CHAPTER 6 URBAN DEVELOPMENT PLANS AT RAILWAY STATIONS AND SURROUNDING AREAS

6.1 Development Objectives for Railway Stations and Surrounding Areas

6.1.1 Planning Direction for Development

Development of railway stations and their surrounding areas is considered as one of the triggers for vitalizing urbanization along the Western Development Corridor and consolidating the existing built-up areas. Railway stations and surrounding areas will be focal areas, where different transportation modes interlink, including the railway, buses, taxis and private cars, and cater for a large number of passengers. Commercial facilities, such as a general merchandise stores and various retail shops, will be located at railway stations and in surrounding areas. The availability of convenient services will attract local residents for shopping, so logistic activities will be based around the station area. Hence, the urban development plan for stations and the surrounding areas will form an important component of the change mechanism that will vitalize urbanization and accelerate the population shift from the main agglomeration into the new development corridor.

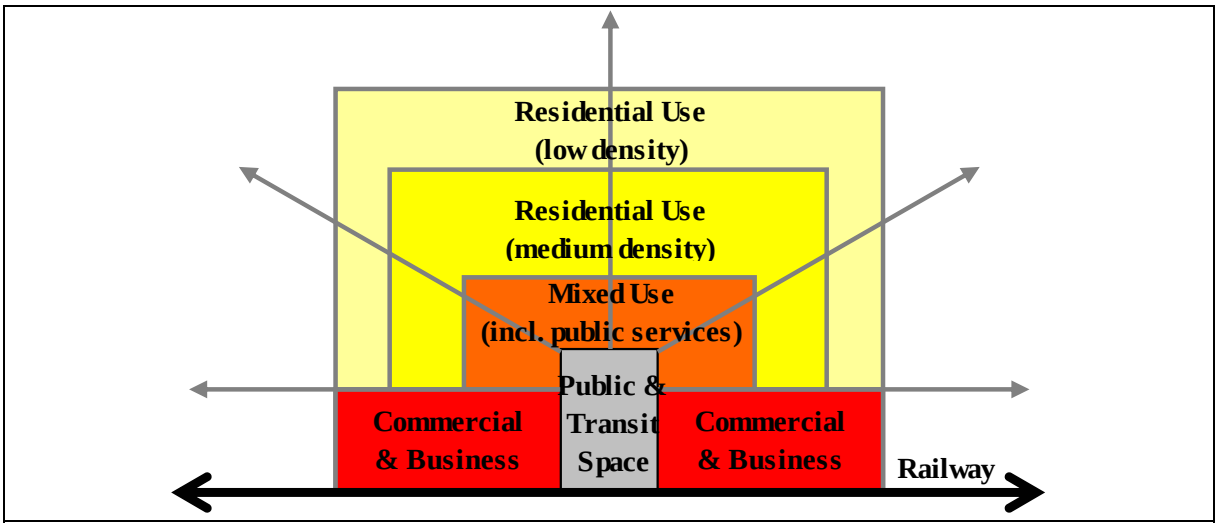
This sub-section focuses on the preparation of urban development plans for station squares and their surrounding areas. Station squares are defined as the central development area of the railway station, including the station platforms and associated railway facilities, as well as the commercial and residential buildings within and adjacent to the station building. Station squares will only be developed at the central station (No. 22) and the terminal station (No.24).

The outputs of the urban development plan comprise physical land use plans, technical regulations such as the building coverage ratio and total floor ratio, and a preliminary cost estimate for developing the station squares and their surrounding areas. The physical land use plans for station squares were designed to meet the following planning criteria:

- To provide facilities for efficient and effective interlinking of different transportation modes; and
- To introduce functions which create a focal point for the surrounding urban areas.

Since the station areas will form a natural focal point where a large number of passengers and residents will gather to use public transport, the land use plans for station areas and their vicinity must allow for development of large scale buildings capable of accommodating various activities for commercial, business, and services in order to create a transport-oriented

center. Figure 6.1.1 shows a generalized conceptual land use plan for transport-oriented development at a typical station.

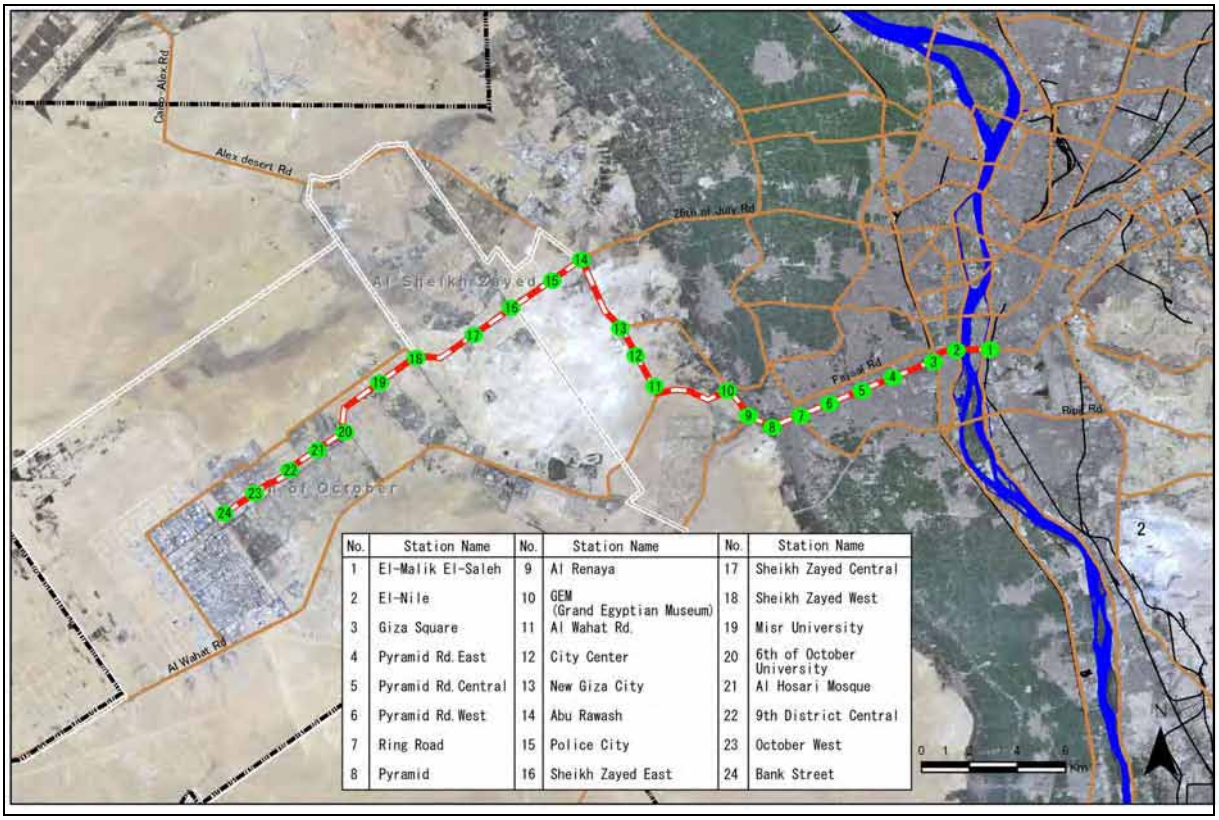


Source: JICA Study Team

Figure 6.1.1 Conceptual Land Use Plan for Transport-oriented Development at a Typical Station

6.1.2 Characteristics of Stations and their Vicinities

There will be the twenty four (24) railway stations along the Western Development Corridor, as shown in Figure 6.1.2.



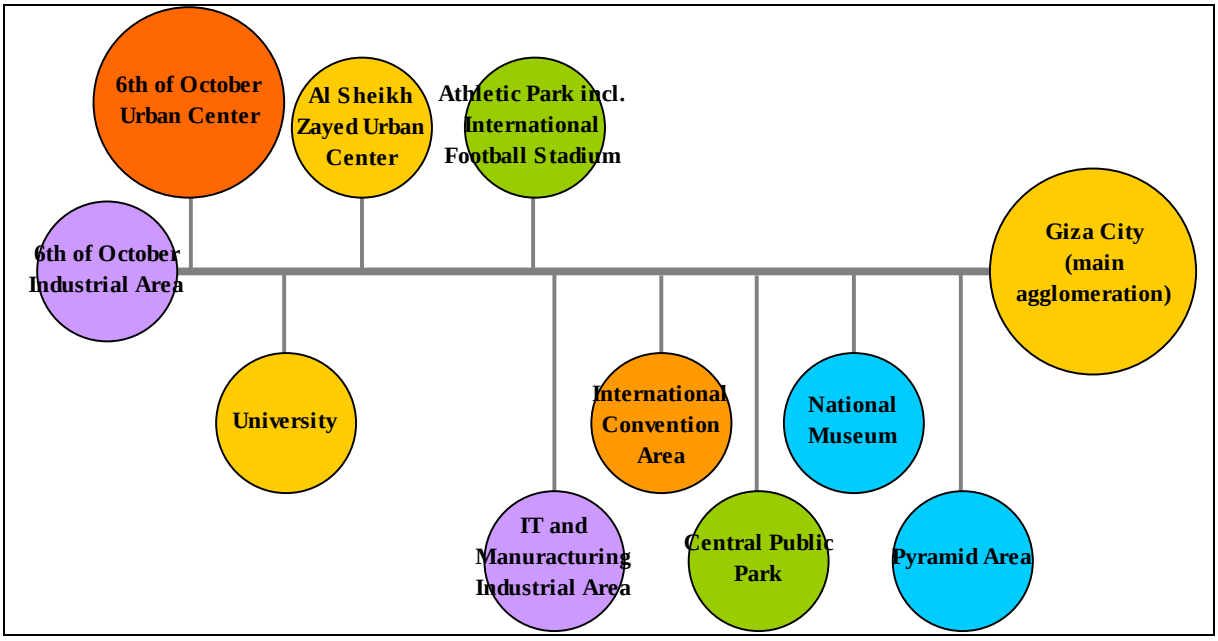
No.	Station Name	No.	Station Name	No.	Station Name
1	El-Malik El-Saleh	9	Al Renaya	17	Sheikh Zayed Central
2	El-Nile	10	GEM (Grand Egyptian Museum)	18	Sheikh Zayed West
3	Giza Square	11	Al Wahat Rd.	19	Misr University
4	Pyramid Rd. East	12	City Center	20	6th of October University
5	Pyramid Rd. Central	13	New Giza City	21	Al Hosari Mosque
6	Pyramid Rd. West	14	Abu Rawash	22	9th District Central
7	Ring Road	15	Police City	23	October West
8	Pyramid	16	Sheikh Zayed East	24	Bank Street

Source: JICA Study Team

Figure 6.1.2 Distribution of Railway Stations along the Western Development Corridor

The railway for the Western Development Corridor will interlink the various urban centers, including the CBD of the main agglomeration, urban centers of NUCs, industrial areas, public parks, a new national museum (Greater Egyptian Museum), and a new international convention center, and various other facilities, as depicted in Figure 6.1.3.

A new football stadium[1] is likely to be included in the public park development and the Western Development Corridor has good potential for development of a new convention center[2].



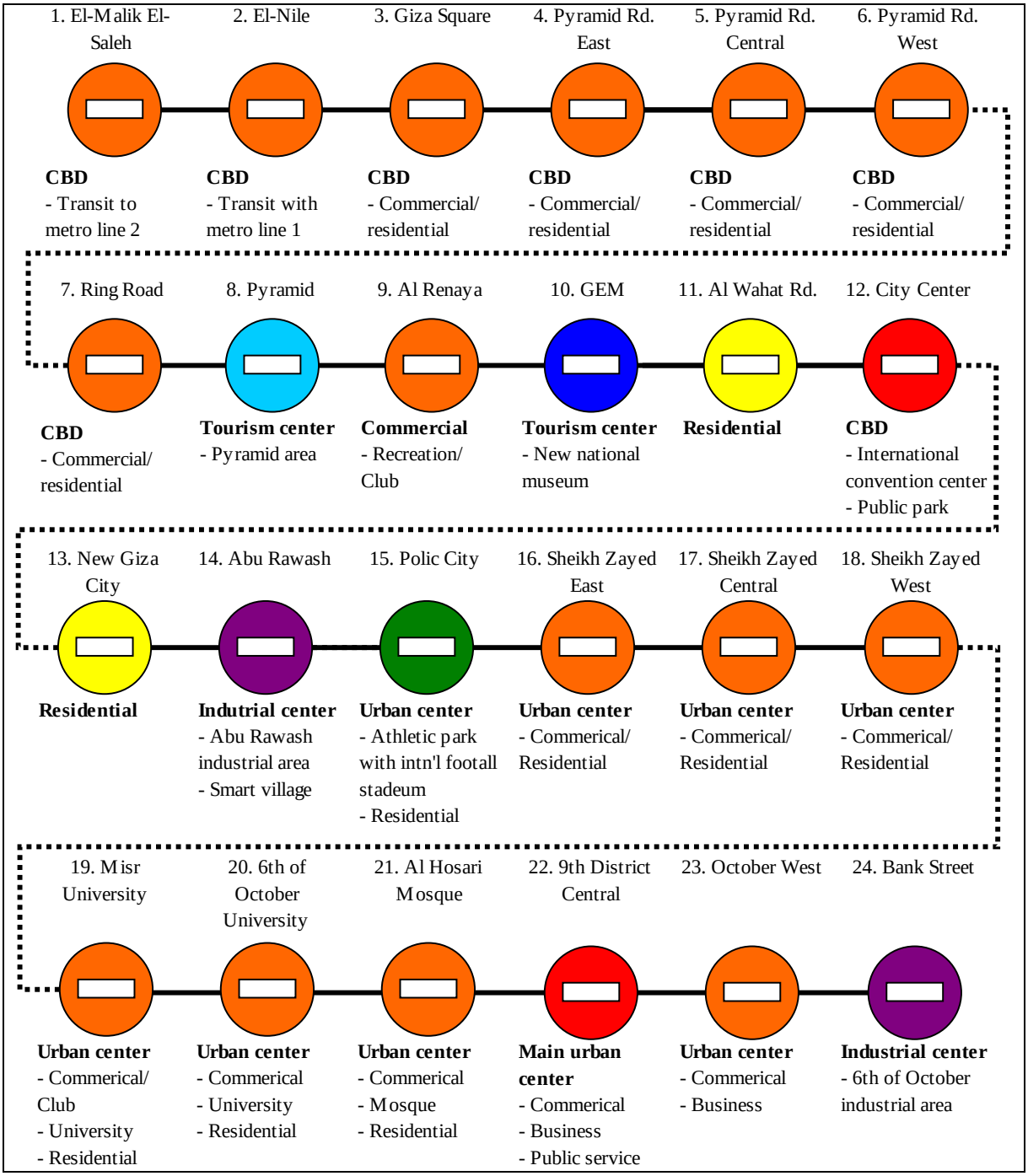
Source: JICA Study Team

Figure 6.1.3 Main Activities along the Railway

The function and typical land use of each station are shown in Figure 6.1.4.

[1] Football is a beloved sport for the citizens of Egypt and in the study area. The Egyptian professional football league consists of 16 clubs, of which seven clubs are based in the Greater Cairo Region. The number of football stadiums is currently limited to three, comprising Cairo International Stadium, Military Academy Stadium, and Arab Contractor Stadium. While the clubs share this limited number of football stadiums, there is a large need to develop additional ones. The Ahly has reportedly prepared a plan to build a new stadium in Al Sheikh Zayed. As shown in the opinion poll survey in the master plan phase, the people in the study area need open space and green areas. The new stadium will need to be constructed in accordance with applicable international standards, particularly the technical recommendations and requirements for football stadiums issued by Federation Internationale de Football Association (FIFA). The technical requirements specifically affect international football events, such as the Confederation Cup and the World Cup. The new stadium will be integrated with public parks for the residents in the study area and visitors to the stadium. Coordination in this regard will be needed for consolidating individual plans.

[2] Cairo has hosted international conferences and conventions for various African nations. For example, Cairo hosted the United Nations International Conference on Population and Development in 1994, Conference of the African Union in 2006, and EU-African Business Summit in 2007. The city has an international convention center, named Cairo International Convention Center, in Nasr City. However, over the past few years, this facility has mainly been used for the domestic events. The summit for the Environment (International Workshop on Evaluating Climate Change and Development) will be held in Alexandria in 2008. Egypt has a large potential for hosting international events, since it has the well-prepared infrastructure, services, and attractions including tourism spots. These features are generally concentrated in Cairo and other major cities, such as Alexandria. Taking into account the relatively strong regional status and role of Egypt, Cairo, as the capital city of Egypt, needs to enhance its capability for hosting the international events and conferences.



Source: JICA Study Team

Figure 6.1.4 Characteristics of Stations and their Vicinities

6.1.3 Stations Selected for the Land Use Planning

The urban development plans in this study have been prepared for two different types of stations, namely a central station and ordinary stations. The single central station will constitute a new urban center, where commercial and business activities at the regional level will be concentrated. This central station is provisionally named 9th District Central Station (No. 22) and is to be located near the center of 6th of October NUC. The proposed site for the

central station is currently vacant and it does not have an existing physical plan. It is also located adjacent to the main commercial areas, which run in an east-west direction in the central part of 6th of October NUC.

Ordinary stations comprise other stations (No. 11 to No. 21 and No. 23). The ordinary stations will form cores for neighborhood areas adjoining each station. The urban development plans presented in the following sections are considered as planning guidelines. In the implementation phase for the Western Development Corridor, these urban development plans will be adjusted to suit the specific conditions at individual railway stations.

A terminal station (No. 24) at the end of the railway in the west of 6th of October NUC will need some additional space for transit between different transportation modes, and thus it will have a higher traffic load than at other ordinary stations. Hence, the terminal station will have a station square, similar to the one proposed for the central station, to ensure safe and effective transport management in and around the terminal area.

6.2 Urban Development Plan for the Central Station

6.2.1 Existing Conditions in the Area Proposed Site for the Central Station

The proposed site for the central station, including the station square and its surroundings, covers an area of 56 ha and is located in the central part of 6th of October NUC. The proposed site is designated for commercial areas in the existing land use plan prepared by NUCA. Areas adjacent to the proposed site to the south are designated as commercial areas, while the medium-density housing areas are planned in the east, west, and north sides of the proposed site, as depicted in Figure 6.2.1.

Source: JICA Study Team

Figure 6.2.1 Existing Land Use Plan of the Central Station Area and its Surroundings

At the proposed site, the existing land use plan does not specify road networks and infrastructure facilities, other than a secondary school, which is not yet developed. The site is still vacant land, and land compensation for urban development will not be required. The proposed site is surrounded by a primary road in the south and secondary roads in the east, west, and north.

Urbanization is progressing in areas to the east, west, and south of the proposed site. The road network is provided to some extent in the south, and connects to housing areas and a school.

Housing development is occurring to the east and west of the site, while the planned public facilities and primary schools in these areas are not yet developed. There are no existing facilities to the north.

Source: JICA Study Team (QuickBird Satellite Image © DigitalGlobe 2007)

Figure 6.2.2 Existing Facilities in the Central Station Area and its Surroundings

6.2.2 Direction of Development for the Central Station Area

The combined population in 6th of October NUC and Al Shiekh Zayed NUC has been estimated at 1.3 million for the target year of 2027, and will reach 3 million in the future. The central station area will be developed as a new urban center for 6th of October NUC, as well as a new sub-center in the overall study area. This new center will complement the business and commercial activities that are currently concentrated in the main agglomeration by providing public services for the people who live and work in 6th of October NUC. The new sub-center will accommodate different functions including business, commercial, service and residential functions to enhance the attractiveness of the area as the urban center. Medium and high-rise housing will be developed in the central station area to provide an integrated urban center.

6.2.3 Land Use Plan for the Central Station Area

(1) Road network plan

The existing network of primary and secondary roads will be utilized as access main roads to the central station area. On-site roads will follow the design principles that have been applied in 6th of October NUC, in which direct access from service roads to primary roads is restricted. With the aim of reducing surplus and through traffic, service roads in the central station area will be connected to the main service roads, which comprise one route each for the east-west and north-south directions. The main service roads will link to the secondary roads.

The road cross-section will consist of traffic lanes in both directions to allow passengers to board or alight from vehicles and for goods to be delivered or picked up. The road cross-section will include sidewalks to ensure the safety of pedestrians.

(2) Public facilities plan

The public facilities will consist of government branch offices, libraries, halls for public gatherings, hospitals, welfare facilities and religious facilities such as mosques, which will be essential for the residents living in the Western Development Corridor. In addition to these public facilities at the regional level, the central station area could accommodate educational facilities and parks will be developed in the surrounding neighborhoods. Public parks will have playing and rest areas for use by the residents and green areas for landscaping.

(3) Utility plan

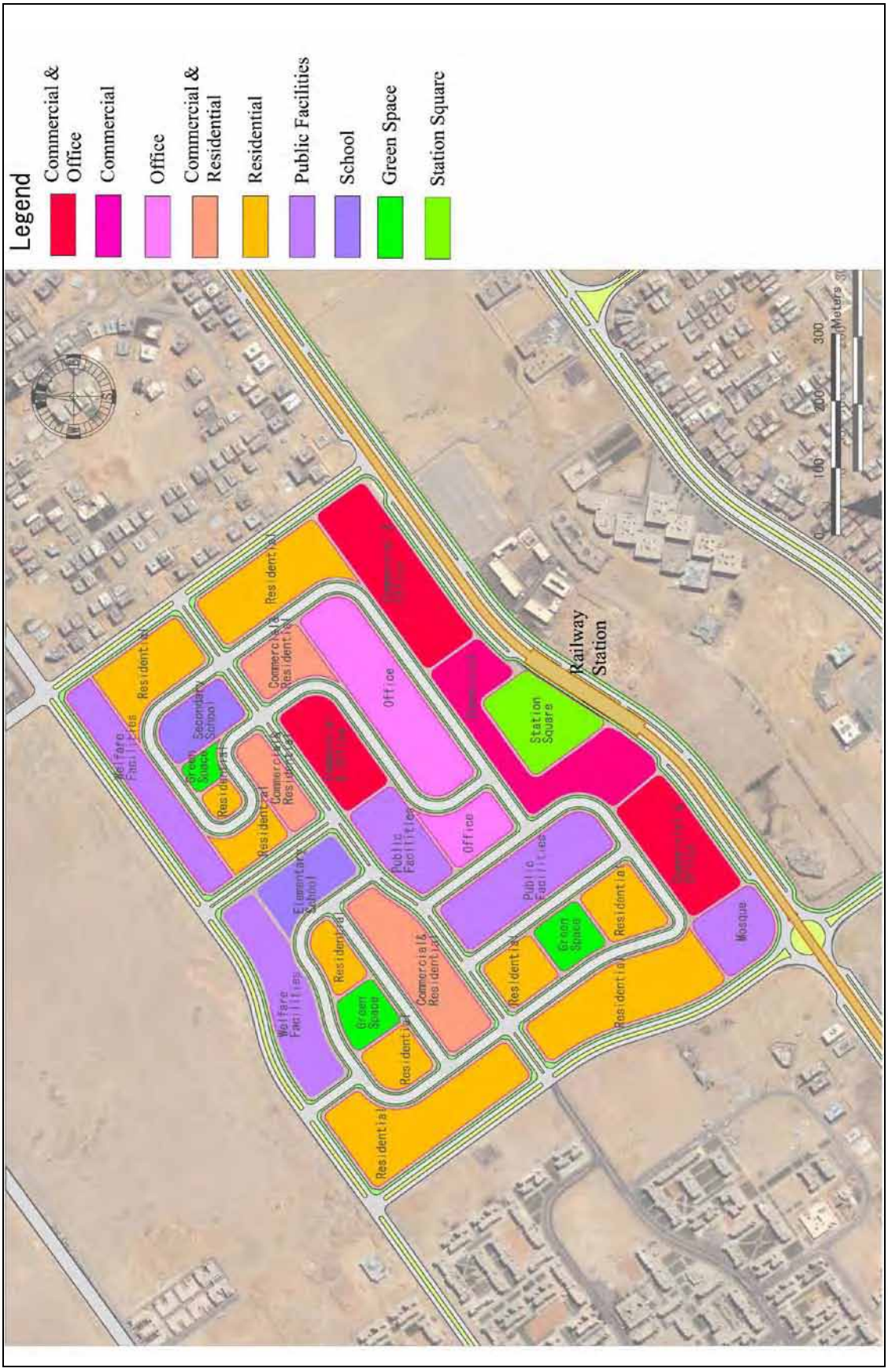
Utilities for water supply, wastewater, gas, electricity, and communications will be provided in the central station area. Pipelines for these utilities will be installed alongside the road network.

(4) Land use plan

The central station area will provide an ideal site for business headquarters and branches offices, services, commercial activities, and finance to create the new sub-center in the Western Development Corridor. These activities will tend to be located in areas that have easy access to and from the transportation systems. Therefore, the land areas allocated for these services and commercial activities are located alongside primary roads and at sites directly facing the station square.

Commercial outlets, such as restaurants and retail shops, will seek to locate along the main streets which will have a large number of people walking through. These commercial facilities are planned along the primary road and main service roads. In addition, medium height and high-rise housing units are planned on the periphery of the station square area.

By following the planning principles described above, the land use plan was formulated as depicted in Figure 6.2.3. The land area by land use category was estimated, as shown in Table 6.2.1.



Source: JICA Study Team and QuickBird Satellite Image © Digital Globe 2007

Figure 6.2.3 Land Use Plan of the Central Station Area

Table 6.2.1 Land Area by Land Use Category for the Central Station Area

Land Use Category			Land Area (m^2)	Share (%)
Land for Public Facilities	Road		103,500	18.5
	Station Square		13,000	2.3
	Park		18,000	3.2
	Sub-total		134,500	24.0
Land for Urban Development	Private-owned Land	Commercial	32,000	5.7
		Business	40,000	7.2
		Mixed Use (Commercial and Business)	63,000	11.3
		Mixed Use (Commercial and Housing)	41,000	7.3
		Housing	154,500	27.6
	Public-owned Land	Primary School	12,000	2.1
		Secondary School	12,000	2.1
		Other Public Facilities	71,000	12.7
	Sub-total		425,500	76.0
Total			560,000	100.0

Source: JICA Study Team

6.2.4 Development Plan for Buildings in the Central Station Area

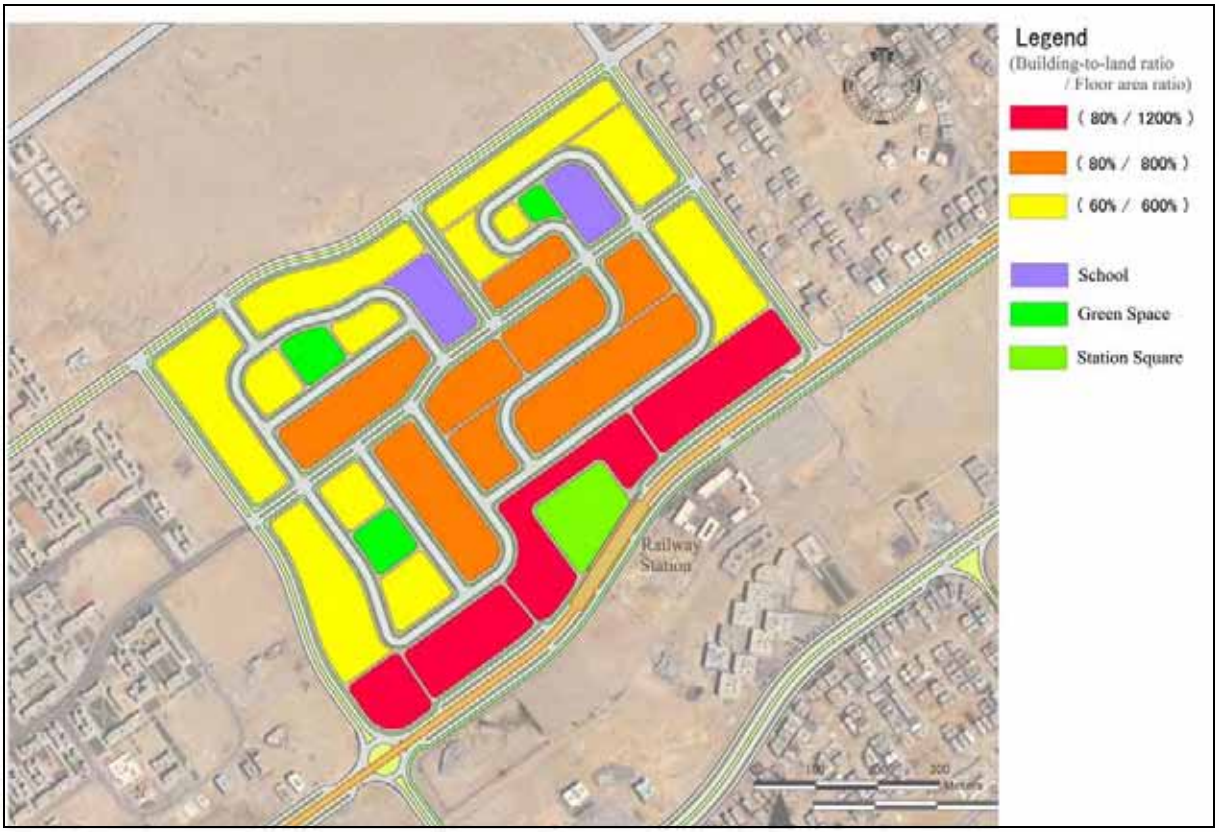
(1) Building coverage ratio and total floor area ratio

The building coverage ratio (BCR) and total floor area ratio (FAR) are the two major control parameters used for planning urban areas. These parameters were used for the central station area based, on the direction of development and the land use plan, as shown in Figure 6.2.4.

Areas around the station square will be the preferred location for commercial and business activities, so these areas will occupy a relatively large area of the development in the sub-center. The allowable capacity for these areas has been set at 80% for BCR and 1,200% for FAR. Buildings up to 15 stories high will be permissible in these areas.

Areas behind the station square are planned for public facilities, as well as commercial and office buildings. The allowable capacity in these areas has been set at 80% for BCR and 800% for FAR. These values are lower than the proposed ratios for areas around the station square. Buildings up to 10 stories high will be permissible in these areas.

Other areas are planned for residential use, and these need to provide amiable living conditions, including open space. Since these areas will be a part of the central station area and sub-center, the allowable capacity has been set at 60% for BCR and 600% for FAR. These levels are higher than the ratios used in other residential areas within 6th of October NUC. Buildings up to 10 stories high will be permissible in the residential areas.



Source: JICA Study Team and QuickBird Satellite Image © Digital Globe 2007

Figure 6.2.4 Building Coverage Ratio and Total Floor Area Ratio in the Central Station Area

(2) Public facilities

In the central station area, public facilities will include government branch offices, libraries, halls for public gatherings, hospitals, welfare facilities, and religious facilities such as mosques, as mentioned previously. In addition, the central station area will need a primary school, a secondary school, a fire station, a police station, a community center, and three public parks. The land required for these facilities has been planned according to the standards issued by different authorities, as shown Table 6.2.2. For example, the primary school will have a land area of not less than 2,500 m^2, while the secondary school will have a land area larger than 6,000 m^2.

Table 6.2.2 Standards for Public Facilities

Category	Requirements	
Primary School(1)	Area per students	Not less than 4m^2/student
	No. of classroom	18classrooms/school
	Land area	Not less than 2,500m^2
	No. of students	40students/class
Secondary School(1)	Area per students	Not less than 6m^2/student
	No. of classroom	36 to 46 classrooms/school
	Land area	Not less than 6000m^2
	No. of students	36students/class
Health Service(2)	No. of bed	3 beds per 10,000 persons
	Area per bed	50 to 70m^2/bed
Social Service(3)	No. of Social Unit	- One unit per 5,000 people for far away zone - One unit per 10,000 people for cities and villages
	Land Area	500 to 800 m^2 per unit
Center for Youth(4)	Service rate	One center for each 25,000 to 50,000 persons
	Land area	2,400m^2
Cultural Center(5)	Culture Center	One location per governorate
	Culture House	One location per *markaz*
	Library	One location per 200,000persons
	Land Area of Culture Center	5000m^2
	Land Area of Culture House	1000m^2
Security Service(6)	Police Station	One location per governorate and *markaz*
	Police Office	One location per district
	Land Area of Police Station	1600m^2
	Land Area of Post Office	800m^2
Postal Service and Communications(7)	Post Office	One office/5,000persons
	Communications Office	One office/5,000 persons
	Land Area	500m^2/location

Source: (1) Education Directorate, Governorate, (2) Health Department, (3) Social Affairs Department, (4) Youth and Sports, (5) Cultural Directorate, (6) Security Directorate, and (7) City council

(3) Size of buildings

Developers and building owners will decide the type and size of buildings within the planning standards including BCR, FAR, and other relevant planning requirements. Following the proposed BCA and FAR in the previous section, a typical distribution of building footprints is prepared as depicted in Figure 6.2.5. A size of land plot is set in the range of 5,000-10,000m^2 for commercial and business thus allowing for relatively large-scale buildings, and 2,000-10,000m^2 for residential uses, typically multi-story housings. The allowable total floor area is estimated at 1.7 million m^2 as shown in Table 6.2.3.

Table 6.2.3 Allowable Floor Area by Type of Buildings in the Central Station Area

Type of Building		No. of Building (building)	Total Floor Area (m^2)
Private Buildings	Commercial	5	294,000
	Business	5	215,000
	Mixed use (Commercial and Business)	12	469,000
	Mixed use (Commercial and Housing)	14	197,760
	Residential	66	361,350
	Sub-total	102	1,537,110
Public Buildings	Primary School	1	12,400
	Secondary School	1	15,500
	Other Public Building	15	136,500
	Sub-total	17	164,400
Total		119	1,701,510

Source: JICA study team

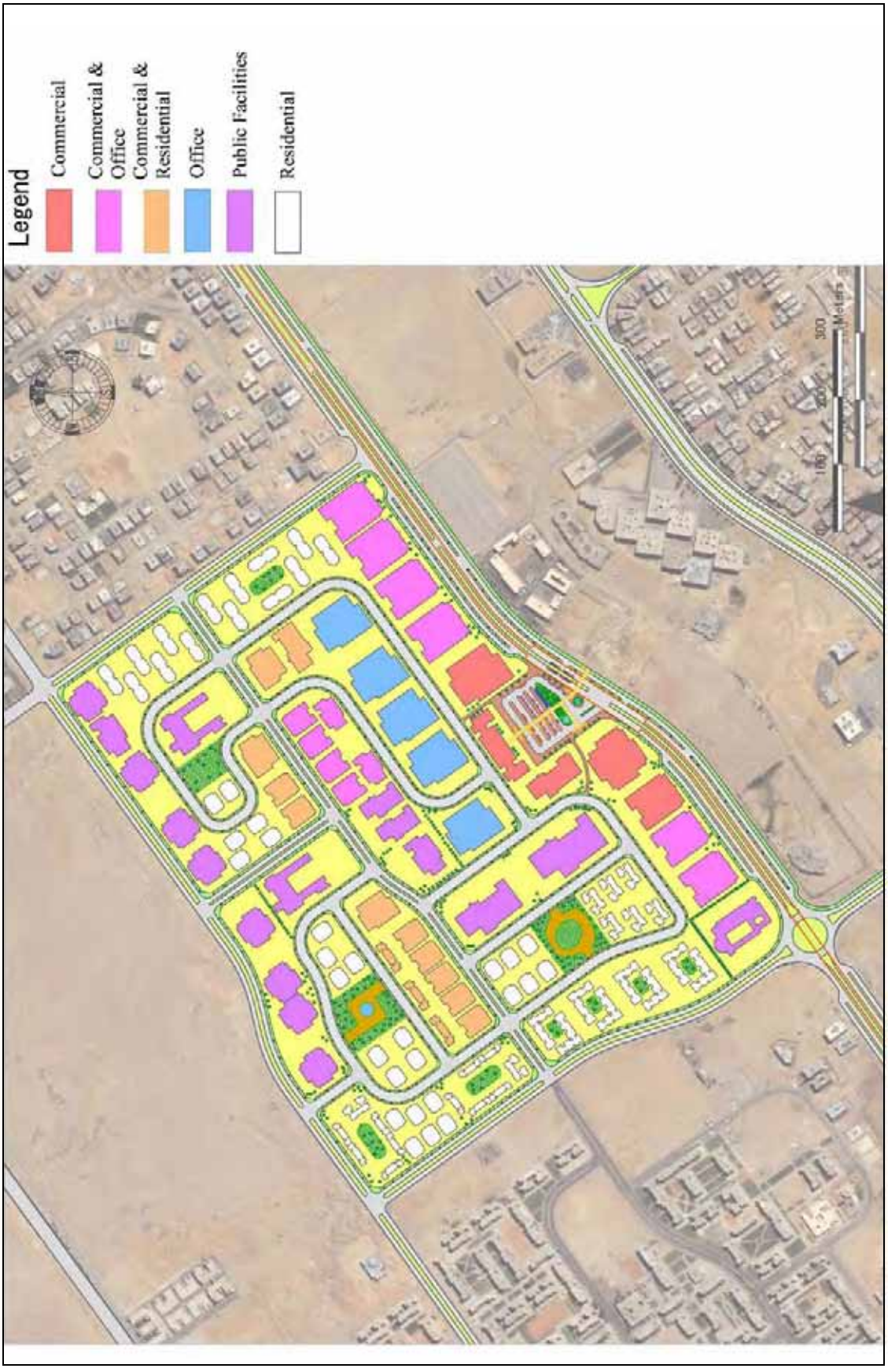


Figure 6.2.5 Ideal Distribution of Buildings in the Central Station Area

Source: JICA Study Team

6.2.5 Plan for the Station Square at the Central Station

(1) Site plan

A station square needs to be located adjacent to the central station to ensure easy transit for passengers moving between different transportation modes. The road traffic direction in the station square will be controlled in the counterclockwise direction. There will be platforms for buses operating on the exclusive busway, feeder buses, shared taxies, taxies, and private cars. These platforms will be interlinked by elevated pedestrian decks leading to the railway station and surrounding facilities. Elevators will be provided for better accessibility and to assist the disabled.

Sidewalks will surround the station square; these will have a width larger than 20 m to provide open spaces that are usable for events and/or festivals.

(2) Estimation for the number of required platforms

The number of platforms was estimated for different transportation modes. This estimation accounted for the following criteria:

- Separate platforms for boarding and alighting should be provided for buses, shared taxis, and taxis.
- A common platform for boarding and alighting should be provided at a single location for private cars.

As shown in Table 6.2.4, three (3) berths will be required for passengers to board buses, while only one (1) berth will be required for passengers to alight from buses. However, one (1) berth each for boarding and alighting will be required for taxi passengers. Shared taxes will require thirteen (13) berths for boarding and two (2) berths for alighting. Private cars will require five (5) berths in total, and these will be used both for boarding and alighting.

Since buses operating on the exclusive busway will use the wide median strip of primary roads, the bus platforms will be provided in the central part of the primary roads. These bus platforms will be located adjacent to the railway stations, which are also located in the central part of the primary roads.

Table 6.2.4 Required Number of Platforms by Transportation Mode at the Central Station

No	Item	Formula	Q'ty
[1]	Passengers at the central station[1)]	-	76,600persons/day
[2]	Total number of visitors at the station square[2)]	[1] x1.5	114,900persons/day
[3]	Visitors for buses	[2] x share for buses (0.12)	13,788 persons /day
[4]	Visitors for taxes	[2] x share for taxes (0.01)	1,149 persons /day
[5]	Visitors for shared taxes	[2] x share for shared taxis (0.27)	31,023 persons /day
[6]	Visitors for private cars	[2] x share for private cars (0.02)	2,298 persons /day
[7]	Visitors for walk and bicycles	[2] x share for walk and bicycles (0.58)	66,642 persons /day
[8]	Boarding passengers at peak time for buses[3)]	[3] x peak factor (0.14) x boarding rate (0.5)	965 persons
[9]	Boarding passengers at peak time for taxes[3)]	[4] x peak factor (0.14) x boarding rate (0.5)	81 persons
[10]	Boarding passengers at peak time for shared taxes[3)]	[5] x peak factor (0.14) x boarding rate (0.5)	2,172pers.
[11]	Alighting passengers at peak time for buses[3)]	[3] x peak factor (0.14) x boarding rate (0.5)	965 persons
[12]	Alighting passengers at peak time for taxes[3)]	[4] x peak factor (0.14) x boarding rate (0.5)	81 persons
[13]	Alighting passengers at peak time for shared taxes[3)]	[5] x peak factor (0.14) x boarding rate (0.5)	2,172 persons
[14]	No of boarding platforms for buses[4)]	[8] ÷ 30 passengers per bus÷ no. of departing buses per berth (60minutes/5minutes interval)	3berths (2.6)
[15]	No of boarding platforms for taxes	[9] ÷ 1.2passengers per taxi x time for boarding (10/60 minutes)÷60 minutes	1berth (0.2)
[16]	No of boarding platforms for shared taxes[4)]	[10] ÷ 12passenger per share taxi ÷no. of departing taxes per berth (60minutes/4minutes interval)	13berths (12.1)
[17]	No of alighting platforms for buses	[11] x time for alighting (2/60minutes) ÷ 60minutes	1berth (0.5)
[18]	No of alighting platforms for taxes	[12] ÷1.2passengers per taxi x time for alighting (30/60minutes) ÷ 60minutes	1berth (0.6)
[19]	No of alighting platforms for shared taxes	[13] x time for alighting (2/60minutes) ÷ 60minutes	2berths (1.2)
[20]	No of platforms for private cars[3)]	[6] x peak factor (0.14)÷ 1.2passengers per car x time for stopping per car (1minute) ÷60minutes	5berths (4.5)

Source: Planning guideline for station squares, Japan Transportation Planning Association, 1998
Note 1) Number of alighting and boarding per day at station No. 22 in 2027
Note 2) Coefficient in assumption
Note 3) Peak factor based on the actual practices at the existing stations
Note 4) Interval in the peak time

Source: JICA Study Team

Figure 6.2.6 Site Plan for the Central Station Square

6.2.6 Preliminary Cost Estimate for the Central Station Area

A rough and preliminary cost was estimated for urban development in the central station area. The cost includes building construction and infrastructure development, and covers the on-site roads, landscaping, station square, parks, elevated pedestrian decks, and utilities including water supply and wastewater disposal. The cost also includes land grading work, topographic surveys, and design works. However, primary and secondary roads have been excluded from the cost estimate, because these roads will serve the whole of 6th of October NUC.

The total implementation cost was estimated at LE6,636 million, which includes LE83 million for infrastructure and LE6,553 million for building construction. If the public sector were to develop the infrastructure and public facilities, an investment of LE884 million would be required. However, if the public sector only developed the station square, elevated pedestrian deck, and public facilities, excluding the on-site roads, the public sector investment would amount to LE853 million.

Table 6.2.5 Preliminary Cost Estimate for the Central Station Area

Item			Unit	Unit price (L.E)	Q'ty	Price (1,000L.E)	Note
Construction cost	Public facilities	Road incl. pavement and sidewalk	m	2,600	4,900	12,740	24m width
			m	1,300	-	-	12m width
		Landscaping incl. trees and sodding	m	70	9,800	686	2 times of road length
		Station square	m^2	3,000	13,000	39,000	
		Park	m^2	200	18,000	3,600	3 locations
		Pedestrian deck	m	1,000	170	170	6m width
	Infrastructure	Water supply pipeline	m	750	4,900	3,675	Road length
		Waste water pipeline	m	800	4,900	3,920	Road length
		Gas pipeline	m	750	4,900	3,675	Road length
		Power cable	m	300	4,900	1,470	Road length
		Telecommunication line	m	500	4,900	2,450	Road length
	Land grading		m2	12	560,000	6,720	
	Topographic survey		m2	0.75	560,000	420	
	Engineering service incl. study, design, construction supervision		%		5	3,926	
	Contingency					548	
	Sub-total					83,000	
Building construction cost (incl. engineering service)	Residence (multi-stories housing)		m^2	1,800	520,230	936,414	
	Commercial		m^2	5,000	320,680	1,603,400	
	Office		m^2	5,000	624,200	3,121,000	
	Public facilities		m^2	5,000	128,100	640,500	
	Hotel		room	250,000	360	90,000	4star (200m^2/room)
	Hospital		bed	450,000	120	54,000	70m^2/bed
	Primary school		m^2	3,000	12,400	37,200	
	Secondary & preparatory school		m^2	4,500	15,500	69,750	
Contingency						736	
Subtotal						6,553,000	
Total						6,636,000	

Source 1) NUCA for unit price
2) JICA Study Team for work quantity based on the land use plan

Figure 6.2.7 Perspective View of the Central Station Area

Source: JICA Study Team

6.3 Urban Development Plan for Ordinary Stations

6.3.1 Planning Direction for Ordinary Stations

This sub-section describes the urban development plan for ordinary stations, other than the central station, The urban development plan includes a typical land use plan covering a land area of 38 ha and technical requirements for stations. In the implementation stage, the proposed urban development plan will need to be adjusted so that it conforms to existing conditions at candidate sites and the surrounding areas for each ordinary railway station. Directions applicable to the proposed urban development plan are listed below. These have been classified into three categories:

- Areas around the railway stations from No.1 to No.10 are either already developed or planned for development. There will not be sufficient area for new large-scale development in these areas. Therefore, the new development for the railway station will focus on providing transit facilities for boarding and alighting passengers. These new facilities will be adjusted to fit in with existing facilities.
- Areas around stations No.11 to No.18 still have vacant land available. Although the existing development plan is already formulated for part of these areas, the actual urban development has not been implemented there yet. Hence, the proposed urban development plan will be adjusted to fit in with the existing development plans.
- Large portions of the area around stations No.19 to No.24, excluding station No.22 (central station), also have existing development plans. However, in these locations, urban development is either on-going or has already been implemented in accordance with the existing development plans. Therefore, the proposed urban development plan will need to be adjusted to fit in with the existing conditions and development plans.

6.3.2 Direction for the Development of Ordinary Stations

The urban development plan includes commercial, business, and residential areas for ordinary station areas. Land parcels will be divided to relatively large plots for the commercial areas. In the residential areas, the road network will be planned to prevent through traffic from affecting the preferred living environment. Commercial and service facilities will be provided for the neighboring residents and passengers using the ordinary stations. The platforms in the station area will be planned to ensure the effective and efficient transit of passengers between different transportation modes.

6.3.3 Land Use Plans for Ordinary Stations

(1) Road network plan

The road network will be formed so as to restrain direct access from service roads to primary roads adjacent to the railway line. The primary roads will only be linked to secondary roads, which will provide access to the on-site roads. Overpasses will be provided at intersections that would cross the railway at ground level. Sidewalks will be provided along every road, including the primary, secondary, and on-site roads.

A vehicle-free pedestrian way will extend from the railway station and across the station area. This will encourage commercial activities to locate on the lower floors of buildings along the pedestrian way.

(2) Public facility plan

Public facilities for the neighboring residents will be provided in ordinary station areas. These will include facilities for education, social security, and amenity. These public facilities will be located in the central part of the ordinary station area. In addition to these fundamental facilities, there will be two public parks that provide landscaping, playing and rest areas.

Since ordinary stations will be smaller than the central station area, and only serve passengers and the residents of the local neighborhood, the transit facility plan will need to be flexible so as to accommodate the existing conditions. Hence, development of the transit facility is planned along the primary road, without a station square.

(3) Utility plan

Utilities for water supply, wastewater disposal, gas, electricity, and communications will be provided in ordinary station areas. Pipelines for these utilities will be installed alongside the road networks.

(4) Land use plan

Land for commercial and business activities will be planned for areas around the railway station and along primary roads that are alongside the railway. Buildings along the main service roads, where a relatively large number of pedestrians is expected, will be planned so that commercial activities, such as businesses and retail shops, occupy the lower floors, while the middle and upper floors will be used for residential accommodation. In other areas, the buildings will be used primarily for medium height and high-rise residential accommodation.

Following the planning principles mentioned above, a land use plan for ordinary station areas was formulated, as depicted in Figure 6.3.1. The land area by land use category was estimated, as shown in Table 6.3.1.

Figure 6.3.1 Perspective View of the Ordinary Station Area

Source: JICA Study Team

Table 6.3.1 Land Area by Land Use Category for Ordinary Station Areas

Land Use Category			Land Area (m^2)	Share (%)
Land for Public Facility	Road		88,500	23.3
	Station Square		3,000	0.8
	Park		15,000	3.9
	Sub-total		106,500	28.0
Land for Urban Development	Private-owned Land	Mixed Use (Commercial and Business)	41,000	10.8
		Mixed Use (Commercial and Housing)	40,000	10.5
		Housing	164,500	43.3
	Public-owned Land	Primary School	16,000	4.2
		Other Public Facilities	12,000	3.2
	Sub-total		273,500	72.0
Total			380,000	100

Source: JICA Study Team

6.3.4 Plan for Buildings in Ordinary Station Areas

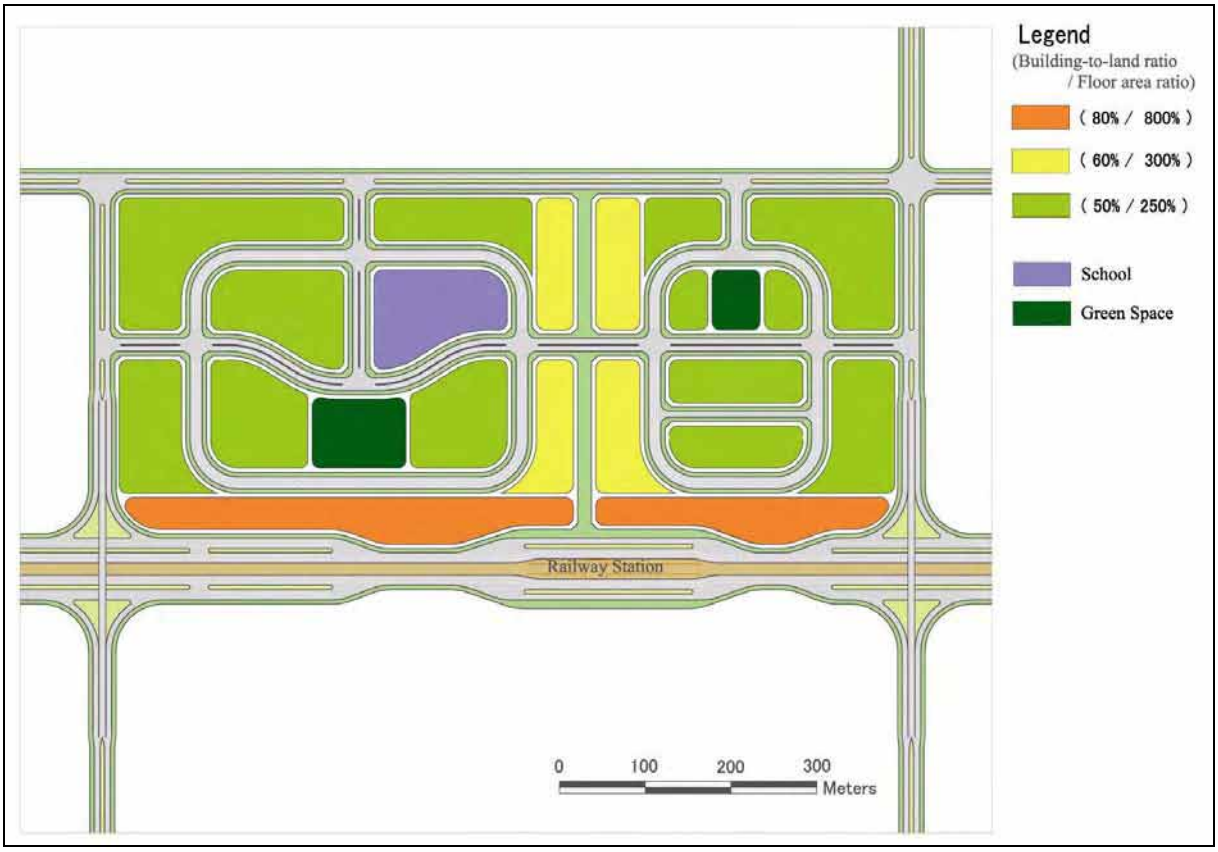
(1) Building coverage ratio and total floor area ratio

Urban control will be achieved by using a building coverage ratio (BCR) and total floor area ratio (FAR). The proposed ratios for ordinary station areas is based on the direction of development and the land use plan depicted in Figure 6.3.2.

