THE MASTER PLAN FOR
LIMA AND CALLAO METROPOLITAN AREA
URBAN TRANSPORTATION IN
THE REPUBLIC OF PERU
(Phase 1)

FINAL REPORT
(Volume – II)

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YACHIYO ENGINEERING CO., LTD
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Preface

In response to a request from the Government of the Republic of Peru, the Government of Japan decided to conduct the Master Plan for Lima and Callao Metropolitan Area Urban Transportation in the Republic of Peru (Phase 1) and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Koichi TSUZUKI of Yachiyo Engineering Co., Ltd., to Peru, seven times between January 2004 and May 2005. In addition, JICA set up an advisory committee headed by Dr. Hisao Uchiyama, Tokyo University of Science between January 2004 and May 2005, which examined the Study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of Peru and conducted a field survey in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to officials concerned of the Government of the Republic of Peru for their close cooperation extended to the team.

August 2005

Kazuhis Matsuoka
Vice President
Japan International Cooperation Agency
Letter of Transmittal

August 2005

Mr. Kazuhisa MATSUOKA
Vice President
Japan International Cooperation Agency

Dear Sir:

It is a great honor for me to submit herewith the final reports of the Master Plan for Lima and Callao Metropolitan Area Urban Transportation in the Republic of Peru (Phase 1).

A study team, which consists of Yachiyo Engineering Co., Ltd. and Pacific Consultants International, and headed by myself, conducted field surveys, data analysis and planning works of the master plan study in Peru based on the terms of references instructed by the Japan International Cooperation Agency (JICA) from January 2004 to August 2005.

The study team held thorough discussions and investigations with officials concerned of the Government of Peru, accordingly, various traffic surveys, present conditions analysis, initial environmental examination, preparation of implementation program, and project evaluation. The results were compiled in the final report, main and summary volumes.

On behalf of the team, I wish to express my heartfelt appreciation to the officials concerned of the Government of Peru for their warm friendship and cooperation extended to us during our stay in Peru.

I also wish to express my sincere appreciation to JICA, Consejo de Transporte de Lima y Callao, Ministry of Transportations and Communications, the Embassy of Japan in Peru, and other concerned government authorities for their valuable advice and cooperation given to us in the course of the Study.

Yours Faithfully,

Koichi TSUZUKI
Team Leader,
The Master Plan for Lima and Callao Metropolitan Area Urban Transportation in the Republic of Peru (Phase 1)
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<tr>
<td>¥</td>
<td>Yen</td>
</tr>
<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation</td>
</tr>
<tr>
<td>AATE</td>
<td>Autonomous Authority of the Special Project of Electric Mass Transport System for Lima and Callao</td>
</tr>
<tr>
<td>ACI</td>
<td>American Concrete Institute</td>
</tr>
<tr>
<td>AIT</td>
<td>Asian Institute of Technology</td>
</tr>
<tr>
<td>AMETUR</td>
<td>Metropolitan Association of Urban Transport Enterprises</td>
</tr>
<tr>
<td>Art.</td>
<td>Article</td>
</tr>
<tr>
<td>ASETRAP</td>
<td>Association of Peruvian Transport Enterprises</td>
</tr>
<tr>
<td>ASETUM</td>
<td>Association of Mass Urban Transportation Companies from</td>
</tr>
<tr>
<td>ASETUP</td>
<td>Association of Urban Transportation Companies from Peru</td>
</tr>
<tr>
<td>ASPEC</td>
<td>Peruvian Association of Consumers and Users</td>
</tr>
<tr>
<td>ATC</td>
<td>Applied Technology Council</td>
</tr>
<tr>
<td>ATLM</td>
<td>Lima and Callao Metropolitan Transport Authority</td>
</tr>
<tr>
<td>ATP</td>
<td>Automatic Train Protection System</td>
</tr>
<tr>
<td>Av.</td>
<td>Avenue</td>
</tr>
<tr>
<td>CBD</td>
<td>Central Business District</td>
</tr>
<tr>
<td>CCTV</td>
<td>Closed Circuit Television System Camera</td>
</tr>
<tr>
<td>CEMTU - PERU</td>
<td>Urban Carriers Company Corporation from Peru</td>
</tr>
<tr>
<td>CEPAL</td>
<td>Economic Commission for Latin American and Caribe</td>
</tr>
<tr>
<td>CEPRERI</td>
<td>Special Committee of Private Investment Promotion</td>
</tr>
<tr>
<td>CGT</td>
<td>General Confederation of Transport</td>
</tr>
<tr>
<td>CIDATT</td>
<td>Investigation and Advisory Center of Terrestrial Transport</td>
</tr>
<tr>
<td>CNG</td>
<td>Compressed Natural Gas</td>
</tr>
<tr>
<td>CNSV</td>
<td>National Road Safety Council</td>
</tr>
<tr>
<td>COFOPRI</td>
<td>Commission of Informal Property Formalization</td>
</tr>
<tr>
<td>CONAM</td>
<td>National Environmental Council</td>
</tr>
<tr>
<td>CONATA</td>
<td>National Assessment Council for Real Estate</td>
</tr>
<tr>
<td>CONATRAP</td>
<td>National Confederation of Public Transport Companies</td>
</tr>
<tr>
<td>CONECSA</td>
<td>Business Consortium of Callao</td>
</tr>
<tr>
<td>CONFIEP</td>
<td>National Confederation of Private Business Institutions</td>
</tr>
<tr>
<td>CORDELCRA</td>
<td>Development Corporation for Lima and Callao</td>
</tr>
<tr>
<td>CORPAC</td>
<td>Peruvian Corporation of Airports and Commercial Aviation</td>
</tr>
<tr>
<td>COSAC</td>
<td>High Capacity Segregated Corridor</td>
</tr>
<tr>
<td>COSAC I</td>
<td>High Capacity Segregated Corridor Phase I</td>
</tr>
<tr>
<td>CPU</td>
<td>Central Processing Unit</td>
</tr>
<tr>
<td>CTC</td>
<td>Central Train Control System</td>
</tr>
<tr>
<td>CTLC</td>
<td>Transport Council of Lima and Callao</td>
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</tbody>
</table>
DC/CD  Direct Credit
dd-S  Subtropical Desiccated Desert
DESCO  Study and Development Promotion Center
DGAC  General Direction of Civil Aviation
DGAS  General Direction of Social Environmental Affairs
DGCF  General Direction of Railway Transportation
DGCT  General Direction of Ground Circulation
DGDU  General Direction of Urban Development
DGTA  General Direction of Marine Transportation
DGTE  General Direction of Transport
DGTO  General Direction of Transit
DGTU  General Direction of Urban Transport (Callao)
DMTU  Municipal Direction of Urban Transport (Lima)
DNI  National Identification Document
dp-PT  Tropical Low-mountain Semi-dry
ds-S  Subtropical Super-dry Desert
ECAs  Environmental Quality Standard Annual Program
EIA  Environmental Impact Assessment
EIA-d  Detailed Study of Environmental Impact
EIA-sd  Semi-detailed Study of Environmental Impact
EMAPE  Municipal Toll Administration Company
ENAPU  Port Services of Peru
ENATRU  National Corporation for Urban Transport
Ex.  Express Way (Freeway)
FINVER  Finver-Callao Investment Fund
FONAM  National Environmental Fund
FONCOMUN  Municipal Compensation Fund
GDP  Gross Domestic Product
GEF  Global Environmental Facility
GHG  Greenhouse Gases
GPS  Geographical Positioning System
GRDP  Gross Regional Domestic Product
HH  Household
HOV  High Occupancy Vehicle
IBRD/WB  International Bank for Reconstruction and Development /World Bank
ICAO  International Civil Aviation Organization
IDB  Inter-American Development Bank
IEE  Initial Environmental Examination
IFC/CFI  International Finance Corporation
<table>
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<th>Full Form</th>
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<td>IMP</td>
<td>Metropolitan Planning Institute</td>
</tr>
<tr>
<td>INC</td>
<td>National Institute of Culture</td>
</tr>
<tr>
<td>INDECI</td>
<td>National Institute of Civil Defense</td>
</tr>
<tr>
<td>INEI</td>
<td>National Institute for Statistics and Information</td>
</tr>
<tr>
<td>INVERMET</td>
<td>Metropolitan Investment Fund</td>
</tr>
<tr>
<td>JBIC</td>
<td>Japan Bank for International Cooperation</td>
</tr>
<tr>
<td>JICA</td>
<td>Japan International Cooperation Agency</td>
</tr>
<tr>
<td>LaeqT</td>
<td>Continuous Sound Pressure Level equivalent to that with Adjustment A</td>
</tr>
<tr>
<td>LCTA</td>
<td>Lima and Callao Metropolitan Transport Authority</td>
</tr>
<tr>
<td>Leq</td>
<td>Noise Parameter</td>
</tr>
<tr>
<td>M/C</td>
<td>Motorcycle</td>
</tr>
<tr>
<td>M/P</td>
<td>Master Plan for Lima and Callao Metropolitan Area Urban Transportation in the Republic of Peru</td>
</tr>
<tr>
<td>MEF</td>
<td>Ministry of Economy and Finance</td>
</tr>
<tr>
<td>MIGA/OMGI</td>
<td>Multilateral Investment Guarantee Agency</td>
</tr>
<tr>
<td>MML</td>
<td>Metropolitan Municipality of Lima</td>
</tr>
<tr>
<td>MOP</td>
<td>Ministry of the Presidency</td>
</tr>
<tr>
<td>MPC</td>
<td>Province Municipality of Callao</td>
</tr>
<tr>
<td>MTC</td>
<td>Ministry of Transportation and Communications</td>
</tr>
<tr>
<td>MTPE</td>
<td>Ministry of Work and Employment Promotion</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
</tr>
<tr>
<td>NMT</td>
<td>Non-motorized Transport</td>
</tr>
<tr>
<td>OD</td>
<td>Origin Destination</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization for Economic Cooperation and Development</td>
</tr>
<tr>
<td>OGPP</td>
<td>Directorate of Management Information</td>
</tr>
<tr>
<td>OIT</td>
<td>Office of Technical Information</td>
</tr>
<tr>
<td>OPP</td>
<td>General Office of Planning and Budgets</td>
</tr>
<tr>
<td>PAR</td>
<td>Displaced People Return Support Program</td>
</tr>
<tr>
<td>PCU</td>
<td>Passenger Car Unit</td>
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<tr>
<td>PFI</td>
<td>Private Finance Initiative</td>
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<tr>
<td>PG/R</td>
<td>Progress Report</td>
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<tr>
<td>PISA</td>
<td>Integral Atmospheric Security Plan</td>
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<tr>
<td>PM</td>
<td>Particulate Matter</td>
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<tr>
<td>PNP</td>
<td>National Police</td>
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<tr>
<td>PPP</td>
<td>Public Private Partnership</td>
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<tr>
<td>PROINVERSION</td>
<td>Private Investment Promotion Agency</td>
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<tr>
<td>PROLIMA</td>
<td>Lima Historic Center Municipal Recuperation Program</td>
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<tr>
<td>PRONAA</td>
<td>National Program of Nourishment Assistance</td>
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<tr>
<td>PROTRANSPORTE</td>
<td>Investments Plan Elaboration Project for Lima's Metropolitan Transport</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>PROTUM</td>
<td>Metropolitan Urban Transport Project</td>
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<td>PROVIAS</td>
<td>Special Project of Transport Infrastructure</td>
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<tr>
<td>PT</td>
<td>Person Trip</td>
</tr>
<tr>
<td>PTUL</td>
<td>Lima Urban Transport Program</td>
</tr>
<tr>
<td>RC</td>
<td>Reinforced Concrete</td>
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<tr>
<td>RIT</td>
<td>Integrated Transport Network</td>
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<tr>
<td>RTMS</td>
<td>Remote Detector Microwave Sensor</td>
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<tr>
<td>S/.</td>
<td>Soles</td>
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<tr>
<td>SAT</td>
<td>Tributary Administration Service</td>
</tr>
<tr>
<td>SEDAPAL</td>
<td>Drinking Water and Sewerage Service of Lima</td>
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<tr>
<td>SEIA</td>
<td>National System of Environmental Impact Evaluation</td>
</tr>
<tr>
<td>SERPOST</td>
<td>Postal Services of Peru</td>
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<tr>
<td>SETAME</td>
<td>Metropolitan Taxi Service</td>
</tr>
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<td>SITC</td>
<td>Southern Inter Tropical Convergence</td>
</tr>
<tr>
<td>SPM</td>
<td>Suspended Particulate Matter</td>
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<td>SUNARP</td>
<td>National Superintendence of Public Registration</td>
</tr>
<tr>
<td>SUNAT</td>
<td>National Superintendence of Tributary Administration</td>
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<tr>
<td>TDM</td>
<td>Traffic Demand Management</td>
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<tr>
<td>TRANSMET</td>
<td>Metropolitan Transport Committee of Lima</td>
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<tr>
<td>TSAS</td>
<td>Traffic Safety Audit System</td>
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<tr>
<td>TTC</td>
<td>Travel Time Cost</td>
</tr>
<tr>
<td>TUPA</td>
<td>Unique Text of Administrative Procedure</td>
</tr>
<tr>
<td>UIC</td>
<td>International Union of Railways</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Education, Science and Culture Organization</td>
</tr>
<tr>
<td>US$</td>
<td>American Dollar</td>
</tr>
<tr>
<td>USTDA</td>
<td>Feasibility Study on Urban Railway Project in Lima</td>
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<tr>
<td>UTPM</td>
<td>Territorial Units of Metropolitan Planning</td>
</tr>
<tr>
<td>VOC</td>
<td>Vehicle Operation Cost</td>
</tr>
<tr>
<td>VIVD</td>
<td>Video Vehicle Detection System</td>
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PART II

