Chapter 8

Signal and Telecommunication System

Chapter 8 Signal and Telecommunication Systems

8.1 Installation Scheme of Signal and Telecommunication

Equipment and devices of signal and telecommunication systems at present are described in the chapter 3.4 of Vol I, Master Plan Report.

Signal and telecommunication facilities for the Feasibility Study (F/S) section (Tartous – Homs – Mhine – Al-Sharqia 275km) were being used since 1982 with equipment of Type 2.

This type of signal equipment and devices were installed at the beginning of 1980, and has been used since 1982 for the section between Hamidia and Damascus (F), Homs and Tartous, Mhine and Al-Sharqui.
This type adopts a semi-automatic-block system for single line.
The track circuits (AC) are installed for all the tracks in the station area , besides for the track at the entrance/exit of the station , and the switches are handled and checked by the switch machine (AC380V) remotely from the station master's room.
Light of the signal is turned after confirmation of the train direction with related neighboring station through block equipment on the control board.
In the Type 2, main signal equipment and devices such as signal relay and track relay are installed in the centralized signal house in the stations.

Telecommunication cables (7Q1.4mm) are buried in the ground along the section. (Cable Section)
These cable lines were constructed at the early 1980's and have been used since 1982.

As for electrical power supply, the 20KV lines of the GESR from the substation of the electric power company are installed along the railway line of the F/S section and led to the transformer in the each station.
These lines have been constructed by degrees since 1976.

Replacement time of signal and telecommunication equipment and devices is schemed based on the Master Plan Report, namely it will be done by the year 2010.

Also, section improvement plan in this F/S will be put into effect based on the Master Plan Report, accordingly signal and telecommunication equipment and devices for section improvement is to be installed as the section improvement plan of the Master Plan Report.

Equipment and devices of signal and telecommunication to be installed in this plan are based on internationally recognized standards and well proven technologies.
They should be also selected carefully considering maintainability from various points.

In the installation of telecommunication cables and transmission system, there should be considered the increase of computer terminals and communication lines due to the expansion of information systems in the GESR such as freight information system, ticket reservation and vending system and other management system in the future.

Centralized supervising system of equipment and devices should be introduced to detect function deterioration and failures of signal and telecommunication equipment and to decrease chances of the equipment failures and the time of recovery.

8.2 Plan of Signal Equipment and Devices

8.2.1 Blocking Equipment

The space interval method (method of operating trains with a certain spatial distance between the trains) is to be used for blocking system.

(1) Double track section

- Samariyan – Homs 2 – Rmeli – Al Rumeila
- Al Fajwa – Al Sharqia

The indication of the signal is to be automatically controlled by the track circuits installed continuously both in the station yard area and in the inter-station section. (automatic block system)

Long track circuits with repeating equipment are to be used in the inter-station section.
A number of signals (block signal) are to be provided in the inter-station section to divide

the section into small block sections. (see Appendix 8.5.1)

(2) Single track section

- Tartous – Samariyan
- Homs 1 – Homs 2
- Rmeli – Al Fajue

Automatic block signal system for single line section is to be used, and traffic levers are installed at the stations.

In the station yard area, continuous track circuits are to be provided, where as in the inter-station section, short track circuits (CT, OT) are to be installed only at the home signals of stations to detect train going/coming.

8.2.2 Signals

Indication of color light signals is to be the same as the current system.

The planned speed of trains is to increase due to improvement of the track, level crossing, rolling stock, and others.
Accordingly, necessary visible distance of signal indication is to be planned to become longer than the present one.
In the station yard area, signals with pole and signals without pole are to be installed as they are now.
It is also necessary to examine introduction of color light signal of LED (Light Emitting Diode) with long life.

In the case of a light bulb, double filament bulb should be installed to decrease chance of entire failure of a signal bulb.

Detector of signal bulb failure is to be provided at the signals to inform its failure immediately to the CTC center/maintenance depot in charge.

In the single track sections, distant signal is to be installed at the outside of the home signal for the purpose of repeating signal aspect in the same way as the current system.

In connection with the double tracking, the signal devices such as signals, track circuits and switches in the station yards are to be modified at the time of section improvement. (see Table.8.5.1)

8.2.3 Interlocking devices

The electronic interlocking devices (computerized interlocking systems) covering the interlocking of the several stations are to be installed at the major stations and are to be connected to the signal interface relays of the each station by the optical fiber cores.
Stations in which the electronic interlocking devices are to be installed in this project are the following stations.

Tartous, Akkari, Kharbettin, Homs1, Homs2, Mhine, Al-Fajue, Al-Sharqia

In connection with section improvement such as the double tracking and newly installed signal stations, the electronic interlocking devices which are to be installed at the time of replacement (2010) are to be modified later at the time of section improvement.

8.2.4 Level crossing protection devices

Level crossing protection devices (crossing alarm, crossing gate) are to be replaced at the time of signal and telecommunication section rehabilitation.

Number of accidents at the level crossing tends to increase due to increase of traffic volume and high speed train operation.
In order to prevent accidents at the level crossing, level crossing protection devices are to be installed at the level crossings with no signal protection devices at present. (see Appendix 8)
In addition to the crossing alarm and crossing gate, warning devices to the trains are to be provided to inform the obstacle to the drivers by using manipulator at the level crossing.
In connection with the double tracking, level crossing protection devices, which are to be replaced or installed at the time of replacement (2010), are to be modified later at the time of the double tracking.
The electronic level crossing protection devices, which are gradually introduced, will be used after comparison of reliability, maintenance method, and the construction cost between the electronic type and the magnetic relay type.

8.2.5 ATS/ATP (Automatic Train Stop/Automatic Train Protection)

In order to prevent train accidents, coping with the sharp increase in traffic density, ATS/ATP (Automatic Train Stop/Automatic Train Protection) system is to be used in all the section lines.

ATS/ATP system is to be installed to prevent train collisions, which occur when judgment and action of the driver are erroneous, by stopping a train automatically before it runs into the block section indicating red signal.

And it is also to be used for the purpose of train speed restriction against the oversight of the sign on driver part in the section with a speed limit such as the turnouts and curved section.

ATS/ATP system to be adopted is comprised of the ground equipment for transmitting the stop conditions when a ground signal is indicating red or trains run at a speed over limit in the speed restriction area, and the equipment provided on the cab to read the transmitted stop condition from the ground and to give a warning to a crew and apply an emergency brake, as required.

8.2.6 CTC (Centralized Train Control)

CTC system, in which the switches and signals of the remote stations are watched and controlled from the CTC center directly, is to be installed to control and supervise efficiently train operation of the section after section lines are upgraded.

Opening of CTC operation

- Tartous – Mhine year 2015
- Al Rumeila – Al Sharqia year 2020

CTC control center of this section lines is to be located in the station yard of Homs 2.

CTC central unit, control board (or control terminal), display board (or display), train number display devices and train diagram recorder are to be provided in the CTC center.

CTC station unit and supplementary control board (it is used in the case of CTC system failure) are to be installed in remote controlled stations in which interlocking devices are located.

CTC station unit is also to be installed in the displayed stations of Tartous and Homs 2.

Tartous and Homs 2, having many signals and switches for train operation within station, are not to be controlled from the CTC center, however CTC station unit is to be installed in Tartous and Homs 2 to display indication of their some signals, train existence and other necessary information at the CTC center. (displayed station)

Fig 8.2.1 shows stations controlled from the CTC center (Homs 2) and displayed to the CTC center (Homs 2). (controlled stations and displayed stations)

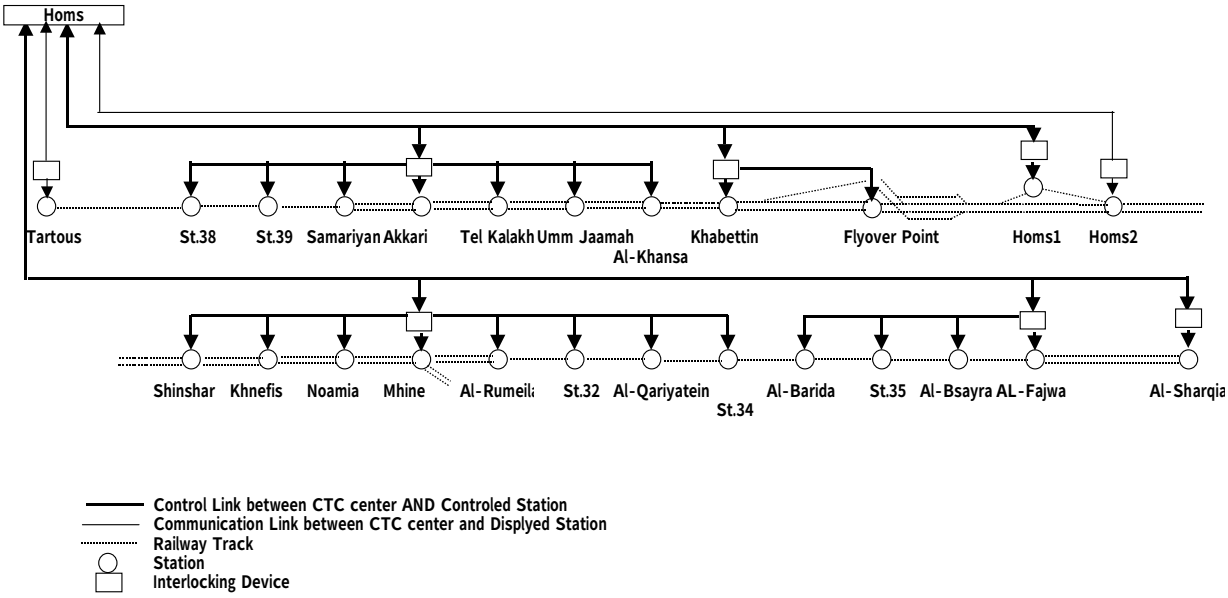


Fig 8.2.1 CTC Network

8.2.7 Centralized monitoring device

It is necessary to detect the deterioration of equipment and to replace or adjust the parts deteriorated before going into failure.

If detection of deterioration is difficult, it is inevitable to detect equipment failure and inform it immediately to the maintenance depot and repair it quickly.

For that purpose the centralized monitoring devices are to be provided in the F/S section lines.

The centralized monitoring device is to detect and inform the deterioration of various signal and telecommunication equipment along the railway lines, or to detect failures of equipment

and to inform it to the CTC center/maintenance depot to repair.

Signal bulb burnout, incorrect-lock of the electric switches, failure of level crossing protection devices, grounding of the cable cores, failure of power supply to the devices, and other signal and telecommunication equipment failures are detected and concentrated to the CTC center by this centralized monitoring device.

Information centralized through this device is utilized by computer terminal at the maintenance depots(Tartous, Homs, Mhine, Al-Sharqia) in charge.

8.3 Plan of telecommunication equipment and devices

8.3.1 Telecommunication cable

Complex optical fiber cable (2Qcu24opt) is to be installed, or optical fiber cable and metallic cable are to be installed under ground along the FS project line sections.
Telephone terminals (socket), which are connected to the metallic lines of the cable, are to be installed alongside the track.

Metallic lines in the cable are to be used for lines of the telephone terminals, lines of the centralized monitoring devices, lines of devices for detecting such disaster as falling rocks and sand pile.

Fiber cores are to be used for the train operation, management of personnel, maintenance of facilities and other basic communication network for the GESR.

Spare fiber cores could be utilized for the non-railway domestic telecommunication infrastructure of Syria.

8.3.2 Fiber optic transmission system

Multiplexer, demultiplexer and regenerator for the fiber optic transmission system are to be installed at every station.

STM-1 (155.52Mbps), interface name of SDH (Synchronous Digital Hierarchy), is to be used for the fiber optic transmission system.

8.3.3 Digital exchanger

Telephone network of the GESR is to be systematized by one numbering plan.
Digital telephone exchangers in F/S project lines are to be installed in the three stations.
(Homs, Mhine and Tartous)

8.3.4 Radio communication

Radio communication link between the train driver and stationmaster in the station area (dispatching radio communication line) is to be extended to the CTC center (Homs) when operation of section lines is to be centralized.

The fiber optic transmission system is to be used to link between the radio base station and CTC center for dispatching radio communication line.

Communication link between adjacent stations is to be replaced by the fiber optic transmission system.

Therefore, radio frequencies which are used for the radio link between adjacent stations at present are to be utilized for the communications between maintenance employee (track, signal and telecommunication) working alongside the track and relevant station/depot , or to be used in the case of accident. (train drivers could carry this radio telephone set throughout their duty)

Radio communication link used in the station yard at present is to be continued after replacement of equipment and devices.

8.4 Maintenance organization

The purpose of the maintenance of the signal and telecommunication equipment and devices is to prevent failures of equipment and to repair their failures quickly in case of trouble.

8.4.1 Basic idea of maintenance

Basic idea of maintenance is to detect deterioration of equipment by inspection and to take necessary restoration measures.
Inspection of equipment is to be conducted at regular intervals and to get necessary data.
Such data as installation date, inspection date and data, date of failure, kind of failure and repaired result are to be accumulated for equipment by equipment.
Equipment failure records and deterioration records are to be accumulated at the maintenance depot in charge
These many kinds of data are to be utilized for later inspection and restoration of later failure.

If failure occurs, equipment failures are automatically detected by centralized monitoring device or reported by such employees as station masters using signal and telecommunication devices to the CTC center, then with the order from CTC center maintenance workers are dispatched to the site promptly from the depot to make necessary repair.

8.4.2 Maintenance employees

Number of maintenance employees of the signal and telecommunication equipment and devices are to be increased, because new signal stations, double tracking and new level crossings with signal protection devices are to be constructed.

Number of maintenance employees in the FS project section lines is to be 112 by 2020 as shown in the table 8.4.1**.**
Enhancement and continuity of maintenance technique, innovation of equipment and reshuffling of personnel are to be considered in recruiting new maintenance employees.

In addition to transfer personnel from the train operation depot after training in the training center, it is necessary to recruit new graduates with much knowledge of electronics and

computer software to maintain such equipment as electronic interlocking equipment and fiber optic terminals, which are to be newly installed.

Except engineers in the head office, number of maintenance employees stationed in the depots in the FS project section lines is as follows.

- Tartous (32), Homs (40), Mhine (25), Al-Shrqia (15)

Maintenance staff is to be collectively positioned so that they can be dispatched to any site in trouble within at least one hour from a depot in charge.
In general, maintenance is conducted centering on equipment inspection by the experts of respective field pooled in the depot concerned.
Maintenance engineers are to be stationed at depot so as someone in the depot can make restoration of any equipment in trouble.

Table 8.4.1 Number of Employees

	at present (2000)	I stage 2001～2005	II stage 2006～2010	IIIstage 2011～2015	IVstage 2016～2020
Number of increase					
Rehabilitation		0	12	0	0
New signal station & Doubletrack		0	12	6	7
Number of increase(total)		0	24	6	7
Total Number of maintenance employee	75	75	99	105	112

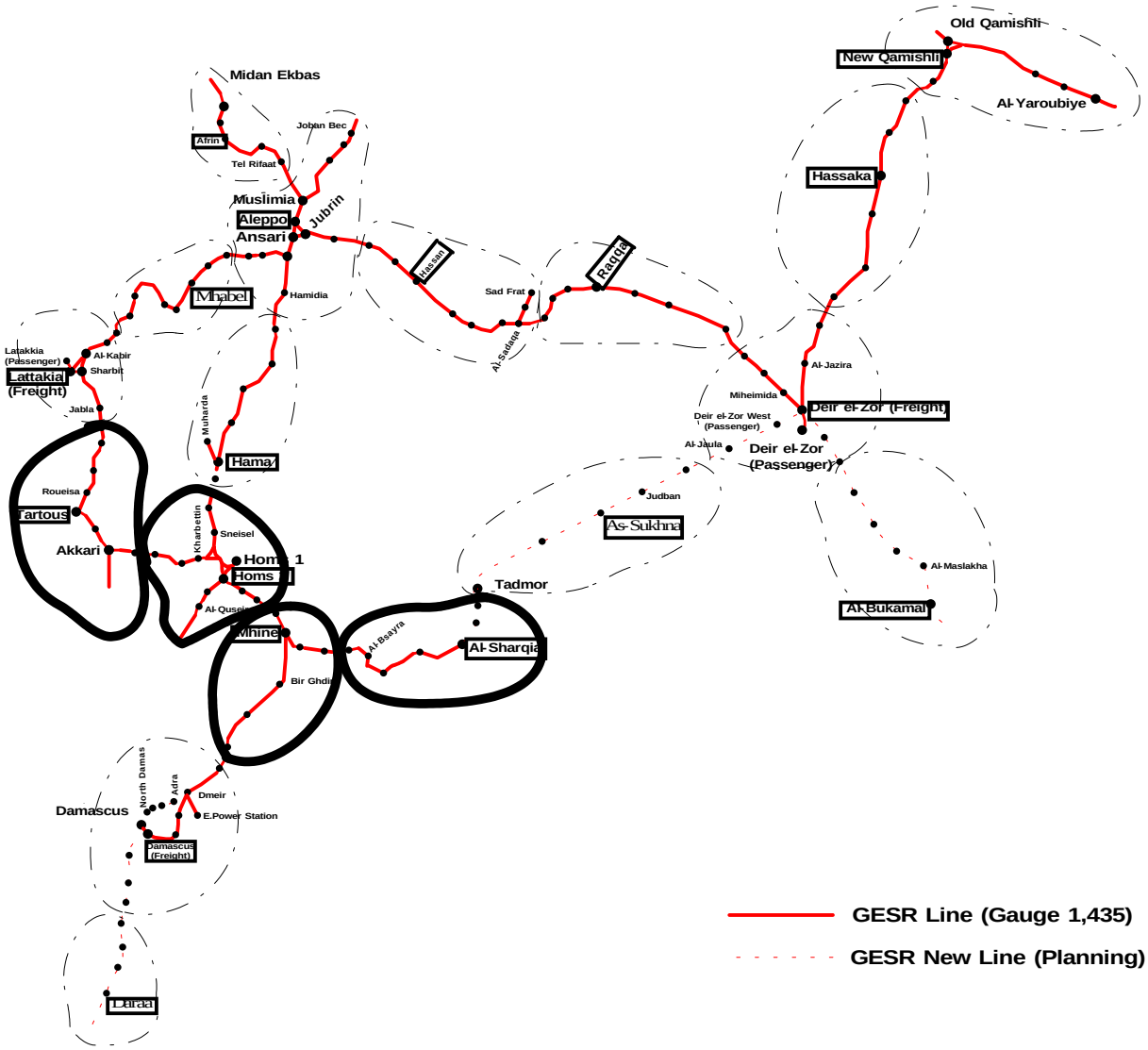


Fig 8.4.1 maintenance depot and covering area

8.5 Phased investment plan for signal and telecommunication equipment

8.5.1 Phased investment plan

Construction stage of the F/S project line sections is divided into three stages (2006 – 2010, 2011 – 2015, 2016 – 2020) in the same way as a Master Plan Report.

