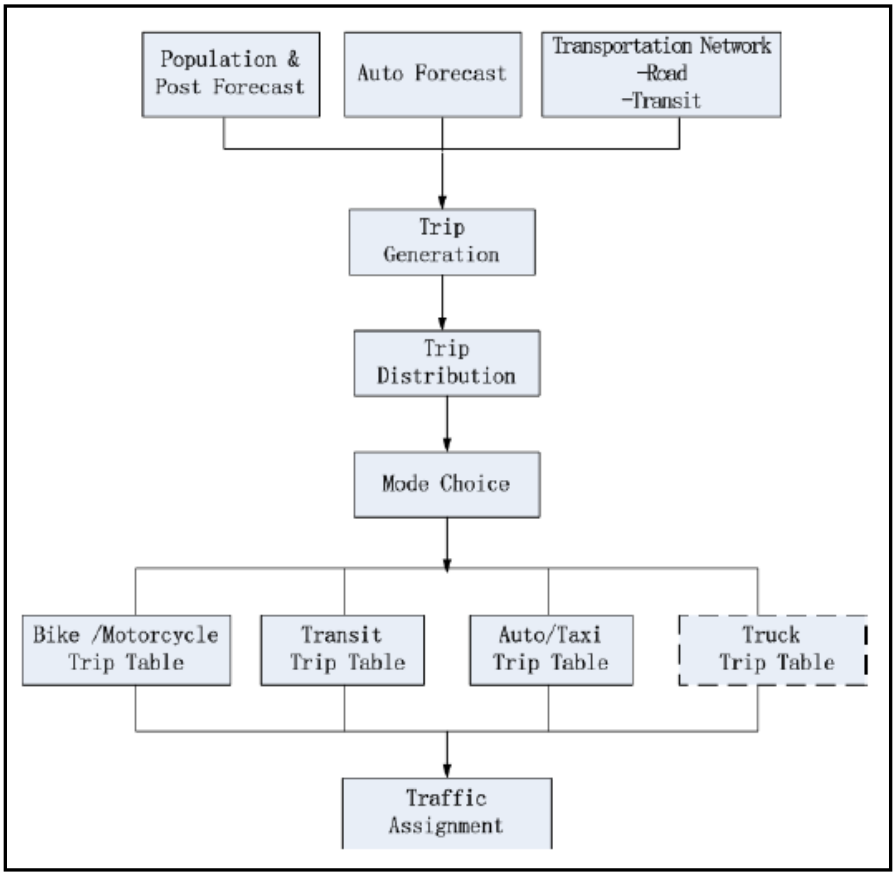

Figure 10: Four-stage Modelling Process

2. Network Building

12. **Traffic Analysis Zone (TAZ).** The study area is subdivided into 141 traffic analysis zones (TAZs) as shown in Figure 11. The TAZs were defined by dividing the administrative districts into zones which following certain physical or administrative boundaries, such as roads, rivers, street blocks, etc. The TAZs are the basic units upon which the travel demand is

estimated. In addition to the traffic zones, 8 external zones are defined in the model, representing the external highways connecting to the study area.