TRANSPORT DEMAND
FORECAST/PLANNING
CHAPTER 10

Future Socioeconomic Framework
10. FUTURE SOCIOECONOMIC FRAMEWORK

10.1. POPULATION PROJECTION

There is no official data available regarding future population projection in the Metropolitan Area of Lima and Callao. The Study Team estimated a future population for 2010 (mid-term) and 2025 (long-term), as a socioeconomic framework for the analysis of future transport demand in the Metropolitan Area.

The INEI is the government agency in charge of publishing official statistical data, including the data of the national population census. The latest national population census was implemented in 1993, and since then it has not been undertaken until now. The INEI estimated a recent population by Department, Province and District from 1990 to 2005, in the report entitled “Perú: Proyecciones de Población por Años Calendario según Departamentos, Provincias y Distritos,” (Peru: Population Projections by Departments, Provinces and Districts) published in 2002. This is the only reliable data source to know the recent population of the Metropolitan Area of Lima and Callao. The Study team, therefore, employed 8,043,256 habitants prepared by the INEI, as the basis for the present population of the Metropolitan Area in the year 2004.

Regarding the future population projection, there are several studies undertaken by the INEI and other agencies. Some of the important studies are:

b) Urban Growth Tendencies in Metropolitan Lima towards the Year 2015 (Tendencias Del Crecimiento Urbano de Lima Metropolitana Al Año 2015), published by the INEI in 1997

The population projections in each study mentioned above are different, and there is no official population projection data for the Metropolitan Area of Lima and Callao.

The future population of the Metropolitan Area during the period between 2004 and 2025 was estimated based on the current population data published by the INEI. For the comparative purpose, the following three cases were examined:

a) Case-1: Extrapolative projection based on the actual number of the population from 1990 to 2005
b) Case-2: Projection by using the trend of growth rate of the Metropolitan Area from 1990 to 2005
c) Case-3: Projection by using the trend of percentage share of the Metropolitan Area in the country from 1990 to 2005

1 According to the INEI, the next national housing and population census will be implemented in 2005. In 1999, the INEI implemented a pre-census survey.
2 The INEI modified the recent population of the Metropolitan Area of Lima and Callao in 2004, from 8,049,619 habitants to 8,043,256 habitants. The Study Team used the modified data of population.
3 The urban and rural population projection was made by the INEI in 2002, entitled “Perú: Estimaciones Y Proyecciones de Población, Total, Urbano y Rural Por Años Calendario y Edades Simples, 1970-2025.”
4 The study, Plan de Desarrollo Metropolitano de Lima and Callao 1990-2010, was made in 1989, before the implementation of the population Census of 1993, and therefore, the population projection in this study is obsolete and not accurate. The population of 2010 estimated by the study is 10,337,081, which is too large in terms of the recent trend.
5 “Perú: Proyecciones de Población por Años Calendario según Departamentos, Provincias y Distritos,” (Peru: Population Projections by Calendar Year according to Departments, Provinces and Districts) in 2002.
The results of the population projection are shown in Table 10.1-1. The population projections of 2025 are not much different in each case: 10,920,302 habitants in the case-1, 10,568,785 habitants in the case-2, and 10,993,498 habitants in case-3. When we look at the past population trend, the case-3 shows more accurate results. In addition, when we compare the results with other unofficial population projection data, such as the “Tendencias Del Crecimiento Urbano De Lima Metropolitana Al Año 2015” (Urban Growth Tendencies in Metropolitan Lima towards the Year 2015) prepared by the INEI, the case-3 shows more reasonable results than those in the other cases. With a series of discussions with the relevant agencies, including the INEI, Ministry of Economy and Finance, and IMP, the Study Team selected the estimation of the case-3, that is, 8,886,181 habitants in 2010 and 10,993,495 habitants in 2025, as a basis for the future population framework of the Metropolitan Area of Lima and Callao. Figure 10.1-1 shows the population projection made by the study team, compared to other projection data.