Table.8.5.1 shows construction time and expenses of signal and telecommunication equipment.

Table.8.5.1 Phased investment plan for signal & telecommunication equipment

(Unit:SP in million)

Item	Year / Classification	2005-2010	2010-2015	2015-2020	Remarks
Investment in replacement of equipment	Tartous-Homs2-Mhine-Al sharqia				ATS/ATP inclusive
Investment in double track	Samariyan-Akkari Akkari-Tel Kalakh Tel Kalakh-Umm Jaamah Umm Jaamah-Al Khansa Al Khansa-Kharbettin Kharbettin-Homs2 Homs2-Shinshar Shinshar-Khnefis Khnefis-Noamia Noamia-Mhine Mhine-Al Rumeila Al Fajwa-Al Sharqia				
Investment in signal station	Signal Station A Signal Station B Signal Station C Signal Station D Signal Station E				
Investment in CTC	Tartous-Homs2 (Homs2)-Mhine (Mhine)-AL Sharqia				
Construction expenses Alternative A	Foreign Currency Local Currency Personnel expenses Local currency Other expenses Total	1,416 164 0 1,580	113 15 0 128	110 15 0 125	1,639 194 0 1,833
Construction expenses Alternative B	Foreign Currency Local Currency Personnel expenses Local currency Other expenses Total	1,446 174 0 1,620	113 15 0 128	110 15 0 125	1,669 204 0 1,873

Replacement of signal and telecommunication equipment including ATS/ATP devices is schemed based on the Master Plan Report, namely it will be done by year 2010 (first stage).

Section improvement plans such as construction of signal station and construction of double track sections will be put into effect based on the Master Plan Report, accordingly installation of signal and telecommunication equipment for improvement plans is to be done at the same time as Table.8.5.1.

Therefore modification of equipment, which is to be replaced by year 2010, such as the

interlocking devices, level crossing protection devices, signals, switch machines and track circuits of station area, and telecommunication equipment, will become necessary, in constructing double track and signal station.

Accordingly construction cost of signal and telecommunication equipment includes such cost of modification of equipment.

Appendix 8.5.1 shows amount of construction expenses of signal and telecommunication equipment and devices both for Alternative A and Alternative B.

8.5.2 Comparison between Alternative A and Alternative B

As for comparison between Alternative A and Alternative B, it is not vital for decision making to compare between A and B from the view of the signal and telecommunication system. However following items can be pointed out.

- In Alternative B, it is necessary to install extra metallic cables along the new route. (around 50km)
- In Alternative B, the length of 20kv access line to the signal devices will become more than double.
- In Alternative B, it will become troublesome to maintain equipment and devices due to dispersion of equipment and devices
- In Alternative B, construction expenses will become slightly high (by 40 million S.P.)

Chapter 9

Investment Planning in Staged Development Plan

Chapter 9 Investment Planning in Staged Development Plan

9.1 Precondition for Calculating the Amount of Investment

In principle, the amount of investment is calculated on the basis of the following preconditions.

(1) In calculating the amount of investment, the price as of January 2001 is applied, and factor related to future escalation are not considered.

(2) The currency conversion rate is :

US $ 1 = ¥115 = SP 46, as of January 2001

(3) The amount of investment is divided into the local currency portion and the foreign currency portion, and both are calculated in Syrian Pound.

(4) As for the improvement and construction cost, the labor cost and material cost (including machine depreciation) are calculated for each construction work item.

(5) The Labor cost is calculated in the local currency for each construction work item.

(6) In calculating the labor cost, material and so forth, the unit prices for each kind of work are based on the data supplied by Syrian side. As for the unit prices for works which have not been conducted in Syria so far, new prices are established suitably by taking into consideration the actual results of construction works in Japan.

(7) As for the imported materials (including rolling stock) and so forth calculated in foreign currencies, CIF prices are applied by taking into consideration the actual results in the GESR.

(8) Rolling stock cost between Tartous – Homs – Mhine – Al-Sharquia is estimated by multiplying the ratio of rolling stock kilometer in this section against that in the whole CESR network by the total rolling stock cost GESR invest from 2001 to 2020.

(9) As the engineering fee, 5 % of the improvement and construction cost is earmarked.

(10) As the contingency fee, 10% of the improvement and construction cost is earmarked.

9.2 Investment Planning in the Staged Development Plan

The amount of investment by item of improvement and construction is as shown in Table 9.1.

Table 9.1.1 Investment Cost (Alternative A)

Unit : million S.P.

Items	Currency			Total
	Foreign	Local Pesonnel	Local Others	
Track and Structure				
Investment Cost	3,673	1,680	2,381	7,734
Engineering Fee (Cost×5%)	184	84	119	387
Contingency (Cost×10%)	367	168	238	773
Sub Total	4,224	1,932	2,738	8,894
Signal and Telecommunication				
Investment Cost	1,639	194	0	1,833
Engineering Fee (Cost×5%)	82	10	0	92
Contingency (Cost×10%)	164	19	0	183
Sub Total	1,885	223	0	2,108
Locomotive and Diesel Car Depot				
Investment Cost	767	225	45	1,037
Engineering Fee (Cost×5%)	38	11	2	52
Contingency (Cost×10%)	77	23	5	104
Sub total	882	259	52	1,193
Rolling Stock				
Investment Cost	14,396	1,442	157	15,995
Sub Total	14,396	1,442	157	15,995
Total				
Investment Cost	20,475	3,541	2,583	26,599
Engineering Fee (Cost×5%)	304	105	121	530
Contingency (Cost×10%)	608	210	243	1,060
Ground Total	21,387	3855.85	2,947	28,190

Table 9.1.2 Investment Cost (Alternative B)

Unit : million S.P.

Items	Currency			Total
	Foreign	Local Pesonnel	Local Others	
Track and Structure				
Investment Cost	4,433	3,232	3,818	11,483
Engineering Fee (Cost×5%)	222	162	191	574
Contingency (Cost×10%)	443	323	382	1,148
Sub Total	5,098	3,717	4,391	13,205
Signal and Telecommunication				
Investment Cost	1,669	204	0	1,873
Engineering Fee (Cost×5%)	83	10	0	94
Contingency (Cost×10%)	167	20	0	187
Sub Total	1,919	235	0	2,154
Locomotive and Diesel Car Depot				
Investment Cost	767	225	45	1,037
Engineering Fee (Cost×5%)	38	11	2	52
Contingency (Cost×10%)	77	23	5	104
Sub total	882	259	52	1,193
Rolling Stock				
Investment Cost	13,486	1,348	148	14,982
Sub Total	13,486	1,348	148	14,982
Total				
Investment Cost	20,355	5,009	4,011	29,375
Engineering Fee (Cost×5%)	343	183	193	720
Contingency (Cost×10%)	687	366	386	1,439
Ground Total	21,385	5558.15	4,590	31,534

(1) Investment cost (excluding engineering fee and contingency fee) by means of each alternative plan, each line and each item are shown in Table 9.2, Table 9.3.

Table 9.2 Investment Cost of Alternative A

Unit : million S.P.

Railway Section	Tartous ～ Homs	Homs ～ Mhine	Mhine ～ Al-Sharqia	Total
Track and Structure				
Land	93	28	10	131
Structure	1,150	347	363	1,860
Track	2,669	1,593	1,481	5,743
Sub Total	3,912	1,968	1,854	7,734
Signal and Telecommunication				
Electronics Equipment	177	134	113	424
Electrical Equipment	426	211	250	887
Cable	203	123	196	522
Sub Total	806	468	559	1,833
Locomotive and Diesel Car Depot				
Building	201	491	0	692
Machine	110	235	0	345
Sub total	311	726	0	1,037
Rolling Stock				
Locomotive	4,861	1,811	1,610	8,282
Diesel Car	551	832	221	1,604
Passengr Car	205	245	207	657
Freight Car	2,737	1,401	1,314	5,452
Sub Total	8,354	4,289	3,352	15,995
Total	13,383	7,451	5,765	26,599

Table 9.3 Investment Cost of Alternative B

Unit : million S.P.

Railway Section	Tartous ～ Homs	Homs ～ Mhine	Mhine ～ Al-Sharqia	Total
Track and Structure				
Land	280	28	10	318
Structure	4,708	347	363	5,418
Track	2,673	1,593	1,481	5,747
Sub Total	7,661	1,968	1,854	11,483
Signal and Telecommunication				
Electronics Equipment	179	134	113	426
Electrical Equipment	432	211	250	893
Cable	235	123	196	554
Sub Total	846	468	559	1,873
Locomotive and Diesel Car Depot				
Building	201	491	0	692
Machine	110	235	0	345
Sub total	311	726	0	1,037
Rolling Stock				
Locomotive	3,849	1,810	1,610	7,269
Diesel Car	551	832	221	1,604
Passengr Car	205	245	207	657
Freight Car	2,737	1,401	1,314	5,452
Sub Total	7,342	4,288	3,352	14,982
Total	16,160	7,450	5,765	29,375

Further, the improvement cost of Homs 2 and Mhine stations are included in the investment cost of between Homs 2 and Mhine section.

Also, the improvement cost of Tartous Locomotive Depot and Diesel Car depot are included in between Tartous and Homs section and the improvement cost of Homs Locomotive Depot and Diesel Car Depot are included in Homs – Mhine section.

(2) Investment Cost of Classified Foreign and Local Cost by means of each Alternative Plan, each line and each item are shown in Table 9.4, Table 9.5.

Table 9.4 Investment Cost of Classified Foreign and Local Currency for Alternative A

Unit: million S.P.

Section	Items	Structure & Track	Signal & Telecom	Depot	Rolling Stock	Total
Tartous - Homs	F/C	1,728	732	231	7,519	10,210
	L/C Personel	914	74	65	752	1,805
	L/C Others	1,270	0	15	83	1,368
	Total	3,912	806	311	8,362	13,391
Homs - Mhine	F/C	1,010	418	536	3,861	5,825
	L/C Personel	373	50	160	387	970
	L/C Others	585	0	30	41	656
	Total	1,968	468	726	4,291	7,453
Mhine - Al-Sharqia	F/C	935	489	0	3,016	4,440
	L/C Personel	393	70	0	303	766
	L/C Others	526	0	0	33	559
	Total	1,854	559	0	3,350	5,763
Ground Total	F/C	3,673	1,639	767	14,396	20,475
	L/C Personel	1,680	194	225	1,442	3,541
	L/C Others	2,381	0	45	157	2,583
	Total	7,734	1,833	1,037	15,995	26,599

Note: excluding engineering fee and contingency fee

Table 9.5 Investment Cost f Classified Foreign and Local Currency for Alternative B

Unit: million S.P.

Section	Items	Structure & Track	Signal & Telecom	Depot	Rolling Stock	Total
Tartous - Homs	F/C	2,488	762	231	6,607	10,088
	L/C Personel	2,466	84	65	661	3,276
	L/C Others	2,707	0	15	74	2,796
	Total	7,661	846	311	7,457	16,275
Homs - Mhine	F/C	1,010	418	536	3,861	5,825
	L/C Personel	373	50	160	386	969
	L/C Others	585	0	30	41	656
	Total	1,968	468	726	4,292	7,454
Mhine - Al-Sharqia	F/C	935	489	0	3,018	4,442
	L/C Personel	393	70	0	302	765
	L/C Others	526	0	0	33	559
	Total	1,854	559	0	3,350	5,763
Ground Total	F/C	4,433	1,669	767	13,486	20,355
	L/C Personel	3,232	204	225	1,349	5,010
	L/C Others	3,818	0	45	148	4,011
	Total	11,483	1,873	1,037	14,983	29,376

Note: excluding engineering fee and contingency fee

9.3 Schedule of Investment

Investment schedule starts from the year 2001 until 2005 for existing line track improvement and emphasis is placed to recover the track to the originally constructed condition in order to exert the safe and stable transportation. Also, this term is to make preparation to strengthen the transport capacity.

Investment for double tracking, establishing signal stations for strengthening transporting capacity is scheduled to start 5 years prior to the timing to become necessary.

Table 9.5 shows the investment schedule by means of each section and each item.

Table 9.5 Schedule of Investment

Railway Section	Item	2001～2005	2006～2010	2011～2015	2016～2020	Remarks
Tartous - Homs	Structure and Track					
	Signal and Telecom					
	Loco & DC Depot					
Homs - Mhine	Structure and Track					
	Signal and Telecom					
	Loco & DC Depot					
Mhine - Al-Sharqia	Structure and Track					
	Signal and Telecom					
Rolling Stock	Locomotive					
	Diesel Car					
	Passenger Car					
	Freight Car					
Improvement Cost (million SP)	Alternative					Total
	A	3,358	8,941	7,111	7,189	26,599
	B	3,358	12,271	6,925	6,821	29,375

Note : ═══ Rehabilitation
▬▬▬ Modernization
■ ■ ■ To cope with the increase of the traffic
"Improvement Cost" means the construction cost excluding engineering fee and contingency fee.

9.4. Organization for Staged Development Plan

Out of grand total length of 276km for Feasibility Study, work execution length for track addition and establishing signal station are approximately 88km between Tartous and Homs, app. 64km between Homs and Mhine and app. 32km between Mhine and Al-Sharqia respectively.

The track improvement of existing line will be completed by year 2005 and construction improvement work by the year 2010. In order to make smooth execution of short-term Urgent Project, it is deemed necessary to firmly establish the work execution organization.

It also becomes necessary to establish exclusive organ other than existing organization at Head Office of GESR and at Central Region and allocate specialists in charge.

One example of Work Execution Organization is shown in Fig.9.1

Organization Concept is as follows:

- Direction and establishment of entire improvement plan shall be enacted by the Head Office.
- Ordering construction work and contractual work shall be conducted by the Head Office.
- Construction office shall be under the direct control of the Head Office and will be the separate office from local traffic department.
- Adjustment work for construction, consultation and so forth shall be all entrusted to the Construction Office.
- Staff of construction office shall be allocated in line with the cost & detail of the work.
- Supervision staff shall be selected in making good use of construction consultant and construction corporation.
- In accordance with the jurisdiction of the construction office, supplemental staff shall be allocated.
- Daily maintenance and repair work of existing line shall be implemented by the existing organization.

- From the long-term point of view, capable members shall be allocated to bring up the succeeding engineers.

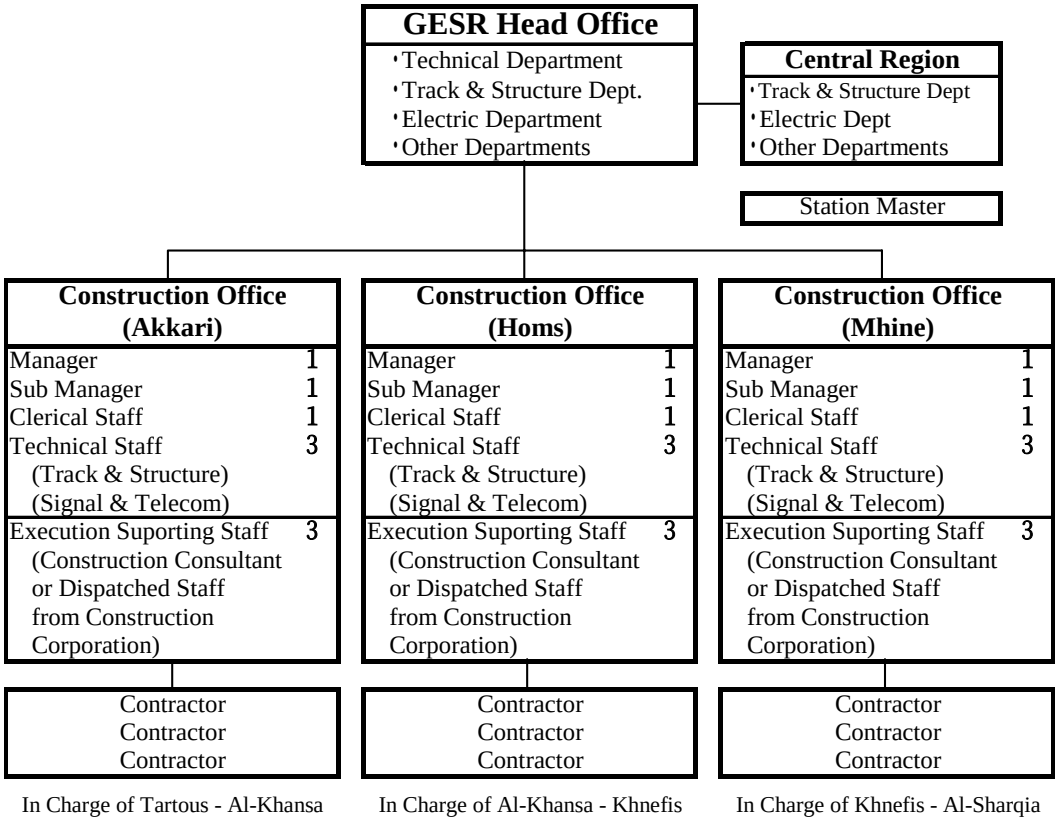


Fig.9.1 Example of Work Execution Organization

Chapter 10

Administration and Operation Plan and Business Improvement Plan

Chapter 10 Administration and Operation Plan and Business Improvement Plan

10.1 Administration and Operation Plan

10.1.1. Organization

Tartous, Homs and Al Sharqia Section belongs to Central Regional Office of GESR. After the completion of rehabilitation/modernization work, the section should be still operated under the control of Central Regional Office. Figure 10.1.1 shows the organization chart of Central Regional Office.

