HO CHI MINH CITY PEOPLE'S COMMITTEE
MANAGEMENT AUTHORITY FOR URBAN RAILWAYS
SOCIALIST REPUBLIC OF VIETNAM

THE PREPARATORY SURVEY
ON
HO CHI MINH CITY URBAN RAILWAY CONSTRUCTION PROJECT
(BEN THANH - MIEN TAY TERMINAL (LINE 3A PHASE 1))

FINAL REPORT
(SUMMARY)

JANUARY 2018

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
TOKYO METRO CO., LTD.
TONICHI ENGINEERING CONSULTANT CO., LTD.
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ALMEC CORPORATION

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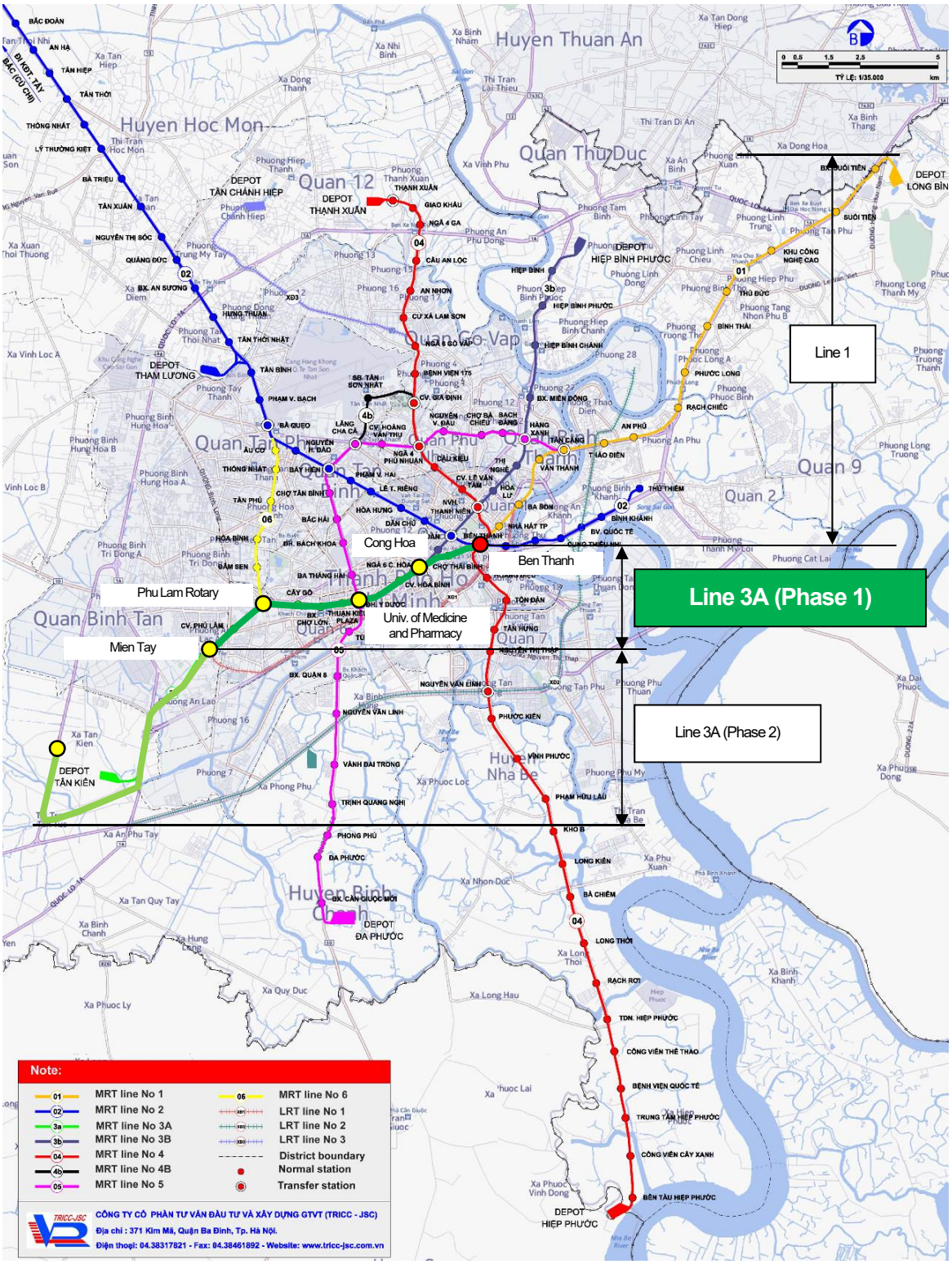
Exchange Rate Used in the Report		
VND 1	= Yen	0.00461
USD$ 1.00	= Yen	101.3
USD$ 1.00	= VND	21,954

(As of November, 2016)

PROJECT LOCATION MAP



Note: Ben Thanh Station, which will be constructed under Line 1 Project, is not counted.

Source: 568/QD-TTg dated 08/04/2013, Decision of the Prime Minister

ABBREVIATIONS

AFC	Automatic Fare Collection
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
ATS	Automatic Train Stop
BAU	Business As Usual
BRT	Bus Rapid Transit
CBD	Central Business District
CCB	Climate Change Board
C/P	Counterpart
CCTV	Closed-Circuit Television
CBTC	Communication Based Train Control
CDM	Clean Development Mechanism
DCSCC	District Compensation and Site Clearance Committee
DPC	District Peoples' Committee
E&M	Electrical and Mechanical
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMA	External Monitoring Agency
EMU	Electric Multiple-Unit
EVN	Electricity of Vietnam
FEED	Front End Engineering Design
FIRR	Financial Internal Rate of Return
F/S	Feasibility Study
GHG	Green House Gases
HCMC	Ho Chi Minh City
HCMC-PC	Ho Chi Minh City Peoples' Committee
IRP	Income Restoration Program
ITR	Interim Report
JCM	Joint Crediting Mechanism
JICA	Japan International Cooperation Agency
MAUR	Management Authority for Urban Railways
M/D	Minutes of Discussion
MOCPT	Management and Operation Centre for Public Transport
MONRE	Ministry of Natural Resources and Environment
MOT	Ministry of Transport

MPI	Ministry of Planning and Investment
MRV	Measurement, Reporting, Verification
NAMA	Nationally Appropriate Mitigation Action
NGO	Non-Governmental Organization
O&M	Operation and Maintenance
OCC	Operation Control Center
OCR	Ordinary Capital Resources
ODA	Official Development Assistance
PC	Pre-stressed Concrete
PHPDT	Peak Hour Peak Directional Traffic
PMSM	Permanent Magnet Synchronous Motor
PPID	Project / Program Investment Decision
PPIP	Project / Program Investment Policy
PPTA	Project Preparation Technical Assistance
PSD	Platform Screen Door
RAP	Resettlement Action Plan
RCS	Replacement Cost Survey
ROW	Right of Way
RPF	Resettlement Policy Framework
RSS	Receiving Substation
SAH	Severely Affected Household
SCADA	Supervisory Control And Data Acquisition
SIV	Static Inverter
SP-RCC	Support Program to Respond to Climate Change
SSTA	Short Scale Technical Assistance
STEP	Special Terms for Economic Partnership
SV	Stored Value (Card)
TBM	Tunnel Boring Machines
TOD	Transit Oriented Development
TSS	Traction Substation
UD	Universal Design
UDAP	Universal Design Action Plan
UMRT	Urban Mass Rapid Transit
VVVF	Variable Voltage Variable Frequency

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1. NEED FOR PROJECT

Travel demand in HCMC has increased significantly during the last decade from 11.5 million person trips/day (excluding walking and intra-zonal trip1) in 2002 to 16.7 million in 2013. The trend is that people prefer private transport and are gradually shifting to the use of Car. This may lead to more serious traffic congestions.

HCMC Line 3A is located at south-western area of the city, which connects from Ben Thanh Station of the city center, where will be an intermodal station of Line1, 2 and 4, to the suburban area to the south-west. It is expected to contribute to expand public railway transport service between east and west areas of the City, and to increase ridership and convenience of Line1 passengers which the Japanese Government provide technical and financial assistance. For this, the HCMC Government prioritizes the Line 3A project for implementation.

In the approved plan, one of the major objectives is to develop urban railway network in the city which promote modal shift from private vehicle to public transport, and specific targets for urban railway project implementation are indicated. This project is to contribute to mitigate worsening traffic congestion and to reduce pollutions caused by traffic by construction of urban mass rapid transit system in place to road transport in the metropolitan of HCMC.

2. DEMAND FORECAST

The ridership of the line was estimated for years 2027, 2030, 2040 and 2050. The number of boarding passengers per day in 2027 is 218,500 and will become 404,800 in 2030 after extension of Phase 2 (C11-C17) section. In 2050, it will reach 561,300 passengers per day.

Many of the passengers come from Line 1 and directly go through Line3A as the entire operating line. The station with the highest number of two-way passengers per day in 2027, except for Ben Thanh Station, is C8 Phu Lam Rotary with over 25,000 passengers for each boarding and alighting. The second is C10 Hoa Binh with over 18,000 passengers per boarding and alighting likewise.

Table 1 Traffic Demand Forecast

Year		2027	2030	2040	2050
Section		C0-C10	C0-C17	C0-C17	C0-C17
No. of Boarding Passenger (Pax/day)	C0-C10	244,700	344,200	398,500	473,700
	C11-C17	-	60,600	77,000	87,600
	Total	244,700	404,800	475,500	561,300
PPHPD (Perk rate 12%) (Pax/Hour/Dir.)		13,500	19,300	22,100	25,000
Off Peak Hour Line Volume (5%) (Pax/Hour/Dir.)		5,600	8,000	9,200	10,400
Pax km (Pax km / day)		1,456,543	2,750,746	3,330,325	3,848,330
Ave. Travel Dist. (km)		5.7	6.8	7.0	6.9
Fare Revenue (million VND/day)		6,369	9,635	11,300	13,322

Source: JICA Study Team

3. ROUTE SELECTION

The selected route envisages underground structure at central and sub-central districts of HCMC, i.e. from Ben Thanh (beginning point) to C8 Station, with due considerations of resettlement, landscape, and other environment issues, while viaduct structure is proposed in the remaining section as no obstructions to build elevated structures are identified. This Option possibly reduce 15% of civil works cost, which derives from alterations from underground to elevated structures for 2km out of 10km in total length. The above alternatives of alignment and structures were thoroughly discussed with MAUR and agreed in principal.

In order to build the elevated section, power cables situated in the road median need relocation to underground level for about 3.6km from C8 to C10. The meeting with EVN concluded to follow the proposal.

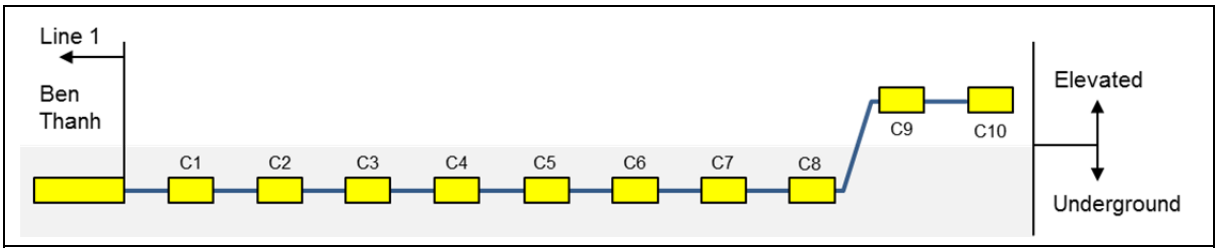


Figure 1 Selected Route Alternative

4. PROJECT DESIGNS

In the course of this study, the Study Team reviewed F/S and established project plans as summarized in the following table.

Table 2 Project Plans of F/S and This Study

Item	F/S	This study
Section	Starting point : Ben Thanh Station*	Ending point : Mien Tay Bus Station
Total length**	Double track with about 9.9 km	Double track with about 9.9 km
Underground section	9.9km	8.2 km
Elevated section	-	1.7 km
Number of stations	10 stations	10 stations
Underground station	10 stations	8 stations
Elevated station	-	2 stations
Average interval	970 m	970 m
Demand forecast	In opening year of 2015	In opening year of 2027
Daily average ridership	127,000	244,700
PHPDT	5,800	13,500
Operation hours	5:00 - 23:00	5:00 - 23:30
Operation interval	In opening year of 2015	In opening year of 2027
Peak hour	11 trains/hour	14 trains/hour
Off peak	5 trains/hour	6 trains/hour
Location of Depot		
Phase 1	Common use of Suoi Tien Depot of Line 1	
Phase 2	Tan Kien Depot of Line 3A	

Source: Study team

5. DESING PARAMETERS AND SYSTEM FEATURES

Design Parameters and system features of the project are shown below.

