Republic of Indonesia
Ministry of Transportation (MOT)
Badan Pengelola Transportasi Jabodetabek (BPTJ)

Republic of Indonesia
Preparatory Survey on Cikarang New Urban Transportation System Project in Indonesia
Final Report

January 2022
Japan International Cooperation Agency (JICA)

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Japan Transportation Planning Association

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Abbreviations

AC	Alternating Current
AFC	Automated Fare Collection
AGT	Automated Guideway Transit
AI	Artificial Intelligence
AMDAL	Analisa Mengenai Dampak Lingkungan
ANDAL	Analisa Dampak Lingkungan
AP	Availability Payment
ATO	Automatic Train Operation
ATP	Automatic Train Protection
ATR	Ministry of Agrarian Affairs and Spatial Planning (Kementerian Agraria dan Tata Ruang)
ATS	Automatic Train Supervision
BAPEDALDA	Badan Pengendalian Dampak Lingkungan Daerah
B/C	Benefit/Cost
BKPM	Indonesian Investment Coordinating Board
BPN	National Land Agency (Badan Pertanahan Nasional)
BPTJ	Greater Jakarta Transportation Authority (Badan Pengelola Transportasi Jabodetabek)
CAPEX	Capital Expenditure
CBTC	Communications-Based Train Control
CCTV	Closed Circuit Television
DC	Direct Current
DGR	Directorate General of Railways
DSCR	Debt Service Coverage Ratio
DX	Digital Transformation
E & M	Electrical and Mechanical
Economic IRR	Economic Internal Rate of Return
EFS	Environmental Feasibility Study
EIA	Environmental Impact Assessment
EIU	Economist Intelligence Unit
EP	Environmental Permit
EPC	Engineering, Procurement and Construction
Equity IRR	Equity Internal Rate of Return
ESC	Escalator
EV	Electric Vehicle

EV	Elevator
FBC	Final Business Case
GCA	Government Contracting Agency
GHG	Green House Gas
GOA	Grade of Automation
GR	Government Regulation
HSR	High-Speed Rail
IC	Integrated Circuit
IEC	International Electrotechnical Commission
IEDC	Indonesia Economic Development Corridor
IEE	Initial Environmental Examination
IFS	International Financial Statistics
IIF	Institute of International Finance
IIGF	Indonesia Infrastructure Guarantee Fund
IMF	International Monetary Fund
ISO	International Organization for Standardization
JICA	Japan International Cooperation Agency
JICA Climate-FIT	JICA Climate Change Finance Impact Tool
JOIN	Japan Overseas Infrastructure
KA-ANDAL	Kerangka Acuan Analisis Dampak Lingkungan
LAN	Local Area Network
LKPM	Investment Activity Report
LKPP	National Procurement Agency
LRT	Light Rail Transit
LVC	Land Value Capture
MOEF	Ministry of Economy and Finance
MOF	Ministry of Finance
MOHA	Ministry of Home Affairs
MOT	Ministry of Transportation
MRT	Mass Rapid Transit
NEXI	Nippon Export and Investment Insurance
NFC	Near Field Communication
NGO	Non-Governmental Organization
O & M	Operation & Maintenance
OBC	Outline Business Case
OCC	Operations Control Center
OD	Origin and Destination
OJT	On the Job Training

OPEX	**Operating Expense**
OSS	**Online Single Submission**
PBX	**Private Branch Exchange**
PC	**Prestressed Concrete**
PCT	**Prestressed Concrete T type**
PPHPD	**Passengers per hour per Direction**
PPP	**Public Private Partnership**
Project IRR	**Project Internal Rate of Return**
PSC	**Public Sector Construction**
PSD	**Platform Screen Doors**
PT PLN	**Perusahaan Listrik Negara**
QR	**Quick Response**
RC	**Reinforced Concrete**
RFP	**Request for Proposal**
RKL-RPL	**Rencana Pengelolaan Lingkungan Hidup dan RencanaPemantauan Lingkungan Hidup**
SCF	**Social Economic Conversion Factor**
SEA	**Strategic Environmental Assessment**
SKKLH	**Decree on Environmental Feasibility (Surat Keputusan Kelayakan Lingkungan Hidup)**
SMI	**PT Sarana Multi Infrastruktur**
SPC	**Special Purpose Company**
SPPL	**Surat Pernyataan Pengelolaan Lingkungan**
SP Survey	**Stated Preference Survey**
TASC	**Train Automatic Stop-position Controller**
TOD	**Transit Oriented Development**
TOR	**Terms of Reference**
UKL-UPL	**Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan**
UPS	**Uninterruptible Power Supply**
VAT	**Value Added Tax**
VFM	**Value for Money**

Exchange Rate

1 IDR = JPY 137.51（IFS, as of May, 2020）

Outline of the Project

1. Project Background

The population of the Jakarta metropolitan area is about 28 million (2010), and has grown by about 1.3 times in the 10 years till 2010 (at the rate of annual average of approximately 2.8%), with the population growth of the Jakarta suburbs (Bogor, Depok, Tangerang, and Bekasi) being particularly remarkable. The Jakarta metropolitan area relies on road transport for 98% of its passenger and freight traffic, and the number of registered vehicles has increased rapidly to approximately 9.63 million (2010), a 3.6-fold increase in the 10 years to 2010, in line with robust economic growth. As a result, serious traffic congestion and air pollution caused by exhaust gases have become major problems.

The Cikarang area of Kabupaten Bekasi, located about 30 km east of Jakarta, has been developed as a complex city with seven large industrial parks, as many Japanese companies have advanced into the area as it is highly convenient in terms of logistics, and an increasing number of expatriates live in the area as a commuting zone to Jakarta. Consequently, the traffic from outside the region is expected to reach about 820,000 people per day in 2008 and about 2.08 million in 2028, according to the Bekasi Provincial traffic survey and future estimates. Thus, it has become essential to develop a new urban transportation system to alleviate traffic congestion.

In the Masterplan for Acceleration and Expansion of Indonesian Economic Development (MP3EI), which is the country's development plan until 2025, the development of the Jakarta metropolitan area is considered to be one of the major economic activities. The National Medium-Term Development Plan (RPJMN: 2015-2019) calls for improving the urban transportation system.

The Cikarang Multimodal New Transit System Introduction Project (hereinafter referred to as "the project") is to contribute to the alleviation of traffic congestions and the reduction of traffic pollution in the Cikarang multimodal Area by constructing a track-based transportation system.

2. Purpose of the Project

This project is designed to alleviate traffic congestion in the Cikarang multimodal urban area, which has become increasingly congested due to the concentration of large-scale industrial parks to enhance the transportation capability for passenger by introducing the track type transportation system. Also, the project aims to contribute to the improvement of the investment environment in the Jakarta metropolitan area by increasing the passenger transportation capacity and improving the convenience of public transportation in the region through the introduction of a rail transit system.

I. Physical Plan

1. Route Planning

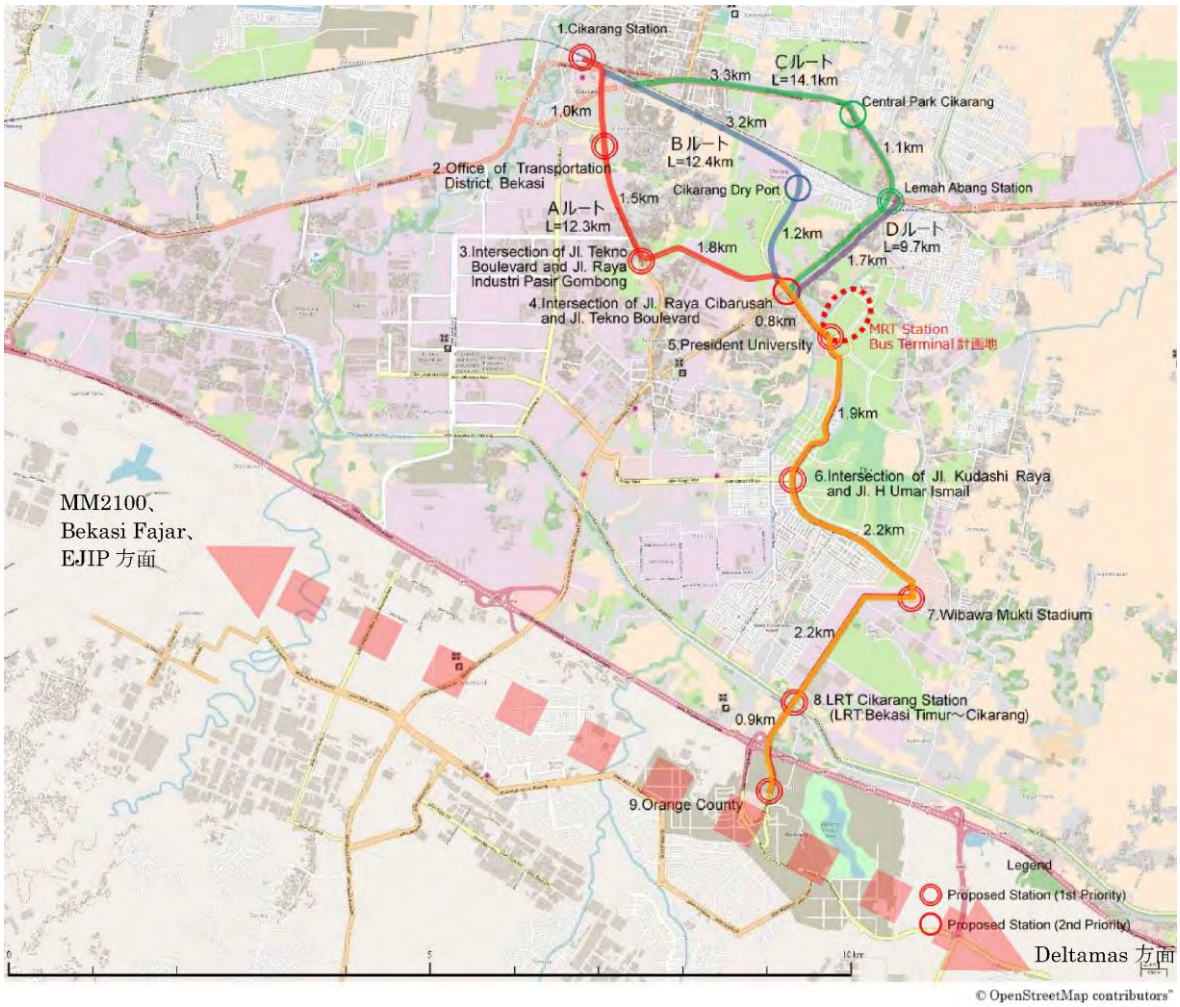
1.1 Selection of Routes and Station Locations

1.1.1 Proposed Routes under the Phase 1 Study

(1) Overview of Proposed Routes

The four route proposals shown in Figure 1-1 below were considered for the Phase 1 Study based on route requests from relevant local entities and the results of a site survey. The starting point was either Cikarang Station or Lemah Abang Station on the Java North Line, with an end point of Orange County, under the premise that the space above the route will be effectively used.

Of these four proposals, Route D route was considered the most promising under the premise of a plan to extend the commuter line to the east of the Cikarang Station and taking into account the possibility of securing the needed space and the project costs.



Source: Final Report of the Phase 1 Study, [Japan International Cooperation Agency (JICA), May 2018]

Figure 1-1: Map of Proposed Routes Under the Phase 1 Study

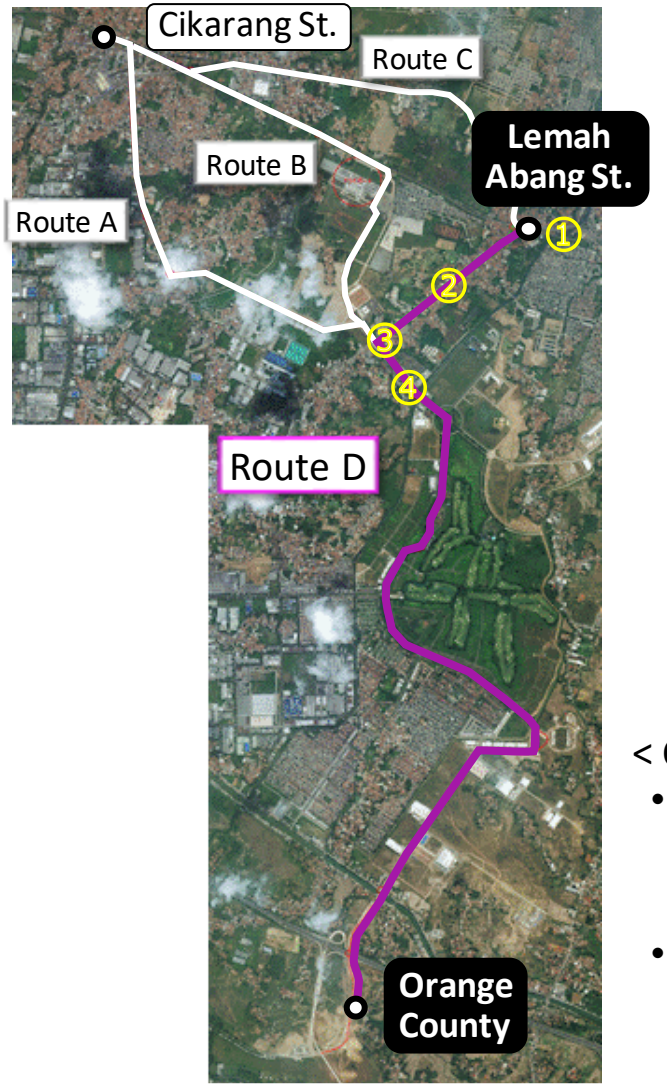
(2) Current Conditions along Route D

Figures 1-2, 1-3 and 1-4 below show the current situation along Route D. Figures 1-5, 1-6 and 1-7 show the current state of Route D roads, which would form the main part of the route.

In terms of the current situation along Route D, the points to be considered when securing the space for the Automated Guideway Transit (AGT) new transportation system are as summarized as follows.

< Main Considerations (circled numbers correspond to items in Figures 1-2 through 1-4) >

- ①: Since there are plans to elevate the level crossing that cuts through the center of Lemah Abang Station, the space above the national road adjacent to the north side of the station cannot be utilized.
  → It is necessary to secure space above the station, on the south side of the station, etc. .
- ②: The narrow width of Jl. Raya Lemah Abang (a provincial road) makes it difficult to secure space for the AGT.
  → Consider alternative routes.
- ⑦: The high voltage power lines that cross over the envisioned AGT route are not high, so it is necessary to check whether or not clearance can be assured in the case of an elevated track.
  → Consider replacing the high voltage power lines or finding another route.
- ⑪ ⑫: It is not possible to use the space above the existing roads on the river bridge and the bridge straddling the expressway.
  → Consider using the space on the east side of the existing roads.
- Other than the above, there are no particular restrictions (road width is sufficient)



① Lemah Abang St.

② Jl. Raya Lemah Abang

③ Intersection

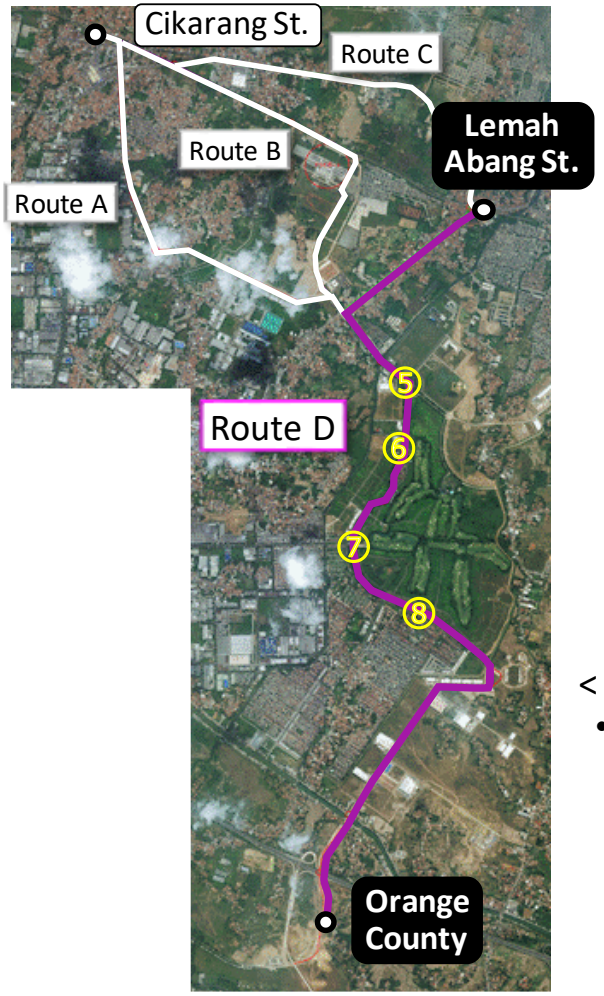
④ Jl. Ki Hajar Dewantara

< Consideration Points >

- ①: It is impossible to utilize the space above the national road because of a plan to elevate a level crossing on the middle of station.
  → To consider to utilize the space above Lemah Abang St.
- ②: It is difficult to ensure the space for AGT due to narrow width.
  → To consider alternative routes.

Source: JICA Study Team

Figure 1-2: Conditions of Route D Area in October 2019 (Part 1)



⑤ Roundabout

⑥ Jl. H. Usmar Ismail

⑦ Farmers Market Jababeka

⑧ Jl. Cikarang Baru Raya

< Consideration Points >

- ⑦: The high voltage overhead power lines are crossing AGT route and the height of the lines isn't high. So it is necessary to check the possibility to ensure the clearance b/w AGT and the lines.
  → To consider to remove to the space above the high voltage overhead power lines if it isn't able to ensure the clearance.