The allowable capacity for commercial and office areas along the primary road and around the railway station has been set at 80% for the BCR and 800% for the FAR. Medium-height buildings up to ten stories high will be allowable in these areas.

Residential areas will have buildings up to five stories high, based on a BCR of 50% and a FAR of 250%. Allowable capacity in these areas has been set with the aim of creating a moderately dense area with open spaces, landscaping, and an amenable living environment.

The allowable capacity for the areas along the main service roads was set at 60% for the BCR and 300% for the FAR. This was done because these areas will form buffer zones between the residential areas and the commercial area along the primary road. In addition, these areas will accommodate commercial and retail activities on the lower floors of the buildings in the neighborhood. Buildings up to five stories high will be allowed in these areas.



Source: JICA Study Team

Figure 6.3.2 Building Coverage Ratio and Total Floor Area Ratio for Ordinary Station Areas

(2) Public facilities

Public facilities in ordinary station areas will basically serve the people in the neighborhood. They will consist of a primary school, a preschool, a fire station, a police station, and a community center.

(3) Size of buildings

The size of land plots ranges from 3,000 to 4,000 m^2 for commercial and office areas. These areas allow for the relatively large scale buildings. For residential multi-story accommodation, the land plot size ranges from 2,000 to 2,500 m^2. However, the type and size of buildings will be subject to the decisions made by developers and building owners. According to the proposed land use plan and the BCR and FAR limits set previously, an ideal distribution of buildings was prepared, as depicted in Figure 6.3.3. The allowable total floor area was estimated at 0.6 million m^2, as shown in Table 6.3.2. Building construction will be controlled in accordance with the proposed land use plan and technical requirements.

Table 6.3.2 Allowable Floor Area by Type of Buildings for Ordinary Station Areas

Type of Building		No. of Building (building)	Total Floor Area (m^2)
Private Buildings	Commercial	2	36,000
	Business	-	-
	Mixed use (Commercial and Business)	13	214,000
	Mixed use (Commercial and Housing)	20	84,000
	Residential	65	209,400
	Sub-total	100	543,400
Public Buildings	Primary School	1	6,200
	Secondary School	-	-
	Other Public Building	4	15,200
	Sub-total	5	21,400
Total		105	564,800

Source: JICA Study Team

Figure 6.3.3 Distribution of Buildings in the Ordinary Station Area (example)

Source: JICA Study Team

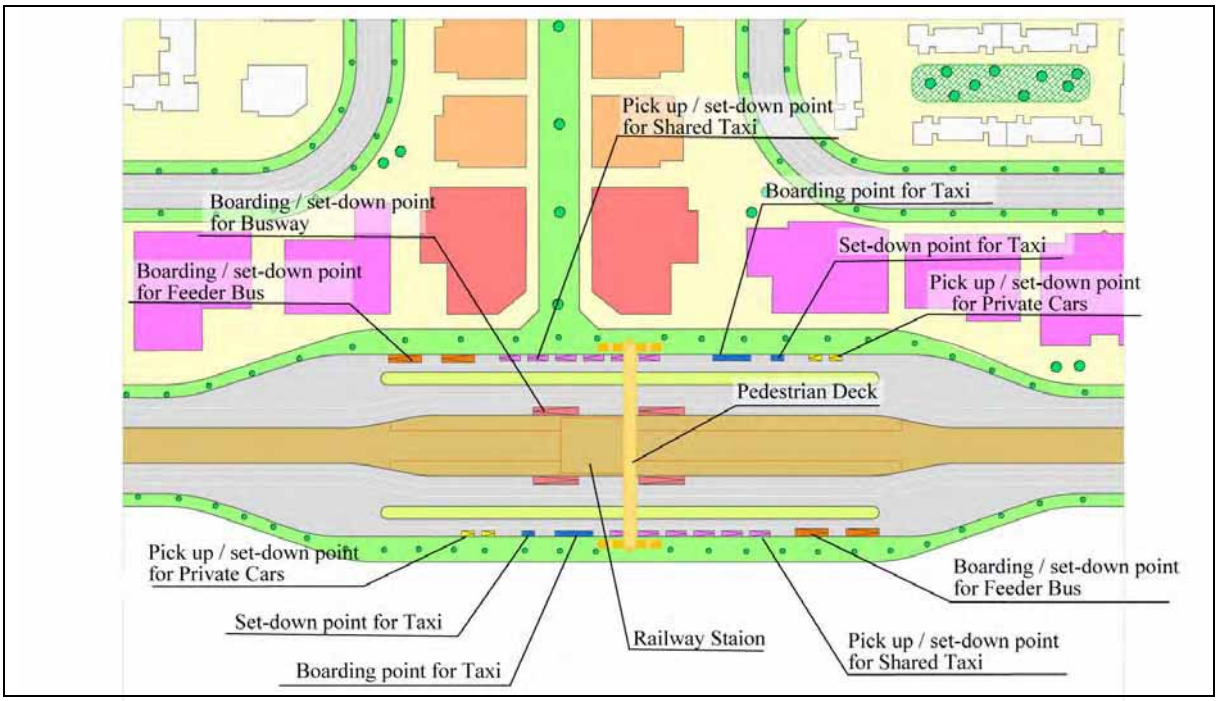
6.3.5 Plan for Transit Facilities at Ordinary Stations

(1) Site plan

Figure 6.3.4 shows a typical site plan for transit facilities around Ordinary Stations. Transit facilities for passengers to board and alight from feeder buses, shared taxis, and private cars will be required. These transit facilities will be located on both sides of the primary road. The platforms for buses running on the exclusive busway will be placed adjacent to railway stations, which will occupy the central part of the primary road.

Areas allocated for boarding and alighting from buses, shared taxis, and private cars will be jointly located on the same platform, since the stopping time will be short at ordinary stations due to light demand. In contrast, the areas allocated for boarding and alighting from taxis will be separate because taxis will require space to wait for passengers. One traffic lane each for stopping and passing will be provided on both sides of the primary road.

The platforms will be interlinked with the railway station by an elevated pedestrian deck. An elevator will be provided for better accessibility and to assist disabled people. Sidewalks along the primary road and the platforms will have a width of not less than 5 m to accommodate waiting spaces and seats for the passengers.



Source: JICA Study Team

Figure 6.3.4 Site Plan for Transit Facilities around Ordinary Stations

(2) Estimation of the number of required platforms

The number of platforms estimated for each transportation mode was based on the following criteria:

- Platforms for boarding and alighting will be provided separately for taxis.

- The platform for boarding and alighting will be provided at one location for other transportation modes, including buses, shared taxis, and private cars. The required number of platforms represents the total number of estimated berths for boarding and alighting.

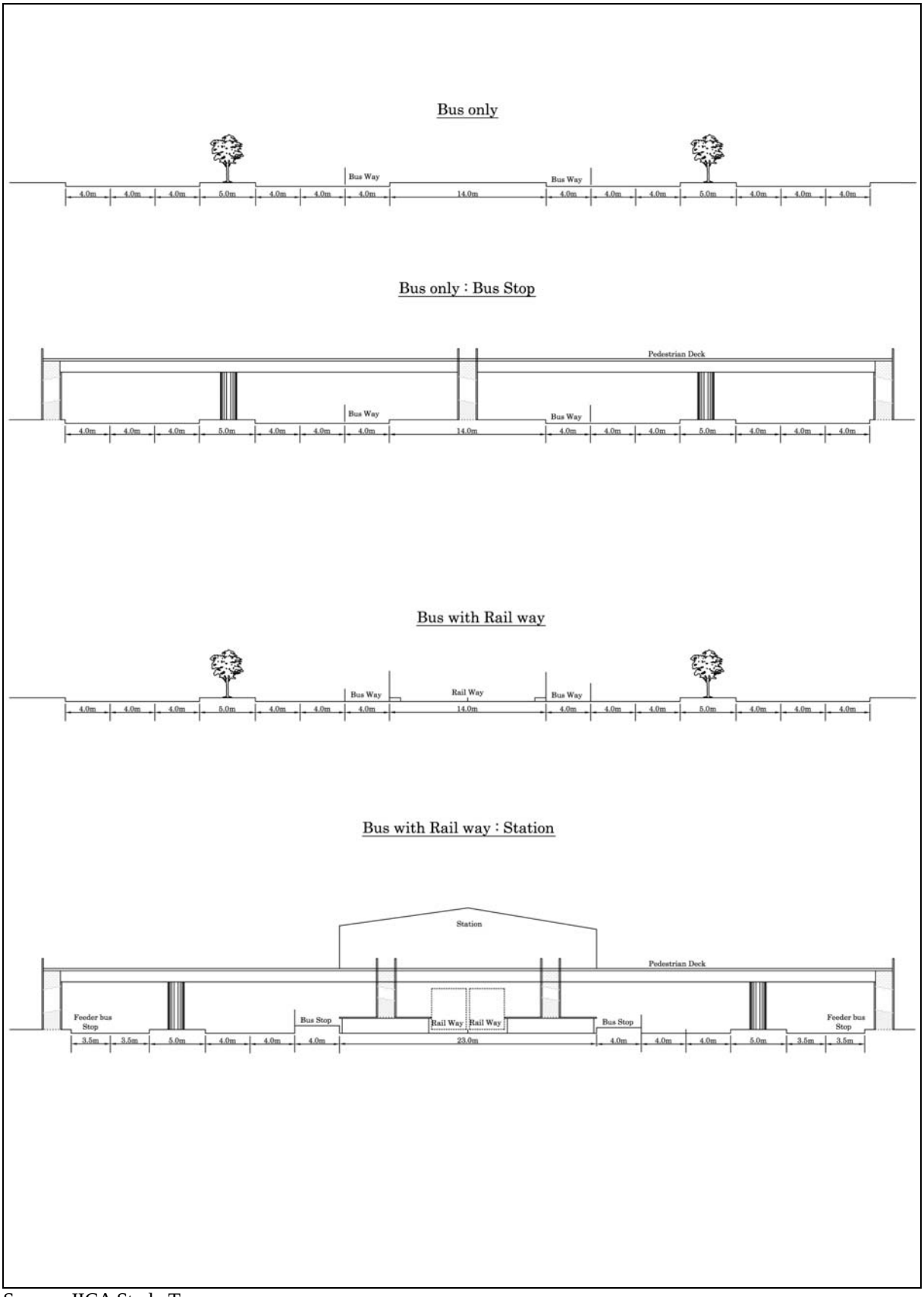
As shown in Table 6.3.3, buses will need three (3) berths in total for boarding and alighting, while shared taxis will require eleven (11) berths in total. Private cars will require three (3) berths, and taxis will use one (1) berth each for boarding and alighting. Since the platforms will be provided on both sides of the primary road, as mentioned earlier, each road side will have platforms that accommodate not less than half the estimated number of berths required for the station.

Table 6.3.3 Required Number of Platforms by Transportation Mode for Ordinary Stations

No	Item	Formula	Q'ty
[1]	Passengers at the central station[1)]	-	50.000persons/day
[2]	Total number of visitors at the station square[2)]	[1] x1.2	60,000persons/day
[3]	Visitors for buses	[2] x share for buses (0.06)	3,600persons/day
[4]	Visitors for taxes	[2] x share for taxes (0.01)	600persons/day
[5]	Visitors for shared taxes	[2] x share for shared taxis (0.33)	19,800persons/day
[6]	Visitors for private cars	[2] x share for private cars (0.02)	1,200persons/day
[7]	Visitors for walk and bicycles	[2] x share for walk and bicycles (0.58)	34,800 persons/day
[8]	Boarding passengers at peak time for buses[3)]	[3] x peak factor (0.14) x boarding rate (0.5)	252persons
[9]	Boarding passengers at peak time for taxes[3)]	[4] x peak factor (0.14) x boarding rate (0.5)	42 persons
[10]	Boarding passengers at peak time for shared taxes[3)]	[5] x peak factor (0.14) x boarding rate (0.5)	1,386 persons
[11]	Alighting passengers at peak time for buses[3)]	[3] x peak factor (0.14) x boarding rate (0.5)	252 persons
[12]	Alighting passengers at peak time for taxes[3)]	[4] x peak factor (0.14) x boarding rate (0.5)	42 persons
[13]	Alighting passengers at peak time for shared taxes[3)]	[5] x peak factor (0.14) x boarding rate (0.5)	1,386 persons
[14]	No of boarding platforms for buses[4)]	[8] ÷ 30 passengers per bus÷ no. of departing buses per berth (60minutes/10minutes interval)	2berths (1.4)
[15]	No of boarding platforms for taxes	[9] ÷ 1.2passengers per taxi x time for boarding (10/60 minutes)÷60 minutes	1berth (0.1)
[16]	No of boarding platforms for shared taxes[4)]	[10] ÷ 12passenger per share taxi ÷no. of departing taxes per berth (60minutes/5minutes interval)	10berths (9.6)
[17]	No of alighting platforms for buses	[11] x time for alighting (2/60minutes) ÷ 60minutes	1berth (0.1)
[18]	No of alighting platforms for taxes	[12] ÷1.2passengers per taxi x time for alighting (30/60minutes) ÷ 60minutes	1berth (0.3)
[19]	No of alighting platforms for shared taxes	[13] x time for alighting (2/60minutes) ÷ 60minutes	1berth (0.8)
[20]	No of platforms for private cars[3)]	[6] x peak factor (0.14)÷ 1.2passengers per car x time for stopping per car (1minute) ÷60minutes	3berths (2.3)

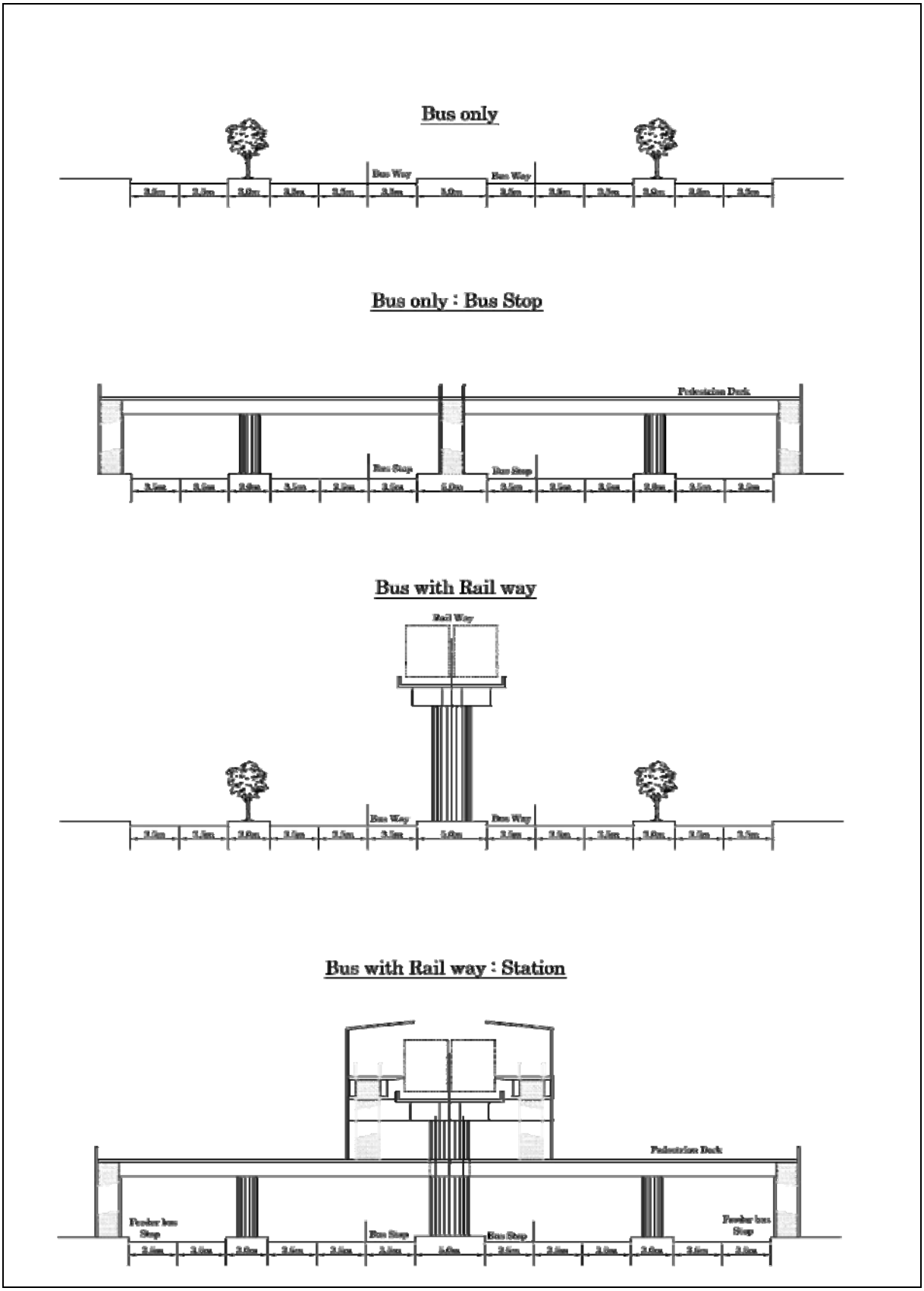
Source: Planning guideline for station squares, Japan Transportation Planning Association, 1998
Note 1) Number of alighting and boarding per day at medium-scale stations for average rates including station no.19, 20, etc in 2027
Note 2) Coefficient in assumption
Note 3) Peak factor based on the actual practices at the existing stations
Note 4) Interval in the peak time

Figure 6.3.5 shows typical cross-sections for primary roadways at ordinary stations constructed at ground level, while Figure 6.3.6 shows typical cross sections for primary roadways at elevated ordinary stations. Both the stations at ground level and the elevated stations have an exclusive busway at ground level. Development stages before and after construction of the railway are shown in both cases. Where the railway is constructed at ground level, the platform for the dedicated buses will occupy the median strip of the primary road. After implementation of the railway, the platforms for buses running on the exclusive busway will be shifted from the median strip and interliked with the facilities for the railway. Where the railway will be constructed as an elevated structure, the platforms for buses running on the exclusive busway will be located at ground level below the railway station. Both the platform and station will be interlinked by an elevated pedestrian deck.



Source: JICA Study Team

Figure 6.3.5 Typical Road Cross-section for Ordinary Stations at Ground Level



Source: JICA Study Team

Figure 6.3.6 Typical Road Cross-section for Elevated Ordinary Stations

6.3.6 Preliminary Cost Estimate for Ordinary Station Areas

Preliminary cost estimation was carried out for ordinary station areas, based on a similar concept to the cost estimates prepared for the central station area. The costs cover building construction and infrastructure development. The preliminary cost estimate includes the on-site roads, landscaping, parks, elevated pedestrian decks, and utilities including water supply and wastewater disposal. It also covers land grading, topographic surveys, and design works. However, primary and secondary roads are excluded from this cost estimate.

The total implementation cost was estimated at LE1,968 million, which includes LE41 million for infrastructure development and LE1,927 million for building construction. If the public sector focuses on providing the pedestrian decks and transit facilities, leaving the other facilities including infrastructure and public facilities to be developed by private developers, the investment required by the public sector will amount to only LE240 million.

Table 6.3.4 Preliminary Cost Estimate for Ordinary Station Areas

Item			Unit	Unit price (L.E)	Q'ty	Price (1,000L.E)	Note
Construction cost	Public facilities	Road incl. pavement and sidewalk	m	2,600	3,300	8,580	24m width
			m	1,300	580	754	12m width
		Landscaping incl. trees and sodding	m	70	7,760	543	2 times of road length
		Station square	m^2	3,000	3,000	9,000	
		Park	m^2	200	15,000	3,000	2 locations
		Pedestrian deck	m	1,000	80	80	6m width
	Infrastructure	Water supply pipeline	m	750	3,880	2,910	Road length
		Waste water pipeline	m	800	3,880	3,104	Road length
		Gas pipeline	m	750	3,880	2,910	Road length
		Power cable	m	300	3,880	1,164	Road length
		Telecommunication line	m	500	3,880	1,940	Road length
	Land grading		m^2	12	380,000	4,560	
	Topographic survey		m^2	0.75	380,000	285	
	Engineering service incl. study, design, construction supervision		%		5	1,942	
	Contingency					228	
	Sub-total					41,000	
Building construction cost (incl. engineering service)	Residence (multi-stories housing)		m^2	1,800	276,600	497,880	
	Commercial		m^2	5,000	117,000	585,000	
	Office		m^2	5,000	149,800	749,000	
	Public facilities		m^2	5,000	15,200	76,000	
	Primary school		m^2	3,000	6,200	18,600	
Contingency						520	
Subtotal						1,927,000	
Total						1,968,000	

Source 1) NUCA for unit price
2) JICA Study Team for work quantity based on the land use plan

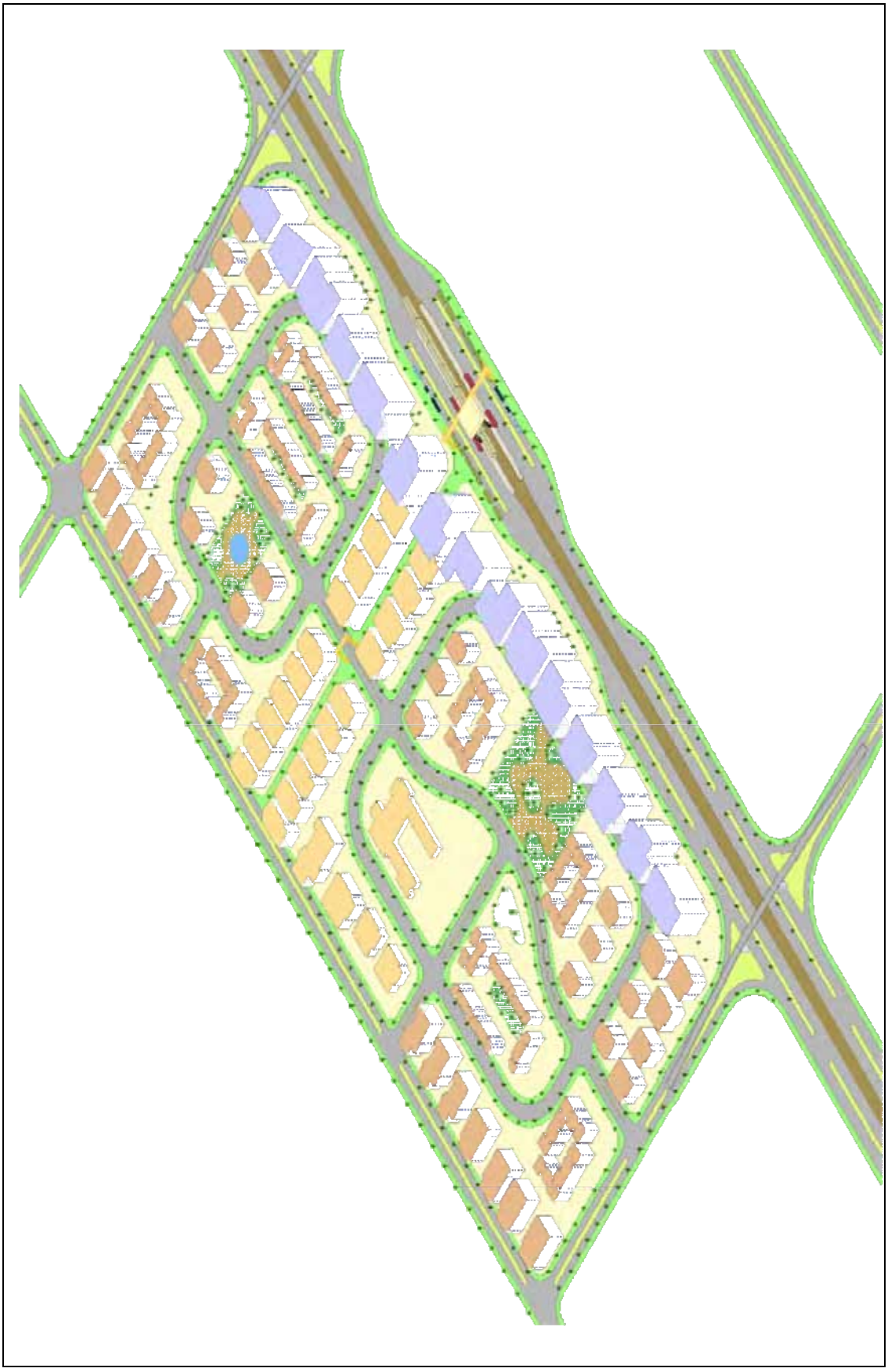


Figure 6.3.7 Perspective View of the Ordinary Station Area

Source: JICA Study Team

CHAPTER 7 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS (IEE AND PRE-EIA STUDIES)

7.1 Initial Environmental Evaluation (IEE Study)

7.1.1 Objectives and Outline of the Project in IEE Study

(1) Objectives

The Initial Environmental Examination of the project (IEE), which is required by JICA within the scope of development projects, is the first stage for the study of potential environmental and social affects of the project. The IEE is a preliminary evaluation of the environmental issues that may relate to the project. The results of IEE are a checklist of the potential impacts of the project on the environment, and a list of items that need a more detailed environmental evaluation.

(2) Outline of the project

The project is an integrated development for transportation and urbanization in the Greater Cairo Region, more specifically focusing on the Western Development Corridor between Cairo and 6th of October NUC. This project matches the objectives of the Master Plan for the Greater Cairo Region. The project has two (2) basic components:

- The development of an appropriate public transportation network to meet future demand, through developing a railway and busway connection.
- The development and revitalization of 6th of October NUC, in order to increase its attractiveness for people and enterprises.

7.1.2 Main Relevant Environmental Standards

(1) Air quality

Annex 5 of the Executive Regulations of Law 4/1994 provides the ambient air quality standards, as listed in Table 7.1.1. Amendments have been adopted for particulate matter (PM_{10}) and the concentration limit has been raised to 150 µg/m^3 daily average, replacing the original value of 70 µg/m^3 for the daily average. In addition, the amendments added a limit for the maximum annual average PM_{10} which is set to 70 µg/m^3. Annex 6 of Law 4/1994

establishes the concentration limits for air pollutant emissions. Air pollution caused by transportation vehicles is controlled through Law 66/1973 by the Ministry of Interior.

Table 7.1.1 Environmental Standards for Ambient Air Pollutants in Egypt

Item	Maximum Concentration ($\mu g/m^3$)	Time of Exposure (measurement period)
Sulfur Dioxide	350	1 hr
	150	24 hrs
	60	1 year
Carbon Monoxide	30,000	1 hr
	10,000	8 hr
Nitrogen Dioxide	400	1 hr
	150	24 hrs
Ozone	200	1 hr
	120	8 hr
Total suspended particulate matter / Total (TSP)	230	24 hrs
	90	1 year
Suspended particulate matter / PM_{10}	70 (before amendment)	24 hrs
	150 (after amendment)	24 hrs
	70 (after amendment)	1 year
Suspended particulate matter / Black Smoke	150	24 hrs
	60	1 year
Lead	1	1 year

Source: Annex 5 of the Executive Regulation for Law 4/1994.

(2) Noise

Permissible noise levels have been established by Law 4/1994 and its Executive Regulations, according to categories of land use and the time of day. These levels are listed for ambient noise levels and for noise levels inside a workplace in Table 7.1.2 and Table 7.1.3, respectively.

Table 7.1.2 Environmental Standards for Ambient Noise

Item	Noise level equivalent (Leq), in dB(A)		
Target areas	Day time 7am-6pm	Evening time 6pm-10pm	Night time 10pm-7am
Rural residential areas, hospitals and gardens	45	40	35
Residential suburbs with low traffic	50	45	40
Residential areas in cities	55	50	45
Residential areas with workshops or commercial establishments, or in front of main roads	60	55	50
Commercial, administrative, and downtown areas	65	60	55
Industrial areas	70	65	60

Source: Law 4/1994

Table 7.1.3 Maximum Period of Exposure to Permissible Noise inside a Workplace

Noise intensity level dB(A)	95	100	105	110	115
Period of exposure (hours)	4	2	1	1/2	1/4

Note: Noise intensity should not exceed 90dB for 8 hours work period. Table provides limits for noise above 90dB.
Source: Law 4/1994

(3) Vibration

No standards have been set in Egypt for vibration levels. Therefore, the standards used in Japan for noise and vibration that is caused by vehicles are provided in Table 7.1.4 for reference.

Table 7.1.4 Environmental Standards for Noise and Vibration in Japan

Target Areas	Noise limit Leq, dB(A)		Vibrations (VdB)	
	Day	Night	Day	Night
Residential area	65	55	65	60
Mixed residential and commercial area	70	65	70	65
Other types of areas	75	70	x	x

Source: Ministry of the Environment, Japan

7.1.3 Results of the IEE

(1) Potential source of impacts

The basic source of environment impacts that may result from the project at the construction and operational stages are listed in Table 7.1.5. The secondary impacts on the quality of the physical environment are reviewed in Table 7.1.6 for the relevant sources of impacts.

Table 7.1.5 Potential Source of Impacts of the Project

Sub-Projects	Location and construction related	Operational phase related
Public railway and busway transport	- Location of civil structures - Land acquisition (leading to relocation) and land clearance - Land use change - Construction work - Traffic conditions - Supply of construction materials	- Traffic conditions - Repair and maintenance - Urban mobility
Inter-modal railway stations and bus terminals	- Location of civil structures - Land acquisition (leading to relocation) and land clearance - Land use change - Construction work - Traffic conditions - Supply of construction materials	- Traffic conditions - Land use plans - Beautification of stations and terminals - Urban waste and wastewater

Source: JICA Study Team

Table 7.1.6 Checklist of Potential Environmental Effects by Impact Source

Source of Impacts	Air Quality	Water Quality	Soil	Noise	Urban Waste	Demolition / Construction Waste	Hazardous Substances and Waste
Land acquisition, land clearance			x				
Construction work	x	x		x		x	x
Supply of construction materials	x			x		x	
Traffic conditions	x	x		x			
Repair and maintenance		x	x	x			x
Land use plans	x			x	x		
Urban waste and wastewater		x	x		x		

Source: JICA Study Team

(2) Checklist of potential impacts

Table 7.1.7 provides a checklist of the environmental criteria used for reviewing the potential impacts, based on the JICA guidelines. In this table, priority is given to the possible impacts caused by the location and operation of the project. Potential impacts arising during the construction phase are considered only if they are important in the context of the Greater Cairo Region, such as the generation of construction and demolition waste, or traffic congestion.

As a result of assessing the potential impacts arising from the Western Development Corridor project, it was concluded that the project will definitely have positive impacts after taking measures to mitigate the possible negative impacts. The project is expected to contribute to the global objective of improved mobility and environmental quality. However, there are some uncertain issues that need more detailed study after design of the alignment and selection of the location for infrastructure has been undertaken.

The development of railway stations and terminals could have negative impacts on the social environment in cases where sensitive sites or vulnerable groups might be affected by land acquisition or nuisances, such as noise. However, as the project will provide the necessary conditions for successful operation of the public railway and busway, the expected positive impacts should largely cancel the negative impacts.

Table 7.1.7 Checklist of Potential Project Impacts, based on JICA Criteria

No	Impacts	Rating	Brief Description
Social Environment (Regarding the impacts on "Gender" and "Children's Right", might be related to all criteria of Social Environment.)			
1	Involuntary Resettlement	C	Locally possible, depending on exact location of the project
2	Local Economy such as Employment and Livelihood, etc.	B	Global positive impact on employment, but local adverse impact possible.
3	Land Use and Utilization of Local Resources	C	The project is expected to be located in the Right of Way (ROW) of existing roads, but limited land use change is possible.
4	Social Institutions such as Social Infrastructure and Local Decision-making Institutions		None
5	Existing Social Infrastructures and Services	C	Possible local adverse impacts on accesses to institutions or social facilities, according to project design and location, but the global result is expected to be an improved access.
6	The Poor, Indigenous and Ethnic People	C	Basically positive at GCR level because of better possibilities of mobility through public transport, but possible adverse impacts locally.
7	Misdistribution of Benefit and Damage	C	Public transport has a positive impact on distribution of benefits, but people living near the project sites could be affected and perceive the project as damageable.
8	Cultural heritage	C	Possible, depends on project design and selected route.
9	Local conflict of interests	C	Possible
10	Water Usage or Water Rights and Rights of Common	B	Potential impacts on water use in workshops, but no significant impact expected of water resources conditions and water rights.
11	Sanitation	B	Possible as related to solid and liquid waste management.
12	Hazards (Risk) Infectious Diseases such as HIV/AIDS		None
Natural Environment			
13	Topography and Geographical Features	C	Possible according to project design
14	Soil Erosion		None
15	Groundwater	C	Potential impact possible according to geological and hydrogeological conditions, project design, and risk of spillage of harmful substances during construction and operation (at workshops).
16	Hydrological Situation		None
17	Coastal Zone (Mangroves, Coral reefs, Tidal flats, etc.)		None
18	Flora, Fauna and Biodiversity	C	Possible impact on flora and fauna species, but impact on biodiversity should not be significant.
19	Meteorology		None
20	Landscape	A	Potentially important in case of elevated structures for example, but depends as well on the perception of people living around, and on project design.
21	Global Warming	B	Positive through potential reduction of GHG emissions
Pollution			
22	Air Pollution	B	Positive impact for GCR. Temporary local negative impacts during construction.
23	Water Pollution	B	Wastewater and liquid waste or oil spillage from workshops are possible sources of water pollution.
24	Soil Contamination	C	Impact possible if contaminated soil is encountered during construction.
25	Waste	B	Demolition and construction waste, risk of illegal dumping. Urban solid waste in operation phase. Waste from workshops.
26	Noise and Vibration	B	Potential impact in residential zones or sensitive establishments lying along the project alignments.
27	Ground Subsidence	C	Possible with construction depending on geological conditions and project sections
28	Offensive Odor		None
29	Bottom Sediment		None
30	Accidents	B	Positive through reducing the potential risk of road traffic accidents, but negative during construction, and negative in operation phase if no appropriate earthquake resistant structures undertaken.

Rating: A- Serious impact is expected. B-Some impact is expected. C-Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses.) No Mark-No impact is expected. IEE/EIA is not necessary.
Source: JICA Study Team

(3) Main impact issues suggested by the IEE study

The railway and busway transport project matches the priority objectives for a transport mode having good environmental performance. It should have a very positive impact on ambient air and noise, and traffic conditions, in GCR. The project is expected to contribute to the reduction of greenhouse gas emissions in the Greater Cairo Region. However, this positive impact only be realized if the new transport mode becomes a substitute for individual road transportation and the usage rate reaches a high level.

Possible adverse impacts of the project on water quality will be controlled through management of waste oil and oil spillage in the maintenance workshops. The impact of the project on the generation of construction and demolition waste is typically related to the construction phase.

A few aspects of the project are still uncertain, as identified by the IEE. These aspects need to be considered in the pre-EIA or EIA, which can be undertaken when the project has reached an advanced level of design. The aspects that need further clarification are:

- Human settlements: The urban development corridor seems to be free of informal settlements, which help to minimize the possible emergence of land use conflicts and involuntary resettlement of people. However, this aspect will remain uncertain until alternative routes and sites for the development project are identified.
- Social groups: The busway and railway transport facilities provided by the project should have positive impacts on the living conditions of low income households. However, this issue largely depends on the selection of the transport route alignment and other related factors. Locally, vulnerable groups might be affected, potentially resulting in social change, segregation or exclusion of low income households.
- Landscape and cultural assets: Direct or indirect impacts on the cultural or landscape value cannot be excluded entirely until the route alignment is defined. Therefore, it is possible that cultural and historical assets in or near the project might be affected in some way. The loss of trees in the ROW would be one potential negative impact because trees provide an important contribution to the urban landscape.
- Living environment: The impact of the project on the living environment of the residents will depend on the design of the transportation infrastructure and its location. As these aspects are not defined yet, they could not be considered in the IEE stage. However, the project will have a positive global impact that improves the mobility of residents, especially those in the NUC area.

7.1.4 Need for Conducting an EIA or pre-EIA

(1) Legal requirements for EIA procedures in Egypt

In Egypt, Law 4/1994 and its Executive Decree 338/1995 require an EIA to be undertaken for licensing new establishments or projects and for expansion of existing establishments. The decision criteria for determining the need for an EIA are defined in Law 4/1994 and the

Guidelines for Egyptian Environmental Impact Assessment. The relevant criteria for this assessment are firstly the type of activity or project, e.g. roads, railways, railway stations, establishments with a noticeable impact. The next criterion is the location, specifically the proximity to sensitive sites. This is based on factors such as the density of the population and significance of tourist areas. The Egyptian system requires an EIA procedure to be undertaken for railway and busway projects that will be constructed within the Grey List category areas. It is assumed that the stations and terminals required for these transportation projects are part of the railway system, and not part of urban development projects.

(2) EIA requirements according to JICA guidelines

Under the JICA guidelines, projects with large scale activities or impacts are considered to have a high sensitivity. Initially, these projects could potentially be classified as "Category A" projects when considering environmental evaluation requirements. However, based on the IEE, overall it was determined that the Western Development Corridor project will not cause large disruptive effects on society or the natural environment, such as requiring resettlement of the population or loss of biodiversity. Even so, possible negative effects might be expected to some extent, as shown previously in the impacts checklist of Table 7.1.7. Accordingly, the project has been assessed as being a "Category B" project.

(3) Recommendation for execution of a pre-EIA study

The IEE has shown that the project should definitely provide environmental benefits for GCR, but potentially might induce local adverse impacts that would require mitigation. At the stage of executing the IEE, the project was still a general proposition, with uncertain impacts on the environment for certain aspects, as shown previously in Table 7.1.7. Therefore, it was recommended that a pre-EIA be conducted for the project.

Table 7.1.8 Analysis of EIA Requirements for the Project

Main components of the project	Category of EIA requirement according to the Egyptian system	Category of EIA requirement according to the JICA system
Railway and busway public transportation.	**Grey List** (Category 2) Mass transit systems of lengths 50 km or less, including underground, bridges, and tunnels; Railway lines of a length of 50 km or less.	**Class B List** (Category 2) Projects having less significant impacts than the Class A List, generally site specific. (Also, possible Class A List projects that require an EIA to be undertaken under the recipient county's legal system.)
Inter-modal railway stations and bus terminals developed as part of the railway project.	**No specific requirement**	**Class B List** (Category 2) Projects having less significant impacts than the Class A List, generally site specific. (Also, possible Class A List projects that require an EIA to be undertaken under the recipient country's legal system.)
Inter-modal railway stations and bus terminals developed as part of urbanization projects.	**Black List** (Category 1) Urban development projects within urban areas	**Class A List** (Category 1) Projects requiring an EIA under the recipient country's legal system.

Source: Guidelines for Egyptian Environmental Impact Assessment (undated), and JICA Guidelines for Environmental and Social Considerations (2004)

7.2 General Presentation of the Pre-EIA Study

7.2.1 Objectives of the Pre-EIA Study

The JICA Study Team sub-contracted the execution of a pre-EIA study to a local Egyptian consultant. The pre-EIA study provided a scoping of the potential impacts on the environment of the railway and busway projects. The main objectives of the pre-EIA study were:

- To evaluate, through a scoping approach, the impacts of the project on the environment, and to identify the key issues and investigation priorities;
- To propose recommendations for the EIA for the project, which may need to be executed when project the project is implemented;
- To assist with the planning process for the project through integration of the environmental conditions in the proposed location of the alignment, in order to minimize the potential impacts of project location at an early stage;
- To provide a preliminary plan for environmental management of the project; and
- To confirm that the project will be environmentally sound and sustainable, and will conform with and significantly contribute to achievement of the environmental policy objectives of GCR.

The project area for the pre-EIA study was the corridor area along the proposed alignments for the railway and busway. The project area is not exactly delimited, but takes into account the areas that might possibly exposed to the potential impacts of the project along the

proposed alignments. The areas covered for the analysis of the environmental conditions of the project area in the pre-EIA are the proposed transportation corridors. More focus was placed on the environmentally sensitive areas that were identified along these corridors.

7.2.2 Conditions and Methods of Execution of the pre-EIA Study

The pre-EIA study was carried out in accordance with the Guidelines for Egyptian Environmental Impact Assessment (EEAA), and the Guidelines for Environmental and Social Considerations (JICA). Field surveys were conducted in the pre-EIA study as follows:

(1) Environmentally valuable assets: A field survey was conducted in May, 2008 to identify street trees and urban vegetation, cultural assets, and urban amenities along the proposed railway and busway alignments.

(2) Noise and air quality: A field survey for measuring ambient air quality and noise levels was conducted in three (3) locations: Behouth Sudan Street, Haram Hospital (Pyramids Road), and Mariuteya Street (in the opposite direction on Pyramids Road). Selection of these sampling locations was done in order to compliment the existing measurement data provided in the CREATS Study (2003), and to collect other pertinent data, such as the ambient measurements that are required to be done in the project area by the Egyptian Environment Affairs Agency (EEAA). Sampling was done for 24 hours on working days between 13 and 15 May, 2008.

(3) Social environment: A social survey was undertaken through group discussions held with people knowledgeable of the project area, or who might potentially be affected by the project. The objective was to make a preliminary assessment of the local social conditions and people's perceptions of the project. The social survey was conducted between mid-May and the end of May, 2008 in 3 locations: 6th of October, Pyramids Road, and Behouth (Boulak El Dakroor informal area). A total of 9 discussion groups were formed, of which only one comprised a mix of men and women. This mixed group contained 61people (35 men, 26 women). Records of discussions in the social survey were summarized in Table 7.2.1.

Table 7.2.1 Record of Discussions by Focus Groups

Participants	General Opinion of Present Conditions and Project	Recommendations by the Participants
6th of October		
- 3 focus groups - 27 participants including 11 women (mainly from a sports club), composed of local residents, mainly young people and low income workers, but also students.	- Participants are not satisfied with the transportation, education, job opportunities, and health services. - Lack of transportation is negatively impacting residents as restricting access to job opportunities. - Women and university students suffer the most from the lack of mobility means. - The project will help in improving present living conditions, particularly transportation. - Participants consider that the no-project alternative would be unacceptable, stressing the very high priority of the project.	- The first phase of the railway development should include a section between 6th of October and Al-Ramayah square. - The railway development will be designed as the underground metro in 6th of October to avoid noise and to keep landscape. - Busway and railway will be extended to reach inside the industrial zone of 6th of October, because of the existing demand.
Boulak El Dakroor informal area (Behouth)		
- One focus group - 9 participants including 5 women - Participants from local residents with very low income and informal work along the railway corridor and Sudan street. - Most of participants come from Upper Egypt	- Participants consider the project as a potential threat to their livelihoods, and particularly as a concern for expulsion from the area. They do not expect any particular benefits from the project. - Alignment of the project has been modified during pre-EIA and will not concern directly this informal area. This area includes a very poor slum area with no electricity, no sewage system, and tap water system.	- Participants are not ready to accept the project, excepted if properly compensated with better conditions of living in the same area.
Pyramids road area		
- 5 focus groups - 25 participants including 13 women - Participants from high income residents of the Pyramids road area, and low income residents in the areas between Faysal road and Tersa road	- The project considered as having adverse impacts on living conditions (noise, landscape), and property values. It may affect the historical value and aesthetic value of the Pyramids road. The project will affect the tourism potential, and valuable landscape along the way to the Pyramid area. - In addition, the project is considered as a factor to cause the adverse impact of night (night clubs) and garbage collection. - Participants of residential zones along the Pyramids road could however see more advantages of the project and would agree on the project in terms of job opportunities during construction. - They are positive for better mobility and the better access to 6th of October. They perceive the cultural value of Pyramids road as important but less than the priority of expected job opportunities.	- The residents of Pyramids road will not tolerate the railway passing through their streets, unless it is underground. The residents of Pyramids road will apply every means to prevent this project. - For residents living in backward areas, the no-project alternative is not a desirable solution. They recommend however that the project should be designed as underground metro.

Source: Pre-Environmental and Social Impact Assessment Study, JICA Study Team, 2008

7.3 Description of the Project and Impact Sources

The predicted number of passengers for 6th of October corridor is summarized in Table 7.3.1 below.

Table 7.3.1 Predicted Number of Passengers for Target Years (Passengers / Day)

Item	2012	2017	2022	2027
Railway	x	425,800	677,600	995,800
Busway	100,800	157,400	209,200	229,700
Total	100,800	583,200	886,800	1,025,500

Source: JICA Study Team

The main infrastructure components of the project, which are detailed in other chapters of the Pre-F/S, are summarized in Table 7.3.2. The main structural components are:

- Elevated (viaduct) structures for the railway and busway;
- Tunnels for the railway;
- At-grade rail tracks and bus lanes;
- Bus terminals, bus stops and railway / Metro stations; and
- Depots with workshops at 2 locations.

The proposed elevated structures for the railway and busway projects are a 9 m width dual rail tracks or lanes on viaduct bridges, supported by single-pole concrete piers having a height of 8 m above the ground. The total length of the elevated structures will be 13.8 km for the railway, and 4.8 km for the busway. The proposed tunnels on the railway are 14 m diameter (single track) or 20 m diameter (double track) shield tunnel, situated at a depth of 10 to 30 m below the ground surface. The total length of these tunnel sections will be 7.5 km.

The main source of potential adverse impacts of the project will be related to the elevated viaduct structures and the stations or terminals proposed for the busway and railway. These structures might have impacts on the environment because they are located in the densely inhabited zones within the project study area.

Table 7.3.2 Outline of the Project, as used for the Pre-EIA Study

Item	RAILWAY (Transportation Corridor Option 5 / 40.5 km)		BUSWAY (Transportation Corridor Option 3 / 35.6 km)
Main project and implementation phase	Metro Line 4 Extension Phase I: El Malik El Saleh (1) – Grand Egyptian Museum (10)	Metro Line 4 Extension Phase II: Grand Egyptian Museum (10) - El Wahat Road (11); and 6th of October Line El Wahat Road (11) – Bank Street (24)	26th July Busway Behouth (A) – Bank Street (24)
Target year	2017	2022	2012
Track or road lane infrastructure	Underground structure El Malik El Saleh (1) – Giza Square (3) and Pyramid (8) – Grand Museum (10), 7.5 km length Elevated viaduct Giza Square (3) – Pyramid (8), 6.2 km length	At-grade structure Grand Museum (10) – Misr University (19), 17.7 km length Elevated viaduct Misr University (19) – Bank Street (24), 7.6 km length	At-grade full segregated busway Behouth (A) – Gamaet El Dowal (B), 0.8 km length (including Behouth bus terminal, 0.6 km) Full segregated viaduct type busway Gamaet El Dowal (B) – 26th July Road, 1.8 km length At-grade full segregated busway Crossing the 26th July Road – Triangle El Bashtir (Imbaba), 0.4 km length Full segregated viaduct type busway Triangle El Bashtir (Imbaba), - 26th July Road, 2.8 km length At-grade median full segregated busway 26th July Road, 12 km length At-grade side full segregated busway 26th July Road, 22 km length
Station and terminal infrastructure	Underground inter-modal station: 1 station, El Malik El Saleh (1) Intermediate underground stations: 5 stations (2-3 and 8 to 10) Intermediate elevated railway stations: 4 stations (4-7)	Elevated 9th District Central station (22) Intermediate elevated stations 5 (20-24 except 22) Intermediate at-grade stations 9 (11-19)	Bus terminal Behouth (A), Bank Street (13) Elevated bus station Gamaet El Dowal El Arabia (B), Imbaba (C) At-grade intermediate bus stations
Depot infrastructure	x	Depot of 15 ha in the desert area (near 11 Al Wahat Road), with car washing track, workshop, but no paint maintenance.	Depot in industrial zone (near 24).
Rolling stock / bus fleet	Heavy rail type train without locomotive: 6 coaches, 12 trains / hour day on one way (5.15am to 23.15pm); Passenger capacity per train: 942 = transportation capacity of 20,300 persons / hour	Heavy rail type train without locomotive: 8 coaches, 13 trains / hour day on one way (5.15am to 23.15pm): 159 trains / day / direction; Passengers capacity per train: 1266 = transportation capacity of 30,400 persons / hour	New bi-articulated buses (24.52 m length, 5 doors), Year 2012: 36 to 140 buses per hour in 2009-2012; Year 2017: Increasing the number of buses to 210 buses per hour in 2013-2017.
Power, speed, signaling system	Electric power, average speed of 37.2 km/h	Electric power, average speed of 39.8 km/h (low speed trains) and 54.6 km/h (high speed trains).	Power supply: diesel fuel.
Facilities	Power supply equipment, signaling system (ATC), operating control center (CTC).	Power supply equipment, signaling system (ATC), operating control center (CTC).	x

Source: JICA Study Team

7.4 Environmental Impact Assessment (EIA) Procedure

7.4.1 Procedure

Based on the results of the IEE and pre-EIA, it was concluded that the project will be classified as a Grey List project. However, the Egyptian Environment Affairs Agency (EEAA) is the agency responsible for deciding which type of EIA and which level of detail it is required. As a Grey List project, the EIA procedure will be based on the project proponent's submission of an Environmental Screening Form B, to the competent administrative authority (CAA), for review by the EEAA. The proponent of this project is not yet established, although the Ministry of Transport is the CAA for mass transit systems and railway lines having a length of 50 km or less. This criterion will apply to the current project, according to the Egyptian EIA guidelines.