Table 3 Design Parameters and System Features

Item		Specifications
Operation	Designed maximum speed	Elevated section : 120km/h Underground section : 80km/h
	Operational direction	Right side
Construction standards	Gauge	1,435mm
	Rail	60kg/m
	Minimum horizontal curve radius	300m
	Minimum vertical curve radius	3,000m
	Maximum cant	150mm
	Maximum grade	3.5 %
	Minimum distance between tracks	3.7m
	Design axial load	14ton or 16ton
	Width of formation level	2,750mm
	Effective platform length	130m
Structures	Stations	Underground section: Two stories of cut and cover tunnel, Elevated section: Single pier and double piers
	Between stations	Underground section: Shield tunnel (single line - twin tubes), Transition section : Cut and cover tunnel and U-shape retaining wall, Elevated section: Viaduct with PC U-shape girder
Rolling stocks	Body dimensions	lengh:19.5m, width :2.95m
	Train consist	Maximum 6 cars
	Maximum output	190kW
	Capacity	942 passenger / trainset (6 car trainset, 3 pax/m^2)
Electric System	Electrification system	DC- electrification
	Current feeder system	DC1,500V
	Receiving substation	110/22 kV 25MVA x 2unit
	Catenary system	Overhead contact system
	Span Cycle	Underground section : 5m, Elevated section : 50m
Signaling	Signaling system	Automatic block system, train radio device
	Train control system	ATS (Automatic Train Stop), ATP (Automatic Train Protection), ATO (Automatic Train Operation)
Communication system	Communication system	Telephone system, dedicated telephone system, train radio, public address system, passenger information display system, CCTV, clock system and data transmission system

Source: Study team

6. ROUTE ALIGNMENT

The route of Line 3A Phase 1 remains unchanged from the F/S i.e. the Line begins at Ben Thanh Station and ends at Mien Tay Bus Station (C10), running along Pham Ngu Lao St., Pham Viet Chanh St., Hung Vuong St., Hong Bang St. and Kinh Duong Vuong St..

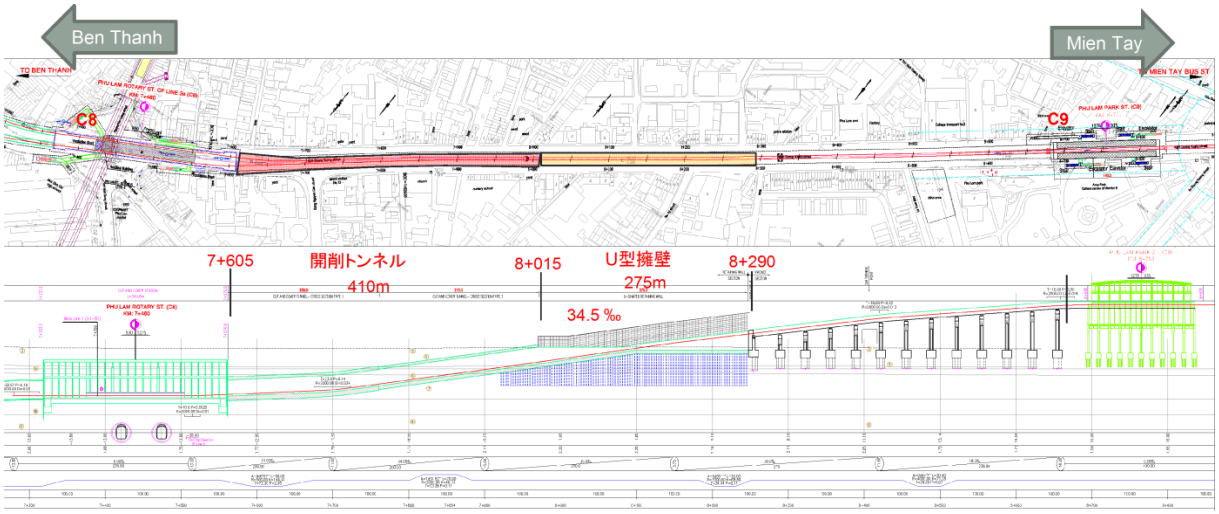


Figure 2 Transition Section from Underground to Elevated Structure

Station locations are specified as follows.

Table 4 Transport Plan

No	Station name	Chainage	Distance	Connecting Line	Structure Type	Function*
C1	Thai Binh Market	0+910	910m	-	Underground	Intermediate
C2	Cong Hoa Six –Way Junction	2+125	1,215m	Line 3B	Underground	Hub
C3	Hoa Binh Park	3+135	1,010m	-	Underground	Intermediate
C4	University of Medicine & Pharmacy	4+200	1,065m	Line 5	Underground	Transit
C5	Thuan Kieu Plaza	4+935	735m	-	Underground	Intermediate
C6	Cho Lon Bus Station	5+645	710m	-	Underground	Intermediate
C7	Cay Go	6+345	700m	-	Underground	Intermediate
C8	Phu Lam Rotary	7+480	1,135m	Line 6	Underground	Transit
C9	Phu Lam Park	8+755	1,275m	-	Elevated	Intermediate
C10	Mien Tay Bus	9+690	935m	LRT Line1	Elevated	Terminal

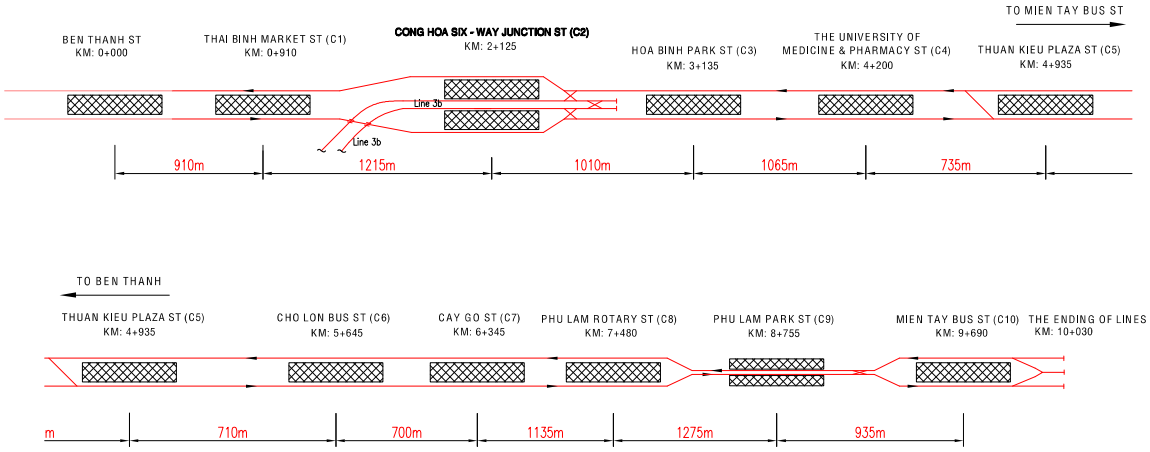
Note)

Intermediate Station : station situated between terminal stations of Line 3A. Transit Station : station where passengers can change trains to other lines , Terminal station : station situated at the end of Line 3A, Hub Station : Intermediate Station -cum- Transit Station.

Source: Study Team

7. TRAIN OPERATION PLAN

Track layout of Line 3A is proposed as follows.



Source: Study team

Figure 3 Track Layout

Year-wise transport plans are summarized in the following table, where Daily Line Volume in 2030 and beyond incorporates the ridership of Phase 2 section.

Table 5 Transport Plan

			Base Case	3A Extension Case (C0 - C17)	
			2026	2030	2040
C0 Ben Thanh - C1 Thai Binh	Daily Line Volume (Passengers)		244,700	404,800	475,500
	Peak time	Peak Hour Peak Direction Traffic	13,500	22,100	25,000
		Number of Trains/Hour	14	26	26
		Headway	0:04:20	0:02:20	0:02:20
		Transport Capacity (Passengers)	13,188	24,492	24,492
		Congestion rate (%)	102%	90%	91%
	Off-peak time	Peak Hour Peak Direction Traffic	5,600	9,200	9,300
		Number of Trains/Hour	6	12	12
		Headway	0:10:00	0:05:00	0:05:00
		Transport Capacity (Passengers)	5,652	11,304	11,304
		Congestion rate (%)	99%	81%	82%
Operating hours			5:00～23:30		

Source: Study team

Fleet requirements and timing of expansion to meet the transport plans are summarized as follows:

Table 6 Fleet Requirements

	2026	2030	2040
Fleet requirement (Number of train)	10	23	24
Fleet requirement (Number of cars)	60	138	144

Source: Study team

8. CIVIL INFRASTRUCTURE

8.1 Underground Section

Typical cross section of tunnel structure is shown as follows. Soil coverage of shield tunnel for general section shall be kept over 1.5D (6.65 x 1.5 =10.0m), while 2D shall be minimum at the section where the tunnel goes under the existing surface structure between C1 and C2.

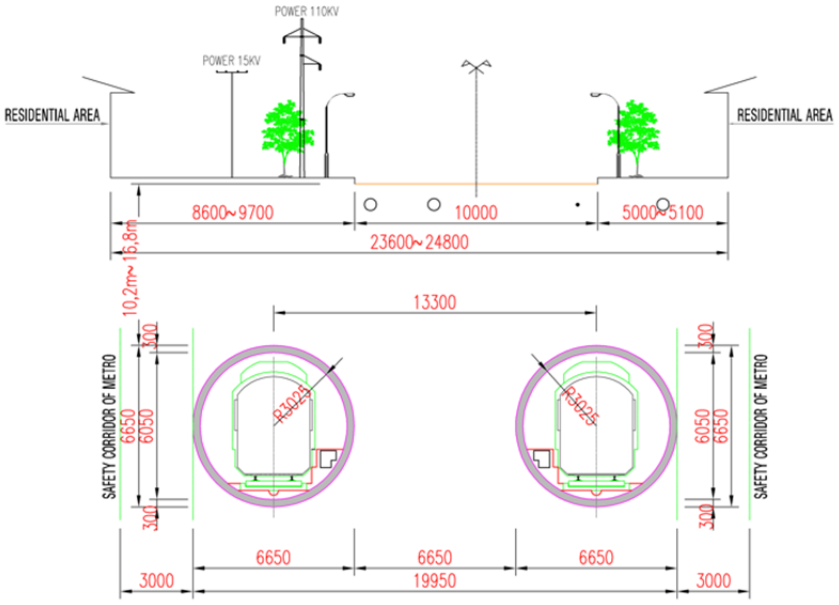


Figure 4 Typical Cross Section of Tunnel Structure

Construction of cut and cover stations, consisting of concourse and platform layers, employs "Top Down Method" using temporary earth retaining wall (diaphragm wall) as the permanent structure. Whilst the design of the F/S and HCM Line 1 adopted double walls, namely in situ concrete plus diaphragm wall to cater for the leakage control, the Study Team proposed a combination of diaphragm wall, drainage and brick wall for the reasons of better control against water leakage, advantage in cost, safety and stability, ease of construction work and maintenance. The decision may be made during the detailed designs considering the leakage condition of Line 1.