Source: JICA Study Team

Figure 1-3: Conditions of Route D Area in October 2019 (Part 2)

⑨ Around Wibawa Mukti Stadium

⑩ Jl. Science Boulevard

⑪ Road Bridge over a River

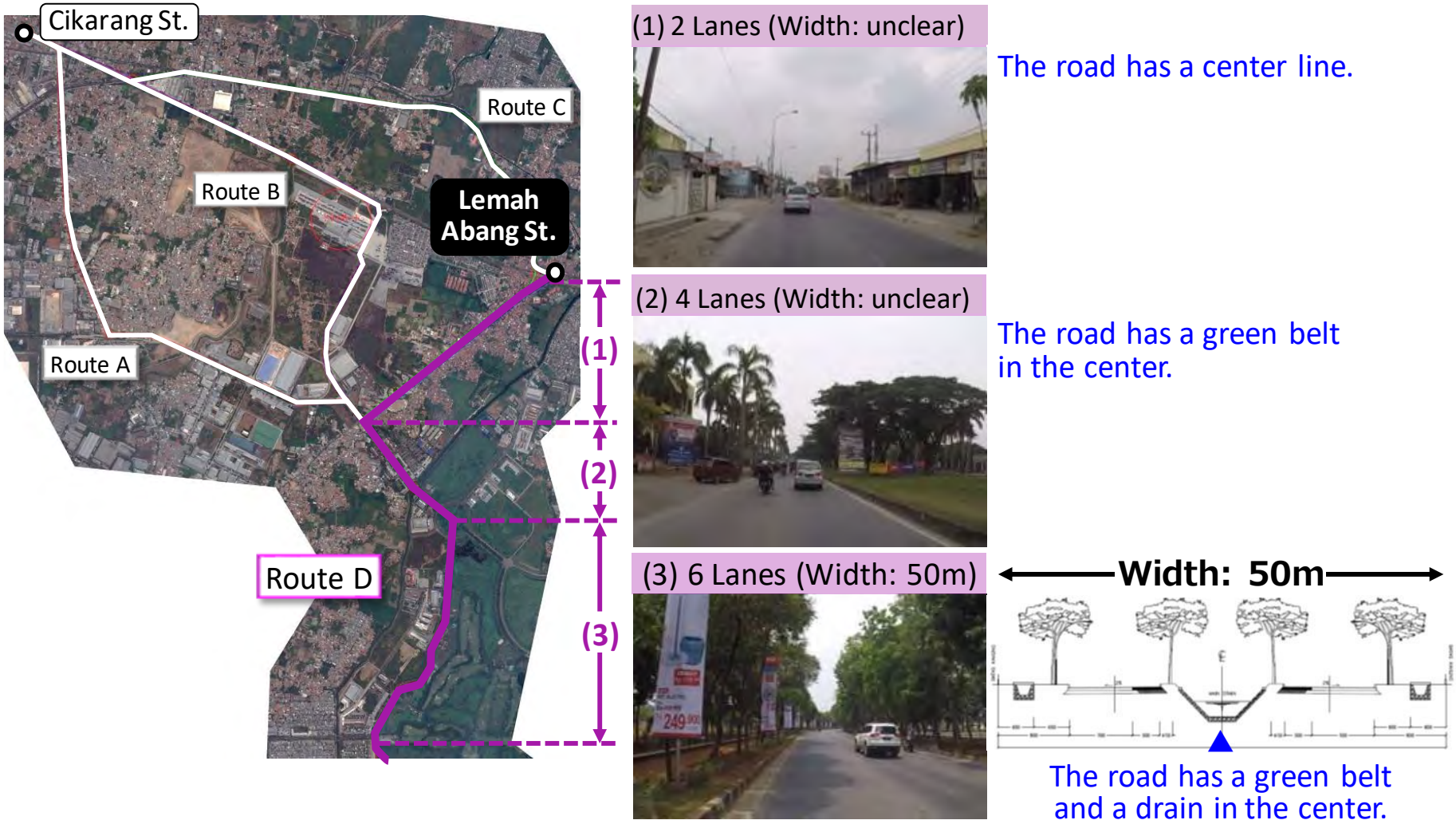
⑫ Road Bridge crossing Expressway and Viaduct of New Expressway

< Consideration Points >

- ⑪ & ⑫: It is impossible to utilize the space above the river bridges over a river and a expressway for AGT.
  → To consider the space on the east side of road bridges for AGT.

Source: JICA Study Team

Figure 1-4: Conditions of Route D Area in October 2019 (Part 3)

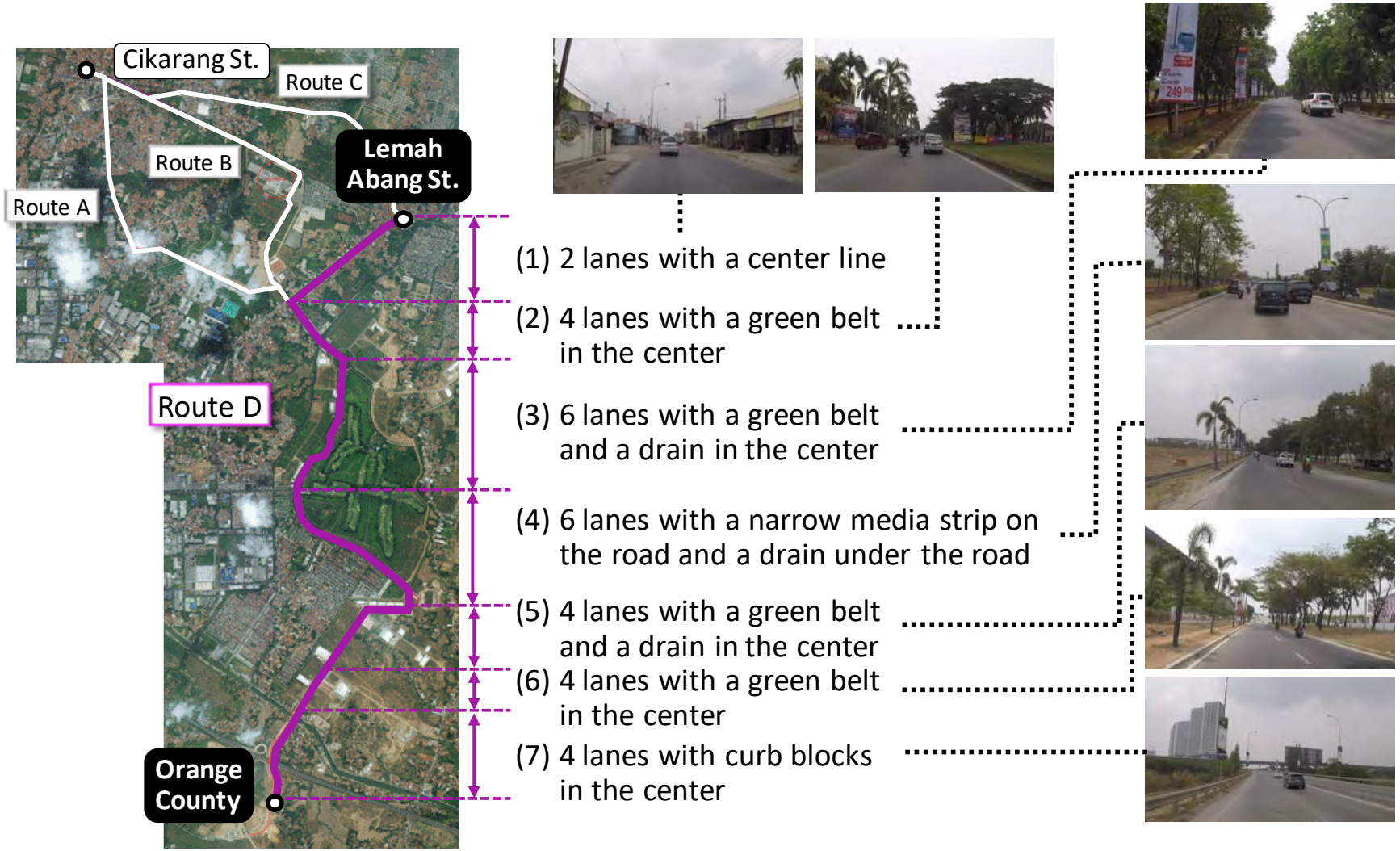


Source: JICA Study Team

Figure 1-5: Conditions of Existing Roads in the Route D Area in October 2019 (Part 1)

Source: JICA Study Team

Figure 1-6: Conditions of Existing Roads in Route D Area in October 2019 (Part 2)



Source: JICA Study Team

Figure 1-7: Road Width and Structures of the Central Areas of Existing Roads in Route D Area (Summary)

1.1.2 Proposed Route for the Phase 2 Study

(1) Existing Transportation Network Plans and TOD Plans in Cikarang Region

Local developers (Jababeka Group and Lippo Group) have gathered information on existing transportation network Public transport-oriented development and Transit-Oriented Development (TOD) plans in the Cikarang area, which has been summarized below.

– The development of Mass Rapid Transit (MRT) and Light Rail Transit (LRT) lines shown in Figure 1-8 are expected to improve public transport accessibility and connectivity to Jakarta.

→ It is therefore preferable to locate the AGT junctions to link with other public transportation lines at points marked with red circles.

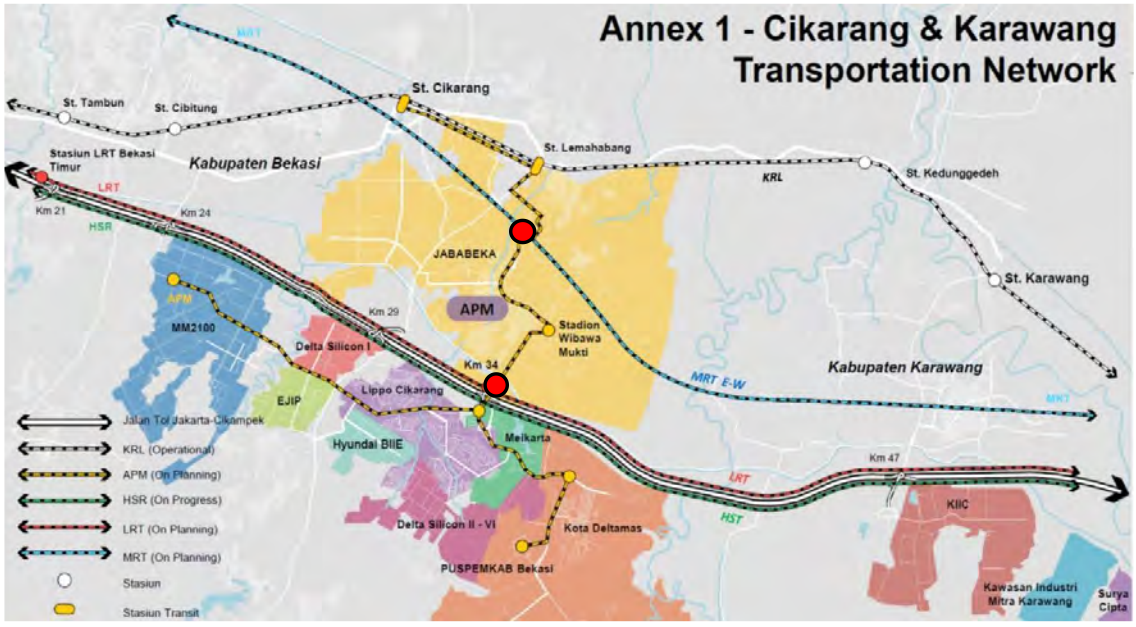
– The AGT route plan for the Jababeka area is shown in the public transportation master plan on the next page. Jababeka has plans to develop a TOD area around the junction between the APM (AGT) line and the MRT line (Figure 1-9).

– The locations and types of TOD projects in Jababeka along the AGT route are shown in Figure 1-10 on the next page. The TOD development plan is located along the currently envisioned D Route, but some development areas (marked in deep orange) are located at a distance from the AGT.

→ Considering the Jababeka development plans and projects, an alternative route running northeast from the roundabout near the Jababeka TOD area is desirable.

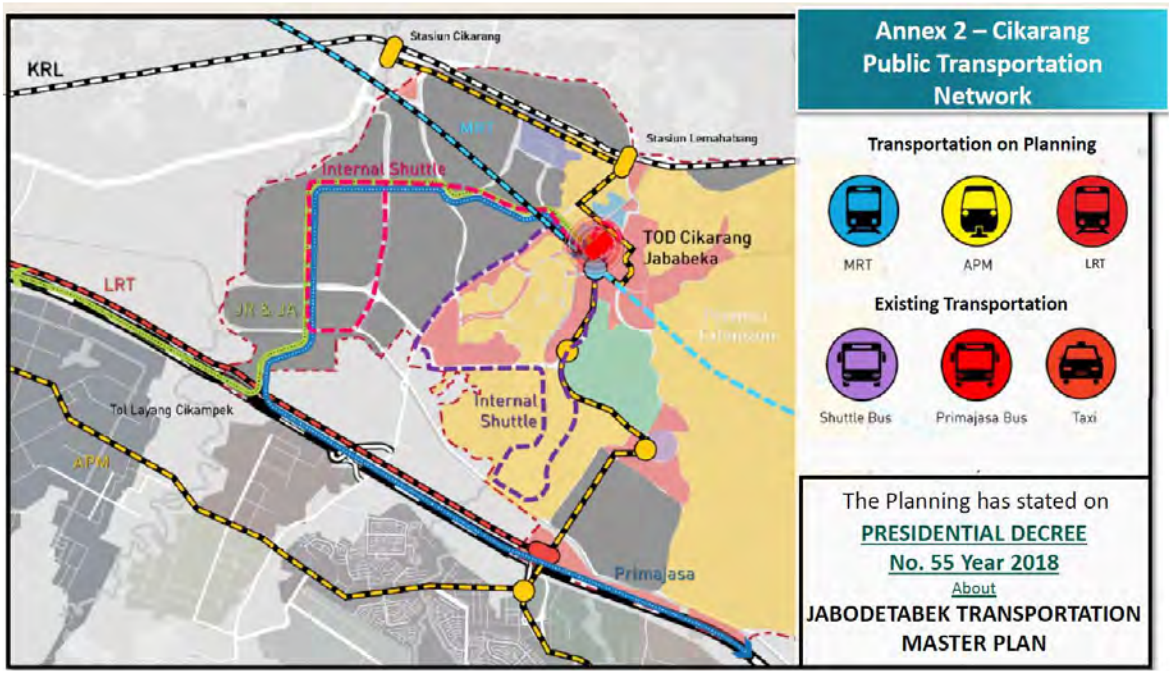
– Figure 1-11 on page 11 shows the land use plan for developing a commercial and residential zone in the Lippo area, including Orange County and Meikarta Lippo.

→ It is desirable to extend the AGT route to Meikarta Lippo and build a station that can serve as the center of this area.