The CAA will submit the completed Screening Form B directly to the EEAA for evaluation. The EEAA must provide an assessment of the proposed environmental outline of the project within 60 days and, if necessary, request studies for assessment to be made of the impacts on the environment. If environmental impact assessment studies are not requested, the project is considered to have been accepted by the EEAA, and the CAA in charge of the project is allowed to authorize the project from the environmental point of view.

7.4.2 Recommendations

The recommended procedure is that the CAA in charge of the project submits the completed Screening Form B to the EEAA, together with the pre-EIA study as an attachment. Submitting the pre-EIA study report could help the EEAA to understand the important issues and to decide if a formal EIA will be required.

Public consultation is not mandatory in the Egyptian EIA procedure. However, it is recommended to implement such consultation through the social surveys whether or not an EIA is required, and to organize public hearings in the areas where inhabitants will be clearly affected by the realization of the project. This is because the JICA guidelines require that local NGOs and affected people be consulted as stakeholders of the project in any case.

7.5 Present Environmental Conditions in the Study Area

7.5.1 Screening of Most Sensitive Zones in the Study Area

Since the project area is very large, it was considered useful to undertake a screening of the geographical areas affected by the project, in order to select the most sensitive ones and focus the pre-EIA study on these sensitive areas. By taking this approach, the analysis of the present conditions and potential impacts of the project covered both the overall project area at a general level of detail and the sensitive areas in specific detail.

The method of screening that was undertaken was to the review of the project sections defined previously in Table 7.3.1 according to environmental sensitivity criteria. Only Phase I of the project implementation was considered relevant for screening because the Phase II

development, which involves construction of the 6th of October Line railway, will be done within the busway corridor that is constructed in Phase I. The environmental sensitivity criteria used were those presented in Law 4/1994 for the purpose of determining the EIA needs of projects. Exception for the criteria referring to the type of activity or project, all of the other criteria were directly representative of the environmental, resource, and energy sensitivity conditions. These criteria were therefore suitable for the purpose of screening the sensitive regions in the project area. Table 7.5.1 is a summary of the relevant criteria in Law 4/1994.

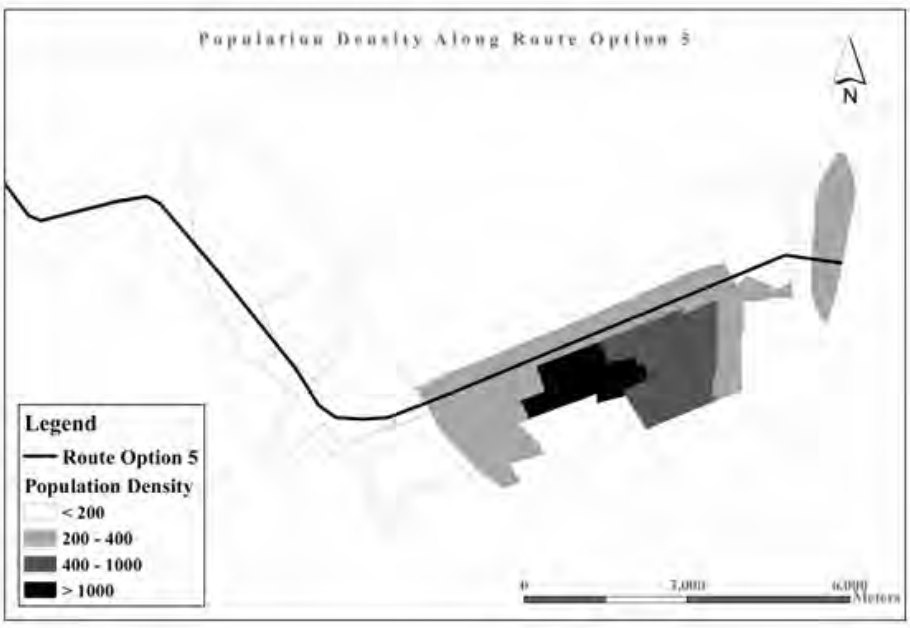
Table 7.5.1 Relevant Sensitivity Criteria Used for the Determination of EIA Requirements in the Egyptian EIA System

Category	Criteria
Depletion	1.Denudation of agricultural land
	2. Desertification
	3. Destruction of trees, palm trees
	4. Pollution of water resources (River Nile, groundwater)
Location	5. Banks of the River Nile
	6. Branches of the River Nile or main canals
	7. Tourist areas
	8. Antiquities sites
	9. Nature reserves
	10. Densely populated areas

Source: Law 4 / 1994

(1) Sensitivity screening in the project area for the Metro Line 4 railway

Screening was done for the Metro Line 4 railway only, because 6th of October Line will be undertaken in Phase II of the project implementation. Table 7.5.2 provides the screening results. This table shows that 3 project sections have sensitivity concerns. However, only the Giza Square - Pyramids sector is particularly sensitive because of the proposed project design, which is a viaduct bridge. Figure 7.5.1 shows the alignment of the proposed railway Metro Line 4 in the urban area (CBD), along with the population density of administrative units.



Source: JICA Study Team

Figure 7.5.1 Population Density along the Proposed Metro Line 4 Railway in the Urban Area (CBD)

Table 7.5.2 Screening of Sensitive Zones in the Metro Line 4 Railway Project Area

Project sectors	Sensitivity criteria				
	1	3	7	8	10
Underground structure / El Malik El Saleh (1) – Giza Square (3), 2.5 km length					x
Underground inter-modal station / 1 station, El Malik El Saleh (1)					
Elevated viaduct / Giza Square (3) – Pyramid (8), 5 km length		x	x		x
Underground structure / Pyramid (8) – Grand Museum (10), 2.5 km length			x	x	
Intermediate underground stations / 5 stations (2-3 and 8 to 10)					
Intermediate elevated railway stations / 4 stations (4 -7)					

Source: JICA Study Team

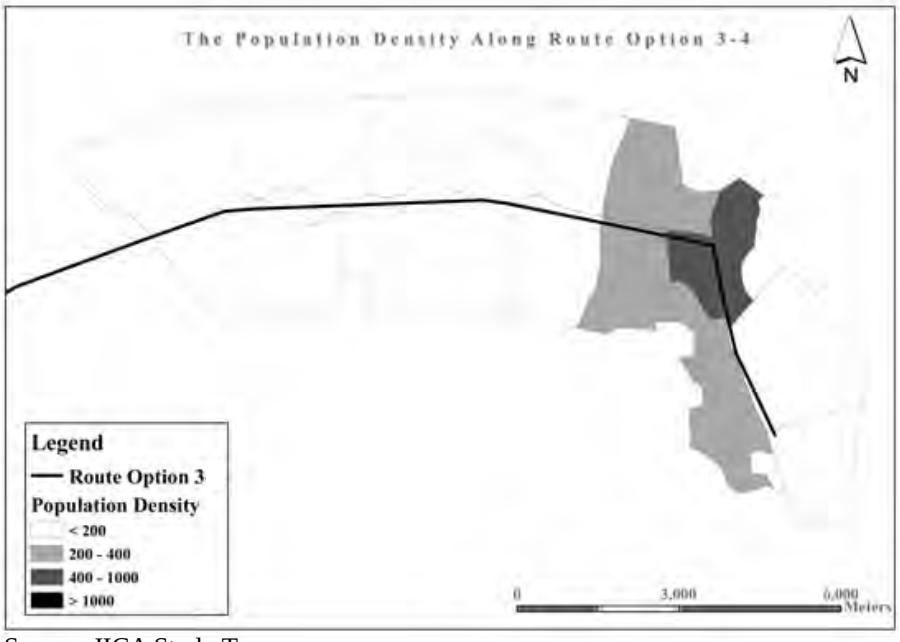
(2) Sensitivity screening in the project area for the busway adjacent to 6th October Line

Table 7.5.3 shows that six (6) project sections have sensitivity concerns. Among these sections, the most sensitive are the viaduct bridge sections which pass through areas having a high population density, specifically the section between the proposed bus terminal in Behouth and 26th July Road. This section mainly comprises the railway corridor between Behouth and El Bashtir, and the isolated residential area of Ard Elwaa, west of El Bashtir. Figure 7.5.2 shows the alignment of the proposed 6th of October busway in the urban area (CBD), along with the population density of administrative units.

Table 7.5.3 Screening of Sensitivity Zones in the 6th of October Busway Project Area

Project sectors	Sensitivity criteria				
	1	3	7	8	10
Elevated bus terminal Behouth (1), 105 m length					x
Full segregated viaduct type busway Behouth (1) – Gamaet El Dowal (2), 0.8 km					x
Elevated bus station Gamaet El Dowal El Arabia (2)					x
Full segregated viaduct type busway Gamaet El Dowal (2) – 26th July Road, 1.8 km length		x			x
At-grade full segregated busway Crossing the 26th July Road – Triangle El Bashtir	x				
Elevated bus terminal Triangle El Bashtir (C)					
Full segregated viaduct type busway Triangle El Bashtir (C) - 26th July Road, 2.8 km	x				x
At-grade median and roadside busway 26th July Road, 34 km length					

Source: JICA Study Team



Source: JICA Study Team

Figure 7.5.2 Population Density along the Proposed 6th of October Busway in the Urban Area (CBD)

7.5.2 Environmental Conditions in the Most Sensitive Areas

(1) Railway corridor between Behouth and El Bashtir

The Behouth Metro Station lies at the intersection of El Tahir Road and El Sudan Road, on the eastern side of the north-south axis of the railway and canal corridor. Figure 7.5.3 shows a general view of the railway corridor. This corridor area is physically and socially complex because of the following factors:

- Informal dwellings, business units (shops, markets) and a few private and government buildings are established immediately adjacent to the eastern side of the corridor between Behouth and El Bashtir. These buildings occupy the relatively narrow space between private settlements built along El Sudan Street in the east, and the railway in the west, as shown in Figure 7.5.5. It is estimated that about 3,000 people reside in these settlements, which do not have any public utilities. Most residents of the informal area belong to a minority population coming originally from Sohag Governorate in Upper Egypt.

- A few informal settlements and a large informal market are established on the western side of the corridor, along Zomor Canal.

- There is a contrasting residential land use between the east and west side of the railway corridor. The eastern side, bordering El Sudan Street, is a large high income and low density residential area (Dokki). The western side of the railway corridor is a very extensive low income and high density informal residential area (Bolak El Dakroor).

- The presence of educational or university facilities on both sides of the corridor, between Behouth in the north and Faysal Road and Giza Square in the south.

- There are pressures on developing this corridor into a major axis for transportation, including the urban expressway project and the Metro Line 3 project.

- Agricultural land is cultivated inside and outside the ROW of the railway in the northern part of the corridor, before widening on the El Bashtir Triangle.

- Very intensive pedestrian traffic crosses the railway corridor in this area, with four (4) pedestrian bridges between El Tahir (Behouth) and Gamat El Dewal El Arabia, and only a single pedestrian bridge between Gamat El Dewal El Arabia and El Bashtir.

- The Zomor Canal has vegetated banks in a few places, but is mostly used as a convenient place for illegal dumping of solid waste, as shown in Figure 7.5.3.

Source: JICA Study Team

Figure 7.5.3 Railway Corridor near Behouth, looking south from the Market Place

(2) Pyramids Road

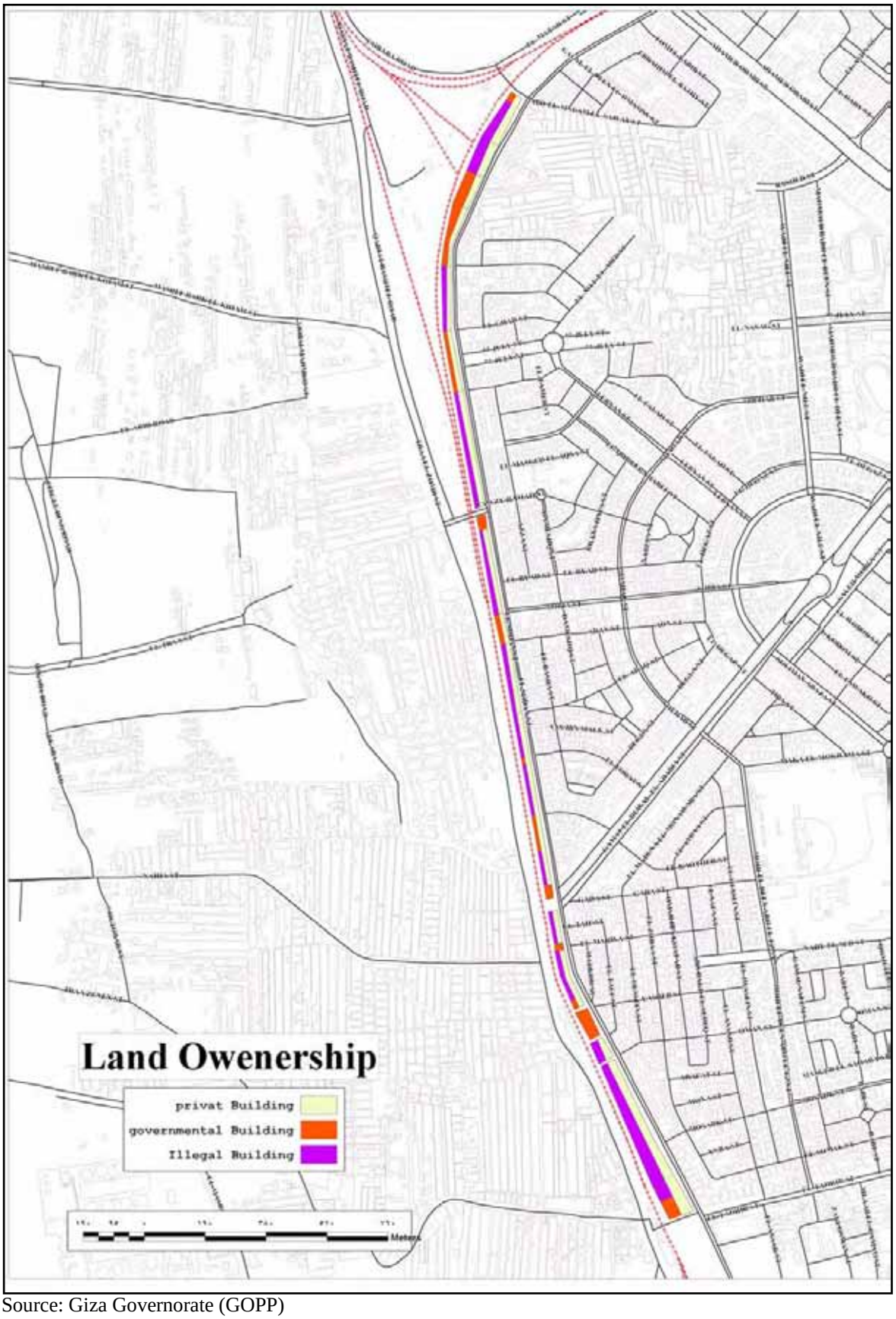
Pyramids Road is a long and wide avenue (about 40 m wide and 5 km long) with a high traffic density and it is congested most of the time. Land use comprises business and residential buildings, with a low density of settlements along the avenue. However, as shown in Figure 7.5.1 above, the population density is very high in the lower income residential zones behind Pyramids Road (Faysal Road, Tersa Street). The western part of the avenue is tourism oriented and leads to the pyramids, as shown in Figure 7.5.4. The avenue crosses two (2) canals in the west (Mansureya Canal and Mariuteya Canal).

The traffic survey conducted for the pre-EIA showed a total traffic volume of 53,242 vehicles over 16 hours for a working day on the Al Haram Road, and 57,777 vehicles on the Faysal Road, which is parallel to it, as shown previously in Chapter 3, Table 3.1.5. The 16-hour traffic fluctuations were shown in Chapter 3, Figure 3.1.22 for Al Haram Road and Figure 3.1.20 for Faysal Road. These figures show a maximum hourly volume of 3,260 and 2,858 vehicles for these 2 roads, respectively.

The social investigations conducted by the local environmental consultant showed that residents living in Pyramids Road perceived the project as being a major nuisance and felt that it would cause a depreciation of the value of their properties.

Source: JICA Study Team

Figure 7.5.4 Western Side of Pyramids Road, with Partial View of a Pyramid



Source: Giza Governorate (GOPP)

Figure 7.5.5 Informal Settlements on the Eastern Side of the Railway Corridor between Behouth and El Bashtir

7.5.3 Natural and Social Conditions in the Project Area

The natural and cultural environment of the project area is summarized in Table 7.5.4.

Table 7.5.4 Natural and Cultural Conditions in the Project Area

Category	Description
Natural and Physical Environment Conditions	- The project area occupies the alluvial plain of River Nile in the east, at an average elevation of 50 m above sea level, and the limestone plateau of Kariet Al Kasheeb in the west, at an elevation that increases westward from 60 m near the Pyramids to 200 m in 6th of October NUC. - The canals in the project area are used for irrigation, and for illegal dumping of waste. The groundwater system of the project area comprises a shallow flood plain aquifer (Nile Alluvium Aquifer) in the east and a deep marginal aquifer in the Miocene layers of the plateau area (Moghra Aquifer) in the west. The River Nile groundwater reservoir is particularly sensitive to the surface pollutants. The Moghra aquifer is a deep, confined aquifer sinking in the synclinal layers to the west, with recharge by deep percolation from the Nile Alluvium Aquifer. - The proposed railway and busway alignments avoid the existing natural protected area and archaeological areas. However, the railway alignment is located relatively close to the limits of the Qubet El Hassana Dome protectorate (geological scientific heritage), near the 26th July Road. - From the point of view of biodiversity, there is no valuable vegetation or wildlife registered in this area. The proposed alignments do not encroach on cultivated land, excepted along the Zomor Canal and west of the El Bashtir Triangle. Most of these cultivated lands are informal areas within the ROW of the existing railway. However, a few of them are developed on private and these will need to be included in the land acquisition required for the project. - Urban vegetation is ornamental in Pyramids Road, functional on the desert plateau (green belts), and inherited along Zomor Canal and the cultivated lands in the railway corridor. - Ambient noise levels exceed the permitted levels at all times of the day, including night. Ambient air quality is particularly affected by high levels of particulate matter (PM10), as shown by the results of the air quality survey and existing measurement data.
Socio-economic and Cultural Environment Conditions	- There are no registered historical assets along the proposed railway and busway alignments. Near the pyramids and archaeological area, the railway will be designed as a tunnel section. - There are very few cultural assets or urban amenities along the proposed alignments. There are few mosques, like on the Pyramids Road (West), and near the railway corridor (Behouth). There are possible informal amenities, but no public amenities along the proposed alignments. - Most of social and health facilities in the general vicinity of the project area are located at a reasonable distance from the project boundary. However, some may be located within 200 m of the project boundary. Except for El Haram Hospital on Pyramids Road, there are few social or health facilities along the proposed alignments. - There are high density settlements, low income groups, very low income illegal settlements, and minority groups living along the proposed alignments, particularly in the busway project area.

Source: JICA Study Team

Table 7.5.5 shows the average population and population density in the urban CBD area within the vicinity of the project alignments for 200 m and 600 m wide corridors on both sides of the alignments. These data are based on the population by *shiakha* (minimum administrative units) provided in the latest Census by CAPMAS in 2006. In the case of the railway, the railway project area has a population of 116,000 (or 212 people per ha) within the 200 m corridor. This demonstrates that the area has an acute sensitivity to the possible positive or negative impacts of the project.

Table 7.5.5 Average Population and Population Density in the Vicinity of the Project Alignments

Areas	Railway		Busway	
	200 m corridor	600 m corridor	200 m corridor	600 m corridor
Urban CBD area crossed by the proposed project	116,311 (212)	412,904 (245)	110,703 (191)	310,318 (176)

Unit: Number of people, and the density inhabitants / ha (in parenthesis).
Source: Census, 2006, CAPMAS

7.6 Impact of the Railway Project on the Environment

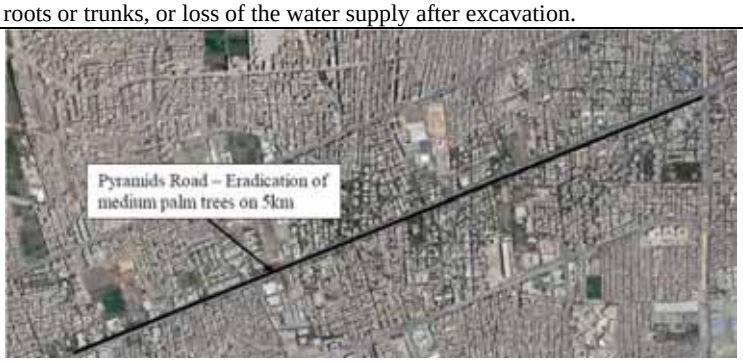
7.6.1 Adverse Impacts of the Railway Project

Checklist tables matching the JICA criteria for reviewing environmental impacts were prepared for the railway project. The potential impacts for physical, natural, socio-economic, and cultural environment induced by the railway project are summarized in tables presented in Annex 2 of this report. The main potential adverse impacts that may be induced by the railway project were identified by referring to the JICA criteria, as summarized below:

- Discharge of drainage water and wastewater;
- Loss of trees and possible damage to urban vegetation;
- Emission of dust and air pollutants from vehicle exhaust during construction;
- Worsening of ambient noise;
- Generation and management of solid waste;
- Generation and disposal of hazardous waste and substances; and
- Change in the urban landscape and the living environment

These impacts are largely related to the construction phase of the project and can be mitigated by various measures to some extent. The most obvious impact that will be difficult to mitigate is the change in the urban landscape and the living environment of the nearby residents along Pyramids Road. This road provides the main access to the pyramids, which makes the area more sensitive to potential impacts of the project. The El Malik El Maleh – Giza Square section and 6th of October section will mostly be affected by nuisances caused by the construction works. Detailed descriptions for the main potential adverse impacts induced by the railway project are described in Table 7.6.1.

Table 7.6.1 Main Potential Adverse Impacts induced by the Railway Project

Item	Description
Discharge of drainage water and wastewater	- Drainage water extracted from the tunnel boring works in the El Malik El Saleh – Giza Square section will be discharged into the sewer system to avoid any possible pollution of the surface water. Wastewater generated by the washing unit of the railway depot will be discharged into the urban sewerage system after pre-treatment (separation of solids and oil). A water recycling system and water saving measures will be included in the environmental management plan for the depot within the scope of EIA.
Loss of trees and possible damages to urban vegetation	- Street trees are valuable assets for air purification, sequestration of carbon dioxide, urban landscape amenity and quality of the living environment. A large number of palm trees, estimated at about 800 trees, and a few other ornamental trees that have been planted in the median strip of Pyramids Road will be extracted during construction of the elevated railway structure. Roadside trees, which are mainly Acacia and Ficus species, could be affected during the construction work due to soil compaction, damage to roots or trunks, or loss of the water supply after excavation.
	 - The EIA for the project will include a replanting / re-vegetation plan, including the replanting of the palm trees in order to compensate the important loss of trees caused by the project in Pyramids Road, and to minimize the overall loss of vegetation. The objectives of the plantation plan will be the beautification of areas surrounding the railway and railway stations in the CBD and 6th of October, and to contribute to prevent desertification on the desert plateau between the Pyramids and 6th of October (greenbelt protection zone).
Emission of dust and vehicle exhaust air pollutants during construction	- Dust generated by the excavation and construction works may be a major source of nuisance and air pollution for the residents between El Malik El Saleh and the Pyramids, and for visitors to the pyramids. Residential areas are already severely exposed to high concentrations of airborne dust and fine particulates. Mitigation measures like watering and clean transportation of the waste and excavated materials will greatly contribute to minimizing dust emissions during the construction work, and ensure that this impact does not exceed acceptable levels. The potential for worsening the air quality may be an indirect impact of the project, due to changed traffic conditions during the construction works. The resident's who may be particularly exposed to vehicles exhaust air pollutants are those who live along the Faysal Road, and along the streets connecting Pyramids Road and Faysal Road. The traffic diversion plan should contribute to an optimal dispersion of the air pollutants. Even so, the impact of construction work will only be temporary.
Worsening of ambient noise	- The present traffic condition between El Malik – El Saleh and the pyramids is a major source of permanent high noise levels that are already above permitted levels. The operation of the railway project is a potential source of noise impact, more particularly at night, but ambient noise should not be significantly affected after countermeasures like speed control, selection of BAT (Best Available Technology) with reduction of noise and vibrations at the source, and if needed, installation of noise barriers. The EIA for the project will include a noise prediction study for the railway in order to establish the potential impacts and identify the residents who will most likely be affected, and to determine appropriate mitigation measures. The morphology of Pyramids Road, which is a large avenue lined by low density medium height buildings and open spaces, makes it practicable to achieve reduced noise levels at the roadside by using an elevated railway line. However, noise could be perceived as a major issue by the residents, because ambient noise levels are relatively high, and because the existing Metro lines in Cairo are particularly noisy. The social surveys and community consultation in the EIA done for the project will clarify the resident's perception of the project in regard to noise, and help to

	develop their awareness of the noise reducing technologies to be incorporated into the project design. - Construction work, including the tunneling works, and the indirect effects of traffic diversion and traffic congestion, may be a major cause of worsening ambient noise levels in residential areas along the project route and the traffic diversion roads. Measures to mitigate these impacts will be implemented, based on appropriate working time schedules and effective traffic diversion plans. Construction in the densely inhabited areas will cease at night. Sensitive areas like the El Haram Hospital, in the pyramids area, will need specific measures to be implemented to limit noise impacts as much as possible.
Generation and management of solid waste	- Solid waste management is an issue that is mainly related to the construction phase of the railway project. Waste generated by the project will include earth and waste materials generated by excavation and clearing in Pyramids Road and 6th of October, sediment contained in water pumped from underground during tunnel boring work in El Malik El Saleh – Giza Square, and waste rock derived from tunnel boring in the plateau area. Transportation of waste and excavation material will be done so as to prevent debris falling onto the roads. In the event that unexpected waste material is excavated in the desert area between the pyramids and 6th of October, appropriate measures for sanitary disposal will be undertaken. - The illegal dumping of urban waste, demolition and construction waste is currently a major source of environmental degradation and nuisance in Cairo. The overall project will be implemented with a good management of solid waste in order to avoid any adverse impact on the environment. The project design will evaluate the expected quantities of solid waste and provide a management plan for waste reduction at the source, waste collection, waste separation, and appropriate disposal. - Urban refuse which will be generated during construction in the work camps and during operation in the railway stations will be properly managed. The project design will estimate the volume of urban refuse generated during operation of the railway and make recommendations for collection and disposal. (At the time of writing, it was not possible to receive data about the volume of waste generated per year in the existing Cairo Metro network.)
Generation and disposal of hazardous waste and substances	- The proper handling and disposal of hazardous waste and substances in the depot / workshop of the railway, which will be located on the plateau area away from the residential zones, will be a critical issue in order to avoid illegal dumping of hazardous waste or accidental spillage of substances. The prevention of accidents and health hazards and the promotion of a healthy and safe working environment will be integrated in the environment management plan of the depot / workshop site.
Change in the urban landscape and the living environment	- Changes in the urban landscape and the living environment will be the major impact of the railway project in the Pyramids Road area. The construction of the elevated railway structure will affect the greenery, appearance of the landscape, the feeling of open space, the natural lighting conditions, and sometimes the privacy of residents. Use of the space left under the elevated railway after construction is also likely to affect the life of some residents. Pyramids Road is large enough to limit the direct physical impacts of the railway's elevated structure on the roadside residents, but it remains difficult to predict the importance of this impact for them. The residents who were previously involved in the focus group discussions undertaken during the pre-EIA were not yet ready to accept the project. The project design will include a detailed study of the landscape and living environment issues in this area, including a survey of the resident's perception of the project. The mitigation measures that can be undertaken will generally be limited to compensation for changes to the quality of the living environment. For example, by providing suitable architectural design of the railway and stations, incorporating landscaping works, and the provision of pedestrian facilities. These measures will be planned in coordination with local residents and NGOs. - The underground section of the project near the pyramids will prevent any adverse impact on this historical cultural landscape. For the visitors, the project should not produce any affect the actual landscape or the World Heritage Area of the Pyramids, nor cause any special affect on the view of the pyramids from the road. However, in the elevated section of the railway, the present landscape might be considered to be degraded by a few residents who currently have an unobstructed view of the pyramids or perceive the open space of the avenue to be a valuable landscape feature of Cairo. Pyramids Road is generally considered as an historical corridor for Cairo, with tourism and landscape potential. From this point of view, the project will definitively affect this potential. However, through the provision of enhanced rail services, this affect will likely be positive rather than negative.

Source: JICA Study Team

7.6.2 Comparative Analysis of the Impacts of the Railway Project

Comparison of the adverse impacts between the "*with*" project and "*without*" project implementation alternatives is useful in order to provide a different viewpoint of the magnitude of the impacts at the regional level for transportation in GCR. The specific items that have been selected for comparison are energy efficiency, air pollution emissions, and CO_2 emissions.

(1) Air pollution levels with and without implementation of the project

Egyptian vehicle emission levels are currently studied by the EEAA in association with JICA within the scope of the REMIP project (Regional Environmental Management Improvement Project). In this study, the emission levels set in Japan are being used. These emission levels largely underestimate the vehicles emissions in Egypt and are not appropriate for use in air pollution prediction studies. However, the Japanese emission levels are meaningful for the purpose of comparing emissions between the "*with*" and "*without*" project conditions for the railway and for providing a different viewpoint for estimating the potential impacts of the project. Table 7.6.2 provides the emission levels for the target years 2012 and 2017, and for the average speeds of 20 and 30 km/hour. These are the conditions which are relevant for the project. The average speed of cars and buses established in the traffic analysis is in a range between 23 to 25 km/h. Vehicle emissions levels are not available for the year 2022. Therefore, evaluation for the target year 2022 is based on the 2017 emission levels. The air emission parameters that were considered are nitrogen oxides (NOx), suspended particulate matter (SPM), carbon monoxide (CO), and sulfur dioxide (SO_2). However, NOx and CO are specifically significant parameters for transport-source pollution.

Table 7.6.2 Vehicles Air Pollutants Emission Levels (g/km/Vehicle) in Japan

Year	Average speed (km/h)	NOx		SPM		CO		SO_2	
		Small	Large	Small	Large	Small	Large	Small	Large
2012	20	0.132	2.26	0.008	0.117	0.689	1.52	0.014	0.054
	30	0.109	1.82	0.007	0.095	0.558	1.22	0.012	0.046
2017	20	0.118	2.08	0.007	0.107	0.636	1.45	0.012	0.033
	30	0.097	1.67	0.006	0.0086	0.510	1.15	0.01	0.028

Note: Small means small sized vehicles; Large means large sized vehicles.
Source: Japan Highway Environment Research Institute

Passenger car unit data were estimated by the JICA Study Team in the traffic analysis study. The relevant data are summarized in Table 7.6.3 for cars and buses and in the target years 2017 and 2022.

Table 7.6.3 Passenger Car Kilometers (PCU x km) for GCR with and without Implementation of the Railway Project

Category	2017		2022	
	With	Without	With	Without
Car	47,020,753	47,032,524	74,521,898	74,556,208
Bus	12,411,146	12,638,388	12,271,681	13,372,279
Total	59,431,899	59,670,912	86,793,579	87,928,487

Source: JICA Study Team

Predicted air emissions induced by road traffic in Greater Cairo with and without implementation of the railway project are compared in Table 7.6.4. It is assumed that the

resulting emission quantities are largely underestimated due to the use of the emission levels from Japan. However, they provide a good indicator of the relative impact of the project for comparing the "*with*" and "*without*" project alternatives. The comparison shows that implementation of the project has quite a positive effect on reducing air pollution emissions for GCR. Transport emissions savings due to the project are significant in 2022, with a potential abatement of about 6% for NOx and SPM, and between 2% and 3% for CO and SO_2.

Table 7.6.4 Simulation of Daily Air Emissions and Emissions Savings with and without Implementation of the Railway Project in Target Years 2017 and 2022 for GCR (in Kilograms)

Category		2017			2022		
		With	Without	Saving	With	Without	Saving
Average speed 20 km/h	NOx	31364	31838	474	34319	36612	2293
	SPM	1657	1682	25	1835	1953	118
	CO	47901	48238	337	65190	66808	1618
	SO_2	974	981	7	1299	1336	37
Average speed 30 km/h	NOx	25288	25668	380	27722	29564	1842
	SPM	389	391	2	553	562	9
	CO	38253	38521	268	52119	53402	1283
	SO_2	818	824	6	1089	1120	31

Source: JICA Study Team

(2) Energy efficiency and fuel consumption

Improving energy efficiency is a major challenge for Egypt's energy management policies. The energy intensity coefficient has been set at 0.53. The transport sector represents 28% of the final total energy consumption and 40% of total petroleum based consumption (SOE report, 2006). Increasing energy efficiency is a very desirable objective for improving environmental performance, in terms of conservation of natural resources, abatement of pollution emissions at the source, contribution to the decrease in greenhouse gas emissions, and energy savings. A comparison of the energetic performances of the "with" / "without" project scenario is a useful criterion for evaluating the regional impact of the project on the environment. However, mobile fuel consumption savings could not be estimated due to the lack of data.

The energy use factors for passenger transportation are not available for Egypt. Therefore, the energy consumption units for passenger transportation modes for 2002 in Japan were used as a substitute. The use of these data for the Cairo transportation system necessarily results in an underestimation of values of energy use, but are meaningful in order to compare the "*with*" / "*without*" project alternatives. The energy use factors considered in the analysis are shown in Table 7.6.5. The relevant data for passenger units that were used for the comparison are those of the traffic analysis study, as summarized in Table 7.6.6.

Table 7.6.5 Energy Use Factors for Passengers Transportation Modes in 2002 in Japan (MJ/Passenger/km)

Cars	Bus	Rail
2.407	0.807	0.186

Source: Japan Research Institute on the Economy of Energy

Table 7.6.6 Passenger Kilometers (passengers x km) for GCR with and without Implementation of the Railway Project

Category	2017		2022	
	With	Without	With	Without
Car	59,844,595	59,859,576	94,846,052	94,889,720
Bus	144,410,035	147,115,269	142,185,309	155,930,029
Rail	47,142,095	45,115,171	64,955,713	52,864,019
Total	251,396,725	252,090,016	301,987,073	303,683,768

Source: JICA Study Team

The results of the comparison are shown in Table 7.6.7. This table shows that implementation of the project improves energy efficiency of transport in GCR. Energy savings of the "*with*" project amount to about 2.4% compared with the "*without*" project alternative in 2022.

Table 7.6.7 Simulation of Compared Daily Energy Needs and Energy Savings with Implementation of the Railway Project in Target Years 2017 and 2022 for GCR (in MWh)

Category		2017			2022		
		With	Without	Saving	With	Without	Saving
Road transport	Car	40013	40023	10	63415	63444	29
	Bus	32372	32978	606	31873	34954	3081
	TOTAL	72385	73001	616	95288	98398	3110
Rail transport		2436	2331	-105	3356	2731	-625
TOTAL		74820	75332	512	98644	101130	2486

Source: JICA Study Team

(3) Comparative carbon dioxide emissions

Egypt has ratified the Climate Change Convention and has integrated the objective of greenhouse gas (GHG) emission reductions in its sectoral policies. The transportation sector is regarded as contributing about one quarter of the total CO_2 emissions in Egypt. The net impact of the project on GHG emissions, and its potential contribution to decrease them, is an important criterion for evaluation of the environmental performance of the project.

The method of evaluation that was used is based on the average CO_2 emission levels for road transportation modes in Japan (Table 7.6.8), and on the predicted energy use factors for passengers transportation modes in 2002 in Japan (Table 7.6.5). The traffic data used for evaluation are the passenger car kilometers for road transport (PCU x km) and the passenger kilometers for rail transport (passengers x km). Railway transportation for electric railways has a zero CO_2 emission in the transport sector. However, the net budget of CO_2 emissions "*with*" and "*without*" the project must take into consideration the indirect emissions through energy use, which is done by the electricity emission factor related to the power generation process.

The electricity emission factor for Cairo was set at 473 gCO_2eq / kWh, according to the United Nations GHG Inventory Estimate from 2007 (using data from the World Resources Institute, 2006). After conversion to rail energy use (energy use factor for rail listed in Table 7.6.4), the CO_2 emission level for rail is calculated as 24.431g / passenger / km. This unit was applied to the passenger kilometer data (passengers x km) of Table 7.6.6, to evaluate the railway induced emissions.

Table 7.6.8 Average CO_2 Emission Levels (g/km/Vehicle) in Japan

Average speed (km/h)	Car	Bus
20	221	781
30	177	660

Source: Japan Research Institute on the Economy of Energy

Table 7.6.9 provides the results of the comparison of the "*with*" and "*without*" project cases for road transport emissions of CO_2, showing a net saving of 3.2% of emissions in 2022, at 20 km/h speed average, for the case of project implementation. Table 7.6.10 shows the results for passenger rail transport emissions and for the net budget of emissions after integration of road transport emissions. The net budget is a saving of about 2% of total CO_2 emissions in the case of project implementation.

Table 7.6.9 Simulation of CO_2 Daily Emissions from Road Transport and Emissions Savings with Implementation of the Railway Project in Target Years 2017 and 2022, for GCR (in Tons)

Category		2017			2022		
		With	Without	Saving	With	Without	Saving
Average speed 20 km/h	Car	10392	10394	2	16469	16477	8
	Bus	9693	9871	178	9584	10444	860
	TOTAL	20085	20265	180	26054	26921	867
Average speed 30 km/h	Car	8323	8325	2	13190	13196	6
	Bus	8191	8341	150	8099	8826	727
	TOTAL	16514	16666	152	21290	22022	732

Source: JICA Study Team

Table 7.6.10 Simulation of CO_2 Daily Emissions from Rail Passenger Transport and Total Net Emissions Savings with Implementation of the Railway Project in Target Years 2017 and 2022, for GCR (in Tons)

Category	2017			2022		
	With	Without	Saving	With	Without	Saving
Road transport (20 km/h)	20085	20265	180	26054	26921	867
Rail transport	1152	1102	-50	1587	1292	-295
TOTAL: Net budget	21237	21367	130	27641	28213	572

Source: JICA Study Team

7.7 Impacts of the Busway Project on the Environment

7.7.1 Adverse Impacts induced by the Busway Project

The potential impacts on the physical, natural, socio-economic, and cultural environment that may be induced by the busway project are summarized in tables presented in Annex 2 of this chapter. The main potential adverse impacts induced by the busway project were identified by referring to the JICA and other criteria, as summarized below:

- Relocation of the ENR settlements of Behouth
- Relocation of the first block of the market in Behouth
- Generation and disposal of hazardous waste and substances
- Generation and management of solid waste
- Loss of agricultural land and trees

- Modification of the crossing patterns for pedestrians
- Emission of dust during demolition and construction
- Worsening of ambient noise
- Change in the urban landscape and the living environment

These impacts are largely related to the construction phase of the project and can be mitigated to some extent by various measures. A few of the impacts are related to the design of the project. These impacts may have important adverse effects if they are not mitigated. However, the effects are still uncertain and need detailed study in the EIA. The busway corridor area is sensitive because of the high population densities and low to very low income groups. The presence of illegal residential settlements near the project site is an additional factor of sensitivity. Relocation of residents to allow construction of the bus terminal could also cause environmental impacts. However, it is worthwhile to note that the route of the busway project has been selected to avoid the need for relocation of illegal residential and commercial settlements located in the railway corridor. More detailed descriptions of the main potential adverse impacts induced by the busway project are shown in Table 7.7.1.

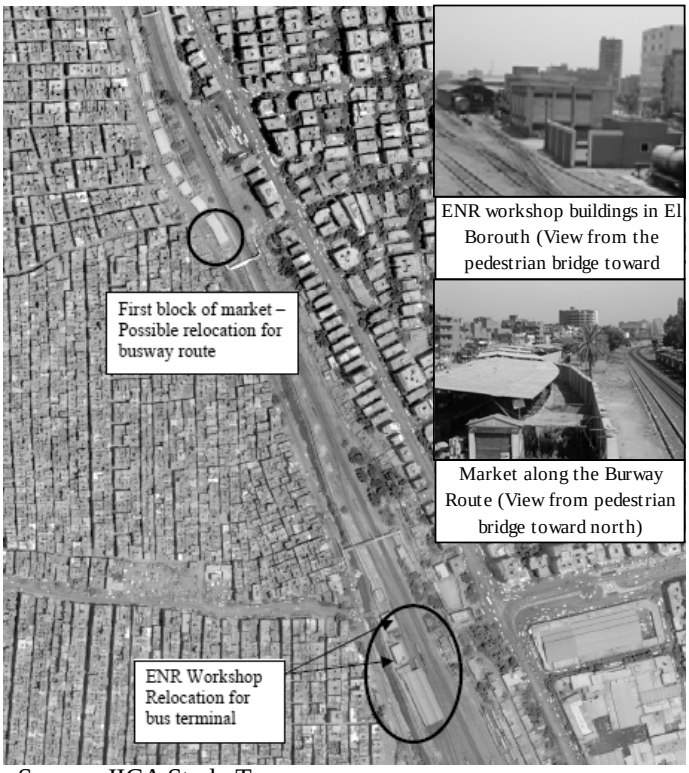
Table 7.7.1 Main Potential Adverse Impacts Induced by the Busway Projects

Item	Description
Relocation of some ENR facilities at Behouth	- The bus terminal and the elevated busway viaduct planned in the railway corridor between Behouth and El Bashtir was relocated to the western side of the ENR railway corridor during the pre-EIA. This relocation has the possibility of inducing any severe or critical potential impacts on the existing illegal communities and settlements established on the eastern side of the corridor (housing, workshops, market and shops). However, the location of the bus terminal at Behouth will induce local impacts where partial removal of the existing ENR workshop facilities is required, as shown in Figure 7.7.1. The workshop facilities are managed by the Ministry of Transport, but are classified as "illegal settlements according to the Giza Governorate (GOPP information). - The ENR workshop site employs about 400 persons and provides services for repair and maintenance of wagons used for freight transportation. From north to south, the ENR workshop facilities comprise a very small unfinished structure, 2 higher buildings having 3 floors each that are used for offices and parts storage, and the actual workshop building, which is a large steel structure. - The workshop building itself is not directly affected by the project location. However, the other ENR buildings must be relocated. Relocation could be difficult because of the lack of available land. The EIA will consider the alternatives for relocation of the workshop facilities in coordination with the Ministry of Transport. The main potential issue related to the relocation of these buildings is the possibility of contaminated soil being present in the current location. This will be thoroughly investigated in the project design.
Possible relocation of the first block of the market in Behouth	- The busway elevated structure north the proposed bus terminal in Behouth will be located alongside the existing market. The Egyptian Building Code (EBC) states that elevated structures such as viaducts have to be built on acquired land after clearance. If the available railway ROW for this project is not large enough, the first block of the market will be directly affected, and it will need to be relocated. The other blocks of the market should not be directly affected by the project.
Generation and disposal of hazardous waste and substances	- The potential impact of the busway project on the generation and disposal of hazardous waste and substances is very important. There are three (3) specific issues that the EIA will focus on: a) The possibility of contaminated soil being excavated when some ENR buildings are relocated; b) The possibility of hazardous waste being encountered in the illegal dump sites along the busway alignment within the railway corridor; and c) The risk of mismanagement of hazardous waste and substances in the Busway Depot / Workshop that is to be constructed in 6th of October.

	- The potential for finding contaminated soil in the planned site for construction of the bus terminal will be considered and investigated in the project design. This will be done through visits to the workshop and storage locality, analysis of the records of activities, and soil quality sampling and analysis. If contamination is detected, the project design will evaluate the importance of the contamination, and implement appropriate procedures before any use of the site for construction of the busway terminal. At present, there is no legislation specifically relating to the management of contaminated sites in Egypt. - There are illegal waste dumping sites all along the railway corridor and particularly along the Zomor Canal on the western side of the corridor. The busway elevated structure will be partly constructed at such locations. Excavation in the affected areas will raise the problem of solid waste management, and possibly hazardous waste that could be mixed with the debris that has been dumped illegally. The project design will investigate the risk of finding hazardous waste in these areas, and prepare a plan for appropriate disposal without causing harmful impacts on the environment. - Good handling and disposal procedures for hazardous waste and substances will be implemented in the busway Depot / Workshop, which will be constructed in the industrial zone of 6th of October. This will be a critical issue in order to prevent illegal dumping of hazardous waste or accidental spillage of substances. The prevention of accidents and health hazards and the promotion of a healthy and safe working environment will be integrated in the environment management plan for the Depot / Workshop.
Generation and management of solid waste	- Solid waste management will mainly be related to the construction phase of the busway project. Waste generated by the project will include earth and waste materials from excavation and clearing along the alignment. In the railway corridor, the excavation and clearing work will induce a large amount of urban waste which will come from cleaning up the existing illegal dumping sites along the construction route. The transportation of waste and excavation materials will be done so as to prevent debris falling onto the roads. - Urban refuse which will be generated during construction in the working camps and during operation in the busway stations will be properly managed. The EIA will provide an estimation of urban refuse generation during operation of the busway and recommendations will be made for the collection and disposal of the refuse. For demolition and construction waste, the project design will provide an evaluation of the expected quantities of solid waste and a management plan for waste reduction at the source, waste separation, and appropriate disposal will be developed.
Loss of agricultural land and trees	- The busway sections will have a limited impact on cultivated land. In the railway corridor, south of the El Bashtir Triangle, the busway will be built on land within the ROW of the railway that has been cultivated illegally. However, between El Bashtir and 26th July Road, the busway will be built between private cultivated lands, and possibly encroach on these cultivated areas. Since the busway will be designed as an elevated structure in these sectors, the loss of soil or cultivated land should not be significant. However, arable soil will be excavated, and this sol may be lost if it is not stored correctly and reused. A loss of trees will occur at specific locations during the construction of the elevated structure along the banks of the Zomor Canal between Behouth and El Bashtir Triangle. The project design will establish a plan of reuse the arable soil, together with a plan for tree planting. These plans will be aimed at compensating for the loss of trees, and providing landscaping of the planned busway stops and surroundings.
Modification of the crossing patterns of pedestrians	- The existing pedestrian bridge that is used intensively for crossing the railway corridor in Behouth will be demolished and replaced by an underground passageway located between the new bus terminal and the Behouth Metro Station. The new passageway will be 300 m long and it will provide a safe and convenient connection between the west and east sides of the railway corridor. However, the location of the bus terminal could induce potential adverse impacts. To avoid these, the passageway planning and design will consider the following issues: a) The livelihood of the shopkeepers above the actual passageway who may loose customers due to reduced numbers of potential customers passing by; b) The need to ensure not only access to the bus terminal, but also the main purpose of the passageway, which is to provide a safe means for pedestrians to cross the railway; and c) The provision of safe access to the market place located on the western side of the corridor. - Geographically, the railway corridor at Behouth is the interface between various social groups, from very low to high income, but mostly low income. The existing bridge over the railway corridor is used

	intensively by residents using the pedestrian mode of transport. The EIA will investigate the social issues in this area, and make sure that the project will not induce any adverse impacts that affect the pedestrians or vulnerable groups of people. The very positive benefits of the busway project, in terms of providing better mobility for the poor, will be complemented by proper design of new pedestrian pathway patterns in this area. Good design of the underground passageway, together with other pedestrian passages around the bus terminal, will ensure positive impacts result from the project in this area.
Emission of dust during demolition and construction	- Excavation and construction works could be a major potential source of nuisance dust and air pollution for the residents along the railway corridor, both in the residential area west of the El Bashtir Triangle, and in 6th of October. Dust generated by the partial demolition of ENR workshop facilities may particularly affect the residents living on the western side of the corridor, and the people who regularly cross the railway corridor. Mitigation measures, such as watering and clean transportation of waste and excavated materials, will strongly contribute to minimizing dust emissions during the construction work, and help to maintain dust levels at acceptable levels.
Increase of ambient noise	- The operation of the busway project should not be a significant source of noise impact along the busway route, excepted in the residential zone between El Bashtir and 26th July Road, where the elevated structure will be closer to buildings. The location of the busway within the railway corridor leaves a buffer distance between the busway structure and the residential buildings, which should prevent significant noise impacts. Noise will be an issue that mainly concerns the construction phase, rather than the operational phase. A social survey will be undertaken during the EIA to clarify the residents' perception of the project with regard to noise and to ensure that any actual noise impacts that do arise will be within acceptable limits.
Change in the urban landscape and the living environment	- Changes in the urban landscape and the living environment could be perceived as a major impact of the busway project by groups of people living along the railway corridor and in Ard Elwaa near El Bashtir. However, this impact should be widely accepted by the residents, given the benefits that the busway will provide them in terms of improving their mobility. The project design will consider the resident's perception of the project to better understand the impact on their living environment.

Source: JICA Study Team



Source: JICA Study Team

Figure 7.7.1 Existing Conditions of ENR Workshop and Market in Behouth

7.7.2 Comparative Analysis of the Impacts of the Busway Project

(1) Air pollution levels with and without implementation of the project

A comparative analysis of air pollution emissions that may be caused by the busway and adversely impact on Greater Cairo was done in the same way as described previously for the railway project in Section 7.6. Again, the target years were set as 2012 and 2017. Passenger cars unit data are summarized in Table 7.7.2 for cars and buses. Table 7.7.3 provides the results of a simulation of air emissions "*with*" and "*without*" implementation of the busway project for the relevant speed average. The air pollutant emission savings attributed to implementation of the project is quite positive. For NOx, which is a typical harmful air pollutant related to the transportation sector, the savings in 2017will be in a range of 3 to 3.5%.

