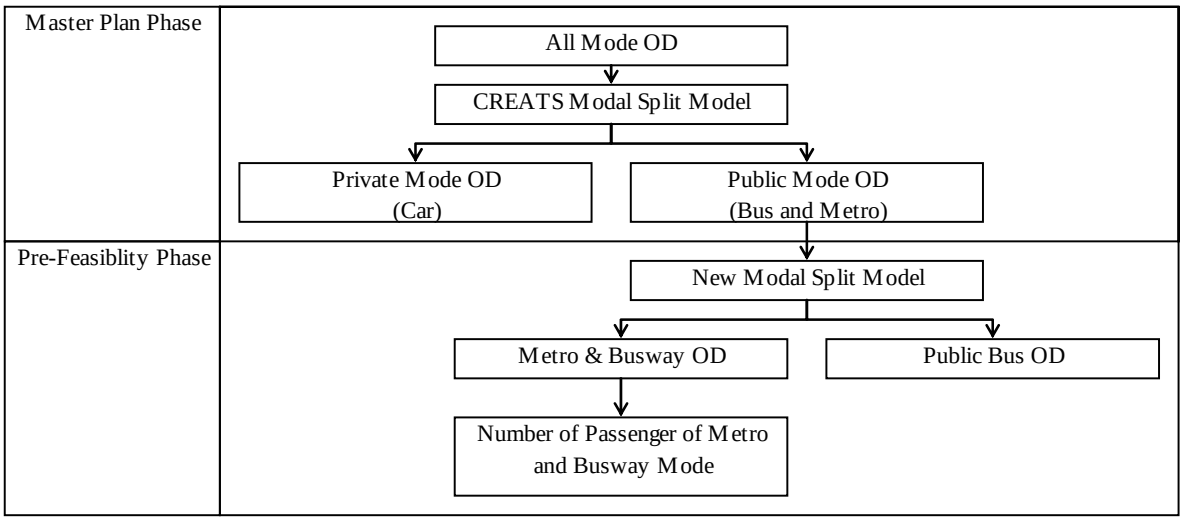
3.4 Additional Modeling Work for Public Transport Modal Choice

3.4.1 Overview

For the Pre-F/S, the Study Team needed to create a new modal split model, which can split public mode users to bus users and Metro and busway users, applicable to the analysis of the railway and busway projects as shown in Figure 3.4.1. The goal of this model was to predict the share and absolute number of trips for using the proposed new transit line. The modal split model in this study comprised a bus model component and a busway and Metro model component. This model provided bus use passenger numbers and Metro use passenger numbers. CREATS HIS data were used in the model to predict passenger numbers.



Source: JICA Study Team

Figure 3.4.1 Work Flow for Modeling Work of Public Transport Mode

3.4.2 Modeling of Bus-Metro Modal Choice

The new modal split model that was developed is a logic type model, as indicated below:

$$Pij\_metro = U\_metro / (U\_metro + U\_bus)$$

$$Uij\_metro = a1 * Tij\_merto + a2 * Rij / (Aij + Eij)$$

$$Uij\_bus = b1 * Tij\_bus + b2$$

Where *Pij_metro* = Modal share of Metro Mode between i zone to j zone

Uij = Utility function between i zone to j zone

Tij_metro = Travel time by Metro mode between i zone to j zone (Unit: minute)

Tij_bus = Travel time by Bus mode between i zone to j zone (Unit: minute)

Aij = Access travel length from i Origin Zone to embarking Metro station

Eij = Egress travel length from alighting Metro station to j destination Zone

Rij = Travel Length between embarking and disembarking Metro stations

a1, a2, b1, b2 are parameters.

(1) Assumption of travel time by mode

Travel speed and waiting time were assumed for modeling purposes. Travel time and travel length among all zone pairs were simulated using JICA STRADA assignment module, with the assumptions listed in Table 3.4.1.

Table 3.4.1 Assumption of Travel Time by Mode for the Modeling Period

Mode	Service Speed (km/h)	Waiting Time (minutes)	Remarks
Metro	40	10	Existing Metro Line 1 and 2 data
Bus Exclusive Lane Use	30	10	
Bus Mixed Transport Condition	20	10	CREATS HIS Data

Source: JICA Study Team

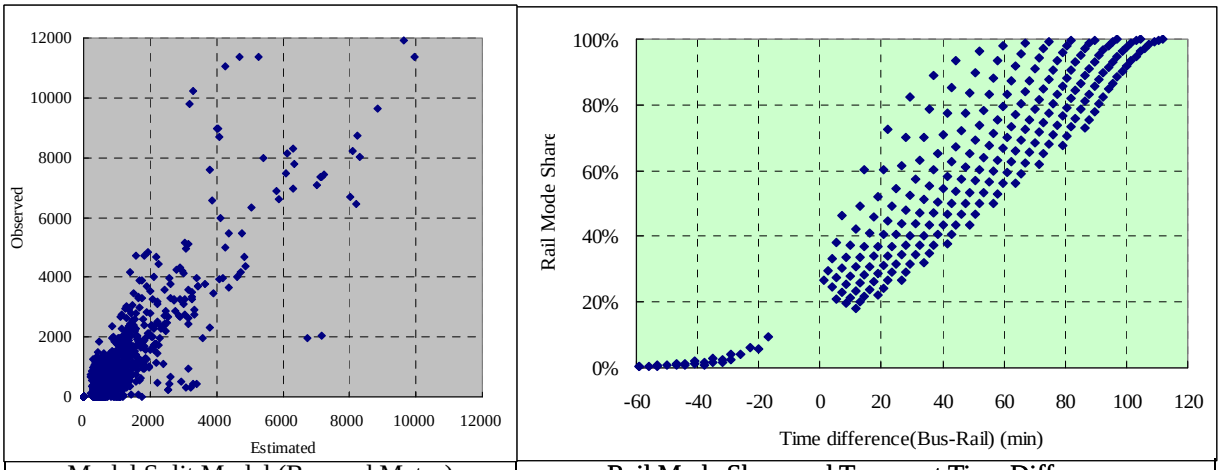
(2) Model Calibration Results

The parameters of the new modal split model were identified and calibrated by using the maximum likelihood method, which attempts to find a set of parameters that is most likely to result in the choices observed in the CREATS HIS data (Table 3.4.2 and Figure 3.4.2). Using the model, rail mode share is calculated and shown in Figure 3.4.2. In Figure 3.4.2, the calibration result shows the modal share by the public transport mode including buses and Metro in the CREATS model (observed in vertical) and the new modal split model (estimated in horizontal). The new modal split model is considered reliable, since the correlation ratio (R-square) is estimated at 0.8839 as shown in Table 3.4.2. A right side graph in Figure 3.4.2 shows the modal share of Metro by time difference between Metro and buses.

Table 3.4.2 Model Calibration Results

Item	Travel Time (t - value)	Station Access Ratio (t - value)	Constant (t - value)
Metro Mode	-0.067948488 (-1.7385)	0.138827632 (0.6038)	-
Bus Mode	-0.04817359 (-1.2440)	-	0.486960221 (0.4869)
R-square	R2= 0.8839		

Source: JICA Study Team
Note: T-value represents the degree of incidence to the modal share by explain variables including the travel time and station access ratio.



Modal Split Model (Bus and Metro) Calibration Results

Rail Mode Share and Transport Time Difference

Source: JICA Study Team

Figure 3.4.2 Modal Split Model (Bus and Metro) Calibration Results and Estimated Rail Mode Share

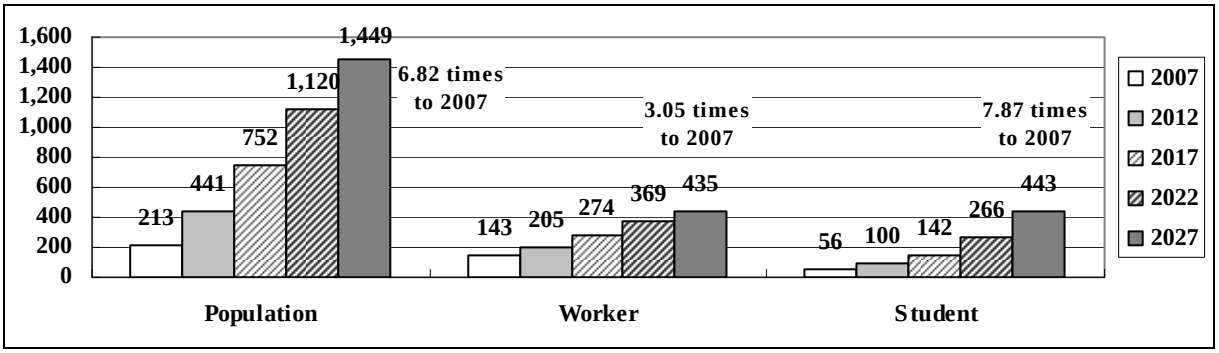
3.5 Future Public Transportation Demand of 6th of October Corridor

3.5.1 Socio-Economic Situation

(1) Socio-economic framework of 6th of October NUC

The socio-economic framework of the Western Development Corridor was discussed in Chapter 2. As described in the Section 4.3.2 of the Master Plan Study Volume 2, the trip generation model consists of household numbers, household size and their economic activity level. The trip attraction model is based on the number of high school or vocational school students at school, university or college students at school, and tertiary industry employment. As a detailed discussion was given in the former chapter, only the population, employment and students at school are presented here as synthetic indices for predicting the increase in traffic demand.

In the Figure 3.5.1, population, number of employed people and number of students at school are summarized. The rate of increase in the number of students between 2007 and 2027 is remarkable, as it represents more than double of the increase in the number of workers. On the other hand, the increase in the population is 6.82 times, which is slightly smaller than increase in the number of students, which is 7.87 times. These figures are interpreted to mean that 6th of October NUC will become a more mature residential area than a work place. However, the NUC work center development will also be high, as can easily be understood from the fact that the ratio of 2027 employment to 2007 employment is 3.05. This will be due to the remarkable influx of younger age families.

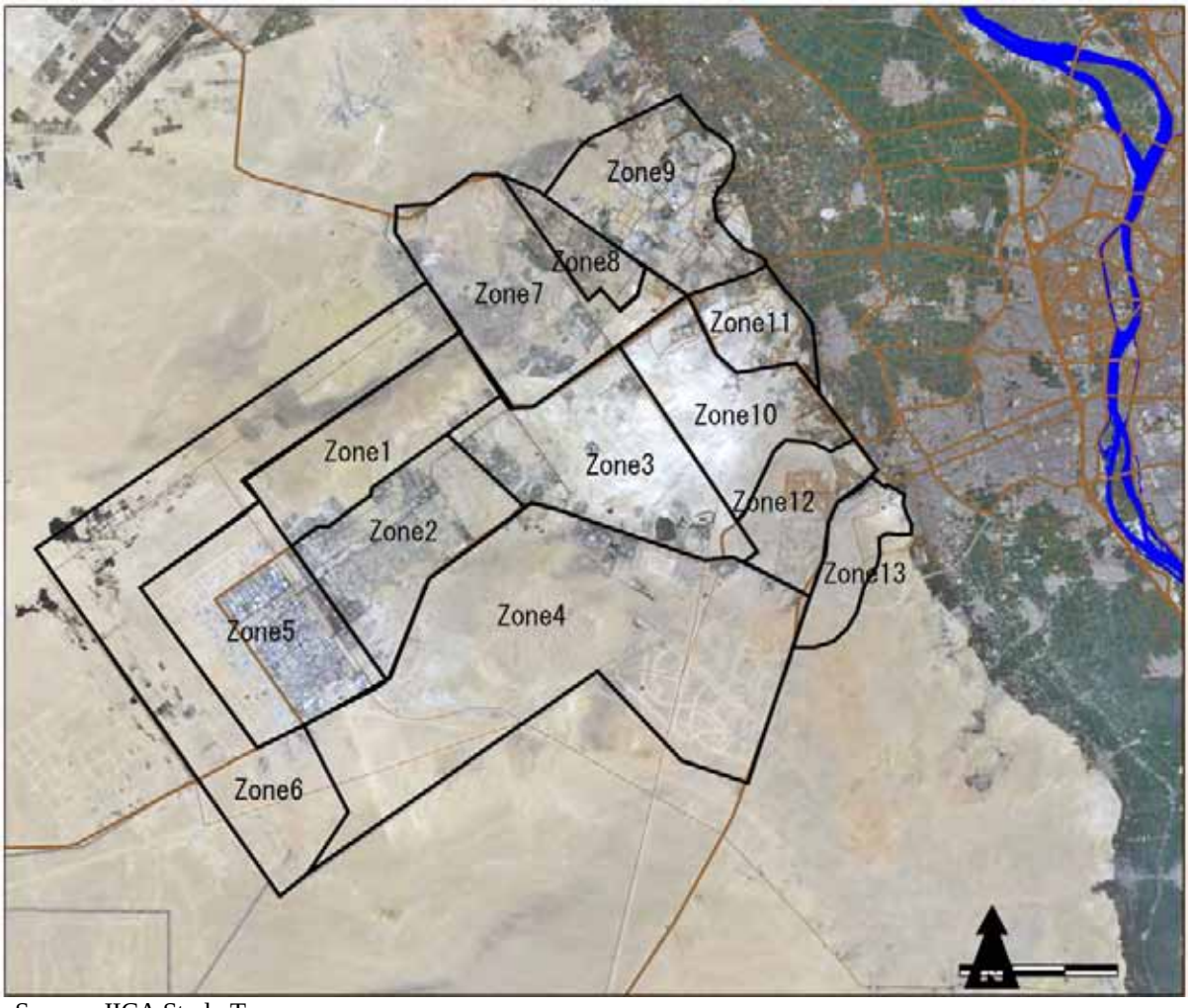


Source: JICA Study Team

Figure 3.5.1 Population, Workers and Students in 6th of October NUC (2007-2027)

(2) Social framework of 6th of October NUC by traffic zone

For the convenience of analysis in the transportation study, 6th of October NUC sector zone was divided to 13 traffic zones, as shown in Figure 3.5.2. Population, employment and the number of students at school were allocated in the same manner as the former subsection allotted numbers to those traffic zones, as shown in Table 3.5.1.



Source: JICA Study Team

Figure 3.5.2 Traffic Zones in 6th of October NUC

Table 3.5.1 Population, Employments and Students at School in 6th of October NUC

Zone	2007	2012	2017	2022	2027
Population					
Zone1	3,782	45,085	98,365	160,824	216,339
Zone2	163,962	264,768	405,849	574,918	726,167
Zone3	3,280	18,883	39,130	62,905	84,048
Zone4	0	3,917	8,943	14,828	20,056
Zone5	5,962	8,701	12,642	17,397	21,660
Zone6	0	0	0	0	0
Zone7	35,588	64,526	105,502	154,754	198,852
Zone8	0	0	0	0	0
Zone9	0	2,632	6,010	9,965	13,478
Zone10	0	26,129	59,663	98,917	133,793
Zone11	0	1,841	4,203	6,969	9,425
Zone12	0	4,989	11,392	18,887	25,546
Zone13	0	0	0	0	0
Total	212,575	441,470	751,699	1,120,364	1,449,364
Employments					
Zone1	304	5,524	13,658	24,180	31,529
Zone2	14,240	32,482	57,241	88,128	108,269
Zone3	264	4,653	9,746	16,877	22,545
Zone4	7,931	10,028	12,136	15,248	17,908
Zone5	84,325	89,429	98,628	113,616	122,038
Zone6	2,085	2,322	2,587	2,886	3,080
Zone7	2,865	10,904	20,495	33,491	43,258
Zone8	233	259	289	322	344
Zone9	30,411	45,688	49,158	55,749	62,760
Zone10	0	3,117	8,104	14,548	19,041
Zone11	0	204	542	976	1,274
Zone12	0	553	1,470	2,645	3,452
Zone13	0	0	0	0	0
Total	142,658	205,164	274,055	368,665	435,498
Student at school					
Zone1	648	7,385	14,943	30,203	50,932
Zone2	47,898	66,946	85,422	145,571	231,542
Zone3	562	3,093	5,944	11,813	19,787
Zone4	0	2,537	3,350	11,693	25,121
Zone5	1,022	1,425	1,920	3,267	5,099
Zone6	0	0	0	0	0
Zone7	6,102	12,465	18,019	37,971	67,215
Zone8	0	0	0	0	0
Zone9	0	431	913	1,871	3,173
Zone10	0	4,280	9,064	18,577	31,498
Zone11	0	302	639	1,309	2,219
Zone12	0	817	1,731	3,547	6,014
Zone13	0	0	0	0	0
Total	56,233	99,682	141,944	265,823	442,601

Source: JICA Study Team
Note: Zone 13 is a reserved area, therefore population, employment and students at school equal zero.

3.5.2 Transportation Demand Characteristics

(1) Modal share by sector zone in CREATS data 2002

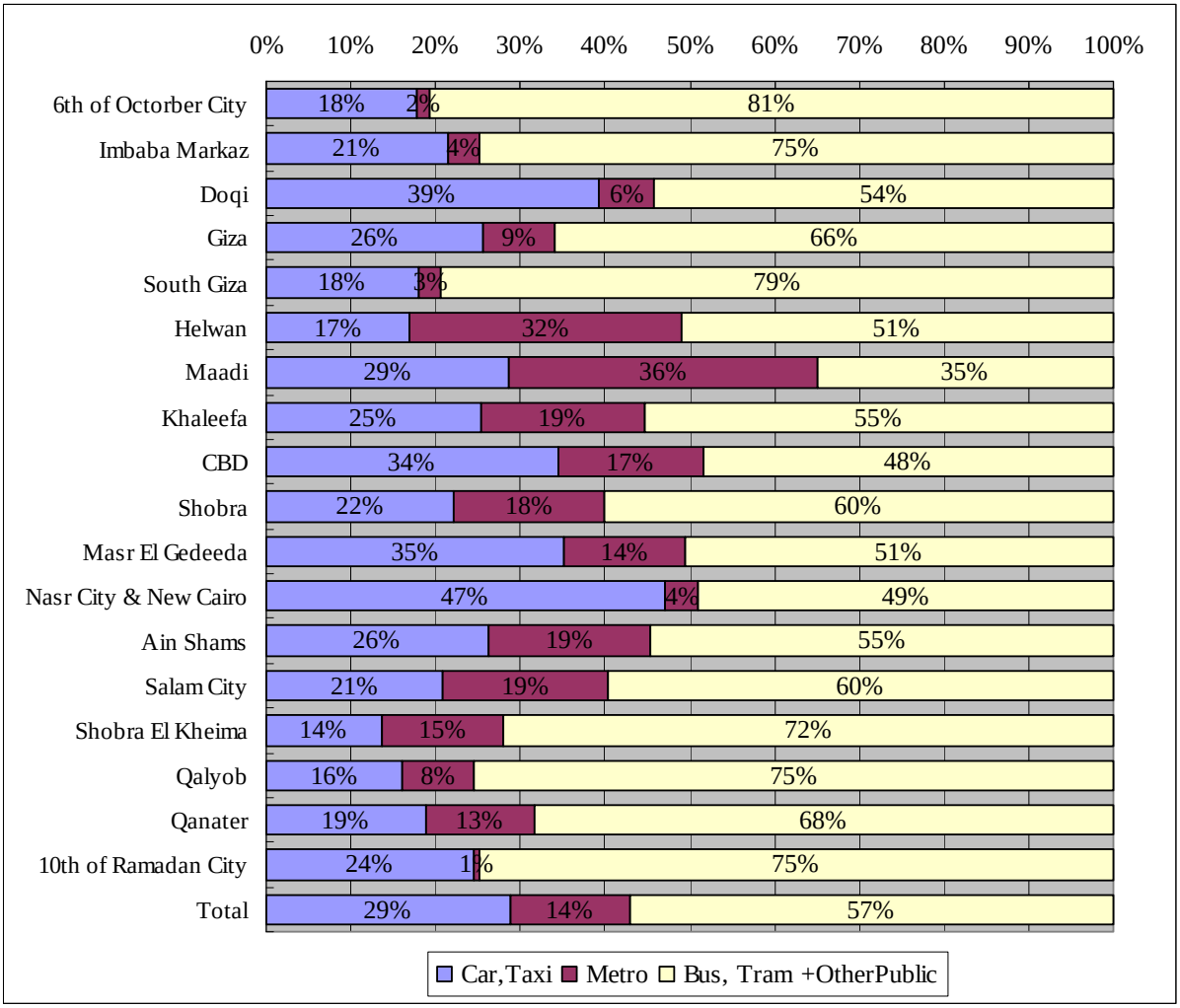
The modal share by sector zone was analyzed using data from the Household Interview Survey (HIS) that was done by CREATS in 2002. Although the transportation behavior of people changes gradually, the modal share shown in the CREATS HIS data is considered to be applicable to the SDMP Study as the five year time period (2007-2002) is relatively short, so it will probably not greatly affect the citizens' modal share behavior. Under that assumption, the JICA Study Team used the CREATS HIS modal share data. The result of the analysis is summarized in Table 3.5.2 and Figure 3.5.3.

Overall, the modal share is roughly considered as Walking 30%, Car and Taxi 20%, Rail 10% and Bus 40%. However, looking more closely at the section receiving service of the Metro, the section between Helwan and Maadi will receive 30-40% of the trips for Metro users. In addition, the focus area of the Western Development Corridor project, comprising 6th of October and Giza, shows higher rates of bus use (70-80%) because of no other public transport is available.

Table 3.5.2 Modal Share by Sector Zone in CREATS HIS 2002

No	Sector Zone Name	Walk Only	Car, Taxi	Metro	Bus, Tram +Other Public	Total
1	6th of October City	72,243	54,290	4,781	247,294	378,609
2	Imbaba Markaz	762,816	122,263	21,067	426,091	1,332,237
3	Doqi	449,579	526,768	85,452	727,638	1,789,437
4	Giza	509,916	328,436	109,772	844,485	1,792,609
5	South Giza	298,211	28,862	4,246	127,559	458,879
6	Helwan	332,182	121,300	230,388	366,133	1,050,003
7	Maadi	321,615	209,185	265,743	254,362	1,050,906
8	Khaleefa	307,907	201,397	154,084	439,033	1,102,421
9	CBD	199,986	390,488	194,544	549,208	1,334,227
10	Shobra	449,144	196,134	156,991	529,264	1,331,532
11	Masr El Gedeeda	333,726	648,770	266,688	934,682	2,183,867
12	Nasr City and New Cairo	197,013	611,639	47,956	636,922	1,493,529
13	Ain Shams	455,491	192,946	139,964	402,755	1,191,155
14	Salam City	335,931	109,305	101,943	313,704	860,882
15	Shobra El Kheima	491,890	71,473	76,542	379,058	1,018,963
16	Qalyob	450,079	54,805	28,589	256,887	790,360
17	Qanater	557,696	72,433	49,759	262,948	942,836
18	10th of Ramadan City	105,372	47,806	1,238	146,606	301,023
Total		6,630,798	3,988,298	1,939,747	7,844,630	20,403,473

Source: CREATS HIS (2002) as analyzed by the JICA Study Team



Data Source: CREATS HIS (2002) as analyzed by the JICA Study Team

Figure 3.5.3 Daily Trip Modal Share by Sector Zone in CREATS HIS 2002

(2) Public transport trip generation by sector zone

Public transport daily trip generation was estimated and this is summarized by sector zone in Table 3.5.3 and Figure 3.5.4. The 6th of October NUC shows a remarkable growth ratio during the period 2007 to 2027, and 10th of Ramadan NUC follows this trend. As for the currently generated trip volume, Giza has the largest volume, with 1.5 million trips per day, and Masr El Gedeeda and Imbaba Markaz follow, with 1.2 million trips per day.

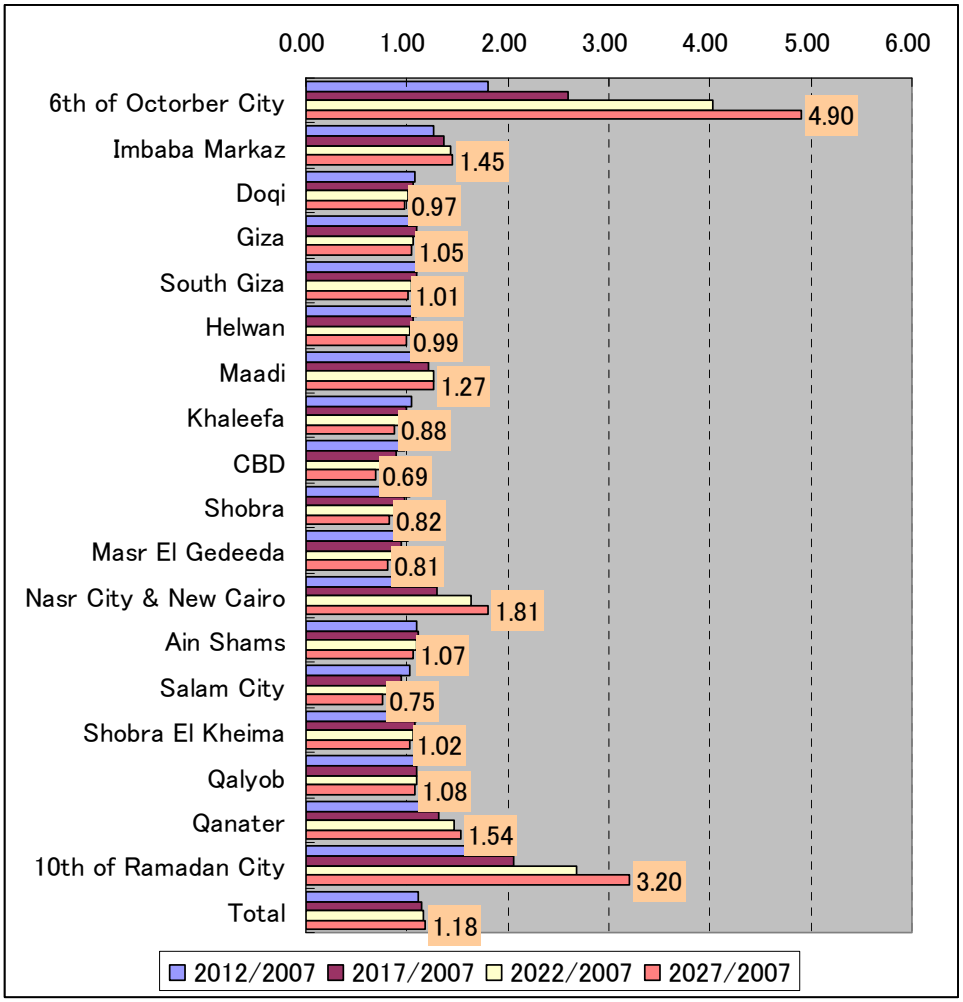
In 2027, the Nasr City and New Cairo Sector show the biggest number of generated trips with over1.8 million. This is followed by Imbaba Markaz, Giza and Qanatar with over 1.7, 1.6 and 1.5 million trips, respectively.

Table 3.5.3 Public Transport Daily Trip Generation

Sector Zone name	2007	2012	2017	2022	2027	Growth Ratio 2027/2007
6th of October NUC	216,409	390,614	560,358	868,892	1,059,497	4.90
Imbaba Markaz	1,224,960	1,540,847	1,680,565	1,755,701	1,772,260	1.45
Doqi	1,113,289	1,197,862	1,175,722	1,121,626	1,077,006	0.97
Giza	1,538,098	1,694,914	1,684,672	1,642,330	1,617,088	1.05
South Giza	377,277	416,811	415,157	395,258	381,680	1.01
Helwan	675,426	741,484	718,017	686,875	668,821	0.99
Maadi	767,843	887,596	936,307	963,995	975,325	1.27
Khaleefa	703,441	732,048	705,051	658,327	619,705	0.88
CBD	583,372	573,342	522,053	454,552	404,122	0.69
Shobra	807,168	832,971	789,732	720,484	664,455	0.82
Masr El Gedeeda	1,263,771	1,274,377	1,183,954	1,104,493	1,022,950	0.81
Nasr City and New Cairo	997,651	1,172,625	1,286,118	1,623,031	1,801,254	1.81
Ain Shams	798,533	879,825	894,459	881,605	856,000	1.07
Salam City	628,054	645,219	593,245	523,024	468,512	0.75
Shobra El Kheima	858,262	932,533	926,293	909,425	875,359	1.02
Qalyob	699,653	766,281	771,089	772,340	754,438	1.08
Qanater	999,283	1,209,728	1,308,409	1,458,439	1,539,546	1.54
10th of Ramadan NUC	122,841	198,592	251,867	328,684	393,140	3.20
Total	14,375,331	16,087,669	16,403,068	16,869,081	16,951,158	1.18

Source: JICA Study Team

Note: For the methodology of trip generation estimation, please refer to Section 4.3 and 4.4 in the Main Report (Volume 1).



Source: JICA Study Team

Figure 3.5.4 Growth Rate (%) of Public Transport Daily Trip Generation

(3) Public transportation trip OD of 6th of October, Giza and surrounding sectors

Table 3.5.4 shows public transport origin-destination (OD) tables for 2007, 2012, 2017, and 2027. The key findings are summarized below:

1) **2007 traffic pattern**: Around 40% of the generated trips from 6th of October sector are intra-sector trips. As for the connection to other sectors, "going to Giza" trips show the highest ratio, which is around 16%. Applying the Maadi-Helwan Metro use ratio of 40% for estimating rapid mass transit passengers, the current daily demand for the busway becomes 86,000 (= 216,000 x 0.4) trips/day.

   Giza intra-sector trips account for 54% of total trips. Assuming the same percentage of 40% for rapid mass transit, 615,000 trips/day are expected for rapid mass transit passengers. Considering that the current Metro Line 2 transports 720,000 passengers/day, the 615,000 trips/day in Giza might be of a sufficient scale to justify the planned Metro Line.

2) **2012 traffic pattern**: Intra-sector trips for 6th of October sector will increase to around 50% and this is understandable when the image of this sector becomes more mature and it becomes a sustainable city. Including the intra-sector trips, the total trips are predicted to total 390,000 passengers/day. Assuming a 14% of peak hour rate and a 40% rapid mass transit preference rate, the peak hour demand will become 22,000 persons/hour. This is considerably higher than the transport capacity of busway (one lane per direction).

   The Giza trip generation pattern will not change significantly because it is considered that Giza sector is already matured and big changes are not expected.

3) **2017-2027 traffic pattern**: 6th of October intra-sector trip rates will increase continuously to 53% in 2017 and up to 63% by 2027. This corresponds to 298,000 trips/day in 2017 and 667,000 trips/day in 2027. Converting these figures to an average yearly increment, between 2012 and 2017, the increment will be 22,600 trips/day per year, and between 2017 and 2027 it will be 36,900 trips/day per year. This increased volume shows that intra-city transport services in 6th of October NUC cannot be overlooked in the West Development Corridor transport system design.

   The mass transit transport demand from 6th of October sector zone will be 224,000 trips/day or 33,600 trips/peak hour in 2017, and 423,600 trips/day or 63,540 trips/peak hour. These increases are significant, but the trip increase is influenced by various factors. Therefore, the actual increase of trips must be monitored carefully so as to provide or maintain the appropriate capacity that meets the required service level.

   Demand from Giza sector will be stable during the planning period, reflecting Giza's mature city profile, as indicated above. Figure 3.5.4 shows that the growth of trip generation in Giza between 2007 and 2017 is 1.05%, compared to 6th of October sector which is 4.90%.

   Overall, the average growth rate of the entire study area will be 1.18% between 2007 and 2027.

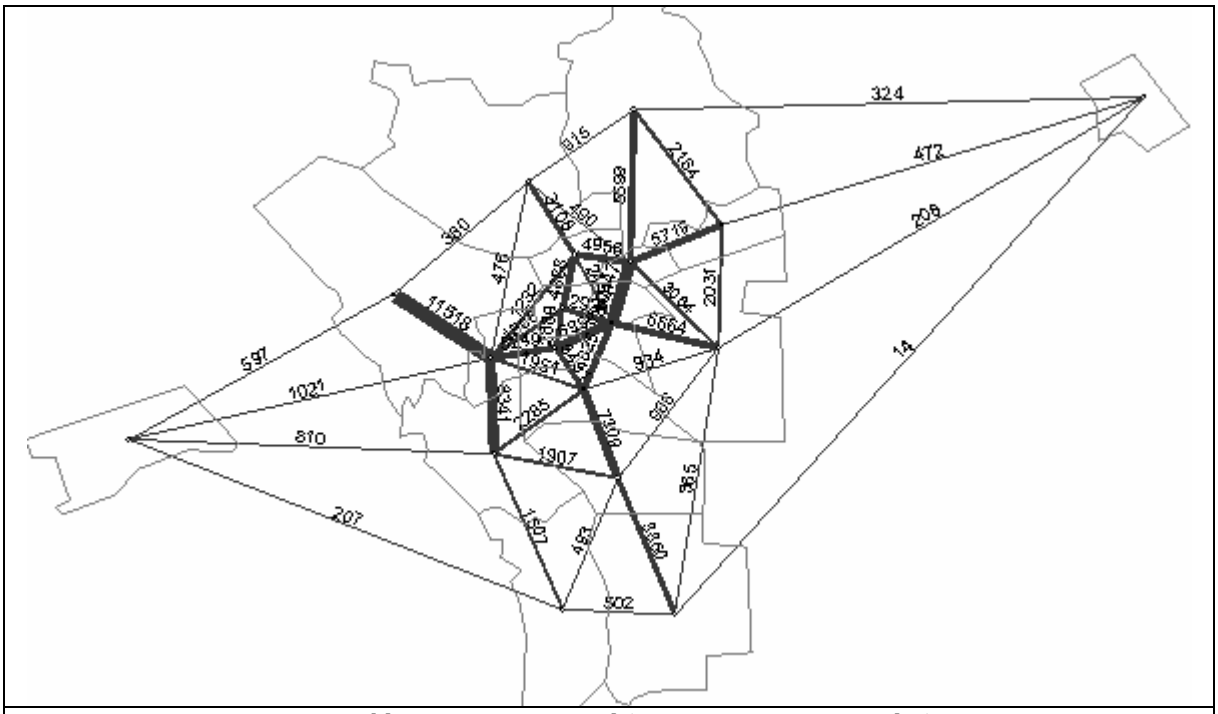
Table 3.5.4 Public Transport Trip OD by Related Sector Zone

Unit: 1,000 trips

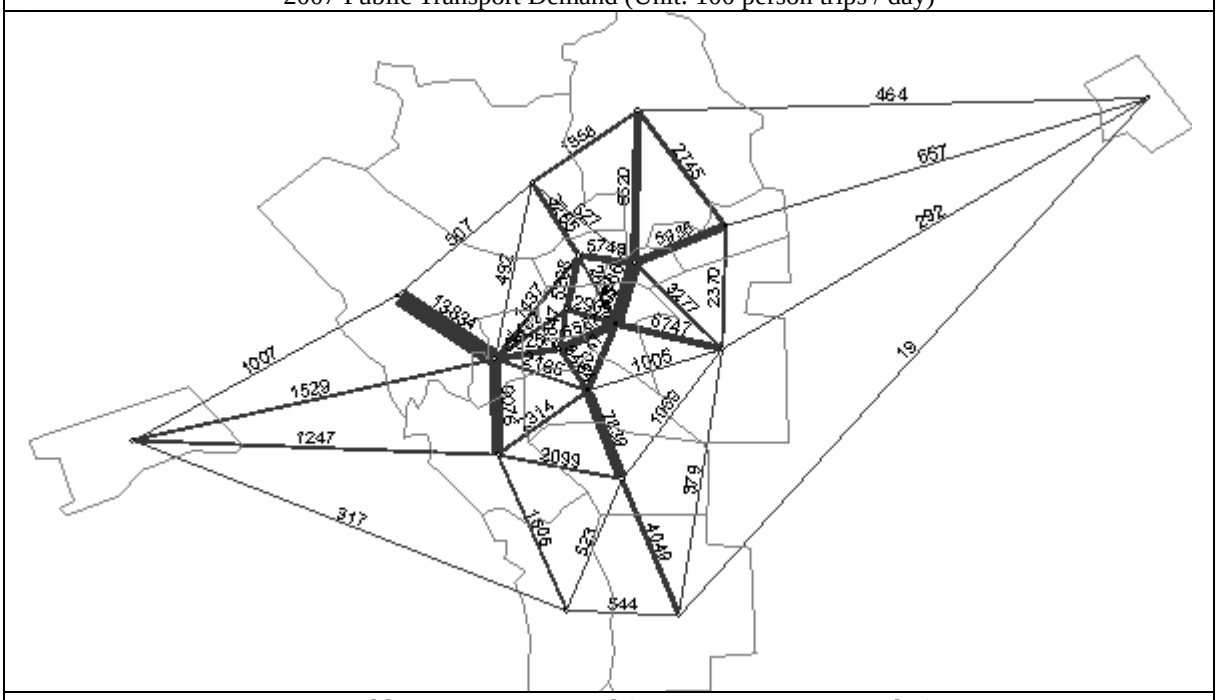
2007	6th Oct.	Imbaba	Doqi	Giza	S. Giza	CBD	Others	Total
6th Oct	84	21	19	34	8	3	44	216
Imbaba	21	617	282	132	2	37	130	1,224
Doqi	17	261	383	197	5	45	201	1,113
Giza	35	138	196	824	66	36	240	1,538
S. Giza	8	3	4	67	246	3	44	377
CBD	3	38	44	34	3	61	396	583
Others	45	144	181	247	45	395	8,261	9,321
Total	216	1,225	1,113	1,538	377	583	9,321	14,375
2012	6th Oct.	Imbaba	Doqi	Giza	S. Giza	CBD	Others	Total
6th Oct	185	37	29	51	12	4	69	390
Imbaba	37	799	344	158	4	41	155	1,540
Doqi	26	321	390	207	5	42	203	1,197
Giza	53	165	205	916	69	35	248	1,694
S. Giza	12	4	4	71	274	2	46	416
CBD	4	42	41	33	3	58	389	573
Others	70	170	181	254	47	388	9,158	10,273
Total	390	1,541	1,198	1,695	416	573	10,272	16,087
2017	6th Oct.	Imbaba	Doqi	Giza	S. Giza	CBD	Others	Total
6th Oct	298	51	36	64	15	4	89	560
Imbaba	52	896	358	164	4	40	162	1,680
Doqi	32	337	371	200	4	37	190	1,175
Giza	65	172	198	916	66	31	233	1,684
S. Giza	15	4	4	68	274	2	45	415
CBD	4	41	36	30	2	51	355	522
Others	89	175	167	238	46	352	9,286	10,356
Total	559	1,679	1,173	1,684	414	520	10,363	16,395
2027	6th Oct.	Imbaba	Doqi	Giza	S. Giza	CBD	Others	Total
6th Oct	667	84	51	94	21	6	133	1,059
Imbaba	85	970	349	165	4	33	163	1,772
Doqi	46	329	321	181	3	27	165	1,077
Giza	95	171	180	881	57	23	207	1,617
S. Giza	21	4	3	60	250	1	39	381
CBD	6	34	26	22	1	37	274	404
Others	134	174	141	210	40	272	9,655	10,629
Total	1,057	1,769	1,074	1,615	380	402	10,639	16,940

Note: To simplify the data, some sector zones are aggregated in Table 3.5.4
Source: JICA Study Team

Figure 3.5.5 shows the total public transport demand for the entire GCR in 2007, 2012, 2017 and 2027. These data are presented in two parts: Part 1 (2007 and 2012) and Part 2 (2017 and 2027).



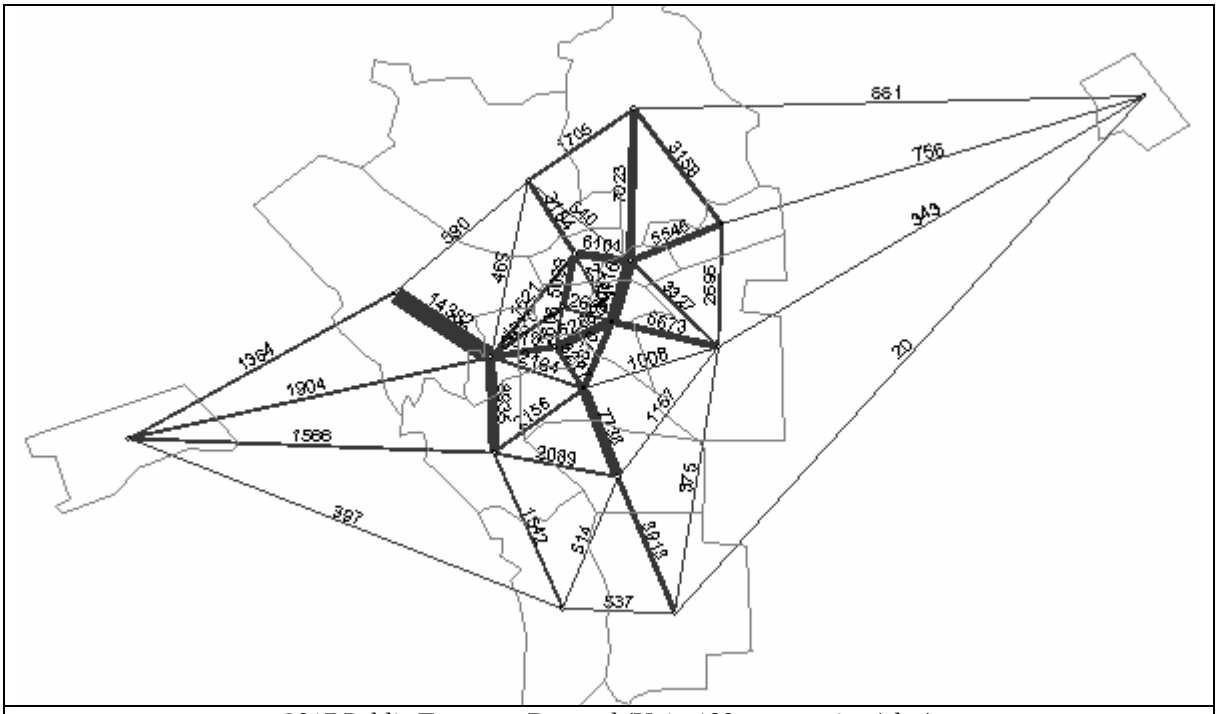
2007 Public Transport Demand (Unit: 100 person trips / day)



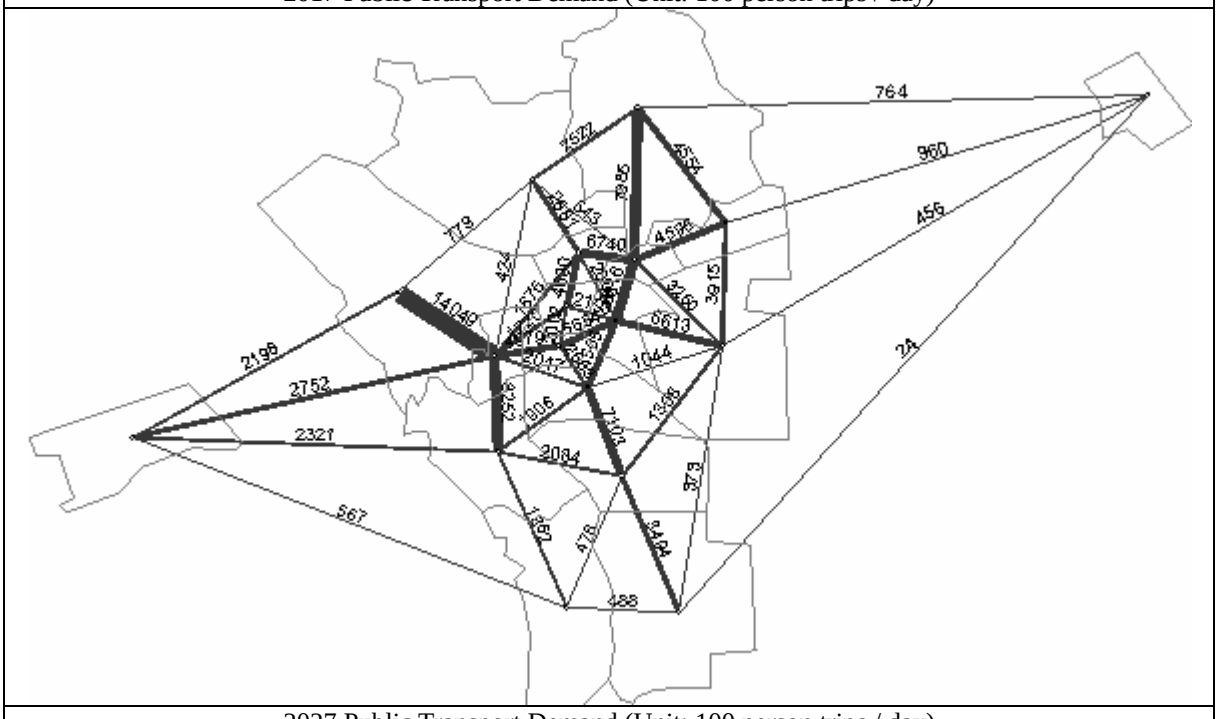
2012 Public Transport Demand (Unit: 100 person trips / day)

Source: JICA Study Team

Figure 3.5.5 Part 1 - Public Transport Demand by Spider Network Assignment for 2007 and 2012



2017 Public Transport Demand (Unit: 100 person trips / day)



2027 Public Transport Demand (Unit: 100 person trips / day)

Source: JICA Study Team

Figure 3.5.5 Part 2 - Public Transport Demand by Spider Network Assignment for 2017 and 2027

(4) Metro peak hour and peak ratio

The peak hour and peak ratio seen in the Metro operation was analyzed using CREATS HIS data as follows. Departure time distributions are listed in Table 3.5.5 and shown as hourly histograms in Figure 3.5.6. Arrival time distributions are listed in Table 3.5.6 and shown as hourly histograms in Figure 3.5.7.