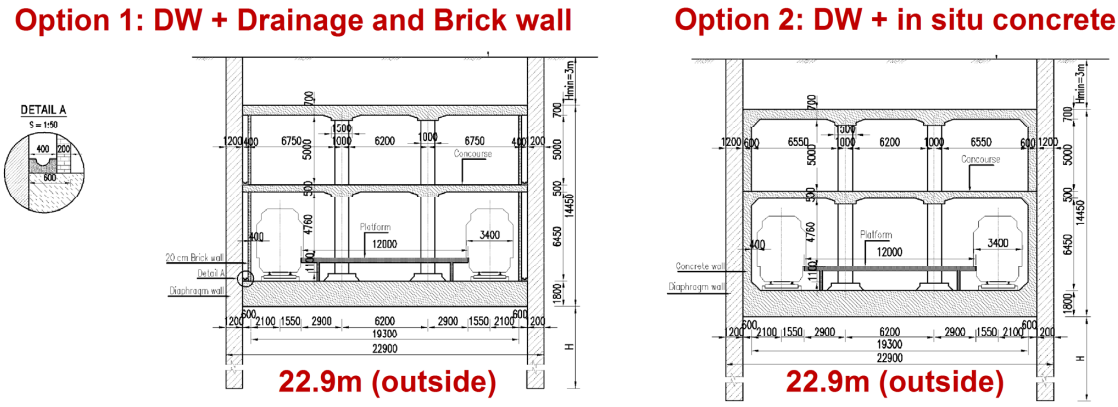
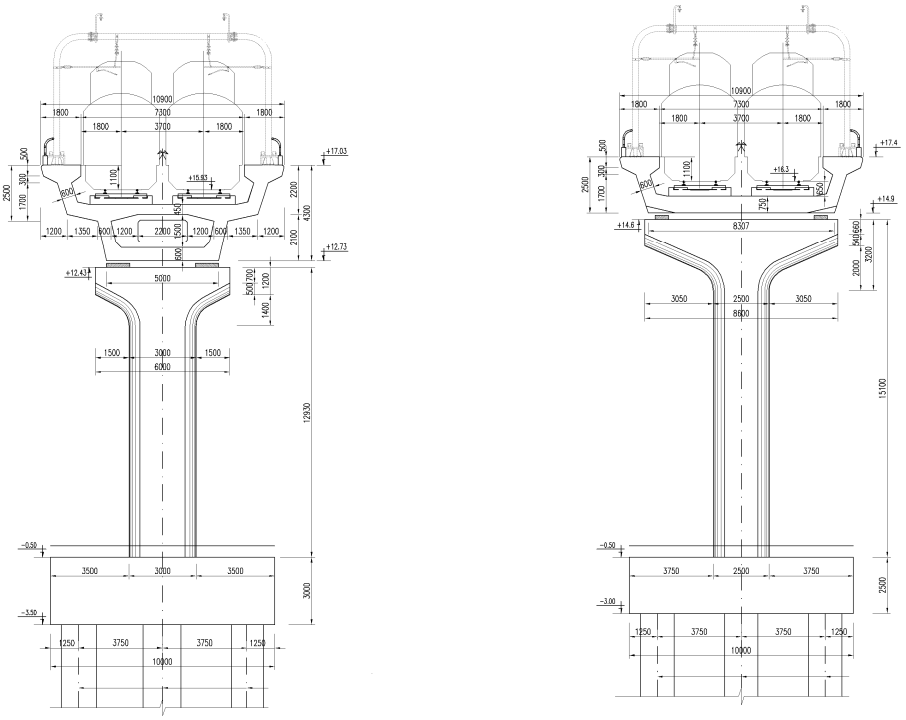


Figure 5 Typical Cross Section of Underground Station

8.2 Elevated Section

Main viaduct is a simple bridge with having 35m span, while PC box girder continuous viaduct with 70m maximum span is planned for the rotary for Hau Giang Street and An Duong Vuong Street in order not to disturb the traffic.



a) PC Box Girder Continuous Viaduct

b) PC U-Shape Girder Simple Viaduct

Figure 6 Typical Cross Section of Viaduct

With the change in vertical alignment, C9 and C10 station became elevated stations. Whilst C9 structure can be supported with single pier, C10 structure, having an island platform with three tracks, should be placed on double piers considering deflection of super structure and stability of whole structure.

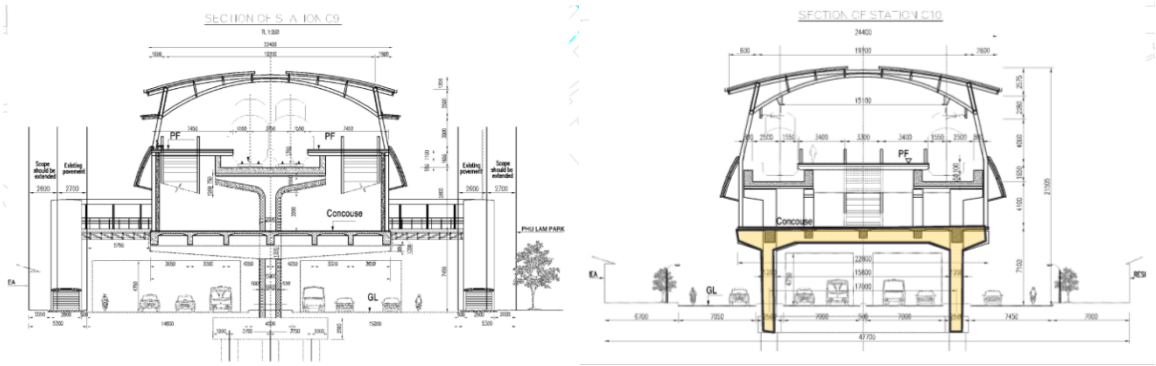


Figure 7 Cross Section of Elevated Station (Left: C9, Right: C10)

8.3 Station Layout

The underground station will have the inside length of 240m and width of 19.3m.

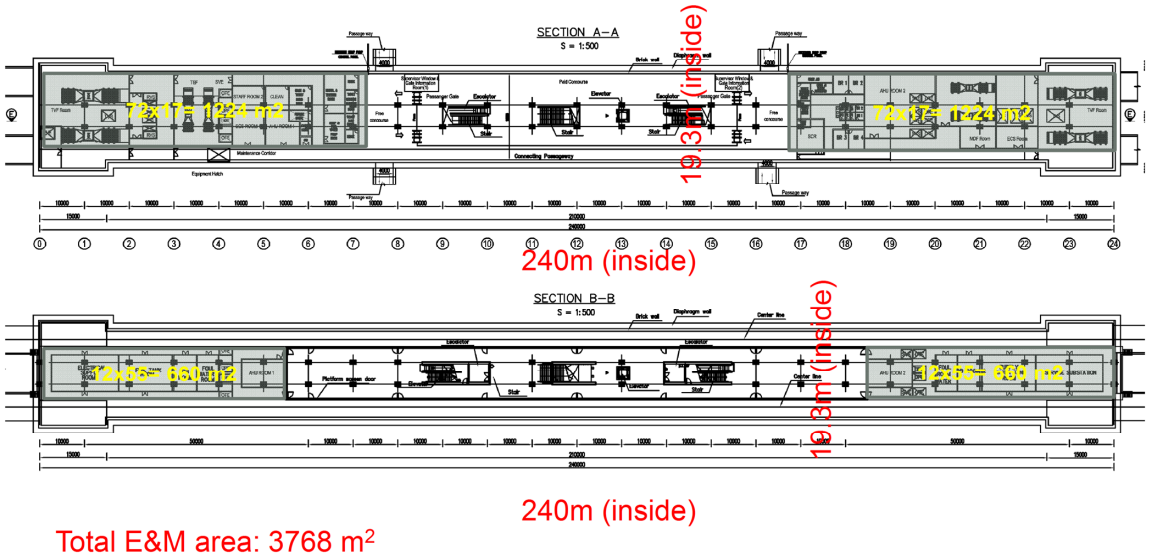


Figure 8 Station Layout

8.4 Auxiliary Facilities and Equipment

The following facilities and equipment are installed at concourse and platform floors. In addition, auxiliary buildings, which have mechanical room, generator room and cooling tower, etc., are built separately within station area.

(1) Concourse floor

- Passenger facilities (ticket vending machines, automatic fare collecting gates, toilets, stairs, escalators and elevators, etc.)
- Station staff facilities (meeting rooms, stationmaster's office, toilets and rest area, etc.)
- E&M facilities (tunnel ventilation room, track exhaust fan room, environmental control system room and air handling unit, etc.)

(2) Platform floor

- Passenger facilities (stairs, escalators and elevators, etc.)
- E&M facilities (power supply room, service substation room, fire water room and air handling unit room, etc.)

8.5 Trackwork

In this study, slab track or direct fastened track, which having an excellent maintenability, is adopted in the main lines, while ballast track is adopted at depot area where travel speed of trains is restricted and separated from commercial line. Key specifications are;

- Rail for main line: heat-treated rail (equivalent to UIC 60kg)
- Turnout (10# for main line, 8# for siding tracks)
- Pre-stressed concrete sleeper
- Anti-vibration box

9. ROLLING STOCK AND DEPOT

9.1 Specifications of Rolling Stock

Specifications of rolling stock in F/S are prescribed as follows. Except route conditions and particulars, these specifications are consistent with typical mass transit trains in Japan.

As the latest rolling stock technology in Japan, the Team consider the introduction of “Permanent Magnet Synchronous Motor (PMSM)”, “fully closed high efficiency induction motor (un-degrated and bearing-changeable type), “SiC Element”, “parallel sync of auxiliary power”, and “saving of auxiliary power during off-peak hours”. Such latest technologies will bring the significant advantages, including reduction in electric power consumption, reduction in maintenance requirements, energy saving, etc.

Table 7 Outlines of Rolling Stock Specifications

Item		Specification
Train Consist (M: Motor Car, Mc: Motor Car with Driving Cabin, T: Trailer Car)		Mc -T- M - M - T - Mc or Mc -T- T - M - T - Mc
Dimensions	Length (Mc)	20,250mm
	Length (T)	19,500mm
	Width	2,950mm
Passenger Capacity	Capacity (Mc)	147 passengers
	Capacity (T)	162 passengers
Body Material		Stainless / Aluminum alloy
Maximum Speed		Elevated Section120km/h, Underground Section 80km/h
Driving Performance	Acceleration	3.3 km/h/s (0.92 m/s^2)
	Deceleration (Ordinary/Emergency)	3.6 km/h/s (1.0 m/s^2), 4.5 km/h/s (1.25 m/s^2)
Traction System	Power Collection	DC 1500V/AC 25kV
	Control System	VVVF IGBT Inverter
	Main Motor	380V 3-phase DC motor
Brake System		Air-pressure brake, regenerative brake
Bogie		Bolsterless type

- Passenger capacity = seating capacity + standing capacity. Standing capacity is estimated with the benchmark of 3.3 persons per square meter for standing area inside the coach.

9.2 Depot Plan

Line 1 Depot will be shared with Line 3A in this project. However, separate depot will be necessary at the time of opening of Phase 2 section (not covered by this project). Line 1 Depot at Suoi Tien equips a range of maintenance facilities and equipment for all necessary inspections and repairs of rolling stock, having a maximum capacity of 32 trainsets (192 cars).

Table 8 Outlines of Line 1 Depot

Capacity	Description	Remarks
Stabling Capacity	Maximum 30 trainsets of 6 cars	
Inspections and Repairs Capacity	• Overhaul (every 8 years) & critical parts inspections (every 4 years) – A total of 32 trainsets per 4 years • Monthly inspections (every 3 months) – 32 trainsets per 3 years • Inspections of trains (at least every 10 days) – 3 trainsets per day • Daily inspections (before departure from depot to operational lines) – All trainsets except spare trains every day	• Having a capacity of 31 trainsets per day for daily inspections, which is equivalent to maximum number of trains to be owned by Line 1 (32 trainsets) minus 1 spare trains

Source: Hitachi and Inspection Period as per Japanese Regulation

A total number of trainsets for Line 1 and Line 3A will grow as below according to the estimate of study team based on traffic demand forecast. This indicates that inspections and repairs requirements will

reach beyond the capacity of Line 1 depot in 2030. It means development of additional depot upon extension of Phase 2 of Line 3A, which is not covered by this project, must be completed by this period.

Table 9 Inspections and Repairs Capacity

Year	Line-1	Line-3A	Total	Remarks
2027	16	11	27	Number of trainsets excludes 1 spare train each. Number of cars = number of trainsets x 6
2028	18	14	32	
2030	23	23	46	
2040	25	24	49	

Note: Number of trainsets of Line 1 is estimated from the train operation diagram with assumed traffic forecast by the Study Team. Time to reach the capacity limit is, therefore, subject to change depending on the actual transport plans of Line 1.

Based on the train operation plans, overnight train stabling of the rolling stock of Line 3A is designed as follows.

Table 10 Overnight Train Stabling

Station / Year	Line-1 Depot	Line-3 Depot	Ben Thanh	Cong Hoa	Mien Tay Bus	Total
2027	5		(1)	2	4	11
2028	8		(1)	2	4	14
2030	3	17	(1)	2	1	23
2040	3	18	(1)	2	1	24

Note: Unit: Number of trains, Stabled trains at Ben Thanh are counted as part of Line 1 operation. Trainsets in the table include 1 spare train.

10. RAILWAY E&M SYSTEMS

10.1 Electrical Systems

The substation location and electrical equipment

Table 11 Substation Location and Electrical Equipment

Location	Electrical Equipment
Mien Tay Bus (C10) Station Substation	TSS
Phu Lam Park Substation	RSS
Van Lang Park Substation	RSS+TSS+INV
Ong Buong Bridge Substation	TSS+INV
Cong Hoa Six-Way Junction(C2) Station Substation	TSS

RSS: Receiving substation, TSS: Traction power substation, INV: Inverter

Station substation and monitoring range at electrical side are illustrated in the following figure.