Table 7.7.2 Passenger Car Kilometers (PCU*km) for GCR with and without Implementation of the Busway Project

Category	2012		2017	
	With	Without	With	Without
Car	37,689,652	37,689,726	47,020,753	47,023,401
Bus	12,401,697	12,693,770	12,411,146	12,945,945
Total	50,091,349	50,383,496	59,431,899	59,969,346

Source: JICA Study Team

Table 7.7.3 Simulation of Air Emissions and Emission Savings with and without Implementation of the Busway Project in Target Years 2012 and 2017 for GCR (in Kilograms)

Category		2012			2017		
		With	Without	Saving	With	Without	Saving
Average speed 20 km/h	NOx	30243	30850	607	34256	35465	1209
	SPM	1591	1622	31	1828	1891	63
	CO	41953	42377	424	51262	52077	815
	SO_2	862	871	9	1328	1357	29
Average speed 30 km/h	NOx	24367	24854	487	27714	28687	973
	SPM	333	335	2	1508	1559	51
	CO	33484	33820	336	41379	42033	654
	SO_2	724	732	8	1135	1160	25

Source: JICA Study Team

(2) Energy efficiency

The energy consumption units for passenger transportation modes in 2002 in Japan were used for the analysis, as shown in previously in Table 7.6.5. The data for passenger kilometers simulated by the traffic demand analysis are shown in Table 7.7.4. The results of the analysis are provided in Table 7.7.5, which show that the busway project will produce a slight advantage in terms of energy savings, in comparison to the "*without*" implementation case.

Table 7.7.4 Passenger kilometers (passengers x km) for GCR with and without Implementation of the Busway Project

Category	2012		2017	
	With	Without	With	Without
Car	47,968,648	47,968,742	59,844,595	59,847,965
Bus	144,584,530	147,921,932	144,410,035	149,453,333
Rail	38,380,787	35,082,205	47,142,095	42,267,304
Total	230,933,964	230,972,879	251,396,725	251,568,602

Source: JICA Study Team

Table 7.7.5 Simulation of Energy Needs and Energy Savings with and without Implementation of the Busway Project in Target Years 2012 and 2017 for GCR (in MWh)

		2012			2017		
		With	Without	Saving	With	Without	Saving
Road transport	Car	32072	32072	0	40013	40015	2
	Bus	32411	33159	748	32372	33502	1130
	TOTAL	64483	65231	748	72385	73517	1132
Rail transport		1983	1813	-170	2436	2184	-252
TOTAL		66466	67044	578	74820	75701	881

Source: JICA Study Team

(3) Carbon dioxide emissions

The method of evaluation for CO_2 emissions was described previously in 7.6. The budget for CO_2 emissions of transport for "with" and "without" project implementation is shown in Table 7.7.6. This table shows a slight decrease of emissions in case of implementation.

Table 7.7.6 Simulation of CO_2 Emissions and Emissions Savings with and without Implementation of the Busway Project in Target Years 2012 and 2017 (in Tons)

Category		2012			2017		
		With	Without	Saving	With	Without	Saving
Average speed 20 km/h	Car	8329	8329	0	10392	10392	0
	Bus	9686	9914	228	9693	10111	418
	TOTAL	18015	18243	228	20085	20503	418
Average speed 30 km/h	Car	6671	6671	0	8323	8323	0
	Bus	8185	8378	193	8191	8544	353
	TOTAL	14856	15049	193	16514	16867	353

Source: JICA Study Team

7.8 Conclusion and Recommendations

7.8.1 Checklist of the Environmental Performance of the Project

Table 7.8.1 provides a checklist of the environmental performance criteria for the project. These criteria are presented in order to cover the important aspects of environmental achievements of the project, which are based on JICA guidelines, environmental performances objectives for GCR, and environmentally sustainability criteria. The following possible cases have been considered, as listed in Table 7.8.1:

- A1: The project fulfills the conditions without any specific measures being required.

- A2: The project fulfills the conditions if mitigation or compensation measures are undertaken.
- A3: The project fulfills the conditions and in addition contributes to improve conditions in the general locality or in GCR.
- B: The project cannot fulfill the conditions, or the issues are still uncertain and need more investigation.

Table 7.8.1 Checklist of the Environmental Performances of the Project

Performance condition criteria	RAILWAY				BUSWAY			
	A1	A2	A3	B	A1	A2	A3	B
NATURAL RESOURCES								
Natural protection areas will be left untouched.	x				x			
Natural habitats, wildlife, biodiversity will not be modified.	x				x			
Cultivated land and arable soil will not be lost.	x					x		
Efficient use of energy will be ensured.	x		x		x			
Mobile liquid fuel consumption will be reduced.	x				x			
Water use capacities or conflicts will not occur.	x				x			
Efficient use of water will be ensured.		x				x		
ENVIRONMENTAL QUALITY								
The River Nile and waterways will not be modified.	x					x		
Surface water quality will not be affected.		x				x		
There is no predicted risk of unsanitary disposal of solid waste.		x			x			
There is no predicted risk of acute pollution from contaminated soil.	x							x
There is no predicted risk of impact from hazardous waste and materials.		x				x		
Ambient air quality will not be significantly affected.	x		x		x			
Ambient noise levels will not be significantly increased.		x				x		
There will not be a significant increase of GHG emissions.	x		x		x			
LIVING ENVIRONMENT								
Access to social and cultural facilities will not be affected		x				x		
The urban vegetation capital will not be significantly affected		x				x		
Urban mobility of the people will not worsen	x		x		x		x	
Pedestrian mobility of the people will not worsen		x				x	x	
Urban amenities will not be lost or degraded		x			x			
Quality of the living environment will not worsen				x				x
LIVELIHOOD AND WELFARE								
Relocation of residential settlements will not be necessary.	x				x			
Relocation of any type of settlements will not be necessary.	x							x
The livelihood of people will not be significantly affected.	x					x		
SOCIAL EQUITY AND SOLIDARITY								
Social segregation or conflicts will not be induced				x				x
Vulnerable groups will be able to benefit from the project		x			x		x	
Women and children will be able to benefit from the project	x				x		x	
Pedestrian groups will be able to benefit from the project		x				x	x	
CULTURAL AND HISTORICAL HERITAGE								
Cultural and historical assets and heritage will not be affected.	x				x			
The value of the urban landscape or city beauty will not be affected.				x				x
Potential values like tourism will not be affected.	x				x			
The working environment will be safe and healthy.		x				x		
ENVIRONMENTAL HEALTH								
The citizens' health will not be affected.	x				x			
DISASTERS AND ACCIDENTS								
Increases in traffic accidents will not be induced.		x				x		
Risks of disaster will not be increased	x				x			

A1: The project fulfills the conditions without any specific measures being required.
A2: The project fulfills the conditions if mitigation or compensation measures are undertaken.
A3: The project fulfills the conditions and in addition contributes to improve conditions in the general locality or in GCR.
B: The project cannot fulfill the conditions, or the issues are still uncertain and need more investigation.

7.8.2 Measures and Recommendations

Measures for limiting the adverse impacts of the project, and recommendations for environmental, social and cultural studies, will be included in the project design. These have been summarized in Table 7.8.2 for both the proposed railway and proposed busway projects.

The railway and busway routes have been selected along the existing ROW of roads or railways in order to avoid adverse impacts on the environment as much as possible. In addition, the location of the busway route and bus terminal in the railway corridor between Behouth and El Bashtir Triangle was revised during the pre-EIA study in order to avoid the need for relocation of existing informal housing and business settlements in the corridor. As a result, the local impacts of the project on the environment have been minimized. Adverse impacts will concern mainly the Pyramids Road and the railway corridor between Behouth and El Bashtir. Adverse impacts will be possible, but more limited in the residential area of Ard Elwaa. In other areas, and in 6th of October, no adverse impacts are expected.

The main potential impacts of the project on the local environment are related to the visual effect of the elevated infrastructures for the railway and busway. In Pyramids Road, the project could significantly affect the tourism and landscape potential of this avenue, and the living environment of residents. The EIA will include a detailed study on the landscape and living environment issues in this area, including a survey of the resident's perception of the project, and consultation with residents and local NGOs. In the railway corridor, the partial relocation of the ENR workshops for construction of the bus terminal could be more complex than expected if contaminated soil is encountered. The EIA will include a soil survey of the site and appropriate measures to deal with any contamination will be implemented.

Other potential impacts of the project on the local environment are mostly related to the construction phase, and few of them relate to the operational phase. These impacts can be mitigated in most cases and will not impair the living conditions of vulnerable groups. Overall, the resulting impacts of the project on the local environment should be acceptable and minimal when compared to the environmental benefits of the project for the Cairo citizens.

At the regional level of Greater Cairo, the comparative analysis of the project that was undertaken for the "with" and "without" project implementation has shown that implementation will contribute to environmental objectives of GCR, such as reducing air pollutant emissions, reducing greenhouse gas (GHG) emissions, and improving energy efficiency.

The pre-EIA has confirmed that the proposed project will comply with the environmental requirements of the Egyptian laws, regulations and policies, and with JICA guidelines, after application of the proposed mitigation measures. This project will not impair the major environmental objectives of GCR, and very often it will contribute to their achievement.

Table 7.8.2 Measures and Recommendations for the Environmental Management of the Project

Adverse impacts	Mitigation measures	Compensation measures	Complementary measures	Recommendations for the project design
CONSTRUCTION Discharge of drainage water and wastewater	Drainage water extracted during the tunnel boring work in the El Malik El Saleh – Giza Square section will be properly discharged into the sewer system, with pre-treatment as necessary. Muddy sediment will be disposed of in sanitary conditions. In the construction camps, sanitation facilities will be provided. Septic tanks will be regularly cleared.	None.	None.	Environmental management plan for the construction works. This plan will include a solid waste management plan with waste separation, waste reduction at the source, appropriate transportation and disposal.
CONSTRUCTION Air emissions, noise emissions, solid waste generation	Provision of hoarding screens, dust covers, watering and clean transportation of waste and excavated materials will be the standard measures. Wheels and bodies of vehicles leaving the construction site will be washed in order to minimize dust emissions outside the construction site on public roads. Dump trucks will be covered as much as possible to reduce spills and minimize dust blowing off. Provision of garbage tanks and a collection service. Proper transportation and disposal of demolition / construction waste. Scheduling of work according to noise abatement objectives, particularly in the most sensitive zones. Proper positioning of construction equipment. If necessary, noise panels for screening noise around equipment will be installed to reduce noise emissions.	None.	Promoting regular control of exhaust emissions and noise emissions of vehicles and equipment, under EEAA guidelines. Improving public awareness about noise regulations.	Environmental management plan of the construction works. This plan will include a solid waste management plan with waste separation, waste reduction at source, appropriate transportation and disposal. Analysis of the expected solid waste quantities (demolition construction waste).
OPERATION Ambient noise	For the railway and busway: Speed control, selection of BAT (Best Available Technology) with reduction of noise and vibrations at the source, and in sensitive cases, construction of noise barriers.	None.	None.	Noise prediction study for the railway. Social survey, including the noise perception of the project by residents. Increase awareness about noise and available noise reducing technologies.
LOCATION, CONSTRUCTION Loss of agricultural land and trees and possible damage to urban vegetation	Storage and recycling of excavated fertile soil. Prevention of damage to roadside vegetation during the construction work.	Replanting of palm trees in appropriate areas to be identified in coordination with the competent authorities.	Landscaping of the planned busway stops and railway stations in CBD and 6th of October, and surrounding areas (beautification works with vegetation). Creating a tree plantation buffer zone around the depot / workshop plants and along the railway tracks on the desert plateau between the Pyramids and 6th of October.	Environmental management plan of the construction work. Plan for landscaping, tree plantations and re-vegetation, in coordination with the competent authorities.
LOCATION, CONSTRUCTION Generation and disposal of hazardous waste and substances during construction	The main potential issue is the ENR workshop site, which will require partial relocation: If contamination is found, transportation and disposal of hazardous materials will be done in strict accordance with Law 4/1994. Appropriate measures will be established in coordination with the competent authorities.	Undefined.	None.	Soil survey and investigation of appropriate handling procedures in case soil contamination is encountered (ENR workshop in the railway corridor / Behouth): Visit of the workshop and storage hall, analyze the records of activities, soil quality survey. Survey of the existing illegal solid waste accumulations along the proposed busway route, especially in the railway corridor. Plan for appropriate disposal of waste and soil materials generated by the location / construction of the project, in coordination with competent authorities.

Adverse impacts	Mitigation measures	Compensation measures	Complementary measures	Recommendations for the project design
OPERATION Environmental management of depots / workshops	Provision of measures and equipment for prevention of accidental spillage of hydrocarbon fuels and oil substances, appropriate management of solid waste and oil waste. Wastewater generated by the washing unit of the railway depot will be discharged into the urban sewerage system after pre-treatment (separation of solids and oil) and according to the licensing requirements.	None.	Installation of a water recycling plant, together with water saving measures. Prevention of accidents and health hazards, promotion of a healthy and safe working environment. Planting of a green belt buffer zone around the plant.	Environmental management plan of the proposed depot / workshop sites.
Changes in the urban landscape and the living environment	None.	Measures to maintain the quality of the living environment, such as architectural design of the elevated structure in Pyramids Road, beautification and landscaping works, pedestrian facilities, creation of amenities, and other measures to be identified in consultation with the affected residents.	Undefined.	Survey of resident's perception of the project to better understand the impact on the living environment. Plan for improvement of the living environment in coordination with local residents and NGOs within a process of public consultation. Study of the potential impacts on property values and mitigating measures.
Relocation of non-residential settlements in Behouth	ENR workshop site: A soil survey will be undertaken before any relocation plans are formulated (see: "Generation and disposal of hazardous waste and substances during construction" above). Pedestrian crossway: Appropriate design of the proposed underground passage way between the bus terminal and the Metro station to facilitate the intensive use by pedestrians crossing the railway corridor.	ENR workshop: In accordance with the relocation plan that will be undertaken in coordination with the Ministry of Transport. First block of the market: In accordance with the relocation or compensation plan that will be undertaken in coordination with public consultation and discussions with competent authorities. The outcome will conform to international standards for relocation procedures. Shopkeepers along the actual passage way under the rail corridor: Compensation measures will be necessary, based on public hearings, in order to compensate for the potential loss of income.	ENR workshop: Undefined. Pedestrian crossway: Develop pedestrian passages around the bus terminal, especially between the bus terminal and the market, to facilitate the circulation of pedestrians in comfortable and safe conditions.	Relocation plan for some ENR workshop buildings, in coordination with the Ministry of Transport, and taking into consideration the results of the soil survey (see: "Generation and disposal of hazardous waste and substances during construction" above). Social survey of pedestrian patterns and project perception by the vulnerable groups of people, as well as potential social issues in this area. Relocation or compensation plan of the first market block, in coordination with discussions held with the affected people.
CONSTRUCTION Traffic diversion: air emissions, noise, accidents	Safety measures to protect pedestrians against traffic accidents: Adequate provision of signals and signs, speed controls, barriers and flag persons. Public awareness campaigns for road security, and providing public information about traffic conditions.	None.	Increase the control of vehicles exhaust emissions.	Plan to prevent excess air pollution, noise, and risks of accidents in relation to traffic diversion plans.
Finding of archaeological remains	If archaeological remains are found, the construction work will stop and the proponent will notify the CAA within 2 days. The CAA will inform the High Council for Antiquities (Law 117/1983).	None.	None.	Procedure description in the project design.

Source: JICA Study Team

CHAPTER 8 ECONOMIC AND FINANCIAL ANALYSIS

8.1 Introduction

This section describes the basis for the economic and financial analysis that was undertaken for Metro Line 4 / 6th of October Line and the 6th of October Busway transportation projects associated with the Western Development Corridor.

8.1.1 Procedures for Economic and Financial Evaluation

An economic evaluation provides a useful criterion for the public sector to make a rational decision about allocation of its limited financial resources from the viewpoint of the national economy as a whole. For an economic evaluation, various benefits which are expected to accrue from a project and costs incurred for construction, operation and maintenance of the project are calculated in economic terms for the life of the project. The costs are estimated as market prices and converted to "economic costs", excluding transfer payments, by employing an "opportunity cost" concept for goods and services that are provided in the distorted market of public transport services.

A financial evaluation provides useful indications for the project owner to predict anticipated returns on their investment. This information supports their ability to make a rational decision about the investment of funds. The "cost of money" in the financial market can be compared and an evaluation of the returns that may be offered by other investment opportunities can be made. Furthermore, the financial viability of the project provides a vital indicator of the need for the government sector to be involved in the project, for example through the provision of government subsidies, and the required magnitude of this involvement.

8.1.2 Major Assumptions

(1) With and Without Project

Costs and benefits are calculated as the difference between the "*with*" and "*without*" project alternatives. For the Western Development Corridor transportation projects, the *with* project alternative represents the situation for transport conditions in the entire study area that will exist if the project is implemented. The *without* project alternative, represents the situation for transport conditions in the entire study area that will exist if only the projects that are already committed, excluding the Western Development Corridor project, are completed as scheduled.

Table 8.1.1 shows a list of the project components and their status to be considered in the transport network in the study area for the *without* project alternative, while Table 8.1.2 shows

the project components for the *with* project alternative, as described previously in Chapter 3, Section 3.6.

Table 8.1.1 Project Components and their States for the *Without* Project Alternative

	2017	2022	2027
Transport System Development in the Western Corridor			
Metro Line 3 Phase I	Completed	Completed	Completed
Metro Line 3 Phase II and Phase III	Completed	Completed	Completed
Exclusive Busway	Completed	Completed	Completed
Projects to be Evaluated			
Metro Line 4 Phase I	None	None	None
Metro Line 4 Phase II (6th of October Line)	None	None	None

Source: JICA Study Team

Table 8.1.2 Project Components and their States for the *With* Project Alternative

	2017	2022	2027
Transport System Development in the Western Corridor			
Metro Line 3 Phase I	Completed	Completed	Completed
Metro Line 3 Phase II and Phase III	Completed	Completed	Completed
Exclusive Busway	Completed	Completed	Completed
Projects to be Evaluated			
Metro Line 4 Phase I	Completed	Completed	Completed
Metro Line 4 Phase II (6th of October Line)	None	Completed.	Completed

Source: JICA Study Team

(2) Price Indices and Project Life

For the economic and financial analysis, the following assumptions were made:

a) Price data: 2007 fixed price

b) Foreign exchanges: US $ 1.00 = 5.5 LE

c) Project life: 30 years, from 2017 through 2046

(3) Type of Benefits

Economic benefits which can be expected to result from implementation of Metro Line 4 / 6th of October Line are as follows:

As a direct benefit:

a) Savings in travel time;

b) Savings in vehicle operating costs (VOC);

c) Decrease in traffic accidents; and

d) Environmental improvement due to decrease of pollution and noise on the road.

As an indirect benefit:

e) Contribution to orderly urban development;

f) Contribution to increase regional economic activities;

g) Contribution to increase people's mobility; and

h) Contribution to increase people's amenity.

In the economic analysis, the direct benefits of savings in travel time cost (a) and savings in vehicle operating costs (b) were selected for review.

8.1.3 Benefits Component

(1) Conversion factor to economic costs

In the economic analysis, all costs were classified into the following categories: i) traded goods; ii) non-traded goods; and iii) transfer items. It was assumed that traded goods are equivalent to the foreign currency portion, and the aggregation of non-traded goods equates to the local currency portion. Transfer items represent the tax component.

It is noted that the cost estimation undertaken for this pre-F/S stage does not include a breakdown of cost components for non-traded goods comprising skilled and un-skilled labor. The economic prices of the whole portion of non-traded goods are assumed to be obtained by applying the standard conversion factor (SCF).

Items such as import duties cause a price different between the domestic market and international market. The standard conversion factor (SCF) is an index which converts domestic prices to at-border prices by adjustment of distortions to domestic prices that may be caused by import duties, etc. The standard conversion factor is estimated by using the following equation:

$$SCF = \frac{I + E}{(I + Di) + (E - De)}$$

Where: I: Total value of imports
E: Total value of exports
Di: Total value of import duties
De: Total value of export duties

According to statistical data regarding foreign trade and government revenue in Egypt, SCF estimates were prepared, as shown in Table 8.1.3. Thus a SCF of 0.84 has been applied in this report.

Table 8.1.3 Estimation of the Standard Conversion Factor (SCF)

Item	Unit	2003/04	2004/05	2005/06	2006/07	2007/08
Import	billion USD	18.3	24.2	30.4	37.8	45.6
Export	billion USD	10.5	13.8	18.5	22.0	26.2
Balance of Trade	billion USD	7.8	10.4	11.9	15.8	19.4
Import Duties	billion USD	9.2	7.7	9.7	10.4	13.3
Export Duties	billion USD	0	0	0	0	0
SCF		0.76	0.83	0.83	0.85	0.84
Exchange Rate	LE/USD	6.16	6.00	5.75	5.72	5.50

Source: JICA Study Team

(2) Unit vehicle operating cost

The unit vehicle operating cost (VOC) by vehicle type was estimated based on an analysis of actual performance data collected from different transport operators, as well as automobile dealers. Estimation of VOC considered the following:

1) Representative Vehicle: Table 8.1.4 shows selected vehicle types and representative vehicles for setting up the estimation of unit vehicle operating costs.

Table 8.1.4 Vehicle Types and Representative Vehicles

Vehicle Type		Representative Vehicle
1	Private Car (Sedan type)	Toyota Corolla 1600 CC
2	Shared Taxi	Hyundai Micro Bus
3	Pick up	Chevrolet Pick Up
4	Mini Bus	MCV Mini Bus
5	Big Bus	MCV C120 City Bus
6	Articulated Bus	APTS, Philas
7	Light Truck	Mercedes (with loading capacity 5 tons)
8	Medium Truck	Mercedes (with loading capacity 9 tons)
9	Large Truck	Mercedes (with loading capacity 15 tons)

Source: JICA Study Team

2) Vehicle Characteristics: Vehicle characteristics, such as vehicle life, vehicle annual kilometers, and annual operating hours, were determined based on the CREATS Phase I Study Report after carefully examining information obtained from car dealers, tucking company and CTA, as shown in Table 8.1.5.

Table 8.1.5 Vehicle Characteristics

Vehicle Type		Passenger Car	Share Taxi	Pick-up	Bus	Articulated Bus	Minibus	Light Truck	Medium Truck	Heavy Truck
Fuel Type	1	P	P	P	D	D	D	D	D	D
No. of Tires	2	4	4	4	6	8	6	6	10	10
Vehicle Life-Years	3	13	10	10	10	13	10	10	12	13
Vehicle Life Kilometers	4	520,000	1,050,000	600,000	760,000	988,000	675,000	500,000	900,000	1,625,000
Vehicle Annual Kilometers	5	40,000	105,000	60,000	76,000	76,000	67,500	50,000	75,000	125,000
Vehicle Life Operating Hours	6	10,400	45,000	12,000	48,000	62,400	48,000	13,000	18,000	29,200
Vehicle Annual Hours	7	800	4,500	1,200	4,800	4,800	4,800	1,300	1,500	2,250
Average Crew Size	8	0.20	1.00	1.00	2.00	2.00	1.00	1.00	2.00	3.00
Average Vehicle Occupancy	9	1.90	11.00	1.30	47.00	21.00	1.00	1.00	2.00	3.00

Source: JICA Study Team

3) Vehicle Prices: The market price of vehicles was obtained from interviews with car dealers, trucking companies and CTA Operation Department. When converting from financial (market) prices to economic prices, information about import duties and sales tax was incorporated, and the tax portion was deducted. The rates of import duties for imported vehicles are: i) passenger car (40 %); ii) mini bus and large bus (40 %); iii) light truck (30 %); iv) medium truck (20 %); v) heavy truck (10 %). The rates of sales tax are 15 % and 10 % for private cars and others, respectively.

4) Tire Prices: Information about market prices for tires was obtained by interviewing tire retailers, trucking companies and the CTA. For converting financial (market) prices to economic prices, information about the import duties and the sales tax was incorporated, and the tax portion was deducted. The rate of import duty and the rate of sales tax that was used was 10 % for both import duty and sales tax.

5) Fuel and Lubricants: Information about the market price of fuel and lubricants was obtained by interviewing gasoline stations and some car dealers. Based on an interview with a petroleum company in Cairo, the following factors were incorporated when converting the market prices to economic prices:

   - For gasoline, there is no sales tax or subsidy. However, there is some subsidy for diesel.
   - As for lubricants, there are two types, i.e., locally made and imported. While no sales tax is charged for locally made lubricants, sales tax is charged for the imported products. According to interviews with vehicles users, almost all were using locally made lubricants. Therefore, the economic price of lubricants is assumed to be the same as the financial prices.

6) Maintenance Costs: There are two types of maintenance costs: i) spare-parts costs; and ii) maintenance labor costs. The spare-parts cost was set as a percentage of the vehicle prices per 1,000 km, based on data which have been applied in road transport studies in other countries. Labor costs were estimated based on necessary maintenance labor hours per year for each vehicle type and annual wage costs for mechanics and their supervisors.

7) Bus Crew Cost: The information about bus crew working hours and monthly wages was obtained by interviewing trucking companies and private bus companies.

8) Depreciation: The percentages of depreciation for distance related and time related travel were based on data which have been applied in road transport studies in other countries.

9) Insurance Costs: Information about insurance costs was obtained by interviewing car dealers, trucking companies, CTA and private bus companies.

10) Unit VOC: Applying the above information and data, the unit operating cost for each vehicle type was estimated. A summary of input data used for unit VOC estimation is shown in Table 8.1.6. Both time-related VOC and distance-related VOC are shown in Table 8.1.6.

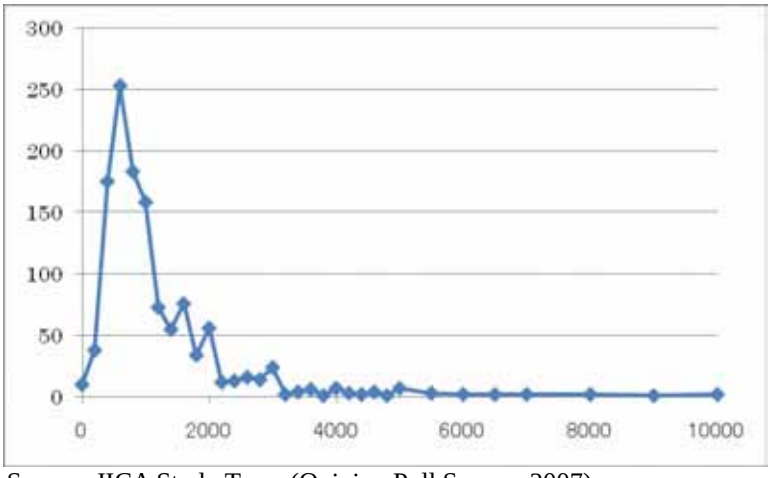
Table 8.1.6 Estimated Unit Vehicle Operating Cost (VOC)

Vehicle Type		Passenger Car	Shared Taxi	Pick-up	Bus	Articulated Bus	Minibus	Light Truck	Medium Truck	Heavy Truck
Distance related VOC LE/'000km	Fuel Cost	196.88	263.86	229.10	597.96	1,195.92	217.80	396.00	495.00	594.00
	Lubricant Cost	31.35	78.38	62.70	78.38	156.75	62.70	125.40	156.75	156.75
	Tire Cost	23.40	33.00	20.57	122.73	163.64	57.12	43.62	90.00	276.92
	Maintenance Spare Parts Cost	56.38	20.70	35.98	37.33	366.83	24.16	90.43	85.53	68.77
	Depriciation Cost	97.14	75.37	35.00	355.37	2,686.32	153.31	658.31	518.90	385.12
	S-Total	405.14	471.31	383.35	1,191.76	4,569.45	515.08	1,313.75	1,346.18	1,481.57
	Overhead Cost	0.00	70.70	30.67	238.35	913.89	103.02	459.81	471.16	518.55
	Total	405.14	542.00	414.02	1,430.12	5,483.34	618.09	1,773.56	1,817.35	2,000.12
Time related VOC LE/Hour	Crew Cost	0.00	4.98	7.03	8.28	11.58	6.63	8.28	8.28	11.58
	Maintenance Labor Cost	1.09	1.02	1.09	1.38	1.82	0.74	2.01	3.27	3.63
	Insurance Cost	0.09	0.05	0.18	0.18	1.34	0.07	0.70	1.07	0.88
	Depriciation Cost	1.26	0.41	0.71	0.63	6.16	0.27	3.54	3.35	2.70
	S-Total	2.44	6.45	9.01	10.46	20.90	7.71	14.53	15.97	18.79
	Overhead Cost	0.00	0.97	0.72	2.09	4.18	1.54	5.09	5.59	6.58
	Total	2.44	7.42	9.73	12.56	25.08	9.25	19.62	21.56	25.36
	Annual Hours	800	4,500	1,200	4,800	4,800	4,800	1,300	1,500	2,250
	Annual Km	40,000	105,000	60,000	76,000	76,000	67,500	50,000	75,000	125,000
	Coversion to Km base	48.79	318.08	194.60	793.14	1,583.78	657.52	510.09	431.24	456.55

Source: JICA Study Team

(3) Estimation of time value

Between June and July 2007, a household opinion poll survey was carried out in the master plan (phase 1) to clarify the public perception of urban planning. The survey results provided useful information about households (HH), including their income. According to the survey, average household income in the study area of the Master Plan phase was estimated at 1,134 LE / HH / Month or 13,590 LE / HH / Year (USD 2,470 / HH / Year) in 2007. The number of workers per household was estimated at 1.09 in 2007, so that the income per worker is estimated at 1,037 LE / month or 12,440 LE / Year (USD 2,260 / Year). Figure 8.1.1 shows the household income distribution.



Source: JICA Study Team (Opinion Poll Survey, 2007)

Figure 8.1.1 Income Distribution in the Study Area of the Master Plan Phase

Table 8.1.7 shows the average household income by household income group.

Table 8.1.7 Average Household Income by Household Income Group

Group	Monthly Household Income Group	Share (%)	Average Household Income (LE/Month)
Low Income	Less than 420LE	18.1	291
Middle Income	1,670LE> I > 420LE	64.6	877
High Income	Above 1,670LE	17.2	2,985
Total/Average		100.0	1,134

Source: JICA Study Team (Opinion Poll Survey, 2007)
Note: Low, Middle and High income groups are defined based on Income Tax definitions.

Table 8.1.8 Socio-Economic Framework in the Study Area of the Master Plan Phase

Indicator		Unit	2006	2007	2012	201)	2027
Population		1000	16,101	16,464	18,411	20,369	24,192
No. of Household		1000	4,007	4,097	4,582	5,069	6,021
HH Size		Person/household	4.02	4.02	4.02	4.02	4.02
Age Structure		%	28.7	29.0	29.9	31.0	32.1
Labor Force		1,000	4,613	4,777	5,506	6,316	7,761
Unemployment		%	7	6	6	5	5
No. of Workers	Primary	1,000	260	266	306	349	427
	Secondary	1,000	1,667	1,741	2,014	2,311	2,824
	Tertiary	1,000	2,384	2,467	2,876	3,323	4,126
	Total	1,000	4,310	4,475	5,196	5,982	7,378
GRDP		million LE	164,372	177,521	260,837	365,837	670,757
GRDP per Capita		LE per capita	10,209	10,782	14,167	17,960	27,726
Household Income		LE/HH	1,072	1,134	1,488	1,886	2,911
No. of Workers in Household		worker/HH	1.08	1.09	1.13	1.18	1.23
Worker's Income		LE/worker	997	1,038	1,312	1,598	2,376

Source: JICA Study Team
Note: This framework is based the Master Plan report (Volume 2).

The average monthly income per worker was estimated as shown in Table 8.1.8. The assumption that the number of working days was 22 days per month and the working time of 8 hours per day resulted in the estimated number of working hours being 176 hours per month. The predicted hourly average income per worker from 2007 up to 2027 was estimated, as shown in Table 8.1.9.

Table 8.1.9 Average Monthly Income and Hourly Income per Worker

Year		Unit	2007	2012	2017	2027
Household Income	Low and Middle Income Household	LE/month	748	982	1,245	1,921
	High Income Household	LE/month	2,985	3,916	4,964	7,664
	High and Middle Households	LE/month	1,322	1,529	1,863	2,769
Workers in Household		Worker/household	1.09	1.09	1.09	1.09
Worker's Income	Low and Middle Income Workers	LE/month	687	901	1,142	1,763
	High Income Workers	LE/month	2,739	3,593	4,554	7,031
	High and Middle Households	LE/month	1,038	1,312	1,598	2,376
Working Hours per Month		Hour/month	176	176	176	176
Hourly Worker's Income	Low and Middle Income Workers	LE/hour	3.90	5.12	6.49	10.02
	High Income Workers	LE/hour	15.56	20.41	25.88	39.95
	High and Middle Households	LE/hour	6.89	7.45	9.08	13.50

Source: JICA Study Team

The above data were adjusted by using an estimated factor related to trip purpose, as shown in Table 8.1.10. The distribution of trip purpose was obtained from the traffic survey results

undertaken as part of the Pre-F/S. By summing the factored share for each trip purpose, the adjusted percentage after incorporating the trip purpose factor was estimated to total 75.5 %.

Table 8.1.10 Estimation of Effective Factor related to Trip Purpose

Trip Purposed	Share (%)	Factor	Factor Incorporated (%)
Work	44.0	1.0	44.0
Business	7.0	1.0	7.0
Study	28.9	0.5	14.5
Private	20.1	0.5	10.1
Total	100.0		75.5

Source: JICA Study Team

The hourly time values for transport users were estimated from the hourly workers income multiplied by the effective factor, as shown above. In this estimation, the following assumptions were adopted:

- Public transport users comprise middle and low income groups;
- Car users comprise the high income group; and
- Taxi and shared taxi users, including air conditioned bus users, comprise high and middle income groups.

The estimated hourly time value for public transport users was predicted for 2007 up to 2027, as shown in Table 8.1.11.

Table 8.1.11 Estimated Hourly Time Value for Public Transport Mode Users

Year	Unit	2007	2012	2017	2027
Public Transport Users	LE/hour/person	2.95	3.86	4.90	7.56
Car Users	LE/hour/person	11.75	15.41	19.54	30.16
Taxi and Shared Taxi Users	LE/hour/person	5.20	5.63	6.86	10.19

Source: JICA Study Team

8.2 Economic and Financial Analysis of Metro Line 4 / 6th of October Line

8.2.1 Economic Analysis

(1) Economic costs

1) Economic construction costs: The construction costs by phases in terms of economic prices were calculated for Phase I (Metro Line 4) and Phase II (6th of October Line), as shown in Table 8.2.1. These economic costs were allocated to each year during the construction period by following the construction schedule as, discussed previously in Chapter 4, Section 4.9.2.

Table 8.2.1 Metro Line 4 / 6th of October Line Economic Construction Cost

(Unit: Million LE)

No.	Item	Phase I (2010-2016)	Phase II (2017-2021)	Total
1	Civil Works	3,815.3	1,362.9	5,178.3
2	Electrical and Mechanical Construction*1	1,306.4	1,834.1	3,140.5
3	Engineering Cost	186.2	116.3	302.5
4	Local Administration	232.8	145.3	378.1
	Total	5,540.7	3,458.6	8,999.4

Source: JICA Study Team
Note *1: Electrical and Mechanical Construction and Management

2) Economic Operation and Maintenance Costs (O&M Costs): The economic operation and maintenance costs for Metro Line 4 / 6th of October Line[1] comprise: i) Administrative Costs; ii) Operation Costs; and iii) Maintenance Costs. Each cost component consists of: i) staff costs; and ii) materials and spare parts costs. The staff costs were estimated on the basis of the number of operation and maintenance staff, as described previously in Chapter 4, Section 4.10, and staff salary levels. The materials and spare parts costs were estimated on the basis of the costs for Metro Line 1 and 2. The financial costs were converted to economic costs using a conversion factor, as shown in Table 8.2.2.

Table 8.2.2 Economic O&M Cost of Metro Line 4 / 6th of October Line

(Unit: Million LE per year)

Phase	Administration	Operation	Maintenance	Total
Phase I	0.92	3.55	43.56	48.04
Phase II	1.10	3.51	72.08	76.69
Total	2.03	7.06	115.64	124.73

Source: JICA Study Team

3) Residual Value: The residual values were appropriated in the last year of the project. The project life of the project for assets for both of civil works and electrical and mechanical construction works is assumed to be 30 years after completion of the Phase I project. The assets of the Phase I project will be depreciated at the end of the project life. However, those of the Phase II project, which will be completed 5 years after Phase I. This means that the Phase II assets will retain five-years of residual value when the Phase I project is fully depreciated, as shown Table 8.2.3.

Table 8.2.3 Residual Value for 6th of October Line Project

(Million LE)

Item	Construction Cost	Residual Cost
Civil Works	5,601.9	245.7
E&M Construction Cost	3,397.4	330.7
Total	8,999.3	576.4

Source: JICA Study Team

[1] 6th of October Line is a general term used for Metro Line 4 Phase II (western section) extending from El Mahab El Saleh to 6th of October NUC.

(2) Economic benefits

1) Type of benefits: The economic benefits were estimated by comparing the *without* project alternative to the *with* project alternative, as shown in Table 8.2.4. The economic benefits derived from implementation of the Metro Line 4 / 6th of October Line project were estimated based on potential changes in the publics' choice of transport mode. In the *without* project alternative, the buswasy project was considered as completed to exclude the economic benefits by the busway project as shown in Table 8.2.4.

Table 8.2.4 *With* and *Without* Project Alternatives for Metro Line 4 / 6th of October Line

Item		*Without* Project	*With* Project
Public Transport Users			
	Busway Users	○	○
	Ordinary Bus User	○	○
	Shared Taxi Users	○	○
	Minibus Users	○	○
	Metro Line 4 / 6th of October Line Users	X	○
	Other Rail	○	○
Private Transport Users			
	Car Users	○	○
	Taxi Users	○	○
	Truck Users	○	○

As mentioned above, the economic benefits described in the economic analysis were assumed to be: i) saving in time cost; and ii) saving in vehicle operating costs. Both benefits are considered as additional surplus to the national economy that will be accrued from implementation of the project.

2) Time saving benefits: The transport time saving (time saving) benefits generated by the introduction of Metro Line 4 / 6th of October Line was computed as a whole in terms of the total transport time of all passengers in the study area for the master plan phase. The passengers of this new Metro service who are diverted from other transport modes will obtain time saving benefits from reduced transport times, as shown in Table 8.2.5. The passengers who use other transport modes will also obtain time saving benefits due to the increased travel speed of other transport modes resulting from reduced road congestion realized by the introduction of the new Metro service. Thus, the beneficiaries will not only be those who are diverted from existing vehicles, such as buses, shared taxies, and cars to the new Metro system, but also those who use the other transport modes.

Time saving benefits were calculated as follows:

a) Time saving was calculated as the difference between the *without* project alternative and the *with* project alternative in terms of total transport times in the study area.

b) The time saving was converted into the economic benefits in monetary terms using economic time value by transport modes.

Table 8.2.6 shows the time saving benefits in the design year.

Table 8.2.5 Passenger Travel Time by Transport Mode *With* and *Without* Metro Line 4 / 6th of October Line

(Million Passenger-Hours per Annum)

Item	2017			2022			2027		
	With	*Without*	*W/-W/O*	*With*	*Without*	*W/-W/O*	*With*	*Without*	*W/-W/O*
Passenger Travel Time by Public Transport Users									
Busway	58	53	6	70	72	(2)	84	174	(90)
Shared Taxi	3,835	3,894	(60)	4,052	4,408	(356)	4,083	4,446	(363)
Mini Bus	1,285	1,304	(19)	1,367	1,471	(104)	1,380	1,488	(108)
Other Bus	1,174	1,192	(19)	1,236	1,352	(116)	1,244	1,361	(118)
Metro Line 4 / 6th of October Line	33	0	33	161	0	161	212	0	212
Other Rails	691	701	(10)	880	831	49	1,089	1,060	29
S-Total	7,076	7,145	(69)	7,766	8,134	(368)	8,092	8,530	(438)
Passenger Travel Time by Private Transport Users									
Car	1,839	1,840	(2)	3,066	3,079	(12)	3,929	3,952	(23)
Taxi	446	446	(0)	743	746	(3)	952	958	(6)
Truck	153	153	(0)	256	257	(1)	327	329	(2)
S-Total	2,438	2,440	(2)	4,065	4,082	(16)	5,209	5,240	(31)
Total	9,513	9,585	(71)	11,832	12,216	(384)	13,301	13,769	(468)

Source: JICA Study Team

Table 8.2.6 Time Saving Benefits by Transport Mode Generated by Metro Line 4 / 6th of October Line

(LE Million per Annum)

Item	2017			2022			2027		
	With	*Without*	*W/-W/O*	*With*	*Without*	*W/-W/O*	*With*	*Without*	*W/-W/O*
Time Saving of Trips using Public Transport Mode									
Busway	286	258	28	437	451	(13)	635	1,316	(681)
Shared Taxi	18,783	19,075	(292)	25,246	27,462	(2,216)	30,874	33,619	(2,745)
Mini Bus	6,292	6,387	(95)	8,518	9,163	(645)	10,437	11,253	(816)
Other Bus	5,749	5,840	(91)	7,698	8,422	(723)	9,405	10,293	(889)
Metro Line 4 / 6th of October Line	163	0	163	1,003	0	1,003	1,606	0	1,606
Other Rails	3,385	3,436	(50)	5,482	5,178	304	8,233	8,017	216
S-Total	34,659	34,995	(337)	48,384	50,675	(2,291)	61,190	64,499	(3,309)
Time Saving of Trips using Private Transport Mode									
Car	35,922	35,957	(36)	76,199	76,501	(303)	118,503	119,204	(701)
Taxi	8,708	8,717	(9)	18,472	18,546	(73)	28,728	28,898	(170)
Truck	2,993	2,996	(3)	6,350	6,375	(25)	9,875	9,934	(58)
S-Total	47,623	47,671	(48)	101,021	101,422	(401)	157,107	158,036	(929)
Total	82,282	82,666	(384)	149,405	152,097	(2,692)	218,296	222,535	(4,238)

Source: JICA Study Team

2) Vehicle operating cost saving: The vehicle operating cost (VOC) saving benefits generated by the introduction of Metro Line 4 / 6th of October Line was also computed for the VOC of all vehicles in the study area. Bus passengers and car users are likely to be diverted to the new Metro service. This will result in a benefit in vehicle operating cost savings resulting from the reduced vehicle kilometers. And the vehicles which use the same vehicle modes will obtain VOC benefits, because passengers will select the routes more preferable and shorter than those used in the *without* project alternative. Therefore, beneficiaries are all vehicle mode users. The VOC saving benefits were calculated as follows:

a) Vehicle-kilometers were calculated as the difference between the *without* project alternative and the *with* project alternative in terms of total vehicle running kilometers in the Study Area.

b) The VOC saving was calculated by using the vehicle-kilometers for both alternatives and unit VOC.

Table 8.2.7 shows the vehicle-km savings and Table 8.2.8 shows the VOC saving benefits in the design years.

Table 8.2.7 Vehicle Kilometer, *With* and *Without* Metro Line 4 / 6th of October Line

(Million Vehicle Km)

Item	2017			2022			2027		
	With	*Without*	*W/-W/O*	*With*	*Without*	*W/-W/O*	*With*	*Without*	*W/-W/O*
Vehicle km by Public Transport Users									
Busway	18	17	2	22	22	(0)	24	42	(18)
Shared Taxi	8,590	8,750	(161)	8,682	9,268	(586)	8,043	8,744	(702)
Mini Bus	2,996	3,048	(52)	3,066	3,212	(146)	2,849	3,046	(197)
Other Bus	808	823	(16)	811	874	(64)	750	823	(73)
S-Total	12,411	12,638	(227)	12,580	13,376	(797)	11,665	12,654	(989)
Vehicle Km by Private Transport Users									
Car	36,818	36,827	(9)	58,351	58,378	(27)	71,896	71,932	(36)
Taxi	7,130	7,132	(2)	11,300	11,305	(5)	13,923	13,930	(7)
Truck	3,073	3,074	(1)	4,871	4,873	(2)	6,001	6,004	(3)
S-Total	47,021	47,033	(12)	74,522	74,556	(34)	91,820	91,866	(46)
Total	59,432	59,671	(239)	87,102	87,933	(831)	103,486	104,521	(1,035)

Source: JICA Study Team

Table 8.2.8 Vehicle Operating Cost Saving Benefits Generated by Metro Line 4 / 6th of October Line

(LE Million)

Item	2017			2022			2027		
	With	*Without*	*W/-W/O*	*With*	*Without*	*W/-W/O*	*With*	*Without*	*W/-W/O*
VOC using Pubilc Transport Mode									
Busway	157	143	13	185	189	(4)	206	356	(151)
Shared Taxi	13,568	13,833	(265)	13,681	14,660	(978)	12,622	13,743	(1,121)
Mini Bus	9,857	10,038	(180)	10,064	10,583	(519)	9,314	9,973	(659)
Other Bus	3,475	3,546	(70)	3,481	3,768	(287)	3,205	3,522	(317)
S-Total	27,057	27,560	(503)	27,411	29,200	(1,789)	25,346	27,595	(2,248)
VOC using Private Transport Mode									
Car	16,554	16,558	(4)	26,236	26,248	(12)	32,326	32,343	(16)
Taxi	3,206	3,207	(1)	5,081	5,083	(2)	6,260	6,263	(3)
Truck	6,876	6,878	(2)	10,897	10,902	(5)	13,427	13,434	(7)
S-Total	26,636	26,642	(7)	42,214	42,234	(19)	52,013	52,039	(26)
Total	53,693	54,202	(509)	69,625	71,434	(1,809)	77,360	79,634	(2,274)

Source: JICA Study Team

(3) Economic evaluation

1) Cost-benefit analysis: A cost-benefit analysis was made based on costs and benefits described previously. The analysis yielded economic evaluation indicators, such as Economic Internal Rate of Return (EIRR), Net Present Value (NPV) and Benefit Cost Ratio (B/C Ratio). Based on the lending rate of the Central Bank of Egypt in February 2008, it is assumed that the social discount rate in this study is 12 % per annum.

Table 8.2.9 Summary of Economic Evaluation of Metro Line 4 / 6th of October Line Project

Indicator	Evaluation
Net Present Value	LE 1,360 million
B/C Ratio	1.268
EIRR	14.05 %

Notes: 1) The discount rate is assumed to be 12 % per annum.
2) The project life is assumed to be 30 years, after being opened to the public.

2) Sensitivity analysis: A sensitivity analysis was conducted under scenarios incorporating an increase and/or decrease in the estimated costs and benefits. Table 8.2.10 shows the results of the sensitivity analysis.

Table 8.2.10 Sensitivity Analysis Regarding Costs and Benefits for Metro Line 4 / 6th of October Line

Item			Benefits		
			20 % down	Reference Base	20 % up
Costs	20 % down	NPV (LE Million)	1,088	2,376	3,664
		BCR	1.27	1.59	1.905
		EIRR (%)	14.05	16.11	17.89
	Reference Base	NPV (LE Million)	72	1.360	2,648
		BCR	1.01	1.27	1.52
		EIRR (%)	12.12	14.05	15.72
	20 % up	NPV (LE Million)	(944)	344	1,632
		BCR	0.85	1.06	1.27
		EIRR (%)	10.62	12.46	14.05

Notes: 1) The discount rate is assumed to be 12.0 % per annum.
2) The life of the project is assumed to be 30 years.

3) Conclusion (Railway, Economic Analysis): The implementation of Metro Line 4 / 6th of October Line project can be justified from the national economic viewpoint. The sensitivity analysis indicates that it is generally feasible, excluding the worst scenario that the benefit is decreased by 20 % and the cost is increased by 20 %. The cost benefit stream of the reference base is shown in Table 8.2.11.