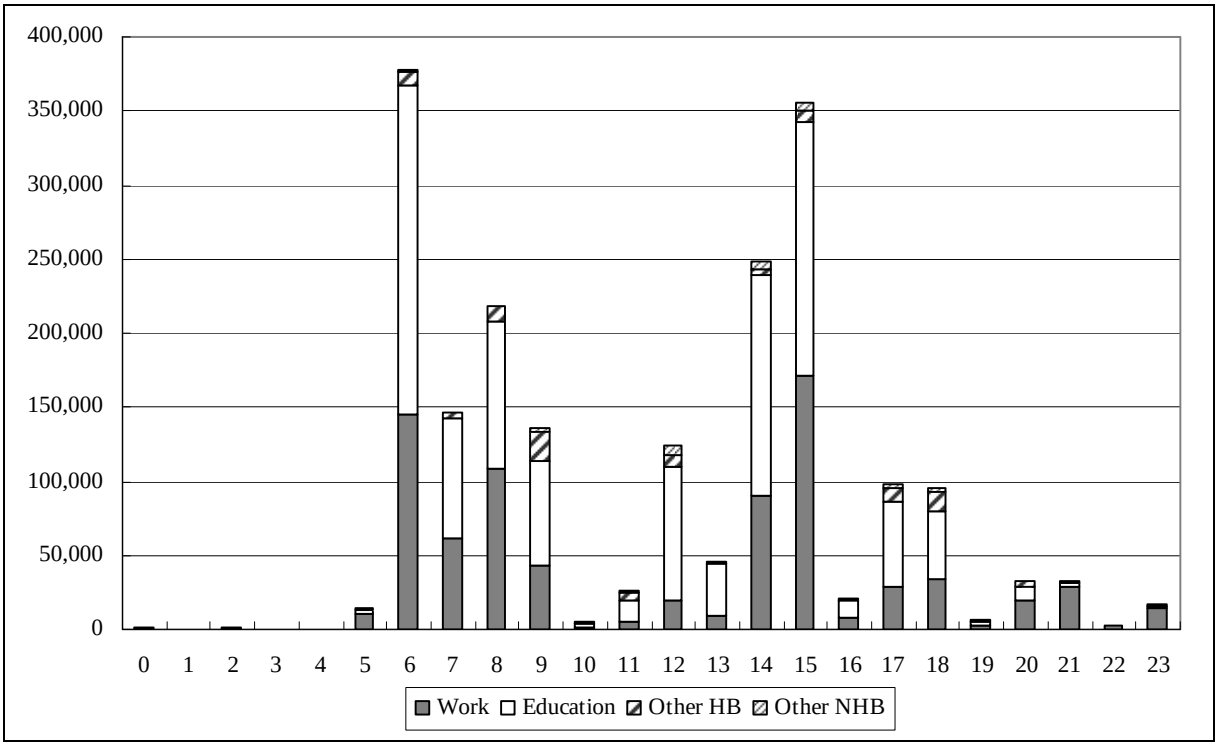
Analysis of these tables and figures shows the following:

- Morning peak: On a boarding time basis, the highest traffic volume was seen between 6:00-8:00 and the daily traffic volume ratio was 13.1%. On an alighting time basis, the highest traffic volume was seen between 7:00-9:00 and the daily traffic volume ratio was 13.7%.
- Afternoon peak: On a boarding time basis, the highest traffic volume was seen between 14:00-16:00 and the daily traffic volume ratio was 15.1%. On an alighting time basis, the highest traffic volume was also seen between 14:00-16:00 and the daily traffic volume ratio was 11.3%.
- Considering that the morning is much critical for passengers not to miss their train, the alighting base is much more stable because although the loading station is different, the alighting station is the common destination. Based on the data shown in Table 3.5.6 for the period between 15:00 and 16:00,14% is adopted as the peak hour ratio.
- On a boarding time basis, 95% of total demand, corresponding to 1,905,000 passengers, was dispersed between 06:00 through 19:00. Of these passengers, 53% (1,066,000) were students and 40% of the demand (807,000 passengers) used the Metro for going to work/school or coming home from work/school.
- On an alighting time basis, 96% of total demand, corresponding to 1,296,581 passengers, was dispersed between 6:00 through 21:00. Of these trips, 39% (742,844) were for work trips and 55% (1,055,737) were for school trip.
- The total number of passengers was 2,006,267 per day. According to Cairo Metro Organization (CMO) data, the average number of passengers per day in 2005/2006 was 1,947,000. Based on this supporting evidence, the above analysis, which was done using CREATS HIS data, is considered to be reliable.

Table 3.5.5 Hourly Peak Hour and Peak Ratio of the Metro (Boarding Time Base)

Departure Time	Trip Purpose					Share (%)
	Work	Education	Other HB	Other NHB	Total	
0	1,018	67	0	0	1,085	0.1
1	25	0	0	0	25	0.0
2	604	689	0	0	1,293	0.1
3	332	199	80	0	611	0.0
4	309	0	0	0	309	0.0
5	10,738	2,882	463	0	14,083	0.7
6	144,580	223,155	8,090	1,598	377,423	18.8
7	61,998	80,328	4,367	0	146,693	7.3
8	108,103	100,034	9,563	0	217,700	10.9
9	43,202	70,229	20,107	1,999	135,537	6.8
10	1,077	2,763	1,489	117	5,445	0.3
11	5,597	14,191	4,416	1,559	25,762	1.3
12	19,776	89,421	8,412	7,207	124,815	6.2
13	9,789	34,306	930	973	45,999	2.3
14	89,693	149,559	3,804	5,683	248,739	12.4
15	170,843	171,419	7,626	5,972	355,860	17.7
16	8,085	10,993	1,362	0	20,440	1.0
17	28,858	56,811	9,272	3,275	98,216	4.9
18	34,538	44,642	13,824	1,860	94,864	4.7
19	2,768	2,809	801	0	6,378	0.3
20	20,118	8,208	4,199	763	33,288	1.7
21	28,750	2,152	1,639	263	32,805	1.6
22	2,024	0	348	0	2,372	0.1
23	14,377	1,660	489	0	16,525	0.8
Total	807,202	1,066,517	101,281	31,269	2,006,267	100.0
	40.2%	53.2%	5.0%	1.6%	100.0%	

Data Source: CREATS HIS (2002) as analyzed by the JICA Study Team
Note: HB = Home Based, NHB = Non-home Based



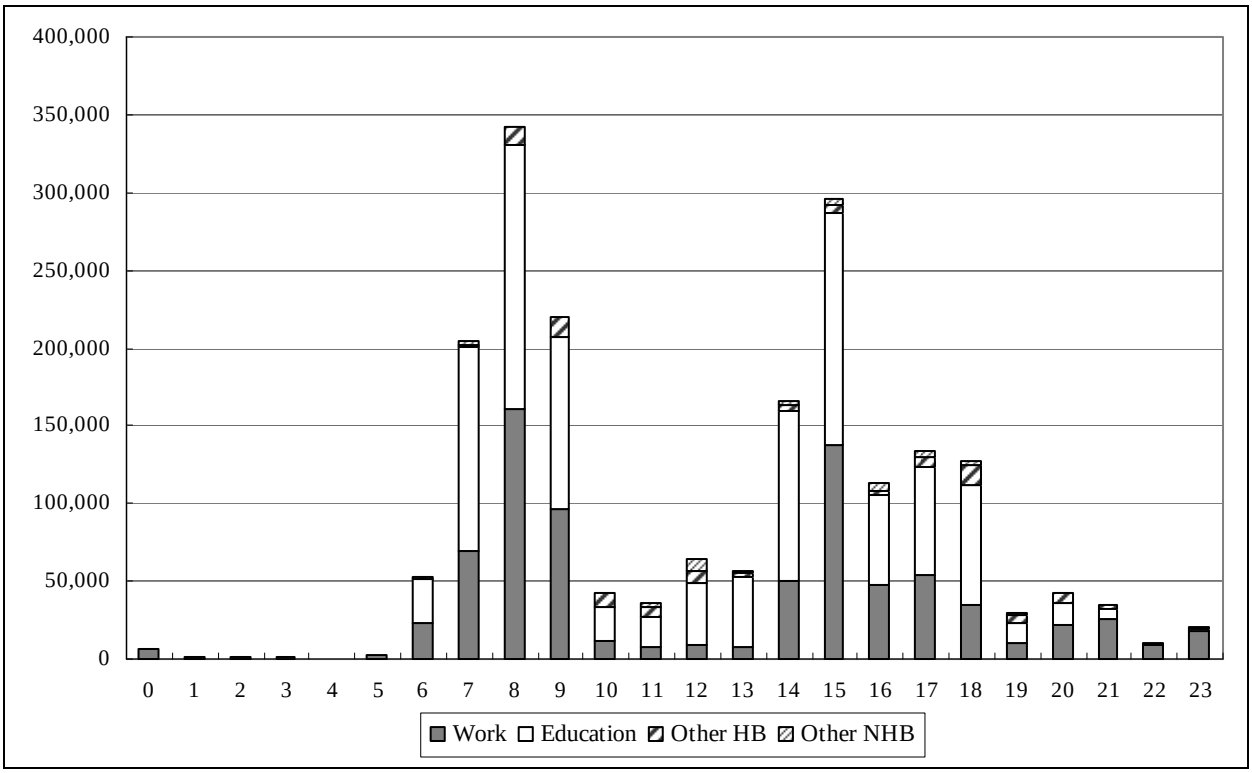
Data Source: CREATS HIS (2002) as analyzed by the JICA Study Team

Figure 3.5.6 Hourly Distribution of Metro Passenger (Boarding Time Base)

Table 3.5.6 Hourly Peak Hour and Peak Ratio of the Metro (Alighting Time Base)

Arrival Time	Trip Purpose					Share (%)
	Work	Education	Other HB	Other NHB	Total	
0	6,255	67	182	0	6,504	0.3
1	1,641	0	69	0	1,710	0.1
2	666	638	0	0	1,304	0.1
3	553	213	0	0	766	0.0
4	134	0	16	0	150	0.0
5	2,725	190	180	0	3,095	0.2
6	23,058	28,645	1,067	0	52,771	2.6
7	69,664	130,340	2,408	1,598	204,009	10.2
8	160,651	170,260	11,624	0	342,536	17.1
9	95,963	111,477	13,018	0	220,458	11.0
10	11,202	22,768	8,291	657	42,917	2.1
11	8,135	18,831	6,895	2,569	36,430	1.8
12	9,174	39,815	7,616	7,361	63,966	3.2
13	7,973	44,958	2,889	517	56,337	2.8
14	50,465	108,637	3,656	3,538	166,297	8.3
15	137,926	148,382	5,566	3,367	295,242	14.7
16	48,172	57,213	3,288	4,281	112,953	5.6
17	53,663	70,255	6,545	2,838	133,301	6.6
18	34,893	76,366	13,449	2,824	127,532	6.4
19	10,265	13,116	5,265	497	29,143	1.5
20	21,641	14,674	5,971	405	42,691	2.1
21	25,946	6,810	1,691	701	35,148	1.8
22	8,991	776	818	0	10,585	0.5
23	17,445	2,087	774	117	20,422	1.0
Total	807,200	1,066,517	101,280	31,268	2,006,266	100.0
	40.2%	53.2%	5.0%	1.6%	100.0%	

Data Source: CREATS HIS (2002) as analyzed by the JICA Study Team
Note: HB = Home Based, NHB = Non-home Based



Data Source: CREATS HIS (2002) as analyzed by the JICA Study Team

Figure 3.5.7 Hourly Distribution of Metro Passenger (Alighting Time Base)

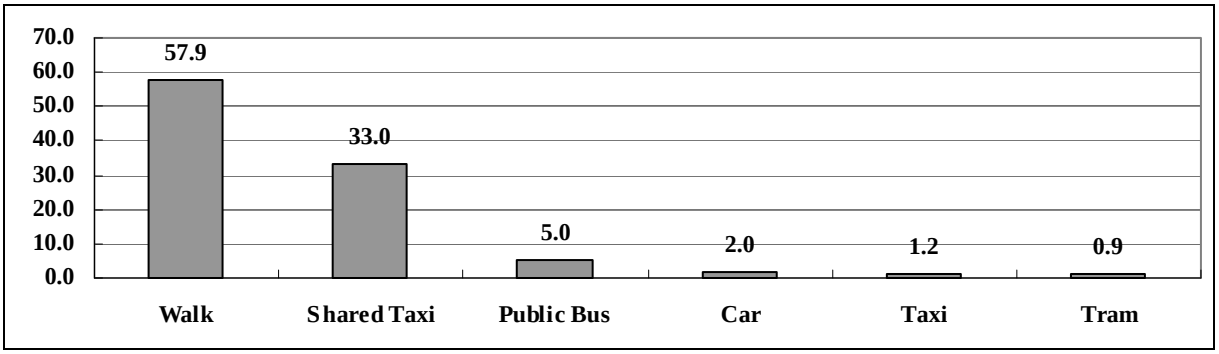
(5) Access and egress travel mode to metro stations

Concerning access and egress transportation from/to metro stations, walking shows the highest percentage of 58%, and shared taxi follows with 33%, as shown in Table 3.5.7 and Figure 3.5.8. These two modes account for more than 90% of access/egress transportation.

Table 3.5.7 Access and Egress Travel Mode to Metro Stations

Access Mode to Metro Station	Trip Purpose					Share (%)
	Work	Education	Other HB	Other NHB	Total	
Walk	610,825	835,649	66,708	27,354	1,540,536	57.9
Car	34,858	16,263	2,556	0	53,677	2.0
Taxi	19,007	9,959	3,042	480	32,489	1.2
Shared Taxi	349,384	472,637	46,571	8,524	877,116	33.0
Public Bus	69,690	55,623	7,349	1,140	133,801	5.0
Tram	9,134	13,133	746	0	23,013	0.9
Total	1,092,898	1,403,263	126,973	37,498	2,660,632	100.0

Data Source: CREATS HIS (2002) as analyzed by the JICA Study Team
Note: HB = Home Based, NHB = Non-home Based



Data Source: CREATS HIS (2002) as analyzed by the JICA Study Team

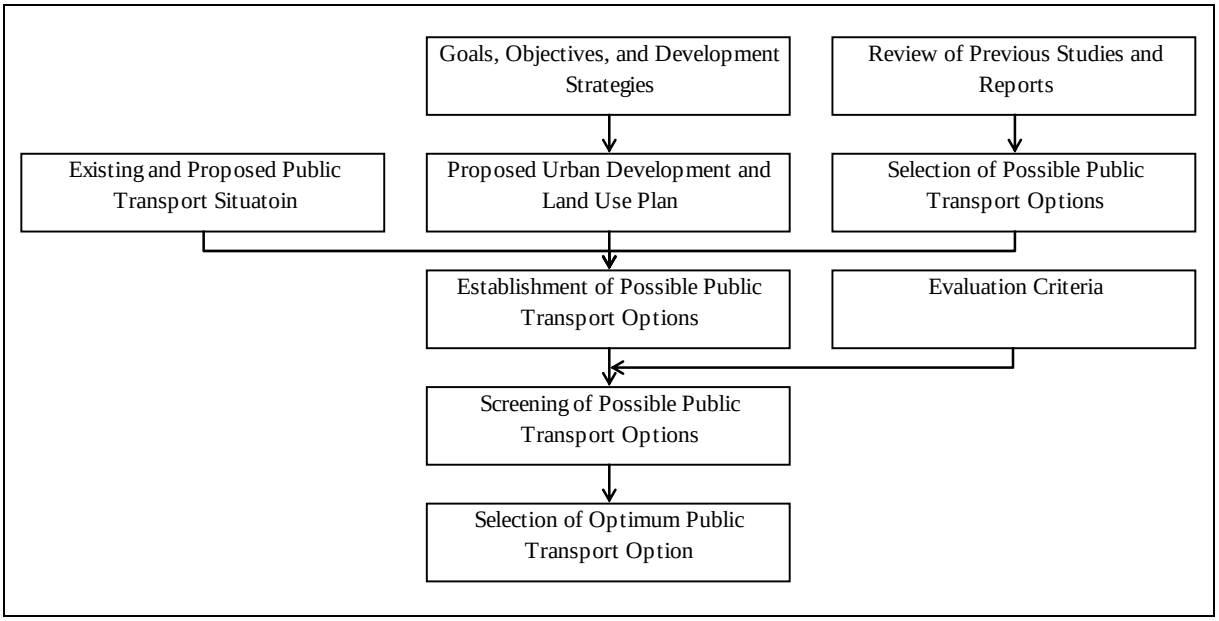
Figure 3.5.8 Access and Egress Travel Mode to Metro Stations

3.6 Railway and Busway Demand

3.6.1 Consideration of Routes and Modes

(1) General Background

The Master Plan study recommended the facilitation of the public transport linkage for the Western Development Corridor between Cairo – 6th of October NUC. As for this public transport corridor, various studies and reports regarding the introduction of a new public transport system have already examined various modes, origins and routes. Based on these previous studies and reports, existing and proposed public transport systems, and proposed urban development directions formulated by this Study, possible public transport options have been established allowing the optimum public transport option to be selected, as illustrated in Figure 3.6.1.



Source: JICA Study Team

Figure 3.6.1 Study Approach for Planning and Selection of Public Transport Options

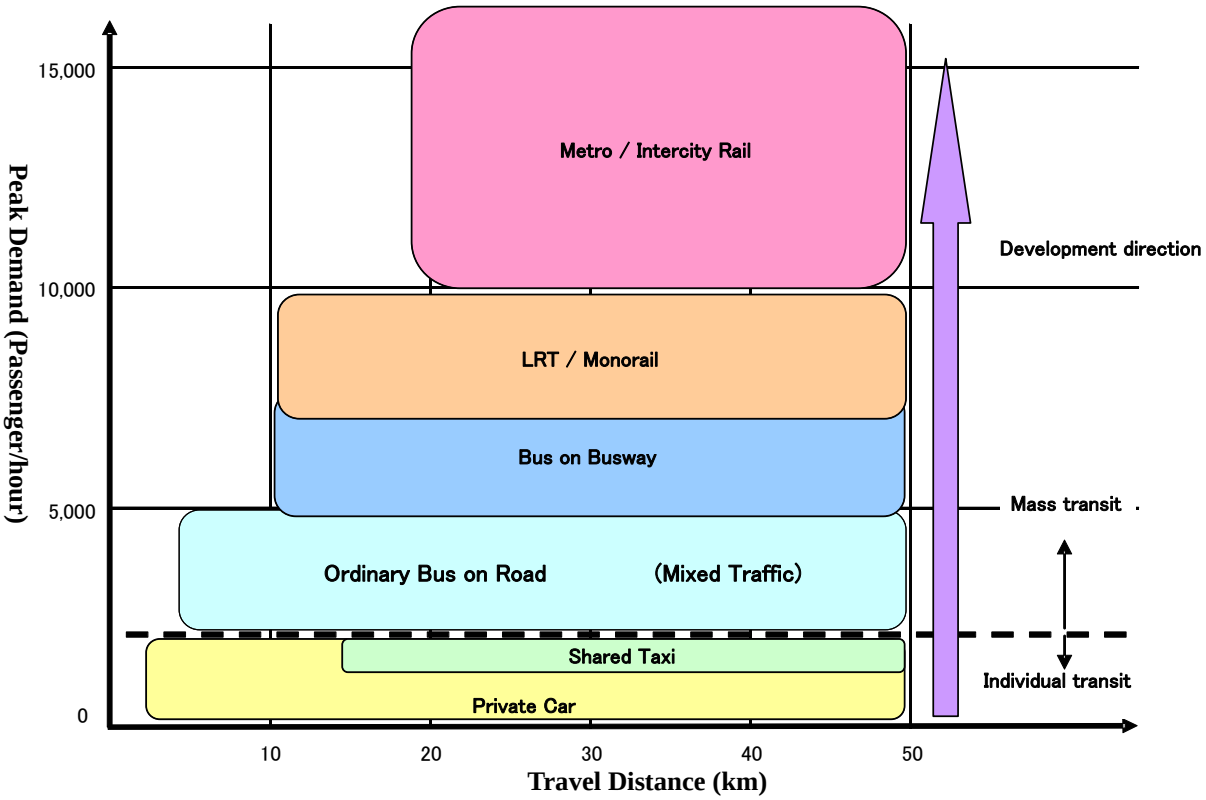
(2) Route and mode options

The transport capacity of applicable transport modes is summarized in Table 3.6.1. Figure 3.6.2 shows transport modes based on the relationship between traffic density and distance. Considering that the length of the corridor between Cairo and 6th of October NUC is about 30 km and the demand is estimated to reach 300,000 (daily) and 42,000 (peak hour), as determined through transport demand analysis for the planning period up to 2027, the urgent necessity for development of a public transport system has been limited to a mixed strategy of an exclusive busway and an intercity railway.

Table 3.6.1 Mode Capacity of the Cairo – 6th of October Transport Corridor

System		Capacity per Car (pax./car)	Congestion Rate (%)	Car/Set (Bus/Train)	Transport Capacity by Headway in Minutes (pax./way/hour)				
					1	3	5	10	15
Bus	Ordinary	60	100	1	3,600	1,200	720	360	240
	Large	100	100	1	6,000	2,000	1,200	600	400
	Bi-Articulated	270	100	1	16,200	5,400	3,240	1,620	1,080
LRT		75	120	4	18,000	6,000	3,600	1,800	1,200
Monorail		100	120	6	-	12,000	7,200	3,600	2,400
MRT		140	150	6	-	16,800	10,080	5,040	3,360
		140	150	8	-	22,400	13,440	6,720	4,480

Source: JICA Study Team



Source: JICA Study Team

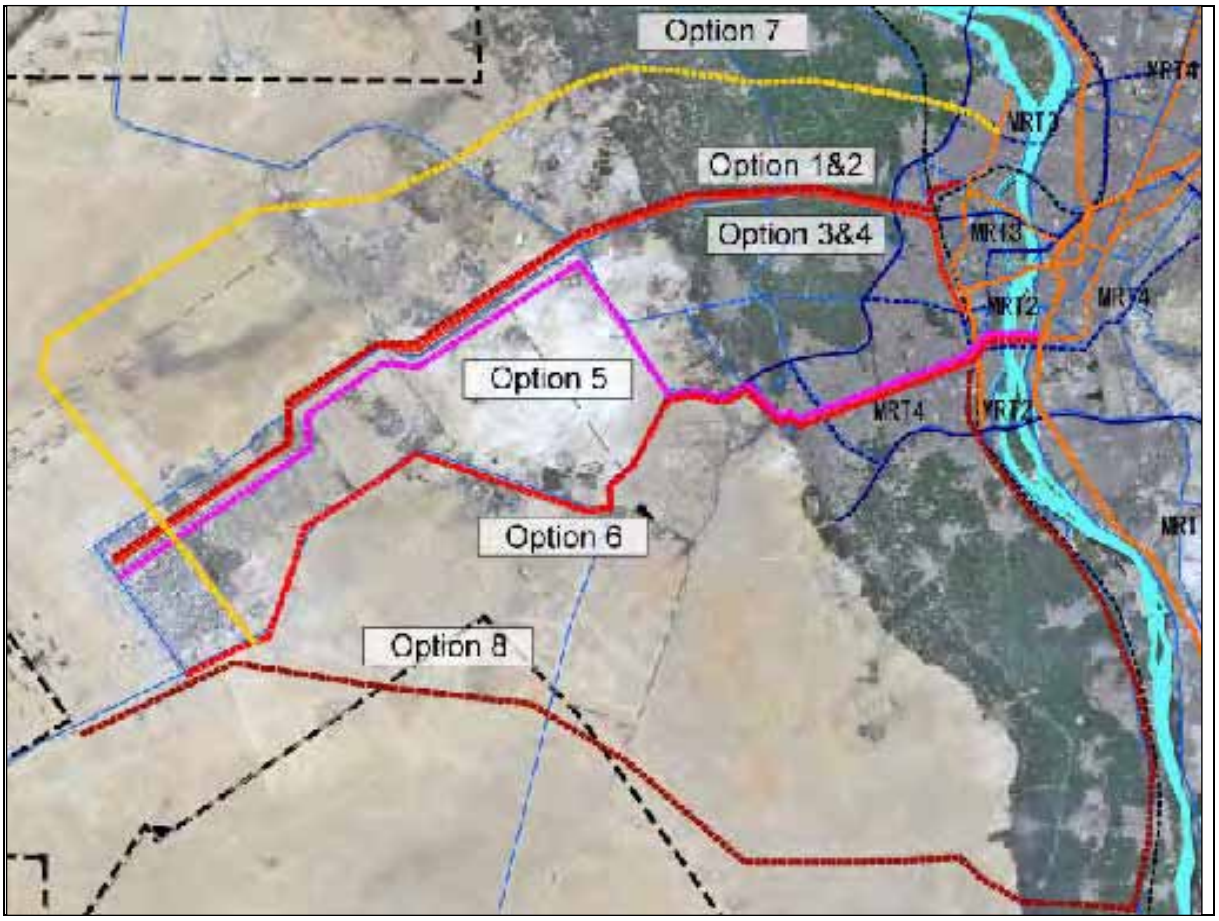
Figure 3.6.2 Transport Mode Selection by Traffic Demand and Travel Distance

Considering the nature of transport mode mix, possible options of a transport system were explored, as listed in Table 3.6.2 and illustrated in Figure 3.6.3. Brief explanations of each option are provided below.

Table 3.6.2 Possible Options for the Cairo – 6th of October Transport System

No.	Name of Option	Candidate Location of Origin	Corridor	Length (km)	Mode	Connection to MRT
1	Bus Plan	Imbaba	26th of July Road	35.9	Bus	Metro Line 3 Imbaba Station (proposed)
2	Railway Plan on the Same Track as Option 1	Imbaba	26th of July Road	35.9	Rail	Metro Line 3 Imbaba Station (proposed)
3	Bus Plan	Cairo University	Ext. of Sh. Abd. Hospital / 26th of July Road	40.73	Bus	Metro Line 1 Cairo University Station
4	Railway Plan on the Same Track as Option 3	Cairo University	Ext. of Sh. Abd. Hospital / 26th of July Road	40.73	Rail	Metro Line 1 Cairo University Station.
5	Extension of Metro 4 to 6th of October	Al-Ramayah	Alex. Desert Road / 26th of July Road	35.19	Rail	Metro Line 4 Al-Ramayah Square Station (proposed)
6	Extension of Metro 4 to 6th of October	Al-Ramayah	Al Wahat Road	32.31	Rail	Metro Line 4 Al-Ramayah Square Station (proposed)
7	Railway Plan on Extension Road of North Expressway	Al Farag	Ext. of Al Wahat	39.99	Rail	Metro Line 3 Al Aohv Station (proposed)
8	Utilization of Egypt Railway Plan	Giza Station	6th of October Railway Corridor	66.39	Rail	Metro Line 2 at Giza Station

Source: JICA Study Team based on the CREATS and McKinsey Study

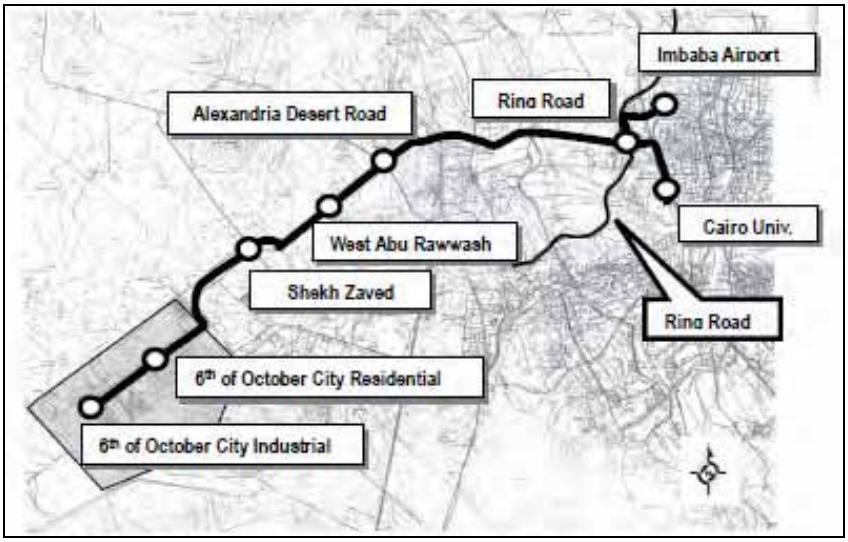


Source: JICA Study Team

Figure 3.6.3 Possible Options for the Cairo – 6th of October Transport System

1) Options 1 and 2: Busway and Railway Plans between Imbaba and 6th of October NUC

This route starts from Imbaba Urban Development Area, passes through 26th of July, enters the main road in 6th of October NUC and terminates at the industrial area of 6th of October NUC. This plan has two options: Option 1 is a busway and Option 2 is railway, as shown in Figure 3.6.4. Total length of these options is about 35 km.



Source: JICA Study Team

Figure 3.7.4 Route and Major Station Plan for Options 1 and 2

2) Options 3 and 4: Busway and Railway Plans between Cairo University and 6th of October NUC

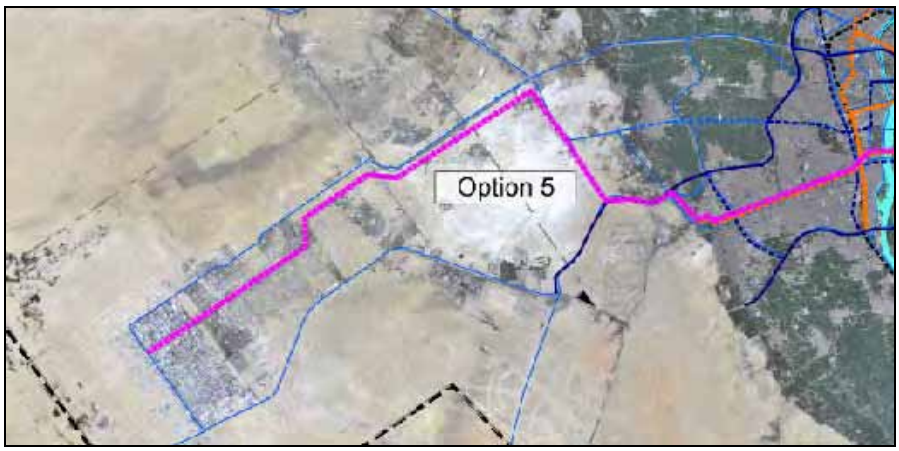
This route starts from Cairo University Metro Station, passes through the ENR track side and 26th of July, enters the main road in 6th of October NUC and terminates at the industrial area of 6th of October NUC. This plan also has two options: Option 3 is a busway and Option 4 is a railway, as shown in Figure 3.6.5. The total length of these options is about 40 km.

Source: JICA Study Team

Figure 3.6.5 Route of Options 3 and 4

3) Option 5: Railway Plan between Al-Ramayah Square and 6th of October via Alexandria Desert Road

This route starts from Giza Station, passes through Al-Ramayah Square, Alexandria Desert Road and 26th of July, enters the main road in 6th of October NUC and terminates at the industrial area of 6th of October NUC. This plan has a railway option only, as shown in Figure 3. 6.6. The total length of this option is about 35 km.

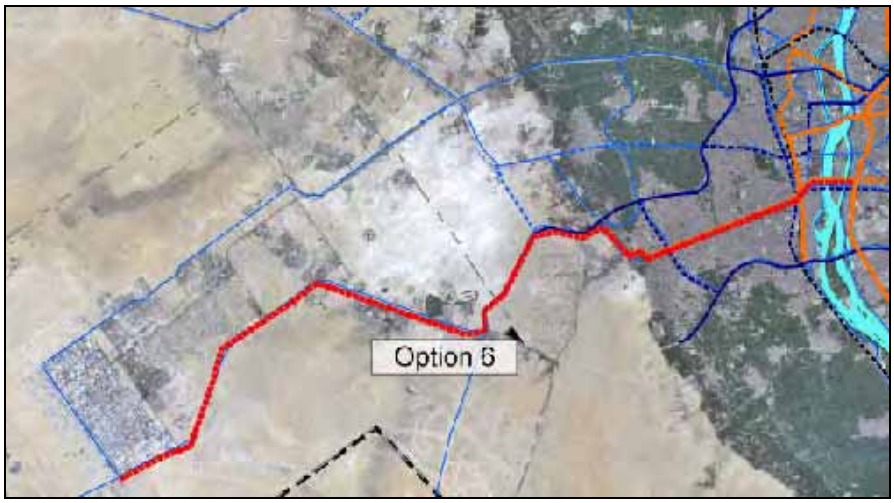


Source: JICA Study Team

Figure 3.6.6 Route of Option 5

4) Option 6: Railway Plan between Al-Ramayah Square and 6th of October via Al Wahat Road

This route starts from Giza Station, passes through Al-Ramayah Square Station, Al Fayoum Road and Al-Wahat Road, enters the main road in 6th of October City and terminates the industrial area of 6th of October. This plan has a railway option only, as shown in Figure 3.6.7. The total length of this option is about 32 km.

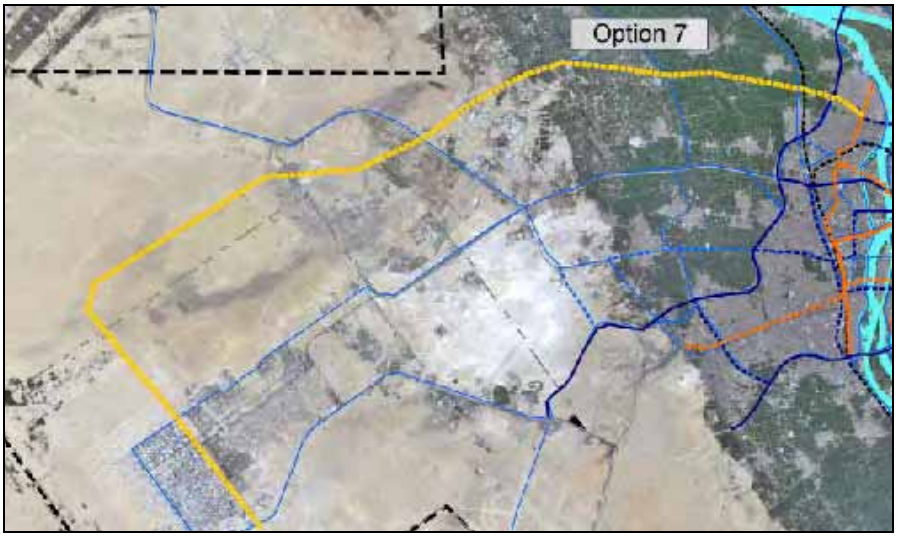


Source: JICA Study Team

Figure 3.6.7 Route of Option 6

5) Option 7: Al Farag Road Extension with Railway between Al Farag Station and 6th of October NUC via Extension of Al Wahat Road

This route starts from the proposed Al Farag Metro 3 Station, passes through extensions of Al Wahat Road, enters the main road in 6th of October NUC and terminates at the industrial area of 6th of October. This plan comprises a road with a possible new railway option, as shown in Figure 3.6.8. The total length of these options is about 39 km.

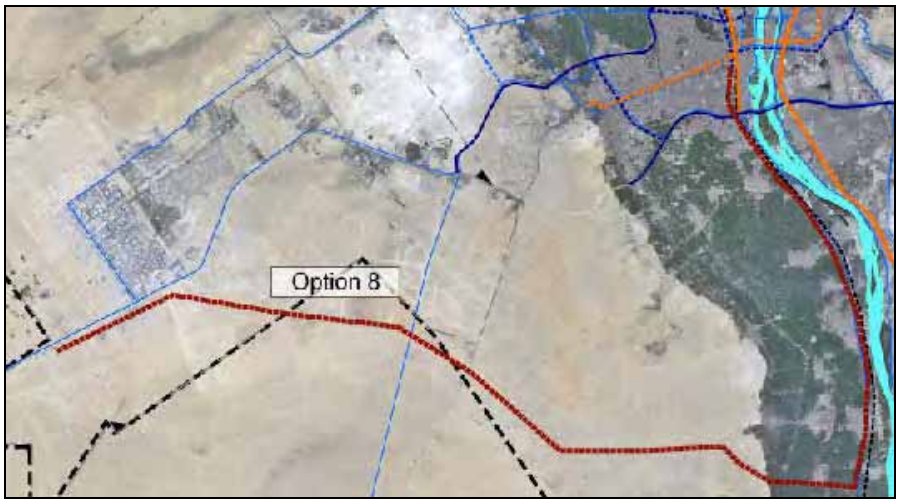


Source: JICA Study Team

Figure 3.6.8 Route of Option 7

6) Option 8: Utilization of Existing ENR Line Connecting Cairo City and 6th of October NUC

This route starts from Giza station on the southern line of the ENR track and terminates at 6th of October Station. This plan fully utilizes the existing ENR Line, as shown in Figure 3.6.9. The total length of this option is about 66 km.



Source: JICA Study Team

Figure 3.6.9 Route of Option 8

(3) Comparative analysis

1) Evaluation Factors Considered in the Overall Assessment

The following evaluation factors were taken into account:

- *General*: Location of the origin and destination, length, mode of transport, and connection to Metro stations.
- *Traffic functionality*: Total passengers and peak hour passengers
- *Urban Development and Land Use*: Preference from the viewpoint of land use and conformity to urban development directions.
- *Engineering Aspects*: Engineering profile and rough cost estimates.
- *Socio-Environmental Aspects*: Necessity for land acquisition, number of families/persons affected by the project, and the natural environment.
- *Economic Aspects*: The integrated index of project cost and number of passengers.

2) Results of the Comparative Analysis

In Table 3.6.3 shows a summary comparison of options to give an overview of the route and mode selection, based on the evaluation factors mentioned above.

3) Evaluation

The most important factors are the possibility of an early start to accommodate the urgent transport needs of the region and coordination of the corridor development policy.

From the early start point of view, Option 3 and Option 8 are favorable. Comparing these two alternatives, both have a relatively low cost feature. Option 8 shows a low investment cost, due to the utilization of existing facilities. However, the route of Option 8 takes a detour to Cairo, so that demand for Option 8 is small. On the contrary, Option 3 has enough demand because this option connects 6th of October and Cairo/Giza CBD through 26th of July Road. As for the cost effectiveness, Option 8 is less cost effective than Option 3. In addition to this, Option 8 appears to be difficult to install because the installation will need coordination with the ENR operation.

One of the determinant factors is that MOHUUD and MOT favored the installation of a busway through 26th of July Road as a short term measures for relieving congestion on 26th of July Road, which is basically similar to the Option 3.

For the viewpoint of integrated urban/transport development, Option 5 is superior to the other options. Considering only the development aid to 6th of October and Sheikh Zaide NUC, Option 2 and Option 4 have appeal. However, 26th of July Road would have already been devoted to Option 3, so that Option 2 or Option 4 can not be selected. Option 7 and Option 8 attract small demand. Option 6 might be the only rival plan to Option 5 when 6th of October City develops southward. However, for the time being, Option 5 is the most preferable option, considering the development pattern of 6th of October NUC.

In conclusion, a transport mode mix of Option 5 (long term, major transport mode) and Option 3 (urgent, auxiliary transport mode with a long term perspective) is recommended.