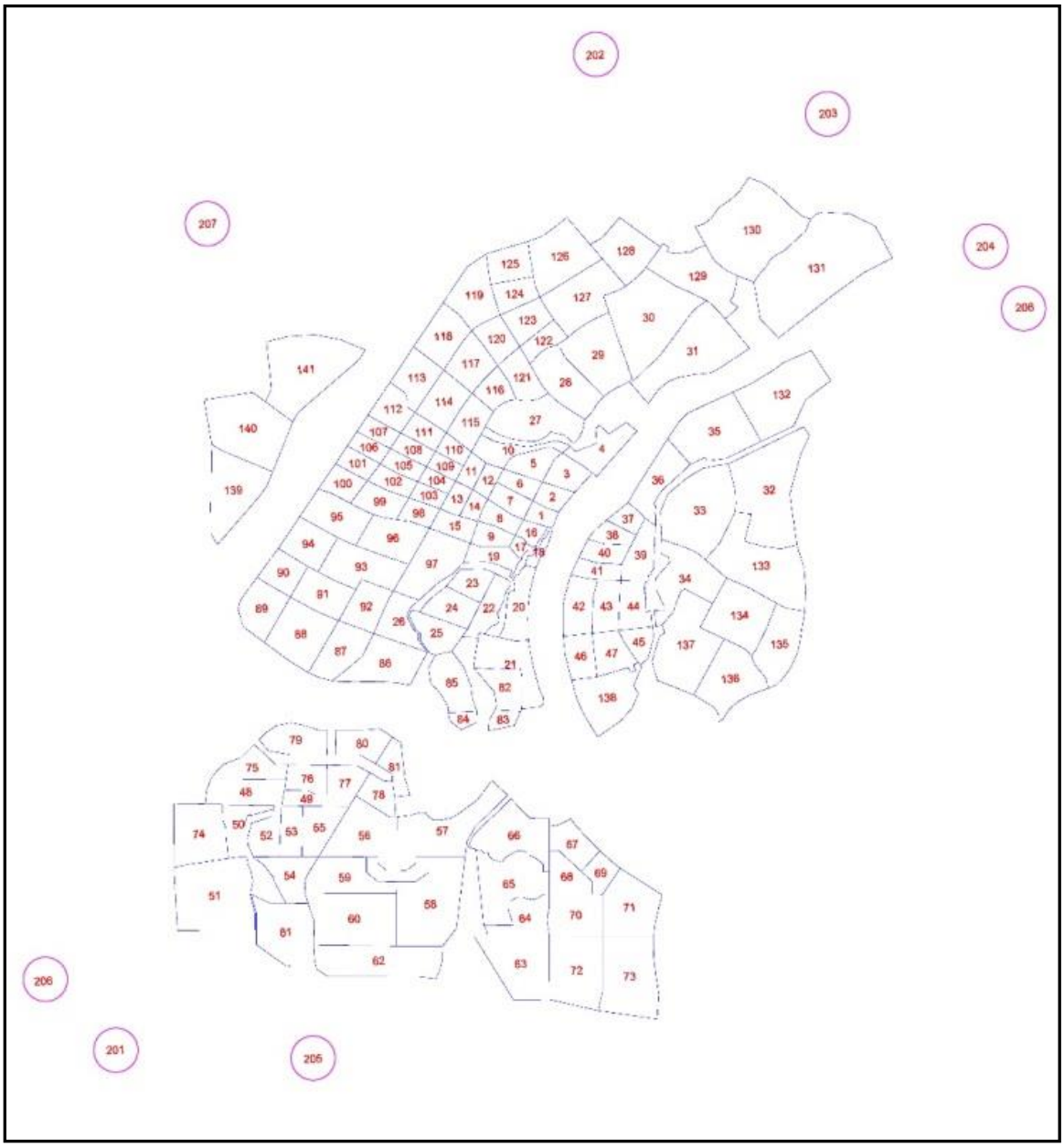

Figure 11: Traffic Analysis Zones

13. The road network in the model study area is encoded in TransCAD. Figure 12 displays the Year 2013 model road network. The network consists of 790 nodes and 980 links, with a total length of 330 kilometers. The transit network includes all the bus lines operating in the model study area. In the Year 2013 model, 19 existing bus lines are encoded.

Figure 12: Year 2013 Urban Road Network

Figure 13: 2012 Ji'an Center City Bus Network

14. **Model Validation and Adjustment.** A set of preliminary base year trip tables was derived based on the model structure. The estimated trip tables are then used to adjust the coefficients and parameters of individual model elements. The estimated trip tables were validated by assigning the trip tables and compare the model assigned traffic volumes and ridership volumes on individual road segment or bus route segments with the observed volume data. Table 4 summarizes the comparison of model estimated and observed traffic volumes on the road network and while Table 5 summarizes the comparison of transit passenger volumes on the transit network respectively.