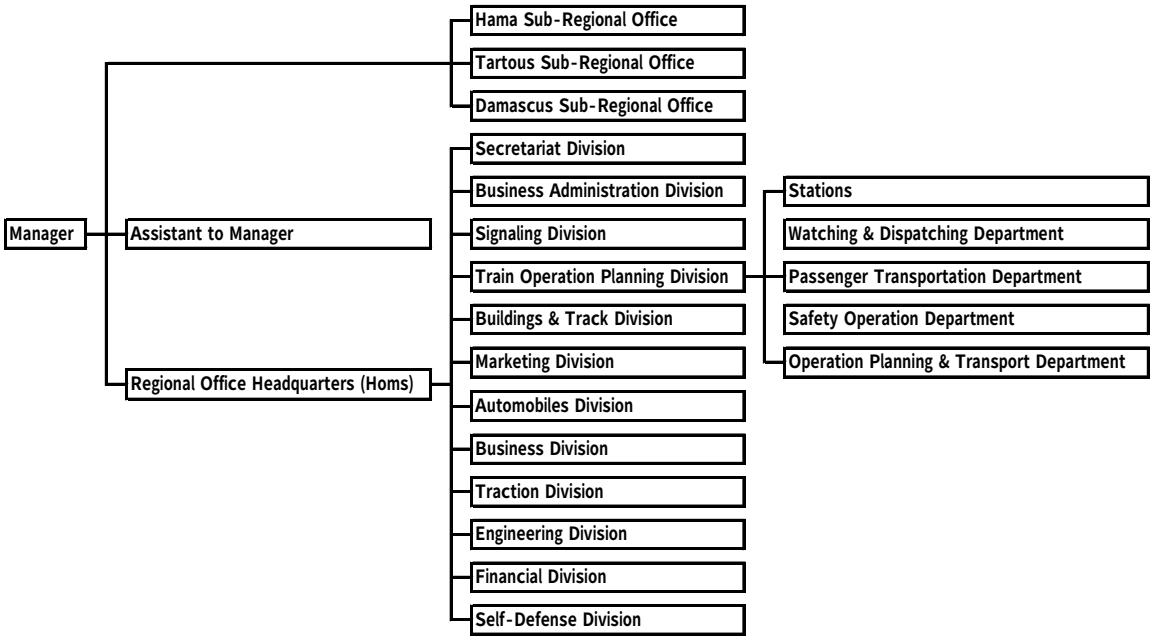


Figure 10.1.1 Organization Chart of Central Regional Office

10.1.2. Number of Personnel

(1) Car Inspection Workshops and Depots

Maintenance and inspection of rolling stock are to be concentrated to three workshops in Aleppo Area, while daily inspection and repair works are handled in various depots in all over the country. Number of personnel required for Tartous, Homs and Al Sharqia Section is calculated by following formula.

Number of Personnel for Car Inspection in the Section……P

Total Number of Personnel for Car Inspection in GESR……..T

Total car km of GESR……...G

Car km of the Section……S

$$P = T \times S / G$$

Table 10.1.1 shows total number of personnel for car inspection in GESR and the personnel plan for the Section is shown in Table 10.1.2.

Table 10.1.1 Personnel Plan of Car Inspection Workshops and Depots

Organizations	Number of Employees				
	at Present	2005	2010	2015	2020
Locomotives and Diesel Cars					
Workshop	390	420	530	770	1,150
Lattakia Depot	55	40	40	40	40
Damascus Depot	35	30	30	40	40
Tartous Depot	50	40	40	40	45
Deriel-Zor Depot	50	40	40	40	40
Qamishili Depot	45	40	40	45	55
Aleppo Depot	360	230	290	425	540
Homs Depot	70	85	105	165	215
Sub-Total	1,055	925	1,115	1,565	2,125
Coaches and Wagons					
Passenger Coach Workshop	180	125	100	60	60
Wagon Workshop	150	150	220	315	520
Jubrin Depot	125	125	180	255	425
Aleppo Depot	140	60	50	30	35
Hama Depot	30	20	25	35	50
Homs Depot	95	60	75	95	155
Damascus Depot	20	15	20	25	40
Raqqa Depot	15	15	15	20	30
Deriel-Zor Depot	25	15	20	25	40
Hasaka Depot	10	10	15	15	20
Qamishili Depot	30	25	30	40	60
Lattakia Depot	50	35	45	60	95
Tartous Depot	110	60	85	115	190
Midan Ekbas Depot	15	15	15	20	30
Sub-Total	995	730	895	1,110	1,750
Grand Total	2,050	1,655	2,010	2,675	3,875

Table 10.1.2 Personnel Plan for Car Inspection in Tartous, Homs and Al Sharqia Section

Year	Number of Employees				
	at Present	2005	2010	2015	2020
Altanative A	569	517	652	750	1,069
Altanative B	569	529	664	763	1,081

(2) Station Personnel and Train Crew

Number of Station Personnel and Train Crew for the section is shown in Table 10.1.3 and 10.1.4.

The number of drivers for the section has been calculated from the total drivers of GESR in proportion to the locomotive km and DC train km in the section to the master plan.

Number of station personnel and conductors has been calculated from the total station personnel and conductors of GESR in proportion to train km in the section to the master plan.

Table 10.1.3 Plan of Station Personnel and Train Crew (Alternative A)

Year	Number of Employees				
	at Present	2005	2010	2015	2020
Driver	90	175	235	285	325
Assistant Driver	60	0	0	0	0
Subtotal	150	175	235	285	325
Station Personnel	611	280	280	280	280
Conductor	100	100	110	135	165
Subtotal	711	380	390	415	445
Total	861	555	625	700	770

Table 10.1.4 Plan of Station Personnel and Train Crew (Alternative B)

Year	Number of Employees				
	at Present	2005	2010	2015	2020
Driver	90	155	215	245	280
Assistant Driver	60	0	0	0	0
Subtotal	150	155	215	245	280
Station Personnel	611	255	280	280	280
Conductor	100	100	110	115	170
Subtotal	711	355	390	395	450
Total	861	510	605	640	730

(3) Personnel for Track Maintenance

Number of track maintenance personnel per 1 km of route length in GESR is too many compared with JR Companies in Japan. The present number of personnel will be enough for the maintenance of the section.

(4) Personnel in Electrical Sector

As the results of replacement and improvement of signal and telecommunication equipment, number of personnel in electrical sector is assumed to increase as follows (Table 10.1.5)

Table 10.1.5 Number of Employees in Electrical Sector for Both Alternative A and B

Year	at Present	I Stage	II Stage	IIIStage	IVStage
		2001～2005	2006～2010	2011～2015	2016～2020
Number of Increase					
Rehabilitation		0	12	0	0
New Section		0	12	6	7
Total Number of Increase		0	24	6	7
Total Number of Maintenance Employee	75	75	99	105	112

*** New Section: Including New Signal Stations and Double Tracking**

Table 10.1.6 Total Personnel Plan (Alternative A)

Year	at Present	2005	2010	2015	2020
Car Inspection	569	517	652	750	1,069
Station Personnel & Train Crew	861	555	625	700	770
Track Maintenance	248	248	248	248	248
Electrical Sector	75	75	99	105	112
Total	1,753	1,395	1,624	1,803	2,199

Table 10.1.7 Total Personnel Plan (Alternative B)

Year	at Present	2005	2010	2015	2020
Car Inspection	569	529	664	763	1,081
Station Personnel & Train Crew	861	510	605	640	730
Track Maintenance	248	248	248	248	248
Electrical Sector	75	75	99	105	112
Total	1,753	1,362	1,616	1,756	2,171

10.1.3 Administration and Operating Cost

Administration and Operating Costs for the Section are calculated by using the same base units as the Master Plan. As for the base units used in the Financial Analysis of the Master Plan, please refer to Table 10.1.8.

Table 10.1.8 Base Units for Administration and Operating Costs of GESR

(Unit: Syrian Pounds)

Expense Item	Base Unit	
Personnel Cost	84,500 ／person	(Number of Employees)
Lubricant & Fuel	3.65 ／km	(Car km)
Maintenance Expenses	2.70 ／km	(Car km)
Other Operating Costs	0.053 ／passenger.ton.km	(Transport Volume)

Lubricant & fuel costs for Alternative A and B are assumed to be the same as the cost of

energy to bring up the same volume of objects to the same heights should be equal. This means that the base unit for lubricant and fuel in Alternative B is smaller (this is reasonable because of better alignment) than that in Alternative A because in Alternative B the route length is longer and the car km is bigger than Alternative A between Akkari and Al-Khansa.

Table 10.1.9 Administration and Operating Costs

(Unit: Million Syrian Pounds)

Year	2005	2010	2015	2020
Alternative A	192	647	1,164	1,818
Alternative B	191	701	1,202	1,836

10.2 Business Improvements Plan

In the Master Plan, general policies for business improvements have been described, however, along with the implementation of FS (Feasibility Study) concrete policies for the business improvements are summarized for objective section between Tartous, Homs, Mhine and Al-Sharqia.

10.2.1 Passenger Business

Regarding the passenger business improvements, a study was made to station facilities and coaches. As the representative stations, Homs (1) and Tartous stations were selected for the study.

(1) Station Facilities, General Provisions for Homs (1) Station and Tartous Station

HOMS (1) Station

Item	Status Quo	Proposed Plans
Station Facilities Waiting Lounge, Toilets etc,	The layout of platforms (0F), waiting lounge and gates (1F), and toilets (GF) is not functional for passengers' convenience. Fig.10.2.1	Passenger facilities such as waiting lounge and gates should be unified in vacated spaces of (0F), and the current (0F) and (1F) should be used for commercial facilities such as supermarkets/kiosk. Synergistic effect for gaining customers should be aimed at combined with the attraction of restaurants.
Environmental Conditions	The structure is of grandeur constructed of marble and tidily maintained.	
Notice Boards for Timetables and Fare Tables	Only notices in A4 size are posted near the ticket windows.	Large size of fare-tables and timetables to major stations of the route readily readable should be posted at upper sections of ticket windows, In addition, timetables of major trains, transfer information, a guide for the routes should be posted or provided at waiting lounge.
Connection to Bus Services	Bus stops are available aside the rotary in the station front.	Bus services connecting train departures/arrivals should be provided with bus stops in station front square

HOMS (1) Station

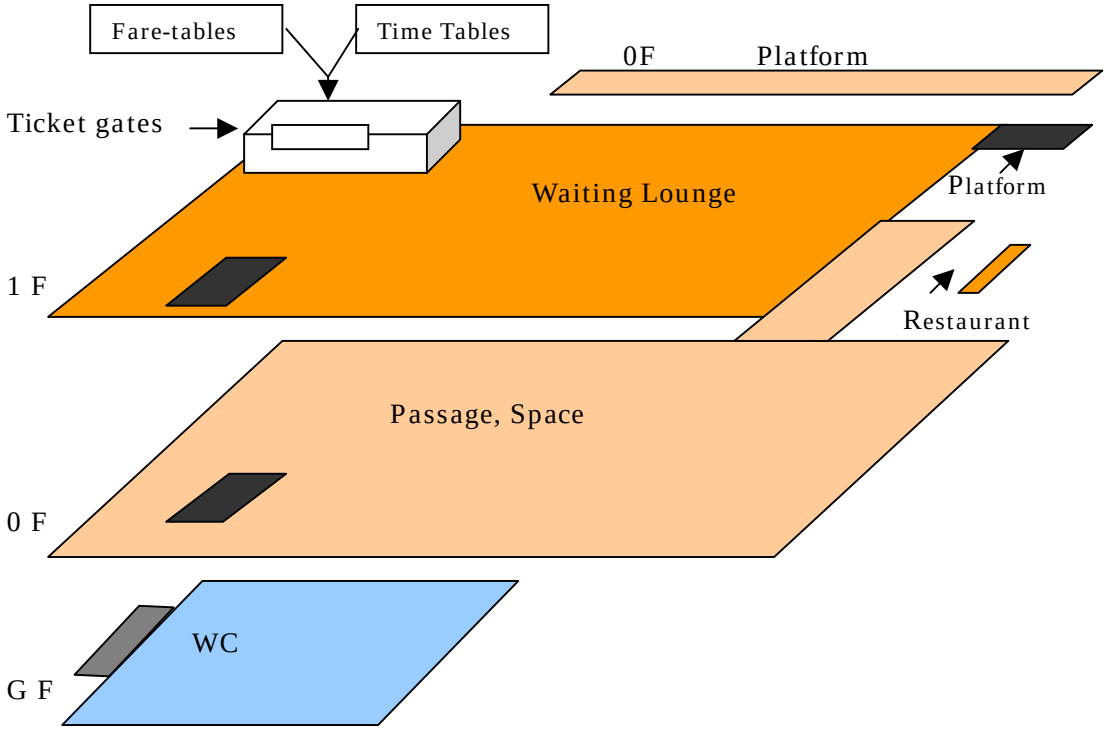


Fig.10.2.1 Existing Situation of HOMS (1) Station

Tartous Station

Item	Status Quo	Proposed Plans
Station Facilities, Waiting Lounge, Toilets and others	Gates, waiting lounge and toilets are well laid out, however, the station front square is provided with a slope because of uneven grade.	The station front is conveniently located to provide a small hotel as there are a souk (suq) market and parking for small-buses.
Environmental Conditions	Cleaning is not made, and the toilet plumbing damaged; as a whole the condition is quite inadequate.	Although, the number of passengers is less, the current conditions should be rectified as quickly as possible.
Notice Boards for Timetables and Fare Tables	The conditions are the same as those for Homs (1) station.	The proposed plans are the same as those for Homs (1) station.
Connection to Bus Services	There is no parking places for taxi and small-buses and no bus stops available in the station front plaza.	In the station-front square, taxies and small buses should be provided.

(2) Coaches

In the passenger transport, passenger comfort in the cabin is extremely essential. In view of competition with bus services in the future, an effort should be made to secure comfort ride. Although GESR has made various improvements, considerations should be given to the following aspects:

① Cleanly Conditions: Window glasses, window frames, handrails of seats are not sufficiently cleaned at present.

② Toilets: Wooden seats of western-style toilets in sleeping cars were broken. Such a condition should be rectified.

③ Air Conditioning: In the summer season, air conditioning should be turned on far earlier before passenger boarding.

④ PA System in the Cabin: As a minimum, a public address system should be made for the next station to halt.

10.2.2 Freight Business

In the freight business, phosphate ores and petroleum are core products transported in the F/S-objective sections. In particular for petroleum-related products, the arrangement of suitable contract forms and shipment system to cope with the increase of demands should be made.

(1) Comprehensive Contract Documents (See Attachment #1)

The traffic of petroleum related products are relatively in a stable condition and is applicable to a comprehensive contract. Also, if trains are either specifically designated or exclusively allocated, stabilized traffic can be secured.

(2) Freight Sales Policy (See Attachment #2)

Each freight train on a time-table is a sales products in the freight sales, and sales policy should be explored based on train diagrams.

Freight sales policy development step is shown in Attachment #2

(3) Consignor-owned wagons system

The advantage of the consignor owned wagon system is to restrain financing required to manufacture new freight wagons. In this context, tank wagons for petroleum and gas products, hopper wagons for grain transport that could be increased in the future are assumed as consignor owned wagons. However, all these consignors are Public Corporation, therefore, a measure should be studied as a part of national transport policy. This system would be an effective means for increased use of railways combined with

promotion of exclusive lines.

(4) Regularly-scheduled trains

Phosphate ore trains are generally operated as regularly scheduled trains. As for the other major commodities, there are petroleum-related products originated from HOMS, though there is no specific effort for collective shipment for respective destinations. Bulk freight for petroleum-related products collected for respective destinations should be enhanced with close cooperation from Petroleum Corporation so that train make-up work at related stations should be minimized.

For example Petroleum related products and general cargoes-train between Homs to (Deir el-Zor) and Qamishli should be studied from the above-mentioned View Point

(5) Tartous Station

1) Handling Facilities for Phosphate ores

At present, handling is carried out with the provisions of two (2) sidings and six (6) pits taking about 10 minutes per wagon. In line with the future demand increase, the work method and facilitates improvement should be reconsidered.

2) Wagon Classification Yard

The current 5,000-m track of classified yard is nearly fully occupied; the storage of wagons and modification of the transport system should be reviewed to meet the future demand.

(6) Homs (2) Station

The current 4,800-m track of classification yard is fully occupied like that of Tartous Station; the number of wagons to be handled amounts to approximately 300 wagons a day (excluding phosphate trains).

The transport system needs to be changed to enable to increase the efficiency of the work to cater for the future traffic increase.

ATTACHMENT #1

COMPREHENSIVE CONTRACT FORM (EXAMPLE)

Company "A" and Company "B" (GESR) hereby agree to conclude the Agreement hereunder with respect to the transportation of petroleum-related products. Provided that anything not contained herein shall be bound to the provisions made elsewhere as defined by Company "B".

1. Transportation Plan
   (1) Commodity: Gasoline, Light Oil, and Kerosene
   (2) Section: Between Station "C" and Station "D"
   (3) Shipment Volume: 30,000 tons/month
   (4) Period: From April 1st 2001 to September 30th, 2001.
   (5) Ways of Transportation; #151 train shall be operated between Station "C" and Station "D" and #152 train (empty) shall be dead-headed between Station "D" and Station "C".

2. Transportation Conditions
   (1) Applicable Fare (Discounted Rate)
   The discounted rate shall be 30% of the normal fare, provided that the gross tonnage exceeds more than 24,000 tons per month.
   (2) Handling Charge
   The handling charge of unloading facility of Company "A" at Station "D" shall be X **yen** per 1 kiloliter.

3. Should any ambiguity arise with respect to the implementation of this Agreement, both parties shall discuss and elucidate the matter amicably.

ATTACHMENT #2

Freight Sales Policy should be established in the following steps.

Step 1 Setting up Train Diagrams (Sales Products Development)

(1) Comprehension of Customers' Needs

Find out what customers really need with respect to: commodity, transport section, shipping period, and freight volume, fares and transport method.