Table 3.6.3 Comparative Analysis of Route and Mode Plans

		1 Busway Plan on 26th of July Road	2 Railway Plan on 26th of July Road	3 Busway Plan along ENR Track and 26th of July Road	4 Railway Plan along ENR Track and 26th of July Road
Outline of the Option	Location of Origin	Inbaba urban development area		Cairo University	
	Location of Destination	Industrial area of 6th of October		Industrial area of 6th of October	
	Route / Mode Plan	・ This route starts from Inbaba Urban Development Area, passes through 26th of July, enter to main road in 6th of October City and terminates the industrial area of 6th of October. ・ Mode plan is utilized as articulated buses.	・ This route plan is the same as the option 1 ・ Mode plan is metro or inter-city type rail	・ This route starts from Cairo University Metro Station, passes through along ENR and 26th of July, enter to main road in 6th of October City and terminates the industrial area of 6th of October. ・ Mode plan is utilized as articulated buses	・ This route plan is the same as the option 3 ・ Mode plan is metro or inter-city type rail
	Length of Route (km)	35.0 km		35.6 km	
	Transport Mode	Large Bus	Metro / Inter-city rail	Large Bus	Metro / Inter-city rail
	Connection of Station in Metro	Proposed Imbaba Station on Metro Line No. 3		Cairo University Station on Metro Line No. 2	
Traffic Functionality	Traffic Demand Forecast (Passengers/day)	2027 Daily Traffic 234,000 Peak Hour / Direction 17,000	2027 Daily Traffic 736,000 Peak Hour / Direction 28,800	2027 Daily Traffic 230,000 Peak Hour / Direction 16,900	2027 Daily Traffic 784,000 Peak Hour / Direction 29,600
Urban Development and Land Use	Land Use	・This route passes through risticted agricultural area (about 10.6 km) up to Alex Desert Road so as not to achieve continuous urban development.		・This route passes through risticted agricultural area (about 13.8 km) up to Alex Desert Road so as not to achieve continuous urban development.	
	Conformity to Urban Development Direction	・Our proposed urban development direction is to GEM project and tourism project along Alex Desert Road. However, this option is not served to the proposed urban development projects.		・Our proposed urban development direction is to GEM project and tourism project along Alex Desert Road. However, this option is not served to the proposed urban development projects.	
Engineering Aspect	Engineering Profile	・Construction of at-grade Busway within ROW of 26th of July Road, 22.3 km. ・Construction of at grade in 6th of October NUC, 7.7 km. ・Construction of grade separated busway between Inbaba and 26th of July, 3.6 km.	・Construction of at-grade Railway within ROW of 26th of July Road, 22.3 km. ・Construction of grade separated railway in 6th of October City, 7.7 km. ・Construction of grade separated railway between Inbaba and 26th of July, 5.0 km.	・Construction of at-grade busway within ROW of 26th of July Road, 22.3 km. ・Construction of at grade busway in 6th of October NUC, 7.7 km. ・Construction of grade separating busway along existing ENR track to 26th of July Road, 5.6 km.	・Construction of grade-separeted railway after utilizing ENR, 3 km, to 26th of July Road, 2.6 km. ・Construction of at-grade railway within ROW of 26th of July Road, 22.3 km. ・Construction of grade separated railway in 6th of October NUC, 7.7 km.
	Rough Construction Cost (US$ Million) as of 2007 prices	Civil & Station 457 Rolling Stock & Others 90 Total 547	Civil & Station 387 Rolling Stock & Others 590 Total 977	Civil & Station 489 Rolling Stock & Others 90 Total 579	Civil & Station 369 Rolling Stock & Others 600 Total 969
Socio-Environmental Aspect	Land Acquisition and Persons affected by this Option	・Possibility to construct structure within ROW of 26th of July Road so as not to need to acquire additional lands and not to affect any families and persons		・Land acqisition may be necessary to construct both busway plan and a little families and persons are affected by this project	・Land acqisition is necessary to construct railway plan and many families and persons especially squatter families are affected by this project
	Natural Environment	・Little advarce impacts to natural environment		・Little advarce impacts to natural environment	・Reserved agriculture areas are affected
Economic Aspect	Investment cost per Passenger (US $ / Passenger)	2340	1330	2520	1240
Evaluation	Coordination to Urban Dev. Cor. Plan	△	△	△	△
	Early Start	○	×	◎	×
	Project Cost	○	○	○	○
	Cost Effective Measure	△	○	△	○
	Demand attracted	△	○	△	○
	Environment Conatraints	○	○	○	○

Source: JICA Study Team

Table 3.6.3 (Continued) Comparative Analysis of Route and Mode Plans

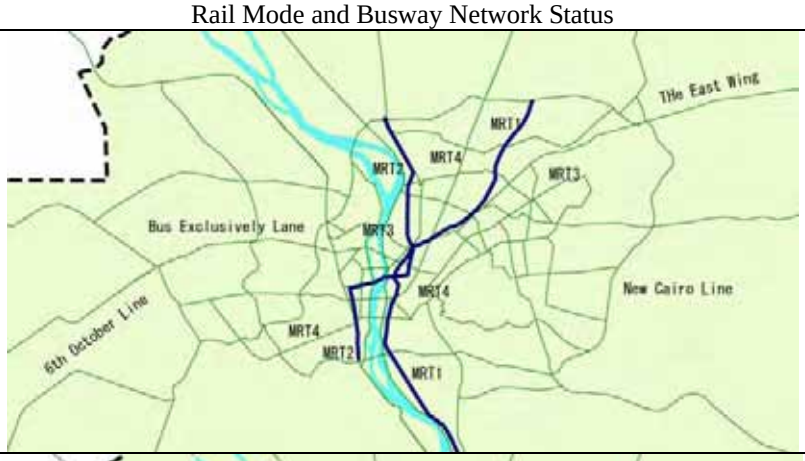
		5 Extension Plan of Metro 4 to 6th of October via Alex Desert Road and 26th of July Road	6 Extension Plan of Metro 4 to 6th of October via Al Fayoum Road and Al Wahat Road	7 Railway Plan on Extension of North Expressway	8 Utilization Plan of ENR 6th of October Line
Outline of the Option	Location of Origin	Giza Station on Metro Line No. 2	Giza Station on Metro Line No. 2	Rawd Al-Farag	Giza Station on ENR
	Location of Destination	Industrial area of 6th of October	Industrial area of 6th of October	Industrial area of 6th of October	Industrial area of 6th of October
	Route and Mode Plan	・ This route starts from Al-Ramayah Sq. Sta. passes through Alex Desert Road and 26th of October, enter to main road in 6th of October City and terminates the industrial area of 6th of October City. ・ Mode plan is metro or inter-city type rail	・ This route starts from Al-Ramayah Sq. Sta. passes through Al Fayoum Road and Al-Wahat Road, enter to main road in 6th of October City and terminates the industrial area of 6th of October. ・ Mode plan is metro or inter-city type rail	・ This route starts from Rawd Al-Farag proposed Metro 4 Station, passes through extension road of Ah. Al Wahat Road, enter to northern part of Al Sheikh Zayed and northern part of 6th of October and terminates the industrial area of 6th of October. ・ Mode plan is inter-city type rail (diesel) bout not	・ This route starts from Giza station of southern line of ENR and terminates station of 6th of October Line. This plan is to utilize full the existing ENR 6th of October Line ・ Mode plan is inter-city type rail (diesel) but not metro type
	Length of Route (km)	40.5 km	40.2 km	52.9 km	66.39 km
	Transport Mode	Metro / Inter-city rail	Metro / Inter-city rail	Intercity rail (Diesel)	Inter-city rail (Diesel)
	Connection of Station in Metro	Giza Station on Metro Line No. 2	Giza Station on Metro Line No. 2	Connection with ENR North Line	Giza Station on Metro Line No. 1
Traffic Functionality	Traffic Demand Forecast (Passengers/day)	2027 Daily Traffic 791,000 Peak Hour / Direction 30,900	2027 Daily Traffic 706,000 Peak Hour / Direction 28,800	2027 Daily Traffic 385,000 Peak Hour / Direction 16,000	2027 Daily Traffic 88,000 Peak Hour / Direction 3,400
Urban Development and Land Use	Land Use	・This route passes through Giza Pyramid area, proposed Great Egyptian Museum (GEM) project area and proposed tourism promotion area so as to achieve continuous urban development up to 6th of October.	・This route passes through Giza Pyramid area, and proposed Great Egyptian Museum (GEM) project area but does not pass through proposed tourism promotion area. However, this route plan is to achieve urban development projects along Al Fayoum Road and Al Wahat Road up to 6th of October.	・This route passes through restrict agricultural area between Ring Road and Alex Desert Road. (About16km) ・ After Alex Desert Road, this route serves Al Sheikh Zayed and 6th of October City development areas.	・ This route passes through desert area between Sakara and 6th of October City. ・ Any urban development is not planned along this route without 6th of October.
	Conformity to Urban Development Direction	・This route plan is fully supported proposed urban development direction by this study.	・ This route plan is partially supported proposed urban development direction by this study. ・ This route plan may not pass through south fringe of development areas of 6th October City.	・Our proposed urban development direction is to GEM project and tourism project along Alex Desert Road. However, this option does not serve to the proposed urban developments	・Our proposed urban development direction is to GEM project and tourism project along Alex Desert Road. However, this option does not serve to the proposed urban developments
Engineering Aspect	Engineering Profile Plan	・Underground and grade separated structure between Giza station and GEM Station, 7.5 km. ・Grade-separated structure in 6th of October NUC, 13.8 km. ・Structure in other section is at-grade level, 19.2 km.	・Underground structure between Giza station and GEM Station, 7.5 km ・Grade-separated structure in 6th of October NUC, 16.2 km. ・Structure in other section is at-grade level, 16.5 km.	・This option is characterized as road network development with supplementary facilitation of railway (Both passenger and freight traffic). ・Grade-separated structure between Rawad Al-Farag and Alex Desert Road, 18.2 km. ・ At grade structure between Alex Desert Road and 6th of October, 28.4 km. ・Grade-separated structure in 6th of October NUC.	・Principally follow the present at-grade level. ・Double tracking with electrification will be necessary.
	Rough Construction Cost (US$ Million) as of 2007 prices	Civil & Station 992 Rolling Stock & Others 613 Total 1,605	Civil & Station 1016 Rolling Stock & Others 590 Total 1606	Civil & Station 552 Rolling Stock & Others 453 Total 1004	Civil & Station 315 Rolling Stock & Others 317 Total 633
Socio-Environmental Aspect	Land Acquisition and Persons affected by this Option	・Some land acquisition is require near stations between Giza station and Al Ramayah Sq. but not much families and persons are affected by the Project	・In general, little land acquisition is required in this route.	・Due to new road contruction, a lot of land acquisition is required in this route. ・A few facilies and persons are affected by this	・No land acquisition is required
	Natural Environment	・A little adverse impacts to natural environment	・A little adverse impacts to natural environment	・A little adverse impacts to natural environment	・No adverse impacts to natural environment
Economic Aspect	Investment cost per Passenger (US $ / Passenger)	2,030	2,270	2,600	7190
Evaluation	Coordination to Urban Dev. Cor. Plan	◎	△	△	×
	Early Start	△	△	×	◎
	Project Cost	×	×	×	○
	Cost Effective Measure	△	△	△	×
	Demand attracted	○	○	△	×
	Emvironment Conatraints	○	○	○	○

Source: JICA Study Team

3.6.2 Consideration of Railway and Busway Demand

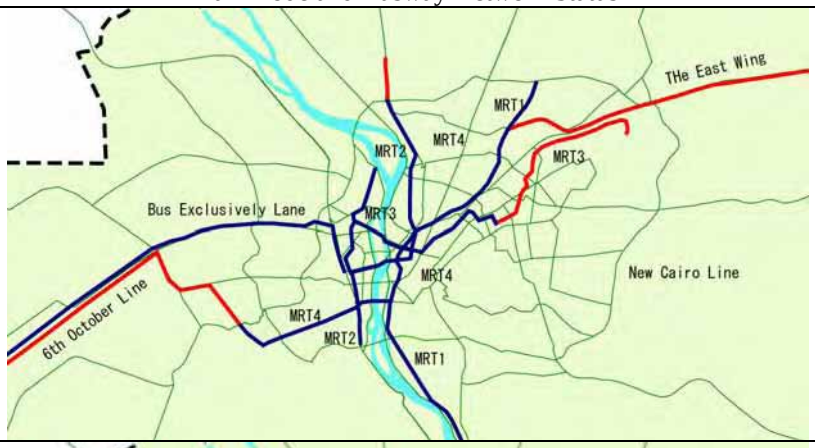
(1) Selected alignment of railway and busway (assumption)

Based on the comparative study summarized in the previous section, Option 5, comprising a railway (hereafter Metro 4 Section 1 up to Pyramids and 6th of October Line from Pyramids thereafter) and Option 3, comprising a busway (hereafter 26th July Busway) have been selected. Figure 3.6.10 shows the date that the operation of services is assumed to start.

Year	Rail Mode and Busway Network Status
2007 (Present Situation)	
2008-2012 Implemented Section: ・ Metro 3 Section 1 ・ 26th July Busway LEGEND New Implementing Existing and Already Constructed	
2013-2017 Implemented Section: ・Metro 3 Sections 2,3 ・Metro 4 Section 1 (up to Pyramids) LEGEND New Implementing Existing and Already Constructed	

Source: JICA Study Team

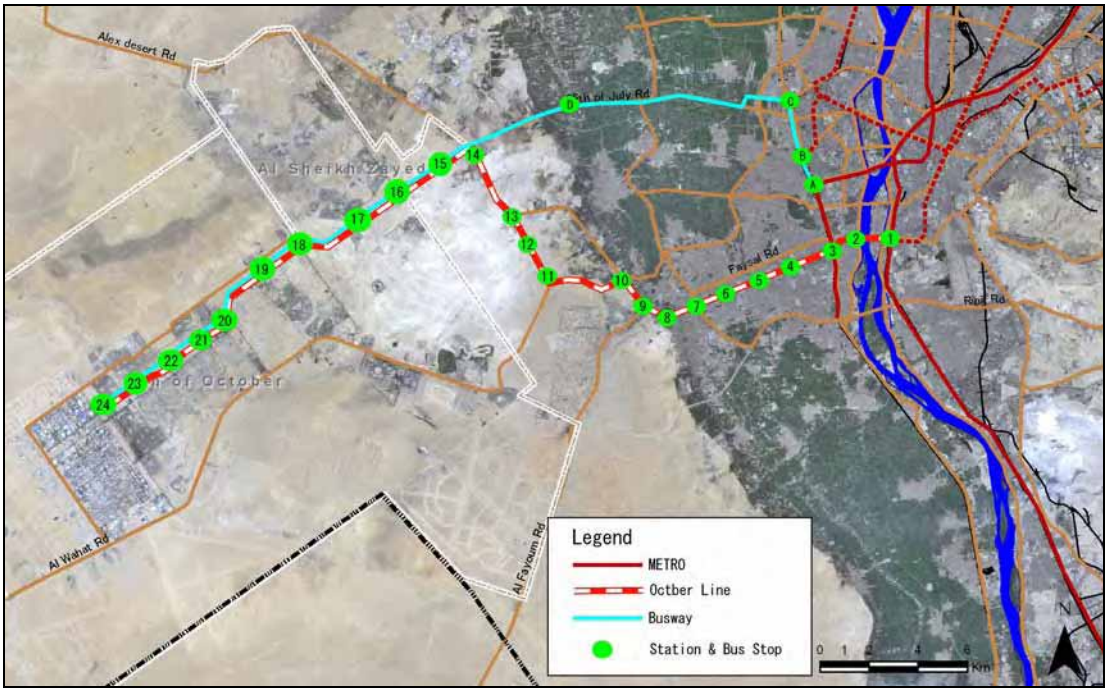
Figure 3.6.10 Setting Up of Alignment and Stage Plan for 6th of October Line and Metro Line

Year	Rail Mode and Busway Network Status
2018-2022 Implemented Section: ・Metro 3 Section 4 ・Metro 2 Extension ・6th of October Line ・East Wing LEGEND New Implementing Existing and Already Constructed	
2023-2027 Implemented Section: ・Metro New Cairo Line ・Metro 4 Sections 2, 3 LEGEND New Implementing Existing and Already Constructed	

Source: JICA Study Team

Figure 3.6.10 (Continued) Setting Up of Alignment and Stage Plan of 6th of October Line and Metro Line

In order to prepare the transport passengers forecast, the route and station locations needed to be defined. In this study, the Study Team assumed a route and stations locations of 6th of October Line and 26th July Busway, as shown in Figure 3.6.11. For simplification, the railway section between El-Malik El-Saleh and Al Wahat Road is called “Metro Line 4”, and the section between Al Wahat Road and Bank Street is named “6th of October Line”.



Source: JICA Study Team

Figure 3.6.11 Route and Station Location of 6th of October Line, Metro 4 Section 1 and 26th July Busway

(2) Future demand of 6th of October Line (including Metro Line 4-1 Section)

Under the assumptions described in the section (1), future traffic demand was estimated based on the modal split model developed in Section 3.4.2, as shown in Tables 3.6.4 through 3.6.7. In this regard, it is to be noted that at El-Malik El-Saleh Station, the proposed line connects to Metro Line 1 and at Giza Square Station the proposed line connects to Metro Line 2. For example, in Table 3.6.10, El-Malek El-Saleh Station has 15,000 alighting passengers and 43,000 transferring passengers and total of 58,000 passengers in the 6th of October direction.

Table 3.6.4 Future Demand of 6th of October Line and Metro Line 4-1 for 2017

(Unit: person trip / day)

No.	Station Name	Alighting	Boarding	Passing Through	
				To 6th of October	To Cairo
1	El-Malik El-Saleh	11,500	12,500		
1	Metro Line 1 Transfer	79,200	82,700	95,200	90,700
2	El-Nile	6,500	6,600	99,100	94,500
3	Giza Square	20,400	20,100		
3	Metro Line 2 Transfer	68,700	67,000	144,800	144,600
4	Pyramid Road East	44,100	43,700	130,400	130,700
5	Pyramid Road Central	64,300	64,300	102,300	102,600
6	Pyramid Road West	49,900	50,200	75,700	75,900
7	Ring Road	43,200	42,900	50,200	50,700
8	Pyramid	20,500	20,300	34,200	34,900
9	Al-Ramayah	19,800	20,300	15,900	16,000
10	Grand Egyptian Museum	12,700	12,800	3,200	3,200
11	Al Wahat Rd	3,200	3,200	0	0
Total		Total Passengers		Maximum	
		425,800		144,800	144,600

Source: JICA Study Team

Table 3.6.5 Future Demand of Metro Line 4-1 for 2022 before 6th of October Line Extension

(Unit: person trip / day)

No.	Station Name	Alighting	Boarding	Passing Through	
				To 6th of October	To Cairo
1	El-Malik El-Saleh	14,000	14,000		
1	Metro Line 1 Transfer	62,000	65,800	94,000	88,500
2	El-Nile	5,900	6,000	97,600	92,000
3	Giza Square	21,200	20,900		
3	Metro Line 2 Transfer	73,800	71,500	151,500	151,900
4	Pyramid Road East	43,300	42,900	137,500	138,200
5	Pyramid Road Central	68,000	68,200	104,500	105,000
6	Pyramid Road West	45,500	45,900	80,400	80,600
7	Ring Road	45,000	44,700	53,400	53,900
8	Pyramid	19,900	19,700	37,900	38,700
9	Al-Ramayah	20,300	20,800	19,300	19,500
10	Grand Egyptian Museum	15,400	15,600	3,900	3,900
11	Al Wahat Rd	3,900	3,900	0	0
Total		Total Passengers		Maximum	
		439,900		151,500	151,900

Source: JICA Study Team

Table 3.6.6 Future Demand of 6th of October Line and Metro Line 4-1 for 2022

(Unit: person trip / day)

No.	Station Name	Alighting	Boarding	Passing Through	
				To 6th of October	To Cairo
1	El-Malik El-Saleh	13,000	13,000		
1	Metro Line 1 Transfer	71,900	76,300	109,100	102,700
2	El-Nile	6,100	6,200	113,000	106,500
3	Giza Square	21,100	20,700		
3	Metro Line 2 Transfer	77,400	75,100	201,400	201,000
4	Pyramid Road East	45,200	44,800	194,900	194,900
5	Pyramid Road Central	74,300	75,100	191,600	190,600
6	Pyramid Road West	46,400	46,800	169,700	168,400
7	Ring Road	47,600	47,100	150,900	150,200
8	Pyramid	20,700	20,400	138,200	137,700
9	Al-Ramayah	21,300	21,600	123,000	122,200
10	Grand Egyptian Museum	17,500	17,500	119,500	118,700
11	Al Wahat Rd	4,400	4,400	115,100	114,300
12	City Center	4,900	4,900	115,700	115,000
13	New Giza City	2,200	2,200	115,700	115,000
14	Abu Rawash	2,200	2,200	115,700	115,000
15	Police City	9,100	9,100	119,900	119,200
16	Sheikh Zayed East	21,000	20,700	121,200	120,800
17	Sheikh Zayed Central	26,700	27,200	114,500	113,600
18	Sheikh Zayed West	19,800	19,400	106,700	106,100
19	Misr University	16,200	16,200	90,500	89,900
20	6th of October University	16,200	16,200	83,400	82,900
21	Al Hosari Mosque	22,800	22,700	65,800	65,400
22	9th District Central	30,200	29,800	38,000	37,900
23	October West	22,800	22,800	15,200	15,200
24	Bank Street	15,200	15,200		
Total		Total Passengers		Maximum	
		676,900		201,400	201,000

Source: JICA Study Team

Table 3.6.7 Future Demand of 6th of October Line and Metro Line 4-1 for 2027

(Unit: person trip / day)

No.	Station Name	Alighting	Boarding	Passing Through	
				To 6th of October	To Cairo
1	El-Malik El-Saleh	15,000	15,000		
1	Metro Line 1 Transfer	42,400	42,900		
1	Metro Line 4	103,800	96,700	161,200	154,600
2	El-Nile	5,600	5,700	184,600	177,800
3	Giza Square	23,200	22,800		
3	Metro Line 2 Transfer	54,100	52,100	221,000	220,700
4	Pyramid Road East	43,200	42,600	216,400	216,800
5	Pyramid Road Central	76,500	77,600	217,500	216,400
6	Pyramid Road West	44,000	44,500	197,100	195,700
7	Ring Road	49,600	49,200	179,100	178,100
8	Pyramid	20,100	19,900	167,300	166,500
9	Al-Ramayah	22,100	22,100	152,300	151,500
10	Grand Egyptian Museum	20,400	20,200	150,600	149,900
11	Al Wahat Rd	5,100	5,100	145,500	144,800
12	City Center	5,100	5,000	146,800	146,300
13	New Giza City	2,700	2,700	146,800	146,300
14	Abu Rawash	2,700	2,700	147,400	146,800
15	Police City	9,900	9,900	151,900	151,400
16	Sheikh Zayed East	30,300	30,200	154,900	154,500
17	Sheikh Zayed Central	37,500	37,300	145,400	145,200
18	Sheikh Zayed West	27,100	27,000	136,000	135,900
19	Misr University	21,400	21,400	114,600	114,500
20	6th of October University	21,400	21,400	106,400	106,200
21	Al Hosari Mosque	31,400	31,400	82,600	82,300
22	9th District Central	38,400	38,200	47,600	47,500
23	October West	28,500	28,500	19,000	19,000
24	Bank Street	19,000	19,000		
Total		Total Passengers		Maximum	
			795,800	221,000	220,700

Source: JICA Study Team

(3) Future demand of the 26th of July Busway

In the same manner, the future demand of 26th of July Busway was estimated for 2012, 2017, 2022 and 2027, as shown in Tables 3.6.8-10. It is noteworthy that 2022 is a critical year for 6th of October Line, so the 26th July Bus demand was forecast for both cases, namely with 6th of October Line and without 6th of October Line.

Table 3.6.8 Future Demand of the Busway on 26th of July Road for 2012 and 2017

(Unit: person trip / day)

No.	Station Name	Alighting	Boarding	Passing Through	
				To 6th of October	To Cairo
2012					
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 Central	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	October West	6,100	6,100	4,100	4,000
24	Bank Street	4,100	4,000		
Total		Total Passengers		Maximum	
			100,800	40,400	39,800
2017					
A	Behouth Metro Station	37,300	37,600	37,300	37,600
B	Gamaet	7,100	7,100	44,400	44,700
C	Imbaba	26,900	27,300	61,700	61,100
D	Mansovria	8,200	7,800	54,000	53,700
15	Police City	5,400	5,400	54,000	53,700
16	Sheikh Zayed East	5,400	5,400	48,600	48,400
17	Sheikh Zayed Central	9,300	9,200	39,400	39,200
18	Sheikh Zayed West	5,500	5,500	33,800	33,700
19	Misr University	9,900	9,800	33,800	33,700
20	6th of October University	9,900	9,800	24,000	23,900
21	Al Hosari Mosque	6,300	6,300	17,700	17,600
22	9th District Central	11,900	11,900	14,400	11,500
23	October West	8,600	8,600	5,800	5,700
24	Bank Street	5,800	5,700		
Total		Total Passengers		Maximum	
			157,400	61,700	61,100

Source: JICA Study Team

Table 3.6.9 Future Demand of the Busway on 26th of July for 2022

(Unit: person trip / day)

No.	Station Name	Alighting	Boarding	Passing Through	
				To 6th of October	To Cairo
Before					
A	Behouth Metro Station	74,300	74,500	74,300	74,500
B	Gamaet	12,200	12,200	86,500	86,700
C	Imbaba	48,200	48,700	120,700	120,000
D	Mansovria	8,300	8,000	114,100	113,600
15	Police City	12,800	12,700	114,100	113,600
16	Sheikh Zayed East	12,800	12,700	103,700	103,300
17	Sheikh Zayed Central	17,500	17,400	86,400	86,000
18	Sheikh Zayed West	12,600	12,500	74,800	74,500
19	Misr University	21,900	21,800	74,800	74,500
20	6th of October University	21,900	21,800	52,900	52,700
21	Al Hosari Mosque	13,800	13,700	39,200	39,000
22	9th District Central	26,700	26,600	31,000	24,800
23	October West	18,600	18,600	12,400	12,400
24	Bank Street	12,400	12,400		
Total		Total Passengers		Maximum	
			313,800	120,700	120,000
After					
A	Behouth Metro Station	26,000	26,300	26,000	26,300
B	Gamaet	5,300	5,400	31,300	31,700
C	Imbaba	49,100	48,800	72,800	72,700
D	Mansovria	14,000	13,800	67,400	67,500
15	Police City	9,100	9,100	58,200	58,400
16	Sheikh Zayed East	9,000	9,200	52,000	52,000
17	Sheikh Zayed Central	14,600	14,000	41,300	41,900
18	Sheikh Zayed West	8,500	8,800	35,000	35,300
19	Misr University	13,100	13,000	35,000	35,300
20	6th of October University	13,100	13,000	25,200	25,500
21	Al Hosari Mosque	8,000	8,000	19,000	19,300
22	9th District Central	13,800	14,100	25,700	25,700
23	October West	15,400	15,400	10,300	10,300
24	Bank Street	10,300	10,300		
Total		Total Passengers		Maximum	
			209,200	72,800	72,700

Source: JICA Study Team

Table 3.6.10 Future Demand of the Busway on 26th of July for 2027

(Unit: person trip / day)

No.	Station Name	Alighting	Boarding	Passing Trough	
				To October	To Cairo
A	Behouth Metro Station	29,500	28,900	29,500	28,900
B	Gamaet	6,300	6,400	35,800	35,300
C	Imbaba	54,900	55,900	80,700	80,300
D	Mansovria	14,300	14,200	75,800	75,500
15	Police City	9,900	9,900	65,900	65,600
16	Sheikh Zayed East	10,600	10,600	59,400	59,100
17	Sheikh Zayed Central	16,300	16,300	49,400	49,100
18	Sheikh Zayed West	10,400	10,400	42,300	42,000
19	Misr University	6,300	6,200	42,300	42,000
20	6th of October University	9,400	9,300	31,200	31,200
21	Al Hosari Mosque	9,200	9,000	24,700	24,800
22	9th District Central	19,400	19,600	33,100	33,000
23	October West	19,900	19,800	13,200	13,200
24	Bank Street	13,200	13,200		
Total		Total Passengers		Maximum	
			229,700	80,700	80,300

Source: JICA Study Team

(4) Summary of 6th of October Rail and 26th July Bus Transport Forecast

Future demand, as described in the previous sections, is summarized in Table 3.6.11 and illustrated in Figures 3.6.12-16. Table 3.6.11 shows that the proportion of railway users is roughly 75% and the proportion of busway users is about 25%. Assuming that a bi-articulated bus has a capacity of 270 passengers and the minimum headway is 1.5 minute, the maximum transportable volume of passengers per hour becomes 10,800 passengers. Also, assuming that the peak ratio is 14%, an hourly peak of 10,800 passengers means the maximum daily transport capacity is 77,100 for passing-through passengers per direction.

Considering that transport demand in 2022 before 6th of October Line extension is predicted to be 120,700 passengers, it is clear that the demand in 2022 before 6th of October Line extension will already be over the capacity of the busway service.

Table 3.6.11 Summary of Future Demand for 6th of October Corridor

(Unit: person/day)

Section	Year	No. of Passengers	Maximum Passing-Through Volume per Direction	Rail Passengers /Total Passengers
6th of October Line + Metro 4 Section 1	2017	425,800	144,800	
	2022 before 6th of October Line Extension	439,900	151,900	
	2022 after 6th of October Line Extension	677,600	201,400	
	2027	795,800	221,000	
Busway on 26th July Corridor	2012	100,800	40,400	
	2017	157,400	61,700	
	2022 before 6th of October Line Extension	313,800	120,700	
	2022 after 6th of October Line Extension	209,200	72,800	
	2027	229,700	80,700	
Total	2012	100,800	40,400	
	2017	583,200	206,500	0.730
	2022 before 6th of October Line Extension	753,700	272,600	0.584
	2022 after 6th of October Line Extension	886,800	274,200	0.764
	2027	1,025,500	301,700	0.776

Source: JICA Study Team

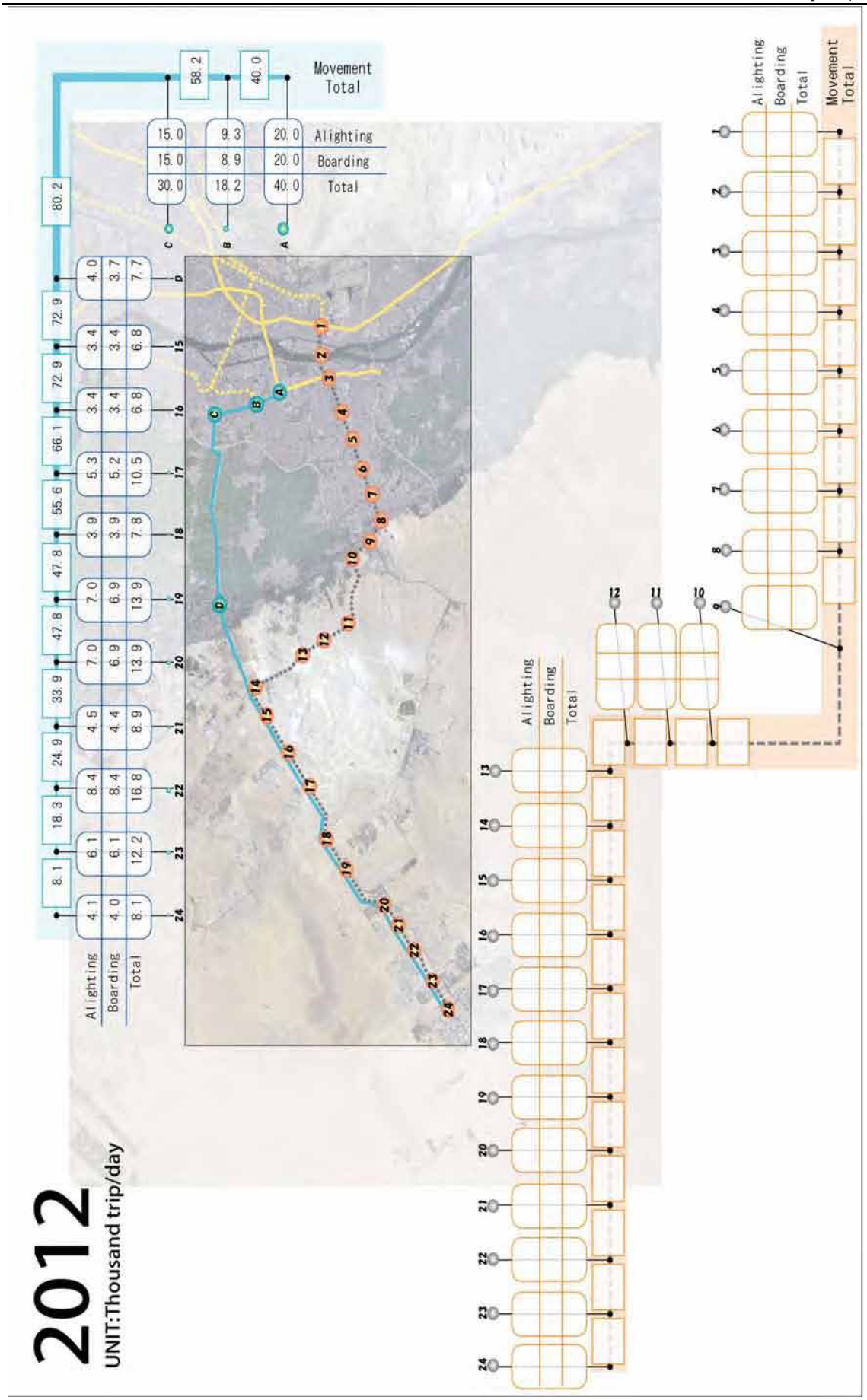
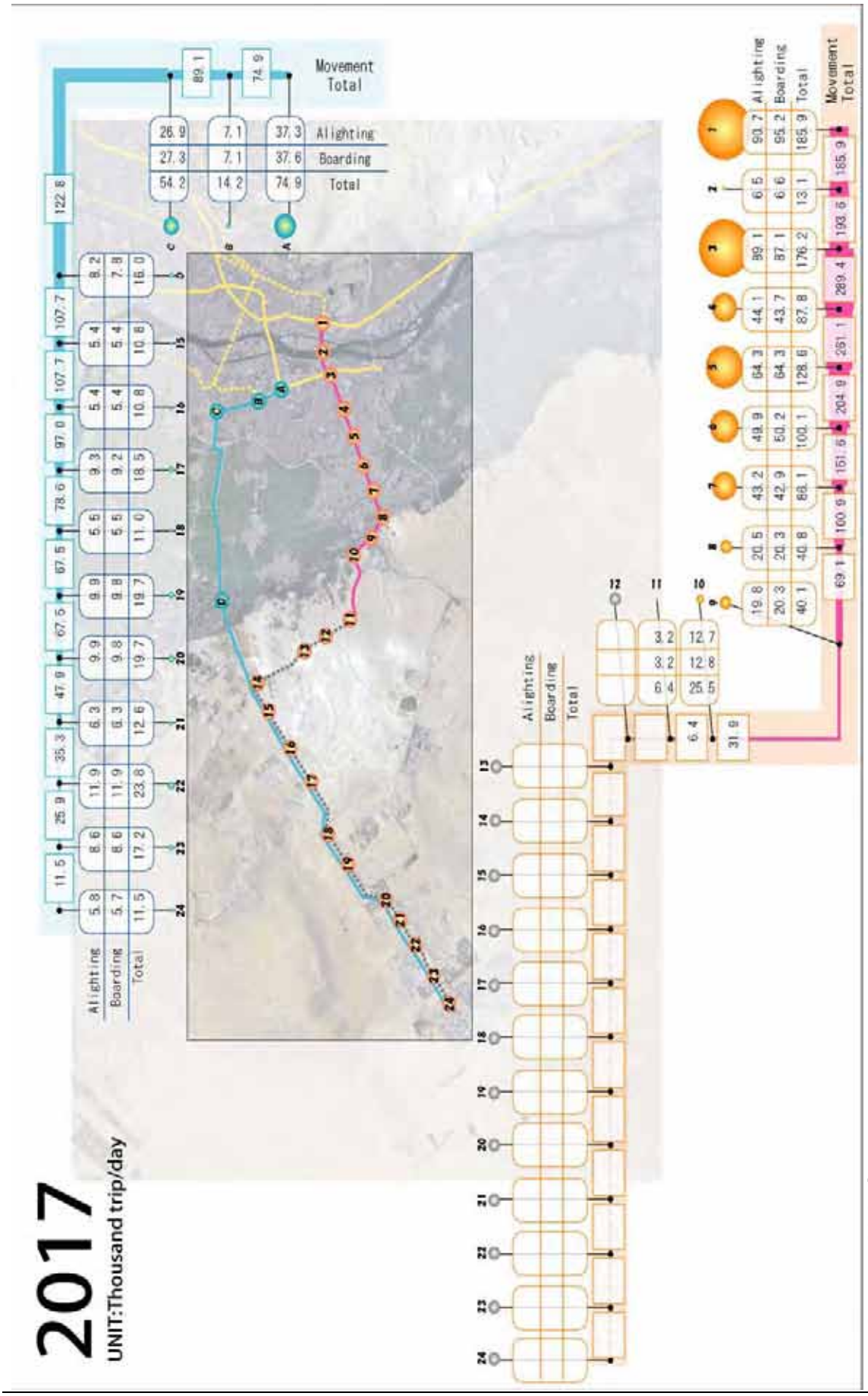


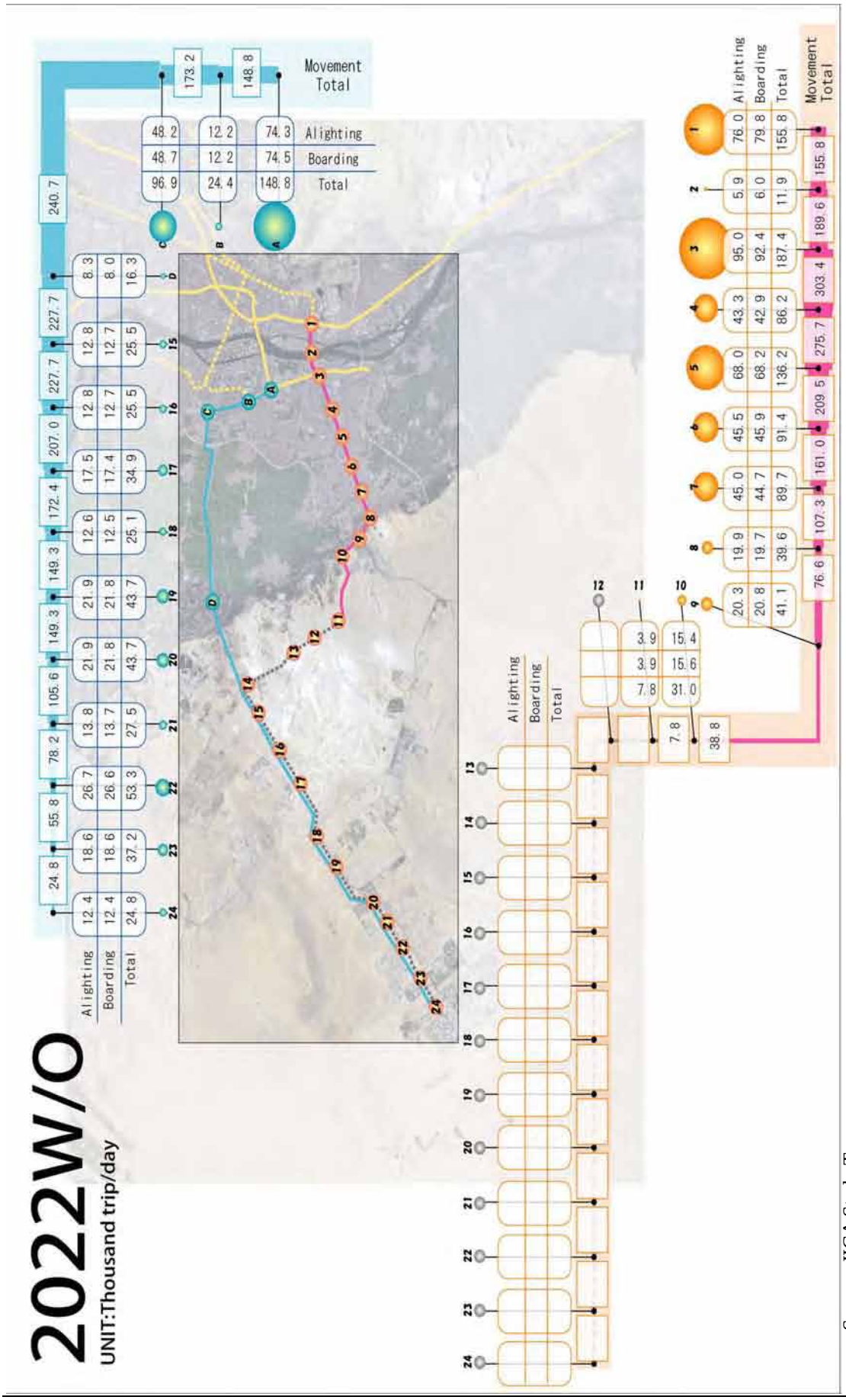
Figure 3.6.12 Future Demand of 6th of October Line and Metro Line, for 2012

Source: JICA Study Team
Note: Unit is set at 100 person/day.



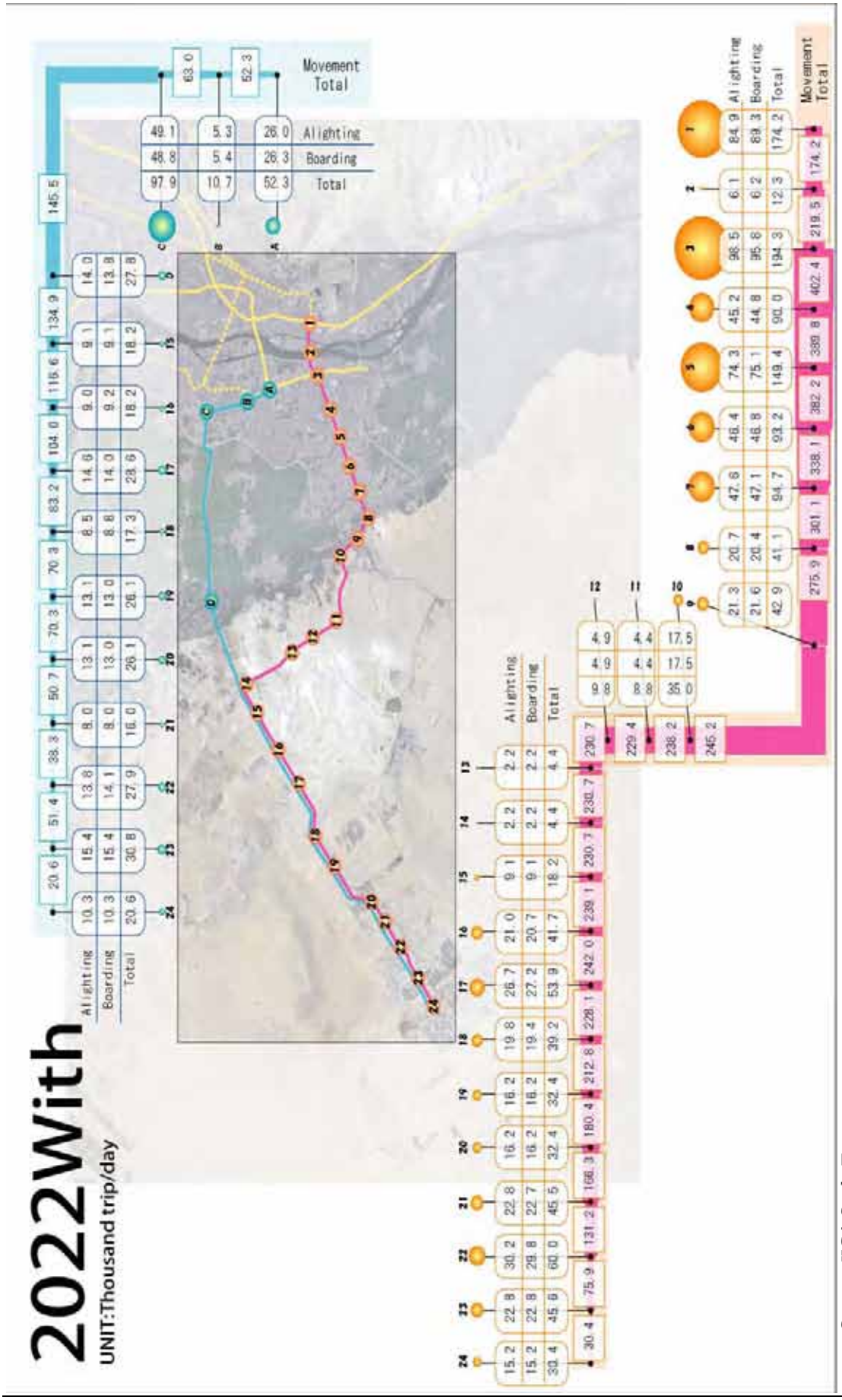
Source: JICA Study Team
Note: Unit is set at 100 person/day.