Table 4: Comparison of Observed and Estimated Screenline Vehicle Traffic Volumes

Site No	Obs.Daily Volume (PCUs)	Model Est. Daily Vol. (PCUs)	Site No	Obs. Daily Volume (PCUs)	Model Est. Daily Vol. (PCUs)
1	4,613	4,442	22	2,959	3,495
2	7,096	7,084	23	1,799	1,797
3	914	905	24	4,573	4,520
4	1,244	899	25	2,475	2,471
5	4,409	4,252	26	709	711
6	4,969	4,754	27	1,614	1,622
7	4,594	4,572	28	1,204	1,205
8	10,423	10,230	29	2,678	2,673
9	3,999	3,996	30	1,883	1,880
10	3,846	3,376	31	5,878	5,722
11	4,306	4,229	32	9,850	9,753
Site No	**Obs.Daily Volume** (PCUs)	**Model Est. Daily Vol.** (PCUs)	**Site No**	**Obs. Daily Volume** (PCUs)	**Model Est. Daily Vol.** (PCUs)
12	2,685	2,691	33	5,693	4,448
14	4,551	4,590	34	6,270	6,231
15	9,895	9,688	35	3,341	3,346
16	3,856	3,165	36	1,479	1,478
17	182	184	37	2,164	2,164
18	9,925	9,384	38	3,549	3,546
19	331	-	39	2,672	2,670
20	1,153	1,115	40	3,354	3,354
21	3,073	3,405			

Table 5: Comparison of Observed and Estimated Screen Line Passenger Volumes

Screen line	Obs. Daily Pax Vol.	Model Est. Daily Pax Vol.	Screen line	Obs. Daily Pax Vol.	Model Est. Daily Pax Vol.
1	8,023	8,178	6	2,285	2,331
2	6,906	7,953	7	13,173	12,164
3	8,087	8,261	8	9,315	9,134
4	19,251	18,191	9	8,529	7,819
5	9,025	8,315			

15. Future networks were built according to the master plan. In 2030, the total roadway length of the road network will reach 1020 km. Figure 14 and Figure 15 display the year 2020 and year 2030 road networks respectively.