Table 8.2.11 Cost Benefit Stream for Metro Line 4 / 6th of October Line (Real Terms)

Undiscounted Cost Benefit Stream

Sq	Year	Construction Cost	Operation and Maintenace Cost	Cost Total	Benefit	Net Benefit
0	2010	42.9		42.9		(42.9)
1	2011	42.9		42.9		(42.9)
2	2012	1,178.0		1,178.0		(1,178.0)
3	2013	1,178.0		1,178.0		(1,178.0)
4	2014	1,178.0		1,178.0		(1,178.0)
5	2015	1,205.6		1,205.6		(1,205.6)
6	2016	339.2		339.2		(339.2)
7	2017	710.1	47.9	758.0	327.0	(431.0)
8	2018	710.1	48.2	758.3	380.9	(377.4)
9	2019	710.1	48.5	758.6	443.9	(314.7)
10	2020	710.1	48.8	758.9	517.6	(241.3)
11	2021	391.8	49.1	440.9	604.0	163.1
12	2022		127.6	127.6	1,636.4	1,508.8
13	2023		131.8	131.8	1,758.8	1,627.0
14	2024		136.2	136.2	1,891.3	1,755.2
15	2025		140.6	140.6	2,034.9	1,894.2
16	2026		145.3	145.3	2,190.5	2,045.2
17	2027		128.3	128.3	2,359.2	2,230.9
18	2028		132.5	132.5	2,468.8	2,336.2
19	2029		136.9	136.9	2,583.4	2,446.5
20	2030		141.4	141.4	2,703.3	2,561.9
21	2031		146.0	146.0	2,828.8	2,682.8
22	2032		148.4	148.4	2,960.2	2,811.8
23	2033		150.9	150.9	3,051.3	2,900.5
24	2034		153.3	153.3	3,145.5	2,992.2
25	2035		155.9	155.9	3,243.0	3,087.1
26	2036		158.4	158.4	3,343.7	3,185.3
27	2037		161.0	161.0	3,447.9	3,286.9
28	2038		163.7	163.7	3,555.6	3,392.0
29	2039		166.4	166.4	3,667.1	3,500.7
30	2040		169.1	169.1	3,782.4	3,613.3
31	2041		171.9	171.9	3,901.7	3,729.9
32	2042		174.7	174.7	4,025.2	3,850.5
33	2043		177.6	177.6	4,153.0	3,975.4
34	2044		180.5	180.5	4,285.2	4,104.7
35	2045		183.5	183.5	4,422.0	4,238.5
36	2046	0.0	186.5	186.5	4,563.7	4,377.2
Total		8,397.0	4,110.8	12,507.9	80,276.4	67,768.5

Discounted Cost Benefit Stream

Sq	Year	Discount Rate	Construction Cost	Operation and Maintenace Cost	Cost Total	Benefit	Net Benefit
0	2010	1.00	42.9	0.0	42.9	0.0	(42.9)
1	2011	1.12	38.3	0.0	38.3	0.0	(38.3)
2	2012	1.25	939.1	0.0	939.1	0.0	(939.1)
3	2013	1.40	838.5	0.0	838.5	0.0	(838.5)
4	2014	1.57	748.6	0.0	748.6	0.0	(748.6)
5	2015	1.76	684.1	0.0	684.1	0.0	(684.1)
6	2016	1.97	171.9	0.0	171.9	0.0	(171.9)
7	2017	2.21	321.2	21.7	342.9	147.9	(195.0)
8	2018	2.48	286.8	19.5	306.3	153.8	(152.4)
9	2019	2.77	256.1	17.5	273.6	160.1	(113.5)
10	2020	3.11	228.6	15.7	244.4	166.7	(77.7)
11	2021	3.48	112.6	14.1	126.7	173.6	46.9
12	2022	3.90	0.0	32.8	32.8	420.0	387.3
13	2023	4.36	0.0	30.2	30.2	403.1	372.9
14	2024	4.89	0.0	27.9	27.9	387.0	359.1
15	2025	5.47	0.0	25.7	25.7	371.8	346.1
16	2026	6.13	0.0	23.7	23.7	357.3	333.6
17	2027	6.87	0.0	18.7	18.7	343.6	324.9
18	2028	7.69	0.0	17.2	17.2	321.0	303.8
19	2029	8.61	0.0	15.9	15.9	299.9	284.1
20	2030	9.65	0.0	14.7	14.7	280.2	265.6
21	2031	10.80	0.0	13.5	13.5	261.8	248.3
22	2032	12.10	0.0	12.3	12.3	244.6	232.4
23	2033	13.55	0.0	11.1	11.1	225.2	214.0
24	2034	15.18	0.0	10.1	10.1	207.2	197.1
25	2035	17.00	0.0	9.2	9.2	190.8	181.6
26	2036	19.04	0.0	8.3	8.3	175.6	167.3
27	2037	21.32	0.0	7.6	7.6	161.7	154.1
28	2038	23.88	0.0	6.9	6.9	148.9	142.0
29	2039	26.75	0.0	6.2	6.2	137.1	130.9
30	2040	29.96	0.0	5.6	5.6	126.2	120.6
31	2041	33.56	0.0	5.1	5.1	116.3	111.2
32	2042	37.58	0.0	4.6	4.6	107.1	102.5
33	2043	42.09	0.0	4.2	4.2	98.7	94.4
34	2044	47.14	0.0	3.8	3.8	90.9	87.1
35	2045	52.80	0.0	3.5	3.5	83.8	80.3
36	2046	59.14	0.0	3.2	3.2	77.2	74.0
		Total	4,668.8	410.3	5,079.2	6,439.2	1,360.0

Discount Rate	12.0%

Net Present Value	1,360
B/C Ratio	1.268
FIRR	14.05%

8.2.2 Financial Analysis

(1) Financial costs

The construction costs were estimated previously in Chapter 4, Section 4.9. The cost estimation was done using 2007 constant prices, as shown in Table 8.2.12. The cost covering the Metro Line 4 (Phase I) and 6th of October Line (Phase II) is estimated at LE 11,553.8 million. The cost for Phase I is estimated at LE 7,031.0 million and the cost for Phase II is estimated at LE 4,522.7 million.

Table 8.2.12 Financial Cost for Metro Line 4 / 6th of October Line

Items		Unit	Phase I	Phase II	Total
1	Civil Works	Million LE	4,802.9	1,798.2	6,601.1
2	E&M Construction Cost	Million LE	1,696.4	2,382.5	4,078.8
3	Engineering Cost	Million LE	236.3	152.0	388.4
4	Local Administration	Million LE	295.4	190.0	485.5
Total		Million LE	7,031.0	4,522.7	11,553.8

Source: JICA Study Team (2007 Constant Prices)

These construction costs were allocated to each year during the construction period by following the construction schedule that was shown previously in Chapter 4, Section 4.9.2.

(2) Operation and maintenance costs (O&M Costs)

The operation and maintenance costs consist of: i) staff costs; ii) maintenance materials; and iii) spare parts costs. The staff costs are estimated on the basis of the number of operating and maintenance staff proposed by the Study Team, as discussed previously in Chapter 4, Section 4.10, and staff salary levels.

The operation and maintenance materials and spare parts were estimated on the basis of future passenger-km and train (rail car)-km and present unit cost of maintenance and spare parts.

Table 8.2.13 Future Passenger-km, Train-km and Rail Car-km

Item	2017	2022	2022	2027
No. of Passenger/Day	425,800	439,900	677,600	791,100
Passenger km/Day	2,056,850	2,141,130	13,721,400	16,019,800
Train km/Day	4,650	4,650	12,880	12,880
Rail Car-km/Day	27,900	27,900	77,280	77,280
Notes	Phase I Section	Phase I section	Whole section	Whole section

Source: JICA Study Team

As a result, the operation and maintenance cost was estimated, as shown in Table 8.2.14.

Table 8.2.14 Operation and Maintenance Cost Estimation (Universal Standard Base)

Phase	Unit	Administration	Operation	Maintenance	Total
Phase I	LE million per year)	1.10	4.23	3.05	8.39
Phase II (Increase)	LE million per year)	1.32	4.18	4.60	10.16
Total	LE million per year)	2.41	8.41	7.66	18.55

Source: JICA Study Team

The number of operation and maintenance staff is based on the universal standard. However, if the CMO standard is followed, the number of staff will increase to about 1.86 times the above mentioned proposed staffing level. On this basis, the operating and maintenance cost is calculated again as follows:

Table 8.2.15 Operating and Maintenance Cost Estimation (CMO Base)

(LE Million per year)

Phase	Administration	Operation	Maintenance	Total
Phase I	1.75	6.12	6.31	14.18
Phase II (Increase)	2.48	7.84	9.93	20.25
Total	4.23	13.95	16.23	34.41

Source: JICA Study Team

(3) Passenger demand

The passenger demand on Metro Line 4 / 6th of October Line was estimated previously in Chapter 3, Section 3.6. Based on the demand projection, streams for the passenger demand were calculated, as shown in Table 8.2.16 and Figure 8.2.1.

Table 8.2.16 Daily Passenger Demand on Metro Line 4 / 6th of October Line

Phase	2017	2022	2027	Average Annual Growth Rate (%)
Phase I section	425,800	439,900		0.82
Whole Section		676,900	795,800	4.13

Source: JICA Study Team

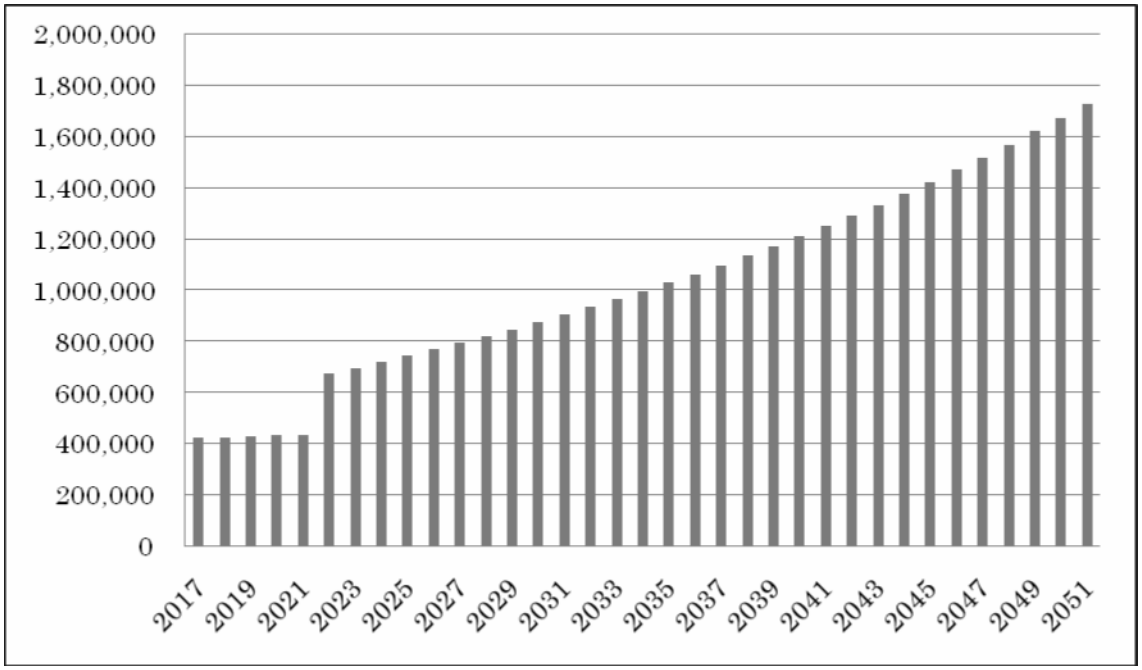


Figure 8.2.1 Daily Passenger Demand for Metro Line No 4

(4) Fare setting for Metro Line 4 / 6th of October Line

1) Review of historical fare systems: In principal, there are potentially three (3) types of fare system applicable for Metro Lines:

a) A fixed fare system, as presently adopted for Metro Lines 1 and 2;

b) A zonal fare system; and

c) A distance-based fare system (a base fare plus a distance-based charge)

For the Cairo Metro system, a zonal fare system was employed during 2000-2003. However, after 2003, CMO changed to a fixed fare system. Table 8.2.17 shows the historical trend of the Metro fare system.

Table 8.2.17 Historical Trend of Metro Fares

Year	Metro Fare (LE)	Notes
2000 – 2003	0.50 for 1-9 stations 0.75 for 10-16 stations 1.00 for 17 or more stations	Zonal fare system
2003 – 2006	0.75	Fixed fare system
2006 – to date	1.00	Fixed fare system

Source: National Tunnel Authority

2) Analysis of the revenue and cost of Metro Lines 1 and 2: Table 8.2.18 shows the results of a comparative analysis of revenue, O&M cost and depreciation cost for the existing Metro Lines 1 and 2. This table indicates that the revenue per passenger in 2005/06 was LE 0.40 while the expenditure per passenger for the Metro system was LE 1.00. This means that operation of Metro Lines 1 and 2 generated a loss of LE 0.60 per passenger or LE 427million overall in 2005/06. This tendency has continued since the opening of the Metro.

Table 8.2.18 Comparative Analysis of Revenue and Cost for Metro Line 1 and 2

Item	Unit	00/01	01/02	02/03	03/04	04/05	05/06
No. of Passengers	Mil/day	1.85	1.87	1.82	1.79	1.86	1.95
Revenue	Mil. LE	200.47	210.38	228.08	255.28	271.13	286.02
O&M Cost	Mil. LE	125.37	158.91	154.08	145.41	190.73	191.49
Depreciation Cost	Mil. LE	383.79	382.72	413.57	606.01	511.12	521.59
Total Cost	Mil. LE	509.16	541.63	567.65	751.42	701.85	713.08
Revenue/Passenger	LE/person	0.297	0.308	0.343	0.391	0.399	0.402
Total Costs/Passenger	LE/person	0.754	0.794	0.855	1.150	1.034	1.002
Revenue/Cost Ratio		0.394	0.388	0.402	0.340	0.386	0.401
Profit/Loss	Mil. LE	(308.69)	(331.25)	(339.57)	(496.14)	(430.72)	(427.06)

Source: JICA Study Team (Analysis of statistical data prepared by CMO)

3) Setting of future fare levels: Since opening of the subway, the government has granted a sizable subsidy to CMO in order to secure transport modes for the inhabitants in Cairo, as determined above. It is assumed that this policy will continue in future.

The above Metro fare includes a factor of inflation. According to IMF Staff Report for 2007 Article IV Consultation, the inflation rate for the period of 2000 and 2006 was about 5.0 % per year, while the nominal increase rate of the fare was about 10.1 % per

year. Therefore, the real increase rate of the fare is estimated at approximately 5.1 % per annum.

Based on the present fare system and real increase rates of the fare, the fare level of the Metro system was estimated for two (2) fare structure options:

a) Option 1: Distance-based fare system.

b) Option 2: Fixed fare system, as employed for Metro Lines 1 and 2.

Table 8.2.19 shows the assumed future fare system for the Metro system, including Metro Line 4 / 6th of October Line.

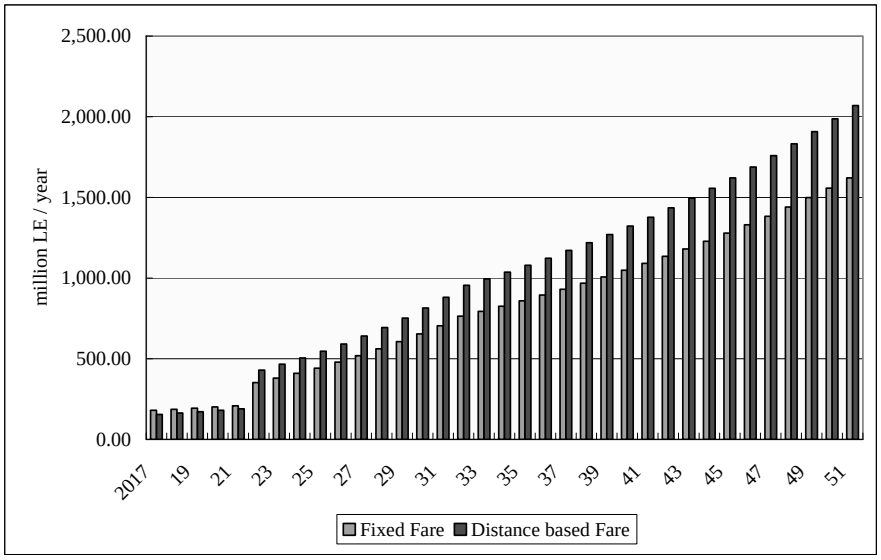
Table 8.2.19 Assumed Fare Level for Metro System

Year	Option 1: Distance-Based Fare (LE)		Option 2: Fixed Fare (LE)
	Base Fare	Distance-based Fare per km	
2008	0.60	0.03	1.00
2012	0.70	0.03	1.20
2017	0.81	0.04	1.40
2022	0.93	0.05	1.60
2027	1.08	0.05	1.90

Source: JICA Study Team

(5) Estimation of revenue

Figure 8.2.2 shows the yearly operation revenues for both fare structure options. In this study, Option 1of the distance based fare system is adopted for the financial analysis as the reference base. The operation revenue based on Option 2, which is a fixed-based fare system, is compared in the sensitivity analysis.



Source: JICA Study Team

Figure 8.2.2 Operation Revenues for Metro Line 4 / 6th of October Line

Additional income accruing from ancillary sources related to the Metro operation, such as advertisement charges, are considered to be 5 % of the operating revenue, taking into account the experience in other countries.

(6) Results of financial analysis

1) Conditions and assumption of the financial analysis

- The evaluation period is assumed to be 30 years the after opening the Metro Line 4 (Phase I) to the public (2017).
- The depreciation for depreciable assets is appropriated linearly over 30 years of useful life for the Metro, with no residual value remaining from the invested capital after 30 years.
- Taxes are not considered in the financial analysis.

2) Government support cases for financial analysis: Three representative government support cases were examined in this study, where the public sector subsidy supports the initial development cost. These support cases are: 0 % (Case 1, i.e. no support), 57.1 % (Case 2, which covers the civil works only), and 100 % (Case 3, which covers the full cost of the project).

Table 8.2.20 Government Support Cases for Financial Analysis for Metro Line 4 / 6th of October Line

Scenario		Case 1	Case 2	Case 3
Fare Setting		Distance based fare system		
Total Fare Revenue (2017-2046)	LE Mil.	27,843		
Total Capital Expenditure (CAPEX)	LE Mil.	11,539		
Civil Work	LE Mil.	6,601		
Electrical and Mechanical Cost	LE Mil	4,079		
Construction cost subsidy	LE Mil.	0	6,601	11,539
Government Contribution	%	0	57.1	100.0

Source: JICA Study Team

3) Results of financial analysis: Table 8.2.21 shows the results of a financial analysis of the above mentioned government support cases.

Table 8.2.21 Results of Government Support Financial Analysis for Metro Line 4 / 6th of October Line

Case	Net Present Value (million LE)	Revenue / Expenditure Ratio	Financial Internal Rate of Return (%)
Case 1	(674)	0.758	9.53
Case 2	299	1.165	13.58
Case 3	1,595	4.091	n.a.

Source: JICA Study Team
Note: The Fixed Fare System (Option 1) was used.
Note: In Case 3, revenue exceeds expenditure at any discount rate. FIRR of Case 3 can not be computed due to the definition of equation of FIRR.

Among the above three (3) cases, Case 3, which is the case that currently applies to CMO, is financially feasible with a positive NPV. In addition, Case 2 is just feasible considering that a Financial Internal Rate of Return (FIRR) of 12 % is considered a threshold discount rate.

For Case 2, where the government provides a subsidy to the operating company to cover 57.1 % of the total project cost (this cost covers all civil works), the FIRR value is 13.58 %. This means that if the government could prepare or arrange an ODA loan, which has a comparatively lower interest rate than ordinary bank loans, the project may be worth implementing financially.

(7) Sensitivity analysis

1) Adoption of the current fixed fare system: When the current fixed fare system is adopted for Metro Line 4 / 6th of October Line, the total fare revenue during the project life is expected to decrease by 19 % compared with Option 1 (distance based fare system). As a result, the financial situation is expected to become slightly worse than that of Option 1, as shown in Table 8.2.22.

Table 8.2.22 Results of the Financial Analysis of Government Support Cases (Option 2: Fixed Fare System)

Case	Net Present Value (million LE)	Revenue / Expenditure Ratio	Financial Rate of Return (%)
Case 1	(968)	0.653	8.04
Case 2	5	1.003	12.03
Case 3	1,300	3.520	n.a.

Source: JICA Study Team

2) Different assumptions for construction costs, fare revenue, and operation and maintenance cost: A financial analysis was made under the assumption that: (i) the estimated construction cost would increase to 20 % more than the original estimate; (ii) the estimated fare revenue would decrease to 20 % less than the original estimate; (iii) operation and maintenance costs would be based on Cairo Metro Organization (CMO) standards, representing an increase of about 24.5 % above the original estimate; and (iv) both construction cost and operation and maintenance cost would increase as shown in Table 8.2.23. This table shows that financial situation would become worse than the original estimate.

Table 8.2.23 Results of Financial Analysis for Different Assumptions (Option 1: Distance Based Fare System)

Assumption	Case	Net Present Value (million LE)	Revenue / Expenditure Ratio	Financial Rate of Return (%)	Note
20 % Increase in Construction Cost	Case 1	(1,422)	0.561	6.88	
	Case 2	(254)	0.877	10.66	
	Case 3	1,300	3.520	n.a.	
20 % Decrease in Fare Revenue	Case 1	(1,332)	0.522	6.06	Additional income, such as advertising charges, was not considered.
	Case 2	(358)	0.802	9.65	
	Case 3	937	2.816	n.a.	
CMO Based O&M Costs	Case 1	(1,095)	0.624	7.44	
	Case 2	(121)	0.937	11.26	
	Case 3	1,174	2.828	n.a.	
20 % Increase in Construction Cost and CMO Based O&M Cost	Case 1	(1,548)	0.540	6.31	
	Case 2	(380)	0.827	9.94	
	Case 3	1,174	2.828	n.a.	

Source: JICA Study Team

(8) Conclusions (Railway, Financial Analysis)

After reviewing the financial analysis results, the following conclusions were made:

1) When the government subsidizes the operating company by providing full construction costs for civil works, equipment and materials (Case 3), this project is financially feasible.

2) If the government only subsidizes the operating company by providing the civil works construction costs (Case 2), the Financial Internal Rate of Return (FIRR) of this project is calculated to be 13.6 %. This means that the project will be feasible if it is coupled with a soft loan from an ODA source.

3) If the government does not provide any subsidies to the operating company (Case 1), the FIRR will decrease to 9.5 %, which is below the viable threshold.

4) If a distance-based fare system is introduced on the Metro Line 4 / 6th of October Line (Option 1), rather than the fixed fare system, the financial situation of the operating company will be improved. This is due to the fact that longer distance passengers will pay proportionally more for the trip.

5) If the estimated construction cost increases 20% above the reference base, or the projected passenger demand decreases 20% below the reference base, the FIRR for government support Case 2 (57.1% support) will become 10.7 % and 9.7 %, respectively. Both of these FIRR rates are below the viable threshold.

6) If the estimated construction cost increases 20 % above the reference base, *and* if the O&M cost increases 24.5 % (by employing the current CMO O&M rates), FIRR for government support Case 2 (57.1% support) will decrease to 9.9 %, which is below the viable threshold.

Taking into account the above mentioned government support cases (Case 1 – Case 3), in order to implement the project, it is concluded that the government will need to provide the full construction cost of the Metro Line 4 / 6th of October Line (Case 3). When Case 3 is adopted, the project will still be financially viable even if there is a considerable increase in the cost of construction or a considerable decrease in the demand for rail transport services.

8.3 Economic and Financial Analysis of 6th of October Busway Project

8.3.1 Economic Analysis

An economic analysis was carried out to determine whether government investment in 6th of October Busway would be feasible in terms of the national economy.

(1) Economic costs

1) Economic construction costs: The construction costs in terms of economic prices were calculated, as shown in Table 8.3.1. These economic costs were allocated to each year during the construction period by following the construction schedule, as described previously in Chapter 5, Section 5.5.3.

Table 8.3.1 6th of October Busway Economic Construction Cost

(Million LE)

Item		Total	Foreign Amount	Local Amount
1	Civil Works	573.74	172.77	400.96
2	Depot and Workshop	53.04	7.93	45.12
3	Procurement of Buses	817.20	817.20	0.00
Total		1,443.98	997.90	446.08

Source: JICA Study Team

2) Economic operation and maintenance costs: The economic operation and maintenance cost for 6th of October Busway consists of: i) maintenance for the busway and its related facilities; ii) bus O&M costs; and iii) additional O&M cost of Metro Line 4 / 6th of October Line. The additional cost of the Metro is included to balance the external diseconomy due to the limited busway capacity. This calculation does not duplicate the economic benefits of the Metro.

The maintenance costs for the busway and its related facilities were estimated previously in Chapter 5, Section 5.5. The O&M cost for buses was estimated on the basis of unit VOC cost and bus-km. Additional operation and maintenance cost of Metro Line 4 / 6th of October Line was estimated through prediction of the number of diverted passengers from the busway for the *without* project alternative, combined with the unit O&M cost of the Metro. The economic operation costs are shown in Table 8.3.2.

Table 8.3.2 Economic O&M Cost for 6th of October Busway

(Million LE)

Item	2012	2017	2022	2027
Busway Maintenance Cost	3.28	3.28	3.63	*3.63*
O&M Cost of Buses	32.98	44.11	53.38	58.42
Additional O&M Cost of the Metro	0	0	63.69	74.88
Total	36.26	47.39	120.7	136.93

Source: JICA Study Team

3) Residual value: The residual values are appropriated in the last year of the project. The project life for the civil works assets is assumed to be 30 years after completion of the project and the project life for the articulated buses is assumed to be 10 years after the commencement of bus operations. The civil works assets will be fully depreciated at the end of the project life, while the residual value of articulated buses is assumed to be 10 % of purchased cost.

(2) Economic benefits

1) Type of benefits: The economic benefits were estimated by comparing the *without* project alternative, in which 6th of October Busway does not exist, and the *with* project alternative, in which 6th of October Busway is put into operation, as shown in Table 8.3.3. The estimated economic benefits of implementation of 6th of October Busway are based on predicted changes in the passengers' choice of transport mode. In the *without* project alternative, the 6th of October Line project was considered as completed to exclude the economic benefits by the railway project.

Table 8.3.3 *With* and *Without* Project Alternatives for 6th of October Busway

Item		2012-2017		2017-2027	
		Without Project	*With* Project	*Without* Project	*With* Project
Public Transport Users					
	Busway Users	X	○	X	○
	Ordinary Bus User	○	○	○	○
	Shared Taxi Users	○	○	○	○
	Minibus Users	○	○	○	○
	6th of October Line Users	X	X	○	○
	Other Rail	○	○	○	○
Private Transport Users					
	Car Users	○	○	○	○
	Taxi Users	○	○	○	○
	Truck Users	○	○	○	○

Notes: ○: is assumed to exist; X : is assumed not to exist

As mentioned above, the economic benefits are assumed to be: i) saving in time cost; and ii) saving in vehicle operating costs. Both benefits are considered as additional surplus that will accrue to the national economy from implementation of the project.

2) Time saving benefits: The transport time saving benefits generated by introduction of 6th of October Busway was computed in terms of the total transport time for all passengers as a whole in the study area. The passengers of this new busway service who are diverted from other modes will obtain time saving benefits from the reduced transport time, as shown in Table 8.3.4. In addition, the passengers who use other transport modes will also obtain time saving benefits as the travel speed of the other transport modes will be improved due to the introduction of the new busway service leading to reduced traffic volumes on the roads. Thus, the beneficiaries of the busway will not only be those who divert from existing vehicles such as private buses, shared taxies, and cars, to the new busway system, but also those who use these other transport modes.

The time saving benefits were calculated as follows:

a) Time saving was calculated as the difference between the *without* project alternative and the *with* project alternative in terms of total transport times in the study area, as shown in Table 8.3.4.

b) The time saving was converted into economic benefits in monetary terms using the economic time value by transport mode, as shown in Table 8.3.5.

Table 8.3.4 Passenger Travel Time by Transport Mode *With* and *Without* 6th of October Busway

(Million Passenger-Hours/Year)

	2012			2017			2022			2027		
	With	*W/O*	*W - W/O*	*With*	*W/O*	*W - W/O*	*With*	*W/O*	*W - W/O*	*With*	*W/O*	*W - W/O*
Passenger Travel Time by Public Transport Users												
Busway	56	0	56	58	0	58	71	0	71	85	0	85
Shared Taxi	3,653	3,683	(30)	3,835	3,894	(59)	4,105	4,141	(36)	4,133	4,154	(21)
Mini Bus	1,224	1,233	(9)	1,285	1,304	(19)	1,385	1,395	(10)	1,397	1,446	(49)
Other Bus	1,118	1,127	(9)	1,174	1,192	(18)	1,252	1,318	(67)	1,259	1,323	(64)
6th of October	32	50	(18)	33	53	(20)	163	174	(11)	215	244	(29)
Other Rails	658	663	(5)	691	701	(10)	891	906	(15)	1,102	1,121	(19)
Sub Total	6,741	6,756	(15)	7,076	7,144	(68)	7,867	7,934	(68)	8,191	8,288	(97)
Passenger Travel Time by Private Transport Users												
Car	1,437	1,438	(1)	1,839	1,839	(0)	3,066	3,074	(8)	3,944	3,955	(11)
Taxi	348	349	(0)	446	446	(0)	743	745	(2)	956	959	(3)
Truck	120	120	(0)	153	153	(0)	256	256	(0)	329	330	(1)
Sub Total	1,905	1,907	(1)	2,438	2,438	(0)	4,065	4,075	(10)	5,229	5,244	(15)
Total	8,645	8,663	(18)	9,513	9,582	(69)	11,932	12,009	(77)	13,421	13,532	(111)

Source: JICA Study Team

Table 8.3.5 Time Saving Benefits by Transport Mode Generated by 6th of October Busway

(LE Million/year)

	2012			2017			2022			2027		
	With	*W/O*	*W - W/O*	*With*	*W/O*	*W - W/O*	*With*	*W/O*	*W - W/O*	*With*	*W/O*	*W - W/O*
Time saving of Trips using Public Transport Mode												
Busways	858	0	858	286	0	286	443	0	443	643	0	643
Shared Taxi	56,291	56,756	(465)	18,783	19,073	(290)	25,571	25,796	(225)	31,255	31,414	(158)
Mini Bus	18,856	19,003	(147)	6,292	6,386	(94)	8,628	8,937	(310)	10,566	10,934	(368)
Other Bus	17,229	17,375	(146)	5,749	5,839	(90)	7,797	8,214	(417)	9,521	10,002	(481)
6th of October	488	769	(281)	163	258	(95)	1,015	1,428	(412)	1,625	2,532	(907)
Other Rails	10,145	10,222	(77)	3,385	3,435	(50)	5,552	5,050	502	8,335	7,790	545
Sub Total	103,867	104,125	(258)	34,658	34,991	(333)	49,006	49,425	(418)	61,945	62,672	(727)
Time Saving of Trips using Private Transport Mode												
Car	22,148	22,158	(10)	35,922	35,937	(15)	76,199	76,386	(187)	118,958	119,299	(341)
Taxi	5,369	5,372	(3)	8,708	8,712	(4)	18,472	18,518	(46)	28,838	28,921	(83)
Truck	1,846	1,846	(0)	2,993	2,995	(2)	6,350	6,366	(16)	9,913	9,942	(29)
Sub Total	29,363	29,376	(13)	47,623	47,644	(21)	101,021	101,270	(249)	157,709	158,162	(453)
Total	133,230	133,501	(271)	82,281	82,635	(354)	150,027	150,695	(667)	219,654	220,834	(1,180)

Source: JICA Study Team

3) Vehicle operating cost saving: The vehicle operating cost (VOC) saving benefits generated by introduction of 6th of October Busway was computed in terms of VOC for all vehicles in the study area. Ordinary bus passengers and car users are likely to be diverted to the new busway service. This will result in a benefit for vehicle operating costs due to the reduced vehicle kilometers that are traveled by the vehicle. And the vehicles which use the same vehicle modes will obtain VOC benefits, because passengers will select the routes more preferable and shorter than those used in the *without* project alternative. Therefore, beneficiaries are all vehicle mode users.

Table 8.3.6 shows vehicle-km for the *with* and *without* project alternatives and Table 8.3.7 shows the VOC saving benefits.

Table 8.3.6 Vehicle Kilometers *With* and *Without* 6th of October Busway

(Million Vehicle km/Year)

	2012			2017			2022			2027		
	With	*W/O*	*W/-W/O*	*With*	*W/O*	*W/-W/O*	*With*	*W/O*	*W/-W/O*	*With*	*W/O*	*W/-W/O*
Vehicle km by Public Transport Users												
Busway	18	0	18	18	0	18	21	0	21	24	0	24
Shared Taxi	8,583	8,663	(80)	8,590	8,824	(234)	8,469	8,554	(85)	8,043	8,156	(113)
Mini Bus	2,993	3,013	(20)	2,996	3,069	(73)	2,991	3,018	(27)	2,849	2,888	(39)
Other Bus	807	814	(7)	808	829	(21)	791	808	(17)	750	767	(17)
Sub Total	12,401	12,490	(89)	12,412	12,722	(310)	12,272	12,380	(108)	11,666	11,811	(145)
Vehicle km by Private Transport Users												
Car	29,511	29,550	(39)	36,818	36,859	(41)	58,351	58,390	(39)	71,974	72,037	(63)
Taxi	5,715	5,723	(8)	7,130	7,138	(8)	11,300	11,308	(8)	13,938	13,950	(12)
Truck	2,463	2,467	(4)	3,073	3,077	(4)	4,871	4,874	(3)	6,008	6,013	(5)
Sub Total	37,689	37,740	(51)	47,021	47,074	(53)	74,522	74,572	(50)	91,920	92,000	(80)
Total	50,090	50,230	(140)	59,432	59,799	(367)	86,794	86,952	(158)	103,586	103,811	(225)

Source: JICA Study Team

Table 8.3.7 Vehicle Operating Cost Saving Benefits Generated by 6th of October Busway

(LE Million/year)

	2012			2017			2022			2027		
	With	*W/O*	*W/-W/O*	*With*	*W/O*	*W/-W/O*	*With*	*W/O*	*W/-W/O*	*With*	*W/O*	*W/-W/O*
VOC using Public Transport Mode												
Busway	157	0	157	157	0	157	180	0	180	206	0	206
Shared Taxi	13,574	13,817	(243)	13,568	14,041	(473)	13,318	13,539	(221)	12,622	12,988	(366)
Mini Bus	9,862	9,927	(65)	9,857	10,088	(231)	9,796	9,843	(47)	9,314	9,360	(46)
Other Bus	3,477	3,506	(29)	3,475	3,563	(88)	3,388	3,466	(78)	3,205	3,270	(65)
Sub Total	27,070	27,250	(180)	27,057	27,692	(635)	26,682	26,848	(166)	25,347	25,618	(271)
VOC using Private Transport Mode												
Car	13,269	13,287	(18)	16,554	16,573	(19)	26,236	26,254	(18)	32,362	32,390	(28)
Taxi	2,570	2,573	(3)	3,206	3,209	(3)	5,081	5,084	(3)	6,267	6,272	(5)
Truck	5,511	5,519	(8)	6,876	6,884	(8)	10,897	10,905	(8)	13,441	13,453	(12)
Sub Total	21,350	21,379	(29)	26,636	26,666	(30)	42,214	42,243	(29)	52,070	52,115	(45)
Total	48,420	48,629	(219)	53,693	54,358	(665)	68,896	69,091	(195)	77,417	77,733	(316)

(3) Economic evaluation

1) Cost-benefit analysis: A cost-benefit analysis was carried out based on the costs and benefits calculated above. The analysis yielded economic evaluation indicators, such as Economic Internal Rate of Return (EIRR), Net Present Value (NPV) and Benefit Cost Ratio (B/C Ratio). Based on the lending rate of the Central Bank of Egypt in February 2008, it is assumed that the social discount rate in this study is 12 % per annum.

Table 8.3.8 Summary of the Economic Evaluation for 6th of October Busway Project

Indicator	Evaluation
Net Present Value	LE 1,017 million
B/C Ratio	1.73
EIRR	21.32 %

Notes: 1) The discount rate is assumed to be 12 % per annum.
2) The project life is assumed to be 30 years after the busway is opened to the public.

2) Sensitivity Analysis: A sensitivity analysis was conducted under the assumption of a 20 % increase and/or decrease of the costs and benefits. Table 8.3.9 shows the results of the sensitivity analysis.

Table 8.3.9 Sensitivity Analysis regarding Costs and Benefits for 6th of October Busway Project

Item			Benefits		
			20 % down	Reference Base	20 % up
Costs	20 % down	NPV (LE Million)	813	1,293	1,773
		BCR	1.73	2.17	2.60
		EIRR (%)	21.32	25.55	29.34
	Reference Base	NPV (LE Million)	536	1,017	1,497
		BCR	1.39	1.73	2.08
		EIRR (%)	17.41	21.32	24.75
	20 % up	NPV (LE Million)	260	740	1,220
		BCR	1.16	1.45	1.73
		EIRR (%)	14.3	18.11	21.32

Notes: 1) The discount rate is assumed to be 12.0 % per annum.
2) The project life is assumed to be 30 years.

3) Conclusion (Busway, Economic Analysis): The implementation of 6th of October Busway project can be justified from the national economic view point. The sensitivity analysis indicates that the project is highly feasible.

8.3.2 Financial Analysis

(1) Financial costs

The construction costs were estimated previously in Chapter 5, Section 5.5. The total cost was estimated at LE 1,654 million. The cost of civil works was estimated at LE 690 million, the cost of the Depot and Workshop was estimated at LE 56 million, and the cost of procurement of the articulated bus fleet throughout the of the project life was estimated at LE 908 million.

Table 8.3.10 Financial Cost for 6th of October Busway

(Million LE)

Item	Total	Foreign Amount	Local Amount	Tax
1 Civil Works	690.37	172.77	400.96	116.63
2 Depot and Workshop	55.75	7.93	45.12	2.71
3 Procurement of Buses	908.00	817.20	0.00	90.80
Total	1,654.12	997.90	446.08	210.14

Source: JICA Study Team
Note: Based on 2007 Constant Prices

These construction costs were allocated to each year during the construction period by following the construction schedule, as shown previously in Chapter 5, Section 5.5.3.

(2) Operation and maintenance costs

The operation and maintenance costs comprise: i) busway and related facility maintenance costs; ii) articulated bus maintenance costs; and iii) administration and operation costs of the Bus Company. The cost for the renewal of buses is included in the procurements costs for buses shown in Table 8.3.10.

The busway and related facility maintenance costs were estimated previously in Chapter 5, Section 5.5. The operation costs of the articulated bus fleet was estimated on the basis of future bus-km and present unit operation costs, as shown in Table 8.3.11.

Table 8.3.11 Future Bus-Kilometer, Operation Costs

Item	2012	2017	2022	2027
Bus – km	12,393	18,630	21,870	23,733
Operating Cost (LE/day)	28,397	42,689	50,113	54,382
Annual Operating Cost (Million LE)	10.37	15.58	18.29	19.85

Source: JICA Study Team

With regards to the staff costs, the number of staff required for administration, operation and maintenance of the Bus Company was estimated previously in Chapter 5, Section 5.4. These data were multiplied by the annual salary level and the result is shown in Table 8.3.12.

Table 8.3.12 Personnel Cost Estimation

Item	Unit	2012	2017	2022	2027
Administrative	Million Le per year	1.68	2.04	2.21	2.32
Operation	Million Le per year	8.96	11.12	12.22	12.86
Maintenance	Million Le per year	1.44	1.88	2.12	2.26
Total	Million Le per year	12.08	15.04	16.55	17.44

Source: JICA Study Team

(3) Passenger demand

The passenger demand for 6th of October Busway was estimated previously in Chapter 3, Section 3.6. The results are summarized in Table 8.3.13.

Table 8.3.13 Daily Passenger Demand on 6th of October Busway

Item	2012	2017	2022	2027
Bus Passenger	100,800	157,450	209,250	229,650
Bus Passenger-km	2,106,608	3,134,981	3,563,593	4,058,279
Average Trip Length (km)	20.90	19.91	17.03	17.67
Notes	6th of October Line is not implemented.	6th of October Line is implemented up to Al Wahat Station (Phase I).	6th of October Line is extended to 6th of October NUC (Phase II).	6th of October Line is in operation (Phase II).

Source: JICA Study Team

(4) Fare setting for 6th of October Busway

1) Review of historical fare system: In principal, there are three (3) types of fare systems applicable to 6th of October Busway:

   a) A fixed fare system;

   b) A zonal fare system; and

   c) A distance-based fare system (a base fare plus a distance-based charge).

2) Setting of future fare levels: Based on the present fare system and the real increasing rate of the fare, the fare level for the busway was estimated, as shown in Table 8.3.14. In this estimation, two (2) types of fare system were assumed as follows:

   a) Option 1: Distance-based fare system; and

b) Option 2: Fixed fare system.

Table 8.3.14 shows the assumed future fare system for the busway, which is basically the same as for 6th of October Line.

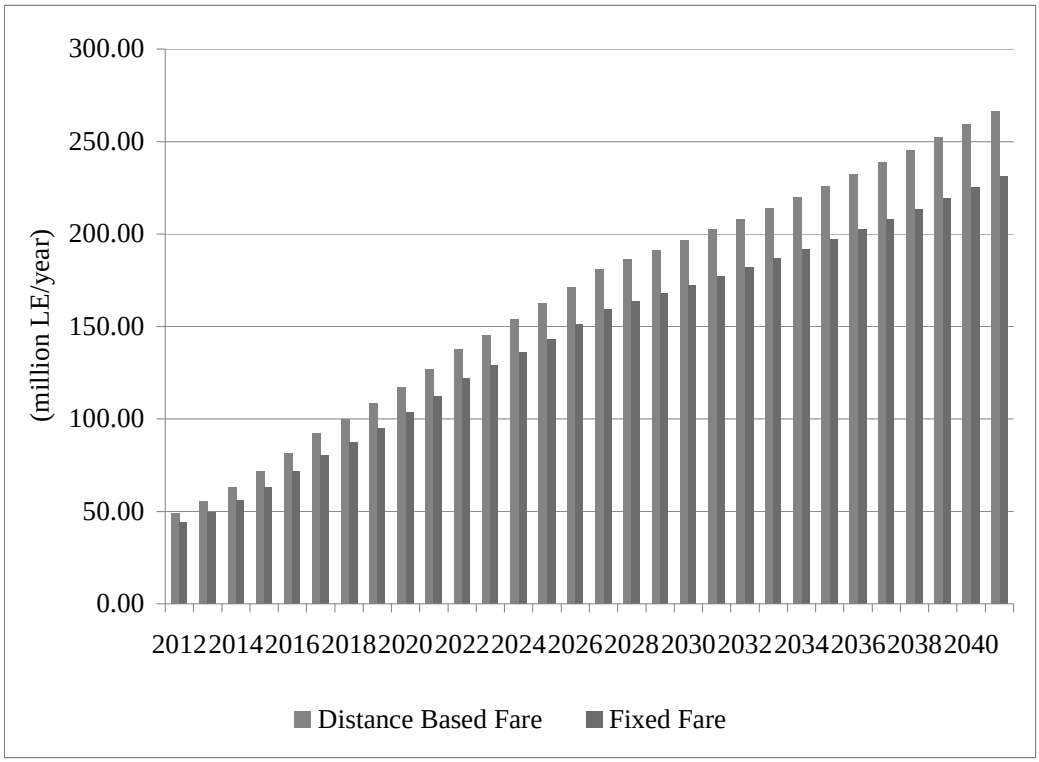
Table 8.3.14 Assumed Fare Level for 6th of October Busway

Year	Option 1: Distance-Based Fare (LE)		Option 2: Fixed Fare (LE)
	Base Fare	Distance-based Fare	
2008	0.60	0.03	1.00
2012	0.70	0.03	1.20
2017	0.81	0.04	1.40
2022	0.93	0.05	1.60
2027	1.08	0.04	1.90

Source: JICA Study Team

(5) Estimation of revenue

Figure 8.3.1 shows the yearly operation revenues for both fare structure options. In this study, Option 1 is a distance based fare system and this was adopted for the financial analysis as the reference base. However, the operation revenue based on a fixed fare system was also examined in the sensitivity analysis.



Source: JICA Study Team

Figure 8.3.1 Operation Revenues for 6th of October Busway

Table 8.3.15 shows the fare revenue for both fare structure options. Additional income accruing from ancillary sources related to the busway operation, such as advertisement charges, were estimated at 5 % of the operating revenue, taking into account experience from other countries.

Table 8.3.15 Fare Revenue for 6th of October Busway

(Million LE/Year)

		2012	2017	2022	2027
Option 1	Distance - Based Fare System	49	92	138	181
Option 2	Fixed Fare System	44	80	122	159

Source: JICA Study Team

(6) Results of the financial analysis

1) Conditions and Assumption of the Financial Analysis

- The evaluation period was assumed to be 30 years after the year of opening services to the public (2017).
- The depreciation of depreciable assets was appropriated linearly over the 30 years of useful life for the busway and its related facilities, and 10 years for the articulated buses.
- The residual value of the busway and its related facilities is not considered after 30 years. However, for the articulated buses, the residual value is considered to be 10 % of the bus cost.
- Taxes are not considered in the financial analysis.

2) Case of financial analysis: Although there may be a number of cases to examine in the financial analysis, this study only considered the following cases:

a) Case 1: No government financial support for the busway project (0 %); and

b) Case 2: Government financial support for construction costs of the civil works comprising the busway and related facilities (41.7 % of the capital expenditure for the project).

Table 8.3.16 Government Financial Support Cases for the Financial Analysis

Scenario			Case 1	Case 2
Fare Setting			Distance based fare system	
Total Fare Revenue (2012-2041)		LE Mil.	4,954.1	
Total Capital Expenditure (CAPEX)		LE Mil.	1,654.1	
	Civil Works	LE Mil.	690.4	
	Bus Depot and Workshop	LE Mil	55.7	
	Procurement of Buses	LE Mil.	908.0	
Government contribution to construction costs for civil works		%	0	100
		LE Mil.	0	690.4
Government Contribution to Total Capital Expenditure		%	0	41.7

Source: JICA Study Team

3) Financial analysis: Table 8.3.17 shows the results of the financial analysis undertaken for the above government support cases. Even if the government does not support to the busway project financially, the project is financially feasible but it is not robust to cost increases or revenue decreases. However, if the government does provide financial support to the project by covering the civil works cost for the busway and infrastructure, the project becomes financially sound.

Table 8.3.17 Results of the Government Financial Support Financial Analysis (Option 1: Distance Based Fare System)

Case	Net Present Value (million LE)	Revenue / Expenditure Ratio	Financial Rate of Return (%)
Case 1	186	1.313	18.46
Case 2	438	2.260	35.70

Source: JICA Study Team
Notes: The evaluation period is 30 years and the discount rate is 12 % per annum.

(7) Sensitivity analysis:

1) Case 1 (0 % government support): A sensitivity analysis was undertaken for an increase and/or decrease of the estimated financial cost and revenue, assuming no financial support from the government for the busway project. The results of the analysis are shown in Table 8.3.18.

Table 8.3.18 FIRR Sensitivity Analysis for 6th of October Busway Project (Government Support Case 1)

		Increase / Decrease of Cost		
		0.80	1.00	1.20
Increase / Decrease of Revenue	0.80	18.46	13.07	9.06
	1.00	24.68	18.46	14.01
	1.20	30.59	23.47	18.40

Source: JICA Study Team

2) Case 2: (41.7 % government support): A sensitivity analysis was undertaken for partial financial support from the government covering the civil works for the busway and infrastructure. Table 8.3.19 shows the results of the analysis.

Table 8.3.19 FIRR Sensitivity Analysis for 6th of October Busway Project (Government Support Case 2)

		Increase / Decrease of Cost		
		0.80	1.00	1.20
Increase / Decrease of Revenue	0.80	35.7	27.8	22.2
	1.00	29.1	35.7	29.1
	1.20	54.2	43.3	35.7

Source: JICA Study Tea

3) Introduction of a fixed fare system for the busway: The above analysis was made on the basis that a distance-based fare system would be adopted, taking into consideration of nature of bus system. A sensitivity analysis of the introduction of a fixed fare system to the busway was undertaken. The results of the analysis are shown in Table 8.3.20.

Table 8.3.20 Results of the Financial Analysis for a Fixed Fare System

Case	Net Present Value (million LE)	Revenue / Expenditure Ratio	Financial Rate of Return (%)
Case 1	93	1.156	15.4
Case 2	345	1.993	31.3

Source: JICA Study Team
Notes: The evaluation period is 30 years and the discount rate is 12 % per annum.

(5) Conclusions (Busway, Financial Analysis)

When the government supports the project by covering the cost of civil works for the busway infrastructure, including terminal facilities, the project will be financially feasible. However, even without any government support, the project will just be viable. However, an increase in costs or a decrease in demand may present critical risks for the project.

8.4 Economic Analysis of Integrated Urban Development along the Western Development Corridor

Urban development activates and enhances the regional economy. In the context of the discussion presented in this section, "urban development" is considered to include industrial, commercial and residential development, as well as other development activities associated with the process of urbanization. Development of an urban transportation system, especially a mass transit system, can facilitate urban development.

In this section, the economic impact of urban development resulting from development of a major transportation project is evaluated by conducting an economic cost-benefit analysis. The economic costs and benefits for urban development have been estimated, based on the difference between the *with* and *without* project alternatives. Urban development conditions would be considerably different following the implementation of a major urban transportation project (*with* project alternative) compared to the case of not developing the project (*without* project alternative). The major conditions for the calculations that were used for the economic analysis of urban development are as follows:

1) Project Evaluation Period: From 2008 until 2046
2) Standard Conversion Factor: 0.84
3) Price Data: 2007 fixed price
4) Foreign Exchange Rate: USD1.00 = LE5.5
5) Social Discount Rate: 12 %

In order to determine the economic impact caused by urban development alone, the economic effects solely due to urban development needed to be separated from the effects of integrated urban development along the transportation corridor. The methodology used to separate the economic impact of urban development from the integrated development effects is discussed in Section 8.4.1. Analysis of the overall economic effect of integrated urban development along the transportation corridor is discussed in Section 8.4.2.

8.4.1 Isolating the Economic Impacts Solely Caused by Urban Development

(1) Economic benefits

Although there are several possible methodologies for estimating the economic benefits of urban development, the Study Team chose to employ the method of analyzing incremental value added by the economic activities. Because the incremental value added is the total

output less total input for production, it was considered the most appropriate index for estimating the benefits created by the economic activities.

When the improvement of transportation facilities is integrated with urban development, it can be expected that development of secondary and tertiary industries will be encouraged in the study area. Therefore, the economic benefits of the incremental value added by the urban development can be estimated from the difference between the project-driven (*with* project alternative) and trend-based industrial activities (*without* project alternative).

In order to calculate this difference, the Study Team first projected the number of people employed by each industrial sector (primary, secondary, and tertiary) for both the *with* and *without* project alternatives. The incremental increase in employment resulting from the implementation of the project (*with* project alternative – *without* project alternative) is summarized in Table 8.4.1.

Table 8.4.1 Incremental Employment (*with* Project Alternative – *without* Project Alternative)

Year	Secondary Industries Employees			Tertiary Industries Employees			Total Employees*		
	with	*without*	*w - w/o*	*with*	*without*	*w - w/o*	*with*	*without*	*w - w/o*
2012	123,309	117,902	5,407	79,274	65,981	13,293	202,583	183,883	18,700
2017	161,980	141,101	20,879	109,199	85,456	23,743	271,179	226,557	44,622
2022	216,238	168,308	47,930	149,219	110,075	39,144	365,457	278,383	87,074
2027**	253,079	191,629	61,450	178,995	129,492	49,503	432,074	321,121	110,953

Note: * The employment for primary industries is considered to be constant. This means that there is no gap between the number of primary industry employees for the *with* and *without* project alternatives.
Note** After 2027, the incremental number of employees is considered to be constant, and remain at the 2027 level.
Source: JICA Study Team

Based upon Ministry of State for Economic Development input and output data for the major industries in Egypt, the unit value added per employee was calculated. For this analysis, the unit value added per employee was set at LE45,000 per annum for secondary industry and LE43,000 per annum for tertiary industry.

The total incremental value added for the project can be estimated by multiplying the above unit value added per employee by the incremental employment for the *with* and *without* project alternatives. The economic benefits that flow for the entire project evaluation period are summarized by major sector in Table 8.4.2.