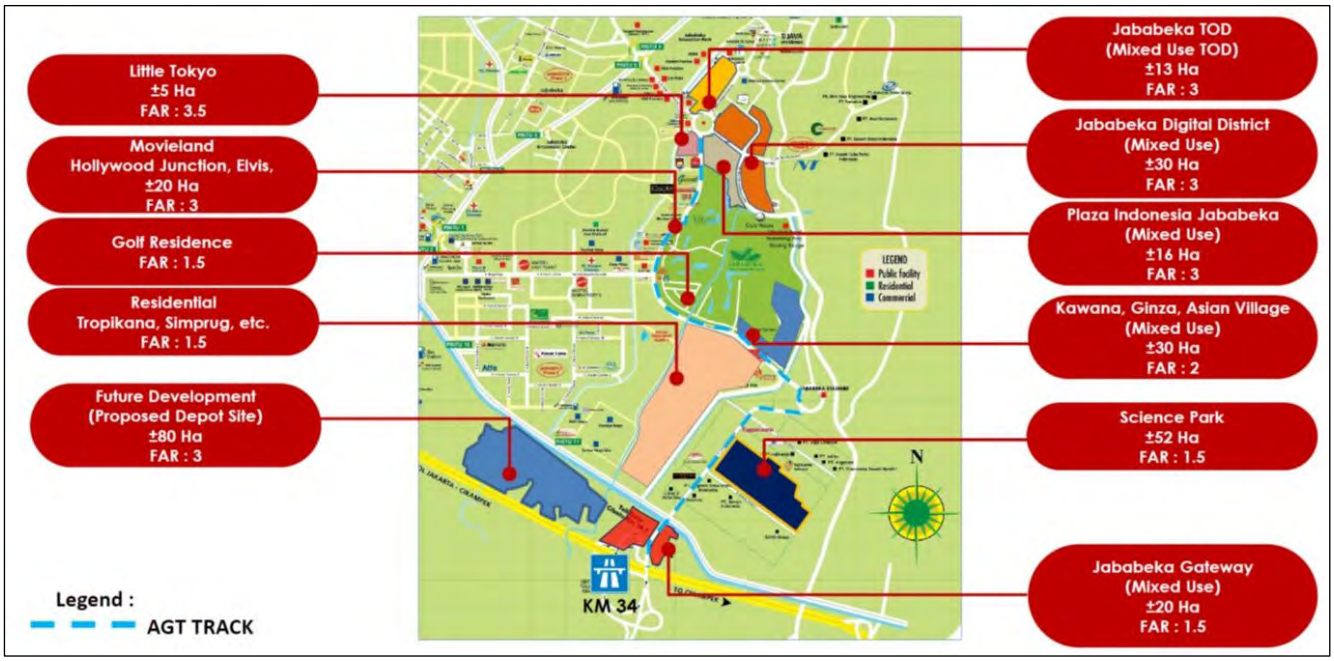
Source: Jababeka Group materials

Figure 1-8: Transportation Network Plan for Cikarang and Karawang



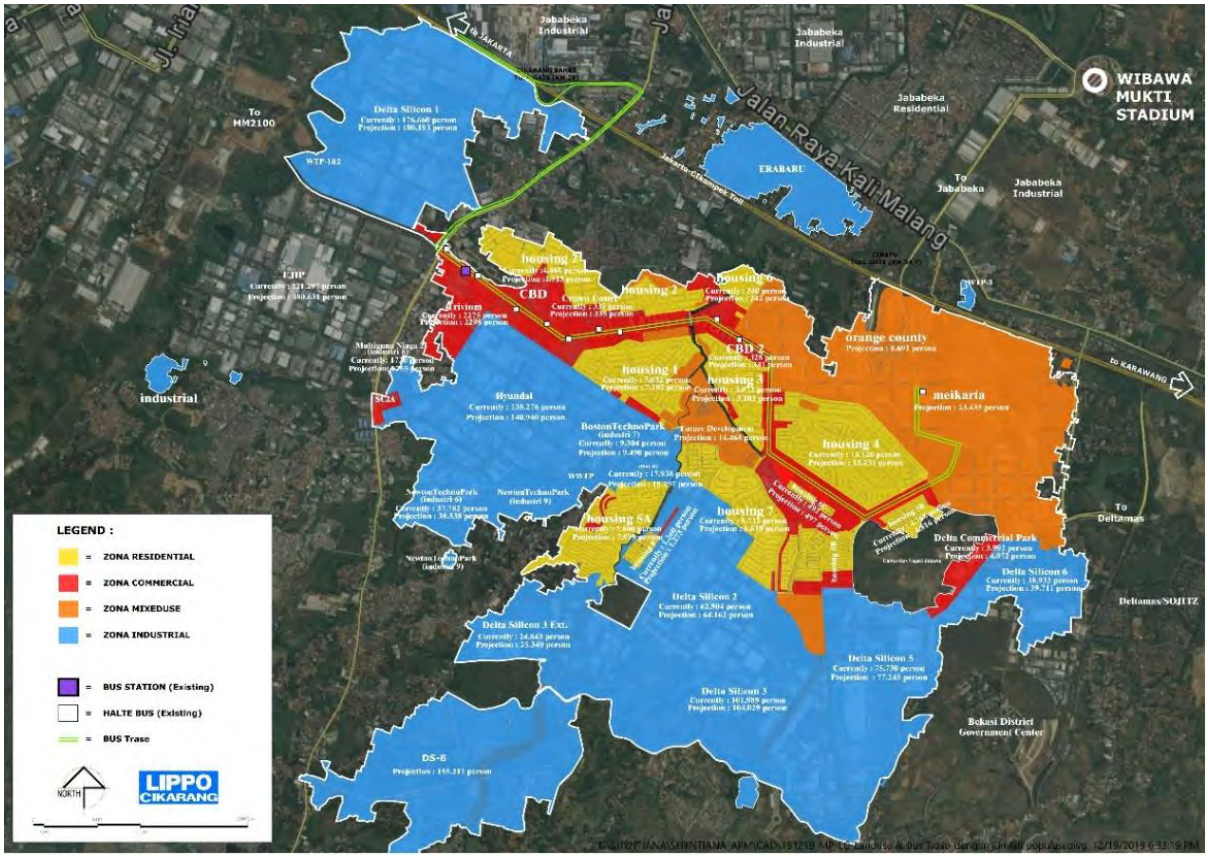
Source: Jababeka Group materials

Figure 1-9: Public Transportation Network Plan for Jababeka Area



Source: Jababeka Group materials

Figure 1-10: TOD Plan for Jababeka Area



Source: Lippo Group materials

Figure 1-11: Land Use Plan for Lippo Area

(2) Alternative Route 1 Considering Current Conditions and Existing Plans

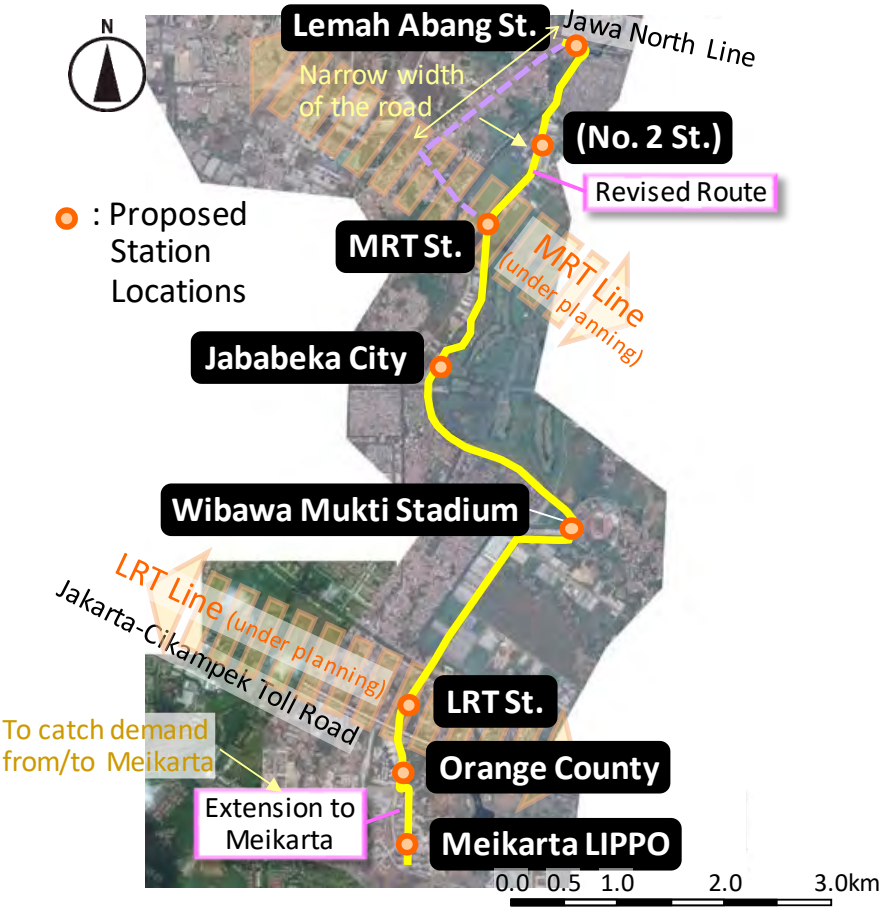
Considering the present conditions around Route D outlined in this survey and the existing plans for the development of the transportation network and TOD in the Cikarang area, Alternative Route 1 has been projected based on the following routing improvements. A map of this alternative route is shown in the Figure 1-12 on the next page.

< Routing Improvements for Alternative Route 1 >

- Alternative route between Lemah Abang Station and MRT Station:
  - Consider utilizing the space above Lemah Abang Station (Java North Line) to construct the AGT station; and
  - Consider a route toward south along the river and Jl. Dr. Satrio from Lemah Abang Station to MRT Station.
- Extension to Meikarta Lippo:
  - Extend the AGT route to Meikarta Lippo to achieve greater passenger demand.
- Others routing alignment matters:
  - Alternative Route 1 presumes the high-voltage power lines near Jababeka Station will be raised higher; and
  - The route alignment will use space to the east of the expressway and river bridge (located north of the expressway).

➢ Station Locations:

- Basically the same as indicated in the Phase 1 Study; and
- Add stations to Alternative Route 1 and the extension to Meikarta Lippo.



Source: JICA Study Team

Figure 1-12: Map of Alternative Route 1

(3) Alternative Route 2 Considering Requests from Relevant Local Entities

Discussions with Jakarta Metropolitan Transportation Authority, [Badan Pengelola Transportasi Jabodetabek (BPTJ)], West Java Province, the Bekasi Regency government and local developers (Jababeka and Lippo Groups) led to a change to the alternative route plan in line with following routing alignment improvements. A map with these changes, Alternative Route 2, is shown in Figure 1-13 on the next page. Alternative Route 2 was adopted as the proposed route for this survey.

< Routing Improvements for Alternative Route 2>

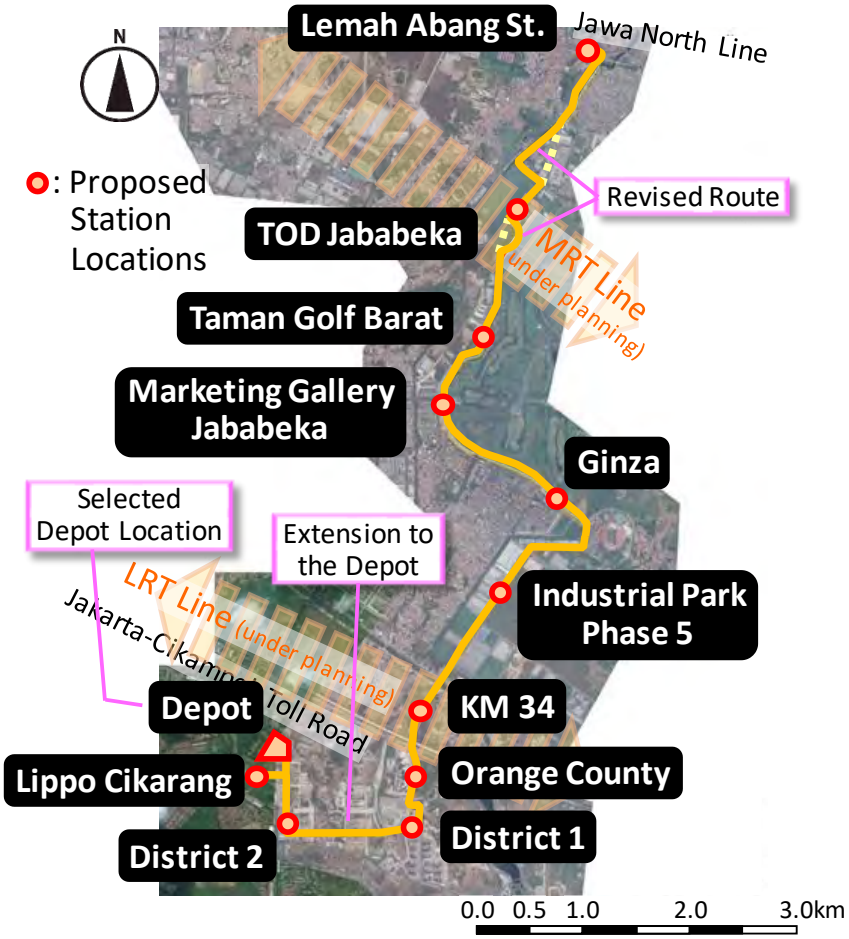
➢ Change the station name from MRT to TOD Jababeka and move the location of the station.

➢ In the vicinity of TOD Jababeka Station, change the route to follow along the river and the road. In addition, eliminate one station in the area.

➢ Change the location of Jababeka City Station and add Taman Golf Barat Station and Marketing Gallery Jababeka Station (one additional station).

➢ Move the location of Wibawa Mukti Stadium Station and change the name to Ginza Station.

- Add Industrial Park Phase 5 Station.
- Change the name of LRT Station to KM34 Station.
- Extend the route at the end of the line at Orange County Station in consideration of the depot station for rolling stock (described in Chapter 5.1 Selection of Depot Location) and add two stations (District 2 Station and Lippo Cikarang Station).



Source: JICA Study Team

Figure 1-13: Positioning of Alternative Route 2 (Adopted as the Phase 2 Study Route)

1.2 Horizontal and Vertical Alignment

1.2.1 Horizontal Alignment Results

The results of the horizontal alignment for the adopted route in Figure 1-13 above are shown in Figures 1-14 to 1-25 on the following pages.

Source: JICA Study Team

Figure 1-14: Horizontal Alignment Results for the Adopted Route (Part 1)

Source: JICA Study Team

Figure 1-15: Horizontal Alignment Results for the Adopted Route (Part 2)

Source: JICA Study Team

Figure 1-16: Horizontal Alignment Results for the Adopted Route (Part 3)

Source: JICA Study Team

Figure 1-17: Horizontal Alignment Results for the Adopted Route (Part 4)

Source: JICA Study Team

Figure 1-18: Horizontal Alignment Results for the Adopted Route (Part 5)

Source: JICA Study Team

Figure 1-19: Horizontal Alignment Results for the Adopted Route (Part 6)

Source: JICA Study Team

Figure 1-20: Horizontal Alignment Results for the Adopted Route (Part 7)

Source: JICA Study Team

Figure 1-21: Horizontal Alignment Results for the Adopted Route (Part 8)

Source: JICA Study Team

Figure 1-22: Horizontal Alignment Results for the Adopted Route (Part 9)

Source: JICA Study Team

Figure 1-23: Horizontal Alignment Results for the Adopted Route (Part 10)

Source: JICA Study Team

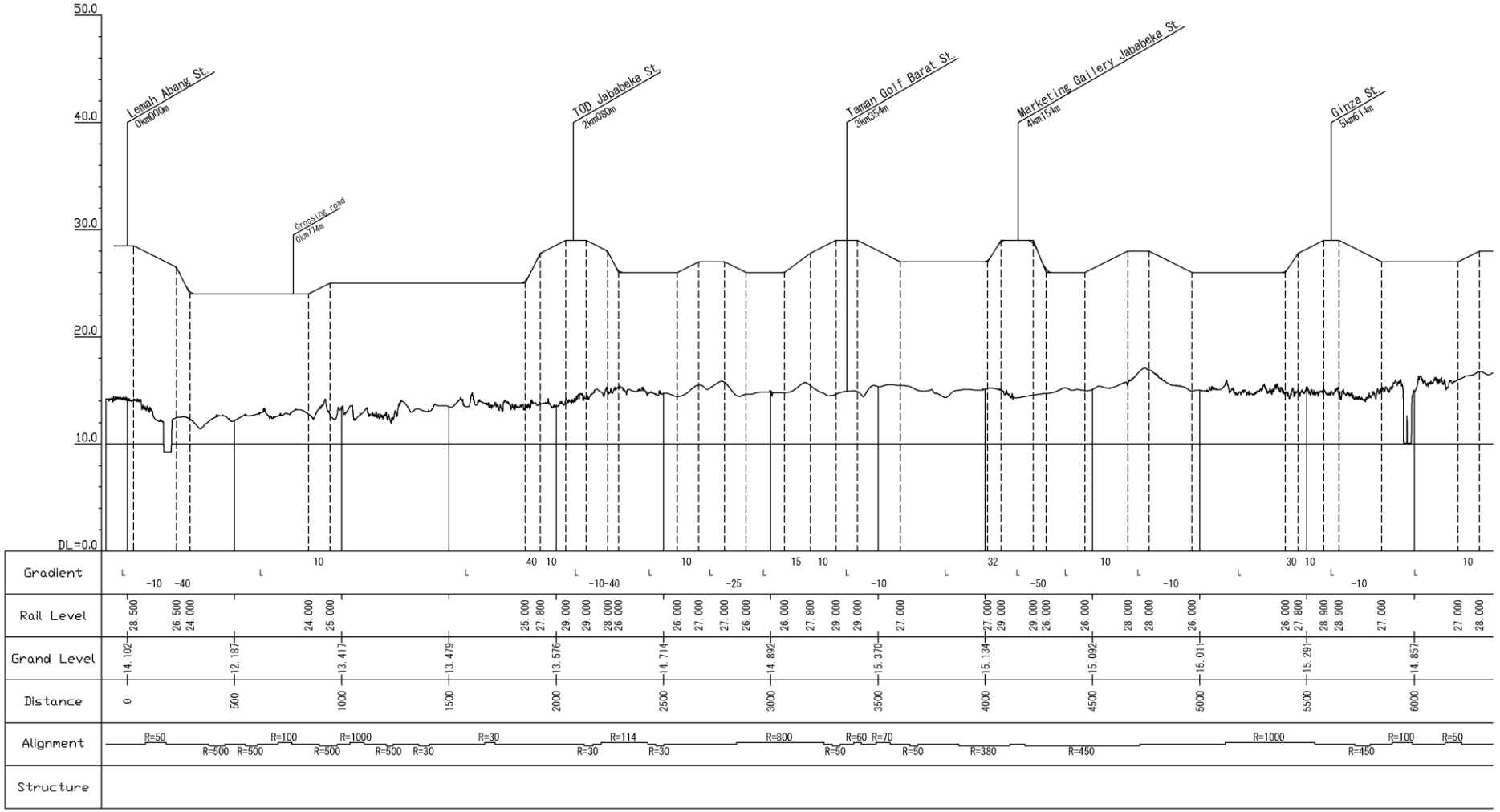
Figure 1-24: Horizontal Alignment Results for the Adopted Route (Part 11)

Source: JICA Study Team

Figure 1-25: Horizontal Alignment Results for the Adopted Route (Part 12)

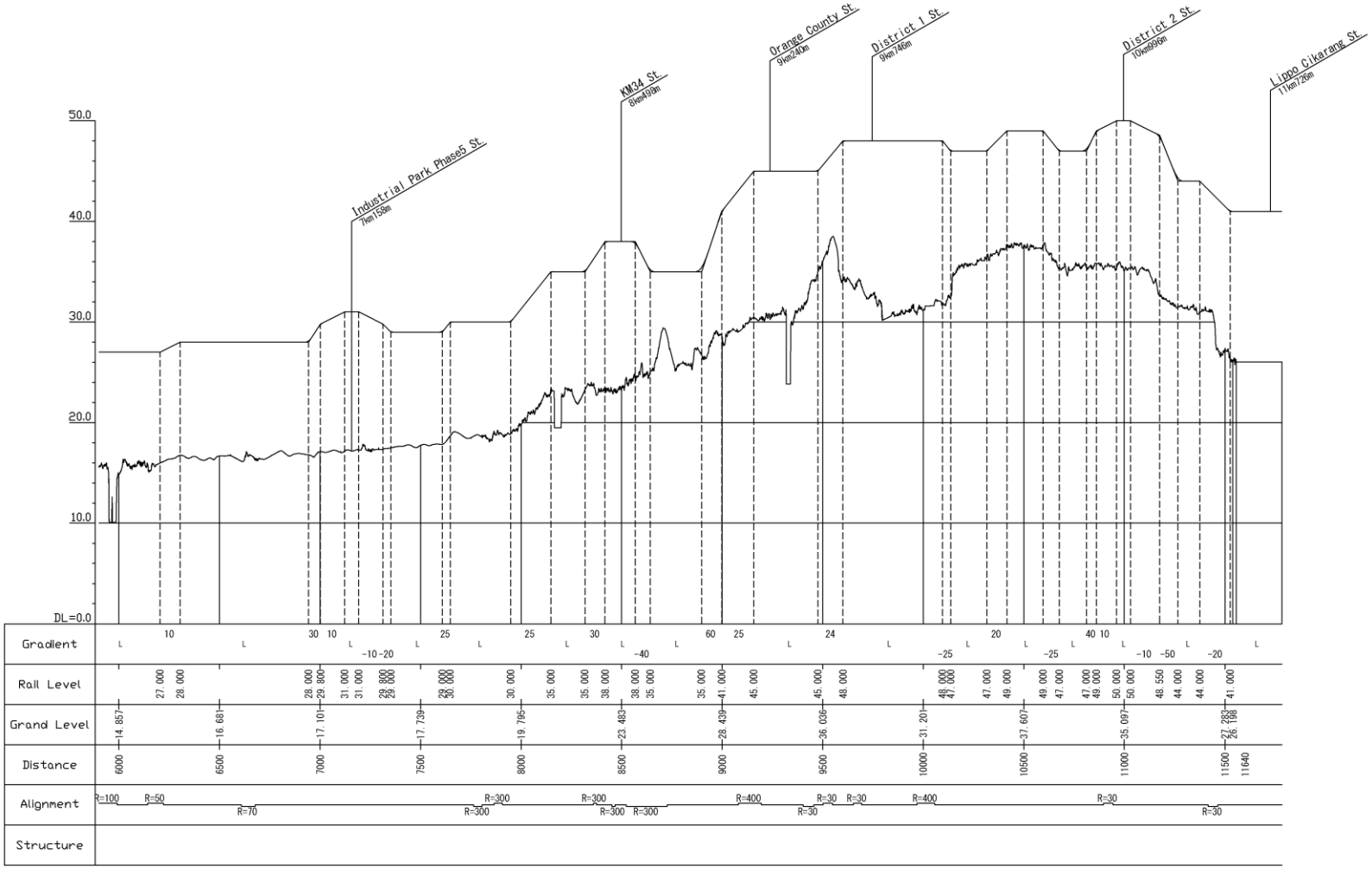
1.2.2 Vertical Alignment Results

Vertical alignment results for the adopted route are shown in Figures 1-26 and 1-27 on the following pages.