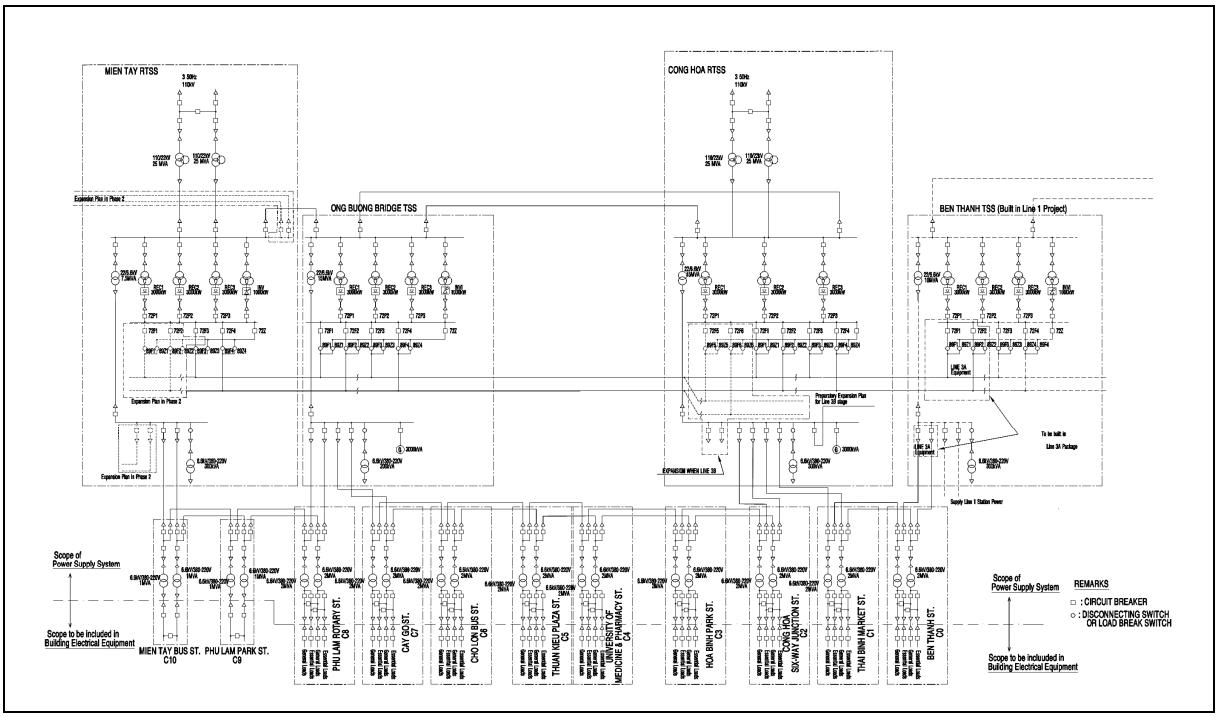


Figure 9 Power System Diagram

For the purpose of Line 3A project, the existing Ben Thanh TSS will require additional two lines of DC1500V and 6.6kV including renovation for these additional lines. This will be installed at the provisional space for the future expansion in the existing Ben Thanh TSS.

10.2 Mechanical Systems

With respect to station facilities, the latest specifications of Line 1 should be adopted taking into account interoperation between Line 1 and Line 3A.

For the following station mechanical systems, the latest specifications of Line 1 should be adopted considering the interoperation between Line 1 and Line 3A.

Table 12 Station Mechanical Systems (Underground Station)

Air Conditioning Facilities	Tunnel Ventilation	Plumbing Systems
- Air conditioning equipment, Cooling tower - Refrigerating machine, Pump set relating air conditioner - Air conditioner, Automatic control indoor radiator relating air conditioner Air condenser - Duct(outlet/inlet/ intake/ exhaust port) - Ventilation Duct, Piping - Air supply and exhaust fan	- Air supply and exhaust fan - Noise control equipment - Exhaust fan (for station railway side) - Duct	- Water tank with accessories - Feed pump - Sanitary equipment - Piping - Sewage pit with pump - Drainage pump - Sewage treatment unit
Fire Prevention Facilities	**Electrical Facilities**	**Lift**
- Fire prevention water tank - Pump for firefighting water - Fire hydrant facilities - Piping for firefighting water - Inert gas injection equipment - Kitchen gas facilities - Portable fire extinguisher	- Power supply equipment - Switch boards for low voltage - Power distribution equipment - Uninterruptible Power Supply - Room lighting device and electrical outlet - Ground fault equipment protector - Fire alarm equipment - Automated facility for building	- Elevator - Escalator

Table 13 Station Mechanical Systems (Elevated Station)

Air Conditioning Equipment	Plumbing System	
- Air conditioner(including plumbing) - Exhaust fan - Duct(outlet/inlet/ intake/ exhaust port)	- Portable fire extinguisher - Feed pump - Sanitary equipment - Piping	
Fire - Prevention Equipment	**Electrical Facilities**	**Lift**
- Fire prevention water tank - Pump for firefighting water - Fire hydrant facilities - Piping for firefighting water - Inert gas injection equipment - Portable fire extinguisher	- Power supply equipment - Power distribution equipment - Uninterruptible Power Supply - Room lighting device and electrical outlet - Ground fault equipment protector - Fire alarm equipment - Automated facility for building	- Elevator - Escalator

10.3 Signalling System

System configuration of Line 3A is required to follow the configuration of Line 1 signaling systems. Namely, the system is composed of following sub-systems and equipment:

1) Automatic Train Protection system (ATP);
2) Interlocking system (IL);
3) Automatic Train Operation system (ATO);
4) Train Detection system (TD);
5) Data Transmission System;

6) Automatic Traffic Supervision system (ATS);

7) Uninterruptible Power Supply System (UPS);

8) Point machine; and

9) Other necessary equipment.

Function of OCC in Line 3A is to follow Line 1's function to supervise operations of Line 3A trains and also Line 1 trains coming into Line 3A zones in the same manner to be implemented in Line 1, in a sense to make it possible to adopt unified train operation control in Line 1 and Line 3A

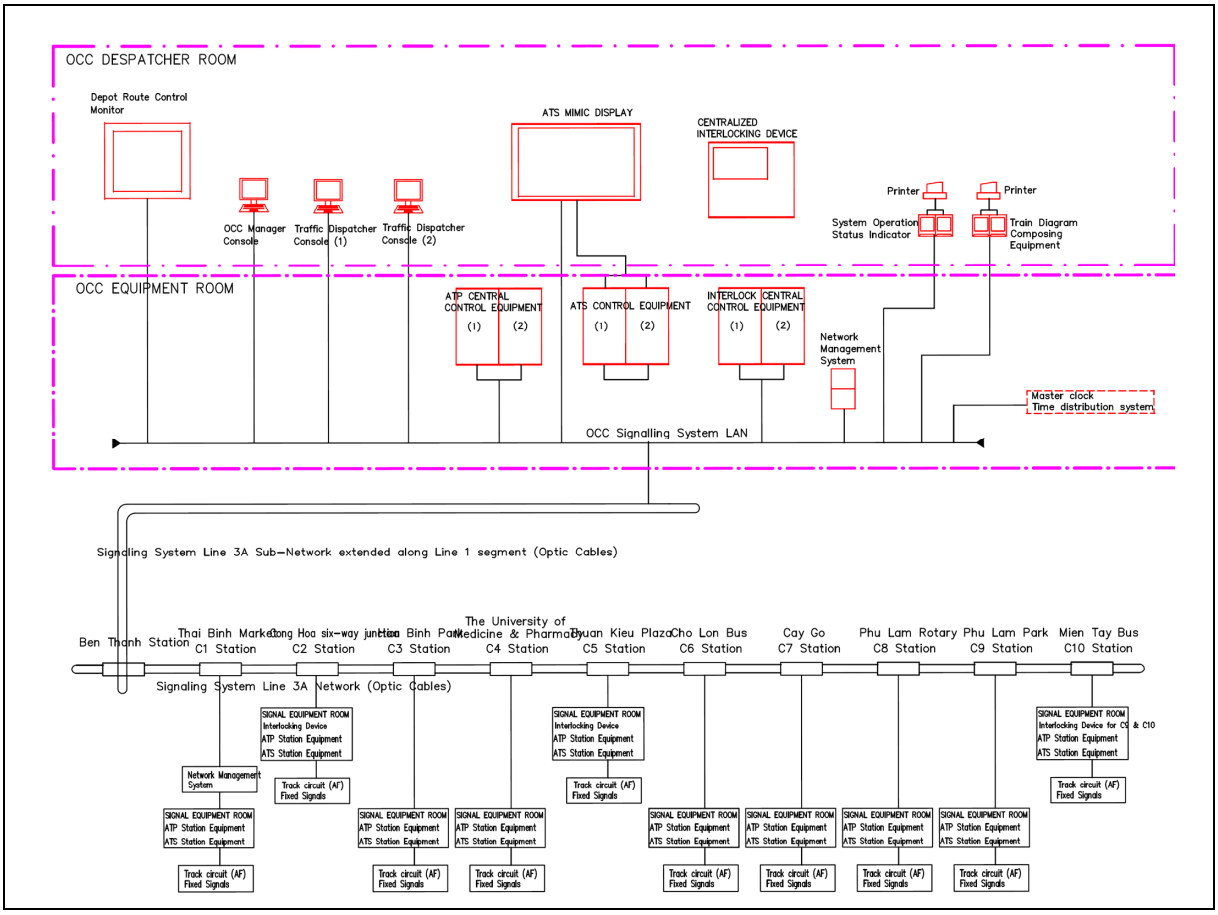


Figure 10 Signalling System Diagram

10.4 Telecommunication System

Telecommunication system consists of the following sub-systems and equipment.

1) Data Transmission System (DTS);

2) Telephone System;

3) Closed Circuit Television (CCTV) System;

4) Public Address (PA) System;

5) Clock System;
6) Train Radio System;
7) Disaster Prevention System;
8) Passenger Information System; and
9) Power Supply System.

Recommendations for telecommunication systems for Line 3A are as follows:

- Avoidance of Double Mount of Onboard Equipment (on-board train radio equipment must be commonly usable on both Line 1 and Line 3A, including use of same frequency and method.)
- No Physical Integration (The interface between Line 1 and Line 3A shall be made and managed for inter-operation, while the two should be physically separated systems, since i) designs of Line 3A will be long after Line 1 designs, ii) up-to-date technologies should be incorporated to the designs of Line 3A.)

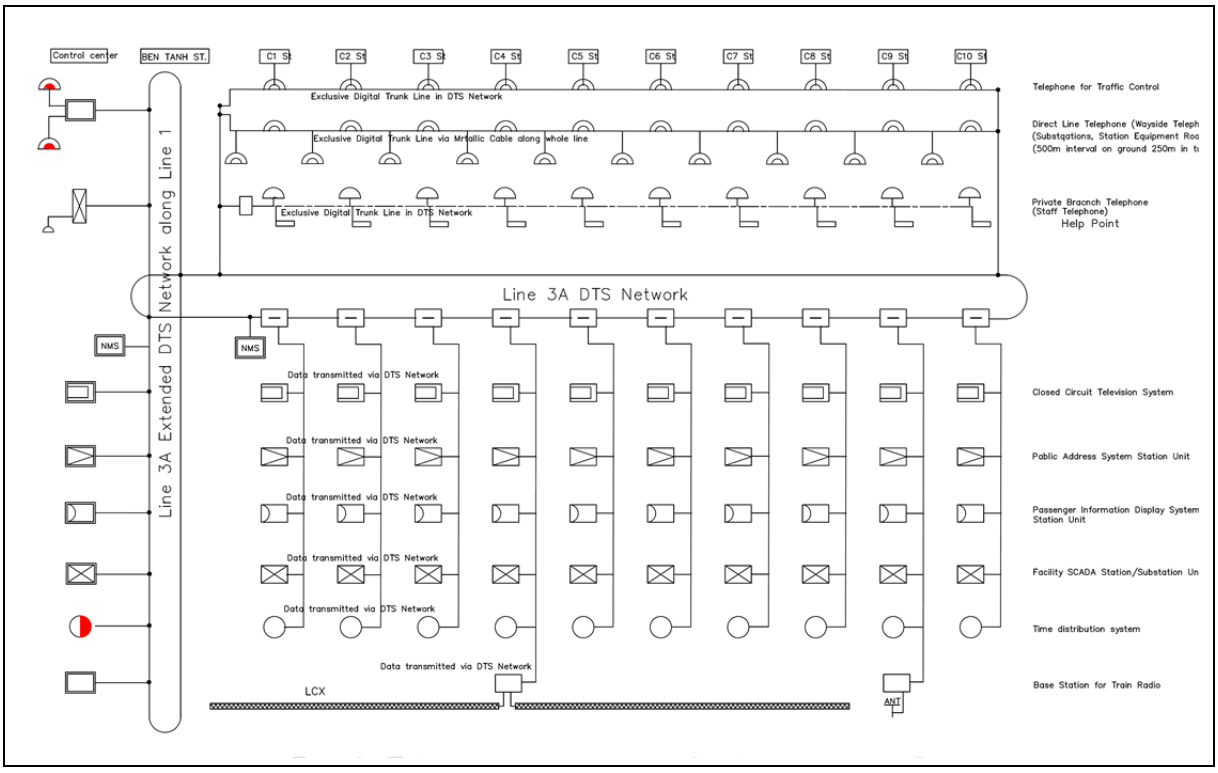


Figure 11 Communication System Diagram

11. INTEGRATION OF FARE COLLECTION SYSTEMS

From the legal interpretation and opinions of MAUR, the study focused on the services where card transaction falls into the account of HCMC-PC and within the use for public transport in the city. The IC card issuer and fare-ownership can be determined from two options, but undecided at this moment: 1) MRT card issuing and ownership of fare are under MAUR, and 2) those are under MRT company.