(2) Recognition of Defects of Current Train Diagrams (Current Sales Products)

Recognition of punctuality of the shipment , arrival dates and times, discounted fares and the level of customer service.

(3) Development of New Train Diagrams (New sales Products)

Develop sales products that satisfy the customers' needs and improve the defects of current sales products.

⟶ New Train Diagrams suggested by Master Plan

Step 2 To Carry out Demand Forecast

(1) Master Plan level

The demand forecast should comprise the total domestic cargo distribution and the traffic share of rail-born service involved.

For carrying out demand forcast, hearings from consignors/shippers should be made to find out why they select such transport system.

(2) Short-term Plan level

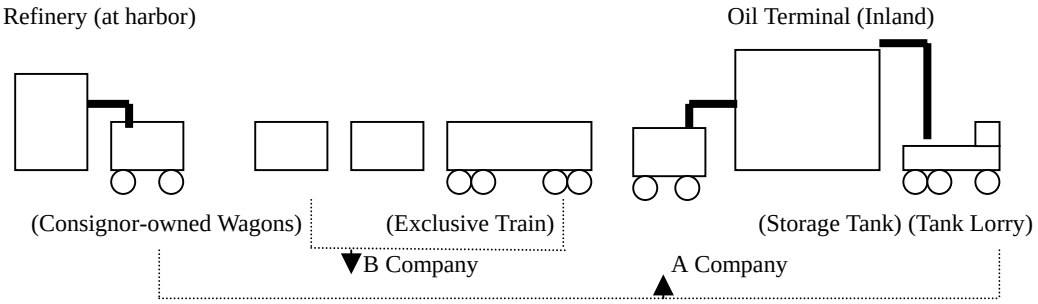
A short-term demand forecast should be prepared based on the past records considering expected socio-economic change..

Step 3 Income and Expenditure Calculation and Revision,if Necessary

Cost of new freight diagrams (products) should be calculated together with expected income in order to estimate expected profit. Product developments should be reviewed. If targeted profit is not achieved, revision of train diagram(revised sales product)should be again developed.

Example of Transport System for Petroleum-related products in Japan

The following transport system for petroleum-related product has been developed in Japan as a result of the above-mentioned step 1, 2, 3.



Chapter 11

Economic and Financial Analysis

Chapter 11 Economic and Financial Analysis

11.1 Economic Analysis

The project of this Feasibility Study (FS) is of such a large scale that 20 years are required for the completion of its construction. It is therefore unrealistic to consider that there will be no changes in the surrounding transport networks (rail and road) during the whole design and implementation period. In addition to that, the significant increase in GESR budget witnessed in recent years suggests the high possibility of realization of the Master Plan on time. Based on these considerations this economic analysis was carried out on the assumption that:

1) Railway network will be developed according to the schedule of the Master Plan, and
2) Road network will be improved according to the schedule of the national road development plan.

11.1.1 Rail Operating Unit Cost (ROUC), Vehicle Operating Unit Cost (VOUC) and Travel Time Unit Cost (TTUC)

ROUC, VOUC and TTUC of the Master Plan are applied to this Feasibility Study. Difference from the Master Plan in these costs is the existence of an extra ROUC for the freight train at the section of dual locomotive operation. Final results of ROUC, VOUC and TTUC are tabulated in Tables 11.1.1 to 4 (note: ROUC in future is shown in Table 11.1.1, while for ROUC at present, refer to Table 15.1.6 of the Master Plan, Volume I).

Table 11.1.1 Summary of ROUC (Train) (unit: SP/train km or SP/train hr)

Items/Type of the Train	Cars	Passenger Train	Freight Train	Freight Train (Dual Loco.)
ROUC subject to Distance (SP/train km)		79.08	140.41	218.95
Fuel and Lubricant		44.40	51.01	51.01
Diesel Fuel		25.47	28.30	28.30
Lubricant		18.93	22.71	22.71
Repair and Maintenance		2.74	11.50	22.40
DC	5	2.74		
LDE3200	1 (2)		10.90	21.79
Flatcars	16		0.61	0.61
Depreciation Costs		31.94	77.90	145.55
DC	5	31.94		
LDE3200	1 (2)		67.65	135.29
Flatcars	16		10.25	10.25
ROUC subject to Time (SP/train hr)		4,720.76	2,485.03	4,287.42
Depreciation Costs		281.31	145.03	257.56
DC	5	281.31		
LDE3200	1 (2)		112.52	225.05
Flatcars	16		32.51	32.51
Capital Opportunity Costs		3,150.68	1,910.41	3,170.69
DC	5	3,150.68		
LDE3200	1 (2)		1,260.27	2,520.55
Flatcars	16		650.14	650.14
Crew Cost	1 (2)	1,288.76	429.59	859.18

Table 11.1.2 Summary of VOUC

Representative Vehicles	Unit	Passenger Car	Microbus	Regular Bus	Light Truck	Heavy Truck
Make		Mazda 323	Mazda E2000	Man	Daihatsu	Mercedes
Model		2000	2000	2000	2000	2000
VOUC subject to Distance						
Speed (km/hr) 5	SP/km	5.19	1.86	17.41	2.78	13.85
10	SP/km	4.38	1.71	15.19	2.62	11.63
20	SP/km	3.99	1.64	14.11	2.55	10.56
30	SP/km	3.88	1.62	13.8	2.53	10.24
40	SP/km	3.86	1.62	13.7	2.53	10.14
50	SP/km	3.88	1.62	13.69	2.54	10.14
60	SP/km	3.92	1.64	13.75	2.55	10.19
70	SP/km	3.99	1.66	13.85	2.57	10.29
80	SP/km	4.07	1.68	13.98	2.59	10.43
90	SP/km	4.17	1.71	14.15	2.62	10.59
VOUC subject to Time	SP/hr	8.59	52.81	182.59	53.91	163.61

Table 11.1.3 Summary of TTUC (Years 2000, 2005, 2010, 2015, 2020)

Item/Year	Unit/year	2000	2005	2010	2015	2020
GDP/capita	SP/person	48,191	57,318	67,309	77,152	87,744
Index to 2000	-	1.00	1.19	1.40	1.60	1.82
Travel Time Unit Cost	SP/hr	14.5	17.2	20.2	23.2	26.4

Table 11.1.4 Freight Time Unit Costs (SP/ton/hr)

Item	Hourly Time Cost	Note
1- Crude oil	0.43829	
2- Petroleum products	0.43829	
3- Natural gas	0.99139	
4- Cement	0.39228	
5- Construction materials	0.87818	
6- Phosphate	0.10846	
7- Iron	0.67340	
8- Coal and coke	0.10846	In conformity to phosphate
9- Other minerals	0.10846	In conformity to phosphate
10- Wheat	0.98996	
11- Cereals	1.09728	
12.1- Vegetables	0.72291	
12.2- Fruit	5.04658	
13- Sugar Beet	0.14037	10% of Sugar
14- Rice	1.57193	
15- Cotton	4.14064	
16- Livestock	8.72418	
17- Animal Products	16.43593	
18- Agriculture Products	7.26608	
19- Sugar	1.40374	
20- Food Oil	3.20435	
21- Animal Fodders	1.41234	
22- Beverages	2.13663	
23- Other Food Products	0.40671	
24- Chemical Products	4.69439	
25- Metal products	3.90282	
26- Textiles and clothes	10.93954	
27- Fertilizer	0.87550	
28- Paper	2.55110	
30- Manufactured commodities	25.17220	
31- Mixed commodities	2.76144	Including house use commodities
32- Cork and wood	1.70826	

Note: MSP = Million SP in 1995 price

11.1.2 Investments and Costs

Investment costs are summarized in Tables 11.1.5 and 6. Due to the reasons described in section 15.1.5 of the Master Plan, Economic Costs are assumed to be the same as Financial Costs.

Table 11.1.5 Annual Investments Schedule and Residual Value in 2020 (Alternative A)

Investment (unit: MSP)

Year	Land	Buildings	Machinery	Comm-unication	Cables	Signals	Roadbed	Rails	Engineering	Total
2001	0	98	42	0	0	0	0	260	20	420
2002	0	99	43	0	0	0	0	264	20	426
2003	0	98	43	0	0	0	0	265	20	426
2004	0	98	42	0	0	0	0	268	20	428
2005	0	98	42	0	0	0	0	267	20	427
2006	30	41	26	65	97	152	273	525	58	1,267
2007	24	40	28	65	98	152	312	572	63	1,354
2008	15	40	27	65	98	152	292	637	65	1,391
2009	15	40	26	65	98	152	259	560	60	1,275
2010	10	40	26	67	102	152	251	539	58	1,245
2011	7	0	0	13	2	11	69	240	16	358
2012	7	0	0	13	2	11	62	241	16	352
2013	8	0	0	13	2	11	63	242	16	355
2014	6	0	0	13	2	11	59	244	16	351
2015	4	0	0	11	2	11	56	245	16	345
2016	3	0	0	8	3	14	56	92	8	184
2017	1	0	0	8	3	14	43	93	8	170
2018	0	0	0	8	2	14	12	47	4	87
2019	1	0	0	8	2	14	42	94	8	169
2020	0	0	0	9	2	16	11	48	4	90
Total	131	692	345	431	515	887	1,860	5,743	516	11,120

Residual Value Calculation

Life	Infinitive	100	40	12	30	20	100	100	In prop.	
Year	Land	Buildings	Machinery	Comm-unication	Cables	Signals	Roadbed	Rails	Engineering	Total
2001	0	50	8	0	0	0	0	134	9	201
2002	0	53	9	0	0	0	0	140	9	211
2003	0	54	10	0	0	0	0	146	9	219
2004	0	56	10	0	0	0	0	153	10	229
2005	0	58	11	0	0	0	0	158	10	237
2006	30	25	8	1	19	13	167	321	31	616
2007	24	25	9	1	21	16	198	363	36	693
2008	15	26	9	2	24	19	192	418	38	744
2009	15	27	10	3	27	22	176	381	37	698
2010	10	28	11	4	32	26	177	380	37	704
2011	7	0	0	1	1	2	50	175	11	247
2012	7	0	0	1	1	3	47	182	11	252
2013	8	0	0	2	1	3	49	189	12	264
2014	6	0	0	2	1	4	48	198	12	271
2015	4	0	0	3	1	5	47	206	13	278
2016	3	0	0	2	2	7	49	80	7	150
2017	1	0	0	3	2	8	39	84	7	144
2018	0	0	0	4	2	10	11	44	4	75
2019	1	0	0	6	2	12	41	91	8	159
2020	0	0	0	9	2	16	11	48	4	90
Total	131	403	95	45	137	165	1,301	3,889	315	6,481

Table 11.1.6 Annual Investments Schedule and Residual Value in 2020 (Alternative B)

Investment (unit: MSP)

Year	Land	Buildings	Machinery	Comm-unication	Cables	Signals	Roadbed	Rails	Engineering	Total
2001	0	98	42	0	0	0	0	260	20	420
2002	0	99	43	0	0	0	0	264	20	426
2003	0	98	43	0	0	0	0	265	20	426
2004	0	98	42	0	0	0	0	268	20	428
2005	0	98	42	0	0	0	0	267	20	427
2006	65	41	26	66	106	152	978	526	94	2,054
2007	61	40	28	66	105	153	1,023	573	99	2,148
2008	52	40	27	66	105	153	1,004	637	101	2,185
2009	52	40	26	66	105	153	973	562	96	2,073
2010	51	40	26	66	105	153	967	539	94	2,041
2011	7	0	0	13	2	11	69	240	16	358
2012	7	0	0	13	2	11	62	241	16	352
2013	8	0	0	13	2	11	63	242	16	355
2014	6	0	0	13	2	11	59	244	16	351
2015	4	0	0	11	2	11	56	245	16	345
2016	3	0	0	8	3	14	56	92	8	184
2017	1	0	0	8	3	14	43	93	8	170
2018	0	0	0	8	2	14	12	47	4	87
2019	1	0	0	8	2	14	42	94	8	169
2020	0	0	0	9	2	16	11	48	4	90
Total	318	692	345	434	548	891	5,418	5,747	696	15,089

Residual Value Calculation

Life	infinitive	100	40	12	30	20	30	100	In prop.	
Year	Land	Buildings	Machinery	Comm-Unication	Cables	Signals	Roadbed	Rails	Engineering	Total
2001	0	50	8	0	0	0	0	134	6	198
2002	0	53	9	0	0	0	0	140	7	209
2003	0	54	10	0	0	0	0	146	7	217
2004	0	56	10	0	0	0	0	153	8	227
2005	0	58	11	0	0	0	0	158	8	235
2006	65	25	8	1	21	13	190	322	40	685
2007	61	25	9	1	23	16	224	363	45	768
2008	52	26	9	2	26	19	247	418	49	848
2009	52	27	10	3	29	22	269	382	49	844
2010	51	28	11	4	33	27	300	380	51	884
2011	7	0	0	1	1	2	24	175	9	219
2012	7	0	0	1	1	3	24	182	10	228
2013	8	0	0	2	1	3	28	189	10	241
2014	6	0	0	2	1	4	29	198	11	251
2015	4	0	0	3	1	5	31	206	12	261
2016	3	0	0	2	2	7	35	80	6	136
2017	1	0	0	3	2	8	30	84	7	135
2018	0	0	0	4	2	10	9	44	4	73
2019	1	0	0	6	2	12	37	91	8	156
2020	0	0	0	9	2	16	11	48	4	90
Total	318	403	95	45	145	166	1,491	3,892	352	6,905

As for administration and maintenance costs, difference of administration costs due to the installment of this Feasibility Study Project is to be zero (negligible if any) because of the nature of this project (improvement). Difference of maintenance costs due to the difference of

running km is calculated applying the empirical formula; maintenance costs of tracks and communication lines in MSP = passenger-ton km / year x 0.096 / 1,000,000. Needless to say Alternatives A and B need different maintenance costs because of the different values of person-ton-km they have. These differences, however, are less than one million Syrian Pounds a year. That is the reason why only one cost sequence is shown in Table 11.1.7.

Table 11.1.7 Difference in Administration and Maintenance Costs between With-F/S Project (Master Plan, Alternatives A and B) and Without-F/S Project

(unit: MSP)

Year	Difference in number of Employees (exc. Crew)	Difference in Salary (MSP/year)	Other Operating Exp. (MSP/year)	Difference of AOC (MSP/year)
2000	0	0	0	0
2001	5	0	0	0
2002	10	1	0	1
2003	14	1	0	1
2004	19	2	0	2
2005	24	2	0	2
2006	20	2	0	2
2007	17	1	0	1
2008	13	1	0	1
2009	10	1	0	0
2010	6	1	-1	0
2011	6	1	0	0
2012	6	1	0	1
2013	7	1	1	1
2014	7	1	1	2
2015	7	1	2	2
2016	240	20	3	23
2017	473	40	4	44
2018	706	60	5	65
2019	939	79	6	85
2020	1,172	99	7	106

11.1.3 Benefits

VOC, ROC and TTC savings contribute to the benefit of the railway improvement. These savings, needless to say, result from traffic assignment conditions. Figures related to benefits are summarized in Table 11.1.8 (Note: No substitute project to satisfy demand increase due to “without F/S improvement” is considered).

Table 11.1.8 Benefits of Alternative A and B (unit: MSP/year)

Item	With-case		Without-case Network	Alternative A Benefit	Alternative B Benefit
	Alternative A Network	Alternative B Network			
2005					
VOC sum	54,165	54,165	54,165	0	0
VOC km	43,929	43,929	43,929	0	0
VOC hour	10,236	10,236	10,236	0	0
ROC sum	2,047	2,047	2,047	0	0
ROC km	1,283	1,283	1,283	0	0
ROC hour	764	764	764	0	0
TTC sum	6,014	6,014	6,014	0	0
TTC Pass.	3,451	3,451	3,451	0	0
TTC Freight	2,563	2,563	2,563	0	0
Total	62,226	62,226	62,226	0	0
2010					
VOC sum	76,581	76,581	79,909	3,328	3,328
VOC km	61,654	61,654	65,254	3,600	3,600
VOC hour	14,926	14,926	14,655	-271	-271
ROC sum	3,173	3,083	1,637	-1,536	-1,446
ROC km	2,056	1,988	967	-1,089	-1,021
ROC hour	1,117	1,096	670	-446	-425
TTC sum	6,875	6,874	7,218	343	344
TTC Pass.	4,974	4,974	4,986	12	12
TTC Freight	1,902	1,900	2,231	329	332
Total	86,629	86,538	88,763	2,135	2,226
2015					
VOC sum	113,226	113,226	120,071	6,845	6,845
VOC km	90,433	90,433	97,849	7,416	7,416
VOC hour	22,792	22,792	22,221	-571	-571
ROC sum	5,383	5,086	2,241	-3,142	-2,846
ROC km	3,566	3,351	1,342	-2,224	-2,009
ROC hour	1,817	1,735	899	-919	-837
TTC sum	9,987	9,959	10,400	412	441
TTC Pass.	7,327	7,327	7,369	42	42
TTC Freight	2,660	2,632	3,030	370	398
Total	128,596	128,270	132,711	4,115	4,441
2020					
VOC sum	168,097	168,097	180,852	12,754	12,755
VOC km	133,422	133,422	147,144	13,722	13,722
VOC hour	34,675	34,675	33,708	-967	-967
ROC sum	8,629	7,705	2,939	-5,690	-4,766
ROC km	5,853	5,222	1,904	-3,949	-3,319
ROC hour	2,777	2,483	1,036	-1,741	-1,447
TTC sum	15,212	15,024	15,323	111	299
TTC Pass.	10,984	10,984	11,037	53	53
TTC Freight	4,229	4,040	4,287	58	246
Total	191,939	190,826	199,114	7,175	8,288

11.1.4 Economic Analysis

Based on the figures obtained in Sections 11.1.2 and 11.1.3, EIRR, NPV and B/C are calculated as shown in Tables 11.1.9 and 10. EIRR of 20.5% (Alternative A) or 18.2% (Alternative B) is higher than the EIRR of the Master Plan by 3.4 - 0.8% points. This indicates the economic importance of this project, especially in the case of Alternative A.