Source: JICA Study Team

Figure 1-26: Results of the Vertical Alignment for the Adopted Route (Part 1)



Source: JICA Study Team

Figure 1-27: Results of the Vertical Alignment for the Adopted Route (Part 2)

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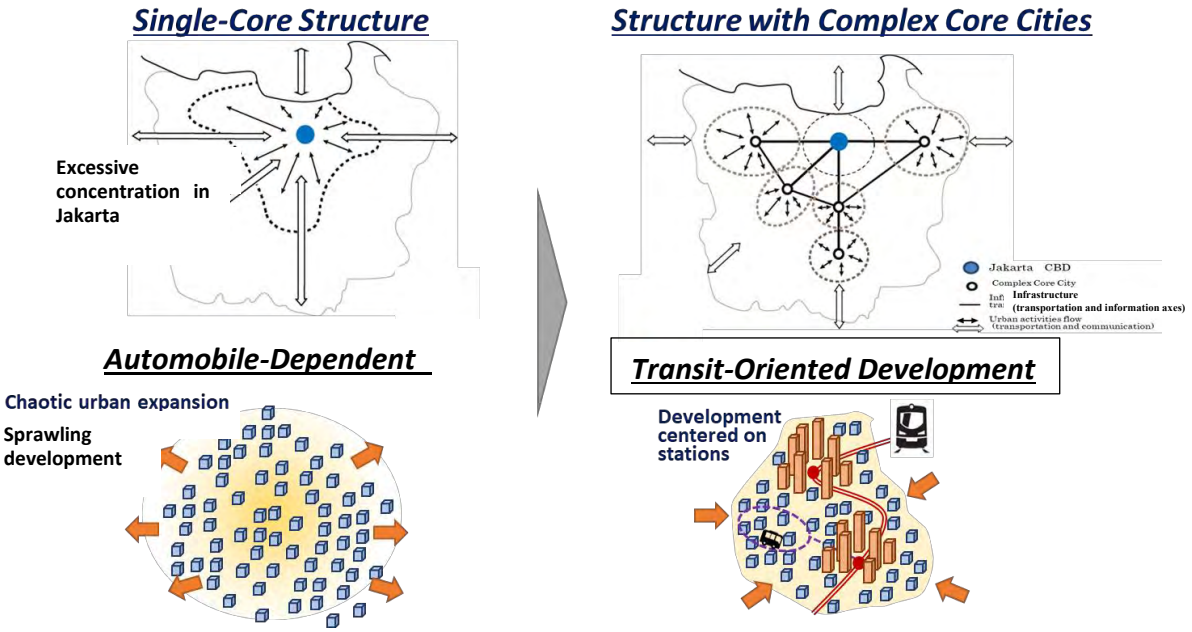
2. Traffic Planning

2.1 Direction of Urban Development in Jakarta Metropolitan Area

Currently, the capital relocation plan is underway in Indonesia, but the relocation will be launched mainly for government functions. Still, Jakarta is expected to continue to develop as the center of Indonesia's economy even after the relocation. Nonetheless, in order to avoid traffic congestion, land subsidence, and other disaster risks, afterward, the main development areas will spread into suburban areas, not just the central part, which means the transition of the city whose structures will hopefully be transformed from "excess concentration in the center of Jakarta Metropolitan Area" to "decentralized associations including satellite cities. "At the same time, it is hoped that each location will shift to high-density development centered on stations and promote TOD-type urban development.



Source: JICA Study Team

Figure 2-1: Urban Development in Jakarta Metropolitan Area

2.2 Potential of the Cikarang Region

Cikarang is located to the east of Jakarta and this Cikarang area has very high potential as will be explained below. For this reason, it is positioned as a "new center of Jakarta" that will be the most highly-anticipated development city among some of the locations in the Jakarta Metropolitan Area in the future.

In developing the area, it is necessary to make it the most advanced area in Indonesia using the latest city planning methods such as a TOD or a Smart City technology.

- Located between Jakarta and Bandung, it is located on the Indonesia Economic Development Corridor (IEDC).
- Many types of transport infrastructure, such as expressways, high-speed railways, and MRT/LRT, have been constructed or planned.
- More than 90% of Indonesia's automotive industry is concentrated in the Jabodetabek region, and particularly many Japanese automakers are concentrated in the eastern Jakarta region that has resulted in that being the center of Indonesia's industry.
- The region has the potential to become the center of new industries and technologies such as electric vehicles (EV)s, Artificial Intelligence (AI), and Digital Transformation (DX) because the government has announced an act to further EVs, and in response to that, a Japanese automaker plans to produce batteries for EVs.

Source: JICA Study Team

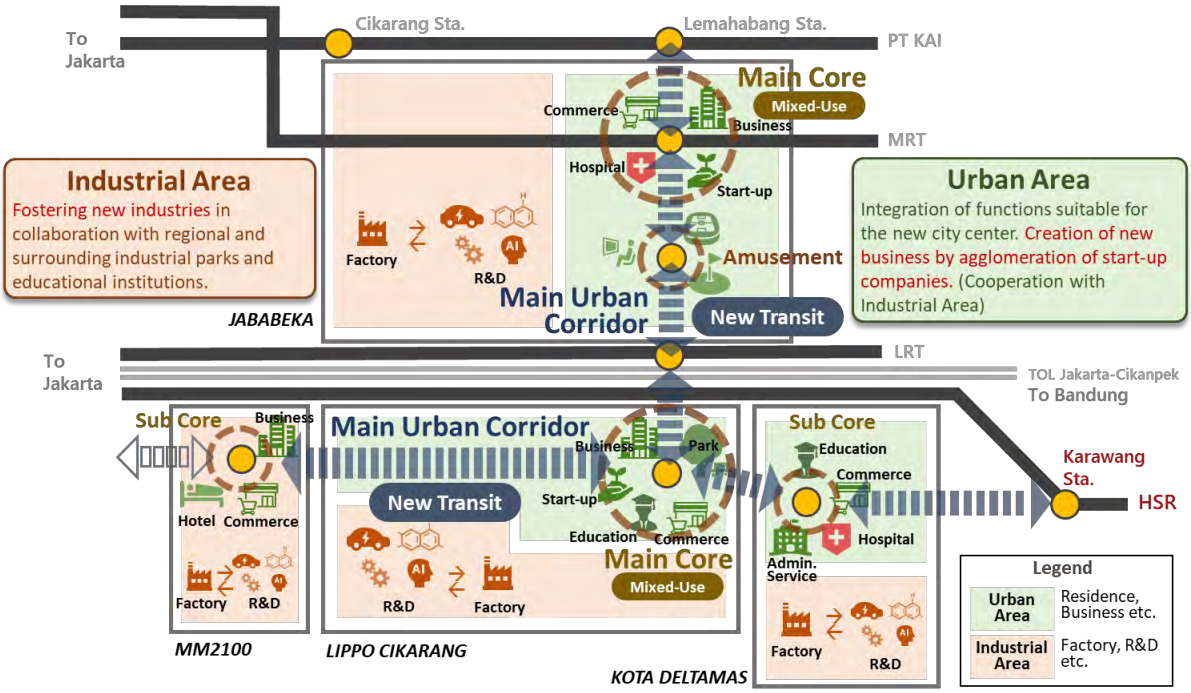
Figure 2-2: Infrastructure Development Project in Eastern Jakarta

2.3 Direction of New Urban Development in Cikarang Region

(1) Direction of urban structure

The direction of the urban structure of the Cikarang region is organized as follows.

- Mixed-use type centers will be distributed, and these will be connected by an urban axis (core public transportation). This will enhance synergy effects as well as a novel urban potential while fostering a sense of unity as a region.
- In addition, the Urban Area aims to create new businesses through the integration of functions suitable for a new city center.
- The clustering of start-up companies in cooperation with the Industrial Area that will play a role in fostering new industries. These new industries are associated with industrial parks and educational institutions in the region and surrounding areas.



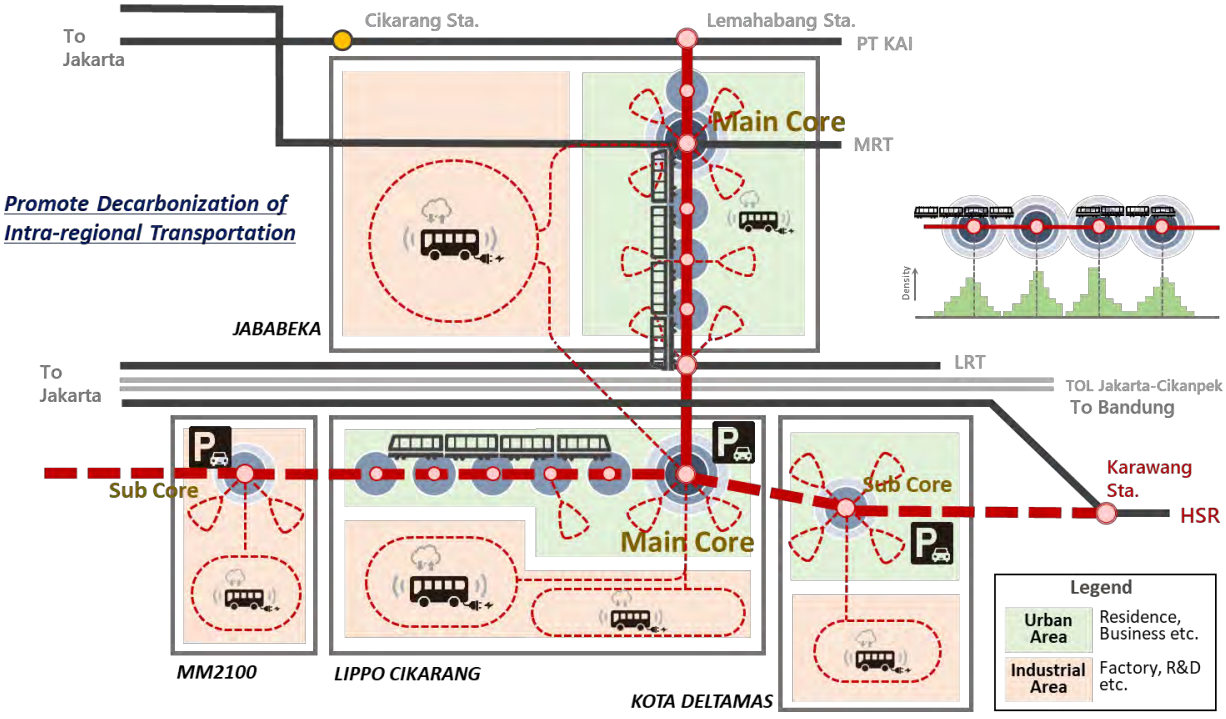
Source: JICA Study Team

Figure 2-3: Urban Structure in Cikarang Region

(2) Direction of Traffic Planning

The direction of traffic planning is organized as follows.

- The new city will aim to provide eco-friendly, congestion-free, smooth and stress-free transportation measures for everyone, introducing a TOD-type land use.
- For the urban axis, a medium-volume public transportation system that enables flexible transportation will be developed together with development centered on stations. [The first phase is centered on the north-south axis; the second phase onward will be constructed on east-west axes that are connected to high -speed rail (HSR) stations.]
- In addition, feeder transportation (e.g., automated EV buses) will be established in remote areas from stations whose residents can only travel freely on foot and public transportation.
- Park-and-ride parking lots will be located on the outskirts of stations, which will enable visitors to the area to travel by public transportation within the area.
- Promote the decarbonization of intra-regional transport throughout the region.



Source: JICA Study Team

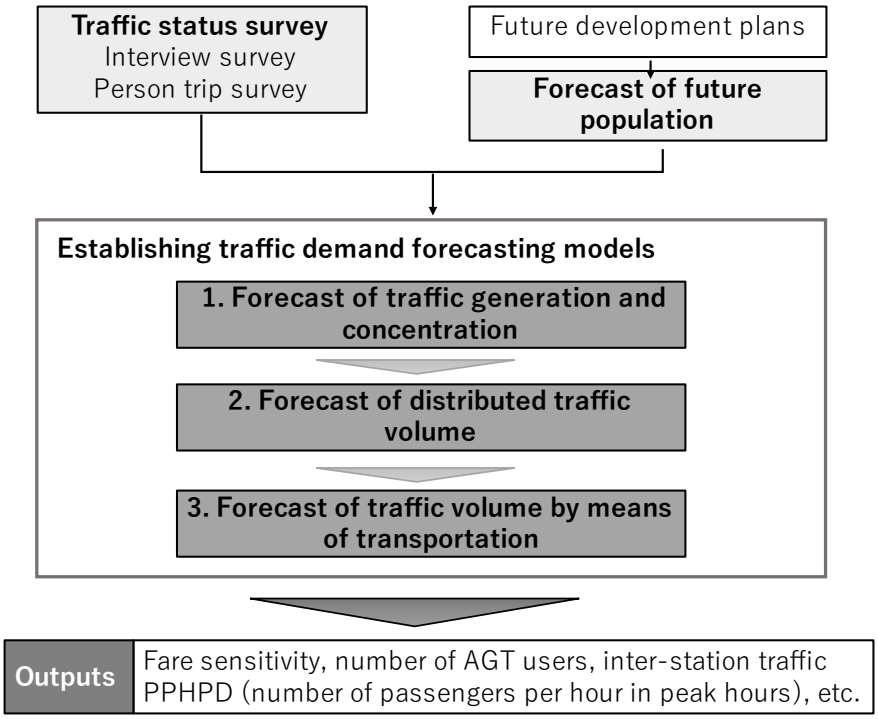
Figure 2-4: Traffic Planning Direction

3. Demand Forecasting

3.1 Examination of Demand Forecasting Method

In Phase 1, a simple traffic demand forecast was implemented using the existing traffic survey. In Phase 2 (this phase), in order to improve the precision of the demand forecast, a new traffic survey was conducted, and a demand forecast model was established based on the results.

For the traffic demand forecast model, a four-stage estimation, which is a general method for predicting traffic demand, was adopted (strictly speaking, it resulted in a three-stage estimation because the estimation of allocated traffic volume was not performed in this forecast). The opening year of AGT is assumed to be 2028.



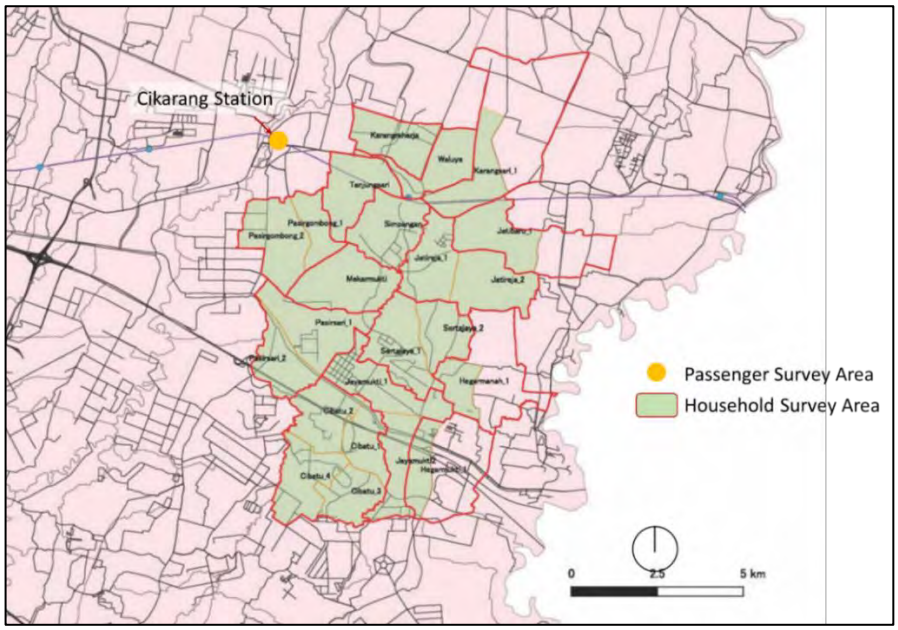
Source: JICA Study Team

Figure 3-1: Demand Forecast Implementation Flow

3.2 Implementation of Traffic Survey

(1) Contents of Traffic Survey

For the purpose of properly understanding the flow of people in the Cikarang region, two surveys were conducted at Cikarang Station of the Jakarta Metropolitan Commuter Railway and in the surrounding area on consideration of the AGT route in December 2019. The first is an interview survey to Cikarang Station users, and the second is a traffic behavior survey (person-trip survey) of residents in the vicinity of the AGT line under consideration.



Source: JICA Study Team

Figure 3-2: Traffic Sites and Areas

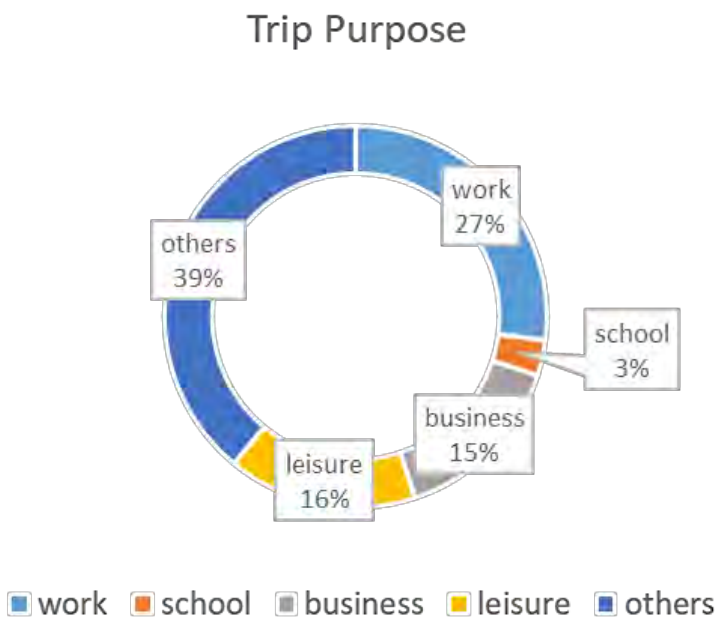
(2) Railway User Interview Survey

The outline of the railway user interview survey is as follows.

