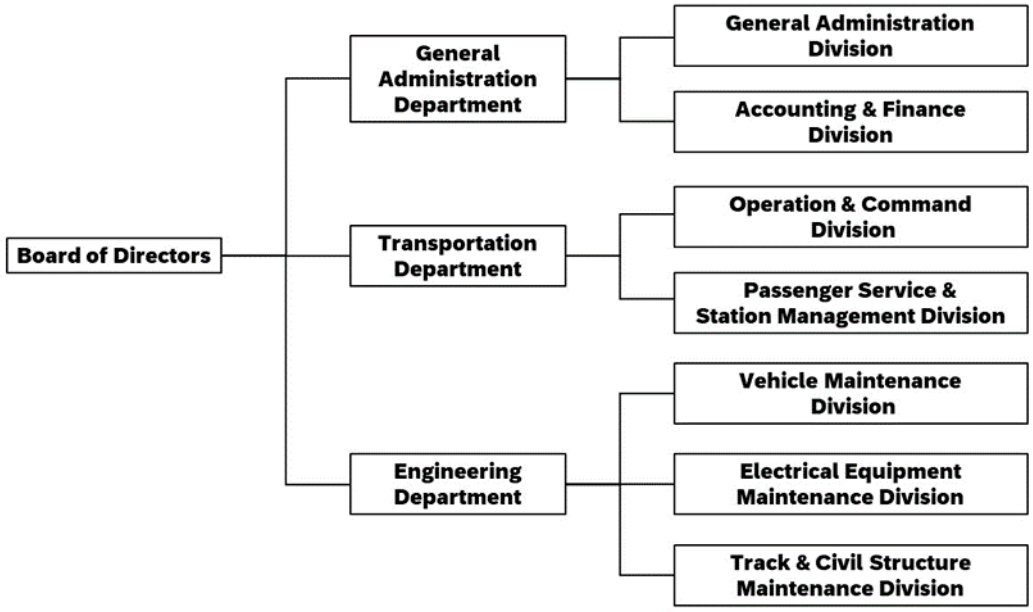
6. O & M Plan

6.1 Personnel Plan

6.1.1 Operating Organization

The management bodies of Cikarang New Transportation System will be set up with reference to a new Japanese transport system operator who has abundant knowledge about AGT operations. The management bodies of the Cikarang New Transport System shall establish the General Administration Department as the head office division, and the Transportation Department and the Engineering Department as two field departments. The organization (draft) of the new Cikarang Transportation System is shown below.



Source: JICA Study Team

Figure 6-1: Operating Organization (Draft)

6.1.2 Personnel Plan

(1) Transport Personnel

The Transportation Department is divided into two divisions such as station service and operation command. Regarding station service personnel, two train operators having a qualification are always deployed for main stations, and one train operator having a qualification is regularly deployed for other stations. Note that AGT is an unmanned, automatic operation, but even station service personnel shall be train operators with licenses for an emergency response. Train operators who can operate an interlocking device will be sent to the interlocking station. As for the operation command personnel, three commanders (two operation commanders and one power commander) shall be stationed at all times in the command room within the vehicle base.

The total number of personnel in the Transport Department (resident staff) stands at 18 people. Considering the actual working conditions that include a three-shift-per-day system, the number of staff taking leave, and the reserve ratio of 1.3, the total necessary number of personnel in the organization will be 72 people, among which a certain number will be managers.

Table 6-1: Number of Personnel in the Transportation Department

(Permanent Personnel)

Number of employees (Including managers) Unit: person

Station	Station staff	Driving handler	Signaling handler
Lemah Abang	2		
TOD Jababeka	2		
Taman Golf Barat	1		
Marketing Gallery Jababeka	1		
Ginza	1		
Industrial Park Phase 5	1		
KM34	2		
Orange County	1		
District 1	1		
District 2	1		
Lippo Cikarang	2		
Depot			3
Total	18		

Source: JICA Study Team

Table 6-2: Number of Personnel in the Transportation Department

(Organizational Personnel)

Number of employees (Including managers) Unit: person

Station	Station staff	Driving handler	Signaling handler
Lemah Abang	8		
TOD Jababeka	8		
Taman Golf Barat	4		
Marketing Gallery Jababeka	4		
Ginza	4		
Industrial Park Phase 5	4		
KM34	8		
Orange County	4		
District 1	4		
District 2	4		
Lippo Cikarang	8		
Depot			12
Total	72		

Source: JICA Study Team

(2) General Administration Dept. and Technical Dept. personnel

The personnel of the General Administration Department (head office personnel) shall be set based on the ratio to the number of personnel in the field departments. The average field ratio of 25.3% for new transportation system operators in Japan will be adopted into the operations in Indonesia.

In addition, the technical department personnel shall consist of three divisions: engineering, electricity and vehicles, and the average ratio of the new transportation system operators in Japan shall be adopted for the basic unit of the personnel.

Engineering personnel: 0.670 persons/km

Electrical personnel: 0.956 persons/km

Vehicle personnel: 0.221 persons/car

At the time of opening in 2028, there will be eight staff members in the General Administration Department and 31 personnel in the Engineering Department, adding up to 39. The number of managers shall be included in the sum of the personnel.

Table 6-3: Number of Personnel in General Administration Dept. and Engineering Dept. (Organisational Personnel) (2028)

○Maintenance staff plan (Unit: person)

Description	Head office staff	Civil Eng. staff	Electrical Eng. staff	Rolling stock staff
Unit	-	km	km	Vehicle
Quantity	31	11.8	11.8	56
Unit person	0.253	0.670	0.956	0.221
Number of employees	8	8	11	12
	39			

Source: JICA Study Team

6.1.3 Training Plan

For smooth business operation, it is necessary to carry out education and training of staff before the opening. Education and training manuals shall be prepared before conducting education and training.

The instructor will be dispatched by the operator of the new transportation system to train about five to ten persons. The trainer shall continue to educate and train the staff after the opening to maintain a safe and smooth operation system. The trainee staff will be given more practical education and training opportunities to improve their technical skills by receiving in-house on-the-job training (OJT) from instructors during the preparatory stage, before opening.

6.2 Operating Expenses

6.2.1 Personnel Expenses

In response to the Personnel Plan in 6.1 mentioned above, personnel expenses will be calculated. Monthly wages for staff will be determined based on the average wages of non-manufacturing-sector workers in Indonesia. In addition, the staff-to-manager ratio shall be estimated at 4:1. The annual bonus shall be two months' worth of compensation, and social security, welfare, and other labor costs shall account for 50% of the monthly wage. Start-up expenses in 2028 will have a budget of 20.454 billion IDR (about 150 million yen) annually.

Table 6-3: Personnel Expenses (2028)

○AGT O & M staff cost (Unit: IDR)

Description	Staff	Manager	Subtotal	Total
Ratio	4	1	-	-
Operation staff	58	14	72	111
Maintenance staff	31	8	39	
Monthly salary	6,702,660	17,158,400	-	-
Monthly cost	596,536,740	377,484,800	-	974,021,540
Annual cost	12,527,271,540	7,927,180,800	-	20,454,452,340

Source: JICA Study Team

6.2.2 General and Administrative Expenses

The basic unit costs refer to the average value of the new transportation system operator in Japan.

Construction: 22,763,000 yen/km (operating kilometer)

Electricity: 18,847,000 yen/km (operating kilometer)

Vehicle: 56.6 yen/vehicle kilometer

Power cost: 10.8 yen/vehicle kilometer

Transportation cost: 15,666,000 yen/station

Other expenses: 28,201,000 yen/km (operating kilometer)

Table 6-4: Setting of Power Cost Intensity

○Electricity (power) cost/bill			
①	Tokyo, Japan	14 USD/KWh	
②	Jakarta, Indonesia	07 USD/KWh	
①/②		0.5 *	
		Length	Weight
	AGT-Type B	8.5 m	18 t
	AGT-Type C	11.2 m	24 t
		1.32	1.33 *

Source: JICA Study Team

Expenses for starting up in 2028 will come out to a sum of 176 billion IDR (about 1.28 billion yen) annually.

Table 6-5: Expenses (2028)

○AGT O & M cost (Unit: Thousand JPY)

Description	Unit	Quantity	Unit cost	Cost (Japan Price)
Civil Eng.	km	11.8	22,763	268,603
Electrical Eng.	km	11.8	18,847	222,395
Rolling stock Eng.	Vehicle km	4,408	53.6	236,269
Train operation *	Vehicle km	4,408	10.8	47,606
Station service	Station	11	15,666	172,326
Other administrative expenses	km	11.8	28,201	332,772
Total	-	-	-	1,279,971

Source: JICA Study Team

6.2.3 O & M Costs (OPEX)

Operation and maintenance (O & M) costs [Operating Expense (OPEX)] will be 196.465 billion IDR (approximately 1.43 billion yen) at opening in 2028 and 202.561 billion IDR (approximately 1.47 billion yen) at maturity in 2064. The O & M costs (OPEX) perspective shows current prices (2020) and do not anticipate Indonesian economic growth rates (inflation, price increases).

Table 6-6: O & M Costs (OPEX)

(Unit: million IDR)

(2028) 196.465 million IDR (1.43 billion yen)
(2032) 197.899 million IDR (1.44 billion yen)
(2039) 199.333 million IDR (1.45 billion yen)
(2048) 200.907 million IDR (1.46 billion yen)
(2064) 202.561 million IDR (1.47 billion yen)

Year	Labor cost	Other costs	Total
2028	20,454	176,011	196,465
2029	20,454	176,011	196,465
2030	20,454	176,011	196,465
2031	20,454	176,011	196,465
2032	20,595	177,304	197,899
2033	20,595	177,304	197,899
2034	20,595	177,304	197,899
2035	20,595	177,304	197,899
2036	20,595	177,304	197,899
2037	20,595	177,304	197,899
2038	20,595	177,304	197,899
2039	20,736	178,597	199,333
2040	20,736	178,597	199,333
2041	20,736	178,597	199,333
2042	20,736	178,597	199,333
2043	20,736	178,597	199,333
2044	20,736	178,597	199,333
2045	20,736	178,597	199,333
2046	20,736	178,597	199,333
2047	20,736	178,597	199,333
2048	21,017	179,890	200,907
2049	21,017	179,890	200,907
2050	21,017	179,890	200,907
2051	21,017	179,890	200,907
2052	21,017	179,890	200,907
2053	21,017	179,890	200,907
2054	21,017	179,890	200,907
2055	21,017	179,890	200,907
2056	21,017	179,890	200,907
2057	21,017	179,890	200,907
2058	21,017	179,890	200,907
2059	21,017	179,890	200,907
2060	21,017	179,890	200,907
2061	21,017	179,890	200,907
2062	21,017	179,890	200,907
2063	21,017	179,890	200,907
2064	21,378	181,183	202,561
2065	21,378	181,183	202,561
2066	21,378	181,183	202,561
2067	21,378	181,183	202,561
2068	21,378	181,183	202,561
2069	21,378	181,183	202,561
2070	21,378	181,183	202,561
2071	21,378	181,183	202,561
2072	21,378	181,183	202,561

Source: JICA Study Team

6.2.4 Cost Reduction Case

The O & M cost (OPEX) can be reduced by 3.186 million IDR (approx. 20 million yen) at the opening in 2028 by reviewing the number of transportation department personnel, cutting the number of trains operated by reviewing the amount of train capacity and the accompanying decrease in the number of train cars.

Table 6-7: O & M Cost (OPEX) (Cost Reduction Case)

■OPEX (2028-2072) Cost cut				Cost cut - Full spec		
西暦年	人件費 million IDR	経費 million IDR	合計 million IDR	人件費 million IDR	経費 million IDR	合計 million IDR
2028	28,984	164,295	193,279	8,530	-11,716	-3,186
2029	28,984	164,295	193,279	8,530	-11,716	-3,186
2030	28,984	164,295	193,279	8,530	-11,716	-3,186
2031	28,984	164,295	193,279	8,530	-11,716	-3,186
2032	28,984	164,295	193,279	8,389	-13,009	-4,620
2033	28,984	164,295	193,279	8,389	-13,009	-4,620
2034	29,125	165,588	194,713	8,530	-11,716	-3,186
2035	29,125	165,588	194,713	8,530	-11,716	-3,186
2036	29,125	165,588	194,713	8,530	-11,716	-3,186
2037	29,125	165,588	194,713	8,530	-11,716	-3,186
2038	29,125	165,588	194,713	8,530	-11,716	-3,186
2039	29,125	165,588	194,713	8,389	-13,009	-4,620
2040	29,125	165,588	194,713	8,389	-13,009	-4,620
2041	29,125	165,588	194,713	8,389	-13,009	-4,620
2042	29,125	165,588	194,713	8,389	-13,009	-4,620
2043	29,125	165,588	194,713	8,389	-13,009	-4,620
2044	29,547	166,952	196,499	8,811	-11,645	-2,834
2045	29,547	166,952	196,499	8,811	-11,645	-2,834
2046	29,547	166,952	196,499	8,811	-11,645	-2,834
2047	29,547	166,952	196,499	8,811	-11,645	-2,834
2048	29,547	166,952	196,499	8,530	-12,938	-4,408
2049	29,547	166,952	196,499	8,530	-12,938	-4,408
2050	29,547	166,952	196,499	8,530	-12,938	-4,408
2051	29,547	166,952	196,499	8,530	-12,938	-4,408
2052	29,547	166,952	196,499	8,530	-12,938	-4,408
2053	29,547	166,952	196,499	8,530	-12,938	-4,408
2054	29,547	166,952	196,499	8,530	-12,938	-4,408
2055	29,547	166,952	196,499	8,530	-12,938	-4,408
2056	29,547	166,952	196,499	8,530	-12,938	-4,408
2057	29,547	166,952	196,499	8,530	-12,938	-4,408
2058	29,547	166,952	196,499	8,530	-12,938	-4,408
2059	29,547	166,952	196,499	8,530	-12,938	-4,408
2060	30,330	168,245	198,575	9,313	-11,645	-2,332
2061	30,330	168,245	198,575	9,313	-11,645	-2,332
2062	30,330	168,245	198,575	9,313	-11,645	-2,332
2063	30,330	168,245	198,575	9,313	-11,645	-2,332
2064	30,330	168,245	198,575	8,952	-12,938	-3,986
2065	30,330	168,245	198,575	8,952	-12,938	-3,986
2066	30,330	168,245	198,575	8,952	-12,938	-3,986
2067	30,330	168,245	198,575	8,952	-12,938	-3,986
2068	30,330	168,245	198,575	8,952	-12,938	-3,986
2069	30,330	168,245	198,575	8,952	-12,938	-3,986
2070	30,330	168,245	198,575	8,952	-12,938	-3,986
2071	30,330	168,245	198,575	8,952	-12,938	-3,986
2072	30,330	168,245	198,575	8,952	-12,938	-3,986

Source: JICA Study Team

7. Operation Plan

7.1 Prerequisites for the Operation Plan

The prerequisites for the operation plan are shown below.

- Operation method: Automatic unmanned operation (Automatic Train Operation, [ATO])
- Maximum operating speed: 80 km/h
- Stop time at station: 30 seconds
- Line length: 11.8 km
- Number of stations: 11 stations (Average distance between stations: Approximately 1.2 km)

Table 7-1: Station List

Station Name	Distance
Lemah Abang	0k000m
TOD Jababeka	2k080m
Taman Golf Barat	3k370m
Marketing Gallery Jababeka	4k170m
Ginza	5k630m
Industrial Park Phase 5	7k190m
KM34	8k530m
Orange County	9k270m
District 1	9k790m
District 2	11k040m
Lippo Cikarang	11k770m

Source: JICA Study Team

- Number of cars: four-car train
- Capacity of a train: 520 persons/trainset
- Curve passing speed

Table 7-2: Curve Passing Speed

Curve radius	Passing speed
30 m	20 km/h
50 m	30 km/h
70 m	35 km/h
100 m	40 km/h
150 m	50 km/h

Source: JICA Study Team

7.2 Examination of the Time Required

Based on 7.1, the prerequisites of the operation plan mentioned above, an operation curve diagram will be drawn up, and the required time will be examined.

The time required for one-way operation is 28 minutes and 15 seconds for both ascending and descending, and the scheduled speed is 25.2km/h.

Table 7-3: Time Required (One Way)

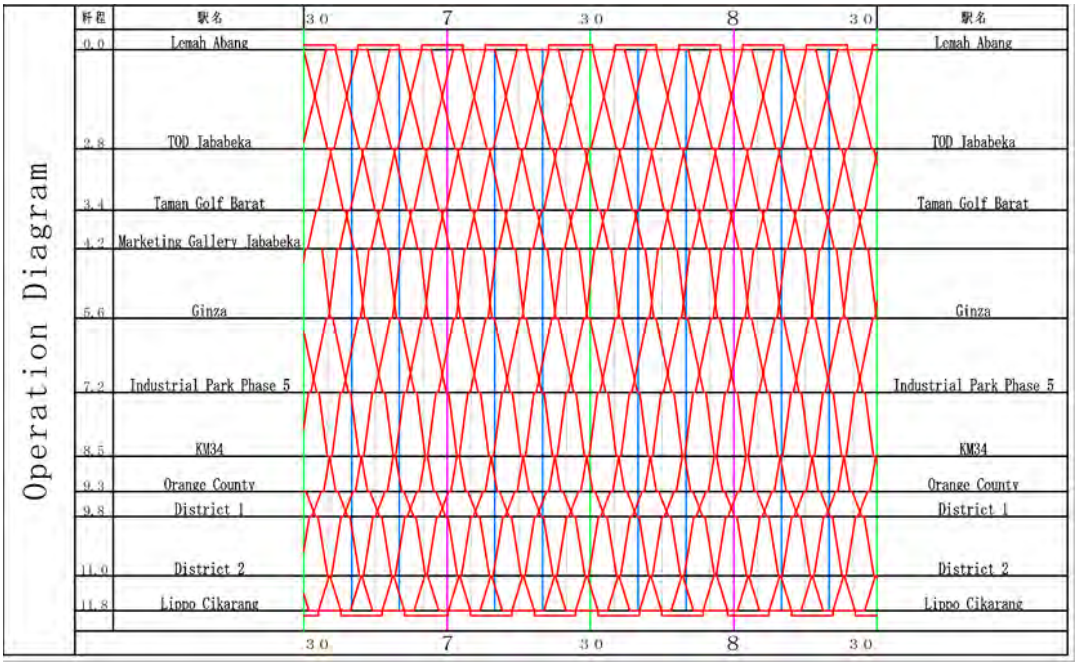
Station Name	Distance [km]		Outbound				Inbound			
	Between stations	Total	Stops	Operation time between stations	Stoppage time	Operation time	Stops	Operation time between stations	Stoppage time	Operation time
Lemah Abang	0.00	0.00	●	-	-	-	●	5 min 00 sec	-	28 min15 sec
TOD Jababeka	2.08	2.08	●	5 min 00 sec	0 min 30 sec	5 min 00 sec	●	2 min 45 sec	0 min 30 sec	22 min 45 sec
Taman Golf Barat	1.29	3.37	●	2 min 45 sec	0 min 30 sec	8 min 15 sec	●	1 min 45 sec	0 min 30 sec	19 min 30 sec
Marketing Gallery Jababeka	0.80	4.17	●	1 min 45 sec	0 min 30 sec	10 min 30 sec	●	1 min 45 sec	0 min 30 sec	17 min 15 sec
Ginza	1.46	5.63	●	1 min 45 sec	0 min 30 sec	12 min 45 sec	●	3 min 15 sec	0 min 30 sec	15 min 00 sec
Industrial Park Phase 5	1.56	7.19	●	3 min 15 sec	0 min 30 sec	16 min 30 sec	●	1 min 45 sec	0 min 30 sec	11 min 15 sec
KM34	1.34	8.53	●	1 min 45 sec	0 min 30 sec	18 min 45 sec	●	1 min 15 sec	0 min 30 sec	9 min 00 sec
Orange County	0.74	9.27	●	1 min 15 sec	0 min 30 sec	20 min 30 sec	●	2 min 00 sec	0 min 30 sec	7 min 15 sec
District 1	0.52	9.79	●	2 min 00 sec	0 min 30 sec	23 min 00 sec	●	2 min 00 sec	0 min 30 sec	4 min 45 sec
District 2	1.25	11.04	●	2 min 00 sec	0 min 30 sec	25 min 30 sec	●	2 min 15 sec	0 min 30 sec	2 min 15 sec
Lippo Cikarang	0.73	11.77	●	2 min 5 sec	-	28 min15 sec	●	-	-	-
					Nominal speed	25.22 km/h			Nominal; speed	25.22 km/h

Source: JICA Study Team

7.3 Operation Plan

According to the demand forecast, the number of trains in operation at peak hours is set at nine trains/hour for the start-up in 2028 and 13 trains/hour when the line reaches maturity in 2064, while the off-peak hours on weekdays shall be six trains/hour, and on holidays, it shall be six trains/hour on all days.

In addition, the business hours shall be 5:00 to midnight, referring to the business hours of the MRT in Jakarta. The operation timetable at the opening in 2028 is shown in Figure 7-1, and the number of trains operated by day of the week and time of the day is shown in Table 7-4.



Source: JICA Study Team

Figure 7-1: Operation Schedule (2028)

Table 7-4: Number of Trains Operated by Day of the Week and Time (2028)

Day of the week	Mon-Fri			Sat・Sun		
Operating hours	5:00-24:00			5:00-24:00		
Days per year	261			104		
5	6	4	24	6	4	24
6	6	4	24	6	4	24
7	9	4	36	6	4	24
8	9	4	36	6	4	24
9	9	4	36	6	4	24
10	8	4	32	6	4	24
11	6	4	24	6	4	24
12	6	4	24	6	4	24
13	6	4	24	6	4	24
14	6	4	24	6	4	24
15	8	4	32	6	4	24
16	9	4	36	6	4	24
17	9	4	36	6	4	24
18	9	4	36	6	4	24
19	8	4	32	6	4	24
20	6	4	24	6	4	24
21	6	4	24	6	4	24
22	6	4	24	6	4	24
23	3	4	12	3	4	12
Total	141	4.00	564	111	4.00	444

Source: JICA Study Team

Table 7-5: Peak-Hour Cross-Sectional Transportation Population, Number of Trains in Operation and Number of Trains Required

Year	Fare sensitivity	Peak-hour cross-sectional transportation population	Capacity	No. of trains in service during peak hrs.	No. of trains/units in operation	No. of back-up trains/ units	No. of trains/units required	No. of cars required
(year)	(IDR)	(Passengers /hour)	(Passengers/ unit)	(No. of units / hour)	(Units)	(Units)	(Units)	(Cars)
2028	9,000	4,582	520	9	11	3	14	56
2029	9,000	4,643	520	9	11	3	14	56
2030	9,000	4,643	520	9	11	3	14	56
2031	9,000	4,643	520	9	11	3	14	56
2032	9,000	4,829	520	10	12	3	15	60
2033	9,000	4,889	520	10	12	3	15	60
2034	9,000	4,949	520	10	12	3	15	60
2035	9,000	5,009	520	10	12	3	15	60
2036	9,000	5,069	520	10	12	3	15	60
2037	9,000	5,129	520	10	12	3	15	60
2038	9,000	5,190	520	10	12	3	15	60
2039	9,000	5,251	520	11	13	3	16	64
2040	9,000	5,312	520	11	13	3	16	64
2041	9,000	5,373	520	11	13	3	16	64
2042	9,000	5,435	520	11	13	3	16	64
2043	9,000	5,491	520	11	13	3	16	64
2044	9,000	5,548	520	11	13	3	16	64
2045	9,000	5,605	520	11	13	3	16	64
2046	9,000	5,662	520	11	13	3	16	64
2047	9,000	5,718	520	11	13	3	16	64
2048	9,000	5,762	520	12	14	3	17	68
2049	9,000	5,805	520	12	14	3	17	68
2050	9,000	5,848	520	12	14	3	17	68
2051	9,000	5,892	520	12	14	3	17	68
2052	9,000	5,935	520	12	14	3	17	68
2053	9,000	5,963	520	12	14	3	17	68
2054	9,000	5,990	520	12	14	3	17	68
2055	9,000	6,018	520	12	14	3	17	68
2056	9,000	6,045	520	12	14	3	17	68
2057	9,000	6,072	520	12	14	3	17	68
2058	9,000	6,095	520	12	14	3	17	68
2059	9,000	6,117	520	12	14	3	17	68
2060	9,000	6,139	520	12	14	3	17	68
2061	9,000	6,161	520	12	14	3	17	68
2062	9,000	6,183	520	12	14	3	17	68
2063	9,000	6,217	520	12	14	3	17	68
2064	9,000	6,252	520	13	15	3	18	72
2065	9,000	6,286	520	13	15	3	18	72
2066	9,000	6,320	520	13	15	3	18	72
2067	9,000	6,354	520	13	15	3	18	72
2068	9,000	6,400	520	13	15	3	18	72
2069	9,000	6,447	520	13	15	3	18	72
2070	9,000	6,494	520	13	15	3	18	72
2071	9,000	6,541	520	13	15	3	18	72
2072	9,000	6,587	520	13	15	3	18	72

Source: JICA Study Team

7.4 Cost Reduction Case

The operation plan when the train capacity and the number of spare trains are reviewed is shown below.

Table 7-6: Peak-Hour Cross-Sectional Transportation Population, Number of Trains in Operation and Number of Trains Required (Cost Cut Case)

Year	Fare sensitivity	Peak-hour cross-sectional transportation population	Capacity	No. of trains in service during peak hrs.	No. of trains/units in operation	No. of back-up trains/ units	No. of trains/units required	No. of cars required
(year)	(IDR)	(Passengers /hour)	(Passengers/ unit)	(No. of units / hour)	(Units)	(Units)	(Units)	(Cars)
2028	9,000	4,582	612	8	10	2	12	48
2029	9,000	4,643	612	8	10	2	12	48
2030	9,000	4,643	612	8	10	2	12	48
2031	9,000	4,643	612	8	10	2	12	48
2032	9,000	4,829	612	8	10	2	12	48
2033	9,000	4,889	612	8	10	2	12	48
2034	9,000	4,949	612	9	11	2	13	52
2035	9,000	5,009	612	9	11	2	13	52
2036	9,000	5,069	612	9	11	2	13	52
2037	9,000	5,129	612	9	11	2	13	52
2038	9,000	5,190	612	9	11	2	13	52
2039	9,000	5,251	612	9	11	2	13	52
2040	9,000	5,312	612	9	11	2	13	52
2041	9,000	5,373	612	9	11	2	13	52
2042	9,000	5,435	612	9	11	2	13	52
2043	9,000	5,491	612	9	11	2	13	52
2044	9,000	5,548	612	10	12	2	14	56
2045	9,000	5,605	612	10	12	2	14	56
2046	9,000	5,662	612	10	12	2	14	56
2047	9,000	5,718	612	10	12	2	14	56
2048	9,000	5,762	612	10	12	2	14	56
2049	9,000	5,805	612	10	12	2	14	56
2050	9,000	5,848	612	10	12	2	14	56
2051	9,000	5,892	612	10	12	2	14	56
2052	9,000	5,935	612	10	12	2	14	56
2053	9,000	5,963	612	10	12	2	14	56
2054	9,000	5,990	612	10	12	2	14	56
2055	9,000	6,018	612	10	12	2	14	56
2056	9,000	6,045	612	10	12	2	14	56
2057	9,000	6,072	612	10	12	2	14	56
2058	9,000	6,095	612	10	12	2	14	56
2059	9,000	6,117	612	10	12	2	14	56
2060	9,000	6,139	612	11	13	2	15	60
2061	9,000	6,161	612	11	13	2	15	60
2062	9,000	6,183	612	11	13	2	15	60
2063	9,000	6,217	612	11	13	2	15	60
2064	9,000	6,252	612	11	13	2	15	60
2065	9,000	6,286	612	11	13	2	15	60
2066	9,000	6,320	612	11	13	2	15	60
2067	9,000	6,354	612	11	13	2	15	60
2068	9,000	6,400	612	11	13	2	15	60
2069	9,000	6,447	612	11	13	2	15	60
2070	9,000	6,494	612	11	13	2	15	60
2071	9,000	6,541	612	11	13	2	15	60
2072	9,000	6,587	612	11	13	2	15	60

Source: JICA Study Team

8. Vehicle / E & M (Electrical and Mechanical) Plan

8.1 Trainset Plan

8.1.1 Overview

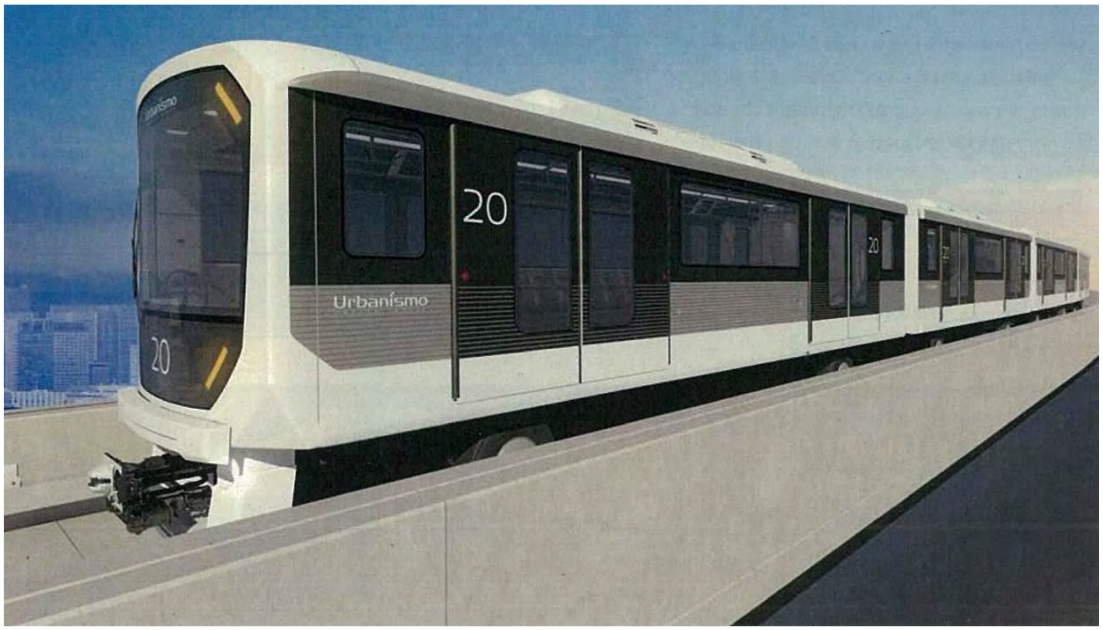
It was assumed that the all trainsets are 4 cars/ unit, but we will also consider plans to improve the flexibility of operations from the perspective of reducing O & M costs. An emergency rescue operation is possible since automatic couplers are equipped on both ends of trainsets. Figure 8-1 shows the vehicle image of the AGT (Automated Guideway Transit) as a reference.

The car body is a welded design with aluminum alloy extrusions and panels in order to reduce weight and increase rigidity. It contributes reinforcing the advantage of AGT as reducing energy consumption and ensuring quietness in operation.

The bogies which are excellent in terms of light weight and rigidity contribute to reduce shaking and comfortable ride with the shock-absorbing mechanism.

The exterior of an AGT vehicle is a simple, modern design and the interior takes universal design into consideration. All generations of passengers can use it safely, comfortably with confidence.

Driverless and fully-automatic operation is assumed in normal case as Base Case, but, manned operation is assumed in Cost-Reduced Case shown below.



Source: JICA Study Team

Figure 8-1: AGT Vehicle (Sample)

8.1.2 Vehicle type and specifications

(1) Main Specifications

Table 8-1 shows the key parameters and specifications of the trainset.

Table 8-1: Key Parameters and Specifications

Item	Specifications
Organization	4 cars/ unit, 2 cars/ unit, Double 2 cars/ unit
Train length	About 46.5 (m)
Widths (overall)	About 2.8 (m)
Rooftop to top of running surface	About 3.8 (m)
Vehicle weight when empty	59,200 (kg) Note 1
Maximum vehicle weight	92,800 (kg) Note 1
Passengers per train	548 passengers (547 passengers in the case of manned operation) Note 2
Minimum horizontal curve radius	30 (m)
Maximum sustained gradient	10 (%)
Maximum design speed	80 (km/h)
Maximum acceleration	3.5 (km/h/s)
Maximum deceleration	3.5 (km/h/s)
Emergency deceleration	4.5 (km/h/s)

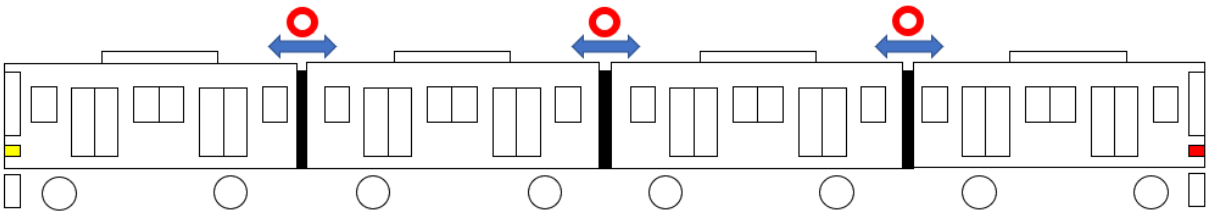
Source: JICA Study Team
Note 1: In the case of 4 cars/ unit
Note 2: According to the Phase 1 Report (JICA, 2018)

a) Vehicle Configurations

The following vehicle configurations are assumed as shown in i) to iii) below.

i) 4 Cars/ Unit

Train configuration of several vehicle. Two cars in the middle do not have a driver's cab, and passengers can walk through from one end to the other. Image of 4 cars/ unit is shown in Figure 8-2.

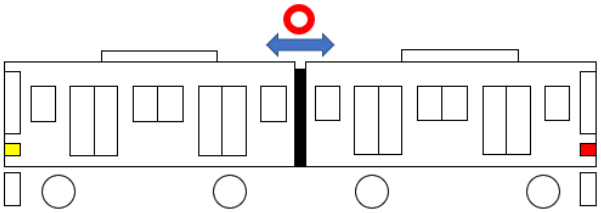


Source: JICA Study Team

Figure 8-2: 4 Cars/ Unit

ii) 2 cars/ unit

Train configuration of Married-pair/ Vehicle. A formation consisted by leading cars which has a driver's cab. Image of 2 cars/ unit is shown in Figure 8-3.

