Chapter 4 Project Plan (Phase 1 Section)

4.1 Route Plan

4.1.1 Route Characteristics

The target route selected during the route selection meeting mentioned in the previous chapters starts at Balaraja on the west of the Banten Province and ends at Cikarang on the east of the West Java Province. It has a total gross route length of 88 km with plane alignment crossing the provincial border, Banten–DKI Jakarta and DKI Jakarta–West Java.

From Balaraja, the alignment runs southeast and connects with Jakarta–Merak Toll Road. Subsequently, it extends along the toll road up to its crossing point with Jl. Iman Bonjol located south of the existing Tangerang Station, passing along Jl. Jenderal Sudirman towards the north up to Tangerang Line, through Jl. Iman Bonjol. The route goes along Tangerang Line up to its crossing point with Daan Motot Flyover, near the existing Pesing Station. It then diverges eastward from Tangerang Line to along Jl. Tangerang route. It runs along Jl. Kyai Tapa, makes a sharp right turn along Jl. Cideng, and turns towards south until the Jatibaru Flyover. Afterwards, it turns east in parallel with Jl. Kebon Sirih, passing through Thamrin – Senen – Galur – Kelapa Gading – Pulogadung – Ujun Menteng, and runs along Jl. Kaliabang eastward. After Bekasi River, it threads the right-of-way (ROW) of the newly, half-built road, which is dispersed and not jointed, and extends towards east up to Cikarang Terminal Station.

1. The Cengkareng River

There is a single-track bridge spanning over Cengkareng River with a level crossing on the west bank. Half-built bridge, apparently for the second track, extended from both river banks towards the middle of the river.

2. The Angke River

There is a single-track bridge spanning over Angke River. There are lots of squatters encroaching on the future double-track space near the river.

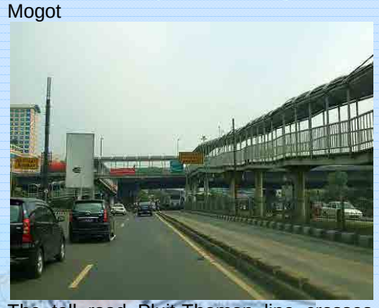
3. The Grogol River

A single-track bride spans over Grogol River.

4. Flyover along Jl.Daan Mogot

flyover along Jl.Daan Mogot crosses over Tangerang Line, where the proposed alignment will split from Tangerang Line to along Jl.Daan-Mogot route.
(Left: view from Tangerang Line, Right: looking west down to Tangerang Line form the flyover.)

5. Toll road flyover crossing Jl.Daan Mogot



The toll road Pluit-Thoman line crosses over the proposed alignment. A river runs along west of the toll road.

10. Kali Cideng

Kali Cideng lies between Jl.Cideng Timur and Jl. Cideng Barat, with a width of around 15m.

6. Proposed transition section

Transition section from the underground to elevated section on the west of the project route is still at the present stage, proposed along Jl. Kyai Tapa where TransJakarta is in operation in the center. In addition, it has a broad width, a center median and a planting zone on each side.
(Left : Inbound lane, Right : Outbound lane)

7 Bansir Canal

New route will be crossing under or running in parallel under an existing river (Bansir canal).

8. Flyover along the proposed alignment

A flyover runs in parallel with the proposed alignment (along Jl. Daan Mogot) over the JABODETABEK Western Line and Bansir Canal.

9. A sharp curve section

The proposed alignment makes a sharp curve where it goes west almost orthogonally from the route along Cideng Barat/ Timur.

11. Flyover in parallel with the proposed alignment (Underground section)

A flyover (Jatibaru flyover) runs in parallel with the proposed alignment making a sharp curve. Drainage lying on west side also curves along the proposed alignment.

Figure 4.1-1Current Situation and Issues along the Alignment (1/2)

Source: JICA Study Team

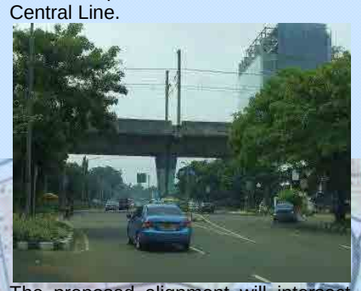
12.Kali Cideng

Kali Cideng lies on the south side of Jl.Kebon Sirih, along which the proposed alignment will run underground.

13. Cross-point with MRT North-South Line.

At the intersection of Jl.Thamrin and Jl.Kebon Sirih, the proposed alignment will be crossing with MRT North-South Line underground.

14. Cross-point with JABODETABEK Central Line.



The proposed alignment will intersect with JABODETABEK Central Line underground. At this cross-point, the structure above the existing railway line is a flyover.

15. Jl. Senen Flyover

Jl. Senen Flyover crosses over the proposed alignment, just before the Senen Station underpass, where the underground is planned.

16. Underpass near Senen station

The proposed route (Letnan Jend Suprato St.) passes under the existing railway line. As an underground structure is planned in this section, the tunnel depth goes deeper underground passing below the existing underpass.

17. Underground section of a flyover parallel to the proposed route

A flyover spans over Sention River where the proposed alignment goes underground.

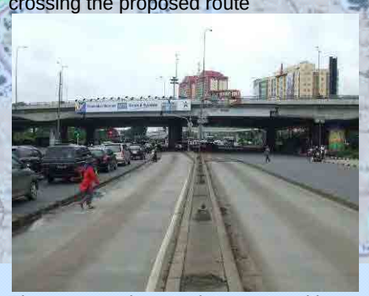
18. Sention River

The Sention River crosses the underground section of the proposed route. A flyover spans over Sention River in parallel with the proposed alignment. Since this section belongs to underground section, alignment has to avert existing piles.

19. Proposed Transition Section

Transition section from the underground to an elevated section east of the project route is proposed to be along Jl.Letnan Jenderal Suprato, where there are Transjakarta busway, center median, and green zone on each side of the road.

20. Underground section of an overpass crossing the proposed route



The proposed route intersects with an overpass as well as a highway toll. Tunnel alignment must be adjusted to avoid interfering with the existing foundation and piles of the overpass structures.

21. Wide crossroads

There is a wide crossroads where two major roads are crossing, namely Jl. Perintis Kemerdekaan and Jl. Bulevar Kelapa Gading, along the proposed elevated section. A long span bridge may be necessary at this point.

22.High Voltage Cable

There is high-voltage cable crossing over the proposed elevated section. The height of the cables will be examined to determine the level of elevated structure.

23. Jl. Bekasi Raya

Six inner toll road is being planned in the center of Jl. Bekasi Raya. The alignment of E-W Line requires averting the toll road alignment.

24. Elevated section of an overpass crossing the proposed route

An overpass of outer ring toll road is crossing over the proposed elevated section.

Figure 4.1-2Current Situation and Issues along the Alignment (2/2)

Source: JICA Study Team

4.1.2 Design Criteria

(1) Integration of Design Criteria with MRT North-South Line

As a result of the studies described earlier, it is proposed that Phase 1 of MRT East-West Line be implemented within DKI Jakarta, and studies made in following sections in this chapter are all based on the proposal. In addition to the advantages of implementing the Phase 1 of the project within Jakarta, it will provide a lot of advantages if MRT East-West Line is operated by the same operator as MRT North-South Line, in which the MRT system will be applied for the first time in Indonesia. Not only managerial but also technical advantages will be derived by introducing the same railway system and rolling stock to MRT East-West Line as described below;

a) Managerial Merit

i) Harmonization Train Operation and Passenger Service

System integration of MRT between two lines will help improve services for passengers, such as operation planning for smooth transfer and reduction of minimum fare.

ii) Material Procurement with Economies of Scale

Integration of operator, railway system and rolling stock between two lines will enable both lines not only to share materials and equipment for maintenance but also to jointly and collectively procure and use those items, which will contribute to achieve economical maintenance of the MRT operation.

iii) Equalization of Maintenance Works

Integration of operator, railway system and rolling stock between two lines will enable both lines to distribute the maintenance works evenly, and, by doing this, part of the manuals can be shared. Moreover, experiences of maintenance works through the operation of MRT North-South Line can be utilized effectively for MRT East-West Line.

iv) Effective Training Program for Staff and Employees

Integration of operator, railway system and rolling stock between two lines will enable both lines to share the same personnel, training programs and their materials. Professional knowledge obtained through the real work experiences will be utilized to create more practical materials for training programs.

v) Effective Assignment to Staff and Employees

Integration of operator, railway system and rolling stock between two lines enable both lines to effectively share or exchange the highly-professional human resources mutually, which will bring about a reduction of O&M cost.

vi) Long term Administration Plan by Lesson Learnt

Operator integration enables both lines to make long term administration plan for MRT system in JABODETABEK system for the future, based on the performances actually made in both lines such as operation plan and management plan.

b) Hardware Merit

i) Consideration of Sharable Facilities

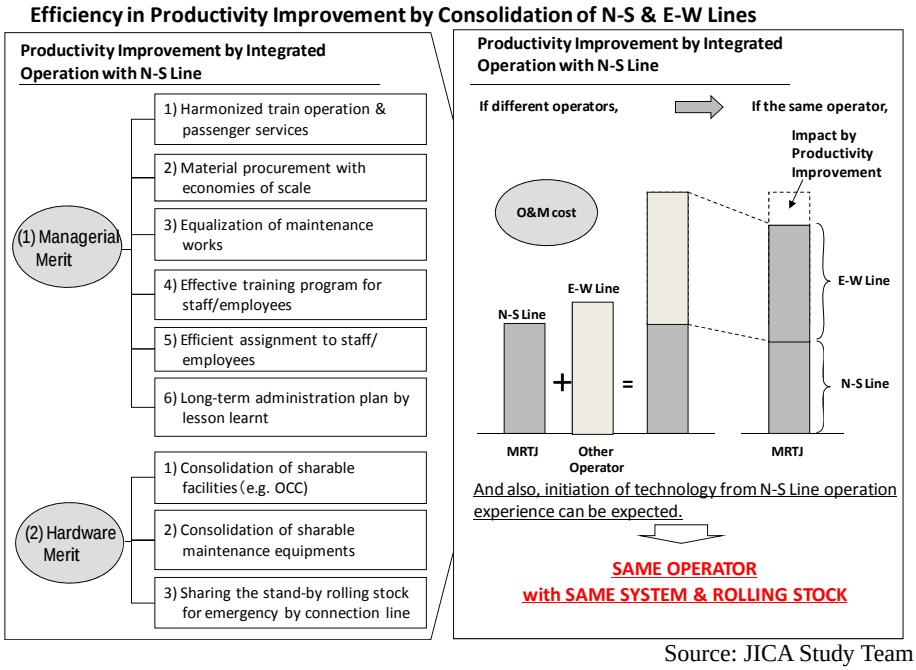
Integration of operator, railway system and rolling stock between two lines enable both lines to share the OCC and the Training Facilities between two lines. Consequently, it is possible to save the cost for investment.

ii) Consolidation of Sharable Maintenance Equipment

Integration of operator, railway system and rolling stock between two lines enable both lines to share materials and equipment for maintenance between two lines, making it possible to save the cost for investment.

iii) Sharing the Stand-by Rolling Stock for Emergency by Connection Line

Integration of operator, railway system and rolling stock between two lines enable both lines to share the stand-by Rolling Stock for Emergency. Consequently, it is possible to save the cost for investment. It is effective that the installation of shunting line can be used as the evacuation route or carry-in route for rolling stock.



Source: JICA Study Team

Figure 4.1-3 Productivity Improvement by integrating

For the similar reasons, it is proposed that standard for safety management system also be integrated with MRT North-South Line. Japanese standard for safety management system will be applied to MRT North-South Line project.

(2) Design Criteria for the Alignment

MRT East-West Line is the second MRT line in the JABODETABEK Region since the development of MRT North-South Line. As mentioned in Chapter 3, one of the indispensable key factors for the success of MRT East-West Line is to enhance the connectivity by linking it with MRT North-South Line. This will enable the sharing of the existing MRT North-South Line resources for effective use. It could also facilitate sharing of the depot and workshop, the rolling stocks in case of emergency, materials and equipment, and other maintenance equipment. Thus, the design criteria and specifications of MRT East-West Line basically apply to that of MRT North-South Line in order to realize the above-mentioned key factor.

In Phase 1 of MRT North-South Line, Indonesian Railway Technical Standards (IMO) were basically applied as the design criteria. However, the following three standards were also used as supplemental standards in comparison with the IMO:

- Railroad Construction Plan (Official Regulation No. 10) (PD-10),
- General Specification for Standard Urban Railway System for Asia, and
- Standards for Civil Engineering and Facilities of Mita Line

Table 4.1-1 shows the design criteria for MRT East-West Line.

Table 4.1-1 Design Criteria

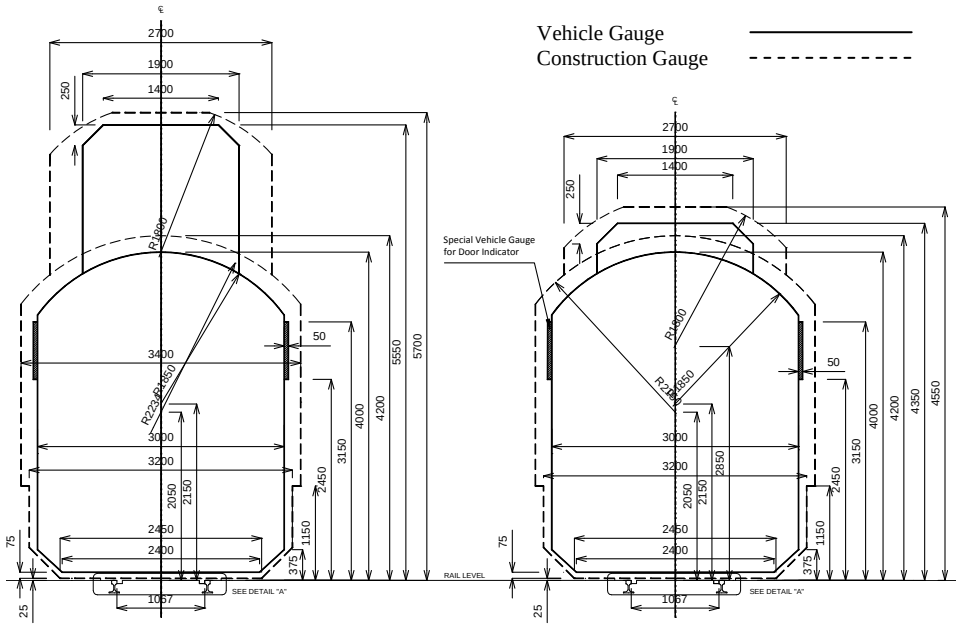
Criteria			Value
1	Gauge		1067mm
2	Design maximum speed	Viaduct	100 km/h
		Tunnel	80 km/h
3	Minimum plane radius	Main track	200 m (Absolute minimum is 160 m)
		Alongside the platform	800 m (Absolute minimum is 400 m)
		Siding	160 m (Absolute minimum is 100 m) (in case of second curve of turnout, Absolute min. 100m)
4	Setting of Cant (Gauge 1067 mm)		$C_0 = 8.4 \times \frac{(V_0)^2}{R}$ Where, C_0: Setting cant (mm) V_0: Average speed (km/h) R: Curve radius (m) Maximum cant = 110 (mm) Permissible cant deficiency = 60(mm)
5	Transition Curve Length (Gauge 1067 mm)		The largest value calculated from the following formulas. Viaduct (90≦V＜110km/h) L1=0.8C, L2=0.01C・V L3=0.009Cd・V Tunnel (70≦V＜90km/h) L1=0.6C L2=0.008C・V L3=0.009Cd・V Absolute Minimum L1=0.4C L2=0.005C・V L3=0.005Cd・V Where, L1, L2, L3: Transition curve length (m) C : Actual cant（mm） Cd : Cant deficiency（mm） V : Highest train speed（km/h）
6	Shape of transition curve		Cubic parabola
7	Gradient		1. Train running section: Viaduct (90≦V＜110km/h) ≦20‰ Tunnel (V＜90km/h) ≦25‰ Absolute maximum ≦35‰ 2. Train Stopping /Parking Section of Main Track: ≦1.5‰ 3. Siding track: ≦1.5‰ However, in the section where neither car parking nor train disconnecting is done, it may be allowed at any other gradient more than 1.5‰, depending on the necessity.

Criteria		Value
8	Grade Revision	In case of the conflicted curve in the grade sections, then gradient shall be rectified with the following formula. Rectification/compensation to Gradient (‰) = 600/R Where, R : Radius of Curve (m)
9	Vertical Curve	1. Main Track VCR=3000m for Plane Curve＞600m VCR=4000m for Plane Curve≦600m 2. Main Track (Absolute Minimum) VCR=2000m for Plane Curve＞600m VCR=3000m for Plane Curve≦600m 3.Siding VCR=2000m At the location whose change in gradient amounts to less than 10‰, Insertion of the longitudinal curve may be omitted.
10	Change of Gradient within Transition Curve	Conflict between vertical curve and transition curve shall be avoided as much as the Circumstances/conditions permit.
11	Distance between Track Centers	1.Main Track 3.8m for Plane Curve≧250m 2.Siding 3.8m for Plane Curve≧250m 3.Depot area more than 4.0m
12	Expansion of Distance between Track Centers	Distance between track center on curve with R<250m is expanded by the following formula: Size of expansion (mm) = A + W1 + W2 Where, A : Deviation due to difference of cant (=2.95|C1-C2| But deviation in interval between rolling stock due to inclination of cant in case it may be apart should be disregarded as negligible) C1:Extent of cant of the line concerned(mm) C2 : Extent of cant of the adjacent line(mm) W1:Extent of deviation towards the inside of the curve (30,000/R1) R1:Radius of the curve concerned (mm) W2:Extent of deviation towards the outside of the curve (30,000/R2) R2:Radius of the adjacent curve (mm)
13	Distance between platform edge with track centers	Straight-line platform: 1.55m On the curvilinear platform, in addition to rolling stock body displacement, inclination of slack and cant is considered to expand above dimension.

Source: JICA Study Team

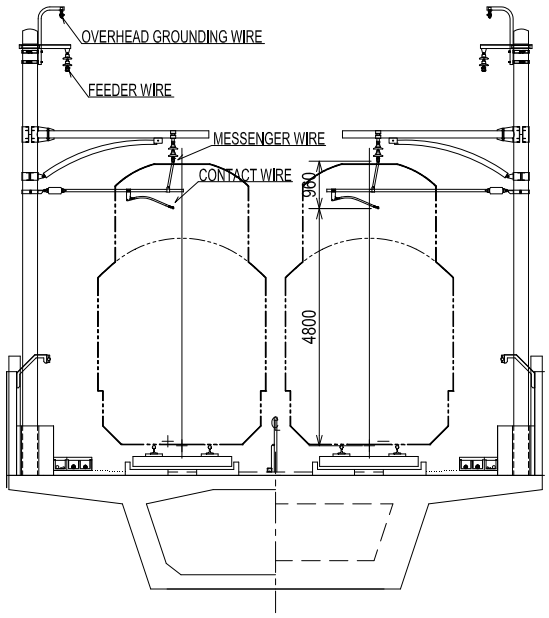
(3) Vehicle and Construction Gauge

As described in the previous section, the General Specification for the Standard Urban Railway System for Asia was applied as the standard for vehicle gauge to integrate MRT East-West and North-South Lines.



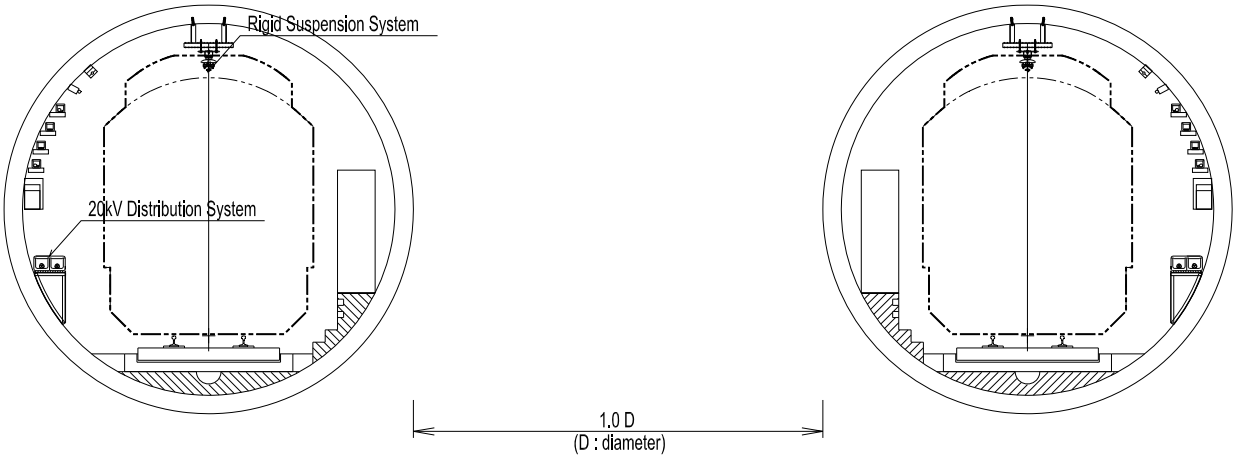
Source: JICA Study Team

Figure 4.1-4 Vehicle and Construction Gauge



Source: JICA Study Team

Figure 4.1-5 Typical Cross Section (Elevated Section)



Source: JICA Study Team

Figure 4.1-6 Typical Cross Section (Underground Section)

4.1.3 Horizontal Alignment

(1) Minor Modification and Applied Alignment

As described in Chapter 3, during the stakeholder coordination meetings, Alternative 1B was decided as the target route for this study. Prior to the planning of the detailed alignment of the route, the pre-FS alignment was scrutinized as the first step. As a result, the following points for consideration have been found in the section from Pesing Station to Cideng Station as illustrated Figure 4.1-7:

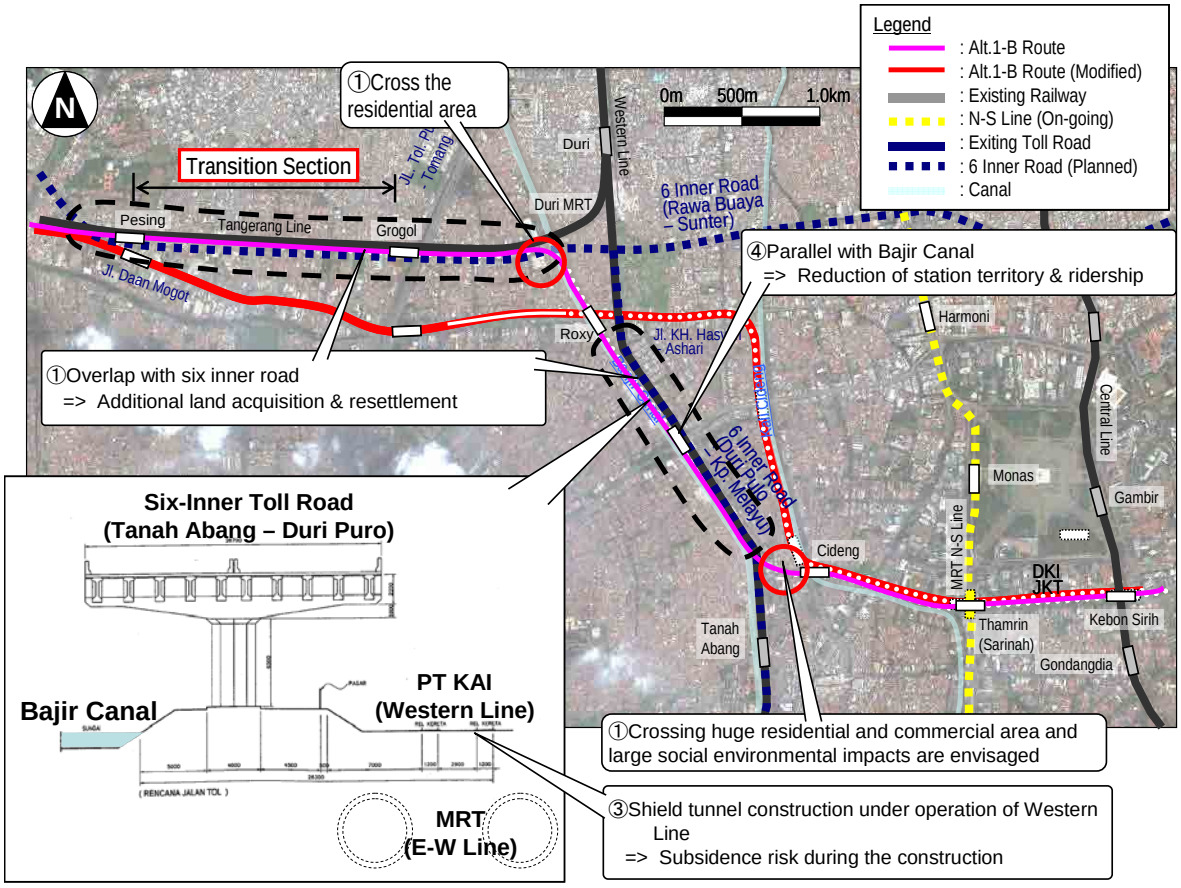
i) In the Tanah Abang area, the alignment passes private lands below and thus, voluminous compensation was foreseen. In addition, some special treatment (underpinning, etc.) will be necessary for the alignment passes below the high-rise buildings.

ii) The adjacent site, which undergoes the Six Inner Toll Road Project, was also planned within the public ROW along West Banjir Canal. Since the remaining construction space for MRT East-West Line is limited to private lands and/or lands under Western Line (PT. KAI). Thus, social impacts due to the usage of private lands were expected.

iii) The longitudinal usage of 1.6 km of Western Line's (PT. KAI) underground may have construction risks in terms of subsidence due to shield tunneling. Such subsidence risk under the operations of railway should be avoided.

iv) Since the alignment in the pre-FS passes just adjacent to Banjir Canal, which is the station territory of Jembatang Tomang and Roxy Station, cannot fully include commercial industries, and business and residential areas, there cannot be much expectation from the future potential of the station development.

In order to cope with the above consideration points, the alignment was rerouted to pass along Jl. Daan Mogot, Jl. Kyai Tapa, Jl. KH Hasym Ashari, and Jl. Cideng Barat/Timur, as shown in Figure 4.1-7. The ROW widths of Jl. Daan Mogot, Jl.Kyai Tapa, and Jl. KH Hasym Ashari are sufficient enough to accommodate MRT structures and allow the construction of transition and elevated facilities. In addition, the rerouted alignment includes proper balance of the developed area and can integrate with buses from Grogol Bus Terminal for short- and medium-distance travel.



Source: JICA Study Team

Figure 4.1-7 Rerouted Alignment between Pesing–Cideng Station

Source: JICA Study Team

Photo 4.1-1 Existing Condition of Jl. Daan Mogot

(2) Horizontal Alignment Planning

The following points were considered in the horizontal alignment planning:

- The center of alignment was planned to be along the center of the existing road as much as possible.
- In order to minimize land acquisition and resettlement, the ROW of MRT facilities should be within the public ROW as much as possible.

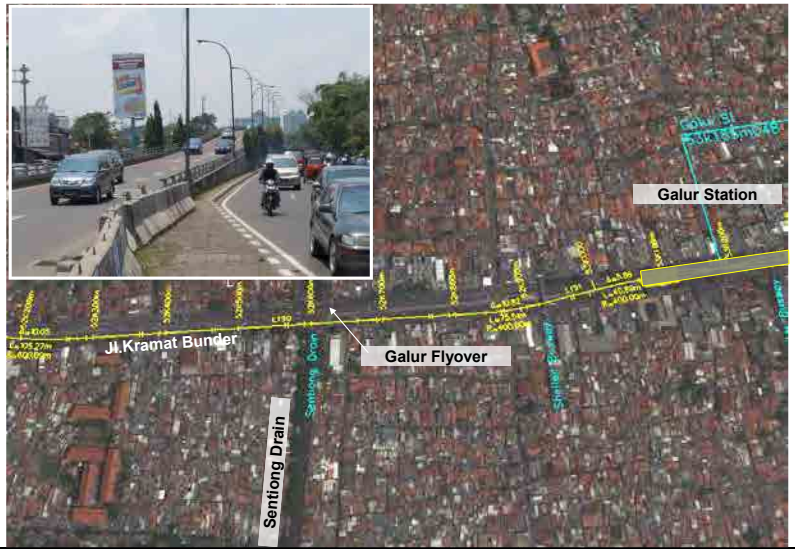
- Even at locations where the alignment is compelled to pass below private lands, large buildings which require special construction treatment such as underpinning, etc. (e.g. high rise buildings which have foundation piles) should be avoided.

(3) Control Points in Horizontal Alignment

The following points are considered in the alignment planning.

Location	Explanation	
41k600m Pesing Flyover		The MRT elevated structure should shift towards the south in order to avoid Pesing Flyover.
44k050m Grogol Station		Jl. Kyai Tapa can be utilized as a transition section because of its wide ROW. The alignment is located at the north side median where it can be utilized for such purpose. The location of Grogol Station was also proposed just above the north side of the existing Grogol Bus Terminal for connectivity purposes. However, the rail level (RL) should be raised in order to provide clearance for Pluit–Tomang Toll Road.

Location	Explanation	
45k240m West Banjir Canal(WBC) and Bridge over WBC		The alignment should shift towards north in order to avoid the existing bridge foundation, retaining wall and large building foundation (Roxy Square). The north side also has a development potential with the utilization of the empty space.
Steep Curve in Jl. Cideng Timur/Barat		The steep curve (less than R = 190 m) is necessary at the intersection point between Jl. Hasym Asyhari and Jl. Cideng Timur/Barat. The alignment around this area was assumed as an underground section, rendering it necessary to occupy the area below private lands. From the site survey, there seem to be no buildings which have pile foundations (higher buildings in the photo can be avoided).
47k900m Kali Cideng and Cideng Flyover		The alignment around Cideng Station should be adjusted in order to avoid the existing Cideng Flyover and minimize private land acquisition inside the curve.

Location	Explanation	
51k645m Senen Station		The proposed alignment is just adjacent to the existing underpass structure. There is a possibility to take necessary countermeasures during construction to ensure that the stability of the underpass structure is not disturbed. Utilization of the area below the private land, situated at the east side of the existing Senen Station, is necessary.
Galur Flyover		At the east side of Senen Station, the alignment should avoid the existing Galur Flyover by locating the alignment at the south side of the ROW.
59k700m S-curve around Perintis Station		The existing ROW forms consecutive S-curves with narrow widths. Even if the steep curve (R = 200 m) is adopted, land acquisition should still be taken into consideration.

Source: JICA Study Team

Figure 4.1-8 Control Point

4.1.4 Vertical Alignment

Study of the vertical alignment of MRT East-West Line has been made based on the following policy:

- ✓ Shield method is applied to construct the underground section between stations in order to minimize the impact to the ground surface. Meanwhile, cut-and-cover method is applied to the construction of the underground station. Since the construction cost of the underground structures is approximately three times as high as that of the elevated structures, the works for the underground structure should be minimized.

Generally, MRT structures are roughly categorized into the following three options:

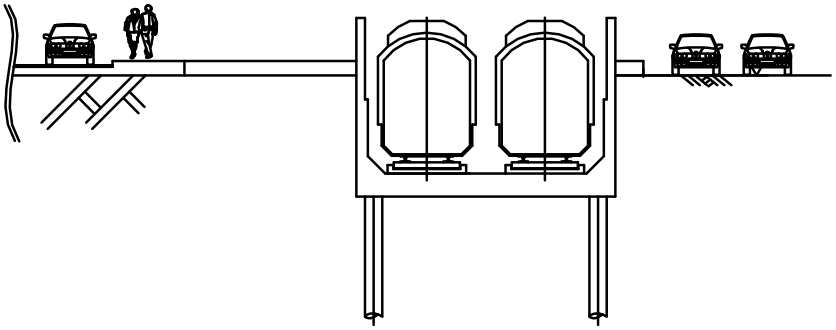
(a) all elevated,
(b) all underground, and
(c) combination of elevated and underground.

For option (a), it is almost impossible to apply an all elevated structure plan for the entire route of MRT East-West Line, because the construction space for the substructure of the elevated structure in the center of Jakarta is insufficient. Furthermore, although the construction cost can be minimized, impact to the present road traffic is still quite high. Option (b) requires construction that is too costly, which obviously worsens the cost benefits, and thus, this option is also excluded. As a result, option (c) will finally be the one to be applied to the Jakarta MRT East-West Line Project. This requires the alignment to run underground in the center of Jakarta, in which the biggest impact to the present traffic is expected. Consequently, there should be two transitions from the elevated to underground sections, one at the west and one at the east.

(1) Study of the Transition Section Location

1) Conditions of the Transition Section

As shown in Figure 4.1-9, the typical transition section occupies the road center upon reaching the ground from the underground alignment. The required length for transition is approximately 850 m in case vertical gradient of 30‰ is applied (difference in height was assumed to be 25 m; underground section RL = - 15 m; elevated section RL = 10 m). The open mouth section occupies about 20 m in width. The cut-and-cover method is applied from the underground station to the open mouth section, and the bearing pile system is applied from the open mouth section to the elevated station.



Source: JICA Study Team

Figure 4.1-9 Typical Section of Transition Section

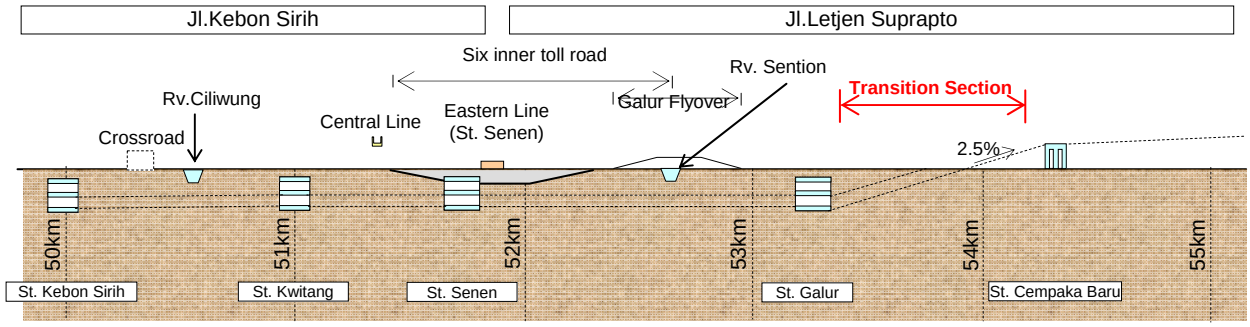
2) Transition Section in the East

The eastern alignment of central Jakarta extends eastward, passing through Jl. Kebon Sirih – Jl. Letjen Suprapto – Jl. Perintis Kemerdekaan. It is preferable to situate the transition section to the west most side as much as possible. However, suitable locations are limited because of the presence of various obstacles. Initially, it was considered to select the location that is on the westernmost street, Jl. Kebon Sirih. In this case, the length will not be sufficient for transition because it has to pass over the flyover of JABODETABEK Central Line after passing under the

Ciliwung River. Moreover, since Senen Station was planned along the elevated Six Inner Toll Road and it seems that it is difficult to construct an underground station below the existing Galur Flyover, the transition section needs to be situated at the eastern portion from this point.

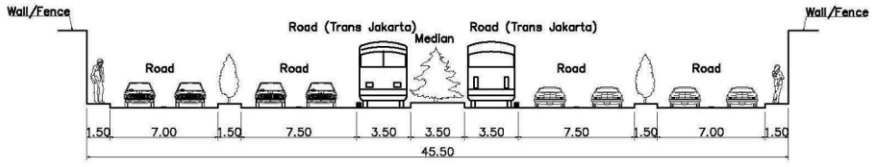
a) Alternative 1

This plan involves building Galur Station as an underground station and Cempaka Baru as an elevated station. The distance between the two stations (eastern edge of Galur Station to the western edge of Cempaka Baru Station) is about 950 m. Moreover, these two stations can be connected with a relatively low gradient of around 2.5%. Since the typical cross section of surface traffic is as shown in Figure 4.1-11, the present traffic must occupy five lanes on one side (four lanes plus one TransJakarta Lane). However, since the widths of the center median and green zone are not wide enough to accommodate traffic during and after construction, the reduction of the number of traffic lanes will be required. On the other hand, given the possibility that MRT East-West Line can be used as an alternative transportation mode for TransJakarta bus way, since the alignment of MRT East-West Line overlaps with that of TransJakarta (Corridor 2) up to the eastern terminal station, Pulo Gadung, it does not necessarily mean that it will decrease the capacity of road traffic. Moreover, since this is the plan to allocate the transition section as far west as possible, it is possible to minimize the underground section as well as the initial investment cost.



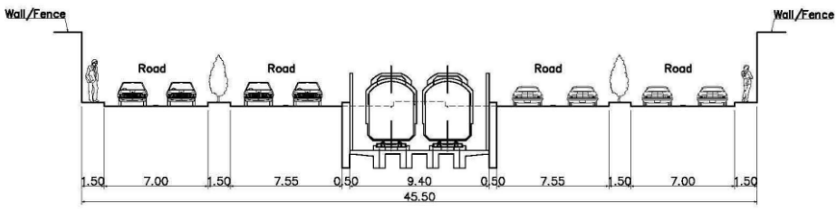
Source: JICA Study Team

Figure 4.1-10 Longitudinal Section of Alternative 1 of the Transition Section at the East



Source: JICA Study Team

Figure 4.1-11 Cross Section of the Existing Jl. Letjen Suprapto

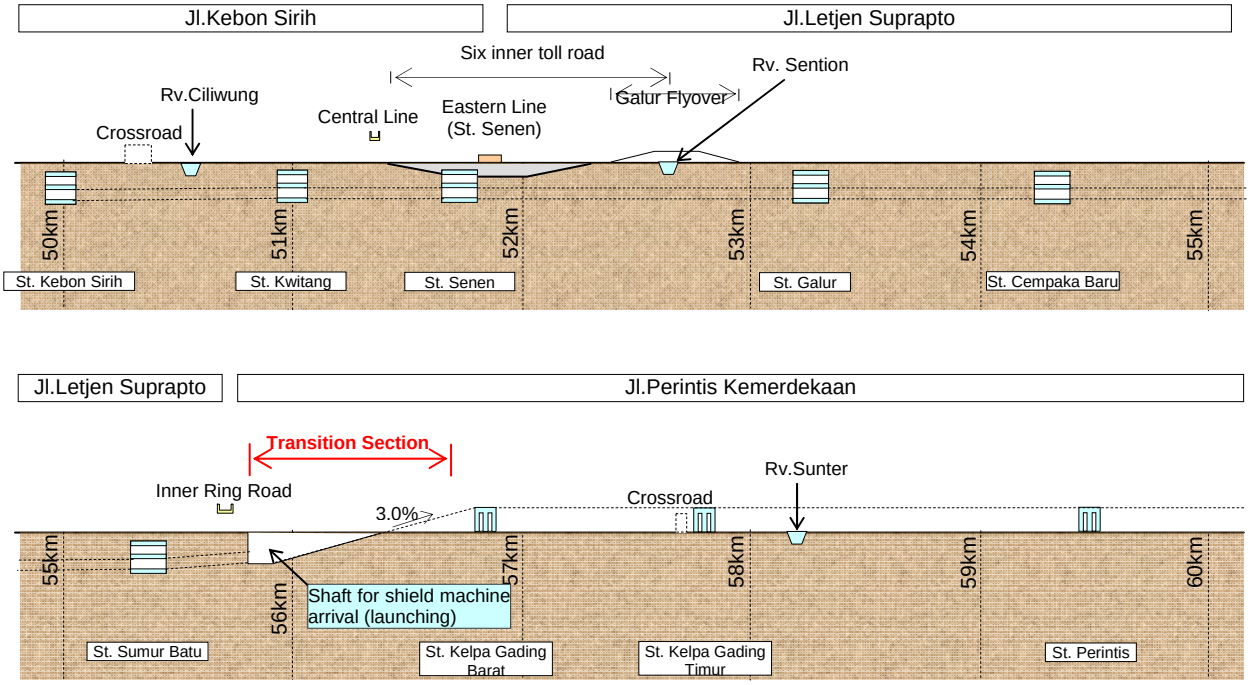


Source: JICA Study Team

Figure 4.1-12 Cross Section of Jl. Letjen Suprapto (Transition)

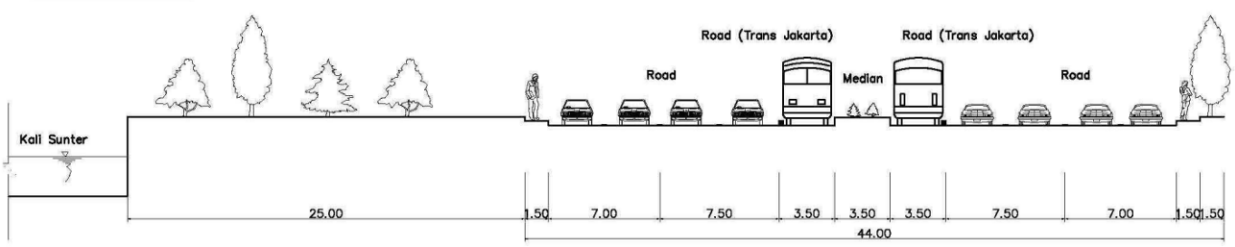
b) Alternative 2

This plan involves building Sumr Batu Station as an underground station and Kelapa Gading Barat Station as an elevated station. A shaft is needed to be constructed on the eastern portion of the Inner Ring Road for the arrival/launching of the shield machine. Since it is unrealistic to construct a cut-and-cover tunnel under the Inner Ring Road Flyover, a shaft will be constructed at the east side of the Inner Ring Road. The distance from the shaft to Kelapa Gading Barat Station is around 750 m, and the shaft and station can be connected with a gradient of 3%. The road structure on the surface is shown in Figure 4.1-14. The said road has five lanes on one side, i.e., four lanes plus one TransJakarta lane. The northbound side runs parallel with the Sunter River, and there lies a strip of green zone with a width of about 20 m. This space can be used for road diversion during construction. It can also be utilized as a relocated existing road for the permanent road after construction, thereby minimizing the impact to present traffic. Compared to Alternative 1, its construction cost will be more expensive as the underground section becomes longer.



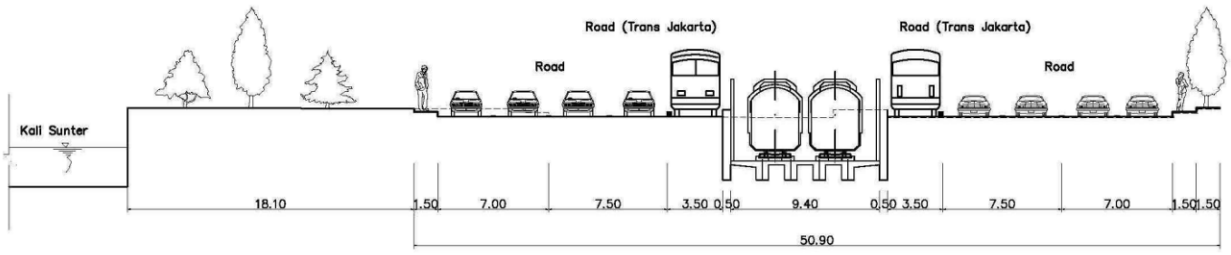
Source: JICA Study Team

Figure 4.1-13 Longitudinal Section of Alternative 2 of the Transition Section at the East



Source: JICA Study Team

Figure 4.1-14 Cross Section of the Existing Jl. Perintis Kemerdekaan



Source: JICA Study Team

Figure 4.1-15 Cross Section of Jl. Perintis Kemerdekaan (Transition)

c) Location of the Transition Section in the East

Table 4.1-2 shows the results of comparison between the two alternatives mentioned above, in light of the following three viewpoints: minimization of underground section (= minimization of initial investment cost), possibility of additional land acquisition, and impact to road traffic. Based on the comparison, it appears that Alternative 1 minimizes the underground section and initial investment cost, thus, it has been set as a transition section in the east of MRT East-West Line (Phase 1).

Table 4.1-2 Comparison of Alternatives on the Location of Transition Section at the East

	Alternative 1	Alternative 2
Minimization of the underground section	O	X
Additional land acquisition	O	O
Impact on Road Traffic	O	O

Source: JICA Study Team

3) Transition Section in the West

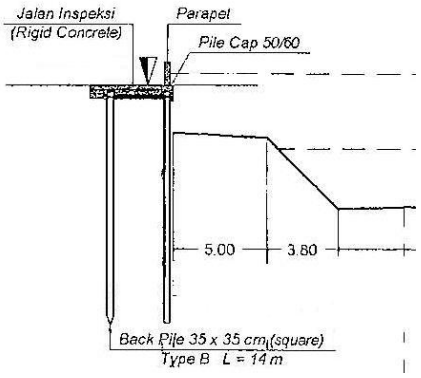
The western alignment of Central Jakarta runs westward through Jl. Kebon Sirih, goes to Jl. Cideng towards north, passing through Jl. KH Hasyim Ashari – Jl. Kyai Tapa – Jl. Daan Mogot, and connects with Tangerang Line. Similar to the case of the transition in the east, it is favorable to locate the transition section to the eastern most side as possible. In the middle of the west and east of Jl. Cideng lies a drainage facility. Thus, it is not possible to use this street as a transition section. Moreover, since there is no center median and green zone on Jl. KH Hasyim Ashari, and its distance to Roxy Station is not long enough to connect the two structures at different levels, Jl. KH Hasyim Ashari is not suitable as a transition section as well. For these reasons, the selected transition section is either from along Jl. Kyai Tapa or along Jl. Daan Mogot.

a) Alternative 1

This is a plan that utilizes Jl. Kyai Tapa as a transition section. A shaft will be constructed for the arrival/launching of the shield machine right after the underground tunnel passes under Bansir Canal running on the west of Roxy Station. Jl. Kyai Tapa has a very wide center median and green zone that can be used for the transition structure. However, the distance for the transition may not be long enough since the existing Pluit-Toman toll road flyover on the west of Grogol Station, crossing the proposed alignment, raises the RL of Grogol Station higher. Tunnel section just before the transition section is required to pass under the existing sheet piles of Bansir Canal in order to connect the elevated structure and underground structure within a maximum gradient of 3.5%. Interrelation of elevations between the bottom level of sheet pile wall and the road surface level of Pluit-Toman Toll Road is critical.

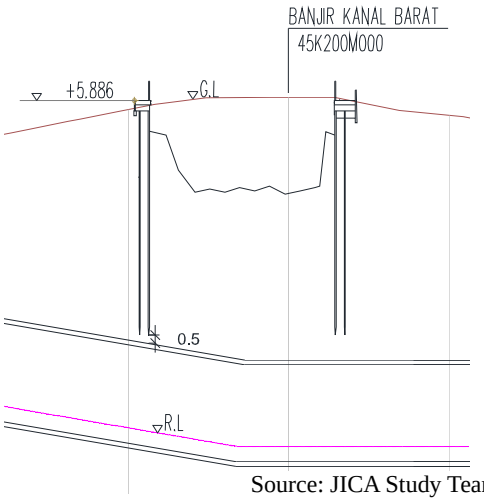
Figure 4.1-16 shows the as-built drawing of revetment structure along Bansir Canal near the proposed alignment. As illustrated, the length of sheet pile is 14 m. The actual elevations of the sheet pile and Pluit-Toman Toll Road have been measured and confirmed by a series of survey works that have been carried out under this Study. It is confirmed that the underground and elevated structures can be connected with a gradient of 3.4%, which is slightly less than the

maximum gradient of 3.5% (50 cm was considered for the clearance between the bottom level of sheet pile and the upper outer level of the tunnel structure).



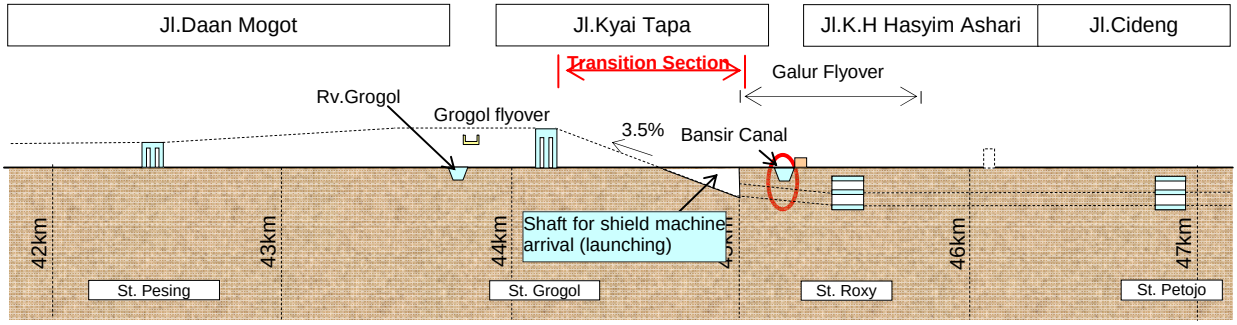
Source: JICA Study Team

Figure 4.1-16 Revetment Structure along Bansir Canal



Source: JICA Study Team

Figure 4.1-17 Clearance between Tunnel Crown and Sheet Pile Bottom

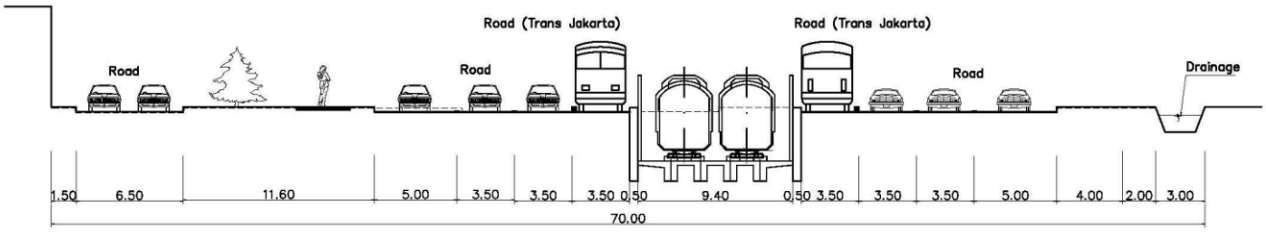


Source: JICA Study Team

Figure 4.1-18 Longitudinal Section of Alternative 1 of the Transition Section in the West

Source: JICA Study Team

Figure 4.1-19 Cross Section of the Existing Jl. Kyai Tapa

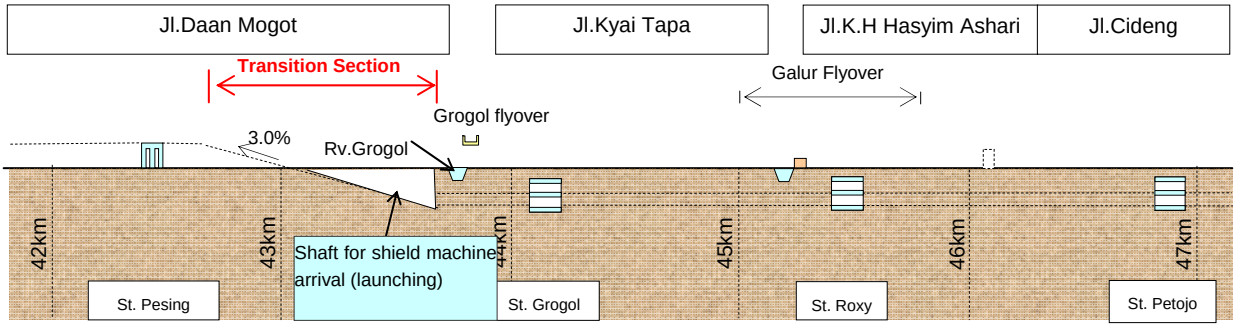


Source: JICA Study Team

Figure 4.1-20 Cross Section of Jl. Kyai Tapa (Transition)

b) Alternative 2

This alternative requires the utilization of Jl. Daan Mogot for the transition section. A shaft will be constructed for the arrival/launching of the shield machine after the underground section passes under the flyover at Pluit-Tomang Toll Road. Then, the shaft and elevated Pesing Station will be connected. As shown in Figure 4.1-22, this section of Jl. Daan Mogot has only three lanes and one TransJakarta lane, without a center median and green zone up to the crossing point with Tangerang Line. Accordingly, it is inevitable to reduce the number of traffic lanes during and after construction, and apparently, acquiring additional land may be necessary in case that this section is utilized as a transition section.

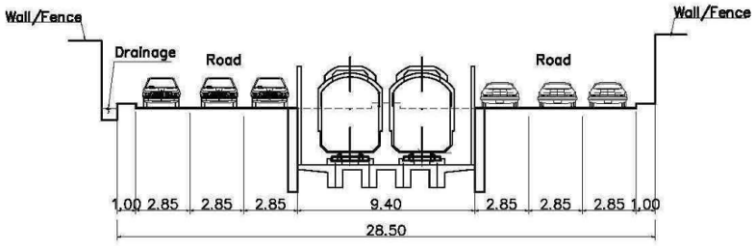


Source: JICA Study Team

Figure 4.1-21 Longitudinal Section of Alternative 2 of the Transition Section at the West

Source: JICA Study Team

Figure 4.1-22 Cross Section of Jl. Daan Mogot (Existing)



Source: JICA Study Team

Figure 4.1-23 Cross Section of Jl. Daan Mogot (Transition)

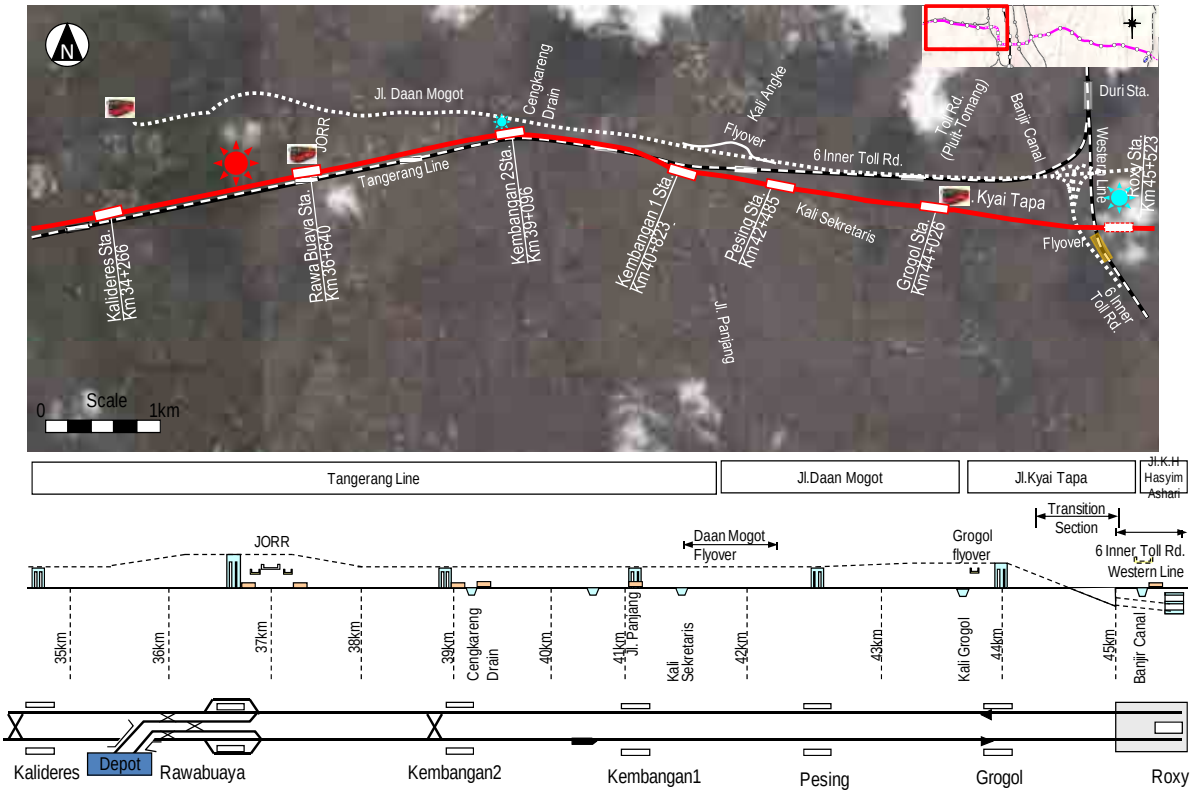
c) Location of Transition Section at the west

For Alternative 1, it is confirmed by the vertical alignment study based on the survey works that it can be connected under the maximum gradient. Therefore, since Alternative 1 has clear advantages over every aspect, i.e., minimization of initial investment cost and land acquisition, and impact to the road traffic, Alternative 1 has been set as a transition section in the west.

4.1.5 Schematic Proposed Alignment (Plane, Longitudinal) and Track Layout

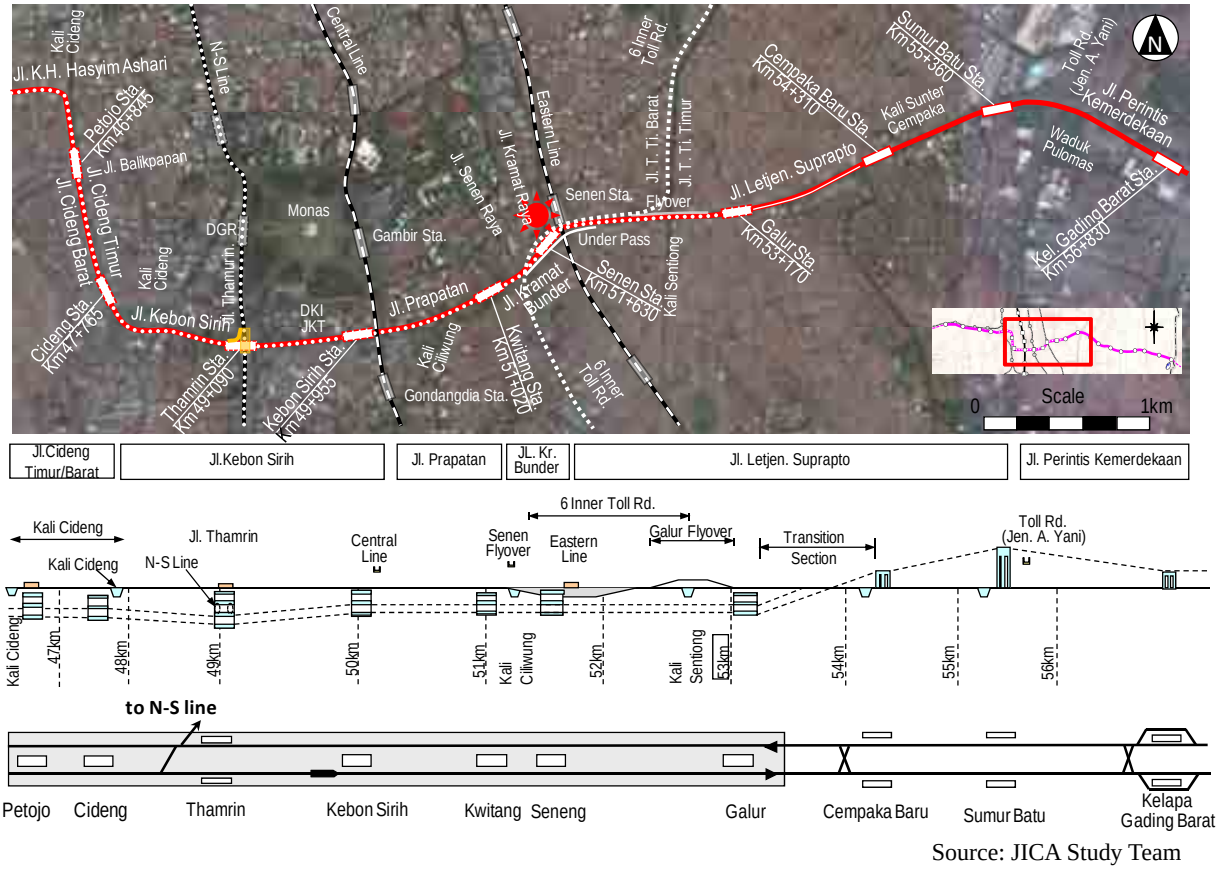
The proposed schematic plane and longitudinal alignment and track layout of Phase 1 of MRT East-West Line are shown in Figure 4.1-24 to Figure 4.1-26. Together with the plane alignment plotted on the satellite image, the existing JABODETABEK railways, bus terminal and potential development area are also indicated. In the schematic vertical alignment, the existing

flyovers, rivers and canals, and crossing points with JABODETABEK railways are indicated as well.



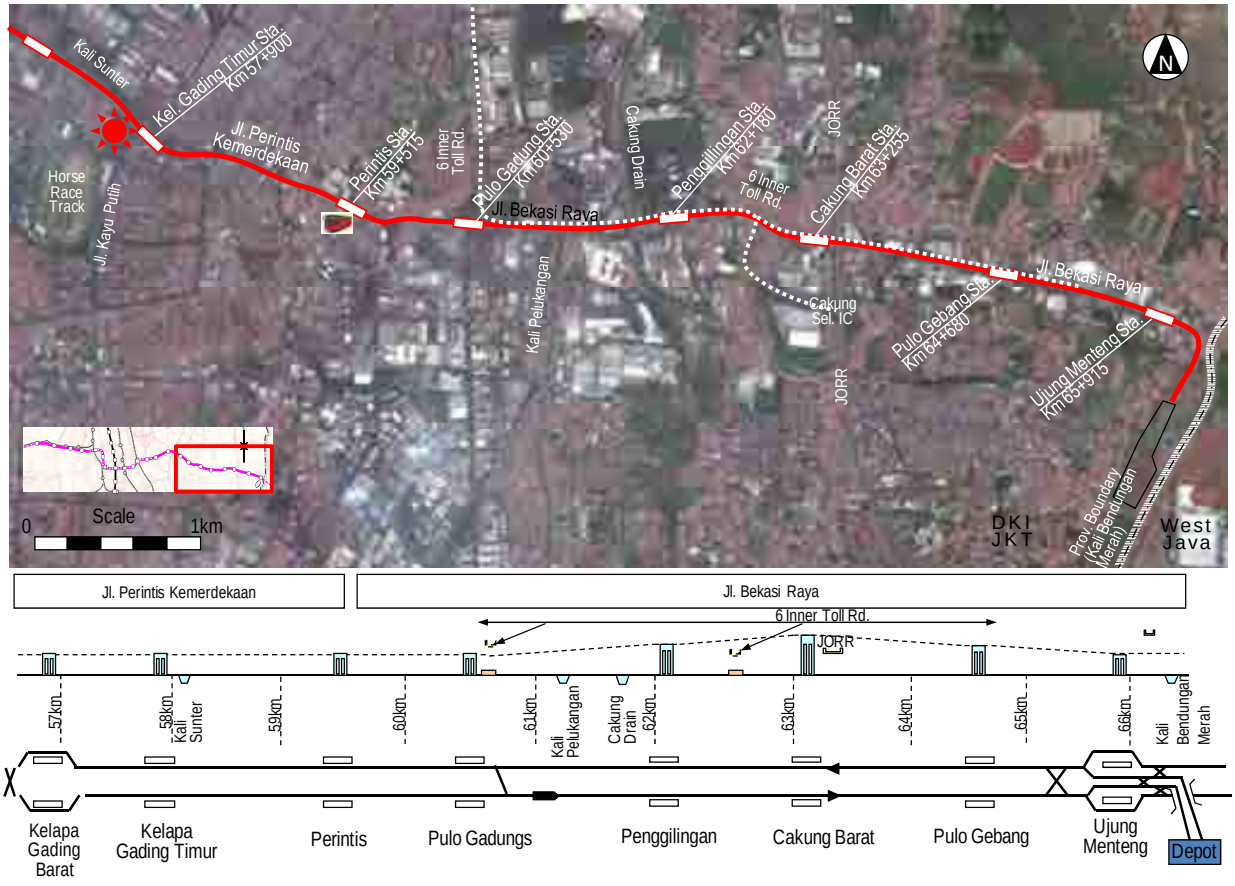
Source: JICA Study Team

Figure 4.1-24 Schematic Alignment, Track Layout（1/3）



Source: JICA Study Team

Figure 4.1-25 Schematic Alignment, Track Layout（2/3）



Source: JICA Study Team

Figure 4.1-26 Schematic Alignment, Track Layout (3/3)

4.1.6 Plan of Connection track between N-S Line and E-W Line

At the southwest of Monas, MRT East-West (E-W) Line crosses with MRT North-South (N-S) Line at the intersection of Jl. Thamrin and Jl. Kebon Sirih. MRT East-West Line has a plan to construct Thamrin Station at the intersection. But MRT North-South Line does not have a plan to construct a station there, but has a plan to construct Sarinah Station at one block south side.

Nevertheless, it is necessary to construct a transfer station between the two lines at the intersection because of the following reasons:

1) it is expected that a number of passengers transfer at this intersection;

2) improvement of passenger service can increase the number of passengers.

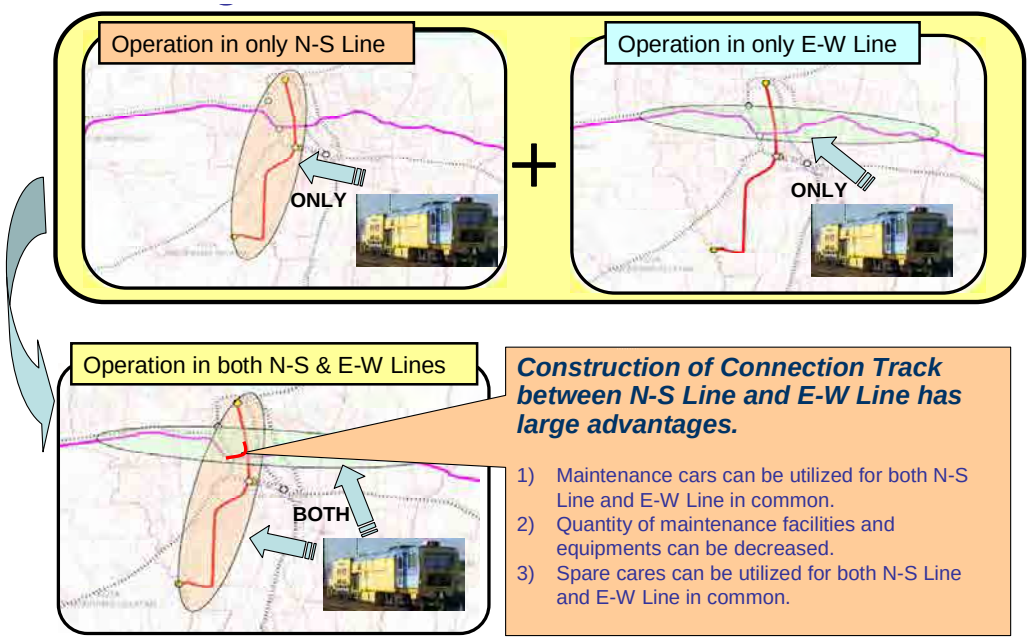
Thus, it is strongly recommended to shift the Sarinah station to one-block north side, and to connect it with MRT East-West Line.

In addition, construction of the connection track around the intersection will have the following large advantages as well:

1) Reduction of O&M costs through sharing maintenance cars and equipment, spare equipment and materials, spare cars and so on between MRT North-South and East-West Lines.

2) Utilization for by-pass in case of emergency.

The amount of construction cost, because of its underground structure, is estimated to be approximately 1.0 billion yen. Nevertheless, the amount of the O&M cost reduction through the connection track is estimated 3.6 billion yen, and the advantages of it's the connection track exceed its construction costs.



Source: JICA Study Team

Figure 4.1-27 Advantage by Connection of N-S Line and E-W Line

Source: JICA Study Team

Figure 4.1-28 Connection Track Plan

4.2 Rolling Stocks

4.2.1 Outline

Rolling stocks of MRT East-West Line adopts the same specifications with that of MRT North-South Line. The technology and human resources of MRT North-South Line can be effectively used for MRT East-West Line in order to achieve efficient operations. The outline of MRT East-West Line is shown in Table 4.2-1

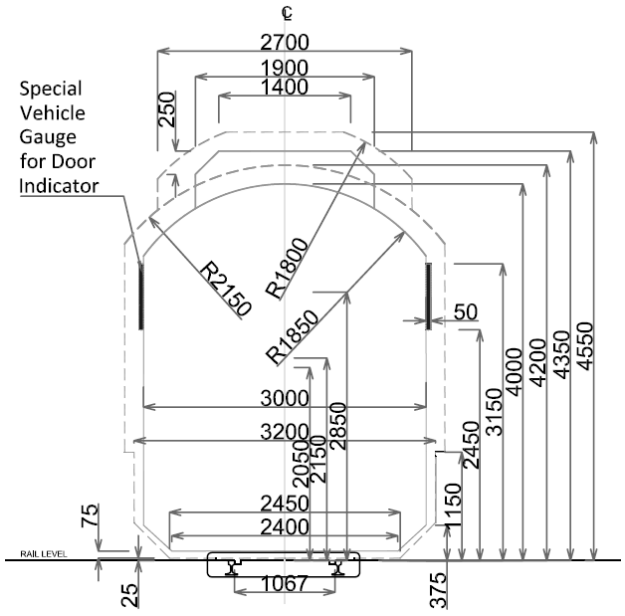
Table 4.2-1 Outline of MRT East-West Line

Line profile		
1	Route length (Stage 1 in Phase-1)	20.0 km
	Route length (Stage 2 in Phase-1)	31.6 km
	Route length (Phase-2)	88.7 km
2	Track configuration	Double track
3	Operation direction	Right-hand side
4	Gauge	1,067 mm
5	Absolute Minimum radius	180 m
6	Absolute maximum gradient	35 ‰
Maximum design speed		
1	Elevated section	100 km/h
2	Underground section	80 km/h
3	Shunting in station and depot	25 km/h
Electrification		
1	Current collection	Overhead Contact line
	Elevated section	Catenary
	Underground section	Rigid conductor
2	Traction power	DC 1500V

Source: JICA Study Team

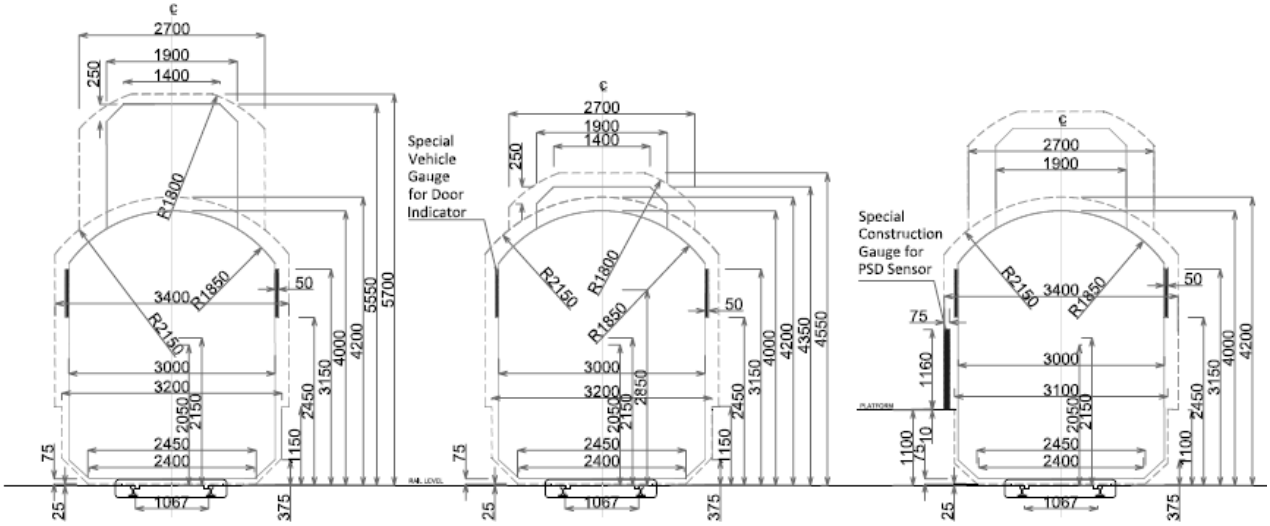
4.2.2 Design Criteria

The vehicle gauge, the structure gauge and the dimensions of the car body are shown in Figure 4.2-1, Figure 4.2-2 and Figure 4.2-3, respectively. The basic specifications of the rolling stocks are described in Table 4.2-1



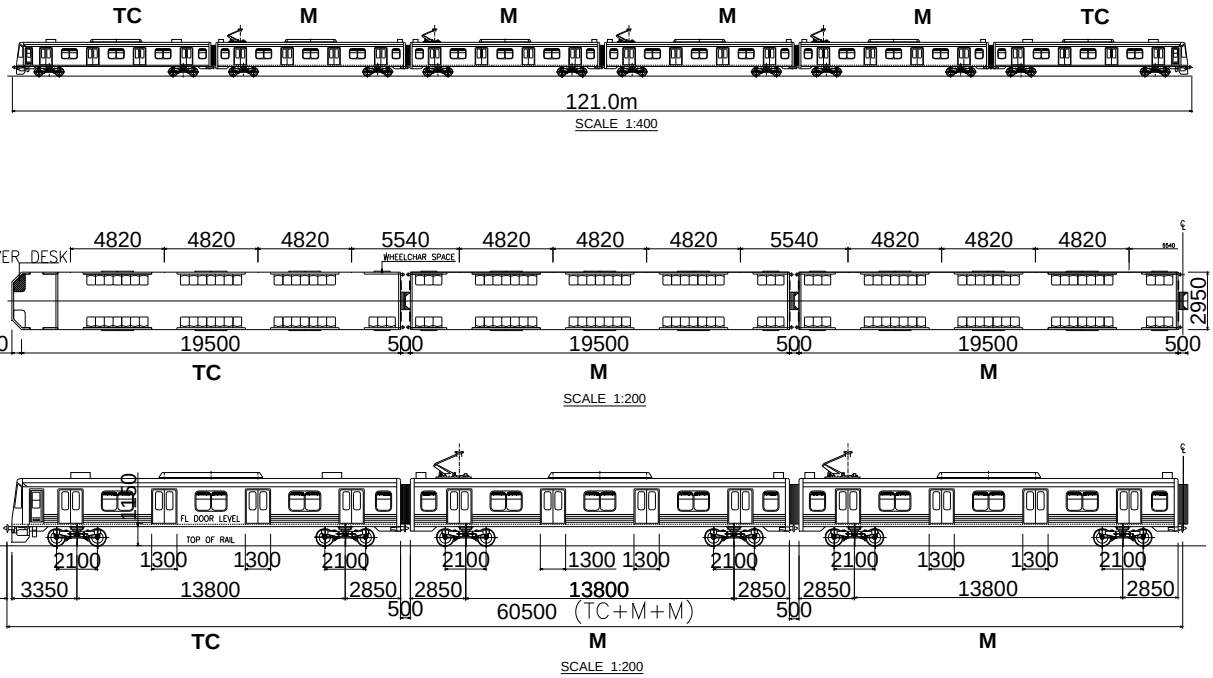
Source: North-South Line Basic Design Report

Figure 4.2-1 Vehicle Gauge



Source: JICA Study Team

Figure 4.2-2 Structure Gauge



Source: JICA Study Team

Figure 4.2-3 Car Body Dimensions

Table 4.2-2 Specification

Rolling Stock		
1	Car length of control car (Tc)	20,500 (mm)
	Car length of intermediate car (M/T)	20,000 (mm)
2	Car width	2,950 (mm)
3	Roof Height	3,655 (mm)
4	Floor Height	1,150 (mm)
5	Tare weight (Tc)	27.7 (ton)
	Tare weight (T)	22.4 (ton)
	Tare weight (M)	35.7 (ton)
6	Acceleration rate	0.92 (m/s²)
7	Number of side sliding doors (one side)	4 doors
8	Material of car body structure	Stainless steel or aluminum

Rolling Stock		
9	Seat arrangement	Longitudinal seat
10	Current collection	Overhead contact line

Source: JICA Study Team

4.2.3 Passenger Capacity

Table 4.2-3 shows the number of passengers including the number of seats and number of standing passengers at a standing density of 3 pax/m2 or 8 pax/m2(crush load). However, a congestion rate of 100% is calculated at the standing density of 3 pax/m2.

Table 4.2-3 Passenger Capacity

Item	Mc/Tc	M/T
Passenger seated (pax)	45	54
Passenger standing (3 pax/m²)	(99)	(108)
Passenger standing (8 pax/m²)	(263)	(284)

Note: Each Tc car has a chair wheel space for 3 people.
Source: JICA Study Team

Therefore, the number of passengers considering a congestion of 100% in a four-car train, six-car train and eight-car train are shown in Table 4.2-4.

Table 4.2-4 Train formation and number of passengers

Sets	Seated	Standing	Total
4-car	198	414	612
6-car	306	630	936
8-car	414	846	1260

Source: JICA Study Team

4.2.4 Train formation

The peak hour peak direction traffic (PHPDT) at the opening of Stage 1 in Phase 1 is 14,900 passengers, thus the number of cars needed for six-car trains will be purchased as stated in item 4.3.4 (2).

Furthermore, as shown in Table 4.2-5, 4M2T type will be adopted for six-car trains upon consideration of the adhesion between M-cars and rails.

Table 4.2-5 is the comparison table, assuming the case where empty cars will rush over for rescue if a train with a congestion ratio of 200% (crush load) breaks down in the middle of the section with 3.5% gradient. According to the table, the six (6) –car train shall consists of 4M2T, considering the cohesion between M-car and rails.

Table 4.2-5 Comparison of Train Formation

No	Item and Calculation condition			No. of car	6
				Formation	4M2T
				M car ratio	0.67
1	Car Weight - Tc=27.7 T=22.4 - M=35.7 M=41 Crush load : 20t/car	Tare weight	……①		198
		Crush Load	……②		318
		Weight of crush M cars	……③		222.8
2	Max. acceleration rate (m/s^2)		……④		0.92
3	Tractive efforts on level F : (KN) or (t) - Inertia : 5%, Train resistance : 3% F=②×④×1.05×1.03		……⑤		316 (32.3t)
4	Adhesion coefficient at driving wheel μ(%) μ=⑤(t)/③				14
5	Rescue Operation on 3.5% gradient : - Failed Train : crush loaded - Rescue Train : Empty Those are the same train formation				
	5.1 Total Train Weight (t) = ①+②		……⑥		516
	5.2 Required minimum acceleration(*)		……⑦		0.01
	5.3 Train resistance, T_R(KN) TR=(40+9.8×35)×10^{-3}/t=0.383×⑥		……⑧		198
	5.4 Tractive efforts on 3.5% gradient F=⑥×⑦×1.05+⑧ (KN) or (t)		……⑨		203 (20.7t)
	5.5 Tare weight of M cars in Rescue train (t)		……⑩		142.8
	5.6 Adhesion coefficient at motoring wheel on Rescue Train μ(%) μ=⑨(t)/⑩		……⑪		14

Note: (*) Mini, acceleration of 0.01 m/sw corresponds to that of "starting up to 10 km/h within about 30 seconds as shown in table of TRAIN FORMATION (3/4)" presented on 3rd March 2010

Source: JICA Study Team

4.2.5 Integrity with MRT North-South Line

MRT East-West Line was assumed to have the same operations, maintenance and management as MRT North-South Line. Thus, integration with the MRT North-South Line should be considered for the purchasing and maintenance aspects. The rolling stock specifications are shown in Table 4.2-6.

Table 4.2-6 Summary of Rolling stock

Rolling Stock			
1	Track Gauge	1,067 (mm)	
2	Car body dimension		
	1) Car length of control car (Tc)	20,500 (mm)	
	Car length of intermediate car (M)	20,000 (mm)	
	2) Car width	29,500 (mm)	
	3) Roof height	3,655 (mm)	
	4) Floor height	1,150 (mm)	
3	Seats arrangement	Longitudinal seat	
4	Number of side sliding doors (one side)	4 doors	
	1) Width of passenger door	1,300 (mm)	
5	Materials of car body structure	Stainless Steel or Aluminum	
6	Bogie		
	1) Type	Bolster less	
	2) Wheel diameter	New: 860mm, Fully worn: 780mm	
	3) Secondary suspension	Air Spring	
	4) Brake	M:	Tread Brake
		T:	Tread Brake and/ or Disk Brake
7	Tare weight	Tc:	27.7 (ton)
	Tare weight	M:	35.7 (ton)

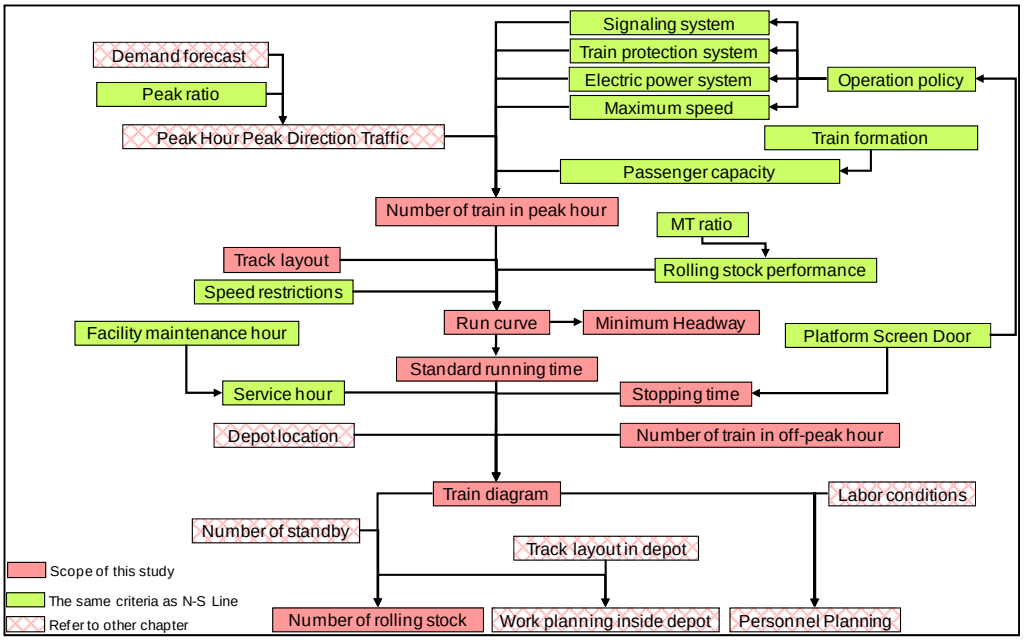
8	Passenger Capacity		
	1) Seated	Tc:	45
		M:	54
	2) Seated + Standing (3 pax/m2)	Tc:	144
		M:	162
9	Passenger crush load weight per car	20 (ton)	
10	Max. axle load	less than 14 (ton)	
11	Formation	Tc – M – M – M – M – Tc	
12	Catenaries voltage (VDC)		
	1) Rated	1,500 VDC	
	2) Range	900 - 1,800 VDC	
13	Performance		
	1) Acceleration rate	0.92 (m/s²)	
	2) Deceleration	SB:	0.80 (m/s²)
		EB:	1.0 (m/s²)
	3) Max. speed	100 Km/h on elevated section 80 km/h in tunnel section	
14	Pantograph		
	1) Type	Single arm	
	2) Operation	Raised by spring and lowered by air pressure	
	3) Rated current minimum	1,500 A	
15	Traction Motor		
	1) System	Cage type 3 phase induction motor	
	2) Capacity	140 kW (Tentative)	
	3) Rated voltage	1,100 V	
16	VVVF inverter (traction inverter)		
	1) Type	IGBT	
	2) Input voltage	1,500 (max. 1,800; min. 900) VDC	
	3) Output voltage	3 Phase AC 0～1,100V	
	4) Capacity	600 kVA (Tentative)	
17	Auxiliary Power Supply/ static inverter type	IGBT (Insulated Gate Bipolar Transistor)	
	1) Input voltage	1,500 VDC	
	2) Output voltage	3 phase, 380 V, 50 Hz/ single phase,220v,50Hz	
	3) Capacity	225 x 2 = 450 kVA (Tentative)	
	4) Battery charger/battery	110 V DC	
18	Lighting		
	1) Type	Fluorescent light in saloon	
	2)Lighting level	In saloon : more than 300lux In Cab: more than 100lux	
19	Passenger doors		
	1) Type	Bi-parting pocket types sliding doors	
	2) Drive system	Pneumatic single cylinder	
	3)Numbers per car	4 per each side, total 8 per car	
20	Air conditioning		
	1) Type	Self-contained package type	
	2) Adjusted room temperature	25°C、60%R.H	
21	Motor Compressor	Screw or scroll	
	1) Capacity	2 x 2,000 (L/min) (if 6 cars/train set)	
	2) Power supply	AC - 380V - 50 Hz - 3 phase	
22	Train Information System (TIS)	Assistant to Train Operation	
23	MDBF	≥100,000 km	
24	Availability	95% for initial service 98% after 2 years revenue service.	

