No.

Ministry of Transport,
National Authority for Tunnels
The Arab Republic of Egypt

JICA Preparatory Survey
On
Greater Cairo Metro Line No.4
In
the Arab Republic of Egypt

FINAL REPORT

Volume 2
(Feasibility Study Report 2)

JUNE 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.
JAPAN RAILWAY TECHNICAL SERVICE
NIPPON CIVIC CONSULTING ENGINEERS CO., LTD

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Exchange Rates

1.00 LE = JPY17.28
USD1.00 = JPY95.25
USD1.00 = 5.512 LE

Preface

In response to the request from the government of the Arab Republic of Egypt, the Government of Japan decided to conduct “JICA Preparatory Survey on Greater Cairo Metro Line No.4”, and entrusted the study and to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team consisted of Nippon Koei Co. Ltd., Japan Railway Technical Service (JARTS) and Nippon Civic Consulting Engineer Co. Ltd, headed by Mr. Hiroshi Izawa, between February 2009 to May 2010.

The team conducted field surveys at the study area and held discussions with the officials concerned of the Government of the Arab Republic of Egypt. Having completed them, now the team prepared this final report.

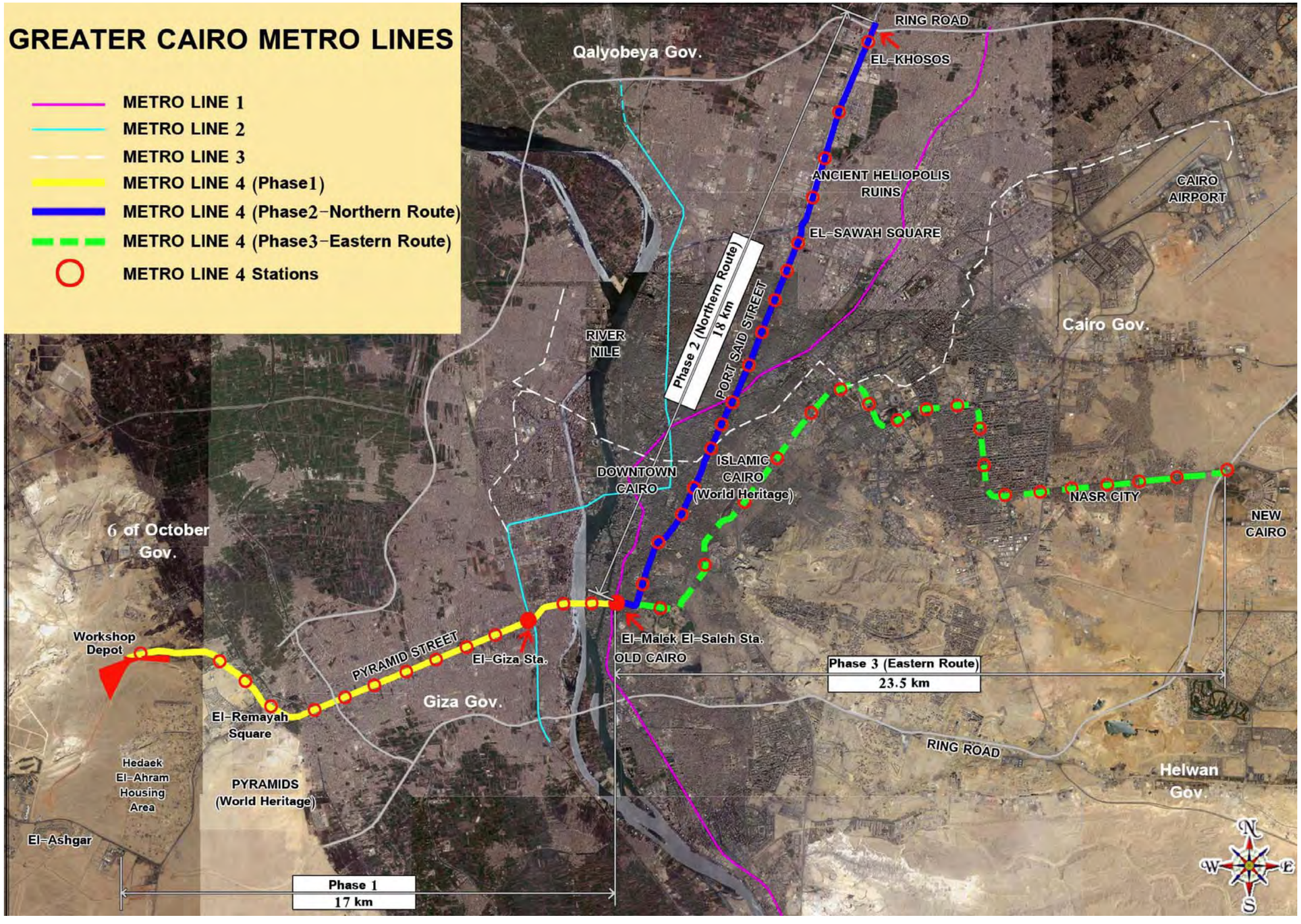
I hope that this report will greatly contribute to the construction and operation of the Metro Line No.4 for the urban transportation in Greater Cairo, as well as to enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Arab Republic of Egypt for their close cooperation to the project.

June 2010

Kiyoshi Kodera
Vice President
Japan International Cooperation Agency

LOCATION MAP



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GROSSARY OF ABBREVIATIONS AND MEASURING UNITS

GLOSSARY OF ABBREVIATIONS AND MEASURING UNITS

ABBREVIATIONS

A

AASHTO	American Association of State Highways and Transportation Officials
AB	Absolute Block
ABS	Automatic Block Signals
A/C	Air Conditioning
AC	Alternating Current
ACE	Arab Consulting Engineers
ACij	Access Length
ADT	Average Daily Traffic
AF	Audio Frequency
AFC	Automatic Fare Collection (system)
AfDB	African Development Bank
AG	Automatic Gate
AGT	Automated Guide-way Transit
AHU	Air Handling Unit
AM	Amplitude Modulation
am	Ante meridian
ANSI	American National Standards Institute
AREMA	American Railway Engineering and Maintenance Association
ARS	Automatic Route Setting
ASCII	American Standard Code for Information Interchange
asl	Above Sea Level
ASTM	American Society for Testing and Materials
AT	Auto Transformer
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
ATS	Automatic Train Supervision
ATS	Automatic Train Stop
Ave.	Average

B

BAS	Building Automation System
BCC	Beginning of Circular Curve
BCR	Benefit Cost Ratio
BD	Basic Design
BNC	British National Connector
BP	Brake Pipe
BRT	Bus Rapid Transit
BS	British Standard
BSE	Base Station Equipment
BT	Booster Transformer
BTC	Beginning of Transition Curve

C

CA	Certification Authority
CAA	Competent Administrative Authority
CAD	Computer Aided Design
C&I	Criteria & Indicator
CAPMAS	Central Agency for Public Mobilization and Statistics
CAPW	Construction Authority for Portable Water and Wastewater
CBD	Central Business District
CBTC	Communication Based Train Control
CCIR	International Radio Consultation Committee
CCITT	Consultative Committee for International Telephone and Telegraphs
CCP	Central Control Point
CCTV	Closed Circuit Television
CCU	Central Control Unit
CCU	Communication with Central Control Unit
CD ROM	Compact Disc Read Only Memory
CDR	Compact Disc Recordable
CIP	Central Interface Panel
CENELEC	European Committee for Electrotechnical Standardization
CI	Computerized Interlocking
CICC	Contactless IC Card
CIPF	Card Initiation and Personalization Function
CIPS	Card Initiation and Personalization System
CMH	Cubic Meter per Hour
CML	Cairo Metro Line

	CMO	Cairo Metro Organization
	CMOS	Complementary Metal Oxide Semiconductor
	CNG	Compressed Natural Gas
	COP	Crew Operation Panel
	CPEE	City Unit Cable
	CPM	Critical Path Method
	CREATS	Cairo Regional Area Transportation Study
	CRT	Cathode Ray Tube
	CS	Cab Signal
	CSC	Contactless Smart Card
	CTA	Cairo Transport Authority
	CULTNAT	Cultural and National Heritage
	CV	Curriculum Vitae
	CWO	Cairo Wastewater Organization
	CWR	Continuously Welded Rail
D		
	DB	Dry Bulb (Ventilation)
	D&B	Design and Build
	DC	Direct Current
	DC	Direct Cost
	DCF	Discount Cash Flow
	DF	Depot Facility
	DIN	Deutsche Industry Norm (German Industrial Standard)
	DO	Dissolved Oxygen
	DOS	Disk Operating System
	DSRSC	Design Standards for Railway Structures and Commentary
	DWG	Drawing
E		
	E&M	Electrical and Mechanical
	ECC	End of Circular Curve
	ECM	Egyptian Company for Metro
	ECMOU	Egyptian Company for Maintaining and Operating the Underground
	ECS	Environmental Control System
	EEAA	Egyptian Environmental Affairs Agency
	EEHC	Egyptian Electricity Holding Company
	Egij	Egress Length

EGP	Egyptian Pound
EGSA	Egyptian General Survey Authority
EHF	Extremely High Frequency (mill-meter wave)
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EIRENE	European Integrated Railway Radio Enhanced NEtwork
EIRR	Economic Internal Rate of Return
ELCB	Earth Leakage Circuit Breaker
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EMU	Environmental Management Unit (Governorate)
EMU	Electric Multiple Unit
ENIT	Egypt National Institute of Transport
ENPV	Economic Net Present Value
ENR	Egyptian National Railway
EPBM	Earth Pressure Balanced Machine
EPI	Environmental performance Indicator
ER	Electric Room
ERs	Executive Regulations
ERTMS	European Railway Traffic Management System
ETC	End of Transition Curve
ETCS	European Train Control System
ETHERNET	Computer Cabling System
EU	European Union
EUA	EU emission Allowance

F

FCC	Federal Communications Commission
FIRR	Financial Internal Rate of Return
FM	Frequency Modulation
FOB	Free On Board
FOC	Fiber Optic Cable
F/S	Feasibility Study
FS	Fail Safe
FSK	Frequency Shift Keying
FSR	Feasibility Study Report
FTP	File Transfer Protocol
FY	Fiscal Year, Financial Year

G

GARBLT	General Authority for Roads, Bridges and Land Transport
GC	General Consultant
GCA	Greater Cairo Area
GCR	Greater Cairo Region
GDP	Gross Domestic Product
GEM	Grand Egyptian Museum
GHG	Greenhouse Gas
GIS	Geographic Information System
GL	Ground Level
GNI	Gross National Income
GOE	Government of Egypt
GOJ	Government of Japan
GOPP	General Organization for Physical Planning
GPS	Global Positioning by Satellite System
GRDP	Gross Regional Domestic Product
GSM	Global System for Mobile communications
GSM-R	Global System for Mobile communications for Railways
GUI	Graphical User Interface

H

HB	Home Based
HFC	Hydro-Fluoro-Carbon
HIS	Home Interview Survey
HMI	Human Machine Interface
Hz	Hertz
hr	hour
HS	Hindrance Sensor
HTTP	Hyper Text Transfer Protocol
HVL	High Voltage Line
HVS	High Voltage Station

I

IBA	Important Bird Area
IBC	International Building Code
IBRD	International Bank for Reconstruction and Development
IC	Integrated Circuit
ICEA	Insulated Cable Engineers Association
IDC	In-Direct Cost