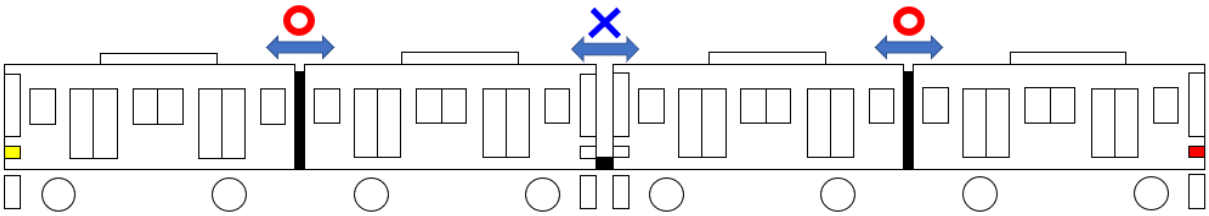


Source: JICA Study Team

Figure 8-3: 2 Cars/ Unit

iii) Double 2 cars/ unit

Double 2 cars/unit is a train configuration that two 2 cars/ unit are connected. Passengers cannot walk through from one end to the other (in the case of this figure below, between Cars 2 and 3). An image of double 2 cars/ unit is shown in Figure 8-4.



Source: JICA Study Team

Figure 8-4: Double 2 Cars/ Unit

It is expected to reduce operating costs during periods or sections with fewer passengers, by operating 2 cars/ unit after the subtraction of connected double 2 cars/ unit into separated. The advantages and disadvantages of the addition/subtraction of trains and formations are summarized in .

Table 8-2: Advantages and Disadvantages of Adding / Subtracting Trains

	Advantages	Disadvantages
No addition or subtraction of trains	➢ The operation is simple, and there is no burden on the driver or staff due to the addition/subtraction. ➢ Intermediate cars have lower costs. ➢ Intermediate cars have a large number of passengers.	➢ Providing unnecessary transportation capacity may incur unnecessary costs.
Trains are added and subtracted	➢ It is possible to provide transportation capacity that meets demand, leading to reductions in operating costs.	➢ For passengers, the boarding/ alighting position depends on the formation. ➢ It takes time to connect/disconnect, and the waiting time on the platform increases. ➢ Increased burden on drivers, station staff, etc. due to connection/disconnection work. ➢ High cost because there is no intermediate vehicle. ➢ Passengers cannot walk through from one end to the other of double 2 cars/ unit.

Source: JICA Study Team

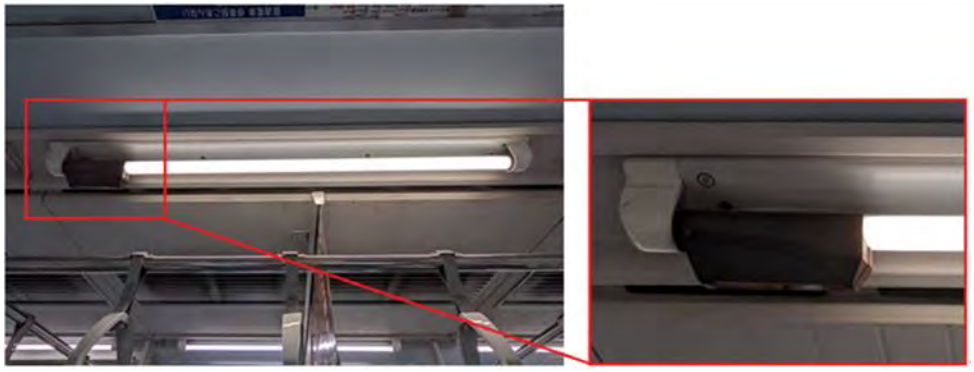
In this study, we will proceed with the examination on the premise of 4 cars/ unit formation as in Phase 1, which is considered to be advantageous in terms of costs and usability.

(2) On-Board Command, Control, Communication Systems

The on-board equipment (commands, controls and communication systems) installed in the vehicle are as follows.

- ATP (Automatic Train Protection)/ ATO controller
- Vehicle communication controller
- Dynamic sign
- Speaker
- Intercom
- Camera (In-car security camera [Note], for checking the opening and closing of train doors [For platform safety confirmation])
- Etc.

Note: In Japan, there are examples of adoption of lighting-integrated cameras with Wi-Fi data communication and 4G communication function as shown in Figure 8-5.



Source: JICA Study Team

Figure 8-5: Security Camera with Integrated Lighting (With Wireless Communication Function)

8.2 E & M Plan

8.2.1 Track Course and Guide Rails

The course is built from the following parts:

- Track course and guide rails
- Turnouts
- Buffer stops
- Emergency route

The track course will also carry power rails, electricity distribution lines, and cables for the signals and telecommunication in the cable trays.

(1) Track Course

Figure 8-6 shows the AGT track course. In this study, a side guidance system is proposed since it is popular in Japan, and a closed floor is proposed since the track course can be used as an emergency evacuation passage with passengers' sense of security.

Source: JICA Study Team

Figure 8-6: Appearance of the Track Course (Running Surface, Guide Rails, Switches)

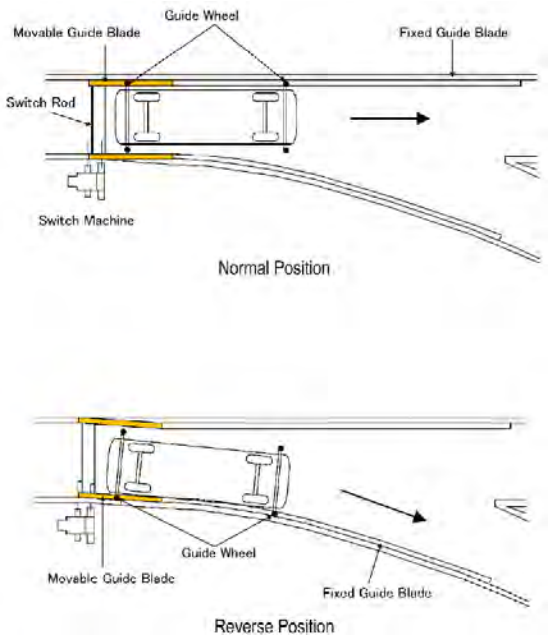
(2) Guide Rails

The guide rails are the structures that support the train cars and weight transfers. The guide rail components include the guide rail, the base plates, and the installation equipment. In general, H-shaped steel beams are used for the guide rails.

(3) Turnout

The turnout mechanism is shown in Figure 8-7. The turnout consists of a fixed and moveable U-shaped board attached to both sides of the track course, with shunts powered by electricity and connecting rods. The idler wheel of the car is guided by the movable boards and used to direct the movement into the desired direction.

Turnouts are controlled by the Communications-based Train Control (CBTC) system ,and because it is particularly protected by an ATP subsystem, safe train operation is possible.



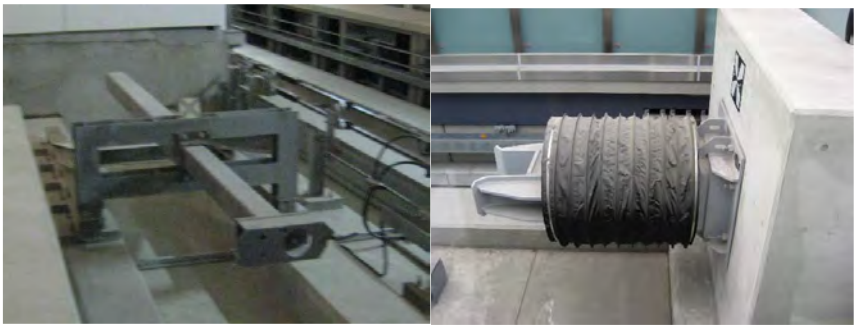
Source: JICA Study Team

Figure 8-7: Turnout Mechanism

(4) Buffer Stops

Buffer Stops are shown in Figure 8-8.

At each end of the track course, a hydraulic buffer is installed. The role of the buffer is to ensure the trains will be brought to a safe and controlled stop in the unlikely event that they overrun the designated stopping position.



Source: JICA Study Team

Figure 8-8: Buffer Stops

8.2.2 Electrical Power Facilities

The AGT system uses electric motors and major equipment such as the signal system and the facilities in stations and depots are powered by electricity. Therefore, a power shortage or interruption in the power supply will directly result in disruption of train service. As a solution, a redundant power system is necessary.

The power supply system will be of the receiving and transforming substation type, and the power is assumed to be supplied from a substation which covers the area and is operated by the Indonesian national electric utility, Perusahaan Listrik Negar (PT PLN).

(1) Power Receiving and Transforming Facilities (Substation)

At each of PT PLN's substations, 150 kV Alternating Current (AC) are received from overhead high voltage power transmission lines and stepped down to 20 kV AC. For the AGT power distribution system, power is supplied from here to AGT receiving substations via the main line and auxiliary line. From these receiving substations 20 kV AC are distributed to each feeding substation and station electrical room in a method in which two systems are interconnected.

At the feeding substations, 20 kV AC are rectified to 750 V Direct Current (DC) and then provided as power for AGT operation to the depot along the main line.

Power for annex equipment is distributed to on-site equipment after the 20 kV AC received by the power rooms of each station and depot are stepped down to 400 V AC/200 V by on-premises transformers.

(2) Distribution Substation

Each substation is arranged in a double-ring redundant configuration. There are two fully-rated heavy duty traction transformers capable of continuous operation for the proposed design.

(3) Backup Power Supply

The Uninterruptible Power Supply (UPS) provides power in the event that primary power is not available. The UPS provides backup power for the following systems:

- CBTC system including central control system
- Control power supply for power supply system
- Closed Circuit Television (CCTV), broadcasting, emergency telephone, wireless, guidance sign
- Emergency light
- Safety/security system
- Data communication, transmission system
- Turnout machine

The UPS equipment uses sealed gel cell batteries. AC input is the power source to charge the batteries.

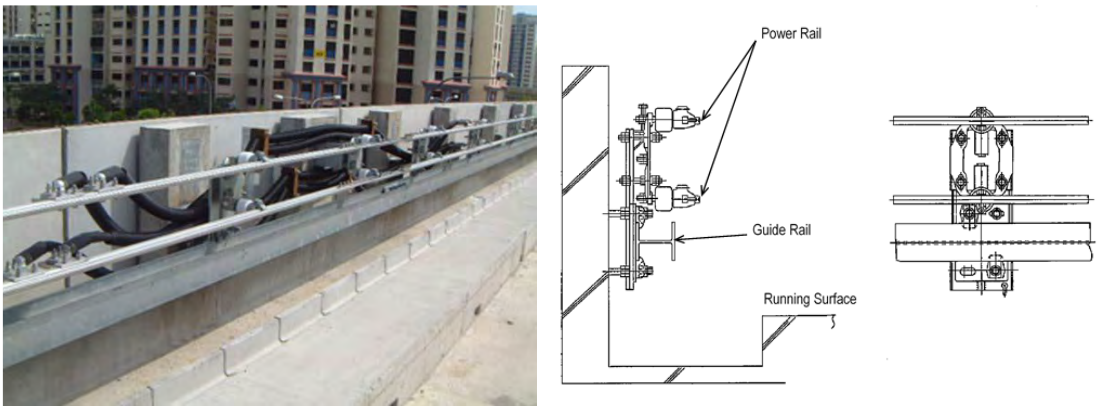
(4) Power Rails

Traction power is supplied to the vehicle through positive and negative power rails installed along the guide way. Propulsion power cables are connected to each segment of the power rails on the guide way to the 750 V DC bus. The traction power is collected by two current collectors from two rigid, side contact power rails mounted on the guide way. The figure below shows a power rail installation from another AGT system.

Power rails are shown in Figure 8-9.

Power rails are made of the following.

- Power rails with an aluminum and stainless-steel alloy
- Mounting devices to clamp the power rails in both the vertical and horizontal directions
- Supporting clamps and anchor bolts
- Thermal expansion points
- Terminal fixtures



Source: JICA Study Team

Figure 8-9: Power Rails

8.2.3 Signal System

The signaling system includes three main subsystems under the Communications-Based Train Control (CBTC) system.

- ATP Subsystem: ATP provides all safety control functions.
- ATO Subsystem: The ATO provides all the automatic operation mode functions under the conditions imposed by the ATP subsystem.
- Automatic Train Supervision (ATS) Subsystem: ATS monitors the operating status and overall operation of the system and manages the communication interface of the system. ATS records operating status data and issues an alarm if there is something wrong with the system. In addition, ATS provides a centrally controllable human-machine interface.

The human interface for the ATS system is located in the Operation Control Center (OCC) as shown in Figure 8-10, where the operators can monitor and control the system through the ATS. In addition, OCC also allows the control and monitoring of the telecommunication system and changes in the power supply system.

Source: JICA Study Team

Figure 8-10: Operation Control Center

(1) ATP Subsystem

The ATP subsystem includes the following main functions:

- Presence detection
- Route settings
- Unintentional motion detection
- Prevention against going over the speed limit
- Overrun prevention
- Prevention of cars from disconnecting
- Protection against losing the signal
- Stop detection
- Prevention of unintentional door opening and closing
- Door control protection interlocking
- Departure interlocking
- Directional change interlocking
- Braking interlocking
- Turnout interlocking

ATP functions have precedence over both the ATO and ATS functions.

(2) ATO Subsystem

The ATO subsystem includes the following main functions:

- Operation control
- Stop at a fixed point according to the program
- Door and stop-time control

(3) ATS Subsystem

The ATS subsystem includes the following main functions:

- Monitor the conditions of operations
- Control and override operations

8.2.4 Communications System

The communication system is for an effective daily operation of the railway system that provides monitoring information on the situation and necessary communication to restore the system quickly during an emergency. The main equipment is as follows:

- Wireless communication systems (train radio, emergency alarms, wireless for maintenance)
- Telephone facilities (office telephones, command telephones, interphones, etc.)
- CCTV monitoring facilities
- Guidance broadcasting facilities
- Other facilities (fiber optic LAN, clock, UPS)

(1) Train Radio and Emergency Alarm Systems

Train radio is for all communications between the OCC and each train on the route for safe operation. Plus, the system provides an exchange of communication for smooth operations within the rail yard.

The emergency alarm system is a facility that responds when an emergency occurs on any train, putting the train on a route that prevents secondary casualties with emergency alarm features and emergency brake systems.

(2) Telephone Facilities

The telephone facilities consist of a telephone line for office use that uses digital Private Branch eXchange (PBX) and a line for direct-method technical operations that is used only for commands. The office telephone at each station goes through fiber optic Local Area Network (LAN) equipment, allowing the simultaneous use of cordless handsets.

There are four command telephone systems: operation, electric power, track course and turnouts, enabling calls contacting with OCC. At the same time, a commercial telephone is used for both the track course and the turnout system.

(3) CCTV

Each station will be equipped with CCTV cameras for monitoring situations on the platform and concourse from the OCC. An exclusive fiber optic LAN is used only for image transmission because the size of transmitted images is large. Plus, each station building can monitor its own station premises. These images at the station including the depot can be recorded.

(4) Guidance Broadcasting Facilities

At each station, announcements are made about approaching, arriving, and departing trains. General broadcasts will be broadcast from the OCC's operation management facility. However, it is also possible for optional broadcasts from each station's broadcasting facility or from the OCC's.

(5) Other Equipment

For the OCC and the trains or to transmit regulated data or audio data efficiently between the stations, fiber optic LAN is used. The fiber optic cables allow high-precision transmission even in environments that have lots of background noises like induced noise, thunder and crosstalk interference. The clocks used by the railway system consist of a master clock that sends time signals to secondary clocks that are placed at rail yards, in each station, time servers that transmit information on the time to the rail yard management equipment, power management equipment and operation management equipment.

8.2.5 Station Equipment

As an Automated Fare Collection (AFC) system, automatic ticket vending machines, automatic ticket gates, and window processing machines are installed at each station to connect to the station server, and the station server monitors the status of each device and aggregates fare collection.

As for ticket media, it is expected that electronic money payments using Integrated Circuit (IC) tokens, IC cards and smartphones will be introduced, without using magnetic tickets, which are factors that increase costs, including ticket gates. As a standard for IC media, we propose to apply FeliCa, which is mainly used for railway toll collection systems and is compliant with the International Organization Standardization (ISO) / International Electrotechnical Commission (IEC) 18092 (Near Field Communication [NFC], commonly known as Type C), which boasts high security performance.

Types of boarding tickets/payment methods are shown in Table 8-3.

Table 8-3: Types of Boarding Tickets/Payment Methods

	IC Card, IC Token (FeliCa)	Smartphone Payment
Image Samples		
Features	➢ An IC chip is embedded in a card or token to record entry/exit history, fares, etc. ➢ Prepaid system, can be used not only as a ticket but also as electronic money ➢ Excellent payment speed	➢ Supports Quick Response (QR) code payment, Google Pay, Apple Pay and various other cashless payments. ➢ By linking with credit card information, there is no need to use cash at the station. ➢ Payment speed is slow compared to an IC system using FeliCa

Source: JICA Study Team

8.2.6 Depot Inspection and Repair Equipment

The main inspection and repair equipment is shown in Table 8-4.

Table 8-4: Main Inspection and Repair Equipment

No.	Inspection and Repair Equipment
1	Car washing machine
2	Lifting jacks (6 tons)
3	Bogie stand
4	Body stand
5	Gantry crane
6	Umbilical power cable (stinger)
7	Wheel tire changer
8	Forklift
9	Mobile lift table

Source: JICA Study Team

8.2.7 Other Facilities

- Receiving substation
- Warehouse, oil storage
- Drainage treatment facility
- Emergency garage
- Other

8.3 Cost Reduced Case of Rolling Stocks (Cars) / E & M

8.3.1 Overview

In order to reduce costs, we propose a plan to make train operation a manual operation and simplify various equipment required for automatic operation.

8.3.2 Cost Reduced Case

Details will be described below.

(1) Definition of Automation Level

As a cost reduction method, the premise of reviewing the automation level of train operation will be considered. The grade of automation (GOA) is defined as a guideline by the IEC as shown in .

Table 8-5: Automation Grade Definition (IEC 62267-1: 2009)

Basic functions of train operation		GOA0 On-sight train operation	GOA1 Non-automated train operation	GOA2 Semi-automated train operation	GOA3 Driverless train operation	GOA4 Unattended train operation
Ensuring safe movement of trains	Ensure safe route	X	S	S	S	S
	Ensure safe separation of trains	X	S	S	S	S
	Ensure safe speed	X	X	S	S	S
Driving	Control acceleration and braking	X	X	S	S	S
Supervising guideway	Prevent collision with obstacles	X	X	X	S	S
	Prevent collision with persons	X	X	X	S	S
Supervising passenger transfer	Control passengers doors	X	X	X	X	S
	Prevent injuries to persons between cars or between platform and train	X	X	X	X	S
	Ensure safe starting conditions	X	X	X	X	S
Operating a train	Put into or take out of operation	X	X	X	X	S
	Supervise the status of the train	X	X	X	X	S
Ensuring detection and management of emergency situations	Perform train diagnostic, detect fire/ smoke and detect derailment, handle emergency situations (call/evacuation, supervision)	X	X	X	X	S
NOTE	X = responsibility of operations staff (may be realized by technical system) S = realized by technical system					
REMARKS	Number of crew	2	2	1	1	0

Source: JICA Study Team

The automatic driving level in the basic plan (Base Case) is assumed to be GOA4. This means fully-automated driving without a driver, conductor or crew member. In the cost reduced cases, the overall cost will be reduced by lowering the automatic driving level and eliminating the equipment that is an essential requirement for advanced automatic driving.

(2) Automation Level of Cost Reduced Case

In the Cost Reduced Case, it is proposed that the automatic operation level GOA1 be adopted. This means operation in non-automatic train operation mode where only one driver is on board one train. This system uses train control based on the CBTC system with a moving block system, so GOA0 is not applicable. Although GOA2 has the same basic ground/on-board equipment configuration as GOA4 in train operation, labor costs are incurred due to the drivers and the possibility of cost reduction is low. Similarly, GOA3, which is premised on automated driving and has a crew member whose main role is as an evacuation guide, is expected only to increase labor costs and will not be adopted because the desired cost reduction cannot be realized.

Automation Level of Cost Reduction Plan is shown in Table 8-6.

Table 8-6: Automation Level of Cost Reduced Case

	Base Case	Cost Reduced Case
Automation level	GOA4	GOA1

Source: JICA Study Team

(3) Items in Which Equipment Costs Can Be Reduced by Changing the Automation Level

a) Cost Reduction by Removing ATO Equipment

By adopting the automatic operation level GOA1, the ATO equipment that was indispensable for automatic operation control without a driver becomes unnecessary.

ATO equipment can be broadly divided into two types: ATO ground equipment and ATO on-board equipment. ATO ground equipment consists of ATO ground transponders used for fixed position stop of trains and signal house equipment that serves as an interface with ATP equipment. Since this is equipment that needs to be deployed for each station or control range, cost reduction is expected by removing the equipment.

The ATO on-board device consists of an ATO on-board transponder that interfaces with the ground element, and an on-board ATO control unit that controls train acceleration/deceleration and fixed position stop control. Since these are devices required for each train formation, cost reduction for each train formation is expected by removing the equipment. The block system when adopting GOA1 is assumed to be an in-vehicle signal system based on the moving block system by CBTC.

Cost Reduction by Changing the Automation Level is shown in Table 8-7.

Table 8-7: Cost Reduction by Changing the Automation Level

Items for Which Costs Can Be Reduced by Adopting GOA1
> ATO ground equipment multiplied by the number of stations
> ATO on-board equipment multiplied by the number of trainsets

Source: JICA Study Team

b) Impact of Manual Operation

By adopting GOA1, we have proposed the removal of ground/on-board equipment used for automatic stop of a train. As an effect of manual operation, it is necessary to manually stop the train at a fixed position on the home track. In order to realize one-man operation, it is ideal to install equipment such as Full-height Platform Screen Doors (PSD) and platform fences on the platform. Additionally, when installing platform doors, the stop position of the train must be accurate. Stopping a train by complete manual operation depends in large part on the driving skill of the driver. Accurate stopping skills are also essential for high-density scheduled train operations.

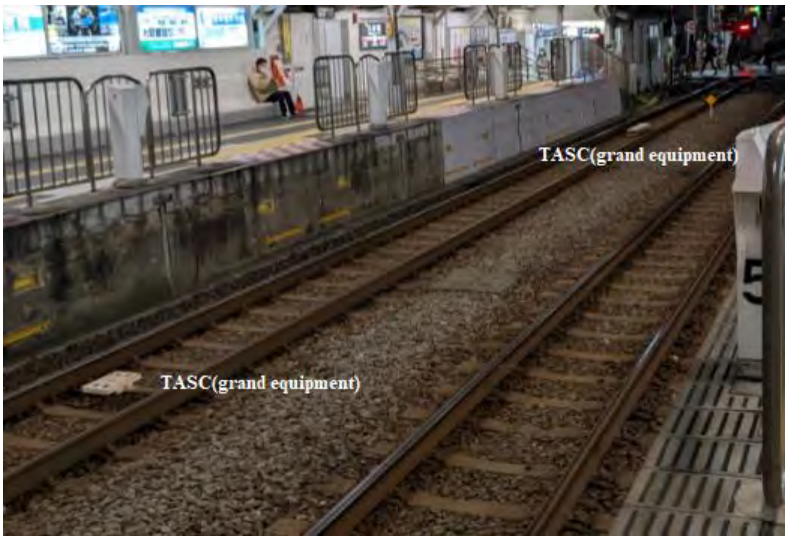
Assuming that there is no ATO equipment, we propose the following as a method to support fixed position stop without incurring a large cost:

i. Introduce Train Automatic Stop-Position Controller (TASC).
ii. Adopt platform doors (elevating type) that do not require an accurate stop position.
iii. Introduce a stop-position detection system as a method of notification that the vehicle has stopped at a fixed position.

i) TASC (Train Automatic Stop-position Controller)

TASC is a support device that automatically brakes and stops trains in place when a train approaches a stop station. They reduce costs compared to ATO equipment and can make automatic train stops possible.

TASC (ground equipment) is shown in Figure 8-11.



Source: JICA Study Team

Figure 8-11: TASC (ground equipment)

ii) Platform Door (Elevating Type)

Elevating platform doors are equipped with pillars on the platform, and when the train is absent, shields such as bars and ropes are lowered between the pillars to separate the track from the platform. During passenger boarding and alighting after the train arrives, the shield rises and all areas between

the pillars are released, so accuracy of the train stop position is not required compared to other types of platform doors.

Elevating platform doors are shown in Figure 8-12.

Source: Guide for Considering the Introduction of New-Type Platform Doors - Various Development Cases (Ministry of Land, Infrastructure, Transport and Tourism, Bureau of Railways, updated in December 2016, available in Japanese language at https://www.mlit.go.jp/common/001156974.pdf)

Figure 8-12: Elevating Platform Doors (Left: Down Position, Right: Up Position)

iii) Automatic Stop-Position Detection System

A train automatic stop-position detection system mounted on the platform notifies the crew that the train has stopped in place. A system assists train fixed position stopping by using this notification. In Japan, automatic opening operations of platform doors, triggered by fixed position stop detection using a fixed-position stop detection system, are also in practical use.

Train automatic stop-position detection system is shown in Figure 8-13.

Source: JICA Study Team

Figure 8-13: Train Automatic Stop-Position System

(4) Cost Reduction by Adopting Loops at Terminal Stations

We propose cost reduction by adopting the loop method as a turnaround method at terminal stations. The adoption of this loop method is based on the premise that there are more than two tracks in the vicinity of the terminal station.

Figure 8-14 shown below is a linear image of the loop type (left) and shuttle type (middle, right) of the terminal station on the island platform. (The train can travel in the direction of the arrow.)

In the loop type, it is not necessary to change the traveling direction at the terminal station and perform a turn-back operation, so that the turnout equipment shown in the red frame in the shuttle-

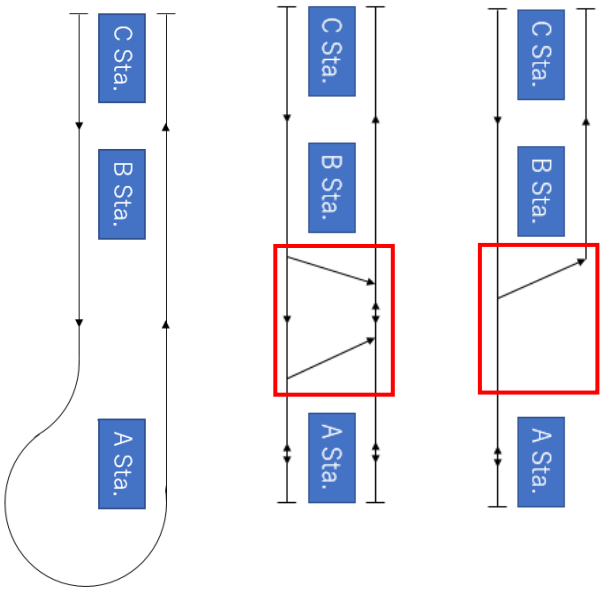
type figure in Figure 8-14 is unnecessary. In addition, since the direction of travel of the train does not change on both the up line and the down line, there is no need for the driver to get on and off at the terminal station for a turn-back operation. Therefore, the possibility of high-density operation is also superior to that of the shuttle method.

In addition, if the platform for boarding and alighting are separated at the terminal station, it will lead to passengers being able to get on and off smoothly, leading to the possibility of high-density driving and improving safety on the platform. On the other hand, there are disadvantages such as an increase in the number of platform door facilities.

If one end is a loop type and the other is a shuttle type, the direction of the train will change for each round trip. When it is necessary to align the vehicle orientation when warehousing at the depot, it is necessary to take care of this, such as by providing a replacement track in the depot.

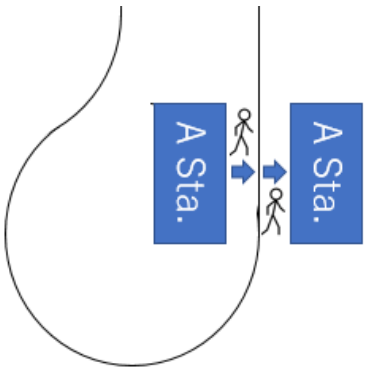
Adopting the loop method may increase the cost required for land acquisition around the terminal station and construction of civil engineering structures, but it will lead to cost reduction in the Electrical and Mechanical (E & M) field.

Turnaround Method is shown in Figure 8-14, Boarding/Alighting Platforms at Loop Method is shown in Figure 8-15, and The direction of the vehicle is switched when only one end is a loop method is shown in Figure 8-16.



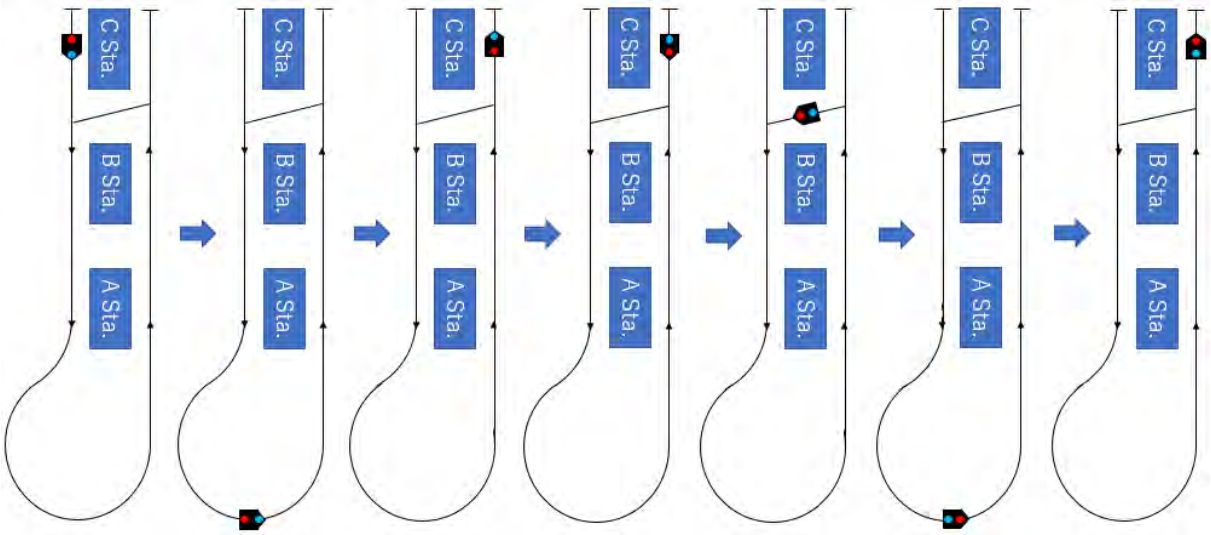
Source: JICA Study Team

Figure 8-14 Turnaround Method
(Left: Loop Method, Middle: Shuttle Method [crossing line 2],
Right: Shuttle Method [crossing line 1])



Source: JICA Study Team

Figure 8-15: Separation of Boarding/Alighting Platforms in the Terminal Station in Loop Method



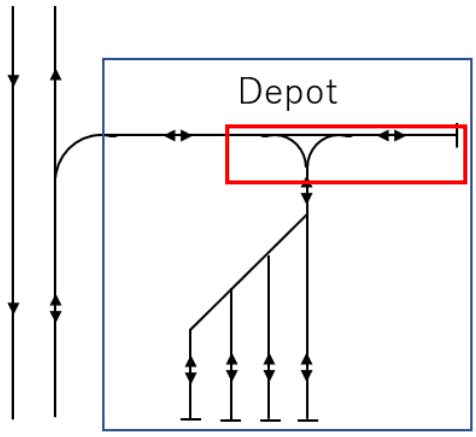
Source: JICA Study Team

Figure 8-16: The Direction of the Vehicle Switches with One End Using the Loop Method

A switchback track in the depot, triangular junction on the main track, and depot entry/exit track in a loop type, are shown in Figure 8-17, 8-18 and 8-19 respectively. When the loop method is adopted only at one end, depending on the operation, the train may enter the depot in a state where the front and rear directions of the train are not aligned for each train formation. If it is necessary to unify the vehicle direction for maintenance and/or other reasons at the time of warehousing, it is necessary to install the following facility.

i. Switchback Track in the Depot (red frame image in Figure 8-17)
ii. Triangular Junction on the Main Track
iii. Depot Entry/Exit Track in a Loop Type

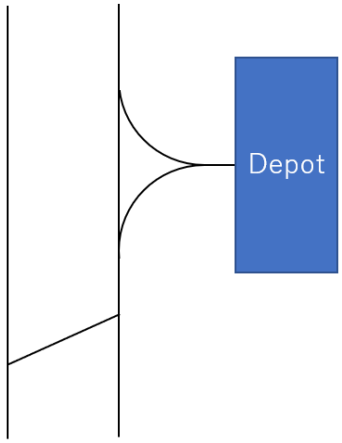
i) Switchback Track in the Depot



Source: JICA Study Team

Figure 8-17: Switchback Alignment for Depot Entry

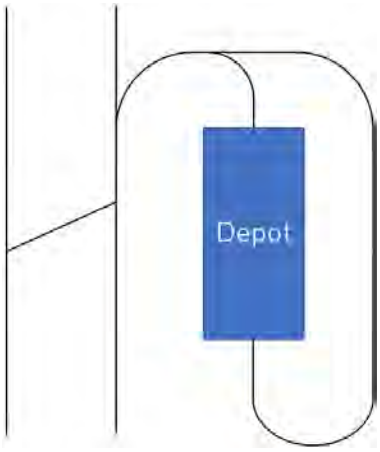
ii) Reverse Triangle on the Main Track



Source: JICA Study Team

Figure 8-18: Reverse Triangle Alignment For Depot Entry

iii) Depot Entry/Exit in a Loop Type

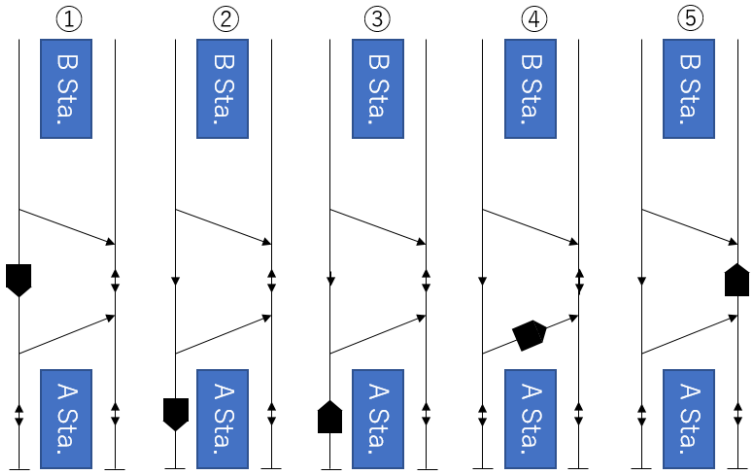


Source: JICA Study Team

Figure 8-19: Depot Entry/Exit Alignment in a Loop Type

Change Direction at the Terminal Station is shown in Figure 8-20.