Table 10.1-1 Population Projection for the Metropolitan Area of Lima and Callao, 2004-2025

<table>
<thead>
<tr>
<th>Year</th>
<th>Case (1): Extrapolative Projection</th>
<th>Case (2): Projection by using the Growth Rate Trend</th>
<th>Case (3): Projection by using the Percentage Share Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Population</td>
<td>Average Growth Rate (%)</td>
<td>Population</td>
</tr>
<tr>
<td>2004</td>
<td>8,043,256</td>
<td>-</td>
<td>8,043,256</td>
</tr>
<tr>
<td>2010</td>
<td>8,886,690</td>
<td>1.64</td>
<td>8,851,532</td>
</tr>
<tr>
<td>2015</td>
<td>9,552,506</td>
<td>1.50</td>
<td>9,479,694</td>
</tr>
<tr>
<td>2020</td>
<td>10,236,404</td>
<td>1.39</td>
<td>10,056,938</td>
</tr>
<tr>
<td>2025</td>
<td>10,920,304</td>
<td>1.30</td>
<td>10,568,785</td>
</tr>
</tbody>
</table>

Note: The present population in 2004 is the data prepared by the INEI.
Source: The JICA Study Team

---

6 Among the three cases, the result estimated in case-3 (4,886,935 habitants in 1981) is more accurate to the Census data of 4,835,793 habitants.
7 According to the report published by the INEI, Tendencias Del Crecimiento Urbano De Lima Metropolitana Al Año 2015, the population was estimated to be 9,641,938 habitants in 2015. The population projections made by the study team are 9,552,506 habitants in case-1, 9,479,694 habitants in case-2 and 9,601,927 habitants in case-3. The result of case-3 is more close to the data of 9,641,938 projected by the INEI.
Figure 10.1-1 Population Projection of Lima and Callao Metropolitan Area

Figure 10.1-1 Population Projection of Lima and Callao Metropolitan Area
10.2. MACRO ECONOMIC PROJECTION

(1) National GDP

The Peruvian economy has experienced a relatively high growth rate over the last decade. Table 10.2-1 shows the real GDP (Gross Domestic Product) growth rates in Latin American countries during the period between 1992 and 2004. The average national GDP growth rate of Peru was 4.0 percent during the period, although there was a wide rage of fluctuation. The Peruvian economy showed the third highest GDP growth rate among the Latin American countries, following Chile (4.9 percent) and Costa Rica (4.8 percent).

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>1.7</td>
<td>9.6</td>
<td>5.9</td>
<td>5.8</td>
<td>-2.9</td>
<td>5.5</td>
<td>8.0</td>
<td>3.8</td>
<td>-3.4</td>
<td>-0.8</td>
<td>-4.4</td>
<td>-11.0</td>
<td>3.0</td>
<td>4.5</td>
</tr>
<tr>
<td>Bolivia</td>
<td>3.3</td>
<td>1.7</td>
<td>4.3</td>
<td>4.8</td>
<td>4.7</td>
<td>4.5</td>
<td>4.9</td>
<td>5.0</td>
<td>0.3</td>
<td>2.4</td>
<td>1.6</td>
<td>2.7</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>2.6</td>
<td>-0.3</td>
<td>4.5</td>
<td>6.2</td>
<td>4.2</td>
<td>2.5</td>
<td>3.1</td>
<td>0.1</td>
<td>1.0</td>
<td>4.0</td>
<td>1.4</td>
<td>1.5</td>
<td>2.8</td>
<td>3.5</td>
</tr>
<tr>
<td>Chile</td>
<td>4.9</td>
<td>10.9</td>
<td>6.6</td>
<td>5.0</td>
<td>9.0</td>
<td>6.9</td>
<td>6.7</td>
<td>3.3</td>
<td>-0.5</td>
<td>4.2</td>
<td>2.8</td>
<td>2.0</td>
<td>3.1</td>
<td>4.8</td>
</tr>
<tr>
<td>Colombia</td>
<td>2.4</td>
<td>3.7</td>
<td>4.6</td>
<td>6.0</td>
<td>4.9</td>
<td>1.9</td>
<td>3.3</td>
<td>0.8</td>
<td>-3.8</td>
<td>2.4</td>
<td>1.4</td>
<td>1.6</td>
<td>2.0</td>
<td>3.3</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>4.8</td>
<td>8.8</td>
<td>7.1</td>
<td>4.6</td>
<td>3.9</td>
<td>0.8</td>
<td>5.4</td>
<td>8.3</td>
<td>8.0</td>
<td>1.8</td>
<td>1.2</td>
<td>2.9</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>Ecuador</td>
<td>2.5</td>
<td>3.0</td>
<td>2.2</td>
<td>3.7</td>
<td>2.1</td>
<td>3.0</td>
<td>5.2</td>
<td>2.2</td>
<td>-5.7</td>
<td>0.9</td>
<td>5.1</td>
<td>3.0</td>
<td>3.5</td>
<td>5.2</td>
</tr>
<tr>
<td>Mexico</td>
<td>2.9</td>
<td>3.7</td>
<td>1.8</td>
<td>4.4</td>
<td>-6.1</td>
<td>5.4</td>
<td>6.8</td>
<td>5.1</td>
<td>3.6</td>
<td>6.7</td>
<td>-0.3</td>
<td>0.9</td>
<td>2.3</td>
<td>3.7</td>
</tr>
<tr>
<td>Paraguay</td>
<td>1.5</td>
<td>1.7</td>
<td>4.0</td>
<td>3.0</td>
<td>4.5</td>
<td>1.1</td>
<td>2.4</td>
<td>-0.6</td>
<td>-0.1</td>
<td>-0.6</td>
<td>2.4</td>
<td>-2.5</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Peru</td>
<td>4.0</td>
<td>-0.4</td>
<td>4.8</td>
<td>12.7</td>
<td>8.6</td>
<td>2.5</td>
<td>6.9</td>
<td>-0.6</td>
<td>0.9</td>
<td>2.7</td>
<td>0.6</td>
<td>5.2</td>
<td>4.0</td>
<td>4.5</td>
</tr>
<tr>
<td>Uruguay</td>
<td>1.0</td>
<td>8.3</td>
<td>3.5</td>
<td>7.0</td>
<td>-2.3</td>
<td>5.0</td>
<td>5.4</td>
<td>4.4</td>
<td>-3.4</td>
<td>-1.9</td>
<td>-3.1</td>
<td>-10.8</td>
<td>-2.0</td>
<td>4.5</td>
</tr>
<tr>
<td>Venezuela</td>
<td>0.1</td>
<td>7.0</td>
<td>-0.4</td>
<td>3.0</td>
<td>4.8</td>
<td>0.0</td>
<td>6.9</td>
<td>0.6</td>
<td>-5.5</td>
<td>3.8</td>
<td>2.8</td>
<td>-8.9</td>
<td>-17.0</td>
<td>13.4</td>
</tr>
</tbody>
</table>


Regarding the future economic projection, the Ministry of Economy and Finance prepared a study report entitled “Study for the Elaboration of Macroeconomic Projections”8 in the year 2000. In this report, three types of future economic development scenarios were examined with the projection of GDP growth rates during the period between 2001 and 2020 (Table 10.2-2). For example, the first scenario shows the trend of moderate growth of per capita GDP: from 1.7 percent, during the period between 2001 and 2005, to 2.7 percent, between 2016 and 2020. The second scenario shows the continuous trend of moderate-high growth of per capita GDP: from 2.1 percent, during the period between 2001 and 2005, to 3.4 percent, between 2016 and 2020. The third scenario shows the trend of low growth of per capita GDP: from 1.4 percent, during the period between 2001 and 2005, to 1.8 percent, between 2016 and 2020. This study report does not indicate which scenario is the most appropriate as a target of the national economy in the future.