Table 11.1.9 Economic IRR, NPV, B/C for Alternative A (unit: MSP)

Year	Initial Invest.	Diff. of Maint. C.	Costs Total	Benefit	B-C	Discounted Values		
						Cost	Benefit	B-C
2001	420	1	421	0	-421	421	0	-421
2002	426	0	426	0	-426	380	0	-380
2003	426	1	427	0	-427	340	0	-340
2004	428	2	430	0	-430	306	0	-306
2005	427	2	429	0	-429	273	0	-273
2006	1,649	1	1,650	0	-1,650	936	0	-936
2007	1,725	2	1,727	0	-1,727	875	0	-875
2008	1,639	1	1,640	0	-1,640	742	0	-742
2009	1,713	1	1,714	0	-1,714	692	0	-692
2010	1,629	0	1,629	2377	748	587	857	270
2011	124	1	125	2804	2,679	40	903	863
2012	35	1	36	3231	3,195	10	929	919
2013	35	1	36	3658	3,621	9	939	930
2014	35	2	37	4085	4,047	9	936	928
2015	35	2	37	4512	4,475	8	923	916
2016	29	23	52	5160	5,109	9	943	933
2017	118	44	162	5808	5,647	26	947	921
2018	162	65	227	6456	6,230	33	940	907
2019	49	86	135	7104	6,970	17	924	906
2020	22	106	128	7752	7,625	15	900	885
R.V.	8,299			8299	8,299	0	964	964
Total						5,730	11,105	5,374
IRR: 20.5%		B/C: 1.94		NPV: 5,374		MSP under Discount Rate		12%

Note:R.V.=Residual Value

Table 11.1.10 Economic IRR, NPV, B/C of Alternative B (unit: MSP)

Year	Initial Invest.	Diff. of Maint. C.	Costs Total	Benefit	B-C	Discounted Values		
						Cost	Benefit	B-C
2001	420	1	421	0	-421	421	0	-421
2002	426	0	426	0	-426	380	0	-380
2003	426	1	427	0	-427	340	0	-340
2004	428	2	430	0	-430	306	0	-306
2005	427	2	429	0	-429	273	0	-273
2006	2,434	1	2,435	0	-2,435	1,382	0	-1,382
2007	2,520	2	2,522	0	-2,522	1,278	0	-1,278
2008	2,435	1	2,436	0	-2,436	1,102	0	-1,102
2009	2,513	1	2,514	0	-2,514	1,015	0	-1,015
2010	2,424	0	2,424	2455	31	874	885	11
2011	132	1	133	2926	2,793	43	942	899
2012	41	1	42	3397	3,355	12	976	964
2013	41	1	42	3867	3,826	11	993	982
2014	41	2	43	4338	4,296	10	994	984
2015	45	2	47	4809	4,762	10	984	974
2016	29	23	52	5609	5,557	10	1,025	1,015
2017	117	44	161	6409	6,248	26	1,045	1,019
2018	162	65	227	7209	6,982	33	1,050	1,017
2019	49	86	135	8008	7,873	18	1,041	1,024
2020	22	106	128	8808	8,680	15	1,023	1,008
R.V.	10,796			10796	10,796	0	1,254	1,254
Total						7,557	12,212	4,655
IRR: 18.2%		B/C: 1.62		NPV: 4,655		MSP under Discount Rate		12%

Note:R.V.=Residual Value

In order to evaluate the economic viability of this project, sensitivity analysis was carried out. The results are shown in Tables 11.1.11 and 12. The results show that this project is economically viable up to a cost increase of 1.8 times or a decrease in benefits of 40% in case of Alternative A, and a cost increase of 1.5 times or a decrease in benefits of 30% in case of Alternative B. These figures assure that the economic viability of this project is definitely not vulnerable.

Table 11.1.11 Sensitivity Analysis Results (Alternative A)

Benefit / Cost	1	0.95	0.90	0.80	0.70	0.60	0.50
1	20.5	19.8	19.2	17.7	16.1	14.4	12.4
1.05	19.8	19.2	18.5	17.1	15.5	13.8	11.8
1.1	19.2	18.6	17.9	16.5	14.9	13.2	11.3
1.2	18.0	17.4	16.7	15.3	13.8	12.1	10.3
1.4	16.0	15.4	14.8	13.4	11.9	10.3	8.5
1.6	14.3	13.7	13.1	11.7	10.3	8.7	7.0
1.8	12.8	12.2	11.6	10.3	8.9	7.3	5.6

Table 11.1.12 Sensitivity Analysis Results (Alternative B)

Benefit / Cost	1	0.95	0.90	0.80	0.70	0.60
1	18.2	17.5	16.8	15.4	13.9	12.2
1.05	17.5	16.9	16.2	14.8	13.3	11.6
1.1	16.9	16.2	15.6	14.2	12.7	11.1
1.2	15.7	15.1	14.4	13.1	11.6	10.0
1.4	13.7	13.1	12.5	11.2	9.7	8.2
1.6	12.0	11.4	10.8	9.5	8.2	6.7

11.2 Financial Analysis

11.2.1 Objectives and Method of Analysis

In this financial analysis two alternatives (Alternative A and B) are compared. The purpose of the analysis is to verify which one is more profitable and can contribute to improvement of financial standings of GESR. Financial Internal Rate of Return (FIRR) is used as index for the analysis.

11.2.2 Main Prerequisites

In principle the same prerequisites are applied as in the financial analysis on the master plan.

(1) Period of Analysis (Project Life)

The evaluation of the project is made for 40 years from 2001 to 2040.

(2) Demand Forecast

Demand forecast has been made until 2020. After that the traffic demand is assumed to keep the same level.

(3) Inflation

Inflation is disregarded in the analysis.

(4) Revenue

1) Fare Revenue

Fare revenue is calculated by multiplying unit fare price by the increase of the transport volume.

Unit fare prices per kilometer are as follows.

Freight: Syrian Pounds 0.8869/ton

Passenger: Syrian Pounds 0.1755/person

2) Miscellaneous Revenue

Miscellaneous revenue is assumed to be 3% of the fare revenue.

(5) Investment Cost

Investment cost is indicated in market price.

(6) Depreciation

GESR's rule provides that depreciation of fixed assets should be made by straight-line method and yearly depreciation (percentage on purchase price) is established for various kinds of equipments.

In this analysis, however, all assets are assumed to be used to the end of their physical durable years, taking the present situation of GESR into consideration. In that case, depreciation is continued after the amount of the purchase price is fully accumulated, but the rate of depreciation per year is reduced to half according to the rule established by Ministry of Finance. Facilities for signal and telecommunication to be introduced in this project are mostly of new type making use of the latest technology. Therefore referring to JR's rule in Japan, appropriate rates of depreciation and durable years are set.

Table 11.2.1 shows the percentage of yearly depreciation and the physical durable years.

Table 11.2.1 Rates of Depreciation & Durable Years of Fixed Assets

Item	Rate of Depreciation per Year		Physical Durable Years
	Up to 100% of Purchase Price	Over 100% of Purchase Price	
Buildings & Structures	2%	1%	100 years
Machinery & Equipment	5%	2.5%	40 years
Rolling Stock			
Locomotives & Diesel Cars	7%	3.5%	28 years
Coaches, Wagons & Tankers	4%	2%	50 years
Signals & Telecommunications			
Computors & Electric Equipment	8.33%		12 years
Signals & Warnings for Crossing ets.	5%		20 years
Cables	3.33%		30 years

(7) Fund Raising

1) Financing in Foreign Currency

In this analysis foreign currency portion of the initial investment cost of the project is assumed to be financed by one of the following two types of loans from international or overseas financial institution.

It has been confirmed by the lending institutions concerned that the following terms and conditions are applicable to Syria.

① Loan Condition 1

Interest: 2.2% p.a.

Grace: 10 years

Repayment: 30 years semiannual equal installment

② Loan Condition 2

Interest: 0.75% p.a.

Grace: 10 years

Repayment: 35 years from 11^{th} to 20^{th} year: 2.5% of total loan amount per year

from 21^{st} to 35^{th} year: 5% of total loan amount per year

2) Financing in Local Currency

The balance of the investment cost is covered by funds in local currency. It is assumed that Syrian Government will pay the total amount of local funds as equity.

11.2.2 The Results of the Analysis

(1) Financial Internal Rate of Return (FIRR)

The results of the analysis for the base case are in Appendix 11-2-3~6. Appendix 11-2-1~2 show the investment cost of both Alternative A and B for each year during the project life including the reinvestment after the useful life. In addition to the base case the sensitivity analysis is made for the following five cases. In sensitivity analysis, the project is verified whether it is bearable to unfavorable fluctuation of uncertain and variable data, for example investment cost and revenue etc.

Case 1: 5% Increase of Total Investment Cost

Case 2: 10% Increase of Total Investment Cost

Case 3: 5% Decrease of Total Revenue

Case 4: 10% Decrease of Total Revenue

Case 5: 10% Increase of Total Investment Cost and 10% Decrease of Total Revenue

Main indices of the analysis including FIRR are shown in Table 11.2.2~3.

Table 11.2.2 Main Indices of Financial Analysis (Alternative A)

(Unit: Million Syrian Pounds)

Case	Loan Condition	FIRR		Local Funds (Cumulative)
		ROI	ROE	
Base Case	1	7.3%	23.0%	1,166
	2		32.5%	721
Investment 5% up	1	6.8%	20.7%	1,408
	2		29.7%	895
Investment 10% up	1	6.4%	18.6%	1,669
	2		27.3%	1,091
Revenue 5% down	1	6.7%	19.8%	1,411
	2		28.7%	909
Revenue 10% down	1	6.0%	16.8%	1,676
	2		25.3%	1,118
Investment 10% up Revenue 10% down	1	5.1%	13.3%	2,199
	2		21.6%	1,539

Table 11.2.3 Main Indices of Financial Analysis (Alternative B)

(Unit: Million Syrian Pounds)

Case	Loan Condition	FIRR		Local Funds (Cumulative)
		ROI	ROE	
Base Case	1	6.1%	12.5%	4,589
	2		17.5%	3,967
Investment 5% up	1	5.6%	11.3%	5,023
	2		16.2%	4,370
Investment 10% up	1	5.3%	10.3%	5,456
	2		15.1%	4,772
Revenue 5% down	1	5.5%	10.9%	4,854
	2		15.8%	4,232
Revenue 10% down	1	4.9%	9.3%	5,119
	2		14.1%	4,497
Investment 10% up Revenue 10% down	1	4.1%	7.4%	5,985
	2		12.1%	5,301

In the base case and every case of sensitivity analyses, Alternative A shows higher FIRR than Alternative B. Even in the worst case (Investment 10% up and revenue 10% down in Alternative B), FIRR is 4.1% that is higher than interest rate of loan condition 1 and 2. This means that both Alternative A and B are feasible, but Alternative A is more recommendable than Alternative B in view of higher FIRR. It is difficult to give priority to Alternative B unless drastic cut of investment cost has been realized.

(2) Profitability

The profit and loss accounts of the Project show surplus from the first year (2001) even in the worst case.

(3) Cash Flow

The amount of funds in local currency required for the project range from 721 (the base case of Alternative A, Loan Condition 2) to 5,985 million Syrian Pounds (Alternative B, Investment 10% up and Revenue 10% down, Loan Condition 1). In all cases the peak years of local currency funds requirement are from 2006 to 2008. As from 2011 no additional funds are required. Even in the worst case the maximum amount of local funds in the peak years is about 1,224 million Syrian Pounds that is within the limit of Government budget for railway. The rehabilitation/Modernization of Tartous, Homs and Al Sharqia Section is considered to have high priority to allotment of the funds for railway improvement.

(4) Evaluation and Recommendation

FIRR (ROI) of Alternative A and Alternative B are 7.3% and 6.1 % respectively. In the worst case of the sensitivity analysis (investment 10% up and revenue 10% down) they are 5.1% and 4.1%. This means that both alternatives are feasible provided that foreign currency portion of the investment cost is covered by long-term loan with interest of 2.2% or 0.75% assumed in this analysis and local currency portion is covered by equity from the Government. In the base case and every case of sensitivity analysis, Alternative A shows higher FIRR than Alternative B. It is difficult to take up Alternative B instead of Alternative A without drastic cut of the investment cost.

Chapter 12

Environmental Impact Assessment

Chapter 12 Environmental Impact Assessment

12.1 Assessment Process

The subject of this assessment is the project for "Rehabilitation/Modernization of the Tartous – Homs – Al-Sharqia Railway Section". For one section of the route, two alternatives are considered. The objective is to determine the potential environmental impacts that may be generated from the project construction and operation. This assessment is a first step towards implementing a comprehensive assessment, which should be completed at the time of detailed design of the project.

The project description and the need for the project have already been described elsewhere in this report. This chapter shall outline the environmental conditions within the project area in section 12.2 and determine the potential impacts on the environment in section 12.3. Section 12.4 summarizes the evaluation result, and the further studies are discussed in section 12.5.

12.2 Environmental Setting

12.2.1 Project Location and Topography

(1) Location

The project route runs through two governorates; Tartous and Homs and links the seaport city of Tartous with Homs city, which is midway between Damascus and Aleppo. Figure 12.2.1 shows the project route and major cities and towns along it.

(2) Topography

The ground level of the existing railway route increases from sea level at Tartous to about 740 meters above sea level at Al-Sharqia. There is a sharp increase in the Samariyan – Al-Khansa section (about 60 km length) reaching an altitude of about 510 m. From Al-Khansa to Mhine (about 75 km) there is an increase of around 400 meters (altitude at Mhine 913 m). The altitude then steadily falls, reaching around 740 m at Al-Sharqia.

12.2.2 Physical Environment

(1) Geology, Soils and Minerals

The route passes through two zones of *Grumusol* (dark brown and red soils) at the feet of the mountains; the first zone from Tartous to Tel Kalakh and the second west of Homs and extending to Mhine. The area in between from Tel Kalakh to west of Homs is a *Cinnamonis* (yellowish-brown soils) soil zone. From Mhine eastwards the route passes through *Desert soil* zone.

This route serves the two major phosphate mines in Khneefis and Al-Sharqia. Sands at Al-Rumeila, west of Khnefis are used in the glass industry.

(2) Climate

The route passes through the four geographic zones characterizing the country. The climatic conditions closely follow these zones. The Mediterranean Sea climate generally prevails; rainy winter and dry and hot summer separated by two short transitional seasons. A general description of the climatic conditions is given in the Appendix (Table App. 12.2.1) and the data recorded at three stations of Lattakia, Homs and Tadmor representing the project route for 1999 are also indicated.

(3) Water resources

Figure 12.2.2 shows the water resources in the Study area. These are mainly rainfall and groundwater. The zones (upper side of the route) indicate the rainfall amounts and the basins (lower side) show the groundwater conditions. Rainfall intensities are over 350 mm annual in the First Zone, around 250 mm in the Third Zone, between 200 – 250 mm in the Fourth Zone and small rainfall amounts in the Fifth Zone, the desert.

In terms of groundwater only the Orontes Basin is fed by external sources (surface water) while the other two basins are fed by rain and snowfall.

(4) Air quality

There is no continuous air-monitoring program in the project site or anywhere else in Syria. This is an ongoing concern of the Ministry of Environment and strong efforts are being made to introduce such a program. Data was collected from various materials available at the ministry and the results are shown in Table 12.2.1 for Homs and Tartous

cities. Although various industries are affecting air quality, the main source of air pollutants, according to a study by the Ministry of Environment in 1998, is from road vehicles emissions.

Table 12.2.1 Air Quality in Tartous and Homs

Pollutant	Tartous	Homs
1) Nitrogen dioxide (NOx)	Oil refinery important source of this problem.	In 1995, measurement of 0.152 ppm recorded near fertilizer plant (standard 0.1).
% Vehicle emissions	*91%*	*97%*
2) Sulphur dioxide (SO_2)	Estimated to be double permissible standards	
% Vehicle emissions	*91%*	*97%*
3) Carbon monoxide (CO)	1995 monitoring results show urban concentrations of 2 – 12 ppm for average 8 hrs (9 permissible)	
% Vehicle emissions	*99%*	*100%*
4) Suspended particulate matter (TSP)	(1994 data) City center: 875 mg/m3 Seaside: 160 mg/m3 Port: 711 mg/m3	(1992 data) 160 – 209 mg/m3 (150 mg/m3 permissible)
% Vehicle emissions	*52%*	*93%*

12.2.3 Protected Ecological Areas

Along the coastal area stretching from Lattakia in the north, southwards to Tartous and the Syrian – Lebanese border some thirty sites have been identified as worthy of protection, these include sand dunes, cliffs, and river mouths estuaries (Seven Water Basins of Syria Report, 1998). It is however safe to assume that these sites are not in the vicinity of the project area which is more inland, although more detailed check on the exact locations of the sites is required. Wildlife is also endangered in this region because of the rapid human development there. The protected forest area of Baqsia is located southwest of Akkari station.

Al Mastoura Mountain protected area is located north of the railway line between Tel Kalakh and Umm Jaamah stations. Some tree species in these mountains are in danger of extinction because of excessive logging and agriculture activities.

For the remaining portion of the route to Al-Sharqia there appear to be no designated protected areas or endangered species.

12.2.4 Human Resources

(1) Demography

Population data are published on the governorate level. In 1999 Homs and Tartous Gov-

ernorates populations were 1,619,000 and 787,000 persons respectively. The total Syrian population was 17,938,000 (data from Statistical Abstract, 2000). The Ministry of Environment Report estimates the population in the two largest cities in both governorates to be 85,000 for Tartous city and 571,100 for Homs city (1998). Although there is no officially published figure, Al-Qariyatein city southeast of Hom, has an estimated population of 25,200 (same source).

In terms of populated areas along the route it is safe to say that the section from Tartous to Homs is continuously populated while that from Homs to Al-Sharqia is sparsely populated at the towns along the route. These towns are Shinshar, Shayarat, Hawarin, Al-Qariyatein, Al-Bsayra, Khnefis and Al-Sharqia. The last one is mining town and populated mainly by the workers in the phosphate companies.

Again along the Homs – Al-Sharqia section Bedouin camps are observed but figures for their numbers are not available.

(2) Land use

The land use activity along the project route is shown in Figures 12.2.3, 4 and 5. The route is divided into 5 sections and the land use along each section, in terms of percentage and kilometer.run (land use along the length of the route) are shown in Table 12.2.2.