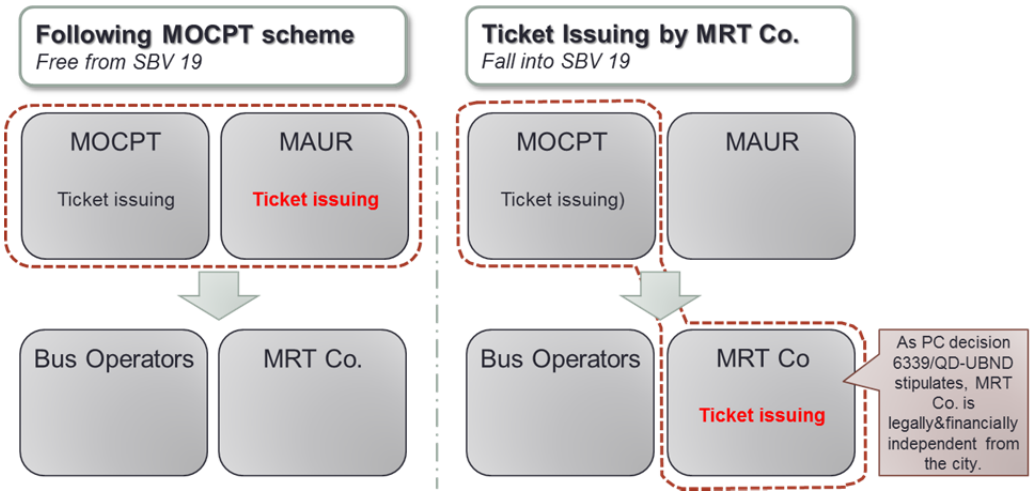
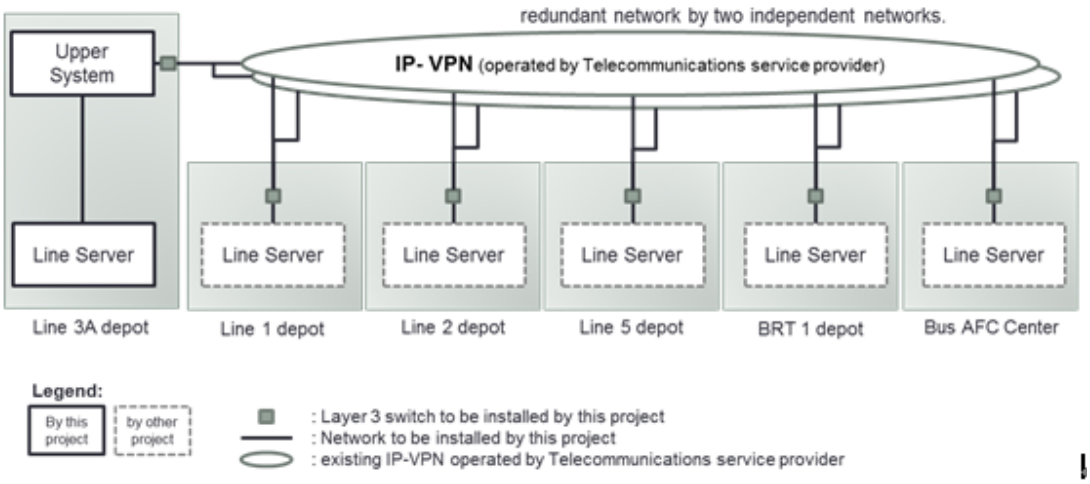


Figure 12 Legal Differences between MRT Ticket Issuing Schemes

The functions to be covered by the AFC system at the upper level include Card Management, Blacklist Management, Revenue Management, Statistics management, and Clearing between entities. It is assumed that the servers for the upper system will be installed in the server room to be built in the Line 3A depot; and the network between the upper system and each transport modes will be realized via IP-VPN like Japanese system. The economic value mentioned above can be expected to be approximately 7 billion JPY after deducting the implementation and 5 year maintenance costs of the upper system.



Source: Study team

Figure 13 Network between Upper System and Each Transportation Mode

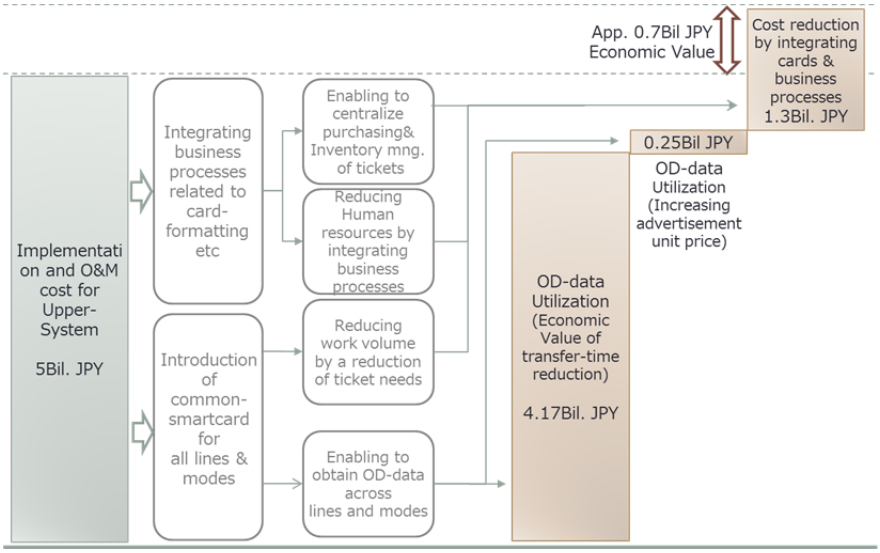


Figure 14 Network between Upper System and Each Transportation Mode

Bid for IC card business operator for the public bus service was called and implemented in 2017 under public-private partnership, while the upper system will become functional in 2027 at the earliest if the introduction is as part of the Line 3A project. Alternatively, the upper system may be introduced by an independent project for earlier implementation.

Table 14 Options for Introduction of Upper System

	Option 1 As part of Line 3A Project	Option 2a Independent Project (1)	Option 2b Independent Project (2)
Budget	JICA ODA Loan	JICA Grant Aid	Local private fund
Executing Agency	MAUR	MAUR or MOCPT	Private Entity
Start of Operation	2027	2023(*1)	
Pros	• Easier to introduce upper system as part of railway construction project	• Earlier implementation	• Earlier implementation • Better sustainability of smartcard business by granting authority of IC card issuer to private entity
Cons	• Late implementation • Need for maintenance organization and technicians by the public	• Need for maintenance organization and technicians by the public	• Need to secure financial soundness and sustainability of the business operation

*1: It took 2 years since F/S completion till bid for the business operator of IC card for public bus service. With the assumption of same timeline, F/S completion in 2019, bid in 2021, commissioning in 2023

12. STATION AREA & INTERMODAL TRANSFER FACILITY

Influenced areas along the corridor are divided into 3 clusters based on socio-economic characteristics, landuse, transport accessibility, etc., which are Central Business District (CBD) cluster, mixed use cluster, and urban fringe cluster. If TOD concept is applied in line with Line3A development, new urban

areas with mixed-use residential facilities will be developed by application of urban redevelopment of degraded low-rise and high dense residential areas and 30% of night population will be increased in 2030. In daytime, thanks to development of commercial and business districts and facilities between the city center and suburban areas, 70% of daytime population (employment) will be additionally increased.

Proposed TOD projects are as follows:

Table 15 List of TOD Projects

Cluster	Station	Other Line	M/C Parking	Drop off & pick up	Station Plaza	TOD Potential Area
CBD	**C1 Thai Binh Market**	Bus terminal	●	●	●	• 23/9 bus parking • Thai Binh Market
	C2 Cong Hoa	Line3B	●[1)]	●		• Government Guest House • Underground space (C&C)[1)]
	C3 Hoa Binh Park			●		• An Dong Market and apartments
Mixed built-up area	**C4 University of Medical and Pharmacy**	Line5		●		• Rotary of Hung Vuong Plaza • Medical University
	C5 Thuan Kieu Plaza		●[1)]	●		• Thuan Kieu Plaza • Underground space (C&C)[1)]
	C6 Cho Lon Bus Terminal			●		• (Cho Lon bus terminal)
	C7 Cay Go					
Urban fringe	**C8 Phu Lam Rotary**	Line6		●		
	C9 Phu Lam Park			●		
	C10 Mien Tay Terminal	Bus terminal	●		●	• Mien Tay Terminal

Source: Study team

Among various intermodal transfer facilities (ITFs), it is proposed to consider to include ITFs into FS for approval together with station facilities for effective construction and operation, especially roadside facilities for transfer, and station-adjoined facilities such as underground parking, intermodal facility under the viaduct.

Table 16 Proposed Intermodal Facilities to be constructed with Stations

Station	Facility	Required land	Necessity of expansion of ROW
All stations	Bus stops, drop off and pick up space	Sidewalk/ carriageway	None
C2 Cong Hoa	Underground bike parking	Underground space[1)]	None
C4 University of Medicine and Pharmacy	Rotary, underground mall connecting to Line5 station, underground bike parking	Rotary land in front of Huong Vuong Plaza	Required (Huong Vuong Plaza)
C5 Thuan Kieu Plaza	Underground bike parking	Underground space[1)]	None
C13 An Lac Three-way Junction	Intermodal facility under viaduct	Space under elevated station	None
C14 Hung Nhon			

Source: JICA Study Team

Integrated development of parking lots and commercial facilities at two underground stations, i.e. C2 Cong Hoa Station and C5 Thuan Kieu Station, are proposed. Those station area and ITFs development proposals were incorporated to the pre-F/S to obtain approval from the National Assembly.