Table 3-1: Summary of Railway User Interviews

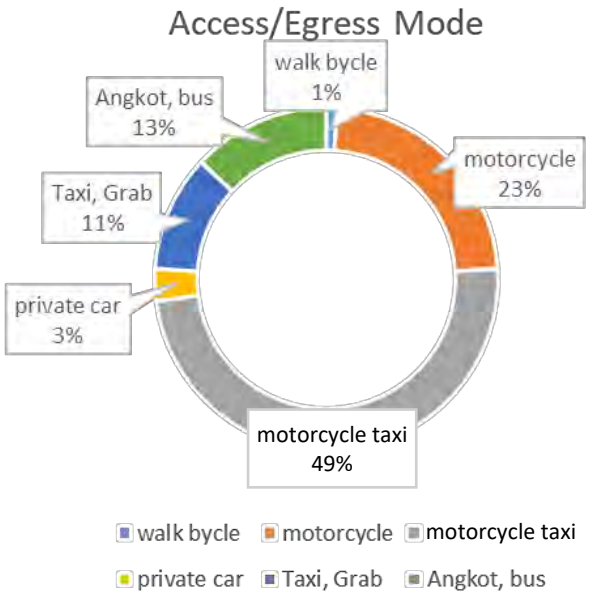
Name of survey	Cikarang Railway Passenger Survey
Survey period	Weekdays: December 6, 2019 (Friday), December 9, 2019 (Monday)
Target area	Cikarang Station
Number of responses	100 people
Survey items	Boarding and disembarking, personal attributes, purpose, frequency of use, Origin and Destination (OD), device transportation, and intention to use AGT

Source: JICA Study Team



Source: JICA Study Team

Figure 3-3: Trip Purpose



Source: JICA Study Team

Figure 3-4: Access/Egress Mode Share

(3) Person-Trip Survey

The outline of the person-trip survey is shown below. The survey was conducted through a home-visit survey in which researchers visited the households covered by the survey.

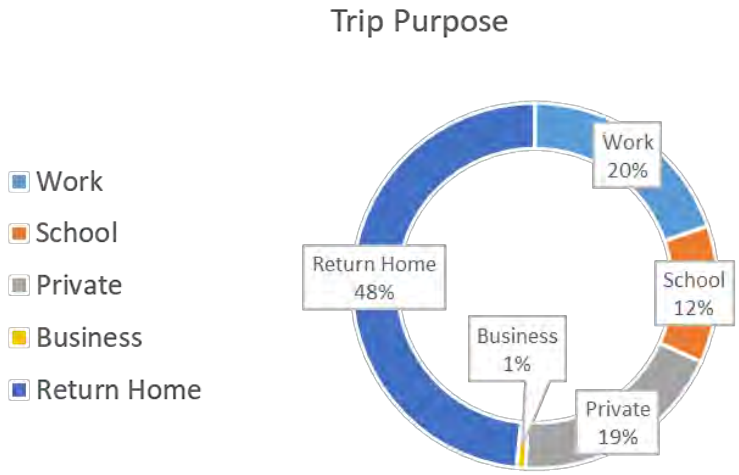
Table 3-2: Overview of Person-Trip Survey

Name of survey	Household Survey
Survey period	December 9, 2019 (Monday) to December 19, 2019 (Thursday)
Target area	Within a 2-km radius of the route being studied
Number of responses	3,154 people from 1,000 households
Survey items	Household information (number of households, age/sex, status of possession of driver's licenses/automobiles, status of residence, annual household income), transportation behavior of household members (destination, purpose, means, time required), intention to use AGT

Source: JICA Study Team

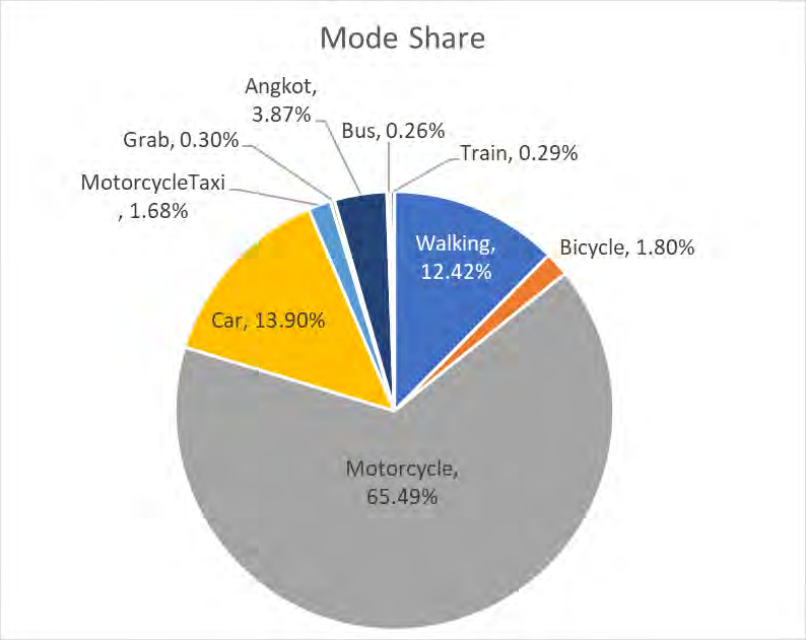
Source: JICA Study Team

Figure 3-5: Vehicle Ownership



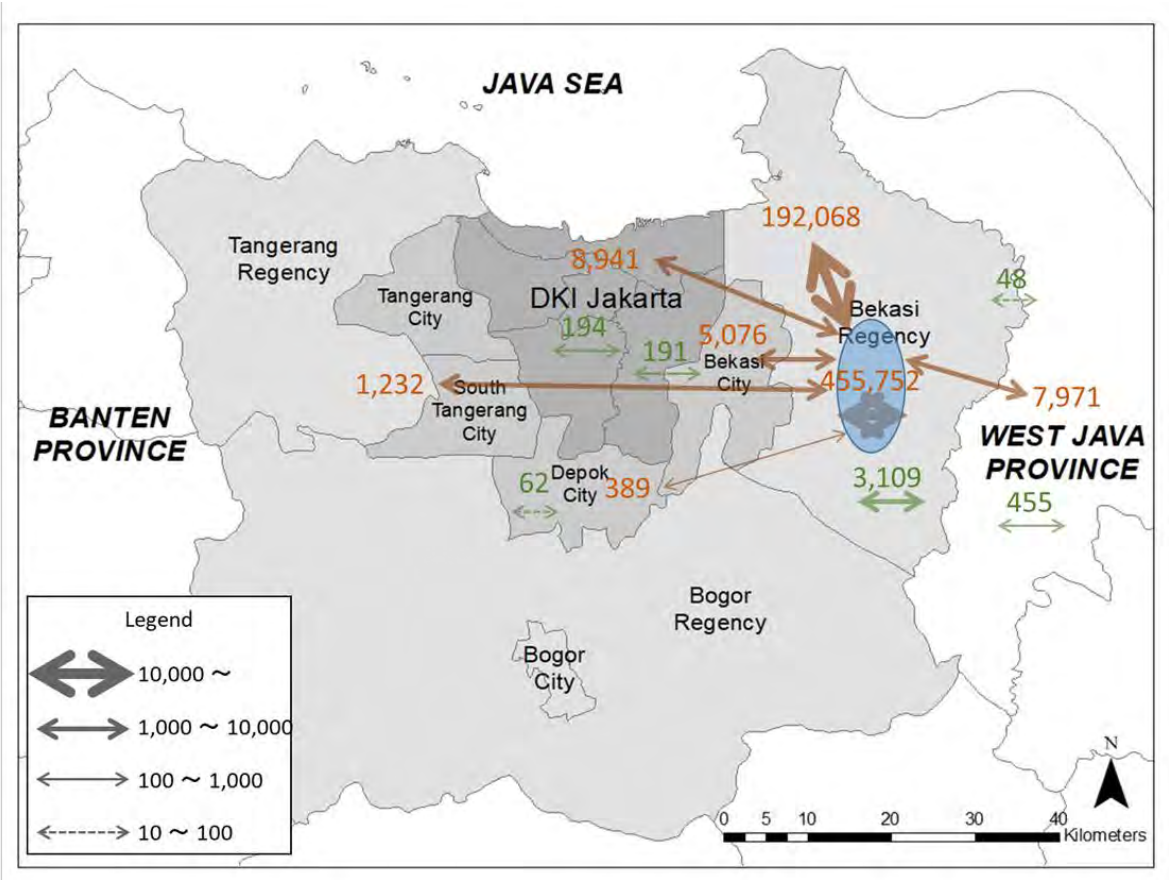
Source: JICA Study Team

Figure 3-6: Trip Purpose



Source: JICA Study Team

Figure 3-7: Mode Share



Source: JICA Study Team
Note: All purposes, trips/day

Figure 3-8: OD Distribution

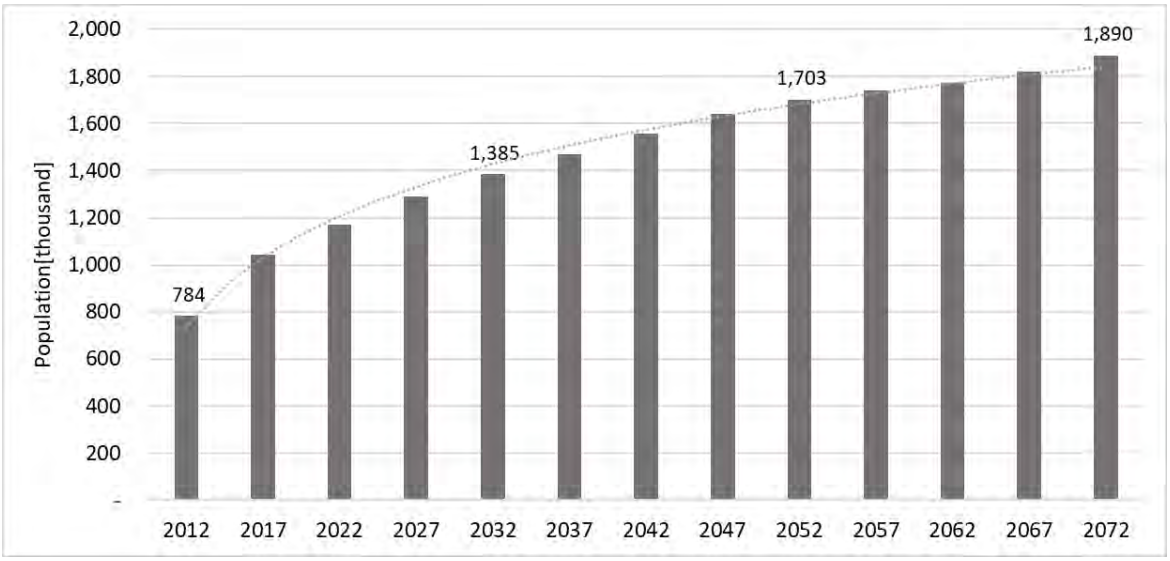
3.3 Perspective of Future Population

(1) Perspective Development Plan

A future land plan was received from a local developer, and an estimated resident population and a working population (commercial and industrial) were established.

(2) Implementation of Population Projections

Population projections were based on the cohort method using Cikarang Kecamatan population data (2012 and 2017). According to the population projection results, the population in 2022, which will be approximately 1.17 million, is expected to increase dramatically to approximately 1.75 million, or to about 1.45 times its 2022 level, by 2052, in 30 years. Without any additional traffic measures, chronic traffic congestion like in Jakarta would be predicted to become a problem.



Source: JICA Study Team

Figure 3-9: Population Projection for the Target District

3.4 Generated and Concentrated Traffic Volume

(1) Generated Traffic

Total generated traffic in the target area was estimated based on the following equation. The consumption rate was set based on the results of the person-trip survey that was conducted.

Total generated traffic in the target area = future population × consumption rate (1.95 trips/day)

(2) Concentrated Traffic

Calculated by trip purpose (commuting to work, commuting to school, entertainment, and those going to the hospital for regular treatment).

For the purpose of going to school and going to the hospital for regular treatment, the trip concentration was estimated by multiplying the future population by the trip concentration consumption rate.

For commuting and recreational purposes, an estimation was made by establishing a multiple regression model that expresses the relationship between intensive traffic volume and development area.

3.5 Distributed Traffic

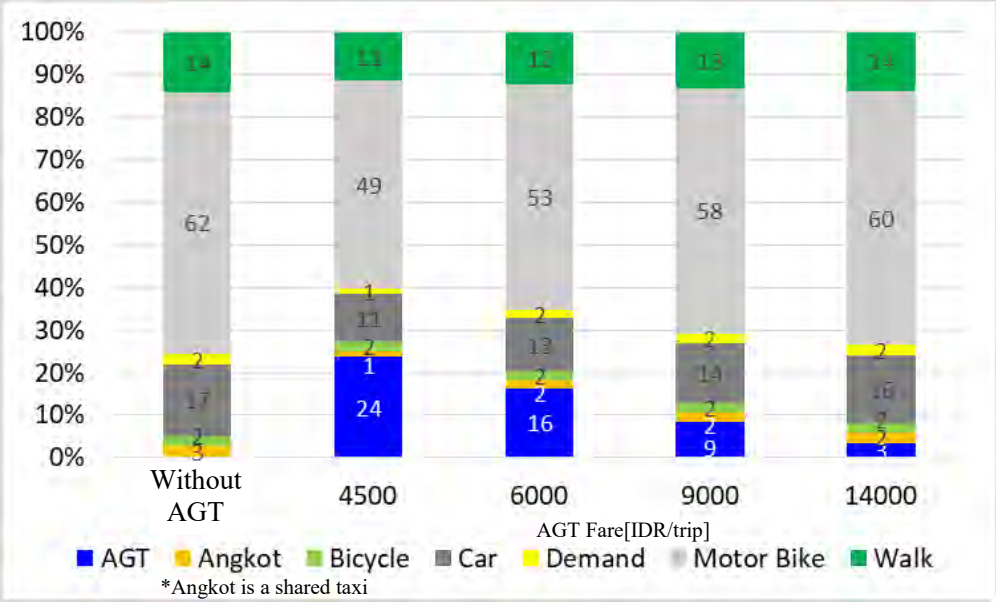
The target areas are currently undergoing large-scale development. For this reason, we used an optimum gravity model in which the distributed traffic volume in the future is expected to differ significantly from that of the present.

Similar to the generated/concentrated traffic, a model was established for each trip purpose (commuting to work, commuting to school, entertainment, and going to and from hospitals) and estimated.

$T_{ij} = k\frac{G_i A_j}{D_{ij}}$	T_{ij}:	Distributed traffic	D_{ij}:	Distance between ODs
	G_i :	Generated traffic	k:	Parameter
	A_j :	Concentrated traffic		

3.6 Traffic Volume by Availability of Different Forms of Transportation

The traffic volume by means of different forms of transportation was estimated based on the traffic modal split rate set under the results of interest in utilizing AGT by fare [Stated Preference Survey (SP) survey]obtained from the questionnaire survey.



Source: JICA Study Team

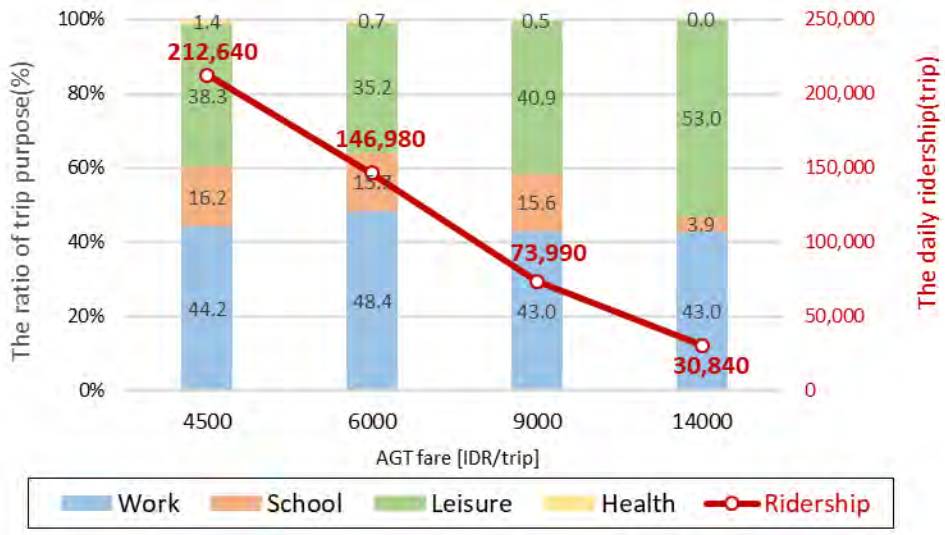
Note: “Demand” is a means of transportation using vehicle dispatching apps (Gojek and Grab)

Figure 3-10: Transportation Sharing Ratio by Fare

3.7 Estimated Number of AGT Users

(1) Number of Users per Day

The number of passengers per day is as follows. The more expensive the fare is, the fewer passengers will use it. The number of passengers is estimated to be 212,000 per day at 4,500 IDR, while the number of passengers is 31,000 per day at 14,000 IDR.



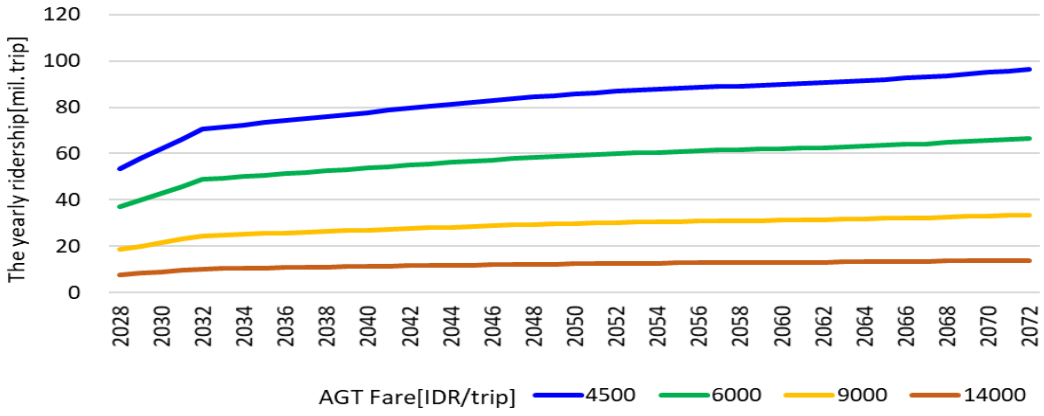
Source: JICA Study Team

Notes: Work (commuting), School (going to school), Leisure (entertainment), Health (doctor visits), Ridership (number of passengers per day)

Figure 3-11: Number of AGT Users by Fare and Trip Purpose

(2) Number of Users per Year

The number of users per year is considered in the five-year period after the operation of AGT commences, during which it is becoming established. Specifically, we assume only 80%, 85%, 90%, and 95% of demand in the first, second, third, and fourth year of the operation, respectively.