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Table 10.2-2 Projection of GDP Growth Rate, 2001-2020

<table>
<thead>
<tr>
<th>Year</th>
<th>Scenario-1: Moderate Growth</th>
<th>Scenario-2: Moderate-High Growth</th>
<th>Scenario-3: Low Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per Capita GDP (%)</td>
<td>Real GDP* (%)</td>
<td>Per Capita GDP (%)</td>
</tr>
<tr>
<td>2001-2005</td>
<td>1.7</td>
<td>3.2</td>
<td>2.1</td>
</tr>
<tr>
<td>2006-2010</td>
<td>2.1</td>
<td>3.5</td>
<td>2.6</td>
</tr>
<tr>
<td>2011-2015</td>
<td>2.4</td>
<td>3.7</td>
<td>3.0</td>
</tr>
<tr>
<td>2016-2020</td>
<td>2.7</td>
<td>3.9</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Note: *The real GDP growth rate is adjusted by the population data estimated by the JICA study team.

In general, future macro economic projection is an uncertainty, because the national economy is always affected by external forces and unpredictable changes of global economy. Therefore, there is no concrete measure to select the appropriate scenario of future economic projection. The study team, however, found that the second scenario (moderate-high growth) seemed to be quite probable, according to the recent trend of the national economy. In addition, the future macro economic framework is characterized as a target or objective to be achieved in the long-term future. Through a series of discussions with the Ministry of Economy and Finance, the study team employed the moderate-high growth scenario, as a long-term economic framework for the Master Plan Study of Urban Transport in the Metropolitan Area of Lima and Callao.

Based on the per capita GDP growth rate in the moderate-high growth scenario mentioned above, the real GDP growth rate was estimated by the study team during the period between 2004 and 2025. Table 10.2-3 shows the results of the projection. The average growth rates of real GDP are: 3.6 percent during the period between 2004 and 2005, 4.0 percent between 2006 and 2010, 4.3 percent between 2011 and 2015, 4.6 percent between 2016 and 2020, and then 4.9 percent between 2021 and 2025.

Table 10.2-3 Projection of Macro Economic Indicators, 2004-2025

<table>
<thead>
<tr>
<th>Year</th>
<th>Per Capita GDP Growth Rate (%)</th>
<th>National Population Growth Rate* (%)</th>
<th>Real GDP Growth Rate*** (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-2005</td>
<td>2.1</td>
<td>1.50</td>
<td>3.6</td>
</tr>
<tr>
<td>2006-2010</td>
<td>2.6</td>
<td>1.40</td>
<td>4.0</td>
</tr>
<tr>
<td>2011-2015</td>
<td>3.0</td>
<td>1.31</td>
<td>4.3</td>
</tr>
<tr>
<td>2016-2020</td>
<td>3.4</td>
<td>1.19</td>
<td>4.6</td>
</tr>
<tr>
<td>2021-2025</td>
<td>3.8**</td>
<td>1.04</td>
<td>4.9</td>
</tr>
</tbody>
</table>

Note: * The national population growth rate is based on the data from “Perú: Estimaciones y Proyecciones de Población, 1950-2050” published by the INEI in 2001.
** The per capita GDP growth rate during the period between 2021 and 2025 is projected by the study team based on the trend of the growth rate during the period between 2001 and 2020.
*** The Real GDP Growth Rate was estimated by the study team
Source: The JICA Study Team

(2) GRDP in the Departments of Lima and Callao

The Study team estimated the GRDP (Gross Regional Domestic Product) in the Departments of Lima and Callao, based on the past trend of the percentage share of the regional product in the national economy and the growth rate of the GRDP prepared by the study report for the Ministry of Economy and Finance (MEF). There is no data available on the GRDP in the Department of Lima and Callao since 1996. The study team estimated the percentage share of the GRDP in the national GDP to be 45 percent in 2001, based on the past information prepared by the INEI and other agencies.

Grupo Maximixe, Study for the Elaboration of Macroeconomic Projections, Prepared for the Ministry of Economy and
estimated values of the GRDP in the Departments of Lima and Callao during the period between 2004 and 2025. According to the projection, the GRDP in the Departments of Lima and Callao will increase from 60,830 million Soles in 2004 to 76,202 million Soles in 2010 and to 148,053 million Soles in 2025. The percentage share of the Departments of Lima and Callao in the national GDP will slightly decrease from 44.3 percent in 2004 to 44.0 percent in 2010 and to 43.5 percent in 2025.

There is no data available on the current GRDP by economic sector. The Study team estimated the GRDP by economic sector, based on the past data prepared by the INEI.\textsuperscript{11} Regarding the future projection, the study report\textsuperscript{12} projected the growth rates by economic sector during the period between 2001 and 2020. Based on this data, the study team estimated the GRDP by economic sector during the period between 2004 and 2025 (Table 10.2-5).

### Table 10.2-4 Projection of the GRDP in the Departments of Lima and Callao, 2004-2025

<table>
<thead>
<tr>
<th>Year</th>
<th>National GDP(\ast)</th>
<th>GRDP in the Departments of Lima and Callao</th>
<th>Growth Rate(\ast) (%)</th>
<th>Share in Peru (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Million Soles</td>
<td>Million Soles</td>
<td>Growth Rate(\ast) (%)</td>
<td>Share in Peru (%)</td>
</tr>
<tr>
<td>2004</td>
<td>137,167</td>
<td>60,830</td>
<td></td>
<td>44.3</td>
</tr>
<tr>
<td>2005</td>
<td>142,363</td>
<td>62,977</td>
<td>3.53</td>
<td>44.2</td>
</tr>
<tr>
<td>2010</td>
<td>173,167</td>
<td>76,202</td>
<td>3.89</td>
<td>44.0</td>
</tr>
<tr>
<td>2015</td>
<td>214,141</td>
<td>93,599</td>
<td>4.20</td>
<td>43.7</td>
</tr>
<tr>
<td>2020</td>
<td>268,811</td>
<td>116,802</td>
<td>4.53</td>
<td>43.5</td>
</tr>
<tr>
<td>2025</td>
<td>341,947</td>
<td>148,053</td>
<td>4.86</td>
<td>43.3</td>
</tr>
</tbody>
</table>

Note: \(\ast\) The GDP was estimated based on the latest data of 117,590 million Soles in 1999 (1994 constant price) prepared by the Central Reserve Bank of Peru (Annual Report 2002).

Note: The GRDP growth rate during the period between 2004 and 2020 is based on the report, Study for the Elaboration of Macroeconomic Projections, prepared for the Ministry of Economy and Finance in 2000. The growth rate between 2021 and 2025 was estimated by the study team based on the trend of the growth rate during the period between 2001 and 2020.

Source: The JICA Study Team

### Table 10.2-5 Projection of the GRDP by Economic Sector in the Departments of Lima and Callao, 2004-2025 (1994 price)

<table>
<thead>
<tr>
<th>Year</th>
<th>Primary Sector</th>
<th>Secondary Sector</th>
<th>Tertiary Sector</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Million Soles</td>
<td>Share (%)</td>
<td>Million Soles</td>
<td>Share (%)</td>
</tr>
<tr>
<td>2004</td>
<td>2,661</td>
<td>4.4</td>
<td>23,118</td>
<td>38.0</td>
</tr>
<tr>
<td>2005</td>
<td>2,736</td>
<td>4.3</td>
<td>23,927</td>
<td>38.0</td>
</tr>
<tr>
<td>2010</td>
<td>3,234</td>
<td>4.2</td>
<td>28,915</td>
<td>37.9</td>
</tr>
<tr>
<td>2015</td>
<td>3,987</td>
<td>4.3</td>
<td>35,969</td>
<td>38.4</td>
</tr>
<tr>
<td>2020</td>
<td>5,031</td>
<td>4.3</td>
<td>45,491</td>
<td>38.9</td>
</tr>
<tr>
<td>2025</td>
<td>6,460</td>
<td>4.4</td>
<td>58,195</td>
<td>39.3</td>
</tr>
</tbody>
</table>

Note: The growth rates in each economic sector during the period between 2004 and 2020 were prepared by the report, “Study for the Elaboration of Macroeconomic Projections.” The growth rate between 2020 and 2025 was estimated by the study team based on the trend from 2004 to 2020.