	IEC	International Electrotechnical Commission
	IEEE	Institute of Electrical and Electronics Engineers
	IGBT	Insulated Gate Bipolar Transistor
	IMF	International Monetary Fund
	IP	Implementation Program
	IRJ	Insulated Rail Joint
	IRR	Internal Rate of Return
	IS	Information System
	ISDN	Integrated Services Digital Network
	ISO	International Standards Organization
	IT	Information Technology
	I-Tax	Import Tax
	ITU	International Telecommunication Union
	ITV	Industrial Television
	IUCN	International Union for Conservation of Nature and Natural Resources
J		
	JARTS	Japan Railway Technical Service
	JBIC	Japan Bank for International Cooperation (former name of JICA)
	JICA	Japan International Cooperation Agency
	JIS	Japanese Industrial Standards
	JNR	Japanese National Railways
	JPY	Japanese Yen
	JST	JICA Study Team
K		
	kCal	kilo-Calory
	kV	kilo Volt
	kVA	kilo Volt Ampere
L		
	LAN	Local Area Network
	LCD	Liquid Crystal Display
	LCU	Local Control Unit
	LCX	Leaky Coaxial Cable
	LE /L.E.	Egyptian Pound
	LED	Light Emitting Diode
	LPS	Lighting and Power Station

LRT	Light Rail Transit
LRV	Light Rail Vehicle
LRU	Line Replaceable Unit
LT	Link Traffic
LV	Low Voltage
LWR	Long Welded Rail

M

MCA	Multi-Criteria Analysis
MCBF	Mean Cycle Between Failure
MCP	Manual Control Panel
MCPC	Monitoring and Control Personal Computer
MCS	Manual Control Switch
MDB	Manual Door Opening Button
M&E	Mechanical and Electrical
MDBF	Mean Distance Between Failure
MDOP	Manual Door Operation Panel
MH	Maintenance Hatch
MIL	Military Specification
min.	minute
MIS	Management Information System
MJC	Misr Japan Alled Company for Rolling Stock Maintenance and Renweal
MLIT	Ministry of Land Infrastructure, Transport and Tourism / Japan
MOH	Ministry of health (Egypt)
MOT	Ministry of Transport (Egypt)
MP	Mimic Panel
MPU	Motive Power Unit
MPU	Micro Processor Units
MRT	Mass Rapid Transit
MSEA	Ministry of State for Environmental Affairs
MSK	Minimum Shift Keying Modulation
MT	Matting Transformer
MT	Magnetic Ticket (AFC)
M4N	Metro Line 4 North section (Phase 2)
M4W	Metro Line 4 West Section (Phase 1)
MW	Mega Watt

N

NAT	National Authority for Tunnel, Ministry of Transport
NATM	New Austrian Tunneling Method
NFPA	National Fire Prevention Association
NGO	Non-Governmental Organization
NHB	Non-Home Based
NOUH	National Organization for Urban Harmony
NOx	Nitrogen Oxides
NPV	Net Present Value
N-Sta.	North line Station (Phase 2)
NUC	New Urban Community

O

OA	Outside Air (Ventilation)
OCC	Operation Control Centre
OCS	Overhead Contact System
OD / O/D	Origin and Destination
ODA	Official Development Assistance
OFC	Optical Fibre Cable
OHC	Over Head Catenary
O&M	Operation and Maintenance
OP	Operation Policy
ORC	Overhead Rigid Conductor

P

p.a.	per annum
P&L	Profit and Loss
PA	Public Announcement/ Public Address
PAP	Project Affected Person
Pax	Passenger
PBX	Private Automatic Branch Exchange
PC	Pre-stressed Concrete
PC	Personal Computer
PCP	Power Control Point
PCU	Passenger Car Unit
p/h	person per hour
PHPDT	Peak Hour Peak Direction Trips
PID	Passenger Information Display
PKI-SAM	Public Key Infrastructure - Security Access Key

	pm	post meridian
	PM	Particulate Matter
	PMSM	Permanent Magnet Synchronous Motor
	PPHPD	Passengers Per Hour Per Direction
	PPM	Planned Preventive Maintenance
	PRC	Programmed Route Control
	PRJ	Projector
	PSD	Platform Screen Door
	P.T.	Piaster
	PT	Person Trip
	PTC	Programmed Traffic Control
	PPM	Parts Per Million
	PSO	Public Service Obligation
	PVC	Poly Vinyl Chloride
	PVU	Portable Verification Unit
	PW	Permanent Way
Q		
	QA	Quality Assurance
R		
	RA	Returned Air
	RAMS	Reliability, Availability, Maintainability and Safety
	RAP	Resettlement Action Plan
	RBO	Regional Branch Offices
	RC	Reinforced Concrete
	RCS	Radio Central Control System
	Rd.	Road
	RF	Radio Frequency
	Rf	Rectifier equipment
	RH	Relative Humidity
	RI	Relay Interlocking
	Rij	Railway Length
	RL	Rail Level
	ROE	Return On Equity
	ROI	Return On Investment
	ROW	Right Of Way
	RP	Revealed Preference
	RPS	Revealed Preference Survey

RPF	Resettlement Policy Framework
RS	Rectifier Station
RS	Rolling Stock
RT	Refrigeration Tons
RTU	Remote Terminal Unit
RTRI	Railway Technical Research Institute, Japan
R/W	Read and Write

S

SA	Supply Air
SAM	Security Access Module
SCA	Supreme Council of Antiquities
SCADA	Supervisory Control and Data Acquisition
SCU	Station Control Unit
SDH	Synchronous Digital Hierarchy
SDMP	The Strategic Urban Development Master Plan Study for a sustainable Development of the Greater Cairo Region in the Arab Republic of Egypt
Sec.	Section
sec.	second
SEVP	Signal Polyethylene Vinyl Cable
SF	Stored Fare (Ticket)
SHF	Super High Frequency (centimeter wave)
SI	Systeme Internationale d'Unites (SI Unit)
SI	Sensitive Indicator
SIFE	Students in Free Enterprise
SL	Screen Line
SM	Single Mode
SO_2	Sulfur Dioxide
SOFRETU	Société Française d'études et de réalisations de transports urbains
SP	Stated Preference
SPAD	Signal Passing At Danger
SPF	Shadow Pricing Factor
SPS	Stated Preference Survey
SPT	Standard Penetration Test
SQEE	Signal Quad Polyethylene Cable
sq.m.	square meter

	SSOP	Station Staff operation Panel
	STA / Sta.	Station
	STRASYA	Standard Urban Railway System for Asia
	STEP	Special Terms for Economic Partnership
	SV	Switching Value
	S/W	Scope of Work
	SWWT	Spine Waste Water Tunnel
T		
	TAC	Track Access Charge
	TAZ	Traffic Analysis Zone
	TBM	Tunnel Boring Machine
	TD	Train Detection
	TD	Tender Document
	TDM	Time Division Multiplex
	TDMA	Time Division Multiple Access
	TEF	Tunnel Exhaust Fans
	TETRA	Terrestrial Trunked Radio
	TIS	Ticket Initialization Unit
	TOM	Ticket Office Machine
	TOR	Terms Of Reference
	TR	Ticket Reader
	TV	Television
	TVF	Tunnel Ventilation Fans
	TVM	Ticket Vending Machine
U		
	UNDP	United Nations Development Programme
	UIC	Union International des Chemins de fer (International Union of Railways)
	UPS	Uninterruptible Power Supply
	USRT	United States Refrigeration Tons
V		
	V	Volt
	VAT	Value Added Tax
	VHF	Very High Frequency
	VOC	Vehicle Operating Cost
	VOT	Value Of Travel Time
	VVVF	Valuable Voltage Valuable Frequency

W

W	Watt
WB	World Bank
WB	Wet Bulb
W/D	Workshop/Depot
W/S	Work Station
WS	Wayside Signal
WAN	Wide Area Network
WWW	World Wide Web
WYSIWYG	What You See Is What You Get

UNITS OF MEASURE

A	Ampere
Amp	Ampere
BTU	British Thermal Unit
dB	Decibel
dBA	Decibel on the 'A' weighted scale
FC	Foot-candles
g	Acceleration due to Gravity (32.2 ft/s2 =9.81 m/s2)
H	Hour
Hz	Hertz
In	Inch
J	Joule
ha	Hectare
kg	Kilogram
kHz	Kilohertz
km	Kilometer
km^2	Square Kilometer
km/h	Kilometer per hour
kWh	Kilowatt hour
kV	Kilovolt
l	Liter
L.E.	Egyptian Pound
m	Meter
m^2	Square Meter
mg/l	Milligram per Litter
MHz	Mega Hertz
min	Minute
mm	Millimeter
MW	Megawatt
MVA	Mega Volt Ampere
mV	Millivolt
ìV	Microvolt
N	Newton
NYU	Nephelometric Turbidity Unit
ppm	parts per million
RT	Refrigeration Tons

sec	Second
ug/m^3	Microgram per cubic meter
USRT	United States Refrigeration Tons
V	Volt
Vac	Volt alternating current
Vdc	Volt direct current
wt	weight
$^\circ$ C	Degree Celsius
$^\circ$ F	Degree Fahrenheit

EXECUTIVE SUMMARY OF VOLUME 2

EXECUTIVE SUMMARY OF VOLUME 2

1. Introduction

1.1 Background and Purpose of the Study

The Greater Cairo Region is the premier city in Egypt. It is rich in history and boasts of a large number of historical structures. It is the largest city in the African Continent and the Middle Eastern Region with a population of over 18 million, representing 25% of the total population of Egypt.

As the population of the Greater Cairo Region is envisaged to increase to 20 million by the year 2017 according to the SDMP Report, the Government of Egypt (GOE) is reforming the urban structure, changing from a mono-centric form to a decentralized form, notably through the development of New Urban Communities (NUCs), such as the 10th of Ramadan City and 6th October City. However, the increasing transport demand has not been accompanied by a substantial solution to urban problems such as road traffic congestion, insufficient public transportation services and air pollution.

At present two metro lines are in service and one metro line is under construction. As a long-term strategic development plan, the General Organization for Physical Planning (GOPP) has prepared “the Cairo Vision 2050”. This vision document proposes 15 metro routes as the main public transport system in the Greater Cairo Region.

Under this circumstanced, GOE has decided to construct, as early as practicable, the Metro Line 4, and requested the Government of Japan (GOJ) to implement the “Development Study on Greater Cairo Metro Line No.4 Project in October 2008, by the Government of the Arab Republic of Egypt”. The Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of GOJ’s programs, has had discussions with the National Authority for Tunnels (NAT) of the Ministry of Transport and has agreed to conduct a feasibility study for the proposed Metro Line 4. The document for the Scope of Work was signed on 21st December 2008.

1.2 Implementation of the Study

The JICA Preparatory Survey on the Greater Cairo Metro Line No.4 was undertaken in March 2009, based on the Scope of Work agreed among the NAT, the Ministry of Transport, and the JICA. The study was carried out by the JICA Study Team (JST), which is the consultant team hired by JICA for the implementation of this study. The JICA Preparatory Survey consists of the following two major studies.

- New Transportation Study on Greater Cairo Metro Line No.4, including selection of the routes for Phase 1 and Phase 2, considering future transport demand up until the year 2050.
- A complete Feasibility Study for the combined Phase 1 and Phase 2 selected route, including Preliminary Design for Phase 1, considering future transport demand up until the year 2050.

2. Transportation Study

2.1 Transport Survey

JICA Study Team has analyzed previous surveys which were carried out by JICA as follows;

- Public Private Partnership Program for Cairo Urban Expressway Network Development (May 2006)
- Feasibility Study on High Priority Urban Toll Expressways in Cairo (January 2009)
- The Strategic Urban Development Master Plan Study for Sustainable Development of the Greater Cairo Region (January 2008)

Based on the above analysis, JICA Study Team has conducted following four surveys.

- Link Traffic Count Survey (LT survey)
- Screen Line Survey (SL survey)
- Interview Survey for Car Users and Public Transport Users
- Interview Survey for Tourists

The purposes of these transport surveys are:

- To recognize the traffic volume characteristics on the roads along the route of Metro Line 4.
- To study the direct impact on the road traffic along the Metro Line 4, such as the level of service, air pollution and noise level.
- To get necessary information for traffic control and management plans during the construction stage.
- Validate the main output of the transportation planning models that will be developed in this study.