Source: JICA Study Team

4.3 Train Operation Plan

4.3.1 Work flow

The considered train operations work flow is shown in Figure 4.3-1.



Source: JICA Study Team

Figure 4.3-1 Working Flow for Train Operation Plan

4.3.2 Outline

(1) Operation Policy

Regarding the train operations plan of MRT East-West Line, it is assumed that PT Mass Rapid Transit Jakarta (PT. MRTJ), the operator of MRT North-South Line, also carries out the operations management of MRT East-West Line. Hence, the train operation plan is proposed based on the regulations of MRT North-South Line, which is also adopted for MRT East-West Line. Outlines and characteristics of Stage 1 section (Kalideres - Cempaka Baru) and Stage 2 section (Kalideres - Ujung Menteng) in Phase 1 are described in follows.

(2) Platform Screen Doors (PSDs)

At stations, platform screen door (PSD) systems are installed as an advanced safety measure. The train stoppage time will be calculated upon the consideration of stations and opening-and-closing time of PSDs. The kinds of PSDs to be installed at the underground stations and elevated stations vary.

There are two types of PSD systems, namely full-height and half-height PSDs. Full-height PSDs are generally applied in underground stations for the purpose of obtaining benefits including passenger safety, reducing the number of station staff and crew, and reducing the energy cost for air-conditioning. Meanwhile, half-height PSDs are generally introduced at elevated and/or at-grade stations for passenger safety.

(3) Signaling Safety Devices

Automatic train protection (ATP) is adopted as a signal safety device for the main line. The signal display method used for the main line is the cab-signal system.

Train shunting operation in depots will be implemented in accordance with the way-side signal. Shunting speed shall be 25 km/h or less. There is a safety system of automatic activation of the brakes in case the speed has surpassed its limit.

(4) Operation Method

As familiar to MRT North-South Line, the automatic train operation (ATO) device is adopted to execute the operation such as starting the train, acceleration, deceleration, and even controlling stoppage position in stations.

4.3.3 Track Layout

(1) At the Opening time of Stage 1 in Phase-1 (Year 2021)

MRT East-West Line is constructed with a double-track railway and direct current electrification in all sections. Figure 4.3-2 shows the layout and Table 4.3-1 shows the information about each station. MRT East-West Line has improved the convenience of access to central DKI Jakarta by installing many transfer stations with other transportations such as JABODETABEK Railway and TransJakarta.

1) Kalideres Station

The location of new Kalideres Station of Jakarta MRT E-W Line is planned to develop at open space about 500m east side from the existing Kalideres Station of Tangerang Line, because there are so many houses around the existing Kalideres Station. Hence, serviceability for passengers as a transfer station is not so high between these stations, and Rawabuaya Station, next to the east side of Kalideres Station, will be proposed as a station with a transfer function.
Stabling tracks for two train sets are installed at the west side of the station and the train operations plan is decided flexibly to meet the demand. However, the stabling tracks will be cleared to give way for the main line during the start of the extension of Phase 2.

2) Rawabuaya Station

The station type of Rawabuaya Station is proposed to construct the new elevated platform of Jakarta MRT E-W Line and at-grade platform of Tangerang Line for effective connectivity service. Kalideres depot is planned at the southwest side of this station, so this station layout is planned two platforms and four tracks, and connection line to depot is started from center tracks.

3) Roxy Station

Roxy Station will be located at crossing point of Western Line, but there is no station on Western Line near here. Hence, the development of new station will be proposed on Western Line for integrated passenger service. Station development and bus terminal were proposed at the open space of north side of Roxy Station for increasing the ridership of E-W Line.

4) Thamrin Station

Thamrin Station is the interchange station with MRT North-South Line. A number of passengers are estimated to transfer to MRT North-South Line, thus the separate type platform will be adopted to ensure an efficient flow line. A connection track between MRT East-West and North-South Lines will be installed for the maintenance of vehicles and equipment delivery.

5) Kebon Sirih Station

Kebon Sirih Station is closest to Central Line, but the distance from the existing Gondandia Station on central line is about 350m. Hence, location of entrance from underground station and pedestrian rehabilitation between stations were proposed for integration of passenger service.

6) Senen Station

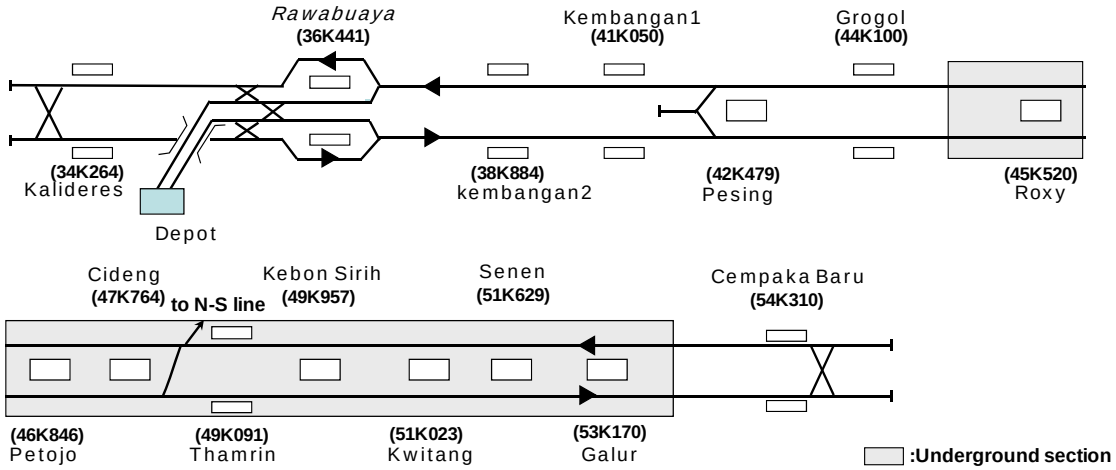
Underground Senen Station is closest to Eastern Line. The location of entrance was planned to north side only, because there is the published development plan at the north side of new station, west side of the existing Senen Station, and south side access from underground station is interrupted by the existing U-shaped concrete structure.

7) Cempaka Baru Station

Cempaka Baru Station is the east end of terminal station in Stage 1 of Phase 1. Stabling tracks for two train sets are installed at the east side of the station and the train operations plan is decided flexibly to meet the demand. However, the stabling tracks will be cleared to give way for the main line during the start of the extension of Phase 2.

8) Other stations

Generally, island type platform is applied to the platform of the underground station considering the offset distance between the two shield machines. On the other hand, opposite platform is applied to the platform of the elevated station considering the continuity with the viaduct structure. Details of civil structure are discussed later in section 4.4.



Source: JICA Study Team

Figure 4.3-2 Track Layout (in the Opening time of stage 1 in Phase-1)

Table 4.3-1 Station Information (in the Opening time of Stage 1 in Phase-1)

	Station		Km	Connection
1	Kalideres	Elevated	34k264	
2	Rawabuaya		36k441	Tangerang Line (PT KA), Bus Terminal
3	Kembangan 2		38k884	
4	Kembangan 1		41k050	TransJakarta Corridor 8
5	Pesing		42k479	Tangerang Line (PT KA)
6	Grogol		44k100	Bus Terminal
7	Roxy	Underground	45k520	Western Line (PT KA)
8	Petojo		46k846	
9	Cideng		47k764	
10	Thamrin		49k091	North–South Line (PT MRTJ)
11	Kebon Sirih		49k957	Central Line (PT KA)
12	Kwitang		51k023	
13	Senen		51k629	Eastern Line (PT KA)
14	Galur		53k170	
15	Cempaka Baru	Elevated	54k310	

Source: JICA Study Team

(2) At the Opening time of Stage 2 in Phase-1 (Year 2024)

MRT East-West Line is constructed with a double-track railway and direct current electrification in all sections. Figure 4.3-2 shows the layout and Table 4.3-1 shows the information about each station. MRT East-West Line will improve the convenience of access to central DKI Jakarta by installing many transfer stations with other transportations such as JABODETABEK Railway and TransJakarta.

1) Kelapa Gading Barat Station

This station will be 4-line and 2-platform station. By installing a scissors crossing in the western section of this station, trains are able to turn back for the center of Jakarta. Turn-back facilities will be installed for the following purposes;

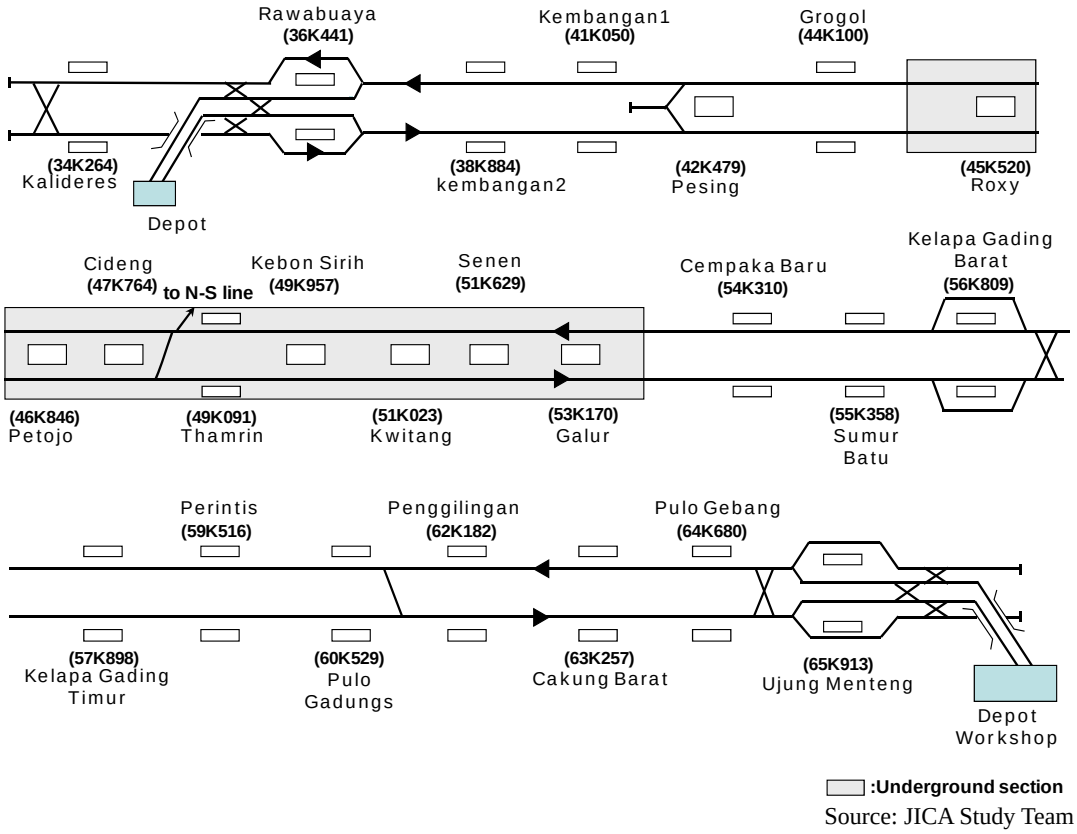
- To improve transportation services in early morning: trains will be stabled in the western part of this station at night so that they can start operation immediately in early morning,
- To provide refuge tracks for trains with failure,
- To provide a turn back facilities for a degraded operation

2) Ujung Menteng Station

Ujung Menteng Station is the east terminal of Phase 1. It consists of two platforms and four tracks. Furthermore, a car depot/workshop, where general inspection is possible, is also constructed in the east side.

3) Other stations

Generally, island type platform is applied to the platform of the underground station considering the offset distance between the two shield machines. On the other hand, opposite platform is applied to the platform of the elevated station considering the continuity with the viaduct structure. Details of civil structure are discussed later in section 4.4.



Source: JICA Study Team

Figure 4.3-3 Track Layout (in the Opening time of Phase-1)

Table 4.3-2 Station Information (in the Opening time of Phase-1)

	Station		Km	Connection
1	Kalideres	Elevated	34k264	
2	Rawabuaya		36k441	Tangerang Line (PT KA), Bus Terminal
3	Kembangan 2		38k884	
4	Kembangan 1		41k050	TransJakarta Corridor 8
5	Pesing		42k479	Tangerang Line (PT KA)
6	Grogol		44k100	Bus Terminal
7	Roxy	Underground	45k520	Western Line (PT KA)
8	Petojo		46k846	
9	Cideng		47k764	
10	Thamrin		49k091	North–South Line (PT MRTJ)
11	Kebon Sirih		49k957	Central Line (PT KA)
12	Kwitang		51k023	
13	Senen		51k629	Eastern Line (PT KA)
14	Galur		53k170	
15	Cempaka Baru	Elevated	54k310	
16	Sumur Batu		55k358	
17	Kelapa Gading Barat		56k809	
18	Kelapa Gading Timur		57k898	
19	Perintis		59k516	Bus Terminal
20	Pulo Gadung		60k529	
21	Penggilingan		62k182	
22	Cakung Barat		63k257	
23	Pulo Gebang		64k680	
24	Ujung Menteng		65k913	

Source: JICA Study Team

(3) The Opening Time of Phase-2 (Year 2027)

For MRT East-West Line, Balaraja – Kalideres section and Ujung Menteng - Cikarang section are planned to be opened in 2027, passing three provinces, namely Banten, DKI Jakarta and West Java, with a total urban railway length of 89.4 km.

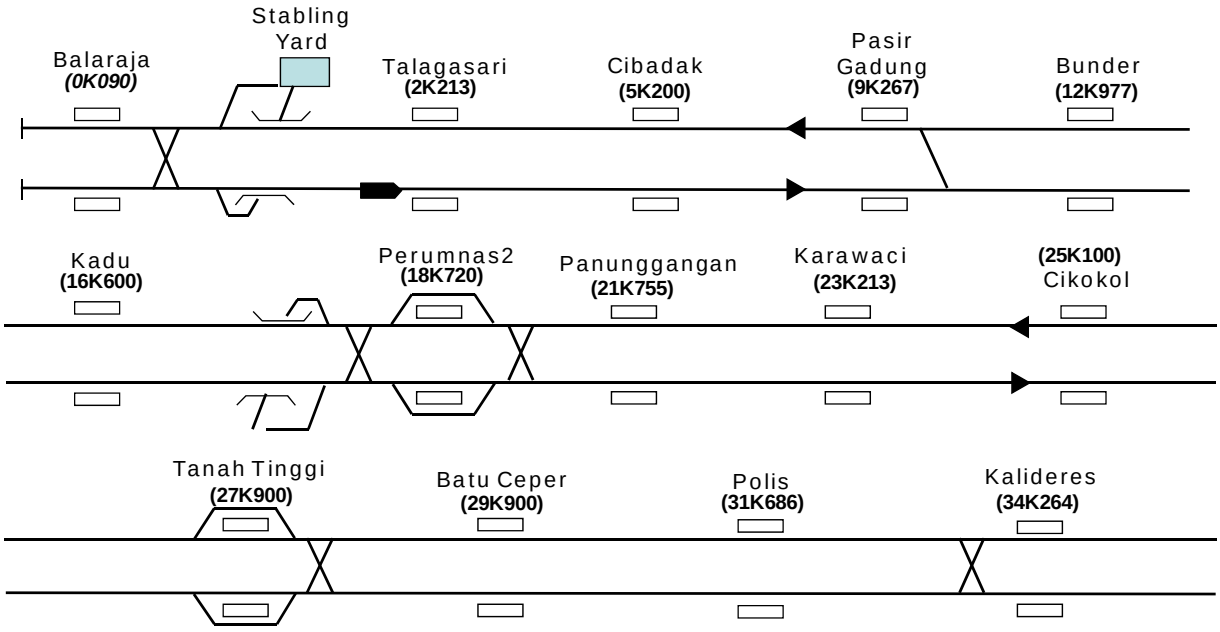
1) Balaraja – Kalideres Section

The section from Balaraja in Banten province to Kembangan 2 has a total length of 39 km. There are 16 stations which are constructed on elevated structures. The layout is shown in Figure 4.3-4.

・Balaraja Station
Balaraja is the west terminal station of the Phase 2 section while the stabling tracks are installed in the east. Effective integration of transportation will be expected at this station, because there is the existing bus terminal at west side of station.

・Perumnas 2 Station
At the west of Perumnas 2 Station, a depot, which will be in operations just in time for the monthly inspection, is installed. Scissors crossings are added on both sides of the station to enable the trains to turn back following an east-west direction.

・Batu Cepar Station
There is a bus terminal, which is expected to play a role as an interchange point, on the front side located at the south of this station.



Source: JICA Study Team

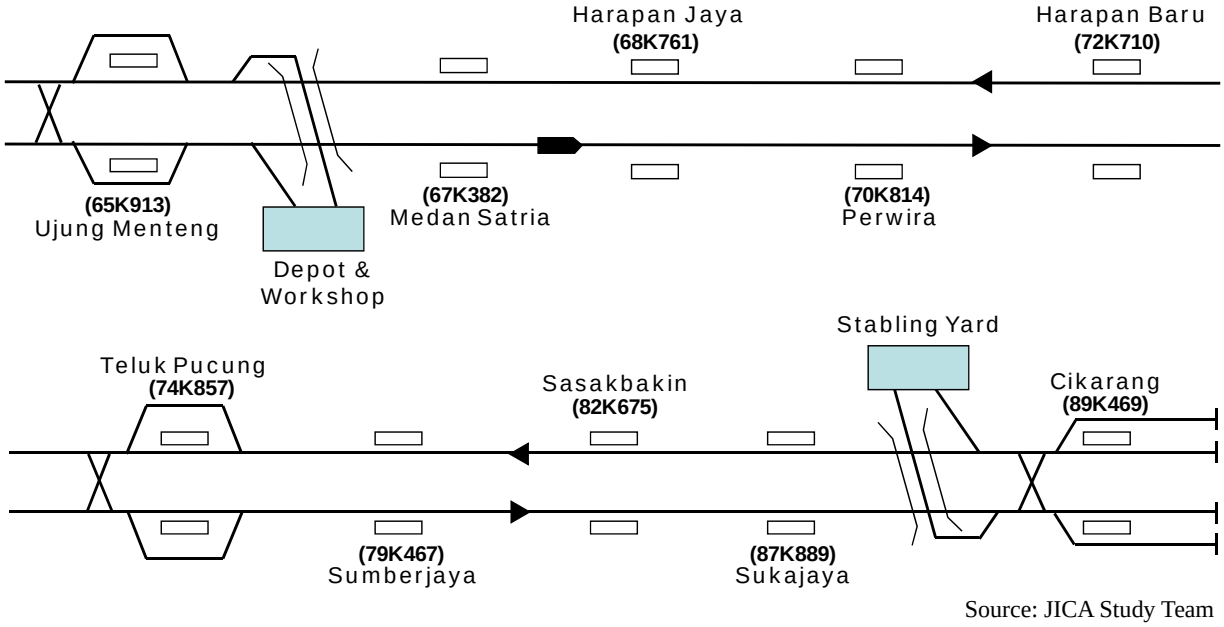
Figure 4.3-4 Track Layout of Phase-2: Balaraja – Kalideres Section

2) Ujung Menteng - Cikarang Section

This is the section from Ujung Menteng to Cikarang in West Java Province with a total length of 23.6 km. There are nine stations which are constructed on elevated structures. Figure 4.3-5 shows the track layout of Ujung Menteng – Cikarang section.

・Teluk Pucung Station
There are two platforms, four tracks and a scissors crossing at the west side to enable the trains to turn back to the center of the city.

・Cikarang Station
This is the east terminal of the Phase 2 section. There are stabling tracks at the west portion of this station.



Source: JICA Study Team

Figure 4.3-5 Track Layout of Phase-2: Ujung Menteng – Cikarang section

4.3.4 Train Operation Plan

(1) Demand Forecast

Table 4.3-3 shows the PHPDT in2021 (the expected opening year of Phase 1), 2027 (the expected opening year of Phase 2) and 2041.

*PHPDT: the maximum direction traffic volume in 1 hour

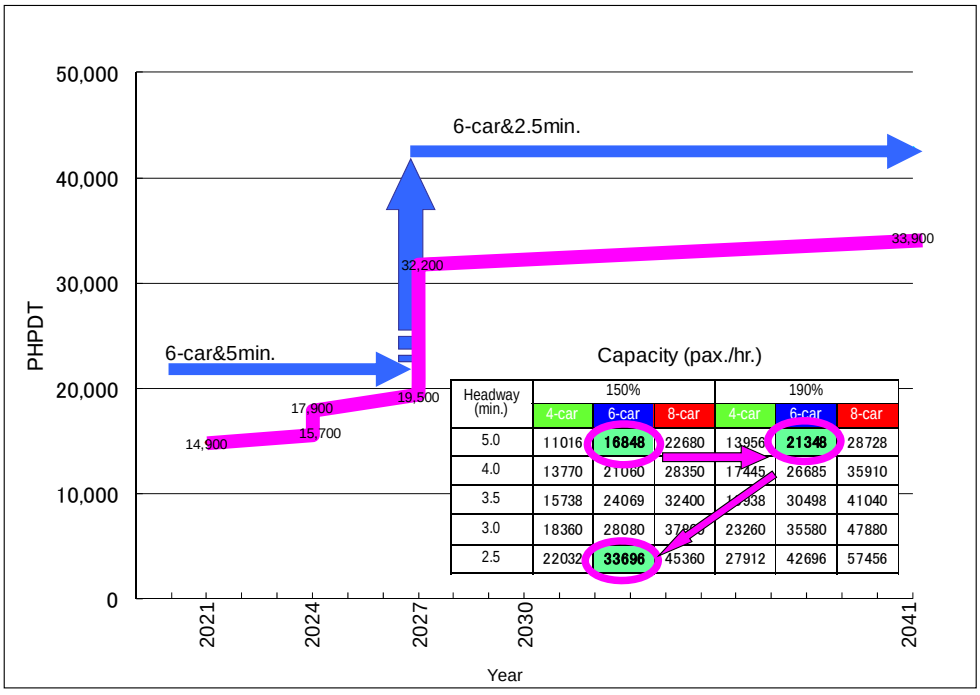
Table 4.3-3 PHPDT

Year	PHPDT	Section	Remarks
2021	14,900	Cideng–Thamrin	East–West Line Stage 1 in Phase- 1
2024	15,700	Cideng–Thamrin	East–West Line Stage 1 in Phase- 1
	17.900	Cideng–Thamrin	East–West Line Phase- 1
2027	19,500	Cideng–Thamrin	East–West Line Phase- 1
	32,200	Cideng–Thamrin	East–West Line Phase- 2
2041	33,900	Cideng–Thamrin	After 20 years from Phase- 1

Source: JICA Study Team

(2) Transportation Capacity (Depending on the train Formations and Headways)

Similar to the Japanese railway and MRT North-South Line, the congestion ratio is set at 150% or less when deciding the operations plan. Based on this figure, transportation plans such as train formation and operation headway have been studied. In the same way, with reference to the example of Japanese railway and MRT North-South Line, the maximum congestion ration has been set at 190%: the ratio that requires support to get the passengers on board, and transportation planning will be reviewed and revised when the congestion ratio exceeds this percentage. Figure 4.3-6 shows the correlation between PHPDTs and transportation capacities (depending on train formations and headways). According to the figure, in the opening of Phase 1, the six-car trains will start operations with headway of 5 min. From the opening of Phase 2, the plan will be revised dramatically to operating six-car formation under headway of 2.5 min. The amount of congestion for the coming years is shown in Table 4.3-4. (For the passenger volume in one car, refer to 4.2.3.)



Source: JICA Study Team

Figure 4.3-6 Correlation between PHPDTs and Transportation Capacities

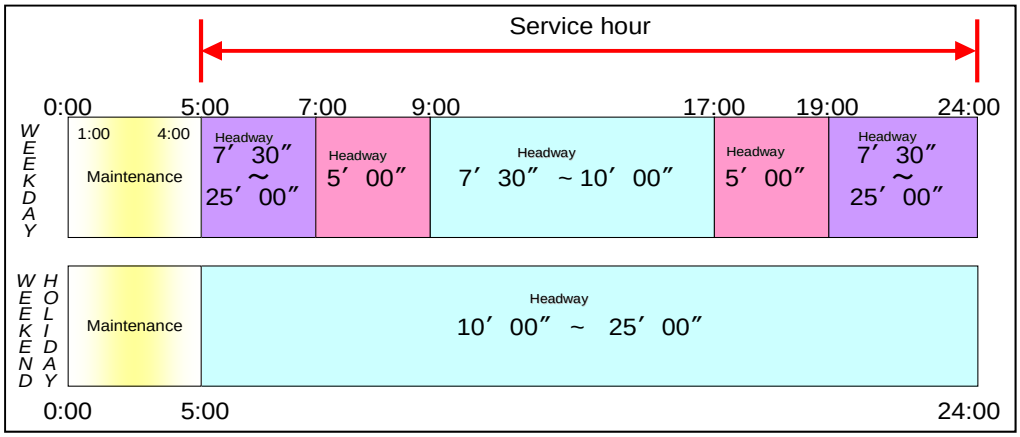
Table 4.3-4 Headway and Congestion Ratio

Year	Passenger Volume (pax)	Train Composition (car)	Passenger Capacity per Train (pax)	Headway (min)	Passenger Capacity per Hour (pax)	Congestion Ratio (%)
2021-2024	14,900 - 15,700	6	936	5	11,232	133-140
2024-2027	17,900 - 19,500	6	936	5	11,232	159 - 174
2027-2041	32,200 - 33,900	6	936	2.5	22,464	143-151

Source: JICA Study Team

(3) Service time and Headway

As shown in Figure 4.3-7, the service time of MRT East-West Line is the same as MRT North-South Line, which is 5:00-24:00, and the maintenance for both lines is done during 24:00-5:00. Furthermore, 7:00-9:00 and 17:00-19:00 of weekdays are set as peak hours.



Source: JICA Study Team

Figure 4.3-7 Train headways (at the opening time of Phase-1)

(4) Running Time

1) Speed Limit

The speed limit on curves and turnouts are shown in Table 4.3-5 and Table 4.3-6.

Table 4.3-5 Speed limits on curves

Curve Radius (m)	Design maximum speed (km/hr.)
160	45
200	50
250	70
300	75
350	80
400	85
450	90
500	95
>550	100

Source: JICA Study Team

Table 4.3-6 Speed limits on turn outs

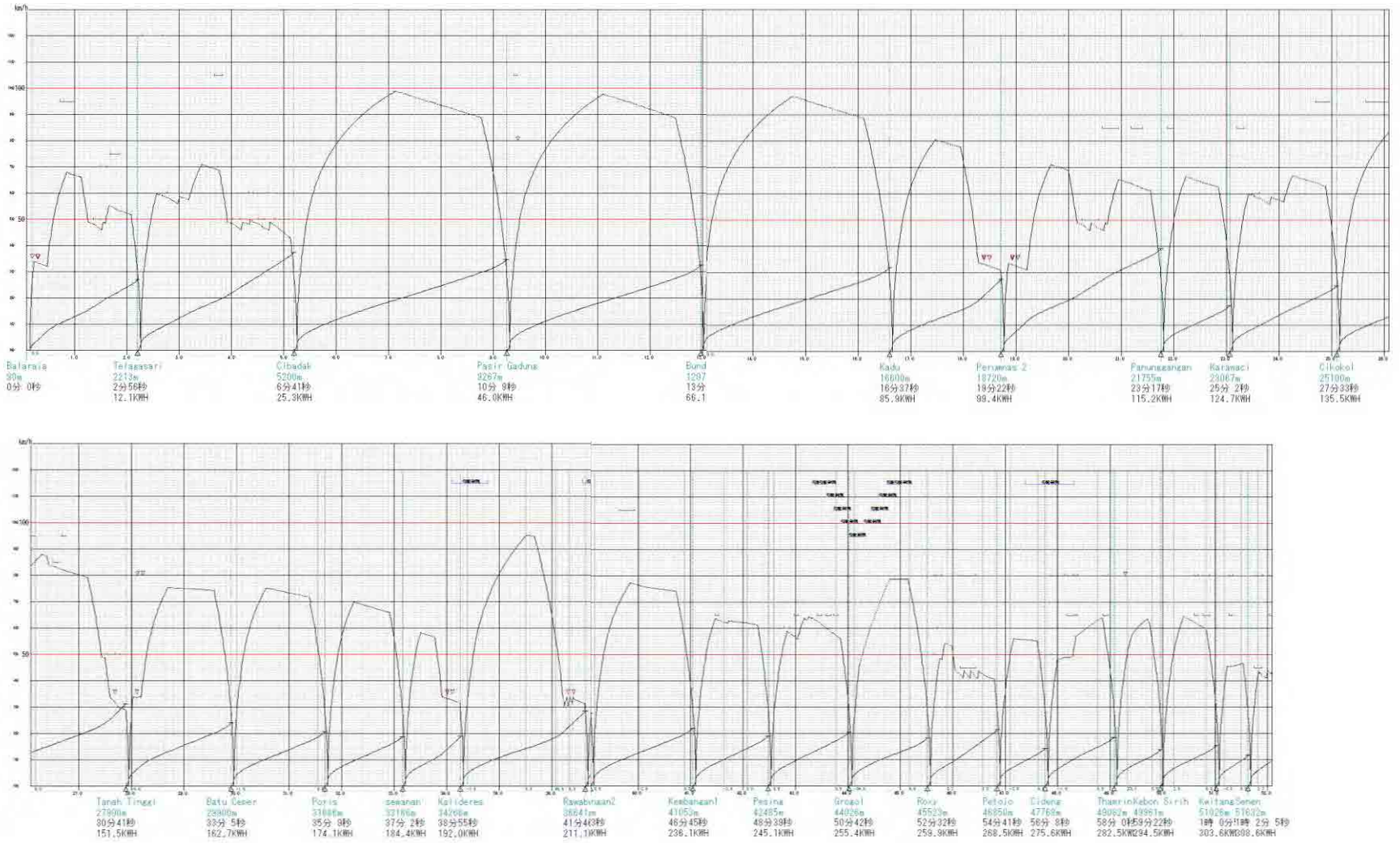
Turnout Number	Speed limit of Branch line(km/hr)
#8	30
#10	35

Source: JICA Study Team

2) Train Performance Curve

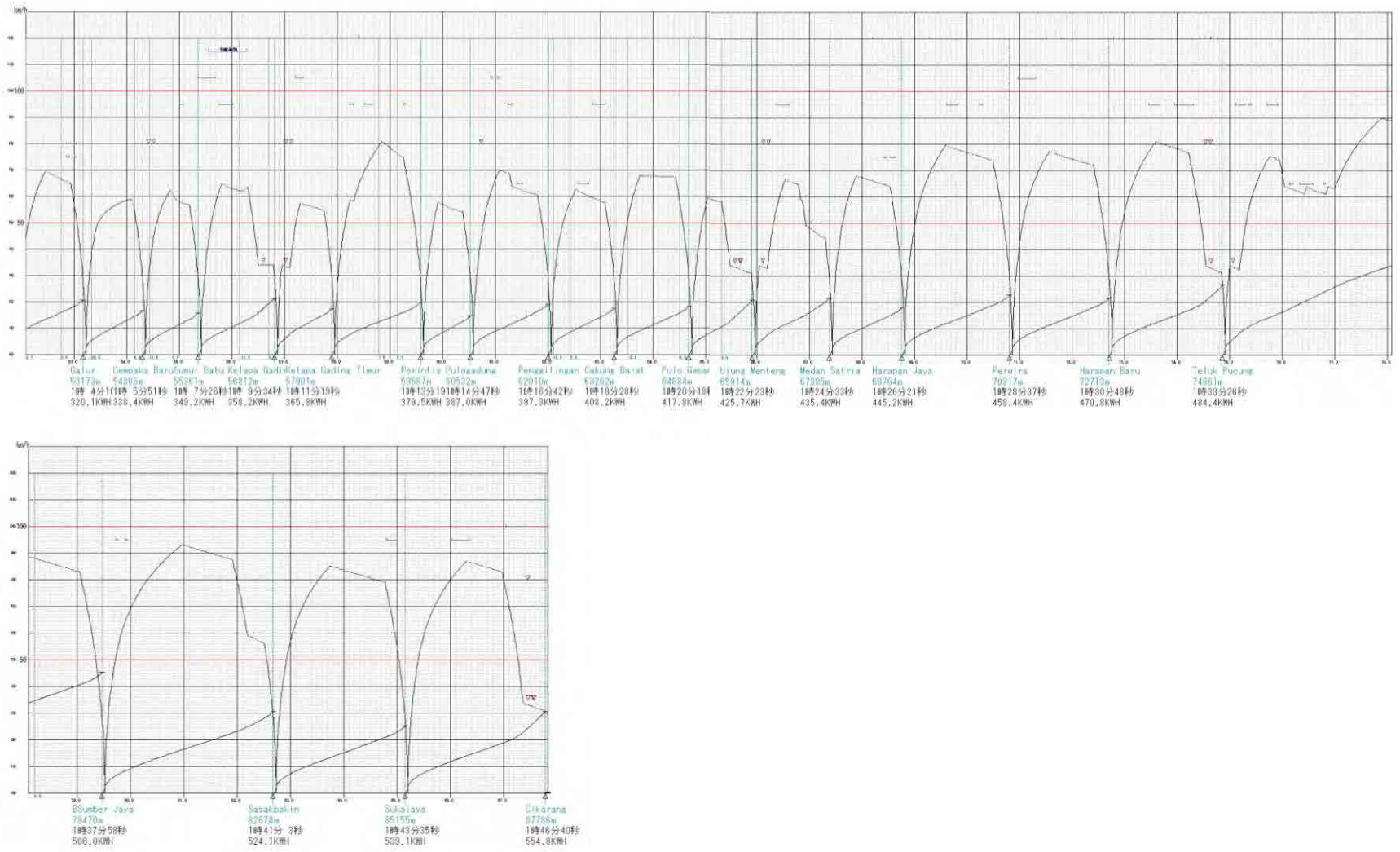
The train performance curves are drawn based on the above-mentioned condition. The horizontal axis is distance, and the vertical axis is speed and time. The train condition is shown by speed curves and time curves at locations.

On Balaraja – Cikarang section, the train performance curves at ridership of 100% and both of east and west direction are drawn. Figure 4.3-8 shows the train operation curve of 100% ridership and eastbound.



Source: JICA Study Team

Figure 4.3-8 Train Performance Curve (East bound) (1)



Source: JICA Study Team

Figure 4.3-9 Train Performance Curve (East bound) (2)

3) Train Running Time and Stoppage Time in Each Station

Based on the results of the train performance curves, a surplus time is added to the calculated running time to determine the running time in each station of Balaraja–Cikarang Section as shown in Table 4.3-7. The stoppage time is determined by classifying the number of boarding–alighting passengers in the origin-destination (OD) table as shown in Table 4.3-8.

Table 4.3-7 Train Running Time

Eastbound								Distance		Station	Westbound							
Peak				Off-Peak							Off-Peak				Peak			
Interval time	Stoppage time	Scheduled time	Total time	Interval time	Stoppage time	Scheduled time	Total time	Partial	Total		Interval time	Stoppage time	Scheduled time	Total time	Interval time	Stoppage time	Scheduled time	Total time
3:10	-	4:00	0:00:00	3:10	-	3:50	0:00:00	2k123	0k090	Balaraja	3:10	-	3:50	2:20:50	3:10	-	4:00	2:26:50
	50		0:04:00		40		0:03:50		2k213			40		2:17:40		50		2:23:40
4:00		4:30		4:00		4:30		2k987		Telagasari	2:40		3:10		2:40		3:10	
	30		0:08:30		30		0:07:00		5k200			30		2:13:00		30		2:18:50
3:40		4:30		3:40		4:20		4k067		Cibaduk	3:20		4:00		3:20		4:10	
	50		0:13:00		40		0:11:00		9k267			40		2:08:50		50		2:14:40
3:30		4:20		3:30		4:10		3k710		Pasir Gadung	4:50		5:20		4:50		5:20	
	50		0:17:20		40		0:16:20		12k977			30		2:04:40		30		2:10:20
3:20		4:10		3:20		4:00		3k623		Bunder	2:50		3:20		2:50		3:30	
	50		0:21:30		40		0:19:40		16k600			30		2:00:40		40		2:06:10
2:50		3:40		2:50		3:30		2k120		Kadu	2:20		3:00		2:20		3:10	
	50		0:25:10		40		0:22:40		18k720			40		1:57:20		50		2:02:40
4:10		5:00		4:10		4:50		3k035		Perumnas 2	2:20		3:00		2:20		3:10	
	50		0:30:10		40		0:25:40		21k755			40		1:52:40		50		1:57:50
1:50		2:40		1:50		2:30		1k312		Panunggangan	2:00		2:30		2:00		2:30	
	50		0:32:50		40		0:28:10		23k067			30		1:50:10		30		1:55:10
2:40		3:30		2:40		3:20		2k033		Karawaci	2:20		3:00		2:00		3:10	
	50		0:36:20		40		0:31:10		25k100			40		1:46:50		50		1:51:40
3:20		4:10		3:20		4:00		2k800		Cikokol	2:00		2:40		1:50		2:50	
	50		0:40:30		40		0:33:50		27k900			40		1:43:00		50		1:47:40
2:30		3:00		2:30		3:00		2k000		Tanah Tinggi	2:00		2:30		2:10		2:30	
	30		0:43:30		30		0:36:20		29k900			30		1:39:40		30		1:44:10
2:10		2:40		2:10		2:40		1k786		Batu Ceper	1:50		2:30		2:10		2:40	
	30		0:46:10		30		0:38:50		31k686			40		1:37:00		50		1:41:30
2:00		2:40		2:00		2:30		1k480		Polis	2:10		2:50		1:40		3:00	
	40		0:48:50		30		0:41:40		33k166			40		1:34:30		50		1:39:00
2:00		2:40		2:00		2:30		1k098		Semanan	1:40		2:10		2:10		2:20	
	40		0:51:30		30		0:43:50		34k264			30		1:32:00		40		1:36:20
3:00		3:40		3:00		3:30		2k192		Kalideres	2:10		2:50		2:00		3:00	
	40		0:55:10		30		0:46:40		36k456			40		1:28:30		50		1:32:40
3:00		3:50		3:00		3:40		2k444		Rawa Buaya	2:00		2:40		2:20		2:50	
	50		0:59:00		40		0:49:20		38k900			40		1:25:00		50		1:29:00
2:20		3:10		2:20		3:00		2k170		Kembangan2	2:20		3:00		1:40		3:10	
	50		1:02:10		40		0:52:20		41k070			40		1:22:00		50		1:25:50
2:00		2:30		2:00		2:30		1k420		Kembangan1	1:40		2:20		1:50		2:30	
	30		1:04:40		30		0:54:40		42k490			40		1:19:20		50		1:23:00
2:10		3:00		2:10		2:50		1k630		Pesing	1:50		2:30		2:10		2:40	
	50		1:07:40		40		0:57:10		44k120			40		1:16:40		50		1:20:20
2:00		2:30		2:00		2:30		1k420		Grogol	2:10		2:50		1:10		3:00	
	30		1:10:10		30		1:00:00		45k540			40		1:13:50		50		1:17:20
2:20		3:00		2:20		2:50		1k320		Roxy	1:10		1:40		1:40		1:50	
	40		1:13:10		30		1:01:40		46k860			30		1:11:00		40		1:14:30
1:30		2:20		1:30		2:10		0k920		Petojo	1:40		2:20		1:30		2:30	
	50		1:15:30		40		1:04:00		47k780			40		1:09:00		50		1:12:20
2:00		2:50		2:00		2:40		1k330		Cideng	1:30		2:10		2:10		2:20	
	50		1:18:20		40		1:06:10		49k110			40		1:06:10		50		1:09:20
1:30		2:20		1:30		2:10		0k860		Thamrin	2:10		2:50		1:30		3:00	
	50		1:20:40		40		1:09:00		49k970			40		1:04:00		50		1:07:00
1:40		2:20		1:40		2:10		1k070		Kebon Sirih	1:30		2:00		2:20		2:10	
	40		1:23:00		30		1:11:00		51k040			30		0.112269		40		1:04:30
1:20		2:10		1:20		2:00		0k610		Kwitang	2:20		2:50		2:10		2:50	
	50		1:25:10		40		1:13:50		51k650			30		1:00:00		30		1:02:40
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	50		1:27:10		40		1:16:40		53k190			40		0:57:10		50		0:59:40
1:50		2:40		1:50		2:30		1k140		Galur	2:10		2:40		2:00		2:40	
	50		1:29:50		40		1:19:20		54k330			30		0:54:40		30		0:57:00
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2:20		3:10		2:20		3:00		1k450		Sumur Batu	2:20		3:00		3:00		3:10	
	50		1:35:40		40		1:25:00		56k820			40		0:49:20		50		0:51:20
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	50		1:38:20		40		1:28:30		57k910			30		0:46:40		40		0:48:30
2:10		2:50		2:10		2:40		1k620		Kelepa Gading Timur	3:00		3:30		2:05		3:40	
	40		1:41:10		30		1:32:00		59k530			30		0:43:50		40		0:45:30
1:40		2:30		1:40		2:20		1k010		Perintis	2:00		2:30		2:00		2:40	
	50		1:43:40		40		1:34:30		60k540			30		0:41:40		40		0:43:10
2:00		2:50		2:00		2:40		1k660		Pulo Gadung	2:00		2:30		2:00		2:30	
	50		1:46:30		40		1:37:00		62k200			30		0:38:50		30		0:40:10
1:50		2:20		1:50		2:20		1k070		Penggilinga	2:10		2:40		2:10		2:40	
	30		1:48:50		30		1:39:40		63k270			30		0:36:20		30		0:37:30
2:00		2:50		2:00		2:40		1k430		Cakung Barat	2:40		3:20		2:40		3:30	
	50		1:51:40		40		1:43:00		64k700			40		0:33:50		50		0:35:00
2:10		3:00		2:10		2:50		1k230		Pulogebang	3:10		3:50		3:10		4:00	
	50		1:54:40		40		1:46:50		65k930			40		0:31:10		50		0:32:10
2:20		2:50		2:20		2:50		1k450		Ujung Menteng	2:40		3:20		2:40		3:30	
	30		1:57:30		30		1:50:10		67k380			40		0:28:10		50		0:29:00
2:00		2:50		2:00		2:40		1k370		Medan Satri	1:50		2:30		1:50		2:40	
	50		2:00:20		40		1:52:40		68k750			40		0:25:40		50		0:26:30
2:20		3:10		2:20		3:00		2k050		Harapan jaya	4:00		4:40		4:00		4:50	
	50		2:03:30		40		1:57:20		70k800			40		0:22:40		50		0:23:20
2:20		3:00		2:20		2:50		1k900		Perwira	2:40		3:20		2:40		3:30	
	40		2:06:30		30		2:00:40		72k700			40		0:19:40		50		0:20:10
2:50		3:20		2:50		3:20		2k150		Harapan Baru	3:20		4:00		3:20		4:10	
	30		2:09:50		30		2:04:40		74k850			40		0:16:20		50		0:16:40
4:40		5:30		4:40		5:20		4k375		Teluk Pucung	3:30		4:10		3:30		4:20	
	50		2:15:20		40		2:08:50		79k225			40		0:11:00		50		0:11:20
3:20		3:50		3:20		3:50		2k950		Sumberjaya	3:40		4:10		3:40		4:10	
	30		2:19:10		30		2:13:00		82k175			30		0:07:00		30		0:07:10
2:40		3:30		2:40		3:20		5k000		Sasakbakin	4:00		4:40		4:00		4:50	
	50		2:22:40		40		2:17:40		82k175			40		0:03:50		50		0:04:00
3:20		3:20		3:20		3:20		1k487		Sukajaya	3:10		3:10		3:10		3:10	
	-		2:26:00		-		2:20:50		88k662	Cikarang		-		0:00:00		-		0:00:00

Source: JICA Study Team

Table 4.3-8 Stoppage Time at the Middle Stations

	Peak hour (sec)			Off-peak hour (sec)	
	A	B	C	A	B・C
Train arriving	—	—	—	—	—
Position confirmation	2	2	2	2	2
Opening door	3	3	3	3	3
Getting off and on	35	25	15	20	15
Closing door	5	5	5	5	5
Safety confirmation	5	5	5	5	5
Train departing	—	—	—	—	—
Total	50	40	30	40	30

*A, B and C are classified following table.

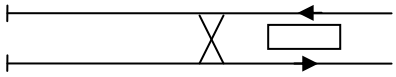
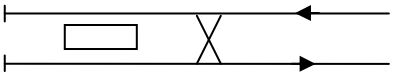
Classification	Passenger Volume (pax. / day)
A	20,001 -
B	10,001 - 20,000
C	- 10,000

Source: JICA Study Team

4) Train's Turn-Back Time

The trains' turn-back time at the terminal station of MRT is calculated as presented in Table 4.3-9 below. The minimum turn-back time for the station at the platform (Ujung Menteng station, Cikarang station and Balaraja station) and via the lead track (Kalideres station and Cempaka Baru station) are computed to be at least five minutes and at least eight minutes, respectively.

Table 4.3-9 Train turn back time

Turn back via lead track		**Turn back at platform**	
			
Train arriving		Train arriving	
・Position confirmation by driver	5 sec.	・Position confirmation by driver	5 sec.
・Opening door（car and PSD）	5 sec.	・Opening door（car and PSD）	5 sec.
・Passenger getting off (included margin time)	100 sec.	・Preparation of cab equipment	50 sec.
・Closing door（car and PSD）	5 sec.	・Walking to another cab and car body check	180 sec.
・Safety confirmation by driver	5 sec.	・Preparation of departure	50 sec.
・Shunting to lead track (300m)	75 sec.	・Closing door（car and PSD）	5 sec.
・Preparation of cab equipment for turn-back	30 sec.	・Safety confirmation by driver	5 sec.
・Walking to another cab	90 sec.	・Train departing	
・Preparation of departure	30 sec.	**Total**	**5 min.**
・Shunting to platform (300m)	75 sec.		
・Position confirmation by driver	5 sec.		
・Opening door（car and PSD）	5 sec.		
・Passenger getting on	40 sec.		
・Closing door（car and PSD）	5 sec.		
・Safety confirmation by driver	5 sec.		
・Train departing			
Total	**8min.**		

Source: JICA Study Team

(5) Train Operation Diagram and Number of Necessary Cars at the Opening Time of Stage 1 in Phase-1

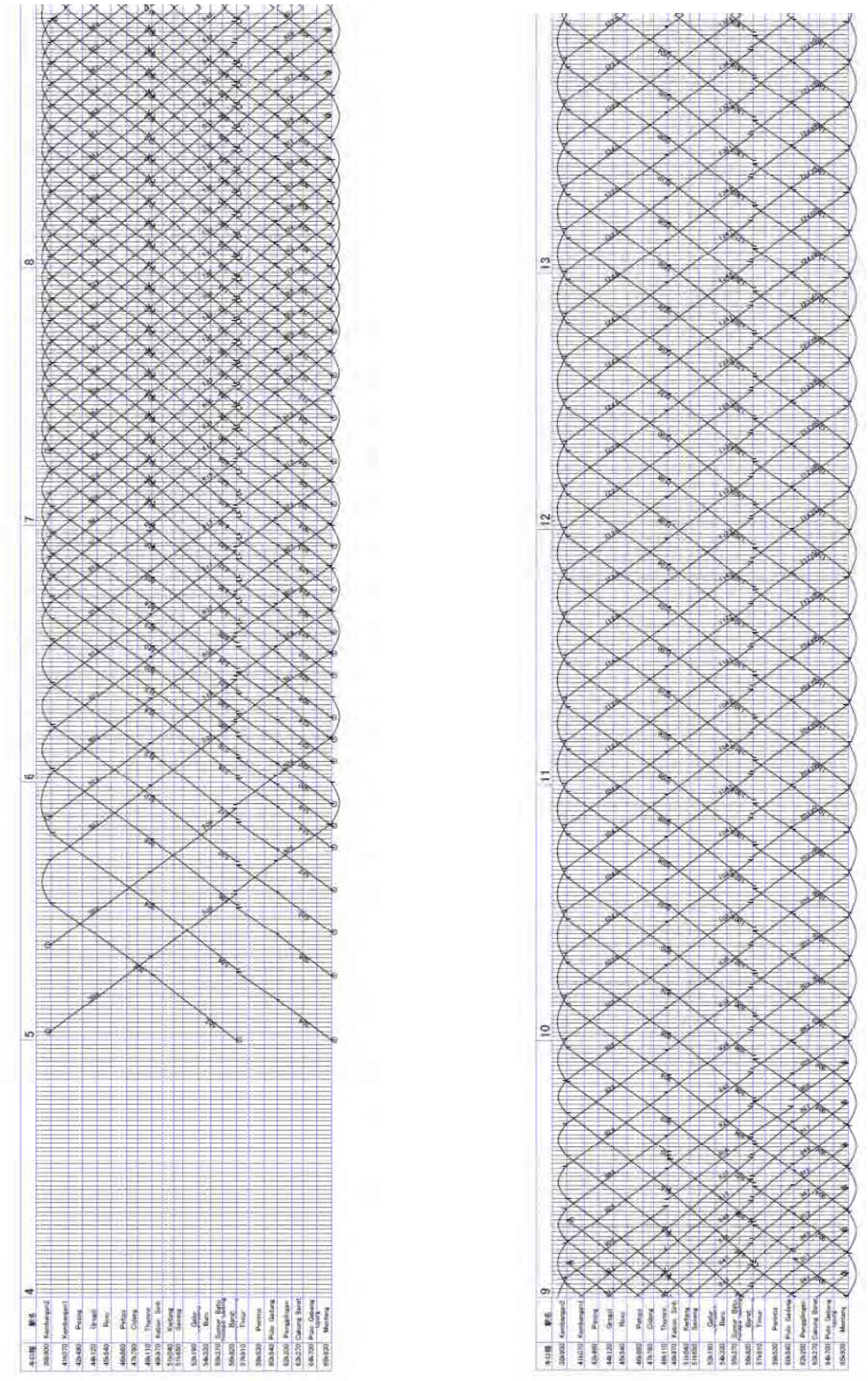
The train operation diagram in the opening time of Stage 1 in Phase 1 is illustrated in Figure 4.3-10 based on the running time and headway in peak hours as mentioned above. As a result, 20 train sets and two stand-by train sets (for maintenance and operation) will be deployed at Kalideres depot.

The spaces allotted for car stabling at night are in Kalideres depot. Moreover, two train sets on stabling track at the west of Kalideres Station and at the east side of Cempaka Baru Station will be placed to ensure an improved transportation service during early mornings. The stabling places and number of stabling train sets are shown in Table 4.3-10.

Table 4.3-10 Stabling places and number of train sets

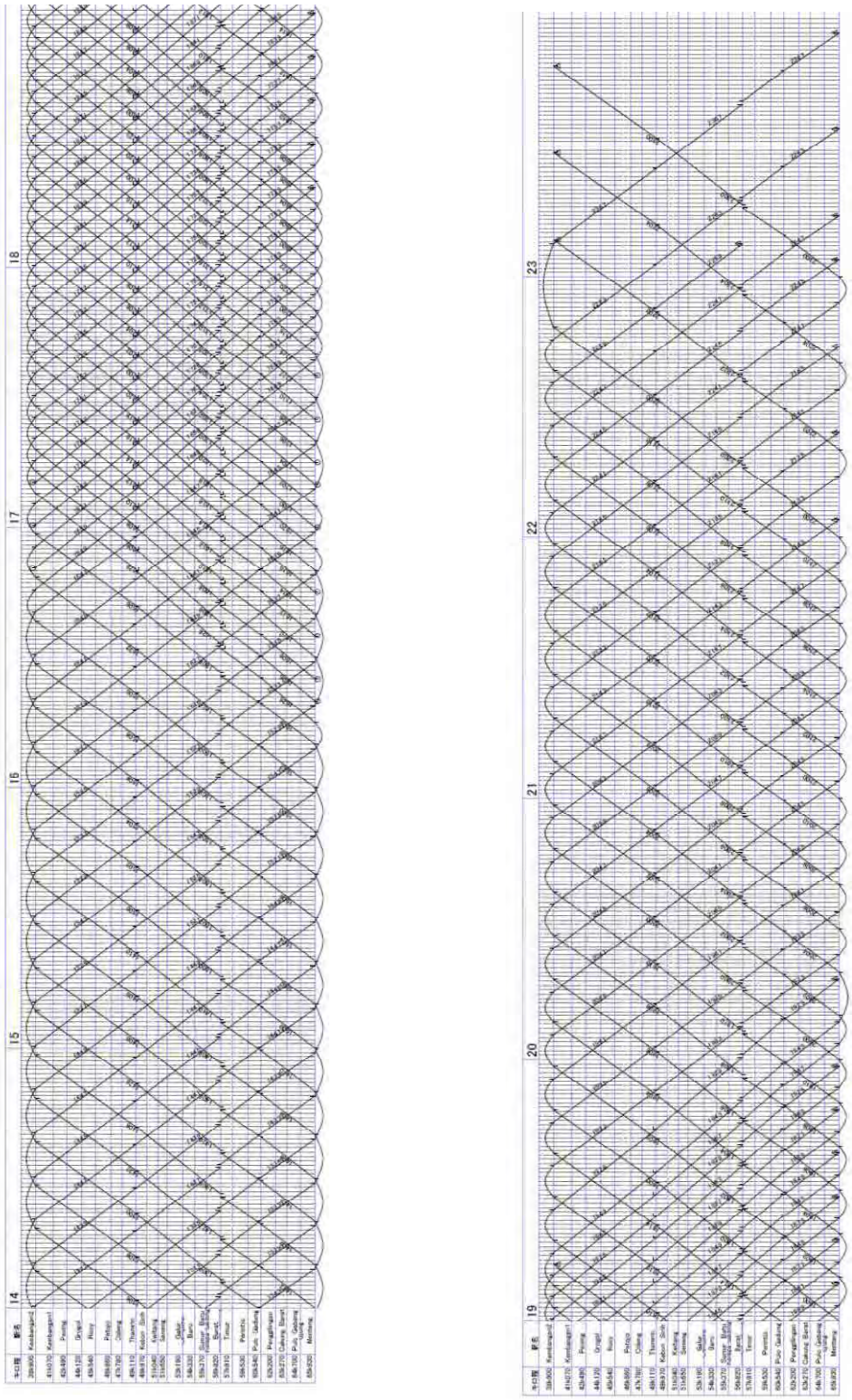
Stabling Place	Number of Sets
Kalideres Depot	15＋(2)
Kalideres Station	2
Cempaka Baru Station	2
Total	19+(2)=21

( ): Number of sets for spare
Source: JICA Study Team



Source: JICA Study Team

Figure 4.3-10 Operation diagram at the opening time of Phase-1 (Year 2021) (1)



Source: JICA Study Team

Figure 4.3-11 Operation diagram at the opening time of Phase-1 (Year 2021) (2)

(6) Train Operation Diagram and Number of Necessary Cars at the Opening Time of Stage 2 in Phase-1

The train operation diagram in the opening time of Stage 2 in Phase 1 need 29 train sets and three stand-by train sets (for maintenance and operation) will be deployed at Kalideres and Ujung Menteng depots.

The spaces allotted for car stabling at night are in Kalideres and Ujung Menteng depots. Moreover, two train sets on stabling track at the west of Kalideres Station and at the east side of Kelapa Gading Barat Station will be placed to ensure an improved transportation service during early mornings. The stabling places and number of stabling train sets are shown in Table 4.3-11.

Table 4.3-11 Stabling places and number of train sets

Stabling Place	Number of Sets
Kalideres Depot	17＋(1)
Kalideres Station	2
Kelapa Gading Barat Station	2
Ujung Menteng Depot	8＋(2)
Total	29+(3)=32

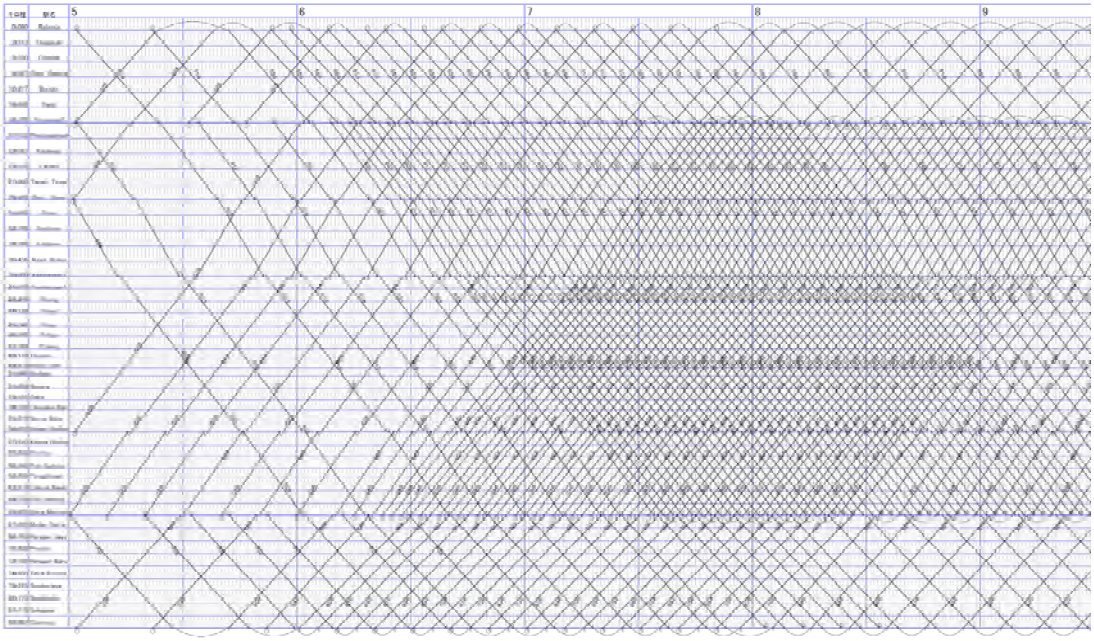
( ): Number of sets for spare
Source: JICA Study Team

(7) Diagram and Number of Necessary Cars at the Opening Time of Phase-2

Similarly, the diagram at the opening time of Phase 2 is presented as described in the following:

(Precondition)

- ･Operating with a headway of 2.5 min during peak hours in Cideng – Thamrin section.
- ･Installing a depot which can implement a monthly inspection at the west of Perumnas 2.
- ･Installing stabling tracks at the east of Balaraja Station and west of Cikarang Station.
- ･The stabling tracks at the west of Kenbangan 2 Station will no longer be used as stabling tracks, but rather as main tracks.



Source: JICA Study Team

Figure 4.3-12 Operation diagram at the opening time of Phase-2 (extract)

According to the diagram, the number of required train sets at the opening time of Phase 2 is 89 (operation train) + 9 sets (stand-by train) = 98 sets (588 cars). Stabling places and number of stabling train sets are shown in Table 4.3-12.

Table 4.3-12 Stabling places and number of train sets

Stabling Place	Number of Sets
Balaraja Depot	10
Perumnas2 Depot	21+(3)
Batu Cepar Station	2
Kalideres Depot	18
Rawabuaya Station	2
Kelpa Gading Barat Station	2
Ujung Menteng Depot	24+(4)
Cikarang Depot	10+(2)
Total	89+(9)=98

( ): Number of sets for spare

Source: JICA Study Team

4.4 Civil Structure Plan

4.4.1 Elevated Structure

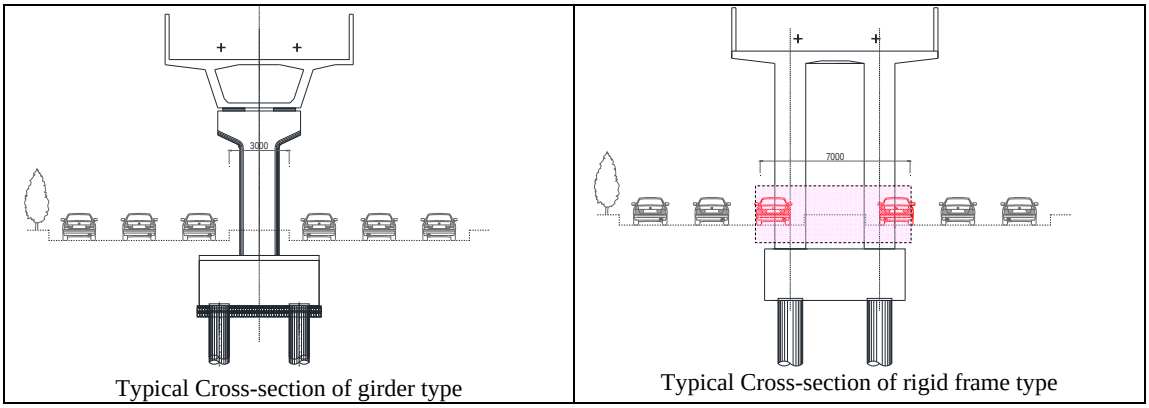
(1) Selection of Elevated Structure

Generally, the viaduct structure for the railway is selected from either girder or rigid frame type. The typical cross section of both structures is illustrated in Figure 5.2-1. The rigid frame structure has a wide dead space under the girders and, thus, it negatively affects the existing road traffic. In addition, in the section where there is no additional space such as wide median or green zone, it may be necessary to expand the existing road width, which will cause additional resettlement and land acquisition.

Comparison of both structure types have been made from the following five viewpoints: 1) economic efficiency, 2) constructability, 3) construction period, 4) landscape, and 5) environmental impact. For economic efficiency, although the construction cost of the girder type structure is 1.3 to 1.5 times higher than that of the rigid frame type, it is recommended that the viaduct structure type of MRT East-West Line be girder type because of the following defining factors:

- Present traffic capacity should be kept not only during the construction period, but also after construction since the present traffic volume has reached its saturated points.
- Construction works should be completed as early as possible in order to start the operation early. This will contribute much in the mitigation of traffic congestion.
- Environmental impacts such as resettlement should be minimized.

In MRT North-South line, girder type structure is selected for viaduct structure from the same point of view.



Typical Cross-section of girder type

Typical Cross-section of rigid frame type

Source: JICA Study Team

Figure 4.4-1 Typical Sections of Girder and Rigid Frame Type Structures

Table 4.4-1 Comparison Table of Elevated Structure

Description	Girder Type	Rigid Frame	Note
Economic Efficiency	△	×	Construction cost of girder type structure is approximately 1.3-1.5 times higher than that of the rigid frame type structure.
Constructability	○	×	Construction of rigid frame type structure occupies a wider area compared to that of the girder type structure.
Construction Duration	○	×	Construction of rigid frame takes two times longer than that of the girder type structure.
Landscape	○	×	Girder type structure is simpler and does not spoil the scenery.
Environmental Impact	○	×	Rigid frame structure occupies a wider area of existing roads during and after construction.

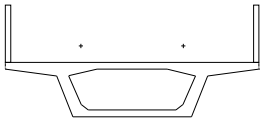
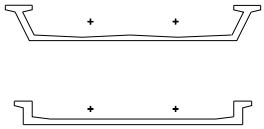
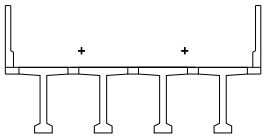
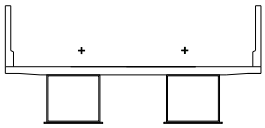
○: good, △: fair, x: worse

Source: JICA Study Team

(2) Selection of Girder Type

Table 4.4-2 shows the list of possible girder type structures and the comparison of each type based on the same comparison items described in the previous section. Although the construction cost of the PC Structure < I Type > is the lowest, the box type girder structure is recommended considering its potential to minimize road occupation, construction period and negative environmental impacts.

Table 4.4-2 Comparison table of girder structure type

No	Description	Economic Efficiency	Constructively	Construction Duration	Landscape	Environmental Impact	Note
1	PC Structure <BOX type>  Single Span Length: 30~50m	○	○	○	○	○	- Road occupation during construction is to be minimized - Construction duration is to be minimized - Less visual impact - Less environmental impact
2	PC Structure <U-type>  Single Span Length: 20~40m	△	△	○	○	○	- Less road occupation during construction - Construction duration is to be minimized - Less visual impact - Less environmental impact
3	PC Structure <I-type>  Single Span Length: 20~45m	○ ○	△	△	△	○	- Lowest cost - Less road occupation during construction - Construction duration is to be minimized - Less environmental impact
4	Steel <Composite Girder>  Single Span Length: 30~90m	×	△	△	△	△	- Highest cost - Less road occupation during construction - Construction duration is to be minimized - Noise generated during operations

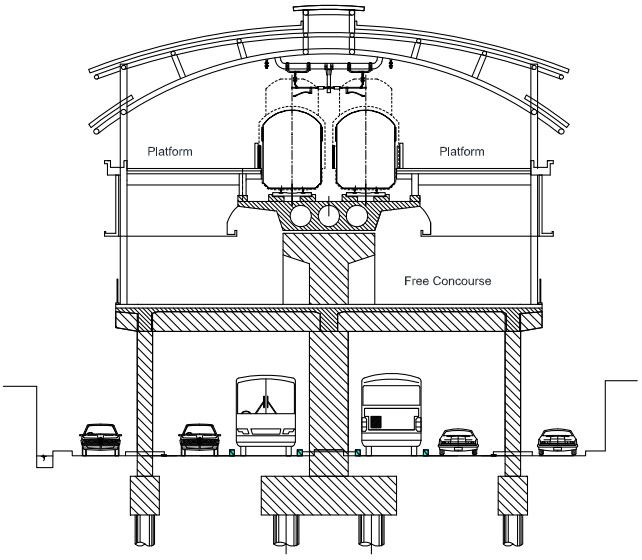
○○: best, ○: good, △: fair, x: worse Source: JICA Study Team

Source: JICA Study Team

Figure 4.4-2 Three Dimensional Image of the Viaduct Section

(3) Selection of the Elevated Station Structure

The elevated station of a MRT system generally consists of two layers, namely concourse level and platform level. Generally, a separate platform is applied for the platform structure, considering the continuity with the viaduct structure. A typical elevated station is shown in Figure 4.4-3 below.



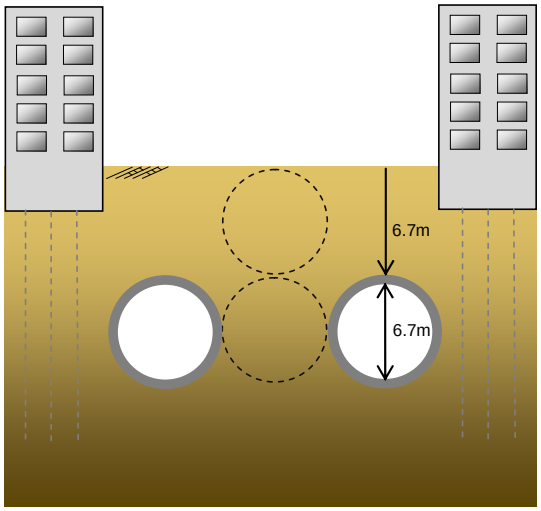
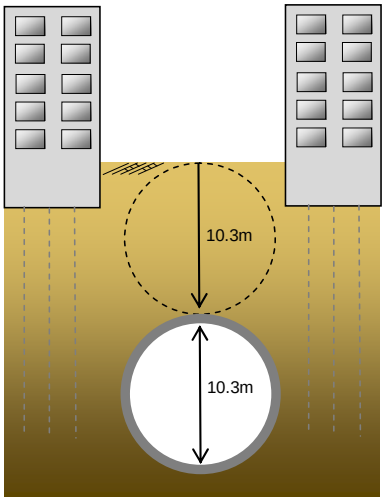
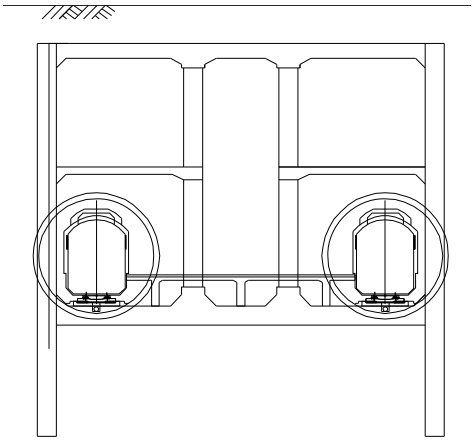
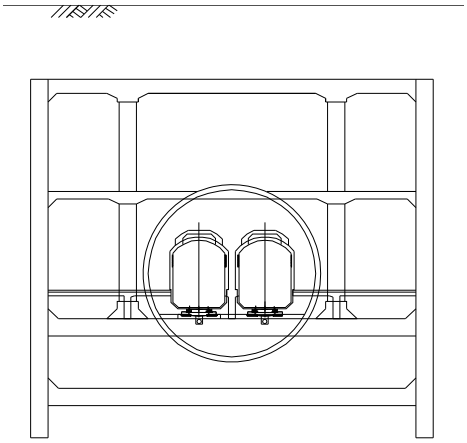
Source: JICA Study Team

Figure 4.4-3 Typical Cross Section of an Elevated Station

4.4.2 Underground Structure

(1) Selection of Underground Structure

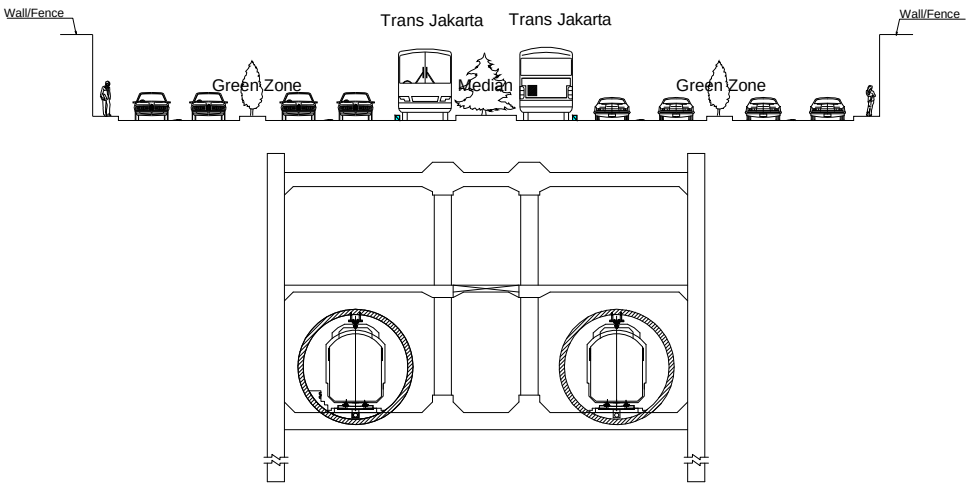
Structure between underground stations will be constructed by shield tunneling method. The shield tunnel section will be excavated by using either two single-track shield machine or one double-track shield machine. Generally, the cost of the tunnel construction is higher when it is constructed by one double-track shield machine. The same can be said to the cost of underground station as tunnel depth goes deeper. The double-track shield method is generally, in many cases, applied to the case where the space on the ground is limited. However, public space on the ground is wide enough in the section where the alignment of this project is planned, and thus, there is no reason to apply DTST (Double Tube Single Track) to this project.

	(A) Single Track Double Tube (STDT)	(B) Double Track Single Tube (DTST)
Cross Section of the Tunnel		
Required Width, Required Depth	Considering the excavation impact to the preceding tunnel, the distance between the two tunnels will be more than the diameter of the tunnel.	Although double track shield machine occupies narrower width, the depths of the tunnel and station goes deeper as equivalent to a diameter, which should be secured from the ground surface in order to avoid the excavation impact to the ground surface.
Excavation Area	Approximately 72.6m2	Approximately 85.7m2
Construction Cost	(A) < (B)	
Construction Period	(A) < (B)	
Typical Cross Section of the Undergtound Station		
Type of Platform	Island type platform	opposite platform

Source: JICA Study Team

Figure 4.4-4 Comparison of STDT and DTST

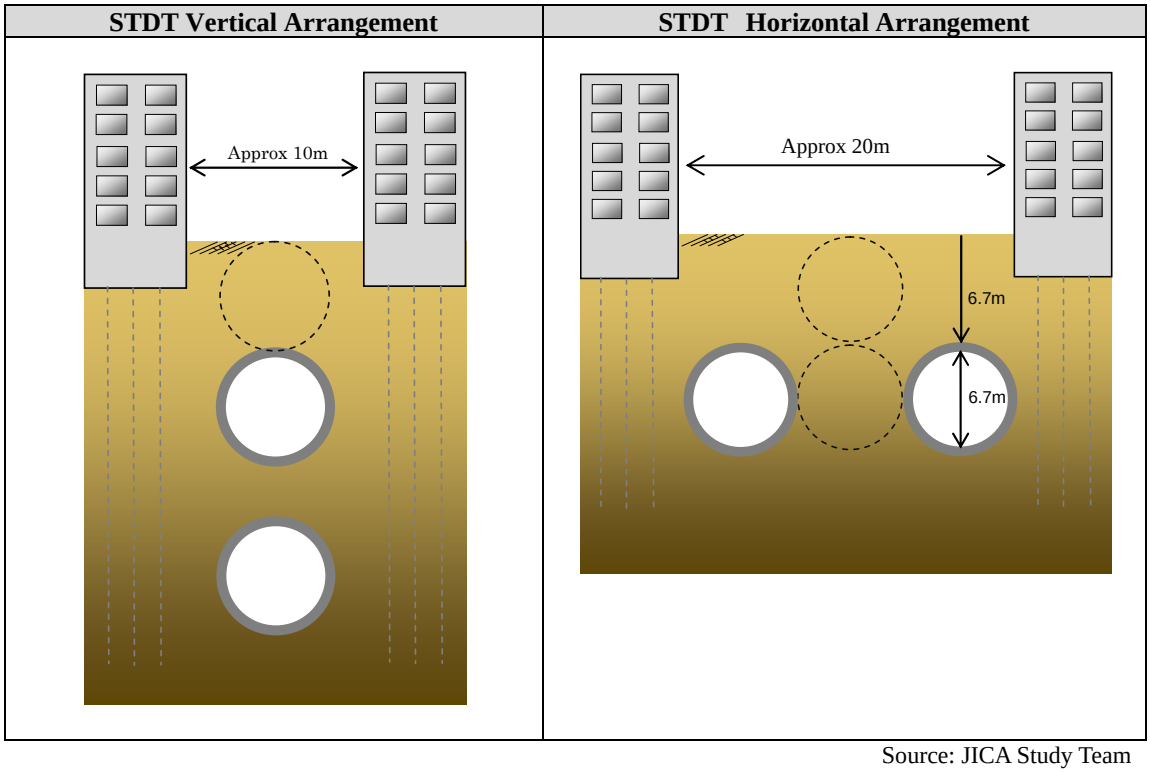
In case that two single track shield machines are used, considering the offset distance between the two shield machines of 1.0 D (“D” represents diameter of the tunnel), the platform type of the underground station is generally opposite platform. Figure 4.4-5 and Figure 4.4-6 show the typical cross section of the underground station.



Source: JICA Study Team

Figure 4.4-5 Typical Cross Section of the Underground Station

In case of STDT, there is an advantage to be adjustable for narrow right-of-way section by arrangement of two tunnels changed from parallel to enfilade.



Source: JICA Study Team

Figure 4.4-6 Typical Cross Section of the Underground Section

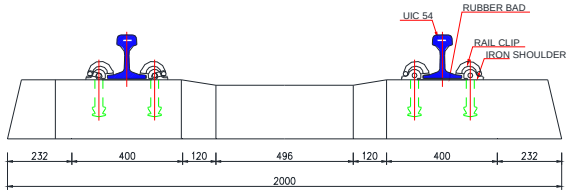
4.4.3 Track Structure

As described earlier, MRT East-West Line is expected to connect with MRT North-South Line. In this regard, considering the shared use of materials, and equipment and machinery for maintenance and operations, it is recommended that the specifications for the track structure be the same as that of MRT North-South Line. The track structure of MRT North-South Line has been determined as shown in Table 4.4-3 based on a series of design standards mentioned in “4.1.2 Design Standard”. Thus, MRT East-West Line also applies the same specifications as that of MRT North-South Line.

Table 4.4-3 Specifications for the Track Structure

Item	Basic Design	Applicable Section
Track Structure	Direct fastened tack with PC sleeper	Main and sub-main line on the underground section
	Direct fastened track with anti-vibration sleeper	Main line on the underground section Main line on the elevated section Depot access line
	Ballasted track	Depot line
Rail	UIC54	Main line and sub-main line Depot access line and depot line
Rail Fastening Device	Wire spring type	Elevated section Underground section Depot area
Sleeper	PC sleeper	Elevated section Underground section Turnout on the depot access line and depot line
	Plastic sleeper	Turnout and scissors on the main line Expansion joint on the main line
Expansion Joint	Laid	Both sides of CWR(Continuous Welded Rail) (except in the underground section) Bridge with length of more than 100 m
Load	140kN	
Gauge	1,067 mm	
Number of Sleepers	n≧39-38/25m	Direct fastened track with anti-vibration sleeper and PC sleeper
	n≧38/25m	Depot (at-grade)

Source: JICA Study Team



Source: JICA Study Team

Figure 4.4-7 Typical Cross Section of the Track Structure

4.5 Depot and Workshop Plan

4.5.1 Basic Conception (Location of Depot/Workshop)

MRT East-West Line will have the same railway system as that of MRT North-South Line. MRT North-South Line will be constructed prior to MRT East-West Line, which intersects each other with the same network service system. However, each of the fleet operations will be carried out individually. Thus, the rolling stocks and the depot facilities of MRT East-West Line will be provided separately for this line.

MRT East-West Line is proposed to be constructed and opened stage by stage, separating the section to Phase 1 (Stage1 and Stage 2) and Phase 2, so storage tracks are required at the depot. The operation plan such as train set and service frequency should be prepared for each stage.

In identifying the candidate sites for depot, possible sites along the alignment were sorted out based on the research with satellite images of the target area in the first place, and then the site

reconnaissance were carried out on those sites to confirm the existing status. As the result, a large vacant lot for storage tracks and train workshops was available at Ujung Menteng station site in Stage 2 section described in the later section. Ujung Menteng station is also a turning point of sectional traffic volume, so the vacant lot was selected as a candidate site for a general depot with workshops.

Meanwhile, it is proposed that these two lines will be connected with each other in the neighborhood of Thamrin Station of MRT East-West Line in consideration of extraordinary operations such as emergencies.

4.5.2 Location of Depot and Workshop

(1) Depot for the Stage 1

Because the general depot is proposed in Stage 2 section, Stage 1 as a temporary service section requires a depot by the opening with minimum necessary facilities for daily inspection and repair.

Stage 1 is located in the middle of urban area, so the possible sites for a depot are farmland, fish pond and idle land along the line between Kalideres station and Kembangan 2 station. Among those sites, three alternatives were selected considering three points: 1) available land area, 2) number of resettlement by depot construction, and 3) difficulty of land acquisition.

The comparison results are shown in the Figure 4.5 1.

As the result, Alt.3 was selected as the most appropriate site for the depot of Stage 1 with the following reasons; possibility of land acquisition is high, smooth entering to the depot is possible without switchbacks, social environmental impacts such as resettlement is less, and the depot does not disturb junction facilities and station development.