In the shuttle method, after the train arrives at Station A from the side of Station B, it is necessary to change the direction of travel of the arriving train toward Station B (Figure 8-20 ②-③ below). That is, after the train arrives at Station A, the driver needs to move in the direction of travel and prepare for departure. After that, as soon as the course lock is secured, the train can start toward Station B (Figure 8-20 ④-⑤ below).

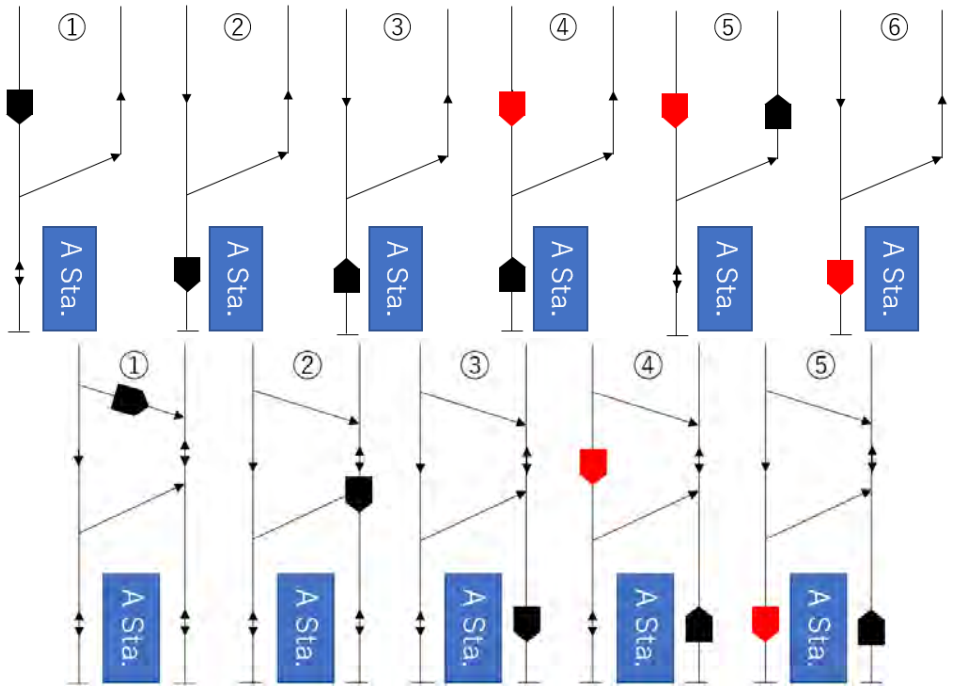


Source: JICA Study Team

Figure 8-20: Change Direction at the Terminal Station

Change Direction at the Terminal Station is shown in Figure 8-21.

Furthermore, in the shuttle type, as shown in Figure 8-20 (terminal station turnaround method), it is conceivable to use only one crossover. Compared to the case of two crossovers, the number of turnouts can be halved and the number of platform facilities such as platform doors and train automatic stop devices can be reduced. However, as shown in the example of ④ in the upper part of Figure 8-21, it is not recommended because there will be situations in which the following train (red train) will be waiting near the platform to enter until the starting train leaves the platform. As shown in the example at the bottom of Figure 8-21, if there are two crossovers, it is possible to have two trains at the platform of "A" station.



Source: JICA Study Team

Figure 8-21: Change Direction at the Terminal Station
(Top: Example of One Crossover, Bottom: Example of Two Crossovers)

Table 8-8 is comparing the number of facilities, transportation capacities, and running costs required for the loop type and shuttle type (by number of crossovers). The amount of transportation was judged by the possibility of high-density operation mentioned above. Regarding running costs, the superiority and inferiority were given based on the presence or absence of turnouts that require special labor for maintenance and the amount of other equipment.

The number of platforms depends on whether it is an island platform or opposite platform. Platform equipment other than the equipment listed in the table below (equipment such as passenger guidance devices and chairs) depends on the platform type adopted.

Table 8-8: Comparison by the Terminal Station Turnaround Method

		Turnouts	Platform Door	TASC	Transportation Capacity	Running Cost
Base Case	Shuttle (2 crossovers)	2	2	2	Fair	Poor
Cost-Reduced Case	Loop	0	2 or 1[Note]	1	Good	Good
	Shuttle (1 crossover)	1	1	1	Poor	Fair

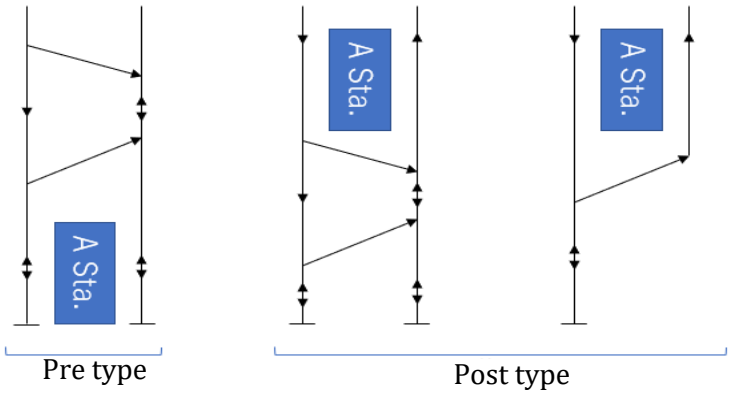
Source: JICA Study Team
Note: If the platforms for getting on and off are separated, they will need two sets of platform doors, and if not, they will have one set.

Further, in the shuttle method, there is a difference in operation depending on whether the crossovers are installed forward from the terminal station platform toward the next station (pre-crossover type) or rearward (post-crossover type).

Changing Route at an Island-Type Terminal Station is shown in Figure 8-22.

As described above, the pre-crossover type is a method in which the train can cross over to the departure track side of the turnaround before arriving at the platform at the terminal station and perform a turnaround operation after arriving at the platform.

In the post-crossover type, after passengers get off at the platform of the terminal station, they proceed to the pocket track, travel on the provided crossover, and turnaround operation is realized. Since passengers do not pass through crossovers with turnouts, there are merits such as being able to have a comfortable ride with less shaking and vibration, and being able to have fixed passenger boarding and alighting tracks. On the other hand, in the first stage of turn-back driving, the driver moves between the cabs, but if there is no passage between the vehicles and it is not possible to move between the vehicles, the driver needs to go out of the vehicle once. In that case, it is also necessary to provide a boarding/alighting place for drivers and a passage for movement.



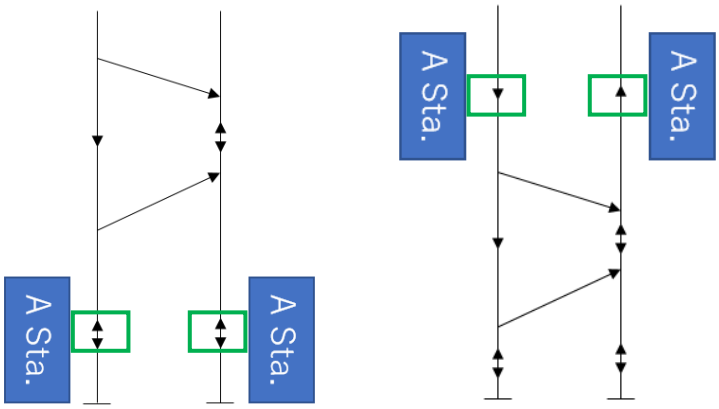
Source: JICA Study Team

Figure 8-22: Changing Route at an Island-Type Terminal Station (Left: Pre-Crossover Type, Middle: Post-Crossover Type [2 Crossovers], Right: Post-Crossover Type [1 Crossover])

Pre-crossover and post-crossover type at opposite platforms is shown in Figure 8-23.

In case adopting the pre-crossover type, the island platform is usually adopted as the platform type. This is because the arrival and departure lines will change depending on the train when the pre-crossover-type opposite platforms are adopted. If passengers go to the wrong platform or just missed the train, they will need to use the stairs or walk a long distance around the end of the platforms to take first train. Or they can wait for the next train at the platform if they give up on using the first train at another platform.

On the other hand, in the post-crossover type, since the arrival track and the departure track can be completely separated, there is no problem even at the opposite platforms. In addition, the post-crossover type has the advantage that the boarding platform and the alighting platform can be separated regardless of the platform shape, which leads to alleviation of congestion on the platform and is friendly to passengers.



Source: JICA Study Team

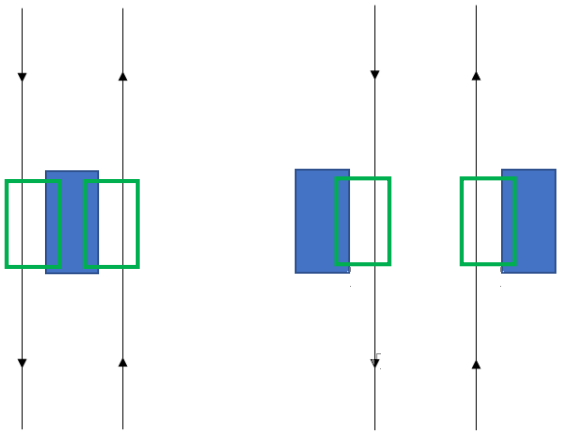
Figure 8-23: Pre-Crossover and Post-Crossover Type at Opposite Platforms (Left: Pre-Type, Right: Post-Type)

(5) Cost Impact of Platform Type

Differences in Equipment Depending on the Platform Type is shown in Figure 8-24.

There are typically two types of platforms: island platforms and opposite platforms. This is the same whether the track is a single track or a double track. Platform door equipment and train automatic stop-position controllers are the equipment related to the E & M field on the platforms mentioned so far, but the required quantity of this equipment is the same for both the island type and opposite type (green frame in Figure 8-24). However, in the island platform, it is possible to reduce costs by sharing some of the equipment other than the equipment listed above on the up line and down line. E & M Equipment Cost Reduction Items on Island Type are shown in Table 8-9.

As described above, at the terminal station, there is a possibility that the platform type may be restricted depending on whether the pre-crossover type or the post-crossover type is adopted.



Source: JICA Study Team

Figure 8-24: Differences in Equipment Depending on the Platform Type (Left: Island Platform, Right: Opposite Platforms)

Table 8-9: E & M Equipment Cost Reduction Items for the Island Type

Equipment that can be shared on the up and down lines:
➢ Passenger information display system
➢ Passenger information broadcasting system
➢ CCTV
➢ Communication equipment related to the above

Source: JICA Study Team

(6) Cost Reduction by Changing PSD (Platform Screen Door) Type

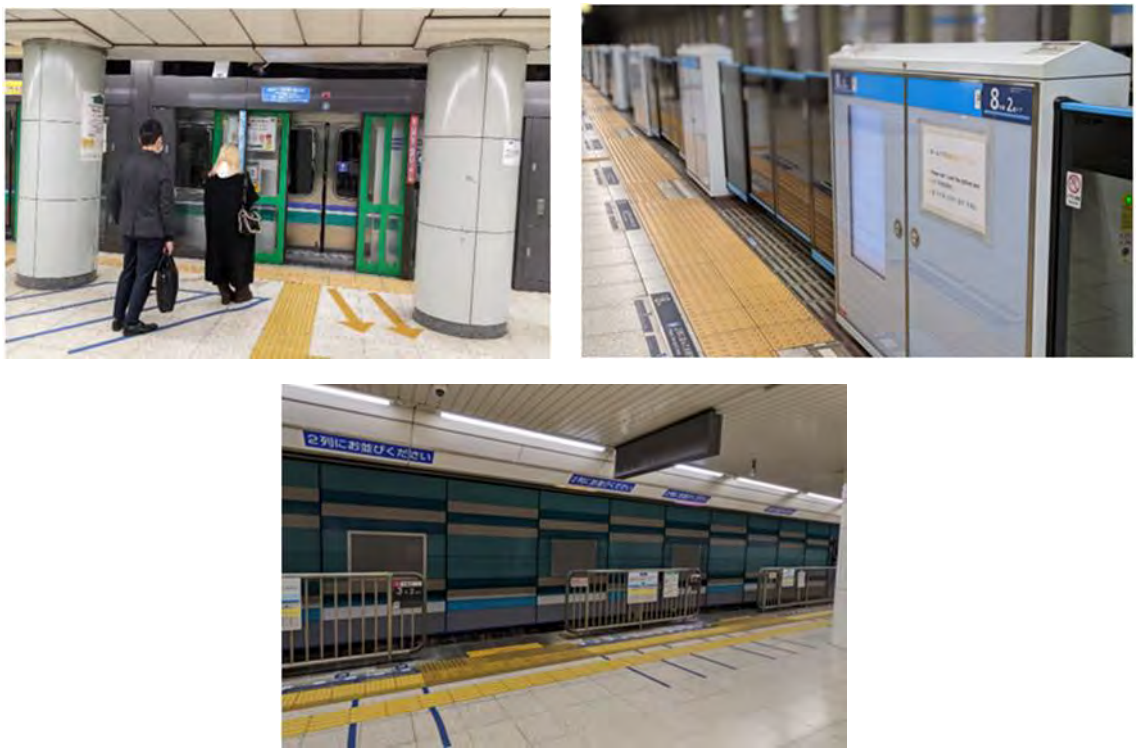
As mentioned above, installing platform doors on the platform is ideal for one-man train operation, and this is costly, but it is not necessary to do away with the installation of platform doors to reduce costs, but rather, just to change their type. However, lowering the cost of platform doors tends to reduce safety. In the case of manual operation, the platform door needs to be opened and closed by the driver, but since a fixed platform fence has no moving parts, the opening and closing operation is not necessary.

Cost reduction through adopting the platform door type is shown in Table 8-10 and each platform door type is described in Figure 8-25.

Table 8-10: Cost Reduction by Platform Door Type

	Platform Door Type	Cost[Note 1]	TASC	Safety[Note 2]	Door Operation
Base Case	PSD	5	Ideal	5	Necessary
Cost-Reduced Case	Movable platform doors	4	Ideal	4	Necessary
	Elevating platform doors	3	Unnecessary	3	Necessary
	Fixed platform fences	2	Ideal	2	Unnecessary
	Nothing installed	1	Unnecessary	1	Unnecessary

Source: JICA Study Team
Note 1: The higher the number, the higher the cost
Note 2: The higher the number, the higher the safety



Source: JICA Study Team

Figure 8-25: Platform Door Type

(Upper Left: PSD, Upper Right: Movable Platform Door and Below: Fixed-Platform Fence)

9. Construction Plan

9.1 Basic Policy

9.1.1 Construction Method

As for each construction method for formulating a construction plan for infrastructure development, the construction methods shown in Table 9-1 were basically used with reference to past implementations and materials based on the local situation.

Table 9-1: Construction Method

Type		Construction Method
Upper structure	PCT-type girder	・Construction girder building method
	PC box girder	・Span-by-span method ・Cantilever construction method
Lower structure	Skeleton	・Casting method
	Pile foundation	・Earth drill method
	Drilling	・Steel sheet pile cut-off method

Source: JICA Study Team

9.1.2 Construction Process

For the process plan of civil engineering structures in infrastructure development, the basic construction period (days) of each type of construction is set to the value shown in Table 9-2 based on the actual results of local MRT and the actual construction results in Japan.

Table 9-2: Calculated Number of Construction Days

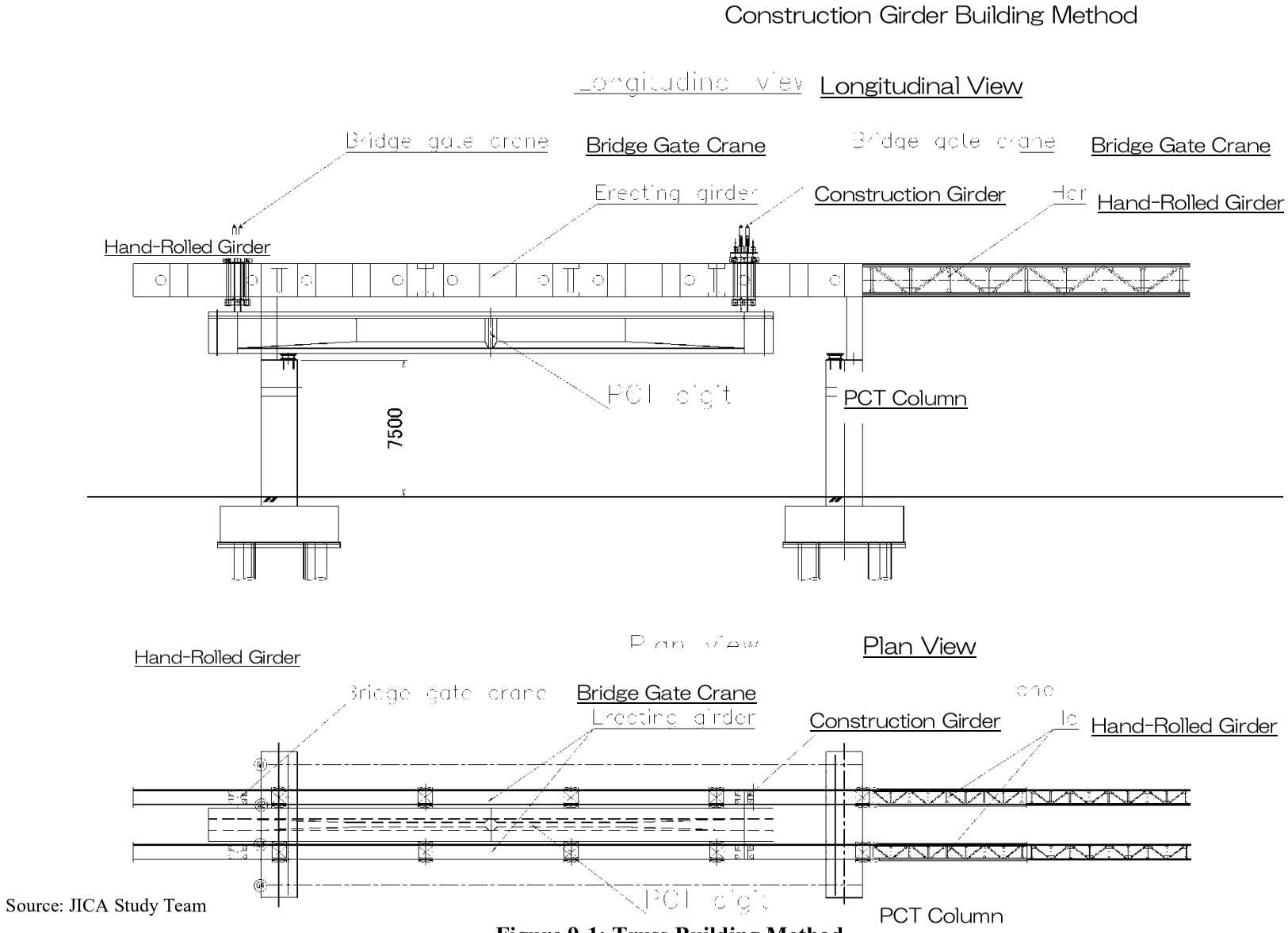
Type		Construction Method	Details	Unit	Calculated Value for the Number of Days
Upper structure	PCT-type girder	Construction girder building method	—	A series of work /day	3
	PC box girder	• Span-by-span method • Cantilever construction method	—	A series of work /day	5
Lower structure	Skeleton	Casting method	Reinforcing bar assembly	t/day	6
			Support	empty m^3/day	100
			Formwork	m^2/day	32
			Concrete placement	day	4
	Pile foundation	Earth drill method	Pile driving	pile(s)/day	0.66
	Drilling	Steel sheet pile cut-off method	Steel sheet pile driving	sheet/day	24
			Pulling out of steel sheet pile	sheet/day	34
			Floor excavation	m^3/day	220

Source: JICA Study Team

9.2 Construction Plan

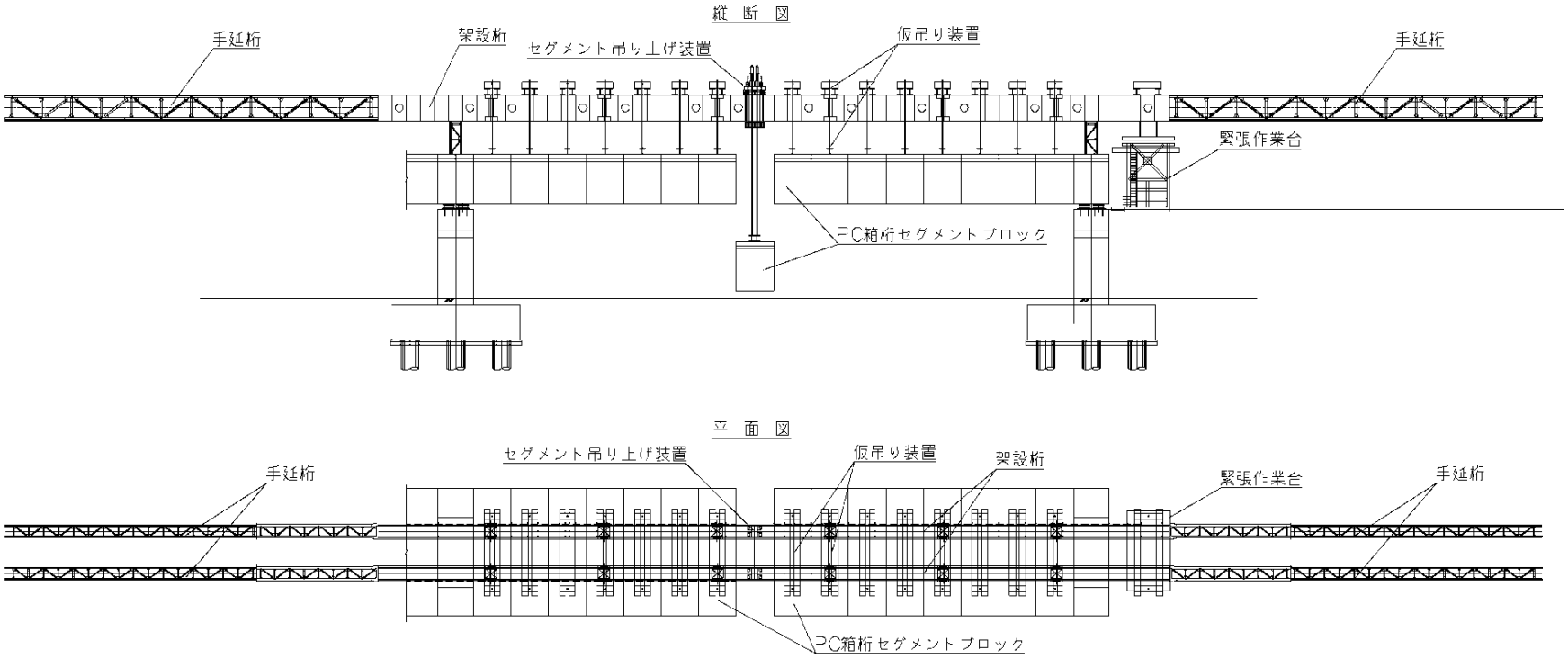
9.2.1 Upper Construction Plan

The PCT girder design drawing of the standard part and the PC box girder design drawing are shown on the following pages. The PCT girder shows the plan for the construction girder building method, and the PC box girder shows the plan for the span-by-span method for the general part and the cantilever construction method for the crossing of the expressway.



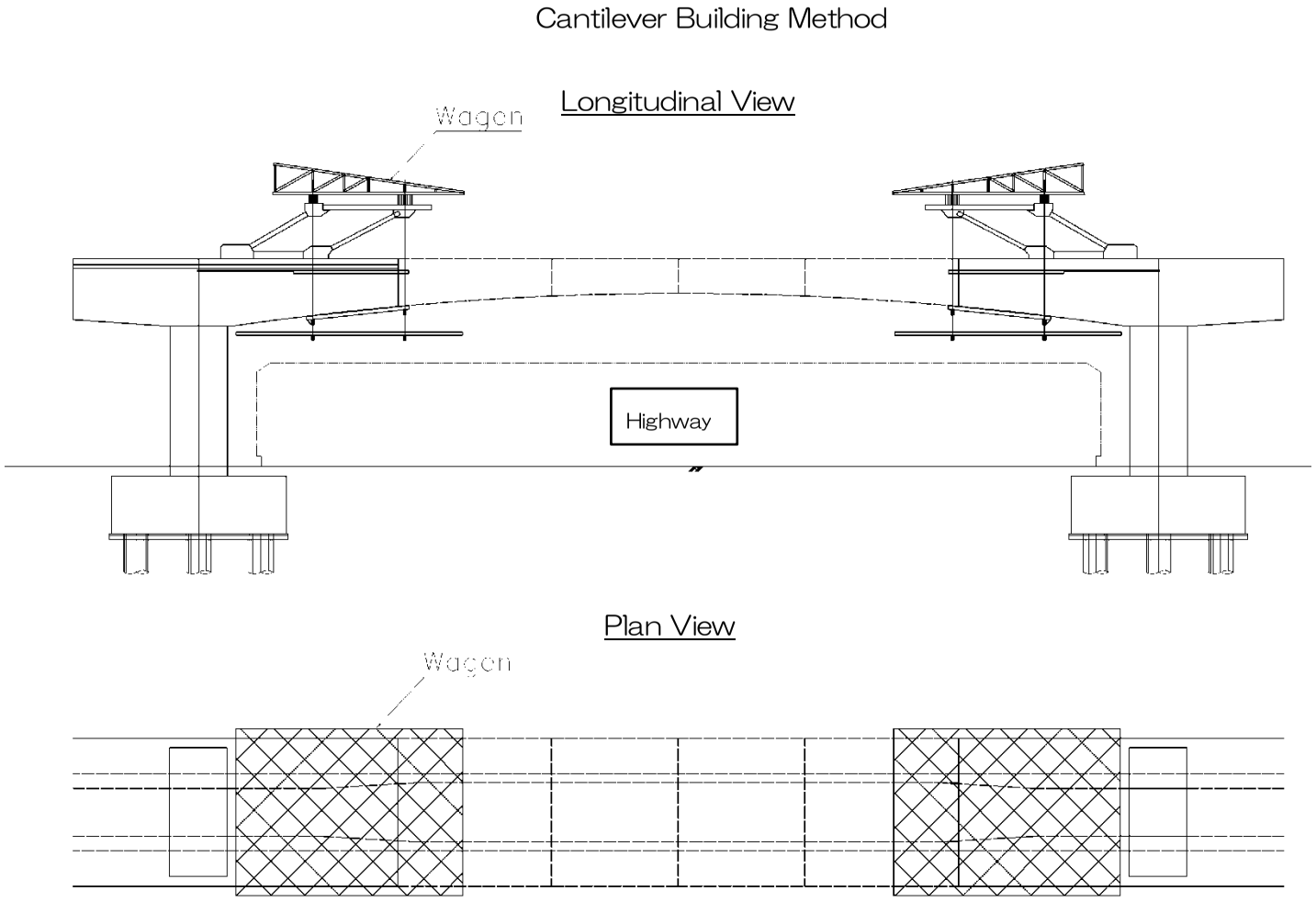
Source: JICA Study Team

Figure 9-1: Truss Building Method



Source: JICA Study Team

Figure 9-2: Span By Span Building Method

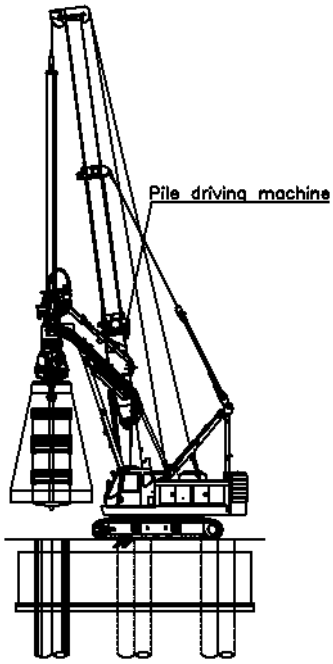


Source: JICA Study Team

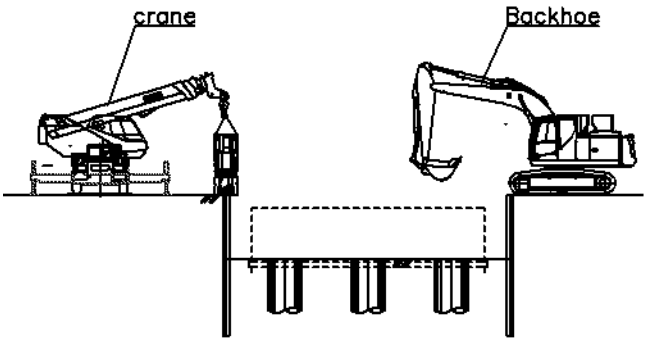
Figure 9-3: Cantilever Building Method

9.2.2 Substructure Construction Plan

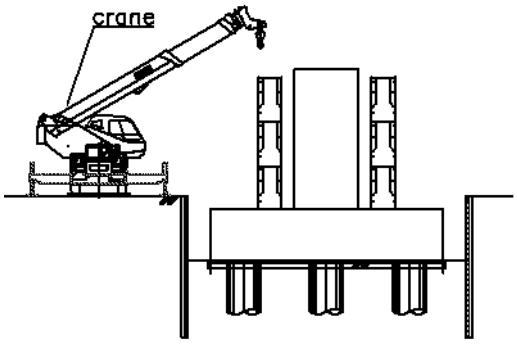
The foundation pile driving plan and the lower skeleton construction plan are shown.



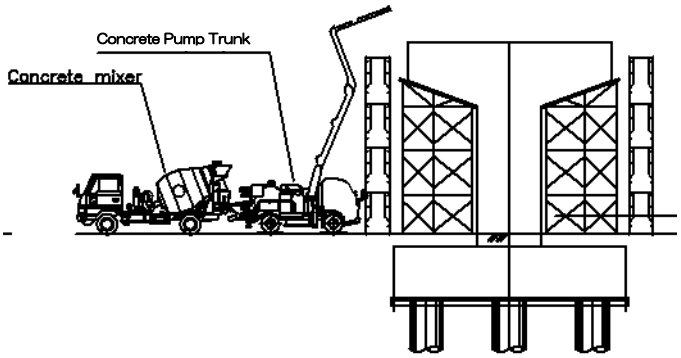
Foundation Pile Driving Work



Earth Retaining Work, Placing and Excavation Work



Scaffolding Installation Work



Support Work Installation/ Concrete Placement Work

Source: JICA Study Team

Figure 9-4:Lower Construction Diagram

9.3 Construction Process

Here, the construction process for infrastructure development is planned.

9.3.1 Basic Thought

It will be divided into three sections and construction will start each year.

Construction Zone 1 : Lemah Abang St.~Marketing Gallery Jababeka St.

Construction Zone 2 : Marketing Gallery Jababeka St ~KM 34 St.

Construction Zone 3 : KM34 St.~Lippo Cikarang St.

Source: JICA Study Team

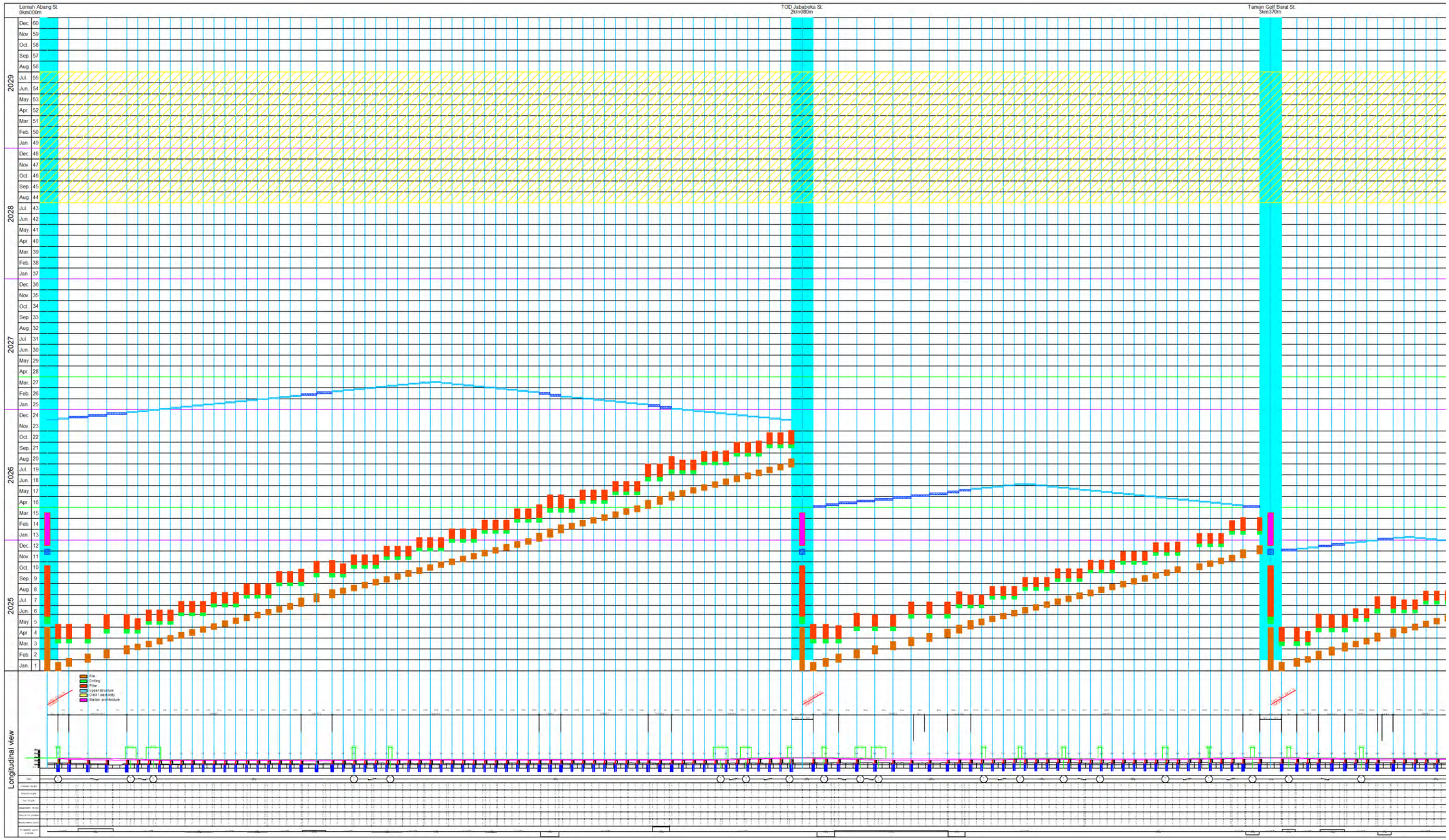
Figure 9-5: Construction Classification Plan

Track construction will be carried out on all lines after the civil engineering frame construction is completed.