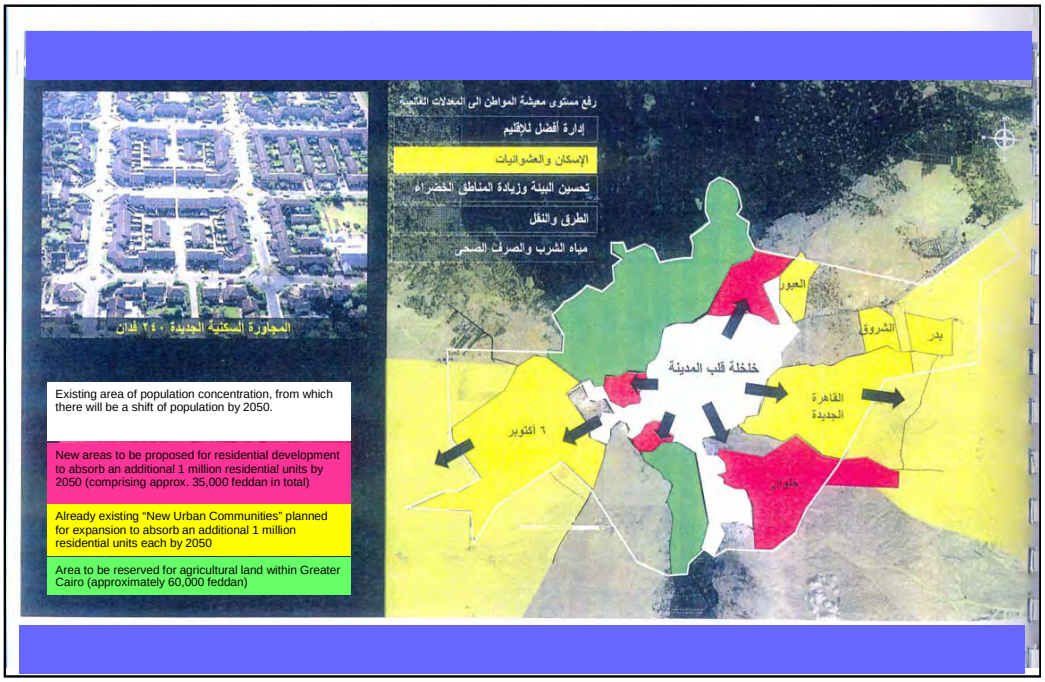
On the other hand, the main objectives of the interview survey are:

- To calibrate a modal choice model
- To measure their willingness to pay for a new metro service that would be safer and more time-saving

2.2 Urbanization and Socio-Economic Development

The study area comprises rapidly growing and newly urbanizing communities at its western and eastern extremities, as well as a mature urban core at its centre and in its northern section. The pattern of urban growth within Greater Cairo up until 2050 was assumed to follow the shift of residential development and population away from the existing urban concentrations (agglomerations) to “New Urban Communities” (NUCs), as envisaged in Cairo Vision 2050.

The strategy for the urban development of Greater Cairo, as presented in Cairo Vision 2050, is given in Figure 1 below.



Source: Vision 2050, General Office for Physical Planning, Ministry of Housing, Utilities and Urban Development

Figure 1 Urban Development Strategy for Greater Cairo up to 2050

2.2.1 Population Projections

For the purpose of summarizing the population forecasts used as inputs for the transport demand forecast, the study area was divided into 18 geographical sectors. Following table shows the summary of forecast population and growth rates by study sectors.

In most cases of sectors containing existing NUCs (see rows shaded green), the average rate of population increase declines significantly between 2027 and 2050, as these areas approach their capacity. Conversely, it shows that in most cases of sectors containing new NUCs (see rows shaded purple), the average rate of population increase either remains constant or expands between 2027 and 2050.

Table 1 Summary of Forecast Population Growth Rates, by Study Sector

No.	Sector	Y2009	Y2027	Y2050	Overall Growth		Av. annual rate of growth	
					2009–2027	2009–2050	2009–2027	2009–2050
1	6th of October	322,880	1,449,364	1,671,672	449%	518%	8.7%	4.1%
2	Imbaba Markaz	1,835,262	2,684,164	3,575,870	146%	195%	2.1%	1.6%
3	Dokki	1,343,380	1,429,463	1,648,719	106%	123%	0.3%	0.5%
4	Giza	1,567,077	1,974,991	2,625,922	126%	168%	1.3%	1.3%
5	South Giza	530,317	590,495	681,067	111%	128%	0.6%	0.6%
6	Helwan	820,100	995,041	2,911,664	121%	355%	1.1%	3.1%
7	Maadi	1,113,044	1,655,522	1,909,452	149%	172%	2.2%	1.3%
8	Khaleafa	858,798	951,550	1,097,502	111%	128%	0.6%	0.6%
9	CBD	399,602	384,529	443,509	96%	111%	−0.2%	0.3%
10	Shobra	1,020,712	1,041,766	1,201,556	102%	118%	0.1%	0.4%
11	Masr El Gedeeda	873,972	976,786	1,126,609	112%	129%	0.6%	0.6%
12	Nasr City	1,118,408	2,355,577	2,716,884	211%	243%	4.2%	2.2%
13	Ain Sham	1,067,601	1,401,467	1,616,429	131%	151%	1.5%	1.0%
14	Salam City	815,377	725,064	836,277	89%	103%	−0.7%	0.1%
15	Shobra El Kheima	1,084,038	1,406,107	1,621,781	130%	150%	1.5%	1.0%
16	Qalyob	924,506	1,270,396	1,465,254	137%	158%	1.8%	1.1%
17	Qanater	1,350,293	2,313,704	3,988,588	171%	295%	3.0%	2.7%
18	10th of Ramadan	171,217	586,024	675,910	342%	395%	7.1%	3.4%
	Total	***17,216,581***	***24,192,010***	***31,814,664***	***141%***	***185%***	***1.9%***	***1.5%***

Sources: (1) SDMP Report 2008 (Population forecasts 2007-2027)
(2) JICA Study Team 2009 (Population forecasts 2030-2050)
Key: Includes existing NUCs
Includes new NUCs identified in Vision 2050

2.2.2 Employment Projections

The growth of employment in the study area is one of the factors having a strong influence on the growth in demand for the proposed Cairo Metro Line 4. Summary of forecast employment and growth rates by study sector is show in table below. It may be observed that the forecast reflects an expectation of a substantial shift of employment away from the main agglomerations to the existing and proposed NUCs. The former (shaded green) are expected to continue employment growth beyond 2027, but at reduced rates, while the latter (shaded purple), for the most part, are expected to more than double their annual rates of growth between 2009 and 2050, as compared with 2009-2027.

Table 2 Summary of Forecast Employment Growth Rates by Study Sector

No.	Study Sector	Y2009	Y2027	Y2050	Overall Growth		Av. annual rate of growth	
					2009-2027	2009-2050	2009-2027	2009-2050
	NUC's - existing	**461**	**1,443**	**2,803**	**313%**	**608%**	**6.5%**	**4.5%**
1	6th of October	119	335	718	282%	603%	5.9%	4.5%
12	Nasr City	47	294	704	631%	1513%	10.8%	6.9%
18	10th of Ramadan	166	365	739	220%	446%	4.5%	3.7%
	Others	130	449	642	346%	495%	7.1%	4.0%
	Agglomerations, small towns and new NUC's	**4,004**	**5,507**	**8,462**	**138%**	**211%**	**1.8%**	**1.8%**
2	Imbaba Markaz	463	747	654	161%	141%	2.7%	0.8%
3	Dokki	347	398	348	114%	100%	0.8%	0.0%
4	Giza	403	549	1,417	136%	352%	1.7%	3.1%
5	South Giza	137	164	387	120%	283%	1.0%	2.6%
6	Helwan	211	277	1,280	131%	606%	1.5%	4.5%
7	Maadi	283	460	403	163%	142%	2.7%	0.9%
8	Khaleafa	221	265	232	119%	105%	1.0%	0.1%
9	CBD	104	107	94	103%	90%	0.2%	−0.2%
10	Shobra	264	290	254	110%	96%	0.5%	−0.1%
11	Masr El Gedeeda	226	272	238	120%	105%	1.0%	0.1%
13	Ain Sham	273	390	341	143%	125%	2.0%	0.5%
14	Salam City	212	202	177	95%	83%	−0.3%	−0.4%
15	Shobra El Kheima	278	391	343	141%	123%	1.9%	0.5%
16	Qalyob	236	353	309	150%	131%	2.3%	0.7%
17	Qanater	342	643	1,985	188%	581%	3.6%	4.4%
	Total	**4,465**	**6,950**	**9,726**	**156%**	**218%**	**2.5%**	**1.9%**

Sources: SDMP report (2008); JICA Study Team (2009)

2.2.3 Student Enrolment Projections

Student enrolments are yet another important determinant for the level of demand for a metro, or indeed for any other form of public transport system. As such, forecasted student enrolments at the traffic zone level are used as an input for the Transport Demand Forecasting Model for the calculation of trip generation. Summary of forecast student enrolment and growth rates by study sector is show in table below. It may be observed that the forecast reflects an expectation of a large shift of student numbers away from the main agglomerations to the existing and proposed NUCs. The former (shaded green) are expected to continuously increase in terms of student numbers beyond 2027, but at reduced rates, while the latter (shaded purple), for the most part, are expected to double their annual rates of growth between 2009 and 2050, as compared with 2009-2027.

Table 3 Summary of Forecasted Student Enrolment Growth Rates by Study Sector

No.	Study Sector	Y2009	Y2027	Y2050	Overall Growth		Av. annual rate of growth	
					2009–2027	2009–2050	2009–2027	2009–2050
	NUC's - existing	**167**	**1,113**	**2,810**	**666%**	**1680%**	**11.1%**	**7.1%**
1	6th of October	31	367	927	1197%	3023%	14.8%	8.7%
12	Nasr City	119	597	1,507	502%	1266%	9.4%	6.4%
18	10th of Ramadan	17	149	375	849%	2144%	12.6%	7.8%
	Agglomerations, small towns and new NUC's	**3,460**	**4,712**	7,719	**136%**	**223%**	**1.7%**	**2.0%**
2	Imbaba Markaz	400	639	610	160%	152%	2.6%	1.0%
3	Dokki	300	340	325	113%	108%	0.7%	0.2%
4	Giza	348	470	1,277	135%	367%	1.7%	3.2%
5	South Giza	118	141	349	119%	295%	1.0%	2.7%
6	Helwan	183	237	1,145	130%	627%	1.5%	4.6%
7	Maadi	245	394	376	161%	154%	2.7%	1.1%
8	Khaleafa	191	226	216	118%	113%	0.9%	0.3%
9	CBD	90	92	87	102%	97%	0.1%	−0.1%
10	Shobra	228	248	237	109%	104%	0.5%	0.1%
11	Masr El Gedeeda	195	232	222	119%	113%	1.0%	0.3%
13	Ain Sham	236	334	318	141%	135%	1.9%	0.7%
14	Salam City	183	173	165	94%	90%	−0.3%	−0.3%
15	Shobra El Kheima	240	335	319	139%	133%	1.9%	0.7%
16	Qalyob	204	302	288	148%	142%	2.2%	0.9%
17	Qanater	296	551	1,785	186%	604%	3.5%	4.5%
	Total	3,635	**5,825**	**8,781**	**160%**	**242%**	**2.7%**	**2.2%**

Sources: SDMP report, 2008 ; JICA Study Team

2.2.4 Car Ownership Projections

A projection of the growth in car ownership until 2050 was made as the basis for estimating the growth in the daily number of car trips within the study area in the “without project” case (i.e. the situation which would apply without Metro Line 4 in operation). Application of the equation derived from the regression process to per capita GRDP resulted in determining the forecasted car ownership rates for the period 2009-2050, as shown in the following table.