Source: The JICA Study Team

\(\ast\) The INEI prepared the GRDP by economic sector in the Departments of Lima and Callao during the period between 1970 and 1995.

(3) Working Population in the Metropolitan Area of Lima and Callao

The current number of working population by economic sector in the Metropolitan Area of Lima and Callao was prepared by the Ministry of Work and Employment Production (MTPE). Based on the current number of working population and the growth rate of the GRDP, the future working population in the Metropolitan Area was estimated by economic sector during the period between 2004 and 2025. Table 10.2-6 shows the results of the projection. The total number of the working population will increase from 3,568,168 persons in 2004 to 6,085,526 persons in 2025. The share of the primary sector is 0.7 percent in 2004, and it will be stable until 2025. The share of the secondary sector will increase slightly from 19.8 percent in 2004 to 20.9 percent in 2025. The share of the tertiary sector will decrease slightly from 79.5 percent in 2004 to 78.3 percent in 2025.

Table 10.2-6 Projection of Working Population by Economic Sector in the Metropolitan Area of Lima and Callao, 2004-2025

<table>
<thead>
<tr>
<th>Year</th>
<th>Primary Sector</th>
<th>Secondary Sector</th>
<th>Tertiary Sector</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Person %</td>
<td>Person %</td>
<td>Person %</td>
<td>Person %</td>
</tr>
<tr>
<td>2004</td>
<td>25,803 0.7</td>
<td>707,090 19.8</td>
<td>2,835,275 79.5</td>
<td>3,568,168 100.0</td>
</tr>
<tr>
<td>2005</td>
<td>27,254 0.7</td>
<td>754,651 20.0</td>
<td>2,995,143 79.3</td>
<td>3,777,048 100.0</td>
</tr>
<tr>
<td>2010</td>
<td>30,326 0.7</td>
<td>838,571 19.9</td>
<td>3,418,450 79.4</td>
<td>4,287,347 100.0</td>
</tr>
<tr>
<td>2015</td>
<td>34,426 0.7</td>
<td>983,526 20.3</td>
<td>3,833,418 79.0</td>
<td>4,851,370 100.0</td>
</tr>
<tr>
<td>2020</td>
<td>39,487 0.7</td>
<td>1,130,652 20.7</td>
<td>4,305,144 78.6</td>
<td>5,475,283 100.0</td>
</tr>
<tr>
<td>2025</td>
<td>44,626 0.7</td>
<td>1,273,066 20.9</td>
<td>4,767,834 78.3</td>
<td>6,085,526 100.0</td>
</tr>
</tbody>
</table>

Note: The working population by economic sector was estimated based on the current data during the period between 1996 and 2003 prepared by the Ministry of Labor. The future projection was made based on the growth rates of the GRDP by sector.

Source: The JICA Study Team

10.3. CONSIDERATION OF FUTURE URBAN STRUCTURE

According to the population framework discussed in the previous section, the Metropolitan Area of Lima and Callao will increase its population from 8,043,000 habitants in 2004 to 10,993,000 habitants in 2025. The increased population will be nearly 3.0 million habitants in total during the period between 2004 and 2025. The future transport demand is closely related to the distribution of population and urban activities. For this purpose, this section examined three alternatives of future urban structure in the Metropolitan Area of Lima and Callao. They are: (1) Mono-centric Ramified Development Pattern; (2) Poly-centric Decentralized Development Pattern; and (3) Self-Sustainable New Town Development Pattern.

(1) Alternative-1: Mono-centric Ramified Development Pattern

In the Mono-centric Ramified Development Pattern (Figure 10.3-1), the major urban activities in the Metropolitan area will continue to concentrate itself in the central area of Lima, and the residential areas will expand in the valleys, along the existing ramified roads: such as the Panamericana Norte, Av. Rosa de America, and Av. Tupac Amaru in the North; Carretera Central and Av. La Molina in the East; and the Panamericana Sur and Av. Pachacutec in the South. The agricultural lands in the valleys will be nearly lost in a near future by the urban expansion to the outskirts. Major economic activities will still be concentrated in the existing metropolitan center, the triangle of Lima, Callao and...
Miraflores. The decentralization of economic activities will not proceed effectively, and the traffic congestion in the central area will be beyond the limit. The regeneration of the historical center of Lima is essential to maintain urban services and economic activities.

Figure 10.3-1 Mono-centric Ramified Development Pattern (Alternative – 1)

(2) Alternative-2: Poly-centric Decentralized Development Pattern

In the Poly-centric Decentralized Development Pattern (Figure 10.3-2), new sub-centers will be developed in the areas within 10-15 kilometer distance from the center of Lima. This concept was originally proposed by the Municipality of Metropolitan Lima in 1989\textsuperscript{14}. The potential sites for the sub-center are the districts of Los Olivos and Comas to the North, Santa Anita and Ate to the East, and Villa El Salvador and Villa Maria Del Triunfo to the South. Some economic activities, especially the employments in the tertiary sector, will be decentralized from the central area of Lima to the sub-centers. Urban development and investment will be intensified in the sub-centers, which will mitigate the traffic congestion in the central area. From the long-term perspective, further urbanization will spill over beyond the 30-kilometer radius from the center of Lima. These areas will cause poor living environments because of the lack of basic infrastructure and urban services. Strong measures will be necessary to avoid disordered urbanization in the outskirts of the Metropolitan Area.

Figure 10.3-2 Poly-centric Decentralized Development Pattern (Alternative – 2)

(3) Alternative-3: Self-Sustainable New Town Development Pattern

In this pattern (Figure 10.3-3), self-sustainable new towns will be developed in the outside of a 30-kilometer radius from the center of Lima. The potential sites for the new towns are Ancon and Carabayllo in the North and Lurin, Punta Hermosa and Punta Negra in the South. These new towns will be characterized as self-sustainable towns and will create employments for the surrounding habitants. Some industries, now located in the central area of Lima, will be relocated in the new towns. Cargo terminals and inter-city bus terminals will be developed in strategic places in the new town, and mass transit will be necessary to connect between the center of Lima and the new towns. From a regional development perspective, these new towns will function as a catalyst to reinforce the North-South regional development corridor in the future.

![Figure 10.3-3 Sustainable New Town Development Pattern (Alternative – 3)](image)

(4) Evaluation of Future Urban Structure

The trend scenario, mono-centric ramified urban structure (Alternative-1), will cause excessive concentration of urban activities and traffic in the central area of Lima. Due to the limitation of available land, urban growth will expand towards the valleys of the Rimac, Chillon and Lurin Rivers. If the present urban growth pattern continues, the agricultural land in the river basins of Chillon and Lurin will disappear in a near future. Furthermore, serious urban and environmental problems would be accelerated, such as long travel times to work, poor living environment in the surrounding areas, and contamination of water and air. This is the worst scenario of the future Metropolitan structure.

The polycentric decentralized urban structure (Alternative-2) is necessary to decentralize existing urban activities from the central area to the strategic sub-centers. The employment opportunities will be generated in these sub-centers, and new residential areas with high- and medium-densities will be developed around the sub-centers. In addition, a ring road will encourage the developments of the sub-centers, and it will alleviate the heavy traffic congestion in the central area. The polycentric decentralized urban structure was originally proposed in 1989, but the actual development of the sub-centers and ring roads has not been implemented smoothly until now.15

The third alternative, self-sustainable new town development pattern is the most suitable urban structure in terms of a balanced development in the Metropolitan Area. Although the term “new town” was not used, the Metropolitan Development Plan proposed the mixed use with farming industry in the areas beyond the 30-kilometer radius to the north and south. These areas may be potential sites for the future development of self-sustainable

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15 Recently, the Municipality of Metropolitan Lima approved the formulation of a new urban development plan for 2020, which includes updating zoning of land use and district plans. The new plan will follow the basic concept of the previous plan encouraging the development of three sub-centers.
new towns. It is, however, not an easy task to develop new towns, and a strong leadership of the government and a mutual collaboration between public and private sectors are essential. The sustainable new town developments should be considered to avoid the spillover of urban growth outside the 30-kilometer radius. In a distant future, the new towns will strengthen the development of the North-South regional corridor, such as the axis from Lima to Huaral, Huacho and Barranca in the North and to Cañete and Chincha in the South (Figure 10.3-4).