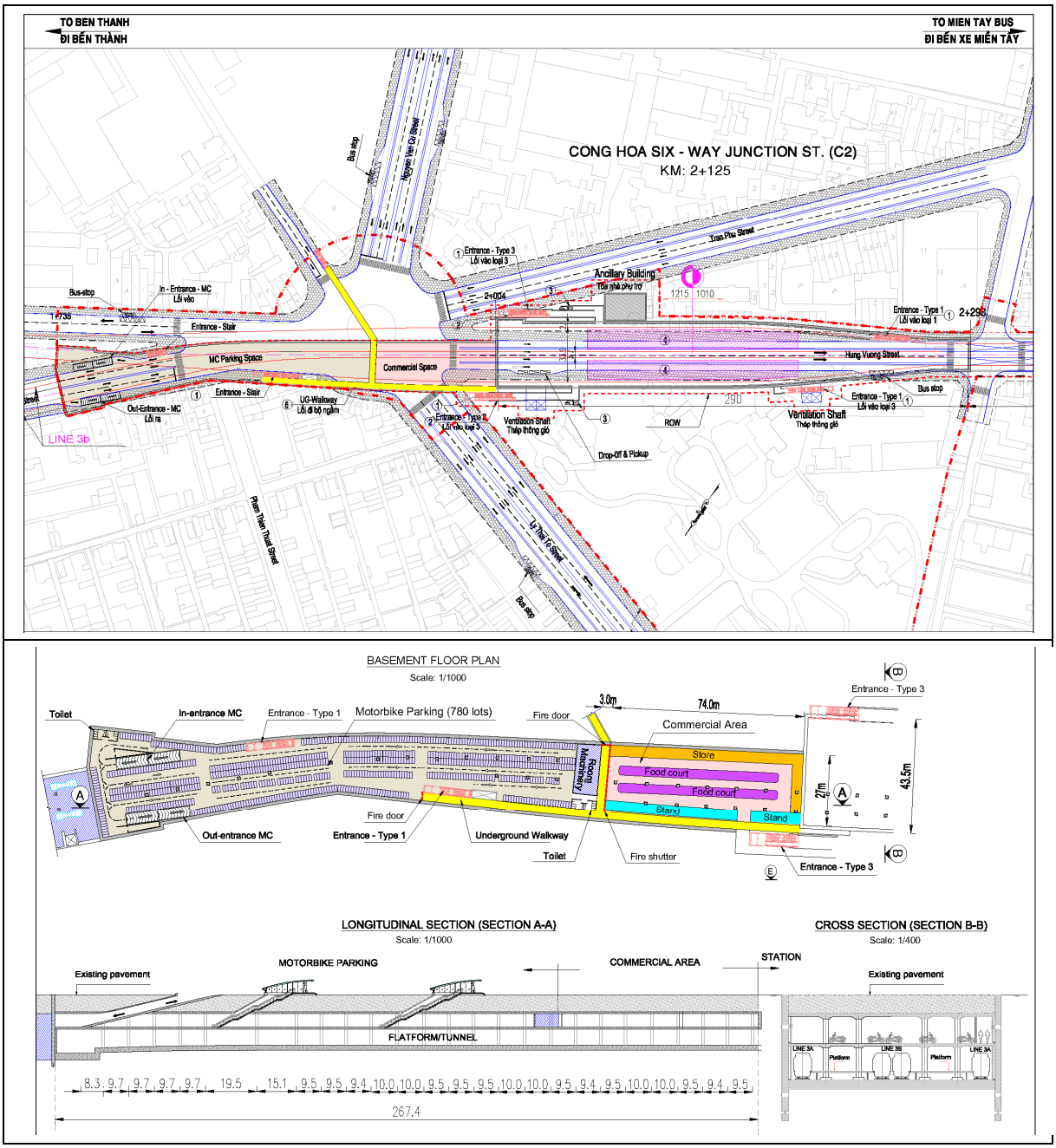


Figure 15 Layout Plan of Underground Parking and Commercial Facilities of Cong Hoa Station

Table 17 Cost Estimate of Underground Parking and Commercial Facilities of Cong Hoa Station

Underground Facilities	Motorbike parking (780 vehicles)	19.6mil. VND/m^2×9.6mil2×9.floor
	Commercial facilities	19.6mil. VND/m^2×9.635m^2×9.floor
	Underground walkway (along commercial facilities)	19.6mil. VND/m^2×9.6m^2
	Underground walkway (expansion to south)	19.6mil. VND/m^2×9.6m^2
Ground Facilities	Bus bay (2 locations)	533mil. VNDloclocations
	Drop off& Pickup space (1 location)	13mil. VND/m^2×3mi2
Total Cost	Construction Cost	17.34 bil. VND
	Total Cost (construction cost, overhead, tax)	21.98 bil. VND (app. 10 mil. USD)

Source: JICA Study Team

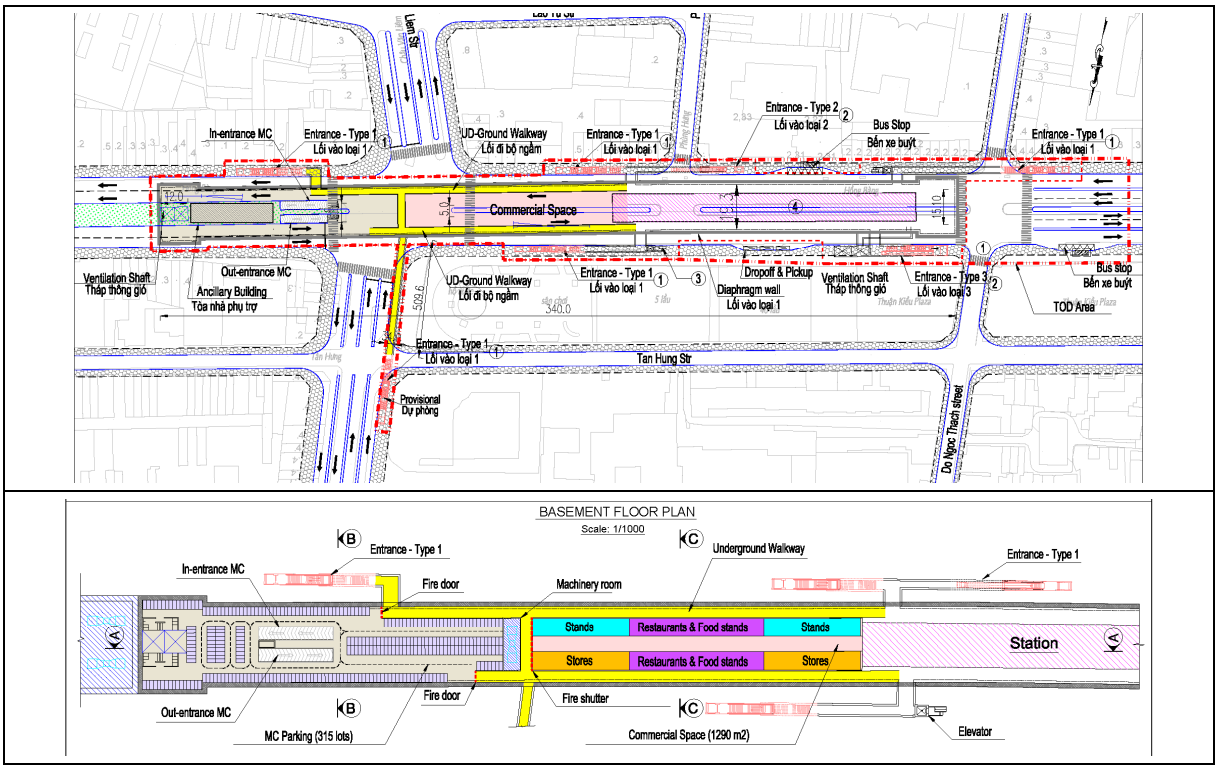


Figure 16 Layout Plan of Underground Parking and Commercial Facilities of Tan Kieu Station

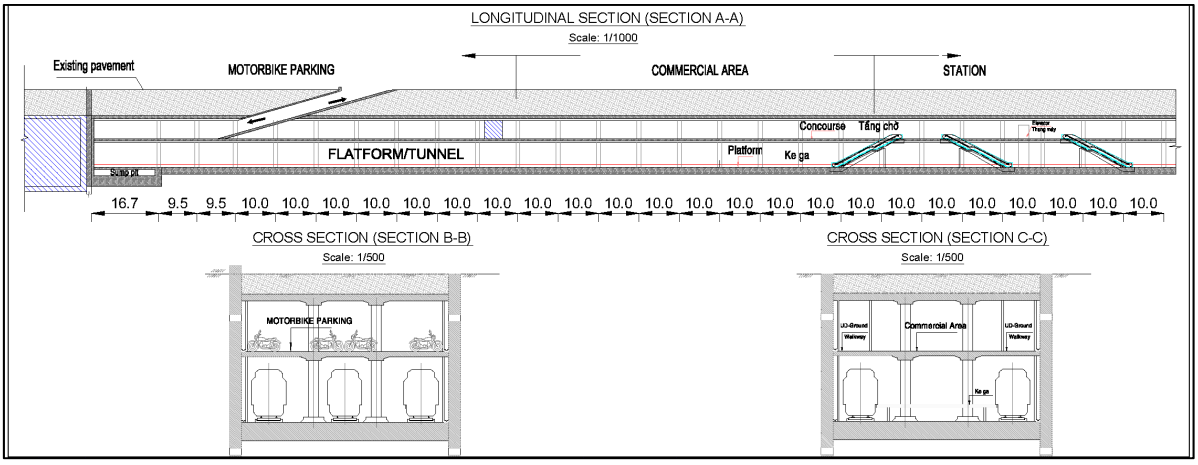


Figure 17 Section Plan of Underground Parking & Commercial Facilities of Tan Kieu Station

Table 18 Cost Estimate of Underground Parking and Commercial Facilities of Tan Kieu Station

Underground Facilities	Motorbike parking (315 vehicles)	19.6mil. VND/m^2×9,000m^2×9,floor
	Commercial facilities	19.6mil. VND/m^2×9,380m^2×9,floor
	Underground walkway (along commercial facilities)	19.6mil. VND/m^2×935m^2
	Underground walkway (expansion to north)	19.6mil. VND/m^2×973m^2
Ground Facilities	Bus bay (2 locations)	533mil. VNDloclocations
	Drop off& Pickup space (1 location)	13mil. VND/m^2×3mi2
Total Cost	Construction Cost	10.75 bil. VND
	Total Cost (construction cost, overhead, tax)	13.61 bil. VND (app. 6 mil. USD)

Source: JICA Study Team

13. PROJECT IMPLEMENTATION PLAN

13.1 Construction Plan

- The top down method is recommended for the station construction and the bottom up method is suggested for the cut & cover tunnel.
- The shallow excavation work for station entrance, ventilation duct and ancillary building is carried out using temporary sheet piles with propping.
- Propping with pre-loading method and sheet piles using hydraulic method, which are widely adopted in Japan, are suggested.
- There is an existing flyover (continuous steel box girder bridge) at the future construction site for Cay Go Station (C7). The flyover will be removed and then reconstructed after C7 construction instead of maintaining it, taking workability of construction and total cost into consideration.

Figure 18 Cay Go Flyover

- Earth Pressure Balance Shield (EPBS) and Slurry Shield types are recommended in this project considering high groundwater (GL-1.2 to -7.0m), accumulation of soft clay and silty sand. The Contractor will decide which machine to be applied in this project, taking into account soil conditions and construction methods.
- The main viaduct is a simple PC-U girder bridge having a 35m span, but a continuous PC box girder bridge having a maximum span of 70m will be constructed on the rotary for Hau Giang Street and An Duong Vuong Street.
- Superstructure work is carried out firstly, precast post-tensioned girder which was fabricated in the precast yard is transported to the site and then it is installed in the designed position. The PC-U segment girder is installed by steel double truss gantry, steel box girder gantry, self-propelled gantry and so on.
- The continuous PC box girder bridge, which will be constructed on the rotary for Hau Giang Street and An Duong Vuong Street, should be constructed by balanced cantilever method.

13.2 Traffic Management and Safety Management

The traffic management plan is proposed as follows:

- Road closing is planned for C1, C2 and C3 station, but important intersections is always maintained during the construction.
- The traffic diversion is planned for C4, C5, C6 and C7 using temporary deck.
- The traffic diversion is planned for C9 and C10 station in the elevated section ensuring traffic road and construction section on the same road.

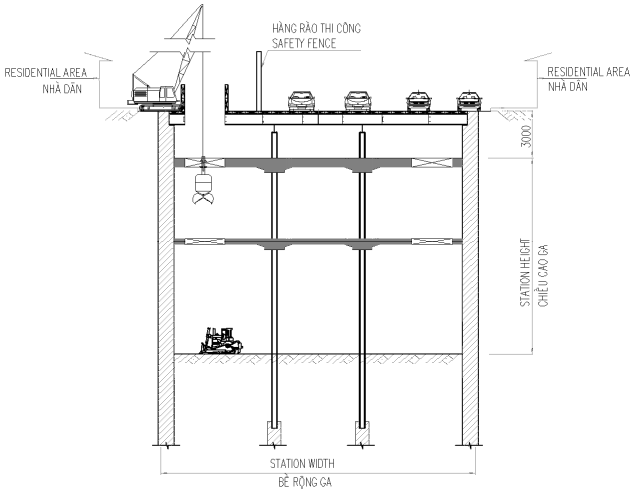


Figure 19 Traffic Diversion using Temporary Deck

With respect to the safety management, safety training for Line 3A by the Contractor needs to focus on three serious accidents, namely 1) falling accident, 2) construction machinery accident and 3) accident by flying and falling objects, and it should be held on a regular basis as duty. Safety management organization and system will be established in order to flow the information and communication properly using IT system. Also, the documents of “Safety manual” and “Safety Case Studies” issued by JICA and MOC of Vietnam in 2012, “The guidance for ODA construction work safety management” issued by JICA in 2014 will be included in bidding documents for the Contractor as reference to encourage compliance.