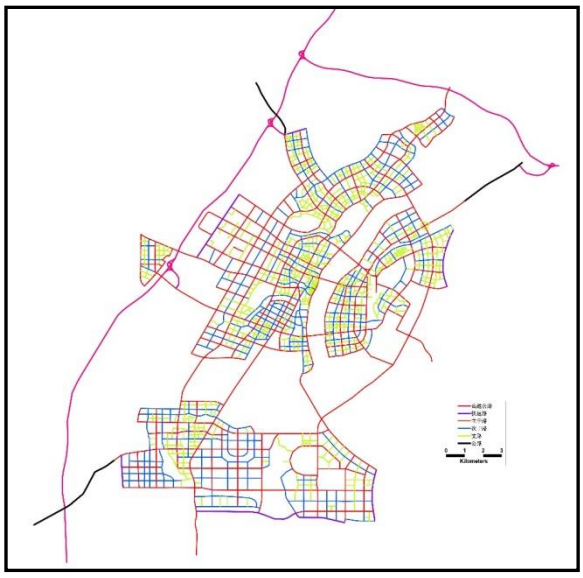

Figure 14: Year 2020 Road Network Plan

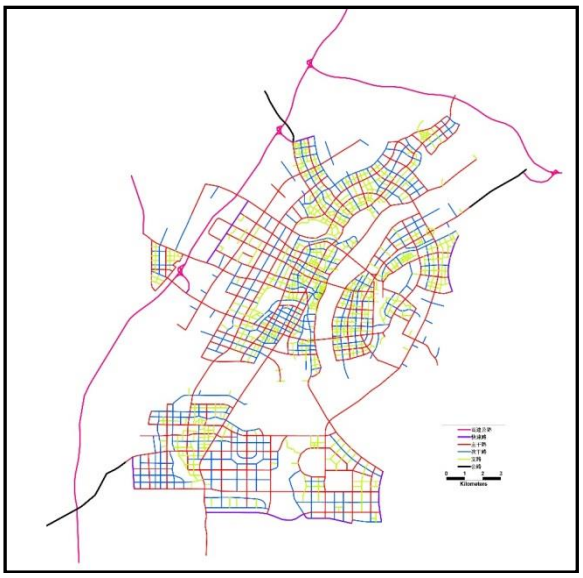

Figure 15: Year 2030 Road Network Plan

16. Future bus routes and the BRT network were built to estimate the future public transport demand and BRT demand.

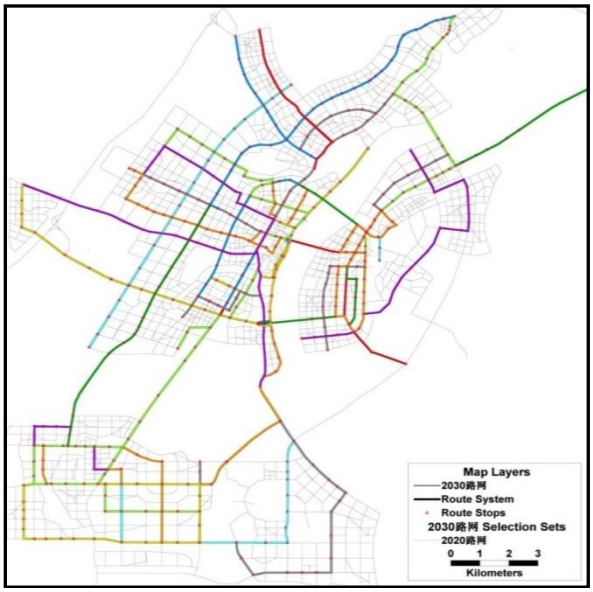

Figure 16: Year 2030 Model Coded Transit Network

Figure 17: Modelled BRT Route Network

E. Travel Demand Forecasts

1. Regional Person Trips Forecasts

17. The total number of person trips generated by residents in the study area is forecast to increase from 1.27 million in 2013 to 2.76 million in 2030. With the development of outskirt areas, travel distance is expected to increase significantly and hence more trips will be made using motorized modes. As shown in Table 6, the non-motorized modal shares (i.e., walk and bicycle) are expected to decline from 82% in 2011 to 53% in 2030. The share of the auto mode

is expected to increase significantly, from 12% in 2011 to 24% in 2030. At present, the transit mode share, at 6% is expected to increase substantially with the expansion of the urbanized area and implementation of BRT. The transit share is forecast to reach 23% in year 2030.

Table 6: Forecast Regional Person Trips and Modal Shares

Index	2013	2018	2030
Total Daily Regional Trips (Millions)	1.27	1.94	2.76
Model Shares			
Walk	34%	30%	29%
Bike/Moped	48%	34%	24%
Car/Taxi	12%	21%	24%
Transit	6%	15%	23%

Note: The forecast bus shares are under the scenario without any premium bus service such as BRT.

18. In 2030, 550,000 motorized vehicle trips are forecast to be generated in the JUCA per day, an increase from 110,000 in 2013. The increase of passenger vehicle trips is likely to be dramatic, from 106,000 in 2011 to 520,000 in 2030.

Table 7: Forecast Regional Vehicle Trips per Day

	2013	2018	2030
Total Motorized Vehicle Trips (1000s)*	111.2	327.3	551.4
Total Passenger Vehicle Trips (1000s)*	106.0	307.8	519.9

* Excluding motorcycles or electric bikes.

2. Demand forecasts for ADB financed project components

19. **Network Performance.** Figures 18 and 19 display road network flow diagrams of the "Build All" scenarios for 2020 and 2030. Most of the road segments will be operated under capacity in 2020, except for few road segments in the city core and the three bridges crossing river. In 2030, there will be more road segments operating over capacity, for example, the two bridges and the roads on the west bank of the river in the center core area. For road segments in the City West District, where the ADB project roads are located, the projected traffic volumes in 2030 are moderate.