Table 8.4.2 Economic Benefits (Total Incremental Value Added) in Selected Years

Year	Unit	Secondary Industry	Tertiary Industry	Total*
2012	Million LE	243	572	815
2017	Million LE	940	1,021	1,961
2022	Million LE	2,157	1,684	3,840
2027	Million LE	2,765	2,129	4,894

Note: * As noted above, there is no gap between the number of primary industry employees for the *with* and *without* project alternatives.
Source: JICA Study Team

Finally, although not quantified for the economic evaluation due to the lack of data and information, the following additional economic benefits are also expected to result from implementation of the project:

1) Additional increase in the value added, due to the industrial cluster effects: The implementation of urban transportation infrastructure project is expected to attract more investment in the secondary and tertiary industries than at present. Therefore, industrial clusters would be formed in certain planned areas. It is generally recognized that industrial clusters can increase productivity due to the acceleration of competitiveness. This may lead to additional increases in the incremental value added, compared to the current situation.

2) Improvement of living standards: It is also expected that housing construction and related urban infrastructure development will improve the living standards of local people. When compared to the current living conditions of residents in the heavily urbanized areas of the main agglomeration and informal settlements, well planned urban areas that include socio-economic infrastructure may have a surplus value due to the improved living conditions.

(2) Economic costs

The economic costs of the urban development project are mainly divided into the construction costs and the operation and maintenance (O&M) costs. In regard with the calculation of the construction costs, the following assumptions were made:

1) Total construction costs were estimated from the construction costs of housing, secondary and tertiary industry buildings and related facilities, educational facilities, public health facilities, and other urban infrastructure such as roads, water supply, electricity, communication and so forth. The construction costs include the engineering services consisting of design and supervision work.

2) The allocation of construction costs was estimated based upon a demographic simulation. The incremental construction cost between the *with* and *without* project alternatives (trend) was considered to accrue from the present up to 2027.

3) The O&M costs were estimated at 0.5 % of the value of housing and infrastructure facilities that have already been constructed.

4) In order to convert the financial costs into economic costs, a standard conversion factor of 0.84 was adopted.

Finally, the construction costs are summarized in Table 8.4.3 as follows:

Table 8.4.3 Urban Development Costs

(Million LE at 2007 prices)

Construction costs			O&M Costs
Construction	Design	Supervision	
29,092	1,455	3,052	4,115

Source: JICA Study Team

(3) Evaluation of results

Using the economic benefits and the costs calculated above, the economic impact of urban development was evaluated by assessing three (3) economic factors: i) Economic Internal Rate of Return (EIRR); the Net Present Value (NPV); and the Benefit-Cost Ratio (B/C Ratio).

The benefit-cost flow for the urban development is shown in Table 8.4.4. The results of the economic evaluation are summarized as follows:

1) The EIRR of the project was calculated at 17.5 %. This exceeds the opportunity cost of capital, which was set at 12 % for the evaluation.

2) The NPV was estimated at LE 2,285 million under the social discount rate of 12 % used for the evaluation period.

3) The B/C Ratio was calculated at 1.20 under the social discount rate of 12 % used for the evaluation periods .

Table 8.4.4 Benefit-Cost Flow Table for the Urban Development (Reference Base)

000LE at current price

Year	Benefits				Costs	Net Benefits (Benefits - Costs)
	Primary	Secondry	Tertiary	**Total**		
2008	0	48,645	114,337	162,982	1,007,387	(844,405)
2009	0	97,290	228,674	325,964	1,011,755	(685,791)
2010	0	145,935	343,011	488,946	1,016,097	(527,151)
2011	0	194,535	457,348	651,883	1,020,440	(368,557)
2012	0	243,315	571,599	814,914	1,015,152	(200,238)
2013	0	382,545	661,469	1,044,014	1,626,170	(582,156)
2014	0	521,775	751,339	1,273,114	1,636,735	(363,621)
2015	0	661,005	841,209	1,502,214	1,647,919	(145,705)
2016	0	800,235	931,079	1,731,314	1,659,827	71,487
2017	0	939,555	1,020,949	1,960,504	1,672,576	287,928
2018	0	1,183,005	1,153,389	2,336,394	2,294,383	42,011
2019	0	1,426,455	1,285,829	2,712,284	2,311,880	400,404
2020	0	1,669,905	1,418,269	3,088,174	2,330,711	757,463
2021	0	1,913,355	1,550,709	3,464,064	2,351,097	1,112,967
2022	0	2,156,850	1,683,192	3,840,042	2,373,295	1,466,747
2023	0	2,278,530	1,772,288	4,050,818	1,978,910	2,071,908
2024	0	2,400,210	1,861,384	4,261,594	1,986,987	2,274,607
2025	0	2,521,890	1,950,480	4,472,370	1,995,065	2,477,305
2026	0	2,643,570	2,039,576	4,683,146	2,003,142	2,680,004
2027	0	2,765,250	2,128,629	4,893,879	2,011,220	2,882,659
2028	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2029	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2030	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2031	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2032	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2033	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2034	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2035	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2036	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2037	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2038	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2039	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2040	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2041	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2042	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2043	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2044	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2045	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
2046	0	2,765,250	2,128,629	4,893,879	145,460	4,748,419
						17.45% IRR
						2,285,046 NPV@ 12%
						1.204091494 B/C

Source: JICA Study Team

The above evaluation results indicate that the implementation of the urban development project should bring high economic benefits to the study area. In addition, the economic benefits that were not quantified for this evaluation, due to the lack of the data and information, are assumed to be substantial. Therefore, for urban development, the *with* project alternative is evaluated as being highly feasible in economic terms.

Finally, sensitivity analyses were also conducted. The results, which are summarized in Table 8.4.5, indicate that the project is more susceptible to the negative effects rather than the benefit side. Therefore, securing the economic benefits is very important for achieving the project goals. The results also imply that the EIRR exceeds 10 %, even the worst scenario of Costs being +20 % and Benefits being -20 %. Overall, the economic impact on the study area is seen as being beneficial.

Table 8.4.5 Urban Development Sensitivity Analysis

Item			Benefit		
			Reference Base	-10 %	-20 %
Cost	Reference Base	EIRR	17.45%	15.19 %	12.96 %
		NPV(LE Million)	2,285	937	(411)
		B/C	1.20	1.08	0.96
	+10 %	EIRR	15.39 %	13.36 %	11.36 %
		NPV(LE Million)	1,165	(183)	(1,530)
		B/C	1.09	0.99	0.88
	+20 %	EIRR	13.70 %	11.86 %	10.01 %
		NPV(LE Million)	45	(1,302)	(2,650)
		B/C	1.00	0.90	0.80

Source: JICA Study Team

8.4.2 Economic Analysis of Integrated Urban Development along the Western Development Corridor

In order to understand the overall economic impact of the urban development when it is integrated with development of the Western Development Corridor, an economic analysis was conducted.

The economic benefits and the costs of urban development, as defined above, were added to the overall economic effects caused by the implementation of the 6th of October Busway and 6th of October Line. The same conditions that applied to the economic analysis for the urban development were employed to estimate the overall economic impact of the integrated urban development and transport corridor:

1) Project Evaluation Period: from 2008 until 2046
2) Standard Conversion Factor: 0.84
3) Price Data: 2007 fixed price
4) Foreign Exchange Rate: USD1.00 = LE5.5
5) Social Discount Rate: 12 %

(1) Economic benefits

Economic benefits of the integrated urban development and transport corridor consist of three components: i) 6th of October Busway; ii) 6th of October Line; and iii) urban development. As mentioned in the previous sections, the main economic benefits of both the busway and the Metro are: i) saving in travel time cost; and ii) saving in vehicle operating cost (VOC). The incremental value added that is attributed to the urban economy is defined as the economic benefit of the integrated urban development and transport corridor.

Regarding the calculation of the economic benefits for both the busway and Metro projects, the respective economic benefits brought about by the travel time cost saving and VOC saving were estimated separately for the busway and Metro projects not to duplicate the economic benefits. The overall economic benefits are summarized in Table 8.4.6.

Table 8.4.6 Economic Benefits of the Integrated Urban Development and Transport Corridor

(Unit: Million LE)

(Unit: Million LE) Component	Economic Benefits		
	Travel time saving	VOC	Incremental Value added
Exclusive Busway*	16,398	5,344	--
6th of October Line	50,026	30,251	--
Urban Development	--	--	140,742
Total	66,424	35,595	140,742

Note: * The total economic benefit of the busway was adjusted to the project evaluation period (from 2008 until 2046) for the calculation.
Source: JICA Study Team

(2) Economic costs

The economic costs are composed of the construction costs and O&M costs of the three (3) components (6th of October Busway, 6th of October Line, and urban development). The overall economic costs during the evaluation periods are shown in the Table 8.4.7.

Table 8.4.7 Economic Cost of the Integrated Urban Development and Transport Corridor

(Unit: Million LE)

Component	Overall Project Costs
Exclusive Busway*	6,246
6th of October Line	12,508
Urban Development	37,714
Total	56,469

Note:* The total economic cost of the busway was adjusted to the project evaluation period (from 2008 until 2046) for the calculation.
Source: JICA Study Team

(3) Evaluation of results

Finally, the EIRR, NPV and B/C Ratio of the integrated urban development transport corridor were calculated. The resulting benefit-cost flow is shown in Table 8.4.8, and the evaluation results are summarized as follows:

1) EIRR was calculated as being 16.48 % for the project evaluation period, which exceeds the opportunity cost of the capital (12 %).

2) NPV of LE3,057 million is secured, even after discounting by the social discount rate of 12 %.

3) B/C Ratio was estimated at 1.19 under the social discount rate of 12 %.

The evaluation results imply that the integrated urban development and transport corridor is feasible. The implementation of the transportation corridor project is accordingly considered to facilitate to enhance the economic activities of the study area and also to improve the living standards of the people through saving the time and cost of traveling.

Table 8.4.8 Benefit-Cost Flow Table for the Integrated Urban Development and Transport Corridor

000LE at current price

Year	Benefits				Costs				Net Benefits
	Urban Development	Metro	Busway	All	Urban Development	Metro	Busway	All	(Benefits - Costs)
2008	162,982	0	0	162,982	1,007,387			1,007,387	-844,405
2009	325,964	0	0	325,964	1,011,755		9,402	1,021,156	-695,192
2010	488,946	0	0	488,946	1,016,097	42,937	303,988	1,363,022	-874,076
2011	651,883	0	0	651,883	1,020,440	42,937	428,190	1,491,567	-839,684
2012	814,914	0	103,804	918,718	1,015,152	1,177,993	37,399	2,230,544	-1,311,826
2013	1,044,014	0	114,018	1,158,032	1,626,170	1,177,993	40,297	2,844,459	-1,686,427
2014	1,273,114	0	128,982	1,402,096	1,636,735	1,177,993	43,441	2,858,168	-1,456,072
2015	1,502,214	0	152,834	1,655,048	1,647,919	1,205,620	46,852	2,900,390	-1,245,343
2016	1,731,314	0	193,536	1,924,850	1,659,827	339,238	112,152	2,111,217	-186,367
2017	1,960,504	327,010	266,411	2,553,926	1,672,576	758,035	54,567	2,485,179	68,747
2018	2,336,394	380,887	324,532	3,041,813	2,294,383	758,329	56,239	3,108,951	-67,138
2019	2,712,284	443,903	404,454	3,560,641	2,311,880	758,626	57,964	3,128,470	432,171
2020	3,088,174	517,650	515,023	4,120,847	2,330,711	758,924	59,746	3,149,381	971,466
2021	3,464,064	603,999	668,708	4,736,771	2,351,097	440,875	273,678	3,065,650	1,671,121
2022	3,840,042	1,636,426	336,943	5,813,411	2,373,295	127,628	129,618	2,630,540	3,182,871
2023	4,050,818	1,758,792	373,385	6,182,995	1,978,910	131,826	132,774	2,243,510	3,939,485
2024	4,261,594	1,891,314	413,904	6,566,812	1,986,987	136,162	136,018	2,259,168	4,307,644
2025	4,472,370	2,034,890	458,968	6,966,228	1,995,065	140,641	139,352	2,275,058	4,691,170
2026	4,683,146	2,190,504	509,098	7,382,748	2,003,142	145,268	223,979	2,372,389	5,010,358
2027	4,893,879	2,359,226	564,879	7,817,983	2,011,220	128,287	146,302	2,285,809	5,532,174
2028	4,893,879	2,468,753	595,919	7,958,552	145,460	132,507	149,923	427,890	7,530,662
2029	4,893,879	2,583,371	628,718	8,105,968	145,460	136,866	153,646	435,971	7,669,997
2030	4,893,879	2,703,316	663,375	8,260,569	145,460	141,368	157,473	444,300	7,816,269
2031	4,893,879	2,828,835	699,998	8,422,712	145,460	146,018	308,405	599,883	7,822,829
2032	4,893,879	2,960,188	722,302	8,576,369	145,460	148,419	162,580	456,459	8,119,910
2033	4,893,879	3,051,317	745,324	8,690,520	145,460	150,861	165,197	461,518	8,229,002
2034	4,893,879	3,145,534	769,087	8,808,500	145,460	153,342	167,857	466,659	8,341,841
2035	4,893,879	3,242,955	793,615	8,930,449	145,460	155,864	170,561	471,885	8,458,564
2036	4,893,879	3,343,697	818,934	9,056,510	145,460	158,427	254,509	558,396	8,498,114
2037	4,893,879	3,447,886	845,069	9,186,834	145,460	161,033	176,103	482,596	8,704,238
2038	4,893,879	3,555,649	872,046	9,321,574	145,460	163,682	178,942	488,084	8,833,490
2039	4,893,879	3,667,120	899,894	9,460,893	145,460	166,374	181,829	493,662	8,967,230
2040	4,893,879	3,782,438	928,640	9,604,957	145,460	169,110	184,763	499,333	9,105,624
2041	4,893,879	3,901,748	958,314	9,753,941	145,460	171,891	187,745	505,096	9,248,845
2042	4,893,879	4,025,200	988,946	9,908,025	145,460	174,718	339,176	659,354	9,248,671
2043	4,893,879	4,152,951	1,020,568	10,067,398	145,460	177,592	193,857	516,909	9,550,489
2044	4,893,879	4,285,164	1,053,211	10,232,254	145,460	180,513	196,989	522,962	9,709,292
2045	4,893,879	4,422,007	1,086,909	10,402,795	145,460	183,482	200,172	529,114	9,873,681
2046	4,893,879	4,563,657	1,121,697	10,579,234	145,460	186,500	284,608	616,568	9,962,666

16.48%	IRR
3,057,426	NPV@ 12%
1.193341221	B/C

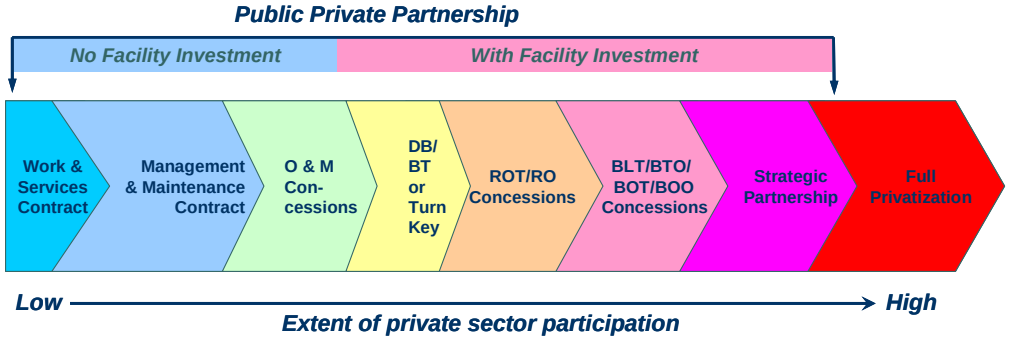
Source: JICA Study Team

CHAPTER 9 STUDY OF PPP FOR AN EXCLUSIVE BUSWAY TRANSPORT SYSTEM

9.1 Applicability of PPP in Egypt

(1) General principles under PPP approach

Public-Private Partnership (PPP) has broad implementation modalities, as illustrated in Figure 9.1.1. These range from contracting out of a simple service through to fully fledged privatization of a public service entity. The difference between various modalities stems from the varying extent of private sector participation. When looking at various modalities, special attention should be focussed on whether or not the responsibility for facility investment is borne by the private sector. This is the primary factor that determines whether long-term financing by the private sector is required for the project. Long-term financing is one of the critical elements for structuring a PPP project.



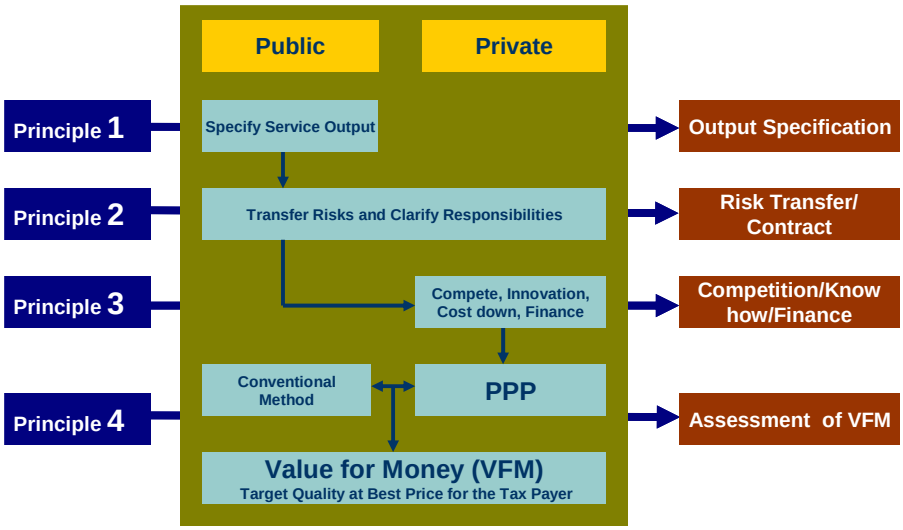
Source: JICA Study Team

Figure 9.1.1 Broad Implementation Modalities of PPP

Under a traditional public sector approach, the public sector designs, builds, operates, and maintains infrastructure, and sets levels for quantity and standards of service quality. However, under a privatization approach, the private sector controls all of these aspects instead of the public sector. In contrast, under a PPP approach, the public sector is ultimately accountable for service provision, although the private sector may design, build, operate and maintain the infrastructure. PPP ensures the provision of services to general public, but at lower cost to government. In addition, the use of private-sector management skills and financing capabilities improves the financial viability of the project.

Despite the variety of implementation modalities, there are four (4) common principles which are generally applied to all PPP projects, as illustrated in Figure 9.1.2:

1) Output Specifications
2) Risk Transfer based on Contract
3) Competition
4) Assessment of Value for Money



Source: JICA Study Team

Figure 9.1.2 Value for Money Mechanism – How to Structure a PPP Project

Under a PPP approach, the public sector specifies its requirements for output, such as the level and volume of the service. This can be expressed simply by "What we or service users want to have." In contrast, in the traditional approach, such requirements are specified on an input basis, specifically "How to do it." For PPP, the public sector specifies the outputs for the service and monitors whether the service that is provided by the private sector is satisfactory and in accordance with the specified outputs. As such, the private sector is able to apply their innovative skills and experience to selecting the methodology for delivering the service at the required level and volume. The service is assured in long term, within the term of the contract, and as a result the accountability of the public sector for providing stable and quality services to users is fulfilled.

Risk transfer is the second principle applied to PPP. The extent of risk transfer from the public sector to the private sector varies depending on the modality that is applied. It is important that such risk transfer must be clearly stipulated in a PPP contract. This assigns specific rights and responsibilities to the public and the private sector, so that such risk allocation is legally binding for implementation of the project. However, excessive risk transfer to the private sector always hinders the formulation of a PPP project. Therefore, optimal risk transfer based on the principle of transferring the risk to those who can best manage the risk at lowest cost, is critical for a successful PPP.

Competition among the private sector players is the key to the source of benefits created by PPP. Under a PPP approach, competitive tendering is the main means for creating competition. Good proposals submitted from the private sector proponents contain the results of strenuous efforts among the consortium members and financiers, reflecting their experience,

management skills, innovative methodology and technology for providing services, innovative and robust financing capabilities, and cost minimization know-how.

Finally, the most important principle of PPP is "Value for Money". The service that is required is specified under the "Output Specification" principle, so that the quality and volume of the service is monitored and secured by the specification. Therefore, the price is effectively the last thing that matters. Under the "Value for Money" principle, the cost of a traditional approach and that of a PPP approach is compared for providing the same output. The savings of the PPP approach over the traditional approach must always be confirmed before implementing the PPP project. This is assessment of "Value for Money" provides the mechanism for realizing the objective of "Target Quality at the Best Price for the Tax Payer".

(2) Country rating

When international financial institutions evaluate the financial viability of a specific PPP project, the country rating for foreign borrowing of the subject country is the starting point of their assessment. Current country ratings for government bonds in foreign currency in different Middle Eastern countries are illustrated in Table 9.1.1. Egypt's rating is Ba1, which is the same as Morocco, but higher than the rating of Jordan and Turkey. Even so, all the countries listed below Tunisia (Egypt to Turkey) are rated as "speculative". When the country rating is "speculative", in order to procure project financing in foreign currency, the project generally needs very strong government support and further coverage by the Export Credit Agency's (ECA)[1] political risk insurance. Based on Egypt's country rating as of June 25 2007, Egypt is generally viewed as being a difficult country in which to arrange long-term financing in foreign currency.

Table 9.1.1 Foreign Borrowing Country Rating of Neighbouring Countries

Country	Country Rating (Moody's 2007.6.25)	GNI[2]/Capita (2005 in US$)
UAE	Aa3	23,950
Israel	A2	18,580
Saudi Arabia	A2	12,510
South Africa	Baa1	4,770
Tunisia	Baa2	2,880
Egypt	Ba1	1,260
Morocco	Ba1	1,740
Jordan	Ba2	2,460
Turkey	Ba3	4,750

Note: Aaa>Aa>A>Baa>Speculative>Ba>B>Caa>Ca>C (1>2>3)
Source: Moody's Sovereign Rating and World Bank World Development Indicator

(3) PPP projects financed in hard currency

Although the general assessment of Egypt by the international financing institutions is "speculative", in the past there have been some successful project financing arrangements in Egypt that are based on foreign currency. Table 9.1.2 lists some examples. It is notable that

[1] Many developed countries have an Export Credit Agency in order to promote their own export activities by providing guarantee insurance and soft loans, mainly to the companies from their own countries.

[2] GNI is equal to GDP + Net income from overseas.

most of the projects have revenue streams in hard currency[3] such as airplane parking fees in the airport project and port usage charges in the port project. Since the revenue stream of the project is generated in hard currency, the international lenders tend to be more comfortable with extending support for financing the project in hard currency.

Table 9.1.2 Hard Currency PPP Projects in Operation in Egypt

(LE million, years)

Project	Cost	Period	Contractors	Status
Hurghada Airport Terminal	15	10	JV Artoc and GOE	Operational (1999)
Marssa Allam Airport	40	49	Khorafi	Operational (2001)
El Alamein Airport	200	50		Operational (2002)
Petroleum Quay (Port) (Alexandria/Dakahlia)	45	30		Operational (2001)
North Sokhna Port	176	25		Operational (2002)
Damietta for Liquid Gas Export (Port)	1,600	25		Operational (2003)
East Port Said Port	481	30		Operational (2004)
Sidi Krir 3and 4 Power Plant	480	20	EDF	Operational(2002)
Suez Gulf power Plant	340	20	EDF	Operational(2003)
Port Said East Power Plant	340	20	Bechtel-Intergen	Operational(2003)

Source: Public-Private Partnership Program for Cairo Urban Toll Expressway Network Development, Final Report, Main Text, May 2006

(4) PPP projects with revenue in local currency

All of the power plant projects listed in the previous in Table 9.1.2 have been financed in hard currency on the project finance basis. This caused some problems when a drastic devaluation occurred at the time that the Egyptian pound was floated in 2003. Electricity bills are paid in Egyptian pounds, whereas the finance for the electricity generated by those PPP power projects was arranged in hard currency and linked to payments to the concessionaire. Because of the devaluation, payments made by the Egyptian Electricity Holding Company to the concessionaires have doubled in Egyptian pound terms.

Similar to the power industry, the same risk exists for other PPP projects which receive revenue in local currency, such as the railway sector, toll roads and water supply. The market in Egypt for long term financing in local currency has not yet developed sufficiently to finance these types of large scale PPP infrastructure projects. Currently, the longest tenure extended to locally financed projects with revenue in local currency is seven (7) years[4], which was for a telecom project. However, some local banks have indicated the possibility of longer tenure over ten years, possibly up to 20 years, with the same loan rolling over at the end of the tenth year. As it will not be possible to confirm the possibility of long term local currency loans until the actual project is submitted for evaluation, it is reasonable to expect that in the medium term, PPP projects with revenue in local currency will experience certain difficulties in structuring long term project finance in local currency, especially when the concession term is very long. When finance is to be extended in hard currency, the foreign exchange risk must be mitigated against or backed up by the predominant equity money.

[3] Hard currency is currency which can be freely exchanged with other currency in international road s, such as US$, Euro and Japanese Yen.

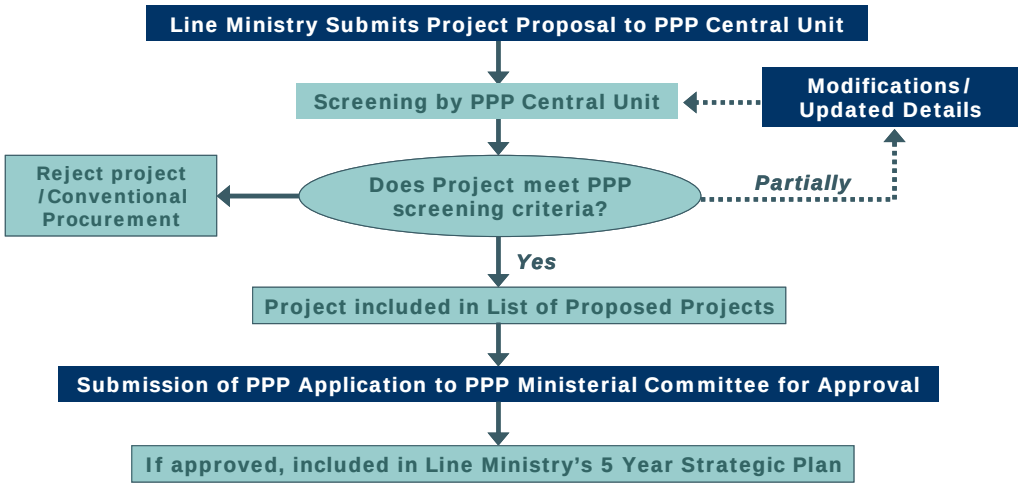
[4] Based on an interview with the Commercial International Bank (CIB) on July 5, 2007. In the interview, the CIB mentioned the possibility of tenure over 10 years being extended to the projects with revenue in local currency.

(5) Legal and regulatory framework for PPP

A PPP law has been drafted and is still under review in the Egyptian Parliament. This law basically stipulates new rules for public procurement to amend the existing rules now stipulated in Law 89 for Public Procurement[5]. The PPP projects which were listed previously in Table 9.1.2 have been implemented on the basis of revised sector laws and regulations in each sector, which have allowed private sector participation in the corresponding provision of services. The revision of the laws and regulations was done basically to allow a BOT scheme to be implemented by the private sector. However, this does not assume support from the public sector or the concept of availability payment, as does the PPP scheme.

Figure 9.1.3 illustrates the institutional setup for which the Ministry of Finance took an initiative in creating with cooperation of Ministry of Investment and Ministry of Planning. Under this system, the PPP Central Unit in the Ministry of Finance will play a pivotal role in providing the required knowledge, streamlining and screening of the line Ministries' PPP projects. A satellite PPP unit has been established in each line Ministry to facilitate the implementation of PPP projects.

Despite the absence of a specific PPP Law, tenders have already been called for a school PPP[6]. Already eight (8) international and domestic consortiums have been pre-qualified for the final bidding.



Source: Ministry of Finance, PPP Central Unit

Figure 9.1.3 Function of PPP Central Unit and PPP Approval Process

(6) Viability gap in PPP projects

Most of the PPP projects implemented in the past in Egypt were structured on the BOT scheme, where the project is presupposed to be financially self standing. However, most PPP projects need carefully designed support from the public sector. One very important concept, especially when a large capital investment is required, is "Viability Gap Funding". Many

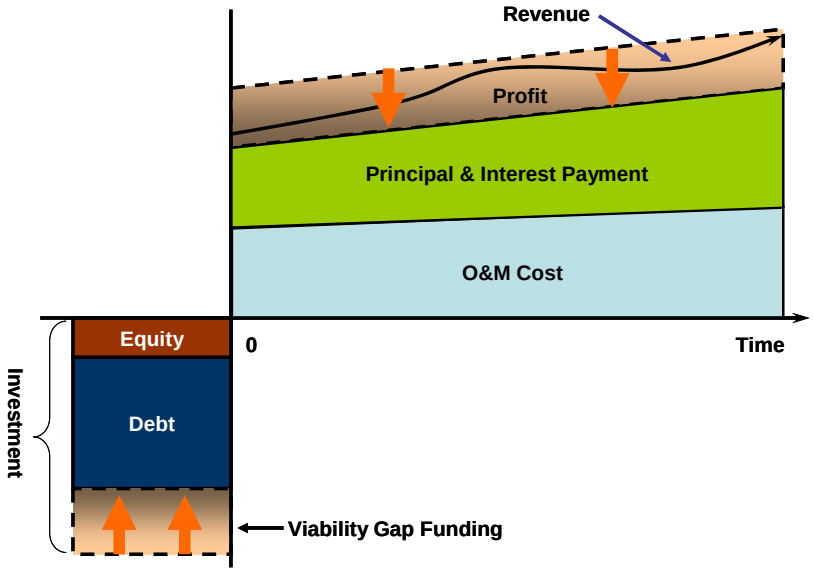
5 Based on an interview with the PPP Central Unit of the Ministry of Finance.

6 345 schools in the 1st batch will be put up for tender. This will be followed by another 6 batches over the next 5 years. The project is based on availability payment on the basis of performance monitoring, as implemented in PFI projects in UK.

infrastructure projects, such as underground metro lines and elevated urban toll roads, need a huge capital investment for facility development where the fare box or toll revenue alone from the operation will not be enough to recoup the initial capital investment. In order for the private sector to participate in such PPP projects, the public sector will need to fill the financial viability gap of the project.

One of the solutions is for the public sector to inject funding for the viability gap into the initial investment in the form of a grant subsidy, as illustrated in Figure 9.1.4. This will reduce the amount which the private sector needs to borrow to cover the initial project, which in turn lowers the amount of principal and interest for repayment of the debt during the operation period. As a result, the total recurrent cost level will be brought down low enough for the private sector to enjoy profits from the project.

There are not many PPP projects which are financially self standing, especially when the service fee is kept at subsidised levels for a long time and the general public becomes used to the situation, as occurs in Egypt. For the success of PPP projects which require a huge capital investment, a large sum from the public budget is required to cover viability gap funding. This requires the formation of a strong political consensus inside the GOE, as well as requiring a proper and enforceable legal and regulatory framework to be formulated as soon as possible.



Source: JICA Study Team

Figure 9.1.4 Viability Gap Funding

9.2 Options for Utilizing PPP for the SDMP

One important effect of adopting the PPP approach in urban planning is to shift away from the current trend of “the supply driven planning approach” to “the market driven planning approach”, in which the citizens and the private sector are the clients of the government and as such are recognized as important stakeholders in the real market. The government could consider moving in this direction, so that urban planning would be conducted predominantly on the basis of real market demand, rather than being based on what the supply side (the government) determines that the demand level should be.

Potential PPP project components that can be accommodated in the SDMP will be found in the following sectors:

1) Public Transport
2) Toll Roads
3) Urban Development

In these sectors, is not likely that many PPP projects can be formulated which will generate revenue in hard currency. Since the market for long term financing in local currency is still premature and uncertain in Egypt, in the medium term, financing of PPP projects such as metro lines and urban toll roads with revenue in local currency may need to either depend on long term financing in hard currency that is provided by both international and selected domestic financial institutions, or on short term financing in local currency. In the former case the foreign exchange risk of the project will be either shared among the stake holders or be borne solely by a particular member of the PPP. In the latter case, the project sponsor may need to accept the risks of interest fluctuation and of rolling over the short term loan. Either consideration will tend to discourage the sound formation of PPP project.

In some cases, the lack of a legal or regulatory framework for providing public support, such as viability gap funding, may also be a constraint on forming an appropriate PPP structure.

Therefore, at present, it would be difficult to structure a fully fledged PPP project for either the Public Transport or Toll Road sectors. The main funding for these projects will need to be based on conventional sources such as budget allocations from the Ministry of Finance, grants/loans from the National Development Bank, and the grants/loans from foreign donors.

Despite some constraints on the formation of fully fledged PPP projects in Egypt, it is important for a new PPP to use a modality that is possible to implement under the current situation. For the Public Transport Sector and the Toll Road Sector, PPP modalities that appear to be practicable at present include contracting out services, management contracts and operation/retail concessions. To a limited extent, Build-Transfer (BT) and Build-Lease-Transfer (BLT) PPP modalities may also be practicable. These practicable PPP modalities can be considered to start with.

In contrast, different arrangements will be required for the Urban Development Sector. A PPP project that generates short term cash returns could be formulated to attract various private sector investors who would be willing to finance the project on a corporate finance basis and provision of their equity money. It may also possible for the public sector to strategically plan and build-in the capturing mechanism. This will allow the development benefits of a PPP project format to flow to the public sector.

Options for utilizing PPP for the SDMP are illustrated in Table 9.2.1.

Table 9.2.1 Options for Utilizing PPP for the SDMP

Low ↓ Extent of Private Sector Participation ↓ High	Implementation/Funding Alternatives		Public Transport	Road	Urban Development
	1. Conventional	(1) Budget Allocation from MOF	◎	◎	◎
		(2) Grant/Loan from National Development Bank	△	△	△
		(3) Loan/Grant from Foreign Donors	◎	◎	◎
		(4) Bond Issues	△	△	△
	2. Public-Private Partnership	(1) Service Contracting Out	◎	◎	○
		(2) Management Contract	◎	◎	○
		(3) Operating/Retail Concession	◎	◎	○
		(4) Design Build/ Build Transfer (BT)	◎	◎	△
		(5) Leasing Concession (BLT)	◎	◎	△
		(6) BOT/BTO/Other PPP (Viability Gap Funding, Service Purchase Model, etc.)	○	○	◎
		(7) Development Benefit - Development Charge - Developer Contribution - Special Assessment District - Land readjustment/ Urban Redevelopment - Land Auction/Sale of LUR/Land Lease	○	○	◎
		(8) Strategic Partnership/ JV	△	△	◎
		(9) Commercial Corporatization	○	○	△
		(10) Full Privatization/ Open Market	○	○	△

Notes: ◎: High Potential, ○: Medium Potential, △: Low Potential
Source: JICA Study Team

9.3 General Recommendations for Implementing PPP Projects

9.3.1 Public Transport

It will probably be more than 5 years from now (mid-2008) before implementation of the first PPP Public Transport Sector project that was proposed in the SDMP. Within this time period, it is uncertain that drastic improvements in the constraints surrounding the formulation of PPP projects in Egypt can take place. For example, the likelihood of improvements in the market for local currency long term financing is unknown. Therefore, the application of PPP to the Public Transport Sector may be limited to the modalities illustrated in Table 9.3.1.

Table 9.3.1 Recommendations for Public-Private Partnership in the Public Transport Sector

Potential Project Components for PPP	Recommendation
1. Public Transport	
(1) Railway	Since the capital investment is large, a PPP structure with viability gap funding is likely to be required. ODA funding may be used for this purpose. However, appropriate project structuring, based on thorough analyses of technical and financial feasibility, and legal and regulatory checks will be necessary. After the Railway Law was revised, ENR was given the ability to grant concessions to the private sector. For a newly constructed section or railway line, a BLT maintenance concession and also an O&M concession may be applicable without capital investment by the private sector. These would be performance based contracts, possibly linked to the decrease of subsidies from the GOE.
(2) Metro Line	In the same way as the railway, viability gap funding will be necessary. The applicable PPP modalities may also be similar to those of the railway. However, the future role of the existing CMO needs to be determined.
(3) Busway	Viability gap funding may be necessary, depending on the project economics. The public entity responsible for the busway operation needs to be determined. BOT, BLT and O&M concessions may be possible, depending on the project economics and the risk allocation. The role of MOT and the CTA needs to be determined.
2. Railway Station/Station Vicinity Integrated Development	For the commercial, office and residential development in and around the stations for rail based transport, the public sector may need to formulate the investment package for each development and properly guide the private sector under an appropriate PPP to implement the integrated development. To this end, necessary land and land use rights should be acquired well in advance before the announcement of each development so as to lower the total cost of the development, especially the land acquisition cost, and to maximize the development benefit which the public sector could enjoy through the development. Applicable PPP modalities may be solicited PPP concessions, unsolicited PPP concessions and strategic partnerships through the formation of a joint venture company or direct partnership with the private sector.
3. Inter-modal Complex/Bus terminal	Same as for Railway Station/Station Vicinity Integrated Development.
4. Feeder-Related Facilities	In order to facilitate increased ridership for urban transit and to maximize the development benefit, feeder-related facilities such as bus terminals, parking facilities, station squares, pedestrian decks, and underground pathways should be constructed, mainly by the public sector. However, a PPP format may be used in an integrated manner for the surrounding commercial development so that some of the feeder related facilities could be constructed by the private sector. ODA funding may be utilized to package the development of feeder related facilities. Applicable PPP modalities may be solicited PPP concessions, unsolicited PPP concessions and strategic partnerships through the formation of a joint venture company or direct partnership with the private sector.

Source: JICA Study Team

9.3.2 Toll Road

The Metropolitan Expressway Authority (MEA) will be established in the future and be responsible for the operation of the entire toll road network of the Greater Cairo Region. Based on "the Public-Private Partnership Program for Cairo Urban Toll Expressway Network Development"[7] (PPP Program for Toll Roads) many of the sections in the network may be

[7] "The Public-Private Partnership Program for Cairo Urban Toll Expressway Network Development" Main Text, Japan International Cooperation Agency, May 2006.

constructed in the PPP format, although the specific modality that will be applied is unknown. The PPP toll road project which was proposed in the SDMP will be an additional section of the network described in the PPP Program for Toll Roads. As discussed in the Program, the most likely PPP format will be BOT, Design-Build-Operate (DBO), or Design-Build-Finance-Operate (DBFO) concessions with properly designed support from the public sector.

Table 9.3.2 Recommendations for Public-Private Partnership in the Toll Road Sector

Potential Project Components for PPP	Recommendation
1. Primary Highway/ Expressway	By the time that the SDMP is implemented, the Metropolitan Expressway Authority (MEA) will have been established and be responsible for the operation of the entire toll road network of the Greater Cairo Region. Based on the PPP Program for Toll Roads many of the sections in the network may be constructed in the PPP format. As proposed in the Program, the most likely PPP formats will be BOT, DBO, or DBFO concessions with properly designed supports from the public sector.
2. Highway/ Expressway Facility Related Concessions	Opportunities for the Highway/Expressway Facility-Related concessions may be limited. Private sector participation may be expected in the utilization of spaces under the elevated road structure and so on.

Source: JICA Study Team

9.3.3 Urban Development

Residents who live in the vicinity of a proposed transport development are likely to benefit in two ways. Firstly, the transport development will improve accessibility to other parts of the GCR. Secondly, it is anticipated that the greater accessibility delivered by the improvement in the transportation network will be felt through higher residential property values. Similarly, commercial and industrial enterprises will also benefit. This benefit may take the form of better accessibility to offices and factories. Owners of commercial and industrial premises will benefit through the possibility of higher rents charged. Finally, there is the possibility of constructing commercial facilities at the entrances to stations. The geographic location of such facilities would be favourable, in particular for shop owners, and would provide access to the wider market of all passengers using the station.

Urban development is a benefit of developing transport infrastructure such as a metro lines and urban toll roads. In most countries, this benefit can be shared among the private sector and the public sector through mechanisms such as property holding tax and transaction tax because the development benefit will ultimately be reflected in the appreciation of property value. However, in Egypt this mechanism does not seem to work in this way at a moment.

Therefore, a mechanism is recommended which is based on property ownership by the public sector and uses the appreciation of property values as leverage, as illustrated in Figure 9.3.1. This might be achieved through the following steps:

1) **Strategic Planning**: Master planning of the urban development corridor will be conducted by the public sector, based on the concept of the Transit Oriented Development (TOD). Strategic investment packages, such as an integrated commercial and office development in the vicinity of the stations and the inter-modal hubs under PPP, will be formulated by the public sector for competitive tendering to potential

private sector investors. Based on the investment packages, strategic locations for the public land and the land that will need to be acquired can be identified.

2) **Acquisition of Land and Land Use Rights**: Planning and budgeting for the acquisition of identified land parcels and land use rights will be conducted. The land purchase and land use rights will be acquired by the public sector well in advance of the announcement of tendering for each development, so as to minimize the land acquisition cost and maximize the sharing of the development benefit in the later stage. By using the public land and the acquired land parcel/land use rights, and by exchanging it with surrounding land if necessary, the required project land area will be provided.

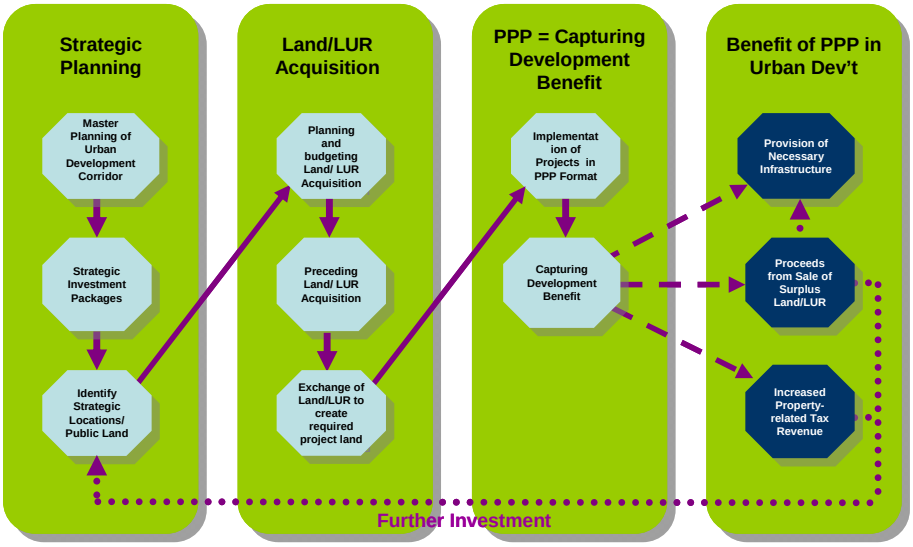
3) **Implementation of Urban Development in PPP Format**: Using the public land, the acquired land and land use rights will form part of the contribution by the public sector. Integrated urban development of commercial, residential and office uses in or in the vicinity of major transport stations and the inter-modal hubs will be implemented under the PPP format, such as solicited PPP concessions, unsolicited PPP concessions and strategic partnership through the formation of a joint venture company or direct partnership with the private sector.

4) **Capturing Development Benefit**: Through the implementation of integrated urban development in the PPP format, the development benefit could be captured by the public sector in the following manner:

    4-1) **Provision of Necessary Infrastructure**: The development cost of the necessary infrastructure to facilitate the increase in ridership and proper use of the urban transit system, such as feeder-related facilities like bus terminals, parking facilities, station squares, pedestrian decks, underground pathways and major district roads, will be shared by the private sector.

    4-2) **Proceeds from Sale of Surplus Land and Land Use Rights**: Surplus land with appreciated value after the development could be sold to a third party in order to partly recover the cost shouldered by the public sector. The proceeds could be used for funding the further investment under the PPP format.

    4-3) **Increased Revenue from Property-related Taxes**: The current property-related tax system is not working efficiently for capturing the development benefit. However, as the system is improved in the future, there will be more sharing of the development benefit by the public sector through the property-related tax system.



Source: JICA Study Team

Figure 9.3.1 Capturing Development Benefit through PPP in Urban Development Projects

The following potential project components may be implemented under a PPP format in the urban development sector:

1) Integrated Urban Development:
    1-1) Station/Station Vicinity Integrated Development
    1-2) Inter-modal Complex/Bus terminal
    1-3) Sub CBD/Commercial/Business/Hotel/Residential;
2) Feeder Related Facilities;
3) Independent Commercial/Residential Development; and
4) Tourism Related Development

The recommendations for each project component are described in Table 9.3.3.

Table 9.3.3 Recommendations for Public-Private Partnership in the Urban Development Sector

Potential Project Components for PPP	Recommendation
1. Integrated Urban Development	
(1) Railway Station/Station Vicinity Integrated Development	For the commercial, office and residential development in and around the stations for rail based urban transit systems, the public sector may need to formulate an investment package for each development and properly guide the private sector under a PPP to implement the integrated development. To this end, necessary land and land use rights should be acquired well in advance of the announcement of each development, so as to lower the total cost of the development, especially the land acquisition cost, and to maximize the development benefit which the public sector could enjoy through the development. Applicable PPP modalities may be solicited PPP concessions, unsolicited PPP concessions and strategic partnership through the formation of a joint venture company or direct partnership with the private sector.
(2) Inter-modal Complex/Bus terminal	Same as for Railway Station/Station Vicinity Integrated Development.
(3) Sub CBD/ Commercial/ Business/ Hotels/ Residential	Basically, the same as for Railway Station/Station Vicinity Integrated Development. However, because the scale of the development is larger and the concentration and density of each land use is higher, more investment needs to be made by the public sector, such as major district roads and trunk utilities, in order to induce private sector development. The development plan should be carefully prepared so as to allow a multiple number of PPP projects to materialize in a large scale urban development. Applicable PPP modalities may be solicited PPP concessions, unsolicited PPP concessions and strategic partnership through the formation of a joint venture company or direct partnership with the private sector.
2. Feeder-Related Facilities	In order to facilitate increased ridership for urban transit and to maximize the development benefit, feeder-related facilities, such as bus terminals, parking facilities, station squares, pedestrian decks, and underground pathways, could be constructed, mainly by the public sector. However, a PPP format may be used in an integrated manner with the surrounding commercial development so that some of the feeder-related facilities may be constructed by the private sector. ODA funding may be utilized to package the development of feeder related facilities. Applicable PPP modalities may be solicited PPP concessions, unsolicited PPP concession and strategic partnership through the formation of a joint venture company or direct partnership with the private sector.
3. Independent Commercial/Residential Development	When public land is available in the urban development corridor, a large scale commercial and/or residential development could be initiated by the public sector under a PPP scheme. The land would form part of the public sector's contribution. Applicable PPP modalities may be solicited PPP concessions, unsolicited PPP concessions and strategic partnership through the formation of a joint venture company or direct partnership with the private sector.
4. Tourism Related Development	Good tourism resources are themselves potential sources of business revenue. Where the existing concentration of tourism resources exist and/or a new tourism resource is expected to be created, a strategic partnership may be adopted to facilitate a large scale tourism development that is properly integrated with commercial and office development. Applicable PPP modalities may be solicited PPP concessions, unsolicited PPP concessions and strategic partnership through the formation of a joint venture company or direct partnership with the private sector.

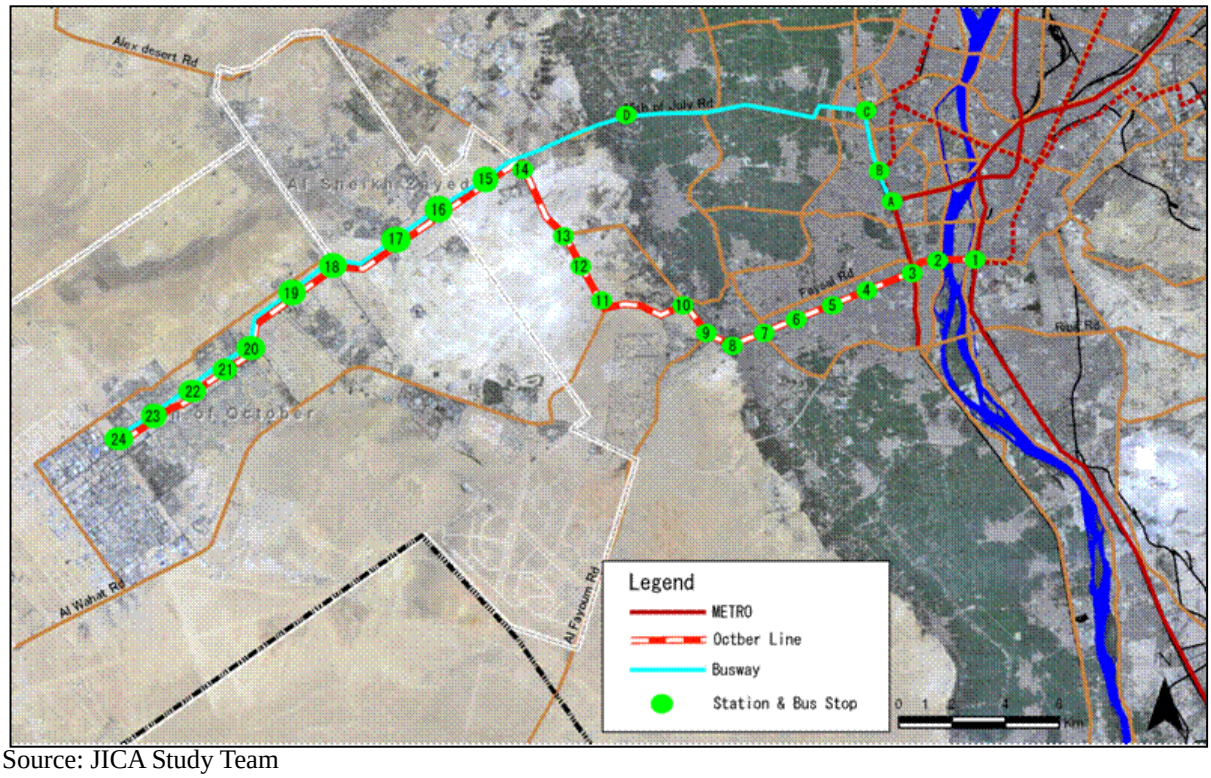
Source: JICA Study Team

9.4 PPP Case Study for the Exclusive Busway Transport Project

9.4.1 Outline of Exclusive Busway Project

(1) Busway route

Figure 9.4.1 illustrates the exclusive busway route connecting the Metro Line 2 (and Metro Line 3 in the future) with 6th of October NUC through 26th of July Road. The busway, which is 35.6 km in length, is planned to start operation in 2012. Figure 9.4.1 also shows the route of 6th of October Line, which is planned to commence operation in 2022.