Location			
Item	**Alt. 1 :** Utilization of DKI JKT Land in front of Rawa Buaya Station along E-W Line	**Alt. 2 :** Western Location near to Kalideres Station along E-W Line	**Alt. 3 :** Utilization of PT. Garuda Land Plan near Rawa Buaya Station away from E-W Line
1 Outline of Plan & Existing Condition	1) Plot Area : 10 ha 2) Rawa Buaya Connection Station, with 2-platform and 4-line, and high rise station controlled by JORR 3) Potential Development Land in front of Station	1) Plot Area : 5 ha 2) Kalideres Connection Station, with 2-platform and 4-line	1) Plot Area : 8 ha 2) Rawa Buaya Connection Station, . with 2-platform and 4-line, and high rise station controlled by JORR
2 Land Owner or Development Right Holder	◎ DKI JKT	● Private Developer (Plural Land Owners)	○ PT. Garuda & Private Developer
3 Technical Aspect			
(1) Connectivity between Main Line and Depot	◎ Along E-W Line	◎ Along E-W Line	○ Approx. 1 km south side away from E-W Line
(2) Operability	● Switch back access to Depot	◎ Direct Access without switch back	◎ Direct Access without switch back
(3) Constructability	◎ New Rawa Buaya Station will be able to constructed next to existing station.	● New Kalideres Station will be sifted from the existing station because of high density residential area.	◎ New Rawa Buaya Station will be able to constructed next to existing station.
4 Environmental Aspect			
(1) Natural Env. Impact	◎ No natural conservation area	◎ No natural conservation area	◎ No natural conservation area
(2) Social Env. Impact (Resettlement Houses)	◎ 0 houses	● 25 houses	○ 7 houses
5 Constraint to the Station Plaza Development	● Depot locates in front of Rawa Buaya station.	◎ No constraint	◎ No constraint
6 Construction Cost with Land Acquisition (LA) for Depot & Access facilities	JPY 1,400 Mil. (L=1.2km) LA cost : JPY 0 Mill.	JPY 1,200 Mil. (L=1.0km) LA cost : JPY 800~1200 Mil.	JPY 1,900 Mil. (L=1.6km) LAcost : JPY 1040~1840 Mil.
7 Comprehensive Evaluation	2nd	3rd	1st

Source: JICA Study Team

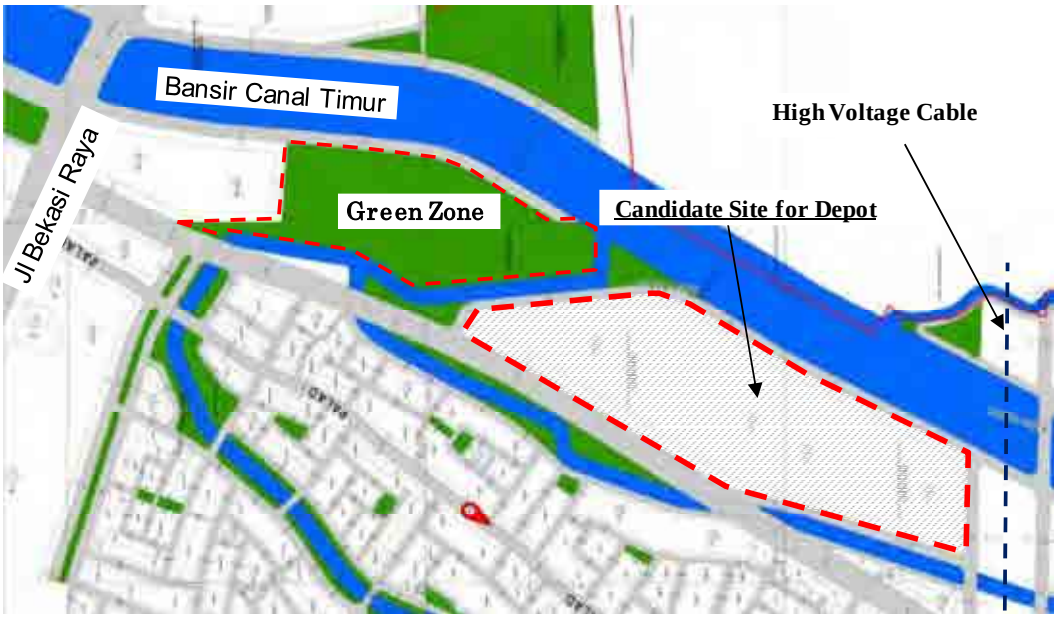
Figure 4.5-1 Comparison of depot sites for Stage 1

(2) Depot for the Stage 2

As mentioned above, a general depot with train workshops is proposed to be constructed by 2024, the opening of Stage 2 section (about 11.6 km) at a large lot in Ujung Menteng station.

Bansir Canal Timur flows on the east of the candidate site for the depot. At present, this candidate site has a wide vacant area. According to Dinas Tata Ruang Spatial Planning Department) of DKI Jakarta, a flood plain, which is referred to as Green Zone, will be constructed on the northern area of the vacant plot. When flooding occurs, the flood plain will absorb the increased river flow. Therefore, the depot cannot be constructed in such an area. However, it was confirmed that the southern part of the vacant plot can be used for depot

construction, wherein a riverbed playground is presently planned. In addition, it was also confirmed during the interview with Dinas Tata Ruang of DKI Jakarta that piers of the viaduct for access to the depot can be constructed in the flood plain area. There are high voltage cables running about 1.5 km south from Jl. Bekasi, and a 'protection yard' having a width of around 150 m. Since this area literally functions to protect objects from electromagnetic wave, the plan of Ujung Menteng Depot is made up of a protection yard for the high voltage cable line.



Source: JICA Study Team

Figure 4.5-2 Spatial Plan of the Candidate Site for Ujung Menteng Depot

Furthermore, at the further extension to the outer side of the Phase 1 section, stabling capacity will be prepared at Balaraja, Perumnas 2 and Batu Cepar in the western area, and Cikarang at the eastern end of the Phase 2 section with length of 56.1 km.

A huge area required for the stabling yard and depot would be acquired in consideration of the environmental condition.

4.5.3 Capacity (Stabling and Inspection)

Table 4.5-1 shows the number of trains required for MRT East-West Line. Stage 1 starts with 22 trains in 2021, and 98 trains run at opening of the entire section or completion of Phase 2. The corresponding capacities of the rolling stock and workshop will be determined based on these data.

Table 4.5-1 MRT East-West Line Fleet Number (Number of Cars)

Description		Number of Train (No. of Car			Remarks
Phase	Opening Year	On-Service	Reserve	Total	
Phase 1 (Stage 1)	2021	20 (120)	2 (12)	22 (132)	Kalideres – Cempaka Baru
Phase 1 (Stage 2)	2024	9 (54)	1 (6)	10 (60)	Kalideres – Ujung Menteng
Phase 2 (Additional)	2027	60 (360)	6 (36)	66 (396)	Balaraja - Cikarang
Total (Final Condition)		89 (534)	9 (54)	98 (588)	

This estimate does not include demand of MRT. North- South line
Train formation: 6 cars/ train set

Source: JICA Study Team

4.5.4 Function

The rolling stock depot and workshop have complex functions for stabling, train inspection, overhaul inspection and maintenance of rolling stock and among others that are related to such works. Therefore, it is necessary to apply many kinds of facilities and machineries for these works in the area, and it is required to arrange these facilities intensively in a single location as much as possible for efficiency.

On the other hand, in order to carry out smooth train operations, some function on stabling will be dispersed in this section. Thus, Ujung Menteng would be selected in general, or a synthetic rolling stock center with full function, and the others would serve only as a stabling yards. It might be possible to secure all fleets in a single yard in Ujung Menteng at the beginning of the Phase 1 section, because all fleets amount to 28 trains (six car trains) including the reserve trains at the time. However, Kembangan 2 and Kelapa Gading Barat Stations would also be used for night stabling aiming for smooth train operations.

Meanwhile, 70 trains will be added in the total fleets in the opening of the Phase 2 section in 2027. Therefore, the stabling yard at the terminal stations, Balaraja and Cikarang, are required and a large-scale depot will be provided at Perumnas 2 area.

4.5.5 Rolling Stock Inspection System

STRASYA as the basic system might be introduced also into MRT East-West Line since MRT North-South Line was already designed with the same system. Therefore, in this section, the facility capacity for the rolling stock inspection and others were estimated in consideration of the same inspection system of rolling stocks in MRT North-South Line. The rolling stock inspection system is shown in Table 4.5-2.

Table 4.5-2 Rolling Stock Inspection System

	Description (Inspection Category)	Inspection Interval	Work place
1	Driver Check	Every time before operation	Depot (Stabling Track)
2	6 days Inspection	6 days or less	Depot (Inspection Shed)
3	3 Month Inspection	90 days or less	Depot (Inspection Shed)
4	Semi-General Inspection (Critical Parts)	4 years or less 600,000 km	Workshop
5	General Inspection	8 years	Workshop
6	Emergency	5% of fleet	Depot (Emergency)

Source: JICA Study Team

4.5.6 Rolling Stock Depot and Workshop Facility

As mentioned above, the OCC (Operation Control Center), rolling stock yard, inspection and maintenance facilities required from the opening are designed for Kalideres depot in Stage 1 section.

Ujung Menteng depot constructed in the Stage 2 is constructed as a general depot including facilities for storage, inspection and maintenance with workshops.

The facilities at each depot are shown in Table 4.5-3, and the layout of the Ujung Menteng depot and workshop is illustrated in Figure 4.5-3.

Table 4.5-3 Major Equipment of Depot and Workshop

Location	Description	Phase 1 (Stage1)	Phase 1 (Stage2)	Total	Remarks
Kalideres Depot					
	- Shop in Track	2		2	Stabling Capacity:
	- Stabling Track	280m× 10		280m× 10	10×2=20
	- Cleaning Track	140m× 1		140m× 1	1×1=1
	- Inspection Shed	140m× 1		140m× 1	1×1=1

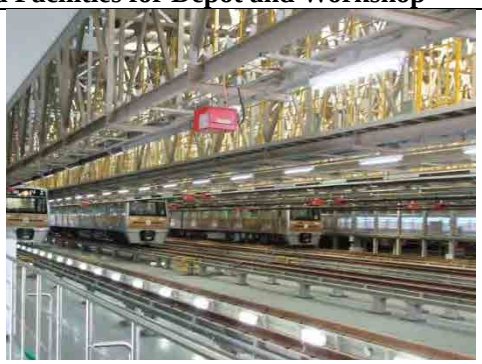
Location	Description	Phase 1 (Stage1)	Phase 1 (Stage2)	Total	Remarks
					Total 22
(Others)	- OCC				
	- Infrastructure Depot	200m× 2		200m× 2	With Machinery
	- Power Plant				
	- Water supply				
	- Water Treatment				
	- Warehouse				
	- Rescue System				
	- Car Garage				
	- Others				
Ujung Menteng Depot					
(Depot)	- Shop in Track		2	2	Stabling Capacity
	- Stabling Track		140m× 28*	140m× 28*	28×1=28
	- Cleaning Track		140m× 2	140m× 2	2×1=2
	- Inspection Shed		140m× 2	140m× 2	2×1=2
	- Wheel Turning Shed		140m× 1	140m× 1	Total 32
	- Emergency shed		140m× 1	140m× 1	
(Workshop)	- Shop in Shed		140m× 1	140m× 1	
	- Workshop Building		140m× 2	140m× 2	Main Shop
	- Other shops				With Machinery
	- Administration Office				
	- Other				
(Others)	- Infrastructure Depot		200m× 2	200m× 2	With Machinery
	- Power Plant				
	- Water supply				
	- Water Treatment				
	- Warehouse				
	- Rescue System				
	- Car Garage				
	- Others				

*note: the number of storage tracks in Ujung Menteng is set to the maximum considering the opening of Phase 2.

Source: JICA Study Team

The following table shows some example photos of equipment and facilities in depot and workshop

Table 4.5-4 Photos of Equipment and Facilities for Depot and Workshop

Inspection Pit

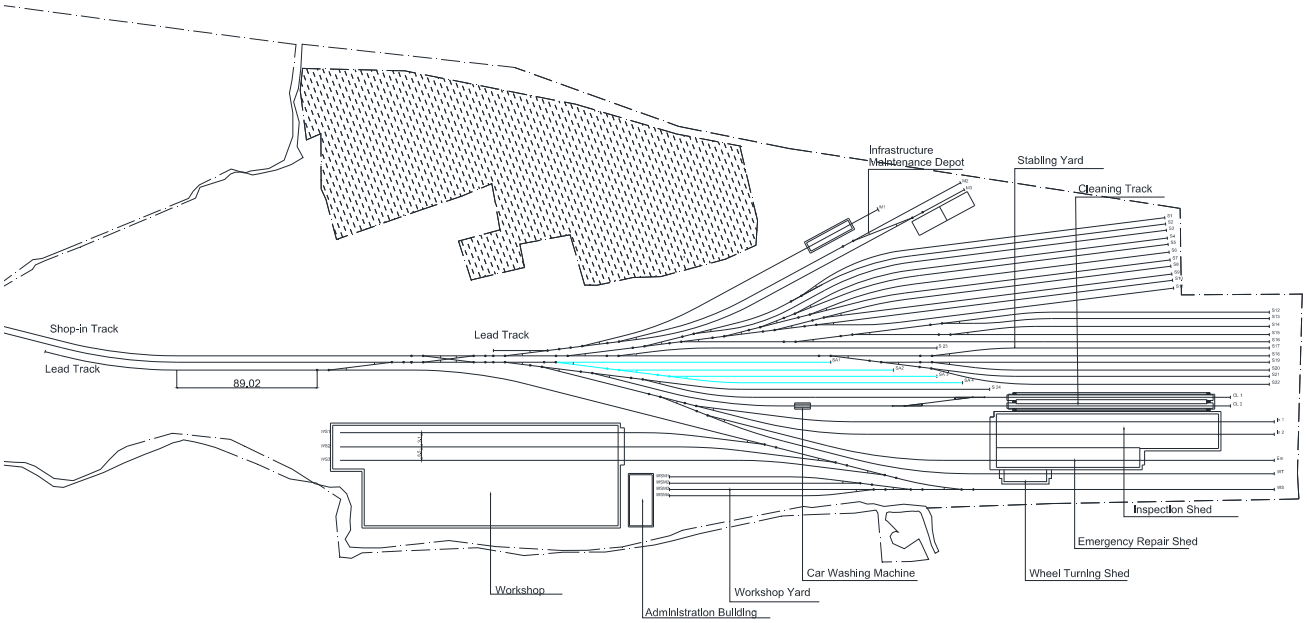
Full Length In-floor Pit Jacks

Ground Wheel Lathe

Hauling Car

Carriage Washing Machine

Source: JICA Study Team



Source: JICA Study Team

Figure 4.5-3 Layout of Ujung Menteng Depot and Workshop

4.6 Railway System

4.6.1 Electric Facilities

(1) Basic Policy

The operating body of MRT East-West Line is likely to be identical to that of MRT North-West Line. Emphasizing on the ease of the operations and maintenance (O&M) and training of operators and workers, the electrical facilities of MRT East-West Line will adopt common specifications with that of MRT North-South Line.

(2) Outline of Electric Facilities for North-South Line

The key specifications of electrical facilities for MRT North-South Line are shown in Table 4.6-1.

Table 4.6-1 Main Specifications of Electrical Facilities for MRT North-South Line

Item	Specifications of North South Line
Receiving substation (RSS)	Two RSS with receiving voltage 150 kV with 60 MVA transformer
Traction nominal voltage	1,500 V DC
Type of contact line	Elevated and at-grade section: overhead catenary (simple catenary system) Underground section: rigid catenary system
Rated rectifier capacity for traction substation	4,000 kW
Distribution to stations and depot from RSS	Two 20 kV circuits
Backup power supply for station facility	Emergency generator in each passenger station

Source: JICA Study Team

(3) Current Status and Future Plan of the Power Grid in DKI Jakarta Area

The current status and future plan of the power grid in Java and Bali Islands including DKI Jakarta were investigated in order to verify the possibility of power supply for the operations of MRT East-West Line.

Table 4.6-2 shows the current status and forecast of the generation capacity and electricity demand in Java and Bali Islands. The demand forecast until 2019 had been conducted by PLN. The forecast shows that the demand will increase at an annual rate of 9%, and reach more than 2.2 times of the demand in 2010.

The enhancement of the generation capacity was planned by PLN to ensure 26% of the capacity margin in 2019. It means that the planned power generation capacity will be able to sufficiently meet the demand in the future. Figure 4.6-1 shows the current power facilities and power development plan in Java and Bali Islands.

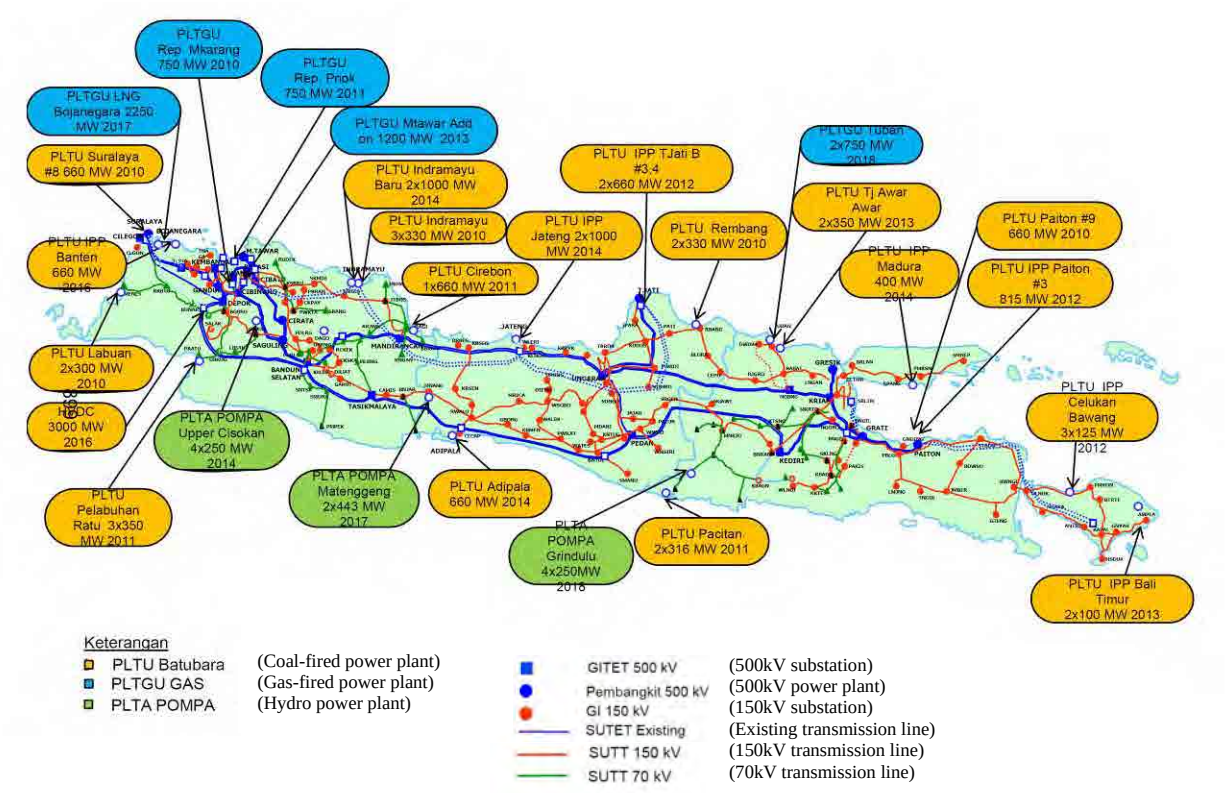
The required power for MRT East-West Line operations will be 400 MW at peak time in 2019 considering the power demand of 100MW for MRT North-South Line. The power demand for Jakarta MRT (both N-S and E-W line) will be around 1% of the total generation capacity in Java and Bali Islands. The sufficient generation capacity can be ensured for the operations of MRT East-West Line.

Table 4.6-2 Current Status and Forecast of the Generation Capacity and Electricity Demand in Java and Bali Islands

Year	2010	2019
Requirement (peak demand) [MW]	19,486	43,367
Generation capacity [MW]	21,784(*)	58,617
Margin	10.5%	26.0%

(*Value of 2009)

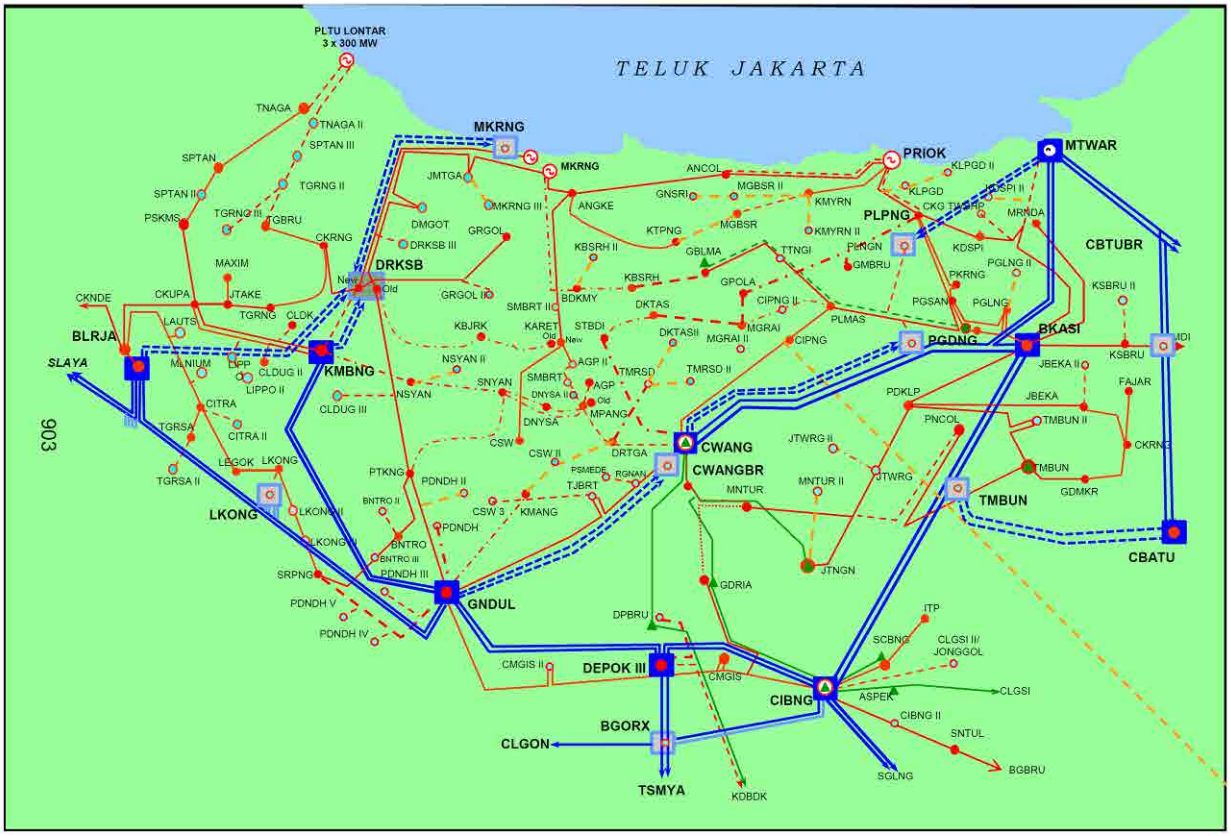
Source: Prepared by JICA Study Team based on "RENCANA USAHA PENYEDIAAN TENAGALISTRIK PT PLN (PERSERO) 2010-2019", PLN, 2011



Source: "RENCANA USAHA PENYEDIAAN TENAGA LISTRIK PT PLN (PERSERO) 2010-2019", PLN, 2011

Figure 4.6-1 Current Power Facilities and Power Development Plan in Java and Bali Islands

Figure 4.6-2 shows the current status of power facilities and planned substations in DKI Jakarta. The receiving voltage of the RSS in MRT East-West Line is supposed to be 150 kV along with MRT North-South Line. As reply to the inquiry from the JICA Study Team, PLN presented an outlook that the required power for MRT East-West Line can be supplied from the planned 500/150 kV substations in addition to the existing 500/150 kV substations.



Source: "RENCANA USAHA PENYEDIAAN TENAGA LISTRIK PT PLN (PERSERO) 2010-2019", PLN, 2011

Figure 4.6-2 Current Status of Power Facilities and Planned Substations in DKI Jakarta

(4) Assumptions of Power Demand for E-W Line

The power demand for E-W Line can be divided into following two parts; one is the power demand for traction. Another is the one for station facilities.

The power demand for traction means the power required to drive the rolling stocks supplied from rectifiers located in Traction Substation (TSS). That is determined based on the passenger demand and the train operation plan. The assumptions for the calculation of the power demand for traction are shown in Table 4.6-3.

Table 4.6-3 Assumptions for the Calculation of the Power Demand for Traction

	Year		
	2021-	**2024 –**	**2027 -**
Phase in operation	Phase-1 Stage 1	Phase-1 Stage1 and 2	Phases-1 and 2
Line length	20.1	31.7	88.8
Headway in peak time (min.)	5:00	5:00	2:30

Source: JICA Study Team

The capacity of Receiving Substation (RSS) and TSS is determined to meet the maximum demand in future because the lifetime of RSS and TSS is more than thirty years. As mentioned in Table 4.6-3, the maximum demand will be the headway of 2:30 after year 2027.

The power demand for station facilities means the power required to operate the all the electrical and mechanical facilities in stations, substations, and depot, such as lightings, air conditioners, office equipment and etc except traction power. The assumptions of the power demand for station facilities per location are shown in Table 4.6-4.

Table 4.6-4 Assumptions for Power Demand per One Station/Depot/Substation

	Elevated Station [kW/]	**Underground station [kW]**	**Depot [kW]**	**Depot with workshop [kW]**	**TSS [kW]**	**RSS [kW]**
Tunnel illumination	-	10.0	-	-	-	-
Small Power Outlet	28.0	28.0	33.6	56.0	7.0	14.0
AFC	19.1	19.1	-	-	-	-
PSD	0.0	33.6	-	-	-	-
Facility SCADA	35.0	35.0	-	-	-	-
Signal and Telecom	28.0	28.0	28	28.0	-	-
Elevator/Escalator	67.2	67.2	-	-	-	-
Signage	25.0	25.0	-	-	-	-
Fire Shelter	-	14.0	-	-	-	-
Station/depot illumination	90.0	300.0	270	450.0	2.0	4.0
Air conditioning	-	576.0	57.6	288.0	144.0	288.0
Machinery	-	-	-	960.0	-	-
Total power demand per location	1135.9	292.3	389.20	1782.0	153.0	306.0

Source: JICA Study Team

(5) Receiving Substation (RSS)

SSs will be required at two locations in the Phase 1 section (One RSS for Stage 1 and 2 respectively) for the enhancement of the reliability of the power supply by adopting a redundant system. The locations of the RSSs are preferable to be of equal interval as possible.

Through the site survey, the selected candidate sites for the RSSs are the northern area in the vicinity of Roxy Station (45k600) and the northwestern area in the vicinity of Pulogadung Station. The locations of the candidate sites are shown in Figure 4.6-3.

PLN replied to the JICA Study Team's inquiry that it is possible to supply power to the candidate sites through two 150 kV circuit lines.

One or two RSSs will be required at each of the western and eastern sections of Phase 2. The RSS will be located at the center of each section

The calculated power demand and receiving capacity under the assumptions in the preceding section are described in Table 4.6-5. Transformers of 50 MVA will be required for each RSS in the Phase 1 section in the commencement year of 2020. In addition, transformers with capacities of 120 MVA and 60 MVA are required for the western and eastern sections, respectively, of Phase 2 in 2027, which is the commencement year of the Phase 2 section.

Table 4.6-5 Calculated Power Demand and Receiving Capacity

	Year		
	2021 – (Ph-1 Stage 1)	**2024 – (Ph-1 Stage 1 + 2)**	**2027 – (Ph-1 + Ph-2)**
Total maximum power per hour for traction [MWh]	6.5	10.3	66.0
Instantaneous maximum power for traction (A) [MW]	20.3	33.7	178.6
Power demand for distribution of stations and depot (B) [MW]	12.2	17.4	29.6
Total instantaneous power (A) + (B) [MW]	32.5	51.1	208.2
Required RSS capacity [MVA]	43.4	68.1	277.6
Transformer capacity to be installed [MVA]	RSS-1 50	RSS-1 50 RSS-2 50	RSS-1 50 RSS-2 50 RSS-3 60 x 2 RSS-4 60

Source: JICA Study Team

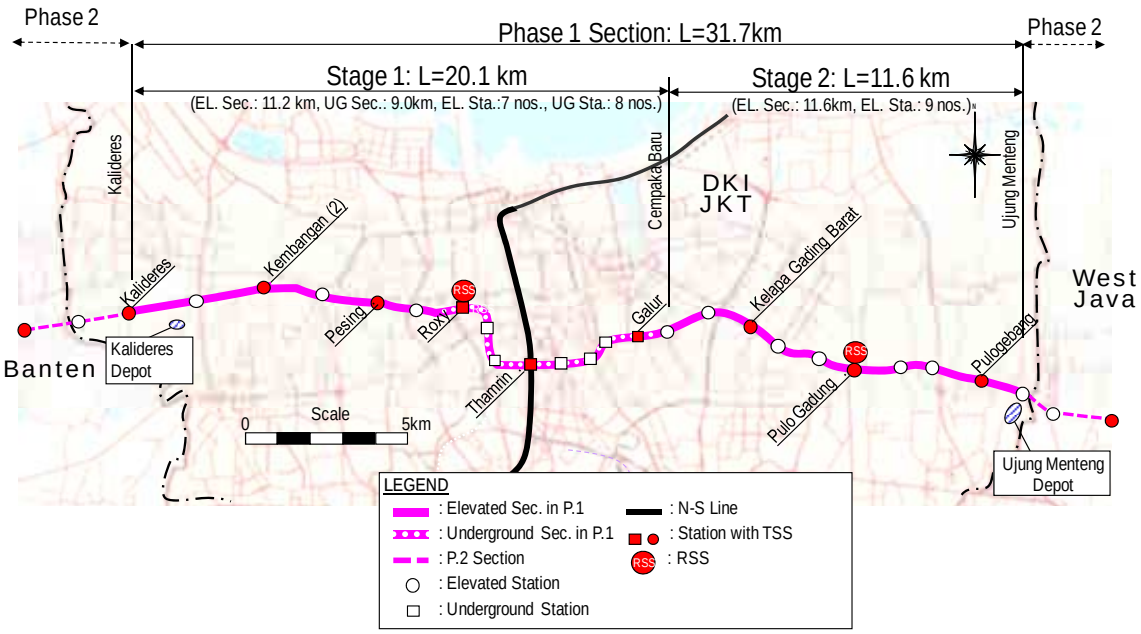
(6) Traction Substation (TSS)

Similar to MRT North-South Line, the TSSs were recommended to be indoor type and constructed inside the stations. The required number of TSSs was calculated based on the voltage drop calculation of the contact line. As a result, six TSSs for Ph-1 Stage 1 section, three TSSs for Ph-1 Stage 2 section, and fifteen TSSs for Ph-2 section were required respectively. The calculated power demands for the traction and rectifier capacity are shown in Table 4.6-6. The locations of TSSs are shown in Figure 4.6-3.

Table 4.6-6 Power Demand for Traction and Rectifier Capacity of the TSS

	Year		
	2021 – (Ph-1 Stage 1)	**2024 – (Ph-1 Stage 1 + 2)**	**2027 – (Ph-1 + Ph-2)**
Maximum traction demand for one TSS[MW]	1,300	1,300	2,600
Rated rectifier capacity for one TSS [kW]	3,000		
Number of TSSs	6	9	23

Source: JICA Study Team



Source: JICA Study Team

Figure 4.6-3 Locations of RSSs and TSSs in Phase 1

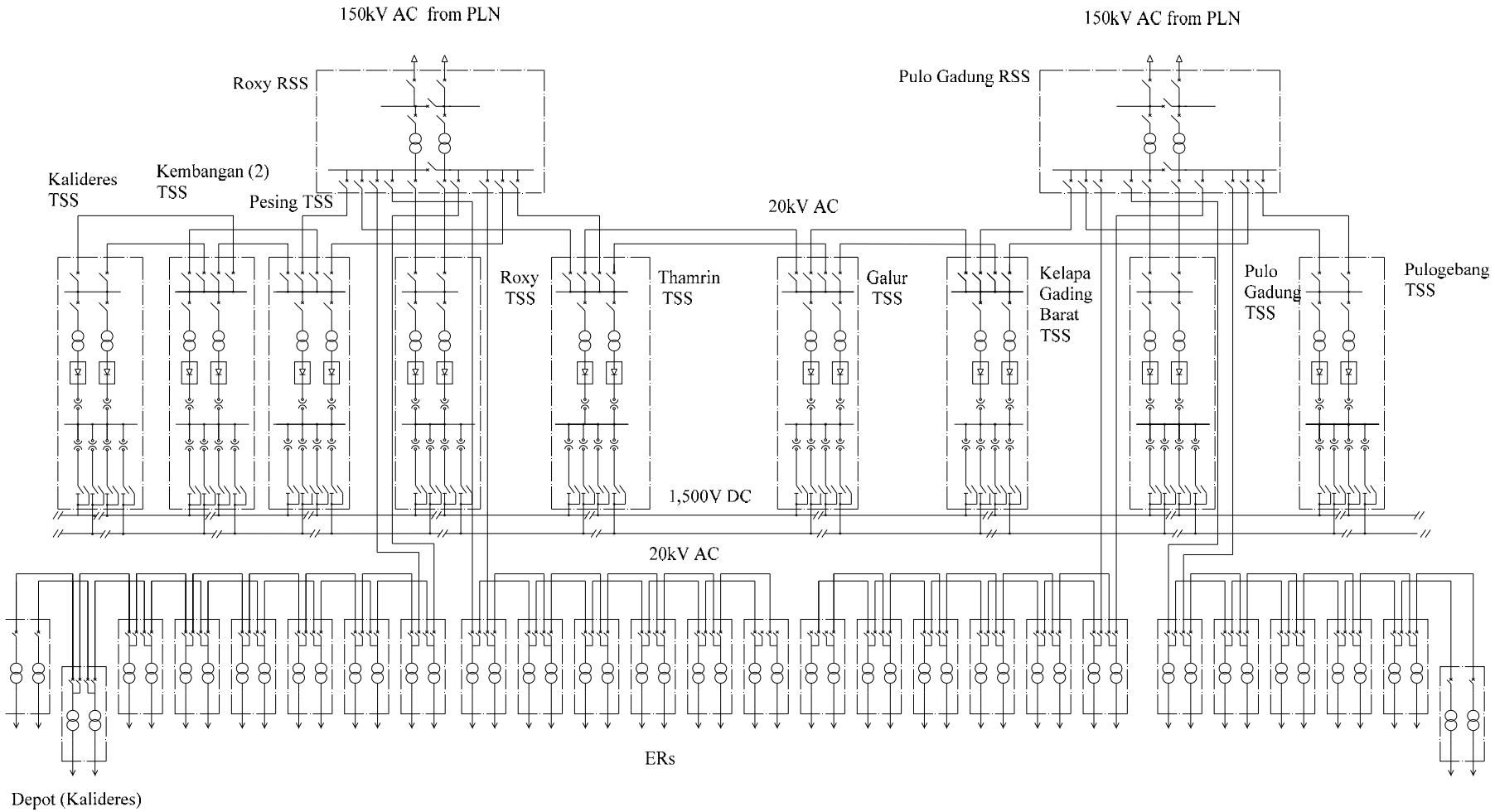
(7) Contact Line System

Similar to MRT North-South Line, the simple catenary system is recommended for the at-grade and elevated section, as well as rigid conductor system for the underground section.

(8) Distribution System

Similar to MRT North-South Line, an electric room (ER) will be installed in each station, and two 20 kV circuit systems were recommended for the distribution system of the power supply from the RSS to the TSS and ER.

A single line diagram for the traction power supply and distribution of the Phase 1 section is shown in Figure 4.6-4.



Source: JICA Study Team

Figure 4.6-4 Single Line Diagram for the Traction Power Supply and Distribution System for the Phase 1 Section

(9) Emergency Power Supply

Similar to MRT North-South Line, the installation of a diesel generator for every station as an emergency generator for power supply to station facilities is recommended.

(10) Power SCADA

The power supervisory control and data acquisition system (SCADA) is required for the control and monitoring of the traction power and distribution system. The location of the Power Control Center (PCC) is recommended to be in the OCC room located at the depot in Ujung Menteng for smooth communication with train operators.

4.6.2 Mechanical Facilities

(1) Air-Conditioning Facilities

1) Outline of Air Conditioning Facilities

The purpose of air-conditioning facilities is to provide comfort in the station.

However, the structure of the station is different from a normal building and the method of air-conditioning is also different. The station is an elongated structure in a longitudinal direction.

In addition, the platform and concourse are connected outside through the exit/entrance and the efficiency of air-conditioning are influenced and decreased by these circumstances. The design heat load per unit area is bigger than that of normal buildings. Therefore, the air-conditioning system in the station should be a simple component and structure, taking into consideration the ease of operations and maintenance work.

2) Cooling Method

a) Central Cooling System

The central cooling system is applied for large space such as the platform, concourse and station offices, etc.

b) Stand-Alone Cooling System

The stand-alone cooling system is basically applied for the electric and communications facility rooms (substation, signaling equipment room, and communications equipment room). These rooms are very important for train operations and refuge guidance in case of emergencies. Thus, standby facilities used as backup in case of emergency are required.

3) Air Conditioning Method

a) Unit Duct System

The unit duct system is used for large spaces such as the platform and concourse.

b) Fan Coil Unit System

The fan coil unit system uses central cooling system and is locally controlled. It is applied in the station office and rooms where station staff stays.

c) Package Air Conditioning System

The package air-conditioning system is a stand-alone system. Therefore, it could be used separately apart from the central cooling system which is stopped when the train is not in operation. It is applied for electrical facility rooms (substation, signaling equipment room and communications equipment room) and rooms related to station operations.

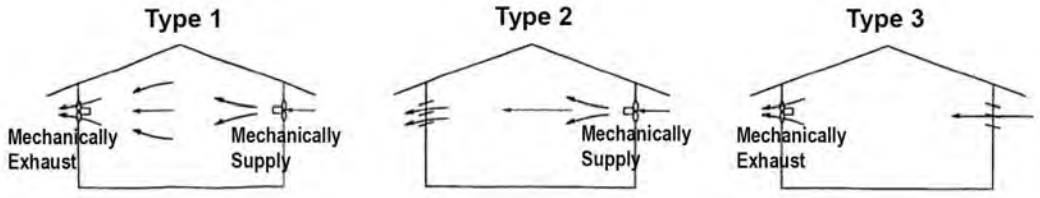
(2) Ventilation System

1) Outline of Ventilation System

The purpose of ventilation is to provide comfortable and hygienic space in the station by taking in fresh air outside the station, and exhausting polluted air inside the station. Ventilation is also purposed to control the temperature inside the station which is raised by the heat from passengers, trains and other facilities. Mechanical ventilation is used for the project. In the stations where full-height platform screen doors are applied, the ventilation system of the platform is separated from that of the tunnel. Therefore, such ventilation systems are designed as separated and segregated systems.

2) Type of Ventilation

The ventilation methods used for rooms and closed spaces is basically classified into three types as shown in Figure 4.6-5.



Type 1: Mechanically supplied air and mechanically exhausted air.

Type 2: Mechanically supplied air and naturally exhausted air.

Type 3: Naturally supplied air and mechanically exhausted air.

Source: JICA Study Team

Figure 4.6-5 Ventilation Methods for Rooms and Closed Spaces

3) Ventilation Method

a) Ventilation Method of Platform

The purpose of ventilation in the platform is to provide fresh air from outside and comfortable and hygienic conditions for passengers, and to exhaust heat in the platform. Based on the structure of the station and the requirements of the huge volume of fresh air, the Type 1 ventilation system is applied and the ventilation system doubles as an air-conditioning system.

b) Ventilation Method of Concourse

The system for ventilation of the concourse is the same as that of the platform.

c) Ventilation Method of Station Office, etc.

The ventilation of the station office and other rooms where the station staff stay longer are planned to meet the requirement of Japanese and Indonesian standards as well as other related standards or regulations.

d) Ventilation Method of Tunnel

The purpose of ventilation of tunnel is to provide fresh air from outside and to exhaust the heat in the tunnel. In the mechanical ventilation method, the air in the tunnel is supplied and exhausted mechanically by fans. This method has the advantage of having a high capability of ventilation for the huge amount of generated heat in the tunnel as compared with the natural ventilation method. In addition, it does not require land acquisition for the vertical shaft, which is required in the natural ventilation method. Therefore, the mechanical ventilation method is recommended as the ventilation method of the tunnel.

(3) Smoke Exhaust System

1) Outline of Smoke Exhaust System

In the event of a fire accident in the station and tunnel, the smoke exhaust is one of the essential factors for passenger evacuation and firefighting. The smoke exhaust system is designed based on Japanese standards (the Standard of Fire Safety Management for Subway Station, etc., Ministerial Ordinance of the Ministry of Land, Infrastructure, Transportation and Tourism, Japan), Indonesian Standards and other related standards or regulations. The dedicated exhaust duct and fans are provided for these areas.

2) Smoke Exhaust Method

Similar to MRT North-South Line, the smoke exhaust system doubles as a ventilation system in order to be economical. The dedicated exhaust duct and fans are provided for the station office, etc.

3) Smoke Exhaust for the Platform

The volume of the smoke exhaust is large and it is not economical to install the air duct only for the purpose of smoke exhaust. In addition, the space above the platform level is limited. Thus, it is reasonable and economical to use the ventilation system for the smoke exhaust in case of a fire accident. The basic policy of the smoke exhaust is as follows:

a) Shared use of exhaust duct

Type 1 ventilation (mechanically supplied and exhausted) is applied for the ventilation of the platform. Therefore, the exhaust duct for the ventilation is used for the exhaust of smoke in case of fire.

b) Residential area

If the mouth of the exhaust shaft is located in the residential area, the air supplied duct will be used for the smoke exhaust after the duct is switched and the direction of air flow is reversed.

4) Smoke Exhaust Method of the Concourse

The smoke exhaust system is designed based on the volume of diffused smoke.

5) Smoke Exhaust Method of the Station Office and Other Rooms where the Station Staff or the Passengers stay longer

The smoke exhaust system is designed based on Japanese and Indonesian standards, and other related regulations. The dedicated exhaust duct and fans are provided for these rooms.

6) Smoke Exhaust Method of the Tunnel

In case of fire accident in the tunnel, the tunnel ventilation fans are used for the exhaust of smoke. The air speed for the smoke exhaust has to be smooth in order to secure the safety of passengers and to help in firefighting. The power of the exhaust fans is to be designed considering that the smoke exhaust system doubles as a ventilation system.

(4) Water supply, Sewage/Drain and Fire Fighting System

1) Water Supply System

The amount of water supply in the station is determined by the number of passengers in the station, the number of station staff and the requirements for air-conditioning.

The following are the main three types of water supply system:

a) Direct connection to public water supply pipe

Water pressure is influenced by the fluctuation of water pressure of the public water supply pipe and it is necessary to connect it with a large diameter pipe in order to secure the large demand of water during peak time. Moreover, this system does not have a local storage water

tank in the station, and there is a possibility that the water supply is stopped due to a stoppage in the public water supply. Therefore, this system is not suitable for water supply of the station.

b) Domestic water supply with the gravity tank

It is difficult to secure enough space in the ground level for the installation of a gravity tank. Therefore, this system is not suitable for water supply of the station.

c) Domestic water supply with the pressurized tank

This system is suitable for the stable water supply of the station.

2) Sewage/Drain System

The metro station is located underground. Thus, drained water is collected in the storage tank and pumped up to the ground level. Drained water is classified into two systems, i.e., one is wastewater and the other is rainwater and groundwater.

a) Wasted water

Wastewater is collected from many places in the station and the length of the drain pipe tends to be longer. In order to secure appropriate hydraulic gradient, the station will be divided into several zones and the storage tank will be assigned in the appropriate position. Drainage treatment facilities will be required for effluent to public sewage based on Indonesian standards.

b) Rainfall and Ground water

Rainwater and groundwater from the tunnel are collected at the end of the platform where the storage tank is installed.

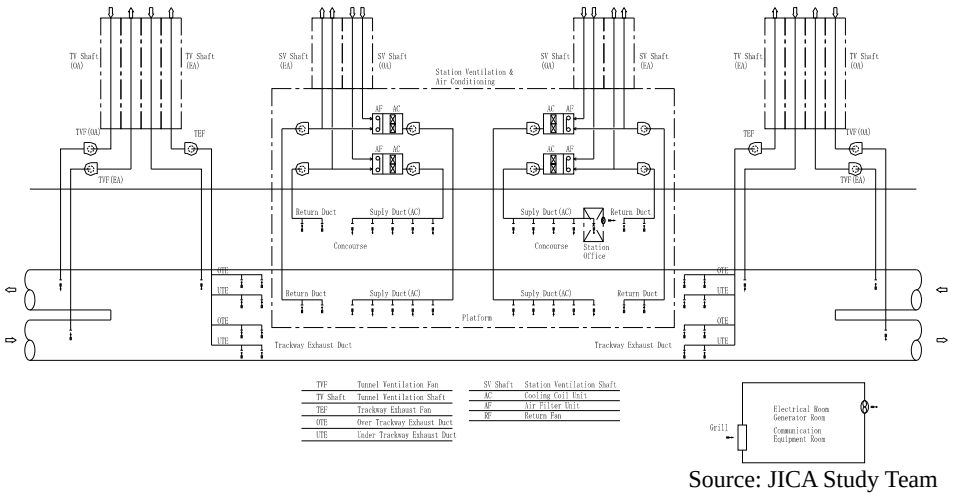
3) Fire Fighting System

In order to prevent and minimize fire accidents, the following firefighting systems will be installed:

1. Hydrant for platform, concourse and other areas
2. Automatic sprinkler for station staff room, etc. and storage room
3. Water supply pipe and hydrant in the tunnel
4. Special fire extinguishing equipment for facilities vulnerable to water damage such as substation and signaling and telecommunications system

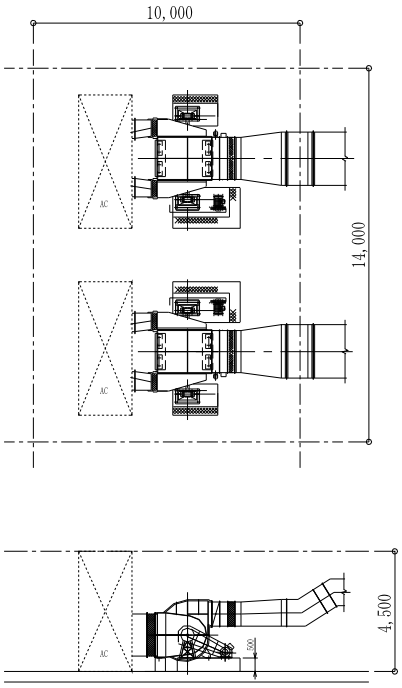
(5) System Diagram and Required Space for Mechanical Facilities

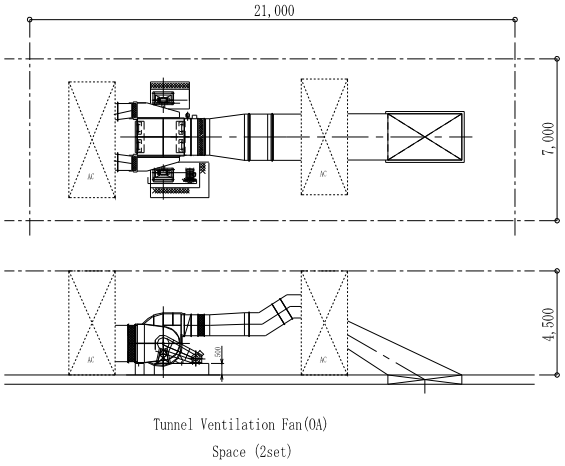
The system diagram of the ventilation facilities for the underground station and the required spaces for mechanical facilities are shown in Figure 4.6-6.

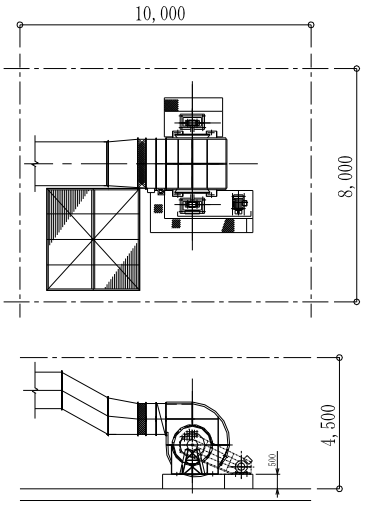


Source: JICA Study Team

Figure 4.6-6 System Diagram of the Tunnel and Track Ventilation Facilities

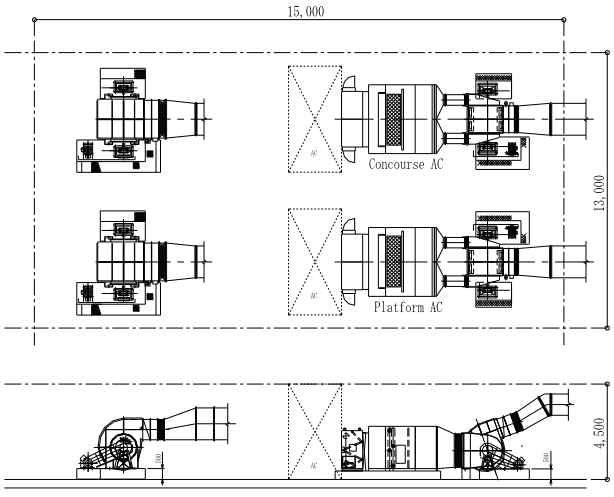






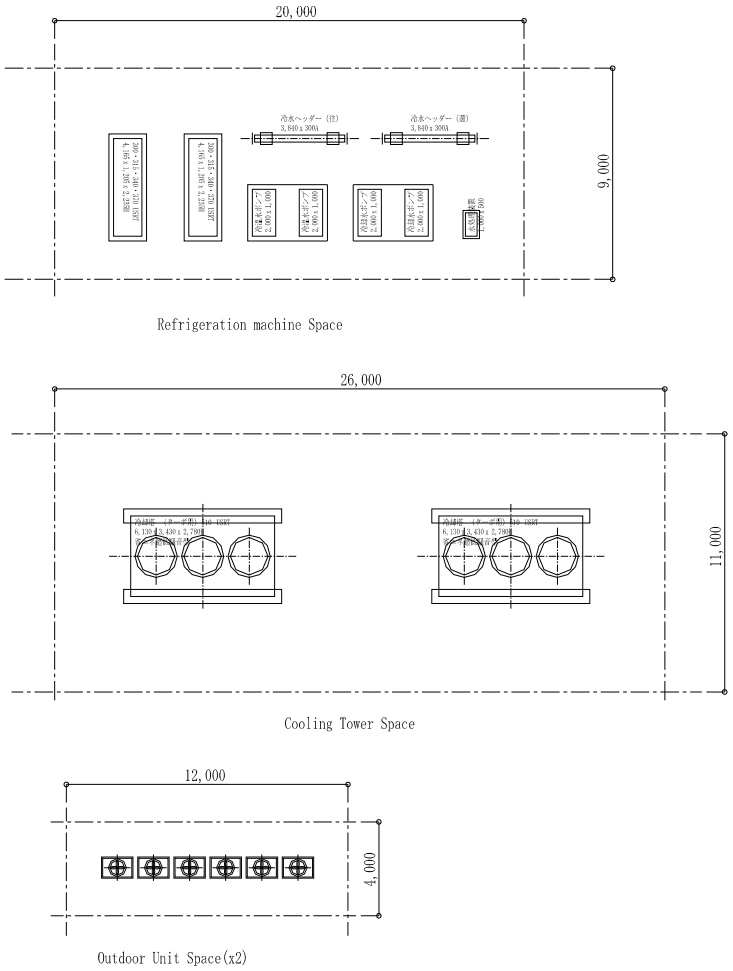
Source: JICA Study Team

Figure 4.6-7 Required Space for the Tunnel and Track Ventilation Fans (TEF/TVF Room)



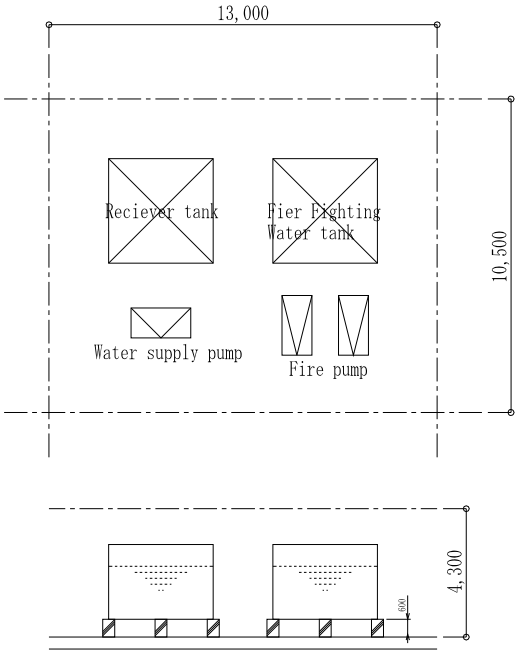
Source: JICA Study Team

Figure 4.6-8 Required Space for Air-Conditioning Facilities (AHU Room)



Source: JICA Study Team

Figure 4.6-9 Required Space for Cooling Facilities (ECS Room at Ground Level)



Source: JICA Study Team

Figure 4.6-10 Required Space for the Water Tank, Pump (Fire Service Tank Room/Water Tank Room/Pump Room)

(6) Elevators and Escalators

The arrangement policy of elevators and escalators is consistent with the one of MRT North-South line. One unit of up and down escalator is proposed to be installed between the ground level and the concourse level at every free concourse for the most of stations. Meanwhile at least one unit of up and down escalator is to be installed in the every platform level in order to transfer the passengers from the concourse level smoothly.

At least a single route with elevator is proposed between the ground level to every platform via the concourse level at each station, allowing wheel chair passengers travel smoothly.

The proposed required number of elevators and escalators in each station is shown in Table 4.6-7.

The above mentioned basic arrangement policy should be verified and arranged according to further information of passenger demand at every exit of the station.

Table 4.6-7 Required number of elevators and escalators in stations

Type of station		Nos of elevators	Nos of escalators	Remarks
Elevated station	St. Grogol, Sumur Batu and Cakung Barat	3	6	Four-story station
	Other elevated stations	3	4	Three-story station
Underground station	St. Thamrin	0	4	St. Thamrin is the cross station with N-S line. Elevators will be provided in N-S Line
	Other underground stations	2	4	

Source: JICA Study Team

4.6.3 Demarcation of Construction Works between the MRT North-South and East-West Lines

Thamrin Station is the cross station of MRT North-South and East-West Lines. It is preferable that the design of station structure and facilities of this station consider the future construction of MRT East-West Line stations within the construction phase of MRT North-South Line stations.

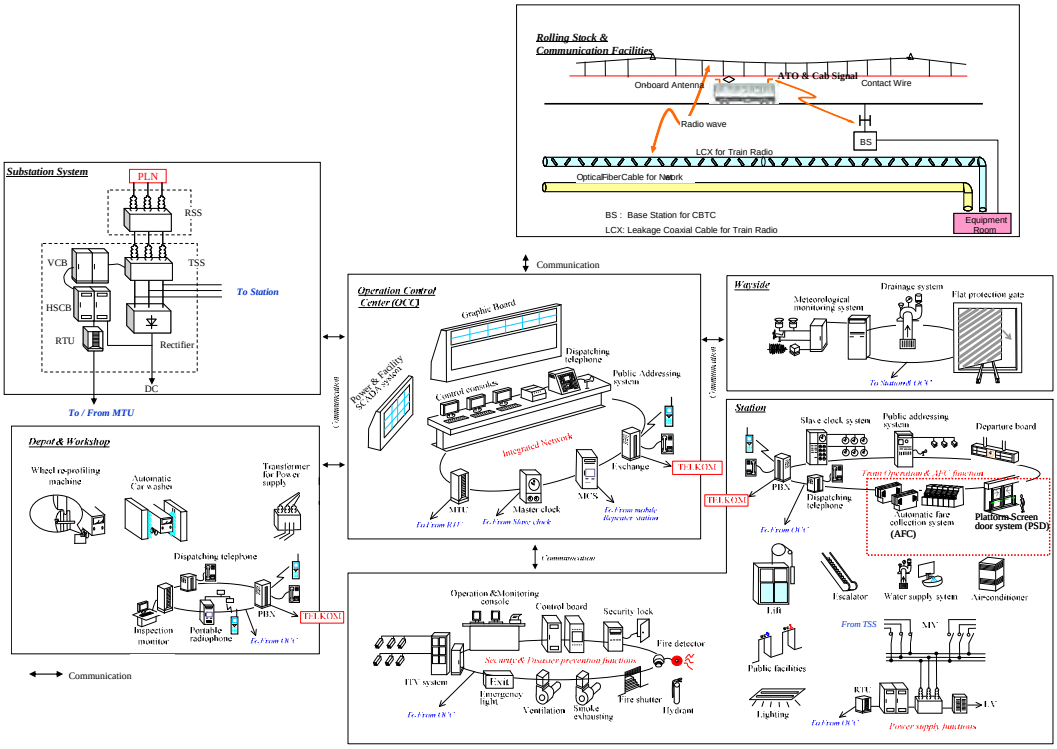
Table 4.6-8 Demarcation Construction Works of Electrical and Mechanical Facilities between MRT North-South and East-West Lines in Thamrin Station

Facility	E-W Line	N-S Line	Remarks
Electrical Facilities			
Traction Substation	○		
Electric Room	○		New ER is installed for E-W line station. If ER in N-S line station also supply the power to E-W line Station, space for expansion is required in the ER in N-S line station.
SCADA	○		Remote Terminai Units are installed in TSS and ER.
Emergency Generator		○	EG in N-S line station is shared with E-W station under the assuption that coinstantaneous accident never occor in N-S and E-W line station
Mechanical Facilities			
Heat Source System			
Refregiration Machine（REF）、Water Cooling Pump（CP）、Cooling Tower（CT）、Cooling Water Pump（CDP）、Others	○	○	The system is expanded in N-S Line Station. The space for expansion for E-W system is required for N-S Line Station
Air Conditioning System			
Air Handling Unit（AHU）、Package Air Conditioner（PAC）	○	○	AHU of E-W Line is only for its platform. Water for AHU is supplied from N-S Line Station
Ventilation System			
Truckway Exhaust Fan（TEF）、Tunnel Ventilation Fan（TVF_OA/EA）	○	○	The system is physically separated from N-S Line System.
Smoke Exhaust System			
Smoke Exhaust Fan（SEF）、Tunnel Ventilation Fan（TVF_OA/EA）	○	○	SEF of E-W Line is only for its platform. The system is physically separated from N-S Line System.
Intake/Exhaust Shaft	○	○	The Shaft is only for ventilation for platform and tunnel of E-W Line.
Water Supply and Sewage/Drain System			
Leading-in. Receiver Tank, Water Supply Pump, Drain Tank, Drain Pump, Drainage Treatment		○	Water is supplied from N-S Line Station
Piping for effluent to public sewage	○	○	Pumped up spring water is drained separated from N-S Line Station.
Fire Fighting System			
Fire Fighting Water Tank, Fire Pump, Sprinkler Pump, Hydrant		○	Supplied from N-S Line Station
Facility SCADA		○	Installed in the same room as N-S Line Station or, N-S Line Station SCADA also covers the E-W Line Station System

Source: JICA Study Team

4.7 Signaling and Telecommunications System Plan

The railway system consists of the following: substation system, overhead contact system and power distribution system for treating high voltages and strong currents; and signaling system, telecommunications system, platform screen door system (PSD), facility SCADA system, AFC system and depot system for treating low voltages and weak currents. The specifications of these systems provided in MRT East-West Line are basically unified with that of MRT North-South Line. The system configuration is shown in Figure 4.7-1.



Source: JICA Study Team

Figure 4.7-1 System Configuration

Table 4.7-1 Main System Specifications

No.	System	Specification or Performance
1.	Gauge	1067 mm
2.	Length (Km)	27.0km (Underground 8.9km Elevated 18.1km)
3.	Number of stations	22 (Underground 8, Elevated 13, At grade 1)
4.	Maximum Speed	Underground 80 km/h Elevated 100 km/h
5.	Traction System	
a.	Voltage	1500 V (DC)
b.	Method of current collection	Overhead Catenary
6.	Rolling Stock	
a.	Train composition	6 cars (4 M + 2 TC)
b.	Propulsion system	3 phase drive system with VVVF control
c.	Traction Motor rating	190 kW
d.	Braking	Regenerative, Emergency, Holding, Parking, electro pneumatic and hand brakes
e.	Acceleration	0.80 m/s/s ± 5%
f.	Deceleration Maximum jerk rate	1.0 m/s/s ± 5% 0.70 ± 0.05m/s/s
g.	Adhesion	Less than 15%
h.	Axle load	Less than 14 ton
i.	Vehicle dimensions Length (coupler to coupler) Width (outer to outer) Height (above rail level)	 20.50 m (Leading Car) / 20.00m (Intermediate Car) 2.950 m 3.655 m
j.	Ventilation arrangement	Air conditioning of coaches
k.	Additional features	Public address system, Passengers emergency alarm through emergency talk back unit, Train radio for communication between OCC and driver, Emergency announcement by OCC to passenger, Automatic door closing, fully vestibule, P A system, Front emergency door, ATO + ATP + TASC

No.	System	Specification or Performance
l.	Passenger capacity of coaches (under dense crush loading) with 6-standees/ sqm floor area) (b)Motor coach (non-driving) (ii) Non-driving trailer coach	Seated+Standing (Max. Pax.capacity) M=162 (308) Tc=144 (338)
7.	Power Supply	
a.	Source	Two circuits in 150 kV AC from PLN grid for one RSS
b.	Facility	Receiving Substation(RSS), Traction Substation
		Electric Room (ER) Power SCADA
c.	Distribution voltage	20kV (to TSS and ER from RSS)
d.	Emergency power supply for ER	One diesel generator for underground each station
8.	Escalator and elevator at station	Each station
9.	Signal appearance type	Cab signal
10.	Train Control System	Centralized train control system comprising ATP, ATO + TASC
11.	Telecommunication System	Integrated system with fiber optic transmission and train radio, centralized clock system, closed circuit television, PA system, Passenger Information Display System Digital train radio and N.P SCADA on stations & control telephones
12.	Fare Collection System	Automatic fare collection system with Automatic Entry/Exit gates, staff operated booking office machines, Ticket Vending Machine and contact less smart card and token based tickets
13.	Ventilation & Air-conditioning for underground	
a	Maximum permissible temperature at station	Concourse, Platform : 29 ℃DB,55-65 % (RH) Back office : 27℃ DB, 55% (RH) Equipment Room : 24℃DB, 65% (RH) Other Rooms : Mechanical Ventilation only
b.	Maximum temperature in running tunnel	Natural and mechanical Ventilation only
c.	Maximum relative humidity inside tunnel	Taking fresh air from Outside only
d.	Partial re-circulation of conditioned air	No specific control

Source: JICA Study Team

A stable electric power supply for the railway system is the most important issue. The Study Team investigated the electric circumstances and electric facility plan in Java Island and Jakarta District, as stated in Section 4.2.4.

The following merits are obtained with specific unification between the systems of MRT East-West and North-South Lines:

(1) Management of the Two Lines by MRTJ Becomes Easier

As a concrete example, the unification of the signaling system brings a common operations control rule. Moreover, the operational flexibility of crew between the two lines increases. The signaling system in MRT North-South Line is a cab signal system and a moving block system. Therefore, the operations method is the same as that in MRT North-South Line. It means that there is no longer a need to prepare another operations control rule, and that the initial cost would decrease.

(2) Common maintainability

The identification of traction power voltage (1500 V DC) brings common maintenance regulation. It means that the spare parts and units are common and can be shared mutually between MRT North-South and East-West Lines.

(3) Unification of OCC

Traffic confusion and interruption of operations in one line affects the other line due to the intersection between MRT East-West and North-South Lines. Quick traffic adjustment between the two lines would be possible if traffic managements of both lines are done in one control center. In addition, it is possible to use a common transportation scheduling system.

(4) Seamless transition with common specification of AFC card system

The common specifications of the AFC card system bring not only better service, but also the integrated management of revenue income between both lines.

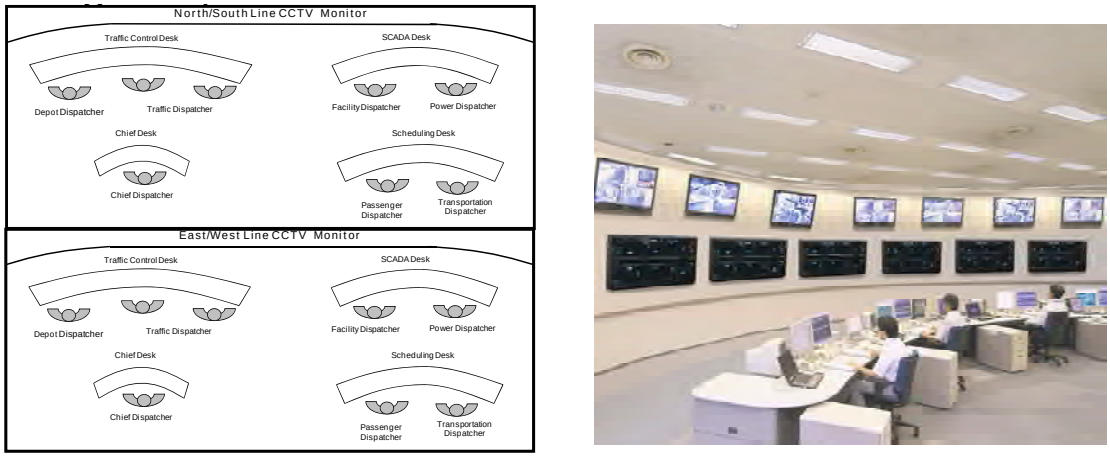
4.7.1 Traffic Control

Traffic control of the entire MRT East-West Line is performed the same to that of MRT North-South Line. It is desirable to control in the same room because of the necessity of traffic adjustment between the two lines when an emergency condition such as traffic confusion occurs.

The JICA Study Team recommended providing an OCC control room for MRT East-West Line in Lebak Bulus Depot where the OCC control room for MRT North-South Line is being planned. In addition, JICA recommended gathering the depot dispatcher in the same OCC control room as there is close relationship between the main line traffic and shipping from/to the depot.

The conference about providing OCC for MRT East-West Line in Lebak Bulus is required because the review of planned dimensions of the OCC control room of MRT North-South Line is needed.

Moreover, an image and layout of the OCC control room are shown in Figure 4.7-2.



Source: JICA Study Team

Figure 4.7-2 OCC Control Room

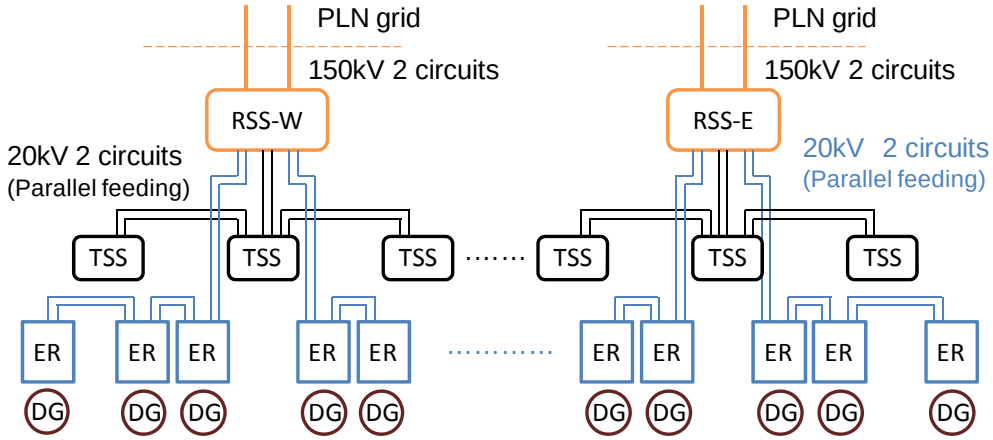
4.7.2 Power supply

The 150 kV RSS for MRT East-West Line is installed along MRT North-South Line in order to receive from the commercial power grid. Two RSSs are required in the Phase 1 section because of voltage compensation to supply power to the TSS and ER.

The locations and power receiving route of the RSSs should be determined based on the candidate sites and estimated power consumption in train operations and station facilities proposed by the JICA Study Team under mutual understanding with PLN through meetings.

In general, TSSs are installed at an interval of 4 to 5 km. Therefore, five to seven TSSs were estimated to be installed for the Phase 1 of MRT East-West Line. The number of TSSs will be determined through the voltage drop study based on the operations plan.

ER will be installed at each station for the power supply to station facilities. Moreover emergency generator will be installed in each underground station. The outline of the power supply system for the Phase 1 of MRT East-West Line (Phase 1) is shown in Figure 4.7-3.



RSS: Receiving Substation
TSS: Traction Substation
ER: Electric Room(for distribution to station facilities)
DG: Diesel Generator (for emergency)

Source: JICA Study Team

Figure 4.7-3 The outline of power supply system

4.7.3 Depot

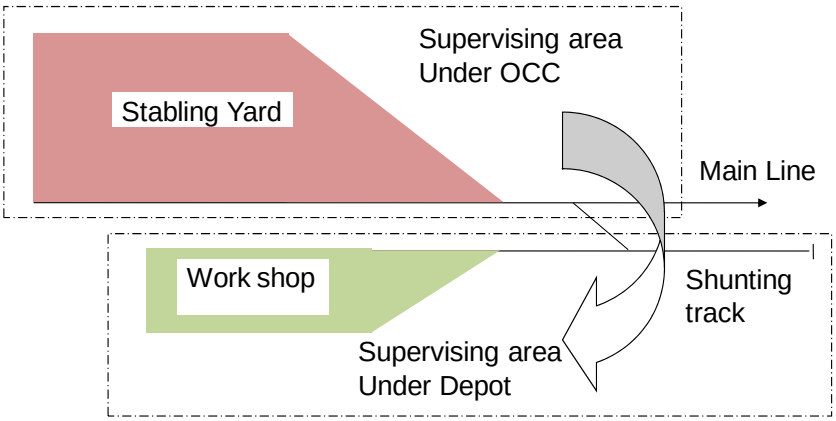
In Ujung Menteng, the depot with stabling yard and workshop is planned. The planned depot track layout is shown in Figure 4.7-4 and Figure 4.7-5.

Source: JICA Study Team

Figure 4.7-4 Ujung Menteng Depot

The operations of shipping between the stabling yard and the main line are performed with cab signaling. Such operations are controlled in the OCC. Shunting operations between the stabling yard and the workshop are controlled locally by signal staff in the depot control room (DCR) installed in each depot area. Therefore, the controlling authority of the stabling yard can shift to DCR from the OCC.

Supervision in the depot is shown in Figure 4.7-5.



Stabling yard authority is shifted to Depot authority only when shunting between Stabling yard and workshop.

Source: JICA Study Team

Figure 4.7-5 Supervision in the Depot

4.7.4 Connecting Line between MRT East-West and North-South Lines

The connecting line is considered from the view of signaling.

Assumption

- Maintenance works are carried out at night after the revenue operations are done until it begins again.
- The maintenance car is operated with radio communication between the maintenance car driver and the OCC. The driver will use a handy transceiver.
- In turnout, the existing station operation for the maintenance car is carried out as follows.
- In the OCC control room, the OCC staff will set the ATP route and this staff will confirm its route as shown on the video display terminal.
- Thereafter, the OCC staff using radio communication will tell if the route is finished for opening to the maintenance car driver.

Based on the above assumptions, the following operations will be carried out at the connecting line:

1) Providing the crossover line at MRT North-South Line side of the connecting line so that operations in all directions are possible to operate.
2) In case of passing on connecting line, both dispatchers of MRT North-South and East-West Lines cooperate to set the route for the maintenance car.
3) A computerized interlocking system (CIL) will be provided at Sarinah Station including the crossover line.
4) The CIL at Thamrin Station of MRT East-West Line should be interfaced with the CIL at Sarinah Station of MRT North-South Line.
5) The route passing the connecting line should be controlled and locked with each signaling system provided in Thamrin and Sarinah Stations at the division of the center of the connecting line
6) When passing the connecting line, communications between the two dispatchers should be protected. Therefore, safe operations should be secured by providing check and lock function in each CIL.
7) Since the revenue operations of MRT North-South Line begin faster than that of MRT East-West Line, when planning MRT North-South Line, the interface between MRT North-South and East-West Lines should be considered.
8) Train mounting ATP is not operated through the connecting line since it will be used only for maintenance purpose.
9) The track layout drawing and route table of MRT North-South and East-West Lines are shown in Appendix

4.7.5 Platform Screen Doors (PSDs)

(1) Features of Platform Screen Doors (PSDs)

There are features brought as advantages due to an introduction of Platform Screen Doors (hereinafter referred to as PSDs) as follows.

1) Prevent passengers on the platform from falling down the track, therefore decreasing the

probability of a delay due to such incident of falling down,

2) Minimize the number of station staff and train crew which are deployed in order to secure safety on the platform, and

3) Efficiently and economically save energy from air-conditioning in case full-height PSDs are installed in underground stations. (PSDs can save about 40% of energy consumption.)

On the other hand, the following are the disadvantages of installing PSDs:

4) Increase of initial cost including signaling and telecommunications in relation to PSDs,

5) Difficulty in reinstalling PSDs in accordance with the number of doors and intervals between the doors of a newly provided rolling stock, and

6) No international standards regarding the reliability of PSDs. (The reliability of PSDs that were applied to MRT has to be considered).

It was proposed for PSDs to be introduced to MRT North-South Line with consideration to the comfort, safety and efficiency of public transportation, even though there are some disadvantages.

It is proposed in this study that MRTJ, the operator of MRT North-South Line, will also operate MRT East-West Line. Furthermore, the systems applied to MRT North-South Line are also expected to be adapted to MRT East-West Line with consideration to the convenience and efficiency of both the MRT operations and passengers. Thus, it is proposed that PSDs will be introduced to MRT East-West Line same as MRT North-South Line. The introduction of PSDs was considered based on the station layout and track layout of MRT East-West Line.

(2) Basic Concept of PSDs Installed in MRT East-West Line

In consideration of the PSDs proposed at MRT North-South Line, it was considered to introduce such in accordance with the conditions of MRT East-West Line.

1) Type of PSDs

i) Full-height and half-height PSDs
There are two types of PSD systems: 1) full-height PSDs and 2) half-height PSDs. In MRT North-South Line, half-height PSDs were proposed to be applied to the elevated stations in consideration of passenger safety and reduction of station staff and crew based on the safety of PSDs. On the other hand, full-height PSDs were proposed to be applied to the underground stations in consideration of the energy that can be saved from air conditioners in addition to the above.

It was considered that MRT East-West Line will also adopt full-height PSDs in the underground stations, and half-height PSDs in the elevated stations based on the same considerations of MRT North-South Line. It was proposed that a train set includes six passenger cars, and each passenger car has four doors. Thus, both types of PSDs will be installed in the underground and elevated stations in accordance with the number of the cars' doors and their location.

ii) Conditions related to the installation of PSDs
The composition of PSDs system depends on: 1) the station structure, e.g., island platform and opposite platform, 2) the number of platforms where passengers get on/off, and 3) the station where bi-directional operations is considered. The features of each station that influence the conditions on installing the PSD systems are mentioned in Table 4.7-2, Table 4.7-3, Table 4.7-4 and Table 4.7-5.

Table 4.7-2 Features of each station in Stage 1 of Phase 1 (between Kalideres and Cempaka Baru)

No.	Station	Elevated/ Underground	Station Structure	Direction of Operation
1	Kalideres	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
2	Rawabuaya	Elevated	2 platforms/4 tracks, island platform	A bi-direction operation is not conducted.
3	Kembangan2	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
4	Kembangan1	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
5	Pesing	Elevated	1 platforms/2 tracks, island platform	A bi-direction operation is not conducted.
6	Grogol	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
7	Roxy	Underground	1 platforms/2 tracks, island platform	A bi-direction operation is not conducted.
8	Petojo	Underground	1 platforms/2 tracks, island platform	A bi-direction operation is not conducted.
9	Cideng	Underground	1 platforms/2 tracks, island platform	A bi-direction operation is not conducted.
10	Thamrin	Underground	2 platforms/2 tracks, opposite platform	A bi-direction operation is conducted in one track.
11	Kebon Sirih	Underground	1 platforms/2 tracks, island platform	A bi-direction operation is not conducted.
12	Kwitang	Underground	1 platforms/2 tracks, island platform	A bi-direction operation is not conducted.
13	Seneng	Underground	1 platforms/2 tracks, island platform	A bi-direction operation is not conducted.
14	Galur	Underground	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
15	Cempaka Baru	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.

Source: JICA Study Team

Table 4.7-3 Features of each station in Stage 1 of Phase 1 (between Cempaka Baru and Ujung Menteng)

No.	Station	Elevated/ Underground	Station Structure	Direction of Operation
1	Sumur Batu	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
2	Kelapa Gading Barat	Elevated	2 platforms/4 tracks, opposite platform	A bi-direction operation is conducted in two tracks.
3	Kelapa Gading Timur	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
4	Perintis	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
5	Pulo Gadungs	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is conducted in two tracks.
6	Penggilingan	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
7	Cakung Barat	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
8	Pulo Gebang	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
9	Ujung Menteng	Elevated	2 platforms/4 tracks, opposite platform	A bi-direction operation is conducted in four tracks.

Source：JICAStudy Team

Table 4.7-4 Features of Each Station in Phase 2 (Between Balaraja and Polis)

No.	Station	Elevated/ Underground	Station Structure	Direction of Operation
1	Balaraja	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is conducted in two tracks.
2	Talagasari	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
3	Cibadak	Elevated	2 platforms/2 tracks,	A bi-direction operation is not

No.	Station	Elevated/ Underground	Station Structure	Direction of Operation
			opposite platform	conducted.
4	Pasir Gadung	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is conducted in two tracks.
5	Bunder	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
6	Kadu	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
7	Perumanas2	Elevated	2 platforms/4 tracks, opposite platform	A bi-direction operation is conducted in four tracks.
8	Panunggangan	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
9	Karawaci	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
10	Cikokol	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
11	Tanah Tinggi	Elevated	2 platforms/4 tracks, opposite platform	A bi-direction operation is conducted in four tracks.
12	Batu Ceper	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
13	Polis	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.

Source: JICAStudy Team

Table 4.7-5 Features of Each Station in Phase 2 (Between Medan Satria and Cikarang)

No.	Station	Elevated/ Underground	Station Structure	Direction of Operation
1	Medan Satria	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
2	Harapan Jaya	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
3	Perwira	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
4	Harapan Baru	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
5	Teluk Pucung	Elevated	2 platforms/4 tracks, opposite platform	A bi-direction operation is conducted in two tracks.
6	Sumberjaya	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
7	Sasakbakin	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
8	Sukajaya	Elevated	2 platforms/2 tracks, opposite platform	A bi-direction operation is not conducted.
9	Cikarang	Elevated	2 platforms/4 tracks, opposite platform	A bi-direction operation is conducted in four tracks.

Source: JICA Study Team

2) Composition of PSDs Systems

① Required systems for connecting the signaling system, communications system and rolling stock

It is required to connect the signaling system, communications system and rolling stock in order to operate the PSD system. At least the following systems are required to coordinate with the PSD system, signaling system, communications system and rolling stock:

- Signaling system and rolling stock
  Train automatic stopping controller (TASC): part of the automatic train operation (ATO) system, onboard antenna
- Communications system and rolling stock
  Closed-circuit television (CCTV) system

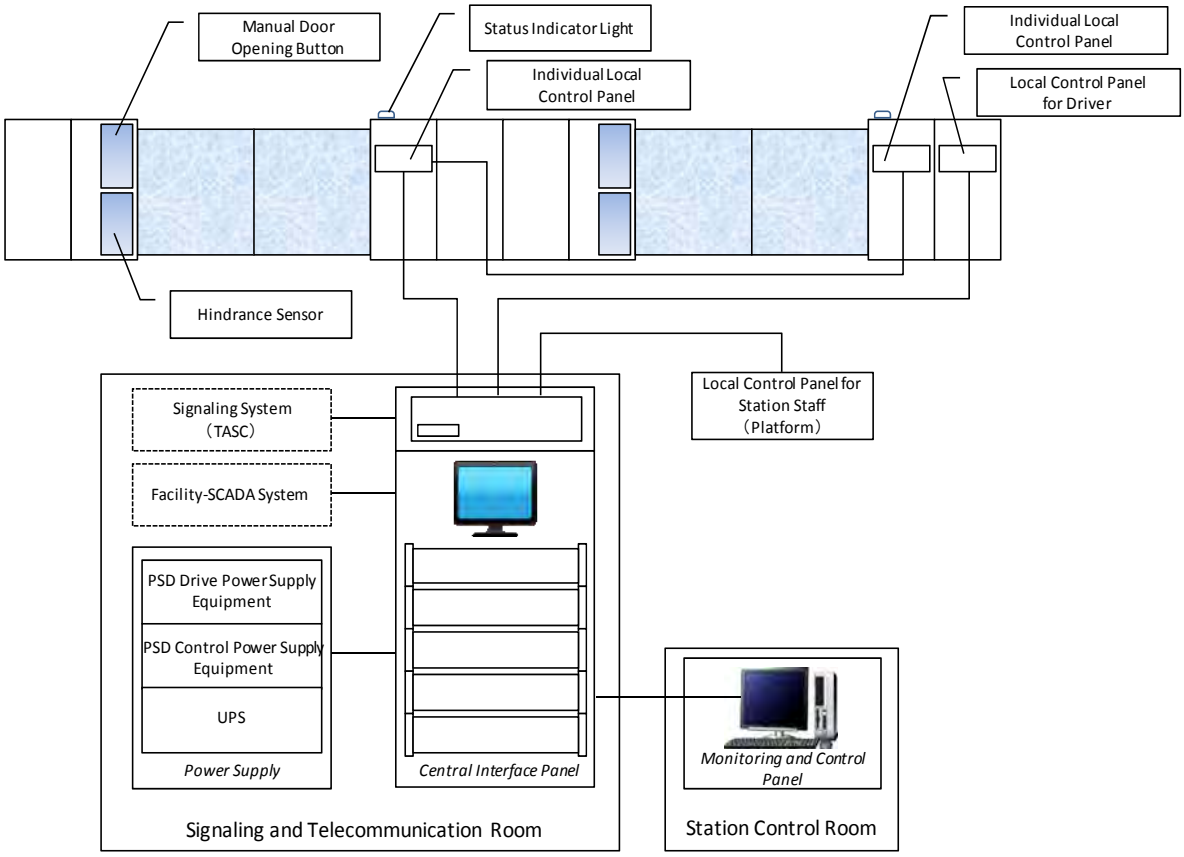
② System structure of PSDs

In addition to the signaling, communication and rolling stock systems mentioned

above, the following are required for the PSD system:

- Fixed screen and sliding screen door (full-height and half-height)
- Exit and entrance door for driving cabin with a suitable locking system
- Individual and integrated control and monitoring system for driver and station staff
- Safety system with sensors, alarms and indicators
- Power supply system including uninterruptible power supply (UPS)

The system structure based on the composition of the PSD system is shown in Figure 4.7-6.