Table 12.2.2 Land use along Project Route

Section		Dist. (km)	Ur-ban	Scattered housing	Agric./ GH	Agric-ulture	Green/ pasture	Desert/ steppe	Ind-ustry
From	To								
A. Shares in Kilometer.run									
Tartous port	Akkari	41.4	3.3	5.8	31.5	0.0	0.0	0.0	0.8
Akkari	Al-Khansa	39.4	0.4	2.8	4.7	12.6	18.9	0.0	0.0
Al-Khansa	Homs 2	24.6	0.4	3.2	0.0	18.4	1.7	0.0	0.7
Homs 2	Mhine	63.7	0.7	4.5	0.0	12.1	21.0	23.6	1.9
Mhine	Al-Sharqia	110.9	0.0	2.2	0.0	0.0	0.0	108.7	0.0
B. Shares in Percent of total route length									
Tartous	Akkari	41.4	8%	14%	76%	0%	0%	0%	2%
Akkari	Al-Khansa	39.4	1%	7%	12%	32%	48%	0%	0%
Al-Khansa	Homs 2	24.6	2%	13%	0%	75%	7%	0%	3%
Homs 2	Mhine	63.7	1%	7%	0%	19%	33%	37%	3%
Mhine	Al-Sharqia	110.9	0%	2%	0%	0%	0%	98%	0%
Total		280	2%	6%	14%	16%	15%	45%	1%
Note:	Agriculture activity is sub-divided into three sections; Agric./GH (Agriculture mixed with green house cultivation), Agriculture (land cultivation for more than one season annually, main crops are cereals, vegetables and fruits), and Green/pasture (uncultivated agriculture lands, pastures for animal grazing and green areas such as small forests).								

In total agriculture activities account for just less than 50% of the land use along the route and 83% along the fertile areas from Tartous to Homs. In this respect the agriculture importance of the route is reflected. Desert/steppes dominate the route from Mhine to Al-Sharqia. Bedouin tribes are observed in these areas raising sheep on the steppes.

This land use pattern reflects the economic activities along the route. Agriculture activity is wide spread along the coastal area up to Akkari. Greenhouses have multiplied there as more farmers resort to full year cultivation. The section between Akkari and Al-Khansa is mountainous and there are green areas, pastures and scenic locations. From Al-Khansa to Homs and southwards to Shinshar Sta. agriculture activity is dominant with industrial areas located at the Homs entrance. From Shinshar to south of Khnefis sta. the activity is mainly seasonal agriculture and pastures for sheep raising. Continuing eastwards the desert nature of the land restricts the economic activity to some sheep breeding by Bedouins and mining works, mainly for phosphates. There are two large mines, one near Al Fajiwa Sta. and the second at Al-Sharqia.

(3) Cultural and historic assets

Figure 12.2.6 shows the locations of historic landmarks and ongoing excavations along the project route. The ongoing excavations near to the route at Amrit, Tel Kazel, Rehaniyeh and Dirdghan may reveal new findings of archeological importance, which would ef-

fect any future construction within the sphere of the excavation site.

12.2.5 Environmental Regulations, Institutions and Issues

(1) Regulations and Institutions

Regulations and institutions related to the environment have been discussed in the master plan report. It is sufficient to repeat here that to date the Draft Law on the Protection of the Environment is still in the discussion stage and it is not clear when it will be enacted. The Draft Law specifies the need for environmental impact assessment but does not specify the types of projects requiring the assessment or the contents of the assessment.

As the draft law now stands, it would be the responsibility of GESR, as the project developer to implement the assessment. The Ministry of Environment would be included within the committee established to review the assessment reports as well as the local authority (Governorate) where the project shall be implemented.

Within the working regulations of GESR the importance of environmental protection is reflected, particularly in the section discussing work safety conditions. However to date GESR has never implemented an environmental assessment for its new projects.

(2) Environmental Issues

The project route passes through the two governorates of Tartous and Homs. The main environmental issues along the project route, and having a bearing on it, as reported by the environmental directories in both governorates and observed during site visits are as follows:

Tartous Governorate:

- Phosphate loading/unloading conditions at the seaport
- Decrease in soil fertility along the coast because of excessive greenhouse cultivation and use of chemical fertilizers and pesticides
- Insufficient treatment of wastewater discharged from olive oil plants
- Excessive tree cutting for use as fuel

Homs Governorate:

- Poor quality of the Qatineh lake waters because of discharge of wastewater from nearby industrial plants
- Oil refinery on the outskirts of Homs, and along the railway line at km 5 causes

odor and air pollution

- Informal housing sprawl because of immigration into the city, shortage in economical housing, and sometime poor resettlement practices in case of construction of public projects (this issue is also reported in Tartous)

12.3 Impacts of Proposed Project

12.3.1 Sequence for Environmental Consideration

EIA is a continuing process from project conception, planning, preliminary design, and alternatives evaluation, to the detailed design and construction planning phases. The EIA should also identify the system for environmental monitoring, which should commence after the project is commissioned and continue for the duration of the project life.

The project under evaluation at present is in the preliminary design and alternatives evaluation stage. Therefore the environmental assessment at this stage shall define detailed areas for attention.

The screening and scoping procedure followed hereafter shall be used for that purpose. The two alternatives studied in connection with the project shall also be evaluated from the environmental viewpoint.

Further environment assessment required at the detailed design of the project shall also be outlined in appendix 12 attached to this report.

12.3.2 Screening and Scoping Procedure

The screening of each section in order to identify whether any impact is expected (Y) or not (N) is shown in Table 12.3.1. The project route has been divided into four sections:

- Section 1: Tartous – Akkari
- Section 2: Akkari – Al-Khansa
- Section 3: Al-Khansa – Mhine
- Section 4: Mhine – Al-Sharqia

Two alternatives are proposed in Chapter 3; Alternative A: Construction of a second track in parallel with the existing track, and Alternative B: Construction of a second track separately from the existing track. Alternative A will require more powerful traction force while Alternative B will provide improved alignment.

Another feature of the project that must be examined from the environmental viewpoint is the rehabilitation plans for the Homs and Tartous locomotive and diesel-car depots. This item is discussed separately in the following section 12.3.3.

Table 12.3.1 Screening of Project Alternatives

Environmental Item and Description	Sections					Remarks
	1	2a	2b	3	4	
Social Environment						
1. Resettlement						
Resettlement due to occupancy of proposed land	N	N	Y	Y	N	Resettlement is expected n Alt. 2B (formal housing) and at 5 kilometers from Homs 2 in section 3 (informal housing).
2. Economic Activities						
Loss of productive opportunity such as land or nearby market	Y	Y	Y	Y	N	Land will be allocated for new tracks and signal stations. Sections 1 and 2 and part of section 3 pass through agriculture lands, which will be effected.
3. Traffic and public facilities						
Influence on existing traffic such as congestion	N	N	N	N	N	No significant effect on existing traffic. Traffic will be made safer by improving crossings with existing roads.
4. Split of communities						
Split of communities by obstruction of railway line	N	N	Y	N	N	Alt. 2B may separate communities. Fencing works are included in some sections but such works should be recognized as improving safety of the citizens in the area and not as splitting communities. Safe crossings should also be included for the residents.
5. Cultural property						
Loss of cultural property and falling of values	N	N	Y	Y	N	Alt. 2B may damage cultural property or effect archeological excavation close to Al-Khansa sta. Excavation work is also in progress near Mhine sta. on section 3.
6. Water rights and rights of common						
Obstruction of fishing rights, water rights, and common rights of forest	N	N	N	N	N	This problem does not exist concerning water rights. Any obstruction of forest access for tree cutting is welcome. Deforesting is causing problems in the area.
7. Public health condition						
Deterioration of hygienic environment and poor working areas	N	N	N	N	N	The project will result in more freight transport and consequently loading/unloading facilities, designs should ensure that these facilities must be safe.
8. Waste						
Occurrence of waste dumps and solid waste	Y	Y	Y	Y	Y	Construction waste will be generated.
9. Hazards (risks)						
Increase of possibility of danger of landslide, structure failure and accidents	N	N	Y	N	N	In general rehabilitation of existing lines will help prevent this risk. However for Alt. 2B, in comparison with the other sections, the potential for impact exists because of the large cut and fill works.
Natural Environment						
10. Topography and geology						
Change of valuable topography and geology by excavation or filling works	N	N	Y	N	N	Cut and fill works will be carried out in all the sections, however by comparison Alt. 2B will involve enormous work and there is potential for impact.
11. Soil erosion						
Surface soil erosion by rainwater after land development (vegetation removal)	N	N	Y	N	N	Vegetation along the new track section (Alt. 2B) may be effected.

12. Groundwater						
Interference with groundwater characteristics by large scale excavation	Y	Y	Y	N	N	Excavation work is expected in Alt. 2B, and to a lesser degree in Sections 1 and Alt. 2A.
13. Hydrological situation						
Changes in river discharge and river bed conditions due to landfill and drainage inflow	N	N	N	N	N	No significant effects on the rivers along the project route are anticipated.
14. Coastal zone						
Coastal erosion and sedimentation due to landfill or change in marine condition	N	N	N	N	N	This effect is not anticipated.
15. Flora and fauna						
Obstruction of breeding and extinction of species due to change of habitat condition	Y	Y	Y	N	N	Alt. 2B may affect surrounding flora and fauna. Sections 1 and 2 in general pass through areas known to be rich in biodiversity.
16. Meteorology						
Change of temperature, precipitation, wind, etc. due to large development	N	N	N	N	N	No large scale development
17. Landscape						
Change of topography and vegetation by land development and harmonious obstruction by structural objects	N	N	Y	N	N	Alt. 2B may generate such impact.
Pollution						
18. Air pollution						
Pollution caused by exhaust gas or toxic gas from vehicles and factories	Y	Y	Y	Y	Y	Increased traffic in all sections and increased traction force (Alt. 2A) may have an impact.
19. Water pollution						
Pollution by inflow of silt and effluent into rivers and groundwater	N	N	N	N	N	Under proper construction methods and operating systems there should be no concern about this problem.
20. Soil contamination						
Contamination of soil by dust and chemicals	N	N	N	N	N	Under proper construction methods and operating systems there should be no concern about this problem.
21. Noise and vibration						
Noise and vibration generated by railway	Y	Y	Y	Y	Y	Increased traffic in all sections and increased traction force (Alt. 2A) may have an impact.
22. Land subsidence						
Deformation of land and land subsidence due to lowering of groundwater	N	N	N	N	N	Under proper construction methods and operating systems there should be no concern about this problem.
23. Offensive odor						
Generation of exhaust gas and offensive odor by facility construction and operation	Y	Y	Y	Y	Y	Increased traffic in all sections and increased traction force (Alt. 2A) may have an impact.
Overall Evaluation						
Environmental Impact Assessment (EIA) required (Y/N)	Y	Y	Y	Y	Y	EIA is required for all sections of the project.

The screening result shows that in Section 4 the project is expected to generate least impacts. This is due to the nature of the section, where the desert area is sparsely inhabited. On the

other hand potential for impacts generated by the project in Section 2 Alt. B is the largest due to the nature of the independent new construction there and the natural terrain that exists. Potential for pollution exists all sections because of the characteristics of rail operation. However the potential impact will be much lower when compared with not implementing the feasibility study project and accommodating the forecast traffic demand by road transport.

The scope of the expected impacts is examined in Table 12.3.2.

Table 12.3.2 Scooping of Master Plan GESR Project Groups

Sections					Remarks
1	2a	2b	3	4	
Social Environment					
1. Resettlement					
D	D	B	C	D	In both sections 2B & 3 a limited number of houses need to be removed. However in Section 3 (about 5-6 houses) the houses are built in an informal area with poor sanitary conditions and removal of the residents to a better area may be better for them. In Alt. 2B (about 10 houses) the families involved mostly work in agriculture in the same area. So the impact on them will be multiplied. Therefore it is necessary to consider adequate compensation.
2. Economic Activities					
C	C	B	C	D	Sections 1 & 2A: The dominant economic activity is agriculture. The land appropriated for signal stations is mostly cultivable land and there will be an impact on the economic activity in the area. Although the government will compensate the mainly private owners, it will be difficult to recover lost agricultural land. This project should be considered within the framework of the government's strategy for protection of agricultural lands. The opinion of the Ministry of Agriculture and related authorities is important. Alt. 2B: Impact in this section is rated higher than the other two sections because of the much larger area to be appropriated there (10 times the land to be appropriated under section 1 and 7 times that under Alt. 2A). Section 3: Almost two-thirds of the land is agriculture and therefore some impact may be expected. On the other hand the urban expansion of Homs will make it very difficult to protect this land and already there is fear from soil contamination because of the industries in the area. Therefore not much impact is expected here. Section 4: Only positive impact is expected in this section.
3. Traffic and public facilities					
D	D	D	D	D	The attraction of traffic from the road mode, improvement of railway crossings with the roads, and provision of more reliable rail service will create better traffic conditions along the project route.
4. Split of communities					
D	D	C	D	D	All Sections: The fencing works included in the project sections should be recognized as improving safety of the citizens in the area and not as splitting communities. Safe crossings should also be included for the residents. Alt. 2B: Care should be taken not to split the homogenous communities residing in the area of the proposed new section. Safe crossings incorporated in the designs should be adequate against the expected increase in train traffic. Although hardly any impact is expected consideration of the locations of these crossings is important to mitigate potential impacts.

5. Cultural property					
D	D	C	C	D	Sections 1, 2A & 4: No antiquities or excavations are ongoing in the project area vicinity at this time. Alt. 2B: Any effect on the ongoing Rehaniyah excavations in the new section route vicinity should be studied in discussions with the Ministry of Culture. Although at present no excavation work was observed the site is listed in the ministry's excavation maps (refer to Figure 12.2.6). Section 3: The same comment as above applies for the two excavation sites of Dirdghan and Hadath near Khnefis and Mhine respectively.
6. Water rights and rights of common					
D	D	D	D	D	In Sections 1, 2A & 2B and 3 where agriculture activity prevails, pipes are to be laid under the tracks as necessary so as not to disturb existing irrigation systems.
7. Public health condition					
D	D	D	D	D	The project is expected to improve freight transport system, which should include loading/unloading facilities at stations and specialized freight cars, as well as other measures.
8. Waste					
C	C	C	C	C	In all the Sections construction waste will be generated. The construction plan should detail a system for removal of the generated waste and its disposal, and the return of the site to its original conditions.
9. Hazards (risks)					
D	D	C	D	D	In Alt. 2B the comparatively large-scale earthworks makes this a potential risk. Accordingly the design and as-built drawings should be carefully studied with the actual natural conditions (soil, topography) in order to avoid this risk.
Natural Environment					
10. Topography and geology					
D	D	C	D	D	In Alt. 2B the comparatively large-scale earthworks on the hilly terrain makes this a potential risk. In addition to potential impact on the landscape, the types of materials involved in the cut and fill works may generate a negative impact. Therefore the extent of impact can be determined only after more detailed studies.
11. Soil erosion					
D	D	B	D	D	In Alt. 2B there are existing concerns by the Ministry of Environment on the widespread cutting of trees and soil erosion in the area. That is one of the reasons the Al-Mastoura Mountain area is being considered as a protected area. However it was not possible to obtain information on the area boundaries or actual status from the Ministry of Environment so it is necessary to coordinate this matter with the ministry and other related authorities.
12. Groundwater					
C	C	C	D	D	The large-scale excavation works expected in Alt. 2B, and to a lesser degree in Sections 1 and 2A may effect the groundwater, although the depth appears to be sufficient to avoid major risks.
13. Hydrological situation					
D	D	D	D	D	The design will involve little or no interference with rivers. Also improved rolling stock will prevent pollution to the waters the rails cross. Under these conditions no impact is expected.
14. Coastal zone					
D	D	D	D	D	Section 1, the only coastal section is far inland from the coast and therefore no impact is expected.

15. Flora and fauna					
C	C	B	D	D	Sections 1 and 2 in general pass through areas known to be rich in biodiversity. Section 1: The coastal area attracts migratory birds, and their numbers have been decreasing in recent years due to the heavy development along the coast. In that sense some impact may be anticipated. However the alternative of more road traffic is more dangerous to the fauna. Alt. 2A and B: This section travels through areas rich in flora, and endangered tree species have been reported there. Some impact is anticipated. However the alternative of more road traffic is more dangerous to the flora. Alt. 2B: Some endangered tree species have been identified within the route area and therefore care should be taken against tree cutting during construction or in route selection. A detailed ecological study is required along this section.
16. Meteorology					
D	D	D	D	D	The project is not of the scale to generate significant climatic changes.
17. Landscape					
D	D	C	D	D	Alt. 2B: The new track section will pass through a very scenic area and impact on the landscape is therefore unavoidable. During the detailed design stage sensitive route selection and consideration of mitigation measures is very important.
Pollution					
18. Air pollution					
C	B	C	C	C	In all sections, the increased traffic due to improved route may have an impact on the air quality. However this is still potentially low when compared to the impact produced by increased road traffic in case of not implementing the project. Alt. 2A: Increased diesel-powered traction force will have an additional impact.
19. Water pollution					
D	D	D	D	D	The protection of Syria's scarce water resources is an important issue. However under proper construction methods and operating systems there should be no concern about this problem.
20. Soil contamination					
D	D	D	D	D	Under proper construction methods and operating systems there should be no concern about this problem.
21. Noise and vibration					
B	B	B	C	C	In all sections, the increased traffic due to improved route may have an impact on the noise and vibration. (Less impact in sparsely populated areas of Section 4). Alt. 2A: Increased diesel-powered traction force will have an additional impact.
22. Land subsidence					
D	D	D	D	D	Under proper construction methods and operating systems there should be no concern about this problem.
23. Offensive odor					
C	C	C	C	C	In all sections, the increased traffic due to improved route may have an impact on the odor. Alt. 2A: Increased diesel-powered traction force will have an additional impact.
Overall Evaluation					
C	C	B	C	C	EIA is required for all sections of the project.
Notes: Evaluation categories: A: Serious impact is predicted, B: Some impact is predicted, C: Extent of impact is not expected to be significant, but further examination is required, D: No impact is predicted, EIA is not necessary					

12.3.3 Rehabilitation of Homs and Tartous Locomotive and Diesel-Car Depots

The description and necessity for this component of the project are outlined in Chapter 6 of this report. A new facility will be constructed in Homs on GESR land while in Tartous the existing facility will be modernized.

