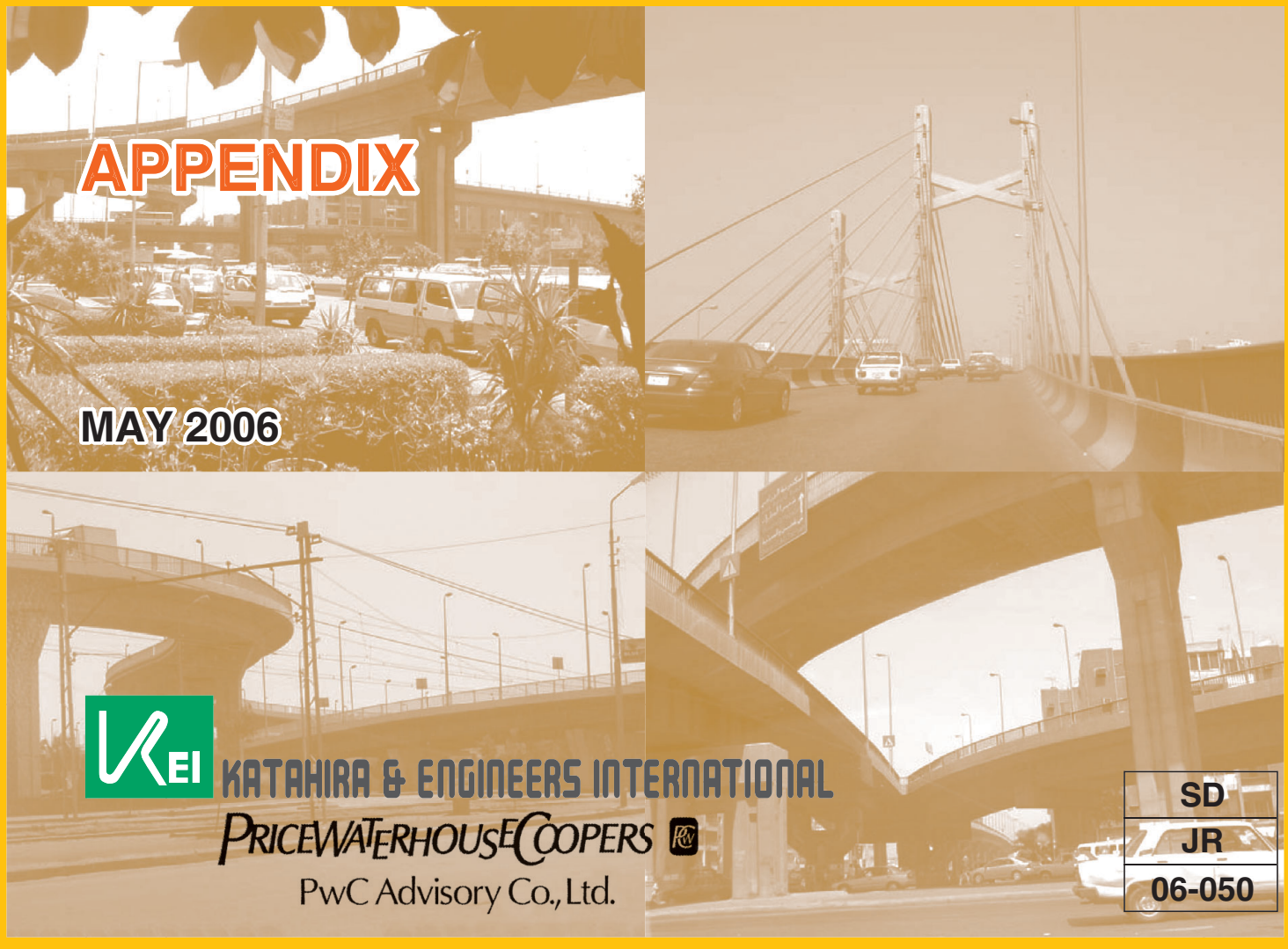
NO.

JAPAN INTERNATIONAL
COOPERATION AGENCY
(JICA)

HIGHER COMMITTEE FOR
GREATER CAIRO TRANSPORT PLANNING
GOVERNMENT OF THE ARAB REPUBLIC OF EGYPT

PUBLIC-PRIVATE PARTNERSHIP PROGRAM FOR CAIRO URBAN TOLL EXPRESSWAY NETWORK DEVELOPMENT

FINAL REPORT



APPENDIX

MAY 2006

KATAHIRA & ENGINEERS INTERNATIONAL
PRICEWATERHOUSECOOPERS
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SD
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06-050

Exchange Rate:

LE 1.00 = US$0.1745

LE 1.00 = JPY 20.9

(As of January 2006)

REPORT COMPOSITION

The Final Report of the Study is basically composed of the following three volumes:

VOLUME 1 - EXECUTIVE SUMMARY: is designed to address decision-makers who do not need deep information in technical and financial aspects. It contains brief information on all the major aspects of the Study and concentrates on the major results and outputs of each task. It includes also a more concentrated summary for the main conclusions and recommendations of the Study.

VOLUME 2 - MAIN REPORT: Chapter 1 is an introduction and is followed by the three major parts of:

PART 1 - Transport Demand Forecast: Chapter 2 explains the characteristics of the road transport system in Cairo, including the organizations in-charge, the functional classification, network development and assessment of existing problems. It is followed by the conducted traffic surveys and analysis of collected data in Chapter 3. Chapter 4 gives the future socioeconomic framework that is applied in the process of forecasting the future transport demand is presented in Chapter 5 in addition to the forecast methodology and main results.

PART 2 – Toll Expressway System: Chapter 6 includes the development of Cairo Urban Toll Expressway Network through the selection of the optimum network, routing and alignment, typical cross sections, right-of-way acquisition and environmental assessment. Methods of setting up the toll road are provided in Chapter 7 in addition to the institutional set up and the steps of developing the required organization and its capacity development. Chapter 8 for the maintenance and operation systems presents the toll collection methods, traffic management techniques, maintenance requirements and measures for environmental protection. Next, Chapter 9 gives the rough cost estimates of different elements of the network, prioritization of links, comparative analysis for different toll application scenarios and economic evaluation of the network and high priority sections.

PART 3 – PPP Structure and Financial Plan: Chapter 10 provides a review and analysis of PPP in Egypt and other countries. Chapter 11 discusses the approach of network development with the participation of the private sector. The financing options and an analysis of the cash flow are included in Chapter 12, including the cash flow analysis for high priority expressways. The required improvements in the legislation system and required procedures for successful PPP programs are included in Chapter 13.

Chapter 14 gives the overall conclusions and recommendations.

VOLUME 3 - APPENDIX: contains the necessary base data and information, drawings, calculations and other information produced during the course of the Study.

APPENDIX 2.1

RELEVANT DEVELOPMENT PLANS AND STUDIES

APPENDIX 2.1 RELEVANT DEVELOPMENT PLANS AND STUDIES

1. National Development Plans

(1) Socioeconomic Development Plan

The Fifth Five-Year Plan for Socioeconomic Development (2002-2007) aims basically at activating the national economy so that Egypt can effectively follow its development path. As a consequence, the Plan has two main components: one relating to the public investment schemes; and the second, dealing with the set of public policies that would stimulate, through the market forces, private initiatives to fulfill pre-determined socio-economic objectives. The Plan includes a long-term vision for the target year 2022. The main objectives of this vision are:

i. Conservation of natural resources and direction of urban growth to desert land.
ii. Steady reduction of current population growth rate.
iii. Achievement of high and sustainable GDP growth
iv. Gradual removal of balance of payments deficit
v. Alleviation of poverty and attenuation of income disparities
vi. Development of human capital and attainment of full employment
vii. Improvement of social services

Such objectives are elaborated in relation to major national problems as follows:

- Urban Growth: The concentration of population is one of the major problems facing the country and effective measures are required to insure proper spatial redistribution. Of population, expected to reach 86 million by the year 2022. Adverse impact includes the continuous decrease of the most fertile agricultural lands, exacerbation of urban housing problem, rapid deterioration of public infrastructure and rising unemployment rates.
- Overpopulation: Actions are required to ensure proper balance between population growth and development resources. A long-term objective of the Plan is to slow down population growth from the present level of 2% to 1% by the year 2022.
- GDP Growth: High and sustainable growth in GDP becomes indispensable in order to achieve structural changes in the economy and substantial improvement in the standard of living. An investment of 49% of the total investments was allocated to public infrastructure during the last two decades, which paved the way for the economy to attain an annual growth rate of 5%. The long-term vision embraces higher growth rates ranging between 6% and 8%.

- Balance of Payment: The major weaknesses in Egypt's Balance of Payment are due to the accumulated deficit in the trade balance between import payments and export proceeds, the volatility of Suez Canal revenues, oil prices and tourism earnings, and the inability of the services account surplus. In the long-term vision, the aim is to eliminate these discrepancies by curtailing trade balance deficit and increasing current account surplus by the end of the next two decades.
- Equity Considerations: Equitable distribution of income and wealth is one of the main objectives of the development plan. Efforts would focus on tapering the income disparities and reducing poverty rates, curtail urban migration and improve living conditions in rural communities.
- Employment Generation: The higher economic growth, which is essential for meeting the challenges of unemployment and poverty, needs to be supplemented by specific actions and policies that directly tackle the unemployment problem. The plan aims at achieving a drastic reduction in open unemployment, confining it to 3-5% of the total labor force.
- Social Development: The social aspects that require special attention include reducing the current illiteracy rate from 30.6% to 3-7% by the year 2022, improving the quality of health services to match with international standards, exerting continuous efforts to spread the social insurance and pension umbrella to cover all citizens, eliminating any gender discrimination and securing proper living environment for child care.

The development targets as embraced by the long-term vision in the Plan are summarized in Table A2.1-1.

Under the pre-requisites of the Plan, the necessary actions required to achieve the above mentioned targets include:

- Attracting foreign direct investment
- Increasing private sector participation in the development process

In order to attain a 6% annual average growth rate, investments are estimated to increase from 16.9% of GDP in 2001/02 to about 19.8% in 2006/07. This is likely to occur through the adoption of measures as mentioned in Item 4.3, such as:

Table A2.1-1 Targets of Long-Term Vision (2022)

Indicator	Alternative	
	Conservative	Optimistic
1. Economic		
Average Annual GDP Growth Rate	6%	8%
Inhabited Area as % of Total Area	10%	12%
Population Growth Rate	1%	1%
Population Size in 2022 (million)	90.8	86.0
Annual Average Export Growth Rate	9%	12%
Annual Average Import Growth Rate	7%	5%
Balance of Trade ($ billion)	3.7	5.0
Current Account Balance ($ billion)	6.1	16.8
Inflation Rate	5%	3%
Unemployment Rate	5%	3%
Poverty Ratio (of total population)	10%	6%
2. Social		
Illiteracy Rate	7%	3%
Education Enrollment Ratio		
Basic Education	100%	100%
Pre-University	95%	100%
University and High Education	35%	40%

- Encouraging private initiatives, as the private sector's share is expected to reach about 60% of the Plan's target investment. Naturally, this requires the devise of an effective incentives system and guaranteeing a stable economic climate as well as the establishment of an efficient institutional and legislative system.
- Opening the door for private sector participation in infrastructure services through appropriate operative systems.
- Speeding up the privatization schemes.

Towards modernization, the Plan highlighted the policies of development in relation to its objectives. Major items of the objectives and policies related to the Study can be summarized as in Table A2.1-2.