Source: JICA Study Team

Figure 4.7-6 System Structure of PSDs

4.7.6 Automatic Fare Collection (AFC) System

(1) Features of Automatic Fare Collection (AFC) System

An AFC system enables the efficient management of not only fare collection, but also OD data of passengers, the number of passengers during peak hours, the amount of passengers at each station per day, and other related information on passengers. Moreover, it can facilitate to provide effective service to passengers at the present and in the future based on the analysis of collected data from the AFC system.

It was already proposed to introduce the AFC system in MRT North-South Line. Meanwhile, it is proposed in this study that MRTJ operate MRT East-West Line, and it was planned for the transfer of passengers of MRT North-South and East-West Lines at Thamrin Station. Thus, it is recommended to introduce the same system applied to MRT North-South Line into MRT East-West Line in consideration of the convenience and efficiency of MRTJ's operations and easy access of passengers.

Therefore, it is proposed that the AFC system is also introduced to MRT East-West Line similar to MRT North-South Line. Hereafter, the introduction of the AFC system was considered in accordance with the number of stations and the required conditions of MRT East-West Line.

(2) Basic Concept of Automatic Fare Collection (AFC) system installed in East-West Line

In consideration of the AFC system proposed to MRT North-South Line, it was considered to introduce it in accordance with the conditions of MRT East-West Line.

1) Ticket

① Ticket Media (IC token/IC card)

It was proposed that an IC token and IC card be introduced to MRT North-South Line as ticket media. Both of them are contactless type. On the other hand, a magnetic ticket was not considered. The advantages of the features that brought about the introduction of the AFC system are the following: 1) high security, 2) flexible expandability, 3) fast processing speed at an automatic gate, and 4) low environmental impact by recycling. Therefore based on the abovementioned, it was also considered to introduce the IC token and IC card to MRT East-West Line. It was expected that the passengers of MRT North-South and East-West Lines can experience the advantages and convenience of using the AFC system.

② Ticket Type

The ticket type proposed for MRT North-South Line is classified into the following two types: 1) normal passenger ticket, and 2) other ticket (for staff and test). It was considered to adopt the same ticket type as the one proposed in MRT North-South Line. The features of the ticket types are discussed in Table 4.7-6.

Table 4.7-6 Features of Ticket Type

Passenger Ticket		
	Single Journey Ticket	The fare for a single journey ticket is subtracted from a value stored in the single journey ticket at an exit gate. In case the ticket media is card type, an amount with the upper limit determined in advance can be stored in the ticket. On the other hand, a token type ticket can store a value of single journey in accordance with traveling distance and collected at an exit gate. In order to top up a value with an IC ticket, ticket vending machine (TVM), ticket office machine (TOM) and fare adjustment machine (FAM) are available. The IC card is issued with a pre-determined amount on deposit. The deposit can be returned to passengers in case the card is returned at the TVM and TOM.
	Day Ticket	A day ticket is valid for traveling with unlimited number of journeys during the specified period of days. In MRT North-South Line, a 1-day ticket and a 3-day ticket were proposed. It was considered to introduce the two types of tickets in MRT East-West Line as the day ticket. Moreover, it was considered to adopt IC card as the media of the day ticket same as in MRT North-South Line. The IC card is also issued with a pre-determined amount of deposit. The deposit can be returned to passengers in case the card is returned at the TVM and TOM.
	Concession Ticket	A concession ticket is issued with a discounted price and valid for traveling for an unlimited number of journeys during a considerably long period. In the commencement of MRT North-South Line operations, it was proposed to introduce a standard concession ticket

Passenger Ticket		
		which is valid for 30 days. It was proposed to introduce a student concession ticket which is valid for 30 days in the extension of the line. Moreover, it was considered to adopt IC card as the media of the concession ticket same as MRT North-South Line. The IC card is also issued with a pre-determined amount of deposit. The deposit can be returned to passengers in case the card is returned at the TVM and TOM.

Source: JICA Study Team

2) Fare of Ticket

In MRT North-South Line, it was proposed for the fare to be in accordance with distance. It was considered to adopt the distance base fare in MRT East-West Line. The fare stages in accordance with distance differ depending on the number of stations which are planned to be constructed in Phases 1 and 2 as follows:

- Phase 1: Maximum of 552 fare stages (24 stations)
- Phase 2: Maximum of 2,070 fare stages (46 stations)

It is needed to determine a fare for all types of tickets mentioned above by MRTJ before the software of the AFC system is developed.

3) Ticketing Conditions

In case of selling an IC ticket, the following conditions should be defined clearly:

- Ticket type, fare of each type of ticket, validity of each type of ticket
- Issuing and refunding conditions (including an amount of deposit and handling fee)
- Penalty conditions

In MRT North-South Line, it was proposed that the minimum conditions which MRTJ should determine are the following: 1) amount of deposit applied when a stored fare ticket is issued, 2) amount of deposit refunded when the ticket is returned, 3) amount of handling fee deducted when the ticket is returned, and 4) validity of each type of ticket. It was considered that the ticketing conditions of MRT East-West Line will follow the ones mentioned above.

4) Required Functions for IC ticket

The following are the two international standards for an IC chip applied to contactless IC media: 1) ISO/IEC 14443 (Type A and Type B) and 2) ISO/IEC 18092 (NFC, called as Type C). For the AFC system introduced to the railway, Type A based on ISO/IEC 14443 and Type C based on ISO/IEC 18092 were mainly adopted. Actually, an IC chip in accordance with the standard mentioned above is mounted on an IC ticket.

An IC card requires high security because it is considered to store an amount of money with a pre-determined limit. On the other hand, high security is not required for the IC token because it is a single journey ticket which is not considered to store some value of money.

In consideration of the performance, features and security mentioned above, it was proposed to adopt an IC card mounting FeliCa II which is an IC chip complied with ISO/IEC 18092 (NFC, called as Type C). As for the IC token, Mifare DES Fire MF31CD8101 which is an IC chip complied with ISO/IEC 14443 (Type A) was proposed to be mounted in it.

In consideration of the IC media proposed in MRT North-South Line and interoperability between MRT North-South and East-West Lines, it was proposed to adopt an IC card mounting FeliCa II complied with ISO/IEC 18092 (NFC, called as Type C) and an IC token mounting Mifare DES Fire MF31CD8101 complied with ISO/IEC 14443 (Type A). In addition, a reader/writer equipped on AFC gate was proposed to be a multi-type so that it can

read and re-write fare information recorded in any IC chip. A comparison of IC chips by media wise is shown in Table 4.7-7 and Table 4.7-8.

Table 4.7-7 Comparison of IC Chip for IC Card

Item	Mifare DES Fire MF3ICD8101	FeliCa II
Data Capacity	8kB	9kB
Type of Memory	EPROM	FRAM
Transmission Speed	106/212/424/(848) kbps *（Maximum speed: already）	212/424/(848) kbps *（Able to improve in the future）
Maximum Data Read/Write at once	–	Read：12 blocks (192 byte) Write：11 blocks (176 byte)
Data Layers	2 Layers	8 Layers
Data Retention	5000,000*1	10,000,000,000*2
Communication Speed	106 kbps~	212 kbps~
Security Certificate	–	Hardware：ISO/IEC 15408 EAL4+ Composite：EAL4

*1：Mifare DES Fire 4k, *2：Felica 4k Source: JICA Study Team

Table 4.7-8 Comparison of IC Chip for IC Token

Item	Mifare Ultra light （Type-A）	FeliCa token （Type-C）
Data Capacity	512 bit (64 byte)	576 byte
Type of Memory	EEPROM	EEPROM
Transmission Speed	106 kbps	212 kbps
Maximum Data Read/Write at once	Read：16 byte Write： 4 byte	Read：16 byte Write：16 byte
Security Certificate	–	–
Duration	10,000 times write/5 years	50,000 times write/7 years

Source: JICA Study Team

5) Automatic Gate

An automatic gate which is to be adapted in the railway station can be classified into following three types: 1) flap-door type, 2) retractable-door type, and 3) turnstile-door type. In MRT North-South Line, it was proposed to introduce the flap-door type for the automatic gate because it can provide a high processing speed, minimize the space of installing, and secure the highest safety in case passengers, especially old persons, pregnant women and children, get caught in the door.

In MRT East-West Line, it was proposed to introduce the flap-door type for the automatic gate in consideration of the safety and convenience it can provide to passengers and the interoperability between MRT North-South and East-West Lines. A comparison of features of the three types of automatic gates is shown in Table 4.7-9.

Table 4.7-9 Comparison of Automatic Gates

Item	Flap-door	Retractable-door	Turnstile-door
Processing Speed	60 passengers/minute	40 passengers/minute	30 passengers/minute
Width of Machine	200mm	300mm	300mm
Protection Performance	Weak compared with others	Strong	Excellent
Passenger Safety	High	There is a possibility that passengers got caught in the doors.	Good

Source: JICA Study Team

6) Ticket Vending Machine (TVM) and Fare Adjustment Machine (FAM)

It can be expected that the introduction of TVMs and FAMs will be able to minimize the number of station staff and station space. Although TVM and FAM can provide the advantages mentioned above, they require the functions of differentiating bank notes and coins, distinguishing insufficient fare, and giving change as necessary. At present, it has not been confirmed that TVM and FAM with the functions mentioned above were introduced in Indonesia. In the study of MRT North-South Line, a manufacture survey of TVM and FAM was conducted. From the results of the survey, it was confirmed though that a validator, which can be used for all types of bank notes and coins in Indonesia, was developed but was not yet used practically. In consideration of the conditions of TVM and FAM mentioned above, it was proposed to sell tickets by station staff operations at the ticket office machine (TOM) in the commencement year of MRT North-South Line (2017) and to introduce TVM and FAM at each station in an experimental study. Moreover, it was proposed to sell tickets with TVM and FAM mainly in 2024 when the AFC system will be replaced.

On the other hand, the operations of MRT East-West Line will be started in 2020. In consideration of introducing TVM and FAM to MRT North-South Line as the experimental study in 2017, it can be expected to practically use TVM and FAM in 2020. In 2024, it was proposed to adopt TVM and FAM mainly in order to sell tickets in MRT North-South Line.

In consideration of the above conditions, it was considered to introduce TVM and AFM to MRT East-West Line since the commencement of the line.

7) Introduction of Multi Purpose IC card

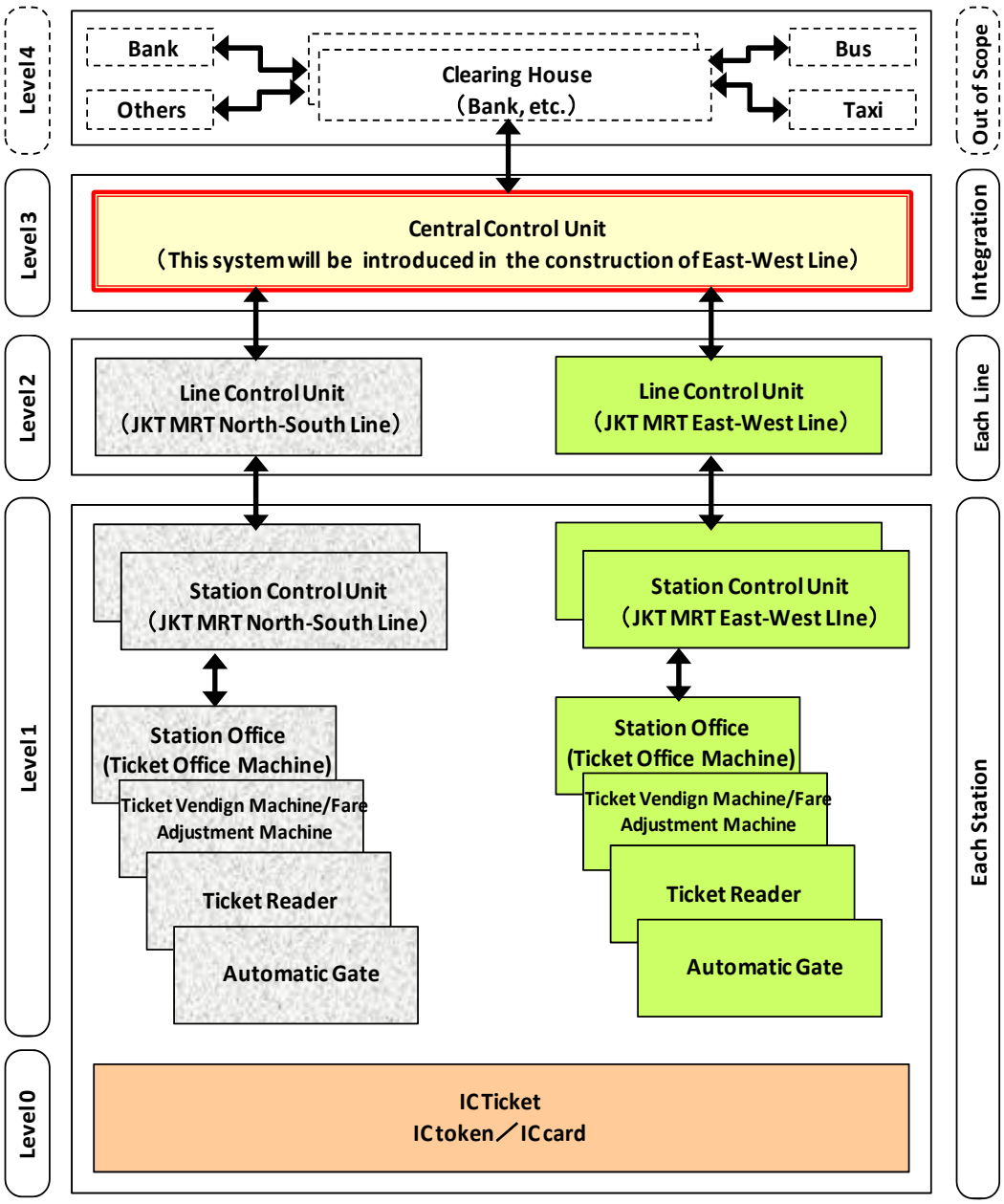
It was planned to introduce a multi-purpose IC card to TransJakarta and JABODETABEK Railways. Bank Indonesia will select a single IC platform including IC card for multi-purpose usage in 2011. On the other hand, the concept of introducing the AFC system including IC card in MRT North-South Line is to be referred to a mature and proven system. On the basis of the concept, it was proposed to introduce an IC card (IEC/ISO18092：FeliCa) for the purpose of passenger ticket in Phase 1, and a multi-purpose IC card in Phase 2 when MRT North-South Line will be extended. In order to introduce the multi-purpose IC card in Phase 2, it is required to introduce multi-R/W (reader/writer) with multi-SAM (security access module) in Phase 1.

Using the IC card (IEC/ISO18092：FeliCa) for the purpose of passenger ticket and multi-R/W with multi-SAM, in order to minimize the cost of introducing a multi-purpose IC in the future on the basis of the above concept, was considered.

(3) Integration between AFC Systems introduced in North-South Line and East-West Line

The AFC system proposed in MRT North-South Line was considered to be integrated with the AFC system installed in MRT East-West Line using minimal investment. It was proposed that the AFC system of MRT North-South Line be composed of the following five levels:

ii). Level 0 (IC ticket media)
iii). Level 1 (Station control unit)
iv). Level 2 (Line control unit)
v). Level 3 (Central control unit)
vi). Level 4 (Clearing house: out of scope of both MRT North-South and East-West Lines)



Source: JICA Study Team

Figure 4.7-7 System Structure of AFC

Levels 0, 1 and 2 were considered as the system structure of MRT North-South Line because there were no other MRT systems to integrate with before. However, there will be two MRT systems due to the addition of MRT East-West Line. Therefore, the integration of the AFC systems introduced in both MRT lines is needed for MRTJ, which is the operator of both lines, in order to manage them efficiently and effectively. In order to integrate the two AFC systems, system structure Level 3 (central control unit) is required. Hereafter, the system structure Level 3 (central control unit) required for the integration of the AFC systems is considered as discussed below.

When the integration of the AFC systems of both MRT North-South and East-West Lines will be conducted, the AFC system of MRT North-South Line is still under its usual operations. In order to integrate the two AFC systems, there is a need to consider the common management system of the two lines. The management system includes the following: 1) operational management, 2) administrative management, 3) ticket management, 4) maintenance management, and 5) security management. Hereafter, it was considered to manage the station

staff and maintenance staff in each line and establish the management system which has the following functions:

1) Line Control Unit (Level 2)

i). Operational management: management of AFC operations in each line, and control of communicating with the central control unit (Level 3)
ii). Administrative management: management of AFC administrative information in each line, and control of set-up operations from the central control unit (Level 3)
iii). Ticket management: management of stock, usage and collection of tickets
iv). Maintenance management: management of maintenance of the line control unit
v). Security management: management of system security with the central control unit (Level 3)

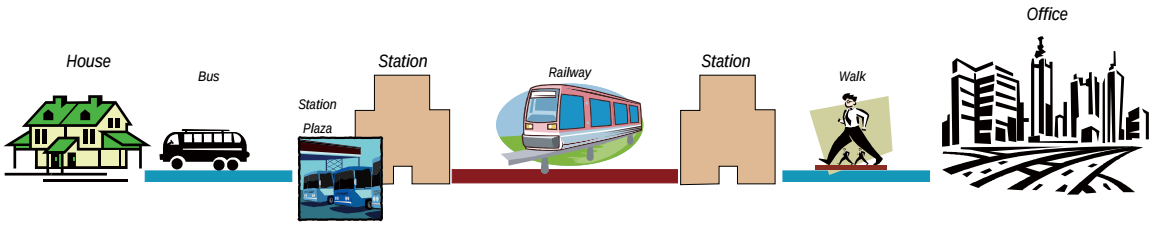
2) Central Control Unit (Level 3)

i). Operational management: intensive management of AFC operations (integration of information from both MRT North-South and East-West Lines)
ii). Administrative management: intensive management of set-up control for line, fare, blacklist, etc..
iii). Ticket management: intensive management of provision, set-up and stock of tickets
iv). Maintenance management: intensive management of the AFC system mode (normal mode/emergency mode)
v). Security management: intensive management of security
vi). External interface: provision of interface with an external system, e.g., enterprise resource planning (ERP) system.

4.8 Development Plan Around Stations

4.8.1 Example of Intermodal Transfer Facility

Generally, traffic movement consists of a number of modes of transportation, and causes the connection with other transport modes. For example as shown in Figure 4.8-1, there are two connections with other transport modes such transferring from bus to railway and from railway to walking.



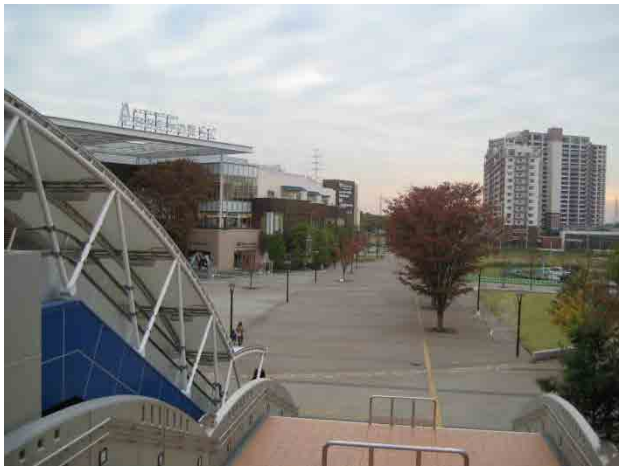
Source: JICA Study Team

Figure 4.8-1 Traffic Movement

It is important to provide not only the good railway system, but also the intermodal transfer facility for connecting with the other transport modes in terms of allowing permanent use by citizens as a Mass Rapid Transit. The case example of intermodal transfer facility in Japan or other countries is described as bellow.

Large-Scale Development Around Stations

It is necessary to provide not only the development around the station in the center of the city, but also the function as a terminal with a certain size in suburb areas in order to protect the influx of private cars to the central area. In case of the development in the center of the city, a new development proposal which is a formulation of a town hub following the existing plan is desired. It is also important to make an effective utilization of the limited land of a central city. In case of the development in the suburb area, it is important to keep the land to install an intermodal transfer facility including bus stops, taxi pool areas and parking lot spaces (park and ride system) in the stage of railway construction. This is because consolidating in this area the existing traffic volume from suburb areas to the center of the city is the effective and durable resolution for lessening traffic jams in the central city. Figure 4.8-2 is a case example of the development for "Tukuba-Expressway" in Japan. This development case includes the function of intermodal transfer, commercial use and residential use.



Source: JICA Study Team

Figure 4.8-2 Case example of Development in suburb area (Otakanomori St. , Tsukuba-Expressway, Japan)

Smooth Intermodal Transfer Facility

It is important to consider the facility where railway passengers can smoothly connect with other transport modes. If the resistance of connection between railway and other transport modes is improved, the passengers of MRT East-West Line would increase. In general, the resistance of connection with other transport modes would occur due to the following cases:

- The frequency of moving up and down is high, and
- The distance of walking from the station to the stop of other transport modes is more than 200 m.

If there are a number of operation organizations for public transportation, such as for railway and bus companies, it would be possible that the intermodal transfer facility is not an attractive space for passengers. In case of an over-track station, when railway passengers get off the train, it is possible that they have a number of opportunities of traveling up and down. For example, there is a wide road between the railway station and the station plaza. In case that there is a pedestrian bridge from the concourse level to the bus stop, the passenger will smoothly reach one time of moving down after going through the concourse. Otherwise, two times of moving down and one time of moving up will occur if there is no pedestrian bridge between the station building and the station plaza. There is another case that passengers getting off the train cannot directly access the station plaza. Passengers need to walk a long way around the station plaza. The way to solve this problem is as follows:

- Pedestrian deck and bridge, named "Skywalk" in Bangkok, and
- Pedestrian bridge connected with the railway station and bus terminal in Okinawa City, Japan.

Pedestrian Deck under Viaduct, BTS in Bangkok, Thailand	**Pedestrian Deck Between Station and Bus Terminal, Monorail in Okinawa, Japan**
	
It is possible for passengers to smoothly connect with their destination after getting off the train. Also, a pedestrian bridge is installed for direct access between the deck and the commercial building. This is an integrated development area between transportation and commercial use.	It is possible for passengers getting off the train to connect to the bus terminal, taxi pool and commercial building. There are direct connections, by escalator or elevator, between the pedestrian bridge and the bus terminal. This is adopted from the viewpoint of "universal design"

Source: JICA Study Team

Figure 4.8-3 Case example of smooth Intermodal Transfer Facility

Station Plaza Design

The station plaza plays a role of not only for transfer function, but also for plaza amenities and service function. The required area for a station plaza is determined by summing up the spaces required for the service level and the characteristics around the station. According to the guidelines of the Station Plaza Research Committee of Japan, Figure 4.8-1 shows the methods for the calculation of the necessary space for the station plaza. This is the unit method based on passenger volume.

Table 4.8-1 Estimating the Station Plaza Space by Passenger Volume

x: Passenger volume in target year

	$x \leqq 73{,}000$	**$x > 73{,}000$**
Basic formula	$A=0.119x$	$A=0.0259x+25.09\sqrt{x}$
Maximum necessary area	$A=0.128x$	$A=0.0277x+26.85\sqrt{x}$
Minimum Necessary area	$A=0.0878x$	$A=0.0189x+18.3\sqrt{x}$

Source: The Station Plaza Research Committee of Japan

The design layout of the station plaza will be decided based on the estimated area calculated in the formulas shown in Table 4.8-1. The station plaza plays a role of not only for transfer station, but also plaza amenities and service function. The required area for a station plaza is determined by summing up the spaces required for the service level and the characteristics around the station. According to the guidelines of the Station Plaza Research committee of Japan, Table 4.8-1 shows the methods for the calculation of the necessary space for the station plaza. This is the unit method based on passenger volume.

Case examples of station plazas are shown in Figure 4.8-4. The first case example is a station plaza in a large-scale terminal station, and the other case is a terminal station in the suburbs.

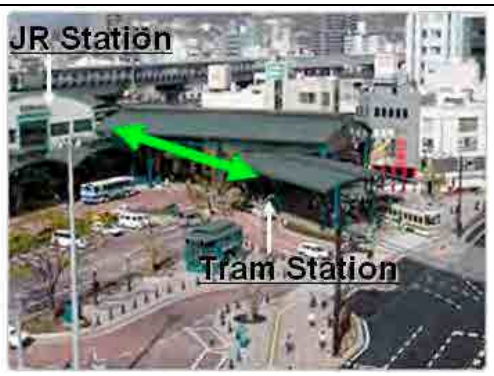
Station Name	Sakuragi-Cho Station	Katakura-Cho Station
Type	Large-Scaled Terminal Station	Suburb Station
Area	12,200 m2	4,500 m2
Passenger / day	276,000 Passengers / day	16,000 Passengers / day
Picture		
Facility	Bus stop : 12 (on a premise; 10) Taxi stop : Yes Private car pool : No	Bus stop : 4 (on a premise; 2) Taxi stop : Yes Private car pool : No

Source: Annual report of city planning, Ministry of Land, Infrastructure, Transport and Tourism, Japan, 2008, Photo by JICA Study Team

Figure 4.8-4 Case example of Station Plaza

Relocation of Existing Station

The Yokogawa Station is the second largest station in urban area of Hiroshima city, Japan. This station is the transfer station between JR Main Line named Sanyo Line and JR Local Line named Kabe Line. The passenger volume is 29,000 passengers /day. The Tram named Yokogawa Line of Hiroshima Electric Railway is also connected with this area, and has passenger volume of 3,000 passengers / day. This station is the terminal station between the north parts of central city to south parts. The front road is national road Line No.54 is the main road of Hiroshima urban area, and have the vehicle volume of 37,000 vehicles / day. Before the improvement of relocation of Tram station, the passengers getting off the train needed crossing of National Road Line No.54, and walking over a long distance from Tram station to JR station. And Tram station was located on the center of the main road. This caused the traffic jam around this area, because of taking sole position of road space. With a goal of the way to solve this problem, the relocation of existing station and the converting the station plaza was conducted. As a result, the Yokogawa station area was Intermodal Transfer Facility satisfied with the demand from the north part of Hiroshima city to central part.

Before (Long Distance for Transfer)	After (Directly connected with Both Stations)
	

Source: JICA Study Team based on website (URL; http://www.hiroden.co.jp/)

Figure 4.8-5 Case Example of Relocation of Existing Station

Utilization under viaduct

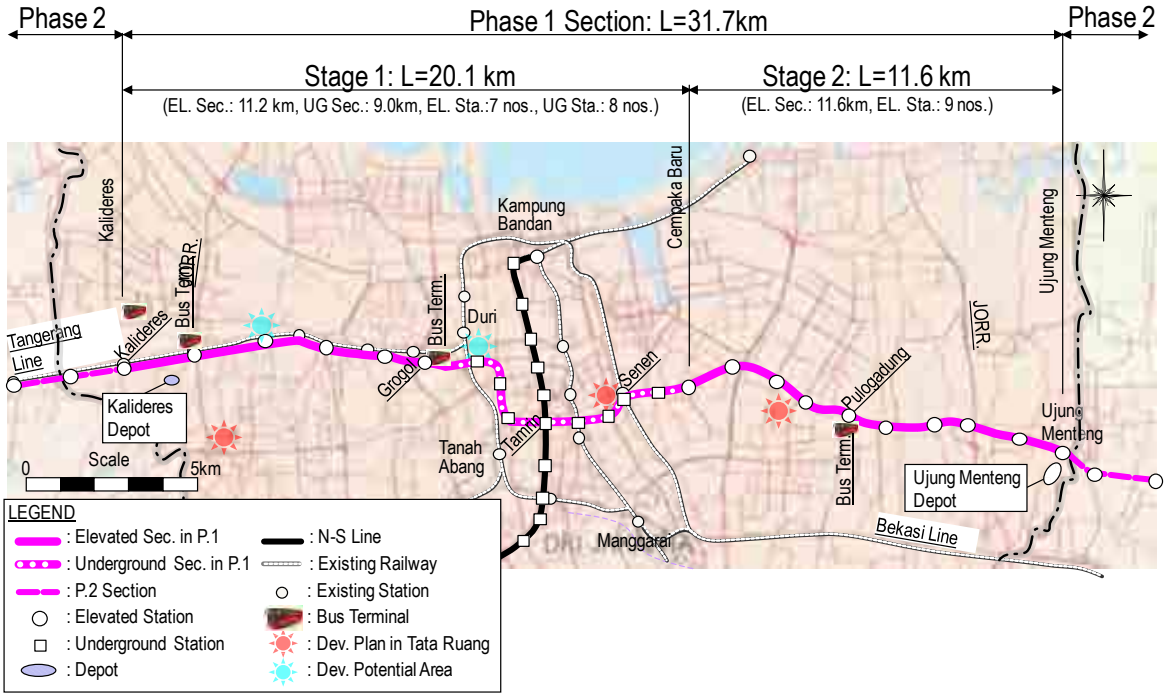
A case example of commercial use under the viaduct of Hinode Station of Keihin Keikyu Line is shown in Figure 4.8-6. There are a lot of cases of utilization of parking lots for cars or bicycles. This is because of the fact that this section keeps only a narrow space between piers. This case has the innovation of spatial division of limited area. This way can provide small-scale spaces for locally-based activities without large-scale development.

Source: Website of Ministry of Land, Infrastructure, Transport and Truism (URL; http://www.mlit.go.jp/)

Figure 4.8-6 Case Example of Commercial Use under Viaduct

4.8.2 Planning of Intermodal Transfer Facility

The location of intermodal transfer facility with large-scale passengers and plan for development is described in Figure 4.8-7.



Source: JICA Study Team

Figure 4.8-7 Location of Intermodal Transfer Facility and Plan for Development

According to the case shown in section 4.8.1 the development method is broken down as shown in Table 4.8-2.

Table 4.8-2 Development Method on each station

Station Name	Large-scaled Development around Station	Smooth Intermodal Transfer Facility	Station Plaza	Relocation of Existing Station	Utilization under viaduct
Kalideress		○			
Rawa Buaya	○	○	○		
Kembangan (2) St.	○		○		
Kembangan (1) St.		○		○	
Grogol St.		○			
Roxy St.	○		○	○	
Thamrin St.		○		○	
Kebon Sirih St.					○
Senen St.	○				
Kelapa Gading Timur St.		○			
Perintis St.		○			

Source: JICA Study Team

The proposed plan for intermodal transfer facility is shown in Table 4.8-3.

Table 4.8-3 Proposed Plan for Intermodal Transfer Facility

Station Name	Connect to	Integration Service	Remarks
1. Kalideres Sta (Elevated St.).	➢ Existing Kalideres Sta. ➢ Kalideres Bus Terminal	● Pedestrian deck between stations ● Improvement of access road to Jl. Daan Mogot	✓ Urge of urban development plan
2. Rawa Buaya Sta. (Elevated St.)	➢ Existing Rawa Buaya Sta. ➢ Rawa Buaya Bus Terminal ➢ Development Potential Area	● Station area development ● Pedestrian deck among stations and development area ● Bus Stop ● Park & Ride	✓ Review of spatial plan by Tata Ruang
3. Kembangan(2) St. (Elevated St.)	➢ New St. on Tangerang Line ➢ Development Potential Area	● Station Plaza ● Bus Terminal ● Park & Ride ● Access way to development area (Pedestrian) ● Access way to Jalan Dann Mogot	✓ New St. on Tangerang Line required
4. Kembangan(1) St. (Elevated St.)	➢ TransJKT Corridor 8	● Connecting Deck and bridge with TransJKT Corridor 8	✓ Bus Terminal (turned-back terminal for Trans JKT Corridor 8)
5. Grogol St. (Elevated St.)	➢ Grogol Bus Terminal ➢ TransJKT Corridor 9	● Connecting Deck or Bridge	
6. Roxy St. (Underground St.)	➢ New St. on Western Line ➢ Developed Potential Area ➢ Shopping Mall	● Connecting Deck and Pedestrian Underpass	✓ New St. on Western Line required
7. Thamrin St. (Underground St.)	➢ Sarinah St. on N-S Line	● Same Concourse and Direct Connection (No Passing Ticketing Gate) ● Combination of Island Platform and Side Platform	✓ Shift Sarinah St. on N-S Line to North side
6. Kebon Sirih St. (Underground St.)	➢ Gondangdia St. on Central Line	● Improvement of Pedestrian	✓ Renovation underneath the elevated railway tracks
8. Senen St. (Underground St.)	➢ Senen St. on Eastern Line ➢ Development Plan Area	● Connecting Pedestrian Underpass	✓ Consideration of development plan approved by Tataluan
9. Kelapa Gading Timur St. (Elevated St.)	➢ Development Plan Area	● Connecting Deck or Bridge	✓ Consideration of re-development plan
10. Perintis St. (Elevated St.)	➢ Pulo Gadung	● Connecting Deck or Bridge	✓ Bus Terminal

Source: JICA Study Team

(1) Kalideres Station

This station is the starting/ending station in the west side of MRT East-West Line. At present, Tangerang Line is being operated and its existing station is located within 500m in the west side of planned station of MRT East-West Line. For the purpose of the smooth transfer between both lines, the horizontal escalator will be installed. Generally speaking, the resistance of connection with other transport modes would occur due to the distance of walking which is more than 200m. In addition, the distance which the passenger wants to walk is up to 400m. In view of these facts, the distance of 500m is judged unsuitable for the connected distance. According to the abovementioned, it is considered good for the new installation of the pedestrian deck including horizontal escalator.

Source: JICA Study Team

Figure 4.8-8 Horizontal Escalator

The bus terminal is located within 1.4km in the north side of planned station. The terminal has the role of the base for the long distance bus and the fixed route bus. The feeder bus from this station to the terminal enables the passenger volume to increase. To realize this plan, the Turn-back Point for feeder bus is to be installed under the pedestrian deck between both lines.

These facilities mentioned above are described as follow.

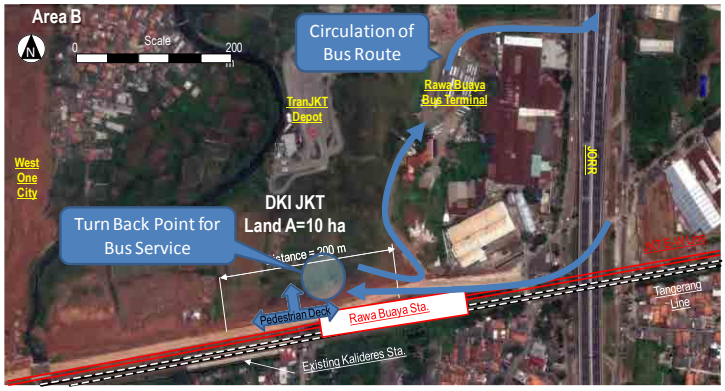
Source: JICA Study Team

Figure 4.8-9 Pedestrian Deck between both lines and Turn-back Point for feeder bus

(2) Rawabuaya Station

The existing bus terminal is located within 350m in the north side of the planned station. In order to utilize the existing bus terminal effectively, the Turn-back Point is to be installed in front of the planned station. In addition, it is necessary to construct the access road between the station and the existing bus terminal for the smooth operation of bus service. This measure has the role of reducing the resistance of connection between the railway service and bus's.

The Turn-back Point is to be located at the land where this area is unused land in the west side of the planned station. The pedestrian deck is to be installed between this transfer facility of bus service and the planned station, which is for direct connection between both services. In addition, the land where the Turn-back Point will be located is owned by local government. It is necessary to have the systematic urban planning for the area around the station. This enables the development potential to catch up.



Source: JICA Study Team

Figure 4.8-10 Turn-back Point for feeder bus including Pedestrian Deck

(3) Kembangan(2) Station

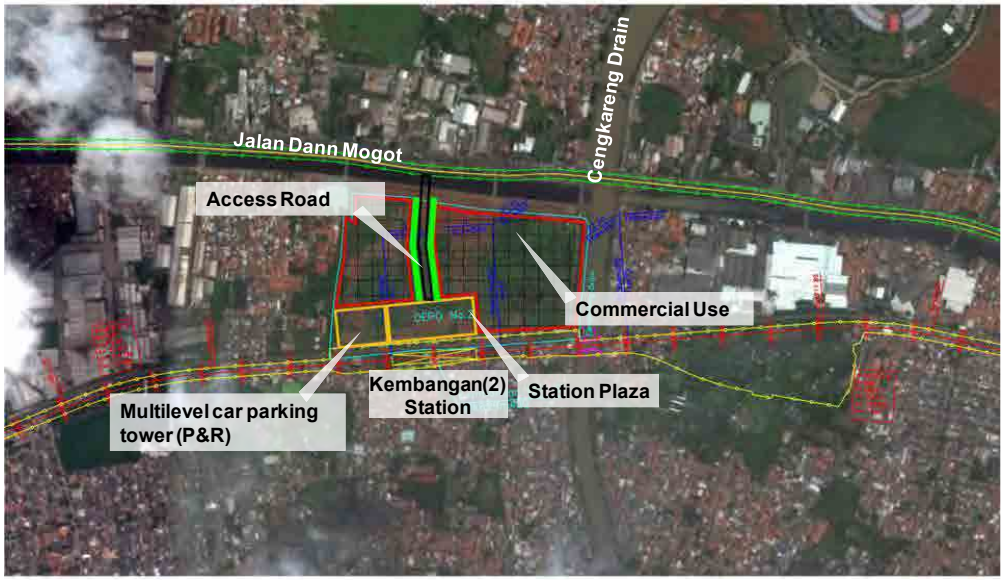
The main road which is named "Jalan Dann Mogot" runs through this area. TransJakarta Line 3 is operated on this road. There are a lot of users from the west of the city to the city center. In addition, the present condition of this location is a vacant land. According to the situation mentioned above, this station is positioned as a terminal station in the west side of MRT East-West Line. In this regard, the JICA Study Team proposed that this station will be filled with people. This station will consist of an intermodal transfer facility between Tangerang Line and MRT East-West Line, including a station plaza and parking lots for park and ride.

According to Dinas Tata Ruang of DKI Jakarta, this plot is owned by PT. Pertamina, a state-owned enterprise often referred to as BUMN, and is classified as a commercial/business area. Since the land belongs to a state-owned enterprise, it is confirmed by Dinas Tata Ruang that the acquisition of this lot will not be difficult and that the planning of the MRT station and development around it can be considered in their spatial plan.

Source: Photo by JICA Study Team

Figure 4.8-11 Present Condition on Kembangan (2) Station

It is necessary to make a plan of the station plaza. The required area for a station plaza is estimated by the unit method based on passenger volume as shown in Table 4.8-1. The required area was guided by the result of this estimation. Within this area, the layout of the station plaza including bus stop, taxi pool and private car pool was decided. In addition, a multilevel parking tower for park and ride was planned. The land in front of this station is owned by PT. Pertamina. It is possible to convert its land use. In this regard, the JICA Study Team proposed in the future that this land will be converted into a business district.



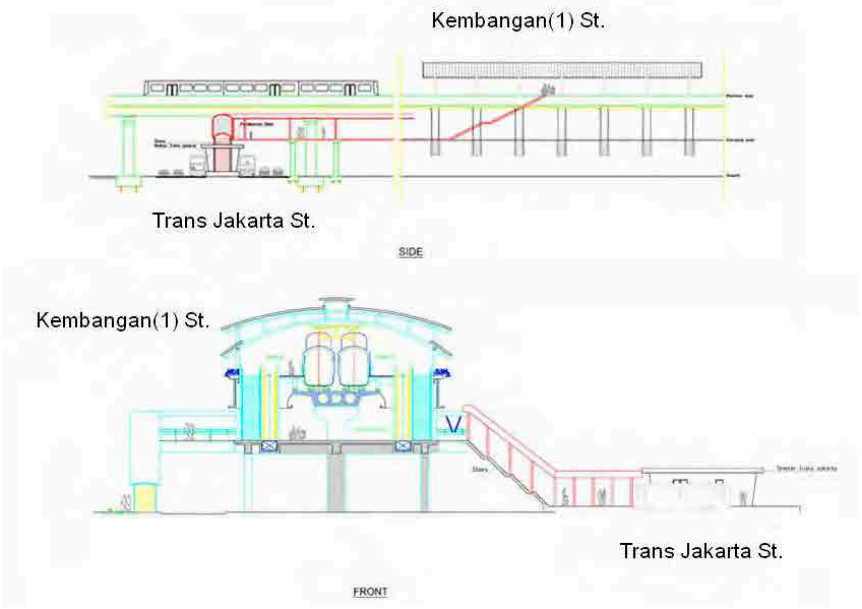
Source: JICA Study Team

Figure 4.8-12 Layout Plan of Kembangan(2) Station

(4) Kembangan(1) Station

This station is put into place on the connection point with "Jalan Parjang" road. TransJakarta Line 8 is operated on this road. It is important that this passenger will be shifted from this TransJakarta to MRT East-West Line. Otherwise, the location of TransJakarta station is far from MRT East-West Line. It is necessary to locate a new station for TransJakarta Line 8, as near as possible to a station of MRT East-West Line. In general, the optimum distance between each BRT station is approximately 300 m to 400 m. According to the abovementioned, it is considered good for the new location of the station.

The JICA Study Team proposed that the pedestrian deck under the viaduct shown in Figure 4.8-3 is installed for smooth connection between the stations of MRT East-West Line and TransJakarta. This enables the passengers to reduce their movement, i.e., going up and down. In addition, as compared with directly transferring without deck, this enables the passengers to reduce the distance of walking.



Source: JICA Study Team

Figure 4.8-13 Pedestrian Deck under the viaduct

The operations of TransJakarta Line 8 from this station to the central city will be replaced the operations of MRT East-West Line. This means that the turn area of TransJakarta Line 8 will be needed. In order to respond to this situation, the existing area for vehicles nearby will be redeveloped, and utilized as a turn area.

Source: JICA Study Team

Figure 4.8-14 Layout Plan of Kembangan(1) Station

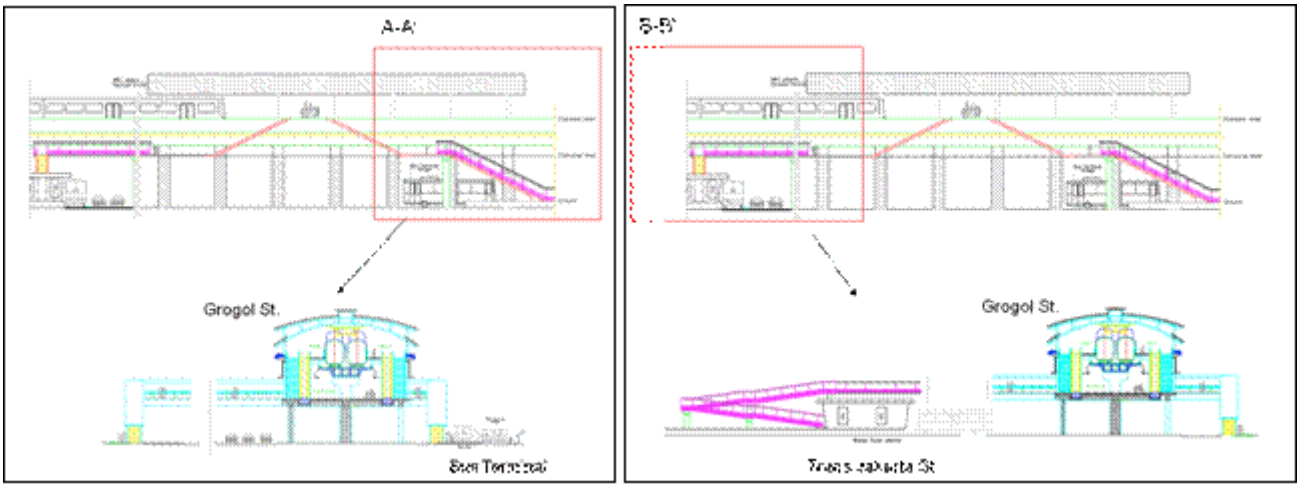
(5) Grogol St.

This station is put into place on the connection point with TransJakarta Lines 3 and 9. In addition, there are bus terminals of the local line. The transfer facility between TransJakarta Lines 3 and 9, which is a pedestrian bridge, has been set up. In addition, there is a pedestrian bridge for the bus terminal. These concepts need to be considered for MRT East-West Line.

As mentioned above, the pedestrian bridge shown in Figure 4.8-3 was adopted.

Source: JICA Study Team

Figure 4.8-15 Layout Plan of Grogol Station



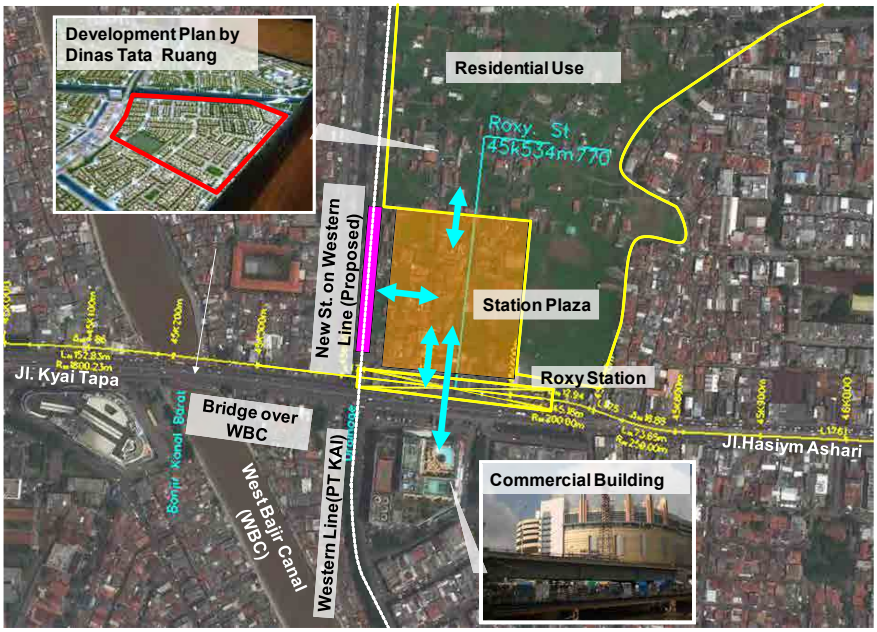
Source: JICA Study Team

Figure 4.8-16 Pedestrian Bridge under viaduct

(6) Roxy Station

This station is situated on the connection point with West Line. The JICA Study Team proposed to relocate the existing station of West Line because of assimilating passengers of West Line into MRT East-West Line. A large-scale shopping center is located around this area. Also, there are vacant lands in the north portion of this area. It means that there is development potential for this area. A common station plaza between MRT East-West and West Lines is to be installed in this potential area. The location was selected in terms of the accessibility of each point, which is for example a station, existing commercial building and residential area in the future. Roxy Station is an underground station. The underground section starts from the transition section, which is located at the center between Grogol and Roxy Stations. The access from Roxy Station to the station plaza is an underground passage. The

JICA Study Team proposed to make an area design of the intermodal transfer facility to be convenient and have the function to attract more customers, which is based on the development plan of Tata Ruang.



Source: JICA Study Team

Figure 4.8-17 Layout Plan of Roxy Station

The proposed layout plan of the station plaza is shown in Figure 4.8-18. In order to avoid congestion of passengers during peak hours and to maintain the convenience of the place, a wide open space is kept inside the station plaza.

Source: JICA Study Team

Figure 4.8-18 Layout Plan of Station Plaza

(7) Thamrin Station

This station is placed on the connection point with MRT North-South Line. According to the demand forecasts, there will be more than 100,000 passengers/day between MRT North-South Line and East-West Line. The provision of an intermodal transfer facility is considered essential for the smooth transfer of passengers between both stations. If the distance between both stations is long, the resistance of connection will increase. An example of such case is that passengers need to go through the ticket gate, move up stairs, and go to the next gate through the pedestrian walkway on the ground. It is the best way to introduce the direct access or access way on the same level between both concourse levels. Actually, the planned location of both stations, which are Thamrin Station on MRT East-West Line and Sarinah Station on MRT North-South Line, is distant. In order to solve this situation, the JICA Study Team proposed to relocate Serinah Station on the north side. This enables the passengers to directly integrate with other lines without going through each ticket gate and use the common concourse. In the case examples in Japan and other countries' stations mentioned above, the escalator or elevator is an area where the concentration of passengers is common. This causes the problem of undermining the security of passengers. It is necessary to introduce escalators and elevators at multiple sites.

Source: JICA Study Team

Figure 4.8-19 Layout Plan of Thamrin Station

Source: JICA Study Team

Figure 4.8-20 Concept of Thamrin Station

(8) Kebon Sirih St.

This station is situated on the connection point with Central Line. However, there is sufficient distance of more than 300 m between both stations. Such a situation is inconvenient. The access way from Kebon Sirih Station of MRT East-West Line to Gambir Station of Central Line is ineffective as an integrated way between both stations. This is because this pedestrian walkway on the road named Jalan Srikaya 1 is very narrow. In addition, the side ditch occupies the space of the pedestrian walkway. This loses the function of the pedestrian walkway. The area under the viaduct of Central Line can be utilized as a commercial area. Around the station are a football field and a private land.

In view of the circumstances mentioned above, the newly constructed underpass connection is relatively ineffective since the walking distance of the integration with the other line is relatively long. In addition, there is movement going up and down, because one is an underground station and the other is an elevated station.

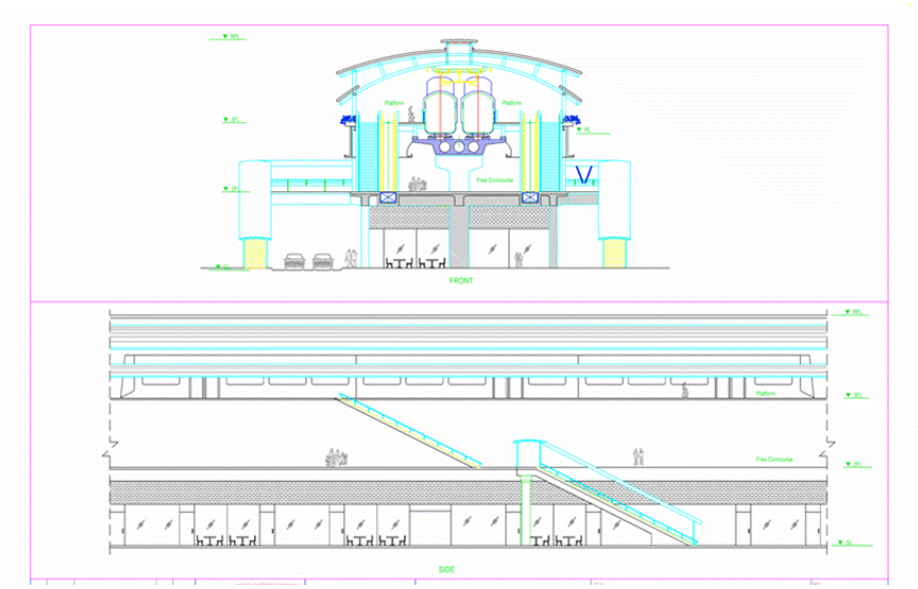
Source: JICA Study Team

Figure 4.8-21 Present Condition on Kebon Sirih(2) St.

Thus, the JICA Study Team proposed to make a spatial plan including the redevelopment of the pedestrian walkway and the introduction of commercial use under the viaduct shown in Figure 4.8-6. The environment around this area will be improved as an attractive space. This would enable passengers to enjoy walking between both stations, and not to feel the long distance..

Source: JICA Study Team

Figure 4.8-22 Kebon Sirih Station



Source: JICA Study Team

Figure 4.8-23 Commercial Use under the Viaduct

(9) Senen Station

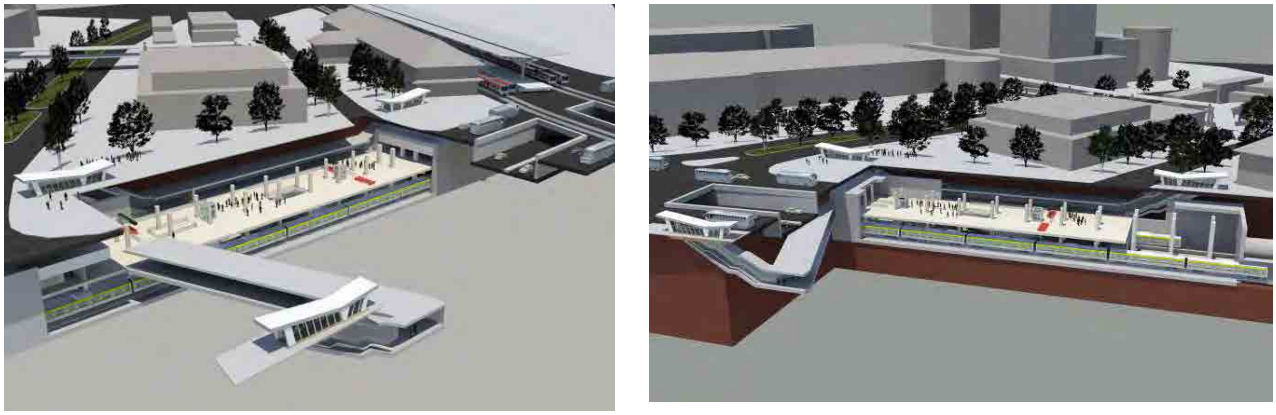
This station is situated on the connection point with Eastern Line. This area is a redevelopment area approved by Dinas Tata Ruang. The pedestrian deck will be installed, which is the center of this development plan. It is necessary to access this center line.

There is a connection point between multiple transportation modes. In addition, the station of Eastern Line, which is a ground station, blocks the flow of vehicles from east to west. In light of this situation, it is desired that the access way, separated from the traffic congestion, will be set up.

Source: JICA Study Team

Figure 4.8-24 Layout Plan of Senen Station

The JICA Study Team proposed, based on the awareness of the situation, to make a plan of installing an underpass from this station to the center line of the development area. The concept plan is as follow.



Source: JICA Study Team Based on Dinas Tata Ruang Plan

Figure 4.8-25 Concept of Senen Station

(10) Kelapa Gading Timur St.

This station lies adjacent to the development plan area approved by Dinas Tata Ruang. There is a lot of traffic volume at the intersection of main roads named Jalan Perintis Kemerdekaan and Jalan Kayu Putih Raya. The residential area is spread outward from the crossing of both roads.

It is necessary to consider not only the development area mentioned above, but also each residential area. The JICA Study Team proposed to install the access deck for direct transfer into all areas. As a result, accessibility and safety will be improved if the passengers can smoothly cross the congested point.

Source: JICA Study Team

Figure 4.8-26 Layout Plan of Kelapa Gading Timur Station

This design of pedestrian deck is shown in Figure 4.8-27. When the passengers get off the train, they can directly access to access deck on the same level of concourse. This is because the passengers can get across an intersection safety and smoothly.

Source: JICA Study Team

Figure 4.8-27 Concept of Access Deck

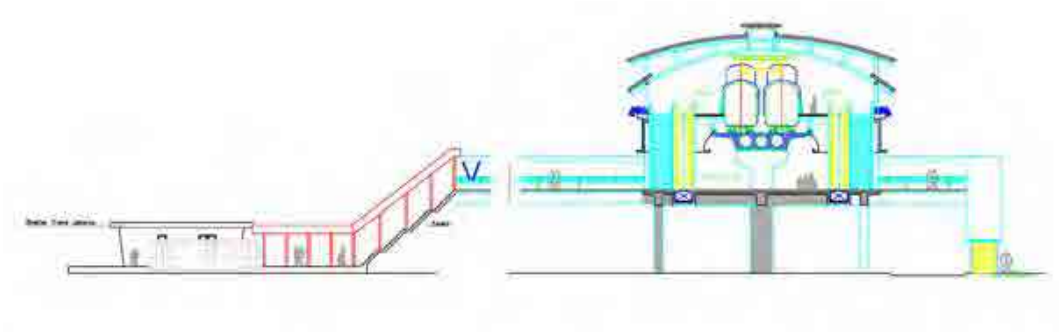
(11) Perintis St.

This station is situated on the connection point with TransJakarta Lines 2 and 4. In addition, there are bus terminals of the local line. The operations of these buses have the role of transferring from this area to the central area. The JICA Study Team proposed that an intermodal transfer facility for smooth integration with other transportation modes will be installed. There are a number of people transferring from TransJakarta Line 2 to Line 4. In addition, the neighboring station between both lines contributes help to the transferring passengers.

With regards to following this idea mentioned above, the direct access deck from this station to the TransJakarta station will be installed.

Source: JICA Study Team

Figure 4.8-28 Layout Plan of Perintis Station



Source: JICA Study Team

Figure 4.8-29 Access Deck from Station to Other Transportation

4.9 Universal Design Plan

The following four functions are needed in light of smooth integration with other transport modes:

- Function of barrier free,
- Function of providing information
- Function of reservoir space, and
- Function of facility for intermodal transferring.

These functions are summarized in Table 4.9-1. These are organized on a section to section basis, which is in the station yard, station plaza and railway passage or around the station.

Table 4.9-1 Universal Design on a Section to Section Basis

	Item	Station Yard	Station Plaza	Railway Passage or Around Station
Barrier Free	Escalator	◎	—	—
	Elevator	◎	—	—
	Staircase rail	◎	○	—
	Braille block	◎	◎	◎
	Audio Assist	◎	◎	◎
	Remove of difference in level around pathway	—	◎	◎
	Disabled stall	◎	○	—
Providing Information	Visual Display Facility for Train Time Table	○	—	—
	Visual Display Facility for Integrated with other transport	◎	◎	—
	Polyglot Visual Display Facility	◎	○	△
Reservoir Space	Bench	◎	○	—
	Waiting Room	○	○	—
	Roof on Bus Stop	—	○	—
Intermodal Transfer	Station Plaza	—	○	—
	Parking	—	○	△
	Cycle parking space	—	—	○

◎:Indispensable ○:Necessary △:Possible

Source: JICA Study Team

Chapter 5 Project Implementation Plan (Phase 1 section)

5.1 Construction Plan and Schedule

As described in the previous chapter, the railway system, type of rolling stock and civil structure for the MRT East-West (E-W) Line have been studied. These should be consistent with those of the MRT North-South (N-S) Line, due to the following reasons: it will enable savings on O&M cost if the equipment and materials for O&M can be shared (for railway and rolling stock); and the type of civil structure selected for the MRT North-South Line will not disturb the existing traffic capacity during construction. Applying the same structure type for the elevated section will possibly minimize the impact to the existing traffic along the proposed alignment, and maintain the number of the current traffic lanes. A tunnel between underground stations will be constructed by shield method, which is commonly applied to tunnel constructions on soft ground. Economic efficiency and minimization of the impact to the surface have also been considered. Consequently, double-tube single-track shield has been selected for the tunneling. The following describes the considerations to be noted in construction works for the said civil structures.

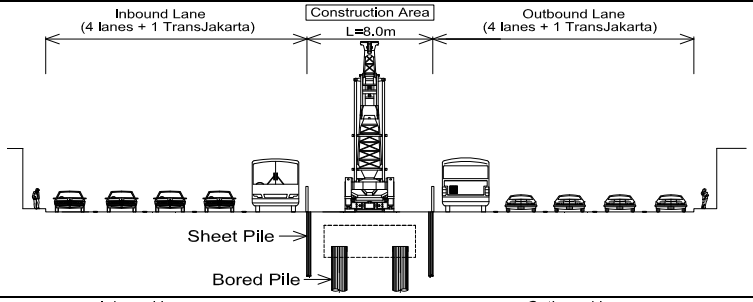
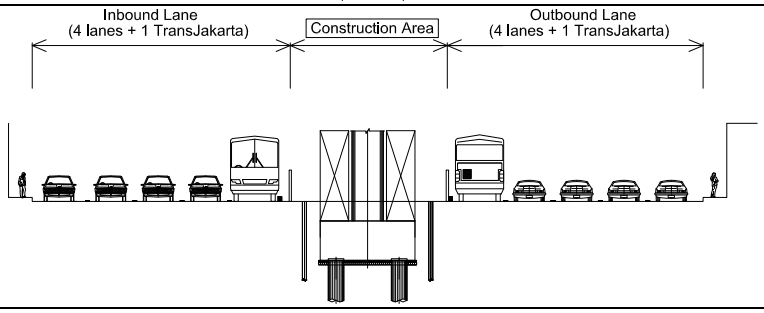
5.1.1 Elevated Section

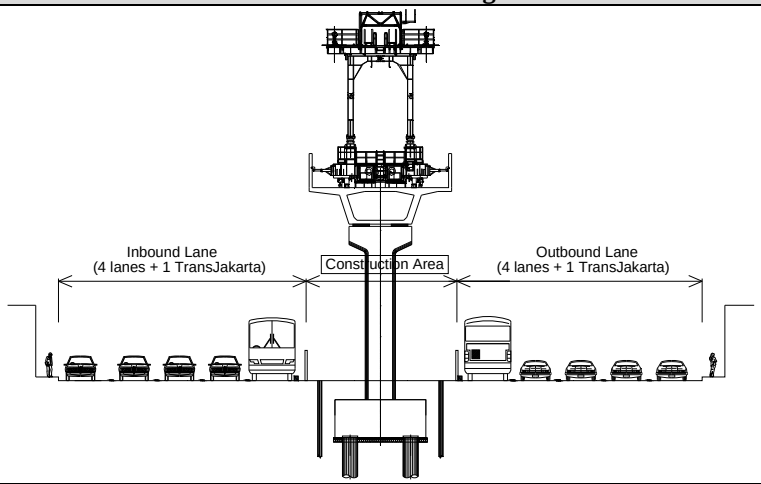
The proposed alignment of the elevated section generally runs parallel to the existing roads. It is assumed that, for the purpose of maintaining the current traffic capacity of existing roads, the number of current traffic lanes will be kept by reducing the working zone during the daytime to minimize the impact along the proposed alignment.

(1) Viaduct Structure

1) Construction of Foundation and Substructure of the Viaduct

The following figure shows general steps for the construction of foundation and substructure of the viaduct, together with a traffic diversion plan. The substructure of the viaduct is a common civil structure and needs no special construction method. However, depending on the ROW of existing roads, either temporary road deck installation or reduction of working area during the daytime will be necessary to maintain the number of traffic lanes, since piling machine occupies wide space on existing road when bored pile construction is adopted.

Step	Cross Sectional Image	Description
1		1. Utility relocation 2. Traffic diversion 3. Sheet piling 4. Bored piling
2		1. Traffic diversion 2. Excavation 3. Foundation concrete work 4. Column concrete work 5. Backfill

Step	Cross Sectional Image	Description
3		1. Superstructure (Precast box girder installation)

Source: JICA Study Team

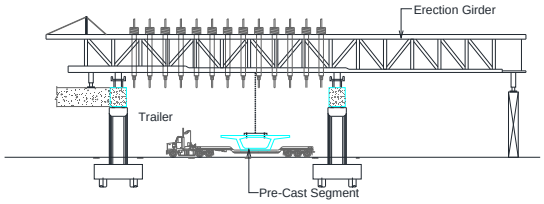
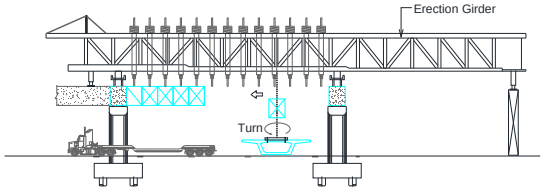
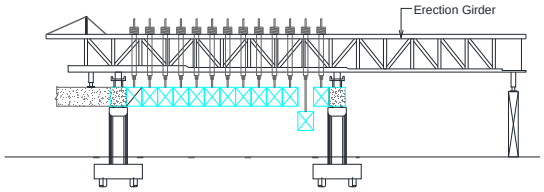
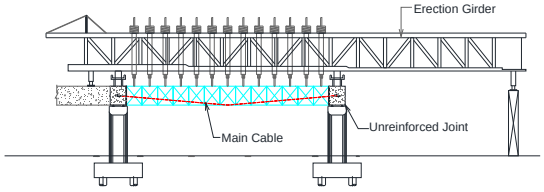
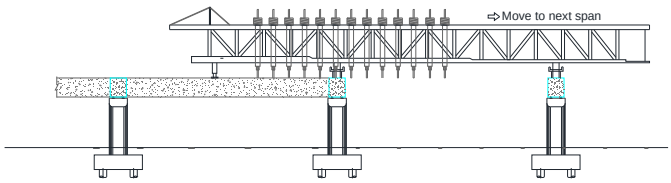
Figure 5.1-1 Viaduct Construction Steps

2) Construction of Superstructure of Viaduct

For the superstructure of viaduct, the span-by-span method is expected to be applied for similar reasons as that for substructure, i.e., to maintain the number of current traffic lane and minimize the impact along the proposed alignment. Precast segments manufactured span by span at the factory or at site will be hung and installed using erection girder, and tensioned and unified using PC steel bars. It is recommended that the precast segments be transported at night time when traffic is less in order to avoid negative impact to the road traffic. The steps for carrying out girder construction are shown in Figure 5.1-2.

http://www.dps.co.jp/business/bridge/kawagoe.html

Photo 5.1-1 Construction of Girders Using Span-by-Span Method

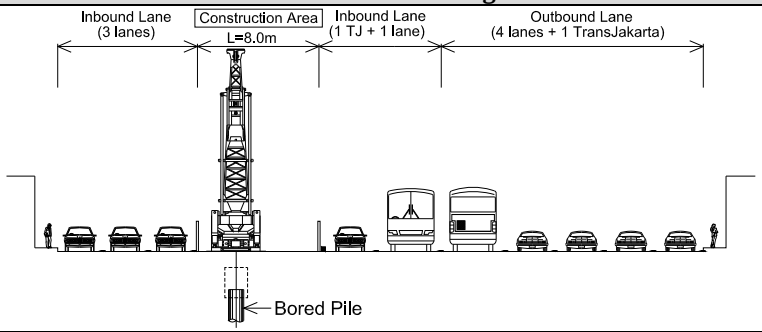
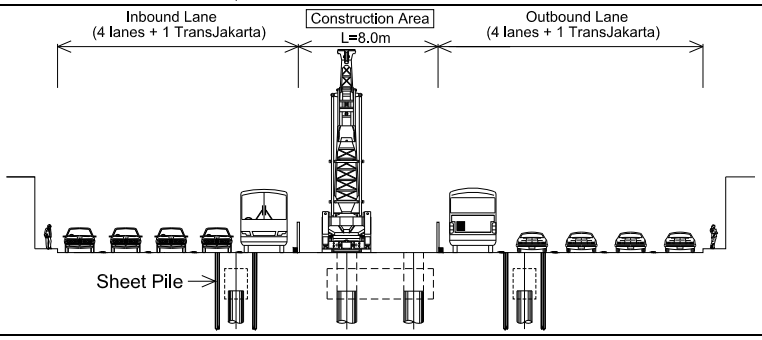
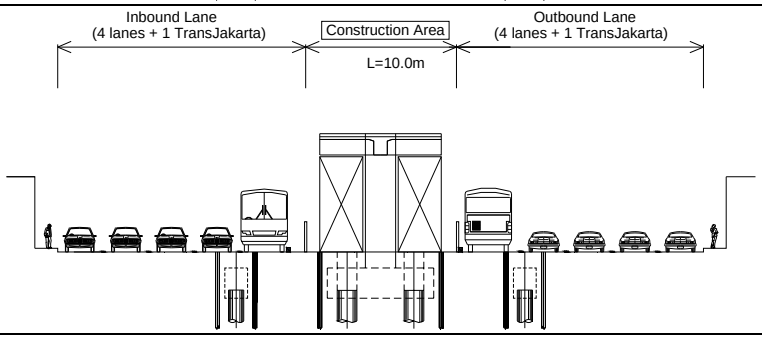
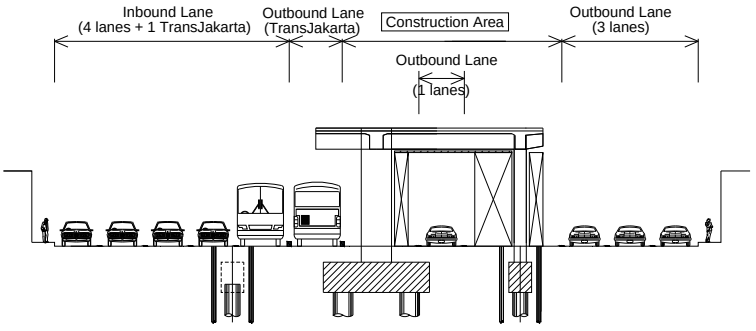
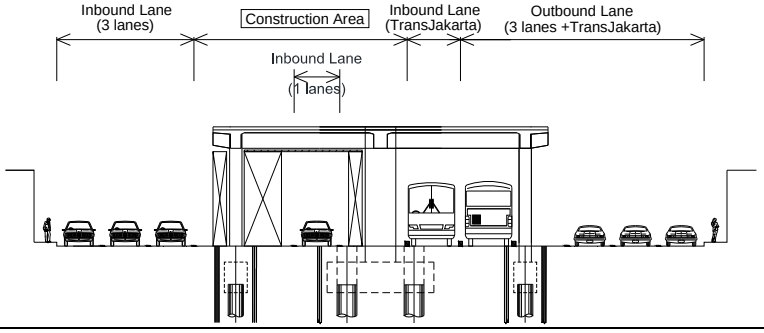
STEP 1 <Transportation>		-Transport Pre-cast segment to the site from stock yard.
STEP 2 <Installation>		-Install the pre-cast segments temporarily by hanging them with erection girder.
STEP 3 <Jointing>		-Unite all the segments tight together using steel bars after applying adhesion bond.
STEP 4 <Tensioning>		-Cast concrete to unreinforced joint between spans. -Install main cables and compress all the segments by tensioning the steel cables.
STEP 5 <Equipment Transfer>		-Move and install the erection girder to the next span.

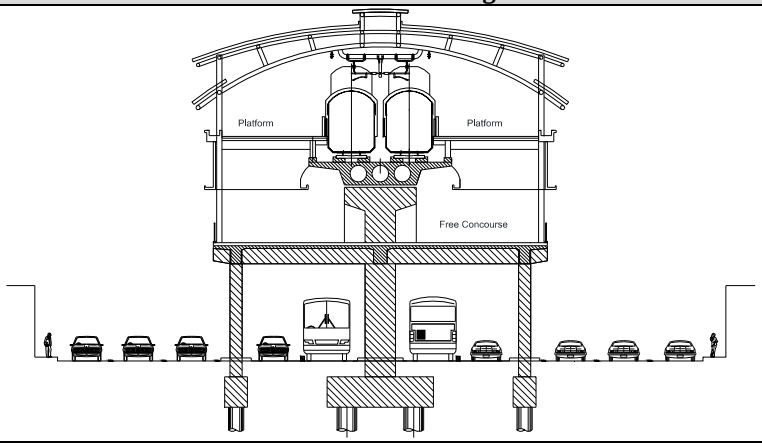
Source: JICA Study Team

Figure 5.1-2 Girder Installation (Span-by-span method) Work Procedure

(2) Elevated Stations

The typical steps for construction of elevated stations are illustrated in Figure 5.1-3. The structure of elevated station needs no special method as it is a common civil structure. As for the viaduct structure, the number of existing traffic lanes should be kept either by installing temporary road decks or by reducing the working area during the daytime. Works which require occupying a wide area should be conducted at night.

Step	Cross Sectional Image	Description
1		(Left or Right Side Section) 1. Traffic Diversion 2. Sheet piling 3. Bored piling
2		(Center Section) 1. Traffic diversion 2. Sheet piling 3. Bored piling
3		(Center Section) 1. Excavation 2. Foundation concrete work 3. Column concrete work 4. Backfill 5. Slab and beam concrete
4		(Left or Right Side Section) 1. Excavation 2. Foundation concrete work 3. Column concrete work 4. Backfill 5. Slab and beam concrete
5		(Opposite Side Section) 1. Excavation 2. Foundation concrete work 3. Column concrete work 4. Backfill 5. Slab and beam concrete

Step	Cross Sectional Image	Description
6		1. Girder erection 2. Concrete works 3. Architect works and station facility installation. 4. Completion

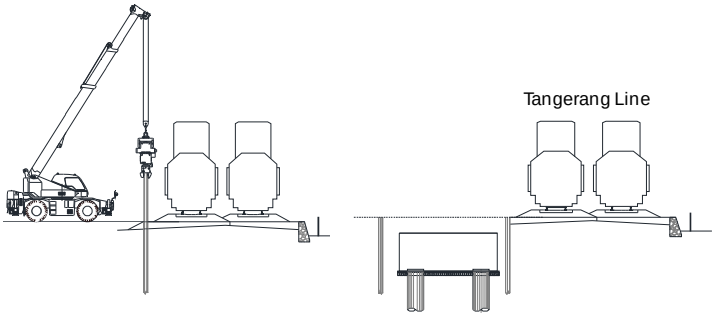
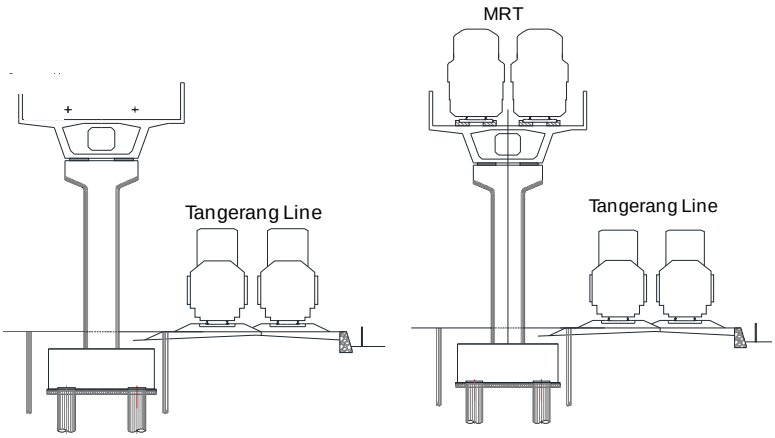
Source: JICA Study Team

Figure 5.1-3 Steps in the Construction of Elevated Structures

(3) Viaducts and Elevated Stations along Tangerang Line

1) Viaducts along the Existing Tangerang Line

In terms of minimization of land acquisition and resettlement impact, the viaduct should be constructed at adjacent point from the existing Tangerang Track. The assumed construction steps for the viaduct along Existing Tangerang Line are shown in the following figure.

Step	Cross Sectional Image	Description
1&2		1. Protection Work(Sheet pile) 2. Excavation work 3. Piling Work 4. Sub Structure Work
3&4		1. Superstructure (Precast box girder installation)

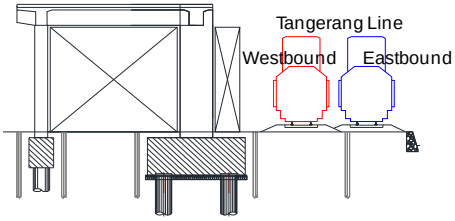
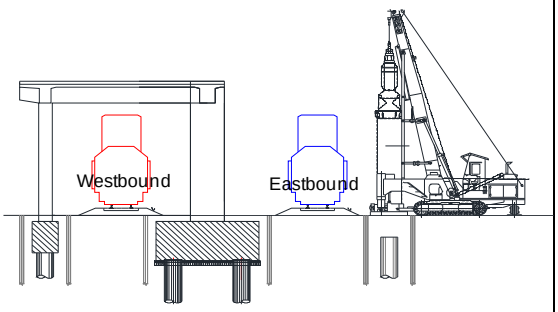
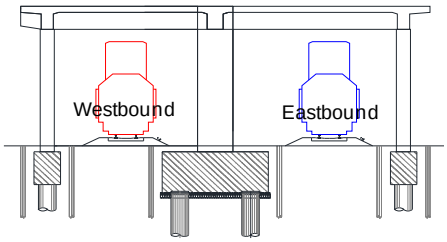
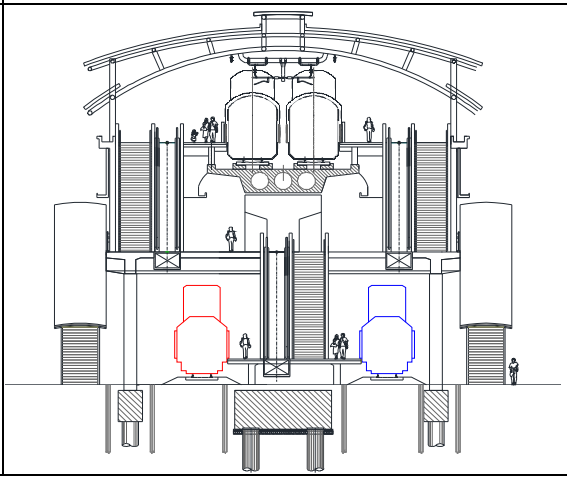
Source: JICA Study Team

Figure 5.1-4 Construction Steps of Viaduct along the Existing Tangerang Line

2) Elevated Station along the Existing Tangerang Line

Since the width of standard station structure are approx. 24 meter wide, in the overlap section with the existing Tangerang Line, the elevated station structure should be constructed with maximum utilization of existing railway land in terms of minimization of land acquisition and resettlement. Those construction works will need shifting of existing railway line by temporary track. Kembangan1, Kembangan2, Rawabuaya, Kalideres station are the station which should be constructed by this procedure.

The assumed construction steps are shown in the following figure.

Step	Cross Sectional Image	Description
1		1. Protection Work(Sheet pile) 2. Piling work and Sub Structure Work for North side of the station structures.
2		1. Temporary Line 2. Piling work and Sub Structure Work for North side of the station structures. 3. Temporary Line work and switching of Westbound Line 4. Switching of Eastbound Line to former Westbound Line track 5. Piling work and Sub Structure Work for South side of the station structures at former East Bound track location.
3		6. Slab and beam concrete of first storey of South side of station.
4		1. Column Work 2. Roof Work 3. Super Structure Work Girder erection 4. Architect works and station facility installation. 5. Completion

Source: JICA Study Team

Figure 5.1-5 Construction Steps of Elevated Station along the Existing Tangerang Line

5.1.2 Underground Section

The policies for planning the construction of underground section are:

- the number of existing traffic lanes should be kept during the daytime so as to maintain the existing traffic capacity, which aims to minimize the impact to the ground surface along the proposed alignment, and
- the influence expected to be caused by flood should be minimized, considering that the proposed alignment runs through the area which experienced floods that occurred in 2002 and 2007.

(1) Tunnel Section

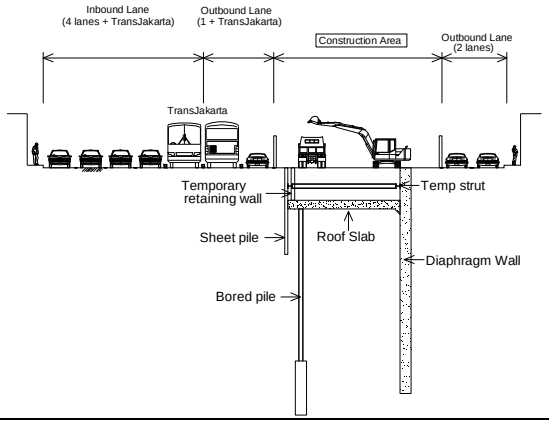
For the tunnel section, shield method will be applied. As this method is widely used especially in Japan for tunnel construction in urban areas, it will also be applied to the tunneling required for Jakarta MRT North-South Line project.

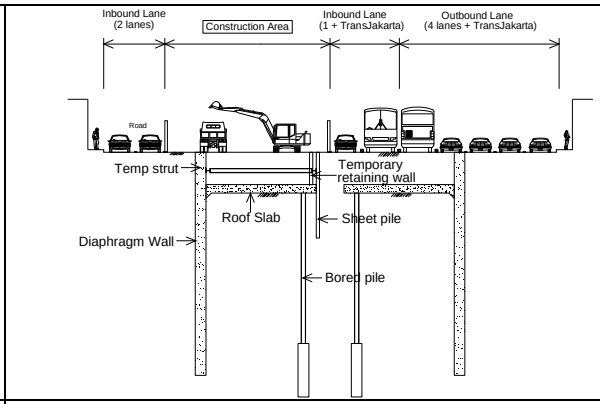
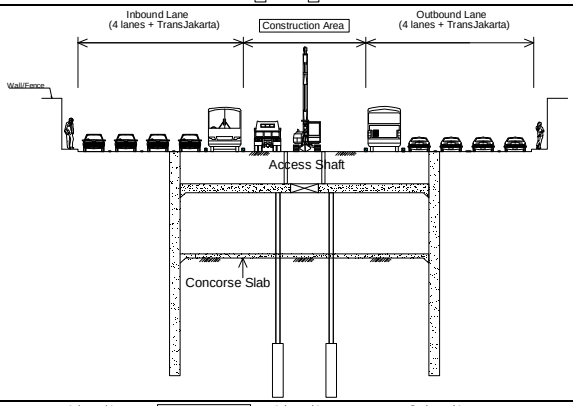
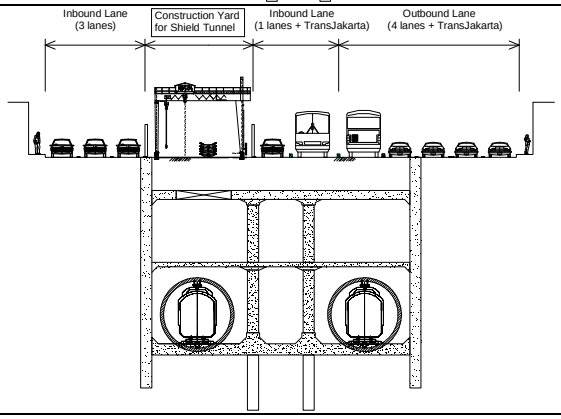
Source: JICA Study Team

Figure 5.1-6 Image of two tunnels running underground

(2) Underground Station

Underground stations will be constructed using cut-and-cover method, which is a typical method for constructing underground stations. Considering the influence of flood, the same construction sequence as for MRT North-South line, the top-down method, will be applied. Construction steps of underground station by cut-and-cover method are shown in figure below.