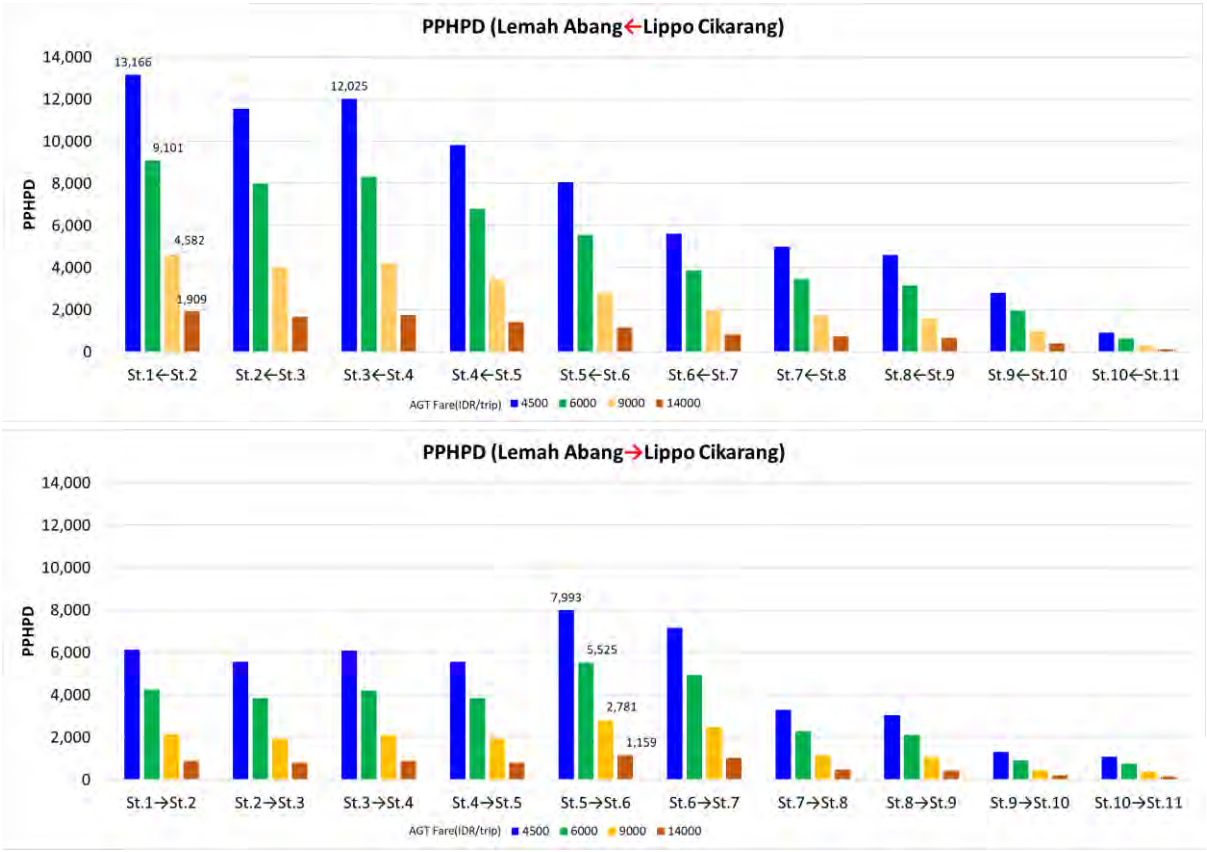


Source: JICA Study Team

Figure 3-12: Annual Number of AGT Users by Fare (Million)

(3) PPHPD (Passengers per Hour per Direction)

PPHPD between Lemah Abang (St. 1) and Lippo Cikrang (St. 11) was calculated.



Source: JICA Study Team

Figure 3-13: PPHPD

4. Civil Engineering Facility Plan

4.1 Basic Policy

The structural plan for the viaduct, which is a civil engineering facility, was based on the following points.

- It is difficult to obtain steelworkers
- Existing viaducts (LRT, etc.) are mainly concrete structures [especially Prestressed Concrete (PC) girders] and many concrete viaducts are built

4.2 General Structure

4.2.1 Upper Structure

(1) Plan Target Span

Since PC girders of around 30 m are often used in the existing superstructure at the site, the target span of this project is basically L = 25, 30, 35 and 40 m.

(2) Upper Structure

The upper structure type is PCT (Prestressed Concrete T) type girder, which is economically superior in terms of the unit cost per square meter of a PC girder type in Japan (see Table 4-1).

Table 4-1: Upper Structure - Worker Performance Costs

Actual superstructure construction cost (Shinkansen)

Digit format	Span length (m)	Hokuriku Shinkansen (Hokuriku Shinkansen Construction Bureau)			Hokuriku Shinkansen (Second Construction Bureau)			Kyushu Shinkansen (Kyushu Shinkansen Construction Bureau)			Average value (IDR / ㎡)	remarks
		Construction cost (IDR)	Base surface width (m)	Unit price (IDR / ㎡)	Construction cost (IDR)	Base surface width (m)	Unit price (IDR / ㎡)	Construction cost (IDR)	Base surface width (m)	Unit price (IDR / ㎡)		
PCT	25	182,884	11.7	626	217,789	13.0	671	180,218	11.3	638	645	
Crane erection	30	239,374	11.7	682	279,978	13.0	671	218,040	11.3	644	666	
	35	292,010	11.7	714	330,739	13.0	671	269,458	11.3	682	689	
	40	387,689	11.7	829	477,913	13.0	671	373,179	11.3	826	776	
Pcbox	30							286,744	11.3	846	282	
Support construction erection	35							356,434	11.3	902	301	
	38				479,291	13.0	971				324	
	50	689,656	11.7	1,179				580,561	11.3	1,028	736	
	55	704,957	11.7	1,096				677,770	11.3	1,091	729	
	60							742,959	11.3	1,096	366	
	67				1,084,008	13.0	1,245					
	104				1,552,357	13.0	1,149					
	148.3							1,689,397	11.3	1,009	337	
PC down road	30							351,560	11.3	1,038	346	
Support construction erection	40							542,927	11.3	1,202	401	
	45							585,262	11.3	1,151	384	
	50							654,612	11.3	1,159	387	
	60							2,015,026	11.3	2,973	991	Extruded erection

Source: JICA Study Team

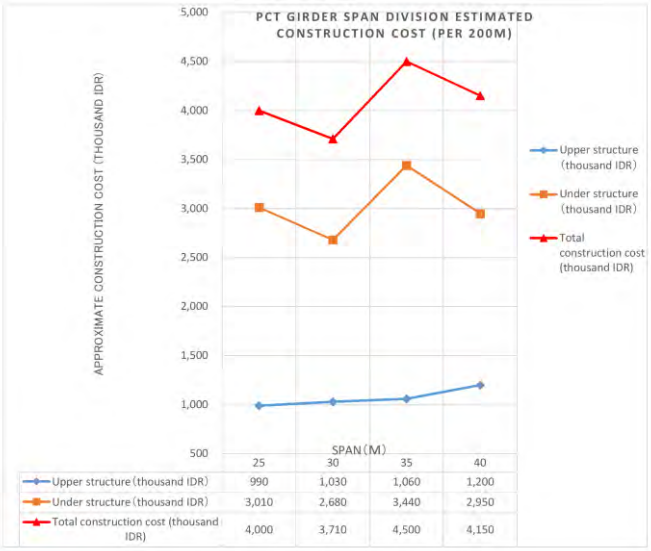
Actual superstructure construction cost (Shinkansen)

Digit format	Span length (m)	Hokuriku Shinkansen (Hokuriku Shinkansen Construction Bureau)			Hokuriku Shinkansen (Second Construction Bureau)			Kyushu Shinkansen (Kyushu Shinkansen Construction Bureau)			Average value (yen / ㎡)	remarks
		Construction cost (yen)	Base surface width (m)	Unit price (yen / ㎡)	Construction cost (yen)	Base surface width (m)	Unit price (yen / ㎡)	Construction cost (yen)	Base surface width (m)	Unit price (yen / ㎡)		
PCT	25	22,645,410	11.7	78,000	26,967,474	13.0	83,000	22,315,280	11.3	79,000	80,000	
Crane erection	30	29,640,113	11.7	85,000	34,667,893	13.0	89,000	26,998,562	11.3	80,000	85,000	
	35	36,157,726	11.7	89,000	40,953,261	13.0	91,000	33,365,221	11.3	85,000	89,000	
	40	48,005,083	11.7	103,000	59,176,994	13.0	114,000	46,208,422	11.3	103,000	107,000	
Pcbox	30							35,505,715	11.3	105,000	105,000	
Support construction erection	35							44,135,017	11.3	112,000	112,000	
	38				59,347,609	13.0	121,000				121,000	
	50	85,395,699	11.7	146,000				71,887,205	11.3	128,000	137,000	
	55	87,290,381	11.7	136,000				83,923,995	11.3	136,000	136,000	
	60							91,995,965	11.3	136,000	136,000	
	67				134,225,844	13.0	155,000					
	104				192,218,578	13.0	143,000					
	148.3							209,187,404	11.3	125,000	125,000	
PC down road	30							43,531,487	11.3	129,000	129,000	
Support construction erection	40							67,227,202	11.3	149,000	149,000	
	45							72,469,317	11.3	143,000	143,000	
	50							81,056,413	11.3	144,000	144,000	
	60							249,507,920	11.3	369,000	369,000	Extruded erection

Source: JICA Study Team

(3) Standard Span

As a result of comparing the estimated construction costs including the substructure, L = 30 m, which was the most economically advantageous, was selected as the standard span.



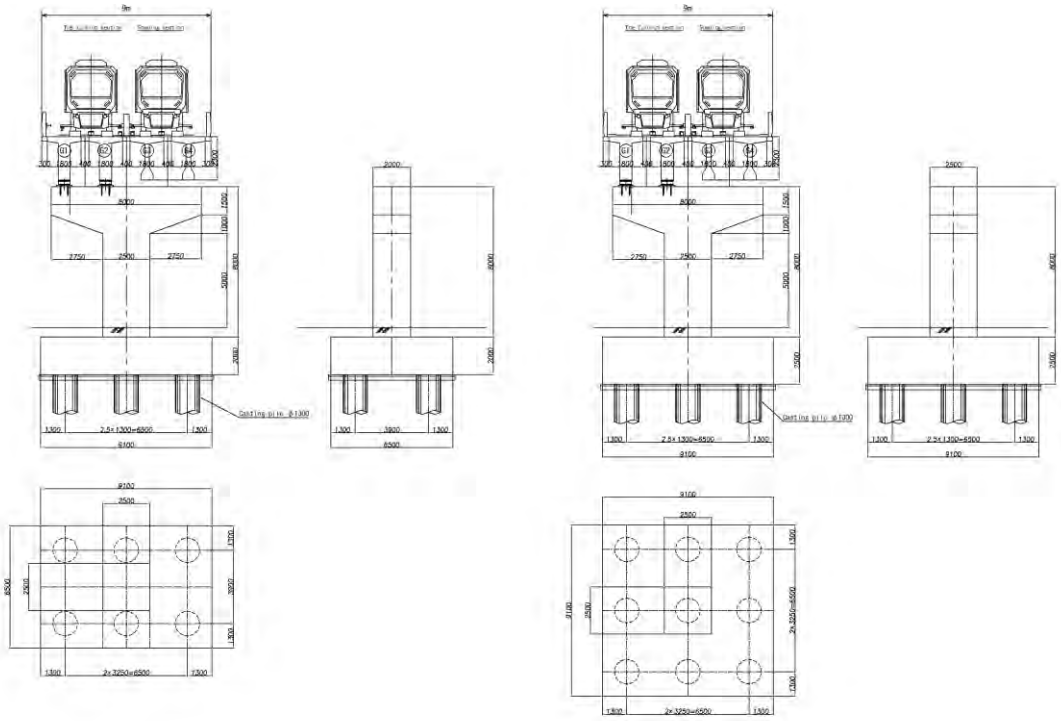
SPAN (M)	25	30	35	40
Upper structure (thousand IDR)	990	1,030	1,060	1,200
Under structure (thousand IDR)	3,010	2,680	3,440	2,950
Total construction cost (thousand IDR)	4,000	3,710	4,500	4,150

Source: JICA Study Team

Figure 4-1: Approximate Construction Costs

(Upper span: L = 20 m ～ 30 m)

(Upper span: L = 35 m ～ 45 m)

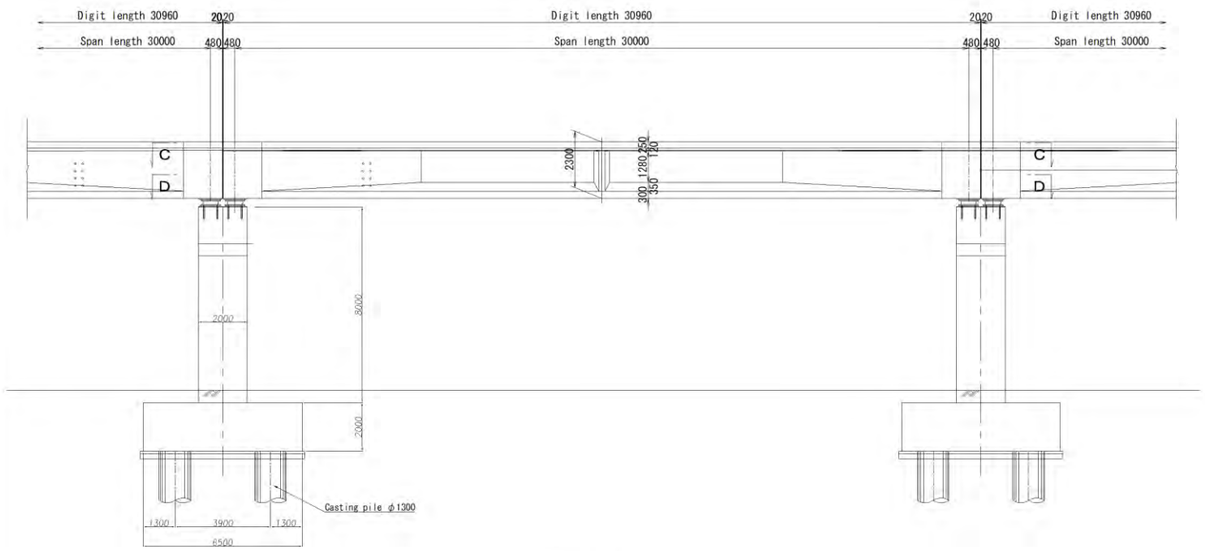


Source: JICA Study Team

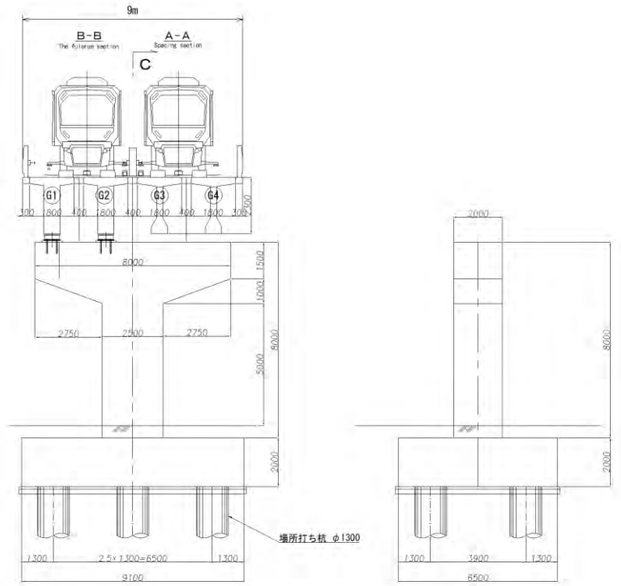
Figure 4-2: Approximate Construction Cost Calculation Model

Standard Part General Diagram S=1:100

Longitudinal View

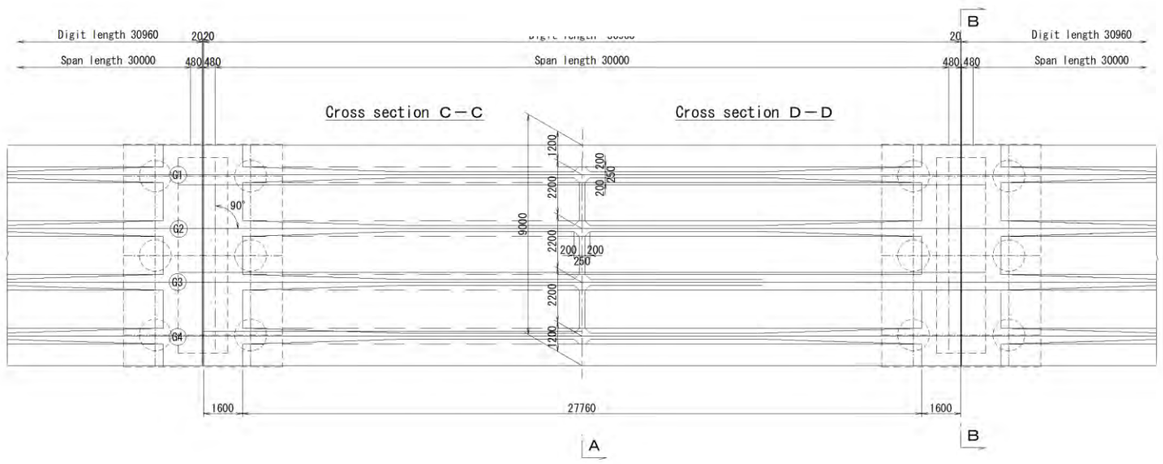


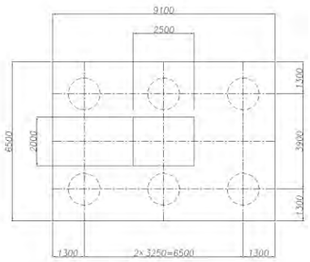
Cross Section



Cast-in-place Pile

Plan View





Source: JICA Study Team

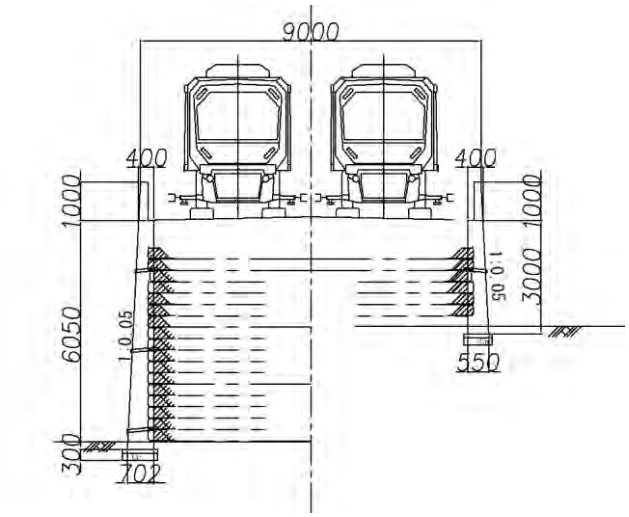
Figure 4-3: Standard Part General Diagram

4.2.2 Substructure Format

The substructure type was based on the general single-column reinforced concrete (RC) pier + pile foundation (cast-in-place pile) type (see Figure 4-2).