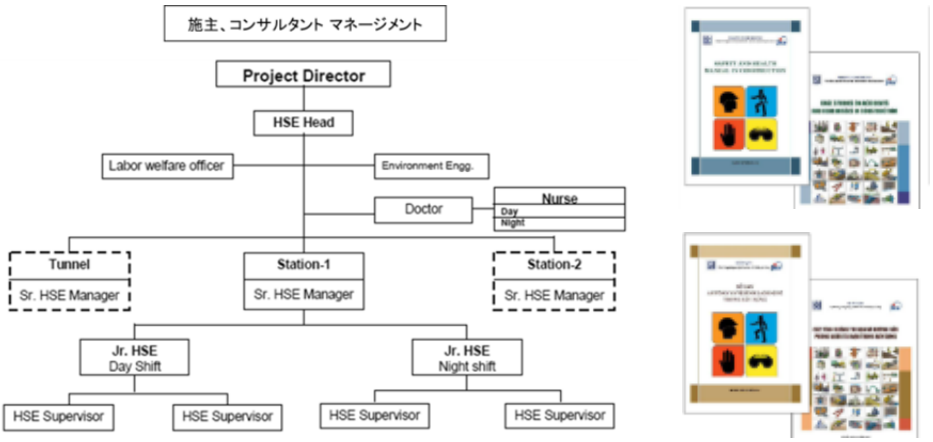


Figure 20 Contractor's Safety Organization and JICA Safety Manual

13.3 Contract Packaging

Non-Disclosure Information

13.4 Project Cost Estimate

Non-Disclosure Information

13.5 Project Implementation Schedule

The construction period for Line 3A phase 1, which is mainly underground civil works, ranges from 4.5 to 5 years.

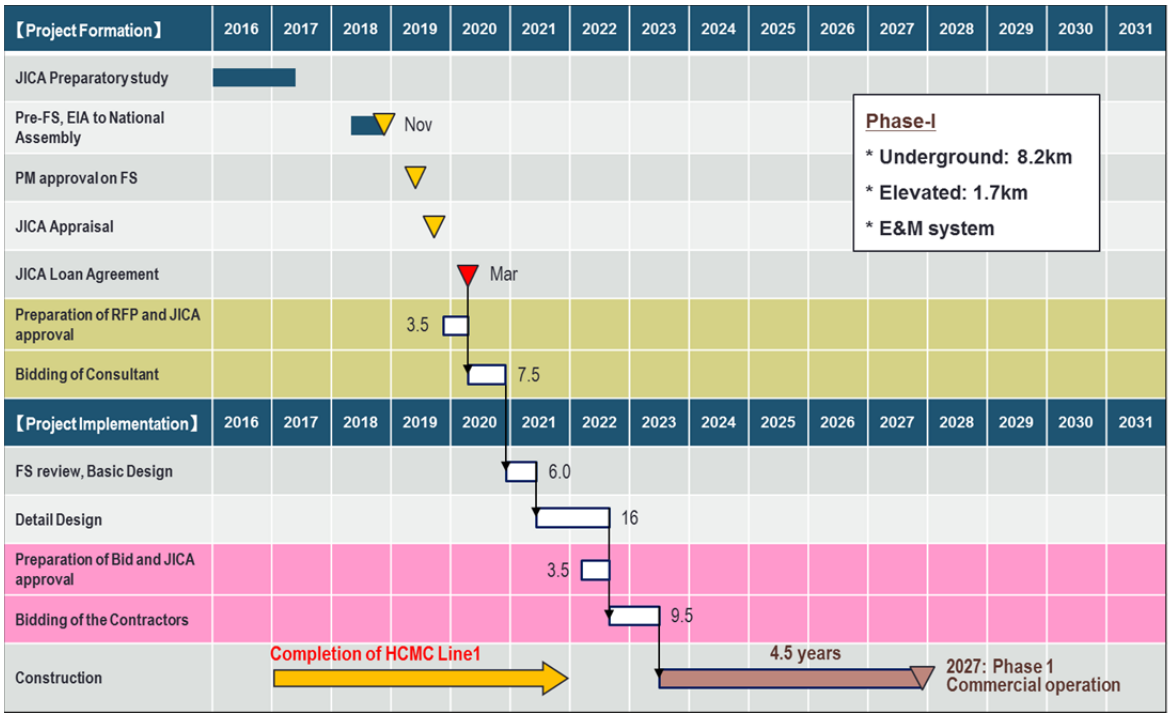


Figure 21 Project Implementation Schedule

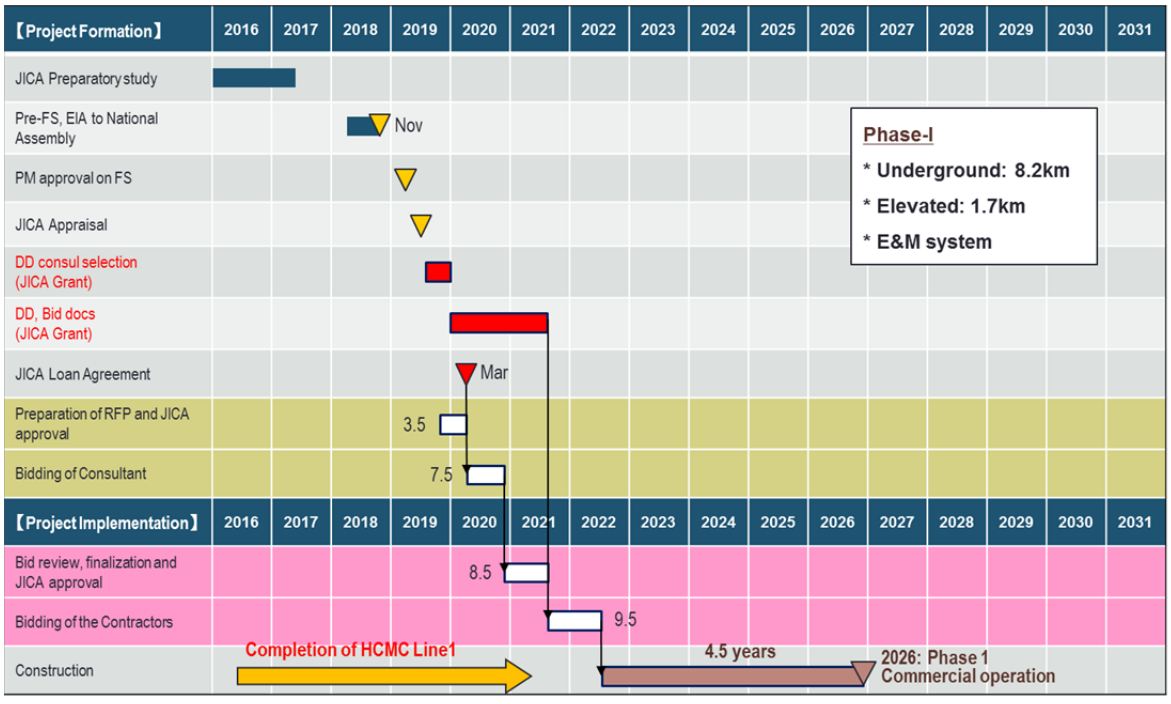


Figure 22 Project Implementation Schedule (Detailed Designs by JICA Grant)

13.6 Consulting Service

Scope of works of consulting services for the project is outlined as follows. The same is planned based on the assumption that the basic and the detailed design, a 4.5 year supervision and a two year maintenance support are carried out by the General Consultant (GC).

- Revising feasibility study and basic design of the project; Additional surveys and investigations; Supplement and improving the basic design; Calculation of the Total Investment Cost; Prepare implementation plan and tendering plan of the project; Setting up "Regulations and Technical Specifications"
- Prepare documents / pre-qualification documents / bidding documents for the underground civil works package
- Prepare technical design, cost estimates and prepare documents / pre-qualification documents / bidding documents for elevated civil works
- Prepare documents / pre-qualification documents / bidding documents for suppling and installing E&M system, rolling stock and two years maintenance package
- Assist the client in selection of contractors and suppliers
- Review and verify the technical design of underground civil package; review and verify the technical design of supplying and installing E&M system, rolling stock and two years maintenance package
- Supervision for construction, supply and installation equipment
- Commissioning and trial runs
- Environmental and social considerations and implementations
- Conducting HIV/AIDS prevention programme
- Preparation of manuals for construction, administration, operation and maintenance
- Organize public relation campaign
- Human resource training programme for the client, formulating training plan for operation unit of project
- Guide and assist the client in first two-year operation and maintenance stage
- Prepare safety documents and system safety plan, assist the client and competent authorities in submission for granting the system safety certificate
- Risk management relevant to the project

Consulting Service

Non-Disclosure Information

13.7 Use of Japanese Products

Non-Disclosure Information

14. PROJECT IMPLEMENTATION STRUCTURE

MAUR will be responsible for project implementation and official coordination with line departments, HCMC-PC and JICA as the implementing agency. Project management will be jointly carried out by MAUR and the consultant hired by MAUR. MAUR will be under the supervision of the Project Steering Committee with the leadership of HCMC-PC as the chairman. Day-to-day coordination with districts and community stakeholders will be handled by MAUR.

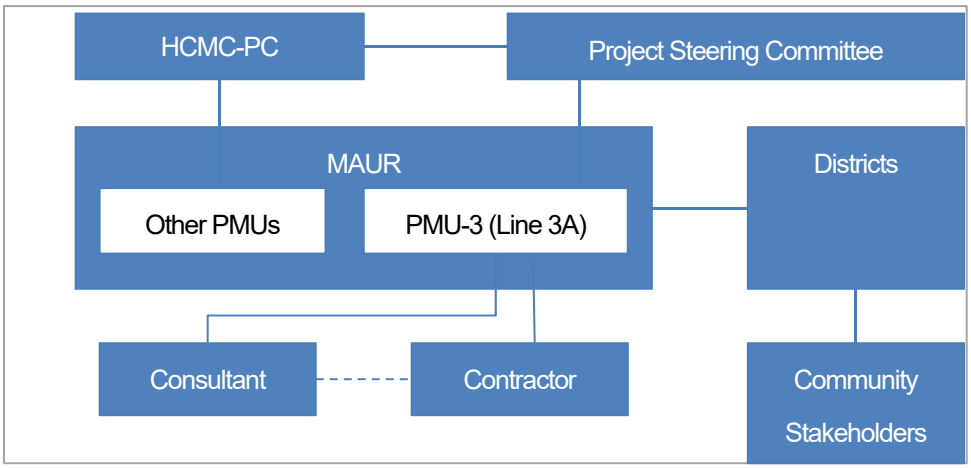


Figure 23 Project Implementation Structure

MAUR will act as the implementing agency of the Project and establish PMU within MAUR for management of the Project. Creation of PMU for ODA projects requires following steps in accordance with the relevant decision of the Prime Minister (131/2006/ND-CP).

- MPI issues a notification about organization structure, functions, and responsibilities of the PMU
- MAUR issues a decision to create PMU after approval of relevant documents by MPI and MOT.
- MAUR hires consultants to manage the Project in compliance with the relevant laws.

MAUR is increasing technical and construction / procurement supervision capacity through on-the-job training by way of Line 1, Line 2 and Line 5 projects implementation. Also, MAUR deepens understandings of urban railway systems through various studies and technical assistance programs under JICA and ADB. Furthermore, majority of MAUR personnel experienced or start experiencing JICA ODA loans and ADB co-financing schemes through Line 1, Line 2 and Line 5 projects. Therefore, MAUR is expected to formulate and implement the Project in smooth and efficient manner.

Creation of the O&M Company under MAUR was decided in December 2015 as the result of past studies below. Preparatory works for opening to public are being handled by the preparation unit within MAUR. In this study, a manpower profile of Line 3A Phase 1 was estimated as 201 persons. With regard to the capacity building on operation and maintenance, JICA already provided technical assistance for establishment of the O&M Company and maintenance management. The assistance will be extended till the start of commercial operation. Therefore, MAUR will equip operational readiness at the time of implementing the Project.

Table 19 Manpower Profile for Integrated Operation across Line 1 and Line 3A

	Line 1	Line 3A Phase 1	Line 3A Phase 2
Route Length (km)	19.7	9.7	19.0
Number of Stations	14	10	17
Headquarter	102		
Total	102		
Operation Division	Division 1	Division 3A-1	Division 3A-2
Director	1	1	1
Drivers	56	35	85
Station staffs	156	111	189
Sub Total	**213**	**147**	**275**
Maintenance Division	Division 1	Division 3A-1	Division 3A-2
Director	1	1	1
Rolling stock maintenance staffs	15	19	41
Track maintenance staffs	15	6	13
Signal/Electric maintenance staffs	35	17	35
AFC maintenance staffs	15	11	18
Sub Total	**79**	**54**	**108**
Total (O&M Division)	**292**	**201**	**383**

Source: Study team

Although the O&M Company faces deficit at the beginning stage, it is expected to turn a single-year profit in 2042. The operating cash flow shows negative during the first five years, and turns positive enough to cover O&M cost and E&M asset replacement fee in 2031 or 6th year. In 2048, cumulative cash flow becomes positive enough to cover its repayment obligation on the initial E&M assets.