Table A2.1-2 Development Objectives and Polices

Main Objective	Detailed Objectives	Policies and Tools
A) Developing Human Resources		
Increasing Income and Standard of Living	- Increasing per capita Income - Decreasing unemployment rate - Stabilizing inflation rate - Expanding social security - schemes - Decreasing population under - Poverty line	- Raising investment rate to 30% of - GDP & saving rates to about 25% - Applying sound fiscal pricing & productivity policies - Linking wage policies to productivity improvement - Embracing population policies to Restrict growth rate at 1.9%p.a.
B) Developing Management & Institutional Structures & Adjustment Mechanisms		
Reforming the legislative base	- Amending some laws to cope with the current and expected domestic regional & international developments - Completing the legislation - foundation for new fields	- Reviewing current laws and regulations to analyze effectiveness in achieving objectives and remove any possible trade-off
C) Developing Production, Economic and Natural Resources		
Expanding and developing infrastructure	- Providing adequate infrastructure for new and remote areas	- Privatizing infrastructure projects and developing alternative means of financing - Assigning high priority to infrastructure projects amicable to the environment
D) Building & Developing the National Base for Science & Technology		
Providing financial sources for R&D	- Increasing the financial sources for R&D to at least 2% of GDP	- Supporting external financing sources through international organizations - Increasing the private sector share
E) Strengthening Interactions with the Regional Environment & Global System		
Maximizing benefits of globalization and partnerships with developed countries	- Maximizing foreign investment and decreasing foreign indebtedness	- Preparing policy packages to protect - the economy from fluctuation - Proper management of foreign debt

Under the Sectoral Development of the Plan, the strategy of developing the transport sector has the following basic elements:

- Achieving integration and coordination between the different means of transport to properly satisfy increasing demand in the most efficient and safe way.
- Raising the efficiency of the transport infrastructure and maximizing its benefits.
- Encouraging the utilization of transport means that use electricity and natural gas as a substitute for gasoline and diesel oil.
- Reinforcing the orientation towards the participation of the private sector in implementing, managing and operating the sector's projects.

(2) Road Sector Development

Projects to develop the road network under the Plan can be summarized as follows:

- Completion of 400 kilometers of roads in Sinai and Red Sea Governorates
- Constructing 2,310 kilometers of roads in new areas
  [Aswan/Bernece: 290kms – Suhag/Aswan: 670kms – East Owainat/Owainat: 358kms – Quena/El Mahrousa: 17kms – Suhag/Assiout Airport: 120kms – Helwan/ Koraimat: 85kms – Paris/Dard El Arbaeen: 300kms – El Boity/Siwa: 380kms – Siwa /Gabob: 90kms]
- Dualization of 623 kilometers of high traffic volume roads
  [Ras Ghareb/Safaga: 160kms – El Ayat/Beni Suef: 64kms – Quanater Khayreia/ Khatatba: 42kms – Kafr El-Sheikh/Desouk/ Damanhour: 56kms – Tanta/Zefta: 25kms – Qena/Safaga: 180kms – Qena/Luxor: 60kms – Abo El Matameer/Kafr El Dawar: 36kms]
- Proceeding with the construction of 9 bridges across the Nile River
  [Kafr el Zayat – Sohag – El Wasta – El Qanater El Khayriya – Mallawy – Fowa - Tama – Gerga – Talkha]
- Continuing the on-going construction of flyovers as well as construction of new flyovers
  [Minya – Samanoud – Kafr El Zayat – El Kofour El Qiblya]

2. Greater Cairo Region Development Plan

A long range urban development Master Scheme for Greater Cairo Region (GCR) was prepared in 1982 and approved by the President of the Republic on March 1983. This Scheme was intended to guide growth till the year 2000. The summary of the Long-Rang Urban Development Plan of GCR, which was published in August 1997, shows that a high executive committee was set up to prepare a preliminary master plan in 1970 with a vision of managing growth in the GCR up till 1990. In 1974, the newly born master plan was ratified by ministerial decree, merely a year after the conception of the General Organization of Physical Planning (GOPP).

The main objective of the Scheme is to provide solutions to the excessive population and activity concentration in central districts, and to urban development expansion on agriculture land. Both problems were dealt with in two ways in the Plan, which are:

- Provision of alternatives in the desert such as New Settlements, close New-Towns and fringe vacant lands
- Reorganization of existing urban areas according to the principal of Homogeneous Sectors

The Scheme relied on a specific economic background and integrated a previously decided National Urban Policy, taking into account an estimate of needs linked with demographic forecasts. At the time of the Scheme, the Egyptian economy experienced a slow down caused by worldwide economic crises. After a period of high growth rates relying on external resources, there was a great need to secure high rates of return on new productive investments and to favor projects in which cost-advantage appeared greatest, i.e., projects located in the vicinity of existing sources of input factors. Under this context, GCR was considered as an adequate place for accommodating new productive investments, under the condition of reducing the adverse effects of an uncontrolled growth of urban areas.

Objectives of the New Settlement Program are:

- To offer an alternative to development of informal housing in agriculture areas
- To be thrifty with public resources
- To rely on existing private dynamics for construction and financing
- To meet the need of low income population

Under the planning concept of homogeneous sectors, GCR is divided into 16 sectors, each of which accommodates about 1 to 2 million inhabitants and plans to be

self-sustainable in terms of urban services and job opportunities. A population decentralization policy has been guided for these sectors aiming to decentralize the inner sectors towards the new settlement areas outside the ring road. Homogeneous sectors had been conceived as means to reorganize the existing agglomeration with the following objectives:

- To encourage and channel the urban de-concentration process by creating a hierarchical network of service centers
- To improve living conditions and urban operation through population density reductions, the provision of green spaces and neighborhood facilities, and the upgrading or creation of public services
- To increase the self sufficiency possibilities of each sector as regards to employment and services in order to reduce transport demand between sectors
- To reorganize the transport system by the separation of the intersectoral network

Other recommendations of the master plan includes the Ring Road as a key factor in the development scheme to curtail through traffic in metropolitan area, to define the metropolitan limits of the urban mass and to open new development corridors in the desert. These development corridors are intended to capitalize on the existing desert road network and direct growth along their path.

In 1968, a guide plan detailing the master scheme objectives for each homogeneous sector was established to propose locations of future service centers and reorganization of the road network.

The Master Scheme was revised and updated in 1991 in order to meet the long range land needs. The report of “Implementation Assessment Updating Proposals” recommended to maintain the urban development strategy proposed by the 1983 Plan and to keep the basic principals of:

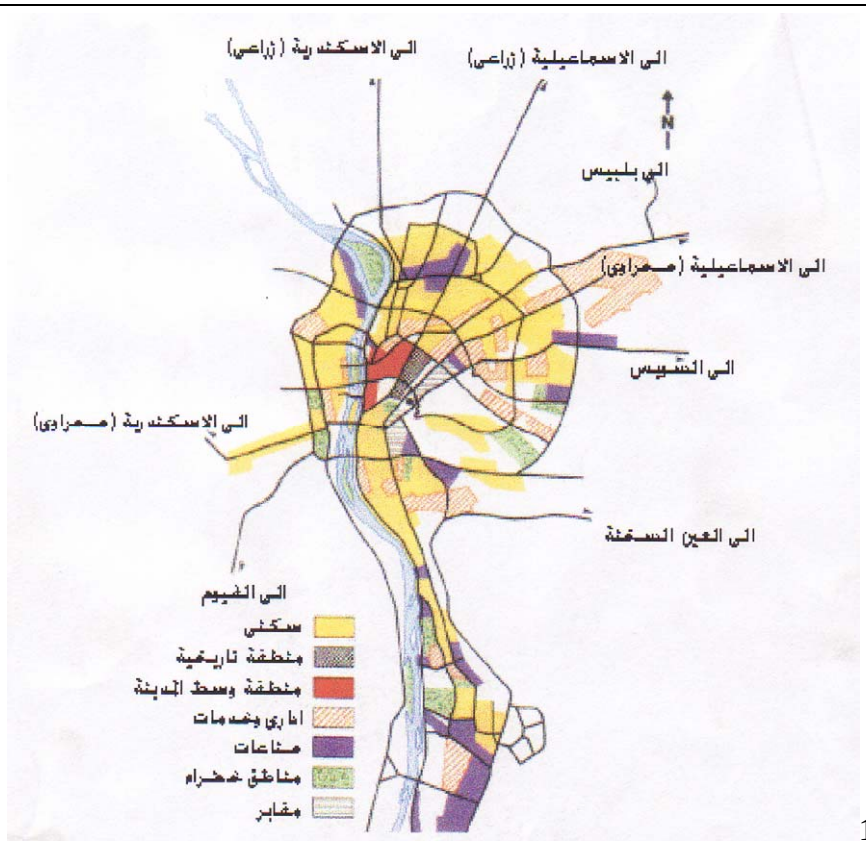
- Strengthening the national urban policy
- Preventing possible urban encroachment on arable land due to the Ring Road
- Applying new settlements development principals by adopting housing development pattern and imposing the relocation of specific down town activities towards the new settlements
- Adopting the Master Scheme with a new concern for ecological protection, research for relocation areas for specific activities and the protection of areas within the existing agglomeration
- Supporting the homogeneous policy through the renewal of the local urban planning process

- Strengthening the institutional coordination

As a conclusion of the implementation assessment carried out in 1991, the urban dynamics acting in GCR were found to comply with the strategic choices of the 1983 Master Scheme. Since that time, development works had been launched in several new settlements and the ring road, which is a key-tool for desert opening to urbanization, had been constructed. In addition, it was found that due to the national economic environment, all future urban projects will have to respect a strict financial and economical with the necessity to closely associate private investors to public urban development projects.

The implementation of the GCR long-term development strategy has had a far-reaching impact on both the physical environment of the region and the extent to which valuable farmland is jeopardized in favor of ever-expanding urbanization.

Figure A2.1-1 shows the updated urban development plans of CGR. It should be noticed that a new study on the urban development planning for CGR is being prepared to be implemented in the near future under the technical assistance program of JICA.



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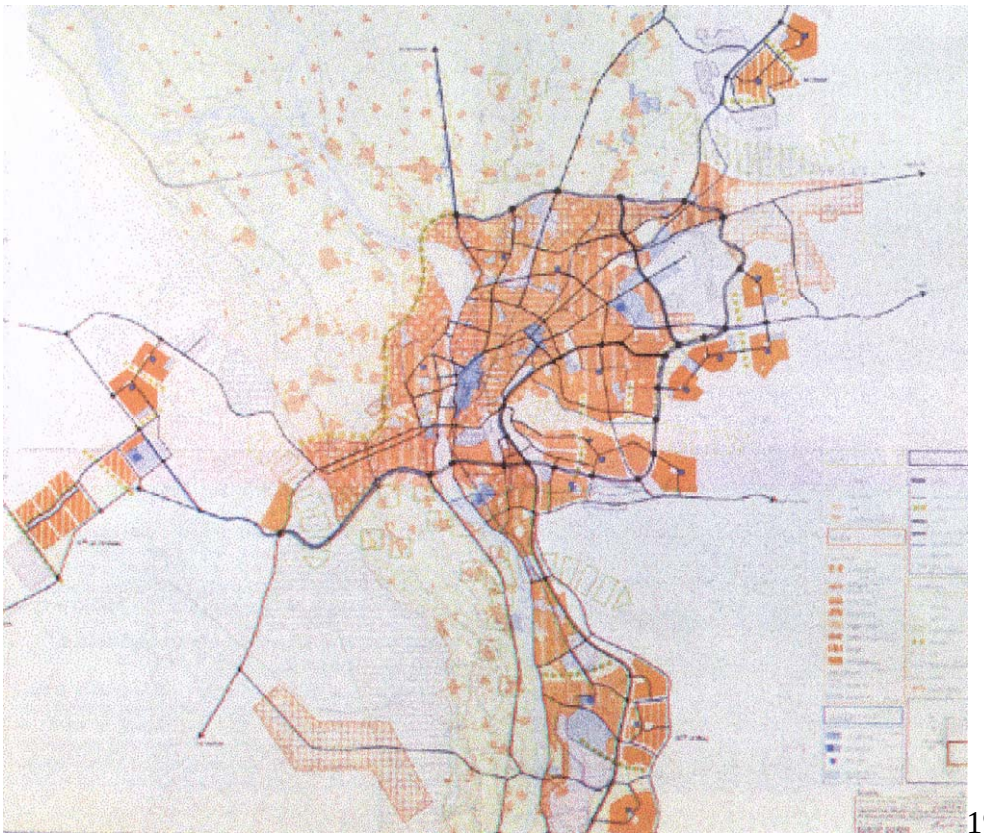