9.3.2 Construction Schedule

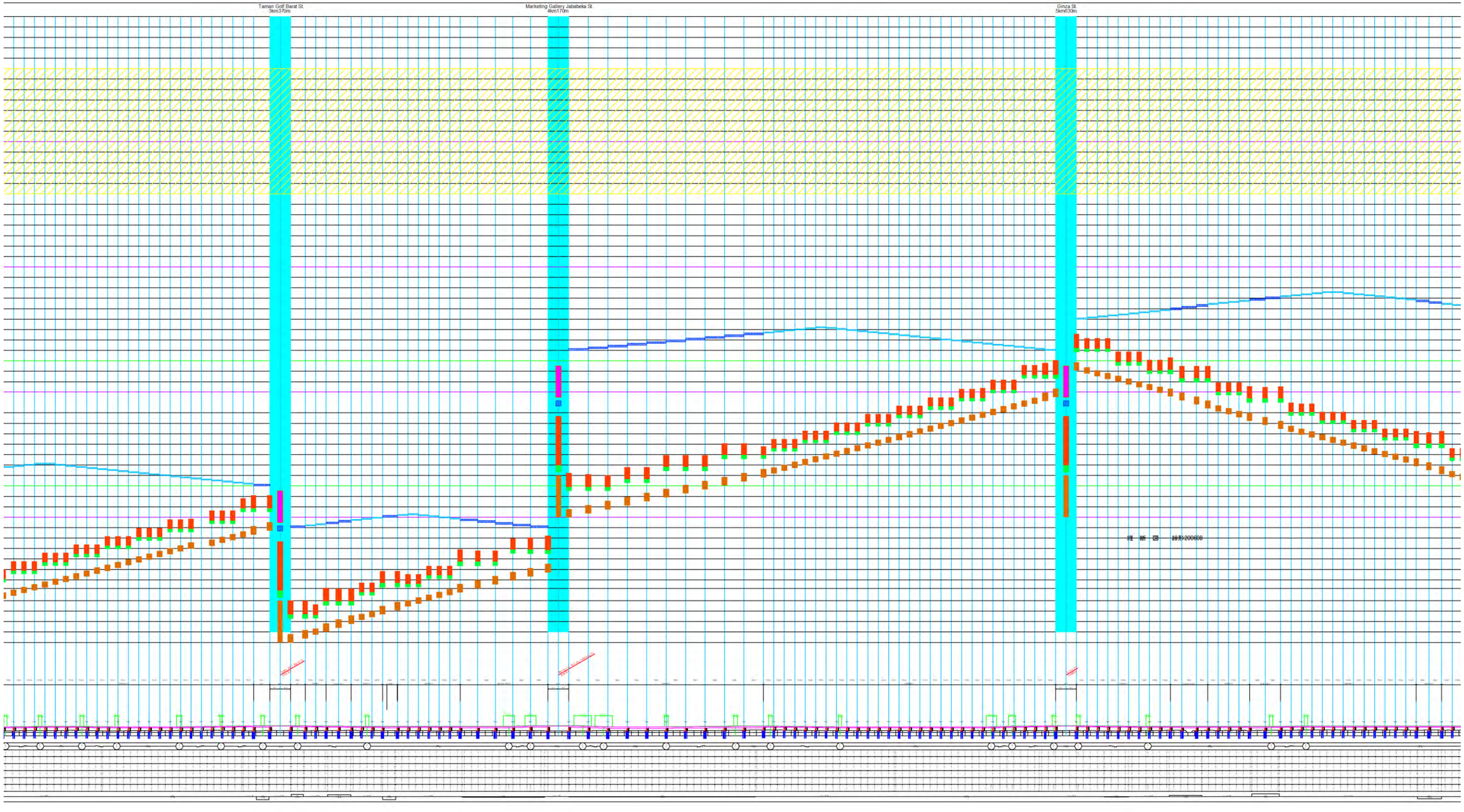
The entire construction schedule is shown on the following pages.

Table 9-3: Entire Construction Work Schedule



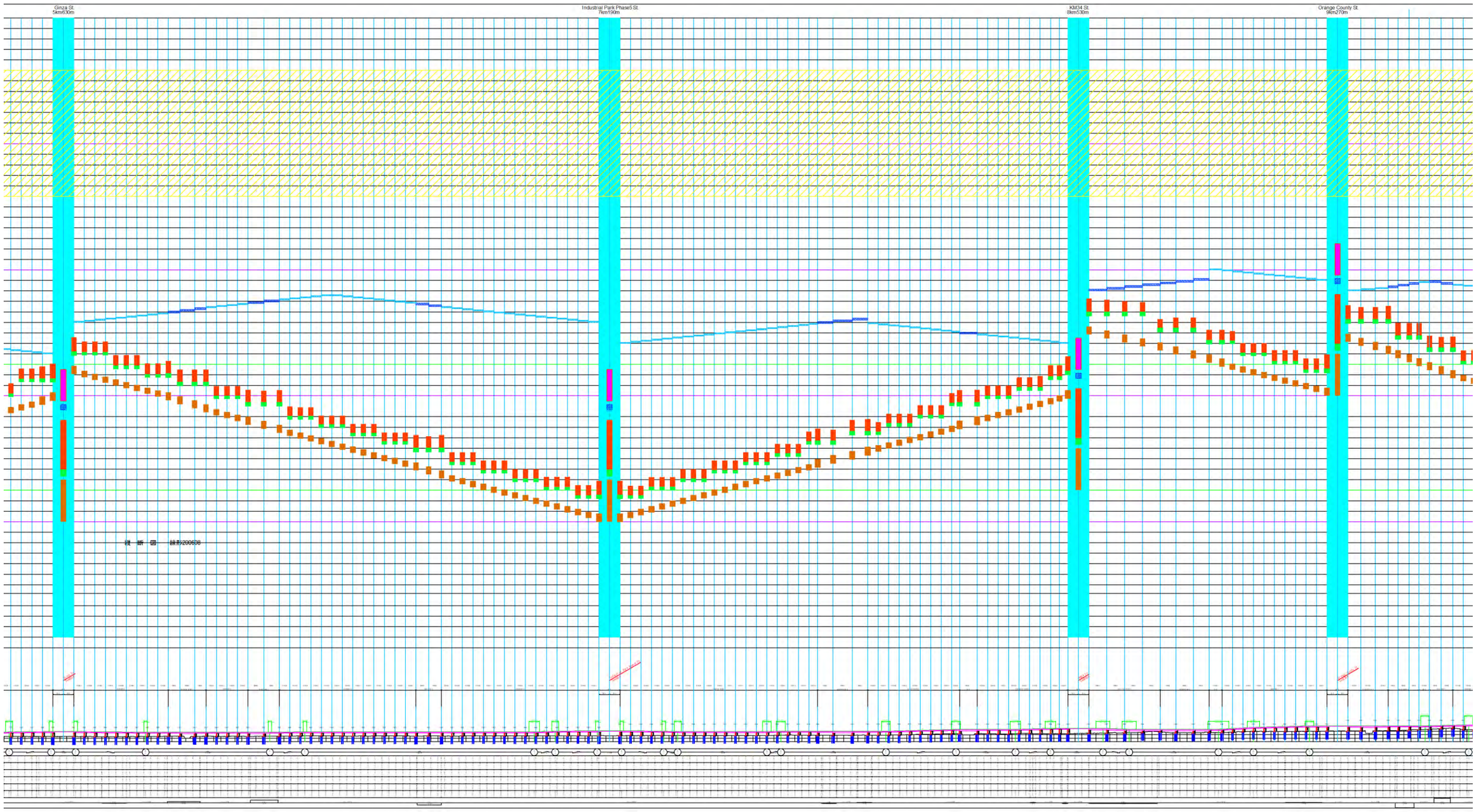
Source: JICA Study Team

Table 9-4: Entire Construction Work Schedule



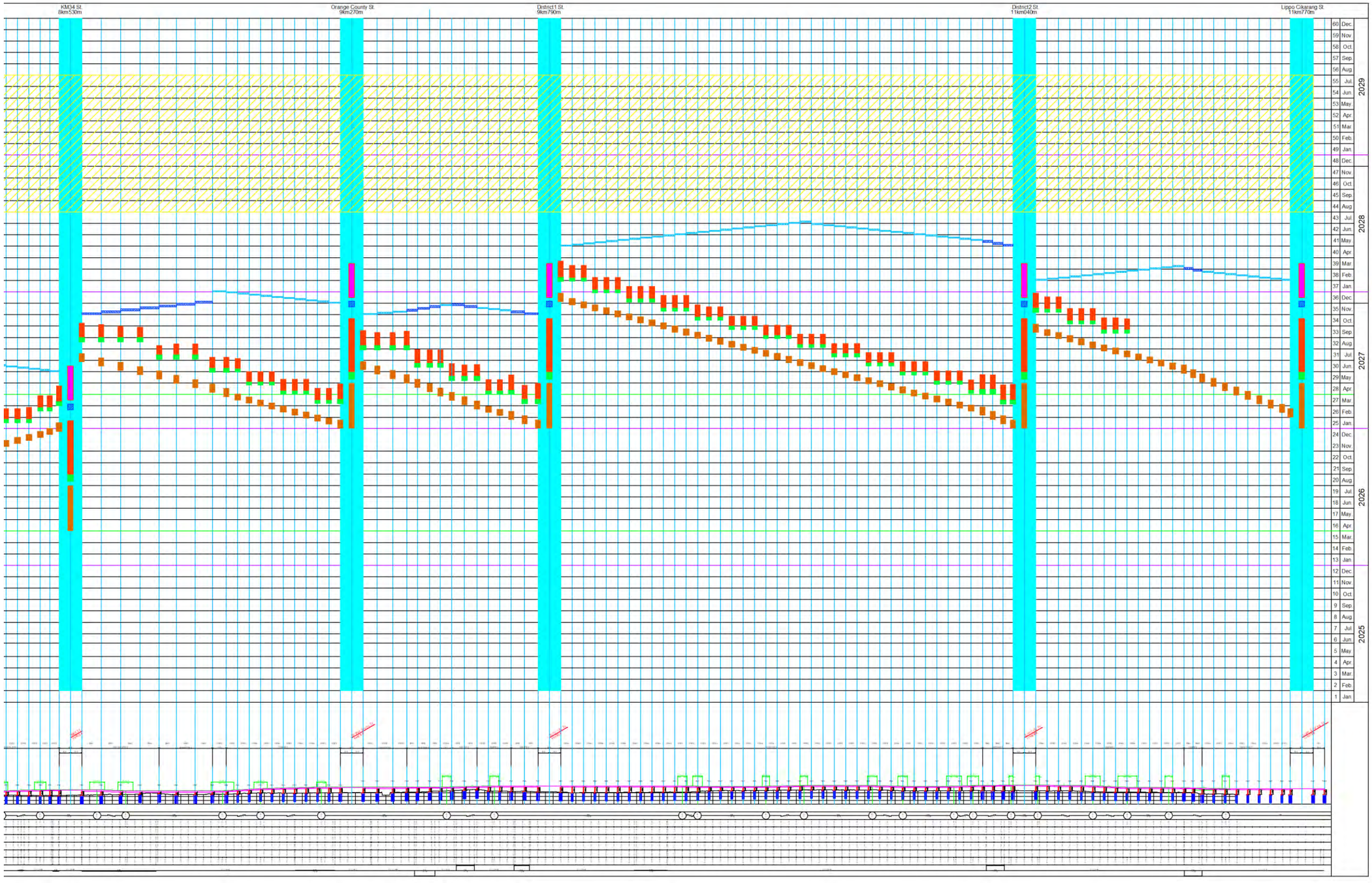
Source: JICA Study Team

Table 9-5: Entire Construction Work Schedule



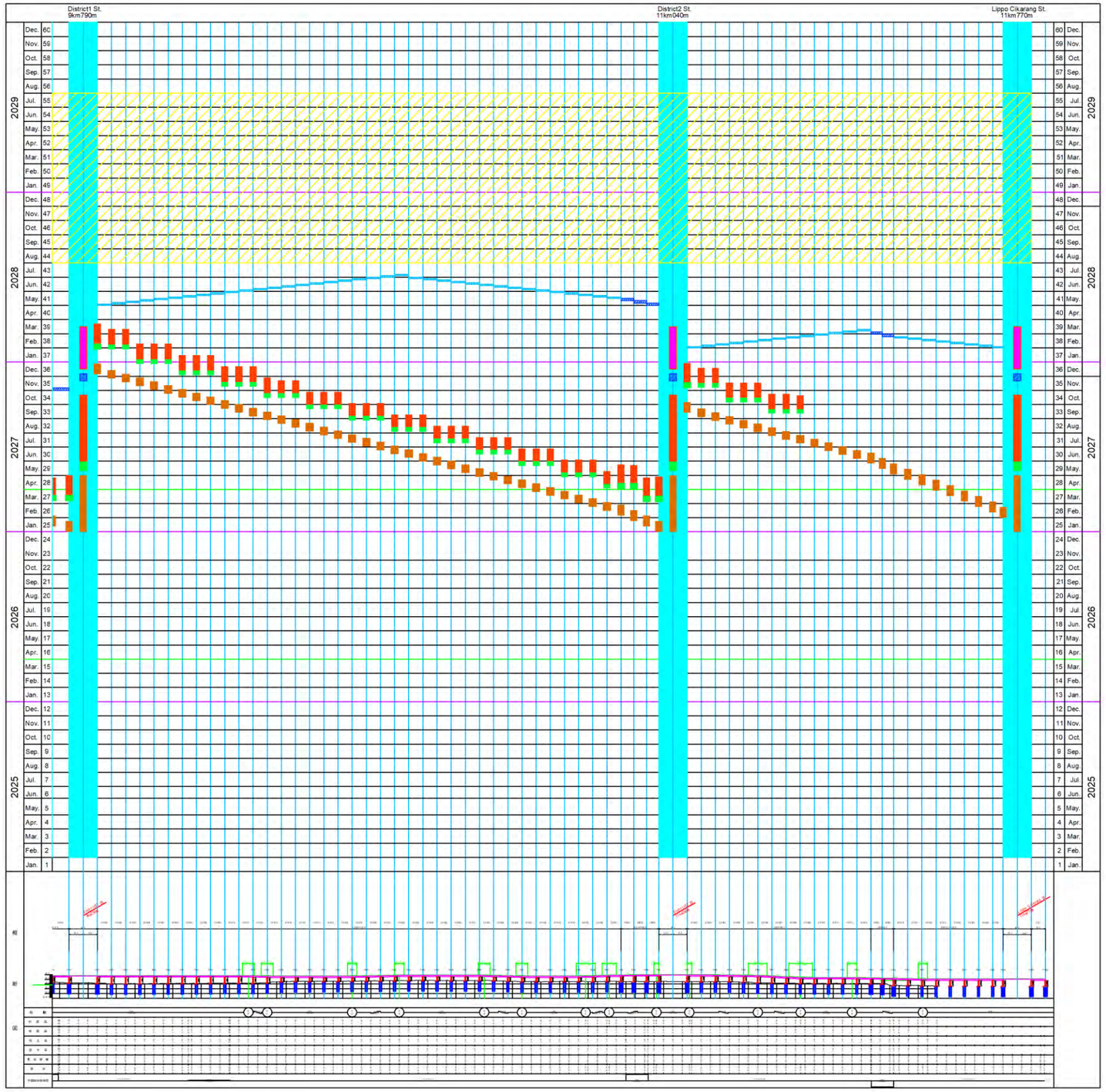
Source: JICA Study Team

Table 9-6: Entire Construction Work Schedule



Source: JICA Study Team

Table 9-7: Overall Construction Schedule



Source: JICA Study Team

10. Estimation of Project Costs

10.1 Base Case

10.1.1 Outline of Project Costs

The project costs shall consist of the construction costs of AGT such as civil works, rolling stock, E & M systems, etc. and other costs such as land acquisition costs, consultant fees and contingency costs. In addition, the costs of rolling stock are to be increased as demand increases in the future, and the associated construction costs such as the additional storage tracks in the depot shall be budgeted for in the next year.

Considering more economical construction methods and the allocation in the Phase 1 Study, the unit price of construction costs shall be divided into local currency (L/C) and foreign currency (F/C) based on the conditions of materials and equipment procurement within Indonesia.

The annual distributions of the project costs shall be considered by adding a value-added tax (VAT).

(1) Civil Work Costs

The civil work costs consist of preparation costs, superstructure costs, substructure costs, station building costs, depot construction costs and costs for environmental protection.

In the Phase 1 Study, the unit costs at the time of the "Indonesia Cikarang Multimodal New Transport System Implementation Plan Study Report (Ministry of Economy, Trade and Industry, February 2012) were reviewed and the civil work costs were estimated considering the tender prices of the Jakarta Urban Express Railway North-South Line Construction Project (Phase 1), which was being constructed at the time. In this study (the Phase 2 Study), based on the actual results of construction costs of the project, the civil work costs shall be estimated according to the structure size of AGT.

In addition, the approximate construction quantity of the viaduct on the main line and station sections shall be estimated after structure planning such as girder length and pier height according to the alignment plan. The number and length of the pile foundation shall be estimated by the results of MRT Jakarta and interviews.

(2) E & M Systems and Rolling Stock Costs

Based on similar cases in the past and results of projects with similar performance in other countries in recent years, the unit costs of E & M systems such as electrical equipment, signal and communication equipment, inspection and repair equipment for rolling stock, etc. shall be estimated, and the costs will be calculated.

In addition, the costs of rolling stock shall be estimated based on the preconditions which will be to manufacture rolling stock in Japan and export it to Indonesia. The amount of rolling stock shall refer to the results of the operation planning based on the route plan and demand forecast of this study in the case of the fare, 9,000 IDR.

(3) Land Acquisition Costs

Since the AGT route is planned to be constructed by utilizing the space over the existing roads or

the space over the roads to be constructed in the future, only the land cost for the depot (about 4 ha) shall be accounted for as a project cost.

(4) Consulting Fees

As consultant fees to support the implementation of this project by the project owner, 5% of the total civil work costs and E & M systems and rolling stock costs shall be budgeted and divided into local and foreign currency.

(5) Contingency Costs

5% of the construction costs (excluding land costs) and consultant fees shall be budgeted as contingency costs.

(6) VAT (Value-added Tax)

The rate of VAT shall be 10%, in accordance with Indonesian regulations.

(7) Exchange Rate and Base Year of Estimation

The exchange rate shall refer to the rate of May 2020, and the budget base is set based on May 2020 as well.

Indonesia Rupiah (IDR)/Japanese Yen (JPY): 137.51 IDR = 1.00 JPY

* Calculated based on International Financial Statistics (IFS/IMF)

10.1.2 Estimated Results of the Project Costs

The outline of the basic case's estimated project costs is shown in Table 10-1 and Table 10-2, and the annual distributions of the initial and additional estimated project costs for the basic case are shown in Table 10 3 and Table 10 4, and Table 10 5 and Table 10 6, respectively. The initial project costs are estimated to be 12.64 trillion IDR (91.9 billion yen), the additional project costs are 0.35 trillion IDR (JPY 2.5 billion), and the total project costs are 12.98 trillion IDR (JPY 94.4 billion).

Table 10-1: Outline of the Estimated Project Costs of the Base Case [IDR Notation]

(Unit: Billion IDR)

Year / Items	2024 ~ 2027 (Initial Costs)			2028 ~ 2047 (Additional Costs)			Grand Total (Total Costs)		
	F/C	L/C	Subtotal	F/C	L/C	Subtotal	F/C	L/C	Subtotal
Civil Works	683	3,472	4,156	3	18	21	686	3,491	4,177
E & M/Rolling Stock	4,883	1,296	6,180	264		264	5,147	1,296	6,444
13. Civil + E & M/RS	5,567	4,769	10,335	267	18	285	5,834	4,787	10,621
14. Land Acquisition		101	101					101	101
15. Consulting Fees	278	238	517	13	1	14	292	239	531
16. Contingency Costs	292	250	543	14	1	15	306	251	558
17. Total	6,137	5,359	11,496	295	20	315	6,432	5,379	11,811
18. VAT	614	526	1,139	29	2	31	643	528	1,171
19. Grand Total	6,751	5,885	12,636	324	22	346	7,075	5,907	12,982

Source: JICA Study Team

Note 1: The costs shown in the above table are not adjusted for inflation and price increases in the future.

Note 2: The land acquisition costs include only costs for the land of the depot.

Note 3: Consulting fee, contingency costs and value-added tax (VAT) are estimated as follows:
Consulting Fee = (3) * 5%; Contingency costs = ((3) + (5)) * 5%; VAT = ((3) + (5) + (6)) * 10%.

Table 10-2: Outline of the Estimated Project Costs of the Base Case in JPY

(Unit: Million JPY)

Year / Items	2024 ~ 2027			2028 ~ 2047 (Additional Costs)			Grand Total (Total Costs)		
	F/C	L/C	Subtotal	F/C	L/C	Subtotal	F/C	L/C	Subtotal
1.Civil Works	4,968	25,252	30,220	23	131	155	4,991	25,384	30,375
2.E & M/Rolling Stock	35,512	9,428	44,940	1,920		1,920	37,432	9,428	46,860
3. Civil + E & M/RS	40,480	34,680	75,160	1,943	131	2,075	42,423	34,811	77,235
4. Land Acquisition		737	737					737	737
5. Consulting Fees	2,024	1,734	3,758	97	7	104	2,121	1,741	3,862
6. Contingency Costs	2,125	1,821	3,946	102	7	109	2,227	1,828	4,055
7. Total	44,630	38,971	83,601	2,142	145	2,287	46,772	39,116	85,888
8. VAT	4,463	3,823	8,286	214	14	229	4,677	3,838	8,515
9. Grand Total	49,092	42,795	91,887	2,357	159	2,516	51,449	42,954	94,403

Source: JICA Study Team; Notes: see Table 10-1

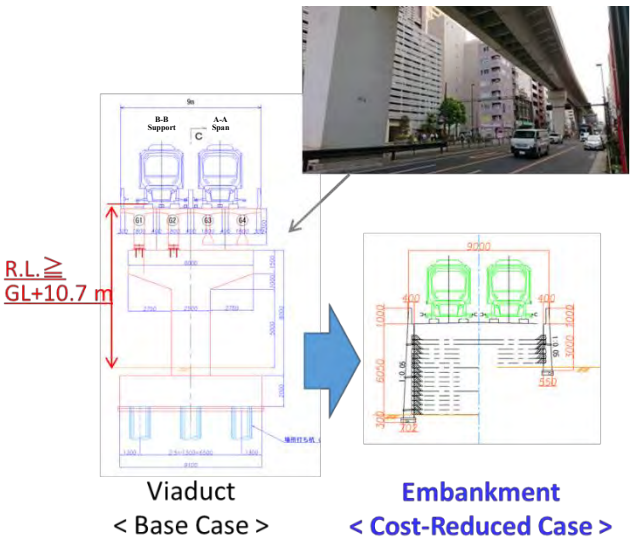
10.2 Cost-Reduced Case

10.2.1 Consideration of Cost Reduction

The study team is considering the following measures to reduce the project costs:

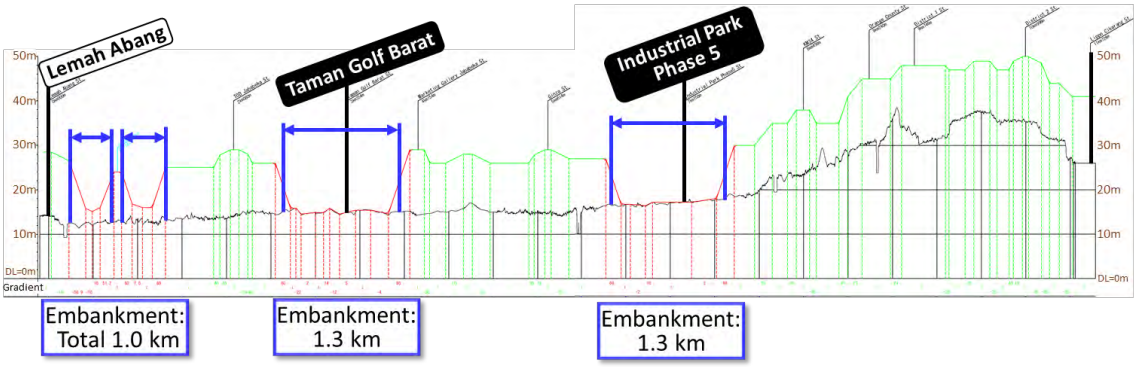
- To change the structure from a viaduct to an embankment in some sections (refer to the figures 10-1 and Figure 10-2). → To select three sections*, shown in Figure 10-3, considering the width of the central part of the roads and the presence of intersections, etc.

  Note: In these sections, however, we have to note that the areas will be divided by the structure of AGT.)
- To reduce concourse floors in elevated stations (refer to Figure 10-4)
- To simplify station equipment significantly such as PSD, Elevators (EV) and Escalators (ESC), (refer to Figure 10-4).
- To reduce the costs of rolling stock and signal & communication equipment by manual operation
- To reduce the amount of rolling stock.



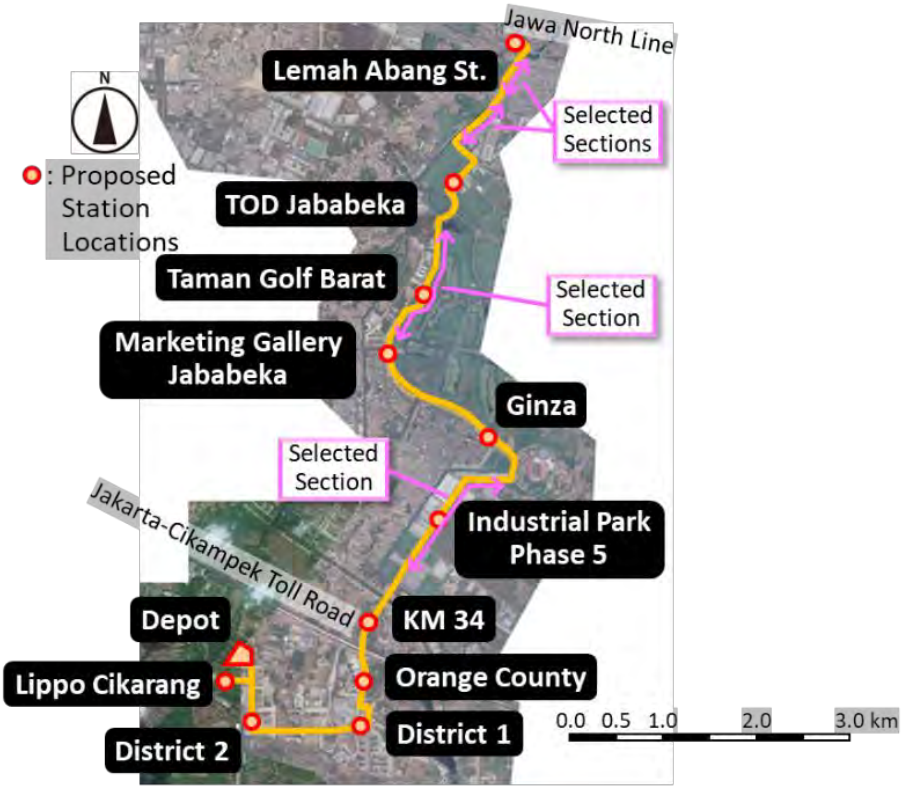
Source: JICA Study Team

Figure 10-1: Image of Structure Change from Viaduct to Embankment (Cross Section)



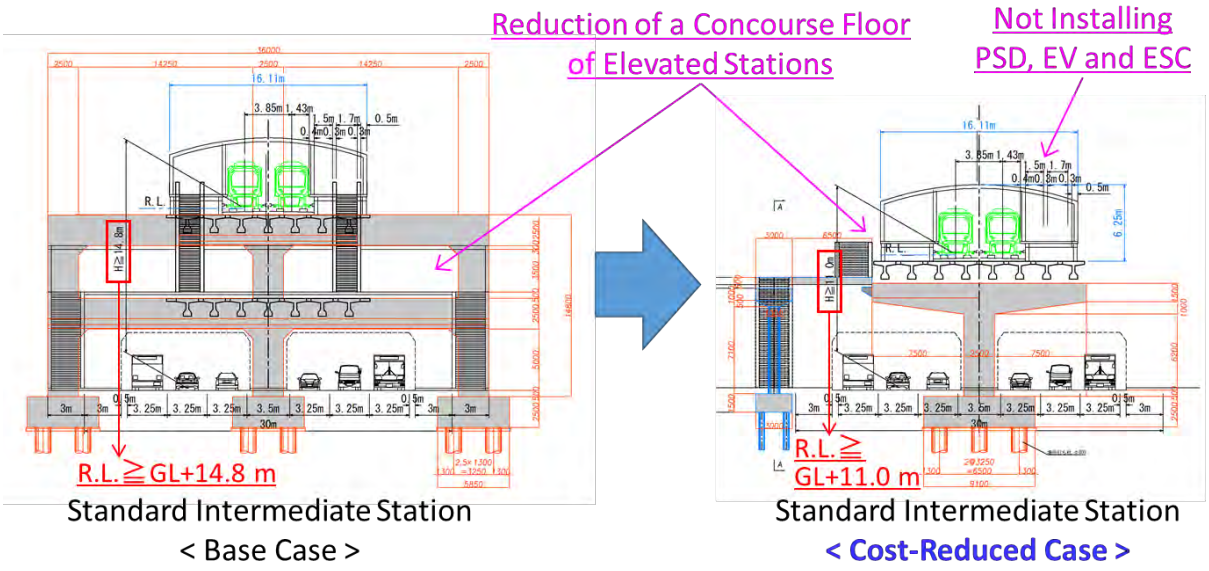
Source: JICA Study Team

Figure 10-2: Image of Structure Change from Viaduct to Embankment (Longitudinal View)



Source: JICA Study Team

Figure 10-3: Location of the Sections where the Structure Was Changed from Viaduct to Embankment



Source: JICA Study Team

Figure 10-4: Image of the Reduction of a Concourse Floor and the Simplification of Station Equipment at an Elevated Station

10.2.2 Estimated Results of the Project Costs

The outline of the estimated project costs in the cost-reduced case is shown in Tables 10-3 and 10-4.

The initial project costs are estimated to be 10.69 trillion IDR (77.7 billion JPY), the additional project costs are 0.33 trillion IDR (2.4 billion JPY), and the total project costs are 11.02 trillion IDR (80.1 billion JPY).

Table 10-3: Outline of the Estimated Project Costs in the Cost-Reduced Case [IDR Notation]

(Unit: Billion IDR)

Year / Items	2024 ~ 2027 (Initial Costs)			2028 ~ 2047 (Additional Costs)			Grand Total (Total Costs)		
	F/C	L/C	Subtotal	F/C	L/C	Subtotal	F/C	L/C	Subtotal
1. Civil Works	506	2,643	3,148	4	21	25	509	2,664	3,173
2. E & M/Rolling Stock	4,333	1,247	5,580	251		251	4,584	1,247	5,831
3. Civil + E & M/RS	4,839	3,890	8,728	255	21	276	5,093	3,911	9,004
4. Land Acquisition		101	101					101	101
5. Consulting Fees	242	194	436	13	1	14	255	196	450
6. Contingency Costs	254	204	458	13	1	14	267	205	473
7. Total	5,335	4,390	9,724	281	23	304	5,615	4,413	10,028
8. VAT	533	429	962	28	2	30	562	431	993
9. Grand Total	5,868	4,819	10,687	309	26	334	6,177	4,844	11,021

Source: JICA Study Team

Note 1: The costs shown in the above table are not adjusted for inflation and price increases in the future.

Note 2: The land acquisition costs include only costs for the land of the depot.

Note 3: Consulting fee, contingency costs and value-added tax (VAT) are estimated as follows:

Consulting Fee = (3) * 5%; Contingency = ((3) + (5)) * 5%; VAT = ((3) + (5) + (6)) * 10%.

Table 10-4: Outline of the Estimated Project Costs in the Cost-Reduced Case in JPY

(Unit: Million JPY)

Year / Items	2024 ~ 2027 (Initial Costs)			2028 ~ 2047 (Additional Costs)			Grand Total (Total Costs)		
	F/C	L/C	Subtotal	F/C	L/C	Subtotal	F/C	L/C	Subtotal
1.Civil Works	3,677	19,217	22,894	27	153	180	3,704	19,370	23,074
2.E & M/Rolling Stock	31,510	9,070	40,580	1,824		1,824	33,334	9,070	42,404
3. Civil + E & M/RS	35,187	28,287	63,474	1,851	153	2,004	37,038	28,440	65,478
4. Land Acquisition		737	737					737	737
5. Consulting Fees	1,759	1,414	3,174	93	8	100	1,852	1,422	3,274
6.Contingency Costs	1,847	1,485	3,332	97	8	105	1,944	1,493	3,438
7. Total	38,794	31,923	70,717	2,041	169	2,210	40,834	32,092	72,926
8. VAT	3,879	3,119	6,998	204	17	221	4,083	3,136	7,219
9. Grand Total	42,673	35,042	77,715	2,245	186	2,431	44,918	35,227	80,145

Source: JICA Study Team

Note 1: The costs shown in the above table are not adjusted for inflation and price increases in the future.

Note 2: The land acquisition costs include only costs for the land of the depot.

Note 3: Consulting fee, contingency costs and value-added tax (VAT) are estimated as follows:

Consulting Fee = (3) * 5%; Contingency = ((3) + (5)) * 5%; VAT = ((3) + (5) + (6)) * 10%.

11. Project Schedule

The planning schedule includes the preparation stage, construction stage, opening preparation stage, and opening. The project implementation schedule is shown in Table 11-1.

The preparatory stages such as licensing and financing will be completed by the beginning of 2024, and construction work will be carried out in about four years thereafter, with the plan to open in 2028.