Based on a series of discussions with the relevant agencies, including the IMP and the Ministry of Housing, the Study Team selected the Poly-centric Decentralized Development Pattern (Alternative-2) as the most probable metropolitan structure by the year 2025. The third alternative, the self-sustainable new town development pattern, may be the better option in terms of balanced development, but it will need a large investment for the development of infrastructure. Accordingly, the areas outside the 30-kilometer radius from the center of Lima will be developed after 2025. Figure 10.3-5 shows the future conceptual urban structure and Figure 10.3-6 shows the urban development scenario for the Metropolitan Area of Lima and Callao.
Figure 10.3-5 Schematic Concept of Future Urban Structure in the Metropolitan Area of Lima and Callao
10.4. BASIC POLICIES FOR FUTURE LAND DEVELOPMENT TOWARDS 2025

The study team selected the poly-centric decentralized development pattern (Alternative-2) for the analysis of future traffic demand in 2025. In order to achieve the poly-centric decentralized urban structure, the governments need to establish land development policies to control urban development. The basic land development policies can be described as follows.

(1) To consolidate the Metropolitan Services in the Central Area

The Historical Center of Lima, including the districts of Lima and Rimac, will strengthen its functions as political, administrative and institutional center on a metropolitan and national level. Applying a special regime defined by a Municipal Regulation from the Province of Lima (Regulation 201), the historical monuments and buildings in the area should be restored as cultural and tourism attractions. The traffic regulations should be strengthened to avoid over congestion of the traffic in the central area.

The Lima–Miraflores Axis, including the districts of Lima, Breña, Jesús María, Lince, San Isidro, Surquillo and Miraflores, will consolidate the business and commercial activities at a metropolitan level. The areas along the Paseo de la República and Av. Arequipa will promote the mixed use of financial, commercial and institutional activities with vertical densification of residential areas.

The Lima and Callao Axis, the current industrial zones along Av. Argentina, Colonial and Venezuela, will be transformed to high-density housing areas. These areas will encourage the revitalization of the urban environment and population restoration in the central area.\(^\text{16}\)

\(^{16}\) Based on discussions with the IMP, July 22, 2004.
The Coastal Axis, including the districts of La Punta, Callao, La Perla, San Miguel, Magdalena Del Mar, San Isidro, Miraflores, Barranco and Chorrillos, will consolidate the metropolitan recreational use as well as medium-density residential areas. The recreational area along the coast will be a tourism attraction.

The San Isidro-La Molina Axis, including the districts of San Isidro, San Borja, Santiago de Surco and La Molina, especially the area along Av. Javier Prado, will consolidate the mixed use of commercial and business activities with vertical densification of residential areas.

(2) To Promote Decentralization of Urban Services in Sub-Centers

The development of the sub-centers will encourage a decentralization of urban activities that are currently concentrated in the central area of Lima. The sub-centers will promote commercial and business activities at district and inter-district level, and their surrounding areas are occupied by medium and high-density residential areas.

The sub-centers will be located in the districts of Comas and/or Los Olivos in the north, Santa Anita and/or Ate in the east, and Villa El Salvador and/or Villa Maria Del Triunfo in the south. In order to encourage the development of sub-centers, some incentive measures should be provided, such as tax incentives.

In addition to the three sub-centers, it is recommended that new commercial and service centers at district level should be developed in terms of the future population growth in the outskirts of the Metropolitan Area. The potential areas of the new commercial centers are Puente Piedra in the north, Canto Grande of San Juan Lurigancho and Chosica of Lurigancho in the east, and Lurin in the south. Figure 10.4-1 shows the existing cores and future potential locations of sub-centers and urban service centers at district level.
(3) To Consolidate the Existing Industrial Areas

The industries will be located in the strategic areas along the Panamericana Norte, the Carretera Central and the Panamericana Sur, outside of the central area. In addition, there are specific locations of industrial parks in Villa El Salvador, Zárate in San Juan Lurigancho, Cajamarquilla in Lurigancho, and Ventanilla and Gambetta in Callao.

In the area of immediate influence of the industrial zones, the mixed use as transition and complementary activities is proposed, such as the small industries, commerce and other urban services.

(4) To Develop Urban Service Equipments at District Level

The basic urban service equipments should be developed according to the population increase at district level, which includes primary and secondary schools, hospitals, parks and other service facilities.
(5) To Develop Informal Housing

A large number of informal housing occupy the outskirts of the Metropolitan area. The most critical issue in the informal housing is the lack of basic infrastructure and deterioration of their living environment. It is recommended that the informal housing should be combined with some productive activities, that is, the mixed use of industrial or agricultural activity. The potential sites of informal housing with the mixed use are: Carabayllo, Ventanilla and Ancon in the north, Punta Hermosa, Punta Negra and San Bartolo in the south, and Caballero and Huachipa in the east.

(6) To Preserve Agricultural Land

Many agricultural lands in the Rimac river basin have been lost and transformed into the residential areas over the last few decades. With strong measures of land management, the agricultural lands in the Chillon and Lurin river basins should be preserved. For this purpose, the upper stream areas of the rivers should be protected as ecological and natural reserves.

Based on the basic development policies mentioned above, the study team prepared a future land use plan in 2025 for the Metropolitan Area of Lima and Callao. In terms of planning perspective, preparation of future land use plan is always controversial because land use is a complex texture created by political decision and a variety of economic activities. If there are no strong measures and government initiatives to control future land development, the future land use plan would be meaningless. Furthermore, unexpected changes of economy or haphazard developments of informal settlements would cause different land use pattern. In this study, the future land use plan is prepared as a parameter to estimate future distributions of population and employment for the analysis of traffic demand.

The future land use plan was prepared based on the following sources: 1) Metropolitan Development Plan for Lima and Callao, 1990-2010 (Plan de Desamallo Metropolitano de Lima and Callao, 1990-2010) published by the IMP in 1989; 2) Land use zoning maps in each district prepared by the IMP (scale is mostly 1:10,000); and 3) On-going and planned projects identified through available documents and interviews to the relevant agencies, including the IMP, Municipality of Lima and Ministry of Housing. The future land use plan is shown in Figure 10.4-2.
Figure 10.4-2 Land Use Plan in 2025
10.5. DISTRIBUTION OF FUTURE POPULATION AND EMPLOYMENT BY TRAFFIC ZONE

(1) Definition of the Traffic Zone

The traffic zone is a basic unit for the analysis of future transport demand and supply. For this purpose, the study team divided the Metropolitan Area of Lima and Callao into 427 traffic zones, in consideration of the administrative boundaries, population census zone boundaries, and land use pattern, physical boundaries such as rivers, arterial roads, railways and slopes.

(2) Methodology of Population by Traffic Zone

1. Get the current population distribution for Metropolitan Area of Lima-Callao from the PT survey
2. Project the macro-population for Metropolitan Area of Lima-Callao
3. Divide the macro-population into 5 areas and set control totals for the 3 sub-centers
4. Set population distribution based on the future land use plan
5. Add a portion of the land use-derived population to each traffic zone
6. Keep adding the population until the total reaches the macro-population for the Metropolitan Area
7. Adjust the population using control totals for the 5 areas and the 3 sub-centers

Figure 10.5-1 Flowchart of Projection Process of Future Population Distribution by Traffic Zone

The projection process of future population distribution by traffic zone in 2010 and 2025 is illustrated in Figure 10.5-1, and each work item in the process is described as follows:

1. From the results of the Person Trip (PT) survey, the current population in 2004 of each traffic zone is obtained. This is the current population distribution and it is the basis for the projection of future population of each traffic zone in 2010 and 2025.

2. Based on the several sources prepared by INEI, such as long-term population projection for Peru and official statistical data for Lima and Callao provinces, future macro-population in the Metropolitan Area of Lima-Callao is estimated.

3. The future macro-population in the Metropolitan Area of Lima-Callao is divided into five areas (Central, North, South, and East Lima, and Callao), taking the balance of future regional development into consideration. In addition to this, the proposed three sub-centers in which intensive urban development is proposed are considered separately from the future macro-population distribution. (The future regional development policies and proposed sub-centers development are discussed in section 10.4 of this report.)