Step	Cross Sectional Image	Description
1		(First Half Section) 1. Traffic diversion 2. Sheet piling 3. Temporary king post piling 4. Diaphragm wall construction 5. Excavation and temporary strut installation 6. Roof slab concrete 7. Temporary retaining wall installation 8. Backfill

2		(Remaining Half Section) 1. Traffic Diversion 2. Sheet piling 3. Temporary king post piling 4. Diaphragm wall construction 5. Excavation and temporary strut installation 6. Roof slab concrete 7. Temporary retaining wall installation 8. Backfill
3		(Center Section) 1. Traffic Diversion 2. Excavation 3. Roof slab concrete 4. Excavation 5. Concourse slab concrete
4		1. Excavation 2. Base slab concrete 3. Permanent wall construction (After completion of underground station, it will be used for shield tunnel construction.)

Source: JICA Study Team

Figure 5.1-7 Steps in Constructing Underground Station

5.1.3 Construction Schedule

Construction works of this MRT project is mainly divided into four categories namely, viaduct section (span-by-span method), elevated station (normal civil works), underground tunnel (shield method), and underground station (cut-and-cover method). According to the implementation schedule that will be described later in this chapter, the overall construction works should be completed within 60 months from the commencement of contract(s), aiming at operation opening in 2021. In this section, preliminary study on the construction schedule for each category of works is made based on a schedule limit of 60 months, as described hereinafter.

(1) Elevated Section

As described earlier, span-by-span method is proposed for the viaduct section. With this method, the superstructure of the viaduct can be constructed within a period of 10 days per one span, regardless of the span length. Increasing the number of erection girders leads to a reduction of construction, consequently meeting the time constraints. Table 5.1-1 enumerates

the span length between elevated stations, and the work period required for superstructure construction when one set of erection girder is mobilized for a section between stations.

Table 5.1-1 Construction Period of PC Box Girder in the Viaduct Section

Stage	Name	Chainage	Distance b/w station (m)	Duration (days)	Duration (months)
Stage 1	St. Kalideres	Km 34 + 266			
	St. Rawabuaya	Km 36 + 640	2,199	855	29
	St. Kembangan (2)	Km 39 + 96	2,281	887	30
	St. Kembangan (1)	Km 40 + 823	1,552	604	20
	St. Pesing	Km 42 + 485	1,487	578	19
	St. Grogol	Km 44 + 26	1,366	531	18
	Underground Stations	～ ～			
	St. Cempaka Baru	Km 54 + 312	874	340	11
Stage 2	St. Sumur Batu	Km 55 + 361	1,276	496	17
	St. Kelapa Gading Barat	Km 56 + 812	913	355	12
	St. Kelapa Gading Timur	Km 57 + 900	1,511	588	20
	St. Perintis	Km 59 + 586	771	300	10
	St. Pulo Gadung	Km 60 + 532	1,477	574	19
	St. Penggilingan	Km 62 + 184	903	351	12
	St. Cakung Barat	Km 63 + 262	1,247	485	16
	St. Pulogebang	Km 64 + 684	1,055	410	14
	St. Ujung Menteng	Km 65 + 914			

※6 working days per weeks, 30m for one span

※except for the days on the table, 30 days for assembly and 20 days for disassembly of the erection girder will be required.

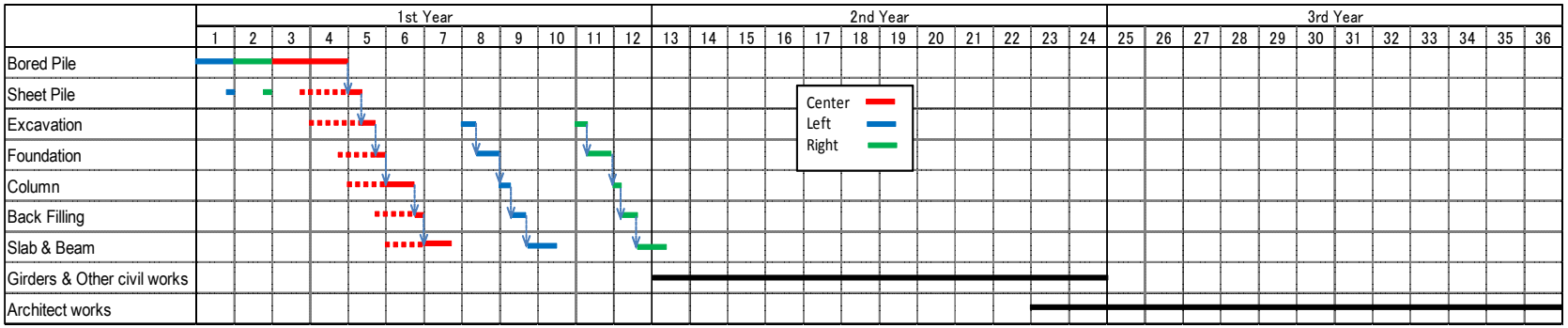
Source: JICA Study Team

According to Table 5.1-1, at the section between Rawabuaya ~ Kembangan (2), which is the longest section, construction period of 30 months is required. However, this will not be critical for the overall schedule since construction schedule can be reduced by reusing the erection girder used for the prior section completed, or by applying more than one set of erection girder from the beginning stage.

(2) Station Construction (Elevated, Underground)

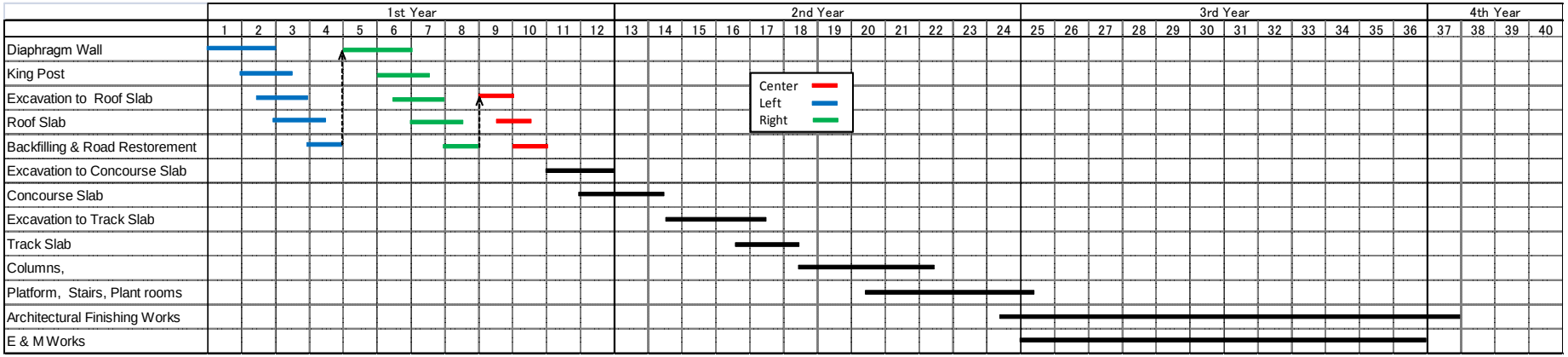
Figure 5.1-8 shows the construction schedule, which follows the construction sequence shown in Figure 5.1-3. Construction of elevated station does not influence box girder construction and vice versa. The schedule shown in Figure 5.1-8 will be the critical path for the overall construction schedule.

On the other hand, since underground station will be used for launching or arrival shaft for shield machine, it significantly affects the time of launching of shield machine. Figure 5.1-9 shows the construction schedule which follows the construction sequence shown in Figure 5.1-7. Based on the construction schedule shown in Figure 5.1-9, study of overall schedule for the underground section is made as follows.



Source: JICA Study Team

Figure 5.1-8 Construction Schedule for Typical Elevated Station



Source: JICA Study Team

Figure 5.1-9 Construction Schedule for Typical Underground Station

Shield method will be applied for the construction of tunnel section between stations. In order to specify the construction schedule for the tunnel section, allocation of shield machines has to be determined as the first step. Hereinafter, allocation of shield machines has been studied based on the following conditions:.

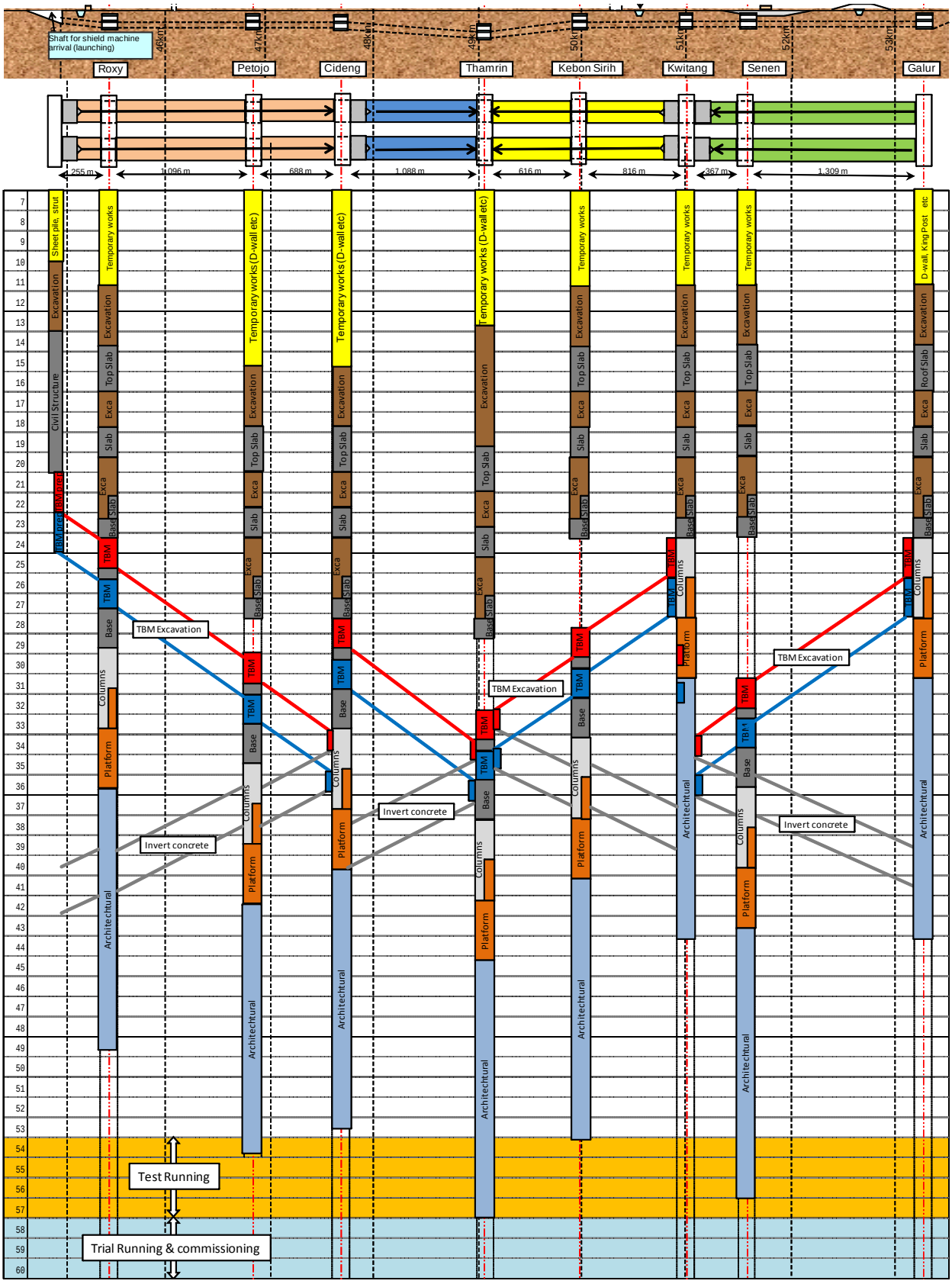
- Shield machine should be launched from underground station or cut-and-cover section, and initiated only after base slab of underground station is constructed. (For launching and arrival of shield machine, base slab concrete will be cast in two divided stages.)
- Shield machine should not be launched from the station where spaces on the ground are limited, as shield method requires huge temporary construction yard on the ground. The following are expected as on-the-ground facilities:
  - ・ Backfill grouting/ slurry plant, silo
  - ・ Cranes including gantry crane and hoist crane and so on
  - ・ Material stock yard for concrete segments and etc
  - ・ Sub station
  - ・ Belt conveyor, ventilation facility
  - ・ Soil Hopper
  - ・ Water treatment Plant
- The number of shield machines should be minimized as initial investment cost for the shield machine itself and other facilities listed above are very costly.
- The following are the average construction speed (m/day) assumed in the study:
  - ・ Average construction speed of shield tunnel :10m/day
  - ・ Average construction speed of invert concrete :15m/day

The result of the study on construction schedule for underground sections based on the abovementioned conditions is shown in Figure 5.1-10. Since the construction period for Phase-1 of the Project is fixed at five years, it is required to divide the underground sections into four as indicated in the schedule. One shield machine should be allocated each for outbound and inbound line, amounting to eight numbers in total.

Table 5.1-2 Allocation of Shield Machine for the Underground Section

	Section Description	Tunnel Length (m)	Quantity of TBM
Section 1	West Transition ~ Cideng St.	2.039	2
Section 2	Cideng St. ~ Thamirin St.	1.088	2
Section 3	Thamirin St.~Kwitang St.	1.432	2
Section 4	Kwitang St.~Galur St.	1.676	2
Total		6.235	8

Source: JICA Study Team



Source: JICA Study Team

Figure 5.1-10 Construction Schedule for Underground Sections (4 Sections, 8 TBMs)

5.2 Traffic and Safety Management Plan

As construction of urban railway, represented by metro construction, is usually conducted along public spaces such as a public road which is in operation, it is necessary for the existing road to only be partially occupied for a certain period in order to facilitate construction of civil structures. In a similar manner, most of the entire alignment presently planned, except for that along-Tangerang line section, runs along the public road in the Phase-1 section of the Jakarta MRT East - West line, which makes it necessary to occupy the existing road width during construction. However, traffic congestion at the center of Jakarta is so severe and chronic that even for short durations, utilizing the roads will further paralyze the traffic if reduction of lanes is required. Therefore, the study of road traffic during construction is necessary to minimize negative impact to the traffic.

In addition, especially for underground station construction, existing utilities currently crossing under the existing road should be diverted or temporarily supported in a proper manner according to utility type.

5.2.1 Existing Road Conditions along the Alignment

Existing roads along the MRT East-West Line are listed in Table 5.2-1. Most of the roads have more than three lanes on each side at the center of Jakarta. Some roads like Jl.Daan Mogot do not have center median or green zones, where the difference between carriageway width and ROW is less. Hence, spaces for future MRT structure are limited. Meanwhile, Jl.Kyai Tapa or Jl.Perintis Kemerdekaan has wide green zone beside the existing road, which can be used for future MRT structure and traffic diversion. Because of this, there will be no additional land acquisition at this section and no reduction of traffic lanes would be necessary. Photos of existing road conditions along the alignment, and their characteristics are summarized in Table 5.2-2.

Table 5.2-1 List of Road Structure along the Proposed Alignment

No.	Road Name	Road Type[1)]	Trans Jakarta	Lanes	ROW (m)	Carriage way (m)
1	Jl. Daan Mogot	6/2 D	○	8	32	28
2	Jl. Kyai Tapa	8/2 D	○	8	50	37
3	Jl. Hasyim Ashari	6/2 D	○	6	30	22
4	Jl. Cideng Barat/ Timur	6/2		6	15+15	11+11
5	Jl. Kebon Sirih Raya	4/2 D & 3/1 UD		4/ 3	17	12,5
6	Jl. Prapatan + Jl.Kwitang	6/2 D	○	6	11+12	9,5+10.5
7	Jl. Kramat Bunder	8/2 D	○	8	50	40
8	Jl. Letjen Suprapto	8/2 D	○	8	50	30
9	Jl. Perintis Kemerdekaan	8/2 D	○	8	50	30
10	Jl. Bekasi Raya (Sultan Hamengkubowono IX)	4/2 D		4	19	15

Note: 1)"Road Type", "D" represents "Divided（with center median）"、"UD" represents "Undivided（without）.
2) Street name of outbound and inbound lane of Jl.Cideng and Jl.Prapatan differs.
3) "/1" indicates one-way traffic, "/2" indicates two-way (inbound and outbound) traffic.

Source: JICA Study Team

Table 5.2-2 Characteristics of Streets along the Proposed Alignment

Jl. Daan Motot	Jl. Kyai Tapa
	
-Narrow median on the center -No green zone -Houses/ buildings exist just beside the narrow walkway. -Limited space available for future MRT structure. -Elevated section.	-Wide median on the center. -Very wide green zone on the south side of the street. -Sufficient space for future MRT structure. -Transition of structure (from elevated to underground) is planned along this street.

Jl. Hasyim Ashari	Jl Letjen Suprapto
	
-Curbstone median on the center -No green zone -Houses/ buildings exist just beside the narrow walkway. -Limited space available for future MRT structure.	-Median on the center. -Divider between outer and inner lanes -Houses exist just beside the narrow walkway.

Jl.Perintis Kemerdekaan	Jl.Bekasi Raya
	
-Wide median on the center. -Very wide green zone on the south side of the street. -Sufficient space for future MRT structure. -Elevated section	-Curbstone median on the center -No green zone. -Houses exist just beside narrow walkway. -Limited space available for future MRT structure. -Elevated section

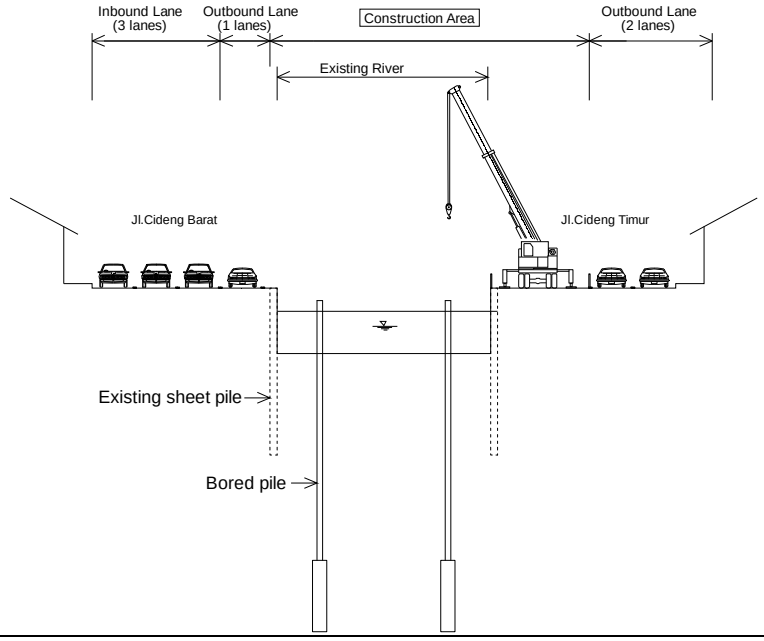
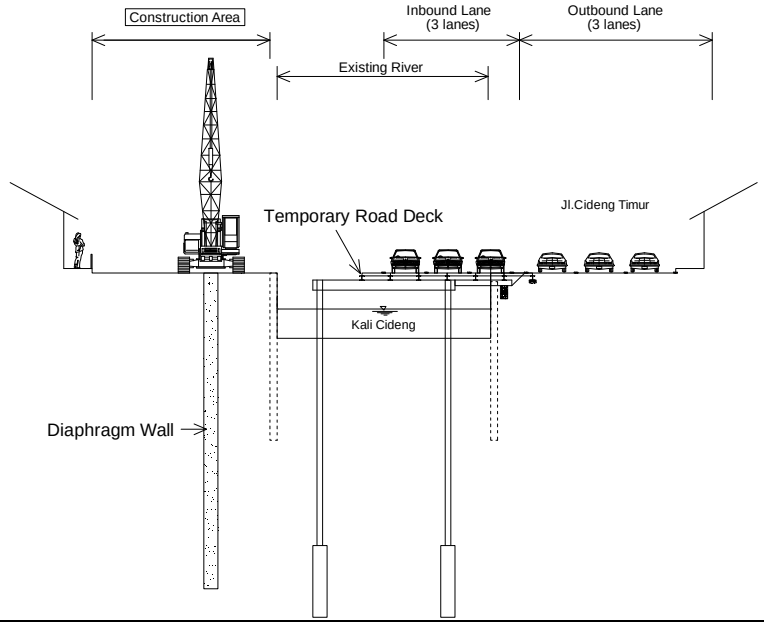
Source: JICA Study Team

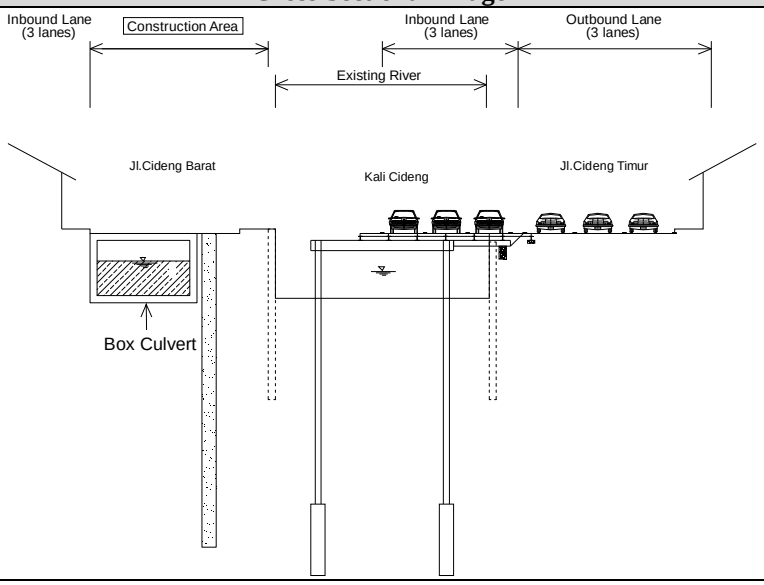
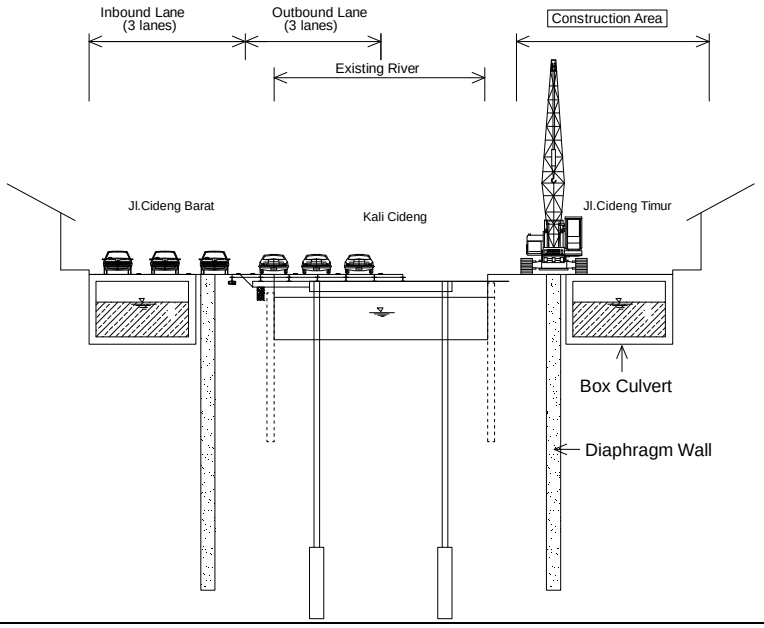
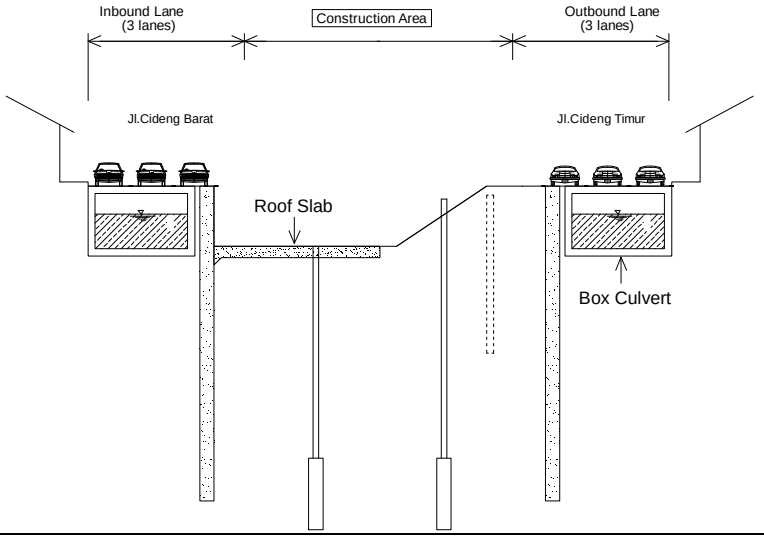
5.2.2 Traffic Management During Construction

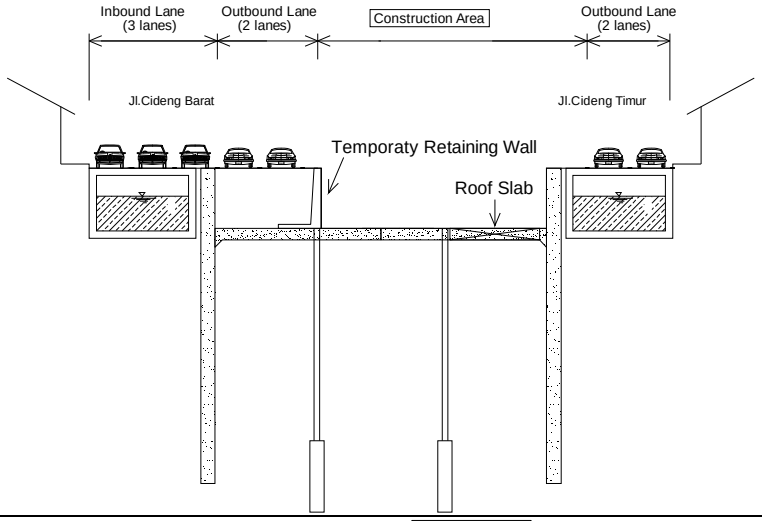
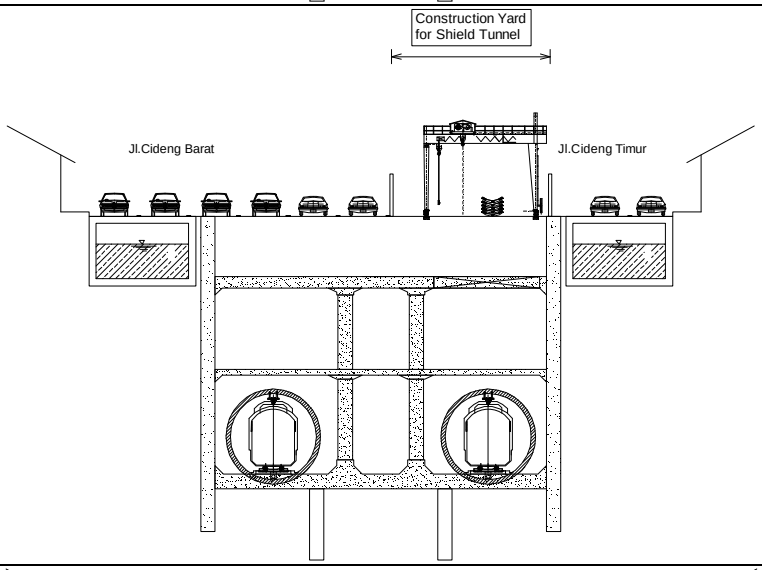
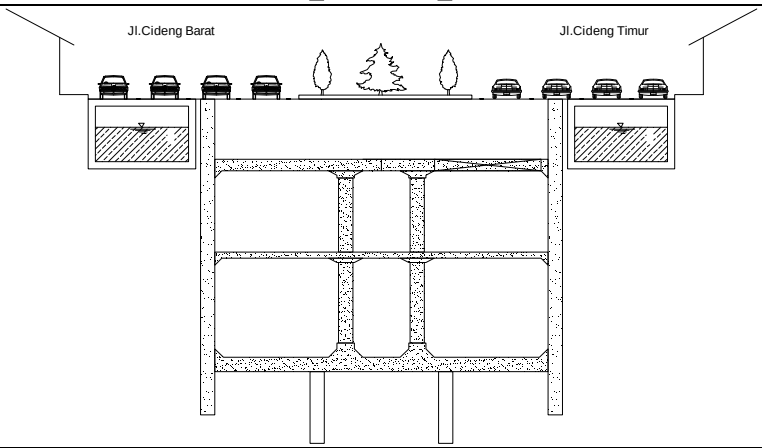
This section discusses the traffic diversion plan at atypical sections, such as the station along Jl.Ciden where there is a canal on the center of alignment or narrow road where it appears difficult to keep existing traffic volume. Typical diversion plans to be adopted during construction are illustrated in section 5.1 of this chapter, together with construction procedure by structure type.

1) Jl.Cideng - Canal at the center of the alignment

Underground structure is planned at sections where a canal (Kali Cideng) flows at the center of Jl.Cideng. In the tunnel section to be constructed by shield method, outbound and inbound tunnel will each run under either Jl.Cideng Timur or Jl.Cideng Barad; however, stations along this section will be positioned on the center. Thus, the existing canal should be temporarily or permanently diverted.

Step	Cross Sectional Image	Description
1		1. Traffic diversion 2. Temporary king post piling (Temporary deck for piling works as required)
2		1. Temporary deck installation 2. Utility relocation 3. Traffic diversion 4. Diaphragm wall construction.

Step	Cross Sectional Image	Description
3		1. Excavation 2. Box culvert construction
4		1. Utility relocation 2. Temporary deck relocation 3. Traffic diversion 4. Diaphragm wall construction 5. Box culvert construction
5		1. Existing river flow diversion 2. Removal of Existing concrete sheet pile 3. Excavation 4. Roof slab concrete

Step	Cross Sectional Image	Description
6		1. Excavation 2. Temporary retaining wall installation 3. Roof slab concrete
7		1. Traffic diversion 2. Shield tunnel construction yard as required
8		Completion

Source: JICA Study Team

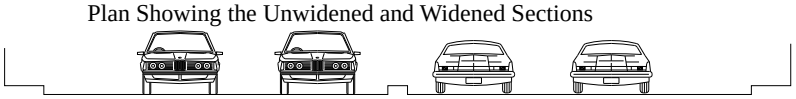
Figure 5.2-1 Construction Step and Diversion Plan for Stations along Jl.Cideng

2) Jl.Bekasi Raya

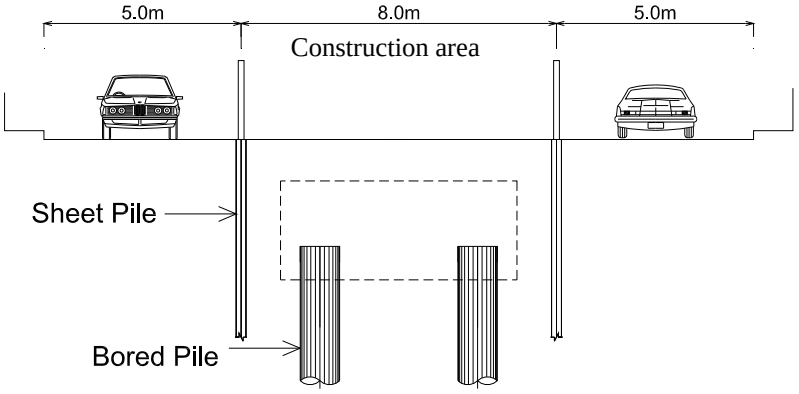
Jl.Bekasi Raya is the narrowest street along the MRT East-West Line. TransJakarta is not in operation eastward from Pulo Gadung as there is an eastern terminal at said location. Moreover, there is only a curbstone median on the center without green zone, having two lanes on each side. Although this road is in a suburban area, it suffers from chronic traffic congestion as many

industrial areas stand closely on both sides of the street. The ROW of existing Jl.Bekasi Raya is merely around 20 m, making it vital to reduce the number of traffic lanes if 10 m of work area needs to be occupied as work zone. However, according to the development plan of DKI Jakarta, Jl. Bekasi Raya will be widened up to more than 50 m in the future (part of the widening works have already been completed). In order not to reduce the number of existing traffic lanes and paralyze the existing traffic, road widening works should be carried out prior to the construction of MRT East-West Line.

Plan Showing the Unwidened and Widened Sections



Current Road Composition: Jl Bekasi Raya



Working Area (when shrunk: 8m)

Source: JICA Study Team

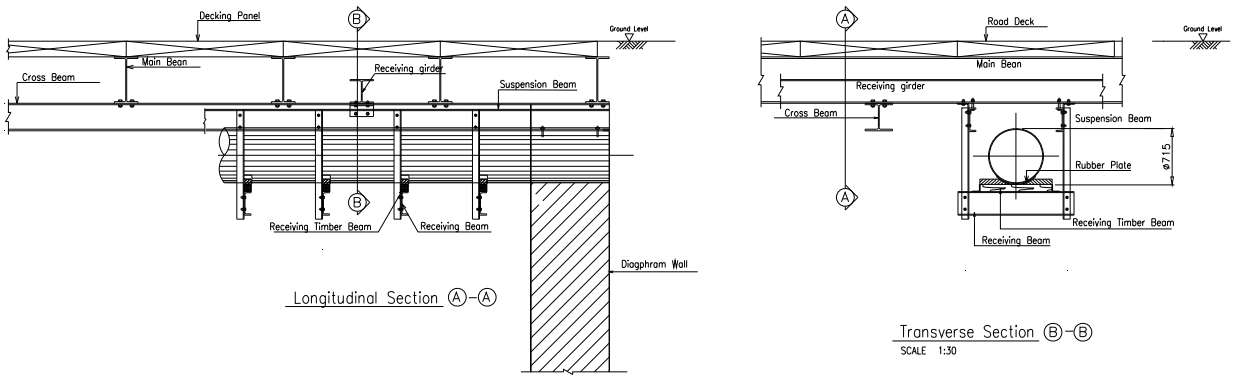
Figure 5.2-2 Road Widening Plan for Jl.Bekasi Raya and its Existing Road Formation

5.2.3 Relocation of Public Utilities and Temporary Support of Diverted Utilities

Under the existing road, many utilities are laid such as water supply pipes, gas pipes, electricity cables, sewage conduits, etc. In the construction of the MRT East-West Line, there will be civil works that require occupying the existing road; for example, excavation and piling works for viaduct substructure, and diaphragm wall construction at underground stations that require excavation of the road. For these reasons, temporary utility diversion, protection and support will be required during the construction period.

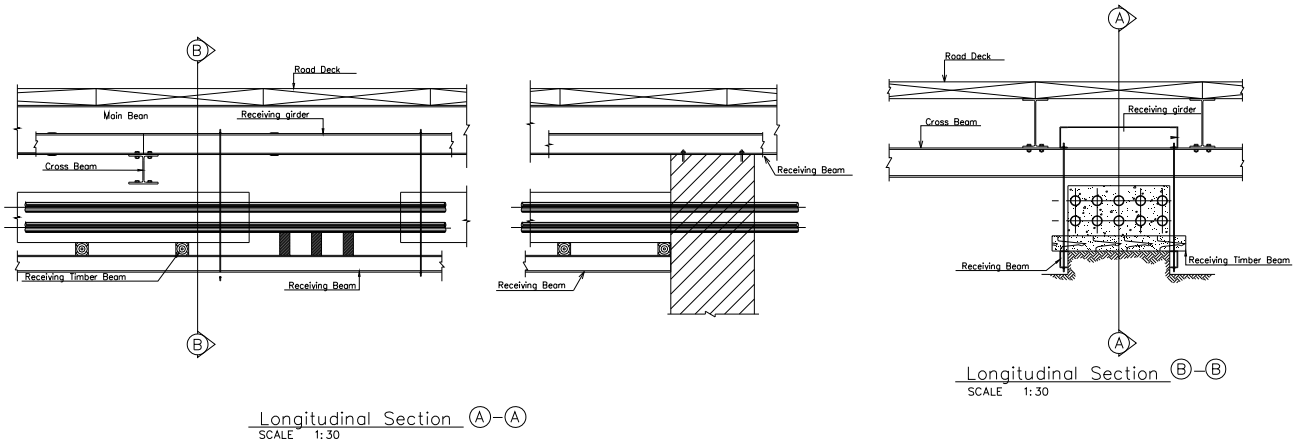
Especially, as the underground section of the MRT East-West Line crosses the center of Jakarta, and as stations are planned to be positioned at the crossroads of major streets considering user-friendliness, it is supposed that there are many underground utilities that exist under these busy crossroads. At locations where cut-and-cover station will be constructed, temporary support and protection for existing utility pipes will be required during construction, as diaphragm wall will be seamlessly constructed along the street,. Temporary support and

protection should be performed in a proper manner according to the utility type as shown in Figure 5.2-3~5.



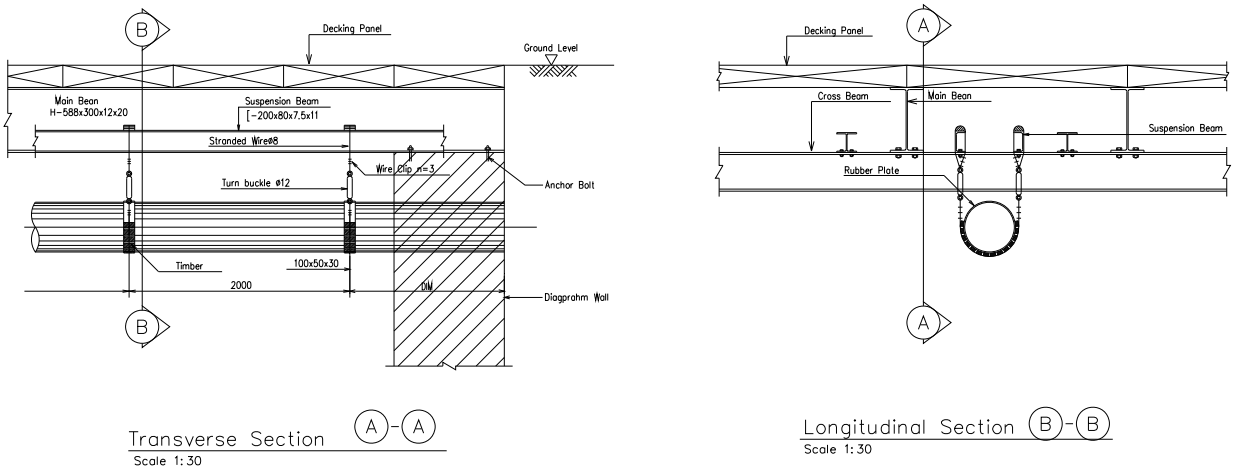
Source: JICA Study Team

Figure 5.2-3 Example of Temporary Utility Protection (for Water Supply Pipe)



Source: JICA Study Team

Figure 5.2-4 Example of Temporary Utility Protection (Electric Cables)



Source: JICA Study Team

Figure 5.2-5 Example of Temporary Utility Protection (Gas Pipes)

5.3 Procurement of Materials and Products

5.4 Project Implementation Schedule

5.5 Consulting Services

5.6 Project Cost Estimate

5.7 Project Cost Reduction

5.8 Key Issues for Project Implementation

Most of the proposed alignment for the MRT East-West Line (especially Phase 1 section) is planned along the public roads where the traffic congestion has become chronic. In the preliminary construction planning described earlier in this chapter, the construction procedures have been studied with particular attention in order not to disturb current road traffic, which has already reached saturation point. However, if the construction works are conducted along Jl. Bekasi Raya where ROW is only 20m, it is unavoidable to reduce the number of traffic lane to regulate traffic. To avert negative impacts on existing road traffic, it is advised that road widening presently being planned be implemented before construction works of the MRT East-West Line.

The overall project schedule sets the target year for operation commencement in 2021, which is based on the assumption that the L/A2 will be signed by the middle of 2015. However, before L/A2, sub-loan agreement has to be agreed after the consensus on the cost demarcation between the central and local governments is established. Considering the fact that the same process for the MRT North-South Line had taken five years, it is advised that the consensus building in Indonesia for L/A2 by middle of 2015 be accelerated even though Phase 1 of the project will be implemented within DKI Jakarta.

Chapter 6 Implementation Structure (Mainly Phase 1 Section)

After Phase 2 of the Jakarta MRT East-West (E-W) Line Project, the total section will cover DKI Jakarta Province, Banten Province and West Java Province. Nevertheless, the section of Phase 1 is confined only within DKI Jakarta Province. Thus, Sections 6.1 to 6.5 mainly discuss the implementation structure of Phase 1.

6.1 Implementation Structure

Railways have been operated in the Republic of Indonesia for more than a hundred years now. Since vertical separation was introduced into the sector in 1992, it was stipulated that DGR be responsible for investment and maintenance costs for infrastructure, and PT. KAI for train operations. In other words, reforms have improved management freedom of the railway operator through corporatization, and at present it implements railway operations utilizing the infrastructure owned by the government. Although the government is responsible for the infrastructure maintenance cost, PT. KAI implements maintenance works of the infrastructure. Thus, the principle aim of vertical separation in the railways in Indonesia is neither for introducing competition among railway operators nor for promoting new entries into the market. Instead, it was aimed to stipulate responsible costs borne by DGR and those by PT. KAI.

After introducing vertical separation, DGR and PT. KAI tried to implement smooth railway operations through their efforts and cooperation such as making medium- and long-term management plans. Nevertheless, railway transport services have not been improved remarkably and PT. KAI had continued its standardized transport services as a single monopolized operator. On the other hand, it was difficult for both PT. KAI and DGR to financially maintain the vast railway system which has been accumulated so far because of the decrease of transport and the limited financial capacity of the government. As a result, the competitiveness of the railway sector against the road sector decreased gradually until 2006.

Following the above mentioned situation, the Government of Indonesia enforced “Railway Law 23rd-2007” in March 2007 in order to improve railway transport services and promote new entry into the market. Supporting the concept of vertical separation, the new Railway Law categorizes the city railway service network into the following three types based on its covered area:

Type 1) Network going across a province;
Type 2) Network going across a regency/city in a province; and
Type 3) Network in a regency/city.

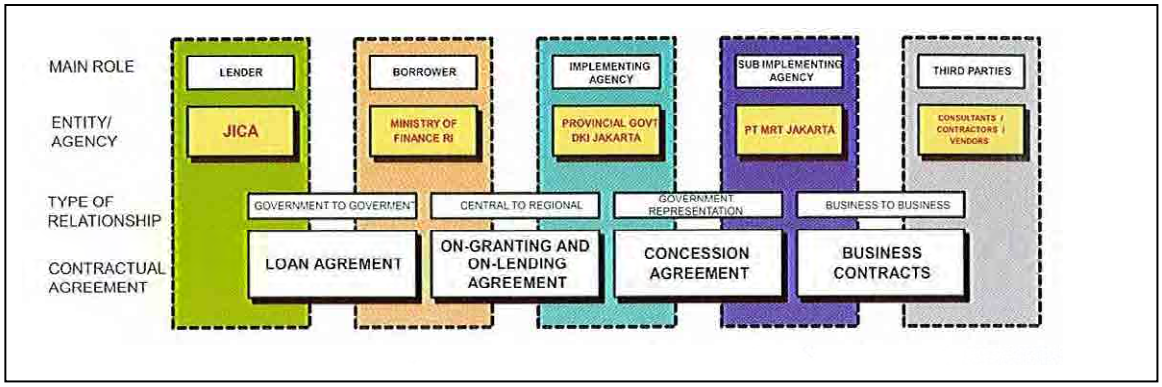
Regarding the city railway service, it was expected that a financially sustainable regional railway system be established through the increase of rail passengers by means of encouraging new entry by the regional government and the private sector, and their provision of rail services that are appropriate for the transport demand of each regional market.

Phase 1 of MRT East-West Line is categorized as Type 2 as listed above, and the total network including Phase 2 is categorized as Type 1.

The MRT East-West Project followed the JKT North-South (N-S) Line Project which has similar characteristics. This two large-scale railway projects, MRT East-West and MRT North-South, are realized by means of new entries into the railway market in Indonesia based on Railway Law 23rd-2007.

The section of MRT North-South Line is confined only within DKI Jakarta similar to the Phase 1 section of MRT East-West Line. MRT North-South Line is now in the construction preparation stage. As an implementation structure of the MRT North-South Line Project, MRTJ was already incorporated in June 2008. MRTJ’s shareholders are composed of 99.5% DKI Jakarta and 0.5% PD Pasar Jaya.

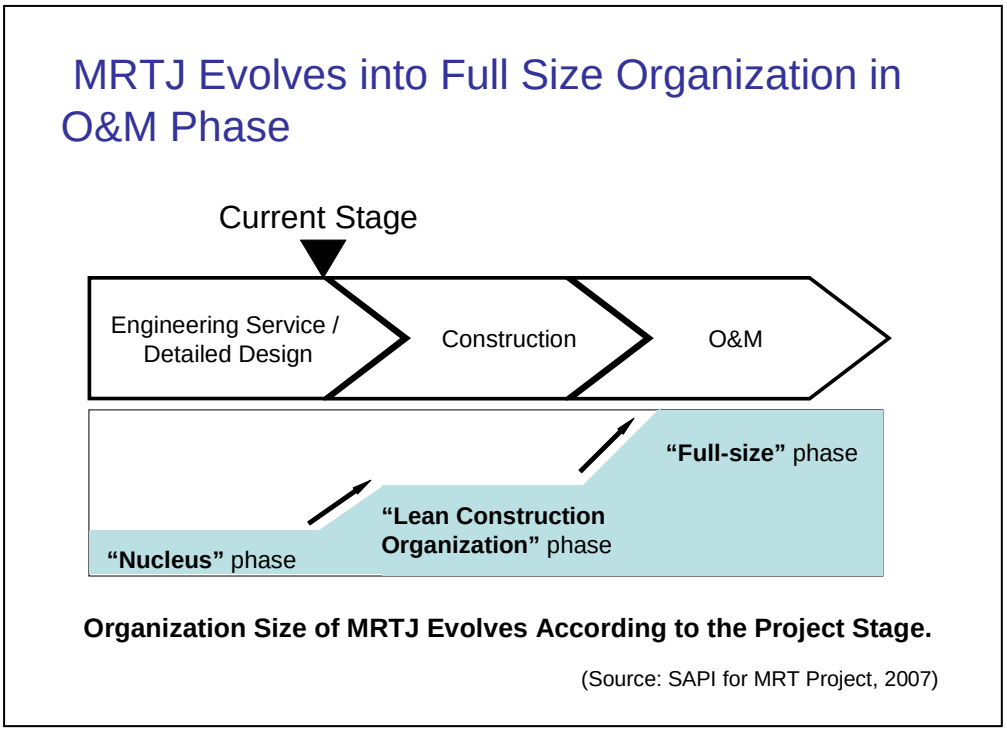
MRTJ will be responsible for all activities starting from engineering services, construction supervision, to O&M as a "Single Window" of MRT operations in DKI Jakarta.



Source: Leaflet of MRTJ

Figure 6.1-1 Relationship among MRTJ and Concerned Entities in MRT N-S Line

Though the size of MRTJ at present is limited to provide necessary bidding assistance to the MRT North-South Line Project, the organization was planned for expansion as the project progresses accordingly from the stage of construction works to O&M. It is expected that MRTJ will improve its technical capability in order to implement such activities.



Source: JICA Study Team based on SAPI for MRT Project (2007)

Figure 6.1-2 Improvement Process of MRTJ

As discussed later, it is considered that MRTJ will also perform O&M for the MRT East-West Line Project (Phase 1) for its smooth implementation and efficient operations after it opens. It should make the most of the capabilities and technical abilities obtained from the MRT North-South Line Project, and also fully utilize the benefit of economy of scale by means of common utilization of facilities and employees with MRT North-South Line.

6.2 Financial Statement, Budget and Engineering Level of Implementing Agency

6.2.1 Current Status of Railway Investment in Indonesia

As discussed in the former section, the railway network in the Republic of Indonesia is operated by PT. KAI under vertically separated structure. DGR owns all railway infrastructure except for the stations. Thus, DGR plans and manages the investment and construction of these railway facilities through its own financing.

Since PT. KAI manages railway operations for access to infrastructure after completion of the construction works, it can be one of the means that PT. KAI also supervises construction works which are funded by DGR. Nevertheless, DGR has been the one responsible for construction supervision in Indonesia. On the other hand, the railway sector in Vietnam has a very similar vertically separated structure to that in Indonesia. But in Vietnam's case, the state-owned Vietnam Railways (VNR) supervises the construction works on railway infrastructure, which is owned and funded by the government. As was indicated in the example in Vietnam, it is recommended that a single O&M entity will be responsible for the project from the construction stage to the O&M stage since such will contribute to the smooth implementation of railway operations and will clarify the responsibilities of the entity.

After the opening of railway construction works, PT. KAI will receive the Infrastructure Maintenance and Operation (IMO) and the Public Service Obligation (PSO) from DGR. Nevertheless, it has been difficult for DGR to sufficiently pay the stipulated amount because of its limited financial resources. This indicates that the financial condition of the government and PT. KAI has been difficult. Though DGR in Indonesia has implemented several railway projects, the reasons behind the failure of large-scale improvements to railway transport are not because of the lack in technical capabilities of the railway sector but of the lack in financial resources of the government and PT. KAI. This has prevented sufficient maintenance and investment to the railway systems after the construction works. The "Independent Committee Report for JABOTABEK Railway Project Assessment (2003)" also indicated the lack of sustainability of the project due to insufficient maintenance works.

6.2.2 Project Implementation Scheme and Issues

Based on the abovementioned background, the Government of Indonesia has enforced Railway Law 23rd-2007 in order to improve the railway transport services by encouraging new entries into the railway market. The MRT North-South Line and MRT East-West Line Projects are based on this new law. Contrary to past conditions, the new railway services will be provided by the entity which has entered into the market, and it is intended to establish financially sustainable regional railway systems that are supported mainly by DKI Jakarta.

In order to effectively promote the MRT East-West Line Project, the implementation structure of MRT North-South Line should be reviewed as it is followed by the MRT East-West Line Project.

As discussed above regarding the former railway projects in Indonesia, DGR is responsible for construction supervision. Thus, the entity which is responsible for construction supervision is different from the one responsible for O&M. In order to promote the railway project effectively, there should be integration of the responsibilities in the whole process of the project.

For the MRT North-South Line Project, MRTJ would manage the whole development process of the project starting from the construction supervision stage. Similar to MRT North-South Line, an O&M agency should manage the whole development process of the MRT East-West Line Project as well. Thus, it is recommended, as was planned and discussed in the next section, that MRTJ would perform O&M since it enables the utilization of technical abilities obtained from MRT North-South Line to a large extent.

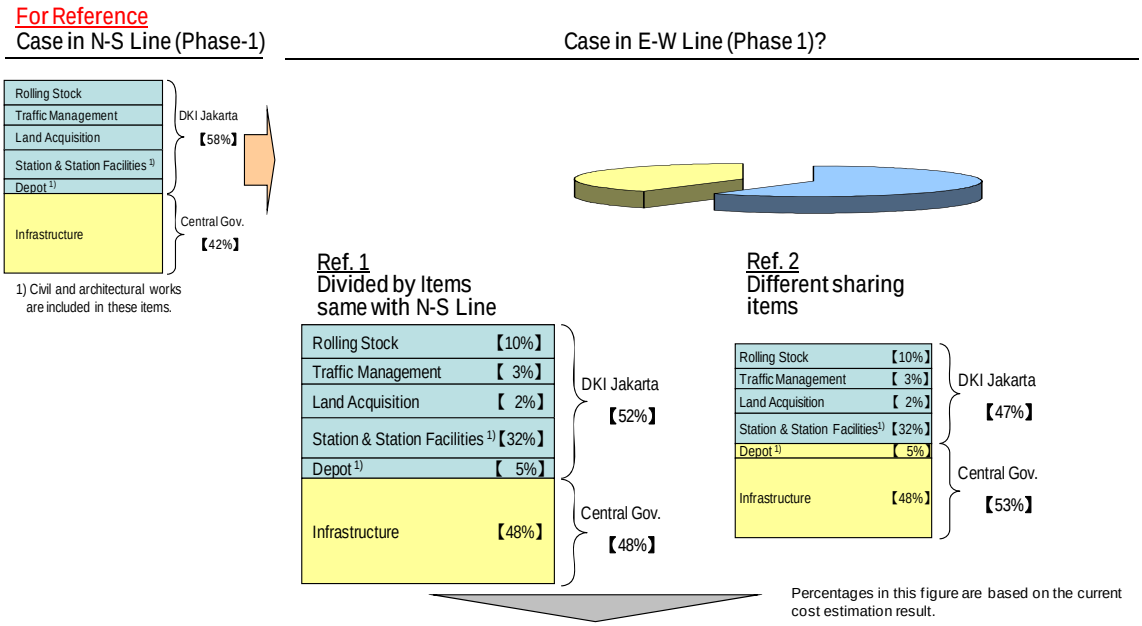
Furthermore, for promoting the MRT East-West Line Project, it is essential to study the lessons learned from past unsuccessful railway projects due to insufficient maintenance after the construction stage. In order to avoid similar problems, DKI Jakarta, which is the implementing agency of this project, should continuously support MRTJ, which is the company in charge with O&M. In order to attain sound management of MRTJ after the opening of MRT East-West Line, not only investment to construction works should be provided continuously but also other necessary supports.

In order to increase the transport volume and revenue of MRT operations, it is essential to improve passenger services for transferring between MRT North-South Line and JABODETABEC railways. The above-mentioned report, "Independent Committee Report for JABOTABEC Railway Project Assessment (2003)", also indicated the following two factors as the key issues: 1) lack of total urban transport planning; and 2) coordination with development planning around stations. These issues cannot be solved with the effort of MRTJ alone. Also, the appropriate measures by the government and DKI Jakarta are indispensable.

In addition, it is impossible to repay the initial cost of investment through the revenue of MRTJ. Thus, similar to the MRT North-South Line Project, it is necessary for the government and DKI Jakarta to provide the initial investment for MRT East-West Line Project.

Regarding initial investment for MRT North-South Line (Phase 1), a decree issued in October 2005 confirmed that the central government paid 42% of the total amount, while DKI Jakarta paid 58%. In order to reach the above agreement between the central government and DKI Jakarta, the estimate for infrastructure (including civil, track, and electric works) and for others such as land acquisition were utilized to calculate for the agreed rate.

It is also necessary to fix the rate of financing among the concerned parties in MRT East-West Line.



Source: JICA Study Team

Figure 6.2-1 Financial Arrangement Between the Central and Local Governments

It is also worth noting that many countries have introduced various measures to bear the financial resources on public transport investment. Especially, taxation at the external social costs generated by private vehicles is effective not only for bearing the financial resources but

also for solving social problems such as promoting modal shift from road (private) to public transport. Taxation on gasoline is a typical example of this.

Considering that traffic jams on roads have seriously worsened, the social environment in DKI Jakarta, it is deemed essential to plan the introduction of the above-mentioned measures.

6.3 Organization for Operation and Maintenance (O&M)

6.3.1 Advantages of Operation by MRTJ

As shown in Table 6.3-1, efficient railway operations can be attained through the following: 1) human resources management with economy of scale; and 2) shared utilization of railway infrastructure and facilities. These advantages can be attained through integrating fundamental technical/design standards and management methods for O&M with MRT North-South Line, which is planned to open in 2018. In addition, since the section of MRT East-West Line (Phase 1) is confined only within DKI Jakarta, the same laws and regulations of MRT North-South Line can be applied to MRT East-West Line (Phase 1).

Therefore as planned, it was recommended that MRTJ will also operate MRT East-West Line (Phase-1) following MRT North-South Line. Table 6.3-1 shows the advantages in case the implementation structure in which MRTJ becomes the company in charge of O&M of MRT East-West Line (Phase-1).

Table 6.3-1 Advantages of MRTJ's O&M for the MRT East-West Line Project (Phase 1)

1. Efficient Railway Operation with Economy of Scale
1) Coordinated Operations and Maintenance Covering both the MRT N-S & E-W Line Projects Efficient maintenance works can be attained through large-scale procurement and coordinated maintenance works planning. Train diagram and various passenger services can be coordinated between the two lines.
2) Coordinated Working Planning for MRTJ's Staff Efficient human resources planning can be carried out since MRTJ's staff is able to work for both lines.
3) Improvement of Engineering and Operational Abilities for Railway Operation Operational and engineering abilities gained form the MRT N-S Line Project can be utilized for the MRT E-W Line. In the long term, the capabilities of MRTJ are expected to improve.
2. Efficient Utilization of the Railway Infrastructure and Facilities
1) Integration of Railway Facilities Based on the standardization of technical specifications and railway operations by a single entity, the integration of some railway facilities can be attained between the two lines. For example, train operations systems can be set up in a single OCC building in order to minimize investment and expenses.
2) Efficient Utilization of Maintenance Machines and Facilities It will become possible to share maintenance machines and facilities between the two lines, in order to reduce investment and expenses.
3) Sharing the Rolling Stocks and Equipment for Emergencies By sharing between the two lines, the number of rolling stocks and equipment for emergencies/accidents can be reduced in order to attain efficient railway operations.

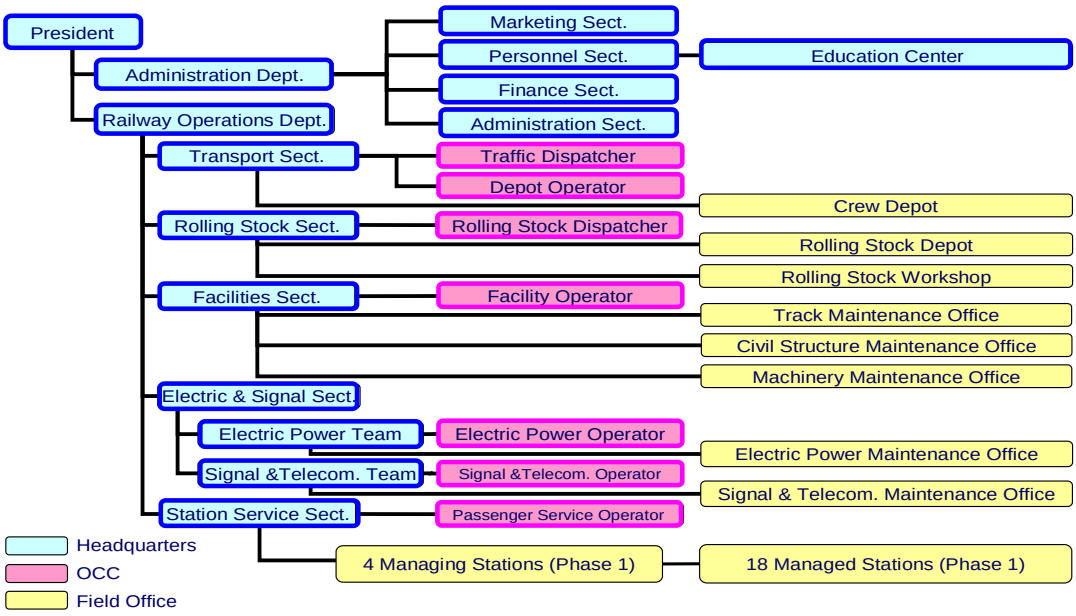
Source: JICA Study Team

6.3.2 Requirements for the Implementation Structure of MRT E-W Line (Phase 1)

This section investigates the implementation structure of MRT East-West Line (Phase 1) after completion of the construction stage.

1) Organization of the O&M Company

Though the size of organization differs depending on the length of the lines, the requirements for the O&M company and its organizational structure for MRT East-West Line (Phase 1) have many similarities with those for MRT North-South Line, since both were planned to install similar systems. An example of the organization chart of the O&M company for MRT East-West Line (Phase 1) is shown in Figure 6.3-1.



Source: JICA Study Team

Figure 6.3-1 Organization Chart for O&M Company in MRT E-W Line (Phase 1)

2) Major Roles of the Field Offices

The field offices cover many sections in the O&M company. Table 6.3-2 shows the major roles of each field office.

Table 6.3-2 Major Roles of the Field Offices

Department	Section	Major Roles
Personnel / General Affairs	Education Center	- Driver trainging to take out license
		- New emplyee training
		- Maintenance crew training
Machinery	Crew Depot	- Management of driver
		- Driver assignment
		- Driver training
	Rolling Stock Depot	- Management of rolling stock
		- Rolling stock allocation
		- Inspection of rolling stock
		- Cleaning rolling stock
	Rolling Stock Workshop	- Overhaul of rolling stock
		- Renewal of rolling stock
	Machinery Office	- Management of machinery
		- Maintenance of machinery
		<Machinery: PSD, Escalator, Elevator, Ventilator, A/C, AFC>
Civil & Track	Track Maintenance Office	- Management of track
		- Maintenance of track
	Civil Structure Office	- Management of civil structure
		- Maintenece of civil structure
		<Civil Structure: Tunnel, Viaduct>
Electricity	Electric Power Maintenance Office	- Management of electric power
		- Maintenance of electric power
		<Electric power: Contact Line, Substation, Distribution Line>
	Signal & Telecom. Maintenace Office	- Management of signal and telecommunication
		- Maintenance of signal and telecommunication
		<Signal and Telecom.: Signal, Switch Machine, Interlocking Device, Train Protection Device, Train Radio, Telephone, Disaster Prevention Device>
Operation	Managing Station (Phase1: 4 Stations)	- Train operation at stations in case of emmergency
		- Controlling of managed station
		- Passenger guidance
		- Selling ticket
		- Watching platform
	Managed Station (Phase1: 18 Stations)	- Passenger guidance
		- Selling ticket
		- Observation of platform and train

Source: JICA Study Team

3) Number of Staff for the O&M Company

The working conditions of the O&M company differ from that of ordinary companies, and are not so simple. This is because of the peculiarity of railway operations. Working in the early morning and at overnight are required, and the latter supplements night rest in the offices. Accordingly, the working pattern of drivers/crews and OCC staff cannot be fixed and their shifts are based on the above conditions. The working hours and patterns of each staff would be planned considering above mentioned special conditions, related rules and regulations for working hours in Indonesia and so on.

Table 6.3-3 shows the number of staff in each field office.

Table 6.3-3 Comparison between the Number of Staff for MRT E-W Line and MRT N-S Line

		Total Number of Staff		
		N-S Line (22.5 km)	E-W (Phase 1) (27.0 km)	E-W (Phase 1,2) (86.6km)
(A) H.Q	Headquarters	40	+10	+20
	Education Center	22	+5	+10
	OCC （Operation Control Center)	29	+25	+28
	Subtotal （A）	91	+ 40	+ 58
(B) Depot & Field Offices	Crew Depot	101	104	220
	Rolling Stock Depot and Workshop	88	88	176
	Track Maintenance Office	20	22	44
	Civil Structure Maintenance Office	10	12	24
	Machinery Maintenance Office	10	12	27
	Electric Power Maintenance Office	25	27	54
	Signal & Telecom. Maintenance Office	25	27	54
	Subtotal （B）	279	341	728
(C)Stations	Managing Stations (N-S:4) (E-W: Phase1: 4, Phase 2: 8)	140	108	216
	Managed Stations (N-S:17) (E-W: Phase 1: 18, Phase 2: 40)	340	216	480
	Subtotal （C）	480	324	696
Total （A+B+C）		850	705	1,482

(A) Staff in H.Q.：It is assumed that MRTJ operates E-W Line as well.

(C) Staff in Stations: Number of Station Staff can be rationalized in E-W Line utilizing improved Ticket Vending Machine

Source: JICA Study Team

In order to calculate the number of staff, it was assumed that MRTJ operates MRT East-West Line (Phase 1), and only the staff in the headquarters were added. This means that the number of staff can be rationalized in case MRTJ operates both lines.

Table 6.3-4 compares the number of staff between Jakarta MRT systems with that of other MRT systems overseas.

Table 6.3-4 Comparison with MRT Systems Overseas

		Number of Staff	Total Length (km)	Number of staff per km
Jakarta MRT E-W Line (Phase 1)		**705**	**27.0**	**26.1**
Jakarta MRT E-W Line (Phase 1 & 2)		**1,482**	**86.6**	**17.1**
Jakarta MRT N-S Line (Phase 1 & 2)		**850**	**22.5**	**37.8**
JAPAN+	Sapporo Metro	**643**	**48.0**	**13.4**
	Sendai Metro	**425**	**14.8**	**28.7**
	Tokyo Metro	**8,433**	**195.1**	**43.2**
	Tokyo Toei	**3,481**	**109.0**	**31.9**
	Yokohama Metro	**902**	**53.4**	**16.9**
	Nagoya Metro	**2,640**	**89.1**	**29.6**
	Kyoto Metro	**558**	**31.2**	**17.9**
	Osaka Metro	**5,605**	**129.9**	**43.1**
	Kobe Metro	**604**	**30.6**	**19.7**
	Fukuoka Metro	**585**	**29.8**	**19.6**
Hong Kong MTR ※		**8,540**	**171.3**	**49.9**
Bangkok Metro BMCL ※		**346**	**20.0**	**17.3**
Singapore	SMRT ※	**2,830**	**89.0**	**31.8**
	SBS ※	**700**	**20.0**	**35.0**
Delhi Metro DMRC ※		**945**	**22.1**	**42.8**

＋ Source : Japan Subway Association Book
※ Source : Japan Subway Association HP

In June 2008, MRTJ was already established in order to perform O&M for Jakarta MRT North-South Line. It is considered that MRTJ will also operate MRT East-West Line (Phase 1) to rationalize the organization structure and to minimize the number of its staff.

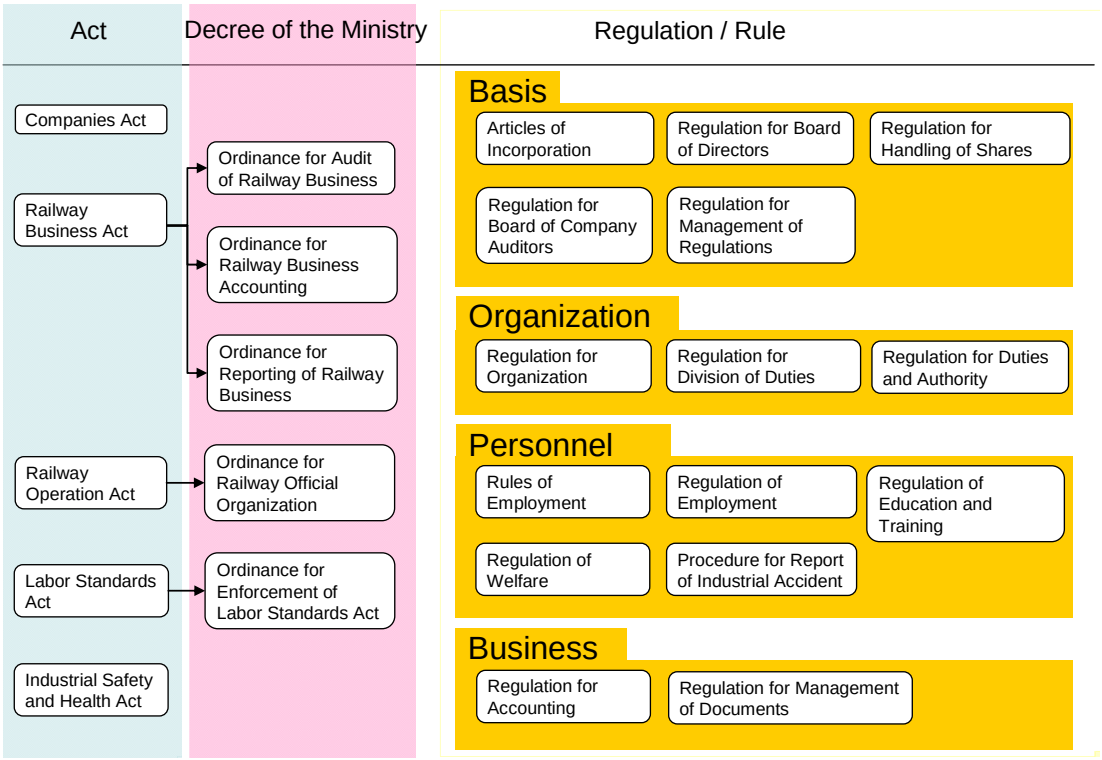
6.4 Financial Statement, Budget and Engineering Level of Operation Agency

6.4.1 Requirements for O&M Company

In order for the O&M company to operate a number of trains safely and punctually, it requires not only technical abilities of construction supervision of the system but also sufficient operational abilities to manage the completed system. It is also required for the company to prepare the rules and regulations of MRT train operations, which should be applicable to emergency cases as well.

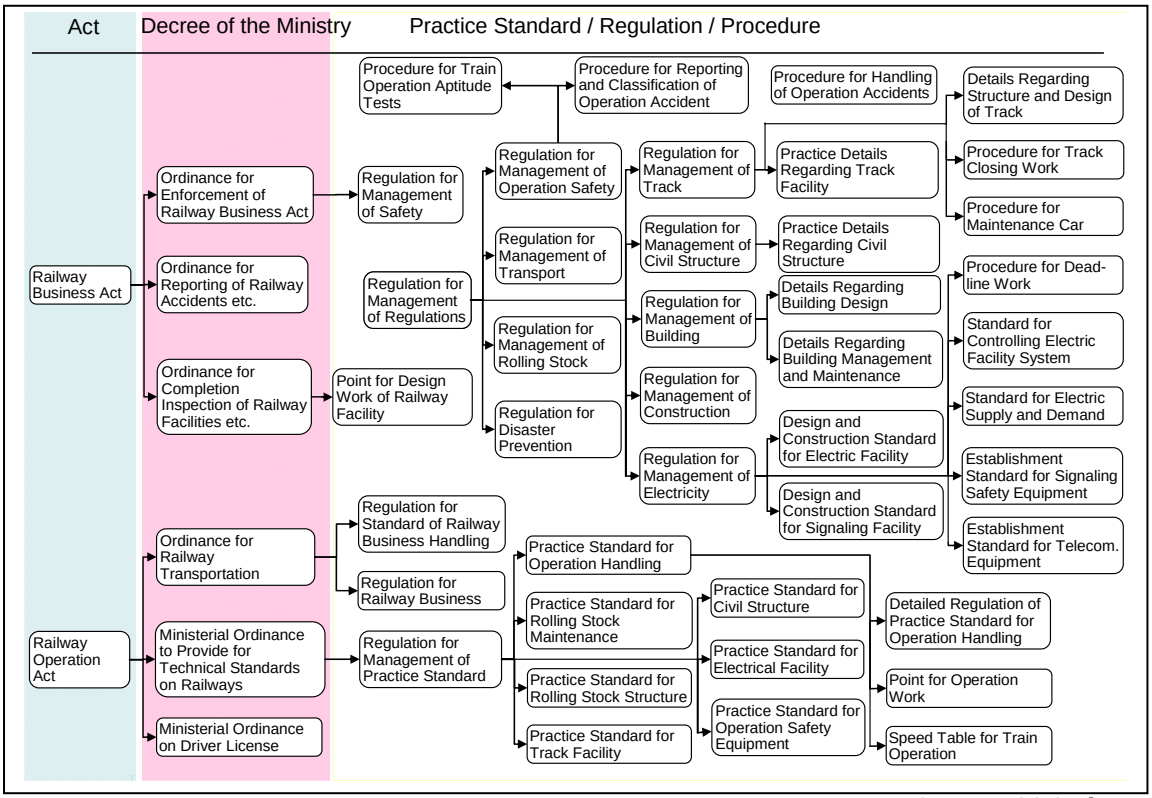
In addition, the O&M company has to acquire staff with technical abilities on managing and maintaining various assets and facilities, such as rolling stocks, signaling, telecommunications, electricity, track and infrastructure (including civil, architectural and mechanical). In order to acquire such abilities, the preparation of a set of regulations and training for the staff based on them should be completed until the opening of the MRT.

The laws, regulations, manuals and guidelines required for MRT operations should cover various fields. Examples of such in Japan are shown in Figure 6.4-1 and Figure 6.4-2.



Source: JICA Study Team

Figure 6.4-1 Example of Laws and Regulations for MRT Operation



Source: JICA Study Team

Figure 6.4-2 Example of Guidelines for MRT Operation

The Republic of Indonesia already has a nationwide railway network and accumulated experiences on railway operations. In addition, EMUs have been operated in JABODETABEK railways for some years. Therefore, the railway industry in Indonesia already has the necessary regulations and technical abilities on conventional railway operations within its organizations such as PT. KAI.

Furthermore, MRT North-South Line (Phase 1) is under preparation for construction works, and the Airport Link Railway Line to Soekarno-Hatta International Airport in Jakarta is being planned. This means that the sector is in the process of acquiring operational and engineering abilities to operate modern EMUs.

Nevertheless, MRT systems in these projects will operate faster EMUs and the number of trains will be also increased largely. Thus the more appropriate O&M abilities should be required than those for the current railway systems. In addition, the manuals and guidelines are not prepared yet for constructing and operating MRT and for new railway technologies such as ATO system and CBTC system. In order to sustain these new technologies which Indonesia will introduce in this project, it is required to prepare the necessary manuals and guidelines and provide training for the engineers.

It has already been decided that the newly established MRTJ, and not PT. KAI, will perform O&M for MRT North-South Line. It has been planned that MRTJ will also perform O&M for MRT East-West Line (Phase 1). Thus, it is essential that MRTJ prepares the necessary rules and guidelines, and gain engineering abilities necessary for the operations of the new MRT systems.

It is practically difficult for MRTJ to provide all the maintenance works by itself, and it should contract out maintenance works to other private companies. This is expected to be effective in order to promote competition among firms and encourage them to enhance their capabilities. Thus staff of MRTJ have to improve their engineering abilities so that they can supervise the maintenance works performed by private firms.

6.4.2 Financial Structure and Issues

Table 6.4-1 and Table 6.4-2 show the financial statements (Profit and Loss: P/L, and Balance Sheet: B/S) of MRTJ for the fiscal years of 2009 and 2010. MRTJ was incorporated in June 2008 by its shareholders, the Provincial Government of DKI Jakarta, and PD Pasar Jaya. (PD Pasar Jaya is a regional government-owned company.)

The current major work of MRTJ is preparing the construction works for MRT North-South Line. Thus, it does not earn revenue yet, and it is operated by utilizing its capital.

Table 6.4-1 P/L Statement of MRTJ

Unit : Million Rp.

Item	2010	2011
Operating income	-19,673	-15,068
Revenue	0	0
General and administrative expense	4,390	3,645
Other income (expense)	-16	-2
Interest income	4,375	3,643
Others (net)	-15,298	-11,425
Loss before income tax	127	-222
Income tax benefit	-15,172	-11,646
Net loss	-19,673	-15,068

Source: PT Mass Rapid Transit Jakarta Annual Report 2010

Table 6.4-2 B/S of MRTJ

Unit：Million Pp.

Item	2010	2011	Main items
1. Current assets	83,932	92,389	Cash, Deposit
2. Non-current assets	5,316	7,204	Office, Office Facilities
Total assets	89,248	99,592	
3. Current liabilities	702	871	Allowances, etc.
4. Non-current liabilities	511	859	Allowances for Retirement
Total liabilities	1,214	1,730	
5. Shareholders' equity	89,034	97,862	
Total liabilities and shareholders' equity	89,248	99,592	

Source: PT Mass Rapid Transit Jakarta Annual Report 2010

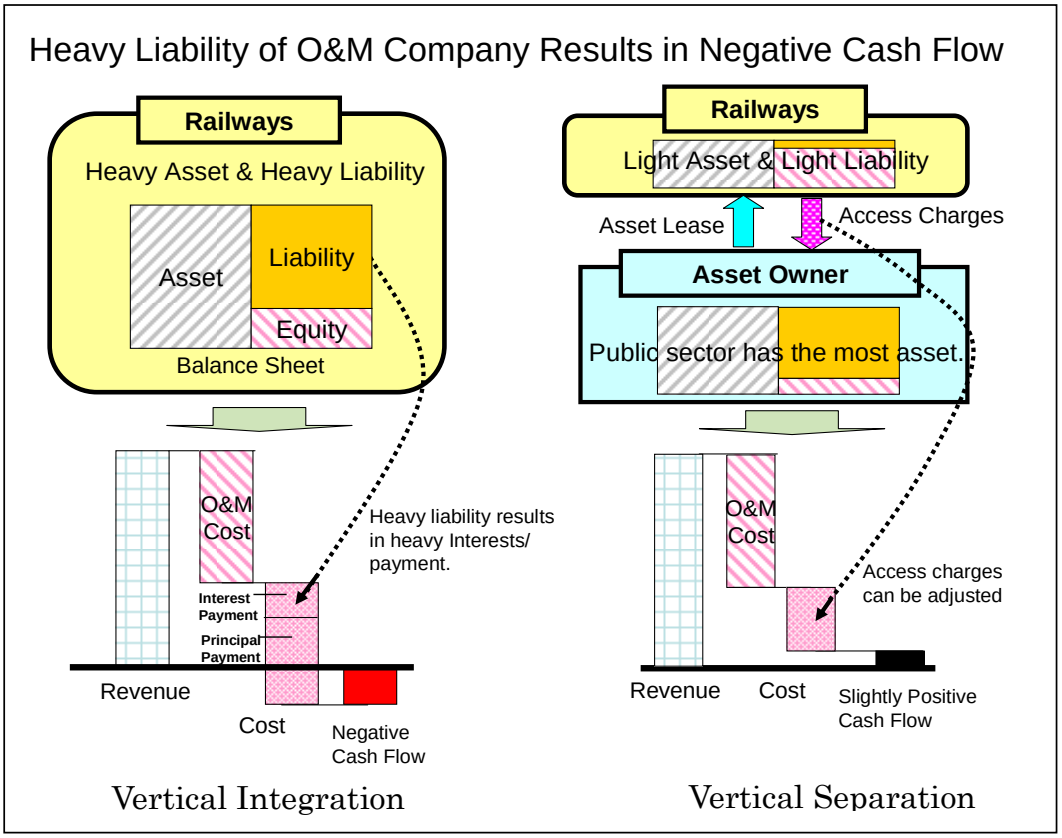
MRTJ's railway management structure largely affects its financial conditions in the process of O&M of MRT East-West Line.

Firstly, it is essential to conduct planning so that MRTJ can continue sustainable management with a positive cash flow after the opening of MRT North-South Line and MRT East-West Line. In order to attain sustainable management, the financial structure of MRTJ should be designed so that its liabilities do not deteriorate its sound management. This kind of financial structure can be realized by separating the assets and liabilities of construction costs from the balance sheet of MRTJ.

Furthermore, MRTJ can continue sustainable management with positive cash flow provided that the amount of its expenses can be adjusted by some means. Since it is very difficult to forecast the revenue and expenses accurately before the opening of the MRT system, instead of fixing the amount of MRTJ's liabilities prior to opening, it should be planned to establish the railway structure which can adjust the amount of repayment for the construction investment considering the practical transport volume.

It is essential to plan the financial structure of MRT East-West Line with close reference to the case of MRT North-South Line. Based on the above mentioned viewpoints, it appears appropriate to establish vertically separated railway structure where infrastructure asset ownership is different from the O&M company.

A comparison of financial structures between different railway models is shown in Figure 6.4-3.



Source: JICA Study Team

Figure 6.4-3 Comparison of Financial Structures Between Different Railway Models

6.5 Financial Analysis and Public-Private Partnership (PPP) Scheme

6.5.1 Development of Framework of PPP and Application to Railway Projects

The issuance of Presidential Decree No 67/2005 was a full-scale introduction of public-private partnership (PPP) in Indonesia. At present, the target GDP growth rate of the Government of Indonesia was 6 to 7%, and it is necessary to keep infrastructure development which is equivalent to 7 to 8% of the GDP in order to achieve the target. However, the government sector could finance only 3% of the GDP. Therefore, the government expected that the private sector would invest in infrastructure projects and fulfill the other 4 to 5%.

After the issuance of Presidential Decree No 67/2005, the Government of Indonesia made efforts to continuously promote PPP, such as the issuance of the Finance Minister's Decree No. 38/PMK.01/2006, the announcements of policy packages in investment and financial market reform (including reform of state-owned enterprises), changes in basic laws for railway, air transport, sea transport, power plant and oil and gas, and organizing the infrastructure summits.

However, PPP projects have not yet come into realization. One of the reasons for this is project risk. The private sector had to bear much project risk in the initial PPP framework. For example, private investors had to be responsible for land tenure. Although the public sector is responsible for providing support to projects including financial support, the support system and financial resource for the support were not clear.

The Government of Indonesia had been continuously modifying the framework of PPP, hearing the opinions of the private sector. The government then issued Presidential Decree No. 13/2010 as comprehensive improvement of the framework. The Presidential Decree basically followed the philosophy and ideas of the original Presidential Degree in 2005, but with some changes made as indicated in Table 6.5-1.