Table 4 Car Ownership Forecast (Three Governorates)

Year	GRDP per cap	Ln (x)	Cars per 1000 persons	
	(x)		Estimate	Actual
2006	8,124.17	9.00	61.82	60.33
2007	8,460.14	9.04	66.90	70.08
2008	8,868.86	9.09	72.82	71.51
2009	8,985.05	9.10	74.46	
2010	9,050.07	9.11	75.36	
2011	9,181.94	9.12	77.18	
2012	9,383.07	9.15	79.90	
2020	14,238.00	9.56	132.24	
2030	23,873.84	10.08	197.11	
2040	37,685.37	10.54	254.40	
2050	55,571.49	10.93	303.15	
Growth factor 2050/2006	6.84		4.90	

Source: JICA Study Team

2.2.5 Summarized Transport Planning Indicators

The socio-economic indicators which have been assessed as bases for transport planning in this feasibility study are summarized in table below.

Table 5 Socio-economic Indicators in the Study Area

Socio-economic framework in the study area

Indicator	Unit	2006	2007	2009	2012	2017	2027	2030	2040	2050
Population	1000 persons	16,101	16,464	17,217	18,411	20,369	24,192	25,387	28,801	31,815
No.of Households	1000	4,007	4,097	4,284	4,582	5,067	5,385	6,318	7,168	7,918
Household Size	Persons/household	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02
Economy										
GRDP	Million L.E.	148,648	159,202	176,808	197,444	283,457	352,138	692,708	1,240,534	2,020,700
GRDP per Capita	L.E. per capita	9,232	9,670	10,270	10,724	13,916	16,273	27,286	43,072	63,515
Labour force	1000	4,613	4,777	5,096	5,506	6,316	7,761	8,193	9,602	11,012
Unemployment	%	7%	6%	6%	6%	5%	5%	5%	4%	4%
No.of Workers (Secondary and Tertiary)	1000 workers	4,051	4,208	4,465	4,890	5,634	6,950	7,272	8,415	9,726
Education										
Primary and Preparatory	1000 students	2,305	2,328	2,447	2,638	2,922	3,614	3,854	4,545	5,249
Secondary and University	1000 students	1,094	1,132	1,187	1,275	1,560	2,211	2,361	2,932	3,531
Total	1000 students	3,399	3,460	3,635	3,913	4,482	5,825	6,215	7,477	8,781

Sources: SDMP report, 2008 ; JICA Study Team estimates, 2009

2.3 Analysis of Transport Demand and Services

Passenger transport share in Cairo is shown in Table 6. The daily number of passengers transported by existing metro is roughly 2 million and total public transport mode passengers are estimated to be 13.7 million. According to the recent data, the average number of passengers per day between 05:15-24:15 amounted to 1.217 million on Metro Line 1 and 0.73 million on Metro Line 2.

Table 6 Estimated Passenger Transport Share

Total Demand	13.7 million
Metro	2.0 million
CTA	4.1 million
Private Bus	7.6 million

Sources: JICA Study Team estimates

2.4 Transport Demand Forecasting Model

During all steps of travel model calibrations and demand forecast, the JICA STRADA system and the facilities of Excel spread sheets are used. In this report, methodology, step and explanation of modelling is described.

2.5 Present and Future Transportation Demand Matrix

Based on the socio–economic framework up to 2050 and the transportation models developed, the present and future transportation demand is estimated according to the following conventional “four-step” approach:

(1) trip generation and attraction,
(2) trip distribution,
(3) modal split and
(4) trip assignment.

The original estimated OD matrices have 464 traffic zone bases, but are not presented in this report due to its large volume. Therefore the forecasting results in this report are integrated into a sector zone system with 18 zones. The demand data and OD matrixes with the original 464 zones are only prepared in electronic based data using Excel or JICA STRADA data format.

The present and future trip generations by zone are estimated as shown in Table 7, and the summary results of modal share among “car mode”, “bus mode” and “rail mode” are show in Table 8.

Table 7 Trip generation and attraction (unit; thousand trips per day)

No.	Sector Zone	Gi2008	Gi2027	Gi2050	Growth Rate 2027/2008	Growth Rate 2050/2008	Growth Rate 2050/2027
1	6th of October	351.7	1,879.0	2,812.4	5.34	8.00	1.50
2	Imbaba Markaz	1,579.9	2,585.0	4,450.0	1.64	2.82	1.72
3	Dokki	1,470.7	1,692.5	2,313.0	1.15	1.57	1.37
4	Giza	2,124.3	2,711.9	4,491.8	1.28	2.11	1.66
5	South Giza	513.3	627.1	865.4	1.22	1.69	1.38
6	Helwan	903.6	1,064.0	3,326.3	1.18	3.68	3.13
7	Maadi	1,098.3	1,712.2	2,873.7	1.56	2.62	1.68
8	Khaleafa	921.3	968.1	1,322.8	1.05	1.44	1.37
9	CBD	719.6	593.3	802.5	0.82	1.12	1.35
10	Shobra	1,094.0	1,118.9	1,556.2	1.02	1.42	1.39
11	Masr El Gedeeda	1,619.2	1,585.1	2,171.9	0.98	1.34	1.37
12	Nasr City	1,369.0	2,583.9	3,473.3	1.89	2.54	1.34
13	Ain Sham	1,062.5	1,385.6	1,907.4	1.30	1.80	1.38
14	Salam City	841.7	773.4	1,071.9	0.92	1.27	1.39
15	Shobra El Kheima	1,137.8	1,404.4	1,927.4	1.23	1.69	1.37
16	Qalyob	882.7	1,103.4	1,477.9	1.25	1.67	1.34
17	Qanater	1,298.2	2,102.6	4,918.2	1.62	3.79	2.34
18	10th of Ramadan	191.7	687.5	1,038.2	3.59	5.42	1.51
	Total	19,179.5	26,577.9	42,800.3	1.39	2.23	1.61

Source: JICA Study Team

Table 8 Result of Modal Share Estimation

Year	Metro Line 4 Phase 2 Alternative	No. of Trip (thousand trip per day)			Modal share (%)		
		Car mode	Bus mode	Rail mode	Car mode	Bus mode	Rail mode
2008		4,584	12,693	2,412	23.3%	64.5%	12.2%
2027	Alt 1 North	9,593	12,365	4,744	35.9%	46.3%	17.8%
	Alt 2 East	9,599	12,374	4,730	35.9%	46.3%	17.7%
2050	Alt 1 North	19,374	16,017	7,809	44.8%	37.1%	18.1%
	Alt 2 East	19,381	15,975	7,845	44.9%	37.0%	18.2%

Source: JICA Study Team

2.6 Present and Future Metro Passenger

Table 9 and Table 10 explain the number of passengers of metro by lines, each year. (Note that the number of passengers for Metro Line 4 includes both for phase 1 and phase 2 sections). For Metro Line 4 alternative 1, the total passenger volume is expected to be 5.36 million per day, which is the same for alternative 2. However the passenger volumes on Metro Lines 1 and 2 are lower than alternative 2, because the alignment of line 4 phase 2 section runs along the northern corridor where Metro lines 1 and 2 also compete. In Metro Line 4 alternative 2, the passenger volume of Metro Line 4 is bigger than alternative 2, but its phase 2 section is in conflict with Metro Line 3. It is also noted that the demand of Metro Line No.3 is very low, as compared with alternative 1.

The demand for Metro Line 1 in 2050 surpasses the design capacity. This result suggests improving the capacity or installing new public transportation service in this area.

Table 9 Summary of Metro Daily Demand (Metro Line No. 4 Alternative 1 North Extension)

Year		**Metro Line 1**	**Metro Line 2**	**Metro Line 3**	**Metro Line 4**	Total
2008	No. of Passengers (Station Boarding / Alighting)	1,237,000	977,000			2,214,000
	Section Maximum Passengers per hour per direction	54,100	42,200			
2027	No. of Passengers (Station Boarding / Alighting)	2,105,000	1,381,000	1,686,000	1,968,000	3,964,000
	Section Maximum Passengers per hour per direction	62,100	36,300	59,100	53,100	
2050	No. of Passengers (Station Boarding / Alighting)	2,704,000	1,821,000	2,087,000	2,347,000	5,362,000
	Section Maximum Passengers per hour per direction	64,600	42,800	67,400	55,700	

Source: JICA Study Team

Table 10 Summary of Metro Daily Demand (Metro Line No. 4 Alternative 2 East Extension)

Year		Metro Line 1	Metro Line 2	Metro Line 3	Metro Line 4	Total
2008	No. of Passengers (Station Boarding / Alighting)	1,237,000	977,000			2,214,000
	Section Maximum Passengers per hour per direction	54,100	42,200			
2027	No. of Passengers (Station Boarding / Alighting)	2,131,000	1,452,000	1,487,000	1,814,000	4,017,000
	Section Maximum Passengers per hour per direction	63,000	39,100	40,000	40,300	
2050	No. of Passengers (Station Boarding / Alighting)	2,700,000	1,896,000	1,904,000	2,360,000	5,365,000
	Section Maximum Passenger per hour per direction	63,600	44,000	44,000	53,000	

Source: JICA Study Team

2.7 Transit Facility Plan

The design of stations along the route of Metro Line 4 will be needed to incorporate facilities for the transfer of passengers between road transport vehicles and the metro concourse and platforms (and vice versa). These facilities may be classified into two types:

- Full modal interchange facilities at, or near, the terminal stations and possibly at one or two major intermediate stations
- Pick-up and set-down facilities at all other stations not having sufficient demand for major interchange facilities

The JICA Study Team has developed conceptual layout plans for two types of modal interchange terminal: one for a large underground terminal (El Remayah Square) and another for an above ground terminal (El Giza Station). While these facilities will be of different size, the same facilities (park and ride for cars and parking bays for other road transport) will be applied to both types.

3. Track Alignment Study for Phase 1 Section

Based on the basic concept and basic design parameter which is shown in Chapter 3 in this report, JICA Study Team proposed the Phase 1 route as shown in Figure 2.

Source: JICA Study Team

Figure 2 Proposed Route for Phase 1 Section

The route will start from El Malek El Saleh Sta. (Connecting Metro Line 1), running along Salah Salem Street, and passing El Rauda, Giza Square and El Giza Sta. (Connecting Metro Line 2 and ENR Line). After the El Giza Sta., it will pass through Pyramids Road and the route will turn at Alexandria Desert Road to El Remayah Square.

From El Remayah Square to Workshop/Depot, three alternative access routes have been studied. The final route will be selected in the further study stage.

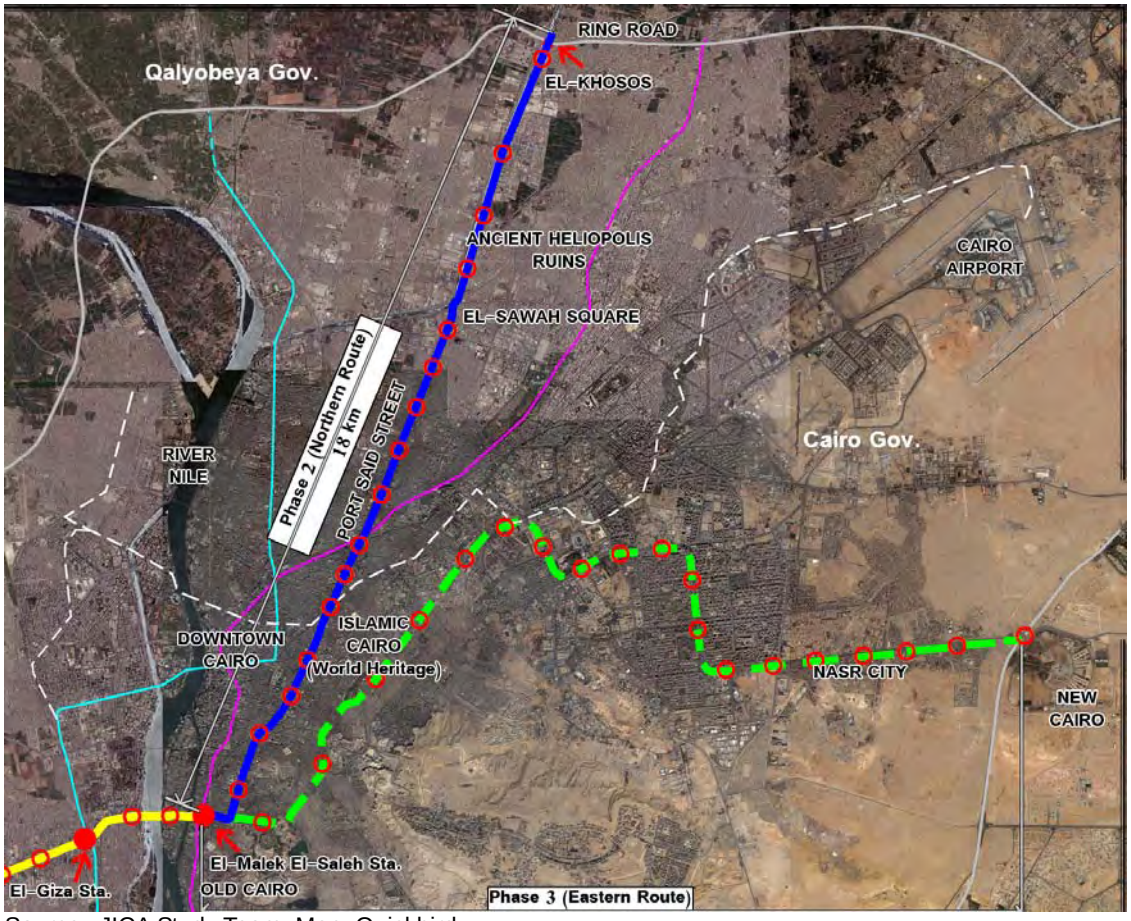
Total length of the route is approximately 17 km with 15 underground stations.