AGT is the first such system to be introduced in Indonesia. At the same time, the railroad operation regulations for Indonesia will be prepared being based on examples from Japan and other neighboring countries.

Education and training are assumed to be conducted in advance in Japan where the AGT system has actually been operating.

Table 11-1: Project Implementation Schedule

Item \ Year	Term (Months)	2021	2022	2023	2024	2025	2026	2027	2028
1 Preparatory stage									
1-1 JICA PPP survey	9								
1-2 EIA	6								
1-3 Bids/contracts	6								
1-4 Project approval	1								
1-5 Technical approval	6								
1-6 SPC establishment	3								
1-7 Permission and license	3								
1-8 Fund procurement	3								
1-9 Acquisition of land	6								
1-10 Relocation of existing facilities	3								
2 Construction stage									
2-1 Preparatory work	3								
2-2 Detailed design	12								
2-3 Construction work	48								
2-4 Test run/delivery	12								
3 Opening preparation stage									
3-1 Establishment of the operating organization	8								
3-2 Preparation of operation rules, etc.	8								
3-3 Education and training	8								
4 Opening									

Source: JICA Study Team

12. Environmental Impact Assessment

12.1 Legal System for Environmental and Social Considerations

12.1.1 Basic Policies, Laws and Regulations Related to Environmental and Social Considerations

The inception of Indonesia's national policy on environmental protection was a report on its own environmental problems at the United Nation’s Conference on the Human Environment held in 1972. Based on the conclusions of this report, the Presidential Decree established the National Environment Committee, which formulated a national plan for natural resources and environmental conservation. The National Environment Committee also built the framework that works for both the nation’s outline and the national plan formulated every five years.

In 1982, the Basic Law on Environmental Management (Law No. 4 of 1982) was enacted, and in the same year, the Ministry of Population and Environment was established as a reorganization of the Ministry of Development and Environment, which also handles environmental administration. The Basic Law on Environmental Management was amended in 1997 and 2009, and the amendment of 2009 was promulgated as the Law on Environmental Protection and Management (Law No. 32 of 2009). It consists of a total of 17 chapters with 127 articles that contain general provisions, principles, objectives and targets, plans, use, management, (IEE-level) environmental management programmes and environmental monitoring programmes (Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan or the name of the IEE-level environmental impact assessment procedure, [UKL-UPL]), damage prevention, hazardous and toxic substances management, rights, obligations and prohibitions, public participation, supervision and administrative actions, handling of environmental disputes, investigations and proof, penalties and transitional measures.

Table 12-1 shows the basic policies, laws and regulations in the environmental and social considerations field in Indonesia.

Table 12-1: Major Laws and Regulations Relating to Environmental Considerations in Indonesia

Classification	Name of Law	Legal No.
General environmental issues	Environmental Protection and Management Law	Law No. 32/2009
	Draft of Technical Guidelines for the Environment, Land Expropriation, Relocation and Indigenous Peoples	Ministry of Public Works /2014
Environmental impact assessment	Ministerial Ordinance Concerning the Type of Project in Which an Environmental Impact Assessment Should Be Conducted	Ministerial Ordinance of the Environment No. 5/2012
	Ministerial Ordinance Concerning Guidelines on Methods of Implementation of Environmental Impact Assessment	Ministerial Ordinance of the Environment No. 8/2006
	Ministerial Ordinance on the Scale of Activities and Projects Subject to Environmental Impact Assessment	Ministerial Ordinance of the Environment No. 17/2001
	Government Ordinance Concerning the Environmental Impact Assessment System	Government Ordinance No. 27/2012
	Government Ordinance on SEA Procedures	Government Ordinance No. 46/2016
Land use	Forest Law	Law No. 41/1999
	Spatial Planning Law	Law No. 26/2007
Land acquisition	Act of Expropriation of Land and Real Estate	Law No. 20/1961
	Act of Land Expropriation for Public Works	Law No. 2/2012
	Government Ordinance on Land Registration	Government Ordinance No. 24/1997
Hazard and waste management	Waste Management	Law No. 18/2008
	Hazardous Waste Management	Government Ordinance No. 101/2014

Source: Prepared by the JICA Study Team based on the Profile of Environmental and Social Considerations in Indonesia (2011, JICA) and The Development and Implementation of the Legal System in Indonesia (2016, Ministry of the Environment).

12.1.2 Overview of Environmental Impact Assessment

The Environmental Impact Assessment in Indonesia is regulated by the Law on Environmental Protection and Management (No. 32/2006) which covers all stages of the project comprehensively, from initial planning to post-closure, including strategic environmental assessments (SEA), business environmental assessments and monitoring/environmental audits. In 2012, the Cabinet Order on Business Environmental Assessment Proceedings (Analisa Mengenai Dampak Lingkungan, [AMDAL]), UKL-UPL, and Environmental management plan (Surat Pernyataan Pengelolaan Lingkungan, [SPPL]) for environmental approval (Environmental Permit [EP] and Ordinance of the Ministry of the Environment (No. 05/2012) for Environmental Approval have been established, and the Cabinet Ordinance of SEA Proceedings (No. 46/2016) was formulated in 2016. However, resettlement and expropriation are separately regulated by the Act on Expropriation of Land and Real Estate (No. 20/1961), the Act on Land Expropriation for Public Works (No. 2/2012) and the Government Order on Land Registration (No. 24/1997).

(1) Environmental Impact Assessment Procedures

Indonesia's environmental assessment system is categorized into three sections: AMDAL level, UKL-UPL level and SPPL level. AMDAL level corresponds to EIA level, and UKL-UPL level corresponds to IEE level. The flow of the environmental impact assessment is shown in Figure 12-1, and the outline of each level is as follows.

a) AMDAL Level

AMDAL (Analisa Mengenai Dampak Lingkungan) stands for “Environmental Impact Analysis” in Indonesian. In the narrowest sense, the AMDAL refers to the "EIA (Environmental Impact Assessment) level" that is the strictest in the environmental impact survey. In this context, "EIA level" refers to the level at which alternatives, detailed projections, assessments, mitigation measures and monitoring plans for environmental impacts are implemented based on detailed field surveys.

The AMDAL level requires the development of an Environmental Impact Statement (Analisa Dampak Lingkungan [ANDAL]). The AMDAL level also requires an Environmental Management Plan and Environmental Monitoring Plan (Rencana Pengelolaan Lingkungan Hidup dan Rencana Pemantauan Lingkungan Hidup[RKL-RPL]).

b) UKL-UPL Level

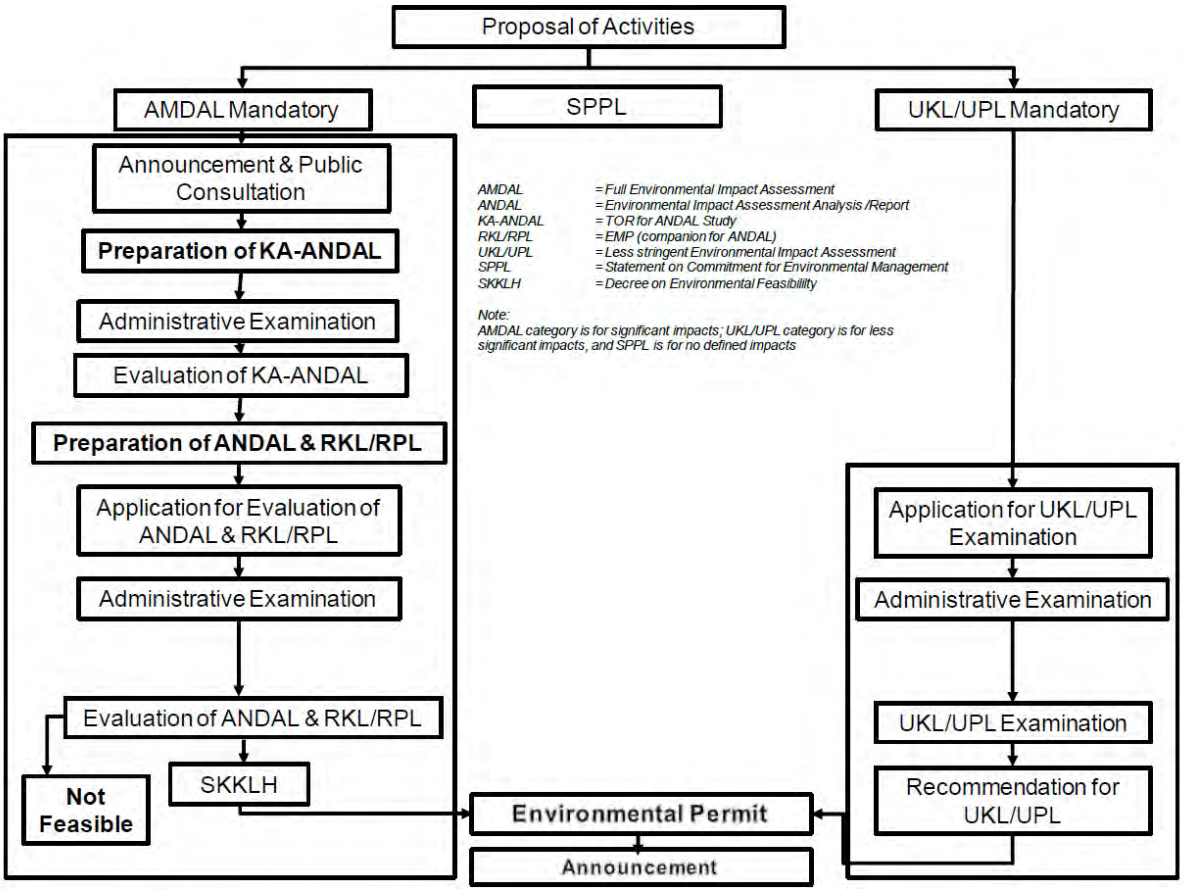
UKL-UPL (Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan) is the Indonesian term used to refer to the environmental management and environmental monitoring plan at a level more relaxed than the RKL-RPL described above, furthermore it is used for the environmental impact assessment at the "IEE (Initial Environmental Examination) level". The IEE level is implemented based on relatively readily available information such as existing data and on-site surveys as necessary for the studies of alternatives, predictions/evaluations, mitigation measures and monitoring plans. The UKL-UPL level requires the development of UKL and UPL.

However, the AMDAL category may be changed. This is at the discretion of local and central government agencies.

c) SPPL Level

SPPL is Indonesian words for "Environmental Management Plans."

At the SPPL level, procedures are completed only by submitting an environmental management plan (SPPL).



Source: Indonesia: Flood Management in Selected River Basins Sector Project (Draft), 2015, Ministry of Public Works, National Housing and ADB

Note 1 - Abbreviations:

- KA-ANDAL: Items to be Studied in EIA Report (TOR: Terms of Reference)
- RKL/RPL: Environmental Management Plan and Environmental Monitoring Plan (EIA level)
- UKL/UPL: Environmental Management Plan and Environmental Monitoring Plan (IEE level) or the name of the environmental impact assessment procedure at the IEE level
- SPPL: Name of the environmental management plan or the environmental impact assessment procedure that is sufficient for its submission.
- SKKLH: Laws and regulations pertaining to EFS (Environmental Feasibility Study).

Note 2: AMDAL category is for significant impacts; UKL/UPL category is for less significant impacts, and SPPL is for no defined impacts

Note 3: AMDAL level is where significant impact is anticipated, UKL-UPL level is where less than significant impact is expected, and SPPL level is where no impact is expected.

Figure 12-1: Flow of Environmental Impact Assessment Procedures

(2) AMDAL Requirements for the Transport Sector

The new transport system of this project meets the requirements stipulated in the Ministerial Ordinance on the Type of Project for Which the Environmental Impact Assessment Should Be Conducted (No. 5/2012): Specifically, the Transportation Sector F (Transportation Sector), 1. Railway construction (with or without station building) and c. Elevation: 5 km or more, as shown in Figure 12-2.

Accordingly, it is assumed that AMDAL procedures will be required for this project.

Table 12-2: AMDAL Requirements for the Transport Sector

Sector Name	Type and Size of Business
F. Transportation Sector (Transportation Sector)	1. Railway construction (with or without station) a. Ground: 25 km or more b. Underground: All c. Elevated: 5 km or more
	2. Construction of passenger and logistics terminals for road transportation: 5 ha or more
	3. Dredging a. Dredging volume: 500,000 m^3 or more b. Dredging in rock-and coral-free rivers or sea areas: using explosives for all sizes over 250,000 m^3 c. Disposal of dredged soil into the sea area: 500,000 m^3 or more or 5 ha or more
	4. Port and harbor development including any of the following: a. At least 200 m or 6,000 m^2 of board- or pile-type wharf b. Massive-construction wharf: all sizes c. Seawall or breakwater: 200 m or more d. Floating facilities: 10,000 DWT or more
	5. Airports and support facilities for fixed-wing aircraft: Runway: 1,200 m or more, or terminal: 10,000 m^2 or more

Source: Ministerial Ordinance No. 5/2012 on the type of project for which an environmental impact assessment should be conducted

12.1.3 Flow of AMDAL Procedure

If the project is classified as AMDAL level, the project proponent is required to prepare a project outline, terms of reference (TOR)/EIA, EIA report, environmental management/monitoring plan and hold a public consultation meeting. Table 12-3 shows the details to be written in the EIA Report.

Table 12-3: Major Information to be Included in EIA Report

Contents of the Environmental Impact Statement (ANDAL)
1. EIA plan (TOR/EIA) (1) Purpose of the project and the business operator (2) Scoping (3) EIA method (4) References (5) Attachment 2. Environmental Impact Statement (ANDAL) 3. Environmental management and monitoring plan (RKL-RPL)

Source: Ministerial Ordinance No. 16/2012 on Guidelines for Preparation of EIA Report (ANDAL), Environmental Management Plan (SPPL) and Environmental Management and Monitoring Plan (UKL-UPL)

The AMDAL procedure is stipulated in the Ministerial Ordinance No. 8/2013 on Guidelines on Methods of Conducting Environmental Impact Assessments. The business operator prepares the EIA Plan (TOR/EIA), the EIA Report (ANDAL), the Environmental Management/Monitoring Plan (RKL-RPL) and holds public hearings.

The flow of the procedure is shown in Figure 12-3, and the details of the procedure are shown as follows.

① The proponent submits a public notice/announcement of the business to the minister, the state governor, the prefectural governor or the mayor of the city.
② The business operator holds a public consultation. (may be conducted before ①).
③ The public may comment within 10 working days of the publication.
④ The proponent shall prepare the TOR/EIA and submit the TOR/EIA to the AMDAL Secretariat (Secretariat) under the jurisdiction of the examiner (Minister, State Governor, Prefectural Governor or Mayor).
⑤ Administrative review of TOR/EIA by AMDAL Secretariat
After passing the administrative review, the TOR/EIA is sent to the AMDAL Technical Review Team to modify the TOR/EIA in consultation with the Technical Review Team and the operator. The modified TOR/EIA is forwarded to the AMDAL Review Committee for consideration and approved if there is no problem.

⑥ The proponent conducts EIA surveys and prepares ANDAL (Environmental Impact Assessment Report) and RKL-RPL (Environmental Management and Monitoring Plan).

⑦ The proponent submits an Environmental Permit Application, ANDAL, and RKL-RPL to the AMDAL Secretariat, which has jurisdiction over the reviewer.

⑧ Administrative review by the AMDAL Secretariat

⑨ After passing the administrative review, the reviewer announces that it has received an environmental approval application from the proponent.

The public may submit comments within 10 business days of the publication.

⑩ AMDAL Technical Review Team reviews ANDAL and RKL-RPL

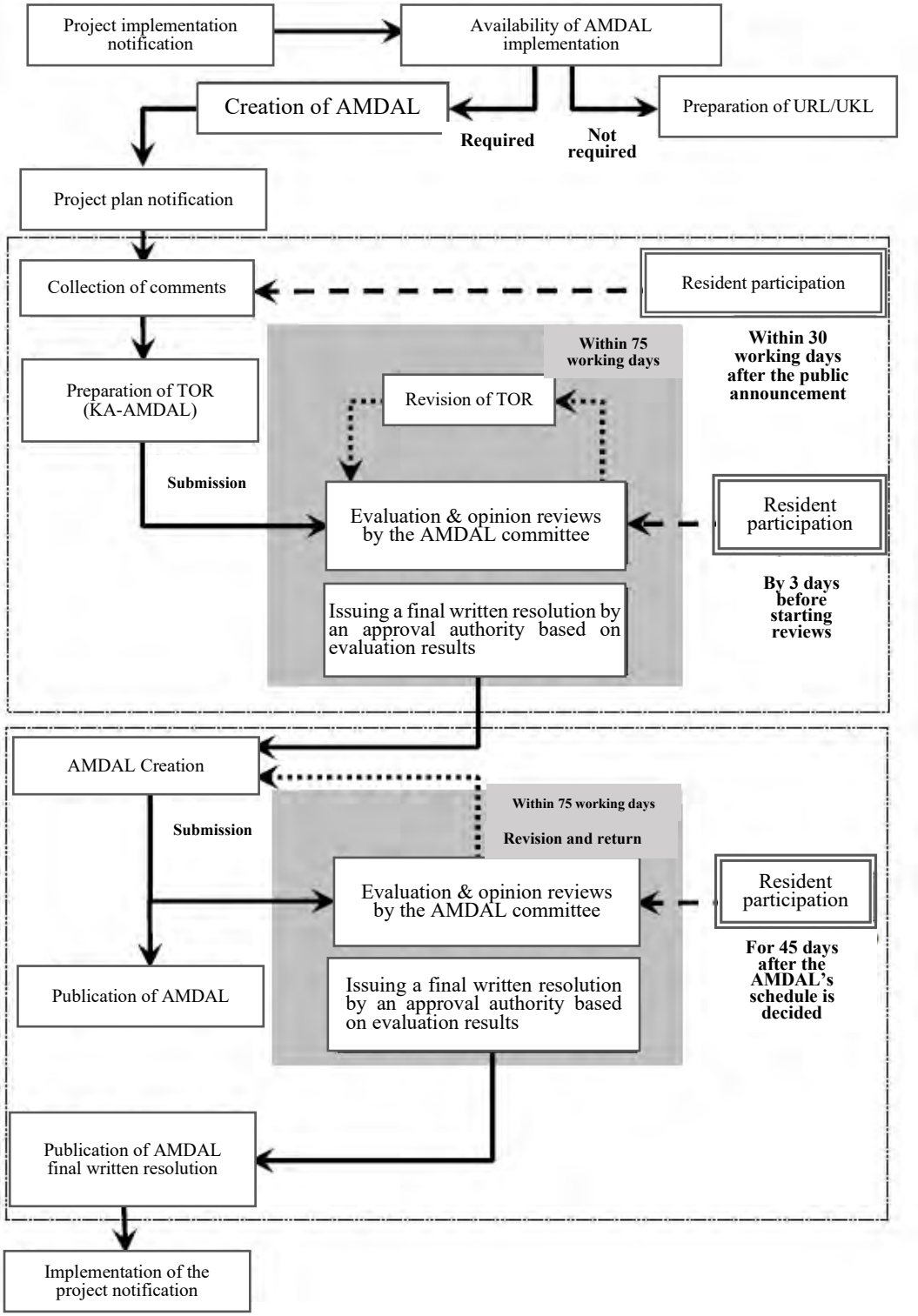
⑪ After the Technical Review Team confirms that the information and quality of ANDAL and RKL-RPL are adequate, the AMDAL Review Committee reviews ANDAL and RKL-RPL against the environmental acceptance criteria.

⑫ Based on the results of the review by the AMDAL Review Committee, the chairman of the AMDAL Review Committee submits the review results to the examiner (the Minister, the Governor of the State, the Governor of the Province or the Mayor of the City).

⑬ If the results of the review are proposed to be environmentally unacceptable, the examiner will not approve the project. If the results of the review are proposed to be environmentally acceptable, the examiner will approve the project and issues an environmental approval.

⑭ The examiner shall announce the issuance of the environmental approval.

The EIA's review procedures and issuance of environmental approvals may take up to 115 business days from filing to approval. TOR/EIA reviews will take a maximum of 30 business days, ANDAL and RKL-RPL reviews will last for a maximum of 75 business days and approval/non-approval decisions and issuance of certificates of approval will take fewer than 10 business days.



Source: Profile of Environmental and Social Considerations in Indonesia (2011, JICA)

Figure 12-2: Flow of AMDAL Procedures

12.2 Administrative Organization Related to Environmental Impact Assessment

The stakeholders associated with the AMDAL process are mainly the business operator, the business jurisdiction, the AMDAL Committee, the agency responsible for the environment as well as the approver, the vulnerable residents and Non-Governmental Organization (NGOs). The main roles of each stakeholder are as follows.

(1) Business Operator

Operators are responsible for planning and implementing projects. The project proponent is obliged to disclose the details of the project to the affected residents. In many cases, consultants employed by the operator conduct surveys in the AMDAL process.

(2) Business Jurisdiction

It is an administrative agency that has jurisdiction over the project and gives permission for operation. AMDAL is regarded as a necessary document for obtaining an operating permit, and the Environmental Management Law provides that administrative agencies must request a business operator provide information about environmental conservation and sustainable development, attaching AMDAL approval to the operating permit.

(3) AMDAL Committee

According to State of Environment Decree No. 5/2008, the AMDAL Commission is organized by the Minister of the Environment, the Governor of the state, the Governor of the province and the Mayor of the city, at the central or local level (at the provincial and municipal levels), respectively, for each project. The AMDAL committee is also called the Evaluation Commission, whose primary responsibility is to review the AMDAL documents such as, implementation plans (Kerangka Acuan Analisis Dampak Lingkungan [ANDAL]), RKL and RPL, and to present opinions and recommendations on the feasibility of the project and activity plan from the viewpoint of environmental protection to the approver at each level (the minister of the environment at the central level, the governor of the state at the provincial level, and the governors of the provincial and municipal governments at the provincial and municipal levels). The AMDAL Committee may establish technical teams composed of sectoral experts and a secretary office to receive assistance and technical knowledge on AMDAL documents for evaluation.

(4) Organization in Charge of Environment and the Authorizer

Based on the results of the review of the AMDAL document, the AMDAL Committee shall obtain approval of its proposals and considerations from the authorizer. The organization in charge of the environment is the government agency that supervises AMDAL. At the central level, it is the AMDAL Bureau of the Ministry of Environment and Forestry, and at the local level, it is the environmental authority (Badan Pengendalian Dampak Lingkungan Daerah [BAPEDALDA], etc.).

(5) Affected Population

Members of the community affected by the proposed operations or activities have the right to obtain information on the project, to make proposals, to comment and to be members of the AMDAL Committee.

(6) NGOs

Indonesian NGOs have the right to be members of the AMDAL Committee. The chairman of the AMDAL committee has appointed one organization for each project, taking into account the industry type of the project (mining development, road construction, etc.) since 1996. As a member of the AMDAL Committee, a nominated NGO can provide input on behalf of the wider community's interests.

13. Land Acquisition Plan

13.1 Basic Framework for Land Acquisition

The procedure for acquiring land for public works in Indonesia has been implemented on the basis of the Basic Land Law No. 5 of 1960. However, the law does not provide details of the procedures for expropriation of land. In addition, due to the lack of the ability of the land acquirers to perform the procedures, and the disapproval of the land providers due to disagreement on price, difficulty in identifying the landowners, etc., in reality, it was not easy to acquire land.

Despite the fact that Presidential Decree No. 36 of 2005, made compulsory expropriation for the acquisition of land for public works possible, the Presidential Decree and its amendment, Presidential Decree No. 65 of 2006, did not have the opportunity to be applied sufficiently due to inadequacies in related systems and the unclear procedures. Thus, the expropriation of land has been a major factor that has impeded infrastructure development in Indonesia so far.

In response to this situation, a new Land Expropriation Law was enacted in 2012. In addition, relevant Presidential Decrees No. 71 of 2012, the National Land Agency's Decree No. 5 of 2012, the Ministry of Interior's Decree No. 72 of 2012, and the Ministry of Finance's Decree No. 13 of 2013, have been developed and enforced, and the improvement of legal systems have made progress to a certain degree to facilitate the acquisition of land for new projects in the future.

The Land Exploitation Law provided for a series of the procedures, the authorities responsible for these procedures and the duration of the handling of each procedure for expropriation of land. Specifically, there are four processes for acquiring land for public works: 1) planning, 2) preparation, 3) implementation, and 4) transfer of rights. On paper, the procedure for expropriation of land can be completed no later than 583 days after the date when the developer submits the plan of the project to the governor of the province.

Under the Land Expropriation Law, institutionally, the responsible organization for "3) implementation" and "4) transfer of rights" shall be the Ministry of Agrarian Affairs and Spatial Planning (hereinafter referred to as "ATP"), being left out of the power of developers, the province, the prefecture, the city, etc. However, because the ATP does not have enough know-how, human resources, organizational structures and materials necessary for land exploitation at present, land exploitation continues to be a major factor that impedes infrastructure development. Therefore, the ATP is required to rapidly strengthen its capacity in order to ensure the reliable and quick acquisition of land for public works, and JICA technical co-operation projects are being implemented from 2018 to 2022.

The Ministry of National Spatial Planning (Agraria dan Tata Ruang [ATR]) was established in 2015 in order to strengthen spatial planning. The ATP was established by integrating related bureaus of the Ministry of Public Works, which had been in charge of spatial planning into the national land agency (Badan Pertanahan Nasional [BPN]), which had overseen land registration. Since the authority of the local government has expanded associated with decentralization, the ATP will manage the work related to spatial planning, including the coordination of interests among local governments, the improvement of the planning capacity of local governments, the formulation and implementation of plans, etc. However, its implementations will be carried out by the Ministry of Public Works and

Public Housing and other ministries and agencies.

13.2 Land Acquisition Plan for This Project

The route of AGT is planned to be constructed utilizing almost entirely the space over the existing roads or the new roads to be constructed in the future although the space over the existing railway in the section of Lemah Abang Station and the river in the section of the south side of Lemah Abang Station. The depot is also planned to utilize undeveloped land owned by a local developer (Lippo).

Since the roads through which the AGT route passes are in the development area of the local developers (Jababeka and Lippo), the ownership of the roads is with the local developers. In addition, local developers also own the land for the depot. Thus, it is necessary to coordinate with local developers concretely in order to secure the land necessary for this project. But there are no inhabitants living on the land, and it is not necessary to relocate them.

14. Estimation of Greenhouse Gas Reductions

14.1 Greenhouse Gas (GHG) Reduction Effect

14.1.1 Collection of Data Necessary for Quantitative Assessment of Greenhouse Gas (GHG) Reduction Effects

The railway construction in the urban area of Cikarang City promotes a modal shift from existing transportation systems such as motorcycles, automobiles and buses to AGT which is considered to have the effect of easing congestion and reducing air pollution, as well as the effect of reducing greenhouse gas (GHG) emissions.

(1) Method for Estimating GHG Reduction

The main method for estimating the reduction in GHG emissions caused by a modal shift from existing transportation systems such as motorcycles, automobiles and buses to AGT is adopted from "3. Alleviation of Congestion on Roads, Bridges, Railways, etc. (passengers)" in the JICA Climate Change Finance Impact Tool (JICA Climate-FIT) Version 3.0 (July 2019).

The estimation of congestion alleviation (passenger) by JICA Climate-FIT is calculated by subtracting GHG emissions (project emissions) at a point of modal shift from GHG emissions (baseline emissions) “Baseline emissions” means when existing transportation systems (buses, private cars, motorcycles, etc.) are used continuously.

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reductions resulting from project implementation in Year Y (t-CO_2e/y)

BE_y : GHG emissions under the baseline scenario in Year Y (t-CO_2e/y)

PE_y : GHG emissions under the project scenario in Year Y (t-CO_2e/y)

The outline of the estimation method for baseline emissions and project emissions in JICA Climate-FIT is as follows.

a) Estimating the Baseline Emissions

i) Basic Concept of Baseline Emissions

Baseline emissions are GHG emissions calculated by taking the same number of passengers that currently ride the AGT, and assuming that they were using transport systems that existed before the AGT (i).

ii) Formula for Baseline Emissions

Baseline emissions are calculated by multiplying the annual passenger-kilometer (or the number of passengers multiplied by the average travel distance by the railroad) by the CO_2 emission factor per passenger-kilometer if no railway (Transportation i) is used. The calculation formula is as follows.

$$BE_y = \sum_i \left(\frac{P_y \times MS_{bi,y}}{OR_{bi}} \times BTDP_{by} \times SFC_i \times NCV_i \times EF_{fuel,i} \right)$$

$$= \sum_i \left(\frac{P_y \times MS_{bi,y}}{OR_{bi}} \times BTDP_{by} \times EF_{KM,i} \right)$$

P_y	: Number of passengers on the AGT in year y of AGT
$BTDP_{by}$	: Mean ride distance (km) of AGT in year y of AGT
$MS_{bi,y}$	: Share (%) of transportation i in year y
OR_{bi}	: Average Riding Rate of Transportation i (Passengers/Vehicles)
$EF_{KM,i}$	: CO_2 emission factor per kilometer of transportation i (t-CO_2/km)
SFC_i	: Fuel consumption rate of transportation i (t/km)

b) Calculating Project Emissions

i) Basic Concept of Project Emissions

Since the railway in this project is powered by electricity, the project emissions are calculated by multiplying the annual electricity consumption of the railway, after the project has started operation, by the CO_2 emissions factor of electricity.

ii) Formula for Project Emissions

Project emissions are calculated by multiplying the annual electricity consumption of railways after they have started operation by the CO_2 emissions factor of electricity.

$PE_y = ECPJ,y \times EF_{elec}$

ECPJ, y : Annual Power Consumption (MWh/year) associated with AGT operation in y year
EF_{elec}: CO_2 Emissions Factor of Electricity (t-CO_2/MWh)

(2) Data Used in the Estimation of GHG

a) Baseline Emissions

For the estimation of baseline emissions in this project, the values shown in Table 14-1, which are obtained from the demand forecast results and the existing survey results, are used.

Table 14-1: Data Used for Baseline Emissions

Data	Data Details		2028	2031	2052	2070	Notes
P_y:	Annual numbers of project users (persons/year)		18,700,000	24,900,000	30,200,000	33,600,000	Based on the results of demand forecasting for this project (Set fare: 9,000 IDR)
$BTDP_{by}$:	Average distance traveled by project users (Km)		4.63				Data by demand forecasting
$MS_{bi,y}$:	Share of Transportation i, without implementation of the project (%).	Motorcycles	61.5				Set based on the results of the household survey in this project Motorcycle: Motorcycle (50.8%), Motorcycle carpooling (10.7%) Car: car (14.8%), cars with two or more passengers (2.1%), Grab (0.3%), Gojek (2.2%) Bus: Bus (0.1%) Jeepney/RTV: Angkot (2.9%)
		Cars	19.4				
		Buses	0.1				
		Jeepney/RTV	2.9				
$EF_{KM,i}$:	Transportation i's CO2 emission factor per kilometer (tCO2 / km vehicles)	Motorcycles	0.0000459				JICA Climate-FIT standard values (Appendix 7)
		Cars	0.0003041				
		Buses	0.0013379				
		Jeepney/RTV	0.0003041				
OR_{bi} :	Average vehicle occupancy rate of Transportation i, without implementation of the project (person/vehicle)	Motorcycles	1.21				Based on the results of the household survey in this project
		Cars	1.06				
		Buses	10.00				
		Jeepney/RTV	6.00				

Source: JICA Study Team

b) Project Emissions

The values shown in Table 14-2 based on the project plan and JICA Climate-FIT are used for the estimation of project emissions in this enterprise.

Table 14-2: Data Used for Project Emissions

Data	Data Details	2028	2031	2052	2070	Notes
SFC_{PJ}:	Annual electricity consumption used by project activities (MWh/year)	9,531	9,847	10,163	10,479	Estimated project value
EF_{elec} :	Average CO2 emission factor for all sources of grid electricity (t-CO2/MWh)	0.713				JICA Climate-FIT standard value (Appendix 3)

Source: JICA Study Team

14.1.2 Estimation of GHG Reduction

As shown in Table 14-3, the amount of greenhouse gas reductions in this project was estimated using JICA Climate-FIT.

Table 14-3: Estimated Greenhouse Gas Reductions

	2028	2031	2052	2070
BE_y : Baseline annual emissions (t-CO_2/yr)	6,977	9,291	11,268	12,537
PE_y: Project annual emissions (t-CO_2/year)	6,796	7,021	7,246	7,471
ER_y: Annual emission reductions (t-CO_2/yr) = BE_y-PE_y	**181**	**2,270**	**4,022**	**5,066**

Source: JICA Study Team

II. Business Plan

15. PPP Scheme and Institutional Analysis

15.1 Identification of GCA and Implementation Unit

The Government Contract Agency (GCA) of this project will be handled by the Ministry of Transportation (MOT), and the Implementing unit will be handled by the Jakarta Metropolitan Area Transportation Agency (BPTJ).

Legally, the Government of West Java and the Government of Bekasi Regency can also be candidates for GCA, but in the discussions with the Government of West Java and Bekasi Regency in this phase, technical support in various application processes can be expected, however, it is mentioned that financial support will be limited from these organization, and MOT can be the only realistic option for the GCA to promote this project.

15.2 Relevant Ministries and Institutions

The expected stakeholders from the public sector are shown in Table 15-1.

Table 15-1: List of Public Stakeholders

Stakeholders	Roles
GCA (Ministry of Transportation)	➢ GCA is responsible to conduct project preparation, procurement of business entity, and monitoring of the project implementation. ➢ GCA is also responsible to provide Availability Payment (AP) to SPC during the PPP Agreement period.
BPTJ	Developing Jabodetabek Transportation Masterplan.
Ministry of Finance (MOF)	➢ Regulating and supervising infrastructure guarantee and AP process. ➢ Granting approval and supervising of AP implementation. ➢ Regulating and implementing PDF ➢ Granting approval of state asset utilization.
Bappenas	➢ Planning and budgeting of APBN. ➢ Regulating and supervising PPP implementation.
National Procurement Agency (LKPP)	Regulating and supervising implementation of PPP transaction.
Ministry of Land and Spatial Plan/BPN	Regulating and supervising the implementation of land acquisition for public interest.
Indonesian Investment Coordinating Board/BKPM	➢ Conducting market sounding of PPP Project. ➢ Issuing investment license, including Investment Activity Report (LKPM).
Online Single Submission (OSS) Agency	Issuing business license to the SPC.
West Java Provincial Government	Issuing Location Determination for land acquisition purposes.
Bekasi Regency Government	➢ Issuing operational license. ➢ Preparing Regional Railway Masterplan.
Indonesia Infrastructure Guarantee Fund (IIGF)	Providing Government Guarantee to the project.