Source: JICA Study Team

Figure 9.4.1 Exclusive Busway Route

(2) Project specifications

There will be 14 stations along the busway route and the stations in the NUC area are planned at the same location as those of the future 6th of October Line.

Total project cost is estimated at 1,654 million LE, as shown in Table 9.4.1, of which civil works will cost 690 million LE, the Depot and Work Shop will cost 56 million LE and purchase of the bus fleet will cost 908 million LE.

The initial investment cost of the project will be about 910 million LE, excluding the future bus purchase cost of 744 million LE.

Table 9.4.1 Total Busway Project Cost

Item	Amount (million LE)
1. Civil Works	690.37
2. Depot and Work Shop	55.75
3. Bus	908.00
Total	1,654.12

Source: JICA Study Team

The concession period for the busway is set at 32 years, with 2 years for the construction and 30 years for operation. The start of operation is planned in 2012. Initial fare levels would be the same as that of Metro Lines being planned in the Pre-F/S, which is a fare of 0.7 LE + distance fare of 0.03 LE/ km. The fare would escalate by 8.4% per annum with a real increase of 3% per annum *plus* an inflation increase of 5.4% per annum, based on the fare increase data for the existing Metro Lines of Cairo.

Table 9.4.2 shows that the demand forecast for the opening year is about 100,800 passengers per annum, which will be equivalent to one third of the private bus passengers moving along the Western Development Corridor at the time. The forecast ridership is about 157,450 passengers in 2017; 209,250 in 2022; and 229,650 in 2027, respectively.

Table 9.4.2 Demand Forecast for 2012

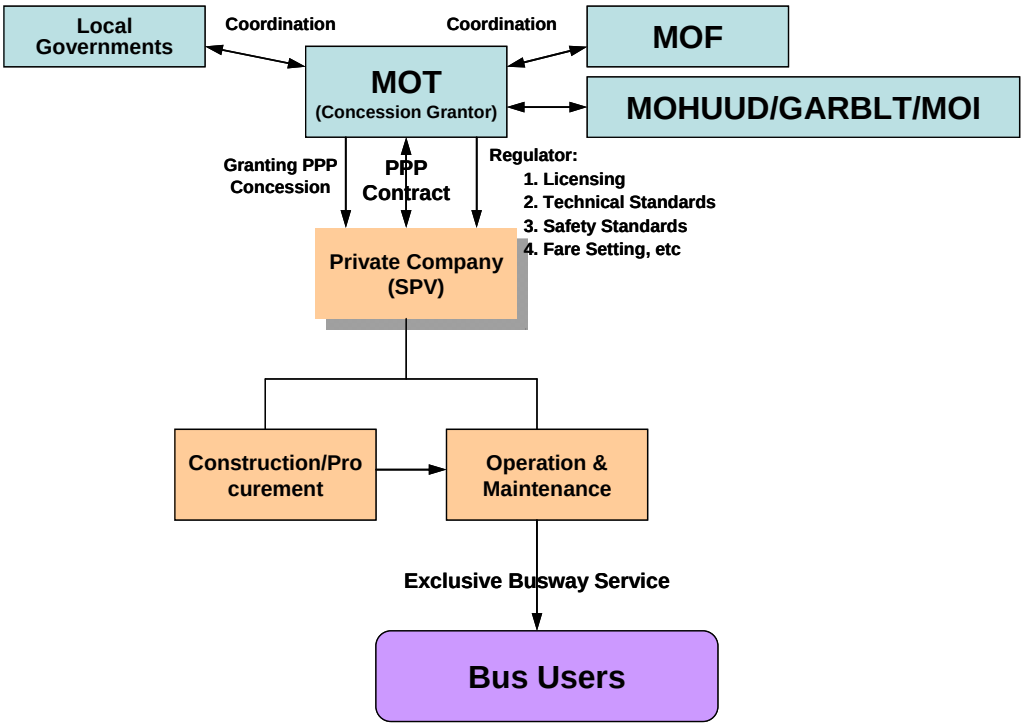
No.	Station Name	Alighting	Boarding	Passing Through	
				To 6th of October	To Cairo
A	Behouth Metro Station	20,000	20,000	20,000	20,000
B	Gamaet	9,300	8,900	29,300	28,900
C	Imbaba	15,000	15,000	40,400	39,800
D	Mansovria	4,000	3,700	36,600	36,300
15	Police City	3,400	3,400	36,600	36,300
16	Sheikh Zayed East	3,400	3,400	33,200	32,900
17	Sheikh Zayed	5,300	5,200	27,900	27,700
18	Sheikh Zayed West	3,900	3,900	24,000	23,800
19	Misr University	7,000	6,900	24,000	23,800
20	6th of October University	7,000	6,900	17,000	16,900
21	Al Hosari Mosque	4,500	4,400	12,500	12,400
22	9th District Central	8,400	8,400	10,200	8,100
23	6th of October West	6,100	6,100	4,100	4,000
24	Bank Street	4,100	4,000		
Total Passengers			100,800		

Source: JICA Study Team

9.4.2 Implementation Setup for the Busway PPP Project

The implementation setup for the Busway PPP Project is illustrated in Figure 9.4.2. In terms of financial support, the grantor of the PPP concession would be MOT, in coordination with MOF, MOHUUD, GARBLT, MOI and local governments such as Giza Governorate and 6th of October Governorate. Urban development, the 26th of July Road, and bus licensing also need to be considered. In addition, it will be necessary for the Project Management Unit for the project be established under MOT and to seek technical assistance from the PPP Central Unit of MOF for necessary expertise regarding the structuring and preparation of the PPP project implementation plan.

The Project Management Unit would be responsible for conducting the PPP tender. MOT would also play the role of the regulator for the project.



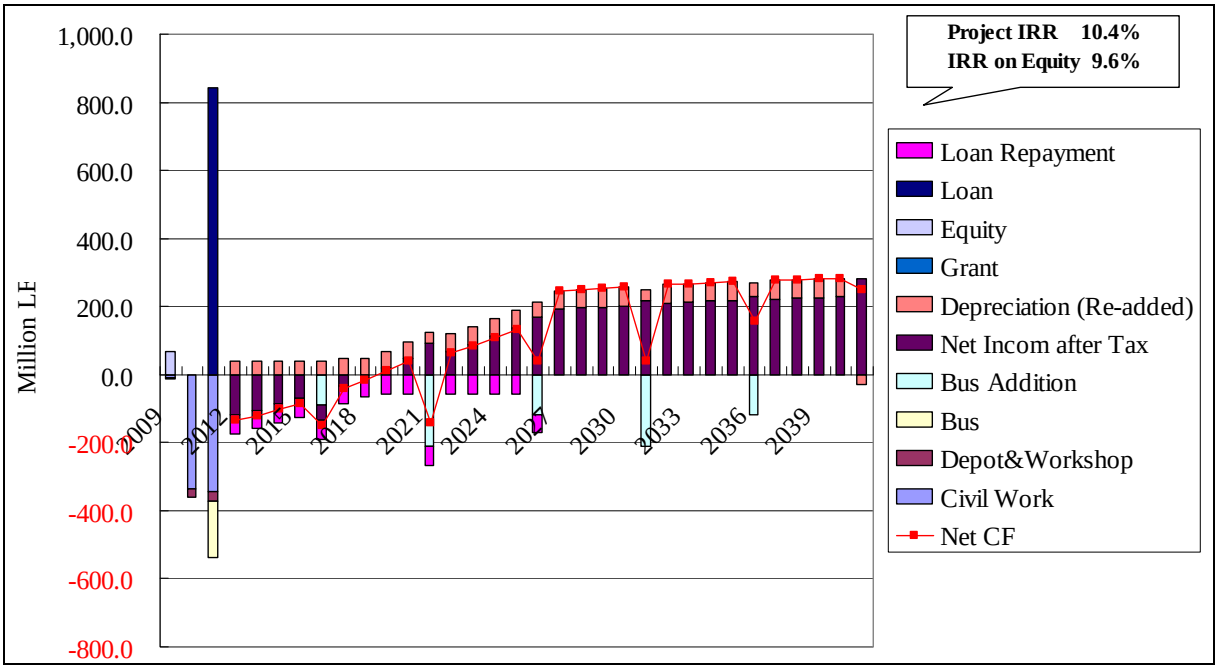
Source: JICA Study Team

Figure 9.4.2 Implementation Setup for the Busway PPP project

9.4.3 Basic Profitability of Busway Project (PPP without Grant)

When implemented as pure private venture the basic profitability of the exclusive busway project was assessed on the basis of the cash flow model constructed in this Pre-F/S. Figure 9.4.3 shows the anticipated cash flow statement of the project as a time series for the duration of the concession period. The assessment was conducted on the basis of the basic assumptions described previously in Chapter 8 for the financial analysis of the project. The direct financial return (DFR) was examined, which is similar to the analysis in Chapter 8, except that the revenue and the costs were calculated on a nominal value basis and inflation and tax costs were considered.

The project IRR was calculated as 10.4% and the IRR on equity was calculated as 9.6%, which are both far lower than the profitability level which the private sector seeks, namely more than 20 %. Therefore, it would be essential for the public sector to provide some measures to improve the profitability of the busway in order to solicit private sector participation in the project.



Source: JICA Study Team

Figure 9.4.3 Basic Profitability of the Busway Project (PPP without Grant)

9.4.4 Important Risks to be Considered

There are important risks which should be properly controlled in implementing the project:

1) **Viability Gap**: This is the absolute gap of financial viability which the project has when compared to pure private investment. This gap exists because the initial investment is too large in proportion to the cash flow which the project would generate. This gap needs to be filled, and in the case of PPP project, this would normally be done through the public sector injecting a grant subsidy into the initial investment.

2) **Slow Ramp Up of Ridership**: This is the risk that the ridership during the beginning phase of the project would not grow at the expected rate. The exclusive busway service will be a new service. However, even though the fare will be set at the same level as the Metro Lines, ridership growth may be slow unless the project delivers better value to the users than the private bus services that exist at the time.

3) **Opening of 6th of October Line**: It is expected that opening of 6th of October Line in 2022 may have a negative influence on the ridership growth for the exclusive busway project. This will occur because the Metro Line will absorb a percentage of the bus user demand for passengers moving along the Western Development Corridor at that time. Some mitigation measures need to be prepared to mitigate this risk because the private sector could not assume such risk.

4) **Difficulty for Fare Increase**: Fare increases for public services always involves some political risk. Some mitigation measures should be prepared, as this risk could not be assumed by the private sector.

5) **Potential Investors**: The risk that potential investors may not participate in the project.

6) **Financing**: The risk that long term financing might not be procured for the project.

9.4.5 Risk Allocation between the Public and Private Sectors

(1) Risk allocation for important risks

Risk allocation and mitigation measures for the important risks have been proposed, as shown in Table 9.4.3.

In relation to the viability gap risk, the government grant could be injected into the initial investment, namely for the civil works portion of the construction cost. The private sector needs to consider effective marketing measures for securing initial ridership patronage and non-bus operation revenue to lessen this viability gap as much as possible.

For the demand risk, such as the slow ramp up of ridership and later the opening of 6th of October Line, revenue support measures should be prepared in such a way that both positive and negative demand risk remains within a 20% range of the base line forecast. This proportion of the risk would be assumed by the private sector. However, where both positive and negative demand risk is outside a 20% range of the base line forecast, this risk would be shared between the public and the private sector at an agreed rate, for example public sector 80 % and private sector 20 % of the total that is outside a 20% range of the base line forecast.

A fare revenue stability fund could be established for reducing the fare increase risk and the above mentioned demand decrease risk. Such a fund could be established in such a way that both the public and the private inject seed money into the fund and a portion of the project revenue would also accumulate in the fund. Financial support for any materialized demand decrease risk could be extended using the proceeds from the fund. The cumulative proceeds in the fund could be liquidated at the end of the concession period in proportion to the amount of contribution from the public and private sectors.

The potential risk that investors may not invest in the project can be reduced by the public sector providing sufficient notification about the project to potential investors well in advance. In addition, the public sector needs to conduct a thorough market research as part of their preparation of the project. Reasonable and fare risk allocation and transparent of the PPP tender are also essential. The private sector also needs to begin formation of its consortium at an early stage.

To minimize the financing risk, the public sector needs undertake the same activities as described above for the potential investor risk, focusing on long-term financing sources. In addition, the private sector needs to have a strong commitment to the project, which includes the provision of sufficient equity to cover the financing risk.

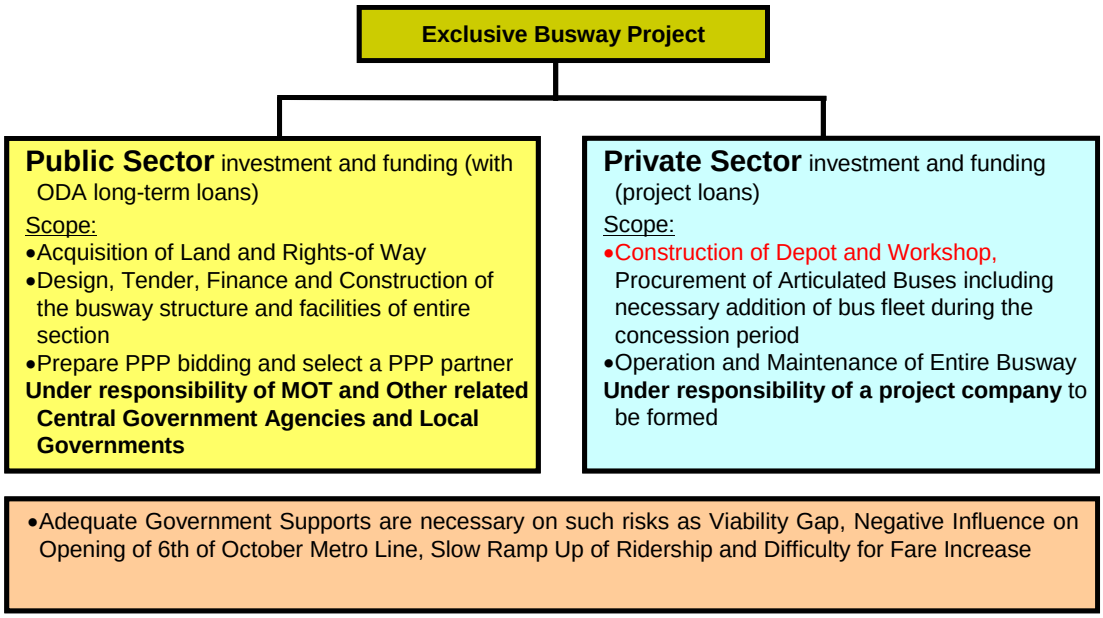
Table 9.4.3 Risk Allocation for Important Risks

Risk	Public Sector	Private Sector
1. Viability Gap	Grant from the government for civil works.	Exploitation of non-bus operation revenue.
2. Slow Ramp Up	Revenue support for patronage below the range of base line forecast.	Downside risk within the range of base line forecasts.
3. 6th of October Line	Revenue support for patronage below the range of base line forecast.	Downside risk within the range of base line forecasts.
4. Fare Increase	Setting up a Fare Revenue Stability Fund.	Injection of initial funds for the private share.
5. Potential Investor	Early announcement, thorough market research, fair and reasonable risk allocation, transparent tender procedure.	Early formation of a strong consortium.
6. Financing	Early announcement, thorough market research, fair and reasonable risk allocation, transparent tender procedure.	Strong sponsor commitment including sufficient equity injection.

Source: JICA Study Team

(2) Form of risk allocation

Figure 9.4.4 illustrates an outline of the risk allocation between the public and the private sector for the project implementation.



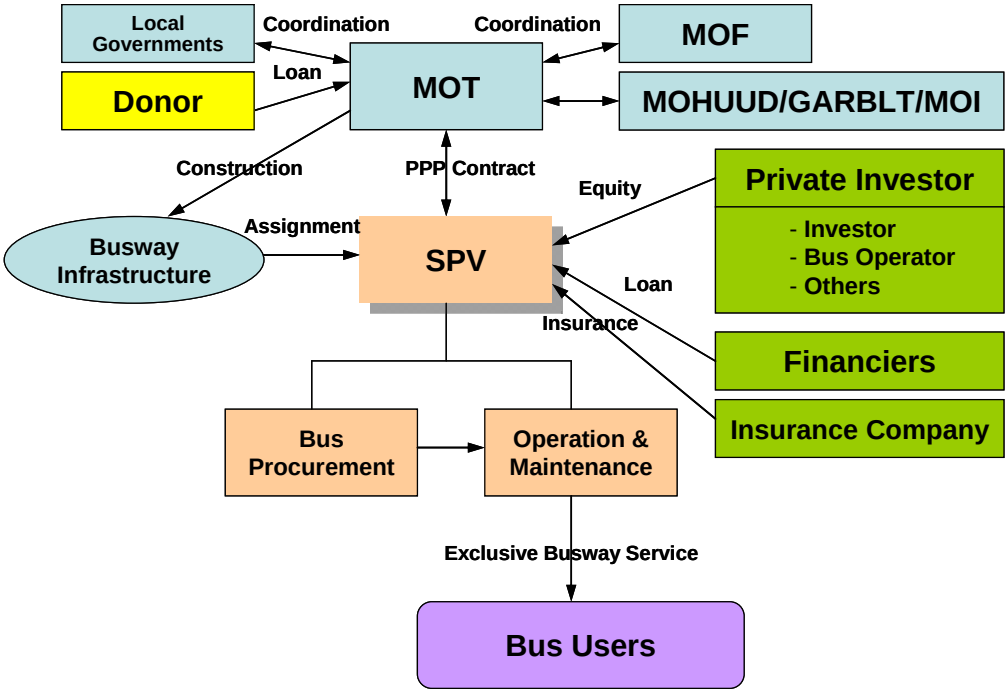
Source: JICA Study Team

Figure 9.4.4 Risk Allocation between the Public and Private Sector

9.4.6 Contractual Structure for Project Implementation

Contractual relationships for the project implementation are illustrated in Figure 9.4.5. MOT, as the grantor of the PPP concession, would enter into the PPP contract with the Special Purpose Vehicle (SPV) that is established by the private sector investor, bus operator and so on. MOT would coordinate with related government agencies, such as MOF, MOHUUD, GARBLT, MOI and related local governments. The donor agency would extend a soft loan for

the construction of the civil works (infrastructure) portion of the busway facility, which could be assigned to or be permitted for the use by the SPV. The SPV would procure the project loan from the financier for the construction of the Depot and the Workshop and for the procurement of initial bus fleet. The project insurance would be procured from the insurance company. Based on these contractual arrangements, the SPV would provide the exclusive busway service to bus users.

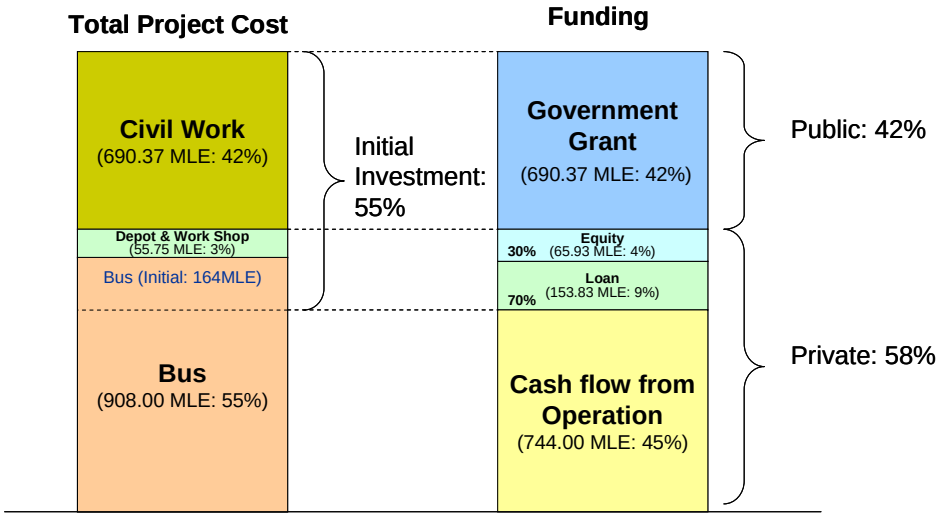


Source: JICA Study Team

Figure 9.4.5 Contractual Structure for Project Implementation

9.4.7 Funding Structure

The total project cost, including the procurement of future buses, is estimated at 1,654 million LE, of which 42% will be assumed by the government and 58% by the private sector. The civil works portion (42% of the total project cost) of the construction cost would be funded by the government, possibly by utilizing donor funding, whereas 13% would be funded by the equity and loan provided by the SPV. The remainder, comprising 45%, could be financed by the cash flow generated by the exclusive busway operation.



Source: JICA Study Team

Figure 9.4.6 Funding Structure

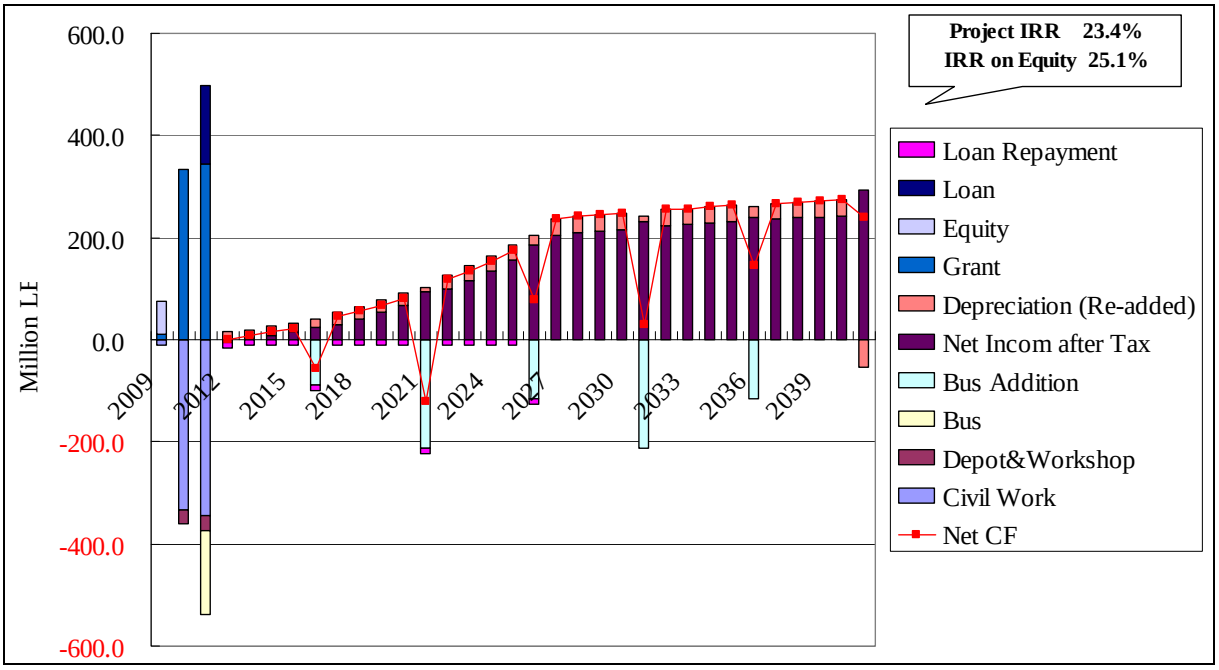
9.4.8 Financial Viability of a Busway PPP project

(1) Base case (PPP project with grant)

The financial viability of the project was evaluated, based on the assumptions described above. Figure 9.4.7 shows the cash flow statement for the Base Case as a time series for the concession period. The columns above the "0.0 line" are "cash in", whereas those below the line are "cash out" in terms of the SPV cash flow. As mentioned above, the civil works portion of the initial investment would be financed by the grant extended to the SPV from the government, so this is not shown in Figure 9.4.7.

The initial investment will be financed by both the equity and the loan. The line graph shows the transition of annual net cash flow for the project. There would be negative net cash flow for a few years in the initial phase, when additional bus procurements are made. However, these investments could be financed by the cumulative cash reserve of the operation.

The project IRR, which indicates the total profitability of the project, is calculated at 23.4% which greatly surpassing the current interest rate level for long term loans. The IRR on equity, which indicates the project viability of the private sector investment, is calculated at more than 25%, which is sufficient for soliciting private sector participation.



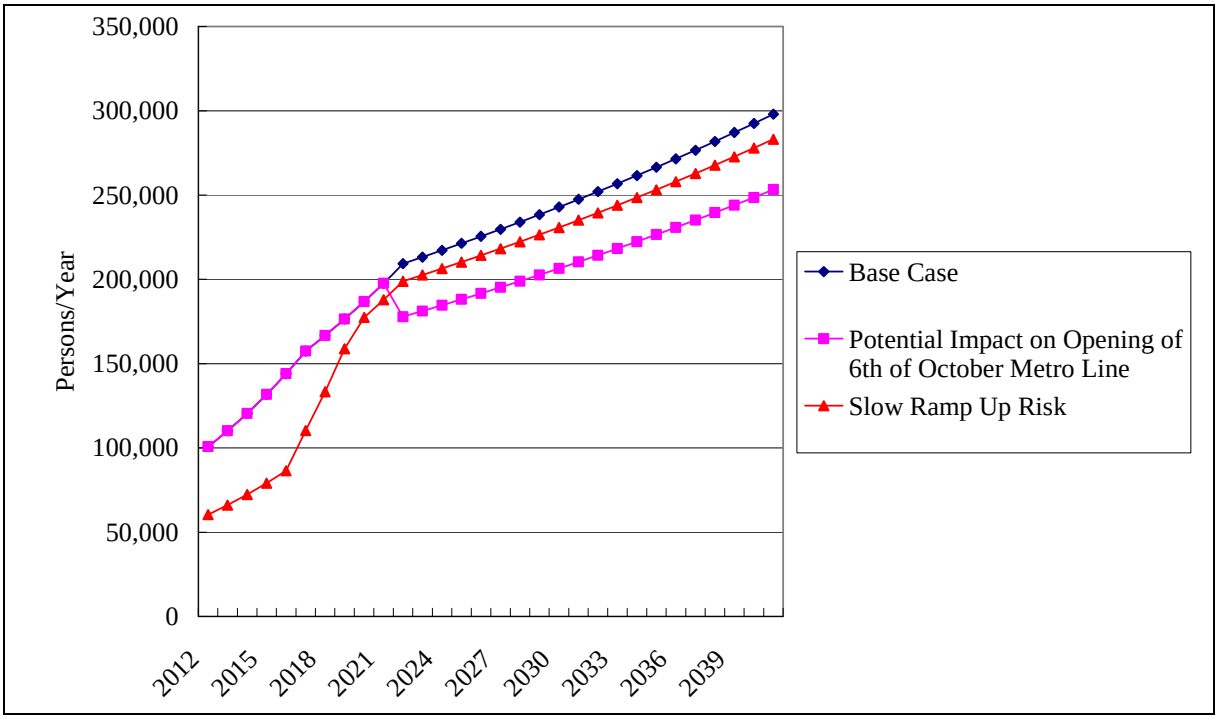
Source: JICA Study Team

Figure 9.4.7 Busway Cash Flow Statement (PPP with grant: Base Case)

(2) Ridership risks

The ridership demand risks are important risks, and these are illustrated in Figure 9.4.8. The Base Case demand is the demand used for the cash flow analysis. The risk caused by the opening of 6th of October Line is assumed to be a 15% decrease in ridership demand below the Base Case, due to the negative impact of the Metro opening.

The slow ramp up risk is assumed to be that only 60% of the Base Case ridership is materialized for the first five (5) years of operation. However, the ridership would increase progressively to 70%, 80%, 90% and 95% over the next four (4) years, respectively. From year ten (10), until the end of the concession period, the ridership would remain at 95% of the Base Case level.



Source: JICA Study Team

Figure 9.4.8 Busway Ridership Risks

(3) Assessment of important risks

The financial viability of the project was evaluated by assuming the important risks are materialized. The impact of the Metro Line opening would not affect the profitability of the project so much, whereas the impact of the slow ramp up risk could have a considerable by lowering both the Project IRR and IRR on equity below 20% level. This would result in the Project IRR being 18.3% and the IRR on equity being 18.7 %.

The fare increase risk is assumed to be that the rate of fare increase (the inflationary portion[8]) becomes half of the Base Case, which follows the annual fare increase of the current Metro Lines of Cairo. The impact of the slow fare increase could be quite considerable, with the Project IRR being 16.1% and the IRR on equity being 16.2 %.

The assessment of these important risks indicates that preparation of the risk mitigation measures will be an essential element to include when structuring a PPP for the exclusive busway project.

[8] The fare is assumed to increase annually at the composite rate of 3 % of the real increase plus an inflationary increase of 5.4 %.

Table 9.4.4 Assessment of Important Risks for the Busway PPP

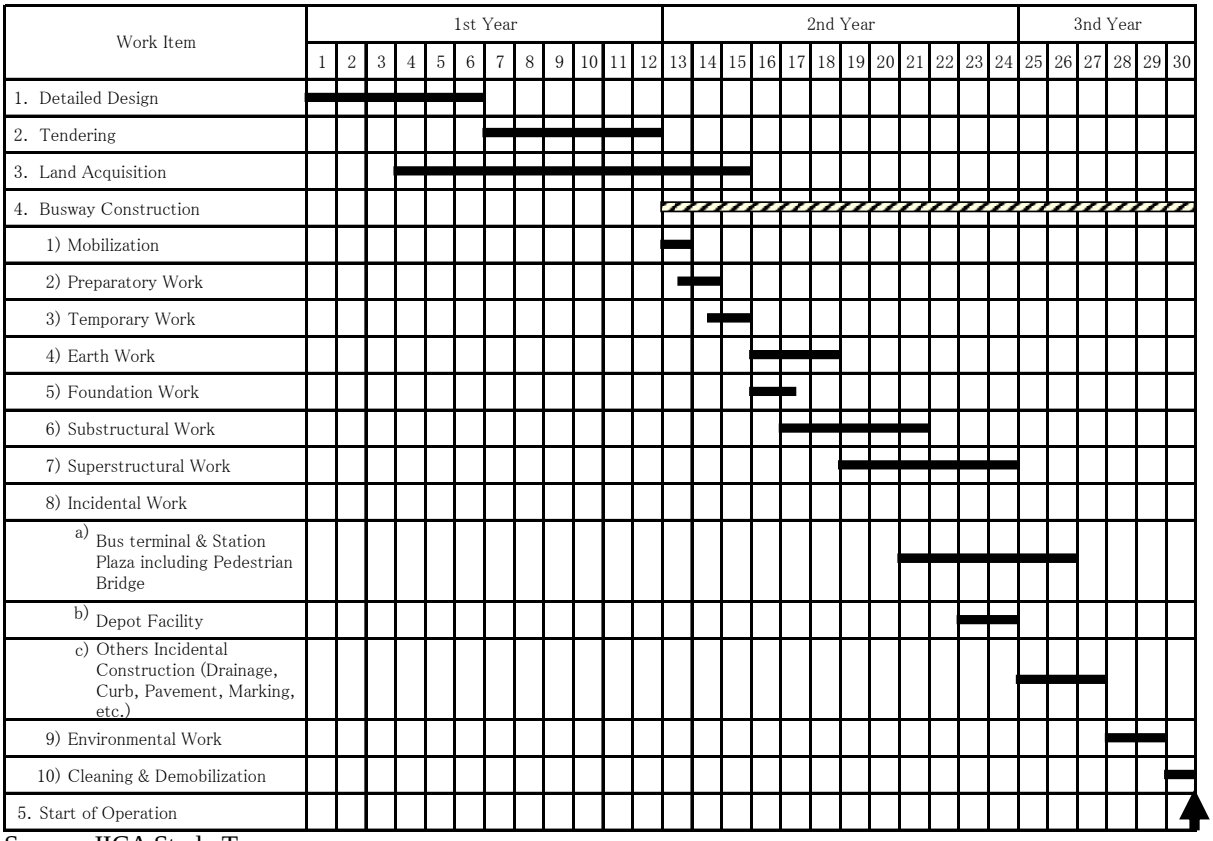
Case	Project IRR	IRR on Equity	Remarks
1. Base Case	23.4 %	25.1 %	
2. Slow Ramp Up	18.3 %	18.7 %	2012-2016: 60 % 2017: 70 % 2018: 80 % 2019: 90 % 2020-2041: 95 %
3. Metro Risk	22.1 %	23.7 %	Base Case x 85 % from 2022
4. Slow Fare Increase	16.1 %	16.2 %	Fare increases slowly at half of the inflation rate (5.4 %=>2.7 %)

Source: JICA Study Team

9.4.9 Implementation Schedule

Figure 9.4.5 shows the project implementation schedule. The project preparation, including tendering, and construction of the project would require 2.5 years in total. This schedule is estimated on the basis of normal public sector projects. However, implementation in the PPP format may take longer because two different tenders may required, with one tender being for the civil works portion as a normal public tender and the other being for the total project implementation as a PPP tender.

Construction of the busway itself is assumed to take 1.5 years.



Source: JICA Study Team

Figure 9.4.9 Busway Project Implementation Schedule

9.4.10 Action Plan Recommendation

If the project is developed as a PPP project, the following recommendations should be implemented:

1) **Legal Assessment:** To check whether the proposed implementation structure is feasible under the current legal framework. If not feasible, necessary legal arrangements should be considered at an early stage.

2) **PPP F/S:** To conduct a full scale PPP feasibility study. If needed, adequate arrangements should be made with donor agencies to provide technical assistance with this task.

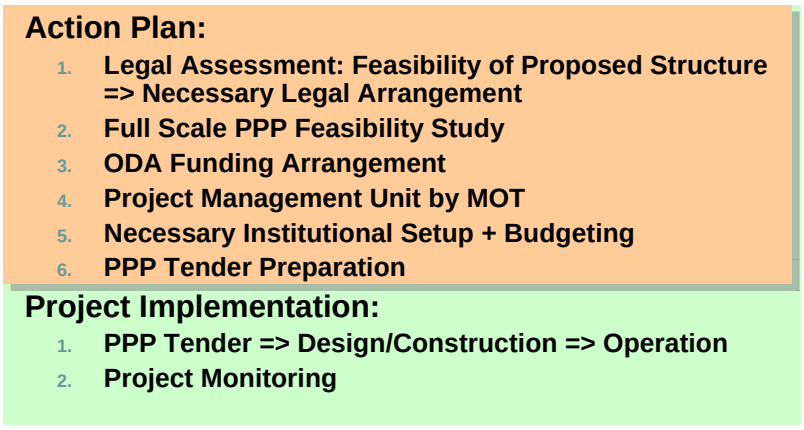
3) **Donor Funding:** To arrange and secure Donor Funding for the construction of the civil works portion of the project.

4) **Project Management Unit (PMU):** To establish a Project Management Unit (PMU) specialized in implementing the PPP projects. The PMU would conduct all the preparation and coordination with relevant government agencies for the project.

5) **Institutional Arrangements and Budgeting:** To prepare and implement all the necessary institutional arrangements and the budgeting, including the establishment of necessary committees.

6) **PPP Tender Preparation:** To prepare the PPP Tender for implementation of the project, including the procurement of necessary experts and expertise.

The government should be responsible for implementation of the PPP tender and for selection of the PPP concessionaire. In addition, the government should be responsible for monitoring the design, construction, operation and maintenance, and the specified service levels for operation. This monitoring should continue for the entire duration of the concession period.



Source: JICA Study Team

Figure 9.4.10 Busway PPP Action Plan

CHAPTER 10 RECOMMENDATIONS AND THE WAY FORWARD

10.1 Justification

In order to realize the goals set out in the Master Plan for the Greater Cairo Region (GCR), the Western Development Corridor was selected as the priority project. Following this, a pre-feasibility study (Pre-F/S) for the corridor was carried out to verify the validity of the project from different points of view including urban development, transportation, environmental effects, and both economic and financial feasibility. The results of the study are summarized as follows:

1) Urban Development: The Western Development Corridor will contribute to restructuring the urban fabric of the GCR. It will encourage the population shift to the NUCs, namely 6th of October and Al Sheikh Zayed. This will meet the goals and objectives proposed in the Master Plan.

2) Transportation: An opinion poll survey conducted in the Master Plan phase revealed that the highest priority condition for moving to the NUCs was that people need a convenient means of transport between the NUCs and GCR. The proposed railway and busway development of the Western Development Corridor will meet the people's needs and thus will encourage the population to shift to the NUCs. In addition, a traffic demand analysis revealed that the transportation network will require improvement to meet the increased traffic demand. This improvement will be provided by the busway by 2012 and the fully implemented railway (Phase I and II) by 2022.

3) Environment: The alignment of the railway and busway was designed to avoid potential negative impacts on the environment, existing facilities and the living environment of local residents as much as possible. Although the project will cause some adverse impacts locally, it will broadly contribute to improving the traffic congestion problems, reducing air pollution and greenhouse gas (GHG) emissions, and energy savings. These positive effects will add to the project's environmental and social benefits in the study area and GCR.

4) Economic Feasibility: Urban development in the Western Development Corridor will be economically feasible, as its economic internal rate of return (EIRR) is estimated at 17.5 %. For the transportation development, the EIRR is estimated at 21.3 % for the busway, and 14.1 % for the railway. The whole of the integrated Western Development Corridor will yield a high EIRR of 16.5 %. Hence, the Western Development Corridor is considered to be economically worthwhile, and it will bring about a net economic benefit of LE3,057 million in net present value (NPV).

5) Financial Feasibility: The financial internal rate of return (FIRR) of the busway is estimated at 18.5 % *without* a government subsidy, and increases up to 35.7 % *with* a government subsidy for all the civil works construction costs, which corresponds to 41.7 % of the busway project cost. If the government subsidy is provided for the construction costs, the busway will be profitable and therefore commercially feasible. This means that the busway could be implemented as a PPP scheme with public sector assistance for constructing the infrastructure.

   In contrast, the railway will require a government subsidy to create a financially viable cash flow. The financial analysis revealed that the FIRR for the railway will exceed the evaluation rate of 12 % if the government subsidy covers the infrastructure cost, which corresponds to 57 % of the railway project cost.

Taking into account the above results, the Pre-F/S has demonstrated that the Western Development Corridor is justified. However, the Pre-F/S also pointed out the necessity for further studies to examine specific issues in order to implement the project effectively. These issues are as follows:

1) A feasibility study for the busway will need to be carried out: i) topographic and geotechnical surveys; ii) delineating the actual route alignment; iii) basic design for each bus terminal and bus station; iv) designing a fare system; and v) a financial plan.

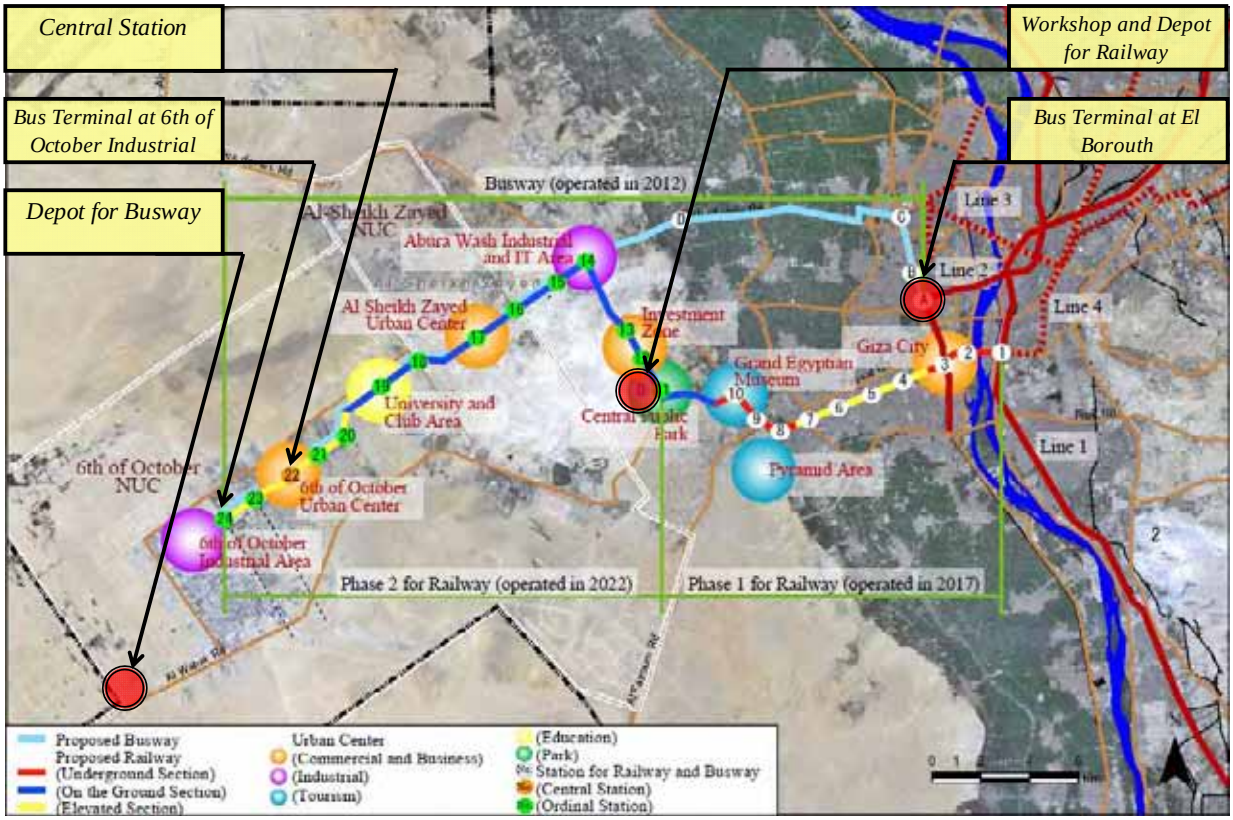
2) A feasibility study for the railway will need to be carried out: i) the same as listed for the busway, *plus* ii) a general plan for Metro Line 4 / 6th of October Line to ensure technical consistency as an integrated system; and iii) construction method analysis.

3) An environmental impact assessment (EIA) for the busway and railway may need to be carried out: i) a social survey of the affected people, especially in the Behouth market area (busway) and along Pyramid Road (railway); ii) a soil survey in the El Bohouth workshop of the Egyptian National Railway (ENR); and iii) a detailed plan for compensation measures.

10.2 Recommendations

An essential factor to successfully implement the Western Development Corridor is to maintain the momentum of the development by carrying out necessary actions consecutively. After completion of SDMP Study, the main tasks that need to be undertaken in the urban planning and transport sectors in the next step of implementation are:

1) Under the initiative of GOPP and GCRUPC, NUCA, the Giza governorate and and/or 6th of October governorate needs to prepare detailed urban plans for 6th of October, Al Sheikh Zayed, and areas along the Western Development Corridor. The detailed plans will designate the medium and high density areas along the corridor, and will assign the sites for priority areas, including a central and terminal stations, depots and workshops for the busway and railway. Figure 10.2.1 shows candidate sites for these priority areas. After the actual locations are decided, these need to be defined in the statutory urban planning system or detailed plans.



Source: JICA Study Team

Figure 10.2.1 Location of Candidate Sites for the Priority Areas

2) Under the jurisdiction of GOPP, capacity development for the establishment of an appropriate legal framework, as well as improvement of the enforcement capacity for urban planning controls will be necessary. The legal framework needs ensure that the land required for the priority areas will be available for the project. It will regulate: i) transferring the land ownership; ii) selling the land; and iii) expropriating the lands. In addition, the legal framework will enhance intensive development along the corridor. It will regulate the urban development, and provide the incentive for various projects that will contribute to the betterment of the living environment and the landscape.

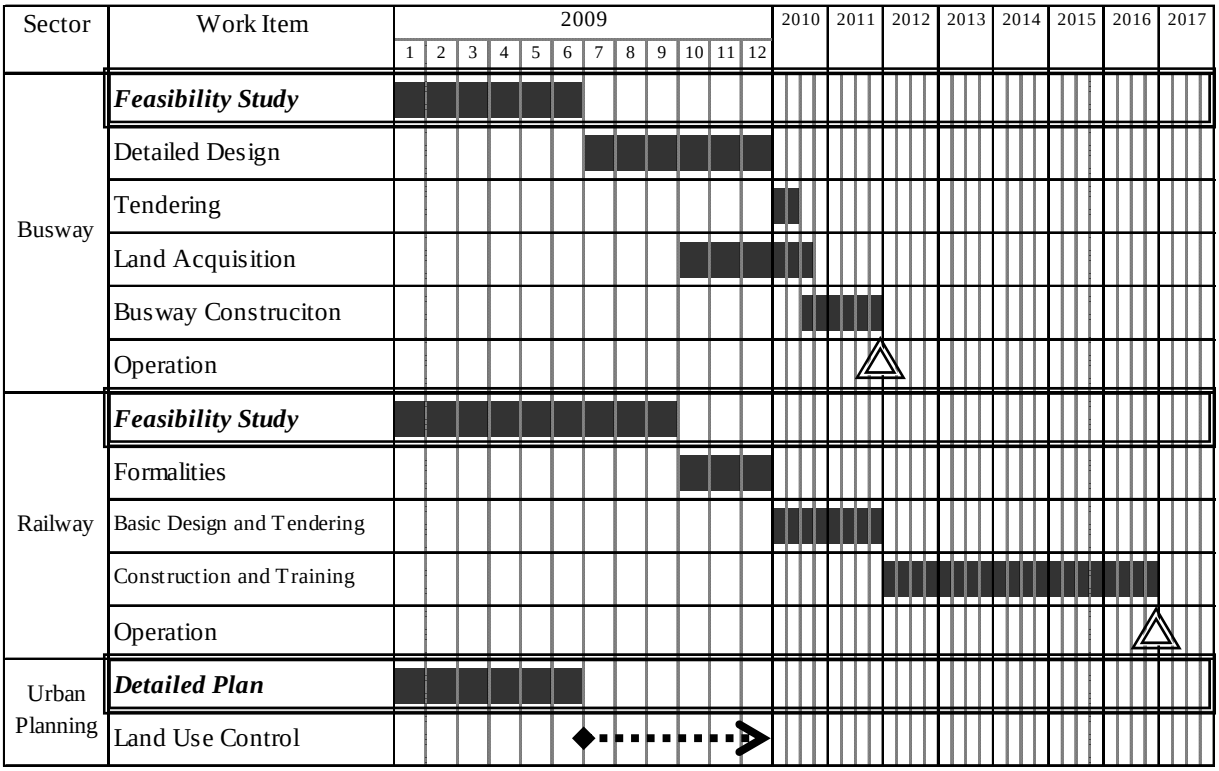
3) Public facilities will be developed in the Western Development Corridor to provide well-planned services and living environments. This will be done by the relevant authorities under initiation by GOPP. The public facilities will include utilities related to education, health, water supply, wastewater, and solid waste.

4) A feasibility study for the busway will be carried out by a competent authority under the initiation of the Ministry of Transport (MOT). The feasibility study will delineate the actual busway alignment and the basic design for the terminals and stations. It will determine an implementation scheme with financial arrangements. The preliminary cost estimate calculated that the total construction cost was LE1,654 million. In the feasibility study, the applicability of the Public Private Partnership (PPP) scheme will need to be determined for the purpose of sharing the financial risk and the capital investment. If necessary, provision of a soft loan for the infrastructure development on the part of the public sector involvement, as well as provision of private sector

financing for the Special Purpose Vehicle (SPV) of the PPP scheme will need to be considered, both in collaboration with international donors. An EIA may need to be carried out in the course of the feasibility study.

5) A feasibility study for the railway will be carried out by the National Authority for Tunnel (NAT) or a competent authority under MOT. The feasibility study will delineate the actual railway alignment for Phase I and the basic designs for stations. The construction cost for Phase I is estimated at a huge amount of USD1,279 million (or LE7,032 million). Since the financial analysis indicated that the railway will require the public sector investment of at least 57 % of the project cost to be financially feasible, the financial plan will need to consider the public investment or use of low interest rate funding resources. In addition, an EIA may have to be carried out in the feasibility study phase.

Figure 10.2.2 shows the schedule for activities required in the next step. This schedule defines the timing needed to meet the target year for introduction of the busway service in 2012 and the railway service (Phase I) in 2017.

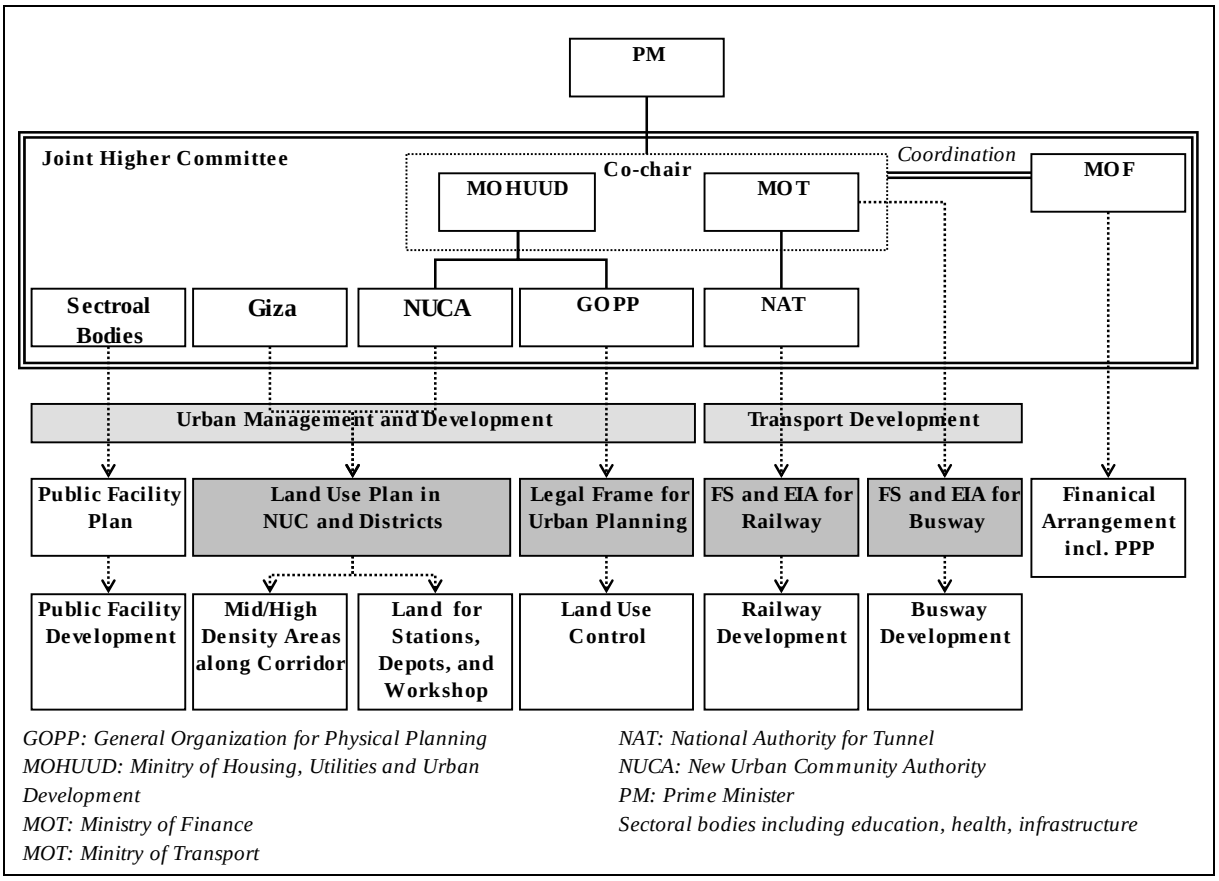


Source: JICA Study Team

Figure 10.2.2 Proposed Schedule for Implementation of Busway, Railway, and Urban Planning

To realize the activities proposed for the next step, the authorities will need to establish a joint high-level coordinating committee to oversee the integrated transport and urban development. The joint high-level coordinating committee will include representatives from GOPP, NUCA, Giza governorate, NAT (National Authority for Tunnel), CTA (Cairo Transport Authority), and other bodies responsible for the environmental assessment and public facility development. The committee will be co-chaired by the Minister of Transport and Minister of Housing, Utilities and Urban Development. A schematic view of the joint high-level

committee organization and the actions to be taken by the committee is shown in Figure 10.2.3.