Figure 3.6.13 Future Demand of 6th of October Line and Metro Line, for 2017



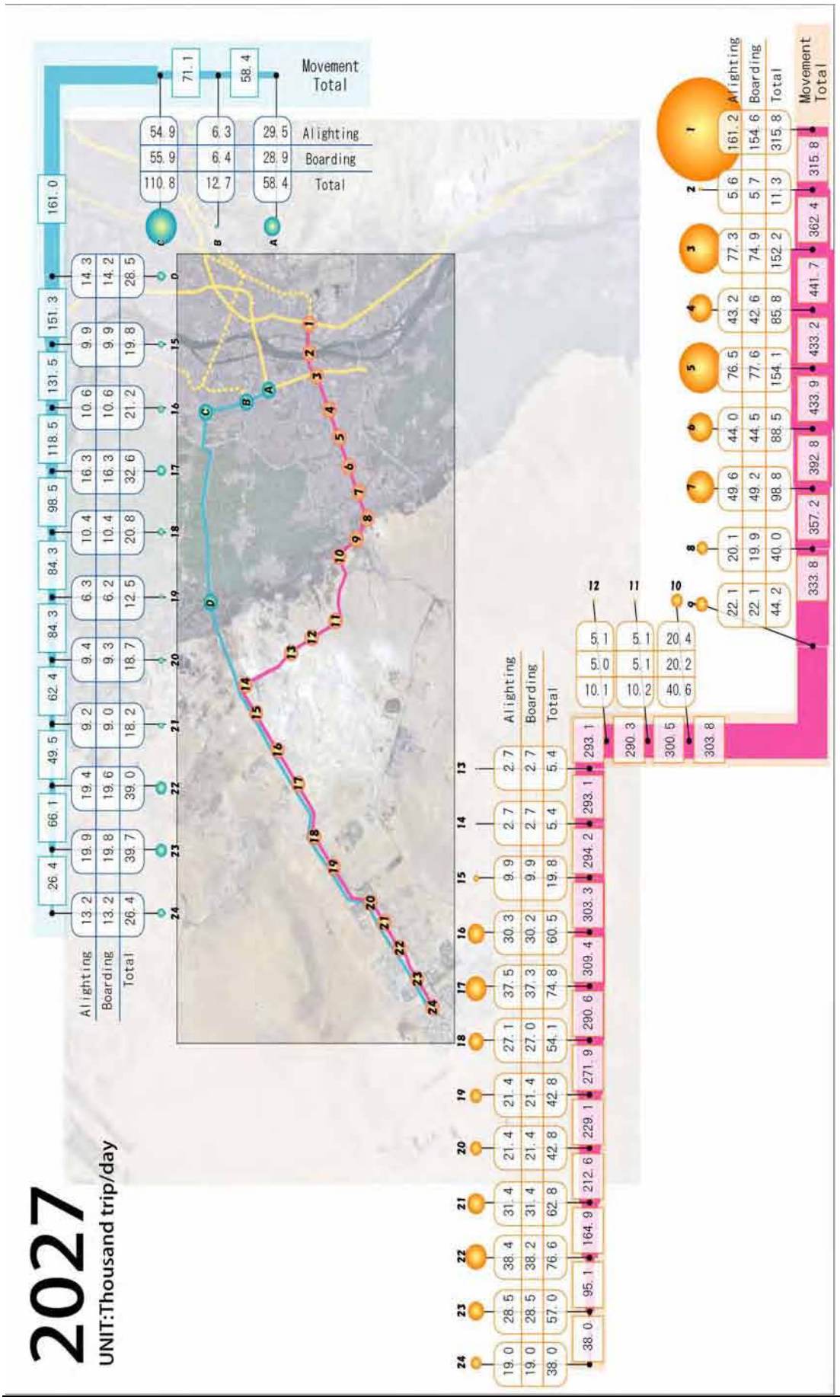
Source: JICA Study Team
Note: Unit is set at 100 person/day.

Figure 3.6.14 Future Demand of 6th of October Line and Metro Line for 2022 without 6th of October Line



Source: JICA Study Team
Note: Unit is set at 100 person/day.

Figure 3.6.15 Future Demand of 6th of October Line and Metro Line for 2022 with 6th of October Line



Source: JICA Study Team
Note: Unit is set at 100 person/day.

Figure 3.6.16 Future Demand of 6th of October Line and Metro Line for 2027

(5) Feeder transportation mode of railway and bus stations

Referring Section 3.5.2 (5) above, and in reference to the present local transport condition, the proportion of feeder transportation modes was forecast. The estimates are presented for access/egress to railway stations first, and later to bus stations.

Table 3.6.12 Feeder Transportation Mode of Metro 4 Section 1 for 2017 and 2022

No.	Station Name	Boarding Alighting	Share by feeder mode (%)				Daily Trips (person trip / day)			
			Walk	Car/ Taxi	Shared Taxi	Public Bus	Walk	Car/Taxi	Shared Taxi	Public Bus
2017										
1	El-Malik El-Saleh	24,000	58	3	33	6	13,900	780	7,910	1,410
2	El-Nile	13,100	58	3	33	6	7,590	420	4,320	770
3	Giza Square	40,500	58	3	27	12	23,450	1,310	10,960	4,770
4	Pyramid Road East	87,800	68	3	28	6	59,620	2,840	24,550	5,170
5	Pyramid Road Central	128,600	58	3	33	6	74,460	4,160	42,390	7,580
6	Pyramid Road West	100,100	68	3	28	6	67,970	3,240	27,990	5,900
7	Ring Road	86,100	58	3	27	12	49,850	2,790	23,310	10,150
8	Pyramid	40,800	68	3	28	6	27,700	1,320	11,410	2,400
9	Al-Ramayah	40,100	58	3	33	6	23,220	1,300	13,220	2,360
10	Grand Egyptian Museum	25,500	58	3	33	6	14,760	830	8,410	1,500
11	Al Wahat Rd	6,400	68	3	28	6	4,350	210	1,790	380
	Total	595,000					368,020	19,260	176,920	42,510
2022										
1	El-Malik El-Saleh	28,000	58	3	33	6	16,210	910	9,230	1,650
2	El-Nile	11,900	58	3	33	6	6,890	390	3,920	700
3	Giza Square	42,100	58	3	27	12	24,380	1,360	11,400	4,960
4	Pyramid Road East	86,200	68	3	28	6	58,530	2,790	24,110	5,080
5	Pyramid Road Central	136,200	58	3	33	6	78,860	4,410	44,900	8,030
6	Pyramid Road West	91,400	68	3	28	6	62,060	2,960	25,560	5,390
7	Ring Road	89,700	58	3	27	12	51,940	2,900	24,280	10,570
8	Pyramid	39,600	68	3	28	6	26,890	1,280	11,070	2,330
9	Al-Ramayah	41,100	58	3	33	6	23,800	1,330	13,550	2,420
10	Grand Egyptian Museum	31,000	58	3	33	6	17,950	1,000	10,220	1,830
11	Al Wahat Rd	7,800	68	3	28	6	5,300	250	2,180	460
	Total	605,000					372,810	19,580	180,420	43,420

Source: JICA Study Team
Note: Share by feeder mode is set up based on CREATS HIS date as shown in Table 3.5.7.

Table 3.6.13 Feeder Transportation Mode of 6th of October Line and Metro 4 Section 1 for 2022 and 2027

No.	Station Name	Boarding Alighting	Share by feeder mode (%)				Daily Trips (person trip / day)			
			Walk	Car/ Taxi	Shared Taxi	Public Bus	Walk	Car/Taxi	Shared Taxi	Public Bus
2022										
1	El-Malik El-Saleh	26,000	58	3	33	6	15,050	840	8,570	1,530
2	El-Nile	12,300	58	3	33	6	7,120	400	4,050	720
3	Giza Square	41,800	58	3	27	12	24,200	1,350	11,320	4,930
4	Pyramid Road East	90,000	68	3	28	6	61,110	2,910	25,170	5,300
5	Pyramid Road Central	149,400	58	3	33	6	86,500	4,840	49,250	8,810
6	Pyramid Road West	93,200	68	3	28	6	63,280	3,020	26,060	5,490
7	Ring Road	94,700	58	3	27	12	54,830	3,070	25,640	11,160
8	Pyramid	41,100	68	3	28	6	27,910	1,330	11,490	2,420
9	Al-Ramayah	42,900	58	3	33	6	24,840	1,390	14,140	2,530
10	Grand Egyptian Museum	35,000	58	3	33	6	20,270	1,130	11,540	2,060
11	Al Wahat Rd	8,800	68	3	28	6	5,980	280	2,460	520
12	City Center	9,800	58	3	33	6	5,670	320	3,230	580
13	New Giza City	4,400	68	3	28	6	2,990	140	1,230	260
14	Abu Rawash	4,400	68	3	28	6	2,990	140	1,230	260
15	Police City	18,200	58	3	27	12	10,540	590	4,930	2,150
16	Sheikh Zayed East	41,700	68	3	28	6	28,310	1,350	11,660	2,460
17	Sheikh Zayed Central	53,900	58	3	27	12	31,210	1,750	14,590	6,350
18	Sheikh Zayed West	39,200	68	3	28	6	26,620	1,270	10,960	2,310
19	Misr University	32,400	58	3	33	6	18,760	1,050	10,680	1,910
20	6th of October University	32,400	58	3	33	6	18,760	1,050	10,680	1,910
21	Al Hosari Mosque	45,500	58	3	33	6	26,350	1,470	15,000	2,680
22	9th District Central	60,000	58	3	27	12	34,740	1,940	16,240	7,070
23	October West	45,600	58	3	33	6	26,400	1,480	15,030	2,690
24	Bank Street	30,400	68	3	28	6	20,640	980	8,500	1,790
	Total	1,053,100					645,070	34,090	313,650	77,890
2027										
1	El-Malik El-Saleh	30,000	58	3	33	6	17,370	970	9,890	1,770
2	El-Nile	11,300	58	3	33	6	6,540	370	3,730	670
3	Giza Square	46,000	58	3	27	12	26,630	1,490	12,450	5,420
4	Pyramid Road East	85,800	68	3	28	6	58,260	2,780	24,000	5,060
5	Pyramid Road Central	154,100	58	3	33	6	89,230	4,990	50,800	9,080
6	Pyramid Road West	88,500	68	3	28	6	60,090	2,870	24,750	5,220
7	Ring Road	98,800	58	3	27	12	57,210	3,200	26,750	11,650
8	Pyramid	40,000	68	3	28	6	27,160	1,300	11,190	2,360
9	Al-Ramayah	44,200	58	3	33	6	25,590	1,430	14,570	2,610
10	Grand Egyptian Museum	40,600	58	3	33	6	23,510	1,310	13,380	2,390
11	Al Wahat Rd	10,200	68	3	28	6	6,930	330	2,850	600
12	City Center	10,100	58	3	33	6	5,850	330	3,330	600
13	New Giza City	5,400	68	3	28	6	3,670	170	1,510	320
14	Abu Rawash	5,400	68	3	28	6	3,670	170	1,510	320
15	Police City	19,800	58	3	27	12	11,460	640	5,360	2,330
16	Sheikh Zayed East	60,500	68	3	28	6	41,080	1,960	16,920	3,570
17	Sheikh Zayed Central	74,800	58	3	27	12	43,310	2,420	20,250	8,820
18	Sheikh Zayed West	54,100	68	3	28	6	36,730	1,750	15,130	3,190
19	Misr University	42,800	58	3	33	6	24,780	1,390	14,110	2,520
20	6th of October University	42,800	58	3	33	6	24,780	1,390	14,110	2,520
21	Al Hosari Mosque	62,800	58	3	33	6	36,360	2,030	20,700	3,700
22	9th District Central	76,600	58	3	27	12	44,350	2,480	20,740	9,030
23	October West	57,000	58	3	33	6	33,000	1,850	18,790	3,360
24	Bank Street	38,000	68	3	28	6	25,800	1,230	10,630	2,240
	Total	1,199,600					733,360	38,850	357,450	89,350

Source: JICA Study Team
Note: Share by feeder mode is set up based on CREATS HIS date as shown in Table 3.5.7.

Table 3.6.14 Feeder Transportation Mode of Busway on 26th of July for 2012 and 2017

No.	Station Name	Boarding Alighting	Share by feeder mode (%)				Daily Trips (person trip / day)			
			Walk	Car/ Taxi	Shared Taxi	Public Bus MRT	Walk	Car/Taxi	Shared Taxi	Public Bus MRT
2012										
A	Behouth Metro Station	40,000	58	3	27	12	23,160	1,300	10,830	4,720
B	Gamaet	18,200	68	3	28	6	12,360	590	5,090	1,070
C	Imbaba	30,000	58	3	27	12	17,370	970	8,120	3,540
D	Mansovria	7,700	68	3	28	6	5,230	250	2,150	450
15	Police City	6,800	68	3	28	6	4,620	220	1,900	400
16	Sheikh Zayed East	6,800	68	3	28	6	4,620	220	1,900	400
17	Sheikh Zayed Central	10,500	68	3	28	6	7,130	340	2,940	620
18	Sheikh Zayed West	7,800	68	3	28	6	5,300	250	2,180	460
19	Misr University	13,900	68	3	28	6	9,440	450	3,890	820
20	6th of October University	13,900	68	3	28	6	9,440	450	3,890	820
21	Al Hosari Mosque	8,900	68	3	28	6	6,040	290	2,490	520
22	9th District Central	16,800	58	3	27	12	9,730	540	4,550	1,980
23	October West	12,200	68	3	28	6	8,280	400	3,410	720
24	Bank Street	8,100	68	3	28	6	5,500	260	2,270	480
	Total	201,600					128,220	6,530	55,610	17,000
2017										
A	Behouth Metro Station	74,900	48	3	13	36	35,880	2,430	9,710	26,880
B	Gamaet	14,200	48	3	13	36	6,800	460	1,840	5,100
C	Imbaba	54,200	58	3	27	12	31,380	1,760	14,670	6,390
D	Mansovria	16,000	68	3	28	6	10,860	520	4,470	940
15	Police City	10,800	68	3	28	6	7,330	350	3,020	640
16	Sheikh Zayed East	10,800	68	3	28	6	7,330	350	3,020	640
17	Sheikh Zayed Central	18,500	68	3	28	6	12,560	600	5,170	1,090
18	Sheikh Zayed West	11,000	68	3	28	6	7,470	360	3,080	650
19	Misr University	19,700	68	3	28	6	13,380	640	5,510	1,160
20	6th of October University	19,700	68	3	28	6	13,380	640	5,510	1,160
21	Al Hosari Mosque	12,600	68	3	28	6	8,560	410	3,520	740
22	9th District Central	23,800	58	3	27	12	13,780	770	6,440	2,810
23	October West	17,200	68	3	28	6	11,680	560	4,810	1,010
24	Bank Street	11,500	68	3	28	6	7,810	370	3,220	680
	Total	314,900					188,200	10,220	73,990	49,890

Source: JICA Study Team

Note: Share by feeder mode is set up based on CREATS HIS date as shown in Table 3.5.7.

Table 3.6.15 Feeder Transportation Mode of Busway on 26th of July before and after 6th of October Line Extension, for 2022

No.	Station Name	Boarding Alighting	Share by feeder mode (%)				Daily Trips (person trip / day)			
			Walk	Car/ Taxi	Shared Taxi	Public Bus MRT	Walk	Car/Taxi	Shared Taxi	Public Bus MRT
Before										
A	Behouth Metro Station	148,800	48	3	13	36	71,280	4,820	19,290	53,410
B	Gamaet	24,400	48	3	13	36	11,690	790	3,160	8,760
C	Imbaba	96,900	58	3	27	12	56,110	3,140	26,230	11,420
D	Mansovria	16,300	68	3	28	6	11,070	530	4,560	960
15	Police City	25,500	68	3	28	6	17,310	830	7,130	1,500
16	Sheikh Zayed East	25,500	68	3	28	6	17,310	830	7,130	1,500
17	Sheikh Zayed Central	34,900	68	3	28	6	23,700	1,130	9,760	2,060
18	Sheikh Zayed West	25,100	68	3	28	6	17,040	810	7,020	1,480
19	Misr University	43,700	68	3	28	6	29,670	1,420	12,220	2,580
20	6th of October University	43,700	68	3	28	6	29,670	1,420	12,220	2,580
21	Al Hosari Mosque	27,500	68	3	28	6	18,670	890	7,690	1,620
22	9th District Central	53,300	58	3	27	12	30,860	1,730	14,430	6,280
23	October West	37,200	68	3	28	6	25,260	1,200	10,400	2,190
24	Bank Street	24,800	68	3	28	6	16,840	800	6,940	1,460
	Total	627,600					376,480	20,340	148,180	97,800
After										
A	Behouth Metro Station	52,300	48	3	13	36	25,050	1,690	6,780	18,770
B	Gamaet	10,700	48	3	13	36	5,130	350	1,390	3,840
C	Imbaba	97,900	58	3	27	12	56,690	3,170	26,500	11,540
D	Mansovria	27,800	68	3	28	6	18,880	900	7,770	1,640
15	Police City	18,200	68	3	28	6	12,360	590	5,090	1,070
16	Sheikh Zayed East	18,200	68	3	28	6	12,360	590	5,090	1,070
17	Sheikh Zayed Central	28,600	68	3	28	6	19,420	930	8,000	1,690
18	Sheikh Zayed West	17,300	68	3	28	6	11,750	560	4,840	1,020
19	Misr University	26,100	68	3	28	6	17,720	850	7,300	1,540
20	6th of October University	26,100	68	3	28	6	17,720	850	7,300	1,540
21	Al Hosari Mosque	16,000	68	3	28	6	10,860	520	4,470	940
22	9th District Central	27,900	58	3	27	12	16,150	900	7,550	3,290
23	October West	30,800	68	3	28	6	20,910	1,000	8,610	1,820
24	Bank Street	20,600	68	3	28	6	13,990	670	5,760	1,210
	Total	418,500					258,990	13,570	106,450	50,980

Source: JICA Study Team

Note: Share by feeder mode is set up based on CREATS HIS date as shown in Table 3.5.7.

Table 3.6.16 Feeder Transportation Mode of Busway on 26th of July for 2027

No.	Station Name	Boarding Alighting	Share by feeder mode (%)				Daily Trips (person trip / day)			
			Walk	Car/ Taxi	Shared Taxi	Public Bus MRT	Walk	Car/Taxi	Shared Taxi	Public Bus MRT
A	Behouth Metro Station	58,400	48	3	13	36	27,970	1,890	7,570	20,960
B	Gamaet	12,700	48	3	13	36	6,080	410	1,650	4,560
C	Imbaba	110,800	58	3	27	12	64,150	3,590	30,000	13,060
D	Mansovria	28,500	68	3	28	6	19,350	920	7,970	1,680
15	Police City	19,800	68	3	28	6	13,440	640	5,540	1,170
16	Sheikh Zayed East	21,200	68	3	28	6	14,400	690	5,930	1,250
17	Sheikh Zayed Central	32,600	68	3	28	6	22,140	1,060	9,120	1,920
18	Sheikh Zayed West	20,800	68	3	28	6	14,120	670	5,820	1,230
19	Misr University	12,500	68	3	28	6	8,490	400	3,500	740
20	6th of October University	18,700	68	3	28	6	12,700	610	5,230	1,100
21	Al Hosari Mosque	18,200	68	3	28	6	12,360	590	5,090	1,070
22	9th District Central	39,000	58	3	27	12	22,580	1,260	10,560	4,600
23	October West	39,700	68	3	28	6	26,960	1,290	11,100	2,340
24	Bank Street	26,400	68	3	28	6	17,930	850	7,380	1,560
	Total	459,300					282,670	14,870	116,460	57,240

Source: JICA Study Team
Note: Share by feeder mode is set up based on CREATS HIS date as shown in Table 3.5.7.

CHAPTER 4 PLAN FOR RAILWAYS

4.1 Route and Mode Selection

4.1.1 Route

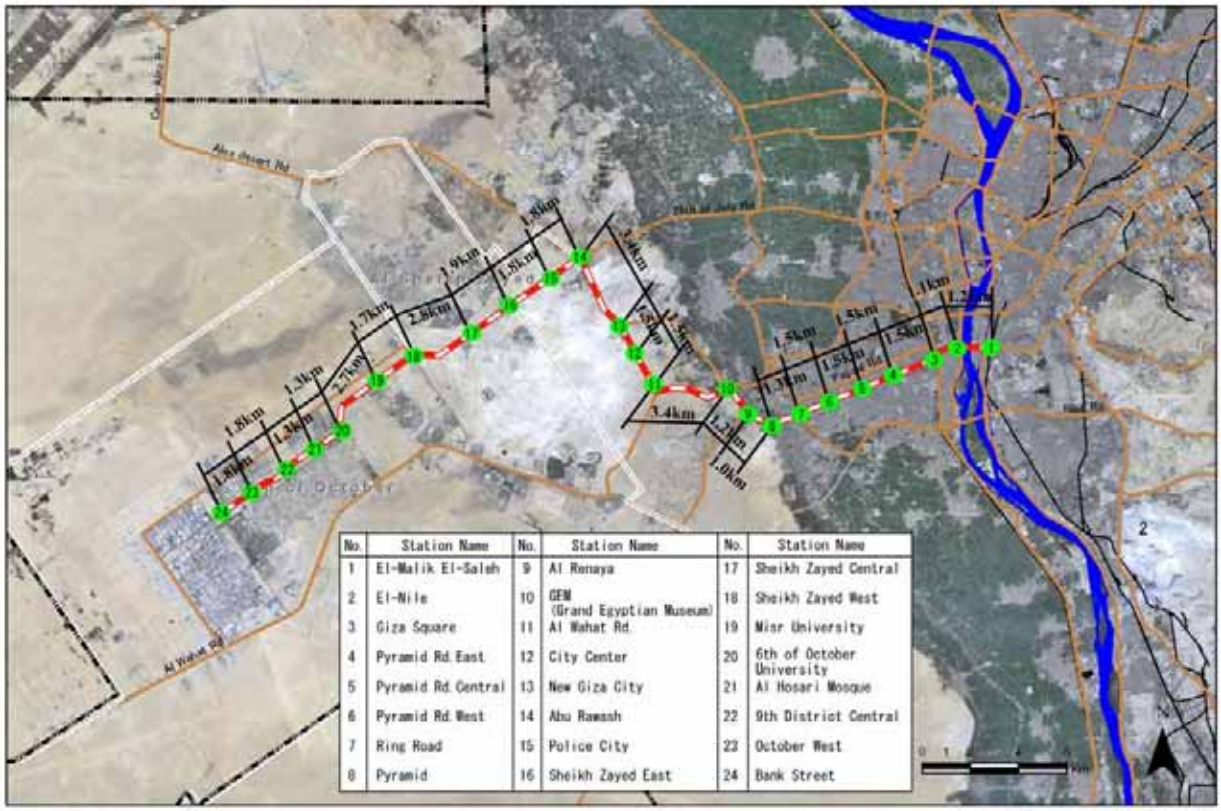
The route of the proposed Metro Line 4 extension and 6th of October Line selection process was based on the discussion presented in Chapter 3 Section 3.6.1, and took into consideration the following points:

- To run through the existing and planned urban areas as much as possible.
- To minimize the acquisition of land as much as possible.
- To ensure convenient transfer between the planned Metro Line 4 and the existing Metro Line 1 and Line 2, Metro Line 4 stations must be provided at the transfer points with the existing Metro lines.
- To minimize landscape effects in the Pyramid area, the section passing near the Pyramids should be designed as underground.

4.1.2 Location of Stations

Selection of the stations was carried out by setting the distance between consecutive stations to be 1.7 km on an average, taking into consideration the case of the existing Metro lines and functional access to the new line, as shown in Figures 4.1.1 and 4.1.2.

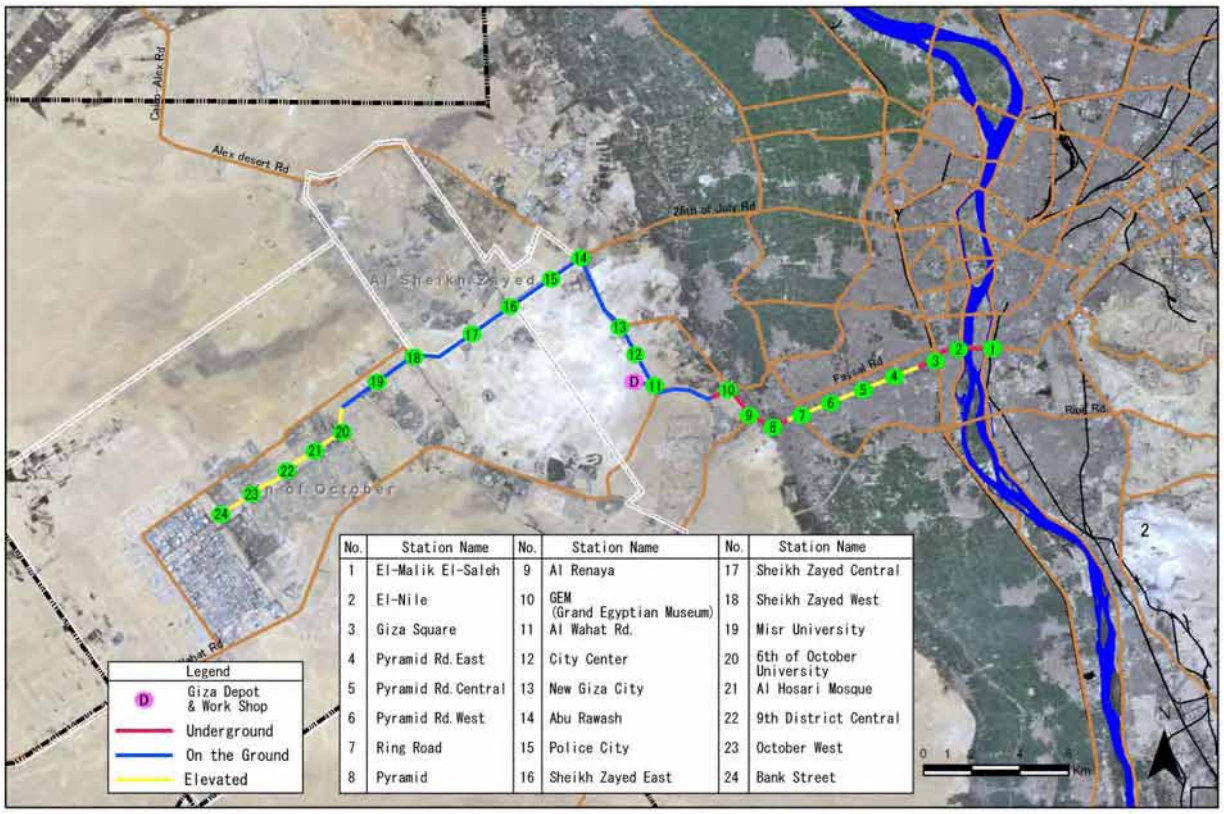
The new Metro Line 4 extension starts at El Malik El-Saleh Station (No.1) on Metro Line 1, and passes under the River Nile to the Giza side. The new line will connect to Metro Line 2 at Giza Square Station (No.3). From here, the new line will provide access to the Pyramids in Giza at Pyramid Station (No. 8) and to the Grand Egyptian Museum at GEM Station (No.10). Al Wahat Station (No. 11) will be the temporary terminal for the Phase I development. The remaining Phase II section (No.12 through 24) will extend the line to 6th of October NUC via the new development areas.



Source: JICA Study Team

Figure 4.1.1 Route and Distance between Stations

The envisaged structure along the route is shown in Figure 4.1.2. Between Stations No.1 and 3, the line is basically underground to pass under the River Nile. The section between Stations No. 4 and 7 is elevated to pass through the urbanized area of southern Giza. The line between Stations 8 and 10 is planned as underground, as the line passes near the Pyramids in Giza. This will ensure that the landscape is not affected in this heritage area. As the section between Stations 10 through 19 basically runs through areas that are under development, and the ROW of the roads is relatively wide, the railway is planned at grade. The section between Stations No. 20 and 24 is a relatively urbanized area in 6th of October NUC, so the line is planned to be elevated in this section.



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 4.1.2 Route and Structure

4.2 Selection of Railway Type

4.2.1 Concept of System Selection

Development of the Metro Line 4 is planned to be done in two sections. The first section (Phase I) comprises part of the Metro Line 4 route proposed in CREATS. The second section (Phase II) will be an extension of Phase I and named "6th of October Line". The first section runs from El Malik El Saleh Station (Metro Line1) up to Al Wahat Road near the Pyramids. The second section will run from Al Wahat Road up to Bank Street at the western end of 6th of October. The first section has the characteristics of the existing Metro network and the second section will have the characteristics of a mid-distance intercity line. The completed line will need to have the transportation capacity to cope with the demand of commuting and middle-distance transport, as a feeder line of the existing Metro network. At the same time, the line is required to operate as a local arterial transport route to 6th of October and Sheik Zahied.

From these points of view, the basic concept for selection of the transportation system was formulated to address the following requirements:

- The system must secure the proper transportation capacity.
- The system must be constructed and operated economically.

- The system must be safe and comfortable.
- The system should basically be constructed inside the existing road area.
- The system should be harmonized with the surrounding scenery.

4.2.2 Railway Modes that were studied

Based on the predicted future transport demand, the selected system must accommodate 20,000 to 40,000 passengers per peak hour per direction. Potential systems that might satisfy this range of demand include a Monorail System, a Linear Introduction Motor (LIM) System and a Conventional System. An outline of each system is provided as follows:

(1) Monorail System

Although there are various types of monorail, the straddle type monorail is common. This type uses a concrete girder as the running way and the train runs on wheels fitted with rubber tires. As the running way is a small section girder, with no need for a slab, it has the merit of being superior for providing passengers with an uninterrupted view of the scenery.

(2) Linear Induction Motor (LIM) System

Linear induction motor (LIM) systems have been developed with the objective of providing a relatively low construction cost by setting a smaller transportation capacity compared to the standard type of subway. This system runs on steel wheels and uses a linear traction type motor. LIM systems have the characteristics of reducing the civil construction costs accruing from the small motor size (due to the nature of LIM), and a low floor height (due to small wheels) which allow construction of smaller cross section tunnels. In addition, LIM systems can run on steep gradients and curves, so they provide more flexibility for the route alignment.

(3) Conventional Heavy Rail (HR) System

Heavy rail (HR) systems are classified into three major categories: i) large capacity and high speed suburban, ii) large capacity intra-city and iii) subway. Urban transport is characterized by a large demand for transport in one direction during certain time periods. Heavy rail systems often connect cities and their suburbs. Even while running in urban areas, they operate at relatively high speed.

4.2.3 Selection of the System for the Route

(1) Required transportation capacity for 6th of October Line

The maximum through-passenger volumes at peak hour per direction in the year 2017, 2022 and 2027 were estimated as 20,000, 28,000 and 31,000 passengers per hour, respectively. However, for the selection of the system, the required capacity should be more than the

estimated demand due to the necessity to provide some allowance to cope with an increase of transportation volumes after the year 2027.

(2) Technical characteristics of the selected system

The technical characteristics of the selected system are shown in Table 4.2.1.

Table 4.2.1 Comparison of Technical Characteristics

System	Unit	Heavy Rail	LIM System	Monorail
Minimum Radius of Curve	m	600	100	100
Steepest Gradient	%	3.5	6	6
Maximum Speed	km/h	110	80	80
Minimum Headway	minute	2.5	3	3
Car Body Length	m	20	16	15
Nominal Passenger Capacity per Coach (including standing)	persons/car	155	100	100
Length of train	m	160	128	120
Transportation Capacity per Hour per Direction (8 Coaches formation, four minutes headway, nominal passenger capacity × 180%)	pphpd	33,480	21,600	21,600

Note: pphpd -passengers per hour per direction
Source: JICA Study Team

(3) Evaluation of the adaptability to the design requirements

Selection of the transportation system was carried comprehensively by considering 3 criteria: i) technical; ii) O&M; and iii) social characteristics. The evaluation of each system based on these criteria is shown in Table 4.2.2. Overall, it was concluded that conventional heavy rail will be the optimum system. LIM systems had little merit due to the length of the underground section being too short. Monorail systems not show good cost performance in the at-grade section. Under these circumstances, heavy rail (HR) was selected.

Table 4.2.2 Evaluation of Each System for a Partial Metro Line 4 and 6th of October Line

Evaluation item		Heavy Rail	LIM System	Monorail	Remarks
Technical Characteristics	Compatibility with route alignment condition	Good for "Ground/Elevated /Underground" Evaluation: ◎	Good for "Underground /Elevated" Evaluation: ○	Good for "Elevated" Evaluation: ○	Maximum gradient is 3.5%
	Transportation capacity	Larger capacity Evaluation: ◎	Large, but smaller than heavy rail Evaluation: ○	Large but smaller than Heavy Rail Evaluation: ○	Required capacity = 31,000 pphpd (in 2027)
	Ease of construction work (viaduct)	By adopting girder type structures, traffic congestion can be mitigated. Evaluation: ○	By adopting girder type structures, traffic congestion can be mitigated. Evaluation: ○	As the track girder is light, the installation work is easy and traffic congestion is the minimized. Evaluation: ◎	
O&M Characteristics	Operation and Maintenance issues	Travel Distance within 100 km Evaluation: ○	Travel Distance within 40 km. Protection of the linear reaction plate required at grade level. Evaluation: △	Travel Distance within 30 km. Frequent maintenance of rubber tires is necessary. Evaluation: △	Operation distance is approximately 40 km. 52% is at grade section and 32% is in elevated sections.
Social Characteristics	Noise, Vibration	If noise prevention for wall and track structures are well designed, problems will be minimal. Evaluation: △	As there is no traction gear, it is relatively small. Evaluation: ○	As rubber tires are used, noise and vibration are low. Evaluation: ◎	
	Scenery (Viaduct)	Installation in the middle of wide roads; as long as design is carefully considered, there are few problems. Evaluation: △	Installation in the middle of wide roads; as long as design is carefully considered, there are few problems. Evaluation: △	The cross section of the structure is small and therefore it is superior for providing passengers with unobstructed views of the scenery. Evaluation: ○	
Overall evaluation		◎	○	○	

Note: ◎: Excellent ○: Good ○: fair △: average
Source: JICA Study Team

4.3 Fundamental Concept of the Transport Operation Plan

The fundamental concepts for planning the transport operation plan between Cairo area and 6th of October NUC are as follows:

(1) Coordination with 26th of July Busway project

Implementation of the 26th of July Busway service will precede construction of the Metro Line 4 Extension / 6th of October Railway Line service. Both services are considered as components of the arterial transport network connecting Cairo/Giza CBD and 6th of October NUC. As a point-to-point service, one competes with the other. However, as an area service along the route, the busway connects the two city centers through 26th of July Road while the railway line runs further to the south and connects the cities via Alexandria Desert Road and El Abram Street. Planning along these different routes should be effectively coordinated, so that the two services will be supplemental to each other.

(2) Coordination with urban development planning

Urban development needs transport services. By the same token, transport services require transport demand, which is induced by urban development planning. Fine tuning of planning for both urban development and transport development is therefore imperative.

(3) Planning as a part of an arterial transportation network, combined with existing Metro Lines for maximal effect

The Metro Line 4 Extension / 6th of October Line is not only connecting Cairo/Giza CBD and 6th of October NUC but also functioning as part of Cairo's railroad network. A large number of passengers will transfer from/to Metro Line 4/6th of October Line to/from Metro Line 1 and Line 2. Economic analysis allowed the maximum contribution to the transport network in Greater Cairo Region to be explored.

(4) Compound consideration of point-to-point transport needs and area development needs along the railroad by mixing express and local services

For a point-to-point transportation system, i.e. Cairo/Giza CBD to/from 6th of October NUC, the number of stations should be small. On the other hand, in terms of urban development, a larger number of stations is preferred. In order to partly satisfy both of these contradicting needs, consideration of mixing express and local services needed to be considered. These considerations have been based on the predicted transport demand distribution.

4.4 Premises of the Plan

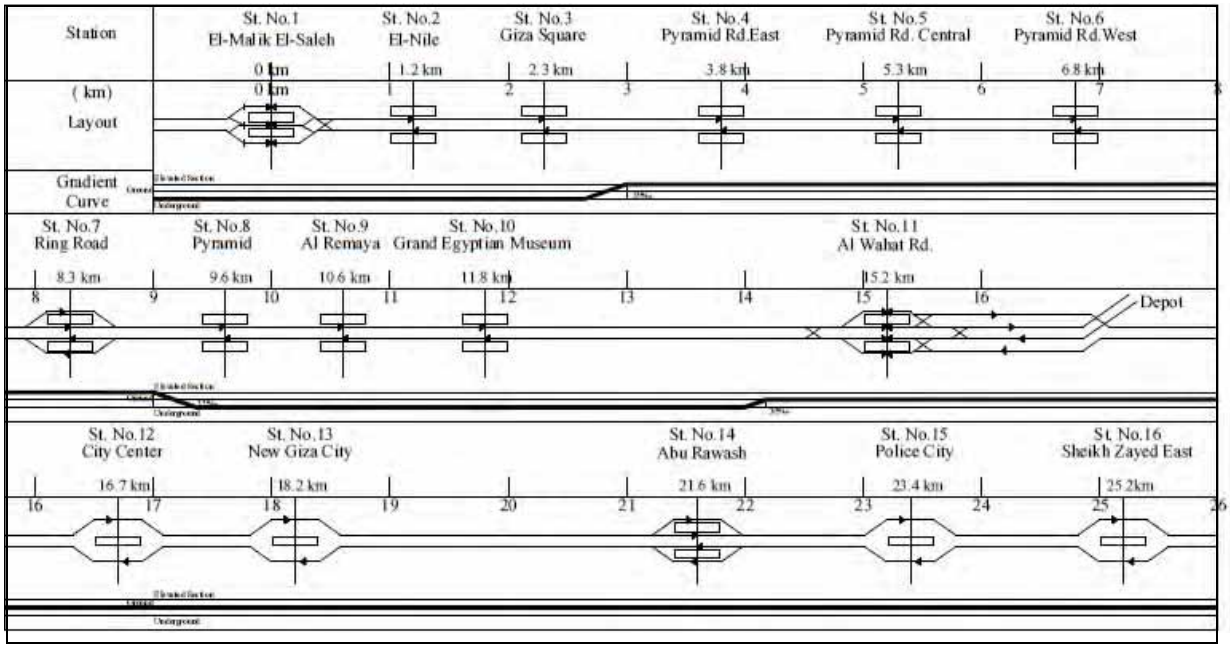
4.4.1 Planned Route, Route Conditions and Track Layout of Stations

Considering the predicted traffic demand, the target year of the implementation was set at 2017 for Phase I (El Malek El Saleh – Al Wahat Road) and in 2022 for Phase II (Al Wahat Road – Bank Street (6th of October)). The track distance for each phase is shown in Table 4.4.1. A summary of the track layout and station locations is shown in Fig.4.4.1. Express trains are planned to stop at eight stations on the section between El-Malik El-Saleh and Bank Street: Giza Square, Pyramid Road Central, Pyramid, Grand Egyptian Museum, Al Wahat Road, Sheikh Zayed Central, 6th of October University, and October West.

Table 4.4.1 Phase-wise Plan

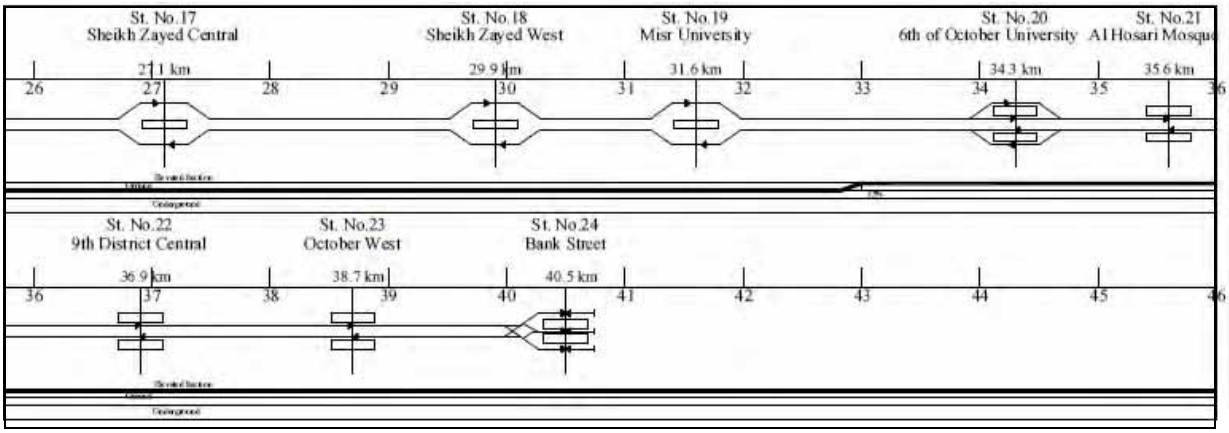
Phase	Section	Track Distance (km)	Target Year
Phase I	El Malek El Saleh – Al Wahat Road	15.2	2017
	Underground Section	7.5	
	At-grade Section	1.5	
	Elevated Section	6.2	
Phase II	Al Wahat Road – Bank Street (6th of October)	25.3	2022
	At-grade Section	17.7	
	Elevated Section	7.6	

Source: JICA Study Team



Source: JICA Study Team

Figure 4.4.1 Track Layout for each Station (1/2)



Source: JICA Study Team

Figure 4.4.1 Track Layout for each Station (2/2)

4.4.2 Transport Demand Volume

The projection of future transport demand was discussed previously in Chapter 3 Section 3.6.2. For convenience, Tables 3.6.4 and 3.6.7 (from Chapter 3) are presented together as Table 4.4.2.

Table 4.4.2 Future Demand of 6th October Line and Metro Line 4-1 for 2017 and 2027 (Unit: Person Trips / Day)

No	Station Name	Alighting	Boarding	Passing Through	
				To 6th of October	To Cairo
2017					
1	El-Malik El-Saleh	11,500	12,500		
1	Metro Line 1 Transfer	79,200	82,700	95,200	90,700
2	El-Nile	6,500	6,600	99,100	94,500
3	Giza Square	20,400	20,100		
3	Metro Line 2 Transfer	68,700	67,000	144,800	144,600
4	Pyramid Road East	44,100	43,700	130,400	130,700
5	Pyramid Road Central	64,300	64,300	102,300	102,600
6	Pyramid Road West	49,900	50,200	75,700	75,900
7	Ring Road	43,200	42,900	50,200	50,700
8	Pyramid	20,500	20,300	34,200	34,900
9	Al-Ramayah	19,800	20,300	15,900	16,000
10	Grand Egyptian Museum	12,700	12,800	3,200	3,200
11	Al Wahat Road	3,200	3,200	0	0
Total		Total Passengers		Maximum	
			425,800	144,800	144,600
2027					
1	El-Malik El-Saleh	15,000	15,000		
1	Metro Line 1 Transfer	42,400	42,900		
1	Metro Line 4	103,800	96,700	161,200	154,600
2	El-Nile	5,600	5,700	184,600	177,800
3	Giza Square	23,200	22,800		
3	Metro Line 2 Transfer	54,100	52,100	221,000	220,700
4	Pyramid Road East	43,200	42,600	216,400	216,800
5	Pyramid Road Central	76,500	77,600	217,500	216,400
6	Pyramid Road West	44,000	44,500	197,100	195,700
7	Ring Road	49,600	49,200	179,100	178,100
8	Pyramid	20,100	19,900	167,300	166,500
9	Al-Ramayah	22,100	22,100	152,300	151,500
10	Grand Egyptian Museum	20,400	20,200	150,600	149,900
11	Al Wahat Road	5,100	5,100	145,500	144,800
12	City Center	5,100	5,000	146,800	146,300
13	New Giza City	2,700	2,700	146,800	146,300
14	Abu Rawash	2,700	2,700	147,400	146,800
15	Police City	9,900	9,900	151,900	151,400
16	Sheikh Zayed East	30,300	30,200	154,900	154,500
17	Sheikh Zayed Central	37,500	37,300	145,400	145,200
18	Sheikh Zayed West	27,100	27,000	136,000	135,900
19	Misr University	21,400	21,400	114,600	114,500
20	6th of October University	21,400	21,400	106,400	106,200
21	Al Hosari Mosque	31,400	31,400	82,600	82,300
22	9th District Central	38,400	38,200	47,600	47,500
23	October West	28,500	28,500	19,000	19,000
24	Bank Street	19,000	19,000		
Total		Total Passengers		Maximum	
			795,800	221,000	220,700

Source: JICA Study Team (Transferred)

4.4.3 Train Operation Plan

(1) Premise of the train operation plan

Under the current Metro schedule, trains operate for 19 hours per day. The first-train departure from a terminal station is 5:15 a.m. and the last train arrival at a terminal station is 24:15 p.m. The proposed Metro Line 4 / 6th of October Line will also follow the current Metro schedule.