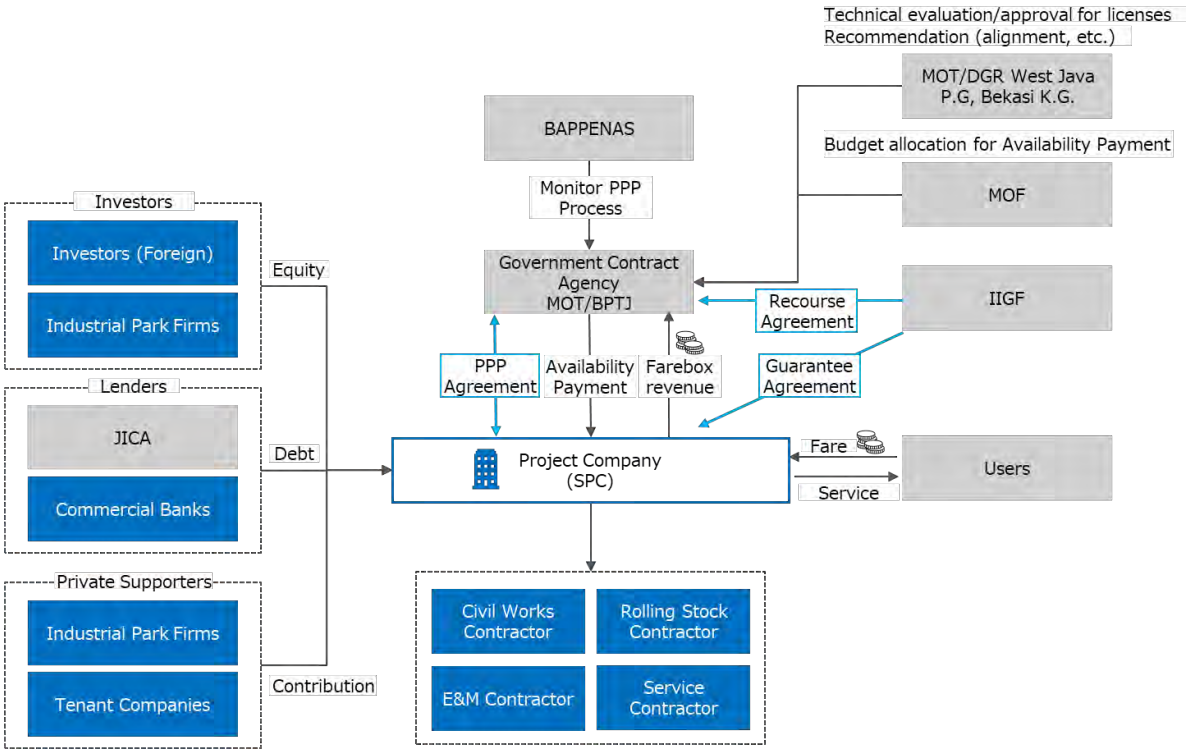
Source：JICA Study team

Note：

National Procurement Agency (LKPP)
Online Signal Submission (OSS)
Indonesia Investment Coordinating Board (BKPM)
Investment Activity Report (LKPM)

15.3 PPP Scheme

To promote the project, the expected Public Private Partnership (PPP) scheme is as follows;



Source：JICA Study team

Figure 15-1: PPP Scheme

This will be a green field railway project, and it will be extremely difficult for Indonesian and overseas investors to take the ridership risk given the nature of project risk. Therefore, as critical requirement for business development, Availability Payment should be granted under the PPP contract concluded between the government and the business Special Purpose Company (SPC), and it is necessary to have a scheme in which the ridership risk is attributed to the public side.

In addition, since Availability Payment is a prerequisite, budget approval by the Ministry of Finance (MOF) and liability guarantee by Indonesia Infrastructure Guarantee Fund (IIGF) must be secured.

15.4 Decision Making Process

The decision-making process is as follows:

Table 15-2: Decision Making Process

Decision	PIC	Requirements
Formation of GCA Organization	GCA	To ensure the coordination between preparation and implementation of the project, also the implementation of rights and liabilities of GCA, GCA shall form an organization of PPP project, which consists of: i) PPP Team; ii) procurement committee; iii) PPP node. Formation of project organization is determined through Ministry of Transportation Decree.
Project preparation implementation	GCA	➢ In this phase, GCA is supported by PPP Team to prepare Pre-Feasibility Study, public consultation, market sounding, land acquisition plan, obtainment of government support and/or government guarantee, and environment study (if the project needs AMDAL) ➢ PPP Project preparation is conducted by PPP Team, which has a function as steering committee for project preparation until financial close. During the implementation, PPP Team ensures that project preparation is carried out according to schedule and also supervises experts carrying out project preparation. ➢ The steering committee oversees and provides direction and also acts as the implementation supervisor for Coordination Team in the PPP project preparation.
Market Sounding	GCA	GCA conducts market sounding in the transaction phase, which aims to obtain input, response, and find stakeholder interests. This activity is carried out through one-on-one meetings and the
PPP Location Determination	GCA	Location determination for PPP is done after location determination for land acquisition. Whereas, for state/regional-owned land for the PPP implementation will follow mechanism of management of state/regional asset in accordance with prevailing regulations. In this case, GCA submit a location determination request based on regulations and carry out before PQ process. GCA shall ensure: i) conformity of land acquisition planning document and resettlement related to the PPP project to obtain location determination, and ii) PPP has obtained environmental permit.
Formation of procurement committee	GCA	➢ Procurement committee is formed by the Minister of Transportation as GCA through the issuance of Minister of Transport Decree. ➢ Procurement committee has roles and responsibilities to prepare and carry out procurement process of PPP at the transaction phase. The Steering Committee provides direction and oversees the performance of PPP project transactions.
Confirmation of PPP readiness	Procurement Committee	Procurement Committee shall fill the checklist of the PPP readiness document/data referring to Bappenas Regulation 4/2015 and LKPP Regulation 29/2018.
Market Confirmation	Procurement Committee	Can be done in several forms, such as review the results of Market Sounding conducted by GCA or carry out discussion with business entity forum.
Arrangement of procurement schedule	Procurement Committee	Proper time shall be allocated to conduct every phase of procurement.

Determination of procurement document and its amendment (if any)	Procurement Committee	➢ Based on GCA approval. ➢ Approval to the amendment in procurement document is provided no later than 5 working days after the amendment is proposed by procurement committee. If the GCA does not provide a response during the period of time, GCA is deemed not to approve the amendment.
Objection evaluation and re-PQ determination (if any)	Procurement Committee	Based on the cause of PQ failure.
Submission of proposals	Procurement Committee	Proposals consist of administrative and technical proposal (envelope I) and financial proposal (envelope II)
Submission of proposals	Procurement Committee	Proposals consist of administrative and technical proposal (envelope I) and financial proposal (envelope II)
Opening of envelope I proposals	Procurement Committee	➢ The opening of envelope I proposal is carried out by procurement committee in front of the participants at the specified time and place. ➢ The opening of envelope I proposal shall be recorded in the Minutes of Evaluation of the Phase I proposals and recognized by all procurement committee and witnesses. Copies of the minutes of opening the bidding documents are distributed to all participants.
Evaluation results of envelope I proposals	Procurement Committee	➢ Procurement committee will carry out evaluation of envelope I proposals submitted according to the evaluation methodology as stated in the RFP document. ➢ Procurement committee will determine a certain numerical value to meet each technical requirement.
Opening of envelope II Proposals	Procurement Committee	Opening of envelope II proposals shall be recorded in the minutes of proposal opening and be signed by all procurement committee and witnesses. Copies of the minutes of opening the bidding documents are distributed to all participants.
Evaluation results of envelope II proposals	Procurement Committee	➢ Procurement committee evaluates envelope II proposals submitted in accordance with the evaluation methodology as described in the Request for Proposal (RFP). ➢ Minutes from the evaluation of envelope II proposals shall be authorized by at least two-thirds of the procurement committee members.
Minutes of Tender Result	Procurement Committee	Recognized by at least two-thirds of the procurement committee members.
Determination of winning bidder	GCA	According to the minutes of tender result, procurement committee prepare and submit a report to the GCA to determine the winning bidder.
Announcement of procurement result	Procurement Committee	Based on the winner determined by the GCA, the Procurement Committee announces the results of the tender offer to all participants via e-mail, and is shown at the location of the GCA and / or newspaper in accordance with the specified schedule.
Responding to the Objection	GCA	Written response to objection is provided by the GCA no later than 10 working days after the objection is received. If the GCA does not provide an answer within this period, the GCA is deemed to have rejected objections. If the objection is declared correct by the GCA, the GCA will re-evaluate or state that the bid has failed.
Letter of Award	GCA	➢ The GCA issues winning bidder letter based on following conditions: ➢ There is no objection from the participants;

		➢ All objections have been declared incorrect; ➢ The winning bidder has extended the guarantee letter, which is valid until the PPP Agreement is signed; ➢ GCA issues the winning bidder letter no later than 7 working days after the objection process ends.
Appointment Letter for winning bidder as PPP Project Implementer	GCA	The letter shall be issued within 10 days after the issuance of winning bidder letter.

Source: JICA Study Team
Note: Request for Proposal (RFP)

16. Socio-Economic Analysis

16.1 Analysis Approach

According to PPP BOOK 2020 published by Bappenass, the Pre-Feasibility Study during the preparation period for PPP projects in Indonesia is divided into two stages: OBC (Outline Business Case) and FBC (Final Business Case). The analysis results of the "Economic and commercial study" are required to be submitted in both the OBC and FBC processes, but the detailed calculation method is not specified. Therefore, in this analysis, the preconditions and calculation methods were set based on the preconditions and calculation method practices of the socio-economic analysis conducted by Deloitte Indonesia in the Medan LRT project, which is the preceding PPP project.

16.2 Assumptions of Socio-Economic Analysis

16.2.1 Assumptions

(1) Project Period

The project period of this project will be 24 years from 2024 to 2047.

- Construction period is 4 years (April 1, 2024-December 31, 2027)
- Operation period is 20 years (January 1, 2028-December 31, 2047)

(2) Inflation

Inflation rate is set at 3.6% / year. Uses the average of the Economist Intelligence Unit (EIU) forecasts for 2021-2023 (acquired in August 2020).

(3) Social Discount Rate

Socio Discount Rate is set at 9.0%, referring from Asian Development Bank. Guidelines for the economic analysis of projects (2017).

16.2.2 Calculation Method for Economic Benefit

(1) Summary of Economic Benefit Calculation Process

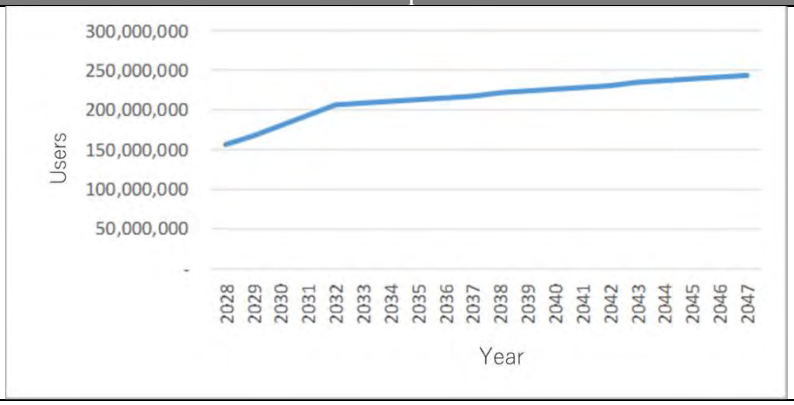
In this socio-economic analysis, the number of AGT users was assumed through the traffic demand model, and the time cost saving effect of AGT users was calculated. In addition, assuming a decrease in the use of cars and motorcycles in Bekasi City, the effect of reducing vehicle running costs and the effect of reducing greenhouse gas emissions, also due to the decrease in the use of cars and motorcycles were calculated.

In addition, a real estate price effect around each AGT station is expected, and the increase in real estate price is expected to be an economic benefit. This is similar to the fact that the effect of increasing real estate prices was included in the economic benefits of Medan Light Rail Transit (Medan LRT), which is a leading PPP project in Indonesia, and the effect of increasing real estate prices is expected in this project as well.

(2) Time Cost Saving Effect

The time cost saving effect is calculated by multiplying the difference in travel time between the case where this project is carried out (With) and the case where this project is not carried out (Without) by the time value basic unit. For the time value intensity, preconditions were set on the basis of the minimum wage and the rate of increase in wages.

Table 16-1: Time Cost Saving Effect

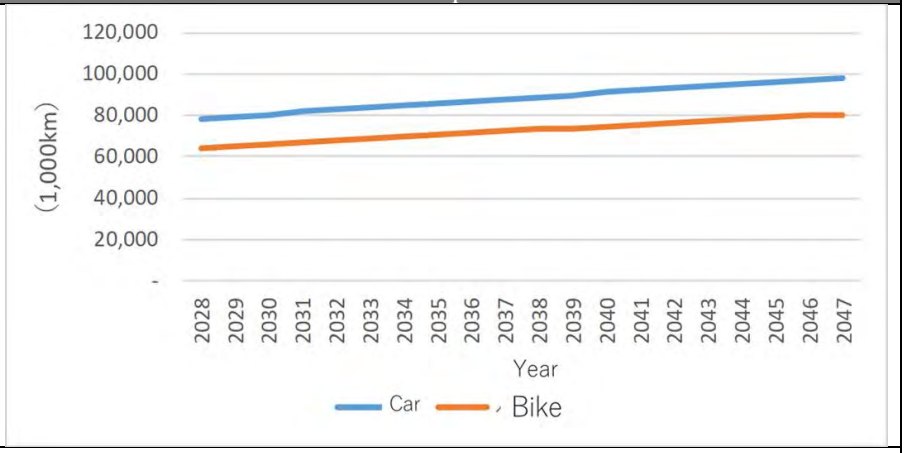
	Assumption
Annual Users	
Average Reduction Time	3.15min/Trip
Minimum Wage in Bukasi (2020)	4,498,961 IDR
Growth Rate of Minimum Wage (CAGR 2016-2020)	8.37%

Source: JICA Study Team

(3) The Effect of Reducing Vehicle Running Costs

The vehicle running cost reduction effect is calculated from the gasoline price and fuel consumption for the difference obtained by subtracting the vehicle mileage when this project is carried out (With) from the vehicle mileage when this project is not carried out (Without). Calculated by multiplying the running cost.

Table 16-2: Assumption of Vehicle Running Costs

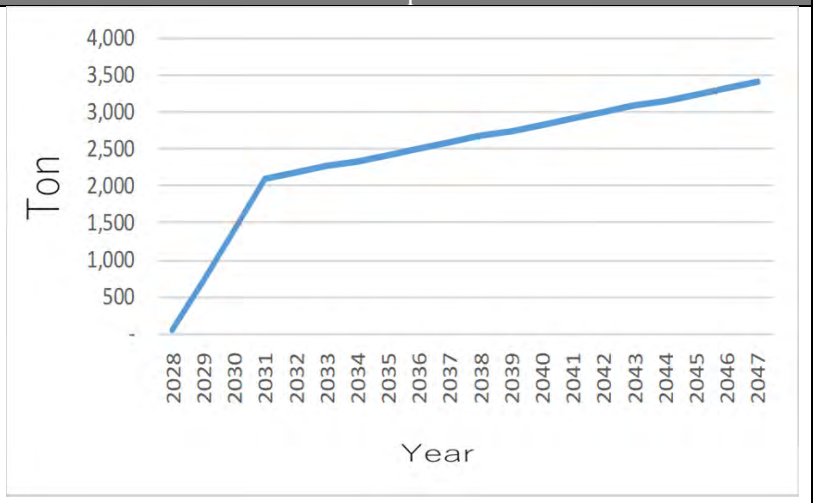
	Assumptions
Annual Distance Reduction (Difference between Without case and With case)	
Gasoline Price	7,650 IDR/Liter（2020）
Fuel Efficiency	Car: 0.12 litter/km Bike: 0.09litter/km Source: Natural Resources Canada

Source: JICA Study Team (for more information on gasoline prices, refer to “Fuel Price Update on Feb 1st 2020” on the above website of PT Pertamina, the state-owned oil and natural gas mining company in Indonesia; and for fuel efficiency, refer to Natural Resources Canada.)

(4) Reduction in Greenhouse Gas Emission

The greenhouse gas reduction effect is calculated in the difference between the greenhouse gas emissions when this project is not carried out (Without) and the greenhouse gas emissions when this project is carried out (With), multiplying by the gas transaction price.

Table 16-3: Assumption of Reduction in Greenhouse Gas Emission

	Assumption
Annual Reduction (Difference between Without case and With case)	
Co2 transaction price/to	10USD Source: "State and Trends of Carbon Pricing 2019," World Bank

Source: JICA Study Team (for CO2 trading price/ton, refer to State and Trends of Carbon Pricing 2019 [World Bank]).

(5) Real Estate Development Effect

Regarding the real estate development effect, we set assumptions that the land price will increase for 5 years after the start of operation around each AGT station and assume the price increase as an economic effect. Following the fact that the effect of increasing real estate prices was included in the study of economic benefits of Medan LRT, the effect of increasing real estate prices shall be expected in this project as well.

Table 16-4: Assumption of Real Estate Development Effect

	Assumption
Increase in Real Estate Price	Price increase will be expected in 11 Station×Radius 300m from 2028 to 2033, 5 years after commercial operation
Real Estate Price in East Cikarang	Land area: 3,082,408 IDR (2020) Building area: 6,533,584 IDR (2020) (20% of land is Building area, 80% of the land is Land area) Source：rumah.com
Price Escalation Rate	17.56%/year

Source: JICA Study Team

16.2.3 Calculation Method for Economic Cost

The assumptions for Capital Expenditure (CAPEX) and Operation Expenditure (OPEX) are referring from the base case in financial analysis. The economic cost is calculated by deducting VAT from CAPEX and OPEX and then multiplying the non-tradable goods (domestic portion) by the economic cost conversion factor 0.85.

Table 16-5: Assumption of Economic Cost

	Assumption
CAPEX	Exclude VAT from CAPEX used in financial analysis Consider SCF for Indonesian domestic potions
OPEX	Exclude VAT from CAPEX used in financial analysis Consider SCF for Indonesian domestic potions
Conversion Factor (SCF)	0.85 Source: Feasibility Study of Jakarta MRT Station Development Project

Source: JICA Study Team

Note: Social Economic Conversion Factor (SCF)

16.3 Analysis Result

The annual economic benefits and costs are as follows. In terms of benefits, the effect of saving time costs is the largest, followed by the effect of raising real estate prices. CAPEX accounts for about two-thirds of the total cost.

Table 16-6: Result of Socio-Economic Analysis

(Unit：million IDR)

	Time Saving Effect	Vehicle Running Cost Effect	Greenhouse Gas Emission Reduction Effect	Real Estate Development Effect	Total Benefit	CAPEX	OPEX	Total Cost
2024	0	0	0	0	0	-3,017,638	0	-3,017,638
2025	0	0	0	0	0	-3,952,528	0	-3,952,528
2026	0	0	0	0	0	-4,094,819	0	-4,094,819
2027	0	0	0	0	0	-1,855,931	0	-1,855,931
2028	389,882	8	152,856	2,639,208	3,181,954	0	-212,513	-212,513
2029	453,552	111	160,496	2,734,219	3,348,378	0	-220,163	-220,163
2030	525,701	213	168,488	2,832,651	3,527,053	0	-228,089	-228,089
2031	607,342	316	176,846	2,934,627	3,719,132	0	-236,300	-236,300
2032	699,601	328	185,589	3,040,273	3,925,791	-148,349	-246,140	-394,489
2033	765,170	341	194,659	0	960,170	0	-255,001	-255,001
2034	836,758	353	204,142	0	1,041,253	0	-264,181	-264,181
2035	914,910	365	214,055	0	1,129,330	0	-273,692	-273,692
2036	1,000,217	378	224,418	0	1,225,012	0	-283,545	-283,545
2037	1,093,325	390	235,249	0	1,328,964	0	-293,752	-293,752
2038	1,195,206	402	246,625	0	1,442,233	0	-304,327	-304,327
2039	1,306,399	415	258,514	0	1,565,328	-148,349	-317,225	-465,574
2040	1,427,743	427	270,941	0	1,699,111	0	-328,646	-328,646
2041	1,560,151	439	283,927	0	1,844,517	0	-340,477	-340,477
2042	1,704,618	452	297,497	0	2,002,566	0	-352,734	-352,734
2043	1,860,728	464	311,425	0	2,172,616	0	-365,432	-365,432
2044	2,030,918	476	325,970	0	2,357,364	0	-378,588	-378,588
2045	2,216,442	489	341,159	0	2,558,090	0	-392,217	-392,217
2046	2,418,666	501	357,020	0	2,776,186	0	-406,337	-406,337
2047	2,639,075	513	373,580	0	3,013,168	0	-420,965	-420,965
Total	25,646,403	7,380	4,983,455	14,180,978	44,818,215	-13,217,613	-6,120,325	-19,337,938

Source: JICA Study Team

The Economic Internal Rate of Return (Economic IRR) calculated based on the results in the above table is 10.04%, which exceeds the social discount rate of 9% set in this survey, and the social cost benefit ratio (B / C), (calculated in Table 16-7, ① / ②) is 1.25. Since it exceeds 1.0, this project is considered to be a highly effective project from a socio-economic point of view.

Table 16-7: Benefit and Cost Result

Benefit	Discounted Present Value (million IDR)	Nominal Value (million IDR)
Time Cost Saving Effect	4,925,032	25,646,403
Vehicle Running Reduction Effect	1,090,718	4,983,455
Greenhouse Gas Emission Reduction Effect	1,552	7,380
Real Estate Development Effect	5,998,169	14,180,978
Total	(①) 12,015,471	44,818,215
Cost	Discounted Present Value (million IDR)	Nominal Value (million IDR)
CAPEX	8,245,102,	13,217,613
OPEX	1,381,693	6,120,325
Total	(②) 9,626,795	19,337,938

Source: JICA Study Team

Table 16-8: Result of Economic IRR and B/C

Indications	Result
Economic IRR	10.04%
B/C	1.25

Source: JICA Study Team

17. VFM Analysis

17.1 Analysis Approach

According to PPP BOOK 2020 published by Bappenass, the Pre-Feasibility Study during the preparation period for PPP projects in Indonesia is divided into two stages: OBC (Outline Business Case) and FBC (Final Business Case). Both the OBC and FBC processes are required to submit the analysis results of the "Economic and commercial study", but the details are not specified. Therefore, in the Medan LRT project, which is the preceding PPP project, Value for Money (VFM) analysis was performed in addition to socio-economic analysis, so VFM analysis was also carried out in this project.

The assumptions and calculation methods were set based on the experiences of Deloitte Indonesia in the Medan LRT project.

17.2 Assumption

17.2.1 Calculation Method of VFM

Assuming a PPP project, the government will bear the Availability Payment, but if it is implemented as a public project, the government will bear the construction cost CAPEX and the operating cost OPEX. VFM is calculated to examine whether government spending will be reduced when this project is implemented as a PPP project compared to when it is implemented as a public project.

Table 17-1: Case Comparison in VFM Analysis

Case	Government Expenditure
[PPP Case] Project will be implemented in PPP scheme	Government expenditures are Availability Payments paid to businesses during the operating period and management costs incurred in PPP projects.
[PSC* Case] Project will be implemented in public works *Public Sector Construction	Fiscal spending is the cost of raising funds to cover construction costs CAPEX and operating costs OPEX and CAPEX.

Source: JICA Study Team

17.2.2 Assumption of VFM Analysis

(1) Project Period

The project period of this project will be 24 years from 2024 to 2047.

- Construction work period is 4 years (April 1, 2024-December 31, 2027)
- Operation period is 20 years (January 1, 2028-December 31, 2047)

(2) Inflation

Inflation rate is set at 3.6% / year. Uses the average of the Economist Intelligence Unit (EIU) forecasts for 2021-2023 (August 2020).

17.2.3 Government Expenditure in [PPP Case]

If this project is implemented as PPP project, it is assumed that the government will bear the Availability Payment and also bear various management costs in implementing the PPP project.

Table 17-2: Government Expenditure of PPP Project

	Assumption
Availability Payment	Government spends Availability Payment during operation (See financial analysis base case)
Management Cost	- OBC and FBC preparation process - GCA contract manager costs - Guarantee fees

Source: JICA Study Team

17.2.4 Government Expenditure of [PSC Case]

When this project is a public works, it is assumed that the government will bear the construction cost CAPEX and operating cost (OPEX), and will bear the financing cost to cover the construction cost (CAPEX).

Table 17-3: Government Expenditure of Public Project

	Assumption
CAPEX, OPEX	See base case in financial analysis
Funding Cost	It is assumed that the government will issue 20-year government bonds to raise funds for CAPEX that will be generated before the start of operations. JGB yield is set at 7.5% (using Indonesia's 20-year JGB yield as of August 19, 2020)

Source: JICA Study Team

17.3 Result of Analysis

The annual government expenditures for PPP case and PSC (public sector construction) case are as follows. In the [PPP case], the average government expenditure is generated every year after the start of the project. On the other hand, in the [PSC case], a very large amount of CAPEX expenditure is incurred before the start of the business, and the amount of government expenditure in financing costs is large.

Table 17-4: Case Comparison and Analysis Result

(Unit：million IDR)

	[PPP Case]			[PSC Case]			
	Availability Payment	Management Cost	Total	CAPEX	OPEX	Funding Cost	Total
2024	0	105,326	105,326	3,622,250	0	272,614	3,894,864
2025	0	84,533	84,533	4,672,404	0	624,264	5,296,667
2026	0	87,576	87,576	4,840,610	0	988,573	5,829,183
2027	0	38,758	38,758	2,127,599	0	1,148,698	3,276,297
2028	2,388,828	12,377	2,401,206	0	238,783	1,148,698	1,387,481
2029	2,397,424	12,394	2,409,819	0	247,379	1,122,248	1,369,628
2030	2,406,330	12,412	2,418,742	0	256,285	1,093,808	1,350,093
2031	2,415,556	12,431	2,427,987	0	265,511	1,063,227	1,328,738
2032	2,452,570	17,210	2,469,780	264,441	302,525	1,030,344	1,597,310
2033	2,463,461	12,470	2,475,930	0	313,415	994,987	1,308,402
2034	2,474,744	12,490	2,487,234	0	324,698	956,969	1,281,667
2035	2,486,433	12,511	2,498,944	0	336,388	916,089	1,252,476
2036	2,498,543	12,533	2,511,076	0	348,498	872,133	1,220,630
2037	2,511,089	12,556	2,523,645	0	361,043	824,868	1,185,911
2038	2,524,086	12,580	2,536,666	0	374,041	774,046	1,148,087
2039	2,540,360	18,701	2,559,061	338,725	390,314	719,400	1,448,439
2040	2,554,411	12,630	2,567,041	0	404,366	660,640	1,065,006
2041	2,568,968	12,656	2,581,624	0	418,923	597,459	1,016,382
2042	2,584,049	12,683	2,596,733	0	434,004	529,522	963,526
2043	2,599,674	12,712	2,612,385	0	449,628	456,472	906,101
2044	2,615,860	12,741	2,628,601	0	465,815	377,925	843,740
2045	2,632,630	12,771	2,645,401	0	482,584	293,466	776,050
2046	2,650,003	12,802	2,662,805	0	499,957	202,650	702,607
2047	2,668,001	12,835	2,680,836	0	517,956	105,000	622,955
Total	**50,433,020**	**578,690**	**51,011,710**	**15,866,029**	**7,432,113**	**17,774,099**	**41,072,241**

Source: JICA Study Team

The government expenditure in terms of the discounted present value of [PPP case] is about 22% less than that of [PSC case] (calculated by ① / ② in Table 17-5). The result was that it was supported to be implemented as a PPP project. However, government expenditure (nominal value) shows that the [PPP cases] cost more (see Table 17-5).

Table 17-5: Government Expenditure

	Public Expenditure (Nominal)	Government Expenditure (Discounted)
[PPP Case]	51,011,710	15,527,933 (①)
[PSC Case]	41,702,241	19,855,520 (②)

Source: JICA Study Team

18. Financial Analysis

In this section, we will conduct a financial analysis as to whether or not this project will be financially viable. As will be described later in this section, the annual Availability Payment in the base case was approximately 18.3 billion yen, which deviated from the expected value of BPTJ, so we conducted scenario analysis with the assumptions where CAPEX can be significantly reduced by reducing the scope of the PPP business.

18.1 Analysis Approach

According to PPP BOOK 2020 published by Bappenas, the Pre-Feasibility Study during the preparation period for PPP projects in Indonesia is divided into two stages: OBC (Outline Business Case) and FBC (Final Business Case). Financial analysis results will also be submitted during the process, but the preconditions and calculation methods for this analysis will be set based on the practices of projects in which Deloitte Indonesia has been involved in the past (including projects at the FBC stage).

The amount of AP was set by back-calculating the level that satisfies the minimum dept service coverage ratio (DSCR) set as the borrowing condition and the target Equity Equity Internal Rate of Return) IRR, following the precedent in the case involving Deloitte Indonesia. According to Deloitte Indonesia, the minimum DSCR varies from sector to sector within the range of 1.0 to 2.0 based on the precedent cases in LRT projects that Deloitte Indonesia is aware of. It was set in 1.2 as a prerequisite for this case. In addition, the target Equity IRR level was set at the 10% level based on market sounding in the LRT projects that Deloitte Indonesia , and in this case it is set at 14% based on precedent and similar transportation PPP projects in Indonesia. The residual value at the end of the operating period was assumed to be 0 in the LRT projects, and cash-in at the end of the operating period cannot be expected. Regarding the debt-to- equity ratio, it is said that there are many cases of 70:30 or 80:20 in Indonesian PPP projects, and in this case it is set at 80:20.

As another precondition, the inflation rate was set to take into account a certain inflation rate throughout the operating period in accordance with the precedent cases of Deloitte Indonesia's involved projects. In addition, the corporate tax rate has been also calculated at 25% for this project, based on the local tax system and the fact that Deloitte Indonesia has conducted financial analysis at 25% for previous projects in which it has been involved.

18.2 Assumption

18.2.1 Base Case Assumption

(1) Project Period

The project period of this project will be 24 years from 2024 to 2047.

- Construction work period is 4 years (April 1, 2024-December 31, 2027).
- Operation period is 20 years (January 1, 2028-December 31, 2047)

(2) Inflation

Inflation rate is set at 3.6% / year, referencing the average from the British research institute, Economist Intelligence Unit (EIU) forecasts for 2021-2023 (acquired in August 2020).

(3) Currency Exchange Rate

Set with JPY = IDR137.51. The exchange rate as of May 2020 obtained from the International Monetary Fund 's (IMF) International Financial Statistics (IFS) is used. It is the same exchange rate used to calculate CAPEX and OPEX.

(4) Discount Rate

Set at 7.6%, referencing Indonesia's 10-year government bond yield as of May 1, 2020.

(5) Tax Rate

Set at 25% as corporate tax.

(6) Financial Conditions

a) General

Debt to Equity Ratio is 80% form debt and 20% from equity.

b) Debt conditions

The loan portion of the financing will be borrowed by non-recourse loan. Initial investment costs Foreign currency potions will be procured in yen-denominated loans, and initial investment costs will be procured in rupiah-denominated local currency potions.

- JPY Facility

  Expecting to fully utilize JICA OIL Loan with Nippon Export and Investment Insurance (NEXI) Covered facility for 70% of loan amounts with interest rate 3%, construction period 4years and repayment period 20 years.
- IDR-denominated financing

  30% of the loan amounts will be procured from local lenders in IDR with 8% of interest, 4 years of construction period, and 20 years of the repayment period.
- Minimum DSCR is set at 1.20, the average value applicable to AP cases in developing countries.

c) Equity

Target Equity IRR is 14%.

(7) Tariff Revenue

Since we are assuming a business scheme with Availability Payment, the tariff revenue does not affect the financial analysis result, but we utilize the tariff revenue for comparison between the Availability Payment and tariff revenue to study the necessity of Availability Payment.

- Tariff is set at IDR 9,000/per head with inflation rate 3.6%/year with every 3 years of tariff revision.
- For the number of passengers, we used the demand forecast data when the tariff is set at IDR 9,000 / person (using the demand forecast results of this survey).

(8) CAPEX (excluding inflation rate)

Table 18-1: Base Case CAPEX Assumption

	million IDR	million Yen
Civil Works	4,176,909	30,375
E & M and Rolling Stocks	6,443,803	46,860
Land Acquisition	101,300	737
Consultant Fees	531,036	3,862
Contingency	557,587	4,055
VAT	1,170,933	8,515
Total CAPEX	12,981,568	94,403

Source: JICA Study Team

(9) OPEX

Table 18-2: Base Case OPEX Assumption

	million IDR	million Yen
OPEX（2028~2031)	179,939	1,309
Annual OPEX (2032~2038)	197,899	1,439
Annual OPEX（2039~)	199,333	1,450
Total OPEX	3,899,046	28,359

Source: JICA Study Team

18.3 Analysis Result

Based on the above prerequisites, the cash flow model was updated and the Availability Payment amount was adjusted to secure about 14% of the target Equity IRR. The results are as follows.

18.3.1 Result of Base Case

(1) Outlines of Base Case

If the total CAPEX is 12,982,568 million IDR (about 94.4 billion yen) and the total OPEX is 3,899,046 million IDR (about 28.4 billion yen) (as described in the prerequisites), the total Availability Payment is 50,433,020 million IDR (about 366.8 billion yen) shown in Table 18-3.

Table 18-3: Base Case Financial Result

	million IDR	million Yen
Availability Payment	50,433,020	366,754
OPEX (Inflation Adjusted)	▲7,432,113	▲54,047
Depreciation	▲15,596,683	▲113,421
Interest Payment	▲8,071,227	▲58,695
Corporate Tax Payments	▲5,063,796	▲36,824
Net Income	14,260,201	103,767

Source: JICA Study Team (▲: negative/loss)

(2) Fund Raising

The loan amount is expected to be 12,948,038 million IDR (about 94.1 billion yen), and the investment amount is expected to be 3,237,010 million IDR (about 23.5 billion yen).