Table 6.5-1 Major Changes of Presidential Decree No.13/2010

Items	Presidential Decree No. 67/2005	Presidential Decree No.13/2010
Implementation bodies in the Public sector	Ministries, institutions and local governments	Adding state owned enterprises (BUMN) and local government owned enterprises (BUMD)
Investors and operators of PPP infrastructure projects	Transport infrastructure (railways, ports and airports), road (toll roads and bridges), water supply and sewerage, communications, power plants, and oil and gas	No change
Target sectors	Cooperation agreement or provision of operational license	Adding e-Government
Type of PPP	Fairness, openness, transparency, competition (selection of investor/operator by open bidding) and accountability, etc.	No change
Principals for PPP	Preparation of pre-F/S which is consistent with upper plans of each sector, demarcation between the public and private sectors, and financial procurement plan	No changes
Project selection process	Method of proposal of an infrastructure project which is not prepared by the public sector (not listed in the PPP Book), process of bidding and merits for the private company which proposed the project	No changes
Proposal from private sector	The Risk Management Unit under MOF analyzes and assesses the project risks, and the public sector supports the project by the central government budget or local government budget	Elaboration of conditions of the proposal from a private company Adding merits to the private company which proposed the infrastructure project (right to match)
Risk management and government supports	Transport infrastructure (railways, ports and airports), road (toll roads and bridges), water supply and sewerage, communications, power plants, and oil and gas	Detailed definition of the supports: fiscal supports (from the central government or local governments), tax exemption, provision of license, land tenure, construction of a part of the infrastructure and guarantee to the project

Source: Presidential Decree No. 67/2005 and No.13/2010

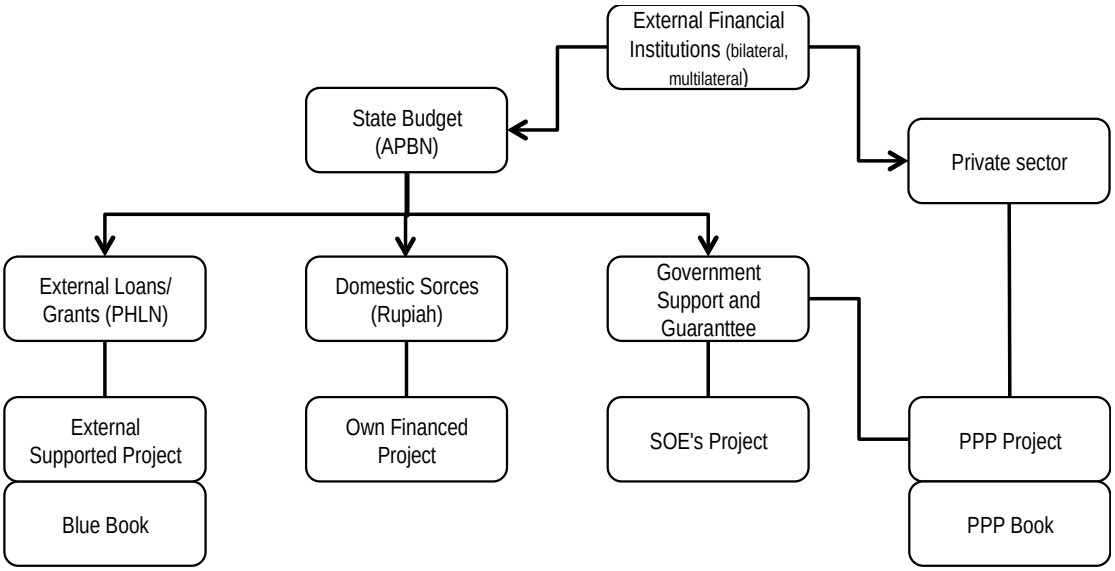
With regards to land tenure, the Government of Indonesia allotted a Rp. 6 trillion fund, and introduced a system in which the government will compensate land cost if land prices in the construction stage exceed 10% of the original cost in the planning stage. In addition, a newly proposed law on land tenure consists of an article stating that if it is judged that compulsory land tenure brings about social benefit, the government can take away the land use right from the affected inhabitants. The Government of Indonesia also set up the following funds and organizations to financially support the private sector: Project Development Facility (PDF) for PPP project formation, and PT SMI and PT IIF for management of project financing.

The Government of Indonesia also prepared the PPP Book, which is a compilation of candidate PPP projects. The latest version is PPP Book 2011 in which 79 projects (total investment volume amounts to USD 53 billion) are listed.

Under such improvements, the first project under the PPP framework, a coal-fired power plant in Central Java, was signed in October 2011. In this project, MOF provides a guarantee to a

project implementation body (PLN) and financial institutions though the state-owned guarantee corporation for PPP infrastructure development (PT PII).

Two urban railway projects, the "Soekarno Hatta Airport – Manggarai Railway Project" and the "Jakarta Monorail", were included in the PPP Book 2011.



Source: Prepared by JICA Study Team based on 'PPP in Railway Sector' a presentation material of "Indonesia Railway Conference" which was held in 21st July 2011

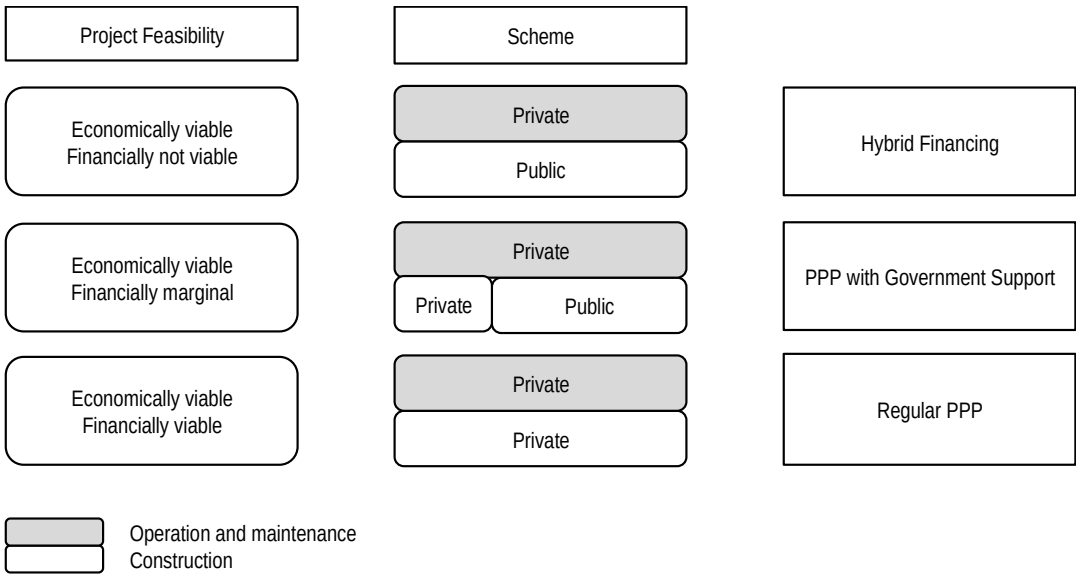
Figure 6.5-1 Relations of Financial Resources for Infrastructure Development

The relations of financial resources for infrastructure development in Indonesia are illustrated in Figure 6.5-1 The officials of BAPPENAS have an idea to employ the following different types of financing for PPP: "Hybrid Financing," "PPP with Government Support," and "Normal PPP," in accordance with difference of financial feasibility, as illustrated in Figure 6.5-2. With regards to urban railway projects, they hope for potential investors to procure rolling stocks as well as to carry out operations of the railway. The situation is "PPP with Government Support", as shown in Figure 6.5-2.

If the MRT East-West Line Project is treated as a PPP project, future investor and operator would be selected through open bidding. In that case, it might be difficult to conduct integrated operations with MRT North-South Line which will be operated by MRTJ1 in the current framework of PPP.

The Law on State-Owned Enterprises (No 19/2003) establishes that state-owned enterprises (BUMN) can receive direct appointment from the Minister of SOE for operations of PPP. In addition, the Presidential Decree regarding operations of the Circle Line Project is under preparation. The Presidential Decree enables PT. KAI to participate in the operations of the Circle Line without bidding. However, such kind of procedure is not prepared for local government-owned enterprises such as MRTJ. As discussed in this chapter, the integrated operations of both MRT North-South Line and MRT East-West Line has great benefit in terms of operations cost reduction and improvement of service quality. It is necessary for local government-owned enterprises to be appointed as operators in PPP projects.

[1] MRTJ, which is practically owned by DKI Jakarta, is classified as a private operator in the current framework of PPP, and it is possible for MRTJ to participate in the open bidding.



Source: Prepared by JICA Study Team based on 'PPP in Railway Sector' a presentation material of "Indonesia Railway Conference" which was held in 21st July 2011

Figure 6.5-2 Alternative Financing Plan for PPP

6.5.2 Asset Ownership of Railway Assets

Following MRT North-South S Line, MRT East-West Line will be the second MRT line of MRTJ. Since the operational and engineering experiences obtained through MRT North-South Line should be fully utilized, the operations structure of MRT East-West Line (Phase-1) should be the same as that of MRT North-South Line.

MRT North-South Line (Phase 1) will be constructed through financing of the central and local governments. At present, the concerned parties are negotiating on the operational structure of the MRT in the O&M stage. The operational structure consists of several types, such as subsidy method and vertical separation.

Regarding asset ownership after construction works, it will affect the railway structure largely. The asset ownership of MRT North-South Line (Phase 1) will be examined through another process of consulting services and negotiations among the concerned parties.

At present, there are various types of asset ownership in MRT systems. Even if all of the railway assets are classified into only three kinds of facilities, there would exist four types of asset ownership, as shown in Table 6.5-2.

Table 6.5-2 Forms of Asset Ownership

Structure	Vertical Separation						Integration	
	Type1		Type2		Type3		Type4	
Organization	DKI	MRTJ	DKI	MRTJ	DKI	MRTJ	DKI	MRTJ
Infrastructure (Civil)	✓		✓		✓			✓
E & M	✓		✓			✓		✓
Rolling Stock	✓			✓		✓		✓

Source: JICA Study Team

An outline of each type is as follows:

Type 1) DKI Jakarta owns all infrastructure (civil), electrical and mechanical (E&M), and rolling stocks.
Type 2) DKI Jakarta owns infrastructure (civil) and E&M, and MRTJ owns rolling stocks.
Type 3) DKI Jakarta owns infrastructure (civil), and MRTJ owns E&M and rolling stocks.
Type 4) MRTJ owns all infrastructure (civil), E&M and rolling stocks.

As discussed above, asset ownership of railways varies from Type 1, in which the local government owns all assets, to Type 4, in which the railway company owns all assets. For Types 1, 2 and 3, the local government owns at least some of the railway assets.

In these three types, the railway asset owner is different from the train operator. This kind of railway structure is called "vertical separation". On the other hand, Type 4 is of the integrated structure in which the train operator owns the railway asset. As an example, Japanese MRT systems, which have extremely large transport volume, are operated by vertically integrated structure in general. Vertical separation has been getting common over the world in the recent years.

The management structure of MRT largely varies from vertically separated structure (Types 1, 2 and 3) to integrated structure (Type 4), and the asset ownership of MRT North-South Line is not yet fixed. Regarding the asset ownership of MRT East-West Line (Phase 1), it is crucial to plan with close reference to the form of MRT North-South Line.

6.5.3 Analysis of Railway Structure (Vertical Separation)

Under vertically separated structure, DKI Jakarta owns the asset of the MRT system. Thus MRTJ pays access charges to DKI Jakarta after the opening of the MRT system. Based on the concession contract between DKI Jakarta and MRTJ, the latter has the right to utilize the MRT system exclusively during the concession period, and operates the trains as it is stipulated on the contract.

For the railway structure, introducing vertical separation has the following advantages:

1) Improving the accountability of public investment on railway infrastructure

In case the local government (DKI Jakarta) owns railway infrastructure such as track, in general, it can improve the accountability for public investment to the infrastructure. Through defining the railway infrastructure as the local government's asset, it becomes more reasonable for the local government to invest into the railway infrastructure. The tax payer might accept public expenditure to the railway infrastructure, such as its construction, improvement, maintenance and renewal, rather than paying subsidies to the railway operator. Vertical separation can be beneficial for promoting equal-footing with other transport modes as well. In other words, vertical separation can put the railway sector on the level-playing field with other modes such as roads.

2) Railway operations by an independent firm

Even the railways are at a loss with the integrated structure, such can be operated with profit-making management by an independent firm by way of vertical separation, in which the local government owns the infrastructure and bears a part/all of its costs such as for construction, improvement and maintenance. In other words, vertical separation can free the railway operator from the burden of infrastructure costs. This can balance the budget of the railway operator making independent management possible.

3) Railway management based on concession agreement

In the recent years, competitive bidding for rail passenger services has been getting common in some countries such as in Europe. At present, DKI Jakarta requires a railway operator that can operate urban railways efficiently. Thus it is essential to develop the engineering and

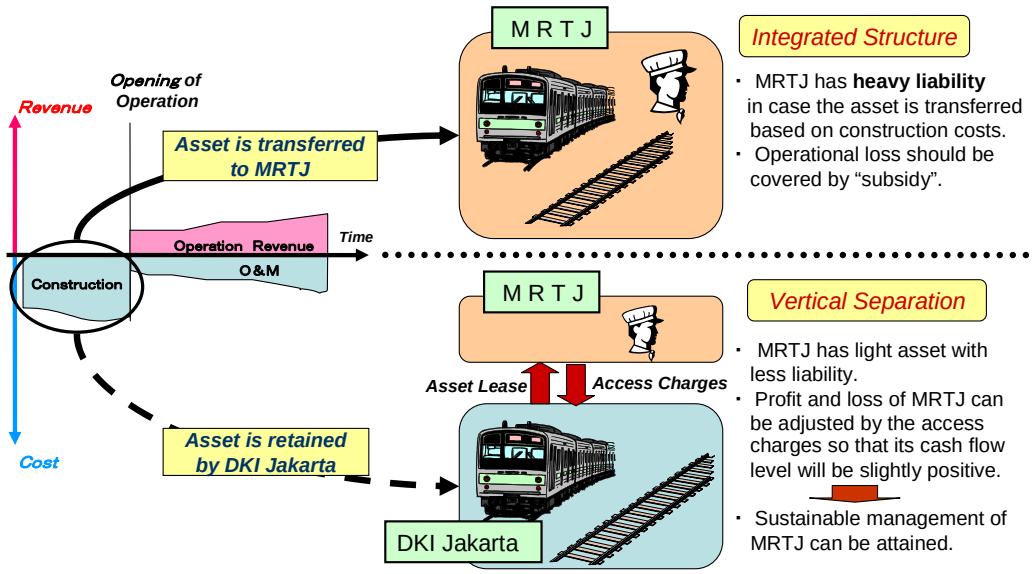
operational abilities of MRTJ. In this regard, the concession contract between DKI Jakarta and MRTJ should not be made based on competitive bidding but rather on the negotiations between the two parties.

On the other hand, the major aim of MRT in DKI Jakarta is not to increase the income of the firm but rather to improve the urban environment through modal shift. Therefore it appears to be rational to make a concession agreement between DKI Jakarta and MRTJ since it is possible for DKI Jakarta to coordinate the planning and operations of MRT with other transport modes, urban planning, and so on.

4) Sustainable management of the railway operator

The railway sector has the following characteristics: 1) the infrastructure is invested through public financing; 2) introducing competition in the railway sector is difficult in general; 3) the major aim of the sector is to improve the urban environment through modal -shift. Based on the above background, it appears unreasonable if the railway operator gains large profit. However, it should be avoided for the railway operator to go into bankruptcy or receive huge amount of subsidy every year. Under the structure of vertical separation, the access charges can be utilized in order to adjust the profit of MRTJ. This will realize the long-term sustainable management of MRTJ.

A comparison of the different railway structures is shown in Figure 6.5-3.



Source: JICA Study Team

Figure 6.5-3 Comparison of Railway Structures

6.5.4 Selection of the Railway Operator

The Government of Indonesia originally made the laws on the PPP scheme in 2005, which were modified in the latter years. Some measures were also prepared in order to lessen the risk of the private sector on land acquisition, and to provide public support in case the private sector cannot expect sufficient amount of profit.

It is possible to consider inviting private firms as an operator of the MRT East-West Line (Phase 1); However, it has the following challenges:

1) Risk of bankruptcy of the new operator

Railway operation services should be provided for many years, and bankruptcy of the railway operator should be avoided by all means. It is difficult to forecast the long-term profit and loss of the operator at the bidding stage, and there are many examples of modifications to the

concession contract and bankruptcies of the operator after the contract, even in European countries with extensive experience in competitive bidding.

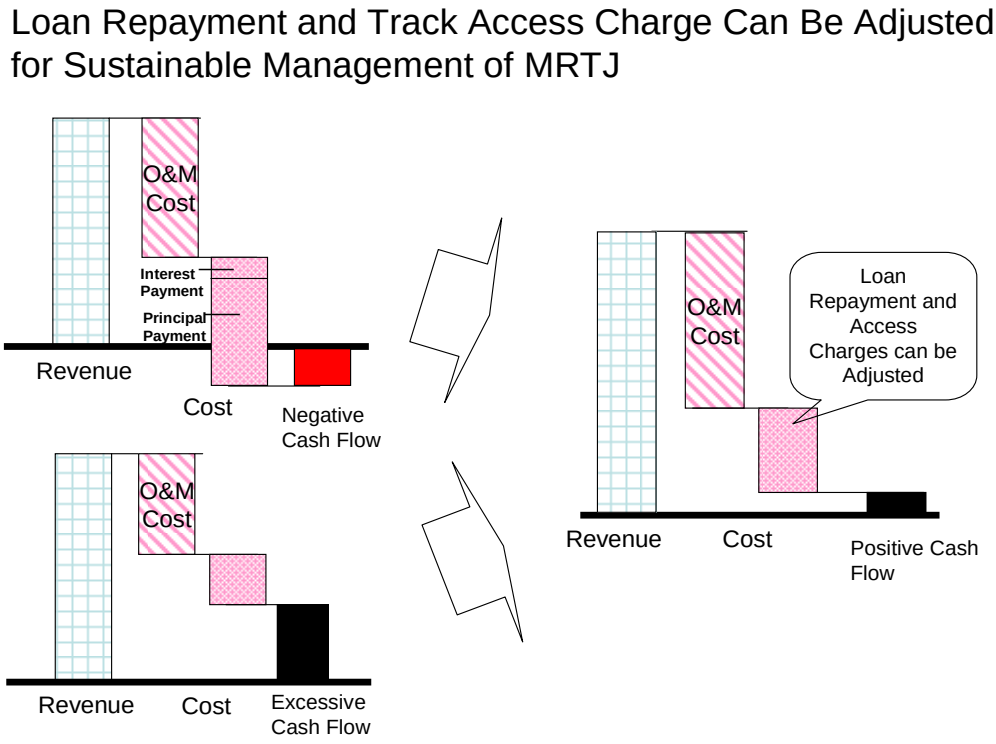
2) Unstable management of the railway operator

As stated above, bankruptcy of the railway operator must be avoided by all means. However, it is expected from the public to think against the fact that a railway operator earns so much profit since it exclusively utilizes the railway infrastructure that have been constructed through public financing. Infrastructure access charges and repayment of a part of investment are included in the expenses of the railway operator in the O&M stage. Therefore it would be possible to continue the sustainable management of the railway operator provided that the amount of the above expenses can be adjusted.

Modification of the access charges and amount of the repayment means the revise of the concession contract between the railway operator and the asset owner. Nevertheless, it would be very difficult to revise the concession contract between the public sector (DKI Jakarta) and the private sector (the new entrant) since they have conflicts of interest. On the other hand, revision of the contract is expected to be relatively easier in case the contract is made between the public sector (DKI Jakarta) and the public company (MRTJ).

This means that the concession contract with MRTJ is more appropriate than that with a private railway company. Therefore the railway operator maintains sustainable management with a slightly positive cash flow since revising the access charges and repayment is effective sustainable management. In addition, it is expected to easily revise the former contract rather than the latter contract.

The outline of loan repayment and track access charges in terms cash flow of MRTJ is shown in Figure 6.5-4.



Source: Revision of " SAPROF for MRT System (2005)"

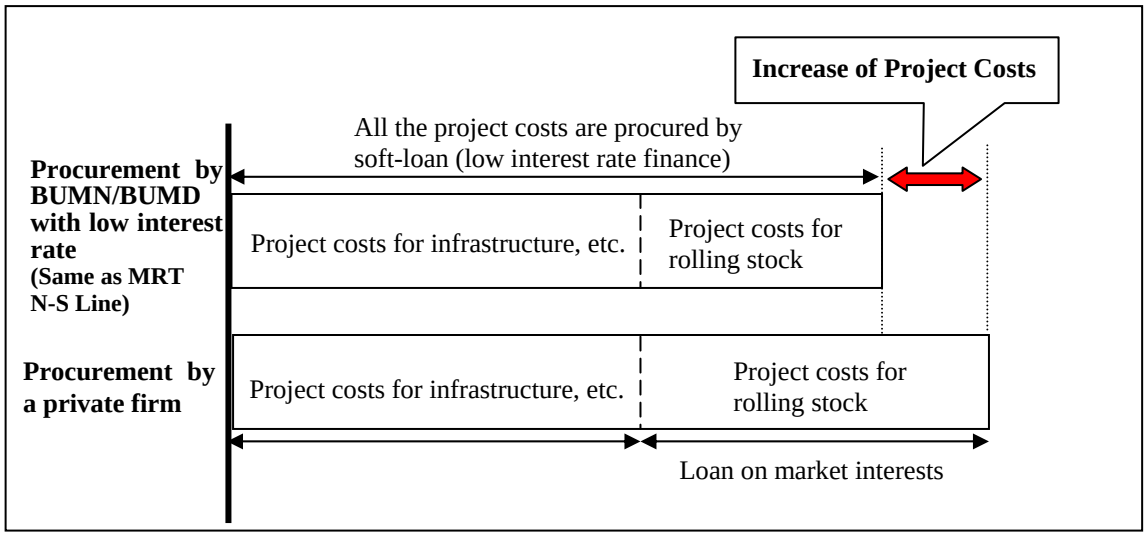
Figure 6.5-4 Sustainable Management of the Railway Operator

3) Increase of the project cost through rolling stock procurement with market interests

The private sector joining in the infrastructure projects must borrow funds with market interests although the Government of Indonesia can guarantee financial procurement. On the other hand,

the central or local governments, BUMN and BUMD can acquire a low interest soft loan through a multilateral development bank. As of November 2011, an ODA loan from JICA to the Government of Indonesia is set at 1.4 % for standard ODA loan. The interest rate of a World Bank loan is expected to be about 1.20% (LIBOR base, USD, fixed spread). On the other hand, 200-300 basis point (2-3%) risk premium is expected to be added on World Bank's loan interest in case they procure a long-term financial loan with market interest.

Provided that the normal yen loan will be provided with the interest of 1.4%, and that the market interest is 3.2%, the difference would be as much as 1.8%. The financial analysis of the railway sector in Section 9.3.4 calculates that the total interest on soft loan procurement amounts to JPY 27 billion (Rp. 2,990 billion), and that on market loan procurement amounts to JPY 62 billion (Rp. 6,834billion). Their difference results in the increase of the project costs.



Source: JICA Study Team

Figure 6.5-5 Increase of Project Costs under PPP Scheme

4) Risk of non-participation by the private sector

In order to make the private sector join the MRT project and procure rolling stocks, a certain level of equity IRR should be secured. Based on the financial analysis of the railway sector in Section 9.3.4, the equity IRR is not more than 8.3%. (It was calculated on the condition that the private sector obtains a loan with a market interest rate to procure rolling stocks and carry out O&M in both Phases 1 and 2.) This level appears to be accepted by the public sector, BUMN and BUMD. Nevertheless, it is uncertain whether this level can be accepted by the private sector, which has to pay corporate taxes and count premiums for taking project risks.

5) Increase of O&M costs by the new operator

In case the private sector (including MRTJ) finances the procurement of rolling stocks and so on, the railway operator should be selected by competitive bidding. As a result of competitive bidding, an operator different from MRTJ might be selected as the O&M company for MRT East-West Line (Phase 1).

In this case, inefficient operations might be provided since the engineering abilities gained from MRT North-South Line cannot be utilized. In addition, the O&M costs might increase since the operations of MRT North-South Line, such as sharing of maintenance machines, cannot be realized and the new operator cannot receive the benefit of economy of scale. The increase in O&M costs would result in the increase of the total project cost.

Based on the above-mentioned issues, inviting private firms should not be applied to the MRT East-West Line Project. Instead, similar to MRT North-South Line, a low interest rate through public financing should be utilized for the construction works, and MRTJ should perform O&M

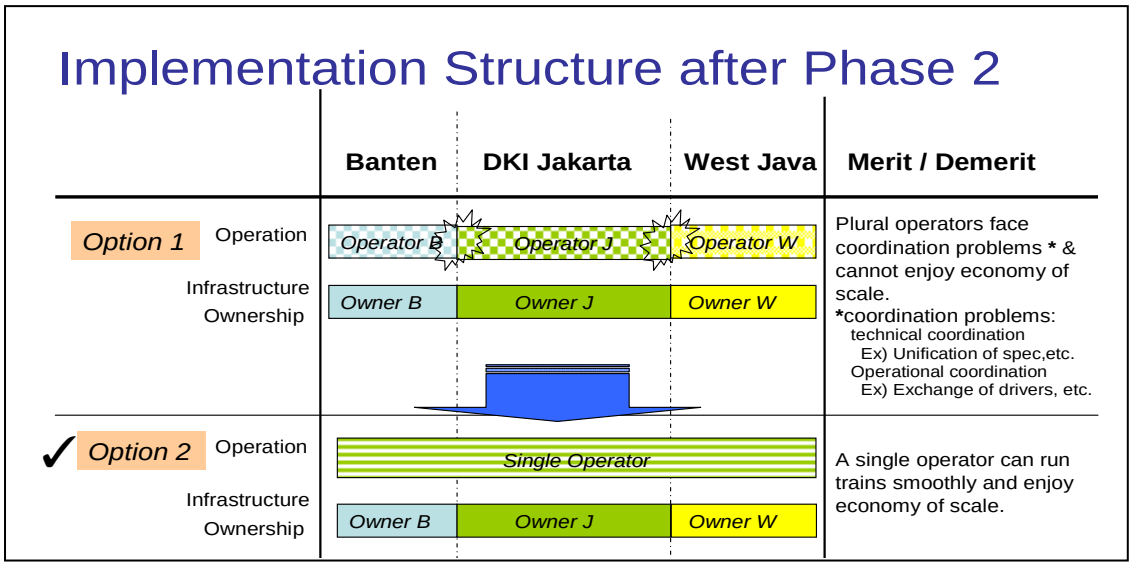
efficiently with economy of scale utilizing its know-how gained through the MRT North-South Line Project. In order to attain this, it is recommended to establish the regulations so that BUMD can join in PPP projects not by competitive bidding but through negotiations. This regulation is similar to BUMN being able to join in PPP projects through negotiations based on the decision by the minister of state-owned companies.

6.6 Implementation Structure After Phase 2

After Phase 2 of the MRT East-West Line Project, the total section of the project will cover not only DKI Jakarta Province but also Banten and West Java Provinces. The concession contract for O&M of the MRT would be required not only with DKI Jakarta but also with other two provinces. Thus, regarding the O&M structure for MRT East-West Line after Phase 2, there are several possible structures as listed in Figure 6.6-1.

In Indonesia, DGR owns the nationwide railway network, and PT. KAI operates the railways under vertically separated structure. The MRT systems within DKI Jakarta, similar to the bus rapid transit (BRT) systems (TransJakarta), have been under planning for them to be operated under vertically separated structure in which DKI Jakarta owns the infrastructure. Based on these present conditions, this section assumes that Banten and West Java Provinces own the asset of the MRT system in the extended sections of Phase 2.

Although the railway line covers the three provinces in Phase 2, in case the different railways operate in each province, they cannot receive the benefits of economy of scale, and they also face difficult coordination problems among operators. Therefore, even if the owners of the infrastructure are different, the implementation structure, in which a single operator performs railway operations on the total section across the three provinces, is expected to be appropriate.



Source: JICA Study Team

Figure 6.6-1 Implementation Structure after Phase 2

The representative implementation structures of MRT East-West Line after Phase 2 are shown in Figure 6.6-1. Among the five types shown, the three types which appear to have more advantages are explained below.

【Type No.2】

Similar to the implementation structure based on the concession contract between DKI Jakarta and MRTJ, Banten and West Java Provinces would also make concession contracts with MRTJ. This would make it possible for MRTJ to operate the total section after Phase 2.

【Type No.3】

The three provinces would establish a coordinating authority, which will stipulate the principles for the operations of MRT East-West Line (Phase 2) and make a concession contract. MRTJ is not required to make separate contracts for each of the three provinces, and it would be possible for MRTJ to provide O&M services based on a single concession contract with the authority. Since the authority coordinates and settles the fundamental principles of MRT operations, this structure has the advantage of MRTJ not needing to worry about the different opinions of various provinces. In this regard, smooth railway operations can be expected.

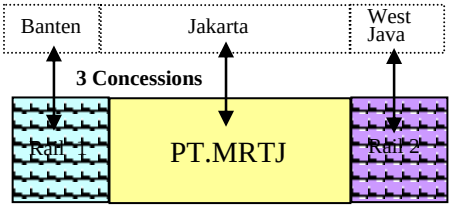
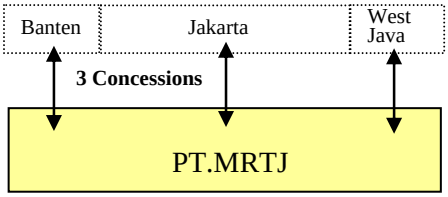
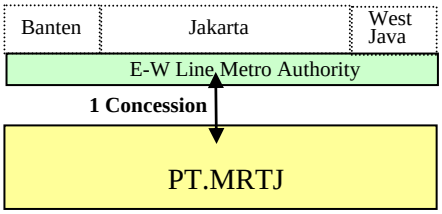
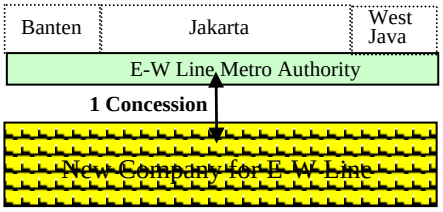
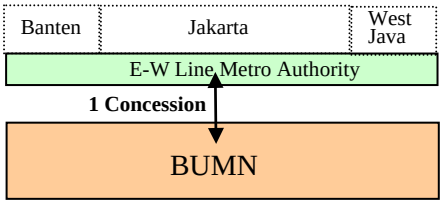
【Type No.4】

For the operations of Phase 2, a new company would be established from investment of Banten and West Java Provinces, and this new company would provide O&M services after Phase 2. From the investment and provision of management know-how by MRTJ, it would be possible to utilize MRTJ's engineering and operational abilities after Phase 2 as well. Although the new company can be an affiliate company of MRTJ, it will still be an independent company. Since it should create some divisions such as headquarters, the benefits of economy of scale can be limited to some extent as compared with the other two types above-mentioned.

"Railway Law 23rd-2007" regulates that the different organizations stipulate the railway businesses according to the area of the network. Since the railway network of MRT East-West Line (Phase 2) crosses the border of a province, DGR would stipulate the railway businesses in Phase 2 of MRT East-West Line.

Considering the characteristics of each type mentioned above, it is necessary for DGR and concerned entities such as DKI Jakarta, West Java and Banten, to plan the implementation structure of MRT East-West Line (Phase 2).

Table 6.6-1 Implementation Structure for MRT E-W Line (Phase-2)

Form	Implementation Structure	Implementation Structure, Merit and Demerit		Suitability
1		Structure	Banten & West Java also make a concession contract with MRTJ.	
		Merit		
		Demerit	1) Three railways have coordination problems among them. 2) Three railways cannot receive the benefit of economy of scale.	
2		Structure	MRTJ will make concession contracts with Banten and West Java as well.	
		Merit	1) MRTJ operates the total section and can receive the benefit of economy of scale with MRT N-S Line as well. 2) MRTJ does not have coordination problems with other railways.	○
		Demerit	1) MRTJ has to make concession contracts with plural Provinces.	
3		Structure	Three Provinces establish an Authority, and MRTJ makes a concession contract with this Authority.	
		Merit	1) Same as Merit No.1 of Form 2 2) Same as Merit No.2 of Form 2 3) MRTJ does not need to coordinate the different opinions of the Provinces, since the Authority makes a principle for MRT operation.	◎
		Demerit		
4		Structure	A new company will be established invested by MRTJ and two Provinces (Banten & West Java). The new company will make a concession contract with the Authority.	
		Merit	1) The new company can operate the total section of MRT E-W Line (Phase 2) efficiently. 2) Same as Merit No.2 of Form 2 3) Same as Merit No.3 of Form 3	○
		Demerit	1) The benefit of economy of scale with MRT N-S Line would be limited to some extent, since MRTJ and the new company are independent.	
5		Structure	A railway that has no relationship with MRTJ operates MRT E-W Line.	
		Merit	1) Same as Merit No.2 of Form 2 2) Same as Merit No.3 of Form 3	
		Demerit	1) It cannot utilize operational abilities of MRTJ although it has accumulated them through MRT N-S Line. 2) It cannot receive a benefit of economy of scale with MRT N-S Line.	

Source: JICA Study Team

6.7 Technical Assistance for Implementation and Operational Agencies

In order to carry out efficient and appropriate O&M of the project, the following proposals on technical assistance are provided to the implementation and operational agencies.

6.7.1 Technical Assistance for Safe and Efficient Railway Operation

In order to safely and efficiently perform O&M of the MRT system, it is essential to plan and design the appropriate railway facilities. MRTJ is recommended to plan and install safety systems and facilities with low maintenance costs. The following are some examples of such facilities:

- Modern safety train operation systems, such as ATO and ATC
- Platform screen doors
- Supervisory control and data acquisition (SCADA) system
- Disaster prevention systems

In order to install railway facilities that can contribute to safe MRT operations and efficient facility maintenance, technical assistance from the planning and design stage would be effective.

6.7.2 Technical Assistance for Introducing Asset Management Systems

In order to sustain safe and stable MRT transport services, it is necessary to perform appropriate maintenance works on the MRT system continuously. For efficient maintenance works, the introduction of an asset management system is effective.

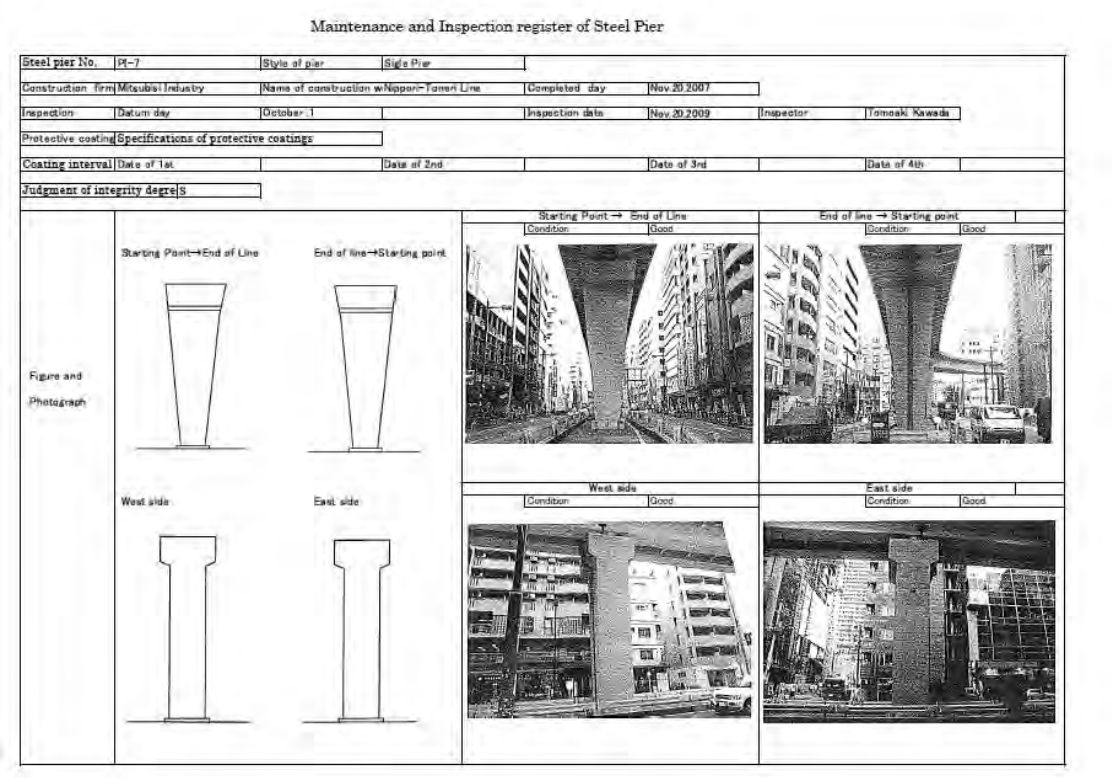
By promoting electrification of drawings and maintenance records of the assets of MRT systems, it would become possible for several different sections to access the newest data of the assets. This would be very effective for efficient operations of the MRT system.

Especially, it has been planned that MRT East-West Line (Phase 1) would apply a vertically separated structure, in which DKI Jakarta owns the railway assets and MRTJ performs railway operations. In case this structure is practically applied to the project, the asset management system plays an important role for efficient O&M since such system enables DKI Jakarta, the asset owner, to access updated data of the MRT systems.

The asset management system can manage the data of each asset systematically. Staff can input and review the data of the asset such as location on the map, drawings, ledgers, inspection records and maintenance records. In addition, based on the data on ledgers and inspection records, it can evaluate the present condition of the assets. It can also forecast the future conditions of the assets, and support the most appropriate maintenance works plan.

A number of Japanese railway operators have introduced asset management systems and have already obtained experiences on asset maintenance utilizing the system. Therefore it is possible to provide technical assistance for the introduction of an appropriate asset management system and for training the staff of MRTJ.

Figure 6.7-1 and Figure 6.7-2 show examples of the forms in the system.



Maintenance and Inspection register of Steel Pier

Steel pier No.	Pt-7	Style of pier	Sigle Pier				
Construction firm	Mitsubisi Industry	Name of construction w	Nippori-Toneri Line	Completed day	Nov.20.2007		
Inspection	Datum day	October .1		Inspection date	Nov.20.2009	Inspector	Tomoaki Kawada
Protective coating	Specifications of protective coatings						
Coating interval	Date of 1st		Date of 2nd		Date of 3rd		Date of 4th
Judgment of integrity degree	S						

Figure and Photograph

Starting Point→End of Line

End of line→Starting point

West side

East side

Starting Point → End of Line — Condition: Good

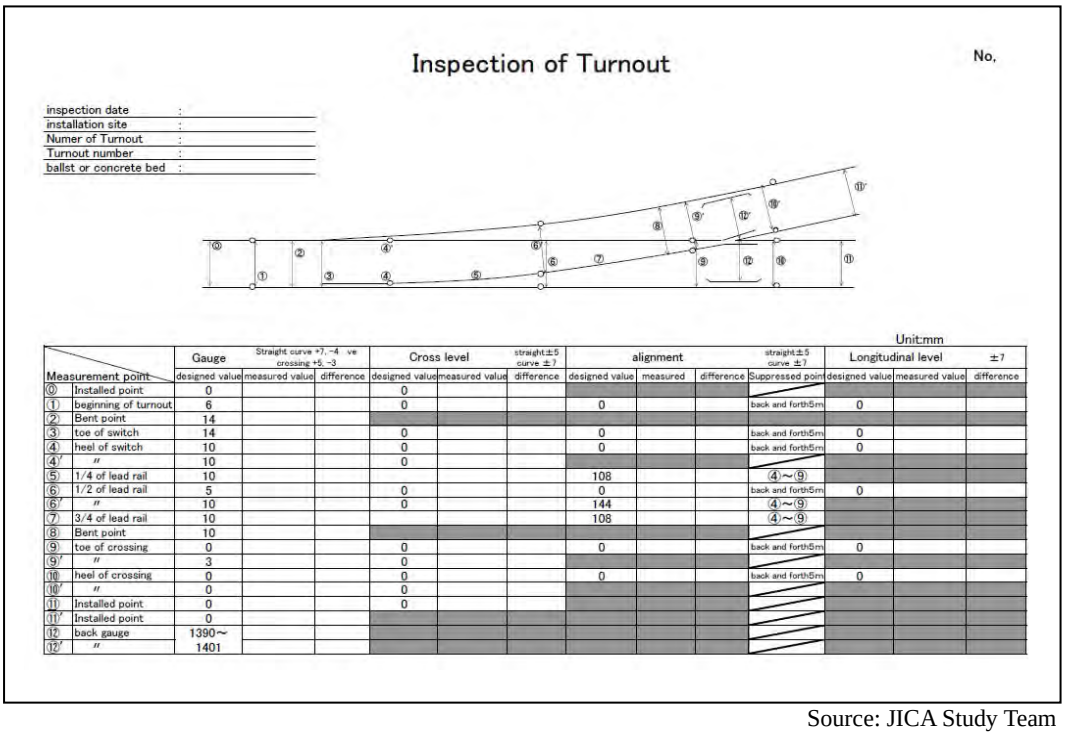
End of line → Starting point — Condition: Good

West side — Condition: Good

East side — Condition: Good

Source: JICA Study Team

Figure 6.7-1 An Example Form in Asset Management System (Civil Structure)



Inspection of Turnout

No,

inspection date :
installation site :
Numer of Turnout :
Turnout number :
ballst or concrete bed :

Unit:mm

Measurement point		Gauge	Straight curve +7, −4 ve crossing +5, −3			Cross level	straight:±5 curve ±7		alignment			straight:±5 curve ±7	Longitudinal level		±7
		designed value	measured value	difference	designed value	measured value	difference	designed value	measured	difference	Suppressed point	designed value	measured value	difference	
⓪	Installed point	0			0										
①	beginning of turnout	6			0			0			back and forth5m	0			
②	Bent point	14													
③	toe of switch	14			0			0			back and forth5m	0			
④	heel of switch	10			0			0			back and forth5m	0			
④′	〃	10			0										
⑤	1/4 of lead rail	10						108			④～⑨				
⑥	1/2 of lead rail	5			0			0			back and forth5m	0			
⑥′	〃	10			0			144			④～⑨				
⑦	3/4 of lead rail	10						108			④～⑨				
⑧	Bent point	10													
⑨	toe of crossing	0			0			0			back and forth5m	0			
⑨′	〃	3			0										
⑩	heel of crossing	0			0			0			back and forth5m	0			
⑩′	〃	0			0										
⑪	Installed point	0			0										
⑪′	Installed point	0													
⑫	back gauge	1390～													
⑫′	〃	1401													

Source: JICA Study Team

Figure 6.7-2 An Example Form in Asset Management System (Turnouts)

6.7.3 Technical Assistance for Improving Capabilities of MRT Operation

For the smooth operations of MRT East-West Line (Phase 1), it is essential to arrange the implementation structure of the O&M company so that most of the rules and know-how in O&M of MRT North-South Line can be utilized to MRT East-West Line (Phase 1).

Since skilled workers of electrified railway systems are limited in Indonesia at present, it is essential to make the most of their knowledge and experience to educate new employees. In order to establish the new organization effectively, in addition to recruiting talented new staff, it is recommended to utilize the O&M staff of MRT North-South Line. Furthermore, they should be trained sufficiently by utilizing various forms such as trial train operations, system functioning tests and so on.

In order to train skilled engineers into managing and maintaining a modern railway system, the training program is very important. Though on-the-job training would be the most fundamental one, some off-the-job training programs also play an important role to train workers. Since the network of urban railways extends and expands, the establishment of a training center might become worth planning for.

There are several developed passenger (urban) railways in Japan, which have trained their employees within their organization. Not only do they have valuable experiences obtained from their training programs on railway business, some have accepted foreign railway engineers so far. Offering such kind of training programs to the staff of an operating company is one of the ways to improve their skills.

Though the contents of education and training have similarities with those established in MRT North-South Line, it would be necessary to hire additional staff and train and educate them for the opening of MRT East-West Line (Phase 1)

Training and education programs should be provided according to the categories of MRT staff. Especially, those under the engineering divisions should be enriched.

Table 6.7-1 and Table 6.7-2 show the categories of staff and the outline of the program, respectively.

Table 6.7-1 Categories of Staff

Section	Categories of Staff
Administration	administration, finance and accounting, personnel, safety management, asset management, affiliated businesses
Transportation	OCC staff, drivers, station staff, trainers in the transport section
Engineering	civil engineers and track maintenance engineers electrical engineers (traction, signaling and telecommunications) rolling stock engineers trainers in the training center

Source: JICA Study Team

Table 6.7-2 Outline of Training and Education in Engineering Section

Categories of Training and Education	Outline of Training & Education
Training during the stage of construction of the MRT system (engineers)	・inspection at depots, testing for acceptance, testing for the completion of works ・testing method at the opening of the MRT system
Training after the opening of the MRT systems	・concerned laws and internal rules ・safety management ・passenger services ・inspection and testing of rolling stocks and other assets

Source: JICA Study Team

6.7.4 Technical Assistance for Effective Utilization of Railway Track

The railway tracks will be extended beyond the area of DKI Jakarta in MRT East-West Line (Phase 2). At present, engineering works for converting into double tracks are in progress for Tangeran Line, consequently increasing the track capacity of the line. Thus the number of trains operating in Tangeran Line can also be greatly increased. Since Tangeran Line has a straight alignment for its most part, it is very suitable for MRT operations.

Since both signaling systems and railway operators are different between MRT East-West Line and Tangeran Line, there is a plan for the rolling stocks of MRT East-West Line not to access Tangeran Line in Phase 2.

On the other hand, there are many examples in European countries and in Japan wherein the rolling stocks owned by different operators access the same track. Certainly, it is important to investigate whether the train delays in Tangelran Line do not affect proper train operation in MRT East-West Line. Nevertheless, in case the rolling stocks of MRT East-West Line (Phase 2) can access Tangeran Line, which would apply double tracks, it would decrease the investment cost largely since land acquisition and construction of viaducts and tracks would be unnecessary.

Since the railway reform in Indonesia in 1992, the government owns the railway infrastructure including that of Tangeran Line, with PT. KAI operating the line. Regarding railway operations with rolling stocks owned by two different companies that can access the same track, there are two kinds of railway operations: 1) through train services with shared operations, which is common in Japan; and 2) vertical separation with many operators, which is common in European countries.

In Railway Law 23rd-2007, although there are regulations on railway services for new entities other than PT. KAI, it is expected that the concerned parties will agree in which a single operator (e.g. PT. KAI) would be responsible for the entire railway operations. Fortunately, Japanese railways have much more experiences in this type of operation than other railways overseas. Under this type of railway operations, neither competition among operators nor complicated procedures such as payment of access charges would occur.

In order for the rolling stocks of MRT East-West Line access the track of Tangeran Line, it is essential to have an understanding and mutual agreement among the concerned parties such as the O&M company, PT. KAI and DGR. However, it can result in largely decreasing the amount of investment costs.

During the promotion of this study, it was expressed that MRT East-West Line should be operated on an independent railway track different from Tangeran Line. Before the final decision of the operational method in this section in Phase 2, it is worthwhile for the concerned parties to deepen their understanding on how various rolling stocks access different tracks, such as some cases in Japan and other countries.

Among the abovementioned suggestions, Japanese railways in particular and the concerned industry have accumulated the abundant experiences and know-how in the following topics: 1) system planning and designing for safe and efficient operations; 2) asset management; and 3) effective utilization of railway tracks. Technical assistance can be effective especially in case it is implemented from the planning stage with close mutual relationship.

Chapter 7 Environmental and Social Considerations (Phase 1 Section)

7.1 Preparation of Environmental Impact Assessment (EIA)

7.1.1 System Related to EIA

(1) System Related to Environmental and Social Considerations in Indonesia

1) Laws and Regulations Regarding Environmental and Social Considerations

In Indonesia, the basic law of environmental protection and management is new Law on Environmental Protection and Management (Law No.32/2009), which has been amended in October 2009 from Environmental Management Law (Law No.23/1997). To implement MRT project smoothly, it is necessary to consider environmental impact with suitable mitigation measure, especially to obtain the environmental permission based on the EIA system (called as AMDAL in Indonesia). The main laws and regulations regarding the implementation of EIA are described in the Table 7.1-1.

Table 7.1-1 Main Laws and Regulations Regarding Environmental Considerations in Indonesia

Classification	Number of Laws and Regulations	Title of Laws and Regulations
Overall environment	Law No.32/2009	Law on environmental protection and management
Environmental Impact Assessment	State Ministry of Environment No.5/2012	Ministry decree related to the type of projects which require the implementation of EIA
	State Ministry of Environment No.8/2006	Ministry decree related to the guidelines of procedure of Environmental Impact Assessment
	State Ministry of Environment No.17/2001	Ministry decree related to the type and size of projects or activities which require the implementation of EIA
	Government Regulation No.27/2012	Government decree on EIA system
Environmental Standards	Government Regulation No.41/1999	Environmental standard of air quality
	DKI Jakarta Decree No.551/2001	
	Government Decree No.82/2001	Environmental standard of water quality（inland water）
	State Minister of Environment No.51/2004	Environmental standard of water quality（seawater）
	DKI Jakarta Decree No.582/1995 (river water quality standard）	Environmental standard related to river water quality
	Ministry of Health Decree No.416/1990	Clean water quality standard
	State Minister of Environment No.48/1996	Noise standards
	DKI Jakarta Decree No.51 / 2001	Noise standards
	State Minister of Environment No.49/1996	Vibration standards
	State Minister of Environment No.50/1996	Odor standards
Hazardous Substance,	Government Decree No.18/1999 and	Government decree on hazardous waste

Classification	Number of Laws and Regulations	Title of Laws and Regulations
Solid Waste Management	No.85/1999	

Source: JICA Study Team based on collected documents

2) EIA System

Necessity and contents of EIA

According to the State Ministry of Environment No.05/2012, the screening criteria of EIA are stipulated as follows:

i) Projects which will affect the environment (specify the type and size)

ii) Projects which will be implemented in a specified area except that project in i)

iii) Projects of which EIA will be decided by the governors of province, city or DKI Jakarta due to its small size, despite not being categorized as i)

iv) The project which other ministries propose AMDAL and the State Minister of Environment find necessary to be subject to AMDAL, although not categorized as i),

This project is the MRT project including underground section. Then, EIA is need according to the screening criteria. Strategic Environmental Assessment (SEA) is not needed for the project because SEA is need for only, policy, plan and program according to the law No.32/2009 and through the confirmation to BPLHD.

In addition, according to the Law on Environmental Protection and Management（No.32/2009） the following basic items in an EIA are necessary:

i) Analysis of the impacts by the project

ii) Evaluation of the activities around the project sites

ii) Proposal and opinions regarding the project

iv) Consideration of characteristics of the project, and quantitative impacts

v) Project activities which have potential impacts on natural protection area and cultural assets

vi) Comprehensive impact assessment to determine the validity of the project in the aspect of environment

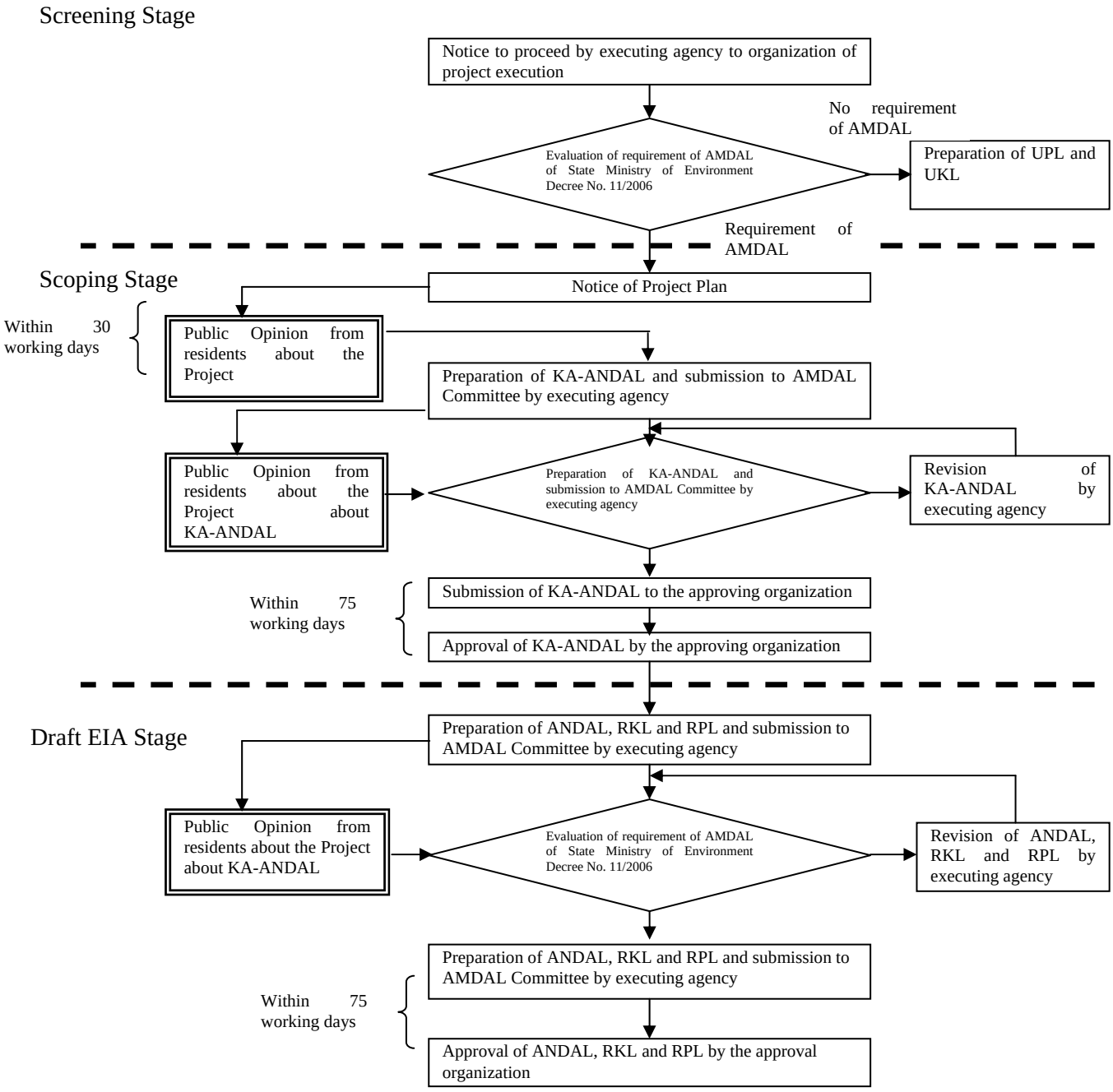
Procedure on EIA

The procedure on EIA (AMDAL) is stipulated in governmental decree No.27/2012. In the screening process, the Ministry of Environment or provincial or local governments will consider the necessity of AMDAL depending on the project plan submitted by the executing agency. In case the project does not require AMDAL, the executing agency will prepare an Environmental Management Direction (UKL) and Environmental Monitoring Direction (UPL). In case that EIA is required, the executing agency will publicize the project plan for 30 days to get the proposal and/or opinions from the public.

During scoping stage, they will prepare the TOR for EIA (KA-ANDAL), which will be evaluated by the AMDAL Committee. KA-ANDAL will be publicized as well as evaluated by the AMDAL Committee. In addition, the executing agency revises the KA-ANDAL based on the opinion of the AMDAL Committee, which consists of an environmental organization and the organization related to technical aspects, as well as experts knowledgeable in project

evaluation and environmental impacts related to the project, the community potentially affected by the project, and environmental NGOs.

During draft EIA stage, after approval of KA-ANDAL, the executing agency will prepare a contract with the consultant which has certification stipulated under the Decree of the Ministry of Environment No.7/2010, and will implement AMDAL. The result of the study will be summarized in the Environmental Impact Statement (ANDAL), Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL), and submitted to the AMDAL Committee for their evaluation and approval. During the evaluation, ANDAL, RKL and RPL will be publicized to obtain public opinion. The summary of the approval procedure of AMDAL is shown in Figure 7.1-1.



Source: Preparation of Decree No.27/2012

Figure 7.1-1 AMDAL Approval Flowchart

(2) JICA Guidelines for Environmental and Social Considerations

The JICA Guidelines for Environmental and Social Considerations (April, 2010) has been promulgated on April, 2010 and has been effective since July 2010. The guideline is prepared since "it clarifies the responsibility and procedure of environmental and social consideration by JICA and the requirement for the target country. The guideline will confirm the suitable implementation of JICA's support in terms of environmental and social considerations.

Because the project is classified as category "A" as it belongs to the railway sector according to the guideline, EIA is required and will be implemented according to AMDAL procedures in Indonesia.

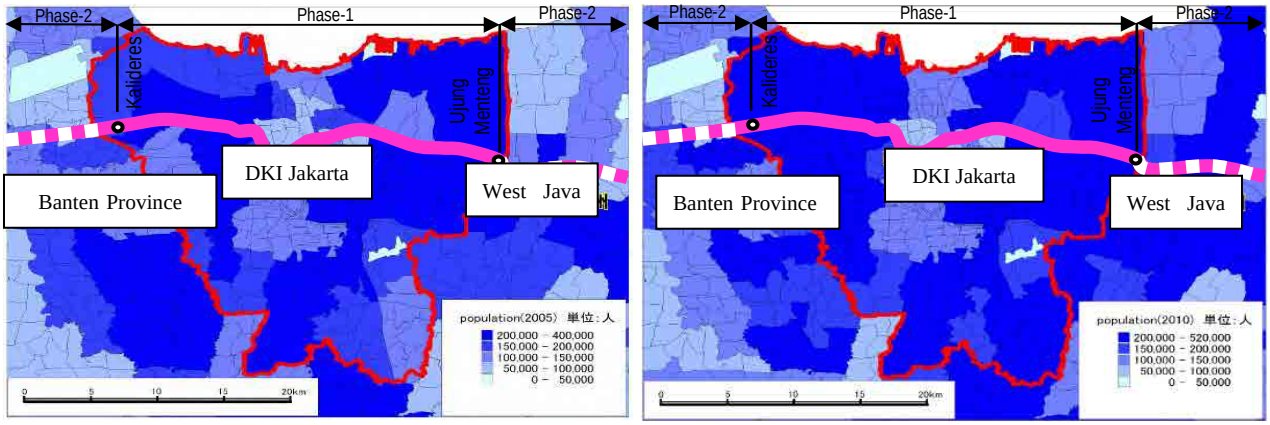
7.1.2 Current Environment Condition

The initial survey of current environmental condition has been implemented for the preparation of the terms of reference (TOR) of the EIA, to grasp the current condition, and to identify the potential impact for the target project area of the selected alternative – Alternative B.

1) Social Environment

Population

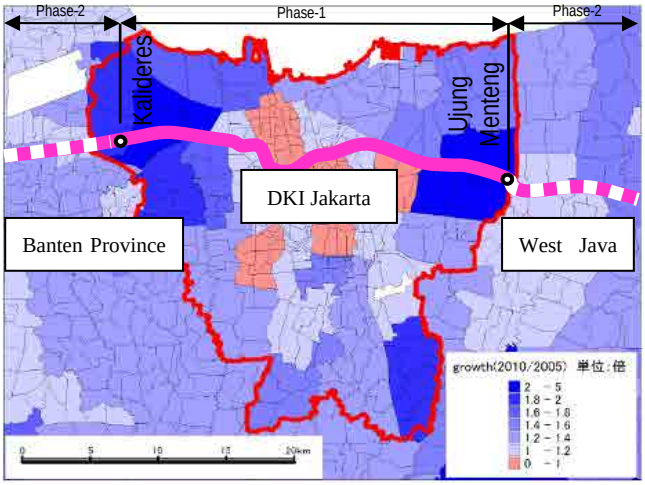
In the target project area, the population growth rate is low (annual growth rate is almost 0% or less than 0%) in the central area, while high (annual growth rate is almost 10% to 30%) in the eastern area of DKI Jakarta such as East Jakarta Municipality and the western areas of DKI Jakarta such as West Jakarta Municipality of DKI Jakarta.



Note：The red circled area include DKI Jakarta, Tangerang City, South Tangerang City and Depok City.

Source: JICA Study Team

Figure 7.1-2 Population in DKI Jakarta and its Surrounding Area in 2005 and 2010



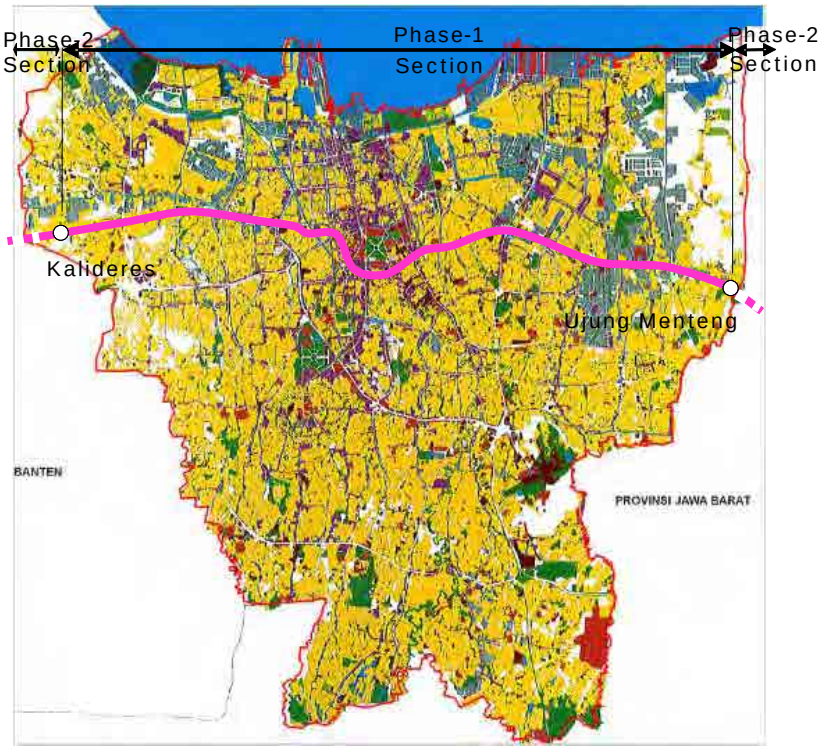
Note：The red circled area include DKI Jakarta, Tangerang City, South Tangerang City and Depok City.

Source: JICA Study Team

Figure 7.1-3 Population Growth Ratio in DKI Jakarta and its Surrounding Area

Land use

The target project area is along the existing main road. The western area from Kembangan to the central area is a residential zone. The central area consists of both commercial and residential zones while the eastern area includes industrial and suburban zones near Ujung Menteng. The current land use is shown in the figure below.



Legend

	Residential Area		Government Offices
	Trade and Park service		Industrial and Warehouse Area
	Office		Park, Green Area
	Foreign Government Offices		River, Lake, Sea

Source : JICA Study Team based on the "Spatial Structure Plan 2011 – 2033（The provincial government of Jakarta Special Capital Region）"

Figure 7.1-4 Land Use in DKI Jakarta

Condition of poor and indigenous people

It was assumed that poor people are living along Tangerang Line based on the condition of building (Refer to right side picture) during initial survey. Some of them seems to be illegal settlers. Land acquisition for another project, which has been conducted as Tangerang Line Double Track Expansion Project. In other areas, there seems to be no poor and indigenous people based on the survey.

Poverty area near Tangerang Line

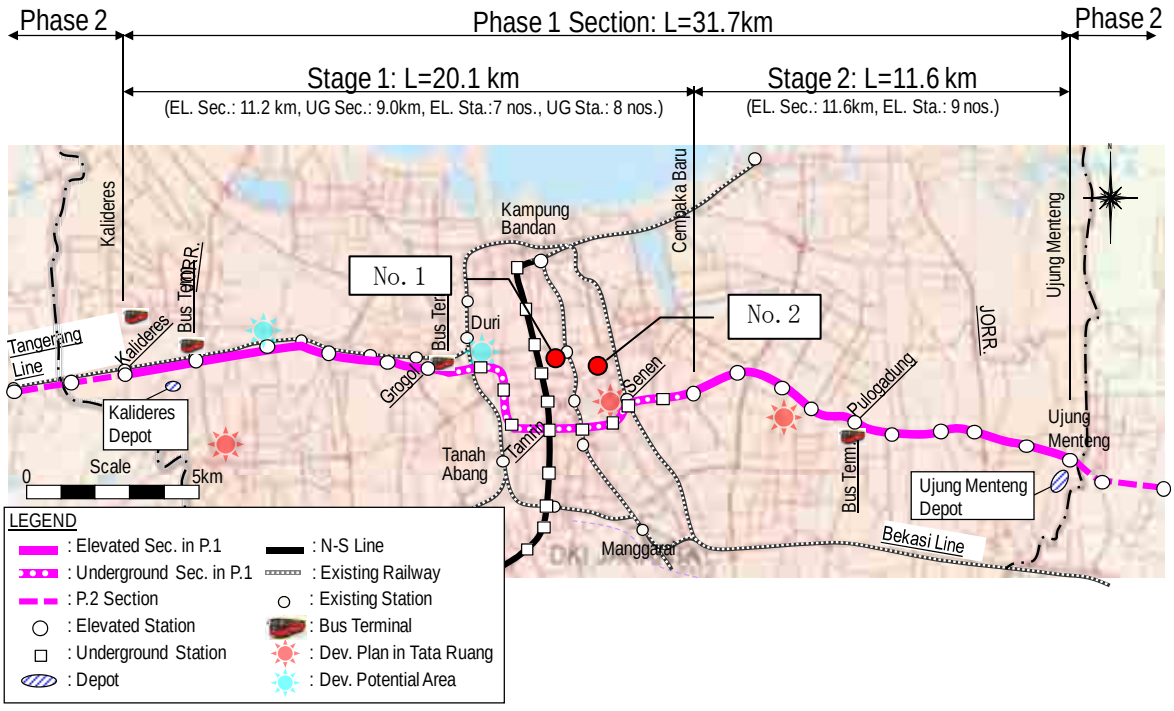
2) Natural Environment and Pollution

Air Environment

Industrial development and deterioration of transport conditions causes air pollution in the JABODETABEK area, especially DKI Jakarta and near the area.

Traffic Congestion along Jl. Bekasi Jaya

There are mainly two types of reasons of air pollution such as that due to mobile emission sources caused by the increasing number of automobile and motorbike and increase of traffic congestion, and stationary emission sources in factories in eastern areas in DKI Jakarta. The target project area is along the main road, where deterioration of air pollution due to mobile emission sources is significant. Figure 7.1-5 and Table 7.1-2 show the locations where air quality was measured and the result of air quality measurement, respectively.



Source: JICA Study Team

Figure 7.1-5 Locations Where Air Quality were Measured

Table 7.1-2 Result of Air Quality Measurement

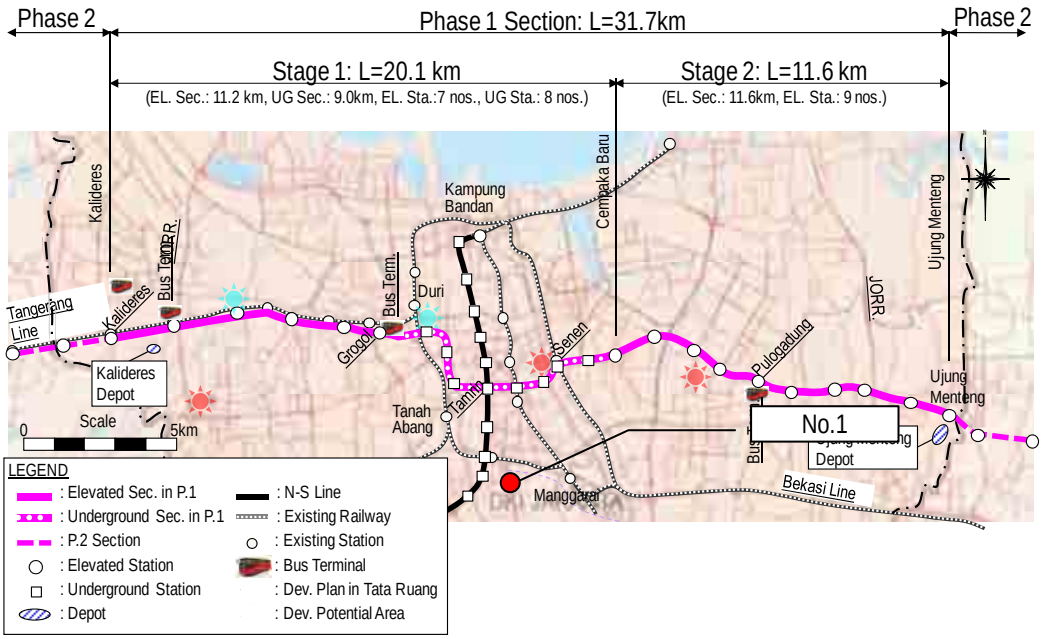
Location/Item		June, 2008	November, 2008	2009	Standard
Measurement point No.1					
SO_2	$\mu g/Nm^3$	50	403	-	260
CO	$\mu g/Nm^3$	699	530	-	26,000
NO_2	$\mu g/Nm^3$	70	39	-	92.5
O_3	$\mu g/Nm^3$	4	1	-	200
TSP	$\mu g/Nm^3$	192	204	-	230
Measurement point No.2					
SO_2	$\mu g/Nm^3$	-	-	8.9	260
CO	$\mu g/Nm^3$	-	-	-	26,000
NO_2	$\mu g/Nm^3$	-	-	21.4	92.5
O_3	$\mu g/Nm^3$	-	-	-	200
TSP	$\mu g/Nm^3$	-	-	151	230

Note：The standard is DKI Jakarta Decree No. 551/2001

Source：RKL/RPL Implementation Report, Busway Project (2008)

Water Environment

Water pollution in some rivers worsened due to the recent economic development and lack of drainage and waste management system as well as topographic feature. The main rivers and water courses, which cross the target route, are Banjir Canal, Ciliwung River, Suntur River and the Cakung Waterway. In these water courses and rivers, deterioration of water quality is significant. Table 7.1-3 shows the existing data on water quality in the Cideng River, which is near the target project area. According to the result of the water quality analysis, oil and grease, COD, coliform and fecal coliform, PO_4 and Methylene Blue Active Substance (MBAS), and organic material (KMnNO4) exceed the water quality standard.



Source: JICA Study Team

Figure 7.1-6 Locations Where Surface Water Quality were Measured

Table 7.1-3 Result of Surface Water Quality Measurement

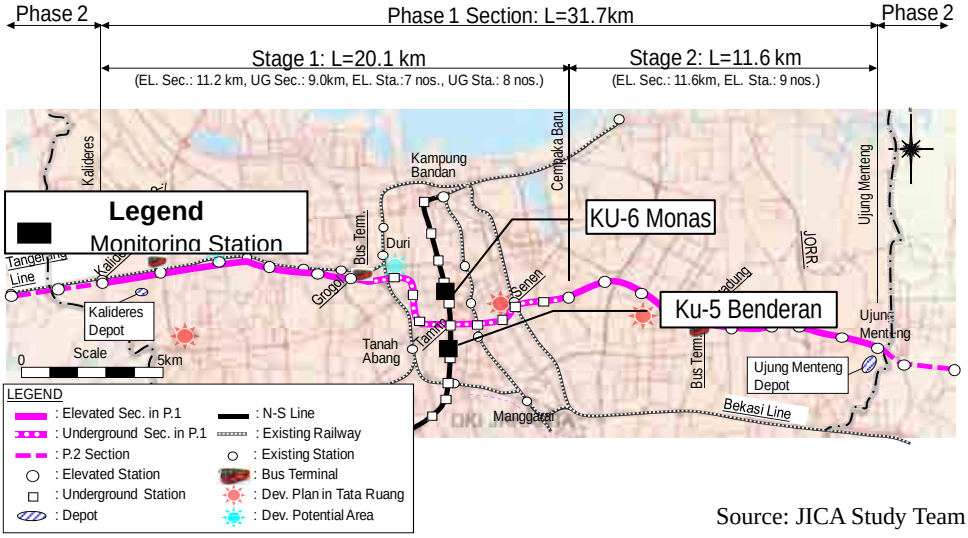
No.	Mesurement Item	Unit	Measurement value	Standard
1	Electric Conductivity (EC)	μmhos/cm	518	1,000
2	Total Suspended Solids (TSS)	mg/l	18	200
3	Total Dissolved Solids (TDS)	mg/l	227	1,000
4	Temperature	^{0}C	29.5	Normal
5	Mercury (Hg)	mg/l	No detected	0.0005
6	Iron (Fe)	mg/l	0.14	2
7	Cadmium (Cd)	mg/l	No detected	0.01
8	Calcium carbonate ($CaCO_3$)	mg/l	72.8	-
9	Hexavalent Chromium (Cr^{6+})	mg/l	No detected	0.05
10	Manganese (Mn)	mg/l	0.07	1
11	Nickel (Ni)	mg/l	No detected	0.1
12	pH	-	7.1	6.0 - 8.5
13	Phosphate (PO_4)	mg/l	0.96	0.5
14	Zinc (Zn)	mg/l	0.01	1
15	Sulfate (SO_4)	mg/l	37.03	100
16	Copper (Cu)	mg/l	No detected	0.1
17	Black Lead (Pb)	mg/l	No detected	0.1
18	Oil and grease	mg/l	0.44	None
19	MBAS (Methylene Blue Active Substance)	mg/l	0.89	0.5
20	Organic ($KMnO_4$)	mg/l	27.3	25
21	BOD(Biochemical Oxygen Demand)	mg/l	10	20
22	COD(Chemical Oxygen Demand)	mg/l	45.3	30
23	Coliform	MPN/100ml	$350x10^3$	20,000
24	Fecal coliform	MPN/100ml	$170x10^3$	4,000

Note : The standard is DKI Jakarta Decree No.582/1995 (River water quality standard)
Source : Updated EIA Report, JMEC (Jakarta Metro Engineering Consultants) (2010)

Noise and Vibration

In the target project area in DKI Jakarta, environmental standard on noise level is stipulated in Decree No.51 / 2001. On the other hand, there is no noise level standard for railway projects. The collected data for identifying current noise level are shown in Table 7.1-4.

The result of noise measurement indicates that the level exceeds the standard at two locations. Thus, the problem on noise is significant due to the recent increase in the volume of transportation.



Source: JICA Study Team

Figure 7.1-7 Locations Where Noise Levels were Measured

Table 7.1-4 Result of Noise Measurement

Location	Weekday (dB)	Weekend (dB)	Standard (dB)
Bundaran HI (KU-5) (Commercial area)	79.9	73.8	70
Monas (KU-6) (Green area)	80.6	79.4	50

Note： Quality Standard: Decision Letter of DKI Jakarta No. 551/2001.

Source： Updated EIA Report, JMEC (Jakarta Metro Engineering Consultants) (2010), Data Survey: April 12- 16 (weekday) and April 17 - 19 (weekend) in 2010.

Flora, Fauna and Ecology

There are no protection areas along the target route in DKI Jakarta, except the mangrove forest near Soekarno-Hatta International Airport. The forest is about 4 km away from the target route. If the plants existing along the route of the MRT are cut during construction stage, the compensation will be considered such as planting in the surrounding area,

7.1.3 Scoping Result

Scoping was conducted in the Phase-1 Section of 31.7 km, including the 20.1 km of stage I section and 11.6 km of stage II section, which form part of the study area covered in Alt.1-B and the proposed area for depot at Ujung Menteng and Kalideres. The scoping focused on the construction and operation and the activities which are executed before construction such as involuntary resettlement, is included in the items under construction. The result of scoping is shown in Table 7.1-5.

Table 7.1-5 Result of Scoping

Category	Construction	Operation	Description of Impact
Social Environment			
Involuntary resettlement	A-	B-	A few hundreds of households will be estimated for involuntary resettlement. It is considered to minimize the number of resettlement by appropriately selecting the route and design the alignment and locations of railway station and underground, elevated and transition sections of the MRT during the planning stage. During operation, some houses and facilities affected during construction shall be rebuilt or compensated to PAPs.
Impact on daily life	B-	B-	It is possible that residents in the neighboring area would be affected by noise and vibration, and traffic control during construction. During operation, the noise and vibration by the train operation would affect the surrounding area though it is expected that they will also benefit in terms of accessibility to transportation.
Impact on local economy such as employment	B+	B+	Employment opportunities are expected to increase by implementing the project, and traffic congestion would be reduced after the MRT starts its services.
Land use	D	C-	Change in land use is expected since population inflow and commercial development will take place due to the project and urban development around the station. However, it is not sure whether they are positive impact or not. Then, it is necessary for the additional examination.
Community division	D	D	Most of the railway lines are constructed as either elevated or underground, and thus, community division is not expected.
Existing social infrastructure and service	B-	B+	Regarding impact on public transportation, especially the dedicated lane for buses, it is planned to continue existing service by temporarily transferring the lane during MRT construction.

Category	Construction	Operation	Description of Impact
			During the operation, the access to public transportation will be improved as MRT starts its operations.
Poverty, indigenous, ethnic people	B-	B-	There is an illegal residential area in a part of the surrounding area of the Tangerang line, and their resettlement was underway during scoping stage. It is necessary to consider land acquisition and resettlement with suitable compensation and livelihood restoration for poor people living in the areas where the new alignment is planned. No community for indigenous and ethnic people is identified.
Misdistribution of benefits and damages	B-	B-	Some misdistribution of benefits and damages would be foreseen regarding the passenger of MRT and affected residents around the project area.
Conflict and dispute of local community	D	D	Conflicts and disputes in local communities are not foreseen in aspect of the project contents.
Water usage and right of water	B-	B-	Regarding water usage and water rights, groundwater is used in some areas in the project area and some impacts on groundwater would be foreseen.
Public health	B-	D	Public health may be affected from the accommodation of workers or construction sites during construction period. However, this will be temporary during construction and its impacts are limited.
Hazards (risks) infectious disease	B-	D	There could be risks due to infectious disease but this will be temporary during construction, and can be managed by educating the workers.
Cultural heritage	C-	C-	The information of historical buildings around the project area is not clear though there is no cultural heritage in ROW.
Natural Environment			
Topography/Geology	B-	C-	Most of the routes are either underground or elevated. Though shield construction method in the underground section is used and the cut-cover construction method is used around underground station. During operation, the surrounding area of underground station will be recovered by backfilling as well as transition section.
Soil erosion	D	D	Expected impact of soil erosion is small since the MRT structure is either underground or elevated.
Groundwater	B-	C-	There is a possibility for change of groundwater level by pump-up or pour-in of groundwater during the construction of a part of underground structures. During operation, there are some possibilities of the remaining the impact.
Hydrology	B-	C-	A change in water flow due to pumping of groundwater or water interception might take place during construction. During operation, there are some possibilities of the continuation of the change.
Coastal zone	D	D	No coastal zone is identified in the surrounding area of the project.
Animal /ecological system	D	D	No natural or ecological system for protection is identified since the route of the MRT is planned to pass through either an urban area or existing roads.
Climate	D	D	No significant change in climate due to the project is identified.
Landscape	B-	D	An impact on the landscape due to construction of elevated structures is expected. However, consideration of design for landscape and planting trees are planned to be conducted.
Global warming	B-	C-	Temporary increase of green house gas due to traffic increase of

Category	Construction	Operation	Description of Impact
			construction activity and usage of heavy equipment is expected during construction. During operation, the impact will be reduced.
Pollution			
Air pollution	B-	C-	During construction, impact on air pollution with the usage of heavy equipment and traffic congestion is expected.
Water pollution	B-	C-	During construction, temporary water pollution due to wastes from workers' accommodation, earthwork, and cut earth is expected. During operation, wastewater from depot will be treated by the wastewater treatment facility in the depot. The domestic wastewater is discharged as same as existing system such as the domestic waste water from commercial buildings.
Soil pollution	D	D	Soil pollution by the project is not identified.
Wastes	B-	B-	During construction, construction wastes and wastes from the worker's accommodation will generate. The resource material such as soil or stone for construction activity will be used for construction activity. In addition, Hazardous waste from depot and domestic waste from depot and stations will generate during operation.
Noise and vibration	B-	B-	Noise and vibration from construction machineries during construction are expected. Also, occurrence of vibration and noise at elevated and transition parts of the railways during operation are expected.
Subsidence	B-	C-	During construction, ground subsidence may occur due to groundwater extraction or groundwater protection as well as boring of shield tunnel. During operation, there are some possibilities to continue the ground subsidence, if there is no countermeasure.
Offensive odor	D	D	It is expected that offensive odor will not occur in the project.
Bottom sediment	D	D	Construction that might impact the bottom sediment will not be planned.
Accident	B-	C-	During construction, operation of construction machineries have the risk of some accidents. During operation, there is not only the accident by train operation but also no function due to failure of electricity. There are some possibilities to earthquake or flooding to take some countermeasure.

Note:
A-: Significant negative impact is expected A+:Significant positive impact is expected
B-: Negative impact is expected to some extent B+: Positive impact is expected to some extent
C-: Extent of Negative/Positive impact is unknown. Examination is needed.
D: No impact or a small impact is expected. Additional examination is not necessary.
The evaluation result of scoping enhances the comments of JICA Advisory Committee.

Source：JICA study team

7.1.4 Environmental Baseline Survey

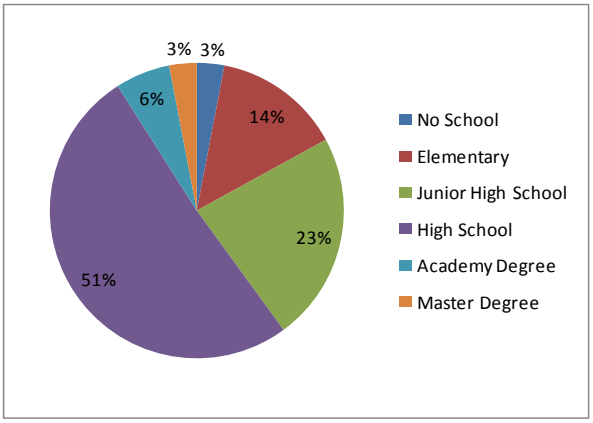
After scoping, the environmental survey has been conducted to grasp the more detail environmental baseline condition. The target area of the survey includes the areas along the alignment from Kalideres Station to Ujung Menteng Station, Ujung Menteng Station to Ujung Menteng Depot and Kalideres Depot, which is only the Phase 1 section.

(1) Social Environment

The JICA Study Team conducted the socioeconomic survey for directory affected people in the project area of the MRT East - West Line and in-directory affected people along the MRT East - West Line, which of the total respondents . The number of respondent is 205, which was selected in this area.