4. Route Selection for Phase 2 Section

Phase 2 route is between El Malek El Saleh via El Sawaha Square and directly to Ring Road Exit #18, with a length of about 18 km, referred to as the “northern route”. In addition, an alternative Phase 2 route, starting from El Malek El Saleh to Nasr City, with a length of about 23.5 km, referred to as the “eastern route”, was evaluated and compared.

The proposed routes to be compared are “Alternative 1 (Northern Route)”, the route studied and proposed by Cairo Regional Area Transportation Study (CREATS), and “Alternative 2 (Eastern Route)”, the route studied and proposed in the “Greater Cairo Public Transport Study, Report 2, Integrated Public Transport Network Scenarios” by SYSTRA.

Northern Route and Eastern Route are shown in Figure 3.



Source: JICA Study Team, Map: Quickbird

Figure 3 Alternative Route Corridor for Phase2 Section (Northern Route and Eastern Route)

JICA Study Team has used Multi Criteria Analysis (MCA) to select the route. Result of the analysis is shown in Table 11.

Table 11 Comparison Considering Transportation Demands in 2050

Multi-Criteria Analysis	Alternative 1 (Northern Route)				Alternative 2 (Eastern Route)			
	Score in words	Score	Weight	Score x Weight	Score in words	Score	Weight	Score x Weight
Transportation Demand in the Far Future:2050	High	9.4	1.2	11.5	High	8.9	1.2	10.9
Cost	Mod	5.4	1.2	6.5	Mod	4.6	1.2	5.5
Hard points	Low	3.2	0.8	2.4	High	8.6	0.8	6.5
Construction Easiness	Mod	5.0	0.7	3.4	High	7.8	0.7	5.3
Construction Schedule	Mod	6.9	0.8	5.4	Mod	5.7	0.8	4.5
Environment	Mod	6.9	0.8	5.6	High	5.3	0.8	4.3
Archaeological Assets	High	7.4	0.9	6.3	Low	3.2	0.9	2.7
Total/Average/Total		44.2	1.0	41.1		44.1	1.0	39.7

Source: JICA Study Team

JICA Study Team recommends the construction of both alternative routes of the metro, considering the future transportation demands. The 2022 transportation demands of both lines are large enough to require the construction of the metro. However, the 2022 transportation demand of Alternative 1 is larger than that of Alternative 2.

The rehabilitation of the tramway line from Abbasia to Nasr City to efficiently connect Nasr City with the Metro Line 3 was recommended in the “Greater Cairo Public Transport Study, Report 2, Integrated Public Transport Network Scenarios” prepared by SYSTRA. Moreover, the study for the rehabilitation of this tramway as a Super Tram has already started with the financial support from World Bank.

The construction of stations on Port Side Street has some conflicts with Spine Waste Water Tunnel (SWWT). However, the recent underground construction technology and experience show that such conflict can be solved with limited additional cost.

Therefore, JICA Study Team recommends to give priority to Alternative 1 (Northern Route) and to implement the feasibility study.

CHAPTER 1
INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The Greater Cairo Region, which steeped in history and contains large numbers of historical structures, is the premier city in Egypt. It is the largest city in the African continent and the Middle East region with a population of over 18 million, representing 25% of the total population of Egypt. The Cairo Metro, the only specialized metro system operating in the African continent, commenced construction in 1981. Its design was based on “Plans for Construction of Cairo Metro 3 Lines”, developed by Société Française d’études et de réalisations de transports urbains (SOFRETU) in 1973 to improve road traffic congestion.

The current status of Cairo Metro is as follows.

Metro Line 1	Phase 1 (28 km) started operation in 1987. The whole line (44 km) in full service by 1989.
Metro Line 2	Phase 1 (8 km) started operation in 1996. The whole line (21.6 km) in full service by 2005.
Metro Line 3	Phase 1 (4.3 km) under construction, scheduled to start operation in 2011. The whole line is 34.2 km.

Metro Line 3 was proposed in the “New Public Transportation Study of the Great Cairo Area” conducted by SYSTRA in 1998-2000 and in the “Cairo Regional Area Transportation Study” (CREATS) conducted under a JICA Study in 2000-2002.

As the population of the Greater Cairo Region is envisaged to increase to 20 million by the year 2017 according to the SDMP report, the Government of Egypt (GOE) is reforming the urban structure, changing from a mono-centric form to a decentralized form, notably through the development of New Urban Communities (NUCs), such as 10th of Ramadan City and 6th October City. However, the increased transport demand has not been accompanied by a substantial solution to urban problems, such as road traffic congestion, insufficient public transportation services and air pollution.

As a long term strategic development plan, General Organization for Physical Planning (GOPP) has prepared the Cairo Vision 2050. This vision document proposes 14 metro routes as the main public transport system in the Greater Cairo Region.

As a consequence, GOE has decided to construct, as early as practicable, Metro Line 4 as initially proposed by CREATS, and requested the Government of Japan (GOJ) in October 2008 to implement the “Development Study on Greater Cairo Metro Line No.4 Project (Metro Line 4 Project)”. Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of GOJ’s program, has discussed with National Authority for Tunnels (NAT) of Ministry of Transport and has agreed to conduct a feasibility study for the Greater Cairo Metro Line No.4 (Metro Line 4). The document for the Scope of Work was signed on 21st December 2008.

1.2 Objective of the Study

The primary objective is to conduct a feasibility study for Metro Line 4 (line length approximately 45 km), from a depot adjacent to Dream Land to El Sawaha Square or Nasr City via the Grand Egyptian Museum (GEM), El Giza Station of Metro Line 2 and El Malek El Saleh Station of Metro Line 1. This feasibility study will adopt suitable approaches for the mitigation of urban transport congestion and contribute to the sustainable development of the Greater Cairo Region. The following four key objectives will form the foundation of the study:

- To formulate a proposed route for Metro Line 4
- To assess the justification of the project
- To appropriately plan the project considering its technical, economical and financial, environmental and social aspects
- To carry out technology transfer to the Egyptian counterpart personnel in the course of the study

The feasibility study entitled “JICA Preparatory Survey on Greater Cairo Metro Line No. 4 in the Arab Republic of Egypt” consists of four reports. The main tasks and activities to be covered in these reports are as follows:

a) Report No. 1 (Volume 1)

- Data collection, diagnosis of the existing public transport system and urban development hypothesis;
- Collection of the relevant data about the existing and foreseen public utilities;
- Collection of the relevant socio-economic data; and
- Collection of the relevant data for preliminary design.

b) Report No. 2 (Volume 2)

- Analysis of all data collected for generation of Origin and Destination (O/D) matrices and development of a transportation study of the Greater Cairo Metro Line 4;
- Recording of all data concerning vehicles and all transport modes, conduct of field traffic survey in the study area, and review of the demand forecast; and
- Comparison and evaluation of two alternative corridors regarding Metro Line 4 alignment.

c) Report No.3 (Volume 3)

- Preparation of design guidelines and criteria and general features of Metro Line 4 Phase 1.
- Preparation of the general design specifications of Metro Line 4.

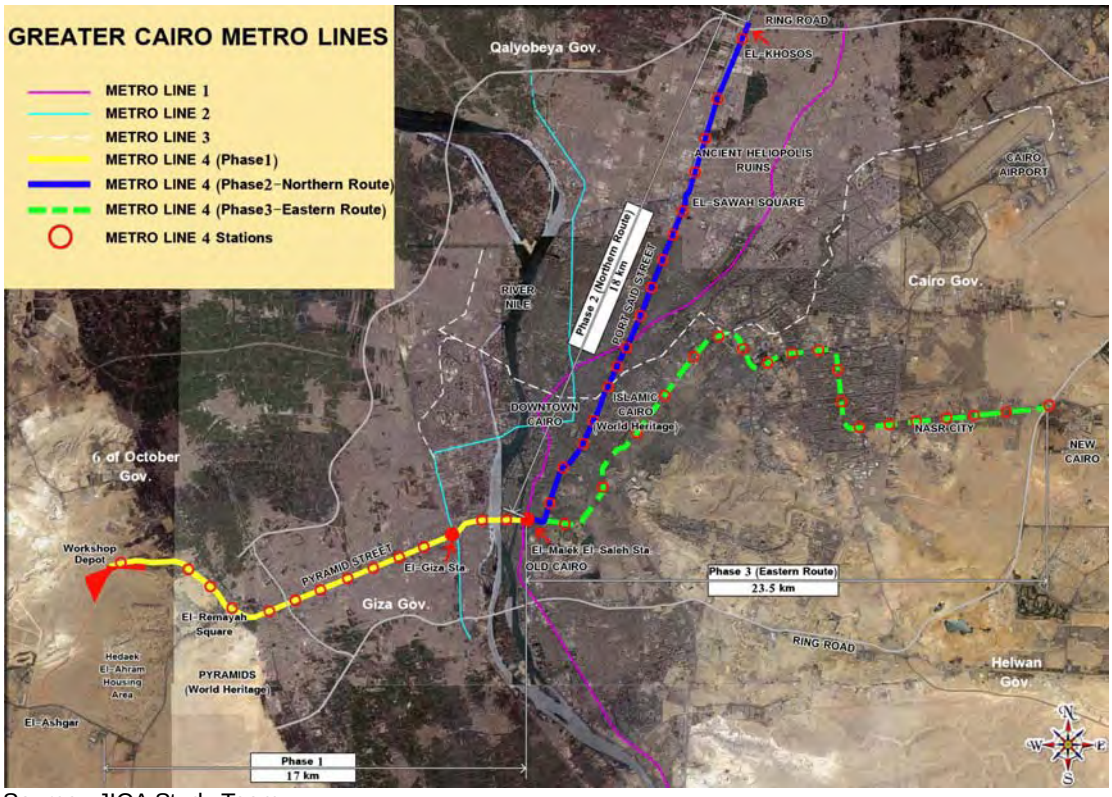
d) Report No. 4 (Volume 3)

- Submission of the final results and the pertinent analysis showing the feasibility

of the implementation of the whole project from both economic and financial perspectives.

1.3 Study Area and Administrative Setting

The Study Area, shown in Figure 1-1, covers two phases, namely, (a) Phase 1 of the proposed Metro Line 4 that runs from a depot/workshop via GEM to El Malek El Saleh Station (with a length of about 21 km) and (b) Phase 2 which is a route between El Malek El Saleh via El Sawaha Square and the Ring Road (Exit No. 18) (with a length of about 18 km). In addition, an alternative Phase 2 route, starting from El Malek El Saleh to Nasr City (with a length of about 23 km), will be evaluated and compared with the originally proposed route.