The peak hour is between 8:00 a.m. and 9:00 am when the trains are operated at 175-190 % of their boarding efficiency. Following the discussion presented in the Chapter 3 Section 3.5.2-(4), the maximum sectional transport volume/hour/direction is estimated as being 14% of the volume/day/direction.

In sections of track that have dense operations, the headway is affected by the acceleration and deceleration of trains, as well as the length of the train sets, the dwell times, and the set up of the signal equipment. The train operation conditions are summarized in Table 4.4.3.

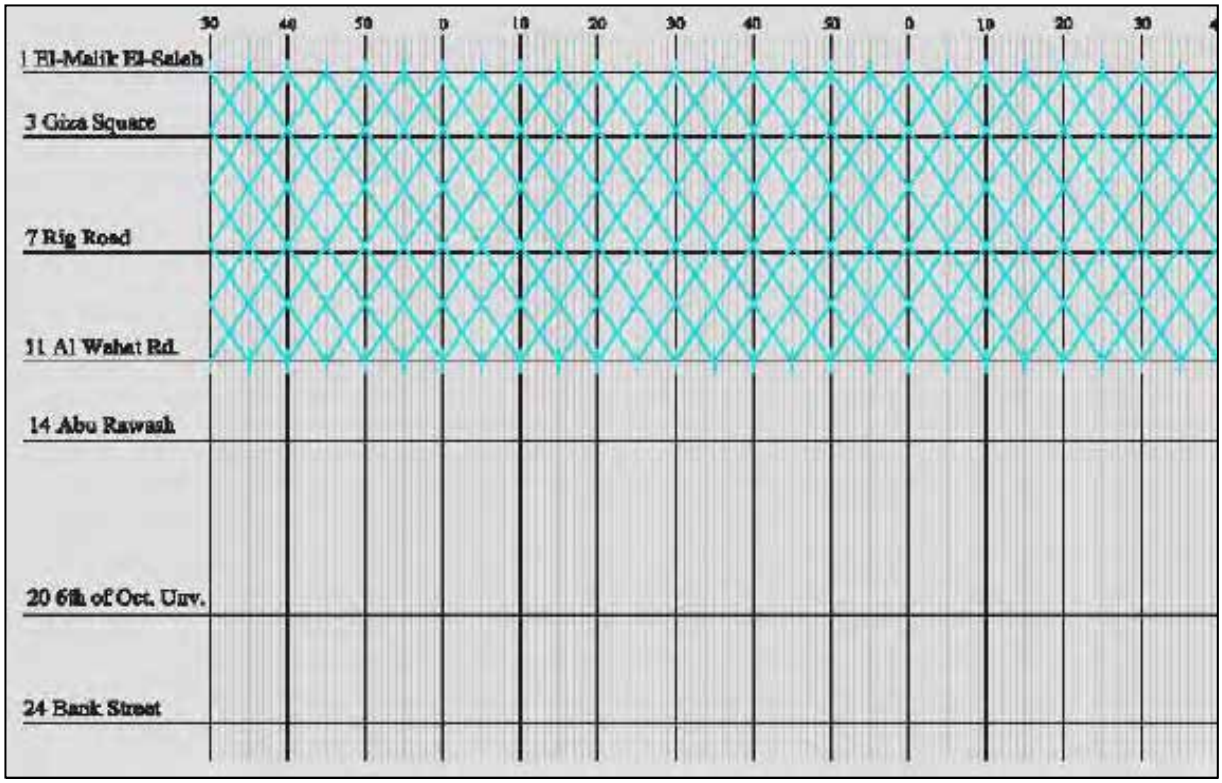
Table 4.4.3 Train Operation Conditions

Item	Unit	Phase I (2017)	Phase II 2022 (2027)
Commercial Section		El Malek El Saleh - Al Wahat Road	El Malek El Saleh - Al Wahat Road - Bank Street
Volume of Sectional Transport (Maximum)	passengers/hour/way	20,272	28,200 (30,940)
Number of Cars per Train	car/train	6	8
Nominal Passengers per Train	passengers/train	942	1,266
Number of Trains at Peak Hour	train/hour/ way)	12	5 (Express: Bank Street) 4 (Ordinary: Bank Street) 4 (Ordinary: Al Wahat)
Train Headway (Peak hour)	minutes	5	4.5
Transport Capacity (Passengers/Hour)	passengers/hour	20,300	31,000
Boarding Efficiency (Congestion Ratio)	%	180	175 (190)
Traveling Time	minutes	24.5	44.5 (Express) 61 (Ordinary)
Scheduled Speed	km/h	37.2	54.6 (Express) 39.8 (Ordinary)
Number of Trains	per day/direction	153	159
Required Train Sets (Reserved)	set	14 (2)	26 (3)
No. of Necessary Cars	car	84	208

Source: JICA Study team

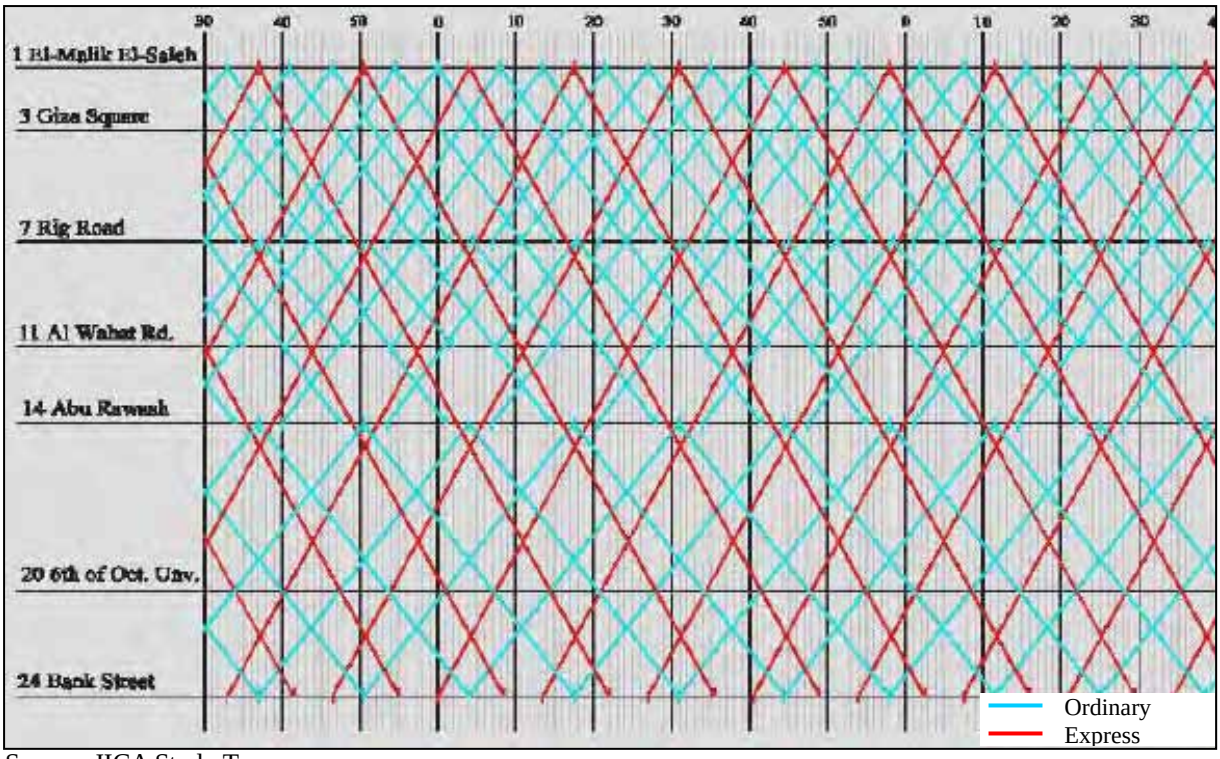
(2) Time table

As discussed earlier, in order to partly satisfy contradicting needs having a different nature, the mixing of express and local services will be adopted for meeting the predicted transport demand distribution. Figures 4.4.2 and 4.4.3 show Train Diagrams compiled for peak hour operation in Phase I and Phase II. Table 4.4.4 shows the number of trains per day per direction.



Source: JICA Study Team

Figure 4.4.2 Train Diagram for Phase I (Peak Hour)



Source: JICA Study Team

Figure 4.4.3 Train Diagram for Phase II (Peak Hour)

Table 4.4.4 Number of Train per Day per Direction

Phase I (2017)																						
Time Period	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Al What Road - El-Malik El-Saleh		2	5	11	12	11	8	8	8	8	11	12	9	8	8	8	8	8	6	2		153
Phase II (2022)																						
Time Period	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Al What Road - El-Malik El-Saleh		1	2	4	4	4	3	3	3	3	4	4	4	4	4	3	3	3	2	1		59
Bank Street - El-Malik El-Saleh		1	4	8	9	8	5	5	5	5	8	9	7	6	6	5	5	5	4	1		106

Source: JICA Study Team

4.4.4 Train Operation Control System

The train operation control system depends on the methods and policies used for establishing the transport plan. A summary of train operation control systems is shown in Table 4.4.5.

Table 4.4.5 Train Operation Control Systems

System	Method	Comments
Interval Control	Speed control	ATC control using cab signals
Signal	Cab signal	Speed signal indication
Interlocking	Sequence control interlocking	Electronic/relay interlocking
Train Protection	Automatic Train Control (ATC)	ATC with one-step control.
Train Operation Control	Centralized Traffic Control	

Source: JICA Study Team

4.5 Rolling Stock

Electric rail cars have been selected. The size and number of the doorways on these cars must be sufficient to enable passengers to enter and exit quickly during rush hour, thereby reducing the boarding/alighting time.

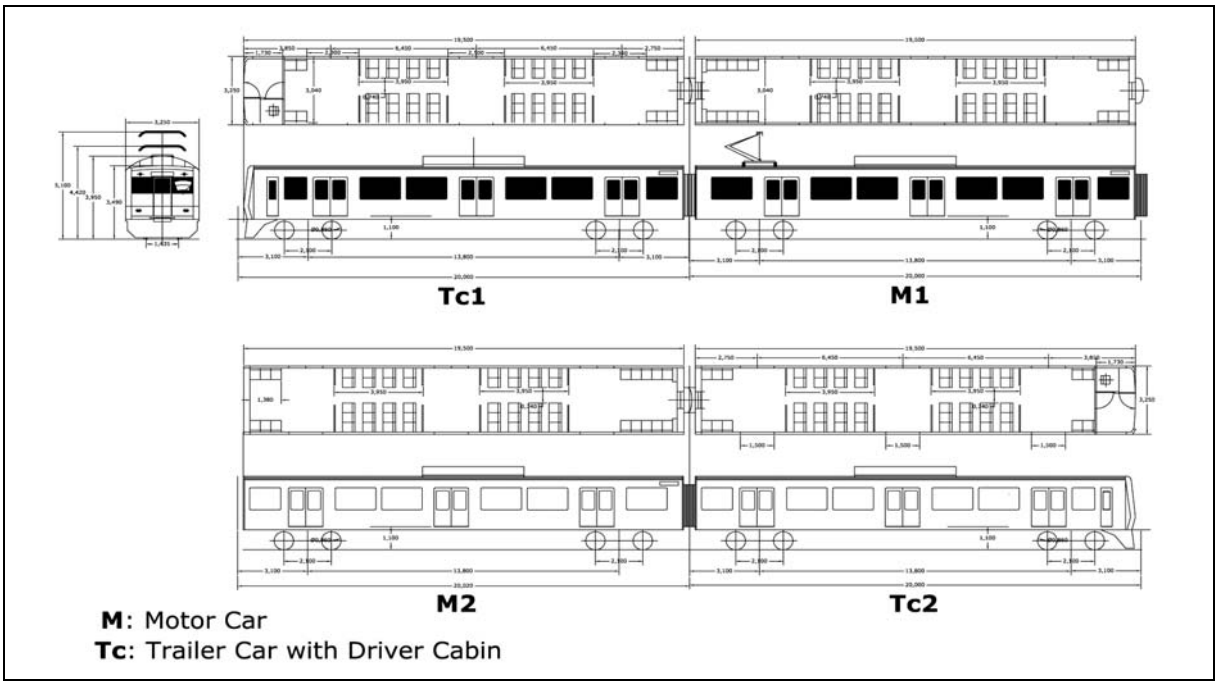
The basic train set will be a four-car train formation comprising 2 motor cars and 2 trailer cars (2M2T). Another motor car and trailer car can be added to create a six-car train formation to better meet transport capacity in the future. In consideration of future increases in transport demand, these train sets will be configured so that one motor car and one trailer car form one unit that can be coupled to allow passage between the cars in each unit. The configurations of typical rail cars are shown in Figure 4.5.1. Figure 4.5.2 illustrates the vehicle gauge.

The maximum speed will be 110 km/h. Because of the short distance between stations in the CBD area, the trains will be equipped to provide fast acceleration and deceleration with the aim of reducing the transit time. The basic technical standards for rolling stock will be based on STRASYA (STandard urban RAilway SYstem for Asia).

Table 4.5.1 Contents of Rolling Stock

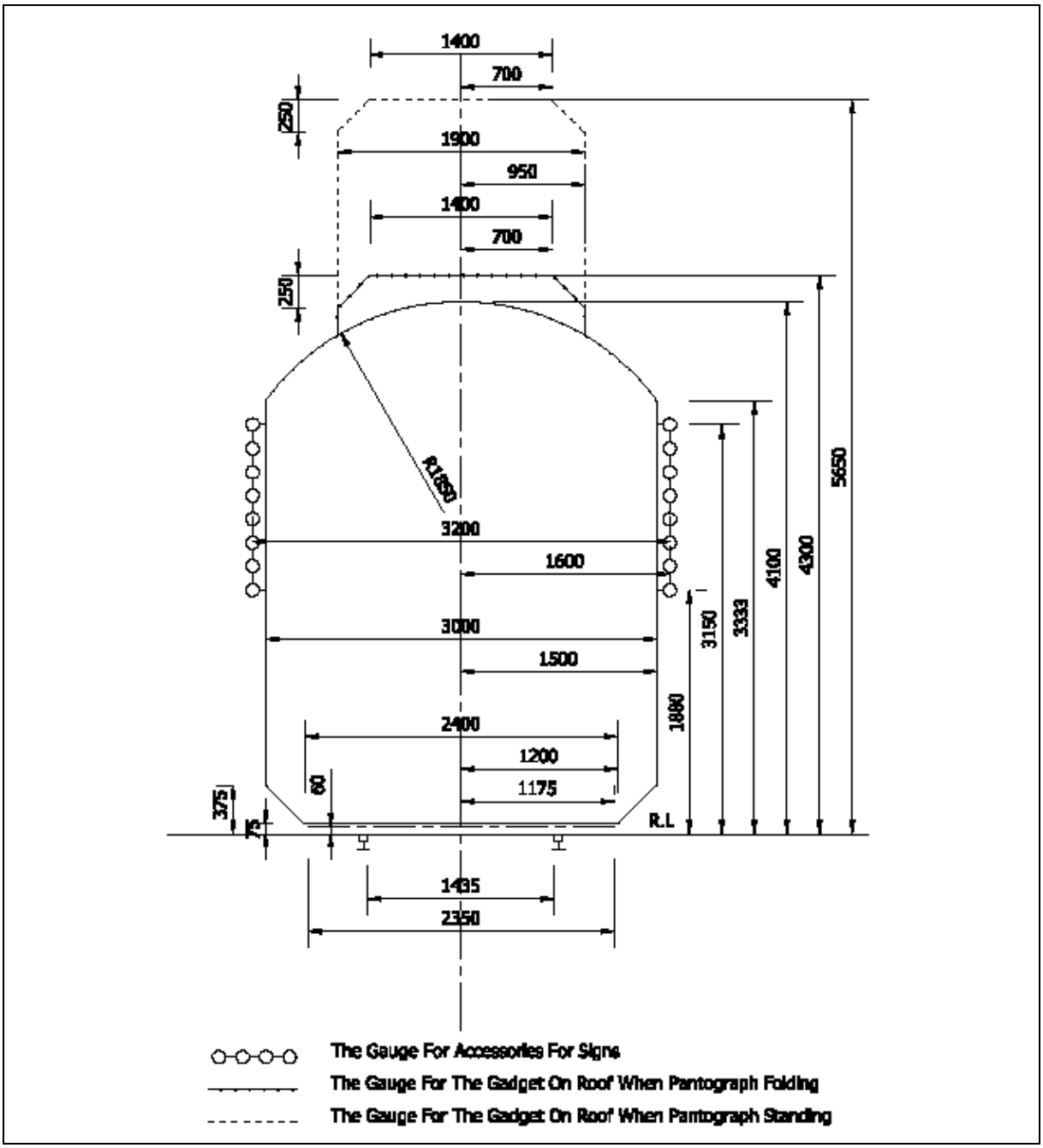
Item		Unit	Quantity	Remarks
Train Formation	Phase I		3M3T	Capable of operating with the headway of 2.5minutes.
	Phase II		4M4T	
Passenger Capacity	Four-car Train	passengers per train	633 (204 seated)	200% car loading factor for peak times.
	Six-car Train	passengers per train	942 (312 seated)	
	Eight-car Train	passengers per train	1,266 (408 seated)	
Performance	Acceleration	km/h/second	3.3	
	Deceleration	km/h/second	3.5	Service braking case

Source: JICA Study Team



Source: East Japan Railway Company

Figure 4.5.1 Typical Configurations of Rail Cars



Source: East Japan Railway Company

Figure 4.5.2 Vehicle Gauge

4.6 Civil Planning

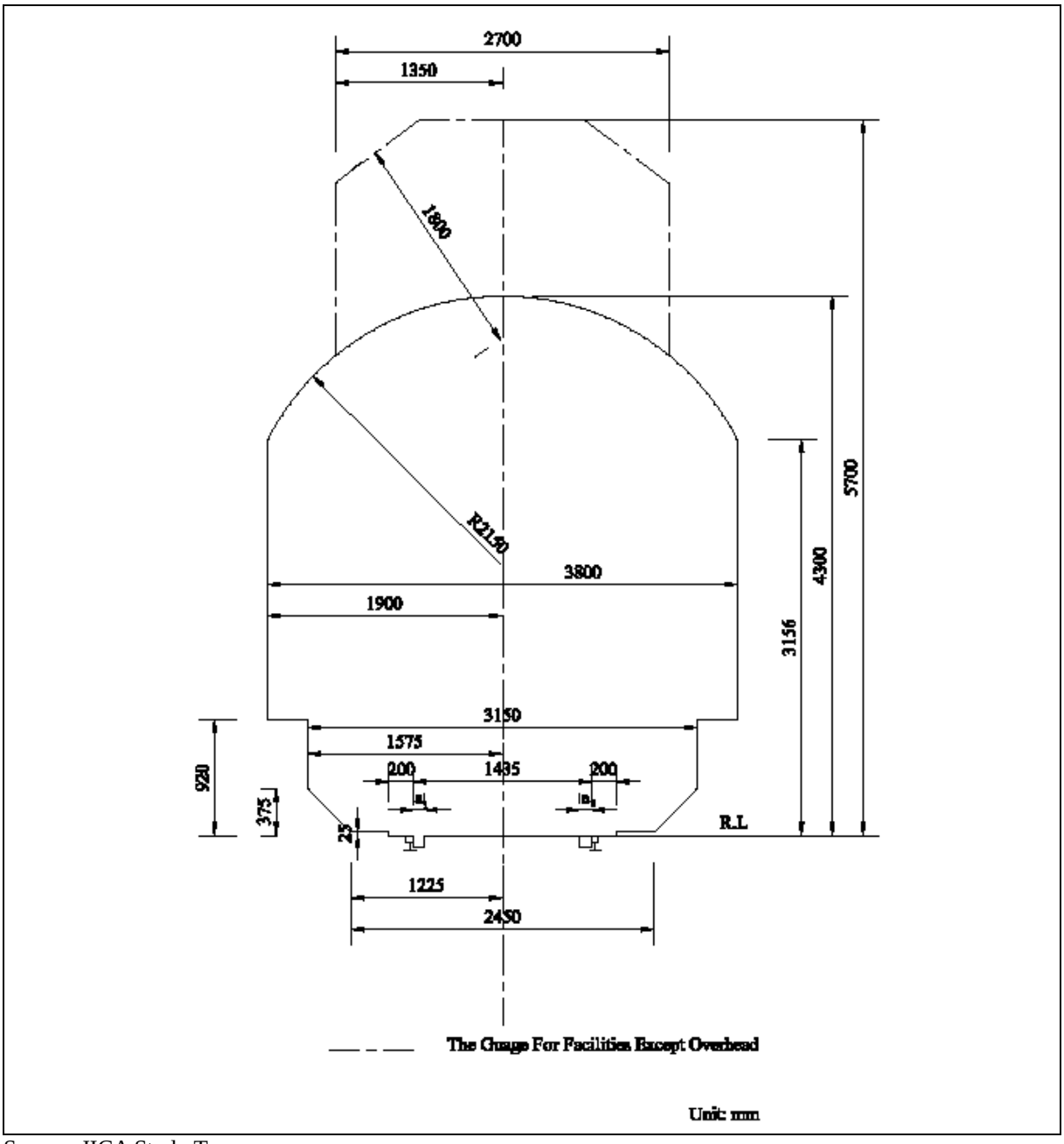
4.6.1 Structure

The construction standards, rolling stock gauge, construction gauge and other related items were determined based on the information presented previously in Section 4.4 “Premise of the Plan” and in accordance with the STRASYA railways standard. The resulting specifications are summarized in Table 4.6.1 and Figures 4.6.1 and 4.6.2.

Table 4.6.1 Construction Standards

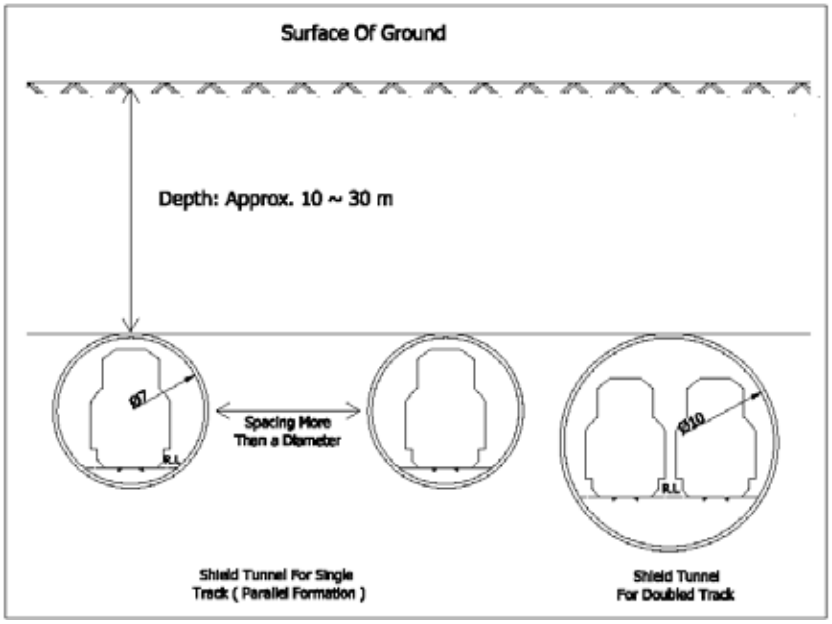
Item	Specification
Track gauge	1,435 mm
Design maximum speed	120 km/h
Operation maximum speed	110 km/h
Minimum radius of curve Main line Platform Side track, car depot	 R = 600 m R = 400 m R = 100 m
Maximum gradient Car depot Minimum vertical radius of curve	 35 ‰ Level
Distance between track centers	3,000 mm
Track structure Main line (Viaduct) Main line (Ground level) Side track, car depot	More than 15’6” (4,724 mm) Slab track Ballast track Ballast track
Rail	110 lb rail
Effective length of platform	170 m
Feeder line voltage	DC 1,500 V
Power collection	Overhead Catenary System

Note1: Existing road width is between 21m and 46m
Note2: No level crossings exist due to fly-over roads.
Source: JICA Study Team



Source: JICA Study Team

Figure 4.6.1 Construction Gauge

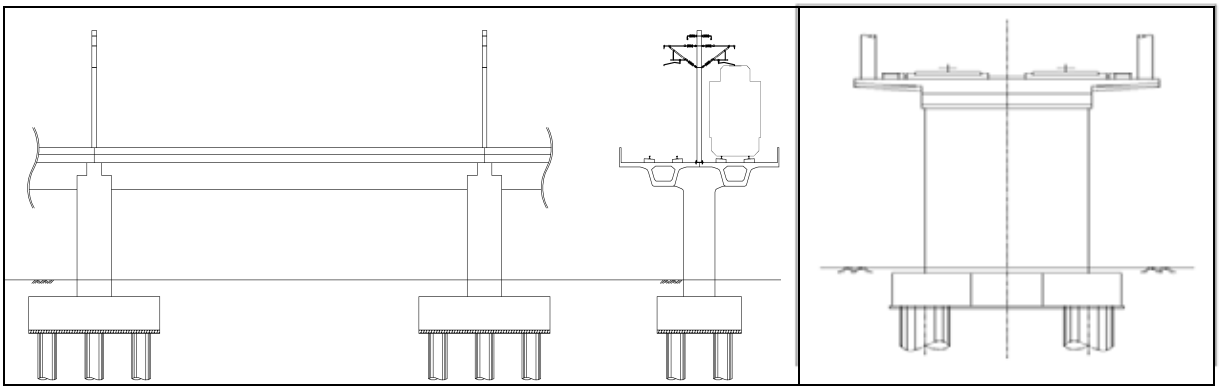


Source: JICA Study Team

Figure 4.6.2 Standard Cross Section in Tunnel

4.6.2 Viaduct

A bridge-type structure is proposed to be adopted for the elevated viaduct section. A drawing showing a typical pre-stressed concrete (PC) box girder structure for the viaduct is shown in Figure 4.6.3. The lower structure, which consists of single-pole piers, is a standard configuration. The foundation is determined by the condition of the ground. Although the occurrence of earthquakes is relatively rare in Cairo, civil structures should be designed to be capable of withstanding earthquakes and in consideration of seismic activity.



Source: JICA Study Team

Figure 4.6.3 Standard Drawing of Elevated Viaduct Structure

4.6.3 Track

The land required for the double track will be secured in the central zone along the existing trunk road in 6th of October NUC. The track structure for a typical at-grade (ground level) section is described in shown in Table 4.6.2 and illustrated in Figure 4.6.4.

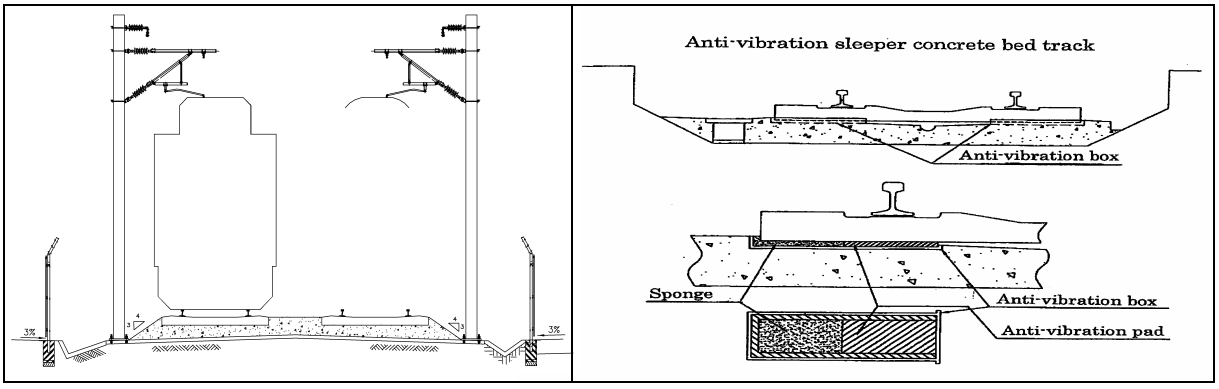
Table 4.6.2 Typical At-GradeTrack Structure

Items	Basic specification
Track bed	Ballast
Rail	110lb rail equivalent to 50kg/m
Sleeper	PC sleeper
Fastening device	Elastic fastening

Source: STRASYA

The track structure has the following specifications in consideration of the speeds of the trains, rider comfort and the preservation of the track.

- The standard of rail is 110 lb rail (equivalent to 50kg/m).
- The rail is continuously welded to be a long rail.
- The thickness of track bed is 30cm in consideration of a train speed of 110 km/h.
- A concrete sleeper is used excluding wooden sleepers at the turn-out.
- The transition curve is introduced in order to improve ride comfort.
- The sides of the tracks have barrier fences to prevent unauthorized entry onto the track or stations yards.



Source: STRASYA

Figure 4.6.4 Typical At-Grade Track Structure

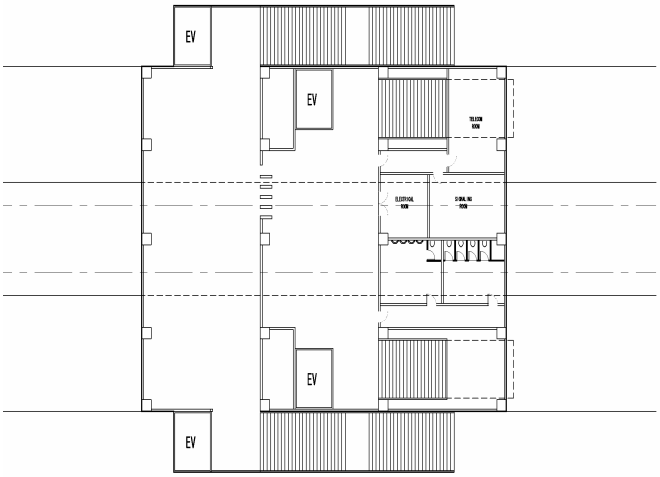
4.6.4 Stations and Facilities

Station entrances/exits will be provided on the both sides of the railway route. The stations at ground level will be an over-track station building with 2 entrances and exits. Typical layouts for a ground level station and an elevated station, and a typical cross section for an underground station are shown in Figures 4.6.5.

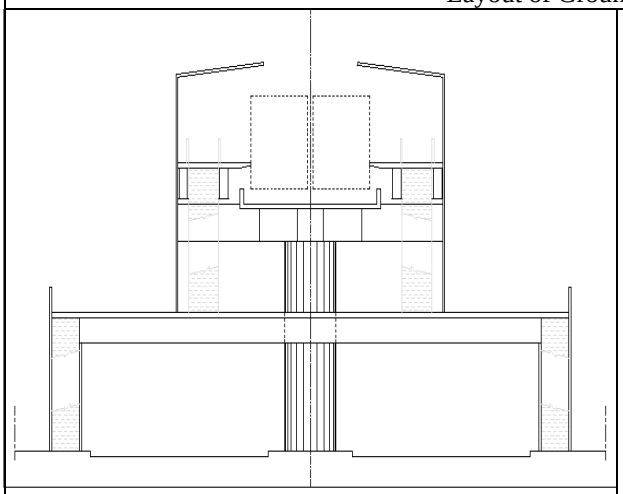
- For elevated stations on the viaduct and for underground stations, separate platforms will be provided where the horizontal alignment is straight. However, for the seven (7) at-grade stations comprising No.12, 13, and No15 through 19, an island type of platform will be adopted.
- The platforms will be 170 meters long in order to accommodate 8-car trains in the future. The width of the platform and staircases will be determined to ensure proper

passenger flows. The height of the platform will be the same as the floor height of the rail cars in order to ensure safe and efficient boarding and alighting.

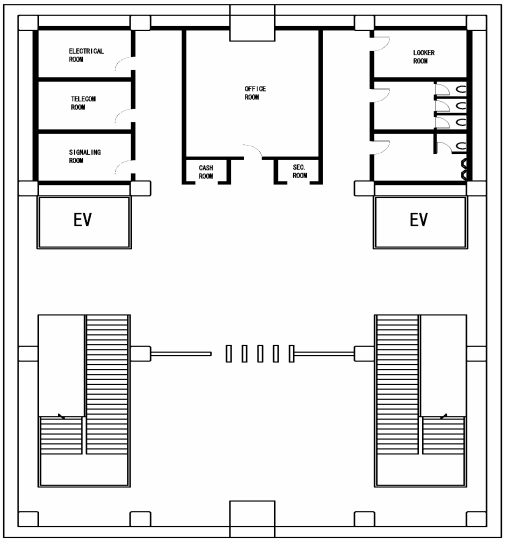
- Office space, toilets and rooms for electrical and telecommunications equipment will be provided at each station.
- In addition to staircases, each station will have an elevator for use by physically handicapped passengers.
- Automated ticket collecting machines will be installed at the ticket gates of all stations.
- In order to connect the new Metro 4 Line to the existing Metro Line 1 at the El-Malik El-Saleh Station, the convenience of through transfer has been considered. The proposed arrangement is for a mutual concourse.
- Transportation plazas will be provided at key stations to facilitate transfer to and from buses and taxis. The construction cost of these transportation plazas and the cost of relocating residents who currently live at the proposed sites of these plazas are assumed to be borne by the relevant local governments, such as Cairo or Giza Governorates, or 6th of October NUC, so that the implementation schedule of these plazas will not affect the railway construction schedule.
- Typical station track layouts were shown previously in Figure 4.4.1.



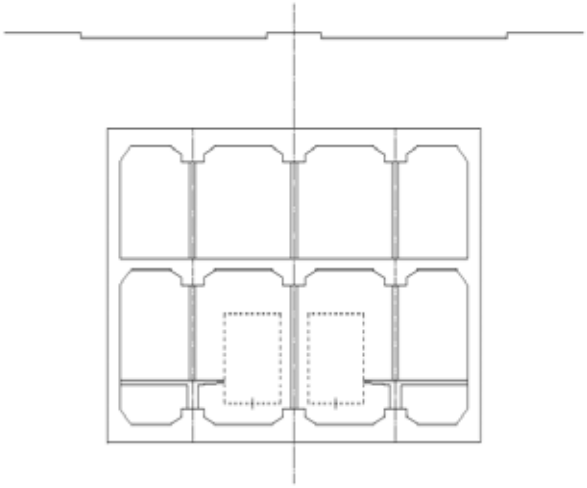
Layout of Ground Level Station



Cross Section of Elevated Station



Layout of Elevated Station



Cross Section of Underground Station

Overview between Line 1 and Line 4 at El Malik Stn.

Source: JICA Study Team

Figure 4.6.5 Typical Layouts for Ground Level, Elevated and Underground Stations

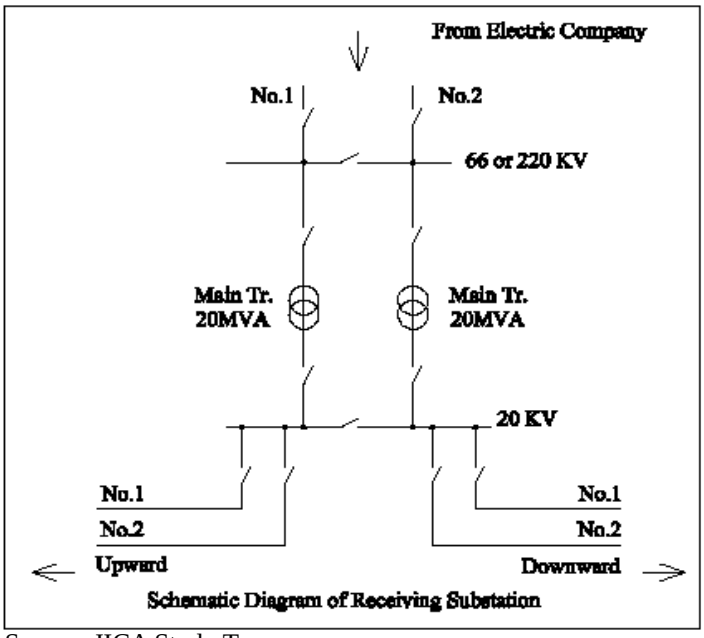
4.7 Electrical Systems

With a stable power supply facility, trains can be operated with the headway of 4.5 minutes with an 8-car formation. Control of the train speed using track circuits will be introduced to ensure safe train operations. A telecommunications system will transmit essential information and data required for the management of the railway. This will be configured using dedicated optical fiber cables for data transmission.

Furthermore, the electrical facilities will be designed in straight forward and reliable way for efficient operation and to minimize the requirements for maintenance.

4.7.1 Power Supply Facility

The receiving substations will be installed near the Car Depot between Al Wahat Street Station and City Center Station. These substations will receive 66 kV or 220 kV electric power from Cairo Electric Supply Corporation. This electric power will be transformed into 20 kV at the receiving substation, and transmitted to the interconnecting power line. The power received through the interconnecting power line will be transformed at substations into direct current (DC) 1,500 V for the traction power supply. These substations will be installed at intervals of about 4 km along railway track. The electric power that is transformed into DC 1,500 V will be fed to the overhead contact lines through a DC high-speed circuit breaker. A schematic diagram for a typical receiving substation is shown in Figure 4.7.1.



Source: JICA Study Team

Figure 4.7.1 Schematic Diagram for a Typical Receiving Substation

4.7.2 Overhead Catenary Equipment for Train Operations

Electric power will be supplied to trains by an overhead contact line. The DC electric power will have an operating voltage based on the standard of 1,500 V, with a maximum of 1,650 V and minimum of 1,050 V. The main components of an overhead contact line are the catenary

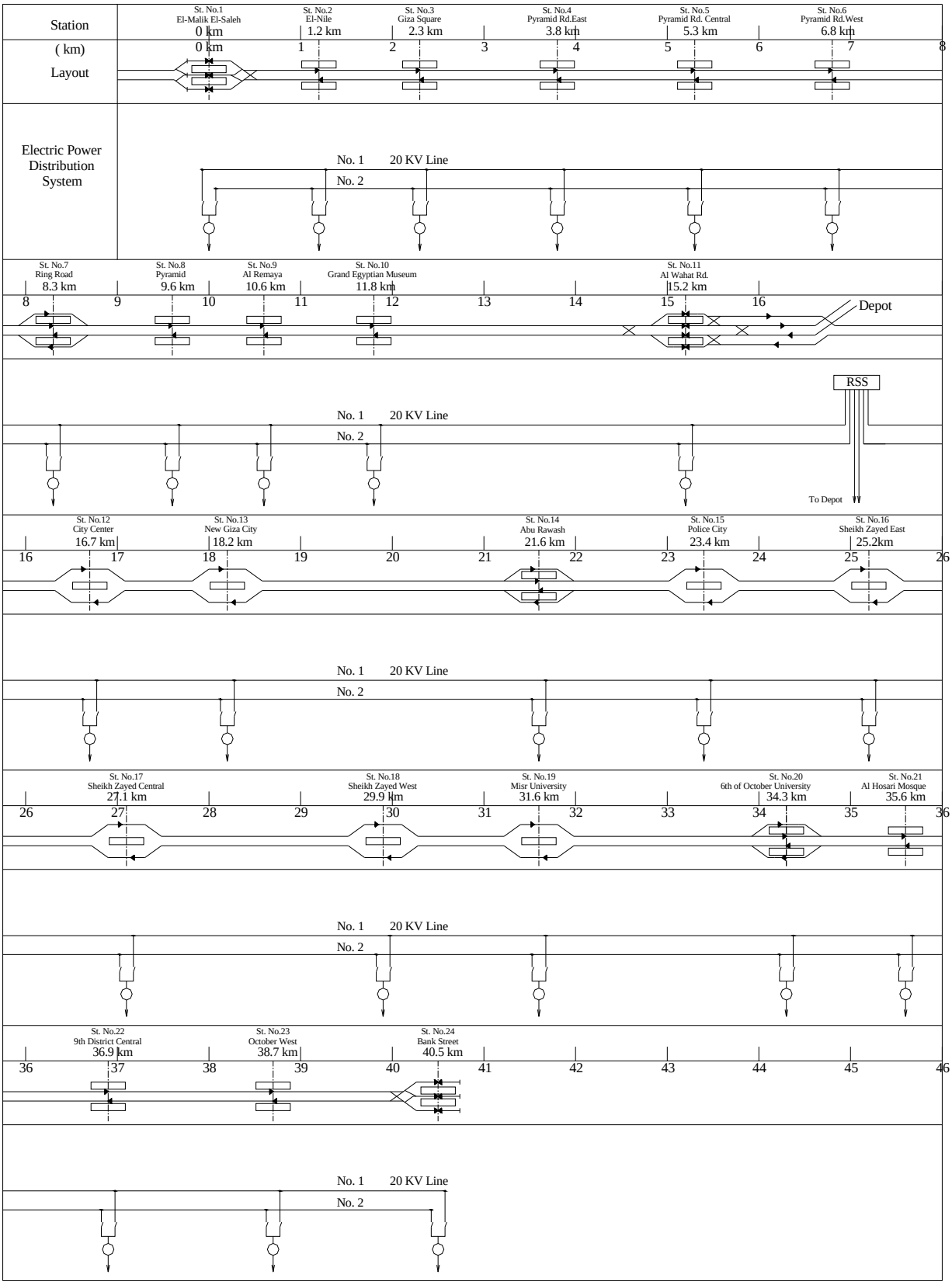
wire, contact wire, feeder and the supporting structures. The characteristics of the specific components will be determined based on the train operating condition, such as the maximum train operation speed, minimum headway and voltage drop. The overhead contact line will be divided by sectioning devices to limit the affects of an accident and allow sectional power cuts to be made for maintenance work.

4.7.3 Power Distribution Equipment for Stations, etc.

Two power distribution lines from the receiving power substations will supply three-phase 20 kV electric power for use in the stations, rolling stock yards, car workshops, the control center and office buildings. The electric power in these distribution lines will be converted into the necessary operating voltage in the electrical equipment room at each receiving location. A diagram showing the electric power distribution system for stations, etc. is shown in Figure 4.7.2.

4.7.4 Remote Control System of Substations

Substations will be unmanned. However, the substations will be monitored and controlled individually by the Control Center (CC). Therefore, equipment that enables monitoring and controlling by the Control Center will be installed at each substation and in the Control Center.



Source: JICA Study Team

Figure 4.7.2 Electric Power Distribution System for Stations, etc.

Table 4.7.1 Power Supply Equipment

Item	Main Equipment
Operating Control Center	- Equipment for the remote monitoring and control of substations.
Receiving Substations	- Location: Between the Sports Park and City Center - Main transformer (66 kV or 220 kV/20 kV): 20 MVA x 2 sets - AC breakers and transformer - Remote monitoring and control equipment installed.
Traction Power Stations	- 11 substations: Installed at intervals of about 4 km along the railway track - Rectifying transformer: 20 kV / 1,500 V 2 sets - Rectifier: 6,000 kW x 2 sets - DC high-speed breaker - Remote monitoring and control equipment installed.
Overhead Contact Lines	- Simple Catenary Type (feeder messenger type)
Distribution Lines	- Three-phase 20 kV power distribution line: Dual line
Electric Equipment Room at each Station	- Transformer for power distribution and AC breakers for power distribution - Remote monitoring and control equipment installed.