Table 18-4: Base Case Fundraising Amount

	million IDR	million Yen
Loan Amount	12,948,038	94,159
Equity Amount	3,237,010	23,540

Source: JICA Study Team

(3) Financial Performance of Base Case

Setting the cash flow model with the Equity IRR set to about 14%, the Project Internal Rate of Return (Project IRR) was 8.69% and the Average DSCR was 1.89. It is considered that a certain level of profitability and bankability are ensured.

Table 18-5 Base Case Financial Performance

	Outcomes
Project IRR	8.69%
Equity IRR	13.94%
Average DSCR	1.89

Source: JICA Study Team

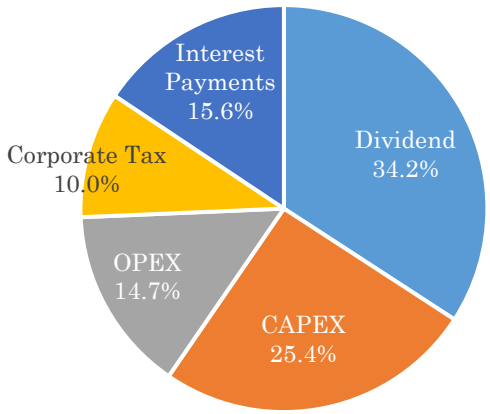
(4) Availability Payment

The breakdown of Availability Payment is as follows. The main components are dividend, CAPEX, OPEX, Corporate Tax Payments, and Interest Payment. In order to secure Equity IRR 14%, it is necessary to secure a certain amount of dividends, and the ratio of dividends to Availability Payment is high. CAPEX and OPEX will be covered by about 40% of Availability Payment.

Table 18-6: Breakdown of Availability Payment

	IDR million	Yen million
Dividend	17,236,865	125,348
CAPEX (Inflation Adjusted)	12,813,456	93,181
OPEX (Inflation Adjusted)	7,432,113	54,047
Corporate Tax Payments	5,063,796	36,824
Interest Payment	7,886,790	57,354
Average Payment (Total)	50,433,020	366,754
Average Payment (Year)	2,521,651	18,338

Source: JICA Study Team



Source: JICA Study Team

Figure 18-1：Ratio of Availability Payment Breakdown

(5) Tariff Revenue and Financial Expenditure

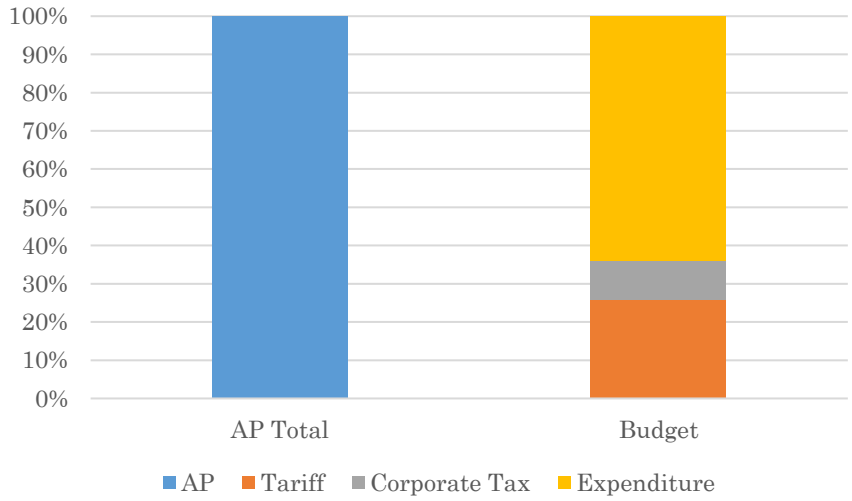
As stated in the assumptions, the tariff revenue does not affect the outcome of financial analysis as the revenue generates from the Availability Payment. The following is an analysis conducted as a Source to understand the amount of tariff revenue and public expenditure for Availability Payment.

The total availability payment is 50,433,020 million IDR (about 366.8 billion yen), while the toll tariff revenue forecast is 13,091,291 million IDR (about 95.2 billion yen), and it is considered difficult to secure the profitability of the business from the tariff revenue.

Table 18-7: Base Case Availability Payment

	Million IDR	Million Yen
Tariff Revenue	13,091,291	95,201
Availability Payment	▲50,433,020	▲366,754
Corporate Tax	5,063,796	36,824
Public Expenditure	▲32,277,934	▲234,728

Source: JICA Study Team (▲: negative/loss)



Source: JICA Study Team

Figure 18-2: Tariff Revenue and Availability Payment Comparison

18.4 Sensitivity Analysis

In the base case, the annual Availability Payment (simple average for 20 years) requires 2,521,651 million IDR (about 18.3 billion yen). This deviates from the BPTJ's expectation on Availability Payment. Having said that, since it is difficult to significantly reduce the business cost in the base case, we the two cases, reducing CPAEX by excluding civil works from the PPP scheme (hereinafter referred to as "vertical separation case"), PPP scheme with limited scope of rolling stocks (hereinafter, "rolling stock only cases").

18.4.1 Assumptions for Each Case

Assumptions for vertical separation case and Rolling Stock Case only cases are as follows;

(1) Vertical Separation Case

It is assumed that civil works will be excluded from the PPP project and the total CAPEX will be reduced by 45.5%.

a) CAPEX

Table 18-8: CAPEX Assumption for Vertical Separation Case

	Vertical Separation Case			Base Case	
	million IDR	million Yen	Change	million IDR	million Yen
Civil Works	0	0	▲100.0%	4,176,909	30,375
E & M and Rolling Stocks	5,831,024	42,404	▲9.5%	6,443,803	46,860
Land Acquisition	0	0	▲100.0%	101,300	737
Consultant Fees	291,551	2,120	▲45.1%	531,036	3,862
Contingency	306,129	2,226	▲45.1%	557,587	4,055
VAT	642,870	4,675	▲45.1%	1,170,933	8,515
Total CAPEX	7,071,575	51,425	▲45.5%	12,981,568	94,403

Source: JICA Study Team

b) OPEX

Table 18-9: OPEX Assumption for Vertical Separation Case

	Vertical Separation Case			Base Case	
	million IDR	million Yen	Change	million IDR	million Yen
Annual OPEX (2028~2033)	193,279	1,406	-	179,939 (2028~2031)	1,309 (2028~2031)
Annual OPEX (2034~2043)	194,713	1,416	-	197,899 (2032~2038)	1,439 (2032~2038)
Annual OPEX (2044~)	196,499	1,429	-	199,333 (2039~)	1,450 (2039~)
Total OPEX	3,892,800	28,312	▲0.2%	3,899,046	28,359

Source: JICA Study Team

(2) Rolling Stock Cases

By limiting CAPEX to E & M and rolling stock, it is assumed that the total CAPEX will be reduced by 54.3%.

a) CAPEX

Table 18-10: CAPEX Assumption for Rolling Stock Case

[Local Currency (million IDR)]

	Rolling Stock Case			Base Case	
	million IDR	million Yen	Changes	million IDR	million Yen
Civil Works	0	0	▲100.0%	4,176,909	30,375
E & M and Rolling Stocks	4,894,409	35,593	▲24.0%	6,443,803	46,860
Land Acquisition	0	0	▲100.0%	101,300	737
Consultant Fees	244,720	1,780	▲53.9%	531,036	3,862
Contingency	256,956	1,869	▲53.9%	557,587	4,055
VAT	539,609	3,924	▲53.9%	1,170,933	8,515
Total CAPEX	5,935,694	43,165	▲54.3%	12,981,568	94,403

Source: JICA Study Team

b) OPEX

Table 18-11: OPEX Assumption for Rolling Stock Case

[Japanese Currency (million Yen)]

	Rolling Stock Case			Base Case	
	million IDR	million Yen	Changes	million IDR	million Yen
Annual OPEX (2028~2033)	193,279	1,406	-	179,939 (2028~2031)	1,309 (2028~2031)
Annual OPEX (2034~2043)	194,713	1,416	-	197,899 (2032~2038)	1,439 (2032~2038)
Annual OPEX (2044~)	196,499	1,429	-	199,333 (2039~)	1,450 (2039~)
Total OPEX	3,892,800	28,312	▲0.2%	3,899,046	28,359

Source: JICA Study Team

18.4.2 Case Comparison

(1) Financial Results

In the vertical separation cases (CAPEX total reduced by 45.5%), Availability Payment is changed from 50,433,020 million IDR (366.8 billion yen) to 30,449,975 million IDR (221.4 billion yen) (Availability Payment was reduced by about 39.6%). In the case of Rolling Stock Case(CAPEX total reduced by 54.3%), Availability Payment was further reduced to 14,111,006 million IDR (102.6 billion yen) (Availability Payment was reduced by about 47.4%).

Table 18-12: Financial Comparison

[Local Currency (million IDR)]

	Vertical Separation		Rolling Stock Case		Base Case
		Change		Change	
Availability Payment	30,449,975	▲39.6%	14,111,006	▲72.0%	50,433,020
OPEX (Inflation Adjusted)	▲7,387,808	▲0.6%	▲7,387,808	▲0.6%	▲7,432,113
Depreciation	▲8,401,410	▲46.1%	▲2,434,250	▲84.4%	▲15,596,683
Interest Payment	▲4,311,411	▲46.6%	▲1,151,673	▲85.7%	▲8,071,227
Corporate Tax Payments	▲2,707,966	▲46.5%	▲814,083	▲83.9%	▲5,063,796
Net Income	7,641,380	▲46.4%	2,323,192	▲83.7%	14,260,201

Source: JICA Study Team

[Japanese Currency (million Yen)]

	Vertical Separation		Rolling Stock Case		Base Case
		Change		Change	
Availability Payment	221,435	▲39.6%	102,617	▲72.0%	366,754
OPEX (Inflation Adjusted)	▲53,725	▲0.6%	▲53,725	▲0.6%	▲54,047
Depreciation	▲61,096	▲46.1%	▲17,702	▲84.4%	▲113,421
Interest Payment	▲31,353	▲46.6%	▲8,375	▲85.7%	▲58,695
Corporate Tax Payments	▲19,693	▲46.5%	▲5,920	▲83.9%	▲36,824
Net Income	▲55,569	▲46.4%	16,894	▲83.7%	103,767

Source: JICA Study Team

(2) Fundraising

In parallel with the reduction in CAPEX, the amount of funding has been also decreased. In the case of vertical separation case(total CAPEX reduced by 45.5%), it is decreased by 46.4%, and in the case of Rolling Stock Case Case(total reduction of CAPEX by 54.3%), it is decreased by 85.6%.

Table 18-13: Fundraising Comparison

[Local Currency (million IDR)]

	Vertical Separation		Rolling Stock Case		Base Case
		Change		Change	
Loan Amount	6,934,730	▲46.4%	1,870,233	▲85.6%	12,948,038
Equity Amount	1,733,682	▲46.4%	467,558	▲85.6%	3,237,010

Source: JICA Study Team

[Japanese Currency (million Yen)]

	Vertical Separation		Rolling Stock Case		Base Case
		Change		Change	
Loan Amount	50,430	▲46.4%	13,601	▲85.6%	94,159
Equity Amount	12,608	▲46.4%	3,400	▲85.6%	23,540

Source: JICA Study Team

(3) Financial Ratios and Indications

In the case of the vertical separation case and Rolling Stock Case, there was almost no effect on both Project IRR and Average DSCR as we apply Equity Internal Rate of Return (Equity IRR) at 14% with all cases.

Table 18-14: Financial Results

	Vertical Separation		Rolling Stock Case		Base Case
		Change		Change	
Project IRR	8.65%	▲0.04%	8.84%	+1.71%	8.69%
Equity IRR	13.96%	-	14.00%	+0.41%	13.94%
Average DSCR	1.89	-	2.04	+7.71%	1.89

Source: JICA Study Team

(4) Breakdown of Availability Payment

In both the vertical separation case and the Rolling Stock Case, the dividend to Availability Payment ratio was suppressed to 30% or less.

The annual availability payment (simple average for 20 years) was reduced to 1,522,499 million IDR (about 11.1 billion yen) in the vertical separation case, and 705,550 million IDR (about 5.1 billion yen) in the case of Rolling Stock Case.

Table 18-15：Availability Payment Breakdown

[Local Currency (million IDR)]

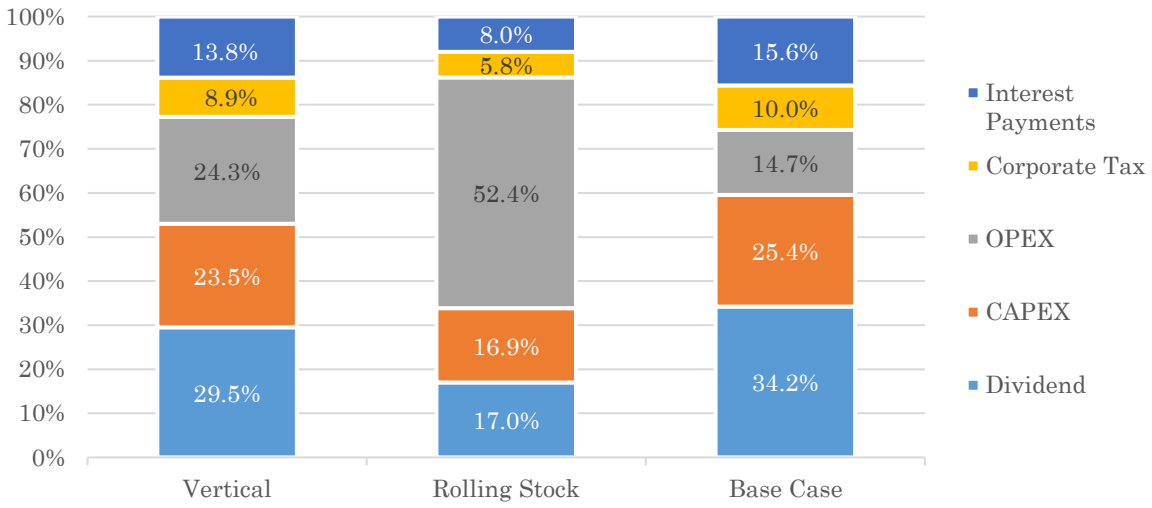
	Vertical Separation		Rolling Stock Case		Base Case
		Change		Change	
Dividend	8,985,617	▲47.9%	2,401,305	▲86.6%	17,236,865
CAPEX (Inflation Adjusted)	7,153,676	▲44.2%	2,379,948	▲81.4%	12,813,456
OPEX (Inflation Adjusted)	7,387,808	▲0.6%	7,387,808	▲0.6%	7,432,113
Corporate Tax Payments	2,707,966	▲46.5%	814,083	▲83.9%	5,063,796
Interest Payment	4,214,908	▲46.6%	1,127,862	▲85.7%	7,886,790
Average Payment	30,449,975	▲39.6%	14,111,006	▲72.0%	50,433,020
Average Payment	1,522,499	▲39.6%	705,550	▲72.0%	2,521,651

Source: JICA Study Team

[Japanese Currency (million Yen)]

	Vertical Separation		Rolling Stock Case		Base Case
		Change		Change	
Dividend	65,344	▲47.9%	17,463	▲86.6%	125,348
CAPEX (Inflation Adjusted)	52,022	▲44.2%	17,307	▲81.4%	93,181
OPEX (Inflation Adjusted)	53,725	▲0.6%	53,725	▲0.6%	54,047
Corporate Tax Payments	19,693	▲46.5%	5,920	▲83.9%	36,824
Interest Payment	30,651	▲46.6%	8,202	▲85.7%	57,354
Average Payment	221,435	▲39.6%	102,617	▲72.0%	366,754
Average Payment	11,072	▲39.6%	5,131	▲72.0%	18,338

Source: JICA Study Team



Source: JICA Study Team

Figure 18-3： Availability Payment Breakdown Comparison

(5) Tariff Revenue and Public Expenditure

The following is an analysis conducted as a source for understanding the amount of tariff revenue and fiscal expenditure for Availability Payment, similar to the analysis in the base case.

In both the vertical separation and Rolling Stock Case, the ratio of tariff revenue to the total availability payment has been decreased, however, in any case, it is difficult to secure profitability from tariff revenue alone, and it is considered that appropriate financial expenditure by the government will be required in the form of Availability Payment.

Table 18-16：Tariff Revenue and Public Expenditure

[Local Currency (million IDR)]

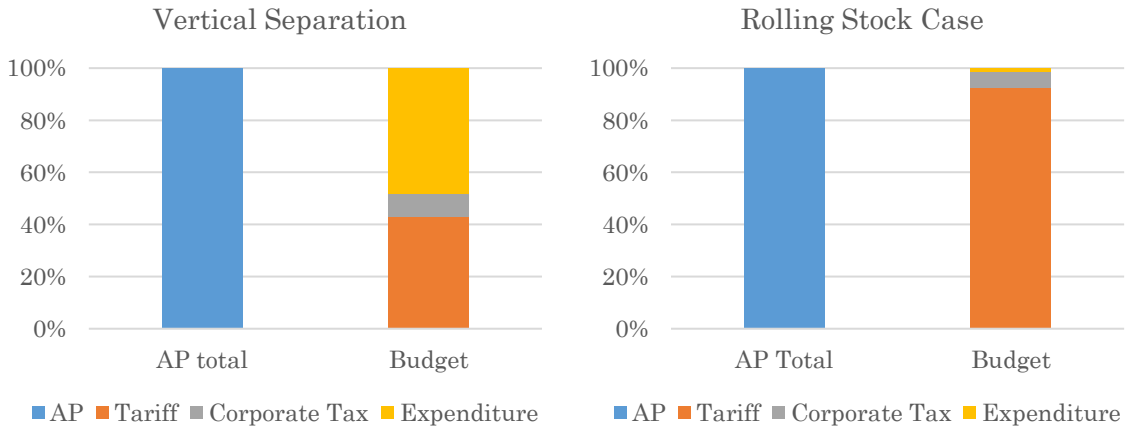
	Vertical Separation		Rolling Stock Case		Base Case
		Change		Change	
Tariff Revenue	13,091,291	-	13,091,291	-	13,091,291
Availability Payment	▲30,449,975	▲39.6%	▲14,111,006	▲72.0%	▲50,433,020
Corporate Tax	2,707,966	▲46.5%	814,083	▲83.9%	5,063,796
Public Expenditure	▲14,650,719	▲54.6%	▲205,633	▲99.4%	▲32,277,934

Source: JICA Study Team (▲: negative/loss)

[Japanese Currency (million Yen)]

	Vertical Separation		Rolling Stock Case		Base Case
		Change		Change	
Tariff Revenue	95,201	-	95,201	-	95,201
Availability Payment	▲221,435	▲39.6%	▲102,617	▲72.0%	▲366,754
Corporate Tax	19,693	▲46.5%	5,920	▲83.9%	36,824
Public Expenditure	▲106,542	▲54.6%	▲1,495	▲99.4%	▲234,728

Source: JICA Study Team (▲: negative/loss)



Source: JICA Study Team

Figure 18-4：Tariff Revenue and Availability Payment Comparison

18.5 Result of Financial Analysis

In the case of a base case where the business is carried out in full scope, the availability payment is about 18.3 billion yen per year, which does not match the budget of BPTJ. Also, the Study Team pursued to minimize the CAPEX including simplifying the structure of stations, however, the impact is limited and Availability Payment can be only reduced approximately 8%. On the other hand, if the business scheme is changed to vertical separation case or the Rolling Stock Case, the amount of Availability Payment can be significantly reduced. From the perspective of public expenditures including public works and PPP projects of the Indonesian government as a whole, if the ODA loan can be utilized, it will be possible to significantly reduce financial costs. Considering that, it is desirable for BPTJ to promote the business through the hybrid of public works and PPP scheme and pursue to utilize the concessional loans from international development institutions such as JICA and ADB for public works to minimize the finance expenses while the hybrid development will incur additional financial burden to the government for procuring public loans. Specifically, assuming that the project will benefit from JICA ODA loan with the financial condition applicable to mid-developing countries, available interest rate will be 1.4% and this will incur financial burdens of 6,329,199million IDR to 12,823,142 Million IDR with interest payments of 1,130,420 Million IDR to 2,273,326Million IDR and annual amortization of 372,979 Million IDR to 2,273,326 Million IDR over 20 years. Also, it is likely that new development initiatives like Land Value Capture (LVC) scheme may minimize the Availability Payment lower and the legality and commercial viability of these schemes shall be further to be analyzed.

19. Risk Allocation

The table below summarizes the project risks, and the desirable risk allocation between the public and private sectors. Since the risk sharing between the public and private sectors in Indonesia needs to comply with the guidelines published by the Indonesia Infrastructure Guarantee Fund (IIGF) in 2021, it is desirable to carry out a gap analysis in the OBC / FBC process in the future.

Table 19-1: Risk Allocation Matrix

Risk Category		Allocation			Mitigation
		Public	Private	Share	
Land Acquisition Risk	In associate with construction of new facilities according to a PPP agreement, land acquisition is required in the period of PPP agreement. Due to delay of the process, cost overrun (including rise compensation expenditures), delay of construction, and cost overrun may occur.			○	In principal, land acquisition shall be carried out by the government. In case of the project, current land owners are private entities expected to be engaged in the project as private proponent. To mitigate the risk, it is expected that the government will reach agreement on either leasing or acquisition contracts with these land owners in the bidding process.
Design, Construction Risk	In associate with construction/installment of facilities, according to PPP agreement, defect in design, delay of construction, and cost overrun may occur.		○		Normally, design and construction risk will be hedged by the private proponent in an EPC contract to pass through any relevant cost overruns to the EPC company.
Operation & Maintenance Risk	Service level provided by a private entity doesn't satisfy required standards, cost overrun, occurs and so on		○		Normally, Operation & Maintenance Risk will be hedged by the SPC in an O & M contract to pass through any relevant cost overruns to the O & M company.
Financing Risk	Terms/conditions of finance and the amount of funding required to		○		The SPC will be directly exposed to Financing risk. However, there are partial

	bankability and not fulfilled				mitigation measures with financing tools such as interest swap etc.
Ridership Risk	Actual traffic volume is lower than forecasted traffic	○			Normally, in case of greenfield railway project, ridership risk will be borne by the government as the predictability of the ridership forecast is highly unstable.
Revenue Risk	The expected revenue cannot be earned from TOD business		○		While the SPC will be directly exposed to volatilities of TOD revenue, the revenue is normally capped within 5% of entire project revenue and this does not incur significant project risk.
Inflation Risk	The construction/O & M cost increase more than expected			○	In construction phase, inflation risk is normally borne by the private proponent, however, this will be passed through to the EPC company under the EPC contract. In O & M phase, inflation risk is borne by the government and fully reimbursed in the form of availability payment.
Regulatory Risk	The risk of law changing and affecting the ability of the project to perform	○			Regulatory risk shall be borne either by the government itself of IIGF.
Force Majeure	Due to force majeure such as natural disaster, a private entity cannot fulfill level that are required in a PPP agreement			○	Covered by IIGF guarantee

Source: JICA Study Team

Note: Engineering, Procurement and Construction (EPC)

20. Government Support

Regarding government support in this project, liability guarantee by IIGF and both financial and technical supports from PT Sarana Multi Infrastruktur (SMI) and IIF can be expected. In addition, it is expected that Availability Payment shall be considered as form of government support.

20.1 IIGF Guarantee

IIGF is an infrastructure guarantee organization wholly owned by the Ministry of Finance, and since the guarantee provided by IIGF reinforces GCA's debt fulfillment capacity, it is considered necessary to utilize IIGF in this project as well. IIGF has already been involved as a PPP Team on the government side in this project, and if it is selected as a priority project in the PPP Book in the future, it will also be involved as the PPP team in the OBC phase, FBC phase, and the subsequent bidding phase.

20.2 Supports from SMI and IIF

SMI / IIF is a semi-governmental and semi-private financial institution funded by the Ministry of Finance, multinational institutions and international financial institutions, and both institutions can provide highly competitive financing conditions. It is also possible to support as a public advisor for the OBC phase and FBC phase together with GCA.

20.3 Availability Payment

Contribution of Availability Payment is indispensable to develop as a PPP project given the nature of project risk. Coordination with MOF and MOHA (Ministry of Home Affairs) are required from very early stage, before OBC phase, in order to proceed the application process.

21. Legal Analysis

In the legal analysis, there are a wide variety of related laws and regulations, so we focused on important issues and analyzed the points that need to be noted in future business feasibility studies in the OBC/FBC process.

21.1 PPP and Railway

MOT has implemented a number of revisions to the regulations, such as abolishing the MOT Regulation 15/2016 that was established when implementing railway projects, and it is necessary to fully consider the latest revisions in the business feasibility study to be conducted after the OBC process in the future.

Also, in Law 23/2007 Article5, railway business is classified into public business and private business, and the support received from the government differs depending on both positions, and the position has to be clarified in further study if this project falls into either of the category.

In addition, when operating the railway business as a PPP business, it is necessary to comply with the requirements stipulated in Bappenas Regulation 4/2015, and further assessment will be required from this perspective.

21.2 Establishment of SPC

Under Presidential Regulation 38/2015 and Bappenas Regulation 4/2015, priority negotiation rights holders are required to establish an SPC within 6 months after being selected by GCA, and in addition, the conclusion of a cooperation agreement needs to be done within 40 days after the establishment of the SPC. Therefore, in the OBC / FBC process, it is necessary to prepare a draft of the cooperation agreement.

21.3 Environment Regulation

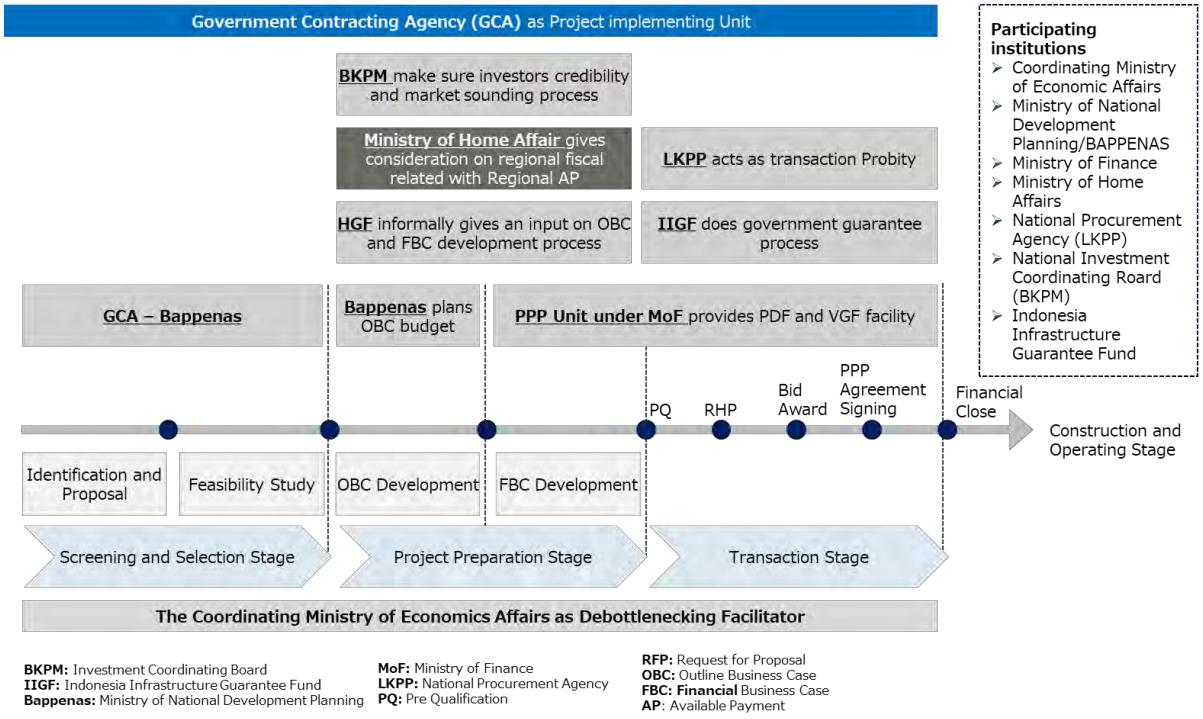
The Indonesian government has tightened environmental regulations very recently, and it is necessary to analyze the consistency with the latest regulations (GR 22/2021 and Ministry of Economy and Finance [MOEF] 4/2021). In addition, when implementing a project with a high environmental impact, it is necessary to carry out an environmental impact assessment (Environmental Impact Analysis / AMDAL document) based on Law 32/2009 and then obtain a license, thus, this needs to be studied further in the later process.

21.4 Land Acquisition

Article 36 of Presidential Regulation 38/2015 requires GCA to carry out land acquisition when implementing PPP projects for land acquisition related to the project. In addition, since GCA requires the GCA to formulate a land acquisition procurement plan in Article 4 of the new regulation GR 19/2021, the BPTJ must also prepare a land acquisition procurement plan in the OBC / FBC process.

21.5 Availability Payment

As shown in Table 7-1, when applying for Availability Payment, it is necessary to apply to MOF from the process before OBC and early action is critically important.



Source: BAPPENAS PPP BOOK 2018

Figure 21-1: AP Application Process

22. Fundraising Analysis

Assuming Availability Payment is applicable in the project, it is assumed that 80% will be financed in the form of debt and 20% as equities, leveraging the advantage of stable cashflow from Availability Payment.

22.1 Fund Procurement Portion

For the debt portion, the project aims to establish a competitive scheme against local financial market procurement conditions, mainly using JICA's overseas investment loans and NEXI insurance scheme.

(1) JICA Overseas Investment Loan and NEXI Guarantee Scheme (JPY Portion)

70% of the total loan amount is assumed to be procured through JICA OIL Loan with NEXI Covered facilities (About 70% of the initial investment cost is a yen-denominated portion. Of that, about half is JICA overseas investment and loan, and the other half is a private city bank). Financial conditions are as follows;

- ○ Interest Rate: 3%
- ○ Repayment Period: 20 years
- ○ Construction Period: 4 years
- ○ Denominated Currency: JPY
- ○ Interest Rate: Assuming the application of the fixed-rate interest swap contracts
- ○ Discussion Points: In the case of a scheme focusing on the overseas investment loan program, we can take advantage with respect to interest rate and term when compared to the procurement conditions in local currency, but it is necessary to take into account the foreign exchange risk. It has been confirmed that it is not possible to make AP payments in a hard currency, or to have the government bear the foreign exchange losses in the PPP contract like Turkish PPP system. Therefore, financing in yen is likely to be a major point of discussions for Japanese companies to enter the market.

(2) Local Currency Scheme

30% of loan will be procured through local banks. Conditions are as follows;

- ○ Interest Rate: 8%
- ○ Repayment Period: 15 years
- ○ Construction Period: 4 years
- ○ Denominated Currency: IDR
- ○ Interest Rate: Assuming the application of the fixed-rate interest swap contracts
- ○ Discussion Points: When raising funds in local currency, the interest rates are significantly less competitive than those of yen-denominated facilities in terms of both interest rate and term. On the other hand, however, it is highly possible to obtain favorable financing conditions by utilizing public financial institutions such as SMI and Institute of International

Finance (IIF). Therefore, it is necessary to aim to raise funds from SMI and IIF whenever possible, but it should be noted that the financing capacity of both SMI and IIF is relatively low for a project.

22.2 Equity

Regarding the capital portion, it is assumed that Japanese companies who are interested in this project will play a central role, and that Japanese companies will be responsible for more than half of the capital structure by utilizing the investment of Japan Overseas Infrastructure Investment Corporation For Transport & Urban Department（JOIN)). On the other hand, since the involvement of Indonesian developers is also essential, it is expected that local companies will contribute to a certain extent. Therefore, it is necessary to take into account the investment perspectives from both Japanese and Indonesian investors (IRR, payback period, business risk, etc.).

III. Summary

23. Summary of the Survey

23.1 Project Outline

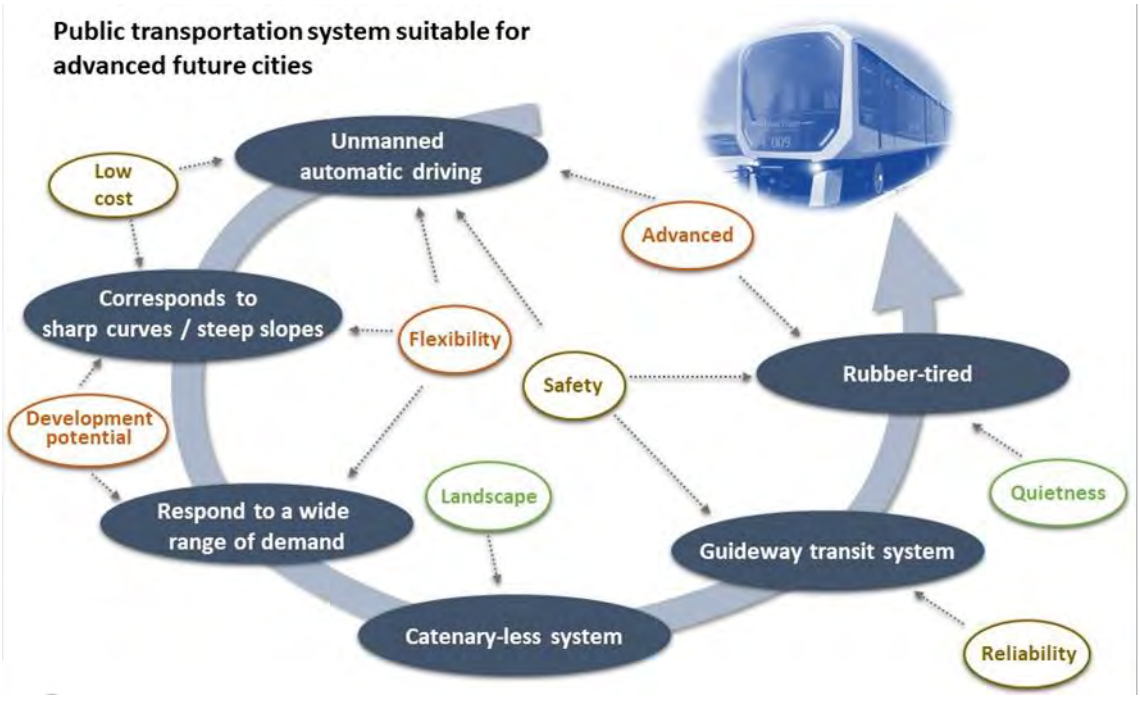
The outline of this project is as follows.

(1) System to Be Introduced

The system to be introduced is the AGT, which is an appropriate medium-volume transportation system with functions suitable for aiding Cikarang in its development into a new hub city.