4. Apart from the current population distribution based on the result of PT survey, another population distribution is prepared based on the future land use pattern as a parameter to project future population distribution in each traffic zone. The land use-derived population in each traffic zone is calculated by multiplying the area of
each land use type (i.e. residential, commercial, industry, agriculture and so on) and the estimated population densities by each land use type. Thus the land use-derived population is a result of population estimation based on future land use pattern and population density by type of land use in each traffic zone.

(5) The land use-derived population in each traffic zone obtained in (4) does not reflect the current population derived from the PT survey, and the aggregated population in the Metropolitan Area, which is an accumulation of the land use-derived population in each traffic zones, is not equal to the macro-population obtained in (2). In this study, we assumed that the future increment of population in each traffic zone will follow the tendency of the land use-derived population distribution. Thus, a certain percentage of the land use-derived population is added to the current population in each traffic zone.

(6) The percentage of the land use-derived population to be added to each traffic zone are determined so as to be equal the accumulated population in the Metropolitan Area to the macro-population that was projected in (2), as a control total.

(7) Finally, the future population in each traffic zone calculated in (6) is aggregated by five areas (Central, North, South, and East Lima, and Callao) as well as by three sub-centers. The future populations of traffic zones in the five areas and three sub-centers are adjusted to meet with the control totals that were estimated in (3).

(3) Distribution of Future Population by Traffic Zone

The future population by traffic zone was allocated in considerations of the future land use pattern and population density by land use category\(^{17}\) in 2025. In our estimation, the total population will increase by nearly 3.0 million habitants between 2004 and 2025. Table 10.5-1 summarizes the results of future population distribution in the areas of Central, North, South and East Lima and Callao. East Lima will increase by about 835,000 habitants from 2004 to 2025, followed by North Lima with about 453,000 habitants and South Lima with about 721,465 habitants. Although the central area shows population decrease in the recent year, it is estimated to increase the population by a vertical densification of the residential area and a transformation of the land use from industrial use to residential use, particularly in the area along the Lima and Callao axis. The distribution of future population in 2025 by district\(^{18}\) is shown in Table 10.5-2. The population densities by traffic zone in 2004 and 2025 are illustrated in Figure 10.5-2 and Figure 10.5-3.

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\(^{17}\) The Study Team used the average population density to estimate preliminary future population by traffic zone. The average population densities are: 10 person/ha in mixed farming area, 60 persons/ha in low density mixed use area, 110 persons/ha in industry, commercial, medium-low density residential and medium-low density mixed use areas; 160 persons/ha in medium density residential and medium density mixed use areas; and 210 persons/ha in medium-high density residential and medium-high density mixed use areas. Then, the number of population by traffic zone was adjusted by the existing population of 2004 in each traffic zone and the control total of increasing population from 2004 to 2025.

\(^{18}\) Due to methodological limitations, some districts, such as La Molina and San Isidro, shows higher population growth than that is estimated by the trend, and the districts, such as San Juan de Miraflores and San Juan de Lurigancho, shows lower population growth than that is estimated by the trend.
Table 10.5-1 Distribution of the Future Population, 2004, 2010 and 2025

<table>
<thead>
<tr>
<th>Area</th>
<th>Year 2004</th>
<th>Year 2010</th>
<th>Year 2025</th>
<th>2004-2010</th>
<th>2010-2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Lima</td>
<td>2,239,144</td>
<td>2,420,873</td>
<td>2,895,250</td>
<td>181,729</td>
<td>474,377</td>
</tr>
<tr>
<td>North Lima</td>
<td>1,728,968</td>
<td>1,881,640</td>
<td>2,182,784</td>
<td>152,672</td>
<td>301,144</td>
</tr>
<tr>
<td>South Lima</td>
<td>1,428,428</td>
<td>1,620,090</td>
<td>2,149,883</td>
<td>191,662</td>
<td>529,793</td>
</tr>
<tr>
<td>East Lima</td>
<td>1,763,395</td>
<td>2,008,245</td>
<td>2,598,992</td>
<td>244,850</td>
<td>590,747</td>
</tr>
<tr>
<td>Callao</td>
<td>883,129</td>
<td>955,333</td>
<td>1,166,589</td>
<td>72,204</td>
<td>211,256</td>
</tr>
<tr>
<td>Total</td>
<td>8,043,064</td>
<td>8,886,181</td>
<td>10,993,498</td>
<td>843,117</td>
<td>2,107,317</td>
</tr>
</tbody>
</table>

Source: The JICA study team
Table 10.5-2 Distribution of Future Population 2025 by District

<table>
<thead>
<tr>
<th>Area</th>
<th>District Name</th>
<th>Area(ha)</th>
<th>2004 Pop.</th>
<th>Density 2004</th>
<th>2010 Pop.</th>
<th>Density 2010</th>
<th>2025 Pop.</th>
<th>Density 2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL LIMA</td>
<td></td>
<td>270,590</td>
<td>7,159,935</td>
<td>26.5</td>
<td>7,930,848</td>
<td>29.3</td>
<td>9,826,909</td>
<td>36.3</td>
</tr>
<tr>
<td>Lima</td>
<td></td>
<td>2,169</td>
<td>345,325</td>
<td>159.2</td>
<td>356,697</td>
<td>164.5</td>
<td>389,291</td>
<td>179.5</td>
</tr>
<tr>
<td>Barranco</td>
<td></td>
<td>276</td>
<td>47,176</td>
<td>171.2</td>
<td>51,614</td>
<td>187.3</td>
<td>57,132</td>
<td>207.4</td>
</tr>
<tr>
<td>Breña</td>
<td></td>
<td>322</td>
<td>96,700</td>
<td>300.8</td>
<td>94,900</td>
<td>295.2</td>
<td>96,751</td>
<td>300.9</td>
</tr>
<tr>
<td>Jesús María</td>
<td></td>
<td>436</td>
<td>68,097</td>
<td>156.3</td>
<td>73,489</td>
<td>168.7</td>
<td>79,276</td>
<td>182.0</td>
</tr>
<tr>
<td>La Victoria</td>
<td></td>
<td>912</td>
<td>233,692</td>
<td>256.4</td>
<td>236,838</td>
<td>259.8</td>
<td>245,223</td>
<td>269.0</td>
</tr>
<tr>
<td>Lince</td>
<td></td>
<td>277</td>
<td>73,071</td>
<td>263.7</td>
<td>71,276</td>
<td>257.2</td>
<td>72,666</td>
<td>262.2</td>
</tr>
<tr>
<td>Magdalena del Mar</td>
<td></td>
<td>328</td>
<td>55,266</td>
<td>168.4</td>
<td>57,387</td>
<td>174.9</td>
<td>62,516</td>
<td>190.5</td>
</tr>
<tr>
<td>Pueblo Libre</td>
<td></td>
<td>464</td>
<td>82,131</td>
<td>177.0</td>
<td>84,822</td>
<td>182.8</td>
<td>86,474</td>
<td>186.3</td>
</tr>
<tr>
<td>Miraflores</td>
<td></td>
<td>919</td>
<td>96,592</td>
<td>105.1</td>
<td>82,131</td>
<td>113.7</td>
<td>96,474</td>
<td>116.4</td>
</tr>
<tr>
<td>Puente Piedra</td>
<td></td>
<td>5,110</td>
<td>175,369</td>
<td>34.3</td>
<td>235,628</td>
<td>46.1</td>
<td>421,275</td>
<td>82.4</td>
</tr>
<tr>
<td>Rímac</td>
<td></td>
<td>1,218</td>
<td>213,470</td>
<td>175.3</td>
<td>215,095</td>
<td>176.6</td>
<td>219,286</td>
<td>180.1</td>
</tr>
<tr>
<td>San Borja</td>
<td></td>
<td>1,040</td>
<td>126,937</td>
<td>135.5</td>
<td>139,321</td>
<td>138.7</td>
<td>164,698</td>
<td>151.6</td>
</tr>
<tr>
<td>San Isidro</td>
<td></td>
<td>974</td>
<td>71,890</td>
<td>172.9</td>
<td>70,647</td>
<td>172.9</td>
<td>71,828</td>
<td>176.2</td>
</tr>
<tr>
<td>San Luís</td>
<td></td>
<td>351</td>
<td>61,476</td>
<td>172.9</td>
<td>60,647</td>
<td>172.9</td>
<td>61,828</td>
<td>176.2</td>
</tr>
<tr>
<td>San Miguel</td>
<td></td>
<td>965</td>
<td>132,663</td>
<td>144.4</td>
<td>150,200</td>
<td>155.5</td>
<td>150,200</td>
<td>155.5</td>
</tr>
<tr>
<td>Santiago de Surco</td>
<td></td>
<td>3,468</td>
<td>55,266</td>
<td>168.4</td>
<td>57,387</td>
<td>174.9</td>
<td>62,516</td>
<td>190.5</td>
</tr>
<tr>
<td>Surquillo</td>
<td></td>
<td>663</td>
<td>100,663</td>
<td>174.9</td>
<td>102,087</td>
<td>182.8</td>
<td>104,423</td>
<td>186.3</td>
</tr>
<tr>
<td>TOTAL LIMA &amp; CALLAO</td>
<td></td>
<td>284,700</td>
<td>8,043,064</td>
<td>28.3</td>
<td>8,688,181</td>
<td>31.2</td>
<td>10,993,498</td>
<td>38.6</td>
</tr>
</tbody>
</table>