Source: JICA Study Team

4.7.5 Signaling

The proposed signaling system is a speed control type that uses the track circuit. An interlocking device will be installed at stations where the railway track diverges. A Centralized Traffic Control (CTC) system will be installed in the Operating Control Center (OCC) at the Giza Car Depot. An outline of the signaling system characteristics is summarized in Table 4.7.2 and a schematic diagram for signaling is shown in Figure 4.7.3.

1) Automatic Train Control System (ATC): An automatic Train Control System (ATC) with cab signals will be adopted. ATC shows the stop signal status using an indicator onboard the train. The indicator operates when the train approaches the point where it should stop. It also performs the deceleration control automatically and stops the train using a single-step brake. To ensure safety, if the train enters a section where it should not go or if there is an abnormality, such as equipment failure, the ATC will stop the train using the emergency braking system.

2) Interlocking Device: An interlocking device will be installed at five (5) stations where the railway track diverges, as shown in Table 4.7.2.

3) Track Circuit: The track circuit will be installed along the entire line for the purpose of determining the train location and for transmission of ATC codes.

4) Depot Device: An interlocking device will be installed in the Giza Car Depot (Rolling Stock Depot/Workshop). If necessary, the track circuit will also be installed at the same location.

4.7.6 Train Operation Management

The operation and management of trains will be performed by the Centralized Train Control System (CTC). The CTC conducts point-to-point monitoring and controls the train operation between the Control Center and each of the stations. The train operation information is

centralized and displayed in the Operating Control Center (OCC). This information is also used by the passenger information system and the passenger guidance announcement system.

A computer-aided CTC device, which is capable of dealing with the Programmed Route Control (PRC) system, will be installed at the OCC.

Table 4.7.2 Outline of Signaling System Characteristics

Item	Main Features
CTC	The Centralized Traffic Control system will be installed in the Operating Control Center (OCC).
ATC/Track Circuit	The track circuit will be used as a transmission line for ATC/TD (train detection) data. The track circuit will be installed to control the train speed and monitor the train location in all sections.
Interlocking Device	The interlocking device will be installed at El Malik El Saleh, Ring Road, Abu Rawash, and Bank Street Stations. If necessary, it will also be installed at 6th of October University.
Signal Cable	Installed in all sections.
Rolling Stock Depot (Giza Car Depot)	The interlocking device and necessary track circuit will be installed in the rolling stock depot and yards. All train operations in the rolling stock depot will be done by manual operation.

Source: JICA Study Team

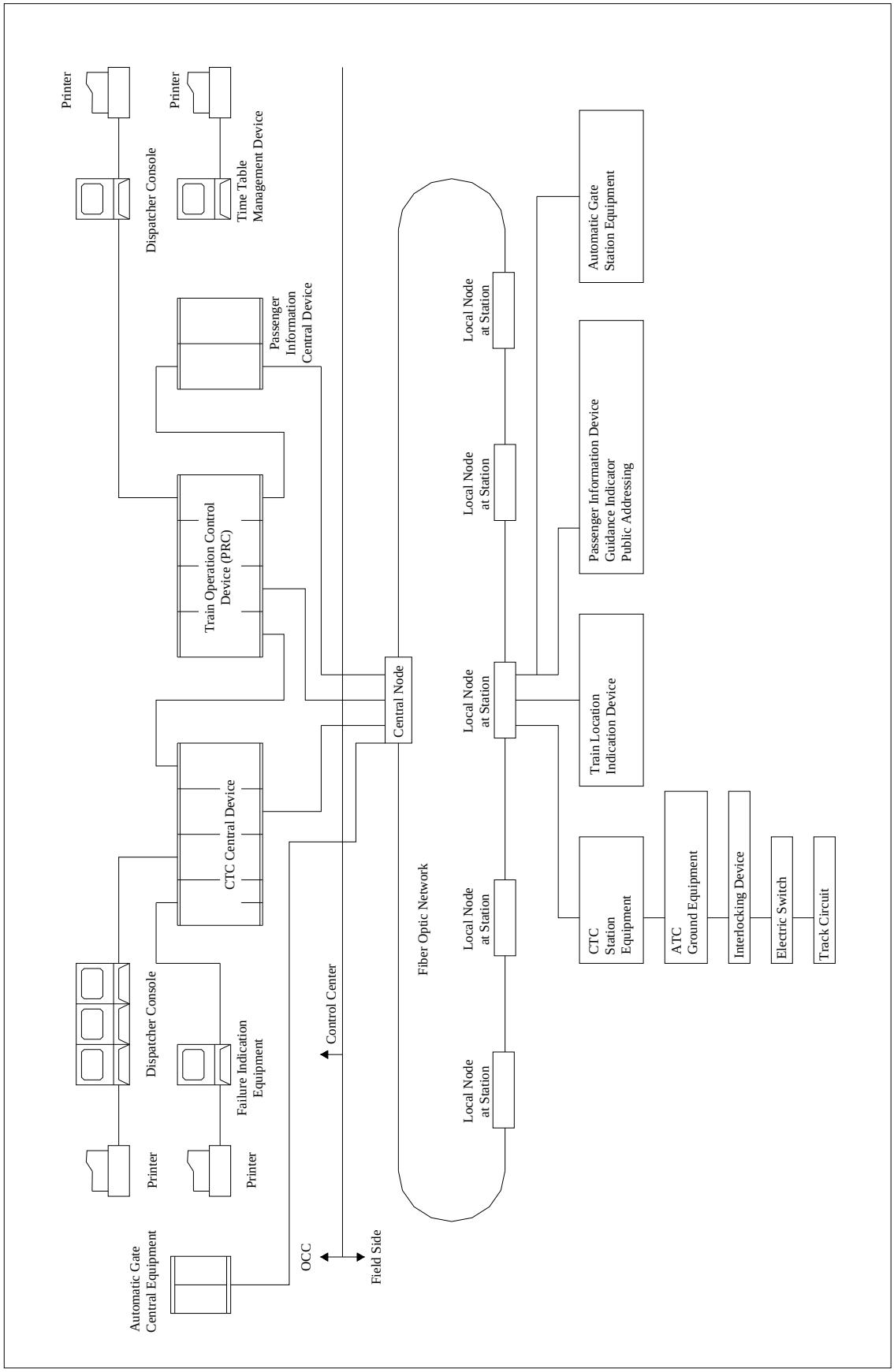


Figure.4.7.3 Schematic Diagram of Signaling and Train Operation Management

Source: JICA Study Team

4.7.7 Telecommunications

The railway telecommunications network will be installed along the wayside as the "central nervous system" of the total railway. The telecommunications network will provide services for train operation to ensure safety, as well as for administration, maintenance of facilities and other such areas.

The telecommunications equipment will comprise a combination of wire communication lines, carrier communications equipment and radio communications equipment. Fiber optic cable will be used for the trunk transmission line and the carrier communication device will be used as the main communications device. The fiber optic cable will be capable of transferring the data with high speed and it is unaffected by electrical noise created during the operation of the railway. A schematic diagram of telecommunications system is shown in Figure 4.7.4. Some notes relating to Figure 4.7.5 are as follows:

1) Optical Integrated Transmission Line: The fiber optic cable will be laid on both sides of the double-track for the entire length of the line. This will create an integrated optical fiber network with the central equipment located in the Operating Control Center (OCC) and extending to each station and the rolling stock depot. This network will also be used as the data transmission line for the CTC, Centralized Substation Control (CSC) and Closed Circuit Television system (CCTV).

2) Private Branch Exchange: A private branch exchange will be installed in the OCC and used for establishing a dedicated telephone network for exclusive use by railway staff. The telephones in each operation unit will also connect to the telephone network.

3) Train Radio Equipment: Train radio equipment will provide interactive communication between the OCC and the trains in operation. It will be available for daily operational reporting and provides a means for close communication through leakage coaxial cables (LCX) to allow prompt response in case of abnormalities and emergencies. For this purpose, a wireless base station will be installed at each station.

4) Closed Circuit Television System: Fixed monitoring cameras will be set up on station platforms. Images from these cameras will be monitored in each station and in the OCC. Image transmission will be done through the integrated optical cable, as mentioned above.

5) Dispatcher Telephone Line for Train Operation, Facility Dispatch and Maintenance: Command communications for train operations will be performed at the dispatcher console in the OCC by using cordless handset terminals set up in a star-type configuration between the OCC and each of the stations, including the maintenance depots. Communication records will be stored via a recording device that is built into the dispatcher console.

6) Wayside Telephone Facilities: Wireless telephone facilities will be installed at specified intervals along the wayside. These telephones will enable communication between train crews and the OCC staff in case of an emergency, as well as between maintenance staff and the OCC regarding maintenance work.

7) Passenger Information Display Equipment: Information about train arrivals/departures and other message will be transmitted from the central equipment in the OCC. The information will be displayed on the equipment installed on the platforms and in the concourse of stations.

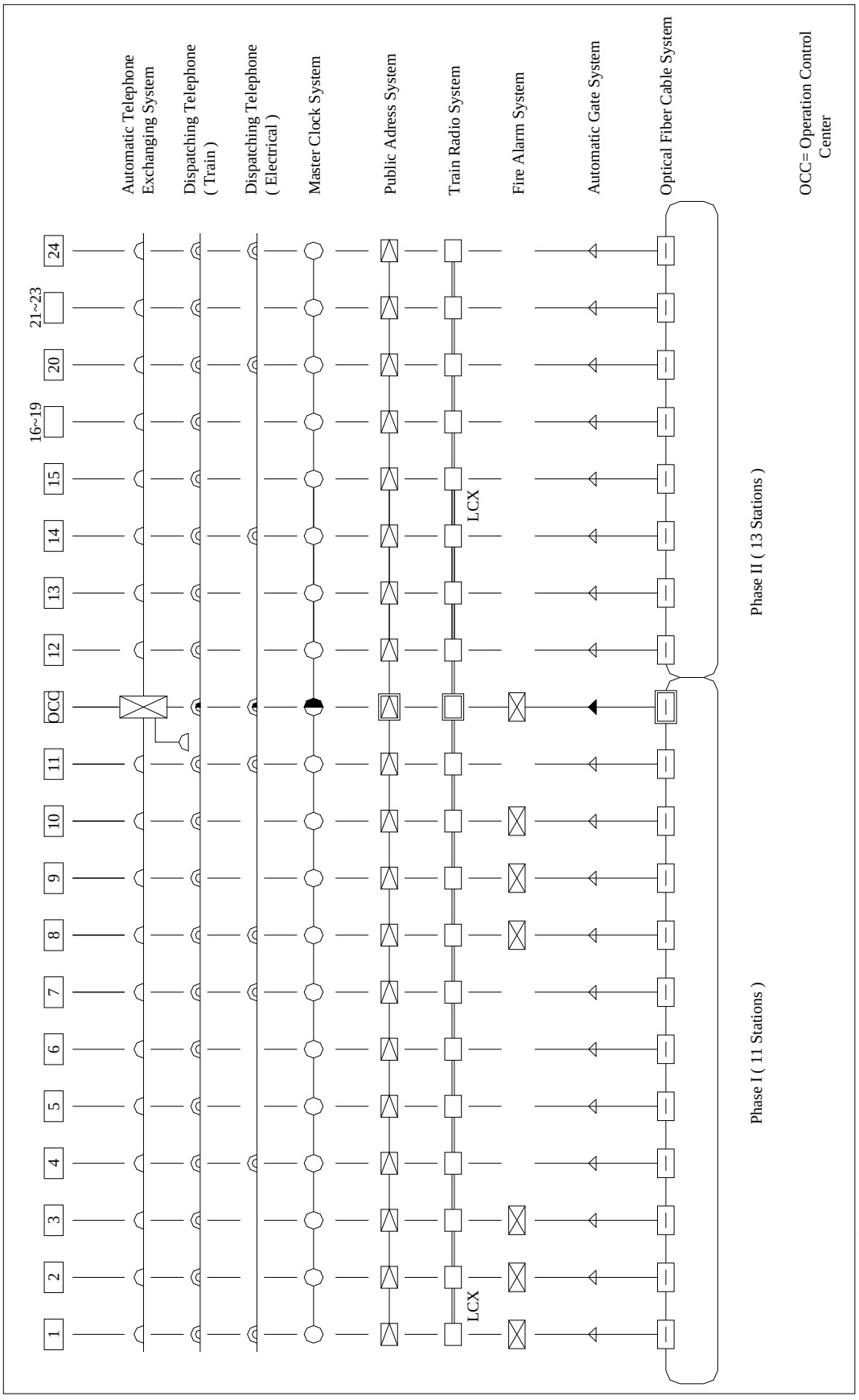
8) Automatic Passenger Guidance Announcement Equipment: Information about arrivals and departures and other necessary announcements about train services will be transmitted from the automatic passenger guidance announcement equipment installed in the OCC to speakers set up on the platforms and concourses in the stations. The OCC can interrupt this system whenever necessary to make additional announcements.

9) Clock System: A master clock in the OCC will send signals to slave clocks in stations and offices, so that all displayed time is synchronized.

10) Fire Alarm System: A fire alarm system will be installed at the OCC, and at the underground stations, namely No.1, 2, 3, 8, 9 and 10.

11) Telecommunication Facilities in the Rolling Stock Depot: In addition to the telephones used for general communications, two-way communication systems (some equipped with a paging function) will be used for communication between trains arriving or departing to/from the rolling stock depot and the section performing shunting operations. Interphones and paging equipment will be provided in the car depot/workshop.

12) Automatic Gate System: The operating status of each gate will be monitored continuously through the station equipment. The gate status will be indicated to passengers on both the entry and exit sides of the gates. The central equipment in OCC will collect and compile the data from all stations, and provide an analysis to various departments within the Finance and Operation and Maintenance Divisions. The station equipment, communicating periodically with the central equipment via the optical transmission system, will include protection of data concerning ticket sales, passenger trips, revenue data and user access.



Source: JICA Study Team

Figure.4.7.4 Schematic Diagram of the Telecommunications System

4.8 Car Depot

Giza Depot will be established in an area adjacent to the Al Wahat Road Station and will be used for the inspection and maintenance of the rail cars and related facilities. A conceptual layout of the depot is shown in Figure 4.8.1.

4.8.1 Assumptions

- The required number of electric cars will be 84 for Phase I (2017) and 208 for Phase II (2022), as indicated in Table 4.8.1.
- Train Formation: The basic formation with inverter control will be: Tc1 + M1 + M2 + Tc2
- Painting maintenance will not generally be required due to the use of stainless steel car bodies.

Table 4.8.1 Assumptions

Item	Phase I (2017)	Phase II (2022)
Number of cars	84 14 train sets including 2 reserved	208 26 train sets including 3 reserved
Train formation	6-car-trains Tc1+M1+M2+T+M3+Tc2	8-car-trains Tc1+M1+M2+T1+T2+M3+M4+Tc2

Source: JICA Study Team

4.8.2 Types of Inspections and Inspection Period

The task of undertaking car inspections is divided into two basic groups: i) operating inspections to be conducted at the car depot; and ii) inspections to be performed during cleaning operations and in the workshop. In total, there are seven different types of inspections that need to be done. The types of inspections, and the frequency at which they must be performed, are listed in Table 4.8.2.

Table 4.8.2 Types of Car Inspections and Inspection Periods

Type of Inspection	Inspection period	Location
1. Daily Inspection	Every time on departure	Stabling Track
2. Inspection by Every 10 Days	Every 10 days	Stabling Track
3.Monthly Inspection	Every 3 months	Inspection Track
4. Semi Overhaul	Every 4 years	Workshop
5. Overhaul	Every 8 years	Workshop
6. Emergency	As required	Workshop
7. Cleaning		
(1) Floor Cleaning	Daily	Terminal Station
(2) Medium Cleaning	Every 10 days	Car Wash Track
(3) Major Cleaning	Every 1 months	Car Wash Track

Source: JICA Study Team

4.8.3 Inspection Facilities

The contents of required inspection facilities are listed in Table 4.8.3.

Table 4.8.3 Contents of Required Inspection Facility

Category	Description
Electric Car Facilities	· Regular Inspection Track (Daily): Inspection of rail car functions, inspection and replacement of consumable parts. · Regular Inspection Track (Monthly): Functional inspection of all main parts, inspection and replacement of consumable parts. · Car Washing Track: Wash the entire car body. · Wheel Turning Track: Wheel turning is performed while wheels are still mounted on the train. · Stabling Track: Night stay for cars. (Initially this will be five tracks for 6 cars each).
Workshop Facilities	· Shop in/out Inspection Track: After the rail car has undergone a disassembly inspection, it is repaired and adjusted. · Disassembly Track: The entire rail car is disassembled in order to do overhauling. · Casual Inspection Track: Inspections and repairs are performed as needed. (1 Track) · Repair Shops: Includes shops for repairing bogies and parts, a parts warehouse and an indoor part repair shop. · Loading Track: Used for transporting materials and for storing incidental parts and materials. · Drill Track: On-site track used for test operations after overhaul inspections. · Control Building: General office space, nap area, dining hall, warehouse.
Shared Facilities	· Power Room: Power receiving equipment, boiler, water pump, others. · Materials Warehouse: For storing hazardous materials. · Shunting Locomotive Shed. · Water Treatment Facilities. · Garage: Parking area for business and operations vehicles. · Elevated Water Tank: Water storage for workshop use and for drinking.

Source: JICA Study Team

4.8.4 Maintenance Depots for Track Work and Electrical System

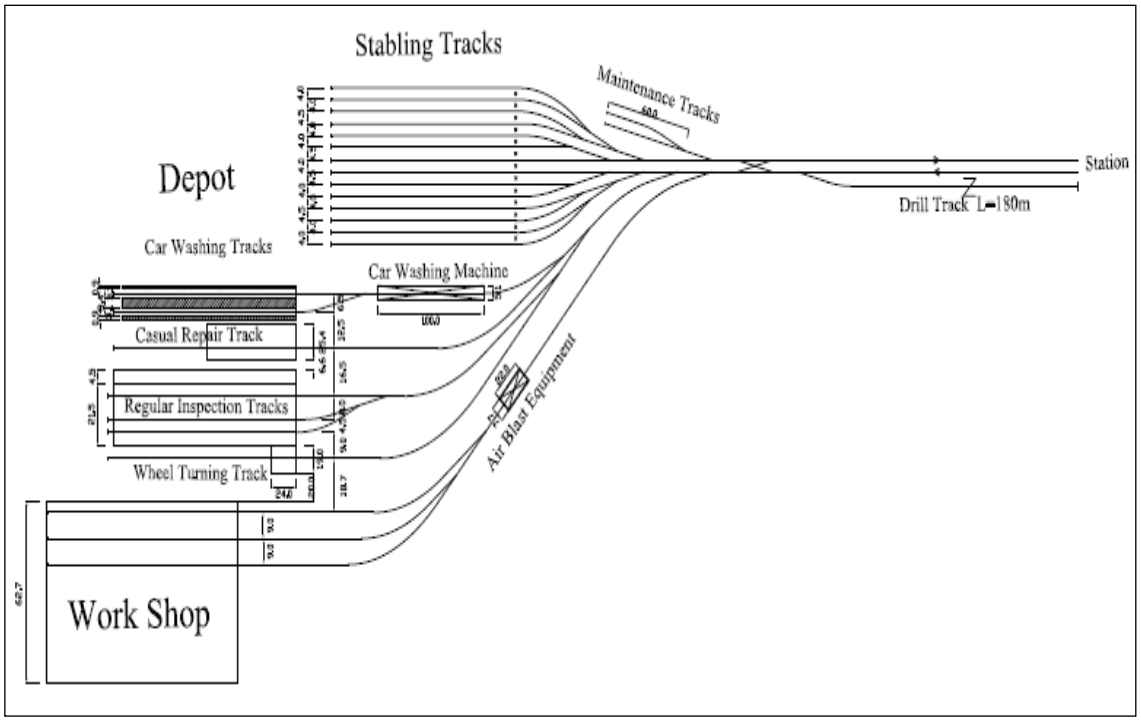
A maintenance depot will be provided adjacent to the car depot. This will include a maintenance track for storing rail vehicles used for maintaining the tracks. The area will also be used for electrical facilities that are required for the overhead catenary, signaling and telecommunications, and for storing inspection cars.

1) Maintenance Workshop Facilities

   - Repair yard for working cars that are used for maintenance.
   - Track work yard, equipment and machining yard.
   - Office space and ancillary facilities.
   - Equipment and materials warehouse, yard (for ballast, ties, rail materials).

2) Depot Signal Cabin: A signal cabin for the depot will be installed inside the complex.

3) Others: A shed for shunting locomotives will be installed inside the depot yard.



Source: JICA Study Team

Figure 4.8.1 Conceptual Layout of the Giza Depot

4.9 Construction Cost and Construction Schedule

4.9.1 Construction Cost

The conditions listed in Table 4.9.1 were taken into consideration for the cost calculation. The basic unit costs for civil construction work are shown in Table 4.9.2.

Table 4.9.1 Conditions for Cost Estimate

Category	Description
Pre-conditions	· The price is valid as at 2007. · The foreign exchange rate used was US$ 1 = LE5.5 = Japanese Yen 110.0 · The construction cost calculation includes a local currency portion and a foreign currency portion. · As for the imported goods (foreign currency portion), 10 % customs duties are appropriated. · The construction cost of power generation plants is not included in the project cost.
Civil construction cost	· Civil construction costs include civil works for underground, at-grade and viaduct sections, building construction for at-grade, underground and elevated stations, track works for underground, at-grade and viaduct sections, as well as construction work for a car depot, substation and other facilities. · When construction cost records from Japan were used, the values were adjusted in consideration of the different unit labor costs and material costs in Egypt. · For the track and other such materials, the procurement from neighboring countries is assumed and the prices refer to the respective Asian countries.

Source: JICA Study Team

Table 4.9.2 Basic Unit Costs of Civil Construction Work

Construction Work	Unit	Unit Cost (US$ million)
Underground Civil works	km	55.9
Elevated Civil works	km	8.7
At-grade stations and Facility	station	4.8
Elevated stations and Facility	station	11.2
Underground stations and Facility	station	26.0
Track work (Viaduct)	km	2.8
Car depot and others	set	27.1

Source: JICA Study Team

(1) Rolling stock: The average unit cost of the rolling stock shown in Table 4.9.3 is assumed to be US$ 1.6 million per car.

Table 4.9.3 Number of Cars to be Introduced and Introduction Cost

Phase	Required number of cars	Cost (US$ million)	Remarks
Phase I	84	134	Incl. design cost
Phase II	124	198	

Source: JICA Study Team

(2) Electrical facilities and car depot facilities: The costs shown in Table 4.9.4 are based on the following:

a) Sub-stations and power distribution facilities: The cost for sub-station and power distribution facilities includes the cost of the electric equipment rooms at stations, cable and wiring work such as installation of the feeder wire, distribution wire, catenary wire, installation work of power monitoring and control facilities, and automatic gate installation work in the stations.

b) Signaling and telecommunication facilities: The cost includes the work related to signaling and safety facilities, the installation work for the ATC, track circuit, interlocking device and installation work for CTC and so on. In addition, the work related to telecommunication facilities, such as the installation of optical fiber cable, installation work for train radio facilities and CCTV is included.

c) Car depot facilities: The cost includes the work for the car depot facilities, such as the mechanical facilities in the car maintenance shop, electric car shed and facilities, and the electricity shed.

Table 4.9.4 Cost of Electrical Facilities and Car Depot Facilities

Installation Work	Total Construction Cost (US$ million)
Sub-station and power distribution facilities	146
Signaling and telecommunication facilities	98
Car depot facilities	36

Source: JICA Study Team

(3) Other costs: Four (4) percent of the construction cost was allowed for the cost of the design and construction supervision. In addition, five (5) % was allowed for the local administration of construction cost. However, the design cost for rolling stock is

considered to be included in the rolling stock cost. Also, 10 % of the construction cost was allowed as a physical contingency to cover unforeseen costs that may be incurred during construction.

The construction cost in each phase and the construction cost per kilometer are shown in Table 4.9.5.

Table 4.9.5 Construction Cost in each Phase and Construction Cost per Kilometer

Phase	Construction Kilometers (km)	Construction Cost (US$ million)	Unit Cost per km (US$ million/km)
Phase I	15.2	1278.5	84.1
Phase II	25.3	822.3	32.5
Total	40.5	2100.8	51.9

Source: JICA Study Team

Details of the construction cost for each phase are shown in Table 4.9.6.

Table 4.9.6 Construction Cost Details for Phase I and II

Item	Phase I				Phase II				Total			
	Total (Mill.US $)	Foreign Amount (Mill.US	Local Amount (Mill.US	Tax (Mill.US $)	Total (Mill.US $)	Foreign Amount (Mill.US	Local Amount (Mill.US	Tax (Mill.US $)	Total (Mill.US $)	Foreign Amount (Mill.US	Local Amount (Mill.US	Tax (Mill.US $)
1 Civil Construction cost												
1-1 Civil Work	479.8	167.1	212.0	100.7	144.0	66.8	40.9	36.2	623.8	234.0	252.9	136.9
1-2 Station	205.6	69.5	93.0	43.1	94.4	42.5	28.6	23.2	300.0	112.0	121.6	66.4
1-3 Track	17.4	4.3	9.5	3.5	21.3	8.7	7.7	4.9	38.6	13.1	17.2	8.4
1-4 Car depot & other	19.0	3.8	14.0	1.1	8.1	1.6	6.0	0.5	27.1	5.4	20.1	1.6
1-5 Station Plaza (9th District Central)	0.0	0.0	0.0	0.0	2.5	1.1	0.9	0.6	2.5	1.1	0.9	0.6
Subotal	721.7	244.7	328.6	148.4	270.3	120.8	84.1	65.4	992.0	365.5	412.7	213.9
2 E & M Construction Cost												
2-1 Rolling Stock	134.4	79.3	24.2	30.9	198.4	117.1	35.7	45.6	332.8	196.4	59.9	76.5
2-2 Substation and power distribution facility	54.9	32.4	9.9	12.6	91.1	53.8	16.4	21.0	146.0	86.1	26.3	33.6
2-3 Signaling and telecommunications facility	36.8	21.7	6.6	8.5	61.2	36.1	11.0	14.1	98.0	57.8	17.6	22.5
2-4 Car depot facility & other	28.8	17.0	5.2	6.6	7.2	4.2	1.3	1.7	36.0	21.2	6.5	8.3
Subtotal	254.9	150.4	45.9	58.6	357.9	211.1	64.4	82.3	612.8	361.6	110.3	140.9
3 Total Construction Cost	976.7	395.2	374.4	207.1	628.2	331.9	148.5	147.7	1,604.8	727.1	523.0	354.8
4 Engineering Cost (4%)	39.1	23.4	11.7	3.9	25.1	15.1	7.5	2.5	64.2	38.5	19.3	6.4
5 Local Administration (5%)	48.8	0.0	43.9	4.9	31.4	0.0	28.3	3.1	80.2	0.0	72.2	8.0
6 Contingency (10%)	97.7	39.5	37.4	20.7	62.8	33.2	14.9	14.8	160.5	72.7	52.3	35.5
Subtotal	1,162.2	458.1	467.6	236.6	747.5	380.2	199.2	168.2	1,909.7	838.3	666.7	404.7
7 Custum Duties (10%)	116.2	0.0	116.2	0.0	74.8	0.0	74.8	0.0	191.0	0.0	191.0	0.0
Total	1,278.5	458.1	583.8	236.6	822.3	380.2	273.9	168.2	2,100.7	838.3	857.7	404.7

Source: JICA Study Team

4.9.2 Construction Schedule

The construction schedule up to the start of commercial operations for the entire line is divided into two phases, as illustrated in Table 4.9.7.

Table 4.9.7 Construction Schedule

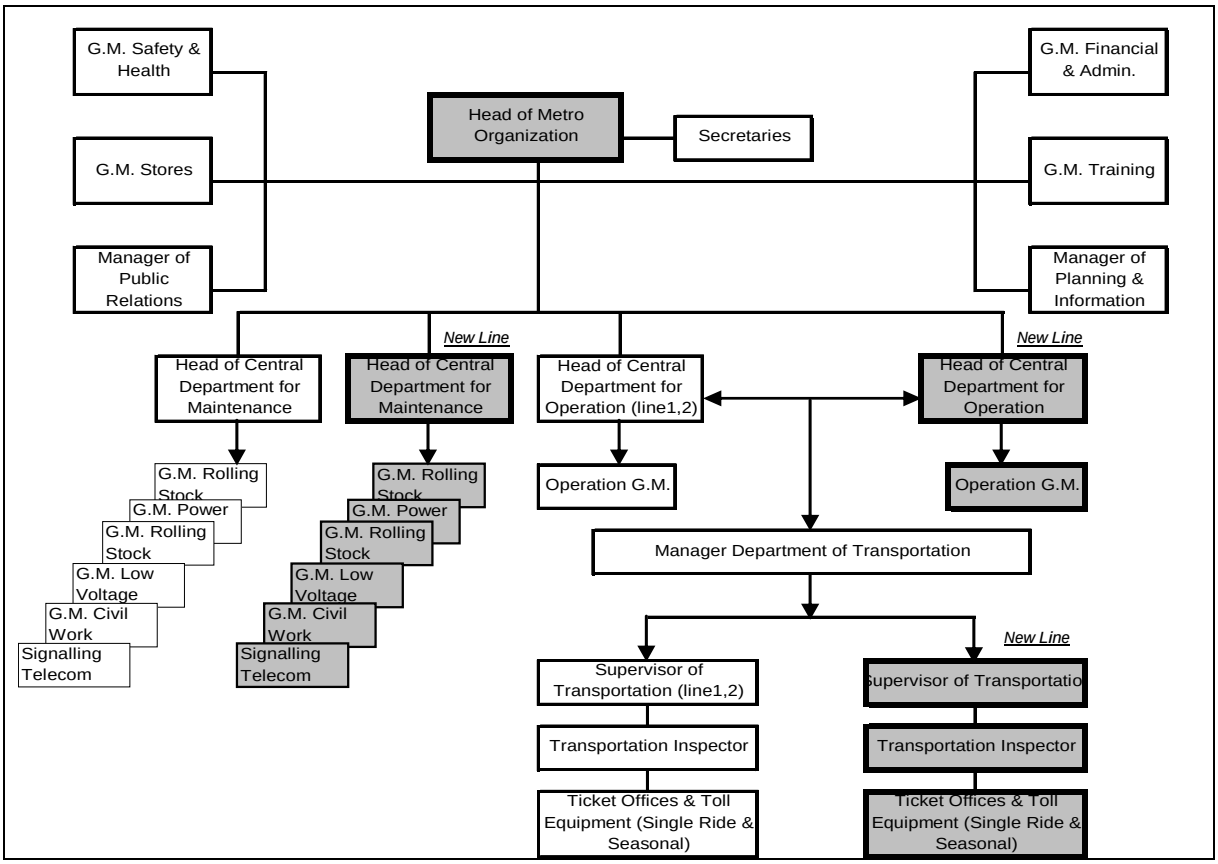
Phase I	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Decision of project implementation															
Various formalities															
Basic design and bidding															
Civil and architectural works															
Civil															
Station															
Track															
Car depot															
Eelectric and mechanical works															
Rolling stock															
Substation and OHC															
Signal and telecommunication															
Car depot															
Training & test															
Start of operation															
Phase II	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Decision of project implementation															
Various formalities															
Basic design and bidding															
Civil and architectural works															
Civil															
Station															
Track															
Car depot															
Eelectric and mechanical works															
Rolling stock															
Substation and OHC															
Signal and telecommunication															
Car depot															
Training & test															
Start of operation															

Source: JICA Study Team

4.10 Management of Operating Organization, Education and Training

4.10.1 Operating Organization

The scale of management and operating organization for the line Metro Line 4 and 6th of October Line, as described in the Pre-F/S, is based on operation volumes predicted for 2017 and 2022, respectively. These predictions take into consideration the actual conditions for Metro Line 1 and Line 2. Figure 4.10.1 shows the new operating organization, which is based on the existing Cairo Metro Organization (CMO). The assignment of personnel in the existing CMO is summarized as in Table 4.10.1.



Source: JICA Study Team

Figure 4.10.1 New Operating Organization based on the Existing One

Table 4.10.1 Current Number of Personnel in CMO

Department of CMO	No. of staff	Share (%)
Administration and financial department	310	5.5
Procurement department	110	2.0
Industrial safety department	240	4.3
Research and training	25	0.4
Sub total	*685*	*12.2*
Transport department L1	690	12.3
Operation department L1	665	11.9
Permanent way department L1	230	4.1
Civil maintenance department L1	174	3.1
Signaling and telecommunication ticket equipment department L1	250	4.5
Electrical power department L1	192	3.4
Rolling stock department L1	843	15.1
Sub total	*3,044*	*54.4*
Transport department L2	422	7.5
Operation department L2	465	8.3
Permanent way department L2	150	2.7
Civil maintenance department L2	75	1.3
Signaling and telecommunication ticket equipment department L2	180	3.2
Electrical power department L2	182	3.3
Rolling stock department L2	397	7.1
Sub total	*1,871*	*33.4*
Total	5,600	100.0

Source: CMO Data Summarized by JICA Study Team

4.10.2 Number of Staff based on the Current CMO Personnel Organization

The basic indices for the assignment of personnel in each department were calculated from Table 4.10.1 and are based on CMO current operations, as shown in Table 4.10.2. Based on theses basic indices, the required staff for Phase I and Phase II were estimated, as shown in Table 4.10.3.

Table 4.10.2 Basic Index for Number of Staff

Department of CMO	Unit	Basic Index
Administration and Finance Department	%	5.50
Procurement Department	%	2.00
Industrial Safety Department	%	4.30
Research and Training Department	%	0.40
Sub Total	%	12.20
Transport Department	Staff/Station/Train	0.0962
Operation Department	Staff/Train-km	19.00
Permanent Way Department	Staff/km	5.76
Civil Maintenance Department	Staff/km	3.77
Signaling and Telecom. Ticket Equipment Department	Staff/km	6.52
Electrical Power Department	Staff/km	5.67
Rolling Stock Department	Staff/Car	2.66

Source: JICA Study Team

Table 4.10.3 Number of Staff Required for 6th of October Line

Department of CMO	Phase I	Phase II	Total	Share (%)
Administration and financial department	58	83	141	5.6
Procurement department	21	29	50	2.0
Industrial safety department	45	64	109	4.3
Research and training	5	7	12	0.5
Sub total	129	183	312	12.3
Transport department	162	205	367	14.5
Operation department	201	227	428	16.9
Permanent way department	88	146	234	9.2
Civil maintenance department	57	95	152	6.0
Signaling and telecommunication ticket equipment department	99	165	264	10.4
Electrical power department	86	143	229	9.0
Rolling stock department	223	329	552	21.7
Sub total	916	1,310	2,226	87.7
Total	1,045	1,493	2,538	100.0

Source: JICA Study Team

4.10.3 Number of Staff based on the Universal Standard

At present, the organization of CMO seems to be overstaffed when compared to a staffing requirement based on the Universal Standard index. The Universal Standard is itemized below and the calculated number of staff is shown in Table 4.10.5.

(1) Headquarters employee requirements:

The required number of headquarters staff is calculated as approximately 15% of the number of field staff. As shown below, the total number of field staff is estimated as 538 staffs in Phase I and 1,185 staffs in Phase II (Phase I + Phase II). Calculating 15% of 538 and 1,185 the required number of headquarters employees is 81 and 178, respectively.

(2) Field staff requirements

1) Station Employee Requirements: With the assumed installation of automatic ticket gate equipment, the required number of employees in each station will be standardized as:

- Staff for a standard station will be 2 for 3 shifts and 1 reserve staff for 2 shifts.
- Staff for a main station, namely El Malik El Saleh, Giza Square, Al Wahat and Bank Street, will include an additional 2 staff for 2 shifts.

A reserve ratio of 1.83 will be applied to the any of assignment. Calculation of the reserve ratio (1.83) is shown in Table 4.10.4.

Table 4.10.4 Calculation of Reserve Ratio

Item		Number
Calendar days in a year		365
Non-working days		
	Friday and Saturday	52 x 2 = 102
	National Holiday	20
	Paid vacation	30
	OJT	12
Non-working days total		166
Working days		365 - 166 = 199
Reserve ratio		365 / 199 = 1.83

Source: JICA Study Team

The total number of station employees is 183 staffs *(((2x3+1x2)x11+2x2x3)x1.83)* in Phase I and an additional 213 staff *(((2x3+1x2)x14+2x2x1)x1.83)* for Phase II (extension section), so the total for Phase II will become 396 staff.

2) Crew: In Phase I, train operation will be an ordinary service only. The crew, comprising a driver and a conductor team, serve five round trips per day. The total number of services is 153 trips per day (see Table 4.4.4), so the necessary crew is 112 staff *(153/5x2x1.83)*.

In Phase II, all planned tracks will be in operation and the operating time for one trip will be approximately 120 minutes for ordinary trains and 90 minutes for express trains. Assuming one work unit serves one trip for express trains and two trips for ordinary trains, and in addition 60 minutes of waiting time and 30 minutes of transportation time are added to the start of work, the working hours for the crew becomes 7 hours. The total number of services is 159 times (see Table 4.4.4), so that necessary crew is 194 staff *(159/3x2x1.83)*.

3) Operation Depot (Depot of Drivers and Conductors): The number of service staff for the operating section is assessed as 15% of the crew. In Phase I, 17 staffs *(112x0.15)* will be necessary and in Phase II, 30 staffs *(194x0.15)* will be necessary.

4) Depot (Inspection and Repair): The required number of rail car maintenance staff in the depot, including management, is calculated as 0.5 employees per car unit. The number of clerical staff required is approximately 10% of the maintenance staff. Thus in Phase I, because there are 84 car units, as shown previously in Table 4.4.3 above, therefore, the Depot will need 85 staffs *(84x0.5x1.1x1.84)*. In Phase II, the depot will require 211 staffs *(208x0.5x1.1x1.84)* in total.

5) Workshop (Heavy Component Inspection and Overall Inspection of Cars): The workshop, which is in the depot, is where major inspections and repairs are performed every four years. The assessment is based on one staff for every 10 cars. It is assumed that 10% of the maintenance staff will be clerical staffs for the materials and other areas. This means that Phase I will need 17 staffs *(84.9x1.1x1.83)* and Phase II will need 42 staffs *(208/10x1.1x1.83)*.

6) Civil and Facilities Depot (Inspection and Maintenance of Track and Structures): The required number of staff for tracks, structures and other facilities was calculated as 2 staffs per commercial kilometer. It was assumed that 10% of that number will be clerical staff. Because the total commercial kilometers is 15.2 km for Phase I and 15.2 km + 23.3 km for Phase II (see Table 4.4.1), required staff is 62 *(2x15.2x1.1x1.83)* and 156 *(2x38.5x1.1x1.83)*.

7) Electric Depot (Inspection of Overhead Catenary and Signal Equipment and their Maintenance including Station Facility): Maintenance staff for power, signal, communication and other electrically related equipment and facilities was calculated at 2 staffs per commercial kilometer. It was assumed that 10% of that number will be clerical employees. Considering the total commercial kilometers is 15.2 km for Phase I and 15.2 km + 23.3 km for Phase II (see Table 4.4.1), the required staff is 62 *(2x15.2x1.1x1.83)* and 156 *(2x38.5x1.1x1.83)*.

The above discussions are summarized in Table 4.10.5.

Table 4.10.5 Management Organization (Number of Staff)

Item	Phase I		Phase II (Additional)		Total
	No. of Staff	Remarks	No. of Staff	Remarks	
Field Staff	538		647		1185
Stations	183	11 Stations	213	14 Station	396
Operating Section	129	153 Trains	95	159 trains	224
Depot	85	84 Cars	126	124 Cars	211
Workshop	17		25		42
Civil and Track	62	15.2 km	94	25.3 km	156
Electrical Section	62	15.2 km	94	25.3 km	156
Headquarters Staff	81	Administration, Operations, Engineering	97	Administration, Operations, Engineering	178
Total	619		744		1363

Source: JICA Study Team

4.10.4 Education and Training (before the Opening of Operations)

(1) Education and training

CMO, with previous experience in the operation of Metro Line 1 and 2, is the likely candidate for operating a high-density train system on the 6th of October Line, including part of Metro Line 4. However, training and education, before the start of the operation will be absolutely essential for ensuring the smooth introduction of operations.

(2) Instructors

Furthermore, there exists an urgent need to nurture "instructors" who will lead education programs to be conducted prior to the opening of operations, thereby assisting the smooth and effective commencement of services. It is desirable that the following process for developing instructors, who will serve as the trainers for the operating staff, be implemented one year prior to the start of commercial operations.

- Education and training programs, especially for the railway technology concerning urban transport, should be conducted in Egypt.
- Those trainee instructors who have completed the above program should be dispatched to the country providing the equipment so that these staff will acquire actual hands-on experience.
- After returning to Egypt, the trainee instructors will edit manuals and arrange various regulations, educational and training materials for the start of operations.

Six months before the start of operations, education and training of the on-site employees will be conducted in preparation for the start of operations.

(3) Specialized fields for the instructors

At least 10 instructors, as shown in Table 4.10.6, will require overseas training on specialized programs, as mentioned above, for one month or longer. A long term training program will also be desirable for acquiring enough understanding of the new rolling stock and signal systems to cope with emergency troubles in the case that equipment failures occur.

Table 4.10.6 Contents of Instruction and Numbers of Instructors

Specialized Field	Item	Description	Instructors
Train Operation	Train operation planning, instruction and training.	Planning of operation, transport planning, organization of regulation documents and measures to prevent accidents.	2
Rolling Stock	Car design, equipment and maintenance.	Maintenance and management function, and performance for cars.	2
Civil and Facility	Maintenance and management of tracks.	Maintenance and management of tracks.	2
Electrical Facility	Maintenance of electrical equipment.	Maintenance and management, function and performance for OHC and power supply equipment.	2
Signaling and Telecommunications	Maintenance of electronic equipment.	Maintenance engineering, function, and performance of ATC, CTC and others.	2
Total			10

Source: JICA Study Team

(4) Overseas instructors

Railway incidents that are beyond the understanding range of instructors might occur within a certain period before or after the opening of operations. Therefore, it would be better to dispatch overseas instructors to Egypt for a certain period prior to the start of operations, to assist with establishing smooth operational procedures. In particular, overseas instructors should assist with maintenance and emergency procedures for signaling, telecommunications and rolling stock.

(5) On the job training

As for the maintenance and management required for a safe and reliable transport system, there is a continuous need for improvement of technical skills and the base knowledge of the staff. Therefore, the operation staff will be required to refine their skills for operating and technical maintenance. Regular on-the-job training will be very effective for maintaining and improving their technical skills.

CHAPTER 5 BUSWAY TRANSPORT SYSTEM FOR THE WESTERN DEVELOPMENT CORRIDOR

5.1 Introduction

5.1.1 General

As mentioned in Chapter 3 Section 3.3.1, the concept of the busway system on the Western Development Corridor that was proposed by CREATS has already been accepted and approved by GOPP. In the present Pre-F/S, the busway was assessed as being appropriate to provide a short-term solution to public transport needs for the Western Development Corridor. However, in order to implement this system, it is necessary to clarify some engineering issues. Therefore, based on the CREATS proposal, the Study Team examined various factors and conducted pre-feasibility engineering design for the busway system.