Source: JICA Study Team

Figure 1-1 Study Area

CHAPTER 2
TRANSPORTATION STUDY

CHAPTER 2 TRANSPORTATION STUDY

2.1 Transport Survey

2.1.1 Introduction

Field data collection in transportation studies can be considered as an important milestone. This is for two main reasons: first, because most of the decision-making process is usually based on these data and second, it needs great effort and cost to be implemented. The data usually needed for transportation studies can be classified into three main types, namely, socioeconomic and land use data, transportation infrastructure data, and travel pattern data. This report is intended to a part of the travel pattern data, which is traffic and interview data.

In that context, it will be very helpful to summarize the main findings of the traffic survey results of the recent related studies as it can be used in this study. These existing traffic count data will be very useful in analyzing the road traffic conditions and its future trends.

2.1.2 Summary of Previous Survey

JICA has carried out various traffic count surveys after the CREATS Project in 2002. The JICA projects after CREATS are as follows (see Table 2-1)

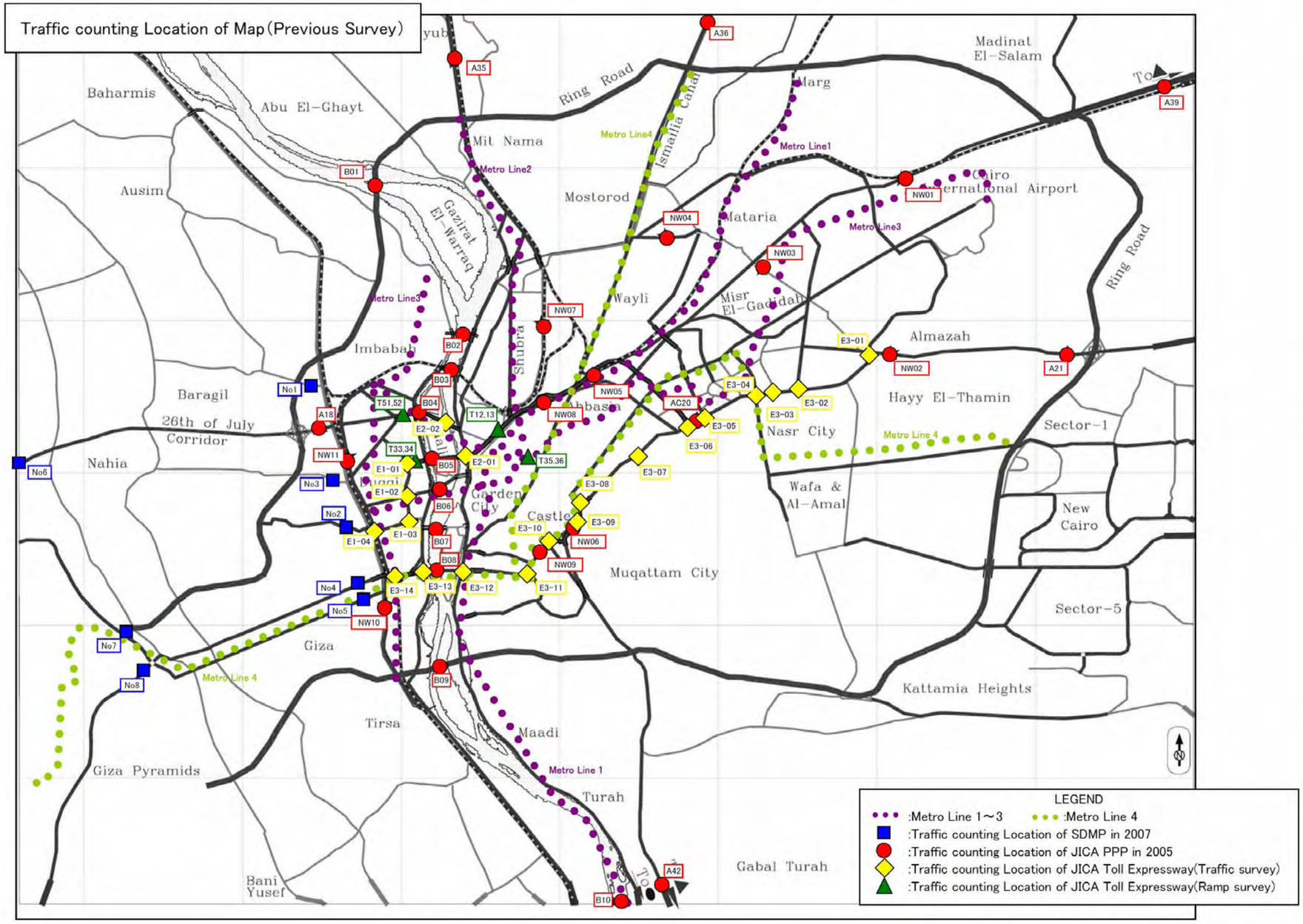
1. JICA PPP
2. JICA Toll Expressway
3. JICA SDMP

Table 2-1 Summary of Previous Survey

Project		Survey Hour	Number of Traffic Survey	Date of Traffic Survey
JICA PPP	Public Private Partnership Program For Cairo Urban Expressway Network Development(May 2006)	16	28	May 2005
JICA Toll Expressway	Feasibility Study on High Priority Urban Toll Expressways In Cairo In Arab Republic of Egypt(January 2009)	18 or 24	24 ※18hour:22, ※24hour:2	Autumn 2007 or Winter 2008
JICA SDMP	The Strategic Urban Development Master Plan Study for Sustainable Development of the Greater Cairo Region in the Arab Republic of Egypt(January 2008)	16	8	December 2007

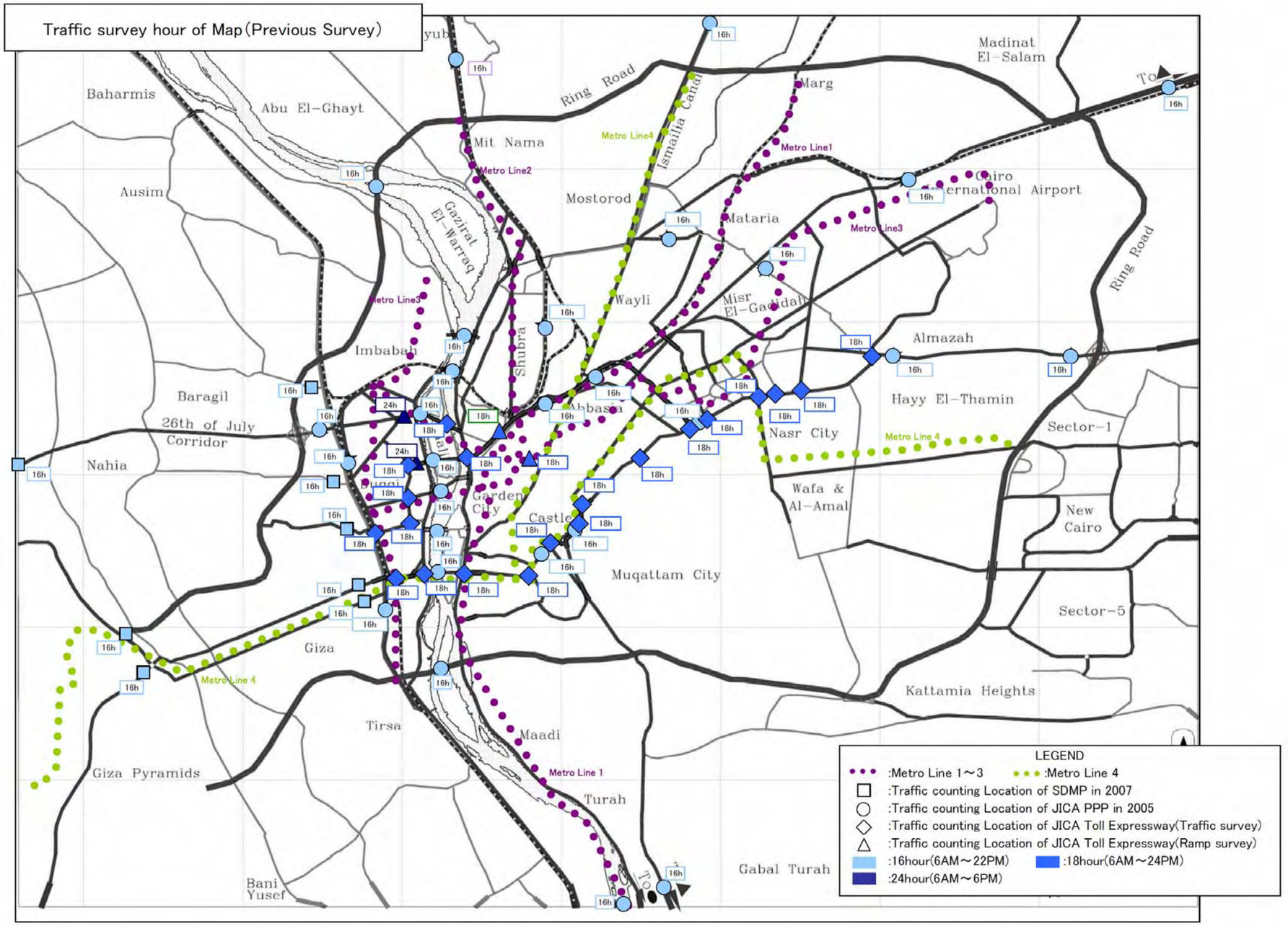
Source: JICA PPP, JICA Toll Express way, JICA SDM

Figure 2-1 illustrates the traffic count locations for the three aforementioned studies while Figure 2-2 shows the traffic survey periods for each location. Figure 2-3 depicts the daily traffic volume at each of these locations on the Greater Cairo map. Table 2-3 summarizes the exact daily traffic volume at each of the traffic count locations.