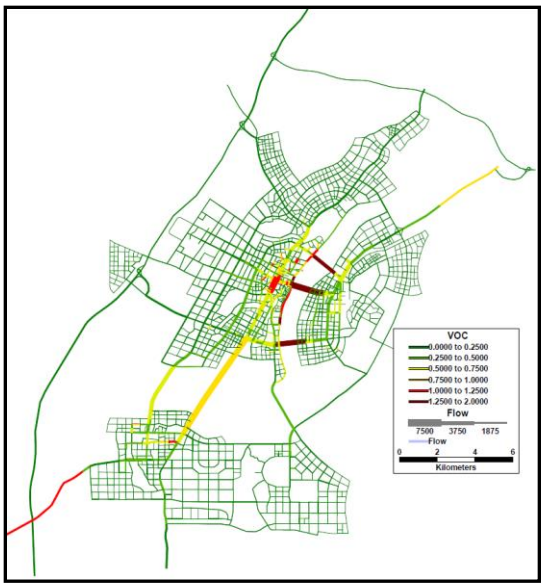

Figure 18: Year 2020 Build All Scenario Road Network Traffic Flow

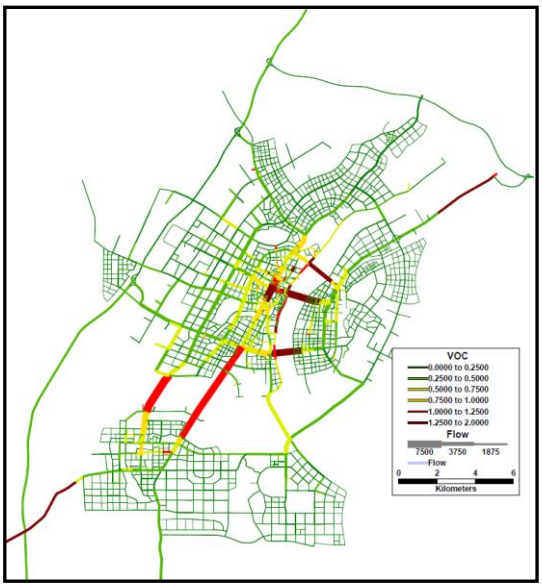

Figure 19: Year 2030 Build All Scenario Road Network Traffic Flow

20. Table 8 summarizes the performance statistics of the road network under the various scenarios for 2030. The forecasts indicate that the ADB road projects are expected to reduce the regional vehicle-kilometers by about 48,000 daily, and the regional vehicle-hours by about 3,700 daily by providing more direct connections by 2030.

Table 8: 2030 Passenger Vehicle Operation Statistics under Various Scenarios

	No Build	Build Yangming West Road Only	Build Junhua Avenue only	Build Yanming & Junhua Road	Build All
Passenger Car					
Veh-Km	5,205,534	5,190,264	5,189,847	5,170,061	5,170,214
Veh-Hr	153,377	151,882	152,085	150,468	150,264
Veh Trips (pcu)	605,516	605,516	605,516	605,516	605,516
Pax-Km	6,767,194	6,747,344	6,746,802	6,721,079	6,721,278
Pax-Hr	199,391	197,447	197,711	195,608	195,344
Person Trips	787,171	787,171	787,171	787,171	787,171
Moped/Motorcycle					
Veh-km	4,137,877	4,113,869	4,128,925	4,105,120	4,093,286
Veh-Hr	276,128	274,466	275,517	273,889	273,110
Veh Trips	693,591	693,591	693,591	693,591	693,591
Truck					
Veh-Km	602,635	601,241	601,322	599,878	599,685
Veh-Hr	15,575	15,514	15,524	15,473	15,463
Veh-Trips	62,399	62,399	62,399	62,399	62,399
Total					
Veh-Km	7,049,532	7,025,666	7,029,847	7,001,475	6,997,884
Veh-Hr	251,790	249,736	250,264	248,108	247,660
Veh-Trips (pcu)	875,992	875,992	875,992	875,992	875,992

21. **Jingangshan Avenue BRT Ridership Forecasts.** The transit networks used in the two forecast years (i.e., 2020 and 2030) were developed by expanding the existing transit service along with population growth and development patterns. The enhanced transit network was examined by the study team to determine if additional bus routes need to be added to cover the

new development areas. The service frequencies of new bus routes are set to 5 minutes for routes within the center city area and 10-20 minutes for routes serving the urban fringe areas. The base bus fare is kept the same “price value” as current year (i.e., to be adjusted following the CPI index).