5.1.2 Route of the Busway in the Western Development Corridor

(1) Route of the busway

The concept of the busway system is to operate articulated buses on an exclusive bus lane in order to serve passengers in the Western Development Corridor. The busway plan that is based on this corridor was originally proposed by CREATS. The necessity for this busway was re-confirmed in this Pre-F/S. Behouth Station on Metro Line 2 is the starting point of the busway transport service, because Cairo University Station does not have sufficient space for construction of a terminal. The industrial area of 6th of October NUC is the termination point of the busway. The main route of the busway that passes through the Western Development Corridor is as follows:

- Behouth Station on Metro Line 2 ～ following a canal and Almamein Street along the ENR Line ～ Imbaba ～ Agriculture Road ～ Ring Road ～ 26th of July Road ～ crossing an intersecting on Alexandria Desert Road ～ 26th of July Road ～ Residential Area in 6th of October NUC ～ Industrial Area of 6th of October NUC.

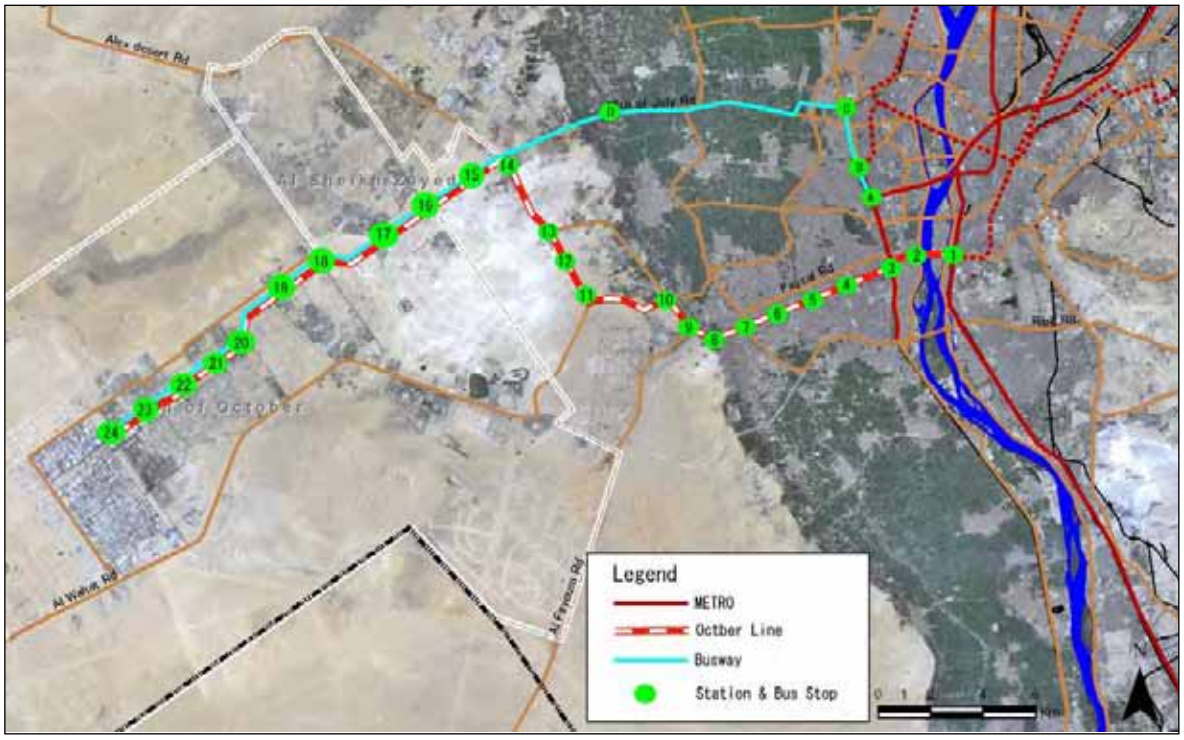
(2) Location of stations

Eleven (11) bus stations and four (4) transfer station plazas have been proposed in this study. The busway route and the location of stations were illustrated previously in Figure 3.6.11 of Chapter 3. This figure is presented again here as Figure 5.1.1. The major features of the recommended busway system are summarized in Table 5.1.1.

Table 5.1.1 Recommended Features of Busway System

Busway Feature	Concept Recommended by SDMP	CREATS Concept (2003)
Busway Route		
Origin of busway	・ Behouth Station on Metro Line 2	・Cairo University Station on Metro Line 2
Destination of busway	・ 6th of October Industrial Area	・6th of October Industrial Area
Cairo University – 26th of July	・Route along wall located at the east of railway.	・Route along the canal on the west side of railway.
Connection with 26th of July	・Busway underpass at 26th of July with transition to an elevated structure to cross the railway line and follow beside the road north of 26th of July. The elevated route passes through agricultural land before joining 26th of July.	・Elevated busway supported on a portal frame pier at the intersection with 26th of July. However, there is no available space to construct the pier.
26th of July – Alexandria Desert Road	・Busway occupies the outside lane	・Busway occupies the median strip.
Alexandria Desert Road – 6th of October Entrance	・Outside lane used as a bus priority lane in each direction.	・Busway occupies the median strip.
6th of October Entrance – Residential Area	・ Outside lane used as a bus priority lane in each direction.	・ Outside lane used as a bus priority lane in each direction.
Busway Total Length	・35.6 km	・38.0 km
Bus Terminal		
Behouth or Cairo University Terminal	・Located on the western side of ENR railway and connected with Behouth Station of Metro Line 2 by an underground pedestrian passage. ・Terminal is elevated type.	・Located on the west side of railway and connected with the Cairo University Station for Metro Line 2. ・Terminal is an elevated type.
6th of October NUC Terminal	・Relocated to the perimeter entrance of the Industrial Area. ・Land acquisition for the Transfer Station Plazas is possible at this location.	・Located in the central part of the Industrial Area. ・Land acquisition for the Transfer Station Plazas would be difficult.
Bus Station		
Number and Type of Bus Stations	11 locations ・8 Locations (At-Grade, outside lane) ・2 Locations (Elevated, outside lane) ・1 Location (At-Grade, intermediate)	3 Locations (At-grade intermediate)
Transfer Station Plazas		
Number and Name of Transfer Station Plazas	4 Locations ・Imbaba (new) ・Sheikh Zayed Central ・Misr University (new) ・6th of October Residential Area 2 of the original CREATS Transfer Station Plazas locations (Cairo University and West Abu Rawash) have been deleted.	6 Locations ・2 Locations in Cairo University Station Transfer Plaza ・West Abu Rawash ・Sheikh Zayed ・6th of October Residential Area ・6th of October Industrial Area

Source: JICA Study Team



Source: JICA Study Team

Figure 5.1.1 Busway Route and Station Locations

5.2 Future Traffic Demand

5.2.1 Daily Traffic

The estimated future transport demand for the Western Development Corridor was provided in Chapter 3 Section 3.7.2. Data for 2012 and 2022 were shown previously in Table 3.6.8 and Table 3.6.9 (before and after operation of 6th of October Line), respectively. These tables are presented again here as Tables 5.2.1 and 5.2.2, respectively.

Table 5.2.1 Future Demand of the Busway on 26th of July for 2012 (Unit: Passenger Trips / Day)

No	Station Name	Alighting	Boarding	Passing Through	
				To October	To Cairo
2012					
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 Central	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	October West	6,100	6,100	4,100	4,000
24	Bank Street	4,100	4,000		
Total		Total Passengers		Maximum	
			100,800	40,400	39,800

Source: JICA Study Team

Table 5.2.2 Future Demand of the Busway on 26th of July for 2022 before and after 6th of October Line Extension (Unit: Passenger Trips / Day)

No	Station Name	Alighting	Boarding	Passing Through	
				To October	To Cairo
Before					
A	Behouth Metro Station	74,300	74,500	74,300	74,500
B	Gamaet	12,200	12,200	86,500	86,700
C	Imbaba	48,200	48,700	120,700	120,000
D	Mansovria	8,300	8,000	114,100	113,600
15	Police City	12,800	12,700	114,100	113,600
16	Sheikh Zayed East	12,800	12,700	103,700	103,300
17	Sheikh Zayed Central	17,500	17,400	86,400	86,000
18	Sheikh Zayed West	12,600	12,500	74,800	74,500
19	Misr University	21,900	21,800	74,800	74,500
20	6th of October University	21,900	21,800	52,900	52,700
21	Al Hosari Mosque	13,800	13,700	39,200	39,000
22	9th District Central	26,700	26,600	31,000	24,800
23	October West	18,600	18,600	12,400	12,400
24	Bank Street	12,400	12,400		
Total		Total Passengers		Maximum	
			313,800	120,700	120,000
After					
A	Behouth Metro Station	26,000	26,300	26,000	26,300
B	Gamaet	5,300	5,400	31,300	31,700
C	Imbaba	49,100	48,800	72,800	72,700
D	Mansovria	14,000	13,800	67,400	67,500
15	Police City	9,100	9,100	58,200	58,400
16	Sheikh Zayed East	9,000	9,200	52,000	52,000
17	Sheikh Zayed Central	14,600	14,000	41,300	41,900
18	Sheikh Zayed West	8,500	8,800	35,000	35,300
19	Misr University	13,100	13,000	35,000	35,300
20	6th of October University	13,100	13,000	25,200	25,500
21	Al Hosari Mosque	8,000	8,000	19,000	19,300
22	9th District Central	13,800	14,100	25,700	25,700
23	October West	15,400	15,400	10,300	10,300
24	Bank Street	10,300	10,300		
Total		Total Passengers		Maximum	
			209,200	72,800	72,700

Source: JICA Study Team

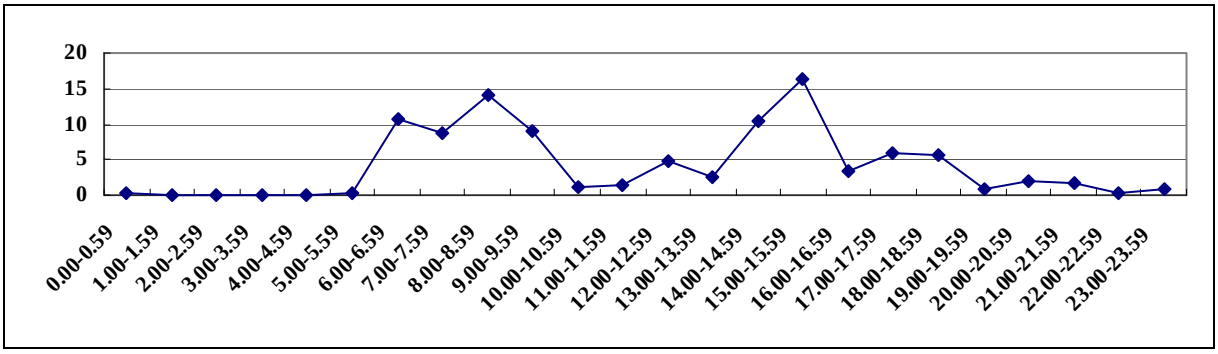
5.2.2 Hourly Demand and Service Frequency

CREATS HIS Metro Passenger Boarding/Alighting time records were analyzed to determine the potential hourly demand for public transport in the study area. The hourly Metro trip share for corresponding time zones is shown in Table 5.2.3 and Figure 5.2.1. Table 5.2.3 shows a summary of the service criteria for four (4) levels of demand: i) High Demand; ii) Medium Demand; iii) Low Demand; and Non-service Time. Table 5.2.4 summarizes the predicted hourly Busway passenger share for the corresponding time zones.

Table 5.2.3 CREATS HIS Metro Passenger Hourly Trip Share

Time Period	Boarding Trips	Alighting Trips	Average Onboard Trips	Average Onboard Share	Corresponding Busway Service Criteria
0.00-0.59	1,085	6,504	7,589	0.2	Non-service Time
1.00-1.59	25	1,710	1,735	0.0	Non-service Time
2.00-2.59	1,293	1,304	2,597	0.1	Non-service Time
3.00-3.59	611	766	1,377	0.0	Non-service Time
4.00-4.59	309	150	459	0.0	Non-service Time
5.00-5.59	14,083	3,095	17,178	0.4	Low Demand Service
6.00-6.59	377,423	52,771	430,194	10.7	High Demand Service
7.00-7.59	146,693	204,009	350,702	8.7	High Demand Service
8.00-8.59	217,700	342,536	560,236	14.0	High Demand Service
9.00-9.59	135,537	220,458	355,995	8.9	High Demand Service
10.00-10.59	5,445	42,917	48,362	1.2	Low Demand Service
11.00-11.59	25,762	36,430	62,192	1.5	Low Demand Service
12.00-12.59	124,815	63,966	188,781	4.7	Med. Demand Service
13.00-13.59	45,999	56,337	102,336	2.6	Med. Demand Service
14.00-14.59	248,739	166,297	415,036	10.3	High Demand Service
15.00-15.59	355,860	295,242	651,102	16.2	High Demand Service
16.00-16.59	20,440	112,953	133,393	3.3	Med. Demand Service
17.00-17.59	98,216	133,301	231,517	5.8	Med. Demand Service
18.00-18.59	94,864	127,532	222,396	5.5	Med. Demand Service
19.00-19.59	6,378	29,143	35,521	0.9	Low Demand Service
20.00-20.59	33,288	42,691	75,979	1.9	Low Demand Service
21.00-21.59	32,805	35,148	67,953	1.7	Low Demand Service
22.00-22.59	2,372	10,585	12,957	0.3	Low Demand Service
23.00-23.59	16,525	20,422	36,947	0.9	Low Demand Service

Source: CREATS HIS Data (2002) analyzed by the JICA Study Team



Source: CREATS HIS Data (2002) analyzed by the JICA Study Team

Figure 5.2.1 CREATS HIS Metro Passenger Hourly Traffic Share

5.2.3 Scheduled Service Frequency

The scheduled service frequency was examined by referring to the predicted passenger demand and bus transport capacity. Table 5.2.5 lists the adopted Busway service frequencies, based on the outcome of analyzing data presented in Tables 5.2.1, 5.2.2, 5.2.3, 5.2.4, and Tables 3.6.8, 3.6.9 and 3.6.10 shown previously in Chapter 3.

Table 5.2.4 Predicted Hourly Busway Passenger Share by Scheduled Service Time

Operation Shift	Time Period	Hourly Average Passenger Share (%)
Low Demand	05:00-05:59, 10:00-11:59, 19:00-23.59	1.1
Medium Demand	12:00-13:59, 16:00-18:59	4.4
High Demand	06:00-09:59, 14:00-15:59	11.5
Non-service Time	00:00-04:59	0.0

Source: JICA Study Team

The estimated daily traffic fluctuation is summarized by time-zone as shown in Table 5.2.6. The high demand hours are from 06:00 till 09:59 and from 14:00 till 15:59 (in total 6 hours), which has a share of 69% of the total daily volume.

In case 6th of October Line is not realized in 2022, the number of hourly services would be 51 services/hour, even with bi-articulated buses (270 passenger capacity). As a service of one minute headway would seem to be too short for the bus priority lane operation, it may be considered to be a critical situation if it were left without construction of 6th of October Line proposed for Phase II. Installation of 6th of October Line in Phase II will thus be essential, which is therefore considered as a prerequisite in this chapter.

Table 5.2.5 Anticipated Busway Daily Service Frequency

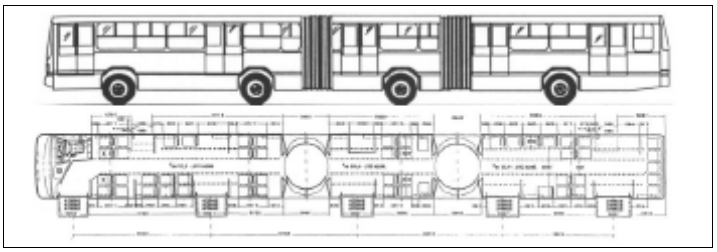
Daily Traffic						
Year		2012	2017	2022 (without 6th of October Line)	2022 (with 6th of October Line)	2027
Total Passengers		100,800	157,450	313,800	209,250	229,650
Maximum Through Passengers		40,400	61,700	120,700	72,800	80,700
Maximum Through-Passengers by Time Zone per Hour						
Time Zone	Hourly Ratio %	2012	2017	2022 (without 6th of October Line)	2022 (with 6th of October Line)	2027
05:00-05:59	1.1	444	679	1,328	801	888
06:00-09:59	11.5	4,646	7,096	13,881	8,372	9,281
10:00-11:59	1.1	444	679	1,328	801	888
12:00-13:59	4.4	1,778	2,715	5,311	3,203	3,551
14:00-15:59	11.5	4,646	7,096	13,881	8,372	9,281
16:00-18:59	4.4	1,778	2,715	5,311	3,203	3,551
19:00-23:59	1.1	444	679	1,328	801	888
Number of Services Required per Hour (bi-articulated bus operation)						
05:00-05:59	1.1	2	3	5	3	3
06:00-09:59	11.5	17	26	51	31	34
10:00-11:59	1.1	2	3	5	3	3
12:00-13:59	4.4	7	10	20	12	13
14:00-15:59	11.5	17	26	51	31	34
16:00-18:59	4.4	7	10	20	12	13
19:00-23:59	1.1	2	3	5	3	3
Total		54	81	157	95	103
Number of Services Required in each Time Zone (bi-articulated bus operation)						
05:00-05:59	1.1	2	3	5	3	3
06:00-09:59	46.0	68	104	204	124	136
10:00-11:59	2.2	4	6	10	6	6
12:00-13:59	8.8	14	20	40	24	26
14:00-15:59	23.0	34	52	102	62	68
16:00-18:59	13.2	21	30	60	36	39
19:00-23:59	5.5	10	15	25	15	15
Total		153	230	446	270	293

Source: JICA Study Team

5.3 Busway System Plan

5.3.1 Bus Fleet

Considering the large volume of demand and good driving conditions provided by the exclusive busway, the bus fleet is presumed to comprise only bi-articulated buses. The dimensions and capacity of a typical bi-articulated bus shown in the CREATS report are presented in Figure 5.3.1 and Table 5.3.1, respectively.



Source: CREATS Phase II Final Report, Vol. II

Figure 5.3.1 Layout of a Typical Bi-Articulated Bus

Table 5.3.1 Typical Bi-Articulated Bus Capacity and Dimensions

Type of Bus	Capacity			Dimensions (m)			Number of Doors
	Seats	Standees	Total	Length	Width	Height	
Bi-articulated	57	213	270	24.52	2.50	3.42	5

Source: CREATS Phase II Final Report, Vol. II

5.3.2 Fleet Size

Assuming an average commercial speed of 40 km/h and using the end-to-end route distance of 35.6 km shown in Table 5.1.1, the total travel time will be 53.4 minutes. Allowing 6.6 minutes waiting time for each bus trip, one trip is assumed to take an hour. Thus, the required number of buses will be equal to the number of services for both directions in peak hour, plus a reserve fleet, as shown in Table 5.3.2.

Table 5.3.2 Number of Buses Required

Item	2012	2017	2022	2027
Buses operating	34	52	62	68
Buses in reserve (20% of operating buses)	7	11	13	14
Total	41	63	75	82

Source: JICA Study Team

5.3.3 Preliminary Design of the Bus Route and Structure

An appropriate and systematic design for the busway and facilities is essential for the safe and smooth flow of bus traffic on the busway. This section of the report describes the preliminary design of the busway and carefully examines the road conditions along the busway. In order to carry out preliminary design of the busway route and structure, the busway was divided into four (4) design sections, as shown in Table 5.3.3.

Table 5.3.3 Design Section of the Busway

Design Section	Section	Distance (km)	Type of Busway System	Type of Road Structure
Major Roads in 6th of October NUC	City industrial area – Boundary of 6th of October NUC	7.5	Bus priority lane.	At-grade
26th of July Road Corridor	Boundary of 6th of October NUC – Alexandria Desert Road	15.6	Outside lane of Bus exclusive lane.	At-grade
	Crossing section of Alexandria Desert Road	1.2	Busway.	Grade-separated bus lane over Alexandria Desert Road
	After Alexandria Desert Road – 1.2 km before the Ring Road	11.0	Outside lane of Bus exclusive lane.	At-grade
Agriculture Road Corridor	26th of July Road - Central Station of Imbaba	2.0	Busway only.	Grade-separated
Almamein Street (Canal)	Central Station of Imbaba – Behouth Station	3.2	Busway only.	Grade-separated

Source: JICA Study Team

(1) Major Roads in 6th of October NUC and 26th of July Road Corridor: There are no major engineering issues of the busway on major roads in 6th of October NUC and 26th

of July Road corridor. In these two (2) sections, the busway will be provided on the outside lane of these roads, as shown in Figure5.3.3. The busway at the crossing point of Alexandria Desert Road comprise a separate structure from 26th of July Road. The anticipated busway design is illustrated in 5.3.4.

(2) Agriculture Road: Because the width of 26th of July Road between Ring Road and ENR Line is too narrow for constructing the busway, the busway of this section will be constructed along the Agriculture Road parallel to 26th of July Road. The anticipated structure of this section is illustrated in Figure 5.3.3.

(3) Almamein Street or Canal along ENR Line: The busway of this section will be a bus-only road provided by a new grade-separated structure (viaduct) on Almamein Street or the canal alongside the ENR Line. A typical cross-section and type of structure is shown in Figure 5.3.3.

The anticipated busway plan and profile on Almamein Street is shown in Figures 5.3.1 and 5.3.2 in the Appendix at the end of this chapter.

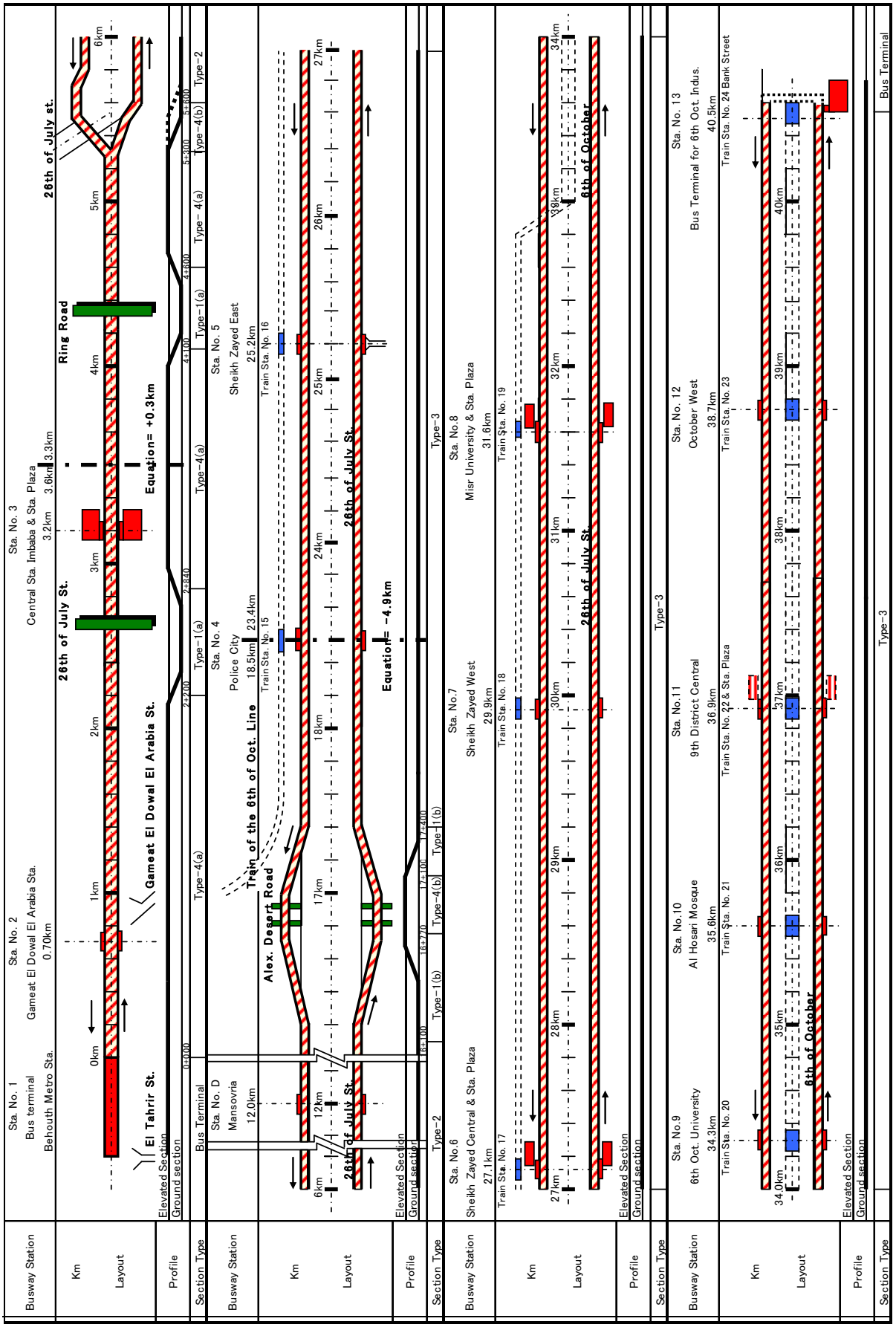
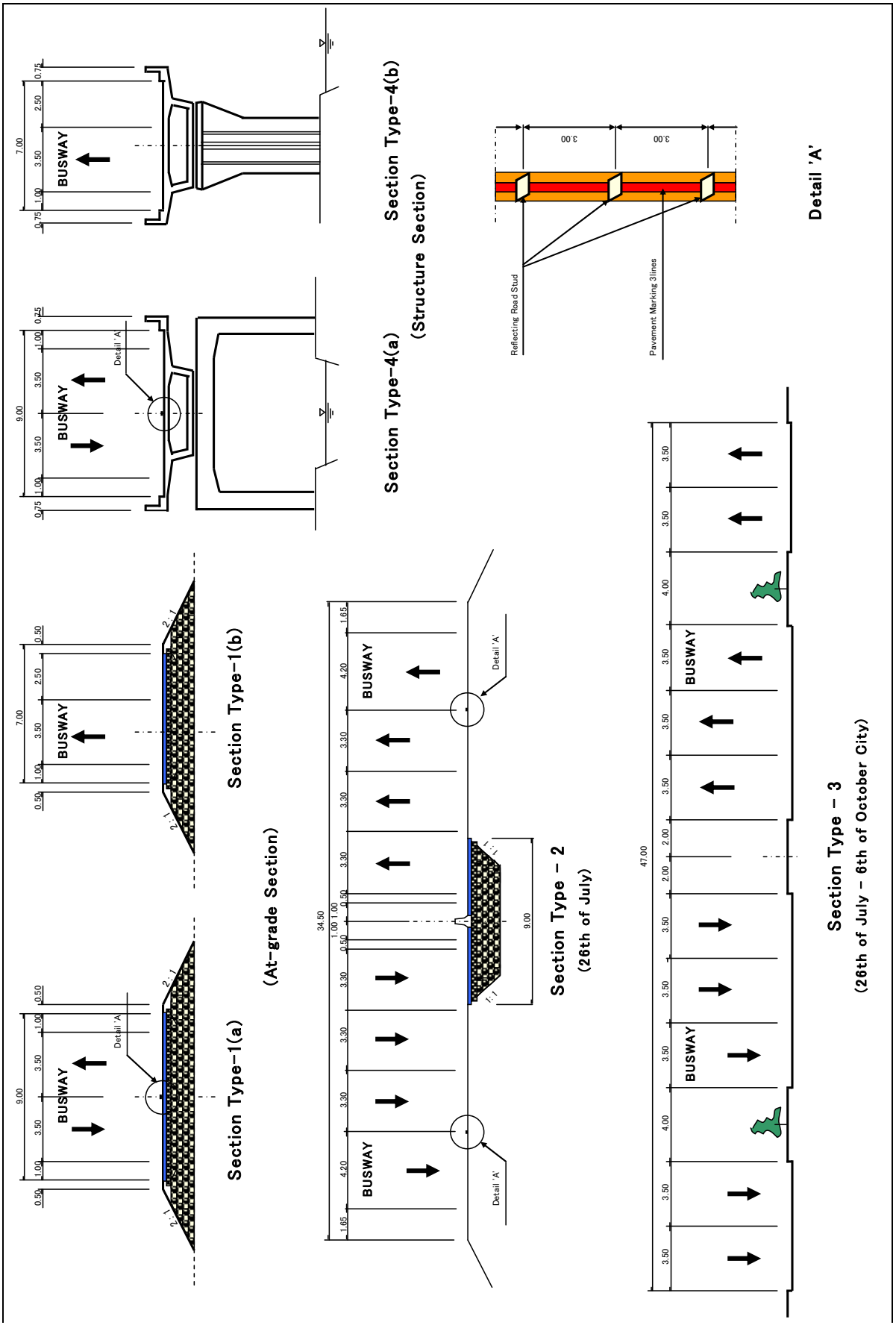


Figure 5.3.2 Schematic Layout of the Busway by Type of Road Structure

Source: JICA Study Team



Source: JICA Study Team

Figure 5.3.3 Typical Cross Section of the Busway Structure

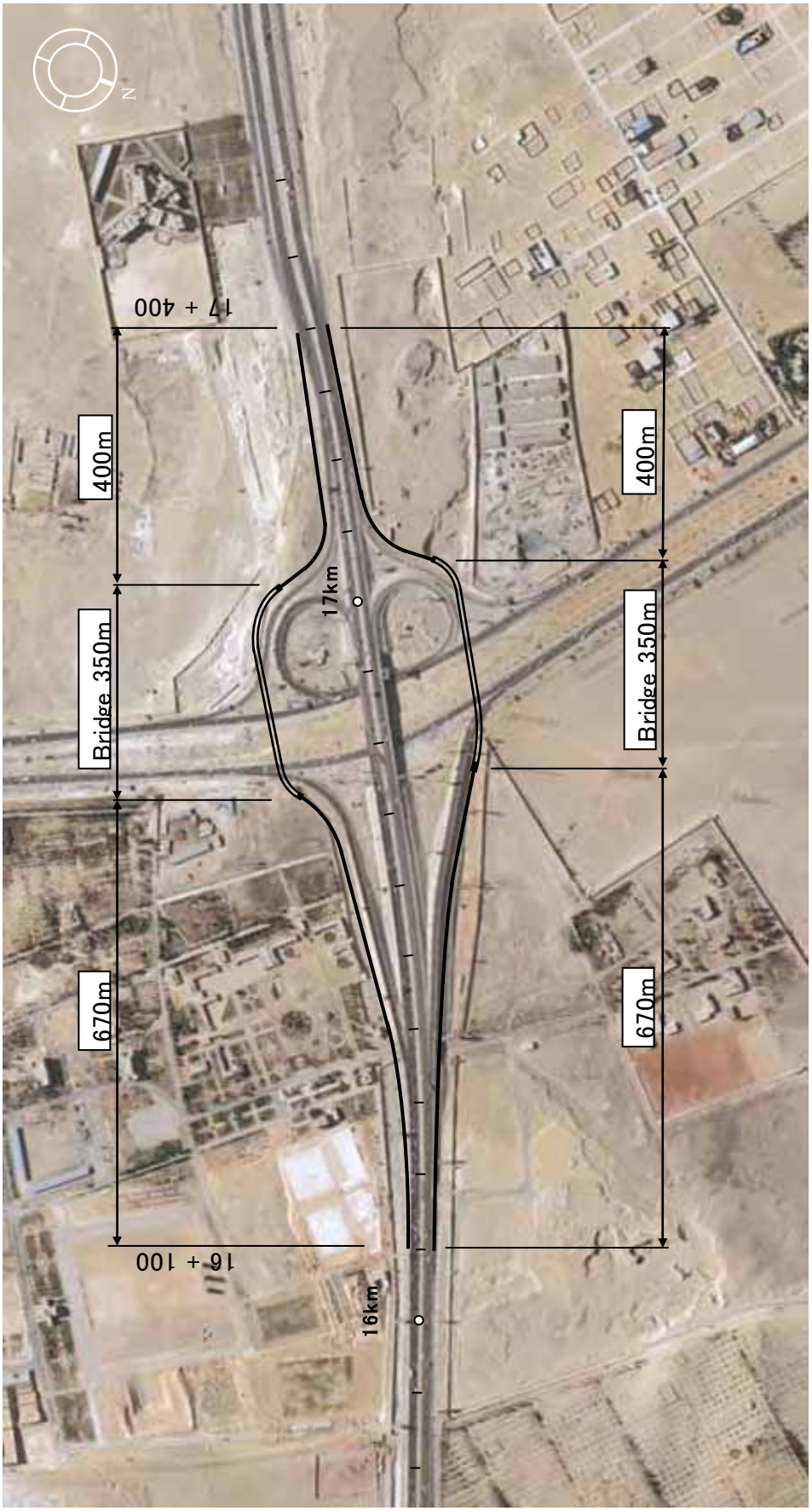


Figure 5.3.4 Design of Busway at the Intersection of 26th of July Road and Alexandria Desert Road

Source: JICA Study Team

5.3.4 Bus Stations

(1) Bus station locations

The locations of the bus stations in the section between Behouth Metro Station Terminal and Mansovria Stop were selected in consultation with GOPP. The stations in the section between Police City Stop and Bank Street Terminal are at the same locations as planned for 6th of October Line stations, as shown previously in Figure 5.1.1.

The access and egress modes and estimated passenger volumes were discussed previously in Chapter 3 Section 3.6.2. The relevant data were presented in Tables 3.6.14 and 3.6.15.

(2) Typical bus station layout plans

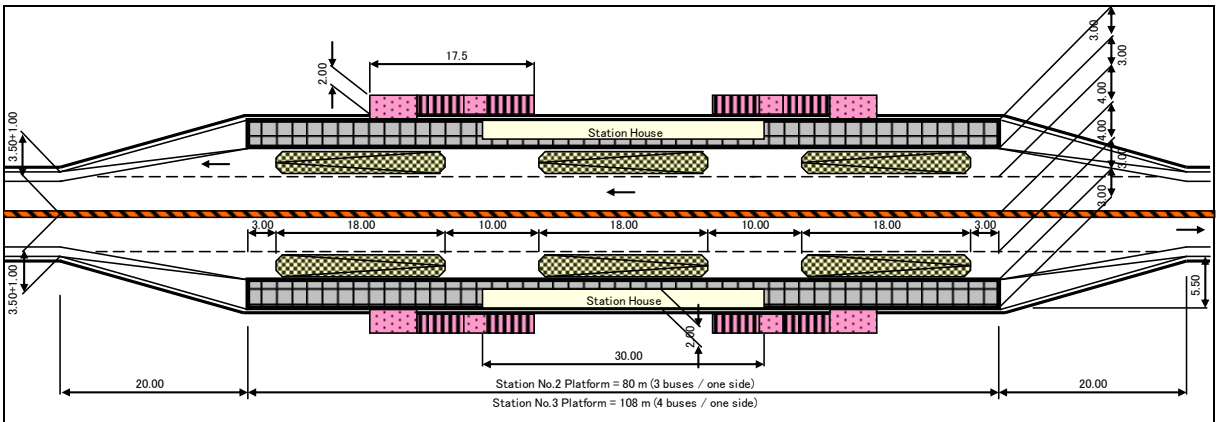
The design requirements for typical bus stations are summarized as follows:

a) Tickets shall be issued, examined and collected at the station to ensure the punctual operation of high frequency bus services;

b) The station should be fenced to ensure safety and prevent fare evasion; and

c) On-line control of traffic signals for buses in the station should be controlled from the control center.

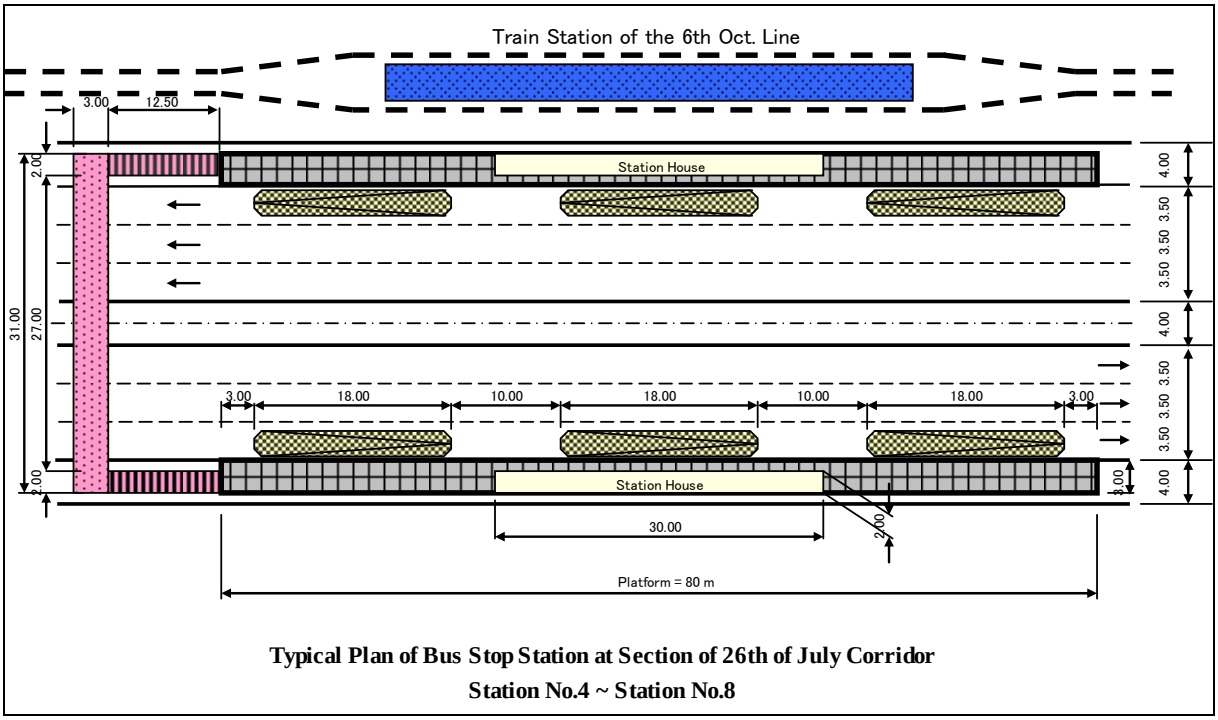
The bus stations along the busway can be classified into three (3) basic configurations: i) elevated bus stations; ii) roadside bus stations alongside train stations; and iii) roadside bus stations associated with train stations in the roadway median strip. Typical plans for various bus station configurations are shown in Figures 5.3.5, 5.3.6, and 5.3.7.



Typical Plan of Elevated Bus Stop Station at Section
Station No.2, Station No.3

Source: JICA Study Team

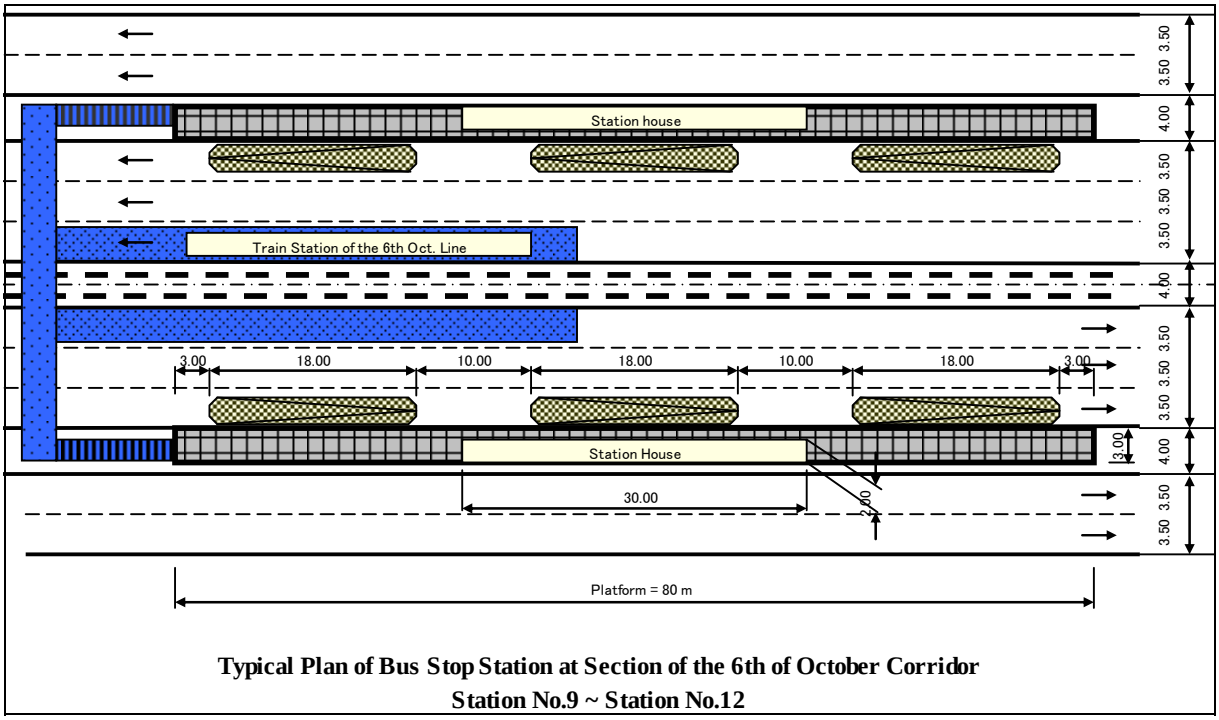
Figure 5.3.5 Typical Plan for an Elevated Bus Station



Typical Plan of Bus Stop Station at Section of 26th of July Corridor
Station No.4 ~ Station No.8

Source: JICA Study Team

Figure 5.3.6 Typical Plan for a Roadside Bus Station alongside a Train Station



Typical Plan of Bus Stop Station at Section of the 6th of October Corridor
Station No.9 ~ Station No.12

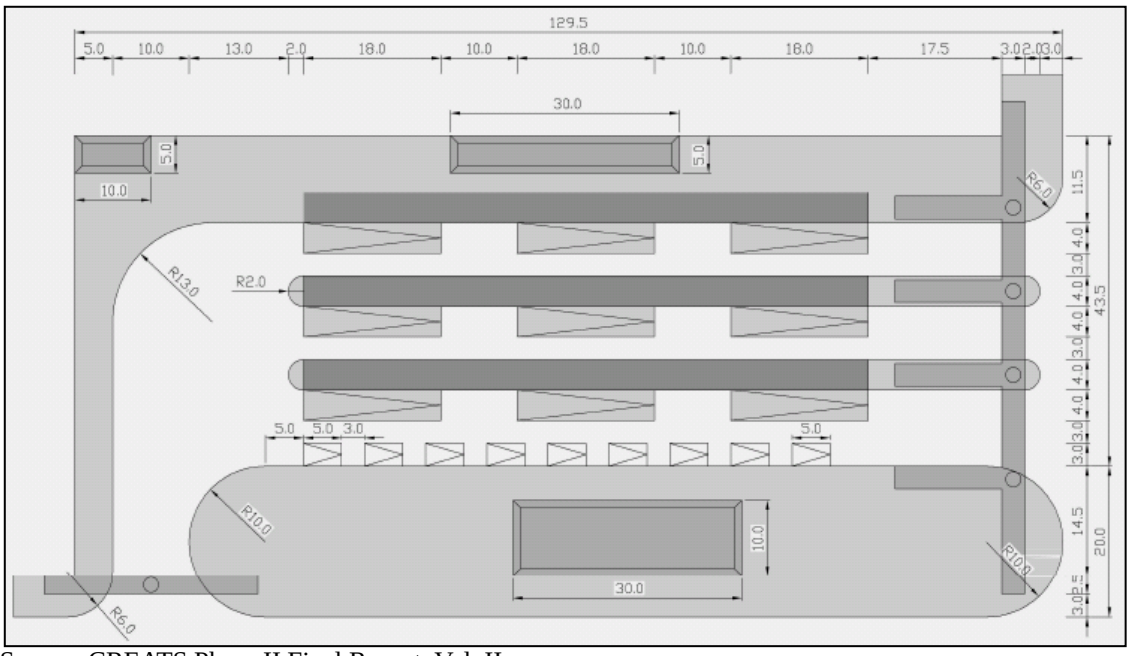
Source: JICA Study Team

Figure 5.3.7 Typical Plan for a Roadside Bus Station with a Train Station in the Median Strip

5.3.5 Typical Bus Station Terminal Plans

(1) Bus terminal in 6th of October NUC

The Bank Street Bus Terminal has been selected as the main terminal in 6th of October NUC, because locating a Depot near Behouth Metro Station Terminal would not be practicable due to limited available space, even only for terminal operations. Thus, operation control facilities are planned to be installed in the Bank Street Bus Terminal. A preliminary terminal plan is illustrated in Figure 5.3.8.