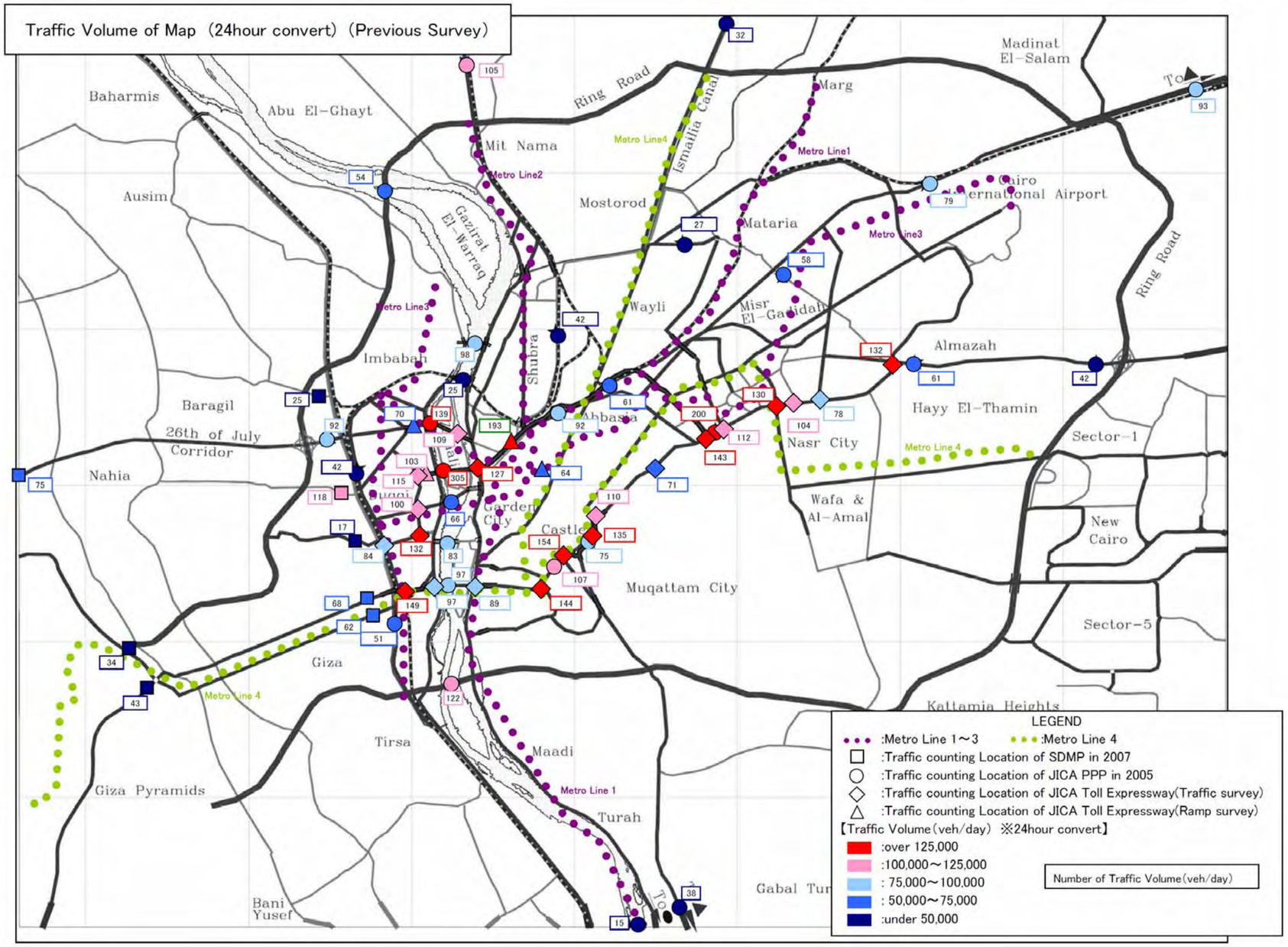
Source: JICA PPP, JICA Toll Express way, JICA SDMP

Figure 2-1 Traffic Count Location Map（Previous Surveys）



Source: JICA PPP, JICA Toll Express way, JICA SDMP

Figure 2-2 Traffic Survey Hours（Previous Surveys）



Source: JICA PPP, JICA Toll Expressway, JICA SDM

Figure 2-3 Traffic Volume at Each Location Converted to 24-hour Unit（Previous Surveys）

Table 2-2 Previous Traffic Survey Data

Sort of survey	Code	Year	Date	Survey hour	Location	Traffic Volume			Notes
							Average	24hour convert	
SDMP	1	2007	4-Dec	16	El- Barageel Street next to Imbaba airport.	21,467	-	25,236	-
	2				Nahya Street next to Boulaq terminal.	14,132	-	16,613	-
	3				26th of July corridor in the reach from Giza to Ring Road (near Ring Road).	100,791	-	118,486	-
	4				Faisal Street next to Sports Collage.	57,789	-	67,935	-
	5				Al-Haram (Pyramids) street next to Electricity Distribution Company Building.	52,862	-	62,143	-
	6				26th of July corridor between Ring Road and Shaikh Zayed entrance.	39,640	-	46,599	-
	7				The beginning of El-Wahat road near the Ring Road.	28,964	-	34,049	-
	8				The beginning of El-Fayyoum road in front of the electricity station.	36,264	-	42,631	-
JICA-PPP	B01	2005	23-May	16	Warraq Bridge	45,992	-	54,066	-
	B02				Rodh El Farag Bridge	83,666	-	98,355	-
	B03				Imbaba Bridge	21,574	-	25,362	-
	B04				15th of May Bridge	118,548	-	139,361	-
	B05				6th of October Bridge	259,798	-	305,409	-
	B06				Galaa Bridge	55,902	-	65,716	-
	B07				Gamah Bridge	70,991	-	83,454	-
	B08				Giza Bridge	82,425	-	96,896	-
	B09				Moneeb Bridge	104,066	-	122,336	-
	B10				Marazeeq Bridge	12,494	-	14,687	-
	A18		24-May		26th of July Corridor	78,439	-	92,210	-
	A21				Suez Desert Road	35,866	-	42,163	-
	A35				Alex. Agriculture Road	89,080	-	104,719	-
	A36		25-May		Ismailia Agriculture Road	27,169	-	31,939	-
	A39				Ismailia Desert Road	79,534	-	93,497	-
	A42		30-May		Autostrade	32,579	-	38,299	-
	AC20				Nasr Road	169,714	-	199,509	-
	NW01		24-May		Gesr El-Suez St.	67,454	-	79,296	-
	NW02		25-May		Suez Desert Road	51,872	-	60,979	-
	NW03		24-May		Abo Bakr El-Sedeeq St.	49,464	-	58,148	-
	NW04		30-May		Kablat Street	22,565	-	26,527	-
	NW05				Lotfy El-Sayed	51,533	-	60,580	Direction of traffic is only one way
	NW06		24-May		Autostrade Road	63,785	-	74,983	-
	NW07		30-May		Ahmed Helmy St.	35,380	-	41,591	-
	NW08				Ramsis St.	78,451	-	92,224	-
	NW09		24-May		Salah Salem Road	90,999	-	106,975	-
	NW10				Tereat El-Zomor Road	42,993	-	50,541	-
	NW11				Sudan St.	35,442	-	41,664	-
JICA-Toll Express No2 Ramp Survey	T12～13	2008	28-Jan	18	Through traffic to Ramsis sq and Tahreer sq.	180,939	-	192,690	-
	T33～34		4-Feb	24	Through to Ramsis direction and Dokki direction	103,056	-	103,056	-
	T35～36		4-Feb	18	Al-Azhar Tunnel	59,973	-	63,868	The traffic movement stopped from 10:10 to 11:50 due to an accident in the tunnel
	T51～52		30-Jan	24	Through Traffic to lebanon sq.	70,281	-	70,281	-

Source: JICA PPP, JICA Toll Express way, JICA SDMP

*Note:24 hours convert is used previous survey result of T51～T52(Rate of 16hours traffic volume:85%, Rate of 18hours traffic volume:94%)

Table 2-2 Previous Traffic Survey Data (2)

Sort of survey	Code	Year	Date	Survey hour	Location	Traffic Volume			Notes
							Average	24hour convert	
JICA-Toll Express No1 Traffic Survey	E01-1	2007	11-Sep	18	AL NAHDA (6th October Bridge / El Batal Ahmed Abdel Aziz / Wazaret Al Zerra)	(121,796)	107,910	114,918	Traffic Volume of Southern section
			29-Oct			(94,024)			
	E01-2		22-Oct		Doqqi Square / Flyover (El Tahrir / Dokki Street)	(93,605)	93,573	99,650	Traffic Volume of Southern section
			6-Nov			(93,540)			
	E01-3		22-Oct		Cairo University (Sarwat / Gamiat El Qahira / Dokki Street)	(122,550)	123,971	132,022	Traffic Volume of Western section
			6-Nov			(125,392)			
	E01-4		23-Oct		Abd Al Salam Arif /Sudan Street / Flyover	(84,471)	78,797	83,914	Traffic Volume of Southern section
			7-Nov			(73,122)			
	E02-1		11-Sep		E1 Highway (Exits/Entrances/Main Way) at North Tahrir /Galaa Street / Ramses Stre	(126,385)	119,711	127,486	Traffic Volume of Eastern section
			30-Oct			(113,037)			
	E02-2		11-Sep		15th of May Bridge East (26th of July Street / Corinch El Nile)	(98,664)	102,174	108,810	Traffic Volume of Western section
			30-Oct			(105,684)			
	E03-1		5-Sep		El Nasr / Cairo Suez Road / Flyover	(104,973)	123,922	131,970	Traffic Volume of Southern section
			29-Oct			(142,870)			
	E03-2		29-Oct		El Nasr Road / Abbas El Aqqad / Nozha	(66,946)	73,468	78,239	Traffic Volume of Eastern section
			31-Oct			(79,990)			
	E03-3		16-Oct		El Nasr Road / El Tayaran	(95,283)	98,078	104,448	Traffic Volume of Eastern section
			31-Oct			(100,873)			
	E03-4		16-Oct		Nair Road / Yousof Abbas	(104,785)	121,771	129,679	Traffic Volume of Western section
			31-Oct			(138,756)			
	E03-5		17-Oct		Fangray / El Nair Road	(96,215)	104,801	111,607	Traffic Volume of Western section
			5-Nov			(113,386)			
	E03-6		10-Sep		Imtedad Ramsis / El Nasr Road / Flyover	(131,718)	133,936	142,634	Traffic Volume of Eastern section
			5-Nov			(136,153)			
	E03-7		17-Oct		El Nasr Road / Ahmed Said / Al Amir Qaraqush	(60,120)	66,843	71,184	Traffic Volume of Eastern section
			5-Nov			(73,565)			
	E03-8		10-Sep		Salah Salem / El Nasr Road / El Mokattm Road	(95,069)	103,382	110,096	Traffic Volume of Northern section
			13-Nov			(111,694)			
	E03-9		10-Sep		Salah Salem / El Nasr Road next to E3-08	(123,370)	127,121	135,376	Traffic Volume of Southern section
			13-Nov			(130,871)			
	E03-10		17-Oct		Sayyidah Ashah Square	(143,828)	144,809	154,213	Traffic Volume of Eastern section
			30-Oct			(145,789)			
	E03-11		23-Oct		Magra El Ayoun / Salah Salem / Ain Al Sira	(150,624)	134,943	143,706	Traffic Volume of Northern section
			7-Nov			(119,261)			
	E03-12		23-Oct		Salah Salem / Corniche El Nil / Flyover	(81,551)	83,506	88,929	Traffic Volume of Western section
			7-Nov			(85,460)			
	E03-13		24-Oct		Giza Bridge (Gamal Abd El Naser)	(87,124)	90,957	96,864	Traffic Volume of Eastern section
			12-Nov			(94,789)			
	E03-14		24-Oct		Giza Square / Flyover	(142,373)	139,444	148,500	Traffic Volume of Western section
			12-Nov			(136,515)			

Source: JICA PPP, JICA Toll Express way, JICA SDMP

*Note:24 hours convert is used previous survey result of T51～T52(Rate of 16hours traffic volume:85%, Rate of 18hours traffic volume:94%)

2.1.3 Components and Purpose of Transport Survey

The transport survey in this study consists of four main components as follows:

1. Link Traffic Count Survey (LT survey)
2. Screen Line Survey (SL survey)
3. Interview Survey for Car Users and Public Transport Users
4. Interview Survey for Tourists

The purpose of this transport survey is:

- To recognize the traffic volume characteristics on the roads along the route of Metro Line 4.
- To study the direct impact on the road traffic along Metro Line 4, such as the level of service, air pollution and noise level.
- To get necessary information for traffic control and management plans during the construction stage.
- Validate the main output of the transportation planning models that will be developed in this study,

On the other hand, the main objectives of the interview survey are:

- To calibrate a modal choice model
- To measure their willingness to pay for a new metro service that would be safer and more time-saving

2.1.4 Link Traffic Count Survey

(1) Survey Locations

As mentioned earlier, JICA has executed various traffic surveys in previous studies. Therefore, the number of survey locations was decided considering the maximum and effective usage of their results. The traffic count survey locations should be along the proposed route of Metro Line 4. The proposed route consists of two phases: the first phase will be along Pyramids Road starting from an area close to El Remayah Square until El Malek El Saleh. As for the second phase, there are two main alternatives: the first will be through Port-Said Street to the north direction and the second will be to the east direction to Nasr City District. Twelve main locations were selected along the route of phase 1 after discussion with National Authority for Tunnel (NAT) representatives. Figure 2-4 shows these locations and Table 2-3 shows the corresponding list. Appendix 1 shows their respective exact locations. As for the north direction alternative of phase 2, ten locations were proposed after discussion with NAT representatives. Figure 2-5 also depicts these locations and Table 2-4 shows the related list. Appendix 2 meanwhile shows the corresponding exact locations.