1) Education Level and Occupation

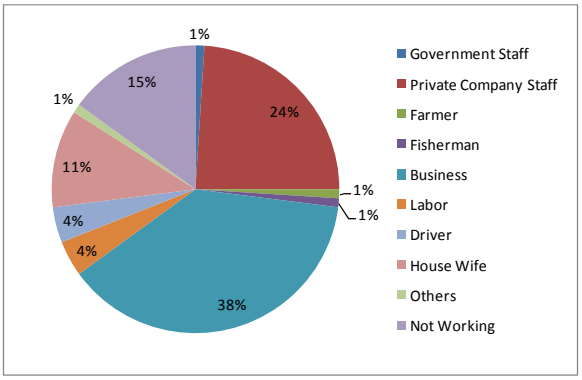
In education level, most of people graduated high school (more than 60%) and there are only few people who could not been educated in any school (3%).



Source: JICA Study Team

Figure 7.1-8 Education Level of People Living near the Project Area

The most common occupation is business staff such as in small shop (38%) and restaurant and the employee in private company (24%). There are some people who do not work except housewife.

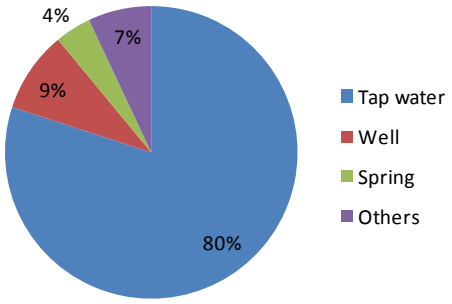


Source: JICA Study Team

Figure 7.1-9 Occupation of People Living near the Project Area

2) Water Usage and Right of Water

Most of respondents (80%) use tap water and only some of the respondents (13%) use well and springs which would be affected by the project. It is necessary to take the countermeasure, if the groundwater drawdown or water pollution occurs during construction stage for the people.



Source: JICA Study Team

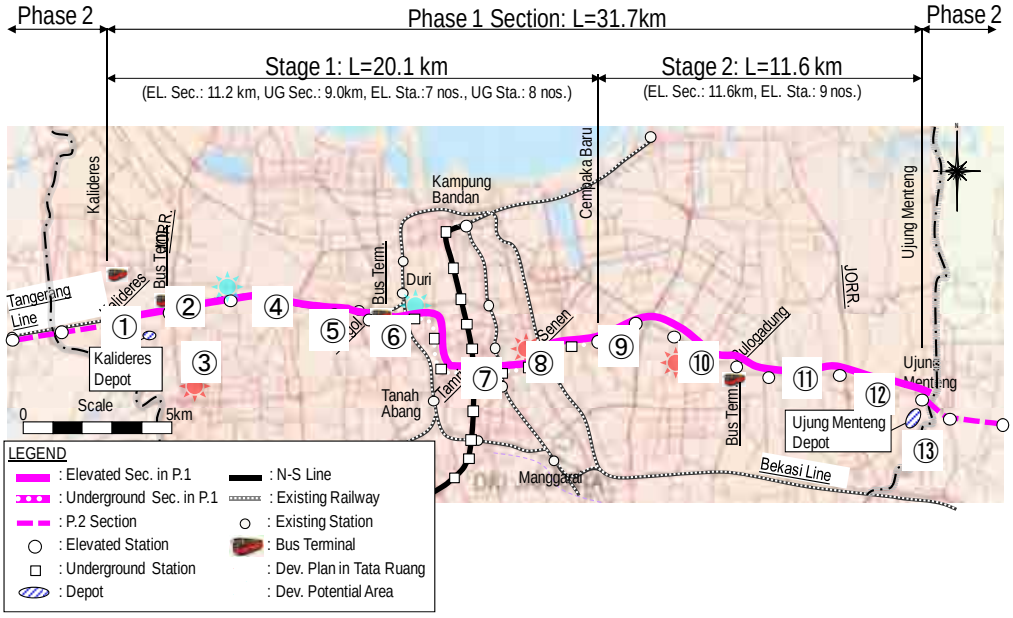
Figure 7.1-10 Water Usage Condition along MRT East - West Line

(2) Pollution and Natural Environment

1) Air Quality

The JICA Study Team conducted the air quality survey along the MRT East - West Line. There are mainly two sources of air pollution namely from mobile emission caused by the increasing number of car transportation and worsening traffic congestion, and stationary emission in factories in eastern areas in DKI Jakarta. The target project area is along the main road, where deterioration of air quality due to mobile emission sources is significant.

Figure 7.1-11 and Table 7.1-6 show the locations and result of the air quality measurement. The result of measurement and analysis of SO_2, CO, O_3, TSP, PM10 and Pb is mostly under the standard. However, the result of analysis of NO_2 is over the standard at location No. 8. This will be caused by the mobile sources such as automobile or motor bike and the stationary sources such as factories.



Source: JICA Study Team

Figure 7.1-11 Sampling Points of Air Quality

Table 7.1-6 Result of Air Quality Measurement

Unit [μ g/Nm3]

Item	Standard	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬
		Weekday												
SO_2	260	152	144	156	127	196	115	127	158	54	84	194	118	115
CO	9,000	1,002	1,060	1,023	1,824	5,630	1,201	1,180	1,283	909	982	1,571	2,125	1,202
NO_2	92.5	124	134	132	44	94	76	44	73	90	56	144	77	27
O_3	200	11	9	9	26	26	54	16	34	6	18	22	26	23
TSP	230	407	229	138	153	128	153	162	169	118	126	196	143	127
PM_{10}	150	-	-	-	66	62	62	54	64	34	26	78	42	58
NO	-	-	-	-	34	58	28	36	52	69	74	96	88	36
Pb	2	-	-	-	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

Item	Standard	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬
		Weekend												
SO_2	260	-	-	-	108	156	94	122	134	27	76	122	98	95
CO	9,000	-	-	-	1,526	4,686	936	956	926	754	754	1,386	1,823	832
NO_2	92.5	-	-	-	44	85	64	38	58	68	45	162	68	24
O_3	200	-	-	-	18	21	28	18	24	24	26	28	18	16
TSP	230	-	-	-	124	116	142	144	139	102	104	152	114	98
PM_{10}	150	-	-	-	64	30	46	50	52	18	18	54	22	46
NO	-	-	-	-	28	74	24	28	46	54	54	83	65	27
Pb	2	-	-	-	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

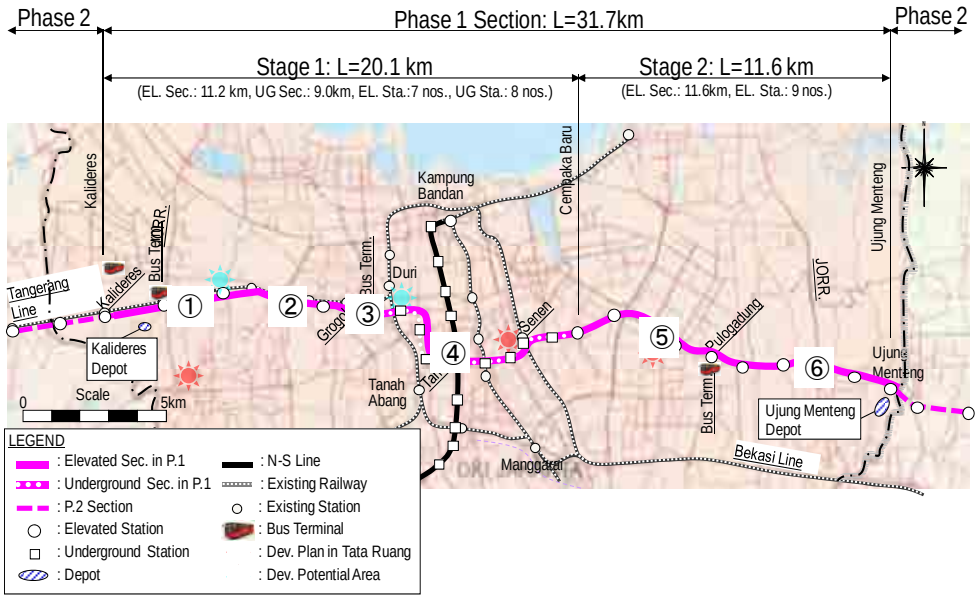
Note : The standard is DKI Jakarta Decree No.551/2001

Source: JICA Study Team

2) Water Environment

Surface Water

The JICA Study Team conducted surface water quality survey in the rivers and canals cross the MRT Line, which, are the Banjir Canal, Ciliwung River, Suntur River and Cakung Waterway. In these water courses and rivers, deterioration of water quality is significant. Table 7.1-7 shows the result of the water quality in Cengkareng Drain, Geling Bridge River, Cideng River, Pulogadung River, East Banjir Canal, which is near the target project area. According to the result of the above water quality analysis, EC, TDS, Cr^{6+}, oil and grease, BOD, COD, coliform and fecal coliform, SS, PO_4 and Methylene Blue Active Substance (MBAS), and organic material ($KMnNO_4$) exceed the water quality standard.



Source: JICA Study Team

Figure 7.1-12 Sampling Points of Surface Water

Table 7.1-7 Water Quality of Surface Water

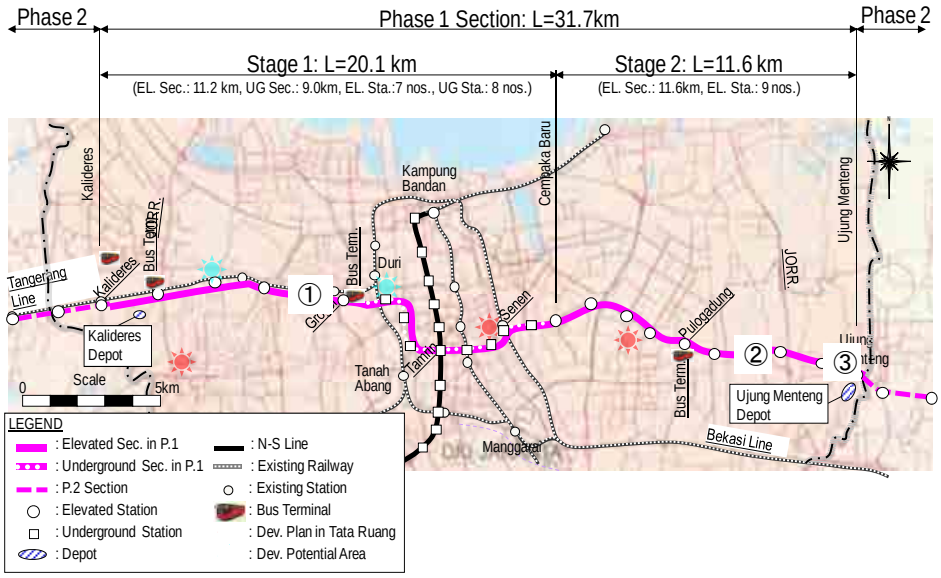
No.	Item	Unit	Standard	①	②	③	④	⑤	⑥
1	EC	Umhos /cm	500	1028	612	339	664	755	534
2	TDS	mg/L	500	760	390	220	400	356	400
3	Turbidity	NTU	100	62	12	3	4	21	12
4	Temperature	°C	—	30.9	30	29	28	31	31
5	Flow amount	m3/s	—	0.02	6.316	4	0.29	3	0.75
6	Fe	mg/L	2.0	—	-	0.2	0.4	0.5	0.4
7	Cd	mg/L	0.010	0.004	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
8	Cr^{6+}	mg/L	0.050	0.053	0.025	0.023	0.038	0.166	0.025
9	Mn	mg/L	0.50	0.04	0.9	0.30	0.28	0.89	0.44
10	Ni	mg/L	0.10	<0.005	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
11	pH	-	6.0-8.5	7.3	7.1	7.1	7.4	7.4	7.7
12	PO_4	mg/L	0.50	3.94	0.12	0.64	1.21	1.86	0.78
13	Zn	mg/L	1.0	0.1	< 0.007	0.05	0.1	0.1	0.03
14	SO_4	mg/L	100	59	6	14	53	16	20
15	Cu	mg/L	0.10	<0.007	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
16	Pb	mg/L	0,10	<0.008	< 0,004	< 0,004	< 0,004	< 0,004	< 0,004
17	Hardness	mg/L	—	—	—	92	133	191	157
18	Oil	mg/L	ND	0.3	5	0.5	1.6	2.5	2.3
19	MBAS	mg/L	1.0	3.18	2.8	3.2	2.4	1.4	1.6
20	$KMnO_4$	mg/L	15.0	37.1	12.1	22.7	25.6	27.6	25.8
21	BOD (5days 20°C)	mg/L	10	59.8	24.8	38	23	77	42
22	COD	mg/L	20	86.2	46.3	60	43	123	79
23	DO	mg/L	3	<0.01	3	1.5	1.5	1.5	1.5
24	SS	mg/L	100	62	30	8	31	180	34
25	Coliform	Jml /100ml	200	210	230	190	154	180	209
26	Fecal Coliform	Jml /100ml	10000	—	2800	2100	2000	4200	7400

Note： 1) The standard is DKI Jakarta Decree No.582/1995 (river water quality standard)
2) Hatched value is over the standard.

Source: JICA Study Team

Ground water

The JICA Study Team conducted groundwater quality survey for the three locations described in Figure 7.1-13. The result of groundwater quality is shown in Table 7.1-8. Fe, Mn, Coliform and MBAS are over the standard.



Source: JICA Study Team

Figure 7.1-13 Location of Sampling Points of Ground Water

Table 7.1-8 Water Quality of Ground Water

No.	Item	Unit	Standard	①	②	③
1	TDS	mg/L	1000	338	758	500
2	Turbidity	NTU	5	52	9	43
3	Temperature	℃	Air temperature± 3	29	32	31
4	EC	umhos/cm	-	499	499	705
5	SS	mg/L	-	22	42	35
6	Fe	mg/L	1.0	7.2	0.1	0.4
7	Cd	mg/L	0.005	< 0.003	< 0.003	< 0.003
8	$CaCO_3$	mg/L	500	106	27	241
9	Cr^{6+}	mg/L	0.05	0.015	0.006	0.008
10	Mn	mg/L	0.5	1.48	0.01	1.9
11	pH	-	6.5-8,5	6.9	7.8	6.9
12	Zn	mg/L	15	0.01	< 0.007	< 0.007
13	SO_4	mg/L	400	88	62	54
14	Pb	mg/L	0.05	< 0.004	< 0.004	< 0.004
15	MBAS	mg/L	0.5	2.2	3.6	1.8
16	$KMnO_4$	mg/L	10	9.0	1.2	0.9
17	Ni	mg/L	-	< 0.008	< 0.008	< 0.008
18	Phosphate	mg/L	-	0.02	0.43	0.03
19	Cu	mg/L	-	< 0.005	< 0.005	< 0.005
20	Oil	mg/L	-	3.4	5.5	2.4
21	BOD (5days 20°C)	mg/L	-	42	65	30
22	COD	mg/L	-	79	103	56
23	DO	mg/L	-	1.2	1.5	1.5
24	Coliform	MPN/100ml	50	3330	3600	4800
25	Fecal Coliform	MPN/100ml	—	265	220	240

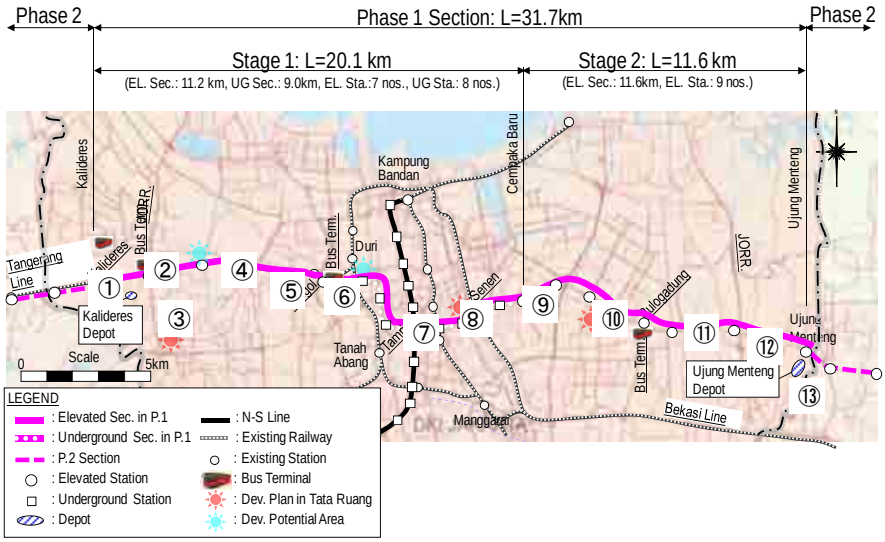
Note：1) The standard is MOH Decree No.416/1990 (Clean water quality standard)
2) Hatched value is over the standard.

Source: JICA Study Team

3) Noise and Vibration

Noise

In the target project area in DKI Jakarta, the environmental standard on noise level is stipulated in Decree No.51 / 2001. On the other hand, there is no noise level standard for railway projects. JICA Study Team conducted noise measurement to identify current noise level as shown in the Table 7.1-9. The result of noise measurement indicates that the level exceeds the standard at most of the locations. Thus, the problem on noise is significant due to the recent increase in the number of transportation as described in the survey data.



Source: JICA Study Team

Figure 7.1-14 Measurement Point of Noise and Vibration

Table 7.1-9 Result of Noise Measurement

Item	Unit	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬
Weekday	dB	67	66	48	69	80	81	81	76	69	72	72	73	58
Weekend	dB	-	-	-	69	73	75	75	72	75	77	66	78	56
Standard	dB	55	55	55	55	55	55	55	55	55	55	55	55	55

Note : The standard is the noise level standard described in DKI Jakarta Decree No.51 / 2001.

Source: JICA Study Team

Vibration

In Indonesia, the Decree of Ministry of Environment of No. 49 of 1996 stipulates a criterion of vibration level. To identify the ambient vibration level, vibration measurement has been implemented at locations shown in Figure 7.1-14 as same as the locations of noise measurement. The measurement results for all locations indicate that the vibration level is still below the standard and classified as category A, accordance with the said decree as shown in Table 7.1-10.

Table 7.1-10 Standard and Measured Data of Vibration Level

No.	Frequency (Hz)	Standard			
		Category A	Category B	Category C	Category D
1	4	<2	＜2-27	>27-140	>140
2	5	<7.5	<7.5-25	>25-130	>130
3	6.3	<7	<7-21	>21-110	>110
4	8	<6	<6-19	>19-100	>100
5	10	<5.2	<5.2-16	>16-90	>90
6	12.5	<4.8	<4.8-15	>15-80	>80
7	16	<4	<4-14	>14-70	>70
8	20	<3.8	<3.8-12	>12-67	>67
9	25	<3.2	<3.2-10	>10-60	>60
10	31.5	<3	<3-9	>9-53	>53
11	40	<2	<2-8	>8-50	>50
12	50	<1	<1-7	>7-42	>42

Note:
Category A : May cause damage
Category B : Will potentially damage wall / structure
Category C : Will potentially destroy wall / structure
Category D : May destroy wall / structure

Source: Decree of Ministry of Environment No. Kkep-49/MENLH/11/1996

No.	Frequency (Hz)				Survey Result (mm/second)								
		G-1	G-2	G-3	G-4	G-5	G-6	G-7	G-8	G-9	G-10	G-11	G-12	G-13
1	4	0.2508	0.2568	0.2210	0.1168	0.1108	0.1088	0.0975	0.0937	0.1222	0.1196	0.0658	0.0996	0.1147
2	5	0.1445	0.1231	0.1814	0.1072	0.1017	0.0998	0.0895	0.0860	0.1121	0.1100	0..604	0.0914	0.1052
3	6.3	0.0242	0.0324	0.0179	0.0735	0..697	0.0684	0.0613	0.0589	0.0769	0.0761	0.0414	0.0627	0.0721
4	8	0.1154	0.1303	0.0980	0.1488	0.1411	0.1386	0.1242	0.1193	0.1557	0.1527	0.0638	0.1269	0.1461
5	10	0.0088	0.0459	0.0307	0.0427	0.0405	0.0398	0.0357	0.0343	0.0447	0.0432	0.0241	0.0365	0.0420
6	12.5	0.0111	0.0459	0.0535	0.0401	0.3038	0.0374	0.0335	0.0322	0.0420	0.0414	0.0226	0.0342	0.0394
7	16	0.0502	0.0552	0.0553	0.1062	0.1007	0.0989	0.0887	0.0852	0.1111	0.1084	0.0598	0..906	0.1043
8	20	0.0502	0.0440	0.0341	0.1142	0.1083	0.1064	0.0953	0.0916	0.1195	0.1169	0.0643	0.0974	0.1121
9	25	0.0059	0.0058	0.0049	0.1024	0.0972	0.0954	0.0855	0.0822	0.1072	0.1048	0.0577	0.0678	0.1006
10	31.5	0.3248	0.0360	0.0412	0.1825	0.1731	0.1700	0.1523	0.1464	0.1909	0.1877	0.1028	0.1557	0.1792
11	40	0.0196	0.0248	0.0185	0.0841	0.0797	0.0783	0.0702	0.0674	0.0860	0.0858	0.0474	0.0717	0.0825
12	50	0.0038	0.0038	0.0040	0.0699	0.0663	0.0651	0.0583	0.0561	0.0731	0.0714	0.0394	0.0596	0.0686
13	63	0.0185	0.0152	0.0172	0.1303	0.1236	0.1214	0.1088	0.1045	0.1363	0.1333	0.0734	0.1112	0.1279
14	80	0.0009	0.0085	0.0104	0.0459	0.0435	0.0427	0.0383	0.0368	0.0480	0.0468	0.0258	0.0391	0.0450
15	100	0.0024	0.0023	0.0018	0.0270	0.0256	0.0251	0.0225	0.0216	0.0262	0.0276	0.0152	0.0230	0.0265
Evaluation		Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A

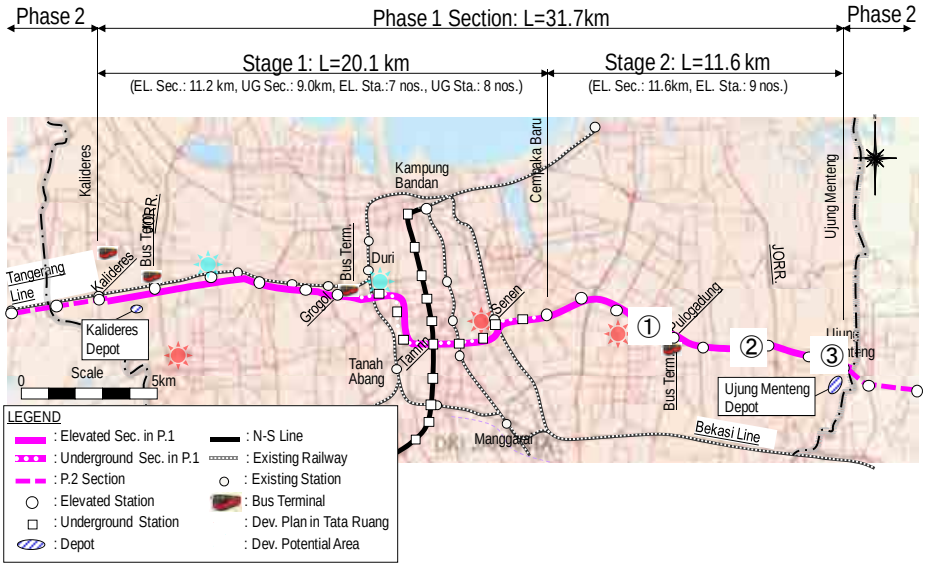
Source: JICA Study Team

No.	Frequency (Hz)	Survey Result (mm/second)									
		G-1	G-2	G-3	G-4	G-5	G-6	G-7	G-8	G-9	G-10
1	4	0.1162	0.1165	0.1175	0.1036	0.1047	0.1163	0.1210	0.0876	0.1048	0.1164
2	5	0.1066	0.1069	0.1078	0.0950	0.0961	0.1067	0.1111	0.0804	0.0961	0.1068
3	6.3	0.0731	0.0733	0.0739	0.0652	0.0659	0.0732	0.0762	0.0551	0.0659	0.0732
4	8	0.1480	0.1484	0.1497	0.1319	0.1334	0.1481	0.1542	0.1116	0.1335	0.1482
5	10	0.0425	0.0426	0.0430	0.0379	0.0383	0.0426	0.0443	0.0321	0.0383	0.0426
6	12.5	0.0399	0.0400	0.0404	0.0356	0.0360	0.0399	0.0416	0.0301	0.0360	0.0400
7	16	0.1057	0.1059	0.1069	0.0942	0.0953	0.1057	0.1101	0.0797	0.0953	0.1058
8	20	0.1136	0.1139	0.1149	0.1013	0.1024	0.1137	0.1183	0.0856	0.1024	0.1138
9	25	0.1019	0.1021	0.1031	0.0908	0.0919	0.1020	0.1062	0.0768	0.0919	0.1021
10	31.5	0.1616	0.1820	0.1836	0.1618	0.1636	0.1817	0.1891	0.1368	0.1637	0.1818
11	40	0.0637	0.0838	0.0846	0.0746	0.0754	0.0837	0.0871	0.0630	0.0754	0.0838
12	50	0.0696	0.0697	0.0703	0.0620	0.0627	0.0696	0.0724	0.0524	0.0627	0.0696
13	63	0.1297	0.1299	0.1311	0.1156	0.1169	0.1297	0.1351	0.0977	0.1169	0.1298
14	80	0.0456	0.0457	0.0461	0.0407	0.0411	0.0457	0.0475	0.0344	0.0411	0.0457
15	100	0.0268	0.0269	0.0271	0.0239	0.0242	0.0269	0.0280	0.0202	0.0242	0.0269
Evaluation		Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A	Category A

Source: JICA Study Team

4) Soil Quality

The concentration of heavy metal, pesticides, PCB and VOC in the sampled soil has been analyzed by dissolution test. The soil has been taken as composite sample from 0 m to 30 m at each location as shown in Figure 7.1-15.



Source: JICA Study Team

Figure 7.1-15 Sampling Point of Soil Quality Survey

According to this analysis as shown in Table 7.1-11, all the items is less than the soil quality standard in Indonesia. However, the sampling points are only three points and it is necessary to implement additional survey at next design stage to identify the risk of soil contamination during construction stage.

Table 7.1-11 Result of Soil Quality Survey

No.	Parameter	Unit	Location			Quality Standard
			①	②	③	
I.	Heavy Metals					
1	Cu	mg/l	0.005	0.003	0.002	10
2	Mn	mg/l	0.04	0.06	0.05	-
3	Co	mg/l	ND	ND	ND	-
4	Ni	mg/l	0.02	0.06	0.08	-
5	Cd	mg/l	0.02	0.01	0.01	1.0
6	Pb	mg/l	ND	ND	ND	5.0
7	Zn	mg/l	0.5	0.8	0.3	50.0
8	As	mg/l	ND	ND	ND	5.0
9	Ba	mg/l	0.02	0.04	0.02	100
10	B	mg/l	ND	ND	ND	500
11	Cr	mg/l	0.009	0.006	0.008	5
12	Hg	mg/l	ND	ND	ND	0.2
13	Se	mg/l	ND	ND	ND	1.0
14	Ag	mg/l	ND	ND	ND	5.0
II.	Organics					
1	Pesticides	mg/l	ND	ND	ND	-
2	Poly Chlorinated Biphenil (PCB)	mg/l	ND	ND	ND	-
3	Volatile Organic Compounds (VOC)	mg/l	ND	ND	ND	-

Note : 1) ND means “not detected”.
2) The standard means is the Decree No.85 / 1999.

Source: JICA Study Team

5) Topography and Geology

In the target project area, the topography is flat and consists of alluvial plain with eroded alluvial area and delta. The area is located on a groundwater basin which is marine Pliocene and Quaternary sand and delta sediments. The rocks types in study area of MRT East-West Line starts from Duri Pulo Gambir District heading to Kemayoran until Pulogebang Cakung occupies on coastal alluvial sediment which has small to medium supporting power and low graduation with saturated groundwater. Based on the previous geological survey implemented in Jakarta MRT North - South Line, N value is less than 4 at the surface layer from 0 to 10 m, and solid layer with N value of more than 10 at 10 to 30 m depths.

6) Flora, Fauna and Ecology

There are no protection areas along the target route in DKI Jakarta, except for a mangrove forest near Soekarno-Hatta International Airport. The said forest is about 4 km away from the target route. It should be noted in the aspect of ecology that re-plantation of existing trees along the road will be required during the construction stage. During this time, the expected number of trees to be replanted is shown in Table 7.1-12.

Table 7.1-12 Number of Trees in the ROW

Section	Diameter of trees			
	≤ 5cm	5-10 cm	10-15 cm	≥ 15 cm
Kalideres - Kembangan 2	0	0	0	0
Kalideres Depot – Rawa Buaya	80	37	-	-
Kembangan 2-Kembangan 1	1	24	147	89
Kembangan 1-Pesing	1	16	46	40
Pesing-Grogol	0	20	51	103
Grogol- (transition point)	3	13	29	70
Roxy	0	4	0	6
Petojo	0	5	2	3
Cideng	0	0	5	13
Thamrin	0	0	0	15
Kebon Sirih	1	0	1	11

Section	Diameter of trees			
	≤ 5cm	5-10 cm	10-15 cm	≥ 15 cm
Kuitang	0	0	0	12
Senen	0	1	5	3
Galur	0	0	3	12
(Transiton point)-Cempaka Baru	2	44	163	305
Sub-Total (Stage 1 of Phase 1)	88	164	452	682
Cempaka Baru-Kelapa Gading Timur	5	1	220	157
Kelapa Gading Timur- Pulogadung	13	13	153	169
Pulogadung-Penggilingan	11	10	43	31
Penggilingan-Cakung Barat	2	111	157	643
Cakung Barat-Pulogebang	0	13	88	41
Pulogebang-Ujung Menteng	25	180	185	143
Depo Ujung Menteng	0	40	61	50
Sub-Total (Stage21 of Phase 1)	56	368	907	1234
Total (Phase 1)	144	532	1359	1916

Source: JICA Study Team

7.1.5 Impact Assessment

(1) Social Environment

1) Involuntary resettlement

Based on the detail survey after the scoping, 497 households are expected for involuntary resettlement and 276 commercial buildings and 15 government facility will be affected (Refer to section 7.2 in detail). It was considered to reduce the number of resettlement by selecting such route and considering the locations of railway station and transition section from underground to elevated section during this study. Some houses and facilities affected during construction will be rebuilt after the completion of the construction. The compensation for the PAPs will be conducted on the JICA Guidelines for Environmental and Social Considerations with the consideration of law and regulations regarding land acquisition and resettlement. In addition, a livelihood restoration program is prepared in the land acquisition and resettlement plan as described in section 7.2.

2) Impact on Daily Life

It is possible that residents in the neighboring area will be temporarily affected by noise and vibration and traffic control during construction. Traffic control will thus be required along narrow road such as Jl. Bekasi Jaya and in the surrounding area of stations or transition sections where the cut-and-cover construction method will be applied, and severe traffic congestion is expected, especially during commuting time in the morning and evening. Therefore, the construction activities of the duration will be avoided and construction activities at night time will be considered, which is described in the transport management plan. However, it is noted that construction activities at night will cause noise and vibration problems. With consideration of the advantages and disadvantages of daytime and nighttime construction activities, a suitable plan will be prepared and the impacts on daily life will be monitored. During the operation stage, traffic congestion will be reduced. On the other hand, the monitoring should be carried out because there are some possibilities of increase in traffic due to the new development and increase of convenience.

3) Impact on Local Economy

During construction, some civil and architectural workers and other staff will be employed from the target area. Moreover, the other employment opportunities such as the staff of local restaurants for the workers will be provided to the local communities, consequently enhancing the local economy and obtaining positive impacts. Currently estimated required labors are as follows.

Table 7.1-13 Estimation of Required Labor for this Project

Item	Number of required labor [person/day]	Rate of required labor for each item [%]
Tunnel	219	4
Underground station	1,638	30
Elevated Station	1,584	29
Foundation and pier	1,182	22
Viaduct	425	8
Depot	217	4
System	218	4

Source: JICA Study Team

During operation, though lack of job of current Bus Rapid Transit (BRT) staff may become a problem, training of workers for re-employment may be considered.

4) Land Use

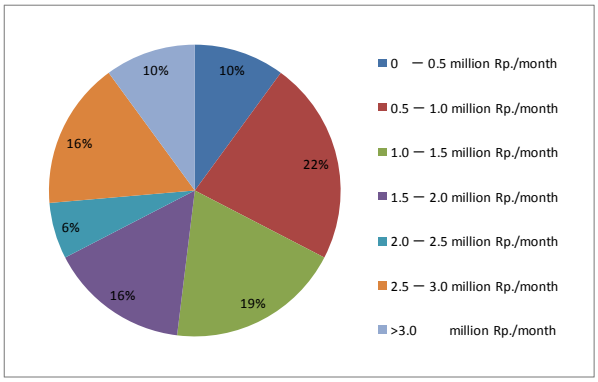
Inflow of outside people according to the development of the MRT East-West Line and urban development along the MRT East-West Line may cause change in land use. Many developers will try to purchase the land for residential areas, commercial areas or as industrial estate and also generates squatter under the elevated section. To prevent unplanned and overdevelopment, limitation of development will be necessary and it is necessary that the development of the surrounding area will be planned to prevent squatter. Especially, the area under elevated section could be utilized as parking areas or green park.

5) Existing social Infrastructure and Service

During construction, the function of existing public transportation system and road network will decline, which will affect the passengers of the public transportation and drivers. Especially, in narrow two lane roads such as Jl. Bekasi Jaya, continuous traffic congestion occurs and during construction of the elevated sections, heavier traffic congestion will be expected. Then, the traffic management such as during night time construction or temporary movement of road will be introduced to prevent traffic congestion due to the construction. During operation, the public transportation system will be improved due to the development of MRT.

6) Poverty, Indigenous, Ethnic People

The JICA Study Team conducted the socio economic survey for the PAPs identified in the study of LARAP. It has been identified that there is some poor people in ROW, whose monthly income are less than lowest income level in DKI Jakarta (1.29 million Rp. / month in 2011). The income level of the PAPs within the ROW is shown in Figure 7.1-16.



Source: JICA Study Team

Figure 7.1-16 Family Income of the Residents along the MRT Line

In addition, as for the native place of the residents, 53% of them are from DKI Jakarta and the others are from Lampung, West or South Sematra. Most of them live there more than 5 years but they do not form their specific community, which maintain traditional life style.

7) Misdistribution of Benefits and Damages

The compensation for resettlement due to the expansion of Tangerang Line is calculated as based on the Tax Object Sale Value (NJOP) and no compensation for illegal squatters. However, in case of that replacement cost is applied for the compensation based on JICA Guidelines for Environmental and Social Considerations, compensation for land acquisition will be different among near areas in the transition area from the section along Tangerang Line to the section along Jl. Daan Mongot for each other. In such case, misdistribution will occur in the aspect of compensation. For the countermeasure, grievance system will be established.

The target user of MRT includes comparatively low and middle income level such as BRT or bus users to prevent the misdistribution of benefits and damages.

8) Water Usage and Right to Water

The reduction of groundwater level and groundwater pollution will be expected due to the excavation and water protection during construction stage. In DKI Jakarta, the unconfined aquifer and/or confined aquifer exists in layers less than 40 m and 40 m to 140 m and 140 m to 250 m and the groundwater flows from south to north. Because the water protection is applied for where cut and cover method is carried out such as at stations or transition section from elevated to underground sections, significant change in groundwater flow will not be expected. Then there is no significant impact on water usage and right to water. However, groundwater will be continuously monitored and ask to the user of groundwater to identify the impact by this project.

9) Public Health and Hazards (Risks) Infectious Disease

Regarding public health, there is a potential risk due to infectious disease by inflow of workers from external areas for construction activities. However, its impact is basically only temporary during construction. The temporary impact will be mitigated through education of workers regarding infectious disease and sanitary manner including AIDS.

10) Cultural Heritage

There is no historical structure or heritage site along the ROW of the MRT Line according to Department of Environment (BPLHD) in DKI Jakarta.

(2) Natural Environment

1) Topography/Geology

Underground sections mostly apply shield construction method and there is a modification of the terrain in the transition section and station which apply cut-and-cover construction methods.

In the section of cut-and-cover methods, diaphragm wall will be installed, and in elevated section, stakes will be driven until the layers have enough bearing capacity. These cause temporary change of topography or geology but countermeasures would be conducted until the completion of the construction, not to affect adverse significant impact.

2) Hydrology/Groundwater

Because most sections of MRT East-West Line are underground and/or elevated section, this project has less significant impact on surface water but development of rainwater drainage system will be required. At underground section, shield construction method will be applied for from station to station to prevent the change of ground water flow. At cut and cover construction section such as underground stations or transition section, diaphragm wall will be installed and pump up the groundwater. In that time, level of groundwater is monitored in the surrounding areas and if it is necessary to recover the groundwater level, recharge will be implemented into groundwater. During operation period, if the drawdown of groundwater level occurs, the countermeasure will be applied such as recharge well construction method, if necessary, to reduce the impact on hydrology.

3) Landscape

During construction, some of trees along the ROW will have to be cut. As mitigation measure, instead of them, other trees will be planted after the construction near surrounding area. The cut and removed trees shall be compensated based on DKI Jakarta Government Regulation (Head of Park and Landscape Agency Decision Letter in DKI Jakarta No. 09/2002.). The compensation in form of replanting should be conducted near the original place, or the other places, or mixture of two places depends on physical condition, also coordination result of the authorized agency (Park and Landscape Agency in DKI Jakarta) and other related stakeholders. In addition, some impacts on surrounding landscape would be expected but harmonized design for elevated structure and station in coordination with surrounding landscape should be implemented.

4) Global Warming

During construction, the operations of heavy equipment and traffic congestion cause temporary increase of greenhouse gas emission. During operation, in case of that current users of BRT and automobiles will shift to the MRT, the greenhouse gas emission would be reduced (The calculation result of greenhouse gas emission is discussed in Chapter 8).

(3) Pollution

1) Air pollution

During construction, due to utilization of construction equipment and increase of traffic congestion by the decrease of road width, the impact on air quality, especially TSP and NO_2 will be expected. In MRT North South Line, the Narita Rapid Railway Construction Project (2005) and the Narita Rapid Railway Construction Project (2007) were utilized for the estimation of increased portion of concentration by construction work as analogous cases. This MRT East West Line also can utilize the method. The location is tentatively selected in No. 9 measured in the environmental baseline survey. The result of impact on air quality is shown in Table 7.1-14.

Table 7.1-14 Prediction of Air Quality during Construction Stage

No.	Item	Increased portion of concentration by construction work (μg/Nm^3)	Background concentration (μg/Nm^3)	Predicted concentration (μg/Nm^3)	Air quality standard in DKI Jakarta (μg/Nm^3)
1	NO_2	9.6	77	86.6	92.5
2	TSP	1.2	143	144.2	230

Source: JICA Study Team

Based on the prediction, both items of air quality are below the standard but NO_2 is similar to the standard value. In addition, the contribution of background concentration is much larger than that of the project. However, air quality should be monitored during construction and suitable countermeasures should be applied, if necessary.

2) Water Pollution

During construction, main pollution sources of water environment are by living wastewater from the project field office and accommodation facilities of workers and from civil work. Regarding the former, concise on-site living wastewater treatment system will be installed, if necessary, to meet the standard of living wastewater. Regarding the later, it is expected that wastewater contains high suspended solid for the construction of excavation of underground section or pier construction. During the construction of pier installation in canals and/or rivers, temporally cofferdam which has high water protection capability will be installed to prevent the inflow of turbid water to water courses. In addition, regarding piers for elevated section and cut and cover section except in water courses, steel sheet piles acting as cofferdams will be installed. Meanwhile, sedimentation basin will be prepared, if necessary, for turbid water generated in the cofferdam from groundwater, spring and rainwater. In addition, if wastewater such as those from washing of concrete batch plant does not satisfy the standard of DKI Jakarta Regulation No.122/2005, this should be treated with suitable wastewater treatment facility.

On the other hand, there is rainwater and living wastewater from the depot and stations and wastewater due to washing of contaminants including oil from the depot during operation. A wastewater treatment facility will be developed for the depot to meet the wastewater standard as per DKI Jakarta Regulation No.122/2005.

3) Soil Pollution

East Jakarta Municipality along Jl. Bekasi Jaya has industrial area and thus, there is the possibility of soil contamination. Due to the possibility of expansion of soil contamination by excavation after the construction, soil quality has been analyzed to identify the current situation. The result indicates no contamination in the sampled locations, the possibility of soil contamination is lower near the area. However, the sampling analysis should be implemented to monitor the condition of soil contamination during construction.

4) Solid Waste

During construction, solid waste generation mainly includes construction waste from construction sites and municipal solid waste from the accommodation of workers or site offices. Construction waste including excavated soil will be possibly reused and soil mixed with chemical or toxic material will be appropriately disposed according to Indonesian law and regulation, with consideration of proper dewatering to prevent adverse impacts on surrounding environment. In addition, to mitigate the impact on natural environment, the construction material including soil and stone should be taken from non natural conservation areas. Preliminary estimated amount of excavated soil are described in Table 7.1-15.

Table 7.1-15 Estimated Amount of Excavated Soil

Unit: [thousand m^3]

Area	Station to station	Station	Total
Underground section	585	1,093	1,678
Elevated section	317	111	428

Source: JICA Study Team

During operation, municipal solid waste generated in the stations includes plastic, paper and food waste. It is estimated that the amount is approximately 0.5 [ton/day] to 17[ton/day] for each station in 2027. The solid waste generated in the depot contains hazardous waste which will be old equipment, parts and material which will be generated during maintenance of rolling stock and sludge from wastewater treatment as well as the municipal solid waste generated from worker's activity. The solid waste will be also treated and disposed according to Indonesian law and regulations.

5) Noise and Vibration

Noise

(i) During construction

In Indonesia, there is no noise standard applicable during construction. However, the standard for noise level for this project has been set similar to that of Jakarta MRT North-South Line and the standard levels are shown in Table 7.1-16.

Table 7.1-16 Noise target level during construction

Area	Day time (6:00 to 22:00)	Night time (22:00 to 6:00)
Sensitive Area and Hotel	75 dB	65 dB
Office and Commercial Area	75 dB	75 dB
Commercial and Service Area	80 dB	80 dB
Area with ambient noise level (>65)	75 dB	75 dB

Source: JICA Study Team

The noise during construction is complex and synthetic generated from some construction equipment. At this moment, though the detailed construction plan has not been prepared, the impact of noise by construction equipment is assessed with the assumption of the utilization of normal construction equipment at 15m from noise generation source.

$$L_{source} = 10\log_{10}(a \cdot 10^{\frac{L_p}{10}} + (1-a) \cdot 10^{\frac{L_{Ambient}}{10}})$$

$$L_{source\_combined} = 10\log_{10}(\sum_{i=1}^{n} 10^{\frac{L_{eqi}}{10}})$$

L_p : Sound power level [dB]

$L_{ambient}$: Ambient noise level [dB]=70dB（set value）

L_{source} : Noise level at source [dB]

$L_{source\_combined}$: Combined noise level at source [dB]

a : Ratio of operation hours with noisy work (0-1)

$$L_C = L_{Source} - 8 - 20\log_{10}\left(\frac{r}{r_0}\right) + \Delta L$$

Lc :Noise Level at evaluation point [dB]

r_0 :Distance from source to measurement point [m]

r :Distance from source to evaluation point [m]

ΔL :Effect of Soundproof barrier [dB]

Note : Above the formula prepared by the institute of noise control engineering in Japan

Table 7.1-17 Noise prediction during construction

Item of construction work	Main construction equipment	Noise level at source	Noise Level at 15m	Day time (6:00 to 22:00)	Night time (22:00 to 6:00)	Target Level
Demolition work	Breaker and Remover	118 dB	87 dB	×	×	75 dB (Day Time) 65 dB (Night Time)
	Excavator (0.4m3) and dump truck	101 dB	70 dB	○	×	
Earthwork, temporary cofferdam work and temporary work	Hydraulic vibratory hammer	104 dB	73 dB	○	×	
	Excavator (0.4m3) and dump truck	101 dB	70 dB	○	×	
	Rough terrain crane	103 dB	72 dB	○	×	
Concrete work (including formwork)	Concrete mixer truck	103 dB	72 dB	○	×	
	Excavator (0.4m3) and dump truck	101 dB	70 dB	○	×	
	Rough terrain crane	103 dB	75 dB	○	×	
	Crawler crane	111 dB	80 dB	×	×	
Track work	Concrete mixer truck	103 dB	72 dB	○	×	

Note) O: Compliance with Target Level, X: Not Comply with Target Level

The noise level at source is based on "Technical Guideline on Environmental Impact Assessment on Road Construction Project, Highway Environmental Research Institute / Japan, 2007" and "Regional Sound Environmental Planning, The Institute of Noise Control Engineering/Japan, 1997

Source: JICA Study Team

The result shows that the noise of all the equipment is over the standard in night time. Therefore, the construction activity in night time should be avoided. In addition, the noise from "Breaker and Remover" and "Crawler Crane" is over the standard of both night and day times. In that case, the temporary enclosure for "Breaker and Remover" and the use of "Crawler Crane with noise prevention" should be considered.

(ii) During operation

In Indonesia, there is no noise standard focused on train operation to receptors, therefore the target noise level at operation phase is set based on environmental standard of noise in Indonesia (KEP-48/MENLH/11/1996), which is similar to the procedure of Jakarta MRT North South Line which applies similar train operation system as follows.

Table 7.1-18 Noise Target Level during Operation

Category	Day time (Leq) (6:00 to 22:00)	Night time (Leq) (22:00 to 6:00)
Sensitive Areas	60 dB	55 dB
Others	65 dB	60 dB

Note :Target noise is only from train passing except for other noise sources. Sensitive areas include residences, hospitals, schools and places of religious worships.

Source: Japan Metro Engineering Consulting Study Team

The basic conditions for noise prediction in this project were set as follows, based on the operation plan.

Table 7.1-19 Condition for Prediction of Noise Impact during Operation

Item	Condition
Rail Type (Straight)	Long Rail
Rail Type (Curve)	Normal Rail
Track Structure	Slab Track
Height of soundproof	1.5m
Prediction Point	Land Boundary
Operation Speed	90[km/h](Elevated straight section) 50[km/h](Elevated curve section) 80[km/h](Underground section)
Train Length (8-Carts x 20 m)	160 [m]

Item	Condition
Number of Trains : Daytime (6:00-22:00)	462（2.5 minutes interval）
Number of Trains : Nighttime (5:00-6:00, 22:00-24:00)	36

Source: JICA Study Team

The noise level for elevated section is predicted by using the following noise prediction formula.

$$L_{AMAX} = 10\log_{10}(10^{\frac{L_{A1}}{10}} + 10^{\frac{L_{A2}}{10}})$$

L_{Amax} : Combined Noise level from rolling motion and elevated structure [dB]

L_{A1} : Noise level from rolling motion [dB]

L_{A2} : Noise Level from structure [dB]

$$L_{A1} = L_{W1} - 8 - 10\log_{10} r_1 + 10\log_{10}\left(\frac{(l/2r_1)}{1+(l/2r_1)^2} + \tan^{-1}\frac{l}{2r_1}\right) + \Delta L$$

L_{A1} : Noise level from rolling motion [dB]

L_{W1} : Sound power level from rolling motion(Lw1=105+30log10(V/100)+ ΔR [dB])

r1 : Distance from rail to evaluation point [m]

l : Length of Train (160m for 8 units)

ΔL : Reduction Factor of Noise Barrier [dB]

V : Speed of Train [km/h]

ΔR : Effect of Long Rail (Long Rain: 0 [dB], Normal Rail: +2 [dB])

$$L_{A2} = L_{W2} - 8 - 10\log_{10} r_2 + 10\log_{10}\left((\cos\theta)\cdot(\tan^{-1}\frac{l}{2r_2})\right)$$

L_{A2} : Noise Level from elevated structure [dB]

L_{W2} : Sound power level from elevated structure (91 [dB])

r_2 : Distance from center of pier to evaluation point [m]

θ : Angle between prediction line and vertical line

Note : above the formula based on “Draft Proposal of the Prediction of Noise from Elevated Section Journal of Institute Noise Control, Japan 1980”

Table 7.1-20 Noise Level during Operation（Elevated Straight Section）

Evaluation point	1F (1.2m)	2F (4.2m)	3F (7.2m)	4F (10.2m)
LAeq-day	60.6 dB	61.4 dB	62.1 dB	63.0 dB
LAeq-night	52.5 dB	53.3 dB	54.1 dB	54.9 dB
LAeq	59.2 dB	60.0 dB	60.7 dB	61.6 dB

Source: JICA Study Team

Table 7.1-21 Noise Level during Operation（Elevated Curve Section）

Evaluation point	1F (1.2m)	2F (4.2m)	3F (7.2m)	4F (10.2m)
LAeq-day	57.4 dB	57.9 dB	58.5 dB	59.0 dB
LAeq-night	49.3 dB	49.8 dB	50.4 dB	51.0 dB
LAeq	55.9 dB	56.5 dB	57.0 dB	57.6 dB

Source: JICA Study Team

At elevated curve section, the predicted noise level is less than the target noise level. However, the former at the elevated straight section is more than the latter at sensitive areas. Therefore, means of soundproofing or reduction of train operation speed will be considered for the sensitive area at the elevated straight section.

On the other hand, at underground section, the noise which occurs in underground section, will be reflected and absorbed by the underground wall and it will not affect the ground (receptor). In addition, it will be expected that the noise level at-grade section such as depot will not have significant impacts due to low speed operations.

Vibration

(i) During construction

The vibration level of main construction equipment at the point of 15m from the source is shown as Table 7.1-22, although it actually depends on the construction methods selected by the contractor.

Table 7.1-22 Vibration prediction during construction

Item of construction work	Main construction equipment	Vibration level at source	Vibration level	Day time (6:00 to 22:00)	Night time (22:00 to 6:00)	Target Level
Demolition work	Breaker and remover	70 dB	62 dB	○	○	85 dB (Day Time) 80 dB (Night Time)
	Excavator ($0.4m^3$) and dump truck	71 dB	63 dB	○	○	
Earthwork, temporary cofferdam work and temporary work	Hydraulic vibratory hammer	101 dB	82 dB	○	×	
	Excavator ($0.4m^3$) and dump truck	71 dB	63 dB	○	○	
	Rough terrain crane	77 dB	69 dB	○	○	
Concrete work（including formwork)	Concrete mixer truck	77 dB	69 dB	○	○	
	Excavator ($0.4m^3$) and dump truck	71 dB	63 dB	○	○	
	Rough Terrain Crane	77 dB	69 dB	○	○	
	Crawler crane	77 dB	69 dB	○	○	
Track work	Concrete mixer truck	77 dB	69 dB	○	○	

Note) (1) O: Compliance with Target Level, X: Not Comply with Target Level
(2) The vibration level at source is based on "Technical Guideline on Environmental Impact Assessment on Road Construction Project, Highway Environmental Research Institute / Japan, 2007"
(3) Target level is set as same as MRT North – South Line

Source: JICA Study Team

(ii) During operation

During operation, the vibration prediction in elevated section is shown as follows.

$$L = L_V - 10\log_{10}\left(\frac{r}{r_0}\right) - 10\log_{10}\{\exp(\alpha(r - r_0))\}$$

L : Vibration level at evaluation point [dB]

L_V : Vibration level at center of pier [dB]

R : Distance from center of pier to evaluation point [m]

r0 : Distance from center of pier to reference point (1.0m)

α : Internal reduction coefficient on surface ground (0.05, Silt, Clay)

$$L_V = 27.7\log_{10} V + 31.7$$

L_V : Vibration level at center of pier [dB]

V : Speed of train [km/h]

Note : Above the formula based on "Vibration prediction model of elevated section proposed by Bureau of Construction, Tokyo Metropolitan Government"

Table 7.1-23 Predicted Vibration during Operation（Elevated Section）

Item	Straight section	Curve section
Lv	65.8 dB	58.8 dB
L	51.3 dB	44.2 dB

Source: JICA Study Team

During operation, the vibration prediction at underground section is calculated as follows.

$$L = K - A\log_{10}\left(\frac{X}{15}\right) - 24\log_{10}\left(\frac{Y}{20}\right) + 20\log_{10}\left(\frac{Z}{40}\right)$$

L: Vibration level at evaluation point [dB]

K: Vibration level at source (72 [dB])

A: Coefficient for ground condition (Soft: 20, Very Soft: 15)

X: Distance from edge of tunnel to evaluation point [m]

Y: Tunnel Weight [ton/m]

Z: Speed of Train (80 [km/h])

Note : Above the formula based on "Vibration prediction model of underground section proposed by Bureau of Construction, Tokyo Metropolitan Government"

Table 7.1-24 Vibration Prediction during Operation（Underground Section）

Item	Straight section	Curve section
K [dB]	72.0	72.0
X [m]	24.9	24.9
Y [ton/m]	14.5	14.5
Z [km/h]	80.0	50.0
L [dB]	77.0	72.9

Source: JICA Study Team

6) Subsidence

During construction, it is possible that ground subsidence may occur not only during pumping up of ground water and protection of ground water flow but also during shield work. The work method for this project would be selected considering ground condition. If necessary, the countermeasure for ground subsidence would be adopted. In DKI Jakarta, especially in northern area, ground subsidence currently occurs due to other activities such as various civil and architectural works and pumping up ground water. Therefore, ground subsidence will be monitored during construction and a certain period of operation and a certain period of the operation to identify its cause and degree of ground subsidence as well as its causes to consider for the countermeasure if necessary. Based on the evaluation, the impact will be prevented with necessary countermeasure.

7) Accident

During construction, it is possible that accident may occur due to malfunction of equipment and anthropogenic mistake. When accidents occur, during operations, the suspension of the signal system due to electricity failure will be considered. Furthermore countermeasure for the accident will be prepared. In addition, countermeasure against earthquake or flood such as escape routes or evacuation manual for flood prevention plan will be applied.

(4) Summary of Impact Assessment

After the impact assessment, the impact of each item in the scoping result has been re-assessed. The result of impact assessment are summarized in Table 7.1-25 with the comparison of the result of scoping stage.

Table 7.1-25 Summary of Impact Assessment

Item	Scoping		EIA		Remark (Reason to be changed during the period from Scoping to EIA)
	Construction	Operation	Construction	Operation	
Social Environment					
Involuntary resettlement	A-	B-	A-	B-	The result of the EIA is as same as of scoping.
Impact on daily life	B-	B-	B-	B-	Even though the operation stage, there may be some negative impacts on daily life
Impact on local economy	B+	B+	B+	B+/ B-	During operation phase, increase of employment or mitigation of traffic congestion will affect the positive impacts on local economy. On the other hand, staff of BRT has to change the job, which cause negative impacts, though some staff may be reemployed by the operation company of MRT.
Land use	D	C-	D	C-	The project activities may have negative impact on land use with suitable development of station or surrounding areas during operation stage.
Community division	D	D	D	D	The result of the EIA is as same as of scoping.
Existing social infrastructure and service	B-	B+	B-	B+	The result of the EIA is as same as of scoping.
Poverty, indigenous,	B-	B-	B-	B-	The result of the EIA is as same as of scoping.

Item	Scoping		EIA		Remark (Reason to be changed during the period from Scoping to EIA)
	Construction	Operation	Construction	Operation	
ethnic people					
Misdistribution of benefits and damages	B-	B-	B-	B-	The result of the EIA is as same as of scoping.
Conflict and dispute of local community	D	D	D	D	The result of the EIA is as same as of scoping.
Water usage and right of water	B-	B-	B-	B-	During construction, there will be some impacts on groundwater quality and level according to the impact assessment. Therefore, this causes the negative impacts on water usage and right of waster.
Public health	B-	D	B-	D	The result of the EIA is as same as of scoping.
Hazards (risks) infectious disease	B-	D	B-	D	The result of the EIA is as same as of scoping.
Cultural heritage	C-	C-	D	D	During the survey, there is no cultural heritage in ROW.
Natural Environment					
Topography/Geology	B-	C-	C-	D	During construction stage, there may have some modification of topography, especially cut and cover section. However, after filling, the impact will be reduced and only small impacts will remain. There are some uncertain about geological condition in this moment. During detail design stage, more detail geological survey will be conducted to select the suitable construction method.
Soil erosion	D	D	D	D	The evaluation in scoping is as same as in EIA.
Groundwater	B-	C-	B-	C-	During construction, the groundwater would be extracted in the cut and cover section with protection of diaphragm wall. It cause may drawdown of groundwater level which depends on the groundwater flow and geological condition. The more detail geological survey will be implemented during the detail design stage to identify the possibility of groundwater drawdown and the countermeasure for its protection.
Hydrology	B-	C-	B-	C-	Even though during operation stage, there may be some impacts on hydrology in the transition section or depot area. Therefore, the monitoring should be carried out.
Coastal zone	D	D	D	D	The result of the EIA is as same as of scoping.
Animal/ecological system	D	D	D	D	The result of the EIA is as same as of scoping.
Climate	D	D	D	D	The result of the EIA is as same as of scoping.
Landscape	B-	D	B-	D	The result of the EIA is as same as of scoping.
Global warming	B-	C-	B-	B+	During operation stage, according to the calculation of greenhouse gas emission, the emission amount of greenhouse gas would be reduced in comparison of no project.
Pollution					
Air pollution	B-	C-	B-	B+	During operation stage, air pollution by the pollutants such as NOx, TSP would be reduced because the reduction of such pollutants would occur similar to the reduction of greenhouse gas by modal shift from motorbike or automobile to the MRT East – West Line.
Water pollution	B-	C-	B-	B-	During operation stage, the wastewater in depot and station will be generated. Therefore, the negative impacts will be anticipated.
Soil pollution	D	D	C-	D	During construction stage, there are some impacts on soil due to the excavation. Therefore, it is necessary for monitoring during the construction stage.
Solid waste	B-	B-	B-	B-	The result of the EIA is as same as of scoping.
Noise and vibration	B-	B-	B-	B-	The result of the EIA is as same as of scoping.
Subsidence	B-	C-	B-	C-	During construction, the possibility of ground subsidence may occur due to the groundwater extraction and shield work. The continuous monitoring is necessary during construction and operation period because even though during the operation period, impacts may remain.
Offensive odor	D	D	D	D	The result of the EIA is as same as of scoping.

Item	Scoping		EIA		Remark (Reason to be changed during the period from Scoping to EIA)
	Construction	Operation	Construction	Operation	
Bottom sediment	D	D	D	D	The result of the EIA is as same as of scoping.
Accident	B-	C-	B-	C-	Not only construction period but also operation one, there may are possibilities of accident. Therefore, continuous monitoring is necessary.

Note:
A-: Significant negative impact is expected A+:Significant positive impact is expected
B-: Negative impact is expected to some extent B+: Positive impact is expected to some extent
C-: Extent of Negative/Positive impact is unknown. Examination is needed.
D: No impact or a small impact is expected. Additional examination is not necessary.
The evaluation result of scoping enhances the comments of JICA Advisory Committee.

Source: JICA Study Team

7.1.6 Environmental Management Plan

The environmental management plan is prepared to reduce and mitigate the anticipated negative impact. During construction, environmental management will be basically implemented by the contractor with supervision by general consultant which will be employed by Project Management Unit (PMU). During operation, the operation unit with the support of general consultant during commissioning period will implement the plan and only the operation unit will perform the implementation after commissioning period. The environment management plan is prepared based on existing information on environment and environmental baseline survey and the assessment of impact by this project and include the contents during construction and operation stages. According the EIA system in Indonesia, the environmental management report have to be submitted to BPLHD in DKI Jakarta and supervision section of this project for once per six month at least..The summary of environment management plan is described in Table 7.1-26.

(1) Pre-construction and Construction

Table 7.1-26 Summary of Environmental Management Plan（Pre-construction and Construction）

Item	Content	Location	Implementation
Social Environment			
Involuntary resettlement	- Compensation regarding resettlement and implementation of livelihood restoration program	Resettlement area and/or relocation area	By DKI Jakarta and the PMU with support of General Consultant （hereafter GC）
Impact on daily life	- Preparation of traffic diversion to prevent traffic congestion - Preparation of traffic sign near the project site - Consideration of transportation for the construction material will be at night time to prevent the traffic congestion	Construction area	
Existing social infrastructure and service	- As the impacts on existing social infrastructure and service, there is a impact on existing BRT line. However, transportation management plan will be prepared and traffic control will be implemented.	Surrounding area of the target line	
Poverty, indigenous, ethnic people	- In the case of poor residents is the target of resettlement, sufficient compensation will be provided and they will be trained based on livelihood restoration program.		
Misdistribution of benefits and damages	- Employment of PAPs as worker would be prioritized. - Compensation for the PAPs in ROW will be equaled not so as to occur misdistribution for		

Item	Content	Location	Implementation
	them.		
Water usage and right of water	- If the change of ground water level or quality deterioration of ground water occurs based on the monitoring of groundwater well, countermeasure (e.g. recharge well method) to mitigate the impact on water utilization will be adopted.		
Public health Hazards (risks) infectious disease	- Sanitary education with awareness raising will be conducted for workers periodically. - Compliance of Indonesia law and regulations as well as periodical health consultation and vaccination		By the Contractor with the supervision of GC
Natural Environment			
Groundwater	- Based on the monitoring result of groundwater level and flow during construction, if the decline of groundwater level occurs outside of construction area, recharge method will be applied to keep the groundwater level.	Surrounding area of the target line	By the Contractor with the supervision of GC
Hydrology	- Preparation of detail construction plan to conserve discharge function in the surrounding target area - Hydrological system including existing drain and consideration of new drain system, if necessary		By the Contractor with the supervision of GC
Landscape	- Tree cut during construction period will be replanted or other trees（basically, local species）will be planted where landscape aspect will be necessary. - Stations and station plazas will be designed in harmonization with surrounding landscape.		By the Contractor with the supervision of GC
Global warming	- Prevention of unnecessary operation of vehicle and heavy equipment - Check and maintenance of vehicle or heavy equipment - Confirmation of compliance of construction plan	Construction area	By the Contractor with the supervision of GC
Pollution			
Air pollution	- Water spray to prevent dust scattering - Prepare the sheet to prevent dust from scattering - Periodic maintenance of vehicle or heavy equipment - Control the vehicle speed - Install temporary fence	Surrounding construction area	GC and Contractor
Water pollution	- Turbid water generated from civil work including excavation for pier construction, temporary road work and concrete work will be discharged after the treatment at sand basin	Surrounding construction area	GC and Contractor
Solid waste	- Excavated soil generated during construction and municipal solid waste generated from a workers accommodation facilities will be disposed with appropriate manner in accordance with Indonesia law and regulations	Surrounding construction area	By the Contractor with the supervision of GC
Noise and vibration	- Selection of construction equipment to be used in consideration of the noise and vibration during construction - Install temporary soundproof barriers to prevent noise - Consideration of working hour for construction	Surrounding construction area	GC and Contractor
Subsidence	- The construction work will be conducted to avoid potential land subsidence during construction. - Control the groundwater extraction - Application of ground subsidence prevention method if the ground subsidence is detected in the monitoring	Underground and transition section (cut and cover and shield boring sections)	By the Contractor with the supervision of GC
Accident	- Based on the safety plan which is prepared by the contractors, countermeasure to prevent	Surrounding construction	By the Contractor with the

Item	Content	Location	Implementation
	accidents will be taken. - Safety education for workers - Implementation of traffic management plan	area	supervision of GC

Source: JICA Study Team

(2) Operation

Table 7.1-27 Summary of Environmental Management（Operation）

Item	Content	Location	Implementation
Social Environment			
Involuntary resettlement	- Monitoring and promotion of implementation situation of land acquisition resettlement and compensation and implementation of livelihood restoration program	Resettlement area and/or relocation area	By DKI Jakarta with the support of GC
Impact on daily life	- Reduction of traffic congestion by suitable development of station plaza and surrounding area	Surrounding area of the target line	
Poverty, indigenous, ethnic people	- Especially, for poor people in PAPs, sufficient compensation or training by livelihood restoration program will be implemented.		
Misdistribution of benefits and damages	- By keeping fair and reasonable tariff setting, the misdistribution of benefit will be prevented.		
Water usage and Right of Water	- If the change of ground water level or quality deterioration of ground water occurs based on the monitoring of groundwater well, countermeasure (e.g. recharge well method) to mitigate the impact on water utilization will be adopted.		
Natural Environment			
Groundwater	- Based on the monitoring result of groundwater level, if the decline of groundwater level occurs outside of construction area, countermeasure should be considered to keep the groundwater level.	Surrounding area of the target line	By the Contractor with the supervision of GC
Hydrology	- If there are some changes of the hydrological condition, the countermeasure such as drain or pit construction will be considered		By the Contractor with the supervision of GC
Pollution			
Water pollution	- Preparation of waste water treatment for waste water including oil from depot - Preparation of on-site primary treatment system and/or drainage system of domestic wastewater from station	Surrounding area of the target line（Including depot）	GC and the Contractor
Solid waste	- Municipal solid waste from each station and depot and hazardous waste from depot will be disposed with suitable matter based on the Indonesian law and regulation.	Surrounding area of the target line（Including depot）	By the Contractor with the supervision of GC
Noise and vibration	- Utilization of long rail and soundproof barrier - Number of train in night time is decreased. - During operation, the train operation will be implemented with suitable mitigation procedure of noise and vibration based on the impact assessment.	Surrounding area of the target line	GC and the Contractor
Subsidence	- During operation, if ground subsidence is	Underground	By the

Item	Content	Location	Implementation
	detected in the monitoring, recharge well or other suitable countermeasure to prevent subsidence will be considered.	and transition section (cut and cover and shield boring sections)	Contractor with the supervision of GC
Accident	- Installation of flood prevention system - Installation of signal system to prevent train collision accident - Installation of fire prevention system - Installation of backup electricity system	Surrounding area of the target line	Operation Company

Source: JICA Study Team

7.1.7 Environmental Monitoring

During construction, surrounding environment will be monitored and the compliance of environmental management plan will be checked to identify the impact of construction work and to enhance corresponding mitigation. During operation, the change in environmental condition or effect of the project including mitigation measure will be checked based on the environmental monitoring plan. According the EIA system in Indonesia, the environmental monitoring report have to be submitted to BPLHD in DKI Jakarta and supervision section for once per six month at least. The monitoring item, its contents and methodology, areas and its implementation bodies are summarized in Table 7.1-28.

(1) During Pre-construction and Construction

Table 7.1-28 Environmental Monitoring Plan（Pre-construction and Construction）

Item	Contents and Methodology	Frequency	Location	Implementation body
Social Environment				
Involuntary resettlement	Monitoring of implementation condition of land acquisition, resettlement, compensation and livelihood restoration program	Every time during resettlement	Resettlement area and/or relocation area	By PMU and Land Procurement Agency in DKI Jakarta with the support of GC
Impact on daily life	Confirmation of the impact on daily life through interview survey	Once a month	Construction area and its surrounding area	
Existing social infrastructure and service	Confirmation of the impact on existing social infrastructure and service through interview survey	Once a month	Construction area and its surrounding area	
Poverty, indigenous, ethnic people	Confirmation of the impact on poor people through interview survey	Once a month	Construction area and its surrounding area	
Misdistribution of benefits and damages	Confirmation of misdistribution of benefits and damages through interview survey	Once a month	Construction area and its surrounding area	
Water usage and right of water	Confirmation of problems regarding water usage and water right through interview survey	Once a month	Construction area and its surrounding area	
Public health	Periodical health check	Four times per a year	Worker's accommodation and/or office	By the Contractor with the supervision of GC
Hazards (risks) infectious disease	Examination of infectious disease	Four times per a year	Worker's accommodation and/or office	By the Contractor with the supervision of GC
Natural Environment				
Groundwater	Monitoring of groundwater level	Continuous monitoring	Construction area and its surrounding area	By the Contractor with the supervision of GC
Hydrology	Check of hydrological condition (Collection of rainfall and	Four times per a year	Construction area and its	By the Contractor with the

Item	Contents and Methodology	Frequency	Location	Implementation body
	flooding condition data)		surrounding area	supervision of GC
Landscape	Confirmation of landscape by field survey	Four times per a year	Construction area	By GC
Global Warming	Confirmation of the compliance of construction plan	Four times per a year	Construction area and its surrounding area	By the Contractor with the supervision of GC
Pollution				
Air pollution	Air quality monitoring (TSP, NO_2, SO_2, NO, CO, Pb)	Once per three month	Construction area and its surrounding area (10 locations)	By the Contractor with the check of GC
Water pollution	Water quality monitoring (Temperature, pH, Turbidity, EC, BOD, COD, DO, Total-P, Total-N, Oil-grease, Coliform)	Once per three month	Construction area and its surrounding area (10 locations)	By the Contractor with the check of GC
Solid waste	Sampling of construction waste including excavated soil (pH, Pb, As, Cr, Cd, Zn, Mn, Cu, Ni) and checking municipal solid waste at generation source by using monitoring sheet	Once a month	Construction area and its surrounding area	By the Contractor with the supervision of GC
Noise and vibration	Measurement of noise and vibration	Once a month	Construction area and its surrounding area (10 locations)	By the Contractor with the check of GC
Subsidence	Monitoring by ground subsidence measurement equipment continuously	Continuous monitoring	Construction area and its surrounding area	By the Contractor with the supervision of GC
Accident	Monitoring the implementation situation of safety measure by using monitoring sheet of accident	Every day	Construction area	By the Contractor with the supervision of GC

Source: JICA Study Team

(2) Operation

Table 7.1-29 Environmental Monitoring（Operation）

Item	Contents	Frequency	Location	Implementation
Social Environment				
Involuntary resettlement	Confirmation of implementation situation of livelihood restoration program	One year after the commencement	Relocated area	By DKI Jakarta with the support of GC
Impact on daily life	Confirmation of the impact on daily life through interview survey	Twice a year for two year after the commencement	MRT East-West Line and its surrounding area	
Existing social infrastructure and service	Confirmation of the impact on existing social infrastructure and service through interview survey	Twice a year for two year the commencement	MRT East-West Line and its surrounding area	
Poverty, indigenous, ethnic people	Confirmation of the impact on poor people through interview survey	Twice a year for two year after the commencement	MRT East-West Line and its surrounding area	
Misdistribution of benefits and damages	Confirmation of misdistribution of benefits and damages through interview survey	Twice a year for two year after the commencement	MRT East-West Line and its surrounding area	
Water usage and Right of Water	Confirmation of problems regarding water usage and right of water	Twice for two year after the commencement	MRT East-West Line and its surrounding area	
Natural Environment				
Groundwater	Groundwater level monitoring	Every time for one year after the	MRT East-West Line and its	By the Contractor with

Item	Contents	Frequency	Location	Implementation
		commencement	surrounding area	the supervision of GC
Hydrology	Check of hydrological condition	Four times for one year after the commencement	MRT East-West Line and its surrounding area	By the Contractor with the supervision of GC
Pollution				
Air pollution	Air quality monitoring (TSP, NO_2, SO_2, NO, CO, Pb)	Four times for one year after the commencement	MRT East-West Line (10 locations)	By the Contractor with the check of GC
Water pollution	Water quality monitoring (Temperature, pH, Turbidity, EC, BOD, COD, DO, Total-P, Total-N, Oil-grease, Coliform)	Four times for one year after the commencement	MRT East-West Line (10 locations)	By the Contractor with the check of GC
Solid waste	Monitor the type and amount of solid waste generated in station and depot by using monitoring sheet.	Four times for one year after the commencement	MRT East-West Line and its surrounding area and disposal or recycling site	By the Contractor with the supervision of GC
Noise and vibration	Measurement of noise and vibration levels	Once a month for one year after the commencement	MRT E-W Line and its surrounding area and disposal or recycling site	By the Contractor with the check of GC
Subsidence	Monitoring by ground subsidence measurement equipment continuously	Continuous monitoring for one year after the commencement	MRT East-West Line and its surrounding area	By the Contractor with the supervision of GC
Accident	Monitoring the implementation situation of safety measure by using monitoring sheet of accident	Every day	MRT East-West Line	By the Operation company with the supervision of GC

Source: JICA Study Team

7.1.8 Public Consultation

According to the EIA law in Indonesia, AMDAL committees will be held and the project proponent should explain the contents of the project to the governmental organization, community leaders and NGOs during scoping and draft EIA preparation stage as it is necessary to obtain their opinion. The enhanced opinions should be included in the final EIA report to be submitted to BPLHD for their approval.

In addition, according to the JICA Guidelines for Environmental and Social Considerations, Public Consultations Meeting (PCM) should be held for twice at least because the study should be implemented with involvement of various stakeholders.

The PCM, where the project contents are explained, has been held with initiative of DGR. The JICA Study Team supported to prepare the presentation material and answer the question regarding the project and environmental impacts by this project and mitigation measures for the impact. The result of public consultation meetings of the project explanation, scoping results in EIA process (as also AMDAL Committee at scoping stage) and the explanation of draft EIA (as also AMDAL Committee at draft EIA stage) are follows.

(1) First PCM (Explanation of Project Contents)

Date and time	4th, August, 2011, 9:00 to 11:30
Place	Ballroom BLPHD Gedung Nyi Ageng Serang Fl. 10, Jl.HR Rasuna Said Kav.C.22, Kuningan, South Jakarta
Title	Explanation of project contents and implementation plan of environmental survey
Participants	Totally approximately 50 participants including BPLHD in DKI Jakarta, DGR, other governmental organization, community leader and NGOs
Main questions and answer	－Please explain the schedule of phase I and phase II and the alignment in detail (North Jakarta Municipality). ⇒ Phase I includes Kembangan to Ujung Menteng and it is planned that Phase I commences the operation in 2020. The detail schedule will be included in FS report which is prepared as well as EIA in parallel. －Please explain the route selection and area of underground and elevated sections (NGO: FORMAPEL East Jakarta). ⇒ The meeting for route selection has been held for three times with Banten and West Java provinces and DKI Jakarta. During the selection process, the route has been selected in demand, cost estimation and land acquisition. Regarding eastside, the alignment is transited from underground section to elevated section, from Senen to North Cempaka. －Regarding the employment of staff for MRT construction, please consider to employ the local workers (By community leader). ⇒ For employment, we need the education or qualification but we will include the consideration in the plan to employ the local workers in the plan as much as possible. －Please hold public consultation meeting in municipality or district levels (NGO:LMK Chairman West Jakarta)⇒ Public consultation meeting will be held in municipal level later. －Land acquisition of Tangerang line has been implemented without previous notice. Please do not implement the land acquisition without previous notice for this project. (By community leader) ⇒ We will prepare the LARAP as well as EIA and explain to PAPs and consult with them during the land acquisition.

(2) Second PCM (Explanation of draft scoping and TOR of EIA【AMDAL Committee】)

Date and time	15th, September, 2011, 9:00 to 11:30
Place	BLPHD Meeting Room, Nyi Ageng Serang Building, 10th Floor, Jl.HR Rasuna Said Kav.C.22, Kuningang, South Jakarta.
Title	Explanation and discussion of draft scoping and TOR of EIA
Participants	Totally approximately 60 participants including BPLHD in DKI Jakarta, DGR, other governmental organization, community leader, NGOs and AMDAL Committee.
Main questions and answer	－If the commencement of operation is 2020, does surrounding environment change from current condition? (NGO: LMK) ⇒ If the project does not commence after three years of EIA approval, EIA have to be implemented again. －Excavated soil, numbers of workers, replant of cut trees, electric powers or industrial water should be included in EIA report (AMDAL Committee) ⇒ In the range that the detail plan of the project is determined in this F/S stage, they will be described in the EIA report. －Please provide the land acquisition plan in each area (DKI Jakarta) ⇒ The land acquisition plan will be briefly described in the EIA（The detail will be describe in the LARAP）. －Please show the relation with other public transportation systems or road construction plans (Transport Department DKI Jakarta) ⇒This will be described in EIA report and F/S report.

(3) Third PCM (Explanation of draft EIA【AMDAL Committee】)

Date and time	10th, February, 2012, 9:30 to 13:30
Place	BLPHD Meeting Room, Nyi Ageng Serang Building, 10th Floor, Jl.HR Rasuna Said Kav.C.22, Kuningang, South Jakarta.
Title	Explanation and discussion of draft EIA
Participants	Totally approximately 60 participants including BPLHD in DKI Jakarta, DGR, other governmental organization, community leader, NGOs and AMDAL Committee.
Main questions and answer	- Please explain the locations underground, elevate and transition sections⇒The elevated section is Kembangan 2 to Grogol and Cempaka Baru to Ujung Menteng. The underground section is from Roxy to Galur. Comprehensible location map will be added in the report. - Alignment has not yet been approved, why study EIA was carried out? It will be many change ⇒Though the alignment has not been approved by Tata Ruang in DKI Jakarta, the route of E-W Line (Phase 1) was fixed in accordance with formal discussions with DGR, DKI JKT, BAPPENAS and other stakeholders. - How to manage about groundwater drawdown for cut and cover section. ⇒The groundwater level will be monitored during preconstruction, construction and operation stages. If there are some issues of groundwater level, the suitable mitigation measure such as recharge well or preparation of protection wall will be conducted. - Please inform the dumping place of garbage. ⇒Municipal solid waste will be disposed in Bantar Gebang landfill site in Bekasi City for landfill site of DKI Jakarta or other sanitary landfill sites prepared by DKI Jakarta. B3 Waste will be disposed in disposal company which is registered based on Indonesian regulations.

7.1.9 Environmental and Social Considerations for the Phase 2 section

(1) Hearing the Opinions Regarding the Alignment of the Phase 2 section

The target area of the EIA is only Phase 1 but environmental and social considerations for in phase 2 section will be required in aspect of the stakeholder's opinion as well as the confirmation of critical points regarding environment. In this context, the meeting with BAPPEDA which is the urban planning section in each municipality has been held. Then, draft alignment for phase 2 section has been explained to them. The opinions and information from BAPPEDA have been obtained with some information regarding future land use plan, urban plan, and road construction plan as well as regarding the information of existence of conservation area, religious facilities as follows.

1) Tangerang Regency

Date and time	15th, October, 2011, 10:00～11:30
Meeting place	BAPPEDA in Tangerang Regency
Title	Confirmation of urban planning, land use plan and critical points in aspect of environment
Participant	Mr. Erwin (BAPPEDA), Mr. Rudy (Tata Ruang), etc
Main questions and answers	－Currently, phase 2 section will includes from Kembangang to Balaraja at the western side. In Tangerang regency, the alignment poses no problem with regard to the environmental aspects at parallel portions along the express toll road. However, we would like to confirm whether there are the religious facilities or conservation areas in the section to Balaraja from normal road entered from express toll road, or not. In addition, if you have a future land use plan, we would like to obtain the document for reference. ⇒In the area surrounding Balaraja market, the road is narrow but there are no conservation areas or large scale religious facilities. In addition, land use plan will be sent by e-mail after the approval of permission of land use plan.

2) Tangerang City

Date and time	14th, November, 2011, 10:00～11:30
Meeting place	BAPPEDA in Tangerang City
Title	Confirmation of urban planning, land use plan and critical points in aspect of environment
Participant	Mr.Hadi Baradin (BAPPEDA)、Mr.Agus Wibowo(Head of assistant for transportation system)、Tri W Wiboso (Head of technical transportation system), etc
Main questions and answers	－We would like to confirm the adjustment between the alignment of Phase 2 in Jakarta MRT East West Line and current urban plan and land use plan. ⇒There is no discrepancy between the alignment and the plans but considering the access with the current Tangerang Line, it is better that the alignment should pass the Tangerang Station. In addition, we already provided the land use plan and urban plan for 2030 (please refer the document). －Are there any sensitive environmental conservation area or important area which has cultural and religious assets along the surrounding area of the alignment in the Phase 2 section ? ⇒The alignment is along existing road and the sensitive area does not exist along the road.

3) Bekasi City

Date and time	15th, November, 2011, 13:30～15:00
Meeting place	BAPPEDA in Bekasi City
Title	Confirmation of urban planning, land use plan and critical points in aspect of environment
Participant	Ms. Marlina Lucianawati, ST, MSE, M.Sc, etc
Main questions and answers	－The alignment of phase II section of MRT is along Jl. Kaliaban and draw the alignment in the residential area, considering the future road extension. Please inform the actual future extension plan and land use plan. ⇒Currently, there is currently no extension plan of Jl. Kaliaban and some developer implements the residential development. It is difficult to prepare the alignment of MRT. －Are there natural conservation area or important religious facility? After obtaining the information, it is necessary to consider the alignment later, We need the background document and maps, etc.⇒ They will send the plan and map. There is no natural conservation area or important religious facility along the area.

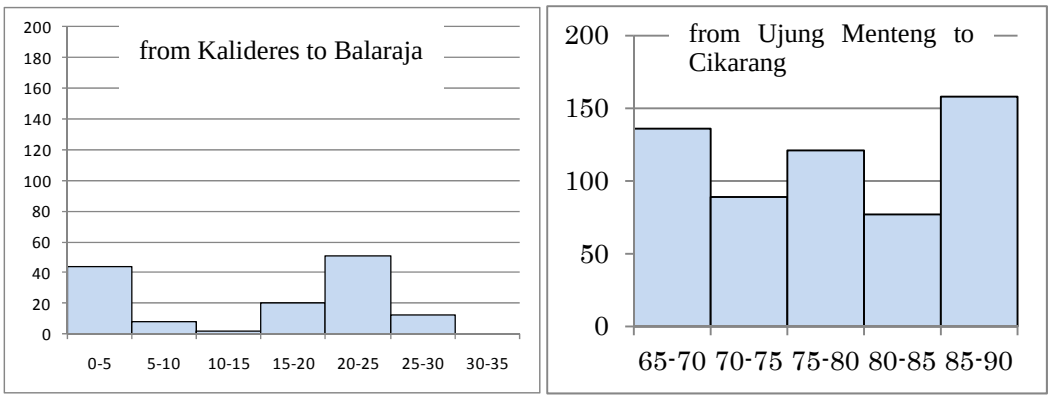
4) Bekasi Regency

Date and time	15th, November, 2011, 9:00～10:30
Meeting place	BAPPEDA in Bekasi Regency
Title	Confirmation of urban planning, land use plan and critical points in aspect of environment
Participant	Mr.Wowo Fadilan (Bidan Fisik dan Prasarana, BAPPEDA)、Mr. Ferry MD. SE、Heri Siswadi, etc
Main questions and answers	－There is no development plan for extension of Jl. Kaliaban along the route and the proposed route is cross the residential area. －Are there land use plan for 2030?⇒There is a land use plan for 2030 but the development plan of the road is not described. －There is no conservation area or environmental protection area near the proposed route.
Obtained document	The land use plan of which target year is 2030

(2) Affected Structures assumed based on a Satellite Image

(i) Affected Households

Number of affected households or other structures which will be acquired in the MRT project are counted based on a satellite image. The more accurate number of the affected households or other structures should be counted after the official determination of the ROW. The profile of the number of affected households is shown in Figure 7.1-17.