Source: CREATS Phase II Final Report, Vol. II

Figure 5.3.8 Preliminary Plan for the Bank Street Bus Terminal

(2) Bus terminal at Behouth station

CREATS proposed a bus terminal at Cairo University Station. Based on the CREATS proposal, two (2) alternative terminal plans were examined in this study:

a) Bus Terminal at Behouth Metro Station

b) Bus Terminal at Cairo University Station

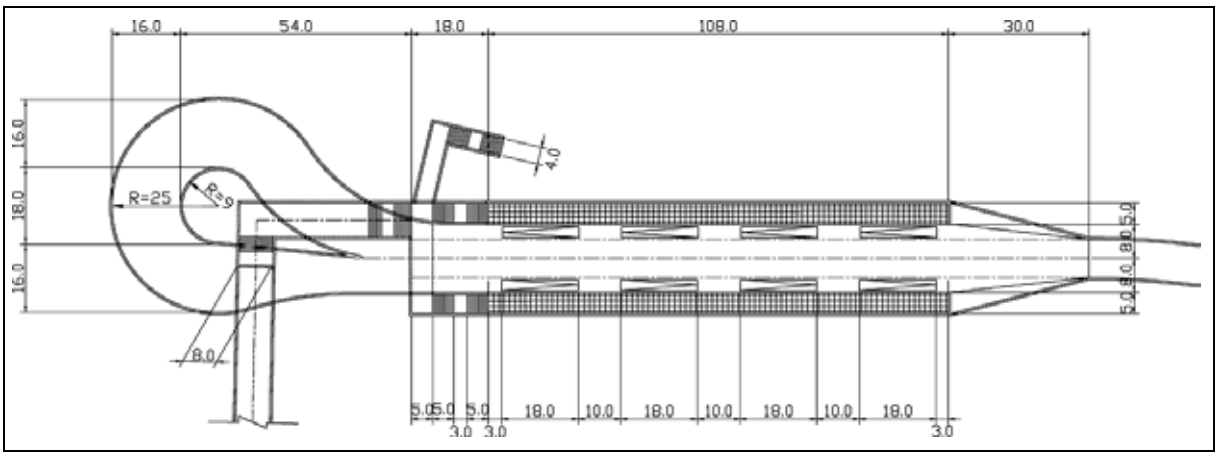
The following projects are now under construction, or are being planned around the Cairo University Area, as at June 2008:

a) Saft al Laban Corridor Project (under construction)

b) Urban expressway E1 route (planning)

Because of the above projects, there is no room to construct a bus terminal near Cairo University Station. Therefore the Cairo University Terminal proposed by CREATS has been relocated to an area near Behouth Station on the western side of the ENR railway, as shown in Figure 5.3.9.

Access from Behouth Bus Terminal to Behouth Metro Line 2 Station is proposed as an underground pedestrian passageway having a total length of 305 meters, as shown in Figure 5.3.10.



Source: JICA Study Team

Figure 5.3.9 Preliminary Configuration for Behouth Bus Terminal

Source: JICA Study Team

Figure 5.3.10 Preliminary Plan for the Underground Pedestrian Passageway for Behouth Bus Terminal

5.3.6 Maintenance System and Depot Facility

The maintenance system and the depot facility plan followed the CREATS proposal, although some revisions of the cost calculations have been made. The maintenance systems for the bus fleet comprise a periodical maintenance program and a corrective maintenance program. The periodical maintenance work is a predetermined program, and the activities follow a pre-set cycle, such as daily and monthly maintenance based on the hours of operation, and 50,000 km / 100,000 km maintenance per bus, based on the kilometers of operation. The corrective maintenance work is required in the case of mechanical failures, accidents, etc. Both of these maintenance programs will be carried out in the Depot.

The Depot facilities will be designed to allow inspection, maintenance and storage of buses, and the Depot will include a workshop. The required Depot facilities are as follows:

(1) Parking Area: The parking area will provide storage for the bi-articulated bus fleet. The number of articulated buses will be 41, 63, 75 and 82 in 2012, 2017, 2022 and 2027, respectively, as shown previously in Table 5.3.2. Considering the size of the bi-articulated buses (61.3m^2), the number of buses (82 buses in 2027), and the need for a maneuvering area that has the same area as the parking area, a total area of 10,000 m^2 (1 ha) will be necessary.

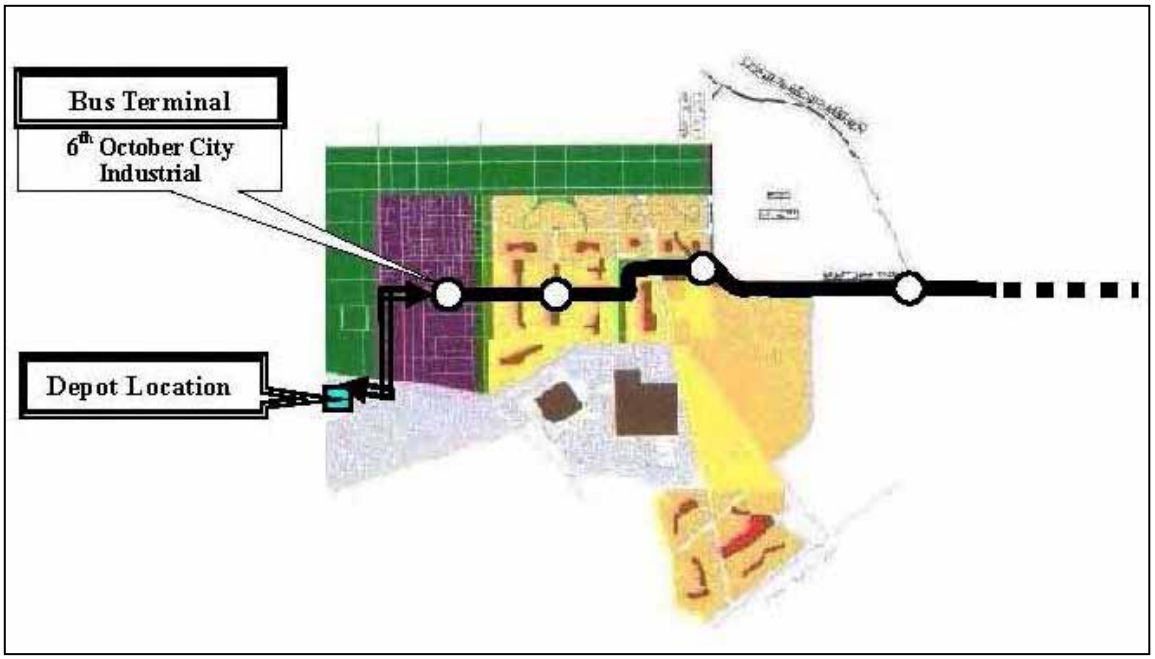
(2) Maintenance Workshop: The bus maintenance workshops will allow for temporary bus storage and provide mechanical workshops, including vehicle testing facilities.

(3) Washing Facility: A bus washing machine, which will be used in association with the daily inspections, will be provided near the workshop.

(4) Filling Station: A filling station will be provided in order to supply buses with daily fuel needs.

(5) Administrative Office and Staff Facilities: The administrative office and staff facilities will be used by administration personnel of the busway organization. These facilities will be provided in a common building within the Depot area in order to allow coordination of the maintenance work and operations. The total required floor area of Depot facilities at 6th of October NUC was estimated to be approximately 3,000 m^2 in CREATS. The same floor area has been adopted for this study.

As noted above, the Depot facility needs to be located near the Bank Street Terminal due to the difficulty of finding a suitable location in the vicinity of the Behouth Bus Terminal. In addition, the Depot location must allow convenient bus service operations. The proposed site of the Depot facility in 6th of October NUC is shown in Figure 5.3.11.



Source: JICA Study Team

Figure 5.3.11 Proposed Site for the Depot Facility in 6th of October NUC

5.3.7 Feeder Transport Facilities Requirement

Bus user feeder transport trips were estimated in Section 3.6.2 above and relevant data were listed in Table 3.6.12 to Table 3.6.15. In this study, the feeder transport facility cost is excluded because the burden of these costs will be borne by local government, not by the bus system operator. Nonetheless, the feeder transport facility handling will be very important for ensuring a comfortable and effective public transport service.

5.4 Busway Operating Organization and Personnel Assignment

It has been assumed that the busway company will be a newly established organization that is created to operate the buses only on the exclusive busway. The envisaged size of the operating organization is based on the busway operation volumes in 2017 and in 2022, and considers the introduction of train services on 6th of October Line, as discussed previously. The calculated number of staff required for the busway operations is summarized in Table 5.4.1.

Table 5.4.1 Personnel Required for the Busway Organization

Item/Year	2012	2017	2022	2027
Headquarters Employees	78	95	103	108
Field staff	520	628	683	715
Bus Station Employees	231	231	231	231
Crew and Support Staff	217	325	380	412
Workshop Staff	42	64	76	83
Civil Works and Station Maintenance	15	15	15	15
Electrical Maintenance	15	15	15	15
Total Employees	598	723	786	823

Source: JICA Study Team

5.4.1 Headquarters Staff Numbers

The required number of headquarters staff has been calculated by taking 15% of the number of field staff. The total number of field staff was estimated to be 520, 628, 683 and 715 in 2012, 2017, 2022 and 2017, respectively, as described below. Therefore, the corresponding number for the headquarters will be 78, 95, 103 and 108 staff, respectively. These staff will be assigned to the Administration and Finance (45.1%), Procurement (16.4%), Industrial Safety (35.2%), and Research and Training (3.3%) Departments.

5.4.2 Field Staff Numbers

(1) Bus station employees

Assuming the installation of automatic ticket gate equipment, the required number of employees in each bus station will be standardized as follows:

a) The standard station personnel will be 2 staff for 3 shifts and 1 reserve staff for 2 shifts.

b) The Bank Street Terminal and Behouth Metro Station Terminal will require an additional 2 staff for 2 shifts.

c) The Control Center will require 2 staff for 3 shifts.

A reserve ratio of 1.83 will be applied to the any staff assignment. The value of 1.83 was calculated previously in Chapter 4 Section 4.10, and summarized in Table 4.10.4. Thus, the total number of bus station employees will be 231 staff *(((2x3+1x2) x14+2x2x2+2x3) x1.83)*.

(2) Crew

In 2012, 153 buses are expected to be in operation. This number will increase to 230, 270, and 293 in 2017, 2022, 2027, respectively, as shown previously in Table 5.2.5. Assuming that the bus crew will comprise a driver and a conductor, and each will operate three round trips per day, 188 bus crew staff *(153/3x2x1.83)* will be required in 2012 and 282, 330 and 358 staff will be required in 2017, 2022 and 2027, respectively.

(3) Support staff for bus operations

The number of ground service staff for assisting with bus operations was assessed as being 15% of the crew staff numbers. The necessary number of support staff will be 29, 43, 50 and 54 in 2012, 2017, 2022 and 2027, respectively.

(4) Workshop (Ordinary inspection and repair)

The required number of bus maintenance staff in the Depot, including management, was calculated as being 0.5 employees per bus unit. The numbers of clerical staff that are required was calculated as being approximately 10% of the maintenance staff. Thus, 42 Workshop staff *(41x0.5x1.1x1.83)* will be required in 2012, and 64, 76 and 83 staff will be required in 2017,

2022 and 2027 respectively. These staff numbers correspond to 41, 63, 75 and 82 buses, respectively.

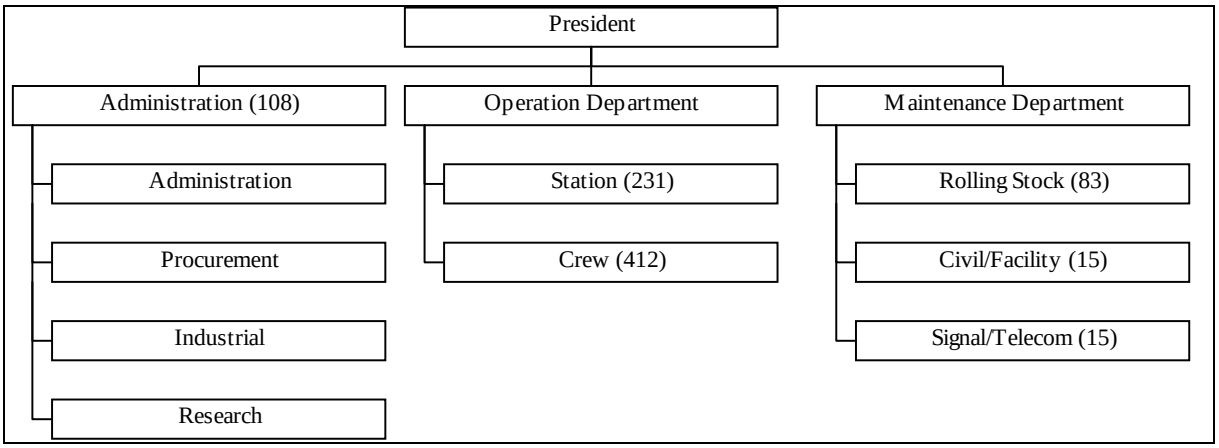
(5) Civil works and bus station maintenance

The required number of staff for maintenance of civil work, bus stations and other facilities was calculated as 0.2 staff per commercial kilometer of the busway. In addition, 10% of that number will be clerical staff. Considering that the busway distance is 35.6 commercial kilometers, 15 staff will be required *(0.2x35.6x1.1x 1.83).*

(6) Electricity depot (Inspection and repair of signal equipment, telecommunications facilities and power supply)

The maintenance staff for power, signals, communications and other electrical equipment and facilities was calculated as 0.2 staff per commercial kilometer. In addition, 10% of that number will be clerical staff. Considering that the busway distance is 35.6 commercial kilometers, 15 staff will be required *(0.2x35.6x1.1x1.83).*

The above discussions are summarized in Figure 5.4.1, which shows the operating organization and the assigned staff numbers for 2027.



Source: JICA Study Team

Figure 5.4.1 Operating Organization and Assigned Staff Numbers for 2027

5.5 Cost Estimate

5.5.1 Construction Cost

(1) Calculation of construction quantities

The concept recommended by the SDMP, as summarized previously in Table 5.1.1, proposes some busway features that are different to the CREATS Plan. The following cost estimate is based on the modified plan (recommended concept) that includes these features.

When calculating the construction quantities, the items established in CREATS were basically maintained. The quantities of most items thus remain unchanged. However, the quantities for

items in the recommended concept that are affected by the modifications have been changed accordingly.

(2) Conditions for cost estimation

The following conditions were taken into consideration when preparing the cost estimation:

a) Unit prices were based upon those established in CREATS, while some additional data were collected from similar construction projects in Egypt, as well as in several foreign countries.

b) The unit price for each work item was determined, based on the cost prevailing in 2007. The price escalation rate of 5% per year was used to update the unit price.

c) The foreign exchange rates that were used are US$ 1 = LE 5.5 = Japanese Yen110.

d) Land acquisition, without compensation (resettlement) costs, was estimated according to the data provided by MOHUUD.

e) Engineering services and construction management costs were assumed to be 4% for detailed engineering and 5% for local administration of the construction cost.

f) The physical contingency was estimated to be 10% of the total construction cost.

g) Sales tax was estimated to be 10% of total construction cost *plus* the cost for engineering services and construction management *plus* physical contingency.

h) The cost for removal of the existing public works was not taken into consideration (gas, electricity, water services, road infrastructure, etc.)

(3) Construction cost estimation

The project cost of the busway was classified into six (6) categories as follows:

a) Busway (At-grade, Elevated)

b) Bus Stations

c) Transfer Station Plazas

d) Bus Terminals

e) Depot and Workshop

f) Buses

It should be noted that the construction costs for the Transfer Station Plaza and the Bus Terminal Building are not included in the project cost.

Construction costs for each of the above categories are summarized in Table 5.5.1.

Table 5.5.1 Summary of Construction Costs for the Busway (1/2)

Investment Item		Unit	Unit Cost (L.E)	Quantity	Total Cost (Mill. L.E)	Foreign (%)	Local (%)	Tax (%)	Foreign Amount (Mill. L.E)	Local Amount (Mill. L.E)	Tax (Mill. L.E)
Bus Way											
At- Grade	Clearing & Grubbing	m^2	3	49,512	0.15	43	31	26	0.06	0.05	0.04
	Earthwork (Cut)	m^3	12	124,320	1.49	43	31	26	0.64	0.46	0.39
	Earthwork (Embankment)	m^3	12	102,562	1.23	43	31	26	0.53	0.38	0.32
	Pavement (Surface)	m^3	300	5,987	1.80	25	55	20	0.45	0.99	0.36
	Pavement (Binder Course)	m^3	300	6,014	1.80	25	55	20	0.45	0.99	0.36
	Pavement (Base Course)	m^3	90	35,331	3.18	25	55	20	0.80	1.75	0.64
	Pavement (Subbase Course)	m^3	80	35,948	2.88	25	55	20	0.72	1.58	0.58
	Pavement marking 3lines/km	km	10,000	22	0.22	39	38	23	0.09	0.08	0.05
	Reflection Road Stud	Each	25	7,380	0.18	39	38	23	0.07	0.07	0.04
Viaduct 1	Structure	m^2	6,000	49,240	295.44	27	52	21	79.77	153.63	62.04
	Pavement	m^3	300	4,924	1.48	25	55	20	0.37	0.81	0.30
	Pavement marking 3lines/km	km	10,000	871	8.71	39	38	23	3.40	3.31	2.00
	Reflection Road Stud	Each	25	1,487	0.04	39	38	23	0.01	0.01	0.01
Land	Agricaltural area	m^2	900	11,250	10.13	0	100	0	0.00	10.13	0.00
	Sub-total				328.72				87.36	174.25	67.12
Outside Lane At Graid 8 Stations & Elevated 2 Stations											
Earthwork	Cut	m^3	12	2,074	0.02	43	31	26	0.01	0.01	0.01
Pavement	Surface	m^3	300	173	0.05	25	55	20	0.01	0.03	0.01
	Binder Course	m^3	300	173	0.05	25	55	20	0.01	0.03	0.01
	Base Course	m^3	90	864	0.08	25	55	20	0.02	0.04	0.02
	Subbase Course	m^3	80	864	0.07	25	55	20	0.02	0.04	0.01
Viaduct 1	Structure	m^2	6,000	2,508	15.05	27	52	21	4.06	7.83	3.16
	Pavement	m^3	300	251	0.08	25	55	20	0.02	0.04	0.02
Pedestrian	Bridge	m	40,128	155	6.22	25	55	20	1.56	3.42	1.24
Bridge (Steel)	Staircase	m	10,336	265	2.74	25	55	20	0.69	1.51	0.55
Station House	Shelter with ticketing system, etc.	Unit	1,976,000	22	43.47	51	27	22	22.17	11.74	9.56
	Sub-total				67.83				28.57	24.68	14.59
Intermediate Station (1 Station)											
Earthwork	Cut	m^3	12	864	0.01	43	31	26	0.00	0.00	0.00
Pavement	Surface	m^3	300	72	0.02	25	55	20	0.01	0.01	0.00
	Binder Course	m^3	300	72	0.02	25	55	20	0.01	0.01	0.00
	Base Course	m^3	90	360	0.03	25	55	20	0.01	0.02	0.01
	Subbase Course	m^3	80	360	0.03	25	55	20	0.01	0.02	0.01
Pedestrian	Bridge	m	40,128	49	1.97	25	55	20	0.49	1.08	0.39
Bridge (Steel)	Staircase	m	10,336	63	0.65	25	55	20	0.16	0.36	0.13
Station House	Shelter with ticketing system, etc.	Unit	3,040,000	1	3.04	51	27	22	1.55	0.82	0.67
	Sub-total				5.77				2.23	2.32	1.22
Station Plaza (4 Station Plazas)											
Earthwork	Cut	m^3	12	31,308	0.38	43	31	26	0.16	0.12	0.10
Pavement	Surface	m^3	300	2,609	0.78	25	55	20	0.20	0.43	0.16
	Binder Course	m^3	300	2,609	0.78	25	55	20	0.20	0.43	0.16
	Base Course	m^3	90	10,436	0.94	25	55	20	0.24	0.52	0.19
	Subbase Course	m^3	80	15,654	1.25	25	55	20	0.31	0.69	0.25
Wating Space	Shelter with bench	Piece	12,160	105	1.28	25	55	20	0.32	0.70	0.26
Green area	Planting	m^2	46	11,200	0.52	0	90	10	0.00	0.46	0.05
Land Acquisition	Land (Sheikh Zayed Central & Mirs University)	m^2	1,300	32,140	41.78	0	100	0	0.00	41.78	0.00
	Sub-total				47.71				1.42	45.13	1.16
Bus Terminal (2 Terminals)											
Earthwork	Cut	m^3	12	4,818	0.06	43	31	26	0.03	0.02	0.02
Pavement	Surface	m^3	300	402	0.12	25	55	20	0.03	0.07	0.02
	Binder Course	m^3	300	402	0.12	25	55	20	0.03	0.07	0.02
	Base Course	m^3	90	2,409	0.22	25	55	20	0.05	0.12	0.04
	Subbase Course	m^3	80	2,409	0.19	25	55	20	0.05	0.11	0.04
Waiting Space	Shelter with bench	Piece	12,160	51	0.62	25	55	20	0.15	0.34	0.12
Pedestrian	Bridge	m^2	13,376	260	3.48	25	55	20	0.87	1.91	0.70
Bridge (Steel)	Staircase	m^2	3,453	376	1.30	25	55	20	0.33	0.71	0.26
Pedestrian Bridge with Staircase (concrete)		m^2	1,216	588	0.72	27	52	21	0.19	0.37	0.15
Pedestrian	Underpass	m	72,000	305	21.96	27	52	21	5.93	11.42	4.61
Station House	Shelter with ticketing system, etc.	Unit	3,040,000	4	12.16	51	27	22	6.20	3.28	2.68
Viaduct	Structure	m^2	6,000	6,747	40.48	27	52	21	10.93	21.05	8.50
Section	Pavement	m^3	300	598	0.18	25	55	20	0.05	0.10	0.04
Land	(6th of Oct. City)	m^2	1,000	8,030	8.03	0	100	0	0.00	8.03	0.00
	(Behouth Metro Sta.)	m^2	6,000	6,747	40.48	0	100	0	0.00	40.48	0.00
	Sub-total				130.11				24.83	88.08	17.20
	Civil Work -Total				580.14				144.41	334.45	101.28
Engineering and Construction Management (4%)					23.21	60	30	10	13.92	6.96	2.32
	Local Administration (5%)				29.01	0	90	10	0.00	26.11	2.90
	Contingency (10%)				58.01	25	58	17	14.44	33.45	10.13
	Total				690.37				172.77	400.96	116.63

Source: JICA Study Team

Table 5.5.1 Summary of Construction Costs for the Busway (2/2)

Investment Item		Unit	Unit Cost (L.E)	Quantity	Total Cost (Mill. L.E)	Foreign (%)	Local (%)	Tax (%)	Foreign Amount (Mill. L.E)	Local Amount (Mill. L.E)	Tax (Mill. L.E)
Depot & Workshop											
Bus Parking		m^2	608	11,200	6.81	0	90	10	0.00	6.13	0.68
Depot & Workshop	Earthwork (Cut)	m^3	12	16,800	0.20	43	31	26	0.09	0.06	0.05
	Surface	m^3	300	1,120	0.34	25	55	20	0.08	0.19	0.07
	Binder Course	m^3	300	1,120	0.34	25	55	20	0.08	0.19	0.07
	Base Course	m^3	90	5,600	0.50	25	55	20	0.13	0.28	0.10
	Subbase Course	m^3	80	5,600	0.45	25	55	20	0.11	0.25	0.09
Building	Management	m^2	3,648	800	2.92	20	70	10	0.58	2.04	0.29
	Maintenance	m^2	1,824	4,000	7.30	70	20	10	5.11	1.46	0.73
Land		m^2	1,000	28,000	28.00	0	100	0	0.00	28.00	0.00
Sub-total					46.85				6.18	38.59	2.08
Engineering and Construction Management (4%)					1.87	30	62	8	0.56	1.16	0.15
Local Administration (5%)					2.34	0	95	5	0.00	2.23	0.12
Contingency (10%)					4.68	25	67	8	1.18	3.14	0.37
Total					55.75				7.93	45.11	2.71
Buses											
Articulated Bus		Vehicle	4,000,000	227	908.00	90	0	10	817.20	0.00	90.80
Bus Total					908.00				817.20	0.00	90.80
Grand Total					1,654.12				997.90	446.08	210.14

Source: JICA Study Team

5.5.2 Maintenance Cost

The maintenance cost was determined for a 30 year period, as established in CREATS. A proposed maintenance schedule is shown in Table 5.5.2.

Table 5.5.2 Proposed Maintenance Schedule for the Busway, Bus Terminals and Transfer Station Plazas

Busway	First 10 years	Every year	5% of the total length will be repaired with a 50 mm thick overlay.
		In the 10^{th} year	The total length will receive a 50 mm thick overlay.
	Next 10 years	Every year	5% of the total length will be repaired with a 50 mm thick overlay.
		Each 20^{th} year	The total length will receive a 50 mm thick overlay.
Bus Terminals and Transfer Station Plazas	First 10 years	Every year	10% of the total length will be repaired with a 50 mm thick overlay.
	Next 10 years	Every year	15% of the total length will be repaired with a 50 mm thick overlay.

Source: CREATS Phase II, Vol. II

Based on the proposed maintenance schedule shown in Table 5.5.2, the maintenance costs for the busway, bus terminals and transfer station plazas were calculated, as shown in Table 5.5.3.

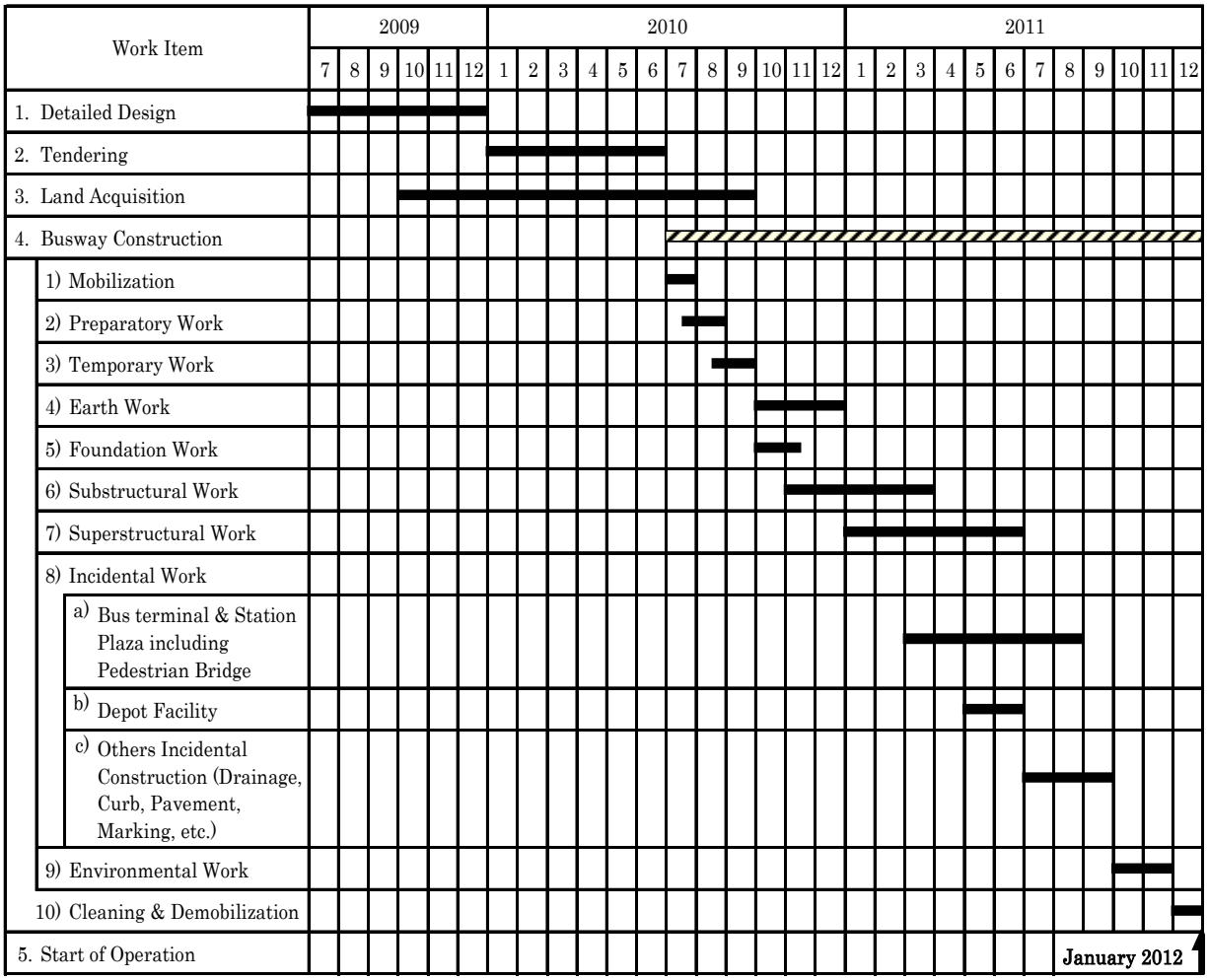
Table 5.5.3 Maintenance Cost for the Busway, Bus Terminals and Transfer Station Plazas

Investment Item		Unit	Unit Cost (LE)	Q'ty	Total Cost (mil. LE)	Foreign (%)	Local (%)	Tax (%)	Foreign Amount (mil. LE)	Local Amount (mil. LE)	Tax (mil. LE)
Busway											
Pavement Surface	First 10years	m^3	300	12,674	3.80	48	29	23	1.82	1.1	0.87
	Second 10years	m^3	300	12,674	3.80	48	29	23	1.82	1.1	0.87
Bus Terminals and Transfer Station Plazas											
Pavement Surface	First 10years	m^3	300	3,507	1.05	48	29	23	0.5	0.3	0.24
	Second 10years	m^3	300	5,260	1.58	48	29	23	0.76	0.46	0.36
Total					10.23				4.91	2.07	2.35

Source: JICA Study Team

5.5.3 Construction Schedule

The anticipated construction schedule up to the start of Busway operations is shown in Figure 5.5.1. In parallel with a six month Detailed Design Stage and the six month Tendering Stage, the schedule allows one year for land acquisition and determination of the ROW in the Detailed Design Stage. It is assumed that construction will start one year after the start of the Detailed Design work. The construction period of 1.5 years is the same as that established in CREATS.



Source: JICA Study Team

Figure 5.5.1 Anticipated Construction Schedule

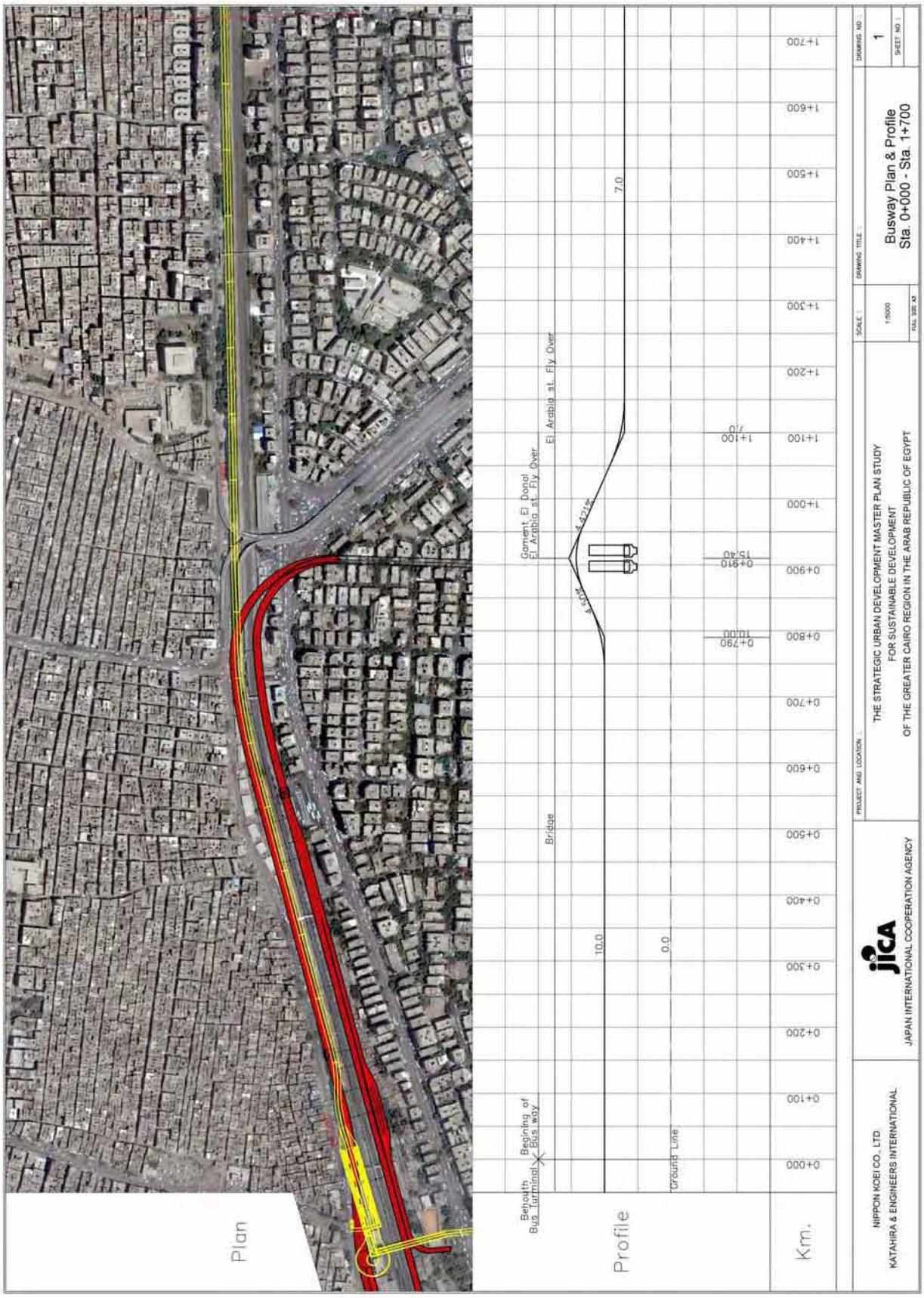


Figure 5.5.2 Plan and Profile for 6th of October Busway Station 0+000 – Station 1+700

Source: JICA Study Team

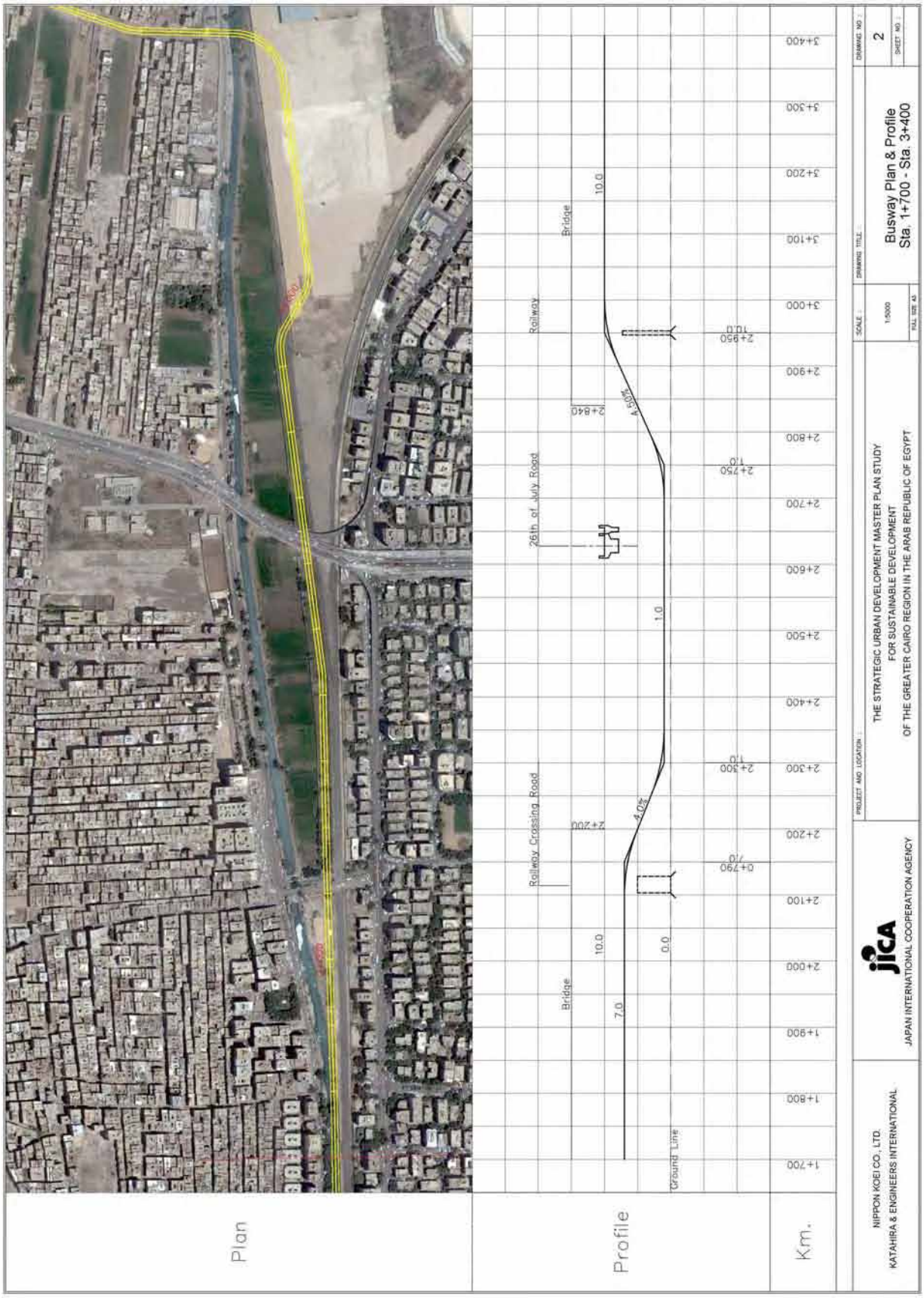
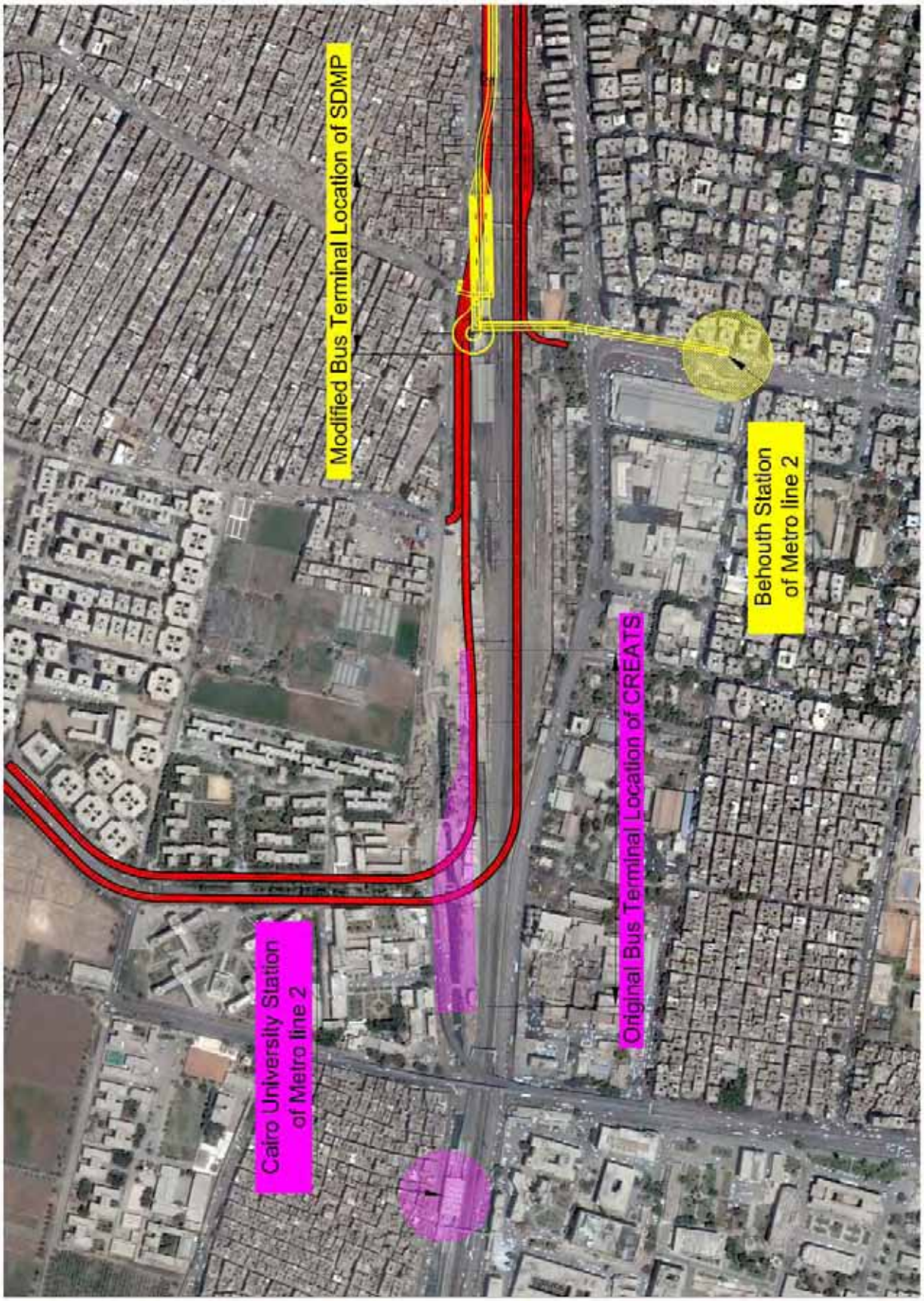


Figure 5.5.3 Plan and Profile for 6th of October Busway Station 1+700 - Station 3+400

Source: JICA Study Team

Figure 5.5.4 Plan for Behouth Bus Terminal

Source: JICA Study Team



Source: JICA Study Team

Figure 5.5.5 Alternative Bus Terminal Location Plans at around Cairo University Station / Behouth Station on Metro Line 2