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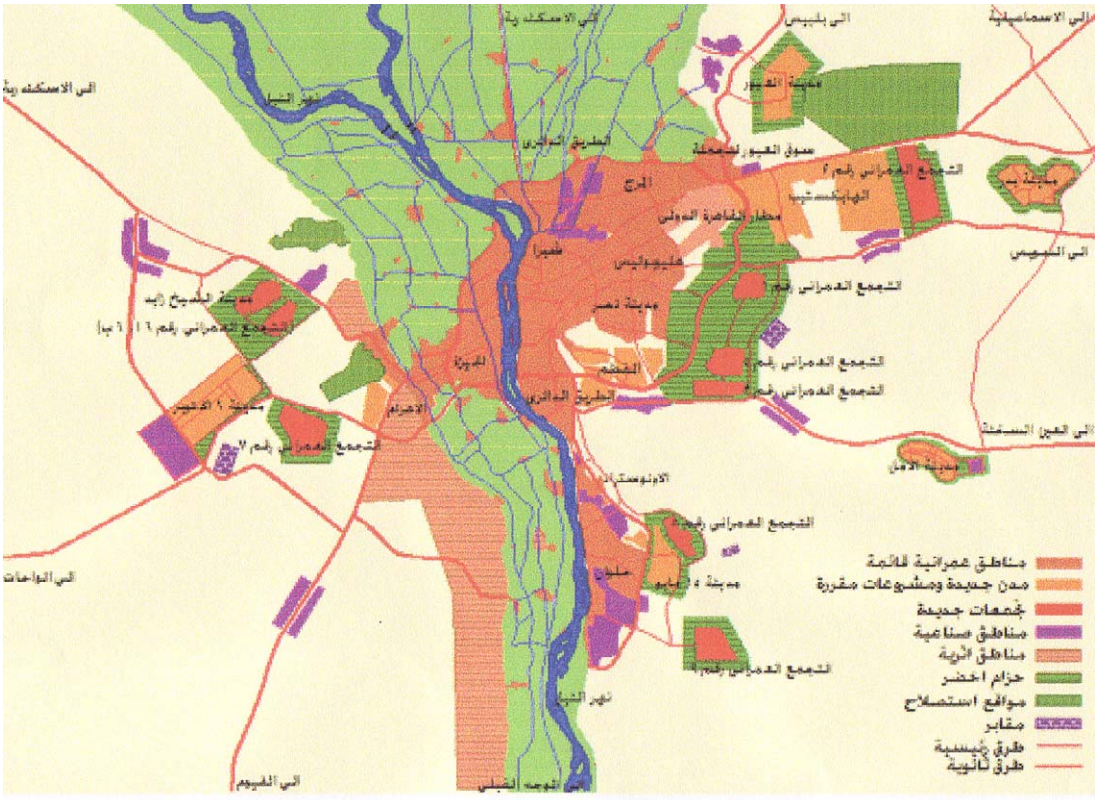
Figure A2.1-1 Updating Greater Cairo Region Development Plans (1/2)



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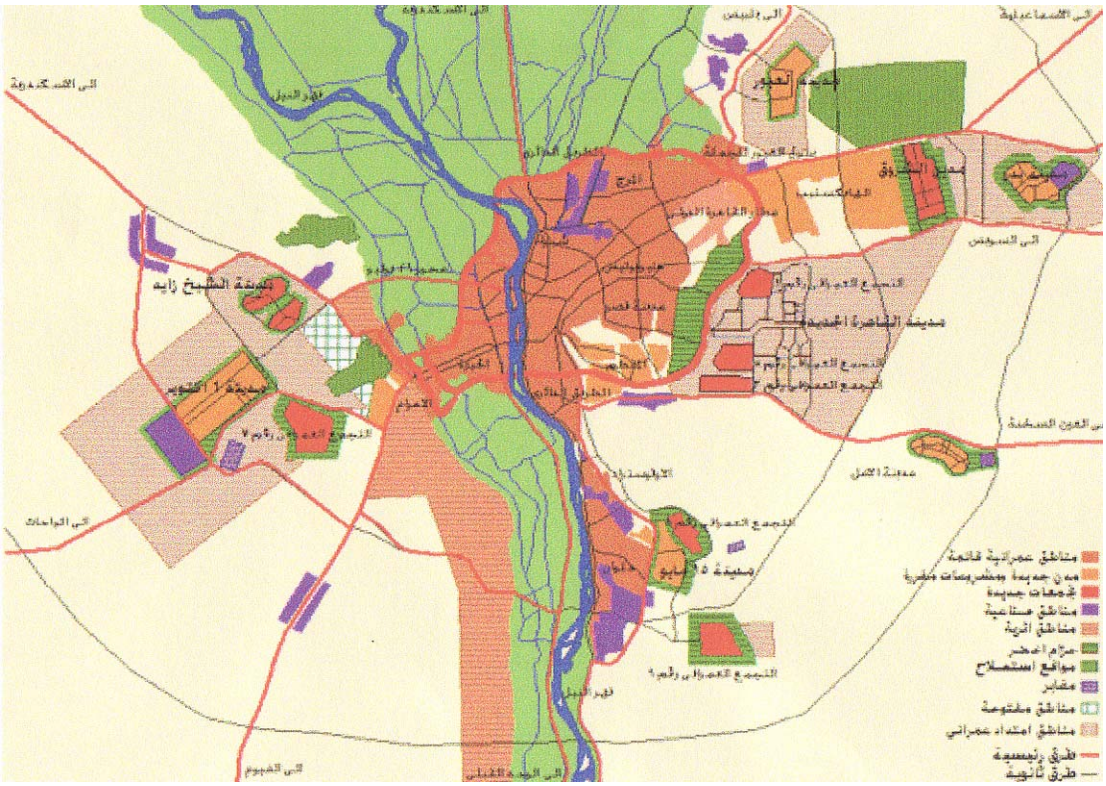

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Figure A2.1-1 Updating Greater Cairo Region Development Plans (2/2)

3. Cairo Regional Area Transport Study (CREATS - Phase I)

The Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region is a comprehensive study divided into two phases of Master Plan or CREATS I from April 2001 to November 2002 and Feasibility Study or CREATS II from February 2003 to December 2003, under the technical assistance program of JICA and in cooperation with the Higher Committee for Greater Cairo Transport Planning.

In CREATS I, the major objective of the Study is to formulate a master plan for the urban transport network to the year 2022. The Study included a full set of transport and traffic surveys with a person-trip home interview survey for about 57,000 sample households for the identification of present condition as well as transport modeling.

The Study has the goal of achieving the following three visions:

- To achieve sustainable social and economic growth
- To assure social equality
- To improve urban environment.

In the line with materializing the above three visions, the Study established the following transport missions that should be satisfied by the Plan:

- Economically effective urban transport systems
- Equitable people's mobility
- Safe and environment friendly transport system.

The following strategies are proposed towards making the Plan innovative over the next two decades time-horizon:

- Improvement of people's mobility
- Optima; infrastructure development and management
- Safe and environment friendly transport
- Accessible transport for all
- Establishment of sustainable institutional and financial mechanisms

(1) Socioeconomic Indicators

As presented in Table A2.1-3, the future socioeconomic indicators of GCR show that population will increase to 20.7 million with an annual average growth rate of 1.7% up to the target year 2022, with the economy growth rate of 4.9% and 2.9% annual

increase in per capita GRDP. This future framework gives an increase in the total number of motorized trips from 14.4 to 25.1 million or almost double of the 2001 trips with an annual growth rate of 2.7%.

Table A2.1-3 Major Indicators of GCR in 2001 and 2022

Socio-Economic Indicators	2001	2022	AAGR % (2001-2022)
Population (Million)	14.4	20.7	1.7
GRDP in GCR (Billion LE)	113	292	4.9
Per Capita GRDP (LE)	7,840	14,110	2.9
Motorization (Million Vehicles)	1.05	2.50	4.2
Trip Generation (Million Trips)	14.4	25.1	2.7

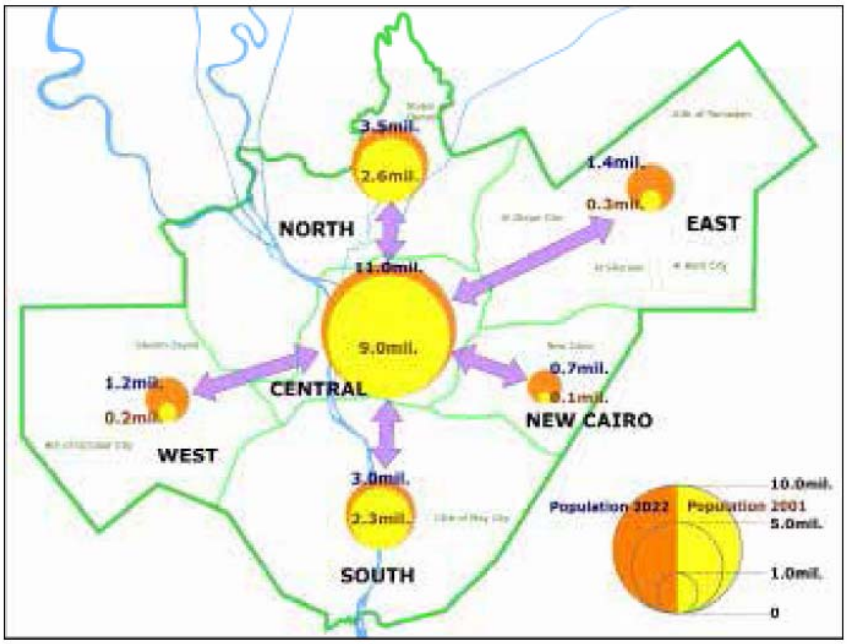


Figure A2.1-2 Population Distribution Plan, 2001 and 2022

(2) Development Scenarios

Different scenarios were analyzed in order to develop the optimum projects of the master plan. The do-minimum scenario is based on the hypothetical assumption of implementing the on going and “committed projects only” which are presented in Table A2.1-4. Under this scenario, it was found that the traffic situation in 2022 would be chaotic.

Table A2.1-4 Major Committed Road Projects in Greater Cairo Region

Agency	Length km	Cost (LE m)	Plan
Ministry of Transport		111	2002-07
Ministry of Housing, Utilities and Urban Communities Ring Road Connection + 6 Regional Roads	98.5	471	2002-07
Cairo Governorate 1 Road Project + 10 Grade Separation Projects		518	2002-07
Qalyubia Governorate 1 Road Project + 1 Grade Separation Project		109	2002-07
Giza Governorate 2 Grade Separation Projects		357	2002-07

The applied model revealed that under such transport conditions, the trip speed on the average of all modes will be as low as 11.6 km/hr in 2022 compared to the 2001 speed of 19.0 km/hr. This means that the major roads will be fully congested all day and the volume/capacity (V/C) rate on the daily average will reach 1.5, i.e. saturated condition, compared to 0.8 in 2001. Another indicator shows that a home-based work trip that takes 37 minutes by car on the average will take more than 100 minutes in 2022. Other different future scenarios with different network conditions in both roads and public transport systems were tested in order to identify an optimal transport network that meets future transport demand.

The proposed CREATS network was derived from the optimization process of the integrated transport network through the evaluation of alternative scenarios. The proposed scenario is composed of several components such as: metro lines, connections to satellite cities, super tram systems based on upgrading the existing lines, optimization of bus route network with operational and inter-modal coordination with shared-taxi and metro system and an urban expressway network.