The locations for the east alternative of phase 2 will be delayed until the exact route alignment is finally established.

Source: JICA Study Team

Figure 2-4 Proposed Link Traffic Count Survey Locations along Pyramids Road

Table 2-3 List of Link Traffic Count Survey Locations along Pyramids Road

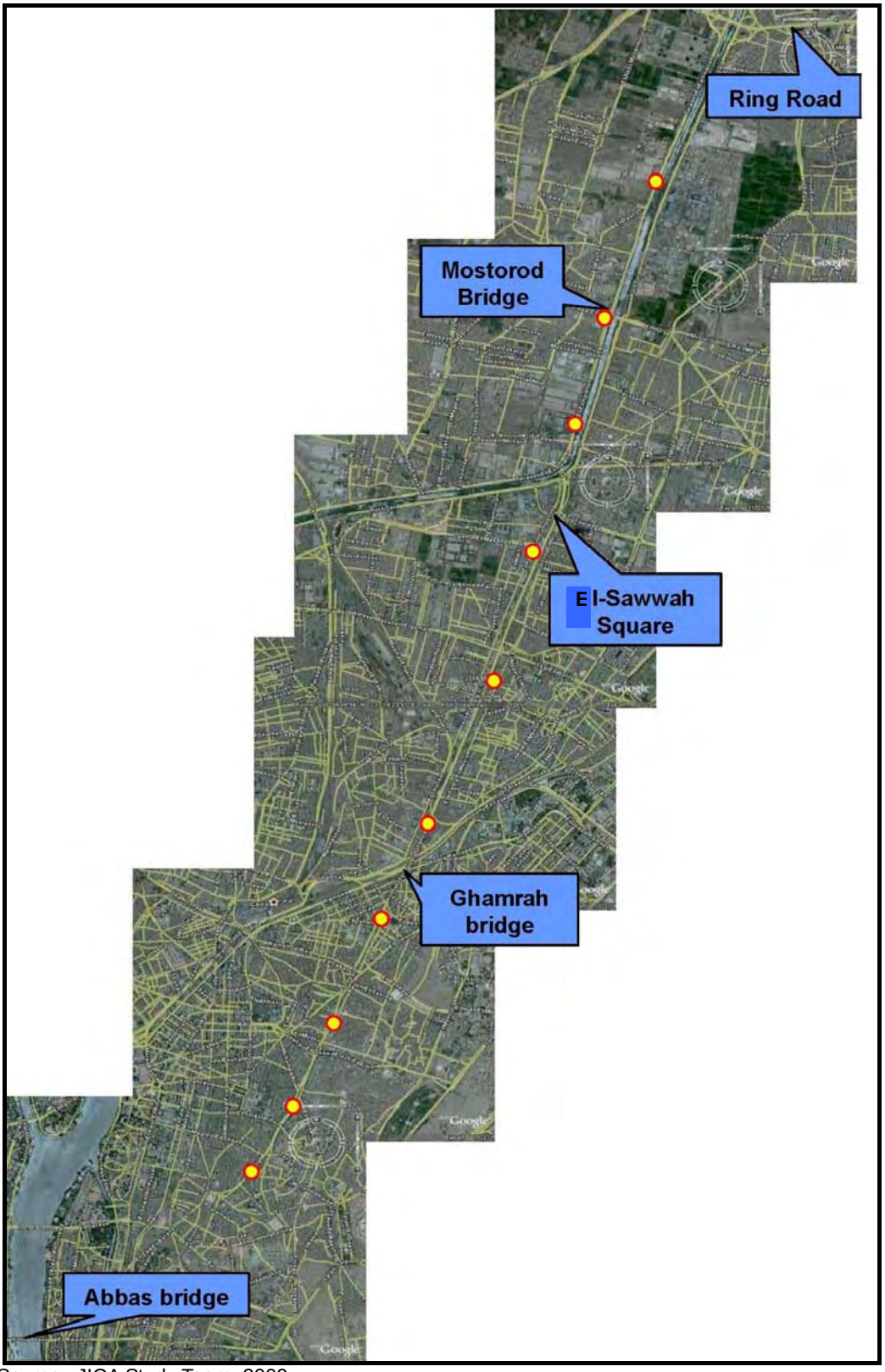
Ser. no	Code	Location
1	LT1	El Remaya Square
2	LT2	Close to Mansouria intersection
3	LT3	Close to Maryoutia intersection
4	LT4	Close to EL-Shaikh El-Sherbini intersection (Matba'ah Station)
5	LT5	Close to Kafr Tohormos Street intersection
6	LT6	Close to Sayed Abo-Khair Street intersection
7	LT7	Close to Ter'et El-Zomor Street intersection
8	LT8	Between El Giza Square and El-Haram Tunnel
9	LT9	El-Gam'ah Street close to Giza Square
10	LT10	Mourad Street close to Giza Square
11	LT11	Close to Abbas Bridge
12	LT12	Rabeea El-Jeezi Street close to Giza Square

Source: JICA Study Team

Table 2-4 List of Link Traffic Count Survey Locations along Port-Said Street

Ser. no	Code	Location
1	LT13	Close to Sayyedah Zainab Square
2	LT14	Port Said between Bab El-Khalq Square and Sayyedah Zainab Square
3	LT15	Port Said - between El-Gaish Square and Bab El-Khalq Square
4	LT16	Close to Ghamrah Bridge from the south direction
5	LT17	Between Dair El-Malak and El-Sharakat Streets
6	LT18	Port Said - between Sekkat- El-Wayly Street and Ghamrah Bridge
7	LT19	Close to El-Swaah Square from the south side
8	LT20	Port Said extension (Ismaellia agricultural road) -between El- Ameeryah Bridge and Mostorod Bridge
9	LT21	Port Said extension (Ismaellia agricultural road) -between Mostorod Bridge and the Ring Road
10	LT22	Between Mostorod and Ring Road

Source: JICA Study Team



Source: JICA Study Team, 2009

Figure 2-5 Proposed Link Traffic Count Survey Locations along Port Said Street

(2) Vehicle Types

The traffic volume will be counted manually. It will be classified based on the following ten vehicle types:

- Passenger Car
- Taxi
- Shared Taxi/Minibus
- Bus
- Pick-up
- Truck
- Heavy Truck (over 3-Axle, trailer and semi-trailer)
- Motorcycle / Bicycle
- Others

A form, shown in Figure 2-6, was designed by JICA Study Team to be used for the traffic count process by the surveyors.

(3) Traffic Count Period

The traffic count will be conducted on two different working days (Monday, Tuesday, or Wednesday). The traffic count period will be 19 hours from 6:00 am to 1:00 am at all locations except for two locations at Pyramids Road (El-Haram Street) and one location at Port Said Street, where the period will be 24 hours. The main objective of the 24-hr counting locations is to get some factors for converting the other 19-hr traffic count locations to equivalent 24-hr counts.

2.1.5 Screen Line Traffic Count Survey

The main objective of the screen line survey is to validate the main output of the transportation planning models that will be developed in this study. The traffic count process at the screen line locations has been already finished.

(1) Screen Line Locations

Nine main locations were selected for the traffic count. All the screen line locations actually consist of bridges over the Nile River. Figure 2-7 shows these locations and Table 2-5 shows the related list. Appendix 3 meanwhile shows the exact locations of each.

Ministry of Transport — JICA

National Authority for Tunnel — Namat for Engineering Consultancy

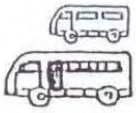
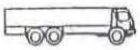
Traffic Count Survey for Greater Cairo Metro Line 4

Vehicle Traffic Count Form

Date:…… Surveyor name: ……

Road:…… Location no : ……

Starting time:…… …… Direction: …… Sheet no: ……

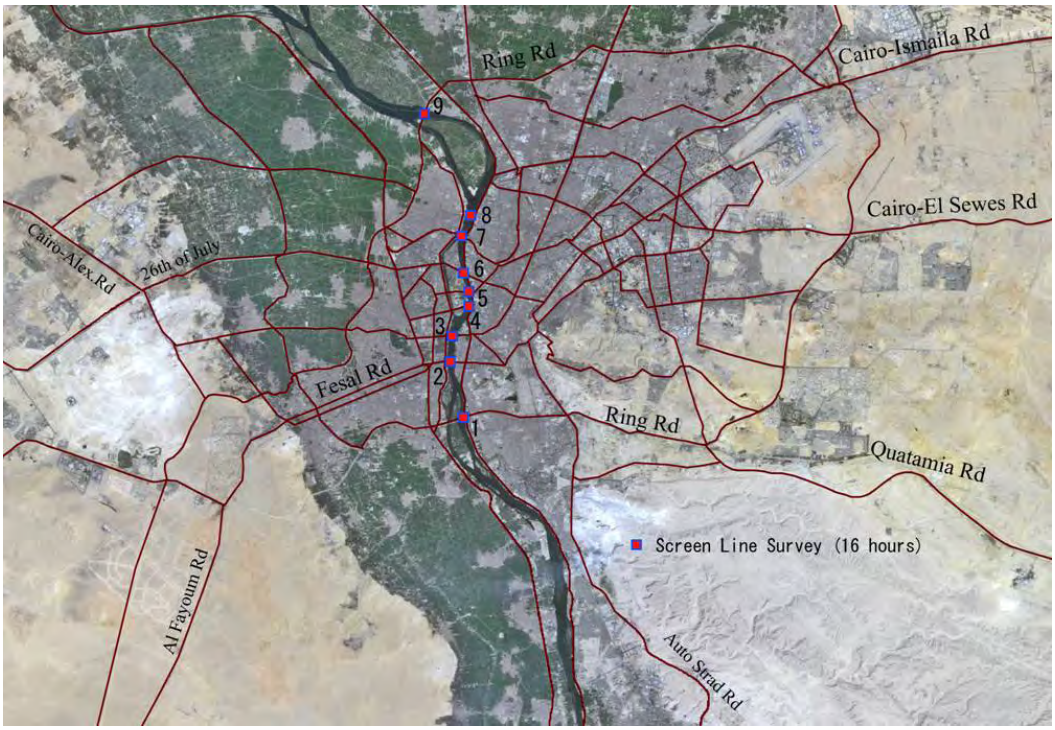
Veh. Type	Veh. Number
Sedan / Wagon (passenger car) 	
Taxi 	
Shared taxi /Minibus 	
Bus 	
pick up 	
2-axle Truck 	
Heavy Truck , (over 3-axle,Trailer and semi- Trailer  	
Motorcycle/bicycle	
Others	

Source: JICA Study Team

Figure 2-6 Traffic Count Form

(2) Screen Line Traffic Count Periods

All the screen line locations were conducted on two days, i.e., one on a normal working day and the other on a Friday. The traffic count period was 16 hours from 6:00 am to 10:00 pm for all locations. The process was conducted with the same procedure as the previous traffic count location considering the same vehicle type classification.



Source: JICA Study Team

Figure 2-7 Screen Line Survey Location Map

Table 2-5 List of Screen Line Survey Locations, Survey Day and Dates

Link Name	Link Code	Day	Survey Date
Ring Road at Maadi Bridge	SL1	Wednesday, Friday	27th May, 29th May
Abbas Bridge	SL2	Monday, Friday	25th May, 29th May
Al-Gamah Bridge	SL3	Monday, Friday	25th May, 5th June
Qasr El Neel Bridge	SL4	Tuesday, Friday	19th May, 12th June
6th October Bridge – between Abdel-Monem Riyadh and Zamalek ramps	SL5	Tuesday, Friday	19th May, 12th June
15 May Bridge	SL6	Tuesday, Friday	19th May, 12th June
Imbaba Bridge	SL7	Wednesday, Friday	20th May, 5th June
Rod AlFarag Bridge	SL8	Wednesday, Friday	20th May, 5th June
Ring Road at Alwarraq Bridge	SL9	Wednesday, Friday	27th May, 29th May

Source: JICA Study Team