4.2.3 Soil Structure Type

In "Chapter 10: Project Cost Estimate", two plans, a full-line viaduct plan and a partial horizon plan, are estimated, but the soil structure type of the partial horizon plan responds to changes in height. Based on the reinforced soil structure, which is easy to prepare and has excellent economic efficiency.



Source: JICA Study Team

Figure 4-4: Soil Structure Plan

4.3 Special Part Structure

4.3.1 Target Location

The special part on this line is the intersection with the highway.

Intersection with public road

Panoramic view of the highway

Source: JICA Study Team

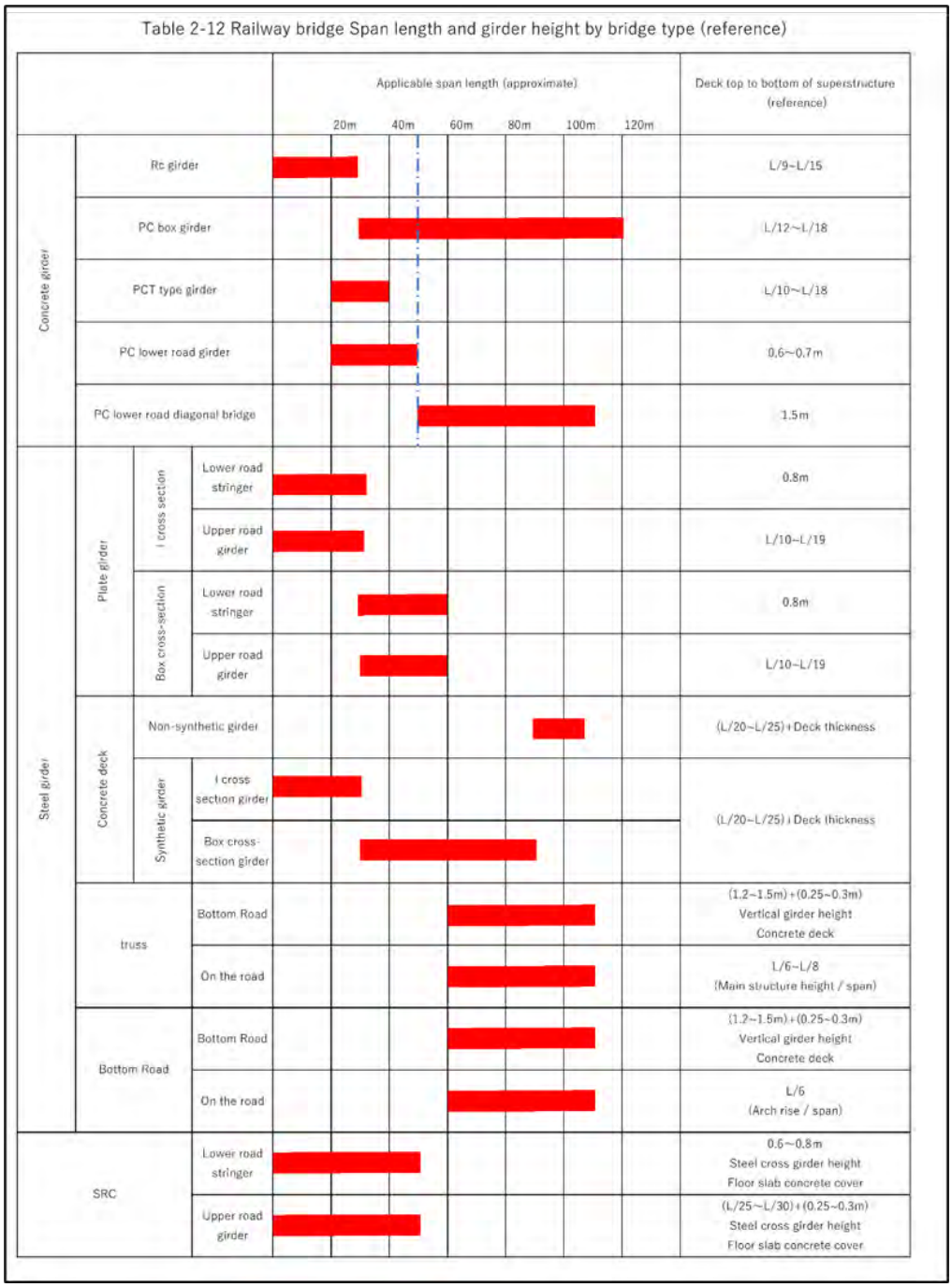
Figure 4-5: Photographs of Highways

4.3.2 Structural Format

The structural form of the relevant part was a PC box girder rigid frame structure with these points.

- The adaptive span length is around 50 m
- It must be a structural type that can be erected on the highway
- The structure should not collapse

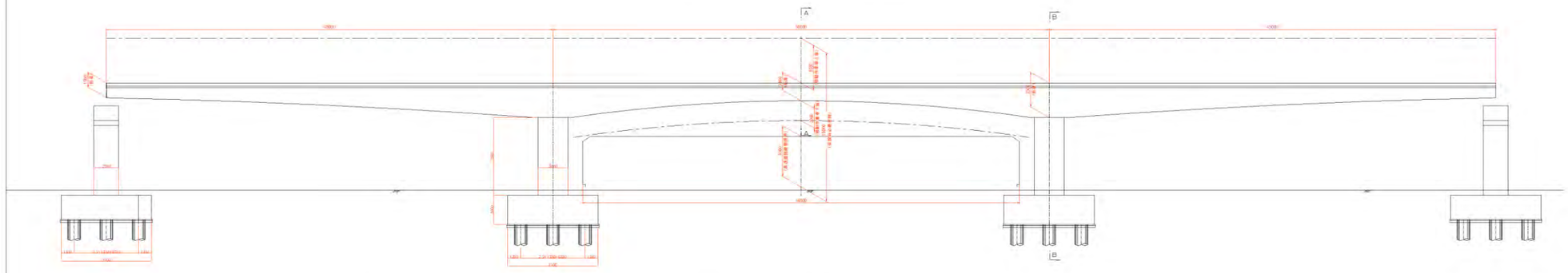
Table 4-2: List of Girder Structure Types According to Adaptive Spacing



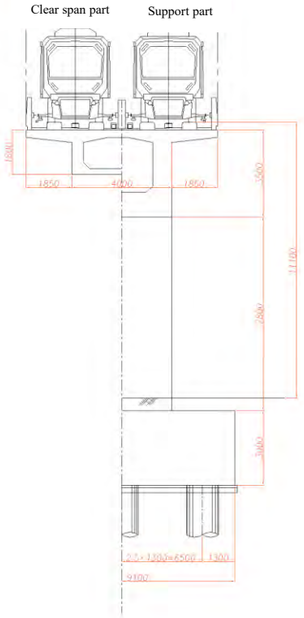
Source: Guide for planning for bridges that cross rivers, issued by Japan Institute of Country-Technology Research Center, in March, 2007.

Highway Cross-Linking Part General Diagram

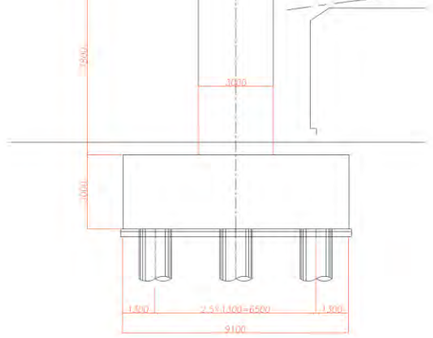
Longitudinal View S=1:200



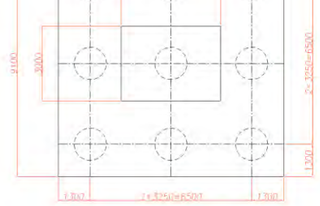
Cross Section S=1:100



Longitudinal View S=1:100



Plan View S=1:100



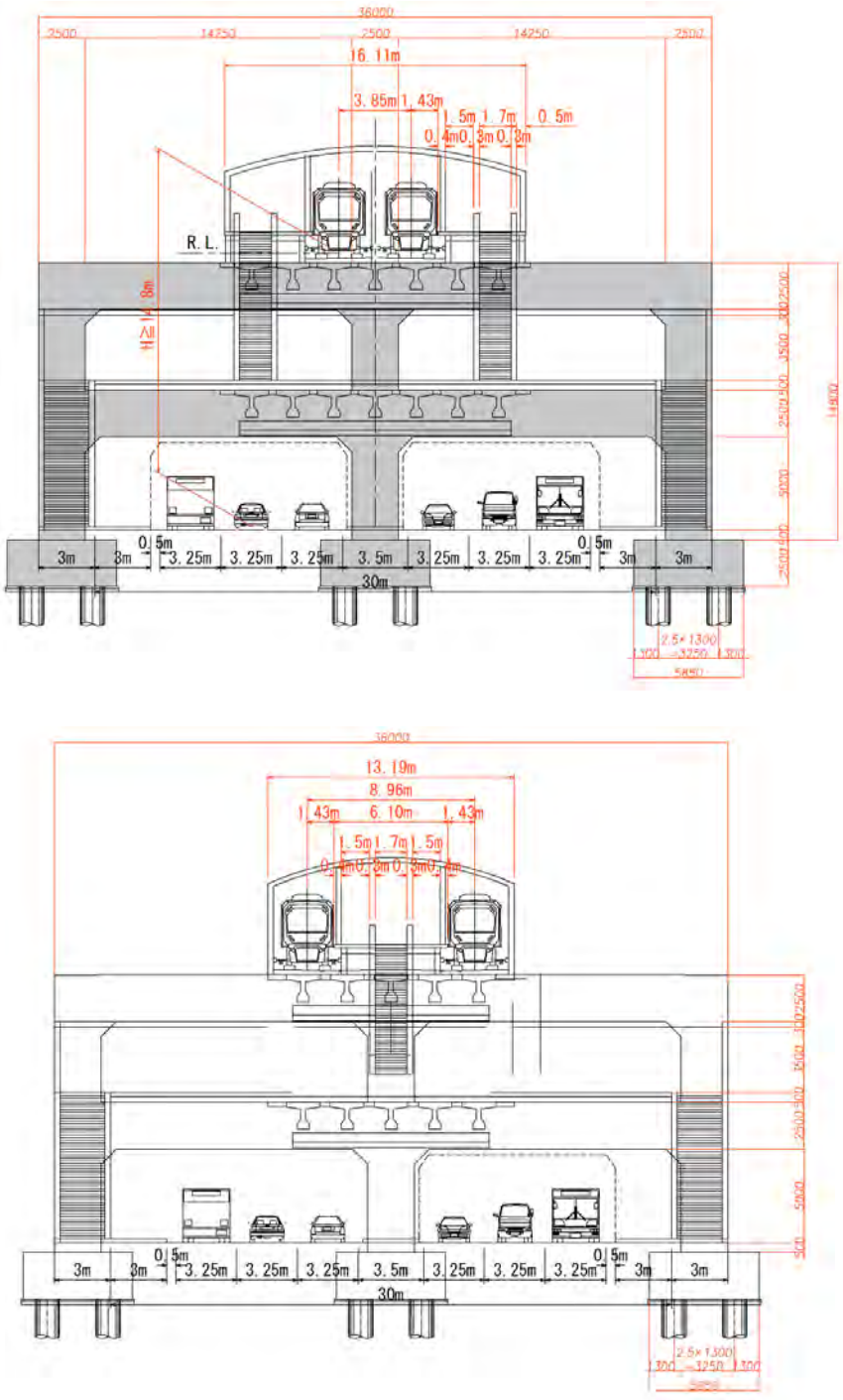
Source: JICA Study Team

Figure 4-6: Highway Cross-Linking Part General Diagram

4.4 Station Structure Type

4.4.1 Basic Structure

The station section is based on a rigid frame structure that straddles the existing road, with PCT girders on the track floor and concourse floor, and piers in the RC rigid frame structure.

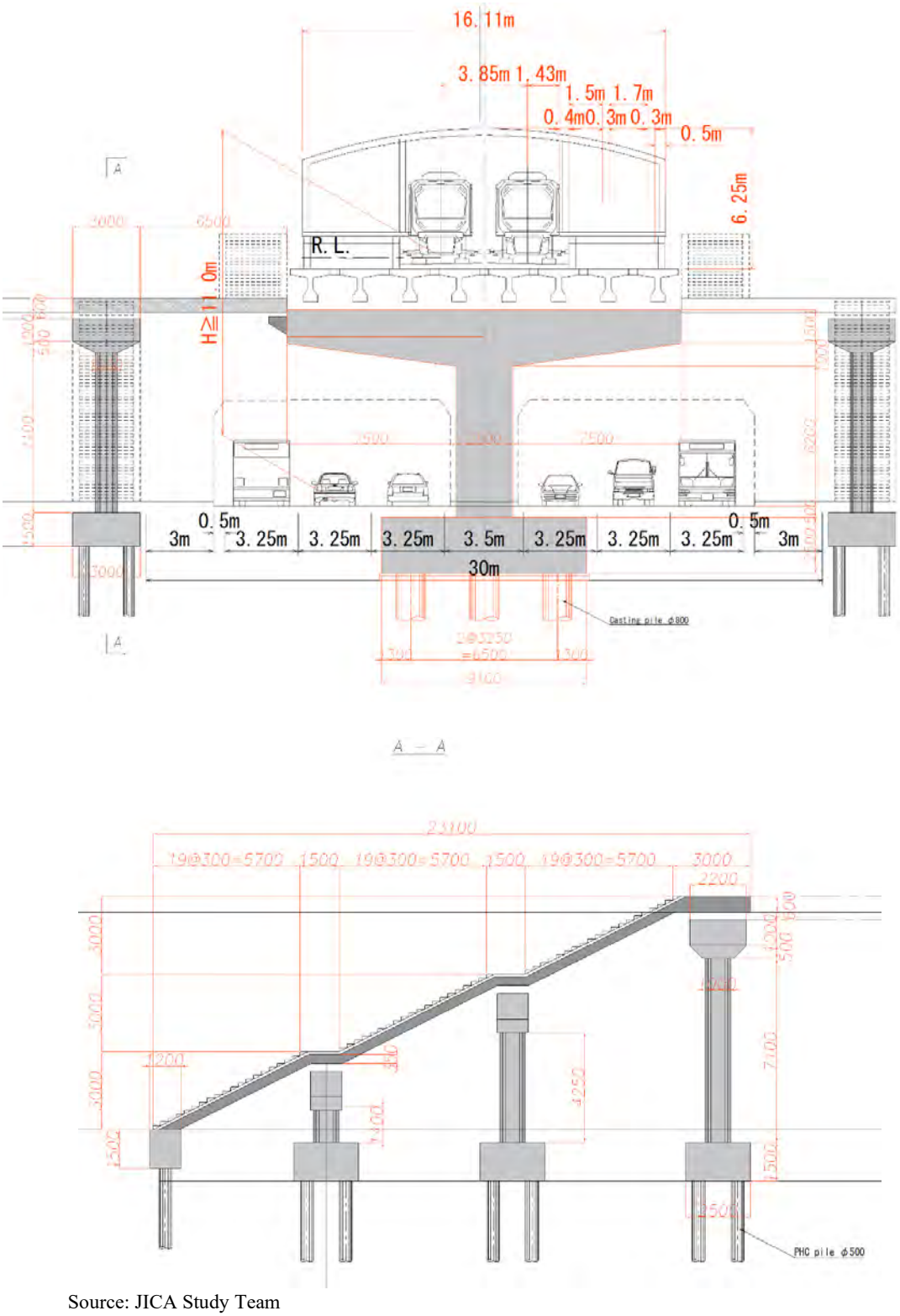


Source: JICA Study Team

Figure 4-7: Cross-Section of Planned Station Area

4.4.2 Construction Cost Reduction Structure

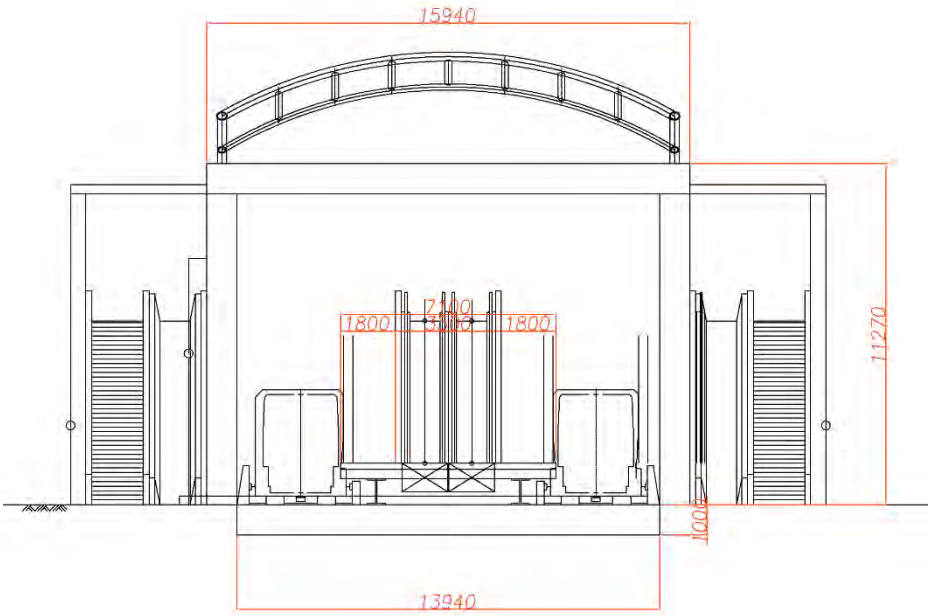
In the construction cost reduction plan (partial-horizon plan), the substructure of the track section of the viaduct station will be a single pillar type. The approach from the sidewalk to the station will be a pedestrian bridge structure.