(3) Optimum Network

The components of the optimized network are in general as follows:

- Road Network: committed projects - proposed improvements - Urban Expressway Network
- Public Transport: MRT: committed network - Metro Line 4 - Line 2 Extension - Satellite cities corridors
  LRT: Super-tram system - network improvements
  Bus / Shared Taxi: optimized route structure - coordination with MRT / LRT Networks

The overall evaluation of the optimized plan, as presented in Table A2.1-5, shows that

the trip average speed will be recovered to be 18.0 km/hr even with the doubled transport demand in 2022, which means that the overall traffic situation, in general, will not worsen than the situation in 2001. The road congestion in terms of V/C ratio will be 1.0, which stands for keeping a balance between the capacity of the network and future demand. Passengers of the public transport will account for 20.3 million/day, compared with 18.2 million in the first scenario. It is expected also that, environmentally, the CO_2 emission will be less by 15% compared with the first scenario. Table A2.1-5 presents a comparison of selected criteria between the optimum plan compared with the present situation and the "committed projects" scenario.

Table A2.1-5 Evaluation of Development Scenarios

Scenario	Present Situation 2001	Committed Projects Scenario 2022	Optimum Scenario 2022
Cost (LE billion)	-	18.2	59.8
Benefit – Cost Ratio	-	-	1.77
Trip Speed (km/hr)	19.0	11.6	18.0
Modal Share of Public Transport (%)	70.9	61.7	57.9
No. of Public Transport Passengers (million/day)	13.3	18.2	20.3
Vehicle-Kilometer (million pcu-km/day)	62.8	127.3	139.7
Volume/Capacity Ratio	0.74	1.11	1.00
Population within 800m of Public Transport (10^6)	2.04	3.09	8.20
Employment within 800m of Public Transport (10^6)	1.11	1.70	4.20
Students within 800m of Public Transport (10^6)	0.74	1.08	2.70
CO_2 Emission (10^6 ton)	12.2	15.9	13.6

The staged public transport program for the optimized plan is presented in Table A2.1-6 while the road sector investment plan is presented in Table A2.1-7. Table A2.1-8 includes a summary for CREATS roads infrastructure development projects. The Master Plan components are presented graphically in Figure A2.1-3.

Under the plan of the Urban Expressway Network, the Toll Road Finance system is proposed as a sustainable financing mechanism. CREATS preliminary financial analysis showed that LE 5.0 toll could self finance the investment if the financial cost can be properly minimized, for example, by international finance. It is recommended, however, that the toll level be initiated with lower level, such as LE 2.0, at earlier years for social acceptance. It is also recommended that the projects be implemented by a new independent organization, such as Metropolitan Expressway Authority, to crystallize the financing system.

Table A2.1-6 Public Transport Investment Program (LE million – constant 2001)

Mode / Period	2002-07	2008-12	2013-17	2018-22	Total
Mass Rapid Transport	0	0	2,851	8,049	10,900
Tram and Super-tram	1,041	1,923	1,469	1,474	5,907
ENR Suburban, Wings	571	1,927	1,994	5,674	10,166
Bus Fleet	1,154	1,009	1,154	1,009	4,326
Priority Bus Facilities	762	738	267	277	2,044
Nile Ferry	25	25	0	0	50
Committed Projects	2,356	6,683	5,675	300	15,014
CREATS Plan	5,909	12,305	13,410	16,783	48,407

Table A2.1-7 Road Sector Investment Program (LE million – constant 2001)

Agency / Period	2002-07	2008-12	2013-17	2018-22	Total
MOT	111	-	-	-	111
MHUUC	471	-	-	-	471
Cairo Governorate	518	-	-	-	518
Giza Governorate	357	-	-	-	357
Qalyubeya Governorate	109	-	-	-	109
Total Committed Projects	1,566	-	-	-	1,566
Regional Roads	190	59	78	0	327
Primary/Secondary	215	105	0	0	321
Grade Separations	140	140	140	105	525
Urban Expressway Network	0	2,652	2,432	2,788	7,872
CREATS Plan	545	2,956	2,651	2,893	9,045
Total Road Investment	2,111	2,956	2,651	2,893	10,611

Table A2.1-8 Summary of CREATS Road Infrastructure Development Projects

CREATS Proposal	Length	Implementation Cost (LE m)				Cost
	km	2002-07	2007-12	2012-17	2017-22	(LE m)
Regional Primary Highway Improvement [3 Road Projects]	66.8	190	59	78	0	327
Primary Arterial Street Improvements [6 Street Projects]	28.3	104	95	0	0	200
Secondary Arterial Street Improvements [5 Street Projects + 1 Nile River Bridge]	17.2	111	10	0	0	121
Intersection Grade Separation Projects [15 Grade Separation Projects]		140	140	140	105	525
Urban Expressway Projects [1 Ramp + 7 Expressway Projects]	78.3	0	2,562	2,432	2,788	7,872
Total for CREATS Proposed Projects		545	2,956	2,651	2,893	9,045

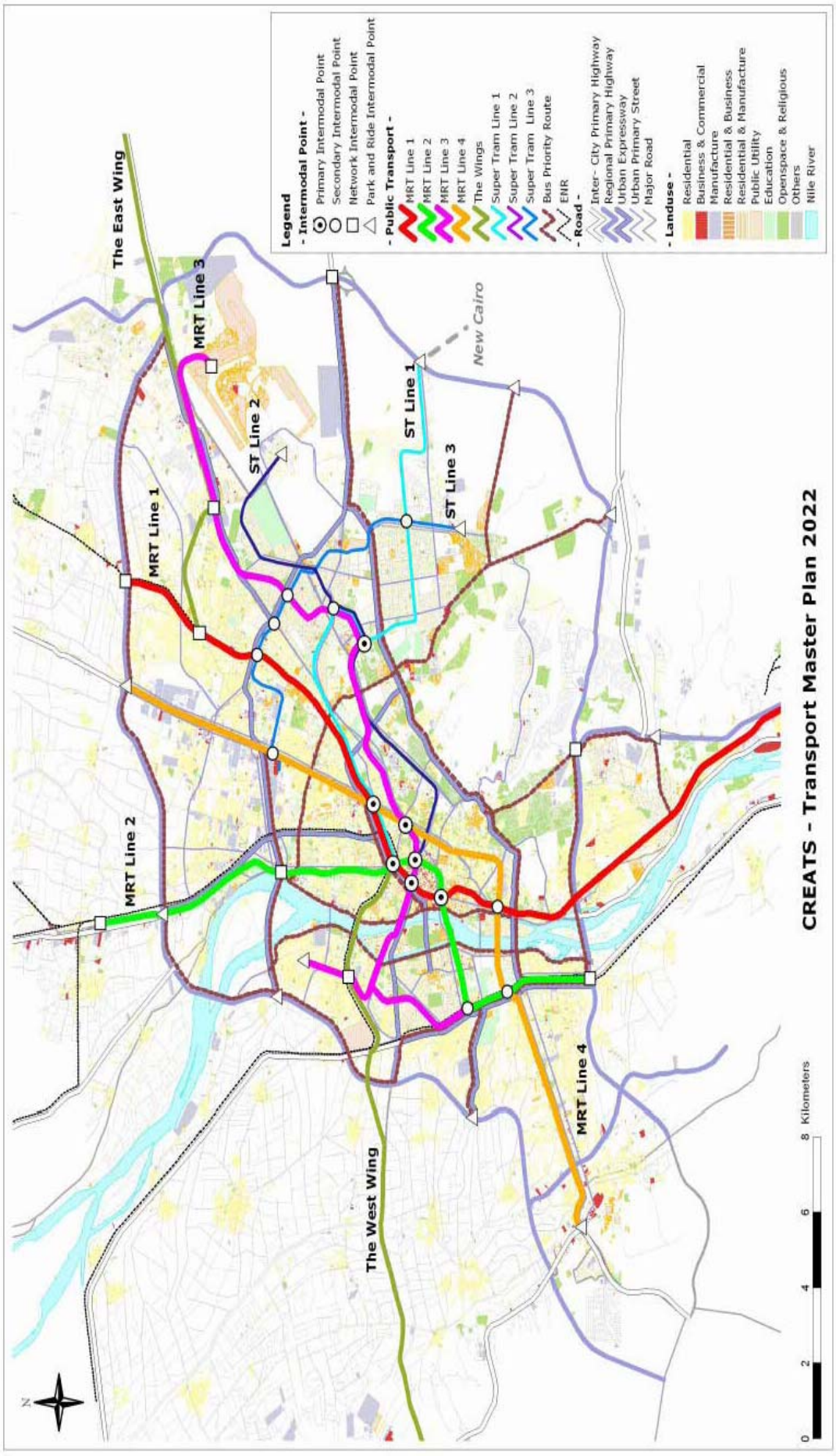


Figure A2.1-3 Transport Master Plan in Greater Cairo Region - 2022

(4) Implementation Plan

The proposed phasing concept of the different components of the integrated transport plan is shown in Figure A2.1-4, divided into hardware, software and human-ware, while Figure A2.1-5 presents the proposed phasing for infrastructure development projects.

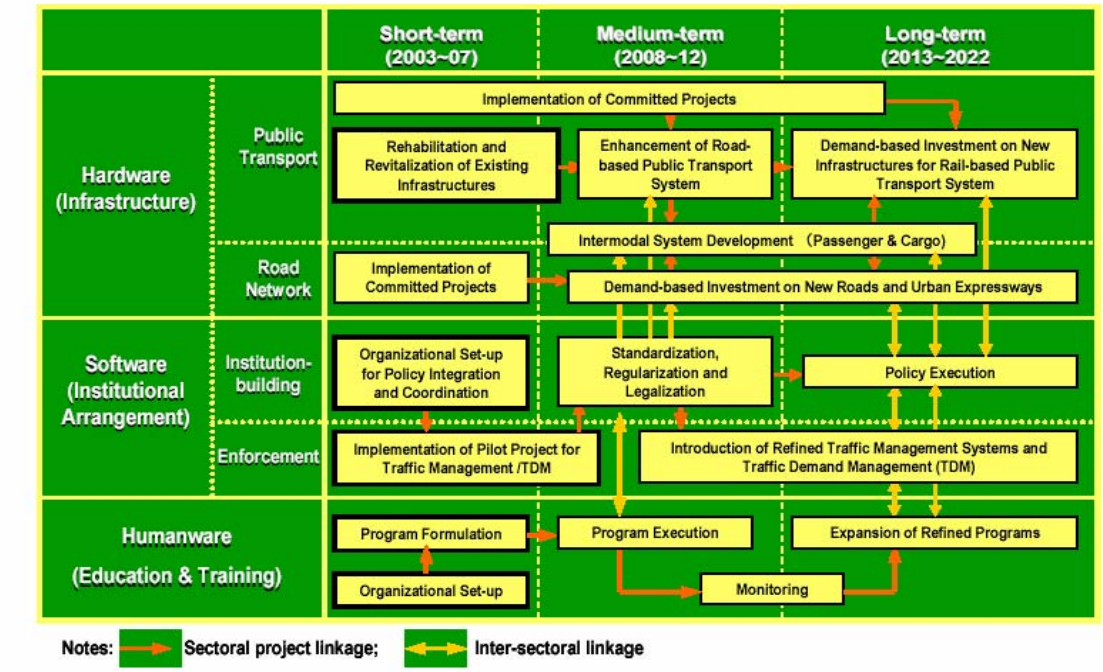


Figure A2.1-4 Proposed Phasing Concept for Integrated Transport Development System

Proposed Measure and Project/Program	Short	Mid.	Long
Rail-based Public Transport			
• Committed Projects	■	■	■
• New Metro Line 4 (Pyramid Line) Development		■	■
• Heliopolis Metro and Tram Upgrading	■	■	
• Super Tram Introduction	■	■	■
• ENR Suburban Line Improvement	■	■	■
• East-West Wing Lines to New Communities		■	■
• Intermodal Facilities Development	■	■	■
Road-based Public Transport			
• Improvement of Public Bus Facilities	■	■	■
• Public Bus Fleet Improvement	■	■	■
• Priority Bus Facility Development	■	■	■
Roads and Highways			
• Committed Projects	■		
• Primary/ Secondary Roads Development	■	■	■
• Grade Separation Works		■	■
• Expressway Network		■	■
Cargo Transport			
• Truck Terminal Development (3 Locations)	■	■	■
• Expansion of Existing Rail and River Terminals	■	■	■
• Sector Restructuring		■	■

Figure A2.1-5 Proposed Phasing Plan for Infrastructure Development

4. Cairo Regional Area Transport Study (CREATS - Phase II)

(1) General

In CREATS II, feasibility studies on five high priority projects, as identified within the framework of the Transport Master Plan, have been conducted. The five projects are divided into Program A and B.