Source: JICA Study Team

Figure 10.2.3 Proposed Implementation Scheme for the Western Development Corridor

ANNEX

ANNEX 1 ROUGH DESIGN WORK OF AL FARAG ROAD EXTENSION

1 Background

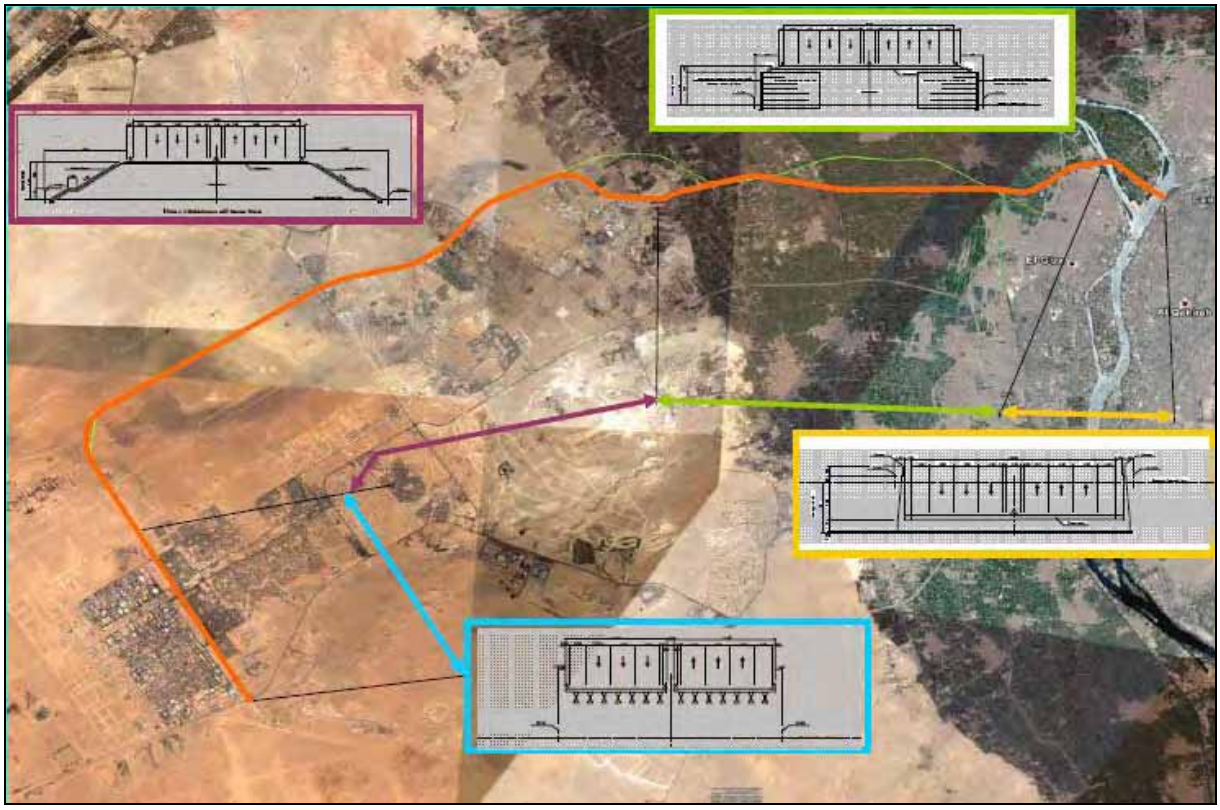
Private car transport capacity through the 26th of July Road shall be limited after construction of the exclusive busway at the median of the road. In fact, based on the busway design submitted by the JICA Study Team in November 2007, the lane width of the 26th of July Road shall be narrowed from 4 meter wise to 3.5 meter wise though number of lanes is same.

Even though the busway project is essential from the public transport point of view, the decrease of private transport capacity is not tolerated when considering the expected rapid increase of private transport demand in the future. As a counter measure of decreasing transport capacity of the 26th of July Road, Al Farag Road extension project is considered as timely and properly.

It is noteworthy, however, that the extension of Al Farag project is on timing and proper as remedy of the private transport issue but not as relief of the public transport. Because it passed through agricultural land basically of no resident and connects to the 6th of October NCU and Cairo CBD in point to point base, public transport demand is limited and that limited point to point demand shall be fully satisfied by the busway through 26th of July Road and the 6th of October Railway Line as extension of the Metro Line 4.

2 Perspective of the Route

Figure A-1 is the perspective of the route. The route shall be composed of four types of road structure as illustrated in figure A-1, from the Cairo side Underground with U type retaining wall, Embankment with mechanical stabilized earth walk, Embankment with mortar ridrap, and Viaduct.

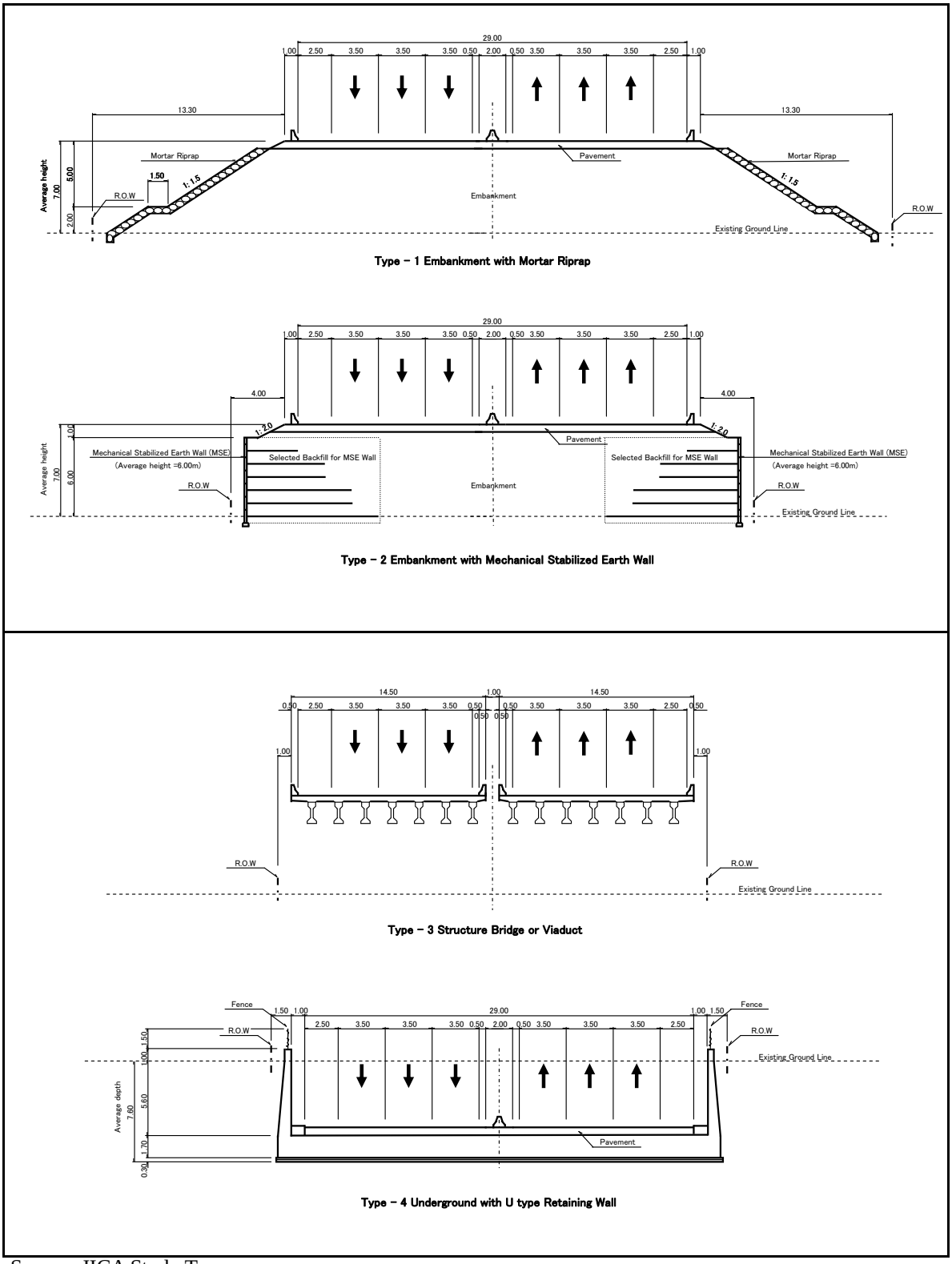


Source: JICA Study Team

Figure A-1 Perspective of the Route

3 Section Type

Typical cross sections of the said four road structure are shown in Figure A-2.



Source: JICA Study Team

Figure A-2 Typical Cross Sections

4 Straight Diagram

Using DigitalGlobe photo the straight diagram of the route is determined as seen in Figure A-3. From Figure A-3 the design sections of the Al Farag Road by type of road structure is summarized as seen in Table A-1.

Table A-1 Design Sections of the Al Farag Road by Type of Road Structure

Section	Distance (m)	Long span Br.	Type-1 (m)	Type-2 (m)	Type-3 (m)	Type-4 (m)	Remarks
0+000							
0+600	600	600					Nile river
0+800	200			200			
2+200	1,400					1,400	
2+400	200			200			
2+890	490	490					Nile river
18+200	15,310			14,430	880		
46+590	28,390		27,050		1,340		
52+900	6,310				6,310		
Total	52,900	1,090	27,050	14,830	8,530	1,400	52,900

Source: JICA Study Team

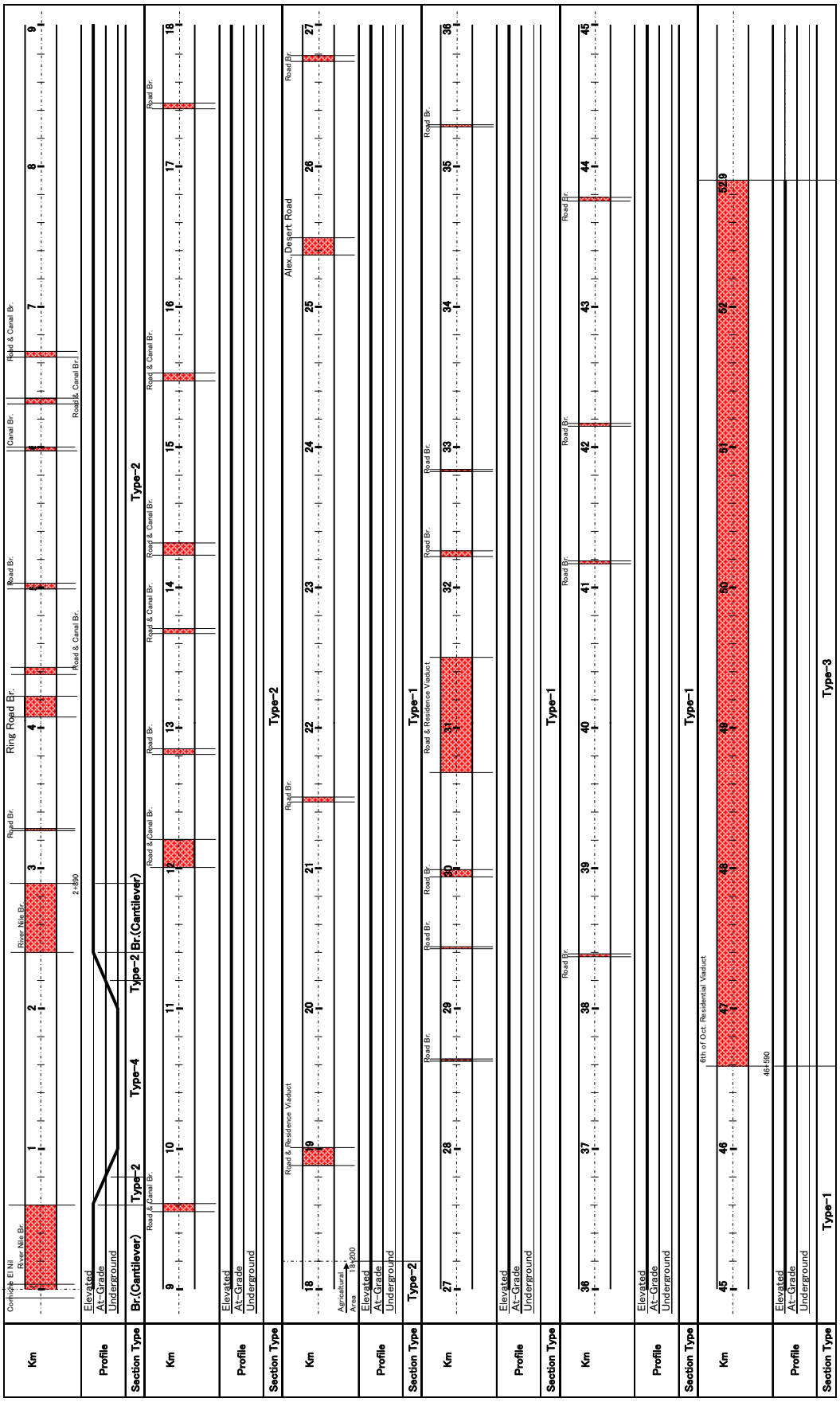


Figure A-3 Straight Diagram

Source: JICA Study Team

5 Structures

Necessary structures (Bridge, Box-Calvert, Over-Bridge) are counted from the route alignment on the DigitalGlobe photo and summarized in Tables A-2, A-3 and A-4.

Table A-2 Bridges

No.	STA.			length (m)	Remarks
1	0+000.00	～	0+600.00	600	Nile River
2	2+400.00	～	2+890.00	490	Nile River
			Subtotal	1,090	
3	3+300.00	～	3+325.00	25	Road
4	4+100.00	～	4+220.00	120	Ring Road
5	4+380.00	～	4+420.00	40	Road
6	4+990.00	～	5+030.00	40	Road
7	5+975.00	～	6+000.00	25	Canal
8	6+300.00	～	6+360.00	60	Canal + Road
9	6+640.00	～	6+680.00	40	Canal + Road
10	9+550.00	～	9+610.00	60	Canal + Road
11	12+050.00	～	12+250.00	200	Canal + Road
12	12+810.00	～	12+850.00	40	Canal + Road
13	13+670.00	～	13+710.00	40	Canal + Road
14	14+230.00	～	14+320.00	90	Canal + Road
15	15+470.00	～	15+530.00	60	Canal + Road
16	17+410.00	～	17+450.00	40	Road
			Subtotal	880	
17	18+880.00	～	19+010.00	130	Road
18	21+550.00	～	21+570.00	20	Road
19	25+370.00	～	25+490.00	120	Arex. Desert Road
20	26+750.00	～	26+790.00	40	Road
21	28+630.00	～	28+640.00	10	Road
22	29+430.00	～	29+440.00	10	Road
23	29+940.00	～	29+990.00	50	Road
24	30+680.00	～	31+500.00	820	Viaduct (Elevated)
25	32+220.00	～	32+260.00	40	Road
26	32+930.00	～	32+940.00	10	Road
27	35+280.00	～	35+290.00	10	Road
28	38+370.00	～	38+390.00	20	Road
29	41+170.00	～	41+190.00	20	Road
30	42+150.00	～	42+170.00	20	Road
31	43+760.00	～	43+780.00	20	Road
			Subtotal	1,340	
32	46+590.00	～	52+900.00	6,310	Viaduct (Elevated)

Source: JICA Study Team

Table A-3 Over-Bridges

No.	STA.	Width (m)	Length (m)	Area (m^2)	Remarks
1	0+810.00	7	32.00	224	
2	1+160.00	7	32.00	224	
3	1+590.00	7	32.00	224	
4	1+940.00	7	32.00	224	
5	2+100.00	7	32.00	224	
	Total		160.00	1,120	

Source: JICA Study Team

Table A-4 Box-Calbert

No.	STA	Type	Length (m)	Remarks
1	2+920.00	5.00 x 5.00	39.10	Road
2	3+050.00	5.00 x 5.00	39.10	Road
3	3+540.00	5.00 x 5.00	39.10	Road
4	3+860.00	5.00 x 5.00	39.10	Road
5	4+720.00	5.00 x 5.00	39.10	Road
6	6+560.00	5.00 x 5.00	39.10	Road
7	7+420.00	5.00 x 5.00	39.10	Road
8	8+700.00	5.00 x 5.00	39.10	Road
9	8+950.00	5.00 x 5.00	39.10	Road
10	9+300.00	5.00 x 5.00	39.10	Road
11	10+410.00	5.00 x 5.00	39.10	Road
12	10+740.00	5.00 x 5.00	39.10	Road
13	10+940.00	5.00 x 5.00	39.10	Road
14	11+340.00	5.00 x 5.00	39.10	Road
15	11+690.00	5.00 x 5.00	39.10	Road
16	11+820.00	5.00 x 5.00	39.10	Road
17	12+390.00	5.00 x 5.00	39.10	Road
18	13+450.00	5.00 x 5.00	39.10	Road
19	14+590.00	5.00 x 5.00	39.10	Road
20	14+740.00	5.00 x 5.00	39.10	Road
21	15+000.00	5.00 x 5.00	39.10	Road
22	15+190.00	5.00 x 5.00	39.10	Road
23	15+410.00	5.00 x 5.00	39.10	Road
24	15+740.00	5.00 x 5.00	39.10	Road
25	15+880.00	5.00 x 5.00	39.10	Road
26	16+140.00	5.00 x 5.00	39.10	Road
27	16+350.00	5.00 x 5.00	39.10	Road
28	16+630.00	5.00 x 5.00	39.10	Road
29	17+000.00	5.00 x 5.00	39.10	Road
30	17+850.00	5.00 x 5.00	39.10	Road
31	19+320.00	5.00 x 5.00	39.10	Road
32	20+130.00	5.00 x 5.00	39.10	Road
33	20+430.00	5.00 x 5.00	39.10	Road
34	20+950.00	5.00 x 5.00	39.10	Road
35	21+100.00	5.00 x 5.00	39.10	Road
36	22+140.00	5.00 x 5.00	39.10	Road
37	23+210.00	5.00 x 5.00	39.10	Road
38	25+270.00	5.00 x 5.00	39.10	Road
39	25+830.00	5.00 x 5.00	39.10	Road
40	26+140.00	5.00 x 5.00	39.10	Road
41	26+440.00	5.00 x 5.00	39.10	Road
42	26+940.00	5.00 x 5.00	39.10	Road
43	31+920.00	5.00 x 5.00	39.10	Road
44	33+840.00	5.00 x 5.00	39.10	Road
45	34+950.00	5.00 x 5.00	39.10	Road
46	36+220.00	5.00 x 5.00	39.10	Road
47	36+950.00	5.00 x 5.00	39.10	Road
48	37+630.00	5.00 x 5.00	39.10	Road
49	39+000.00	5.00 x 5.00	39.10	Road
50	39+730.00	5.00 x 5.00	39.10	Road
51	40+320.00	5.00 x 5.00	39.10	Road
52	41+350.00	5.00 x 5.00	39.10	Road
53	42+970.00	5.00 x 5.00	39.10	Road
54	44+760.00	5.00 x 5.00	39.10	Road

Source: JICA Study Team

6 Unit Cost

Construction unit costs are obtained by applying unit material and labor costs to each typical cross section (Tables A-5, A-6, A-7 and A-8).

Table A-5 Type-1 Structure Construction Cost

Item	Unit	Unit Price (L.E)	Quantity	Cost (L.E)	Remarks
1. Earthwork					
1.1 Clearing & Graving	m^2	3	55.60	167	
1.2 Embankment From Borrow	m^3	13	279.70	3,636	
1.3 Selected Backfill for MSE Wall	m^3	16	0.00	0	
Subtotal				**3,803**	
2. Slope Protection					
2.3 Mortar Riprap	m^3	215	13.04	2,804	
2.4 Mechanical Stabilized Earth Wall (MS	m^2	950	0.00	0	
Subtotal				**2,804**	
3. Pavement					
3.1 Surface Course (t=5cm)	m^3	300	1.36	408	
3.2 Binder Course (t=5cm)	m^3	300	1.37	411	
3.3 Base Course (t=20cm)	m^3	90	5.72	515	
3.4 Sub-base Course (t=30cm)	m^3	80	10.02	802	
Subtotal				**2,135**	
4. Miscellaneous					
4.1 Concrete Barrier (median)	m	607	1.00	607	
4.2 Concrete Barrier (outside)	m	300	2.00	600	
4.3 Road Marking	m	10	2.00	20	
Subtotal				**1,227**	
Construction Cost Total				**9,969**	
5. Land Acquisition (Aguricaltural Area)	m^2	900	57.60	**51,840**	
Total				**61,809**	

Source: JICA Study Team

Table A-6 Type-2 Structure Construction Cost

Item	Unit	Unit Price (L.E)	Quantity	Cost (L.E)	Remarks
1. Earthwork					
1.1 Clearing & Graving	m^2	3	37.00	111	
1.2 Embankment From Borrow	m^3	13	115.70	1,504	
1.3 Selected Backfill for MSE Wall	m^3	16	130.00	2,080	
Subtotal				**3,695**	
2. Slope Protection					
2.3 Mortar Riprap	m^3	215	0.00	0	
2.4 Mechanical Stabilized Earth Wall (MSE)	m^2	950	13.00	12,350	
Subtotal				**12,350**	
3. Pavement					
3.1 Surface Course (t=5cm)	m^3	300	1.36	408	
3.2 Binder Course (t=5cm)	m^3	300	1.37	411	
3.3 Base Course (t=20cm)	m^3	90	5.72	515	
3.4 Sub-base Course (t=30cm)	m^3	80	10.02	802	
Subtotal				**2,135**	
4. Miscellaneous					
4.1 Concrete Barrier (median)	m	607	1.00	607	
4.2 Concrete Barrier (outside)	m	300	2.00	600	
4.3 Road Marking	m	10	2.00	20	
Subtotal				**1,227**	
Construction Cost Total				**19,408**	
5. Land Acquisition (Aguricaltural Area)	m^2	900	39.00	**35,100**	
Total				**54,508**	

Source: JICA Study Team

Table A-7 Type-3 Structure Construction Cost

Item	Unit	Unit Price (L.E)	Quantity	Cost (L.E)	Remarks
1. Bridge					
1.1 PCDG	m^2	6,000	29.00	174,000	
1.2 Voided Slab	m^2		0.00	0	
Construction Cost Total				**174,000**	
2 Land Acquisition (Aguricaltural Area)	m^2	900	32.00	**28,800**	
Total				**202,800**	

Source: JICA Study Team

Table A-8 Type-4 Structure Construction Cost

Item	Unit	Unit Price (L.E)	Quantity	Cost (L.E)	Remarks
1. Earthwork					
1.1 Clearing & Graving	m^2	3	41.60	125	
1.2 Structure Excavation	m^3	12	287.28	3,447	
Subtotal				**3,572**	
2. Pavement					
2.1 Surface Course (t=5cm)	m^3	300	1.36	408	
2.2 Binder Course (t=5cm)	m^3	300	1.37	411	
2.3 Base Course (t=20cm)	m^3	90	5.72	515	
2.4 Sub-base Course (t=30cm)	m^3	80	10.02	802	
Subtotal				**2,135**	
3. Structure					
3.1 Concrete	m^3	800	65.50	52,400	
3.2 Reinforcing Bar	t	6,000	13.10	78,600	
3.3 Leveling Concrete	m^3	430	3.32	1,428	
3.4 Fence	m	600	2.00	1,200	
Subtotal				**133,628**	
4. Miscellaneous					
4.1 Concrete Barrier (median)	m	607	1.00	607	
4.2 Concrete Barrier (outside)	m	300	0.00	0	
4.3 Road Marking	m	10	2.00	20	
Subtotal				**627**	
Construction Cost Total				**139,962**	
5. Land Acquisition (Aguricaltural Area)	m^2	900	34.00	**30,600**	
Total				**170,562**	

Source: JICA Study Team

7 Construction Cost Estimates

Applied unit cost of a cross section to the length of km of the cross section, the construction cost is estimated as follows (Table A-9). Total cost becomes LE3,580 million. Divided by total road length 62.9 km, construction cost per km becomes LE56.9 million /km.

Table A-9 Construction Cost

Item	Unit	Unit Price (LE.)	Quantity	Cost (Mill.
1. Road Section				
1.1 Type - 1	m	9,969	27,050	270
1.2 Type - 2	m	19,408	14,830	288
1.4 Type - 4	m	139,962	1,400	196
Subtotal				**753**
2 Drainage				
2.1 Cross Drainage RCPC 1.220dia.	m	1,400	3,367	5
Subtotal				**5**
3 Service Road & River Replacement				
3.1 Service Road (Road width = 6.0m)	m	324	8,898	3
3.2 Replace Canal	m	16,000	560	9
Subtotal				**12**
4 Bridge				
4.1 Cantilever Type (Nile river)	m^2	34,360	31,610	1,086
4.2 PCDG (Type - 3)	m^2	6,000	247,370	1,484
4.3 Ov-Br.	m^2	6,000	1,120	7
Subtotal				**2,577**
5 Al Farag Underpass (Box Culvert)				
5.1 Box Culvert (5.0m x 5.0m)	m	22,000	2,111	46
Subtotal				**46**
6 Junction & Interchange				
6.1 Ring Road	Each	65,000,000	1	65
6.2 Alex. Desert Road	Each	65,000,000	1	65
6.3 6th of Oct	Each	33,000,000	1	33
Subtotal				**163**
7 Miscellaneous				
7.1 Road Lighting	km	610,000	52.90	32
Subtotal				**32**
Construction Cost				**3,589**

Source: JICA Study Team

ANNEX 2 CHECKLIST OF POTENTIAL IMPACTS INDUCED BY TRANPORT PROJECTS

1 Checklist of the Potential Impacts Induced by the Railway Project

Table A2.1 Potential Significant Impacts of the RAILWAY Project on the Natural and Physical Environment

ITEM	LOCATION	CONSTRUCTION	OPERATION
Morphology, geology, land subsidence	The project location will not induce any significant impact on the natural morphology. The alignment is however crossing the immediate surroundings of the natural protectorate of Kubiet El Hassana, which is a geological patrimony. The railway route must be kept outside this area. Land subsidence risk should be considered in the tunnel section between El Malik El Saleh and Giza square, according to possible modifications in the hydro-geological conditions. A technical study will be needed.	Tunnels will be done by boring 10m depth underground, which prevents the risk of land subsidence during works.	None
River Nile and waterways, water quality	The location of the railway project will not affect river Nile or water canals.	Tunneling works in El Malik El Saleh – Giza Square section area will generate significant amounts of drainage water due to boring in the groundwater layers. Take the drainage water to a local sewer.	Management of wastewater generated by the railway stations and services, and by the depot / workshop units.
Groundwater	The location of the metro tunnels in the shallow groundwater layers between El Malik El Saleh and Giza Square is a potential source of impacts on the hydro-geological conditions, which will need specific studies.	Accidental spillage of oil substances in the shallow groundwater from heavy machines is possible but can be prevented by simple measures.	Sensitivity of the groundwater to surface accidental spillage of hazardous substances in the depot and workshop site (11) depends on the geological layers. Since the aquifer is confined, preventing any pollution risk will be a requirement.
Water use	No impact.	Construction works can affect the potable water canalisations through direct or indirect damage (spillage of pollutants entering the network due to low pressure and water leakage).	Maintenance workshop and services in the railway stations will increase water use, especially for washing of the wagons. Water supply capacities are large enough to satisfy this demand without generating conflict.

ITEM	LOCATION	CONSTRUCTION	OPERATION
Natural habitats and wildlife	The desertic plateau crossed by the project railway route is already affected by urban development according to urban development plans. The project will have no impact on wildlife or biodiversity. Urban birds in roadside ficus and acacia trees of Pyramids road are common species and will not be affected by the location of the railway elevated structure. Greenbelts planted around the project site for the railway depot will not be affected by optimal location of the railway route.	There is no predicted impact on wildlife and natural habitats during construction.	There is no predicted impact of operation of the project on natural habitats or wildlife.
Cultivated lands	The railway route will not encroach on cultivated land.	No impact	No impact
Street trees and urban vegetation	The elevated structure along the Pyramids road will induce the removal of about 800 palmier trees planted in the median of the road, most of them being common species. There are however valuable ornamental palmier trees near Giza square, that should be replanted. The total loss of trees must be compensated by new plantations.	Care should be given to avoid indirect impacts on roadside trees along the Pyramids road: Soil compaction, damages to roots or trunks, diversion of water sources due to excavation.	No adverse impact. An integrated plan of tree planting and beautification works should be prepared as part of the environmental management plan. Planting sites are along the tracks, around the stations, and around the depot site in the desertic zone (greenbelt function).
Soil and sediment	The location of the project will not encroach on agricultural land, and soil loss is not an issue. There is no identified soil contaminated site in the location area of the project, but EIA must investigate this aspect. Excavation of contaminated soil during construction remains possible, and appropriate measures should be undertaken in such case.	Excavated arable and safe soil will be definitively lost if not reused. The excavated muddy sediments during the tunnel works of El Malik El Saleh – Giza Square section are possibly contaminated by surface leakages and wastewater and should be carefully disposed of.	Possible in case of removal of contaminated soil during construction. Not known because no inventory of contaminated sites.
Solid waste	No impact.	Construction works will generate demolition and construction waste that need an appropriate and dynamic management.	Management of the railway stations garbage generated by the passengers. Solid waste generated by the depot / workshop. Sanitary collection and disposal.
Noise and vibrations	Location is a potential source of impact in relationship with operation at proximity of sensitive zones.	Noise and vibrations are a major issue related to construction and tunnel especially by night. Special care should be given to the sensitive institution (hospital, school) at proximity of the selected route.	Noise and vibrations from the railway operation are a potential impact for the residents of Pyramids Road, particularly at night. The Pyramids avenue is large enough to reduce noise levels for neighbour residents. Noise reduction at source by selecting the most appropriate equipment is needed for mitigating the noise impacts. The hospital near the Ring Road is sensitive to the potential noise impacts.

ITEM	LOCATION	CONSTRUCTION	OPERATION
Ambient air quality	No impact.	Construction is a source of direct and indirect impacts on air quality. Direct impact is mainly the dust generated by construction in the Pyramids road, and transportation of demolition or excavation materials. Indirect impact is the worsening of air quality along the traffic diversion streets during the works. These impacts can be important because of the density of population in exposed zones, but will be temporary.	No emission and no impact on ambient air quality of the local environment. Contributes to air pollutants emissions from power stations, but the impact is not significant. In the long term, the project will contribute to the objective of clean air in Cairo.
Energy use and energy resources	No impact	Possible impacts are the business-as-usual energy used for works, and the possible damages on existing electric utilities, which can be however easily avoided.	Railway is the most energy efficient mode of urban transport. The impact on energy use is limited and positive in the long term with the expected shift from private transport to public transport. The impact on liquid fuel savings should be strongly positive because Cairo power plants are gas fired plants.
Desertification	The location of the project is not a physical factor of erosion or soil loss with desertification effects. The location area is however affected by sand storms and needs protection by planting a buffer zone with trees.	No impact	No impact
Global warming	No impact.	Construction works have an adverse impact on GHG emissions (machines, transportation, extraction and supply of materials), but this impact is temporary.	The railway operation will induce a low level of GHG emissions due to energy efficiency and energy sources (gas fired power plants). In the long term, the project will have positive saving effects on GHG emissions.

Source: JICA Study Team

Table A2.2 Potential Significant Impacts of the RAILWAY Project on the Socio-economic and Cultural Environment

ITEM	LOCATION	CONSTRUCTION	OPERATION
Land ownership	The railway route will be located in the ROW of existing roads and on the desertic plateau area. No encroachment of private ownership is expected. There is no illegal informal settlement on the selected project alignment. The land ownership survey will be performed later. It is possible that properties value of building lining the Pyramids road will be reduced, but uncertain.	No impact.	No impact.
Human settlements, involuntary resettlement	The railway route will be underground or located in the ROW of existing roads and on the desertic plateau area. No impact on existing settlements and no risk of involuntary resettlement is expected. The inter-modal station El Malik El Saleh will be an underground structure and should not affect surface settlements. The technical design of railway stations will be done later, but no impact on existing settlements is expected at this stage.	No impact.	No impact.
Livelihood and employment	No impact.	Positive impact as construction works will generate job opportunities.	Positive as increased mobility for the low income groups backward the Pyramids Road will access more easily job opportunities, in 6th of October for example.
Social groups and social organization	Uncertain	Uncertain but possible.	Uncertain but possible since the operation will increase the potential number of visitors to night clubs of Pyramids Road.
Vulnerable groups	The location of the railway near low income residential zones and the improvement of mobility conditions between these zones and the CBD area is a source of positive impacts on the vulnerable groups.	No specific significant impacts, except on the group of pedestrians, particularly sensitive to the adverse impacts of construction works: Loss of accesses, nuisances, increased risk of traffic accidents. Socially vulnerable groups are pedestrians, and pedestrians are vulnerable to road traffic (disturbance, accidents).	Poor and marginalized people are the most dependent on public transport for ensuring their mobility. Consequently, operation of the railway will have a very positive impact on vulnerable groups. The technical design of stations must integrate the need of easy access to the physically disabled people. Pedestrian modes of transport must be developed around the stations and carefully designed in the inter-modal stations, as a measure to promote the access to and use of the railway and public transport.

ITEM	LOCATION	CONSTRUCTION	OPERATION
Women and children	No impact.	Since women and children are more potential pedestrians than men, construction works may have more significant impacts on them.	Operation of the railway has a potential positive impact for women and children, who generally depend more on the public transport than men. They will benefit of the improved mobility conditions.
Access to social and cultural facilities and services	The railway will be built on elevated structures or underground in the densely inhabited zones, which basically prevents severe impact on the access to social and cultural facilities and services. The installation of barriers or facilities under the elevated structure could however induce severe effect along the Pyramids road, and should be prevented.	Construction works are a major source of impacts on usual accesses for people, and could strongly affect the patterns of access to facilities and services. These impacts are however temporary and can be partly mitigated.	Operation of the railway has no impact on the local patterns of access to facilities and services, but has a positive impact at the GCR level for access to specific services.
Cultural and historical assets and heritage	The project will not induce any loss of historical or cultural asset, and the route is located outside the protected archeological area of Giza.	Construction will not induce impacts excepted in case of archeological discovery during excavation. In such case, the legal procedure will be undertaken.	No impact
Landscape and architecture	A tunnel section is planned in the Pyramids area in order to avoid adverse impact on the landscape and tourism attraction value. The depot will have no impact. The elevated structure along the Pyramids road will affect the urban landscape of the green alignment of trees, and possibly the approach corridor to the pyramids archaeological sites. The best possible design of the railway should be considered. There is no panoramic or valuable view from the Pyramids road at ground level along the project section which is planned to be elevated. The landscape value of the Pyramids road needs however a specific survey. People in residential apartments could be affected severely affected, and more importantly, the future potential of the road for tourism and urban landscape could be definitively lost.	Construction works may severely affect the urban landscape but this is a temporary impact.	No impact
Urban amenities	There is no urban park, place or attractive site for the local citizens that could be affected by the location of the project.	No impact	No impact.

ITEM	LOCATION	CONSTRUCTION	OPERATION
Quality of the living environment	Pyramids road is large enough to limit the direct physical impacts of the railway elevated structure on the roadside residents. These impacts (loss of natural light, loss of open space, loss of privacy), together with the replacement of trees by a concrete structure, can however be perceived as a very severe source of impacts on the quality of living of few residents. It is possible that residents will not be ready to accept this change, as shown by the focus groups discussions.	Construction works are an important source of nuisances for the residents living around, which in turn cause the degradation of the quality of life.	The operation of the railway is a positive factor of increased quality of the mobility conditions for Cairo citizens.
Working environment and working conditions	Possible impact of the elevated structure on the working conditions of shops keepers and informal business along the Pyramids road, but not significant.	Construction works can severely affect the working conditions of shop keepers or informal business. Working conditions of the workers staff for construction of the project structures must be in conformity with legal requirements.	Working conditions and working environment in accordance with legal requirements. No adverse impact.
Road traffic and road accidents	The location of the project should not affect the traffic conditions of Pyramids road, which are already very bad due to chronic congestion.	Construction works will worsen the traffic conditions in the area between El Malik El Saleh and the pyramids. Traffic in Faysal road will increase.	Operation of the railway will not have impacts compared with the present traffic conditions. At best, it will have a positive impact of avoiding the worsening of present congested conditions.
Public health	The location of the project will have no impact on public health of local residents.	Construction works are likely to induce acute health effects on sensitive residents exposed to the direct or indirect effects on ambient air and noise.	Operation of the railway will not affect the health of local residents. Noise should be kept at required levels.
Natural or technological risk of disaster	The location of the project is not a source of such risks, provided that the elevated structure will be designed as an earthquake-proof structure.	Construction works can induce disaster situations and accidents. The sensitive points are tunneling works in El Malik El Saleh – Giza square section, construction works, and traffic management. A security plan must be established.	Operation is planned to be done according to the modern required security conditions.

Source: JICA Study Team

2 Checklist of the Potential Impacts Induced by the Busway Project

Table A2.3 Potential Significant Impacts of the BUSWAY Project on the Natural and Physical Environment

ITEM	LOCATION	CONSTRUCTION	OPERATION
Morphology, geology, land subsidence	The project location will not induce any impact on the natural morphology. There is no risk of land subsidence.	No impact.	No impact.
River Nile and waterways, water quality	The location of the busway elevated structure along the Zomor canal is a potential source of impact on the morphology of the waterway.	Excavation and earthworks of the busway are a potential source of obstruction or pollution of the Zomor canal. This canal	Management of wastewater generated by the depot / workshop unit.
Groundwater	The location of the busway is not a factor of impact on the shallow groundwater.	Construction works are a possible source of accidental spillage of oil substances in the shallow groundwater.	Sensitivity of the groundwater to surface accidental spillage of hazardous substances in the depot and workshop site depends on the geological layers. Since the aquifer is confined, preventing any pollution risk will be a requirement.
Water use	The Zomor canal along the busway is used for irrigation of gardens in the railway corridor and cultivated fields outside Cairo. The project will not affect this water use.	Construction works can affect the potable water canalisations through direct or indirect damage (spillage of pollutants entering the network due to low pressure and water leakage).	Water use induced by bus washing will not be an adverse impact and will not affect supply capacities.
Natural habitats and wildlife	The location of the project will have no significant impact on wildlife or biodiversity. Common bird species in trees along the Zomor canal in few sections of the railway corridor will be displaced, with no impact on biodiversity.	Construction could induce the disturbance of a small breeding colony of cattle Egret birds, south of the El Bashtir Triangle.	No impact.
Cultivated lands	The busway route could encroach on cultivated land in the south of El Bashtir and between El Bashtir and 26th of July road.	Construction works could damage few cultivated lands or gardens in the railway corridor.	No impact
Street trees and urban vegetation	The elevated structure along the Zomor canal will induce the removal of vegetation and few trees.	No impact.	No adverse impact.
Soil and sediment	The location of the project busway elevated structure on cultivated lands in the railway corridor and near 26th of July road will have a limited impact on the loss of soil. The location of the bus terminal in Behouth on the site of ENR workshops should be considered as a potential possible contaminated site. Excavation of contaminated soil during construction remains possible, and appropriate measures should be undertaken in such case.	Demolition of the ENR buildings in Behouth for construction of the bus terminal is a potential source of excavation of contaminated soil. This site will need a specific attention. It should be considered as a potential contaminated site, requiring investigation in the EIA.	No impact.

ITEM	LOCATION	CONSTRUCTION	OPERATION
Solid waste	The location of the busway route in the railway corridor is used for illegal dumping of solid waste along the road and canal. These waste materials will be managed properly during the construction works.	Construction works and demolition of the ENR buildings will generate demolition and construction waste, and possibly hazardous waste. Waste management will be an important issue for avoiding adverse impacts on the environment.	Passengers garbage in the bus terminals will need an appropriate management to avoid adverse impacts like waste litering. Solid waste generated by the depot / workshop will need to be disposed of according to legal requirements.
Noise and vibrations	The location of the busway in the railway corridor leaves a buffer distance between the structure and the residential buildings, which prevents potential noise impacts. The location in the residential zone between El Bashtir and 26th July road is closer to the buildings, which is likely to become a source of noise nuisance.	Noise and vibrations are a major issue related to construction, especially by night. Special care should be given to the sensitive institutions (hospital, school) at proximity of the selected route.	The railway corridor is large enough to reduce noise levels of bus traffic on the elevated structure for neighbourhood residents. The noise impact of the busway should not be significant here. Between El Bashtir and 26th July road, the busway route in the residential zone is likely to have noise impacts for the nearest households.
Ambient air quality	The location of the busway in the railway corridor is a favourable factor of dispersion of air pollutants.	Construction is a source of direct and indirect impacts on air quality. Direct impact is mainly the dust generated by construction in the Pyramids road, demolition of the ENR buildings in Behouth, and transportation of demolition or excavation materials. Indirect impact is the worsening of air quality along the traffic diversion streets during the works. These impacts can be important because of the density of population in exposed zones, but will be temporary.	In the railway corridor and in 6th October, the bus air pollutants emissions will be dispersed and will not affect ambient air of the residents lining the corridor. A limited impact on ambient air is expected along the elevated structure crossing the residential area between El Bashtir and 26th July road. The main sources of air pollution in this zone are the illegal waste dumps, and busway emissions will not affect air quality beyond legal requirements. Since busway emissions per passenger are lower than those per private car passenger, the project does contribute to the objective of clean air in Cairo.
Energy use and energy resources	No impact	Possible impacts are the business-as-usual energy used for works, and the possible damages on existing electric utilities, which can be however easily avoided.	Busway is an energy efficient mode of urban transport compared with private cars. The impact on energy use is then limited, and it is positive in the long term with the expected shift from private transport to public transport.
Desertification	No impact	No impact	No impact
Global warming	No impact.	Construction works have an adverse impact on GHG emissions (machines, transportation, extraction and supply of materials), but this impact is temporary.	The busway operation has an impact on GHG emissions, but the global impact for GCR is a positive saving effect on GHG emissions due to the low level of emissions per passenger compared with emissions of private car passengers.

Source: JICA Study Team

Table A2.4 Potential Significant Impacts of the BUSWAY Project on the Socio-economic and Cultural Environment

ITEM	LOCATION	CONSTRUCTION	OPERATION
Land ownership	The busway route will be mostly located in the ROW of the ENR railway corridor and in the ROW of the 26th July road. The bus terminal project in El Bashtir Triangle will occupy a land of the old airport of Imbaba. Encroachment on private land will concern the cultivated lands on South and West of El Bashtir. In the railway corridor, it is possible that few plots of cultivated land could be informal, possibly arising problems of ownership or compensation rights in case of acquisition. The land ownership survey will be performed later.	No impact.	No impact.
Human settlements, involuntary resettlement	The busway route has been finally located on the Western side of the railway corridor, in order to avoid the informal settlements of the Eastern side. The bus terminal planned at Behouth will be located on a site presently used by ENR with 4 buildings. The construction of the bus terminal will necessitate the demolition and relocation of 3 buildings used as offices, storage of parts, and workshop. The main workshop south the other buildings is not directly affected. The pedestrians bridge intensively used for crossing the railway corridor will be demolished and replaced by the underground passage to the bus terminal. The first market block in Behouth could be directly affected depending on the exact location of the busway structure.	Possible impact on the market facilities, but this impact can be avoided.	No impact.
Livelihood and employment	The location of the bus terminal will induce the relocation of the ENR settlements, which employ about 400 persons. This relocation should not affect employment and livelihood, but this is still uncertain. The relocation or compensation of the first market block could have impacts on the livelihood of few shopkeepers. The relocation of the pedestrian passage in Behouth should have impacts on the livelihood of few shopkeepers established along the pathway.	Construction works can affect the market vendors but this impact can be mitigated and is temporary.	The shift of the pedestrian passage way across the railway corridor from the actual bridge to the new underground passage of the bus terminal will have severe impacts on the business of shopkeepers and street vendors, with a loss of income source. The new bus terminal will generate business opportunities and employment.

ITEM	LOCATION	CONSTRUCTION	OPERATION
Social groups and social organization	The railway corridor area is an interface area between high, medium, low and very low income groups. Marginalized people (mostly coming from Upper Egypt) are living in few informal settlements of the corridor. Potential impacts are uncertain. This area needs a social survey.	No impact.	
Vulnerable groups	The railway corridor in Behouth is the core of informal settlements and socially vulnerable groups. The location of the busway project in the railway corridor will have positive or negative impacts on vulnerable groups. See D14 and D15. The relocation of the busway alignment on the Western side of the railway corridor has permitted to avoid the direct impact on relocation of the vulnerable group households of the Eastern side. The location of the busway near low income residential zones and the improvement of mobility conditions between these zones and the inner city is a source of positive impacts on the vulnerable groups.	Potential impacts on the group of pedestrians, particularly sensitive to the adverse impacts of construction works: Loss of accesses, nuisances, increased risk of traffic accidents. Socially vulnerable groups are pedestrians, and pedestrians are vulnerable to road traffic (disturbance, accidents).	Poors and marginalized people are the most dependent on public transport for ensuring their mobility. Consequently, operation of the busway will have a very positive impact on vulnerable groups along the railway corridor and near El Bashtir. The technical design of the bus terminal must integrate the need of easy access to the physically disabled people. Pedestrian modes of transport must be developed around the bus terminal as a measure to promote the access to and use of the busway and public transport. The underground passage should be carefully designed for access to the bus terminal and as a passage way to cross the railway corridor. The pedestrian link between the bus terminal and the market should be integrated in the design of the bus terminal and its surroundings.
Women and children	The location of the bus terminal could adversely affect the pedestrian patterns of women and children, who are certainly highly sensitive to changes.	Since women and children are more potential pedestrians than men, construction works may have more significant impacts on them. Access to market, shops, and local services can be seriously damaged, and risk of accident increased.	Operation of the busway has a potential positive impact for women and children, who generally depend more on the public transport than men. They will benefit of the improved mobility conditions.
Access to social and cultural facilities and services	The busway will be built on elevated structures in the densely inhabited zones, which basically prevents severe impact on existing pathways. The bus terminal project will modify the railway corridor crossing pathways, with no adverse impact on access to social and cultural facilities and services, if carefully designed.	Construction works are a major source of impacts on usual accesses for people, and could strongly affect the patterns of access to facilities and services. These impacts are however temporary and can be partly mitigated.	Operation of the busway has no impact on the local patterns of access to facilities and services, but has a positive impact at the GCR level for access to specific services.
Cultural and historical assets and heritage	No impact.	In case of archeological discovery during excavation, the legal procedure will be undertaken.	No impact
Landscape and architecture	No impact.	No impact.	No impact

ITEM	LOCATION	CONSTRUCTION	OPERATION
Urban amenities	Almost no impact. An informal amenity (café under tree) has been seen in Ard Elwaa on the proposed alignment. Compensation by recreating new amenities is possible through landscaping measures.	No impact.	No impact.
Quality of the living environment	If pedestrian pathways are well integrated in the design of the bus terminal and its surroundings, the impact of the busway on the quality of the living environment should be quite positive. No adverse impact is expected.	Construction works are an important source of nuisances for the residents living around, which in turn cause the degradation of the quality of life.	The operation of the busway is a positive factor of increased quality of the mobility conditions for Cairo citizens.
Working environment and working conditions	Possible impacts on the market workers, but should not be significant.	Construction works can severely affect the working conditions of shop keepers or informal business. Working conditions of the workers staff for construction of the project structures must be in conformity with legal requirements.	Appropriate design of the bus terminal should provide an appropriate working environment.
Road traffic and road accidents	The location of the bus terminal and bus stations on the Western side of the railway corridor will modify traffic conditions of the area.	Construction works will worsen the traffic conditions in the area between El Malik El Saleh and the pyramids. Traffic in Faysal road will increase.	Traffic could increase on the Western side of the railway corridor and in El Bashtir, due to operation of the busway. At the level of GCR, the busway will contribute to avoid worsening of the present traffic conditions.
Public health	No impact.	Construction works are likely to induce acute health effects on sensitive residents exposed to the direct or indirect effects on ambient air and noise.	Operation of the busway will not affect the health of local residents.
Natural or technological risk of disaster	The location of the project is not a source of such risks, provided that the elevated structure will be designed as an earthquake-proof structure.	Construction works can induce accidents. Traffic management will help to mitigate traffic accidents.	Operation of the busway and design of bus terminals are planned to be done according to the modern required security conditions.

Source: JICA Study Team