22. The travel demand model was applied to forecast regional transit trip tables for scenarios without and with the BRT. Table 9 summarized the totals of regional transit trips under various scenarios. Under the no-BRT condition, the total number of regional transit trips increase from 75,000 in 2013 to 290,000 in 2020, and further increase to 620,000 in 2030. With the planned expansion of the center city, more people will have to use transit for daily travel. With the implementation of the BRT system, the numbers of regional transit trips will increase, by about 7,000 in 2020 and 12,300 in 2030, reflecting that more people will use transit trips due to the service improvement.

Table 9: Forecast Transit Trips under Various Scenarios

Year/Scenario	Total Transit Trips	Change from No-BRT
2013	75,002	–
2020 No-BRT	288,975	–
2020 BRT	295,942	6,967
2030 No-BRT	621,759	–
2030 BRT	634,038	12,279

23. Figure 20 and Figure 21 illustrate the bus passenger flows of the regional transit network under the “2020 BRT” and “2030 BRT” scenarios. The figures reveal that while the BRT corridor is the major transit corridor with high passenger demand. In 2030, the transit passenger flow on major arterials connecting the new development areas will also be substantial, in particular on corridors connecting the Economic Development District to the south of the center city and the new areas west of the center city.

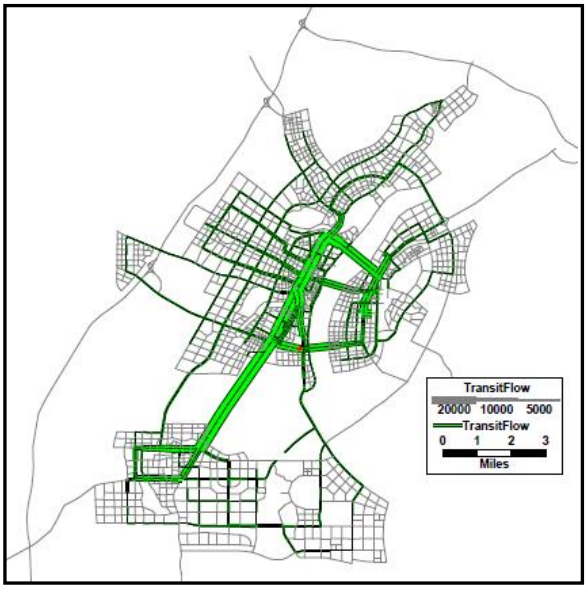

Figure 20: Forecast Bus Passenger Flow under 2020 BRT Scenario

Figure 21: Forecast Bus Passenger Flow under 2030 BRT Scenario

24. Table 10 summarizes the operating statistics of the transit service under the “No-BRT” and “BRT” scenarios. As shown in the table, with BRT operation, total numbers of system-wide passenger kilometers and passenger hours increase. This is due to the increase of total passenger trips (about 7,000 more daily in 2020 and 12,000 more in 2030). For the BRT routes, which would operate outside the BRT corridor for some part of the routes, the total number of passenger kilometers on these routes is about 979,000 in 2020, accounting for more than half of the system-wide passenger kilometers (1,653,000). On the other hand, the total number of vehicle kilometers of the BRT routes is about 25,000 in 2020, accounting for less than 30% of the number of system-wide vehicle kilometers.

Table 10: Forecast Transit Ridership Statistics under Various Scenarios

	2020 No BRT	2020 Build BRT	2030 No BRT	2030 Build BRT
System-Wide				
Passenger Kilometers	1,561,846	1,653,762	4,243,876	4,405,155
Passenger Hours	91,173	91,537	243,800	243,421
Passenger Boardings	363,502	374,404	946,620	967,651
Passenger Trips	288,975	295,942	621,759	634,038
Vehicle Kilometers	88,235	88,235	151,937	151,937
Vehicle Hours	5,167	4,935	8,828	8,578
BRT Lines				
Passenger Kilometers		977,812		1,934,372
Passenger Hours		52,450		103,317
Passenger Boardings		166,124		316,930
Vehicle Kilometers		25,139		25,152
Vehicle Hours		1,343		1,344
BRT Corridor				
Passenger Kilometers		293,247		566,030
Passenger Boardings		81,782		154,410