Program-A focuses on the following three (3) components:

- Public transport connection between Cairo and 10th of Ramadan City (Component A-1)
- Public transport connection between Cairo and 6th of October (Component A-2)
- Formulation of a short term traffic management and bus priority plan (Component A-3)

Program B consists of the following two components:

- Improvement, upgrading and modernization of Heliopolis Metro tram system
- Organizational and institutional reform for Cairo Transport Authority (CTA)

The two programs are shown in the location maps of Figures A2.1-6 and A2.1-7.

(2) Program A

1) Component A-1

This component deals mainly with the public transport connection between Cairo and 10th of Ramadan City. Along the East-West Corridor, which was defined as a corridor between Ain Shams and 10th of Ramadan City in the East, several community developments have been in progress as shown in Figure in A2.1-8.The total length of the corridor is about 50km. Among those new communities, the 10th of Ramadan City has the biggest population and is expected to accommodate 576,000 residents in 2022. The Oboor and Shorooq new communities will have 300,000 populations while the Badr new community will be with a population of 200,000 inhabitants.

The current and future population growth potential along the East Wing is very robust, and several suburban centers need a mass transit system development to cope with the future transport demand.

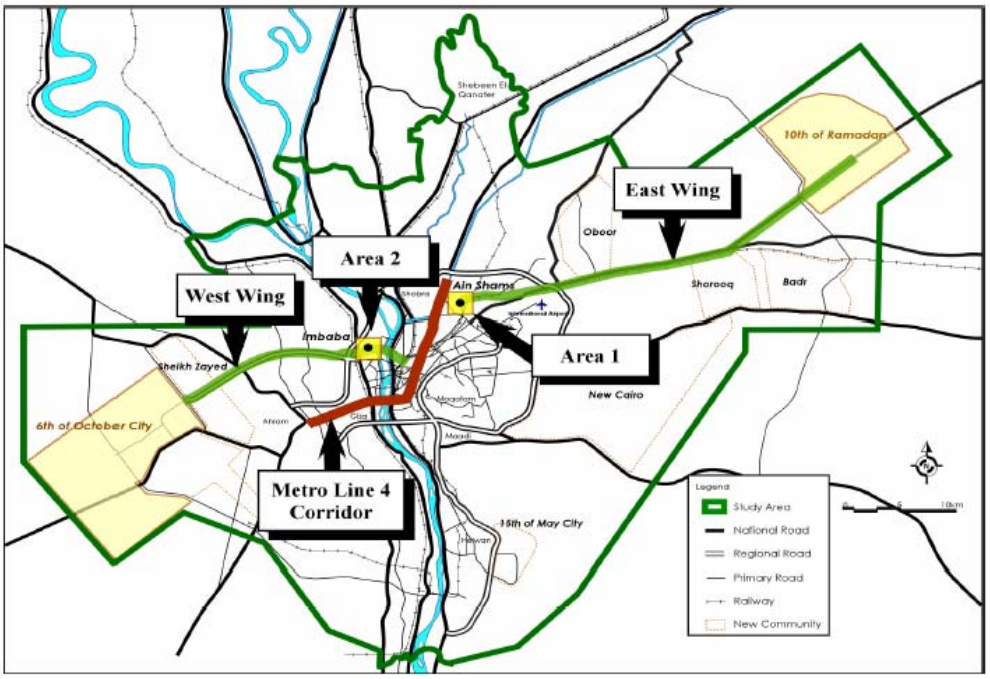


Figure A2.1-6 Location Map for Program A

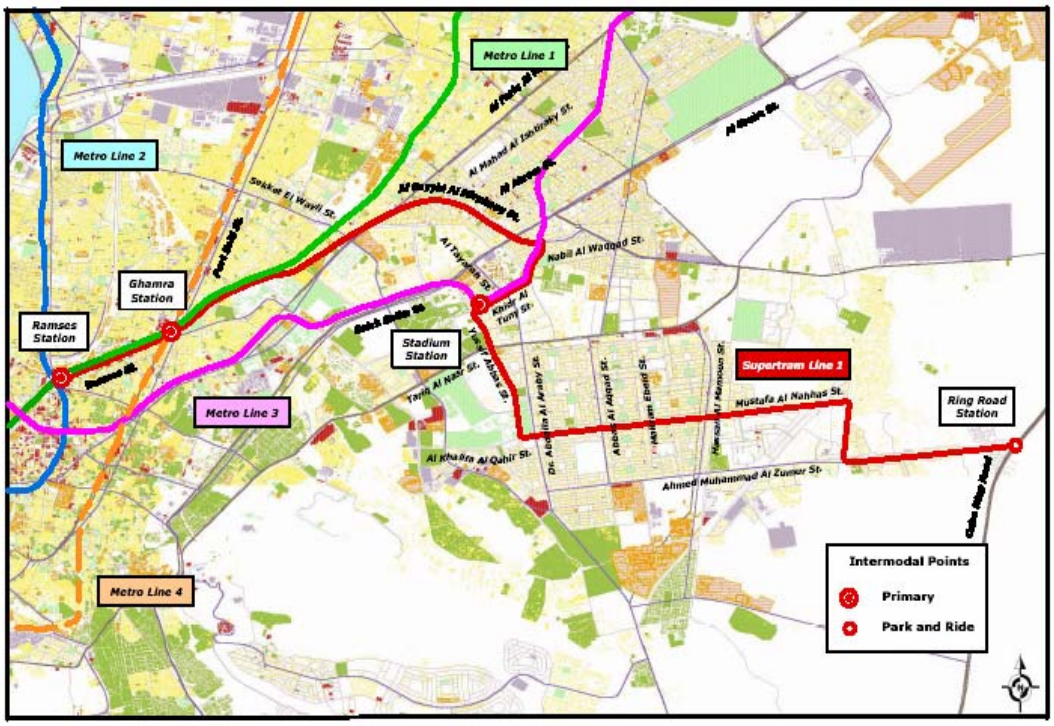


Figure A2.1-7 Location Map of Super-tram Line 2

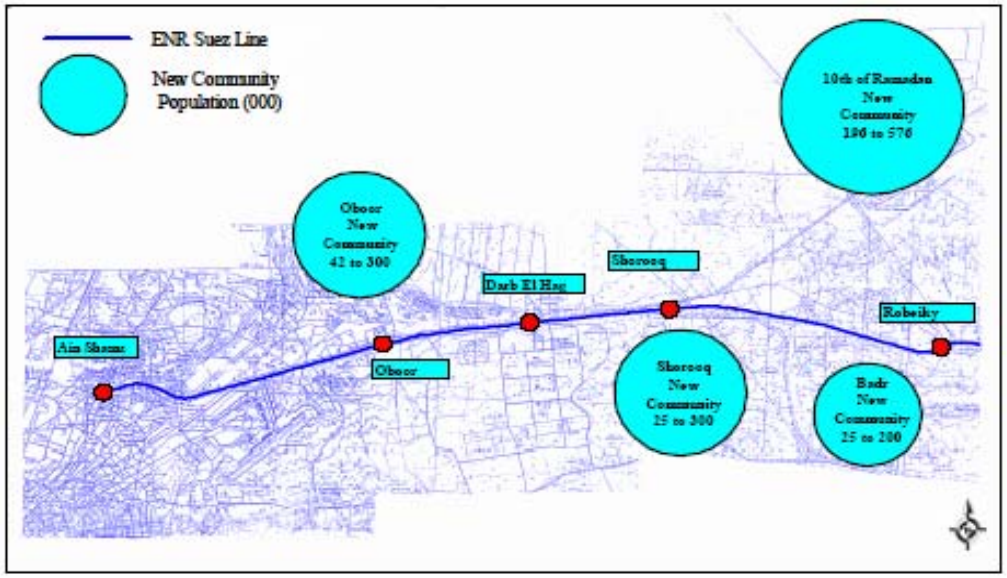


Figure A2.1-8 New Communities along East Wing

As a result of an alternative route analysis on the various railway route options with bus-way option, the railway alignment that connects Ain Shams and the 10th of Ramadan City at shortest distance is selected as the best option. The initial investment cost of this East West line accounts for approximately LE 2.4 billion.

When the East Wing project be commenced from 2007 and the railway system be operated from 2010 (option 2), the project is economically feasible from the view point of national economy, as presented in Table A2.1-9.

Table A2.1-9 Economic Evaluation Results for East Wing Railway Project

Evaluation Indicators	Option 1	Option 2
Economic Internal Rate of Return (EIRR)	11.1%	13.1%
Net Present Value (NPV) at mid-2003 *	- 157.6 million LE	143 million LE prices
Benefit – Cost (B/C) Ratio *	0.92	1.09

*Notes: * at 12% discount rate*

Option 1: East Wind project be commenced from 2004 and the railway system be operated from 2007
Option 2: East Wind project be commenced from 2007 and the railway system be operated from 2010

The results of the financial analysis are summarized in Table A2.1-10. The Financial Internal Rate of Return (FIRR) for the East Wing Railway project is calculated at 3.3%, which implies that the Project will hardly be viable from the financial point of view.

Table A2.1-10 Summary of Financial Analysis for East Wing Project

Evaluation Indices	Result
FIRR (Financial Internal Rate of Return)	3.31%
The First Year of Positive Operation Profit at Annual Basis	Year 2014
The First Year of Positive Net Profit at Annual Basis (after Interest and Depreciation)	Year 2015
The First Year of Positive Accumulated Net Profit	Year 2022

Source: JICA Study Team calculations

2) Component A-2

CREATS Master Plan proposed that the 6th of October Corridor should ultimately be served with a dual-track rail system connecting the 6th of October new community and Ramses Station in 2022. In the short- and medium-term plans, a more cost-effective solution should be pursued, that is, the provisions of a trunk bus-way system. The 6th of October Bus-way System consists of two bus lanes with an exclusive alignment and high-order service. The bus-way system is flexible in operation and responsive to demands, thereby providing a cost-effective transport service.

The at-grade bus priority lane system is introduced at the same level as that on the existing major streets within the 6th of October City. The total length accounts for 38 km, within which five stations for bus-way system are planned at the strategic locations along the alignment.

The project costs, which include all those for construction of the infrastructure and facilities, bus fleet procurement, land acquisition, and engineering costs, are estimated at about 586.3 million LE as the initial project cost with an additional cost of LE 513.1 million to be used after 2018. The results of the cost-benefit analysis are shown in Table A2.1-11. Since the Economic Internal Rate of return (EIRR) is significantly higher than the Egyptian social discount rate of 12%, it is evaluated that the Project is economically feasible.

Table A2.1-11 Economic Evaluation Results for West Wing Bus-way Project

Evaluation Indicators	Value
Economic Internal Rate of Return (EIRR)	48.9%
Net Present Value (NPV), at 12% discount rate	5,243 million LE at mid-2003 prices
Benefit/Cost (B/C) Ratio	9.6

Source: JICA Study Team

The west Wing Bus-way project is evaluated also from the financial point of view. The results of the financial analysis show that the FIRR for the West Wing Bus-way

Project is estimated at as high as 22.3 %, which implies that the Project will be, financially, very viable, as presented in Table A2.1-12.

Table A2.1-12 Financial Analysis Results for West Wing Bus-way Project

Evaluation Indices	Result
FIRR (Financial Internal Rate of Return)	22.3%
The First Year of Positive Operation Profit at Annual Basis	Year 2008
The First Year of Positive Net Profit at Annual Basis (after Interest and Depreciation)	Year 2008
The First Year of Positive Accumulated Net Profit	Year 2009

Source: JICA Study Team calculations

3) Component A-3

The objectives of the traffic Management Program along the Metro 4 Corridor is to formulate a short term transport management program to enhance the capacity of the public transport along the proposed Metro Line 4 corridor with a view to achieving smooth traffic flow on the corridor. This program also aims to shift private car users to public transport modes, thereby mitigating traffic congestion at bottlenecks.