(1) Existing Environmental Conditions at each Depot

1) Homs Locomotive Depot

- Working conditions are poor, floors are covered with oil and grease and are very slippery
- Mixed water and oil are drained from the work pits into a nearby pit for separation.
- No leakage problems are reported in the underground oil and fuel tanks
- Water used in maintenance works is pumped up from wells and distilled at the depot. There is a laboratory to test the distilled water.
- Waste from the depot, mainly scrap metal heavily mixed with oil and grease is piled up outside. Municipal cleansing authorities are charged with removing the waste 1-2 times per week.
- There is a plan to construct a new depot on a site adjacent to the existing one (which is a component of this project). Soil investigation has already been completed and no shallow groundwater has been reported. Design work is reported in progress.

2) Tartous Locomotive Depot

- Working conditions are very poor and the floors are covered with oil and grease and are very slippery
- Mixed water and oil is pumped out of the work pits on a regular basis because pipes connecting to the oil pit are blocked.
- No leakage problems are reported in the underground fuel tanks. However in the case of the oil underground tank it is not in use and oil is stored in barrels in the depot.
- Water used in the depot maintenance works is taken from the municipal water system and distilled in the facility. There is a small laboratory to test the distilled water
- The waste from the depot, mainly scrap metal heavily mixed with oil and grease is piled up outside the depot. Municipal cleansing authorities are charged with removing the waste 1-2 times per week.
- The internal wall in the depot separating the working space from the offices had many cracks and appears to be structurally unsafe. A runaway locomotive caused this. A new office building is being constructed nearby.

(2) Environmental Consideration

The construction of a new locomotive workshop in Muslimia is the subject of the second feasibility study implemented in this study. Volume III Report discusses this project and the environmental impact assessment is also described there. It is recommended to refer to that report in considering the future environmental studies to be addressed to the Homs and Tartous locomotive and diesel car rehabilitation plan. However some of the preliminary environmental concerns are identified in Table 12.3.3 hereafter.

Table 12.3.3 Environmental Considerations for Depot Rehabilitation

Environmental Item	Homs Depot: New Depot construction	Tartous Depot: Existing Depot rehabilitation
1. Resettlement	D The new depot is located in GESR ROW and no land acquisition or resettlement is necessary	D The rehabilitation project will be implemented on the existing facility.
2. Workers health and safety	C The design and operation plan of the new facility should carefully consider measures to avoid recurrence of existing conditions	B In addition to the need to improve working conditions it is also necessary to consider the structural safety of the building itself.
3. Waste	C The design and operation plan of the new facility should carefully consider measures to manage construction and operation wastes.	C The rehabilitation plan should carefully consider measures to manage construction and operation wastes.
4. Water pollution	C The new underground storage tanks should be designed to avoid any potential groundwater pollution.	C The rehabilitation plan should include checking of the existing underground storage tanks and implementation of any remedial measures.
5. Noise and vibration	C The design and operation plan of the new facility should carefully consider measures to mitigate this problem and ensure the workers safety	B It is not clear to what extent mitigation measures can be included in a rehabilitation plan.
Notes: Evaluation categories: A: Serious impact is predicted, B: Some impact is predicted, C: Extent of impact is not expected to be significant, but further examination is required, D: No impact is predicted, EIA is not necessary		

12.3.4 Overall Result

(1) Route component

The results of the scoping exercise are summarized in Table 12.3.3. The table shows only the environmental items where impact is expected.

Table 12.3.3 Overall Result

Environmental Item	1	2A	2B	3	4
A. SOCIAL ENVIRONMENT					
1. Resettlement			B	C	
2. Economic Activities	C	C	B	C	
4. Split of Communities			C		
5. Cultural Property			C	C	
8. Waste	C	C	C	C	C
9. Hazards			C		
B. NATURAL ENVIRONMENT					
10. Topography and geology			C		
11. Soil erosion			B		
12. Groundwater	C	C	C		
15. Flora and fauna	C	C	B		
17. Landscape			C		
C. POLLUTION					
18. Air pollution	C	B	C	C	C
21. Noise and vibration	B	B	B	C	C
23. Offensive odor	C	C	C	C	C
Notes: Evaluation categories: A: Serious impact is predicted, B: Some impact is predicted, C: Extent of impact is not expected to be significant, but further examination is required, D: No impact is predicted, EIA is not necessary					

(2) Homs and Tartous Depot Rehabilitation

Careful consideration should be given to:

- Working conditions within the depots
- The management of liquid and solid wastes generated at the depots

12.4 Evaluation

Based on the project need, review of the potential impacts on the environment and their scope and considering the impact on the environment of greater road traffic in the absence of the project, it is considered feasible to implement the project from an environmental viewpoint. However the following points are emphasized.

(1) Comparison of Alternatives A and B Routes

The main environmental concerns in the case of Alternative B (referred to as Section 2B in this chapter) may be grouped into two main issues. These are land appropriation and the protected area.

a. Land appropriation

It will be necessary to resettle about 10 legal households and appropriate about 150 hectares of mostly agriculture land. Concerning resettlement, the survey shows that in general the Government can easily resettle the inhabitants in such a rural area. However previous resettlement experience shows that the compensation paid out is very small and the replaced homes are not suitable. In addition no social survey is done to determine the effect on the resettled persons. These problems should be resolved in order to ensure resettlement with minimum adverse effects.

b. Protected area

The Ministry of Environment report prepared in 1998, “The Seven Water Basins of Syria: Environmental Action Plans” identified the Mastoura Mountain area as one of the main protected areas in the Orontes Basin. The reason stated is to protect the endangered trees species (*Quercus Aegilops).* However it is not clear whether the area has actually been so designated and as well as the boundaries and agency responsible. The area also suffers from soil erosion due to excessive tree cutting. Therefore the route selection should be carefully considered in consultation with the relevant ministries and agencies.

Selection of Alternatives B over A can be accepted from the environmental viewpoint only after mitigating the above problems.

(2) The entire project route

The main environmental issues are in Section 2 Alt. B. In the other sections concerns are related to a large extent to construction activity (waste, groundwater, flora and fauna) as well as design of track and equipment (air pollution, noise and vibration and odor). However the benefits from rail service outweigh the concerns and it is believed that under certain mitigating measures these concerns can be greatly reduced.

(3) Homs and Tartous Depot Rehabilitation

Existing Homs and Tartous depots are in very poor condition from environmental viewpoint. The detailed designs for the new Homs depot and rehabilitation plan for the existing Tartous depot should be carefully studied to confirm that sufficient consideration has been given to the safety and healthy working conditions of the workers in each depot. Environmental monitoring plan should be implemented once both depots are brought into operation. Items to be monitored include the environmentally sound management of the wastes generated during operation and avoidance of polluting the surrounding environment.

12.5 Impact Mitigation Considerations

As explained in section 12.1, this is a first step in the process of environmental evaluation that should continue through the detailed design and construction planning stages.

The Environmental Impact Assessment process must be reinforced by institutional, regulatory, technical and public measures. The importance of each is briefly reported in Table 12.5.1.

Table 12.5.1 EIA Process Reinforcement

Reinforcement measure	Importance
1. Institutions	Institutions assigned responsibility for: • EIA implementation and review • Environmental monitoring • Arresting environmental pollution and punishment of violators • Developing environmental standards
2. Regulations	Laws and regulations for: • EIA implementation procedure • Punishment of polluters and violators • Enforcement of environmental standards
3. Technical	Technological development for: • Implementation of a scientific and sound EIA • Integrating technical solutions to the design, construction, and manufacturing in order to mitigate environmental problems • Implementation of environmental monitoring, collection and analysis of data and identification of present problems and prediction of future ones
4. Public awareness	Develop public awareness to involve the public in: • Public hearings in the course of EIA implementation • Understanding the consequences of environmental mismanagement and monitoring the activities of potential violators • Reporting on environmental violations

It is noted that much remains to be done to strengthen these measures in order to implement a comprehensive EIA for this and other projects of similar significance. Appendix 12 outlines the recommenced measures required as well as the impact mitigation considerations which are of relevance to this project and may be adopted during the design, construction and operation stages.