Source: JICA Study Team

Figure 4-8: Construction Cost Reduction Plan Station Area Plan

For the ground level station after the leveling construction, the island platform is approached from the sidewalk by elevators.



Source: JICA Study Team

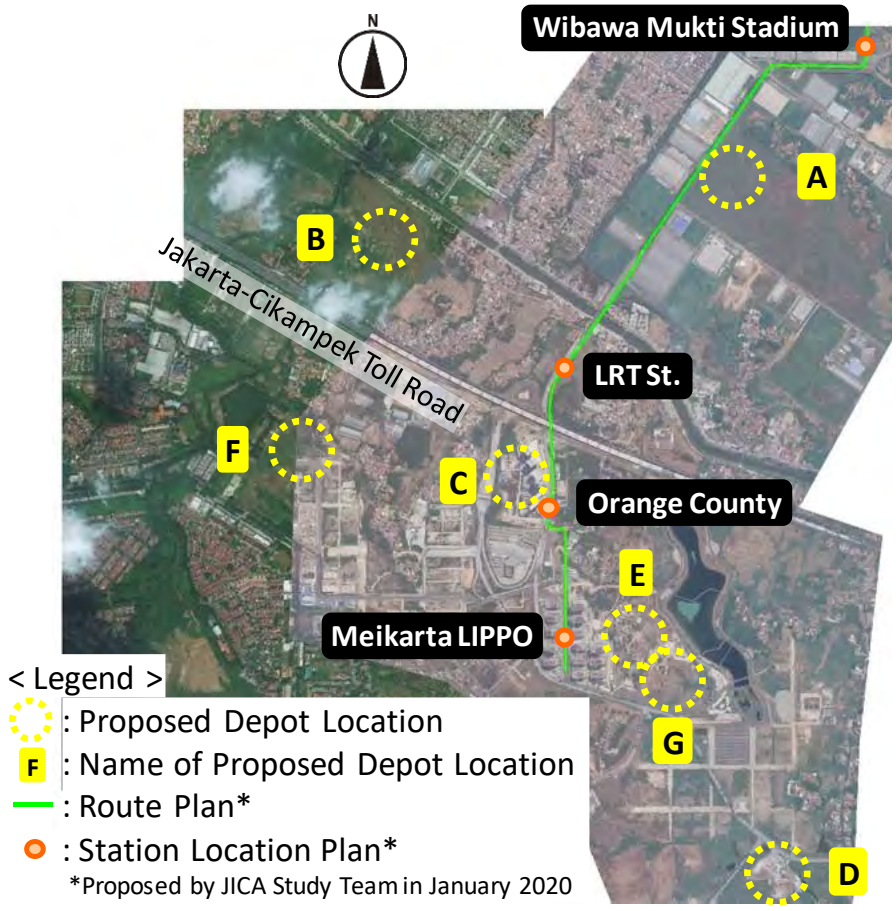
Figure 4-9: Above-Ground Station Composition Plan

5. Depot Planning

5.1 Selection of Depot Location

5.1.1 Proposed Locations and Features

The required conditions for the depot location are land of at least 4.0 hectares and being located as close as possible to the AGT route, while also creating as much passenger demand as possible along the route to the depot. The study team also discussed depot locations with local developers (Jababeka and Lippo Groups), which also done for the routing alignment. The proposed depot locations listed in the discussion are shown in Figure 5-1. The current conditions and issues at each proposed location have also been summarized.



Source: JICA Study Team

Figure 5-1: Map of Proposed Depot Locations

(1) Location A: Science Park

The JICA Study Team proposed location A at the January 20 meeting. However, Jababeka already has plans to develop a science park in the area, which includes location A (See Figure 5-2).

(2) Location B: Era Baru

Jababeka recommended utilizing location B for the AGT depot (See Figure 5-2).

But LIPPO noted the following issues:

– Gas pipelines run through the area; and

–There is no existing road access, so it would be necessary to acquire land for the spur line.

Source: Jababeka Group materials

Figure 5-2: Development Plans near Locations A and B

(3) Location C: Orange County Mall

Location C, in the Orange County Mall building, was proposed by Lippo (see Figure 5-3). However, planning for the building is already underway, which would necessitate a drastic redesign to accommodate the depot. A particular issue is that it is not possible to position storage tracks because of the column layout of the current building design, as shown in in Figure 5-4 on the following page.

If the building were to be redesigned, impacts such as increased construction costs and a delayed schedule can be expected.

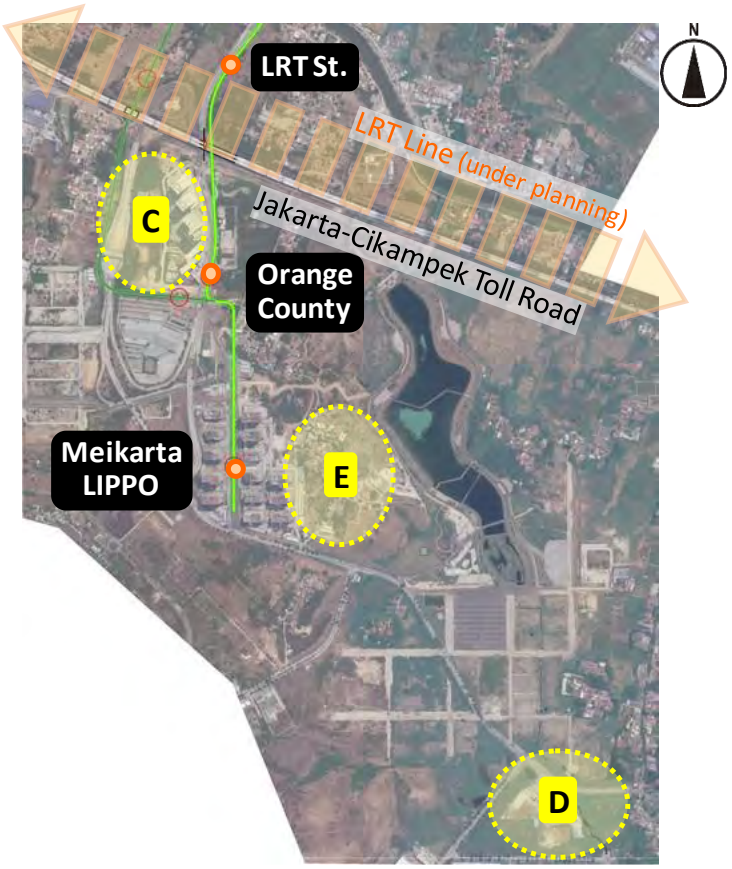
(4) Location D: South of Central Park

Location D was proposed by Lippo and is 2.5–3.0 km from Location D (Orange County) (See Figure 5-3). An AGT line extension would go through a Phase 2 area that is scheduled for development. However, there is a possibility that passenger demand along this extension would not be sufficient to cover the construction costs.

(5) Location E: East of Meikarta

Location E was proposed by the JICA Study Team (See Figure 5-3). Located in the area east of Meikarta Lippo Station, this location has a higher land value and requires joint development with residential or commercial use to match the value of the land. Another issue is that the depot structure and coordination would be complicated.

Furthermore, there is a possibility that about half the space above the depot would be used for building development, as shown in Figure 5-5.

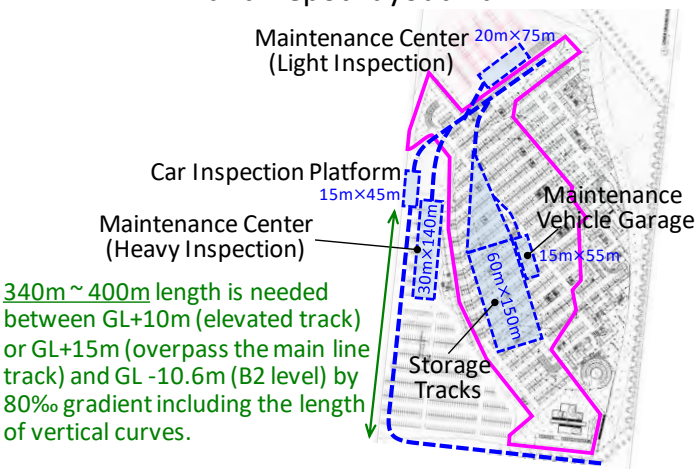


Source: JICA Study Team

Figure 5-3: Wide-Area Map for Locations C, D and E

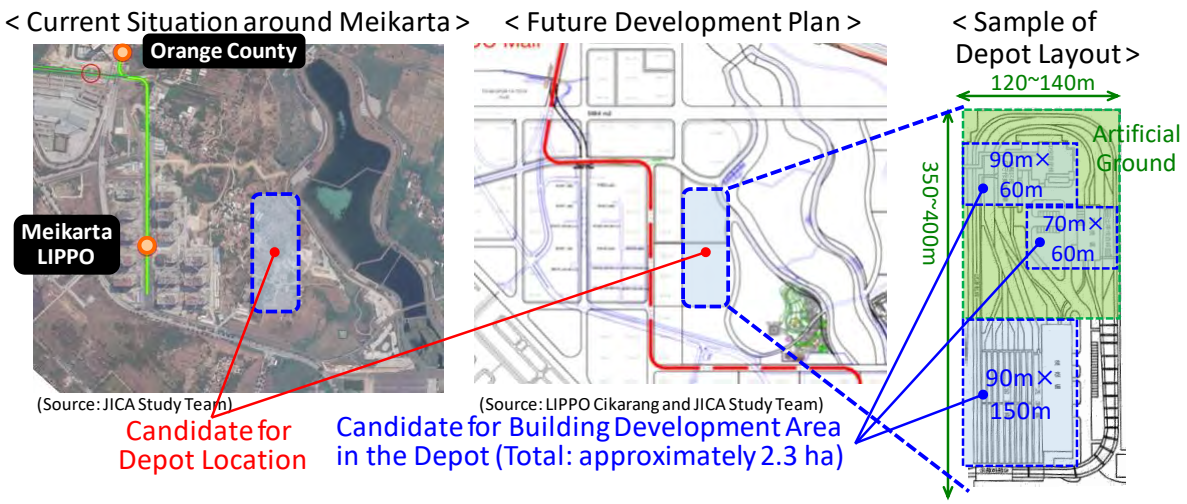
< Map around Orange County >

< Lower Ground Level Plan of OC Mall Building and Depot Layout Plan >



Source: JICA Study Team

Figure 5-4: Enlarged Map of Location C (Orange County) and Envisioned Depot Layout Image



Source: JICA Study Team

Figure 5-5: Aerial View of Location E and Surrounding District and Simplified Image of Depot with Overhead Building Development

(6) Location F: District 2

Location F was proposed by Lippo and is 2.0-2.5 km from Orange County (See Figure 5-6). The length of the AGT line extension would be longer than what is required for Location G. However, the extension would go through a developing residential area, creating passenger demand. Since there is also an existing residential development west of the terminal station (Lippo Cikarang), there is even further potential for increased passenger demand.

(7) Location G: Southwest of Central Park

Location G was proposed by Lippo and is 1.5–2.0 km from Orange County (See Figure 5-6). The length of the AGT line extension is shorter than what is needed for Location F. Although the extension will go through a Phase 2 area scheduled for development, the extension is not expected to create more new passenger demand than Location F.

Source: Lippo Group materials

Figure 5-6: Enlarged View of the Area around Locations F and G

5.1.2 Evaluation and Selection of Proposed Depot Locations

The evaluation of each proposed depot location was based on the current conditions and issues at each site, as shown in Table 5-1.

Based on the evaluation results, Location F will serve as the depot location for this project.

Table 5-1: Evaluation and Selection of Proposed Depot Locations

Location	Name	Proposed	Features	Evaluation
A	Industrial Park	JICA Study Team	• Jababeka already has a plan to develop a science park in the area, which includes Location A.	×
B	Era Baru	Jababeka	• Gas pipe lines run through the area, including Location B. • No existing road access means that land must be acquired for the spur line.	×
C	Orange County Mall	Lippo	• Storage tracks cannot be installed at this site due to the current building design, which is already in the planning stages. A drastic redesign of the building would be required. • In the case of a redesign, increased construction costs and a schedule delay are to be expected.	×
D	South of Central Park	Lippo	• Located 2.5–3.0 km from Orange County. • Since the AGT line extension would go through a Phase 2 development area, increased passenger demand may not be sufficient to cover the extension construction costs.	×
E	East of Meikarta	JICA Study Team	• This location would require joint development with residential or commercial use to match the land value. The site could also be subject to building development over the depot, which would cover about half the depot space. • A building over the depot would complicate the structure of the depot.	×
F	District 2	Lippo	• Located 2.5–3.0 km from Orange County. • The AGT line extension will go through a residential area currently in development, creating passenger demand. • Additional passenger demand may also be possible from an existing residential area west of the terminal station.	○
G	Southwest of Central Park	Lippo	• The AGT line extension will be shorter than what is required for Location F. • However, the extension will go through a Phase 2 area that will be developed. However, passenger demand is not expected to exceed what could be expected for Location F.	×

Source: JICA Study Team

Note: In the above table, red text signifies benefits and blue text signifies shortcomings

5.2 Depot Internal Layout Considerations

5.2.1 Overview and Necessary Functions

The AGT depot is used for storage and maintenance of trains, which requires storage tracks, car washing tracks, a test track, various inspection tracks, tracks for maintenance vehicles, etc. For the safe operation and maintenance of trains, general administration buildings, substations and other necessary facilities are normally also built.

The main functions required for the depot are summarized as follows.

< Main Required Functions in the Depot >

- Storage Facility: To store trains outside operating hours.
- Inspection and Maintenance Facility: For the inspection and maintenance of rolling stock
- Washing Facility: For washing and cleaning rolling stock.
- Storage Facility for Maintenance Vehicles: To store vehicles required to inspect and maintain track, structural elements, electrical equipment, etc.
- General Control Building: A general administration office that includes the head office, the operation control center, the maintenance office, etc.
- Substation: Provides the necessary power for train operations on the main line and depot, lighting and various other power needs.
- Other Needed Facilities: Wastewater treatment facilities, stockrooms, oil storage, etc.

5.2.2 Track Functions and Roles

Referencing the results of the Phase 1 Study, the functions and roles of each line in the depot are shown below. The major inspection and repair facilities are listed in Chapter 8.2.6 “Depot Inspection and Repair Equipment”.

(1) Spur Line

The spur line branches off from the main line and connects the depot. The steepest gradient on the spur line shall be 6% or less. To reduce construction costs, the spur line is planned as a single track.

(2) Arrival/Departure Inspection Tracks (2 tracks)

These tracks are installed in the flat and straight section along with an inspection platform to check trains arriving at/departing from the depot.

(3) Storage Tracks (8 tracks)

Tracks for 16-car trains will be installed, with some tracks for two-car trains.

(4) Automatic Car Washing Tracks (2 tracks)

Washing devices will be installed on the automatic car washing tracks to wash the trains. Manual cleaning inside the train cars will also be done on these tracks.

(5) Test Track (1 track)

A 300-meter test track will be installed in the outer part of the depot .

(6) Lead and Crossover Tracks

Lead tracks are used to move trains within the depot. Trains are not stored on these tracks.

(7) Maintenance Train Storage Tracks (2 tracks)

There will be two storage tracks for maintenance trains, which are used to maintain tracks and equipment.

(8) Heavy Maintenance Track (1 track)

This track will be used for important component inspections (every 4 years) and comprehensive inspections (every 8 years).

(9) Monthly Inspection Tracks (2 tracks)

These tracks will be used for regular maintenance inspections (every 3 months).

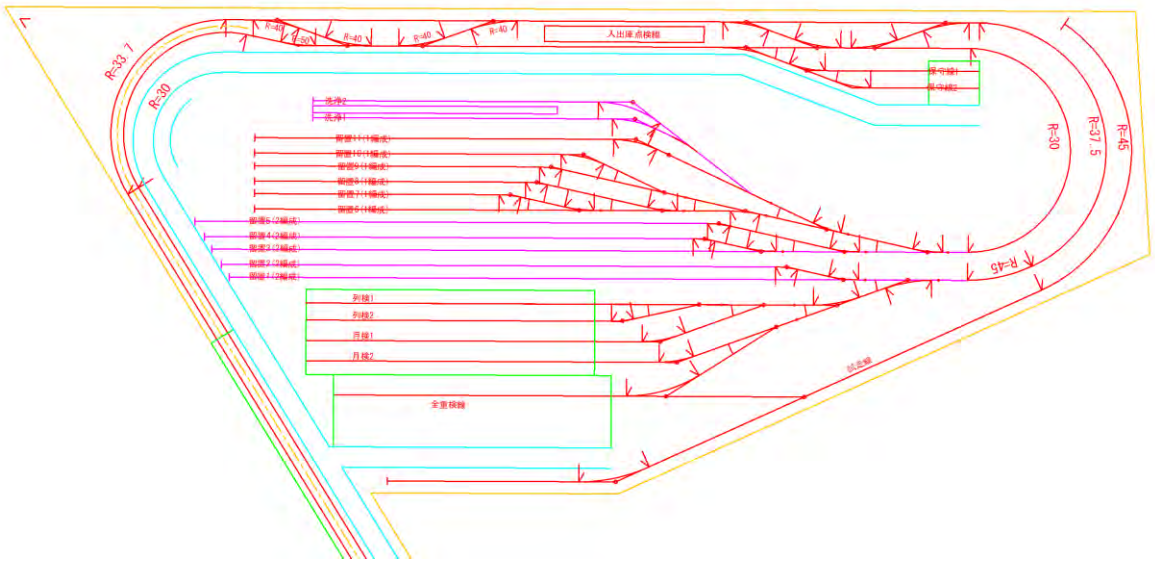
(10) Daily Inspection Tracks (2 tracks)

These tracks will be used for day-to-day maintenance inspections (every 3 days).

5.2.3 Track Layout Plan

The planned layout for the depot tracks is shown in Figure 5-7.

The area is approximately 3.8 hectares. Even if the scale of the administration buildings and the substation are tangibly considered and installed in the depot as the project progresses, they should fit within the initial space assumption (4.0 hectares).



Source: JICA Study Team

Figure 5-7: Depot Track Layout Plan