Three employed (3) basic planning strategies are as follows:
1) To promote service level of bus transport system;
2) To mitigate traffic congestion, and
3) To create pedestrian-friendly environment.

The Traffic Management Program along the Metro 4 Corridor composes of several components:

1) Bus priority system
2) Improvement of bus stop/terminal
3) Improvement of traffic signal control system
4) Improvement of intersections
5) Parking system
6) Pedestrian friendly system
7) Traffic circulation system

The initial investment cost for the proposed Traffic Management Program, will total about LE 211.0 million.

(3) Program B

1) Component B-1

One of the essential tenets of the CREATS plan has been met by cost effective utilization of available assets, in particular right-of-way. Therefore, the alignment of the Heliopolis Metro tram (Super-tram Line 1) follows the current Heliopolis Metro service between Ramses Station and Nasr City. The Super-tram Line 1 extends beyond the current Nasr City terminus to the Cairo Ring Road. Total line is 22 kilometers in length and includes 19 stations including four (4) inter-modal points. Figure A2.1-9 shows the alignment of the Super-tram Line 1.

The project costs may consider outlays necessary for realization of the Super-tram such as new infrastructure, systems, rolling stock, depot, control center, ancillary improvements, engineering, construction management, administrative and contingencies. The total cost is estimated at LE 2,332 million. The results of the cost-benefit analysis are summarized as shown in Table A2.1-13. The Financial Rate of Return (FIRR) for the Super-tram is computed to be negative, as shown in Table A2.1-14, which implies that the project will hardly be viable from the financial point of view.

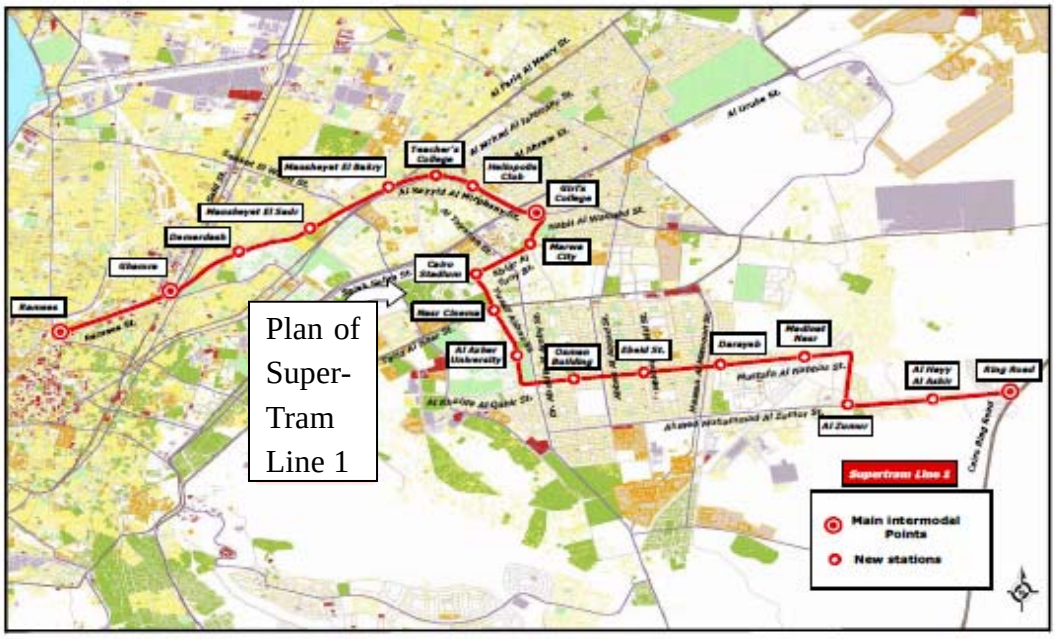


Figure A2.1-9 Alignment of the Super-tram Line 1

Table A2.1-13 Economic Evaluation for the Super-tram Line 1 Project

Evaluation Indicators	Value
EIRR (Economic Internal Rate of Return	12.2%
NPV (Net Present Value)	LE 32.9 million at mid 2003 prices
B/C (Benefit / Cost Ratio)	

Table A2.1-14 Financial Evaluation for the Super-tram Line 1 Project

Evaluation Indices	Result
FIRR (Financial Internal Rate of Return)	Negative
The First Year of Positive Operation Profit at Annual Basis	Year 2019
The First Year of Positive Net Profit at Annual Basis, after Interest	Year 2024
The First Year of Positive Accumulated Net Profit	Beyond 2030

2) Component B-2

Since the Cairo Transport Authority (CTA) is facing many financial and organizational problems that prevent the authority from operating efficiency, it is becoming urgent for the Egyptian Government to start the organizational and institutional reform of the CTA.

Therefore, three (3) areas of reform are proposed to improve public transport service operation through restructuring of CTA; new organizational reform, deregulation of CTA business; and rationalization of employment.

The recommended organization for operation and maintenance for the Super-tram is shown in Figure A2.1-10. The staff organization will be in charge of operation, the maintenance and management of the system.

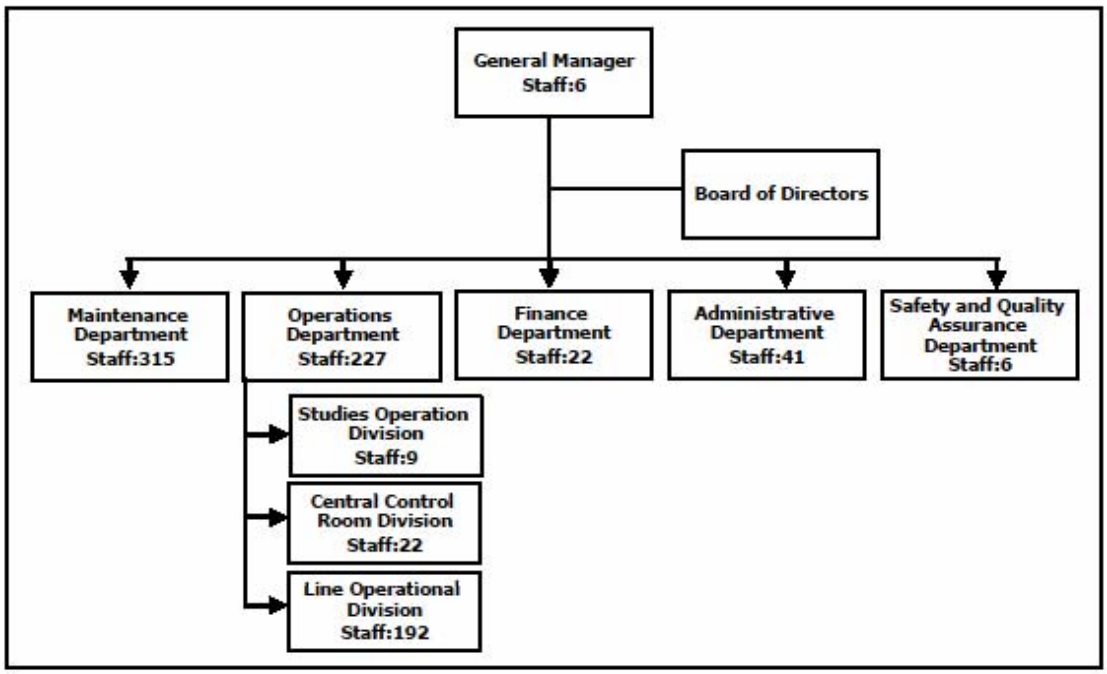


Figure A2.1-10 Super-tram Company Structure

It is proposed that the CTA undergo a restructuring and reorganization program. The Public Transport Training Program (PTTP) should encompass all relevant components of the public transport system, both at the operational and managerial levels. The establishment of the PTTP requires a practical study that consists of several sequential phases:

- Identification of the framework components and resources needs assessment program
- Establishment a Roll-Out Plan,
- Human resource and Expertise Building Program, and
- Technical assistance program

In order to efficiently respond to a constantly changing public transport environment, and to react to explicit needs of various operators, the entire structure of the PTTP must be correspondingly flexible, hence the building block structure.

5. Toll Roads in Egypt

(1) Existing Toll Roads

Table A2.1-15 shows information on the existing toll roads in Egypt. There are only five (5) toll roads and one (1) bridge over the Suez Canal existed in Egypt with a total length of 453 km although there are roads of 86,377 km in length in Egypt. All these roads are classified as inter-city highway, of which four (4) roads and one (1) bridge are operated and managed by GARBLT and one (1) road is operated and managed by the National Company under the Ministry of Defense. GARBLT can be classified as the servicing agency under MOT, which is a public authority and a part of the governmental institution, while the National Company can be classified as the economic authority, which is defined as a company in commercial basis.

Toll rate of four (4) toll roads; namely Cairo - Alexandria Road, El Qatamya – El Aeen El Sakhna Road, Cairo – Fayoum Road, and Cairo – Ismailia – Port Said Road is adopted as 2 times higher than the toll fees designated in the Public Road Law, that of El Hekesteb – Belbess Road, and Moubarak Bridge is adopted as similar rate in the same law. These toll rates are determined by the Prime Minister and proclaimed in the Prime Minister’s Decree.

The toll rates of these roads have increased in about 50 % (in average) in 2000/01, as shown in Table A2.1-16. As for Mubarak Bridge, the toll rate was adopted as the same rate as the other road section (except El Hasesteb – Belbess section), but due to

complains by the road users for its high rate, it was modified and decreased about one half of the original rate.

As shown in Table A2.1-17, the toll revenues have been increased from 41 LE million in 1999/00 to 78 LE million in 2003/04 with an average annual growth rate of 18%. This is due to increases in the toll rate at around 2000/01 and increases in vehicular traffic volume on these toll roads.

The toll levy collected from these roads goes to Ministry of Finance (MOF) as revenues for investment and may be reallocated to the Ministry of Transport or GARBLT as maintenance expenses. Partially, it includes accident insurance.

Data of the annual average traffic volume on the toll roads show approximate growth rates between 7 %– 10% as presented in Table A2.1-18.

(2) Toll Road Plan

Table 2.5-19 shows the planned toll roads in Egypt. There are seven (7) roads planned to be toll roads. The location map of these toll roads is shown in Figure A2.1-11. In Cairo region, the Ring Road is one of the candidate projects, but so far it is under study and there is no announcement for the sections of the Ring Road that will be subject to the toll system and what scheme will be adopted.

6. Development of Greater Cairo Region Ring Road

The Ministry of Transport (MOT) newly proposed a plan toward the development of Greater Cairo Region Ring Road (GCRRR) to an integrated transport corridor. The plan includes upgrading the GCRRR to a toll freeway and possibly adding a rapid transit system. A study is being carried out at present to ensure the economic and financial viability of implementing the transport corridor.