(Source: JICA Study Team)
(4) Distribution of Future Working Population by Traffic Zone

According to our estimation, the total working population will be increased by nearly 2.5 million persons in the Metropolitan Area: from 3,568,000 persons in 2004 to 6,086,000 persons in 2025. The distribution of the increased working population by sector was estimated based on the future locations of the industries. The employments of the primary sector will be located mainly in the river basins of Chillon and Lurin. The increased employments of the secondary sector will be located at strategic places along the Panamericana Norte, Panamericana Sur and Carretera Central as well as proposed industrial parks outside the central area of Lima. The increased employments of the tertiary sector will be allocated in the proposed three (3) sub-centers.

Although the tertiary employments will be located in the three sub-centers to promote decentralized urban structure, the existing central area will maintain its major functions as political, administrative, commercial and financial center on a national and metropolitan level. The central area of Lima will show a moderate growth of the tertiary employments, which will be achieved through the urban renewal of the historical center of Lima (Cercado) and a vertical densification of urban activities, particularly in the Lima-Miraflores axis and the San Isidro-La Molina axis. Table 10.5-3 summarizes the distribution of the future working population in the Central, North, South and East Lima, and Callao. Figure 10.5-4 shows the increment of the working population between 2004 and 2025 by traffic zone. According to this figure, a large number of increased working populations can be seen in the north, south and east, particularly the areas outside of 10 km radius from the central area.

Table 10.5-3 Distribution of the Future Working Population, 2004, 2010 and 2025

<table>
<thead>
<tr>
<th>Area</th>
<th>2004</th>
<th>2010</th>
<th>2025</th>
<th>2004-2010</th>
<th>2010-2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Lima</td>
<td>2,451,554</td>
<td>2,640,316</td>
<td>2,856,138</td>
<td>188,762</td>
<td>315,822</td>
</tr>
<tr>
<td>North Lima</td>
<td>291,774</td>
<td>369,059</td>
<td>645,548</td>
<td>77,285</td>
<td>256,489</td>
</tr>
<tr>
<td>South Lima</td>
<td>192,782</td>
<td>312,445</td>
<td>617,515</td>
<td>119,663</td>
<td>295,070</td>
</tr>
<tr>
<td>East Lima</td>
<td>361,869</td>
<td>563,418</td>
<td>1,061,109</td>
<td>201,549</td>
<td>457,691</td>
</tr>
<tr>
<td>Callao</td>
<td>270,196</td>
<td>422,109</td>
<td>905,215</td>
<td>151,913</td>
<td>453,106</td>
</tr>
<tr>
<td>Total</td>
<td>3,568,178</td>
<td>4,307,347</td>
<td>6,085,525</td>
<td>738,169</td>
<td>1,778,178</td>
</tr>
</tbody>
</table>
Distribution of the Future Population by Social Estrato

Based on the analysis of the Parson Trip survey conducted by the Study Team and the data prepared by the INEI\(^\text{19}\), the present population was classified into five categories of socioeconomic Estratos (from A-high, B-medium high, C-medium, D-medium low to low-E). The Study Team estimated future population distribution by the socioeconomic Estrato, based on the macro economic projection discussed in the section 10.2 of this report. Table 10.5-4 summarizes the distribution of population in 2004 and 2025 by each socioeconomic Estrato.

According to our estimation, the socioeconomic structure will be changed significantly from 2004 to 2025. The population of socioeconomic Estratos A (high) and B (medium high) will increase from 1,635.8 thousands persons in 2004 to 3,817.2 thousands persons in 2025, and the percentage shares in the total population will also increase from 20.2% to 34.7% during the period. Due to the economic growth of per capita income, the population of socioeconomic Estrato D (medium low) will decrease from 3,306.9 thousands persons or 41.1% in 2004 to 2,425.4 thousands persons or 22.1% in 2025. The population of socioeconomic Estrato E (low) will also decrease from 1,228.8 thousands persons or 15.3% in 2004 to 1,007.2 thousands persons or 9.2% in 2025.

\(^{19}\) Planos Estratificados de LimaMetropolitana Nivel de Manzanas Segun Estratos Cocioeconomicos de Los Hogares, 1998, INEI.
### Table 10.5-4 Distribution of Future Population by Estrato

<table>
<thead>
<tr>
<th>Estrato</th>
<th>Number of Population (1,000 persons)</th>
<th>Increase (B)-(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2004 (A)</td>
<td>2025 (B)</td>
</tr>
<tr>
<td>Estratos A&amp;B</td>
<td>1,635.8</td>
<td>3,817.2</td>
</tr>
<tr>
<td>Estrato C</td>
<td>1,871.6</td>
<td>3,743.7</td>
</tr>
<tr>
<td>Estrato D</td>
<td>3,306.9</td>
<td>2,425.4</td>
</tr>
<tr>
<td>Estrato E</td>
<td>1,228.8</td>
<td>1,007.2</td>
</tr>
<tr>
<td>Total</td>
<td>8,043.1</td>
<td>10,993.5</td>
</tr>
</tbody>
</table>

The population distribution in 2004 and 2025 by socioeconomic Estrato are illustrated through Figure 10.5-5 to Figure 10.5-12. According to these figures, the distribution of each socioeconomic Estrato shows a centrifugal pattern from the center to outskirt. For instance, the population of high and medium-high socioeconomic Estratos is concentrated in the central areas and it will expand mostly to the vicinities within 10-15 km radius from the existing central area. The population of medium socioeconomic Estrato occupies the areas outside of high and medium-high socioeconomic Estratos and will expand to the outside of 15 km radius. The population of medium-low and low socioeconomic Estratos occupies the areas outside of medium socioeconomic Estratos and will expand to the far outside, beyond 30 km radius. This population distribution pattern by socioeconomic Estrato tells us that future transportation planning in the Metropolitan Lima and Callao must pay much attention to the mobility of the people in medium-low and low socioeconomic Estratos who will live in the area far away from the existing central area.
Figure 10.5-5 Population Distribution of Estrato A and B in 2004 by Traffic Zone

Figure 10.5-6 Population Distribution of Estrato A and B in 2025 by Traffic Zone

Figure 10.5-7 Population Distribution of Estrato C in 2004 by Traffic Zone

Figure 10.5-8 Population Distribution of Estrato C in 2025 by Traffic Zone

Estrato AB Ratio in 2004:
- 80% to 100% (19)
- 60% to 80% (18)
- 30% to 60% (77)
- 0% to 30% (313)

Estrato AB Ratio in 2025:
- 80% to 100% (39)
- 60% to 80% (42)
- 30% to 60% (142)
- 0% to 30% (204)

Estrato C Ratio in 2004:
- 80% to 100% (1)
- 60% to 80% (10)
- 30% to 60% (119)
- 0% to 30% (297)

Estrato C Ratio in 2025:
- 80% to 100% (0)
- 60% to 80% (0)
- 30% to 60% (300)
- 0% to 30% (127)
Figure 10.5-9 Population Distribution of Estrato D in 2004 by Traffic Zone

Figure 10.5-10 Population Distribution of Estrato D in 2025 by Traffic Zone

Figure 10.5-11 Population Distribution of Estrato E in 2004 by Traffic Zone

Figure 10.5-12 Population Distribution of Estrato E in 2025 by Traffic Zone