Source: JICA Study Team

Figure 7.1-17 Affected Structures

(ii) Affected Sensitive Receptor

Sensitive receptors (e.g. hospitals, schools and mosques), which need special attention in terms of noise and vibration were counted along the MRT corridor. It is necessary to consider mitigation measures like anti-vibration sleepers and sound insulation walls in the design stage of the phase 2..

Table 7.1-30 No. of Sensitive Receptors along the Route

Sensitive Area	Phase 2 (from Kalideres to Balaraja)	Phase 2 (from Ujung Menteng to Cikarang)
Hospital	6	2
School	10	5
Mosque	7	2
Total	23	9

Source: JICA Study Team

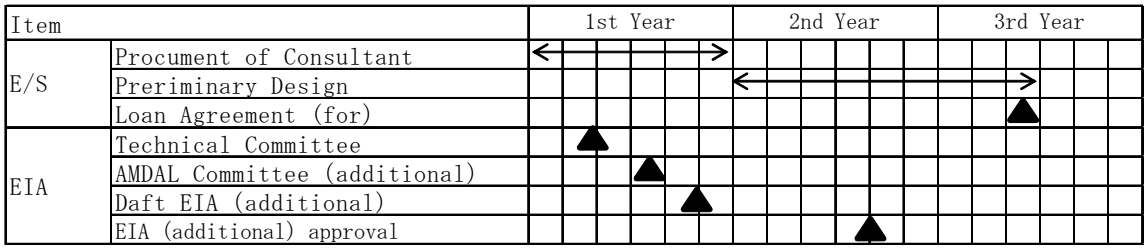
(3) Future actions to be taken

In this study, the JICA Study Team carried out the hearing to BAPPEDA, which is the representative of the region and check the critical points in aspect of environment. In the stage of FS Study of Phase 2, the stakeholder meeting including community leaders, NGOs and local residents should be held after the stakeholder analysis in the process of EIA system in Indonesia.

7.1.10 Schedule for Environmental and Social Consideration

The schedule from the preparation of the draft EIA to its approval of it is shown as following figure. Regarding the follow-up of DGR, the JICA Study Team will support the responsible person of DGR, especially for, explaining further actions to the comments of AMDAL Committee. After the submission of Draft EIA, DGR should implement the revise of the EIA

according to the comments of AMDAL Committee. The future schedule to be considered is shown in Figure 7.1-18 .



Source: JICA Study Team

Figure 7.1-18 Future Schedule

7.2 Preparation of Land Acquisition and Resettlement Action Plan (LARAP)

The objective of this study is to support the project proponent to prepare LARAP according to JICA Guidelines for Environmental and Social Considerations (April, 2010). The TOR is as follows:

1) To provide relevant regulations and information on land acquisition and resettlement in Indonesia
2) To conduct inventory on assets/properties to be affected by the project
3) To obtain information depicting socioeconomic conditions of Project Affected People (PAP) and
4) To capture perception and aspiration of local residents living in the project area considering the presence of the Jakarta MRT East–West Line Project as LARAP supplement
5) To hold public consultation meetings (PCM) to reflect opinions from the PAP into the project plan
6) To identify market price of lands and properties at each province
7) To prepare the LARAP document based on the above information or concept

Table 7.2-1 Schedule for the LARAP Study

Work Item	2011				2012			
	4～6	7～9	10～12	1～3	4～6	7～9	10～12	1～3
Processing permission letter								
Field orientation								
Preparing socialization in each municipality								
Preparing socialization in West Jakarta								
Preparing socialization in Central Jakarta								
Preparing socialization in North Jakarta								
Preparing socialization in East Jakarta								
Household inventory survey (Questionnaire survey)								
Identifying market price of land and property								
Supporting to hold public consultation meetings with PAP								
Preparation of draft LARAP document								
Household inventory survey (Questionnaire survey) for additional section								
Identifying market price of land and property for additional section								
Supporting to hold public consultation meetings with PAP for additional section								
Preparation of draft LARAP document for additional section								

Source: JICA Study Team

7.2.1 POLICY FRAMEWORK

(1) Indonesian Policy Frameworks on Land Acquisition

The main legal basis as reference for land acquisition implementation in Indonesia had been initially regulated by Presidential Decree No. 55 Year 1993, before it was superseded by Presidential Decree No. 36 Year 2005. The latest revision made on this regulation was Presidential Decree No. 65 Year 2006.

The latest decree defines that the activity for acquiring land requires the provision of compensation/redress in return for the acquired land, including the existing structures, trees, crops or goods on it.

Head of National Land Agency Regulation No. 3 Year 2007 stipulates implementation details of land acquisition, consultations, determination of compensation, settlement of complaint, etc. on both Presidential Decrees No. 36 Year 2005 and No. 65 Year 2006. This is the most fundamental regulation on land acquisition for implementation of development.

Land acquisition needed for the implementation of the development for public interest is only possible if it is in accordance with the Regional Spatial Plan endorsed previously by the government. Any region that has not prepared its Regional Spatial Plan, will conduct land acquisition by referring to any existing Regional Spatial Plan available. Local Regulation No.6

of 1999 on Spatial Plan of DKI Jakarta sets out the plan for land utilization in the area of DKI Jakarta

Those who intend to purchase any land that has been determined as a development area of the public interest as per decree endorsed and issued by the regent/mayor or governor, are required to obtain written permission from the said regent/mayor or governor.

Especially for solving the objection/conflict of compensation, the Governor of DKI Jakarta No. 146 Year 2006 and No. 1119 Year 2007 will be addressed besides the above national laws& regulations. Regulation issued by the Governor of DKI Jakarta No. 83 Year 2005 and No.1222 Year 2005 also stipulate information disclosure and establishment of land acquisition committee respectively.

(2) World Bank Operational Policy 4.12

Bank experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social, and environmental risks. Such risk include the following: production systems are dismantled; people facing impoverishment when their productive assets or income sources are lost; people relocated to environments where their productive skills may be less applicable and the competition for resources is greater; community institutions and social networks are weakened; kin groups are dispersed; and cultural identity, traditional authority, and the potential for mutual help are diminished or lost. This policy includes safeguards to address and mitigate these impoverishment risks.

Involuntary resettlement may cause severe long-term hardship, impoverishment, and environmental damage unless appropriate measures are carefully planned and carried out. For these reasons, the overall objectives of the World Bank's policy on involuntary resettlement are the following:

【a】 Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.

【b】 Where it is not feasible to avoid resettlement, related activities should be conceived and executed as sustainable development programs. This can be realized by providing sufficient investment resources to that persons displaced by the project will have a share of the project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.

【c】 Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living, or at least restore them, in real terms, to pre-displacement levels or levels prevailing prior to the beginning of project implementation, whichever is higher.

(3) JICA Policy on Environmental and Social Considerations

Based on JICA Guidelines for Environmental and Social Considerations (April, 2010), the policy is summarized as follows:

1) Social Acceptability

Projects must be adequately coordinated so that they are accepted in a manner that is socially appropriate to the country and locality where they are planned. For projects with a potentially large environmental impact, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at a time when alternatives for project plans may be examined. The outcome of such consultations must be incorporated into the contents of the project plans.

Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, the poor and ethnic minorities, who are all susceptible to environmental and social impacts and may have little access to decision-making processes within the society.

2) Involuntary Resettlement

Involuntary resettlement and losing means of livelihood are to be avoided when feasible, by exploring all viable alternatives. When proven unfeasible after such an examination avoidance, effective measures to minimize impact and compensate for losses must be agreed upon with the people who will be affected.

People who must be resettled involuntarily and whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by the project proponents, etc., in a timely manner. Prior compensation at full replacement cost[1] must be provided as much as possible. Host countries must make efforts to enable people affected by projects improve their standard of living, income opportunities, and production levels, or at least restore these to pre-project levels. The measures to achieve this may include the following: providing land and monetary compensation for losses (to cover land and property losses), supporting means for an alternative sustainable livelihood, and providing expenses necessary for the relocation and reestablishment of communities at resettlement sites.

Appropriate participation by affected people and their communities must be promoted in the planning, and implementation stages. Consequently, the monitoring of resettlement action plans and measures to prevent the loss of their means of livelihood should be initiated. In addition, appropriate and accessible grievance mechanisms must be established for affected people and their communities.

For projects that will result in large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.

3) Indigenous People

Any adverse impacts that a project may have on indigenous people are to be avoided when feasible, by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous people for their losses.

When projects may have adverse impacts on indigenous peoples, all of their rights in relation to land and resources must be respected in accordance with the concept of relevant international declarations and treaties, including the United Nations Declaration on the Rights of Indigenous People. Efforts must be made to obtain the consent of indigenous people in a process of free, prior, and informed consultation.

Measures for the affected indigenous peoples must be prepared in the form of an indigenous people plan (which may constitute a part of other documents for environmental and social considerations) and must be made public in compliance with relevant laws and ordinances of the host country. In preparing the indigenous people plan, consultations must be made with those affected based on sufficient information made available to them in advance. When consultations are held, it is desirable that explanations are given in a form, manner, and language that are understandable to the people concerned.

4) Gaps Between Indonesian Laws and the JICA Guidelines

Table 7.2-2 shows the gaps between Indonesian laws and the JICA Guidelines regarding LARAP.

[1] 'Replacement cost' is the total valuation of assets that helps determine the amount sufficient to replace lost assets and cover transaction costs.

Table 7.2-2 Gaps between Indonesian Laws and JICA Guidelines Regarding LARAP

Item	Indonesian Law	JICA Guidelines	Gap
Laws regarding resettlement	No laws regarding resettlement. No stipulation to make a resettlement action plan (RAP). On land procurement with the aim of regaining spatial function, the provincial government offers an alternative location to the residents to move.	For projects that will result in large-scale involuntary resettlement, resettlement action plans must be prepared.	There are no laws regarding resettlement, and making a RAP is not stipulated in Indonesia. However, the JICA Guidelines requires a RAP for large-scale involuntary resettlement.
Support system to vulnerable social groups	No stipulation regarding support to vulnerable social groups. On land procurement with the aim of regaining spatial function, the provincial government offers an alternative location to street vendors whether they are temporary or permanent.	Appropriate consideration must be given to vulnerable social groups, which are susceptible to environmental and social impacts and may have little access to decision-making processes within the society.	The JICA Guidelines contains advice on the consideration of vulnerable social groups. On the other hand, there is no clear advice in Indonesian laws.
Compensation for loss of assets, appraisal of land value and time of payment	In accordance with the request of the Land Procurement Committee (LPC), the Land Value Appraisal Team conducts appraisal of land value for compensation by analyzing official and market values, referring to location of the land, use, arrangement, land use plan by local governments, infrastructure building, etc. However, time of payment is not stipulated.	Prior compensation at full replacement cost must be provided as much as possible.	Losses must be sufficiently compensated by project proponents, etc. in a timely manner in the JICA Guidelines. However, there is no clear advice in Indonesian laws.
Rebuilding of life	Provincial governments offer alternative locations to resettle the residents, especially for peddlers with either temporary or permanent stalls.	Host countries must make efforts to enable people affected by projects improve their standard of living, income opportunities, and production levels, or at least restore these to pre-project levels.	Indonesian laws stipulate compensation payment and secure of temporary stall without improvement of standard of living similar to that in the JICA Guidelines.
Support to illegal settlers	To restore the function of the area as stipulated in the Spatial Plan of DKI Jakarta, there is some discretionary compensation paid to illegal settlers in accordance with the policy of the provincial government. In addition there is also relocation site for trading or temporary shelter with temporary trading permission.	People who must be resettled involuntarily and whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by project proponents, etc. in a timely manner.	No stipulation regarding support to illegal settlers is contained in Indonesian laws.
Grievance procedure	If any objections regarding land, ownership, compensation, etc. occur, Land Acquisition Committee investigates and assesses the objections.	Appropriate and accessible grievance mechanisms must be established for affected people and their communities.	No stipulation regarding grievance procedures of resettlement is contained in Indonesian laws.

Source: JICA Study Team

7.2.2 Project Policy on Land Acquisition and Resettlement

According to the JICA Guidelines for Environmental and Social Considerations (April, 2010), policy on land acquisition and resettlement for the project is proposed as follows;

1) Involuntary resettlement will be avoided, or minimized, by identifying possible alternative project designs. Where displacement of households is unavoidable, all PAPs will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.
2) Compensation and rehabilitation support will be provided to any persons having the following affects.
    - Standard of living adversely affected
    - Right, title or interest in any house, interest in, or right to use, any land including premises, agricultural and grazing land, commercial properties, tenancy, or right in annual or perennial crops and trees or any other fixed or moveable assets, acquired or possessed, temporarily or permanently
    - Income earning opportunities, business, occupation, work or place of residence or habitat adversely affected temporarily or permanently
    - Social and cultural activities and relationships affected or any other losses
3) All affected people will be eligible for compensation and rehabilitation assistance, irrespective of tenure status, social or economic standing.
4) PAPs that lose only part of their physical assets will not be left with a portion that will be inadequate to sustain their current standard of living.
5) Payment for land and/or non-land assets will be based on the principle of replacement cost.
6) The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement.
7) Because the target area of the project is urban area and there is no specific community in aspect of religion and ethnic, the compensation regarding the resettlement of the PAPs will be supplemented for each PAP instead of the development of relocation sites including infrastructure.
8) PAPs and their communities will be consulted about the project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the decisions that are made concerning their resettlement.
9) Appropriate reporting, monitoring and evaluation mechanisms, will be identified and set in place as part of the land acquisition and resettlement management system. An external monitoring group will be hired by the project and will evaluate the resettlement process and final outcome.

7.2.3 Inventory Survey

(1) Survey Method

1) Approach

The first consideration in LARAP, namely (i) to identify the existing condition of the appearance using QUICKBIRD satellite imagery; in order to obtain preliminary information regarding the distribution of households and other land information that may be encountered at site by using remote sensing techniques, and (ii) do some image interpretation technique with different analytical methods in order to obtain the distribution pattern and the appearance in accordance with the existing condition.

The study approach on LARAP, especially in the spatial approach, is necessary in order to identify the biophysical environment of MRT Section using QUICKBIRD imagery interpretation, which is combined with Persil Map from BPN and Indonesia Basemap or Rupa Bumi Indonesia Map (RBI Map), 1:25,000 scale from BAKOSURTANAL.

The survey is conducted by implementing the following three approaches:

【a】 Census approach is conducted with quantitative enumeration against all households or institutions whose either asset or commercial site are adversely affected by the development of the Jakarta MRT line.

【b】 Sampling approach is conducted with quantitative enumeration against respondent samples who have been selected by stratified random sampling method. The respondent samples are taken from population surveyed by census (approximately 20% of people surveyed by census).

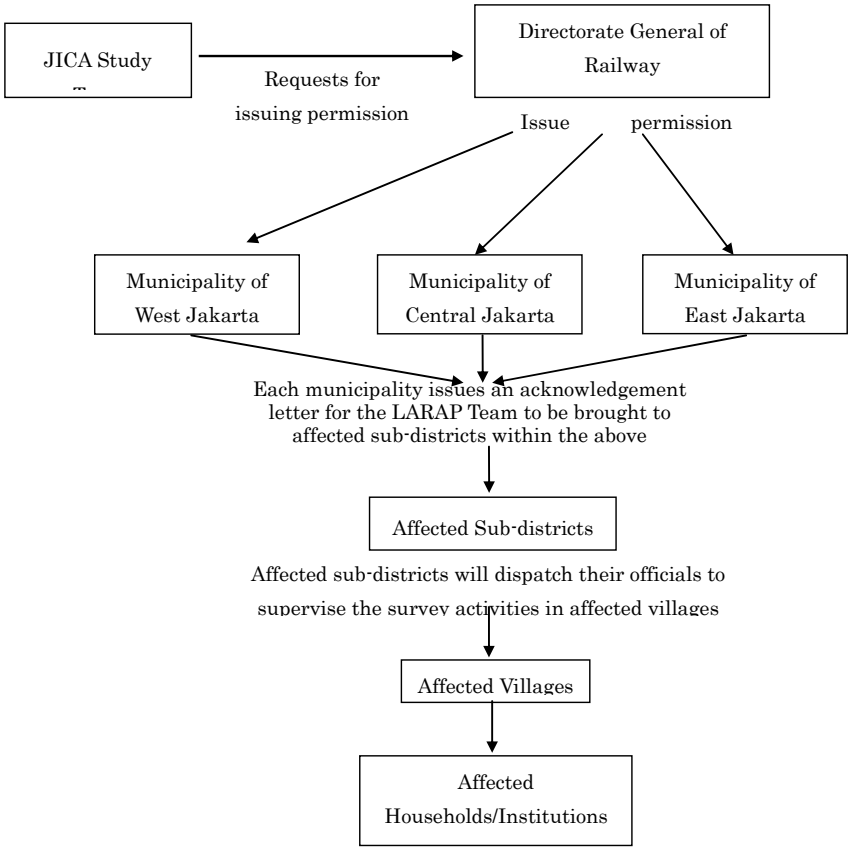
【c】 Specific approach is qualitatively conducted through focus group discussion (FGD) approach. This approach is conducted along with public consultation and interactive dialogue. Respondents are purposively selected by considering the completeness and deepness of information that need to be obtained.

Data collection of primary information, especially by census and sampling approach was conducted through structurally developed questionnaire.

2) Application for Inventory Survey

Before commencing the survey of inventory and social assessment, the proponent is requested to issue a permission letter to the involved municipality/regency government, whose areas are affected by the project, as their acknowledgement of the survey is being conducted.

In this study, the proponent is the DGR under the Ministry of Transportation. The DGR will issue a permission letter for the survey to affected municipalities namely, Municipality of West Jakarta, Municipality of Central Jakarta and Municipality of East Jakarta. Each municipal government will then issue an acknowledgement letter for submission to affected sub-districts located within the municipalities' authority. The scheme of proceeding permission letter is outlined in Figure 7.2-1below.



Source: JICA Study Team

Figure 7.2-1 Proceeding the Permission Letter

(2) Results of Inventory Survey

Location of development activities for Jakarta MRT East–West Line consists of 4 administrative areas: West Jakarta, Central Jakarta, East Jakarta and North Jakarta. The number of sub-districts (kecamatan) and villages (kelurahan) which might be affected by the project is 11 sub-districts and 20 villages. Table 7.2-3 shows number of affected assets according to the results of inventory survey. According to this, commercial building, residential building and other assets except for government facility and government land in West Jakarta are affected most, followed by East Jakarta. There are a total of 497 affected residential buildings (households), 184 of which were served as interview survey. Among those, 125 households are in west Jakarta, 32 in East Jakarta and 27 in Central Jakarta.

Table 7.2-3 Result of Inventory Survey

City / Type of asset	Section	West JKT	Central JKT	North JKT	East JKT	Total
Agricultural Land	SF	72 (14.1ha)	- (-)	- (-)	3 (0.14 ha)	75 (14.14ha)
	UG	- (-)	- (-)	- (-)	- (-)	- (-)
Commercial Building	SF	273	-	12	84	369
	UG	9	52	-	-	61
Commercial Land	SF	109 (0.45 ha)	- (-)	11 (0.01 ha)	70 (1.01 ha)	190 (1.47 ha)
	UG	8 (0.04 ha)	49 (0.25)	- (-)	- (-)	57 (0.29 ha)
Government Facility	SF	3	-	-	4	7
	UG	-	8	-	-	8
Government Land	SF	3 (0.01 ha)	- (-)	- (-)	4 (0.01 ha)	7 (0.02 ha)
	UG	- (-)	2 (0.07 ha)	- (-)	- (-)	2 (0.07 ha)
Public Facility	SF	9	-	-	9	18
	UG	1	8	-	-	9
Public Land	SF	9 (0.02 ha)	3 (0.01 ha)	- (-)	9 (0.05)	21 (0.08 ha)
	UG	1 (0.01 ha)	5 (0.01 ha)	- (-)	- (-)	6 (0.02 ha)
Residential Building	SF	345	-	2	110	457
	UG	6	34	-	-	40
Residential Land	SF	250 (1.02 ha)	- (-)	- (-)	58 (0.41 ha)	308 (1.43 ha)
	UG	6 (0.01 ha)	17 (0.08 ha)	- (-)	- (-)	23 (0.09 ha)

Note:
"Agricultural land" includes fish pond, rice field, other fields, "Commercial building/land" include small and large shops, industrial facilities and their land, "Government facility and land" include national and local government office, other government's facilities and their land, "Public facility and land" include religious facility, educational facility and community's facility and their land.
"SF" means elevated section, depot, transition and at grade sections, "UG" means underground section

Source: JICA Study Team

1) Socio-economy

Social economy level of citizen who lives in the project site is lower to middle according to the results of the survey. This fact is important to consider "The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement.", one of the LARAP policies proposed in Section 7.2.2.

Table 7.2-4 shows Respondents based on Age Group. Most of respondents are from middle-aged people.

Table 7.2-4 Respondents based on Age Group

No.	Age	Number	%
1	15-44	79	43
2	45-64	93	51
3	> 65	12	6
Total		184	100

Source: JICA Study Team

The Betawi who constitute 84%of respondents are the descendants of the people living around Batavia (the colonial name for Jakarta) from around the 17th century. Pluralism ethnic is apparent in people who live in the project areas.

Table 7.2-5 Respondents' Ethnic Background

No.	Ethnic	Number	%
1	Betawi	84	45
2	Bugis/Makassar	1	1
3	Jatim/Madura	7	4
4	Javanese	68	36
5	Madura	1	1
6	Sumbar/Bengkulu/Jambi	4	2
7	Sumut/Aceh	1	1
8	Sundanese	13	7
9	North Sumatera	1	1
10	Other (unspecified)	4	2
Total		184	100

Source: JICA Study Team

Half of respondents' families who live in the area extend across 2 generations. Sociologically, the communities in the project areas have created steady living pattern in term of absorbing (and shaping) the community's culture and behavior patterns.

Table 7.2-6 Duration of Residency

No.	Duration of Residency	Number	%
1	< 5 years	20	11
2	5 – 10 years	32	17
3	11 – 15 years	34	18
4.	16 – 20 years	51	28
5.	21 – 25 years	11	6
6.	> 25 years	36	20
Total		184	100

Source: JICA Study Team

Most of the respondents have formal educational background to bachelor degree (Table 7.2-7).

Table 7.2-7 Educational Background

No.	Educational Background	Number	%
1	No formal education	9	5
2	Not graduate from Elementary School	8	4
3	Elementary School graduate	56	30
4	Middle School graduate	55	30
5	High School graduate	44	24
6	Diploma	6	3
7	Bachelor/Master/Doctoral Degree	6	3
Total		184	100

Source: JICA Study Team

Respondents' main occupation is in service sector and only 1 % work in agriculture sector (Table 7.2-8).

Table 7.2-8 Respondents' Main Occupation

No.	Sector of Occupation	Number	%
1	Business/Trading/Seller/Shop	76	41
2	Employee (Civil Servants/Private/Armed Forced/etc)	32	17
3	Labor/Driver	27	15
4	Other	14	8
5	Retired	8	4
6	Unemployment	8	4
7	Agriculture	19	10
Total		184	100

Source: JICA Study Team

Table 7.2-9 shows that most of respondents' households have less than 1.5 Million Rp, income per month. By using Regional Minimum Wage (UMR) in Jakarta (2010), which is Rp. 1.29 Million per month, almost half of the total respondents' households are considered low.

Table 7.2-9 Respondents' Income

No.	Income (Million Rp.)	Number	%
1	< 1.0	62	34
2	1.0 – 2.0	74	40
3	2.0 – 3.0	31	17
4	3.0 – 5.0	10	5
5	>5.0	7	4
Total		184	100

Source: JICA Study Team

In Table 7.2-10 most of respondents' expenses go to consumption (food/beverages), followed by educational cost.

Table 7.2-10 Household Expense Structure

No.	Highest Expense Type	Number	%
1	Consumption	92	50%
2	Education	36	20%
3	Communication and Transportation	22	12%
4	Clothing	15	8%
5	Household Routine Expenses	12	7%
6	Social Expenses	4	2%
7	Investment	3	2%
Total		184	100%

Source: JICA Study Team

2) Respondents' Knowledge of the Project

Most of respondents stated that they didn't know about the project in their residence areas (Table 7.2-11).Most of respondents with the knowledge knew through mass media and internet. From the public consultation meetings in East Jakarta and West Jakarta, the team recognized that the community leaders do not clearly understand how the land acquisition mechanism is and also when the project starts.

Table 7.2-11 Respondents' Knowledge of the Project

Area	Do you know MRT Development Plan?		Number
	Yes	No	
West Jakarta	23	102	125
Central Jakarta	5	22	27
East Jakarta	0	32	32
Total	28 (15%)	156 (85%)	184

Source: JICA Study Team

Respondents who are against the project have many reasons; some of them are because they're already satisfied with the current situation and they don't want to change their business location (Table 7.2-12 and Table 7.2-13).

Table 7.2-12 Respondents' Opinion about Affection of their Land/Building

No.	Respondent	Number	%
1	Agree	114	62
2	Disagree/Refuse	70	38
Total		184	100

Source: JICA Study Team

Table 7.2-13 Reasons for Disagreement/Refusal

No.	Reason	Number	%
1	Comfortable with current situation	23	33
2	Don't know where to move	16	23
3	Don't want to change business location	27	39
4	Feel disadvantaged	2	3
5	Don't want to get negative impacts	2	3
Total		70	100

Source: JICA Study Team

Most of respondents prefer compensation in cash, followed by compensation in the form of house of equal size and quality in another location (Table 7.2-14).

Table 7.2-14 Choice of Compensation

No.	Choice of Compensation	Number	%
1	Cash	86	47
2	House of equal size and quality	52	28
3	Don't know yet	32	17
4	Others (still consider, combination)	14	8
Total		184	100

Source: JICA Study Team

Expectations from community who gets direct impact of project implementation show various responses as shown in Table 7.2-15. Half of respondents expected reduction of traffic jams, followed by provision of benefits for community.

Table 7.2-15 Community's Expectations for the Project

No.	Expectations	Number	%
1	Reduce traffic jams	83	45
2	Provide benefits for community	42	23
3	Provide works in the project	22	12
4	Provide suitable compensation	16	9
5	No one is being disadvantaged	9	5
6	Don't know	12	7
Total		184	100

Source: JICA Study Team

7.2.4 Support for Holding PCMs with PAP

In October and December 2011, four PCMs were held to explain the draft LARAP, and to reflect opinions of the PAP into the project plan.

The LARAP Study Team supported DGR on the following tasks;

- Arrange venue,
- Copy and distribute invitation letters,
- Translate necessary documents into Indonesian,
- Copy handouts,
- Dispatch facilitator for the public consultation meetings, and
- Prepare minutes of meeting.

The relevant stakeholders were identified as listed in Table 7.2-16.

Table 7.2-16 Identification of Stakeholders

Government Institutions	Administration City of East Jakarta, sub-district and village Administration City of Central Jakarta, sub-district and village Administration City of West Jakarta, sub-district and village
Ministry	Ministry of Transportation
Other Public Entities	Public Work Office Landscaping Office Transportation office Facility and infrastructure office P2T (Land Acquisition Committee)
Village Consultation Institution	LMK in affected village in East Jakarta LMK in affected village in Central Jakarta LMK in affected village in West Jakarta
NGOs	Bina Desa Bina Swadaya WALHI ISAI
Local People	Project Affected People

Source: JICA Study Team

PCM was held at three municipalities related to the project. Table 7.2-17 shows the summary of PCM. Table 7.2-18 shows the minutes of PCM held at each municipality. Figure 7.2–2 shows the PCM photos.

Table 7.2-17 Summary of PCM

Items	1st PCM	2nd PCM	3rd PCM	4th PCM
Purpose	To explain a draft LARAP, and get opinions on the plan from the project affected people (PAP) by Indonesian project proponent with JICA Study Team.			
Date	6th of October 2011	27th of October 2011	2nd of November 2011	21st of November 2012
Place	East Jakarta Municipality	Central Jakarta Municipality	West Jakarta Municipality	Cengkareng Sub-district,
Agenda*	8:00-8:20 Opening speech by East Jakarta Mayor 8:20-8:40 Explanation of MRT project by DGR 8:40-9:30 Presentation of survey results by LARAP consultant 9:30-11:00 Discussion among Participants, DGR, JICA Study Team and LARAP consultant 11:00-11:30 Closing remarks by Moderator *Agenda is for East Jakarta Municipality. The other two municipalities' differ in time and speaker for opening.			
Residents	Total of about 100 (PAPs, Community leaders, Related authorities, NGOs etc. on each consultation) for each PCM			

Source: JICA Study Team

Table 7.2-18(1) Minutes of Meeting-East Jakarta Municipality

Opinions from Participants	Comments from DGR
1) We expect construction of an elevated line because the current significant problem is the transportation. We strongly support the plan. 2) I am unhappy with large structures in front of my house and displacement of my family. Therefore, I request you to consider other alternatives. 3) You should give each participant the PCM papers, provided the legal basis, so that after the PCM finished, it can be discussed by the citizens with the RT / RW. 4) Is there any socialization in our kecamatan (sub	1) At this moment, we are conducting the feasibility study on MRT development, followed by the complete study with the engineering. 2) MRT construction is intended to enable the road users to take a train, thus MRT is expected to help reduce the load of Jl. Bekasi Raya. We have not conducted the detailed design on MRT yet. 3) The suggestion about the PCM paper will be submitted to the organizers. 4) Yes, there is. Socialization in each related sub district will be held by the land acquisition

Opinions from Participants	Comments from DGR
district) for the citizen so that they can know about this program? 5) In the land and building acquisition plans, I have objection if the compensation is based on NJOP standard. It should be at least 3 to 4 times of NJOP price. 6) In what year will the implementation of MRT construction be realized? If the MRT development is beneficial to all concerned people, then I agree. 7) What about us, who live in the house that belongs to government? Do we get compensation?	committee. 5) The value of compensation is still being discussed, whether the appropriate standard of NJOP, market value or other standards. 6) In the year 2016 it is planned to start the construction. In the year 2021, the construction is finished and available for use. 7) Your convenience will not be disturbed, but you can not claim the house you live in since the building belongs to government.

Source: JICA Study Team

Table 7.2-19(2) Minutes of Meeting-Central Jakarta Municipality

Opinions from Participants	Comments from DGR
1) The presentation material should be delivered to the participant. Please deliver the compensation to PAPs directly without intermediary. 2) When is MRT implemented? Will the line be changed after survey? What about the environmental damage and other impact caused by construction of MRT, for example, landslide? What about the process of the land acquisition? 3) What about the compensation system? We suggest that the compensation is better than NJOP. What about loss of job or business opportunity? 4) What about the people who do not have the IMB (License to build)? Does the MRT line traverse all parts of the RT 15?	1) Detailed calculations of the value of affected assets have not been done since the detailed design have not been undertaken. The point is that the PAPs life should not be worse than before the development of the MRT. 2) In the planning schedule, the MRT will be available in 2020. The process is: preliminary study, then updating data, final study during detailed engineering design as well as environmental and technical assessment. Current stage is preliminary study. 3) Compensation is based on the regulation/legislation and through various discussion/consolidation in province, city to village level. As we already presented earlier, both physical and non-physical affected assets will be compensated in accordance with the regulation/legislation. 4) The compensation will also consider non license building (assets without IMB). The width of the line is about 22 m, so possibly not all RT 15 will be traversed.

Source: JICA Study Team

Table 7.2-20(3) Minutes of Meeting-West Jakarta Municipality

Opinions from participants	Comments from DGR
1) Why wasn't Wijaya Kusuma village included in your survey? 2) How wide is the area to be used for MRT? The replacement should be coordinated with the RT / RW. 3) What is the follow-up of this consultation? 4) Compensation should include both physical and non-physical assets. What is the legal base of this compensation? 5) What about depot plan in Rawa Buaya? And what is the affected area? 6) What about the compensation for the land and the structure/building?	1) The village was surveyed based on the planned line. 2) The ROW is 22 m wide in south part of the existing rail. Yes, all the programs will be coordinated with the RT/RW. 3) We will conduct follow-up study- under the detailed engineering design. This study focuses on survey of affected assets and affected households. 4) After the Detailed Engineering Design, the program will be more coordinated with all the stakeholders. Compensation will be delivered to PAPs even if they are not owners of the assets. 5) Depot plan at Rawa Buaya was canceled. The depot will be at Ujung Menteng.

Opinions from participants	Comments from DGR
	6) All the affected assets will be considered in the program. The compensation will be based on the legislation and regulation.

Source: JICA Study Team

Table 7.2-21(4) Minutes of Meeting-Cengkareng Sub-district

Opinions from participants	Comments from DGR
1) If the assets of our Company (PT. Garuda) will be affected, we expect a formal letter from the government so that our company can decide whether willing or not to remove the asset. 2) What is the width of the rail lines that already exist? I am currently building a rented house in the middle around the rails. 3) I am a representative of street vendors who occupy the rail (in the morning market around the station Kalideres). I want to ask please inform the process of land acquisition?	1) We will definitely provide a formal letter. There are special procedures of the government. Currently we are waiting for a report from the team's overall field. 2) Its width is 10 meters calculated from the middle rail to the north. 3) After the final identification of affected persons, we will calculate its value to determine the compensation of affected buildings and land around the site, which will be listed.

Source: JICA Study Team


1st PCM- East Jakarta


2nd PCM- Central Jakarta


3rd PCM- West Jakarta


4th PCM in Cengkareng

Source: JICA Study Team

Figure 7.2-2 PCM photos

7.2.5 Entitlement Matrix

Entitlement Matrix on type of loss, application, entitled residents, compensation policy and implementation are shown in Table 7.2-22.

Table 7.2-22 Entitlement Matrix

Type of Loss	Application	Entitled Residents	Compensation Policy	Implementation
Loss of residential land and / or commercial land	Land / housing land and commercial land located in MRT corridor plan and Depot	PAPs legitimate and owners	a. Compensation in the form of cash b. For residential land if the remaining land ≤ 60 m^2; replaced entirely; c. For commercial land, if the remaining area ≤ 18 m^2; replaced entirely	- The land price is estimated based on NJOP of the current year and real/actual value. - Compensation is paid at replacement cost before implementation of the project. - The date of inventory survey is the determination date (the cut-off date) for residents who are entitled to receive compensation.
Loss of residential buildings	Residential buildings located in the MRT corridor plan and the depot	1. PAPs legitimate owner of the building 2. PAPs having contract and settlement.	a. Compensation in the form of cash b. If the rest of the building < 21 m^2, replace entirely or offer a simple flat (resettlement plan) c. PAPs contracts, if there is still money left over contract (which has been paid), will be replaced in the form of simplified flat (resettlement plan)	- Value of building damages are estimated based on the standards established by the Mayor - Compensation is paid at replacement cost before implementation of the project. - The date of inventory survey is the determination date (the cut-off date) for residents who are entitled to receive compensation. - Proposed to move to simple flats located in Marunda and Cilincing, where the simple flat project is implemented by Jakarta Government. - Plan of restoring of livelihood
Losing of the place of business	Residential buildings located in MRT corridor plan and Depot	1. PAPs legitimate owner of the building 2. PAPs having contract and settlement. 3.PAPs without title but being recorded in the list of citizens in local	a. Compensation in the form of cash b. If the rest of building < 21 m^2, replaced entirely or offered substitute for building a place of business in the form of kiosk provided by the government of Jakarta (resettlement plan) c. PAPs contracts, if there is still money left over contract (which has been paid), will be	- Value of building compensation is estimated based on the standards established by the Mayor - The amount of money paid to PAPs set by the Mayor. - Compensation is paid at replacement cost before implementation of the project. - The date of inventory survey is the determination date (the cut-off date) for residents who are entitled to receive compensation. - Plan of restoring of livelihood

Type of Loss	Application	Entitled Residents	Compensation Policy	Implementation
		neighborhood	replaced in the form of simplified flat (resettlement plan) d. PAPs without a title given the compensation money and involved in a resettlement plan	
Loss of Plant	Plants that have economic value and / or environmental value contained in the MRT corridor and depot	PAPs plant owner	a. Garden plants owned by citizens be compensated in the form of cash money b. Cover crops in the street or the green line / city park are replaced with plants that have similar function.	- Value of plant damages estimated by the relevant agencies (public property) - The species and locations of replacement set by the office of DKI Jakarta Garden (owned by the government of Jakarta)
Structures for residence / business by squatters and illegal settlers	Structures in the MRT corridor and depot	Vulnerable groups[2]	a. Compensation in the form of cash b. Provision of simple flat / kiosk (resettlement plan)	- Consideration to Vulnerable groups - Plan of restoring of livelihood

(Note) Remaining land 60m2, 18m2, 21m2, 12m2 is based on the value determined in land acquisition committee of Jakarta MRT North-South Line in Jakarta.

Source: JICA Study Team

7.2.6 Resettlement and Facilitation Program

The displaced residents are offered to participate in resettlement program in accordance with the resources available from the government.

Resettlement plan is:

- To be implemented by TK-PKP team (Working Team of Resettlement and Facilitation) this will be coordinated by the office of Mayor of Jakarta in line with his authority;

- To be prioritized for the PAPs which are forced to move and with low income and/or have practices in informal sector;

- To be fully supported for the PAPs by the government through appointed facilitator for the purposes, selected from the competent university and NGOs or integrated to social development program operated by the government (i.e. Empowerment program at sub-sub-district level/ PPMK[3]).

(1) Resettlement Location

According to the result of inventory survey, most of respondents prefer compensation in cash, followed by compensation in the form of house of equal size and quality in another location.

[2] Women of child bearing age, elderly people and people with disability and children were vulnerable people who is referred in OP 4.12 and "Involuntary Resettlement Sourcebook" (World Bank, 2004)

[3] PPMK is Urban Village Community Empowerment Program, which empower community, especially to develop local economy and to alleviate poverty, which was introduced at year 2000.

Although the percentage of the latter was 25 %, in order to comply the need of PAPs who prefer house as the compensation, the resettlement should be an alternative option of compensation which comprises of:

1) Simple Mansion/Flat

The simple mansion/flat is located at Marunda and Cilincing (North Jakarta) which is the existing simple mansions of DKI Jakarta local government and is equipped with adequate social facilities. They could get the mansion/flat by way of installment through housing credit mechanism or by way of leasing in affordable price.

2) Substitute Location for Economic Practices

The resettlement location is prioritized for the people whose lands on which they have small enterprises/informal sectors. The facilities include kiosks with alternative locations selected as available in many locations such as existing local markets operated by the local government and business locations built around the location of the simple mansion/flat. The mechanism of ownership is by way of credit installment and leasing in affordable prices.

(2) Facilitation Program for PAPs

Besides giving compensation and resettlement facility, the government will also gives aid of facilitation to the PAPs, aiming to improve quality of life and socio- economic level of them.

1) Methods of Facilitation Approach

Implementation of land release and relocation on plural community could instigate complex problems since this program is an introduction program which requires high commitment from the government and PAPs. In this case the key of implementation is the involvement of PAPs in the process of development including planning, implementation, monitoring and evaluation.

a. Preliminary Facilitation

This is implemented in 3 stages as below:

- Information Distribution

Distribution of information on project introduction including relevant agencies, status, function and role of each agency towards PAPs is arranged by the facilitator and coordinating with P2T and/or the project organizer.

Explanation is done on policy of land acquisition including policy of compensation, regulation and implementation rules, management of complaints and the solution techniques as well as options of compensation provided by the DKI Jakarta local Government.

- Dissemination

Meetings are organized for PAPs (community Forum), involving beneficiaries community who are going to get benefits of the development of Jakarta MRT when it is accomplished and operated;

Assets (conditions of houses and their facilities, flower plant, etc.), economic functions (location for economic practices, land for practices), and social function (religious places; relevancy with origin such as school children, membership with social organization, etc) existing within the community members of target groups are identified.

- Early Facilitation

Groups plan towards chances, other possibilities towards options (compensation) available, relevant initiatives to project are proposed and agreed matters among PAPs are facilitated to implement.

b. Facilitation during Land Acquisition

Facilitation is provided for PAPs in expressing complaints from PAPs to DKI Jakarta local government /P2T/SKPT/TK-PKP, and prepared for moving PAPs and their school children (elementary school), including building and assets annihilation.

c. Facilitation after Land Releasing and Relocation

Facilitation after land acquisition and relocation includes 4 main activities as follows:

- Selection of relocation self-sufficiently

When the PAPs relocated decide to select new location by themselves as they wish (compensation in cash), the facilitation (monitoring) will be provided until the facilitated PAPs be independent and self-sufficient and live moderately

- Proposal for simple mansion/flat

If the PAPs propose for simple mansion/flat, the practices location and land substitute for practices, the facilitation will be provided until the facilitated PAPs can live under condition as agreed.

- Assistance of facilitation

The facilitation is provided by way of developing the paradigm of community empowerment, self reliant and sustainability, implemented in the following strategies:

・Assistance of community infrastructure, multi-purpose revolving fund or credit for micro-enterprise, initiatives to increase capacity(capacity building) for human resources (such as technical assistance for simple business management);

・Facilitation for community members to participate in construction of Jakarta MRT, or as supplier of required construction material for the project, especially related to their practices such as supplying drinks and food daily for construction laborers.

- Monitoring and evaluation

Monitoring and evaluation are to check the progress of action plan implementation for recovering the livelihood condition and the life of the community.

7.2.7 Implementation Structure

The implementing agency for the project is responsible for land acquisition based on Head of National Land Agency Regulation No. 3 Year 2007. The regulation stipulates that the land acquisition committee and the land price appraisal team are to be established. Figure 7.2-3 shows the implementation structure for LARAP.

(1) Budget Management

The institution is responsible for managing the budget to finance land acquisition, and also serves as the government, which will carry out consultation directly with PAPs in order to determine compensation and implement compensation payment.

In accordance with the location of land acquisition required for the construction of Jakarta MRT Line, this institution needs 2 agencies, namely:

a. Jakarta Provincial Transport Department, to handle the procurement activities of the land around the area of Ujung Menteng (MRT depot location)

b. Public Works Department (PU) of DKI Jakarta, to handle the procurement activities of the land along the line.

(2) Land Acquisition Committee

The land acquisition committee will be established by the Governor of DKI Jakarta to acquire land for implementation of development for the public interest. To acquire land covering an area of more than one hectare, the committee is formed with a maximum of 9 members, consisting of:

a. Regional Secretary as Chairman;

b. Provincial echelon II officials Appointed as Vice Chairman;

c. Head of Regional Office of the Provincial National Land Affairs Agency or official appointed as Secretary; and

d. Head of Department/Office/Agency in the province related to the implementation of land acquisition or the official appointed as a Member.

The committee has the following duties:

a. provide direction, guidance and coaching for the implementation of land acquisition in the district/city;

b. coordinating and classifying the implementation of the acquisition of land in the district / city;

c. give consideration to the Governor for decision-making for the form and/or amount of compensation proposed by the Mayor; and

d. supervise and control the implementation of the acquisition of land in the city.

(3) Land Price Appraisal Team

To determine the value of compensation for land, buildings and plants that exist on the land, land price appraisal team is appointed by the land acquisition committee. The team is an institution that has obtained a license from the National Land Affairs Agency of the Republic of Indonesia.

Members of the team consist of:

a. agency in charge of building and/or plants elements;

b. elements of the central government agency in charge of the National Land Affairs;

c. elements of agency of Land and Building Tax Service;

d. expert or experienced person as an appraiser of land prices; and

e. academicians who are able to appraise the price of land and/or buildings and/or plants and/or other objects related to the land.

The membership of the team if needed can be added NGOs.

The team has the following duties:

a. survey on location, layout and status of the land, land use, suitability of land use with the urban / regional spatial plan, facilities and infrastructure available, etc. on the request of the land acquisition committee;

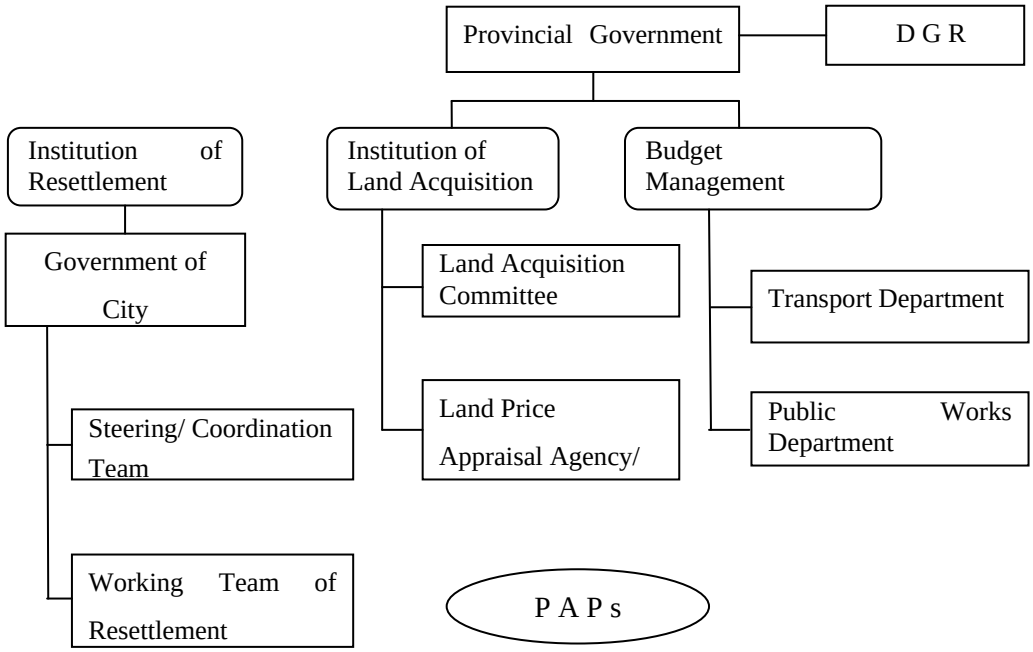
b. appraise the land prices based on the Tax Object Sale Value (NJOP) or real/actual value by considering NJOP of the current year, and can be guided by the variables; and

c. submit the result of the appraisal value to the land acquisition committee.

(4) Institution for Supporting Resettlement

The responsible organization for the resettlement program and coaching the people affected by the project is the Government of Jakarta City Administration. In order to implement the program, it is necessary to form the steering/coordination team and the working team of resettlement. Steering /Coordination team implements coordination with relevant ministries or agencies and monitor the implementation as well as the preparation of resettlement program. On their hand, the working team of resettlement implements the preparation of budget, the preparation of resettlement area or the coordination with residents.

The composition of the implementation structure is shown as follows figure.



Source: JICA Study Team

Figure 7.2-3 Implementation Structure of LARAP

7.2.8 Monitoring and Evaluation

In order to confirm implementation of land acquisition and resettlement, monitoring will periodically be carried out under the coordination of Jakarta Provincial BAPPEDA by involving NGOs and academicians / universities.

An independent team will carry out an evaluation study, one year after implementation of land acquisition and resettlement, to confirm whether the living conditions of PAPs have been recovered.

Figure 7.2-4 shows the monitoring mechanism.

Monitoring of the implementation of land acquisition, resettlement and capacity building, can be conducted internally by the implementing agencies (SKPT, P2T, and TK-PKP). However, the participation of outside parties, such as Academicians/University, NGOs and local civil society organizations, will be very helpful in getting more accurate data/information, and can assist in the resolution of issues, constraints and problems that may arise during the implementation of the Action Program.

The monitoring implementation of the Program Action activities will be coordinated by the Regional Development Agency (Bappeda) of Jakarta Province assisted by consultants, and will involve the Universities and NGOs. Consultant serves to assist BAPPEDA in coordinating all monitoring activities and preparation of reports to be submitted to the various relevant agencies (including JICA, the Ministry of Transportation, and BAPPENAS). Academicians/University will provide input for resolution attempts to the problems that developed on the basis of academic standpoint, while the NGOs will provide input from the social standpoint, and also functions to mediate between the interests of AP with SKPT/P2T/TK-PKP.

The reports consist of the following 3 types.

1) Monthly Report

This report contains the results of implementation of land procurement activities (created by SKPT and P2T), resettlement and capacity building of PAPs (made by TK-PFM), as well as the activities implemented by NGOs and universities.

2) Mid-Year Report

This report contains the results of discussions on "The Assessment Meeting Forum" and summary of monthly reports.

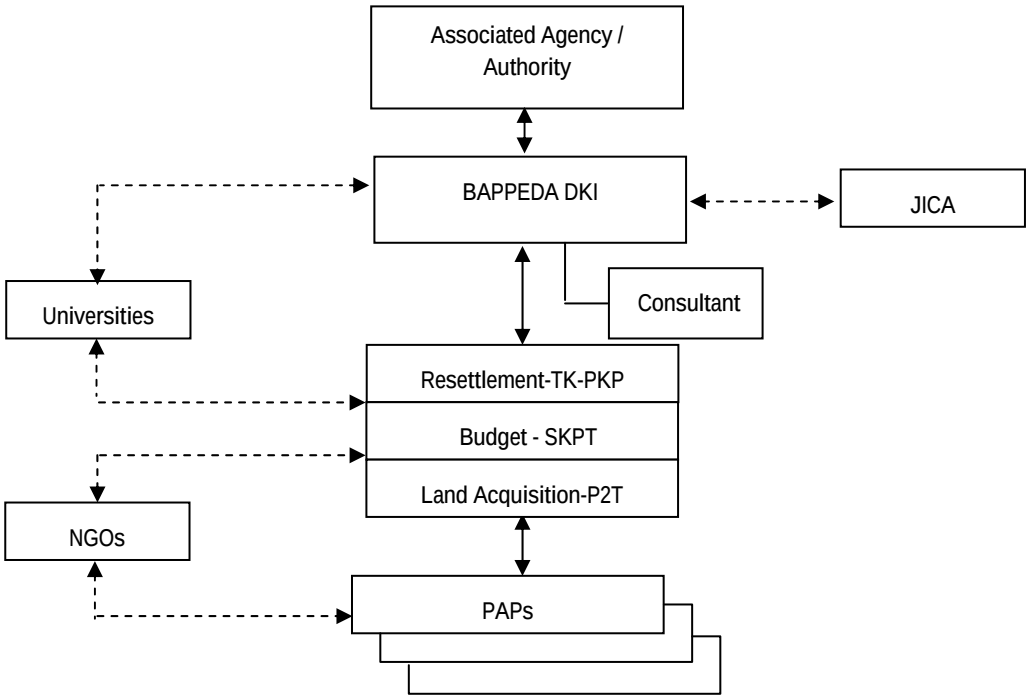
3) Annual Report

This report will be completed after coordination with the various parties concerned. It contains achievement of action plans set out in Document of Action Program and solutions to several critical problems that develop during the implementation of activities.

Table 7.2-23 Monitoring Indicators

Land Acquisition	a. Preparation of alternative forms of compensation and the estimated compensation value, and entitlement matrix. b. The number of residents who have received compensation, and release of rights to land and other assets. c. The number of residents who have demolished the building.
Resettlement and Capacity Building of PAPs	a. Implementation of basic socio-economic survey of displaced residents. b. Preparation/construction of potential relocation sites, including the location of temporary shelters (if needed). c. Preparation of capacity building scheme. d. Implementation of consultation, dissemination, and facilitation process, including facilitating the transfer of school children. e. Citizens' readiness to move to a new location f. Readiness of moving locations (including infrastructure support); g. The delivery of relocation aid and living cost aid during the transition period h. Implementation of facilitation of the provision/distribution of business place/kiosks/simple flats in a new location
Post-relocation	a. The number of residents who have received/utilized economic business development aid (revolving capital, micro credit, technical assistance of simple management, etc.) b. The number of residents who have attended training to improve their skills c. The number of residents absorbed as a project worker d. The number of economic business owned by citizens who participate in project activities e. Conditions/development of ; school children in new schools, citizens' economic activities and income pattern and social and economic life of families
Restoration of living standards	a. Are the payment of compensation freed from the depreciation, levies/taxes, moving expenses and other charges? b. Are PAPs willing to accept the replacement house and/or business place? c. Has the "perception" of citizen been recovered? d. Have the residents managed to restore the primary social and cultural conditions? e. Have the school children been able to reasonably follow the lessons as before moving?
Restoration of livelihood	a. Are the payment of compensation freed from the depreciation, levies/taxes, moving expenses and other charges? b. Can the payment of compensation restore the lost wealth/assets? c. Do the replacement location/ business place meet the standard? d. Can the displacement and relocation aid cover the costs incurred? e. Does assistance/income aid make it possible to develop the business and production as before? f. Have the PAPs received capacity building assistance to redevelop its economic business? g. Are vulnerable groups given the opportunity to earn income? Is this efficient and sustainable? h. Are jobs that provided able to recover the income and standard of living as before the project?

Source: JICA Study Team



Source: JICA Study Team

Figure 7.2-4 Monitoring Mechanism

7.2.9 Implementation Schedule

Table 7.2-21 shows schedule of land acquisition and resettlement. Physical resettlement starts after the PAPs have received compensation and assistance necessary for resettlement including moving expense etc.

Table 7.2-24 Schedule of Land Acquisition and Resettlement

Items	1st Year				2nd Year				3rd Year			
	1	2	3	4	1	2	3	4	1	2	3	4
Preparation of land acquisition												
Socialization												
Fixing / staking-out												
Inventory survey												
Map & draft list of nominative												
Announcement map/inventory list												
Discussion												
Determination of compensation value & the finalization of the list of nominative												
Application / issuance of a warrant of payment												
Payment of compensation to the PAPs												
Discharging land												
Certification of land												
Preparation of resettlement												
Base-line data survey												
The preparation of the resettlement program and facilitation assistance												
Socialization and community consultation												
Facilitation process to get the location/place of settlement and/or new business location												
Construction of a temporary place of business												
Relocation of PAPs to the new settlements location/new business premises												
The post-relocation assistance												

Source: JICA Study Team

Chapter 8 Mitigation of Climate Change Impacts

One of possible positive impacts in environmental field by railway projects is reduction of greenhouse gas (GHG) emission due to modal shift from vehicle transportation to railway transportation, which is expected to contribute to mitigation of climate change impacts. In this chapter, the result of estimation of greenhouse gas emission is reported. Outline of the procedure for GHG emission reduction and required data for estimation are explained in the section 8.1. A series of the process of estimation of GHG emission reduction is described in the section 8.2, and estimation results are reported in the section 8.3.

8.1 Procedure and Required Data for Estimation of Greenhouse Gas (GHG) Emission Reduction

8.1.1 Procedure on Quantitative Estimation of GHG Emission Reduction

When MRT East-West Line is operated, it will be expected that GHG emission amount from the transportation sector in Jakarta will be reduced due to modal shift of passengers from their existing transportation mode, such as private vehicles, motor bikes, and buses, to MRT. Through the Project, expected reduction amount of GHG was estimated quantitatively.

For the estimation, the following existing methodologies were used as references:

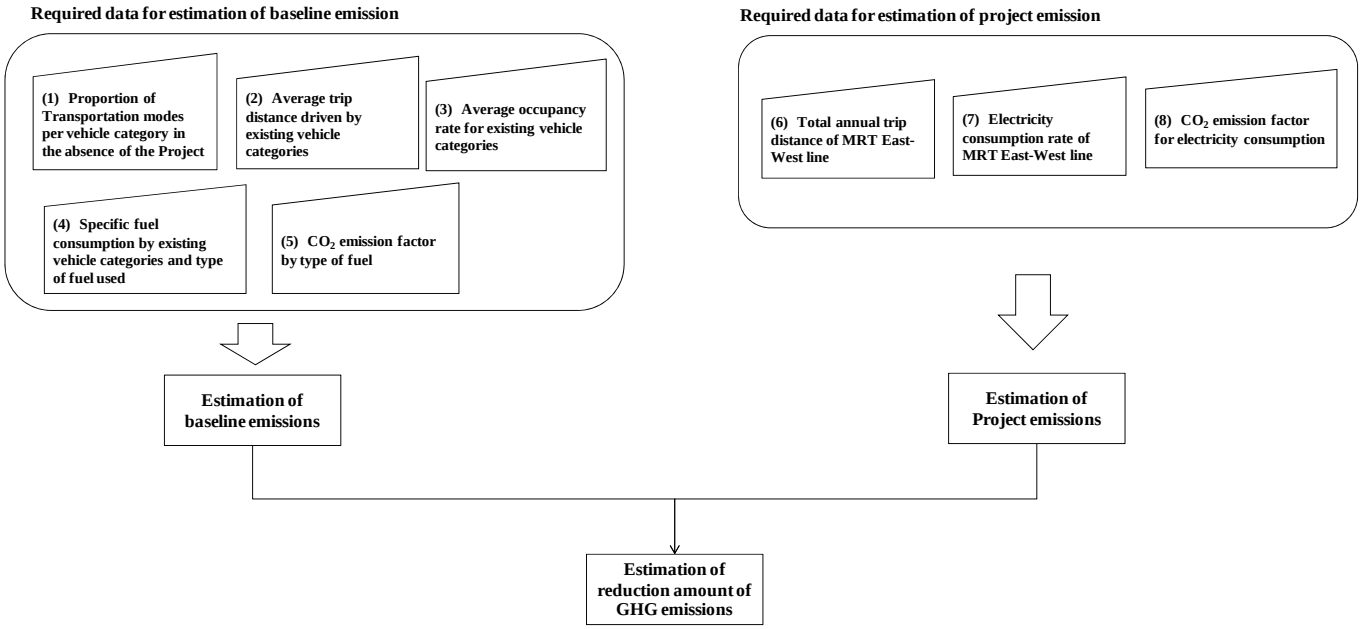
- JICA Climate Finance Impact Tool/ for Mitigation and Adaptation Draft Ver. 1.0

"JICA Climate Finance Impact Tool/ for Mitigation and Adaptation Draft Ver. 1.0" was proposed for evaluation of projects effectiveness on GHG emission reduction when JICA plans and implements a project for adaptation or mitigation of impacts by climate change in April 2011, based on the CDM methodologies "ACM0016：Baseline Methodology for Mass Rapid Transit Projects" which was approved by UNFCCC in October 2009.

GHG emission reduction amounts were estimated in the following target years which are turning points of MRT East-West line operation.

- Year 2021: MRT's operation will be started in the Stage 1 of the Phase I section
- Year 2024: MRT's operation will be started in all of Phase I section
- Year 2027: MRT's operation will be started in the Phase II section
- Year 2041: 20 years after operation of MRT East-West line

GHG emission reduction amounts were estimated by comparison of "Baseline Emission", where the existing transport modes would accommodate a fraction of the forecast passenger traffic transported by MRT East-West line, and project emission and "Project Emission", where MRT East-West line will be operated. Outline of the estimation procedure is shown in Figure 8.1-1.



Source: JICA Study Team

Figure 8.1-1 Procedure of Quantitative Estimation of GHG Emission Reduction

8.1.2 Required data for Quantitative Estimation of GHG Emission Reduction

The type and description of the required data for quantitative estimation of GHG emission reduction by the Project and the methods for data acquisition are shown in Table 8.1-1.

Table 8.1-1 Required Data for Quantitative Estimation of GHG Emission Reduction

Category	Data Type	Description of Data	Data Acquisition Methods	
			Baseline Emissions	Project Emissions
Required data for estimation of baseline emission	(1) Proportion of transportation modes per vehicle category in the absence of the Project	Number of persons using other vehicle categories without construction and operation of MRT East-West Line. The total number of passengers of existing transport systems is equal to the passengers of MRT	Interview survey results on willingness to pay for MRT East-West line	-
	(2) Average trip distance driven by existing vehicle categories	Average trip distance for each vehicle category in the absence of MRT East-West line operation	Result of person-trip survey	-
	(3) Average occupancy rate by existing vehicle categories	Occupancy rate of each vehicle category in the absence of MRT East-West line operation	Information collected by Jakarta Mass Rapid Transit South-North Line Project	-
	(4) Specific fuel	Fuel consumption rate	SITRAMP and	-

Category	Data Type	Description of Data	Data Acquisition Methods	
			Baseline Emissions	Project Emissions
	consumption by existing vehicle categories and type of fuel used	each vehicle category in the absence of MRT East-West line operation	information collected by Jakarta Mass Rapid Transit South-North Line Project	
	(5) CO_2 emission factor by type of fuel	CO_2 emission factors by type of fuel, such as gasoline, diesel and CNG	CDM MethodologyAM0031 "Baseline Methodology for Bus Rapid Transit Projects" and "JICA Climate Finance Impact Tool/ for Mitigation and Adaptation Draft Ver. 1.0"	
Required data for estimation of Project emission	(6) Total annual trip distance of MRT East-West line	Total annual trip distance driven by MRT East-West line	-	Planned values
	(7) Electricity consumption rate of MRT East-West line	Electricity consumption rate of MRT East-West line	-	Planned values
	(8) CO_2 emission factor for electricity consumption	CO2 emission factor for electricity consumption in the Jakarta Metropolitan Area	-	Emission factor publicized by Indonesian government

Note: Numbers of data type correspond to Figure 8.1-1.

Source: JICA Study Team

(1) Proportion of transportation modes per vehicle category in the absence of the Project

Number of persons transported by existing vehicle categories under the 'without-the-project scenario' was estimated based on results of willingness-to-pay interview survey conducted for the Project. Based on the survey results, by each transportation mode, ratio of transportation mode sifting to MRT East-West line with total number of expected passengers was estimated. The estimated result is shown in Table 8.1-2.

Table 8.1-2 Ratio of Transportation Mode Shifting from Existing Mode to MRT Wast-West Line

Unit: %

Existing Transportation Mode	2021	2024	2027	2041
Passenger car	23.6	26.3	32.7	34.5
Motorcycle	52.0	49.7	44.8	43.6
Bus	19.0	18.7	17.5	17.0
BRT	5.4	5.3	5.0	4.9
Train	23.6	26.3	32.7	34.5

Source: JICA Study Team

(2) Average trip-distance travelled per existing vehicle category

In case the MRT East-West line is not constructed and operated, the forecast diverted passenger traffic to MRT will use the existing transportation modes. Average trip-distance of these transportation modes were estimated using existing vehicle categories, such as private passenger vehicles, motorcycles and buses, based on the person-trip survey results.

(3) Average occupancy rate for existing vehicle categories

Average occupancy rates for each existing vehicle category were set based on the information collected by Jakarta Mass Rapid Transit South-North Line Project, as shown in Table 8.1-3.

Table 8.1-3 Average Occupancy Rate by Each Vehicle Category

Unit: person

Vehicle Category	Average Occupancy Rate
Passenger car	1.2
Motorcycle	1.2
Large Bus	51.4
Medium Bus	22.3
Small Bus	7.7
BRT	51.4

Note: Average occupation rate of bus was set as average of large bus, medium bus and small bus.
Source: The Preparatory Survey for Jakarta Mass Transit System North-South Line Extension Project

(4) Specific fuel consumption of existing vehicles categories and type of fuel used

Specific fuel consumption rates for each existing vehicle category were estimated considering average trip-speed based on SITRAMP and information collected by Jakarta Mass Rapid Transit South-North Line Project, as shown in Table 8.1-4.

Table 8.1-4 Specific Fuel Consumption Rate for Each Vehicle Category

Unit: L/km

Vehicle Category	Specific Fuel Consumption
Passenger car	0.118
Motorcycle	0.033
Large Bus	0.575
Medium Bus	0.283
Small Bus	0.167
BRT	0.575

Note: BRT diverts its fuel from compressed natural gas to diesel oil from the end of 2012. Therefore, specific fuel consumption of BRT is set as same value with large bus.
Source: The Preparatory Survey for Jakarta Mass Transit System North-South Line Extension Project

(5) CO_2 emission factors per fuel type

Indonesian government has not officially publicized the CO_2 emission factors, per fuel type and per vehicle category, that can be used for qualitative estimation. Consequently, CO_2 emission factors described in the CDM methodology AM 0031 entitled, “Baseline Methodology for Bus Rapid Transit Projects” and “JICA Climate Finance Impact Tool/ for Mitigation and Adaptation Draft Ver. 1.0”,, were adopted for estimation of GHG emissions reduction in the Study. The emission factors are shown in Table 8.1-5.

Table 8.1-5 CO_2 Emission Factor by Type of Fuel

Type of Fuel	Emission Factor ($grCO_2/L$)
Gasoline	2,313
Diesel Oil	2,661

Source: CDM Methodology AM0031, , JICA Climate Finance Impact Tool/ for Mitigation and Adaptation Draft Ver. 1.0

(6) Total annual trip distance and Electricity consumption rate of MRT East-West line

The forecast total annual trip-distances and electricity consumption rates for the MRT East-West line were adopted in the estimation of GHG emissions reduction in the Study.

(7) Electricity consumption rate of MRT East-West line

Based on the design of MRT East-West line, electricity consumption rate per one train set was set as 73.6 kWh/km.

(8) CO_2 emission factor of electricity consumption

Indonesian government publicized CO_2 emission factors of grid electricity for Jakarta metropolitan area. For estimation of the amount of GHG reduction in the Study, an emission factor on the combined margin for JAMALI electric grid was adopted. The emission factor is shown in Table 8.1-6.

Table 8.1-6 Adopted Emission Factor of Grid Electricity

Grid	Emission Factor (tCO2/MWh)
JAMALIGrid [1]	0.713

Note: Ex-post emission factor was adopted.
Source: http://pasarkarbon.dnpi.go.id/web/index.php/dnacdm/read/20/emission-factors-for-jawa-madura-bali-electricity-grid-jamali-2010-.html

8.2 Estimation of GHG Reduction

8.2.1 Procedure of Quantitative Estimation of GHG Emission Reduction

GHG emissions reduction due to the operation of MRT East-West line is calculated as the difference between the estimated GHG emissions under “Baseline Emission” case (where the MRT East-West line will not be constructed and operated and existing transportation mode, such as private passenger cars, motorcycles and buses, will be utilized continuously) and emissions for the case entitled “Project Emission” (where expected modal shift will be realized under the Project). The basic equation for estimation of GHG emission reduction is shown below.

[1] “JAMARI Grid” is the largest electricity grid in Indonesia which covers Java, Madura, and Bali area.

$$ER_y = BE_y - PE_y \quad (\text{t-}CO_2/\text{y})$$

$\boldsymbol{ER_y}$: GHG emissions reduction by the operation of MRT East-West Line in year *y* (t-CO_2/y)

$\boldsymbol{BE_y}$: GHG emissions without construction and operation of MRT East-West line in year *y* (t-CO_2/y) (Baseline emissions)

$\boldsymbol{PE_y}$: GHG emissions after realization of expected model shift with the construction and operation of MRT East-West line on year *y* (t-CO_2/y) (Project emissions)

(1) Baseline Emissions Estimation

The baseline emissions, in case the existing transport modes would accommodate a fraction of the forecast passenger traffic transported by MRT East-West line, was estimated by the following equation, with prospective ratio of passengers using each transportation mode under the said case, and respective CO_2 emission factors per passenger:

$$BE_y = \sum_i \left(EF_{P,i,y} \times P_{PJ,i,j} \right)$$

Items	Description
$\boldsymbol{BE_y}$	Baseline emissions: without construction and operation of MRT East-West line in year *y* (gr-CO_2/y)
$EF_{P,i,y}$	CO_2 emission factor per passenger for vehicle category *i* in year *y* (gr-CO_2/passenger)
$P_{PJ,i,y}$	Annual number of passengers transported by vehicle category *i* after operation of MRT East-West line

CO_2 emission factors per passenger for each vehicle type was estimated by the following equation, with average trip-distance and average occupancy rate for each vehicle type, and CO_2 emission factors per kilometer travelled for each vehicle category:

$$EF_{P,i,y} = \frac{EF_{KM,i} \times TD_i}{OC_i}$$

$EF_{KM,i}$: CO_2 emission factor per kilometer travelled by vehicle category *i* （gr-CO_2/km）

TD_i : Average daily trip distance travelled by vehicle category *i* (km/vehicle)

OC_i : Average daily occupancy rate for vehicle category *i* (person/vehicle)

$EF_{KM,i}$ was calculated by the following formula:

$$EF_{KM,i} = \sum_x \left[\frac{1}{SEC_{x,i}} \times EF_{CO2,x} \times \left(\frac{N_{x,i}}{N_i} \right) \right]$$

$SEC_{x,i}$: Specific fuel consumption by vehicle category *i* (km/L)

$EF_{CO2,x}$: CO_2 emission factor of fuel category *x* (gr-CO_2/L)

$N_{x,i}$: Number of vehicle category *i* using fuel category *x* (vehicle)

N_i : Number of vehicle category *i* (vehicle)

(2) Project Emissions Estimation

Project emissions are calculated by multiplying the total annual electricity consumption by MRT East-West line with the CO_2 emission factor of electricity. The equation is shown as follows:

$$PE_y = TC_y \times EF_{CO_2,x}$$

Type	Item	Description
Output	$\boldsymbol{PE_y}$	Project emissions: GHG emissions after realization of expected model shift due to the construction and operation of MRT East-West line in year *y* (t-CO_2/y)
Input	*TCy*	Total annual electricity consumption of MRT East-West line (kWh/y)
	$EF_{CO2,x}$	CO_2 emission factor of electricity (gr-CO_2/kWh)

The total electricity consumption of MRT East-West line was estimated using the following equation wherein its electricity consumption rate and total annual trip-distance are taken into account:

$$TC_{et\,y} = DD_y \times SEC_{et,y}$$

$SEC_{et,y}$: Electricity consumption rate (kWh/km)

DD_y : Total annual trip distance travelled by passenger trains (train km/y)

8.2.2 Estimation Result of GHG Emission Reduction due to Project Phase 1

As a result of the calculation based on the procedure shown above, the expected reduction in the amount of GHG emission were estimated as shown in Table 8.2-1.

In 2021, GHG emission reduction amount was estimated as approximately 110,000 ton-CO_2/year by operation of MRT East-West line in the Phase I section. Even though operation of MRT East-West line would be restricted in the Phase I section, in 2024, expected GHG emission reduction amount were estimated to increase 180,000 ton-CO_2/year, of which ratio were 1.6 times as many as reduction amount in 2021.

In case that MRT East-West line is fully operated in the Phase I and Phase II section from 2027, effectiveness of GHG emission reduction amount is expected to increase significantly. Based on the estimation results, the amount of GHG reduction amount were calculated as approximately 515,000 ton-CO_2/year in 2027 and 546,000 ton-CO_2/year in 2041.

Based on the estimation results, it is considered that the MRT East-West line will contribute to reduce GHG emission by actualization of modal shift from vehicle transportation and railway transportation. After operation of MRT East-West line, it is desirable to review the estimation results of GHG emission reduction shown in this chapter by interview survey to passengers of MRT East-West line to confirm actual status of modal shift.

In case that the Project is applied as a Clean Development Mechanism (CDM) project, a Project Design Document (PDD) will be necessary. For preparing PDD, GHG reduction amount will be reviewed with setting a project boundary considering applied measures for monitoring, report and validation, and considering leakage impact.

Table 8.2-1 Estimation Result of GHG Reduction by the Project

Unit: ton-CO_2/year

Operation	Year	Daily passenger	GHG Emission Reduction Amounnt by the Project (a) – (b)	Baseline Emissions (a)	Proejct Emissions (b)
Operation in Phase I Section	2021	252,629	110,000	127,000	17,000
	2024	405,524	180,000	207,000	27,000
Operation in Phase I and Phase II Section	2027	1,181,329	515,000	651,000	136,000
	2041	1,227,624	546,000	682,000	136,000

Note: In case that MRT East-West line is operated only in the Phase I section, same train operation plan is adopted in 2020 and 2027. Therefore, estimated project emissions were same figure in 2020 and 2027.

Source: JICA Study Team

Chapter 9 Project Evaluation

9.1 Economic Internal Rate of Return (EIRR)

9.2 Qualitative Effects

9.3 Operation Effects Indicators

9.4 Financial Analysis

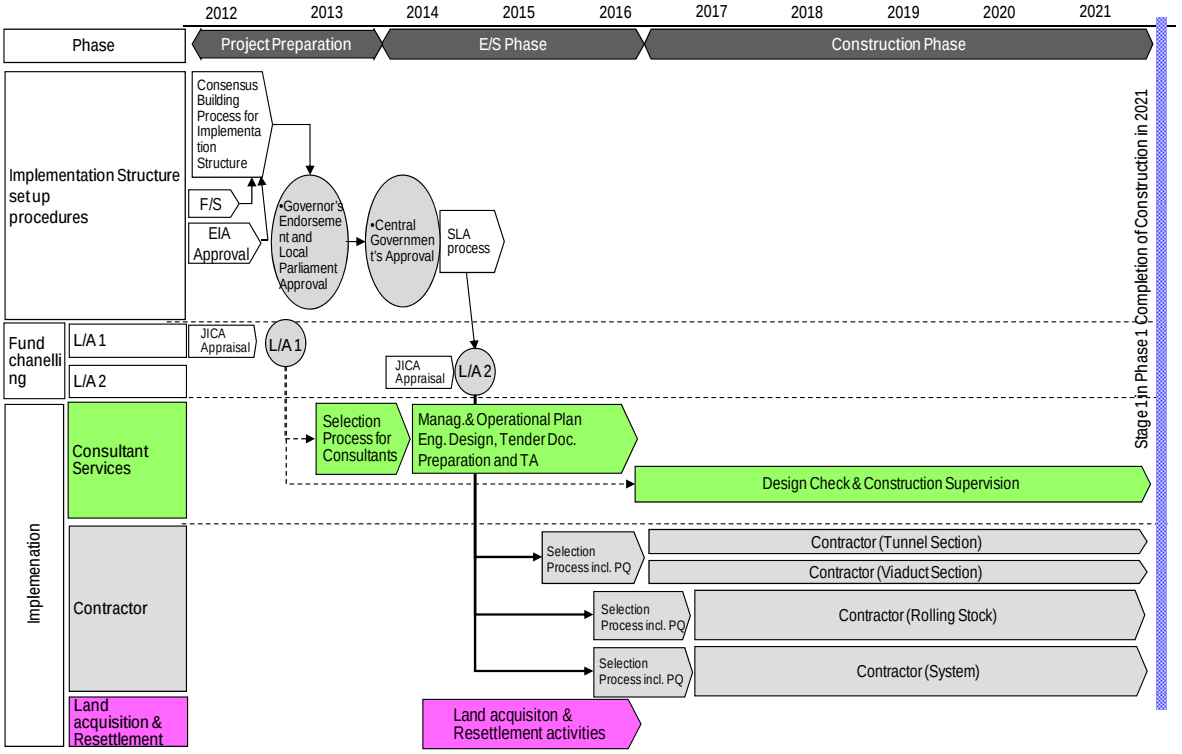
Chapter 10 Recommendation for Project Implementation

10.1 Recommendation for Implementation

(1) Acceleration of Consensus Building in Indonesia

In the implementation schedule of the project, it is assumed that the loan agreement for the main portion of the project (L/A2) will be signed by the middle of 2015. Since consensus building process among authorities of central and local governments of Indonesia generally requires long time (e.g. for MRT North-South Line, the process had taken 5 years from commencement of SAPROF to E/S) and since a sub-loan agreement (SLA) has to be prepared after the consensus on the cost demarcation between the central and local governments is established, it is essential to build a consensus smoothly in Indonesia to meet the overall project schedule which aims at operation commencement in 2021.

Figure 10.1-1 shows the project road map in which consensus building process has been taken into account1.



Source: JICA Study Team

Figure 10.1-1 Project Road map (Stage 1 in Phase 1)

(2) Development Plan of Facilities for Station Access

Demand forecast in this survey has been calculated for base case: TOD not considered, and Enhanced case: TOD considered. The number of passenger to be increased in the future has been estimated around 200,000 passengers/day in 2041 as described in Chapter 3. Although it is suggested in this survey that operation and management of the MRT East-West Line Phase-1 be implemented by MRTJ (the implementation organization same as the MRT North-South Line), the development of other transportation mode will play important roles to increase demand of the MRT East-West Line will be performed by other authorities (e.g. DKI Jakarta, TransJakarta, DGR etc.). For this reason, MRTJ is required to work closely, jointly and cooperatively with these authorities and to establish a consensus on the development of intermodal transfer facilities, the acceleration of development for connection facilities and the development of feeder transportation. In order for the MRT East-West Line to transport the forecasted demand

and to play a role to mitigate severe traffic congestion in Jakarta, it is essential to arrange and establish a consensus among these authorities smoothly for the development of transportation hubs.

10.2 Recommendations for Organization of O&M

10.2.1 Recommendations for Establishment of O&M Organization

(1) Project Implementation with Low-Interest Government Funds

As motorization has been developed these days, it is generally difficult to cover the total project cost through the revenues after the opening of the mass rapid transport system. Similar to projects in other countries, it is analyzed that this is also the case in MRT E-W Line Project (Phase-1). Therefore, in order to implement this project, instead of borrowing private funds based on PPP scheme, utilizing low-interest public funds for the whole investments will result in minimizing the total project costs. Hence, it is recommended that this project be implemented through public funds only. And consequently the study for enhancement of IRR should be conducted in more detail at next stage.

(2) Vertical Separation for Sustainable Management of O&M Organization

In case an O&M company incurs a large amount of debt at the time of the opening of the MRT, the debt interests will be a factor for obstructing the sustainable management of the organization. Vertical separation, where the ownership of railway assets and operation are different, has various advantages and enables the sustainable management of the O&M company. Considering these advantages, it is recommended that vertical separation be introduced in the E-W Line, where DKI Jakarta owns the infrastructure and MRTJ performs the railway operation.

As for O&M of MRT N-S Line, MRTJ is obviously responsible to perform the railway operation. The rail infrastructure ownership and burden percentage of project cost have been reviewed between the Government of Indonesia, DKI Jakarta and MRTJ.

(3) Railway Management by MRTJ with Economies of Scale

MRTJ was already established as an O&M company for MRT N-S Line. It is expected that MRTJ will enlarge its organization and improve its engineering and operational abilities for commencing construction works and O&M of MRT N-S Line. In Phase 1, the section of MRT East-West Line is limited within DKI Jakarta, as it is the case with MRT N-S Line. In addition, since PT.MRTJ would operate MRT E-W Line, from the view point of railway regulations in Indonesia, the same laws and regulation can be applied. It is recommended that MRTJ also operates MRT E-W Line (Phase-1) since it can utilize its operational know-how, which was gained through the operation of the N-S Line. Furthermore, it can operate MRT systems with economies of scale.

10.2.2 Recommendation for O&M in Phase 1

(1) Improvement of Technical Capability of the O&M Company

The railway industry in Indonesia already has the fundamental railway technical abilities since PT.KAI has been operating railway systems all over the country for many years. Nevertheless, it does not have sufficient experiences in maintenance works of ballastless tracks and other railway facilities for Mass Rapid EMU systems. In addition to necessary preparation before the opening of the operation such as setting regulations and manuals, education and training for the staff should be conducted continuously even after the opening phase. In order to improve the

technical abilities for O&M of EMU systems, it is effective to offer opportunities in exchanging technical capabilities with Japanese railway operators, which have abundant experiences. It is recommended to continue efforts for improving technical capabilities of O&M companies by utilizing these opportunities.

(2) Introducing Asset Management Systems

In most of the railway projects in Indonesia, the railway system could not fully benefit from its advantageous characteristics because of insufficient maintenance after the opening phase. In implementing this project, related past lessons learned should be considered. For continuation of efficient maintenance and avoiding similar failures, introducing an asset management system is an effective means. Many Japanese railway operators have experiences in asset maintenance utilizing specific systems. Thus, it is recommended that the designated railway operators learn in advance from their overseas counterparts, and establish a structure which can implement asset maintenance utilizing the most appropriate system for this project.

10.3 Recommendation for Phase 2

(1) Operation with a Single Operator

In the railway operation in Phase 2, it is expected that efficient management be implemented with economy of scale and minimal coordination problems in the borders between the provinces. In order to attain this kind of operation, a single operator should fundamentally perform the railway operation throughout all the sections. Since MRTJ has the status of a stock company, it is possible for MRTJ to provide railway transport services based on concession contracts with related provinces, such as Banten and West Java, as well as DKI Jakarta. Regarding railway operation in Phase-2, it is recommended that the appropriate operational structure be planned, in which MRTJ can utilize its accumulated know-how in MRT operation and can fully benefit from economy of scale.

10.4 Recommendation on Environmental and Social Considerations

(1) Approval of AMDAL and Implementation of AMDAL

It is vital that the EIA (AMDAL), which has been approved in Indonesia, be publicized on JICA's website for 120 days before L/A 2, which means that the EIA needs to be approved in Indonesia at least 120 days prior to L/A 2. As of February 2013, original EIA (Kembangan - Ujung Menteng section) is not approved by BPLHD. First of all, it should be got an approve for it. After this process, DGR shall submit for the approval of the draft modified EIA (Kalideres – Ujung Menteng section) prepared in this study, it is necessary for DGR to review and revise the draft. To do so, it is necessary to set up the environment section in the implementation agency which has the capacity of environmental management and monitoring as well as the knowledge of AMDAL system. The necessary budget for implementation as well as to set up and maintain the organization should be secured to actualize the project.

(2) Implementation of Resettlement

For resettlement, land acquisition and the payment of compensation are preferably completed prior to the commencement of construction. In addition, it is essential to arrange a monitoring system such as establishment of grievance committee, and implementation of livelihood programs. Although DGR is the project proponent of this study, DKI Jakarta is responsible for the land acquisition as an implementation agency, according to the MRT North-South Line. Therefore, it is advised that DGR make an agreement with DKI Jakarta that DKI is responsible to prepare budget and to establish institutions, and is also responsible for carrying out land acquisition and relocation program for the construction of the MRT East-West Line. In this regard, DGR, as an initiator and project proponent, should support and facilitate all the needs required by the provincial government of DKI Jakarta in order to implement the project.