According to the MOT Plan, this project aims to enhance the performance of the existing GCRRR to meet current and future transportation needs and integrate transport with development plan to create more accessible, multi-modal communities. A multi-modal transportation development strategy is suggested to provide a network of cost-effective transit services along with the ring road transportation services. This shall be through:

Table A2.1-15 Existing Toll Roads in Egypt, 2005

	Road Section	Road Length (km)	Toll Fee (LE)	Operating System	Agency	Toll Levy in 2003 / 04 ('000 LE / Year)	Use of Levied Toll
1	Cairo – Alexandria (Al Haram & El Amereya)	95	Private car: 2.00 Pickup: 3.00 Bus: 5.00 Truck & Lorry: 15.00 Heavy duty Veh.: 15.00	Public	GARBLT	34,687	O/M
2	El Hakesteb – Belbess	45	Private car: 1.00 Pickup: 1.50 Bus: 2.50 Truck & Lorry: 5.00 Heavy duty Veh.: 5.00	Public	GARBLT	4,283	O/M
3	El Qatamya – El Aeen El Sakhna	118	Private car: 2.00 Pickup: 3.00 Bus: 5.00 Truck & Lorry: 10.00 Heavy duty Veh.: 10.00	Public	National Company	8,980	O/M
4	Cairo – Fayoum	45	Private car: 2.00 Pickup: 3.00 Bus: 5.00 Truck & Lorry: 10.00 Heavy duty Veh.: 10.00	Public	GARBLT	10,493	O/M
5	Cairo – Ismailia – Port Said	130	Private car: 2.00 Pickup: 3.00 Bus: 5.00 Truck & Lorry: 10.00 Heavy duty Veh.: 10.00	Public	GARBLT	18,820	O/M
6	Moubarak El Salam Bridge		Private car: 1.00 Pickup: 1.50 Bus: 2.50 Truck & Lorry: 5.00 Heavy duty Veh.: 5.00	Public	GARBLT	1,138	O/M

Source: GARBLT

Table A2.1-16 Toll Rate adopted by Vehicle Type (Cairo-Alexandria Road)

	1999/00	2000/01	2001/02	2002/03	2003/04
Class 1:Private car:	1.25	2.00	2.00	2.00	2.00
Class 2: Pickup	2.25	3.00	3.00	3.00	3.00
Class 3: Bus	3.50	4.50	5.00	5.00	5.00
Class 4: Truck & lorry	5.50	7.00	10.00	10.00	10.00
Class 5: Heavy Duty Vehicle.	7.00	8.50	10.00	10.00	15.00

Source: GARBLT

Table A2.1-17 Toll Revenues from Toll Roads (LE '000)

Road Section		1999/00	2000/01	2001/02	2002/03	2003/04	AAGR (%) 99/00-03/04
1	Cairo – Alexandria Road (Al Haram & El Amereya)	14,261	23,681	26,430	31,260	34,687	24.9
2	El Hakesteb – Belbess Road	3,389	3,980	3,597	4,151	4,283	6.0
3	El Qatamya – El Aeen El Sakhna Road	6,271	7,790	8,748	10,237	8,981	9.4
4	Cairo – Fayoum Road	5,770	7,646	8,428	9,636	10,493	16.1
5	Cairo – Ismailia – Port Said Road	10,964	14,380	15,153	17,256	18,819	14.5
6	Moubarak El Salam Bridge	-	-	1,290	2,489	1,138	-
Total		40,655	57,478	63,646	75,028	78,402	17.8

Source: GARBLT

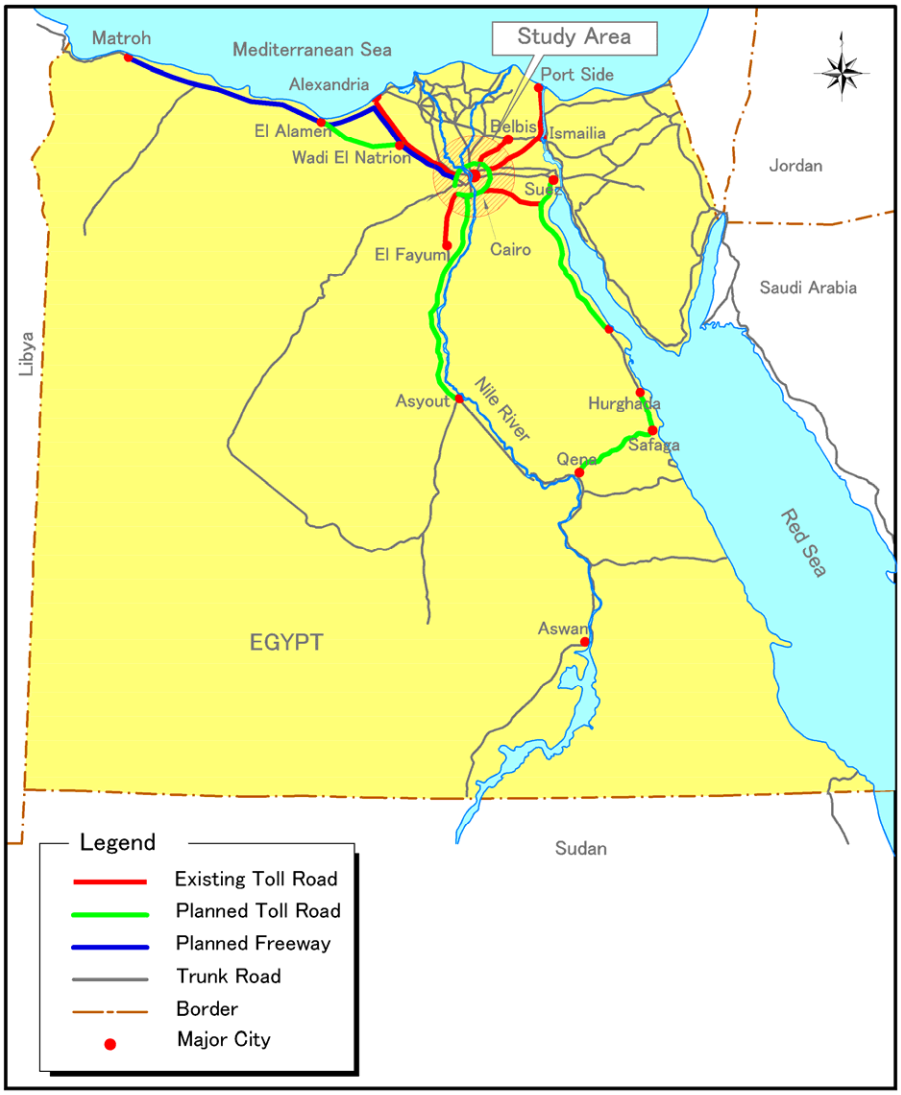
Table A2.1-18 Annual Average Daily Traffic Volume on Toll Roads (Vehicles)

Road Section		1999	2000	2001	2002	2003	2004	AAGR (%) 1999-2004
1	Cairo – Alexandria Road (Al Haram & El Amereya)	16,119	17,886	23,736	24,588	25,137	25,483	9.6
2	El Hakesteb – Belbess Road	NA	NA	NA	NA	12,377	NA	NA
3	El Qatamya – El Aeen El Sakhna Road	NA	NA	NA	NA	5,578	NA	NA
4	Cairo – Fayoum Road	8,417	7,416	9,187	10,830	10.575	11,958	7.3
5	Cairo – Ismailia – Port Said Road	28,791	20,290	35,027	39,147	41,451	43,582	8.6
6	Moubarak El Salam Bridge	-	-	1,660	NA	NA	NA	NA

Source: GARBLT

Table A2.1-19 Planned Toll Roads in Egypt, 2005

Road Section		Road Length (km)	Toll Fee / Fare Collection Period	Operating System	Agency	ADT in 2004 (Veh/day)	Planned Use of Levied Toll
1	Cairo – Assute Road	208	Not determined	Public	GARBLT	4,886	O / M
2	El Adibia - El Zaafarana – Ras Ghareb Road	110	Not determined	Public	GARBLT	12,067	O / M
3	Qena – Safaga Road	160	Not determined	Public	GARBLT	3,123	O / M
4	Hurghada – Safaga Road	60	Not determined	Public	GARBLT	-	O / M
5	Wady El Natron – El Alamen Road	118	Not determined	Public	GARBLT	-	O / M
6	Dafra – Kafl El Zayat Road	28	Not determined	Public	GARBLT	-	O / M
7	Cairo Ring Road	-	Not determined	Public	GARBLT		O / M



- Upgrading the existing ring road to a freeway to enhance performance.
- Establishing RRTS (Rapid Rail Transit System) and/or RBTS (Rapid Bus Transport System) to solve transportation problem in GCR and neighboring old/new cities.
- Establishing local area bus system (LABS) and Park-and-Ride facilities.

(1) Project Description

The project deals with upgrading the current existing ring road to freeway standard and to construct a new Rapid Transit System including Park-and-Ride facilities, pedestrian bridges or tunnels, and local areas transit systems. The proposed project is to be accomplished through the following phases:

1) To conduct a thorough review of international practice in the field of transport planning, developing and constructing freeways, with a comparison between the findings and the current practice in the Egyptian local condition and standards.
2) To conduct careful review and summary of any relevant studies including, but not limited to, Cairo Regional Area Transport Study (CREATS) prepared by JICA.
3) To identify and evaluate current and potential problems as well as future needs in traffic, geometric, and pavement conditions. Conduct transportation planning and traffic study for GCRRR and the adjacent neighboring important mass transit facilities (Metro, Train, Bus and Micro bus) that involve traffic demand, O/D, modal split, and traffic forecast for 40 years starting from year 2005. Propose areas of possible enhancements. Traffic analysis should include origin destination analysis and modal split for existing modes of transportation on GCRRR (Vehicles, Micro-buses, Buses, nearest Metro, and Train lines).
4) To identify and evaluate potential transportation alternatives (such as upgrading to freeway only, constructing of RRTS and/or RBTS in GCRRR strip and the connection with the nearest existing metro and train lines, etc). Based on the analysis, the best alternative that results in better transportation services along the GCRRR corridor will be determined.
5) To conduct geotechnical, hydrological and socioeconomic studies and investigation on the study area according to its potential future land uses. Conduct environmental impact assessment for GCRRR and adjacent neighboring area.
6) To propose upgrading scenarios that should include identification, assessment and selection of transportation planning alternatives. Multi-modal transportation development scenarios shall be suggested to provide a network of cost-effective transit services along with the ring road transport services. That shall be done through:
    - Upgrading of existing Ring Road a freeway to enhance performance.
    - Establishing a Rapid Rail Transit System (RRTS) – or Rapid Bus Transit System (RBTS) in GCRRR strip – to encourage shifts to transit. This includes Park-and-Ride facilities and local areas transit services.
    - It is desired to have highly advanced efficient transit system operating along the upgraded freeway. The design would account for a smooth operation and interaction between the freeway and the transit system, including elevated terminals, traffic access to elevated terminals through ramps, bus stops at the terminals, Park-and-Ride facilities adjacent to the terminals, bicycle parking, etc.
7) To design the required improvements to upgrade the road to a freeway standard with a design speed at least 150 km/hr and axle load not less than 13 ton. Design the required infra/info structures for all facilities (freeway, Rapid Transit System, interchanges, elevated terminals, Park-and-Ride facilities, parking lots, pedestrian

tunnels or bridges, etc). This might include (but not limited to) some or all of the following:-

- RTS track within GCRRR strip.
- Geometric design of GCRRR, Park-and-Ride facilities.
- Pedestrian bridges or tunnels
- Terminals
- Traffic element
- Pavement structure.
- Interchanges.
- Parking facilities.
- Exits and accesses roads.
- Utilities
- Services and maintenance centers.
- Toll stations
- Rest areas
- Landscape
- Lighting, etc.

Design ITS frame work to be employed and implemented as part of the proposed improvements. Design the required connection of RTS with the nearest existing Metro, Train, and Bus lines.

8) To conduct economical analysis and feasibility study.

(2) Project Benefits

The expected benefits of the proposed Development of Greater Cairo Region Ring Road to an integrated transport corridor, as proposed by MOT, are expected to include the followings:

1. Provide an integrated transportation corridor serving the GCR.
2. Provide mobility to GCR residents & surrounding settlements.
3. Promote use of transit services within & around GCR.
4. Connect new residential, industrial and recreational areas around GCR with each other and with metropolitan Cairo.

APPENDIX 2.2

ENGINEERING STANDARDS AND SPECIFICATIONS

APPENDIX 2.2 ENGINEERING STANDARDS AND SPECIFICATIONS

1. Design Speeds

The design speeds for the different class of roads are presented in Table A2.2-1.

Table A2.2-1 Design Speeds (km/hr)

Road Class	Urban Highways		Rural Highways	
	Divided	Undivided	Divided	Undivided
Free Highways	≥ 90	---------	≥ 110	---------
Major Highways	70 ~ 90	60 ~ 80	80 ~ 110	70 ~ 90
Distributor Highways	50 ~ 70	40 ~ 60	60 ~ 80	50 ~ 60
Local Highways	----------	≤ 50	----------	≤ 50

(Source: Egyptian Code, Part 3, Geometrical Design, pages 4 & 5)

2. Standard Level of Services

The Standard Level of Services for the different terrain in cases of rural and urban roads are presented in Table A2.2-2.