15. ENVIRONMENTAL & SOCIAL CONSIDERATIONS

In the course of this study, 2 Stakeholder Meetings were carried out at the time of scoping and DF/R. Along with the results of environmental and social surveys and the stakeholder meetings, reports on Environmental Impact Assessment (EIA) and Resettlement Action Plan (RAP) were prepared.

Particular concern with regard to environmental protection for the project is tree cutting. Result of the survey on affected trees is shown in the following table. As mitigation measures, replantation of all

street trees to the depot site is proposed. For this purpose, program for street trees preservation will be prepared during the design stage of the project.

Table 20 Number of Trees Affected by the Project

No.	Species	Classification				Total
		Newly planted	L1 (h ≤ 10m)	L2 (10m<h≤15m)	L3 (h>15m)	
1	*Peltophorum pterocarpum*		103	7		110
2	*Erythrophleum fordii*		2			2
3	*Dipterocarpus alatus*	2	3	16	88	109
4	*Mimusops elengi*		57			57
5	*Casuarina equisetifolia*		3	1		4
6	*Khaya senegalensis*		2			2
7	*Lagerstroemia floribunda*	171	5			176
8	*Terminalia catappa*		4			4
9	Areca catechu		1			1
10	Plumeria		26			26
11	*Tamarindus indica*	52	75	1		128
12	*Tectona grandis*	4		10		14
13	*Berrya cordifolia*	2				2
14	Cassia		7			7
Total		**231**	**288**	**35**	**88**	**642**

Source: Baseline Survey by the Study Team

Figure 24 Trees along the Corridor (Left: Thai Binh (C1), Right: Cong Hoa (C2))

In terms of social impact, 449 households (2,435 persons), 35 enterprises and 20 government agencies will be affected by the Project. Out of these, 17 households and 1 enterprise will require physical relocation.

Table 21 Number of Affected Households and Persons

No.	Station	District	Ward	Physically Relocated		Partially Affected	
				Household	Person	Household	Person
1	C1	1	Phạm Ngũ Lão	0	0	42	227
2	C2	3	2	2	8	12	61
3	C2	5	4	3	16	73	389
4	C3		9	0	0	55	301
5	C4-5		11	0	0	8	45
6	C4-5		12	0	0	0	0
7	C5-6		14	0	0	81	441
8	C6		15	0	0	35	188
9	C6	6	2	0	0	9	47
10	C7		6	0	0	15	80
11	C8-9		12	3	15	22	119
12	C8		13	1	4	5	25
13	C8		14	0	0	0	0
14	C2	10	1	3	14	43	255
15	C6-7	11	16	5	26	32	174
Total				**17**	**83**	**432**	**2,352**

Source: RAP Report

According to the Inventory of Loss (IOL) Survey, a total of 17 households and 1 enterprise will have remaining land area less than 15 m^2, and other 45 PAHs will count for those with remaining land area of 15 – 36 m^2.

Table 22 Number of Households and Enterprises that may Require Physical Relation

No.	District	Ward	Remaining land area is less than 15 m^2		Remaining land area is from 15 - 36 m^2	
			Households	Enterprise	Households	Enterprise
1	1	Phạm Ngũ Lão			1	
2	3	2	2		3	
3	5	4	3	1	19	
4		15			1	
5	6	2			1	
6		12	3		4	
7		13	1		1	
8	10	1	3		9	
9	11	16	5		6	
	TOTAL		**17**	**1**	**45**	**0**

Source: RAP Report

16. PROJECT APPROVAL PROCEDURE

- The procedure for project approval is specified in the Law on Public Investment (No. 49/2014/QH13), where public investments are categorized by budget and nature. According to this law, the Project is defined as the “National Important Project” (NIP). The pre-F/S of NIP

requires approval of Program/Project Investment Policy (PPIP) by the National Assembly after examination of the council, which is to be organized by the Prime Minister (PM).

- In addition to pre-F/S, it is understood certification of EIA provides necessary basis for approval of PPIP according to the Law on Protection of Environment and Natural Resources. Although "Decision on Application and Management of ODA Loan (No. 16/2016/ND-CP) rephrased to PPIP, this is, in fact, identical to the investment policy under the Law on Public Investment.
- Once PPIP approval is made, NIP shall obtain PPID by the PM. This approval will be made to the bunch of documents ("Van Kien") including F/S report to be prepared based on the already approved pre-F/S. The PM issues PPID upon acceptance of these documents.
- RAP shall be prepared and approved by Vietnamese side at early stage of project preparation and disclose at donor's website, albeit this is defined nowhere in the legal framework in Vietnam.

Premises for the project formulation schedule are as follows:

- The Project will obtain investment policy approval by the National Assembly in Nov.– Dec. 2018.
- At least 90 days will be required to obtain investment policy (pre-F/S) approval by HCMC-PC.
- At least 95 days will be required to obtain investment policy (pre-F/S) approval by the Central Government as prescribed in the relevant decree.
- Applications to the Regulatory Body of the National Assembly shall be made at least 60 days before the opening day of the National Assembly.
- EIA shall be approved by MONRE prior to the above application to the National Assembly.

The time-bound action plan toward investment policy approval is proposed as follows:

Table 23 Action Plan toward Investment Policy Approval

No.	Document	Procedure	Responsibility	Due
1	Project Proposal	Approval of PP by PM	MPI	Immediate
2	Pre-F/S	Submission of Pre-F/S to Central Gov't / PM	HCMC-PC	Feb. 2018
		Submission of Pre-F/S to National Assembly	MPI	Jun. 2018
		Approval by National Assembly (investment policy approval)	National Assembly	Nov. – Dec. 2018
3	Resettlement Action Plan (RAP)	Submission of RAP to HCMC-PC	MAUR	Feb. 2018
		Approval of RAP by HCMC-PC	HCMC-PC	Jun. 2018
4	Environmental Impact Assessment (EIA)	Submission of EIA to MONRE	MAUR	Feb. 2018
		Approval of EIA by MONRE	MONRE	Jun. 2018

Source: Study team

17. GENDER CONCERNS AND PROTECTION OF DISADVANTAGED

With respect to gender concerns and protection of disadvantaged, the Gender Action Plan (GAP), Action plan for labour protection, poverty reduction and anti-infection, and Universal Design Action

Plan (UDAP) proposed by this study shall be embodied in the project designs and monitoring frameworks.

Table 24 Action Plan on Gender Concerns and Protection of Disadvantaged

Action Plan	Outline
Gender Action Plan (GAP)	• Set women employment target and applied labour standards with provisions of gender mainstreaming • Perform facility and equipment designs incorporating the needs of women • Set capacity building target in relation to participation of women and gender mainstreaming • Comply with gender equality in resettlement, develop anti-trafficking programs, and develop HIV/AIDS prevention programs
Action plan for labour protection, poverty reduction and anti-infection	• Specify the requirements of labour protection and anti-infection in the construction contract • Ensure compensation for poverty groups and income recovery measures during resettlement • Contractors shall fully comply with the Labour Law and the Law on Industrial Health and Safety during construction works. • Contractors shall perform HIV/AIDS prevention programs during construction works • Conduct enlightening activities and capacity building programs on labour protection, poverty reduction and anti-infection
Universal Design Action Plan (UDAP)	• Develop design standard manuals by enhancing the employer's requirement of Line 1 (at the beginning of designs) • Design facilities and equipment, complying with universal design standards • Conduct design reviews and feedbacks by relevant agencies / organizations and DPOs • Setup target benchmark for capacity building on universal designs • Conduct test walks and feedbacks prior to the commencement of commercial operation • Develop and enhance design standard manuals and action manuals for the O&M company • Prepare and distribute universal design handbook for users • Develop quality control program on service for people with disabilities

Source: Study team

18. CLIMATE CHANGE MITIGATION

The annual Green House Gas (GHG) emission reduction by the project is increased from 6,606 ton in the opening year to approximately triple at 20,185 ton in 2050 due to the increase in the number of annual passengers and the average distance travelled by a passenger. The total reduction by the Project for 25 years till 2050 is 388,671 ton, giving an annual average of 15,547 ton.

19. PROJECT EVALUATION

The EIRR and FIRR of the project indicates 9.65% and 7.27%, respectively. The financial internal rate of return is a relatively low number in this project since the underground section is the majority. However, this project is an economic infrastructure development with a high public nature, and it is necessary to judge the projectability together with the economic internal rate of return.

Table 25 Economic Analysis

Non-Disclosure Information

Table 26 Financial Analysis

Non-Disclosure Information

The proposed Operation and Effect Indicators include availability ratio, mileage, number of trains per day, ridership, and reduction in journey time. For each of quantitative indicator, the target value for the target year targeted at 2 years after completion, along with the reference value is set.

Table 27 Operation and Effect Benchmark

Indicator	Base line (2016)	Target Value (2029) 2years after completion
Availability Ratio (%)	N/A	93%
Number of Trains (#/day)	N/A	485
Mileage (km/day)	N/A	23,422
Ridership (pax./day)	N/A	307,000
Journey Time (Ben Thanh – Mien Tay Terminal) (mins.)	32	19
Journey Time (Suoi Tien – Mien Tay Terminal) (mins.)	83	49

Source: Study team

Qualitative effects include i) traffic alleviation, improvement of traffic conditions, relief of traffic pollution, ii) reduction in GHG emissions, mitigation of climate change, improvement of living environment by reducing air pollution and noise, iii) improvement of convenience by more efficient and punctual railway transportation in the area, iv) improvement of the city's investment climate, promotion of redevelopment along the corridor, development of peripheral regional economy, v) generation of employment opportunities (including promotion of gender equality), etc.

20. RISK MANAGEMENT

The Study Team summarized the points to note in the project implantation and prepared the Risk Control Sheet using the JICA format. The project stakeholders shall carefully manage the risks by use of this sheet throughout the project, beginning with project appraisal, during implementation and preparation for commercial operation, and at the operation stage. Once the Loan Agreement is reached, MAUR and consultants will be required to periodically update the sheet, share the observed potential risks with JICA as the donor agency, and take appropriate actions to manage the risks.

21. CAPACITY BUILDING AND TECHNICAL ASSISTANCE

At the time of implantation of the Project, ranges of capacity building and technical assistance for the Line 1 project had already completed. Therefore, programs for the Project should focus on the activities to enhance values of urban railway service and associated area development along the corridor, encompassing 3 pillars, namely "Establishment of integrated management structure for urban

railway network", "Enhancement of the functions of station areas", and "Improvement of urban railway services".

Table 28 Proposed Capacity Building and Technical Assistance Programs

	item	Content
Capacity Building	Capacity Building for O&M Personnel	• Enhance passenger service capacity of station operation personnel • Build train control and inter-operation capacity of OCC controllers • Build train inter-operation / driving capacity of train drivers • Build general overhaul capacity of rolling stock personnel
	Capacity Building for Regulatory Personnel	• Assist institutional designs of regulatory and supervisory systems • Conduct case studies for regulatory and supervisory personnel • Pay particular focuses on fare adjustment, safety management, and system certification
	Capacity Building for Urban Planning and Redevelopment Personnel	• Joint works by forming Joint Coordination Committee (JCC) and taskforces (on institutional framework and urban development institutions) • Provide technical assistance, verification, and monitoring of urban planning and redevelopment implementation along with the Project • Hold seminars, workshops and study tours
Technical Assistance	System Integration and Operation Assistance	• Develop common ticketing system and operation guidelines • Develop integrated operation control center and operation guidelines • Develop integrated maintenance system and maintenance guidelines
	Station Area and ITF Development Assistance	• Assist preparation of concept designs at each station and development plans of public facilities including station plaza • Form an advisory group consisting of Japanese railway operators and developers to jointly work on concept designs • Ensure consistent and coherent assistance, ranging from basic designs, cost estimate, bid documentation, to implementation
	Universal Design Introduction Assistance	• Develop design standard manuals by enhancing the employer's requirement of Line 1 (at the beginning of designs) • Design facilities and equipment, complying with universal design standards • Conduct design reviews and feedbacks by relevant agencies / organizations and DPOs • Setup target benchmark for capacity building on universal designs • Conduct test walks and feedbacks prior to the commencement of commercial operation • Develop and enhance design standard manuals and action manuals for the O&M company • Prepare and distribute universal design handbook for users • Develop quality control program on service for people with disabilities

Source: Study team

22. WAY FORWARD

The expected project schedule after this report is as follows:

- Submission of documents for PPIP from HCHC-PC to the Central Government Feb. 2018
- Approval of PPIP Nov. 2018
- JICA Fact Finding Mission Aug. 2019
- JICA Appraisal Mission Oct. 2019
- ODA Loan Agreement Mar. 2020
- Approval of PPID During D/D