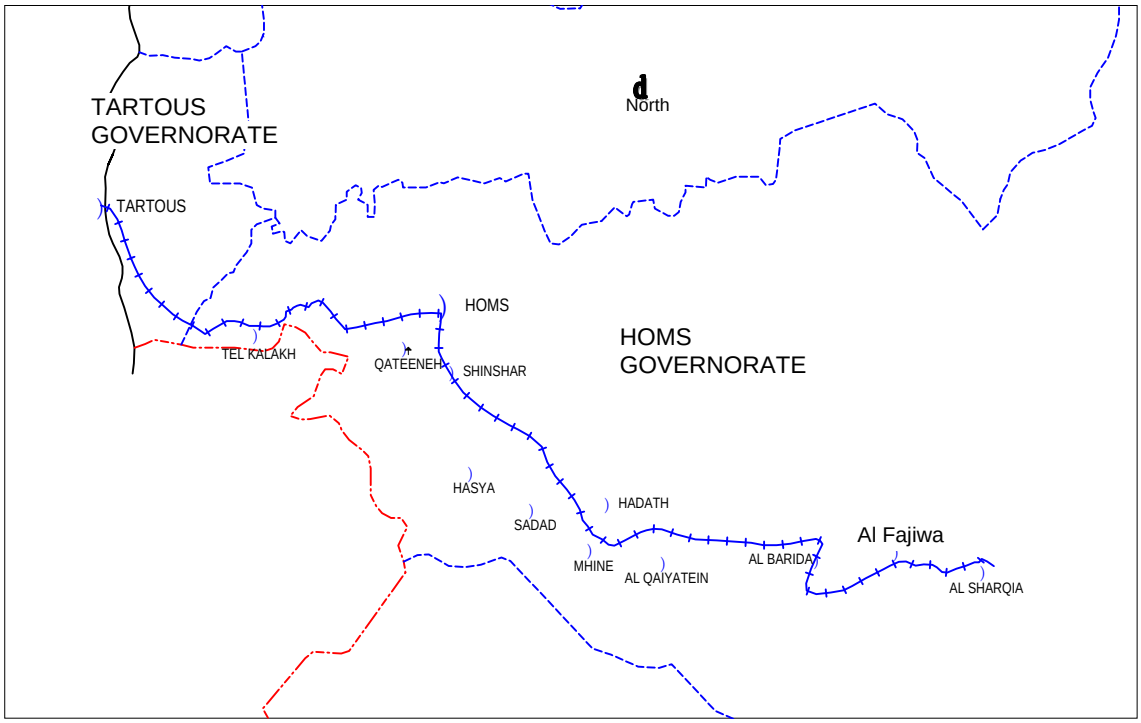


Figure 12.2.1 Project Location

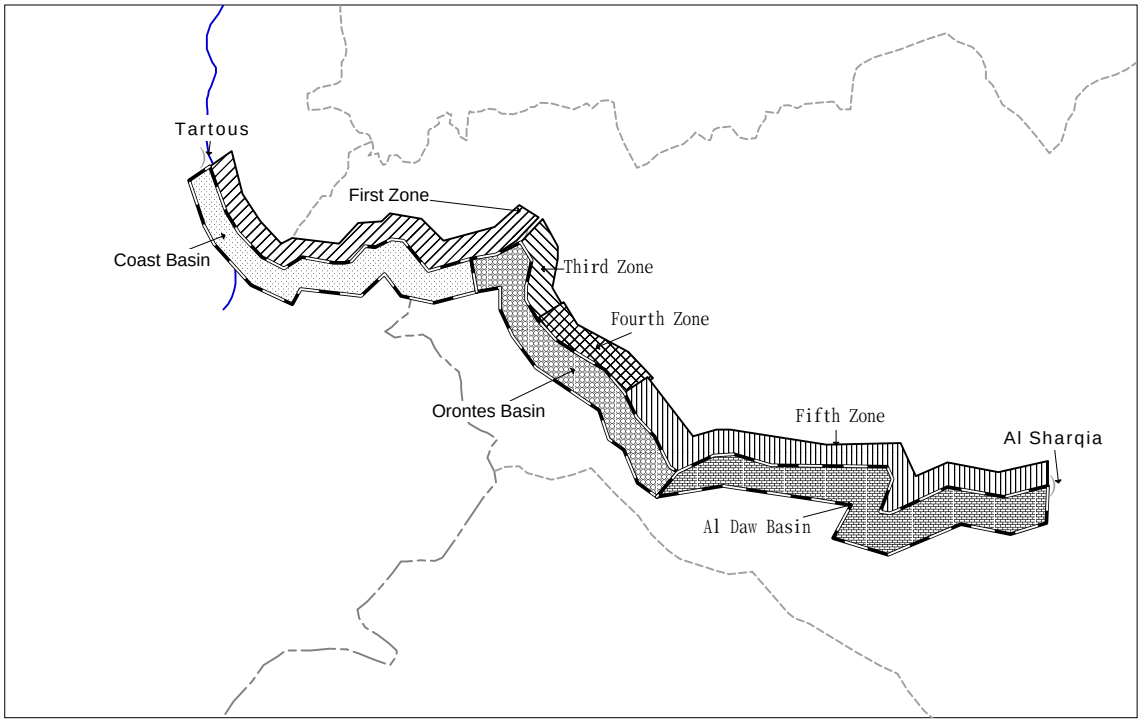


Figure 12.2.2 Water Resources

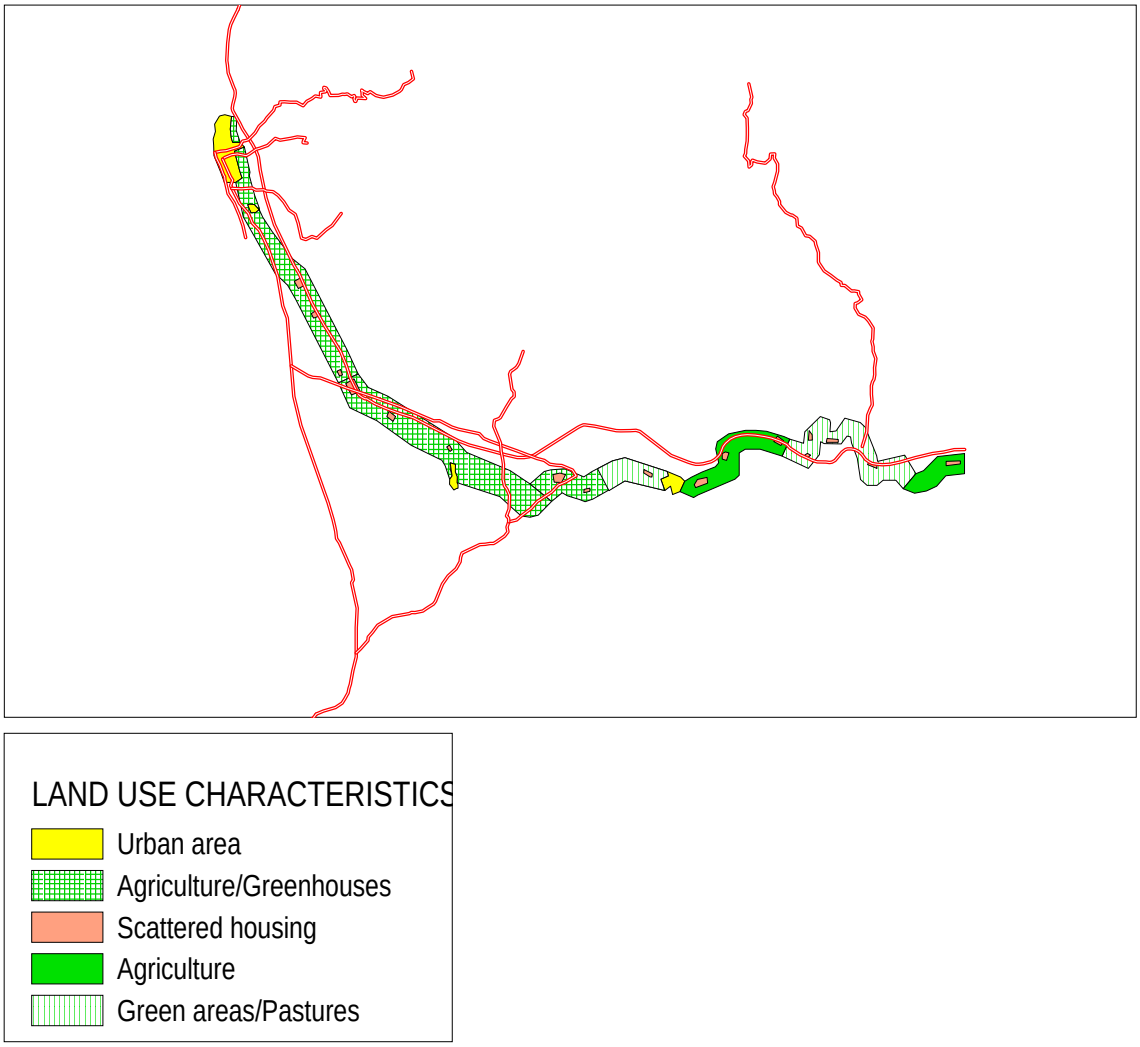


Figure 12.2.3 Land Use (1) Tartous to Al Khansa

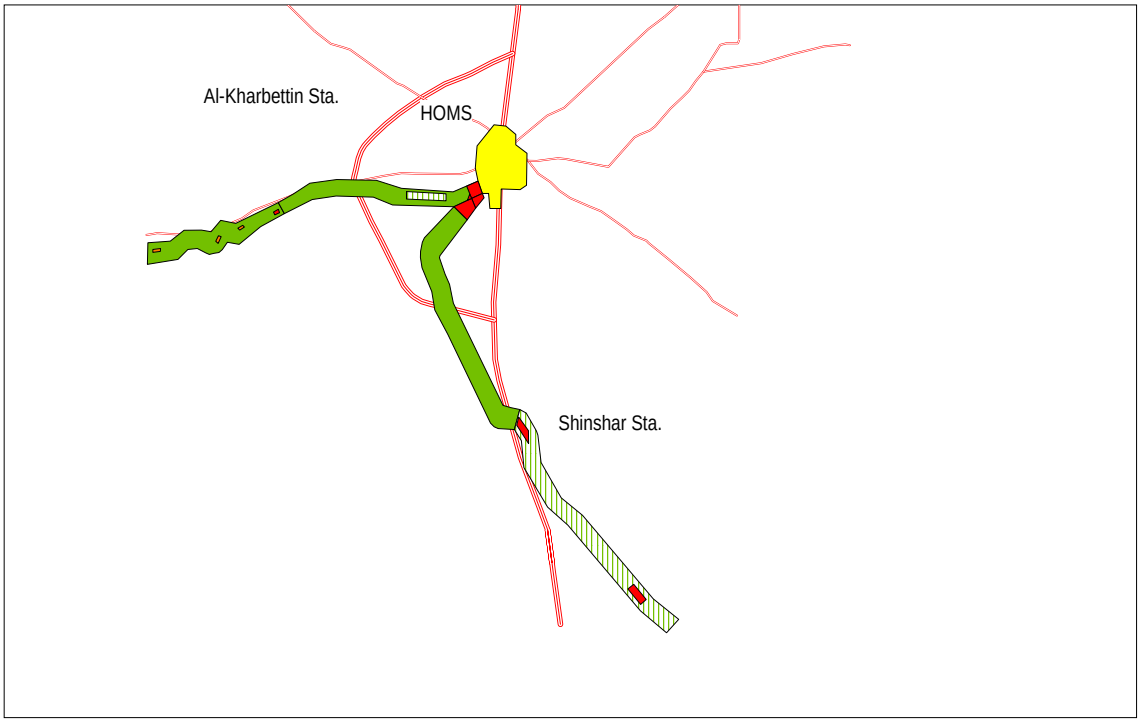


Figure 12.2.4 Land Use (2) Al Khansa – Khneffis

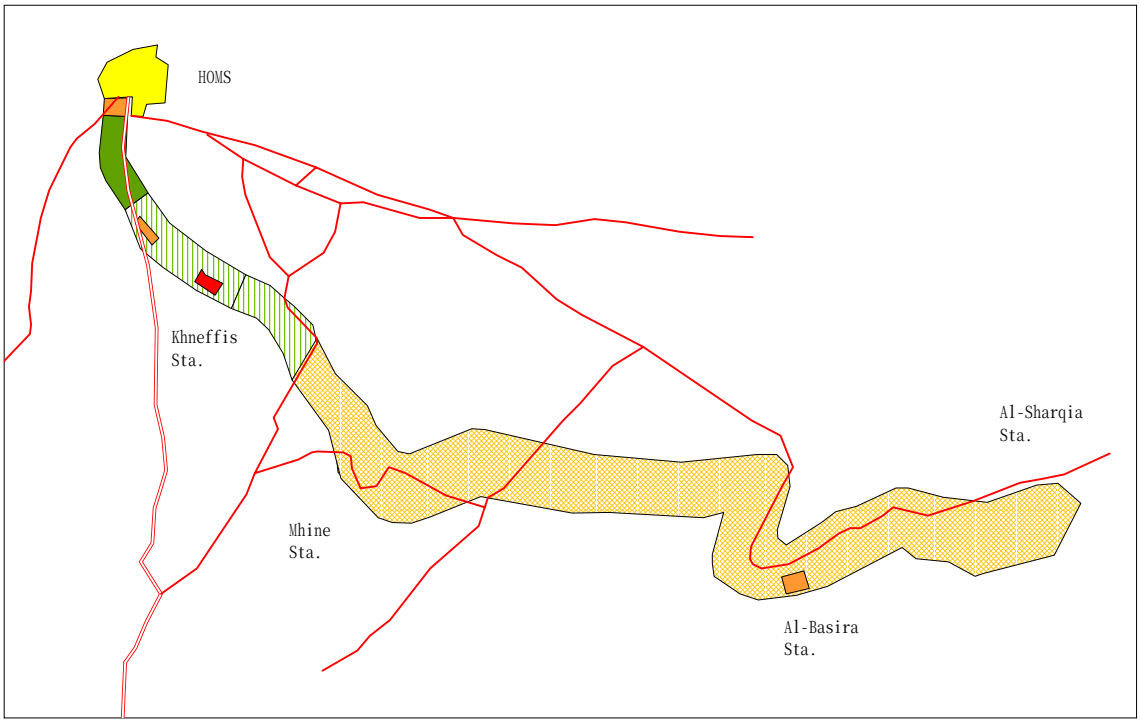


Figure 12.2.5 Land Use (3) Kneffis – Al-Sharqia

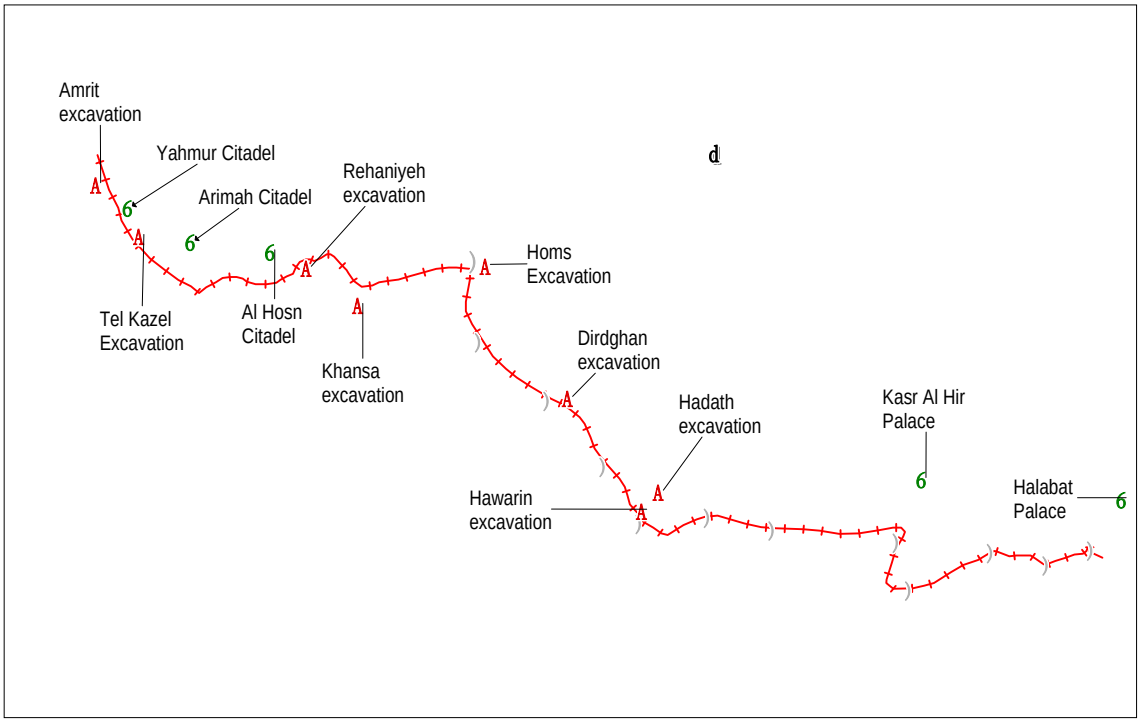


Figure 12.2.6 Historic Landmarks and Excavation Sites

Chapter 13

Conclusion and Recommendation

Chapter 13 Conclusion and Recommendation

13.1 Conclusion

13.1.1 Project Outline and Optimum Plan Selection

This project covers the route of about 270km running from Tartous (an important port for import and export) to Al Sharqia (with phosphate ore mines) via Homs and Mhine. For this route, the project aims at the rehabilitation and modernization of the existing track facilities, electric facilities and so forth; as well as at the additional construction of signal stations and double tracking for the smooth operation of trains which will be increased to cope with the growth of demand.

Especially, two alternative plans (Alternative A and Alternative B) were set up and studied for the section of about 40km between Akkari and Al Khansa, because this section has a steep gradient of 20‰ and many sharp curves of 300 – 400m radius at present and is becoming a bottleneck in transport.

Alternative A aims at the transport system using two locomotives of LED 3200 type and also at the track addition in parallel to the existing line. Alternative B aims at the transport system using one locomotive of LED 3200type and also at the construction of a separate line (not parallel to the existing one) with the steepest gradient of 12‰ and the minimum radius of curve of 600m. The comparative study results concerning the two alternatives from various aspects are as shown in Table 13-1. Project including Alternative A was finally selected as the optimum plan.

(1) Transport and rolling stock aspects

In Alternative A, pusher locomotives are necessary for freight trains except for the empty ore trains. In this case, coupling work at Akkari Station, uncoupling work at Al Khansa Station, and dead-head operation to Akkari Station of the pusher locomotives are also needed. In Alternative B, there is no problem of train operation handling as seen at these stations in Alternative A, because pusher locomotives are not used.

Between Akkari and Al Khansa, the number of trains, locomotive-km, number of necessary locomotives and so forth in Alternative B are smaller than the corresponding figures in Alternative A. The running time (transport time required) of passenger trains in Alternative B is almost the same as that in Alternative A. As for freight trains, the transport time required in Alternative B is larger than that in Alternative A by about 30 minutes. However, for freight trains, the clear forecast of arrival time is more important than the reduction of transport time.

In view of the above, Alternative B is estimated to be advantageous in transport and rolling stock aspects.

(2) Ground facilities aspect (track facilities, electric facilities)

Between Akkari and Al Khansa, both Alternative A and Alternative B are technically feasible. However, the total length of tracks constructed in Alternative A (about 39.4km) is shorter than that in Alternative B (about 49.4 km) by about 10km. Therefore, the necessary construction cost in Alternative A is smaller than that in Alternative B.

As for the maintenance aspect, the inspection, repair and so forth of track facilities and electric facilities are easier in Alternative A than in Alternative B. This is because while Alternative A aims at the construction of a line parallel to the existing line, Alternative B aims at the construction of a line which runs separately.

In view of the above, Alternative A is estimated to be advantageous in the ground facilities aspect.

(3) Environmental aspect

Between Akkari and Al Khansa, there are no large problem in Alternative A, because it aims at the construction of a line parallel to the existing line.

In selecting the route of Alternative B, care was taken to prevent the geographical division of villages and relocation of residents. However, detailed investigations are necessary in the stage of construction execution concerning resident relocation and so forth. Furthermore, there are environmental preservation areas in some parts of the section between Tel Kalakh and Umm Jaamah. In materializing the new line construction,

therefore, it is necessary to carry out further detailed investigations and to make efforts to prevent unfavorable effects on the environment.

In view of the above, Alternative A is estimated to be advantageous from the environmental aspect.

(4) Economic and financial aspects

The total amount of investment for the Rehabilitation/Modernization between Tarotus, Homs, and Al Sharqia (about 270km) is about 28.2 billion SP for the case including Alternative A and about 31.6 billion SP for the case including Alternative B.

The Economic Internal Rate of Return (EIRR) is 20.5% for Project including Alternative A and 18.2% for that including Alternative B. The Financial Internal Rate of Return (FIRR) is 7.3% for Project including Alternative A and for that including Alternative B 6.1 %.

From economic and financial aspects, each Project including Alternative A or Alternative B is feasible, with that including Alternative A showing higher figures in both EIRR and FIRR.

In view of the above, the Project including Alternative A is evaluated as more advantageous from economic and financial aspects.

(5) Comprehensive Evaluation

Based on the Table 13.1 the Project including Alternative A is taken up as the Project for evaluation of the feasibility study.

Table 13.1 Evaluation of Alternatives by Various Aspects

Aspects of evaluation	Transport and rolling stock aspects	Ground facilities aspect (track facilities, electric facilities)	Environmental aspect	Economic and financial aspects	Comprehensive evaluation
Alternative A	△	○	○	○	○
Alternative B	○	△	△	△	△

13.1.2 Project Evaluation (Conclusion)

The Rehabilitation/Modernization Project between Tartous, Homs, and Al Sharqia (about 270km) aims at the reinforcement of facilities on the existing line, as well as the additional introduction of rolling stock, double tracking, signal station construction and so forth to meet the increase in demand. This project with these targets is technically feasible, and does not inflict large influence on the environment.

The EIRR of the project from the national economic standpoint is 20.5 %. In view of this, and also taking into account other indirect benefits, the project is considered to be feasible from the national economic standpoint.

The FIRR of the project from the view point of enterprise of GESR is 7.3 %. This means that the Project is financially feasible, in case low interest loan from foreign countries or international organizations are used for foreign currency portion and Government finances the local currency portion without interest.

From the comprehensive standpoint, it is considered that the project is a development project for an important freight transport route of GESR and is feasible from technical, environmental, economic, and financial aspects. The execution of the project will enable smooth and stable railway transport between Tartous, Homs, and Al Sharqia, and will contribute to the promotion of economic activities in Syria.

Furthermore, if the new line is constructed between Al Sharqia and Deir el-zor to form a well-balanced railway network, the sound socio-economic activities in Syria will further develop.

In this connection, for the effective implementation of the project, it is necessary to make improvement in software aspects (such as management, transport administration, facilities maintenance, accident prevention, training, marketing) in addition to improvement in hardware aspects (such as rolling stock, ground facilities).

Lastly some comments should be made on Alternative B, namely the new line (separate route) construction plan between Akkari and Al Khansa. GESR is now planning to carry out

full-scale investigations on separate route line starting with the preparation of topographical maps by aerial survey and also including route selection, construction cost estimation, and so forth.

As described before, the Project including Alternative B is also found feasible from economic and financial standpoints, and Alternative B has various merits in train operational aspects. Therefore, when detailed study results including detailed route selection and detailed cost estimate will have been obtained later based on detailed photographical map developed from aerial survey, it may be meaningful that GESR will try to compare again Alternative A and B from overall view points.

13.2 Recommendation

In executing this project, the following recommendations are made so that the project can be further effective.

(1) Smooth construction promotion and environmental consideration

1) Consultation and coordination with the organizations concerned

① In securing land, it is necessary to promote consultations with the organizations and personnel concerned at an early stage and solve related problems so that the scheduled period of construction will not be hampered.

② Concerning the works at the two places between Umm Jaamah and Al Khansa where the railway crosses under an expressway, and also for such works as the grade separation of the level crossing at a place near the 5-km point from Homs Station, it is necessary to hold sufficient consultations and make full adjustments with the road-related organizations and the like in advance, on such matters as the construction execution methods and railway and road protection methods, in order to ensure smooth construction promotion.

2) Establishment of work execution system for construction works near tracks

As described before, this project aims at the reinforcement of the existing lines, additional construction of tracks parallel to the existing line, new construction of signal stations, and so forth. All of these construction works are carried out at places near the existing commercial line during the commercial operation time. In the construction execution, therefore, special attention should be paid to the prevention of hindrance to train operation on the existing line, injury accidents of construction workers, and so forth.

In actually implementing the project, it is necessary to establish adequate methods and systems for the construction execution, by setting up detailed work process which considers the proximity of the construction sites to the existing commercial line, and also by grasping the entire construction process.

3) Procurement of equipment and materials

It is necessary to procure equipment and materials at adequate times based on the entire construction process. Special care should be taken in procuring equipment and materials from foreign countries, by establishing reasonable procurement plans beforehand in order to ensure smooth construction execution.

4) Environmental consideration

① As for the noise and vibration entailed by the construction execution, the degree of their influence is estimated to be small in general. However, in the case where construction is executed in a place near a residential area, it is advisable to obtain the understanding of the residents concerned, by explaining to them the purpose and contents of the construction and so forth.

② As for the disposal of waste produced by the construction, it is essential to study a system of carrying the waste to an adequate place of disposal, in order to prevent social problems after waste dumping.

(2) Reduction of investment

Although this project is financially feasible, it is necessary to strive to reduce the amount of investment, in order to further enhance the investment effect.

① In procuring rolling stock, rail, electric devices and other equipment and materials, efforts should be made to secure the most inexpensive objects possible, as far as the necessary material quality is ensured.

② Since the project is implemented in places near the existing tracks, efforts should be made to reduce the period and cost of the construction, by studying efficient methods of construction execution, and also by sufficiently considering the train operation and securance of safety in construction works.

③ In procuring funds, efforts should be made to obtain money with the lowest interest possible.

(3) Maintenance

The execution of this project will enable the reinforcement of hardware aspects of rolling stock, track facilities, electric facilities, and so forth. To make the rolling stock and facilities sufficiently display their functions, it is necessary to carry out improvement of software aspects, such as their maintenance and administration, at the same time.

As for the maintenance in the future, it is necessary to conduct data-based maintenance of rolling stock and railway facilities and to establish and steadily implement rational maintenance plans.

At first, it is needed to arrange registers, such as track maintenance registers. Then, it is necessary to conduct systematic inspection and accumulate relevant data in the registers. Therefore, a reasonable maintenance plan should be established on the basis of these statistical data and from the standpoint of preventive maintenance. Lastly, the maintenance plan thus established should be steadily put into practice, in order to ensure functions of railway facilities.

At the same time, it is necessary to establish a system which can ensure early restoration after the occurrence of a trouble.

With the progress of modernization of rolling stock and railway facilities, training of staff for new technology will become necessary. In introducing new technologies, therefore, it is needed for GESR to give relevant training to the staff and also to request the suppliers of the equipment/facilities to supply teaching materials for training schools at the same time, so that employees can obtain new technologies at the training schools and adequate train operation handling and sufficient maintenance of railway facilities can be ensured.

(4) Double tracking between Akkari and Al Khansa

Concerning the double tracking between Akkari and Al Khansa, it has been found that the plan of constructing an additional line parallel to the existing line is more advantageous than the plan of constructing a separate-route line. However, the project including the latter alternative is also feasible from economic and financial standpoints and the latter alternative has various merits in train operational aspects.

In this connection, GESR is now planning to carry out full-scale investigation on a separate new line. The study includes drawing up full-scale topographical map to be developed by aerial survey, route selection, planning of structures, construction cost estimate so forth. When the detailed study results will have been obtained later, it may be meaningful that GESR may compare the Alternative B and A again based on the detailed study results mentioned above.