Table A2.2-2 Standard Level of Services

Road Type	Terrain	Highway Class			
		Free	Major	Distributor	Local
Rural	Flat	B	B	C	C
	Rolling	B	C	C	C
	Mountainous	C	C	D	D
Urban	Flat	B	C	C	D
	Rolling	C	C	C	D
	Mountainous	D	D	D	E

(Source: Egyptian Code, Part 3, Geometrical Design, page 6)

3. Minimum Traffic Lane Widths

Table A2.2-3 shows the minimum traffic lane widths for the different class of roads.

Table A2.2-3 Minimum Traffic Lane Widths (m)

Road Class	Urban Highways	Rural Highways
Free Highways	3.6	3.6
Major Highways	3.6	3.6
Distributor Highways	3.0	3.3
Local Highways	2.7	3.0

(Source: Egyptian Code, Part 3, Geometrical Design, pages70 & 71)

4. Shoulder Widths (m) in Rural Highways

Table A2.2-4 presents the specified shoulder widths for the different class of roads versus the expected ADT.

Table A2.2-4 Shoulder Widths (m) in Ruler Highways (m)

Road Type		Free	Major	Distributor	Local
Shoulder Width*	ADT ≤ 400 veh/day	2.5 ~ 3.5	1.25 (0.6)	0.6	0.6
	400 < ADT ≤ 1000 veh/day		1.8 (1.25)	1.25	1.25
	ADT > 1000 veh/day		2.5 (1.5)	1.8	1.8

* Notes: In case of median the inner shoulder width is 0.6 ~ 1.2 m. If there is side barrier the barrier should be at least 1.25 m far from the pavement edge. The number between brackets show the minimum shoulder paved width.

(Source: Egyptian Code, Part 3, Geometrical Design, page 75)

5. Minimum Sidewalk Widths (m)

Table A2.2-5 presents the minimum sidewalk widths for the different class of roads.

Table A2.2-5 Minimum Sidewalk Widths (m)

Road Type	Free	Major	Distributor	Local
Sidewalk Width	2.5	2.5	1.5	1.5

(Source: Egyptian Code, Part 3, Geometrical Design, page 76)

6. Median Widths (m)

Table A2.2-6 presents the specified median widths for the different class of roads.

Table A2.2-6 Median Widths (m)

Road Type	Free	Major	Distributor	Local
Rural Roads	4.0	2.0	2.0	------
Urban Roads	3.6	3.6	0.6	------

(Source: Egyptian Code, Part 3, Geometrical Design, pages 77&78)

7. Vertical Clearance

The desirable vertical clearance at interchanges and flyovers is 5.5 m from the top face of pavement up to the bottom face of the structure wherever this can be achieved and taking into consideration the cross-slops and thickness of future over layers.

8. Overpass Cross Section

The Egyptian Code specified the following standards as shown in Figure A2.2-1:

- The minimum lane width is 3.6 m coinciding with road lane width
- The minimum median width is 0.6 m
- The minimum sidewalk width is 0.6 m
- The minimum parapet width is 0.25 m

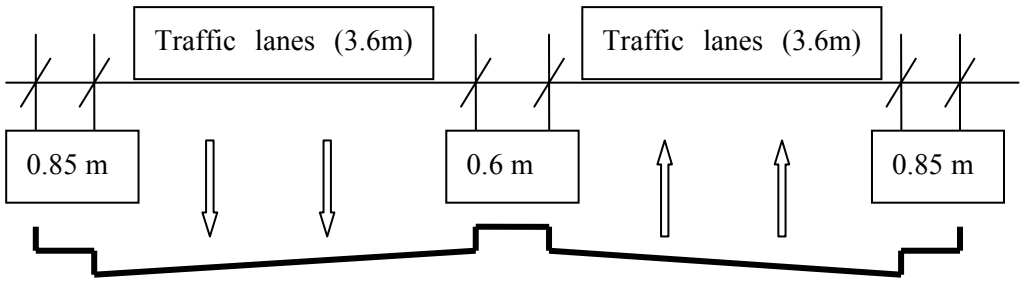


Figure A2.2-1 Minimum Standard of Overpass Cross-Section Widths

9. Interchanges General

Based on the Egyptian Code, there are several types of interchanges and the principal six types are:

1- Trumpet
2- Cloverleaf
3- Partial Cloverleaf
4- Diamond
5- Directional
6- Rotary

The selection of most reasonable type is based on:

1- Allowance of high speed
2- Full control over traffic movements
3- Completely separation of traffic conflicts at intersection
4- Traffic density
5- Topographical condition

10. Interchanges Planning

The following principals shall be considered in alignment and selecting the type of the interchange:

1- The planning principals and types of interchanges at all intersections along same corridor should be homogeneous.
2- The spacing between successive interchanges will be about 3 km in urban areas and about 8 km in rural areas.
3- The entrances and exits to the high speed road are preferred to locate on the right hand side of the through traffic.
4- In case that one more exit will be required at a certain location, it will be preferable to design only one exit that can be branched to other exit after at least 6 sec travel time.
5- The design speeds on entrance and exits (ramps and loops) will be half to one third the high design speed of the major corridor.
6- It is preferable to locate the low speed corridor intersecting a high speed corridor in the higher level and maintain the higher speed traffic at the ground surface level.
7- Moderate longitudinal gradients are preferable.
8- The interchange should be provided with the required road marking and signs.

11. Design Principals and Fundamentals

1) Design Speed (see Table A2.2-7)

Table A2.2-7 Design Speeds at Interchanges (km/hr)

Design Speed on Main Road (km/hr)		50	60	70	80	90	100	110	120
Design Speeds on Ramps and Loops (km/hr)	Maximum	40	50	60	70	80	90	100	110
	Average	30	40	50	60	60	70	80	90
	Minimum	20	30	40	40	50	50	60	70
Corresponding Radius (m)	See Next Table								

(Source: Egyptian Code, Part 3, Geometrical Design, page144)

2) Minimum Radius of Intersections (see Table A2.2-8)

Table A2.2-8 Minimum Radiuses of Intersections (m)

Design Turning Speed (km/hr)*	15	20	30	40	50	60
Lateral Friction Coefficient (f)	0.40	0.35	0.28	0.23	0.19	0.17
Minimum Super Elevation (e)	0.00	0.00	0.02	0.04	0.06	0.08
Sum (e + f)	0.40	0.35	0.30	0.27	0.25	0.25
Minimum Calculated Radius (m)	5	9	24	47	79	113
Minimum Proposed Radius (m)	7	10	25	50	80	115
Average Running Speed (km/hr)	15	20	28	35	42	51

** In case of Design Speed Grater than 60 km/hr, the free way values will be adopted.*
(Source: Egyptian Code, Part 3, Geometrical Design, page115)

3) Carriageway Widths at Curved Entrances and Exits (see table A2.2-9)

Table A2.2-9 Carriageway Widths at Curved Entrances and Exits (m)

Inner Radius of Paved Road (m)	Carriageway Width (m)								
	Case 1: One- Way One-Lane, and Over-taking Prohibited			Case 2: One- Way One-Lane, and Over-taking of Stopped Vehicle is Allowed			Case 3: Tow lanes One-Way or Tow-Way		
	Traffic Level of Service								
	A	B	C	A	B	C	A	B	C
15	5.4	5.4	6.9	6.9	7.5	8.7	9.3	10.5	12.6
25	4.8	5.1	5.7	6.3	6.9	8.1	8.7	9.9	11.1
30	4.5	4.8	5.4	6.0	6.6	7.5	8.4	9.3	10.5
50	4.2	4.8	5.1	5.7	6.3	7.2	8.1	9.0	9.9
75	3.9	4.8	4.8	5.7	6.3	6.9	8.1	8.7	9.3
100	3.9	4.5	4.8	5.4	6.0	6.6	7.8	8.4	9.0
125	3.9	4.5	4.8	5.4	6.0	6.6	7.8	8.4	8.7
150	3.6	4.5	4.5	5.4	6.0	6.6	7.8	8.4	8.7
Tangent	3.6	4.5	4.5	5.1	5.7	6.3	7.5	8.1	8.1

(Source: Egyptian Code, Part 3, Geometrical Design, page116)

4) Longitudinal Slope

It is recommended that the slope does not exceed 6%.

5) Acceleration and Deceleration Lanes

The major standard elements are presented in Tables A2.2-10 to A2.2-12.

Table A2.2-10 Lengths of Deceleration Lanes (Longitudinal Slope ≤2%)

Main Road Design Speed (km/hr)	Average Running Speed (km/hr)	Length in Case of Stopping (m)	Length (L) of Deceleration Lane (m)						
			Design Speed of Ramp/Loop						
			20	30	40	50	60	70	80
			Average Running Speed of Ramp/Loop (km/hr)						
			20	28	35	42	51	63	70
50	47	75	70	60	45	---	---	---	---
60	55	95	90	80	65	55	---	---	---
70	63	110	105	95	85	70	55	---	---
80	70	130	125	115	100	90	80	55	---
90	77	145	140	135	120	110	100	75	60
100	85	170	165	155	145	135	120	100	85
110	91	180	180	170	160	150	140	120	105
120	98	200	195	185	175	170	155	140	120

(Source: Egyptian Code, Part 3, Geometrical Design, page146)

Table A2.2-11 Lengths of Acceleration Lanes (Longitudinal Slope ≤2%)

Main Road Design Speed (km/hr)	Average Running Speed (km/hr)	Length in Case of Stopping (m)	Length (L) of Acceleration Lane (m)						
			Design Speed of Ramp/Loop						
			20	30	40	50	60	70	80
			Average Running Speed of Ramp/Loop (km/hr)						
			20	28	35	42	51	63	70
50	37	60	---	---	---	---	---	---	---
60	45	100	85	70	---	---	---	---	---
70	53	145	125	110	85	50	---	---	---
80	60	195	180	165	135	100	55	---	---
90	67	275	260	240	210	175	130	50	---
100	75	370	345	330	300	265	220	145	55
110	81	430	405	390	360	330	285	210	120
120	88	520	505	500	470	445	400	335	245

(Source: Egyptian Code, Part 3, Geometrical Design, page149)

Table A2.2-12 Correction Factors of Acceleration and Deceleration Lanes Due to Slope Effects

Deceleration Lanes						
Main Road Design Speed (km/hr)	Ratio of length along inclined surface to length along plane surface for turning speed (km/hr)					
	Ascending Slope 3% ~ 4%			Descending Slope 3% ~ 4%		
All Speeds	0.9			1.2		
	Ascending Slope 5% ~ 6%			Descending Slope 5% ~ 6%		
All Speeds	0.8			1.35		
Acceleration Lanes						
Main Road Design Speed (km/hr)	Ratio of Length along inclined surface to length along plane surface for turning speed (km/hr)					
	40	50	60	70	80	All Speeds
	Ascending Slope 3% ~ 4%					Descending Slope 3% ~ 4%
60	1.3	1.4	1.4	---	---	0.70
70	1.3	1.4	1.4	1.5	---	0.65
80	1.4	1.5	1.5	1.5	1.6	0.65
90	1.4	1.5	1.5	1.5	1.6	0.60
100	1.5	1.6	1.7	1.7	1.8	0.60
	Ascending Slope 5% ~ 6%					Descending Slope 5% ~ 6%
60	1.5	1.5	---	---	---	0.60
70	1.5	1.6	1.7	---	---	0.60
80	1.5	1.7	1.9	1.8	---	0.55
90	1.6	1.8	2.0	2.1	2.2	0.55
100	1.7	1.9	2.2	2.4	2.5	0.50
110	2.0	2.2	2.6	2.8	3.0	0.50
120	2.3	2.5	3.0	3.2	3.5	0.50

(Source: Egyptian Code, Part 3, Geometrical Design, pagse150 & 151)