Source: JICA Study Team

Figure 23-1: System to be Introduced



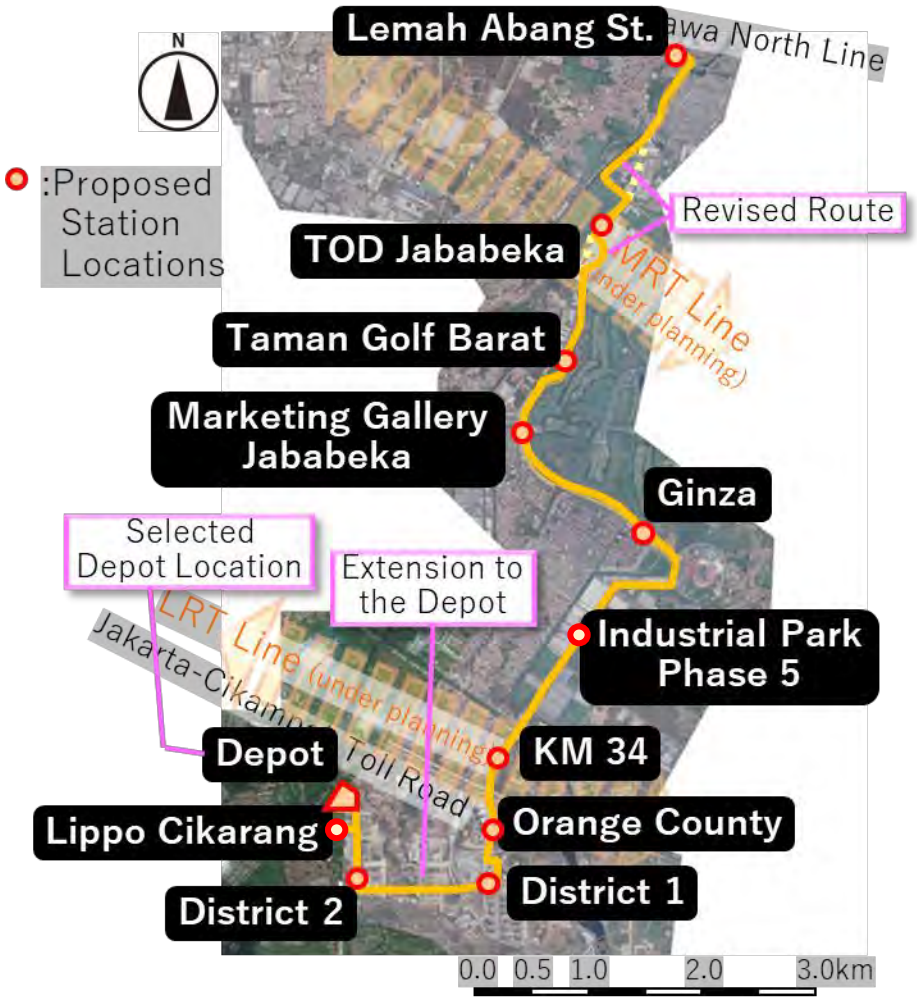
Source: JICA Study Team

Figure 23-2: Functions of the New Hub City Cikarang's Transport System (AGT)

(2) The Route for Implementation

The route will be approximately 12 km from Lemah Abang Station to the Lippo-Cikarang development area. The depot will be located in the Lippo development area.

- Lemah Abang Station - Lippo District Extension: 11.9 km, 11 stations
- Rail Yard: Lippo Development Area



Source: JICA Study Team

Figure 23-3: The Introduced and Proposed Route and its Station Locations

(3) Future Demand

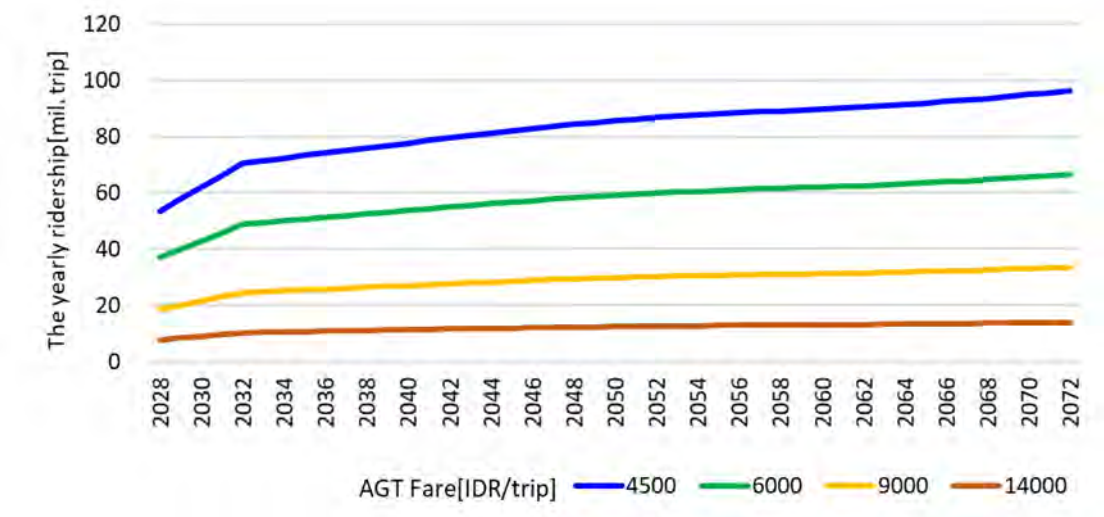
Future demand is assumed to be approximately 74,000 passengers per day (in 2028, at the freight rate of 9,000 IDR), based on the standards of fares in Indonesia.

Table 23-1 : Estimated Number of Passengers per Day at the Time of Opening (2028) for each Fare Case

Fare 【IDR】	4,500	6,000	9,000	14,000
Passengers at the time of opening in 2008 (/day)	212,640	146,980	73,990	30,840

Source: JICA Study Team

The figure below shows the annual number of users for each fare case. With the progress of development plans in the surrounding area, the annual number of users will increase by approximately 1.6 times by 2052 and 1.8 times by 2070 compared to the initial opening.



Source: JICA Study Team

Figure 23-4: Number of Passengers per Year for Each Fare Case

(4) Project Costs

The initial cost of AGT will be approximately 13 trillion IDR (90 billion yen), or approximately 11 trillion IDR (80 trillion yen), if cost reduction by the simplification of station facilities, etc. is expected.

Table 23-2 : The Result of the Project Costs Estimate

(Unit: Billion IDR)

Case Items	Base Case			Cost Reduced Case			Change Factor (Base → Cost Reduced)
	Initial	Add.	Total	Initial	Add.	Total	
Civil Works	4,156	21	4,177	3,148	25	3,173	Running on the ground level in some sections, Reduction of a concourse floor of elevated stations
Rolling Stock/ E&M	6,180	264	6,444	5,580	251	5,831	• Reduction of rolling stock (64→56 cars), Manual operation • Manual operation, Simplified station equipment
Others	1,161	29	1,190	996	28	1,024	
Land Acquisition	101	0	101	101	0	101	Reduced by the above costs
Consulting Fee	517	14	531	436	14	450	Reduced by the above costs
Contingency	543	15	558	458	14	473	Reduced by the above costs
Value-added Tax	1,139	31	1,171	962	30	993	
Total	12,636	346	12,982	10,687	334	11,021	

Source: JICA Study Team

The business expenses for this project are expected to be the same level as the other LRT projects in Indonesia or other Asian countries around Indonesia.

Table 23-3 : Other LRT Projects' Business Expenses

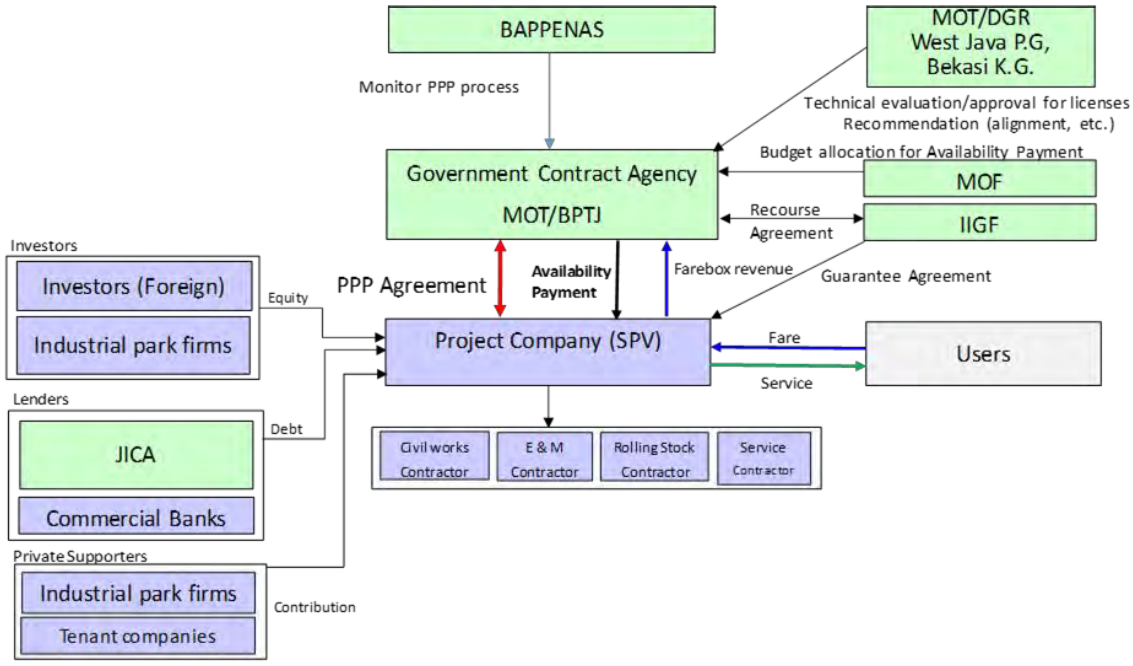
(Unit: Billion IDR/km)

Projects	Cikarang AGT		Jakarta LRT	LRT Kelana Jaya Line (Malaysia)	Manila LRT (Philippines)
	Base Case	Cost Reduced Case			
CAPEX (IDR Billion/km)	1,063	899	1,103	810	900

Source: JICA Study Team

(5) Development Scheme

The development scheme will be the PPP scheme based on the AP precondition



Source: JICA Study Team

Figure 23-5: Development Scheme for the Project

(6) Financial Analysis

The result of the financial analyses of the PPP scheme is as follows: the average annual AP is expected to be 2.5 trillion IDR (Base Case) to 2.2 trillion IDR (Cost-Reduced Case), and the real administrative burden considering fare revenue is expected to be 1.6 trillion IDR (Base Case) to 1.3 trillion IDR (Cost-Reduced Case).

Table 23-4: The Result of the Financial Analysis

(Unit: million IDR, million JPY)

Item	Phase 2 Base Case (Operation period: 20 years)		Phase 2 Cost Reduced Case (Operation period: 20 years)	
	IDR m	JPY m	IDR m	JPY m
Total Availability Payment*	**50,433,020**	**366,754**	**43,744,033**	**318,111**
⇒ Consider Fare Revenues and Tax Revenues	**32,277,934**	**234,728**	**26,288,475**	**191,173**
Annual Average of Availability Payment*	**2,521,651**	**18,338**	**2,187,202**	**15,906**
⇒ Consider Fare Revenues and Tax Revenues	**1,613,897**	**11,736**	**1,314,424**	**9,559**
Total CAPEX (Inflation Adjusted)	15,866,029	115,379	12,883,050	93,687
Total OPEX (Inflation Adjusted)	7,432,113	54,047	7,357,548	53,505
Total Debt Amount	12,948,038	94,159	10,950,918	79,636
Total Interest Payment	8,071,227	58,695	8,392,117	49,828
Project IRR	8.69%		8.84%	
Equity IRR	13.94%		14.00%	
Average DSCR	1.89		1.88	

Source: JICA Study Team

(7) Socio-economic Impacts

The results of the cost-benefit analysis showed that the B/C ranged from 1.25 (Base Case) to 1.44 (Cost-Reduced Case), exceeding 1 in each case. The internal rate of return based on economic value was 10.04% (Base Case) to 10.72% (Cost-Reduced Case), exceeding 10% in all cases.

The Value for Money was 20.85% (Base Case) to 21.80% (Cost-Reduced Case),and exceeded 20% in all cases.

As a result, the socio-economic effects of this project were found to be socially worth the investment as shown below.

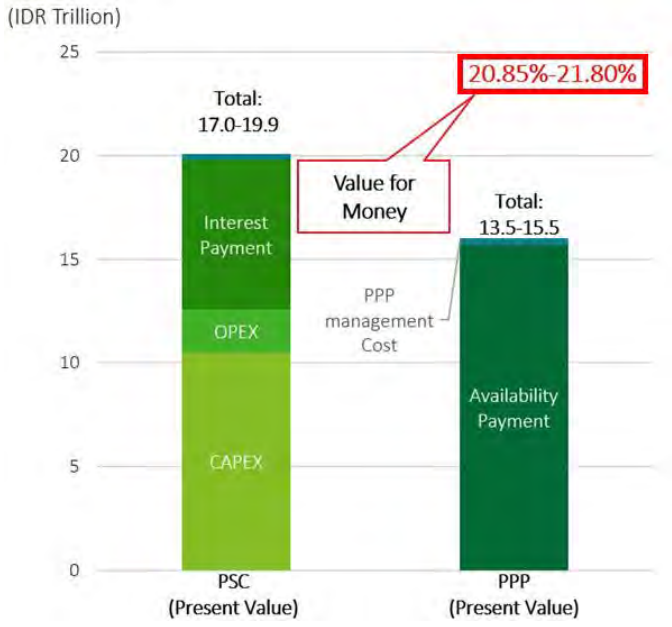
	Base Case	Cost Reduced Case
Economic IRR	10.04 %	10.72 %
B/C	1.25	1.44

(IDR m)

Item		Base Case (Present Value)	Cost Reduced Case (Present Value)
Cost			
	CAPEX*	-8,245,102	-6,942,031
	OPEX*	-1,381,692	-1,408,496
	Cost Total	-9,626,795	- 8,350,769
Benefit			
	Travel time cost saving	4,925,032	4,925,032
	Greenhouse gas reductions	1,552	1,552
	Vehicle operational cost reduction	1,090,718	1,090,718
	Increases in property price	5,998,169	5,998,169
	Benefit Total	12,015,471	12,015,471
Grand total		2,388,676	3.664,701

Source: JICA Study Team

Figure 23-6 : The Results of the Cost-Benefit Analysis



Source: JICA Study Team

Figure 23-7: Value for Money Results

23.2 Overview of the Proposed Alternative Analysis

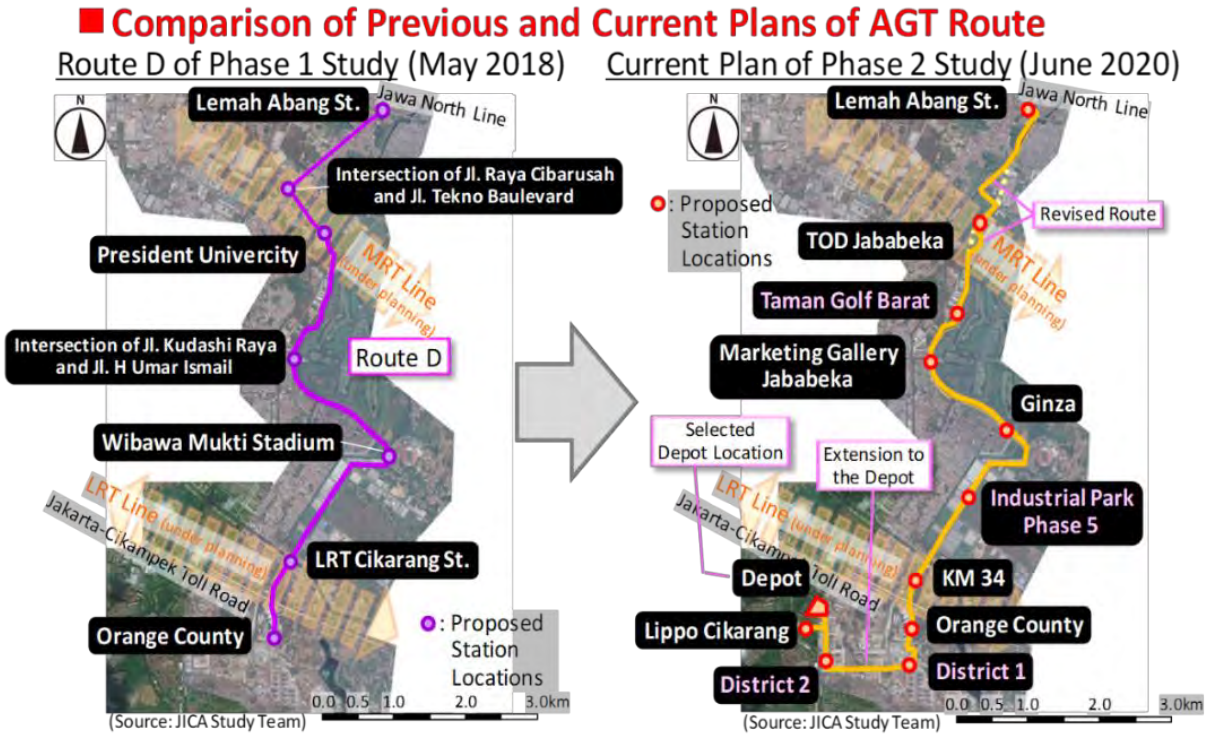
The results of the financial analysis under the PPP scheme show that the large number of AP is an issue to be addressed. The Indonesian side asked us to propose measures to reduce the amount of availability payments, so we made a proposal under the alternative scheme. For this purpose, we conducted the analysis under the alternative (proposed) scheme, assuming the following reviews of the preconditions

23.2.1 Review of Preconditions

(1) Review of the Number of Stations to be Developed

The four stations which increased after the Phase 1 (stations shown in pink below) are assumed to be unimproved at the time of opening. This is expected to lead to the reduction of approximately 600 billion IDR (4.34 billion yen).

In addition, it is assumed that feeder traffic will be maintained at the time of opening, and that the relevant organizations will discuss the maintenance of the four stations, depending on the development status.



Source: JICA Study Team

Figure 23-8 : The Stations that Remain Undeveloped at the Time of Opening (in pink)

(2) Review of the Number of Cars

The number of cars has been revised by reviewing the train density and the backup trains. As a result, the number of cars at the time of opening will be reduced by 8 cars, from 56 to 48, which is expected to result in a reduction of approximately 320 billion IDR (23.3 billion yen).

- Review of the density of standing seats:
  from 6 passengers/m^2 and 70 kg/person, to 8 passengers/m^2 and 60 kg/person.
- Review of car capacity attributed to the physical differences between Westerners and Asians
  Note: (Capacity to be reduced from 153 passengers per car to 130 passengers per car)
- Review of backup trains: reduced from 3 to 2.

(3) Review of the Site-Related Expenses by Using the Release Contract

The land required for the depot site (approx. 4 ha) is assumed to be leased rather than purchased. At that time, the related organizations will discuss how to bear the cost of the land for the depot without reflecting the land use fee in the AP by building profit-making facilities above the depot.

(4) The Result of Reconsidering Costs

Aforementioned prerequisites are reconsidered and the assumed business operation costs will be as follows:

Table 23-5: Comparison of the Costs Before and After the Reconsideration

Project Items	Cikarang AGT Base Case		
Total Length	11.9 km		
No. of Stations	11 stations		
Costs	(IDR Billion)	(/km)	(%)
Total CAPEX	**12,636**	**1,063**	**100**
Civil Works	4,859	409	38
RS/ E&M	7,207	607	57
Depot	569	48	5
Source	JICA Study Team		

Project Items	Cikarang AGT Revised Cost				
Total Length	11.9 km				
No. of Stations	7 stations				
Costs	(IDR Billion)		(/km)		(%)
Initial CAPEX	**11,617**	**(-1,019)**	**977**	**(-86)**	**100**
Civil Works	4,337	(-522)	365	(-44)	37
RS/ E&M	6,812	(-395)	573	(-33)	59
Depot	468	(-101)	39	(-9)	4
Source	JICA Study Team				

Source: JICA Study Team
Note: RS (Rolling stock)

23.2.2 Financial Analysis of the Alternative Plan

In order to reduce the amount of availability payments, financial analysis was conducted assuming a combined scheme with yen loans through separation of infrastructure and operation.

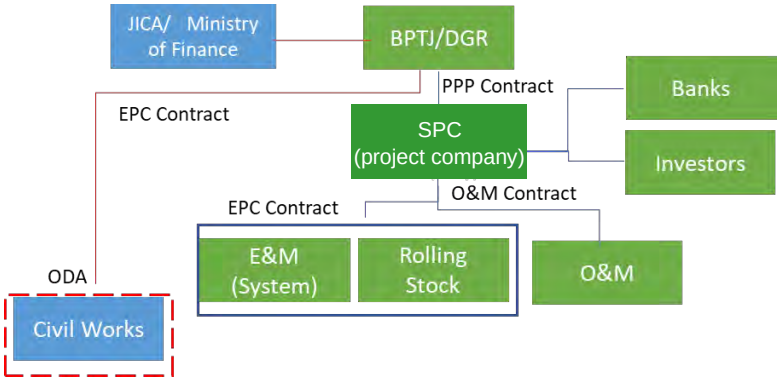
(1) Alternative Scheme

This project has been expected to incorporate effects beneficial to the public and various social effects such as urban structure induction which covers an entire metropolitan area, which includes consideration including fluid transportation and novel urban development as well, thus we would assume two schemes through PPP, and public funds (yen loans, Asian Development Bank loans, etc) in parallel as an alternative scheme. However, LVC is not suitable for PPP projects from the perspective of bankruptcy remoteness, although it is an effective method for financing TOD development. Therefore, LVC was excluded from the analysis of alternative schemes. In addition, from the perspective of AP reduction, measures to increase equity can be considered. However, given the preconditions for securing 14% Equity IIR in the financial analysis, it is necessary to increase the amount of AP to cover the amount of distribution, although the amount of principal and interest repayment of loans will decrease. Therefore, measures to increase the equity ratio were also excluded from the alternative scheme.

○Alternative Scheme A

・Targets of public financing (yen loan)：Civil work facility as transportation infrastructure as a target of the yen loan

・PPP：Applicable for PPP: operation-related facilities such as vehicles, E & M and O & M



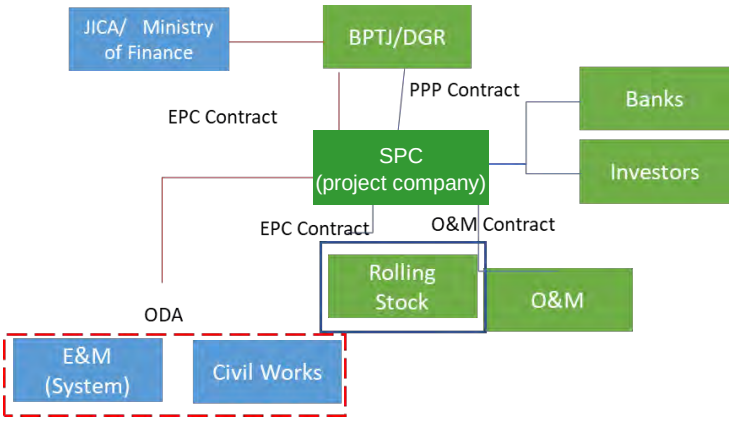
Source: JICA Study Team

Figure 23-9 : Alternative Scheme A

○Alternative Scheme B

・Targets of public financing: civil work facility as transportation infrastructure as a target

・Applicable for PPP: operation-related facilities such as vehicles, E & M and O & M

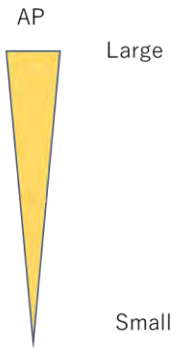


Source: JICA Study Team

Figure 23-10: Alternative Scheme B

The amount of the AP can fluctuate significantly depending on the scope of the PPP project application.

Pattern	Public or Developer (Assumption: ODA loans or Developer-funded)	Private (Assumption: PPP)
Pattern 1	Civil Works/Land	Track/E&M Rolling Stock Operation
Pattern 2	Civil Works/Land Track/E&M	Rolling Stock Operation
Pattern 3	Civil Works/Land Track/E&M Rolling Stock	Operation



Source: JICA Study Team

Figure 23-11 : Fluctuation of the Amount of AP and PPP Project Applicable Boundaries

(2) Results of Financial Analysis

Assuming the use of yen loans (20-year redemption period and general condition of fixed interest rate of 1.4% for middle developed countries) and Asian Development Bank loans, the AP amount of the PPP project was expected to be reduced by 30-70% compared to the Base Case, if a project with combined schemes of PPP and public works with separation of infrastructure and operation was assumed. However, it should be noted that a yen loan with a total of 6 to 13 trillion IDR (about 46 to 93.2 billion yen) in principal and interest, or borrowing from Asian Development Bank, etc. will be required. It means that annual repayment obligation of 370 billion IDR to 640 billion IDR (about 2.7 to 4.6 billion yen) over a 20-year redemption period with a total interest rate of 1.1 to 2.3 trillion IDR (about 8.2 to 16.5 billion yen) will be incurred.

○Alternative Scheme A

AP: Approx. a 33% Reduction

⇒ Annual Average of AP: 2,521→1,549 billion IDR（△39%）

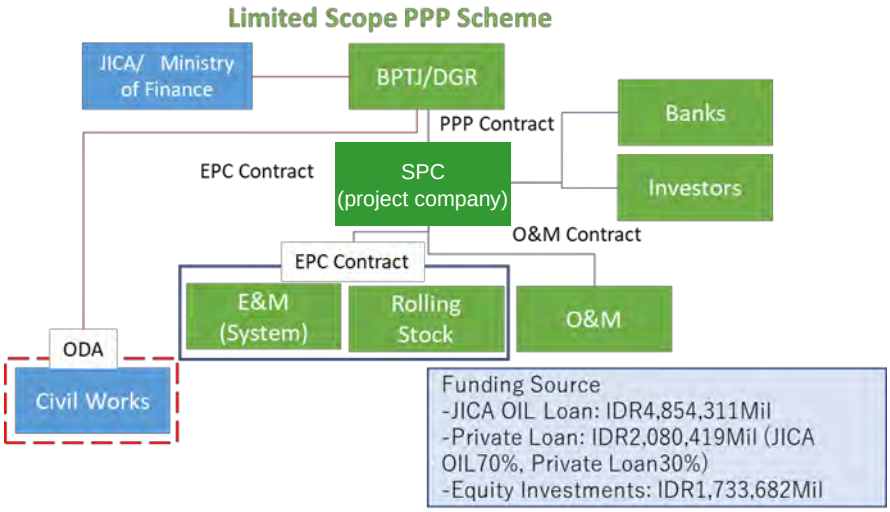
⇒ Total AP: 46,430→30,970 billion IDR（△33%）

Table 23-6: Financial Analysis Result (Alternative Scheme A)

(Unit: million IDR)

Item		Limited Case
Revenue		
	Availability Payment	30,449,975
	(Annual Amount)	(1,522,499)
Cost		
	OPEX	▲7,387,808
	CAPEX	▲8,790,855
Net Income		7,641,380
Required Debt Amounts		6,934,730
Required Equity Amounts		1,733,682
DE Ratio		80:20
PIRR		8.65%
EIRR		13.96%

Source: JICA Study Team
Note: DE Ratio (Debt equity ratio)



Source: JICA Study Team

Figure 23-12: Alternative Scheme A and SPC Fund Procurement

○Alternative Scheme B

AP： approx. 69% reduction

⇒ Annual Average of AP： 2,521→723 billion IDR（△71%）

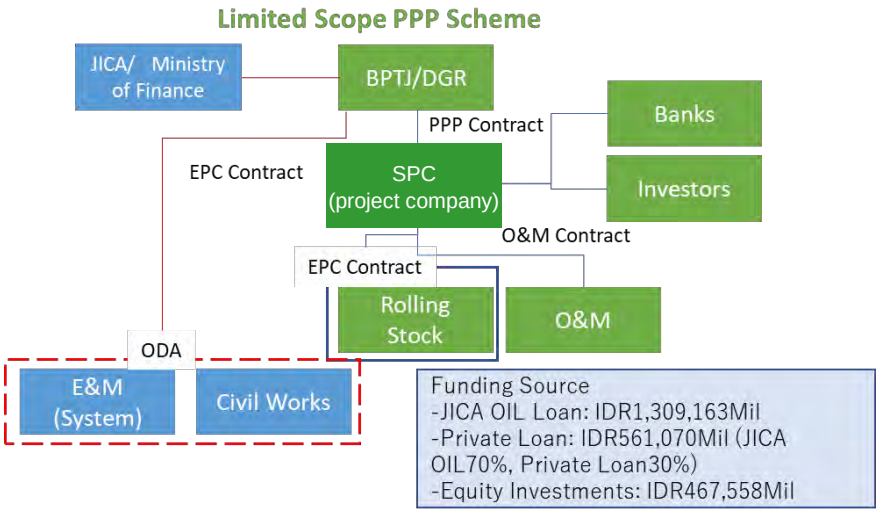
⇒ Total AP： 46,430→14,460 billion IDR（△69%）

Table 23-7: Financial Analysis Result (Alternative Scheme B)

(Unit: million IDR)

Item		Limited Case
Revenue		
	Availability Payment	14,111,006
	(Annual Amount)	(705,550)
Cost		
	OPEX	▲7,387,808
	CAPEX	▲2,823,695
Net Income		2,323,192
Required Debt Amounts		1,870,233
Required Equity Amounts		467,558
DE Ratio		80:20
PIRR		8.84%
EIRR		14.00%

Source: JICA Study Team
Note: DE Ratio (Debt equity ratio)



Source: JICA Study Team

Figure 23-13 : Alternative Scheme B and SPC Fund Procurement

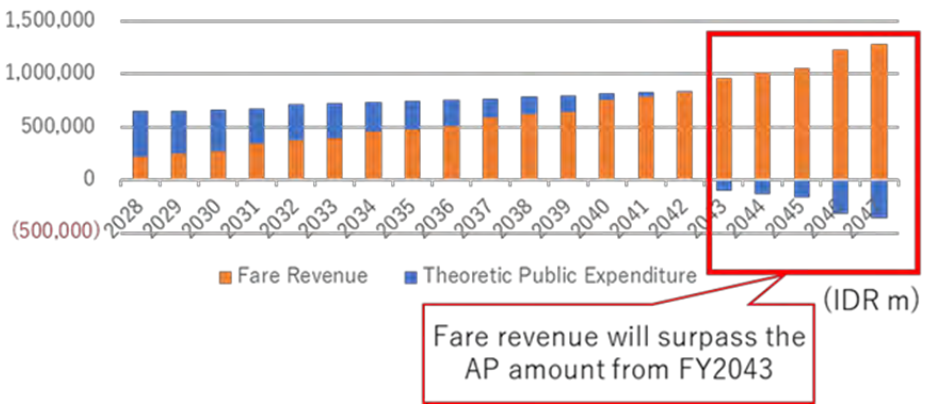
On the other hand, the actual administrative burden in terms of fare revenue is expected to decrease year by year, and under Alternative Scheme B, fare revenue is expected to exceed the Availability Payment from around the 16th year of operation.

Table 23-8 : Real AP Charge Amount After Taking into Account the Fare Revenue (Alternative Scheme B)

(Unit: million IDR)

	Another Case
Total AP Amounts	14,460,778 m
Fare Revenue	13,091,291 m
Theoretical BPTJ's Expenditure	1,369,487 m

Source: JICA Study Team



Source: JICA Study Team

Figure 23-14: Changes in the Fare Revenue and Actual AP Charge Amount

23.3 Roles and Responsibilities of Relevant Organizations

Based on the results of this study, the Indonesian government will select the proposed scheme and promote the project under the following division of roles among related organizations.

(1) MOT

- Responsible for GCA.
- Procedures for securing AP budget with the Ministry of Finance (interface between MOF)
- Support for the reliable implementation of the electrification extension of the commuter line from Cikarang to Lemah Abang Station
- Public financing through separation of infrastructure and operation, procedures for the application of yen loans in this case (interface between MOF and Bappenas) → in case of an Alternative Scheme

(2) BPTJ/MOT

- BPTJ/MOT will act as the executing agency for the project, and will work to reach an agreement between SPC and PPP.
- Overall management for each phase of the project (selection, preparation, contract, construction and operation, etc.)
- Register the project in the PPP Book and position it as a national project.

(3) DGR/MOT

- Technical evaluation and approval required for project licensing (in collaboration with Bekasi Province)
- Support for the reliable implementation of the electrification extension of the commuter line from Cikarang to Lembang station.

∗Directorate General of Railways（DGR）

(4) West Java

- Clearly position the project in the Province Spatial Plan.
- Implementation of land acquisition and other activities related to the provincial government
- Collaborate with and support developers to develop AGT-related facilities and implement TOD.

(5) Beksi

- Clearly position the project in the Regency Spatial Plan.
- Granting of project licenses.
- Implementation of land acquisition and other activities related to the regency.
- Collaborate with and support developers to develop AGT-related facilities and implement TOD.

(6) Developer (Lippo / Jababeka)

- Free of charge for road occupancy on the route
- Land Rental for depot → Clearly state the scope outside the PPP
- Study on how to bear the cost of depot land (in collaboration with developers, West Java Province, Bekasi Province and other related organizations)
- Provision of feeder services to the four stations to be reduced
- Development of AGT-related facilities (traffic nodes, feeder traffic, station connecting corridors, etc. in cooperation with West Java Province and Bekasi Province)
- Implementation of TOD

23.4 Term Sheet

Based on the results of the feasibility study on the new Cikarang transportation project, the following issues should be considered by the Indonesian government.

1. It is critically important that the current rail routes shall be extended from Bekasi station to Lema Aban station
2. For the application of technology, JICA Study Team convinces that Automated Guideway Transit System is the recommended mode in the current route in Cikarang
3. GCA shall be identified and nominated by Indonesian Government shortly. JICA Study Team believes that MOT and or BPTJ are the most appropriate GCA in this project
4. This project shall be further studied with the Availability Payment scheme
5. In the meantime, it is recommended that alternative project structure shall be considered such as separation of infrastructure and operation

6. Upon necessity, the Availability Payment of GCA needs to be guaranteed by government institutions such as IIGF
7. The government and GCA need to obtain supports from stakeholders and private developers to secure land acquisition