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LOCAL DEVELOPMENT II
URBAN PROJECT

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Submitted by

WILBUR SMITH ASSOCIATES

in association with

PUBLIC ADMINISTRATION SERVICE
DEVELOPMENT CONSULTING OFFICE

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ENGINEERING AND GEOLOGICAL CONSULTING OFFICE

LD II URBAN PROGRAM

REPORT ON TRAINING AND REORGANIZATION

OF SUEZ GOVERNORATE ROADS DIRECTORATE

CONTENTS

		Page No.
1.	INTRODUCTION	1
	1.1 General	1
	1.2 Street and Road Maintenance Objectives	2
	1.3 U.S. AID Funds	4
2.	OVERVIEW OF OBJECTIVES OUTLINED IN PROPOSAL	5
	2.1 Asphalt Plant	5
	2.2 Workshops, Laboratory, Stores and Offices	5
	2.3 Laboratory Equipment	6
	2.4 Equipment and Tools	6
	2.5 Heavy Equipment Repairs	6
	2.6 Spare Parts	7
3.	TRAINING AND REORGANIZATION	10
	3.1 Background	10
	3.2 Reorganization	10
	3.3 Training	11
	3.4 Materials Needed for Road Maintenance	11
	3.5 Equipment Necessary for Road Maintenance	15
	3.6 Repair of Utility Cuts	15
	3.7 Maintenance Management System	15
4.	FINANCIAL ROAD MAINTENANCE COSTS & PROGRAM BUDGETS	24
	4.1 Road Maintenance Program Costs	24
	4.1.1 Road Network	24
	4.1.2 Derivation of Work Quantities and Crew Days	24
	4.1.3 Resource Needs and Costs	24
	a. Personnel Cost	24
	b. Equipment Cost	35
	c. Raw Materials Cost	40
	d. Overhead Cost	40
	e. Total Road Maintenance Program Costs	40
	4.2 Program Budgets	43
	4.2.1 Past and Present Bab Allocations	43
	4.2.2 Current Year	43
	4.2.3 Future Years	43
5.	ECONOMIC COST-BENEFIT	50
	5.1 Methodology for Determining Vehicle Operating Costs	50
	5.1.1 Vehicle Characteristics	50
	a. Cars	51
	b. Mini-Bus and Taxis	51
	c. Light Trucks	51
	d. Heavy Trucks	51

b

5.1.2 Vehicle Fleet Size & Composition 51
5.1.3 Basic VOC Data 52
5.1.4 Depreciable Value 52
5.1.5 VOC By Vehicle Type 52
5.1.6 Consumption Factors 52
5.1.7 Basic Test Vehicle Characteristics 60
5.1.8 Per Kilometer VOC 60
5.1.9 VKT by Vehicle Class and Road Condition 60

5.2 Economic Costs and Benefits: 67

5.2.1 Annual Road Maintenance Costs 67
5.2.2 Repaving vs. Rehabilitation 67
5.2.3 VOC savings over 20 years 69
5.2.4 Economic Benefits derived from RM 73

APPENDICES 77

Appendix A : Seminar Conclusions and Outputs 78
Appendix B : Road Maintenance Asphalt Requirements 82
Appendix C : Performance Standards PS02 thru PS08 89
Appendix D : Work Accomplished Summaries WAS01 thru WAS12 96

C

LIST OF TABLES

		Page No.
OVERVIEW OF OBJECTIVES OUTLINES IN PROPOSAL		5
Table 2-1	Road Maintenance Vehicle and Equipment Inventory and Replacement Costs	8
TRAINING AND ORGANIZATION		10
Tabel 3-1	Suez Roads Directorate	22
FINANCIAL ROAD MAINTENANCE COSTS & PROGRAM BUDGETS		24
Table 4-1	Road Length in Km	25
Table 4-2	Road Area in Km	25
Table 4-3	Curb Length in Km	27
Table 4-4	Sidewalk Area in Km	28
Table 4-5	Maintenance Levels	29
Table 4-6	Derivation of Work Quantities and Crew Days - Arbeen	30
Table 4-7	Derivation of Work Quantities and Crew Days - Ataka	31
Table 4-8	Derivation of Work Quantities and Crew Days - Suez	32
Table 4-9	Derivation of Work Quantities and Crew Days - Ganaen	33
Table 4-10	Summary of Crew Days	34
Table 4-11	Annual Work Hours Available Per Employee	36
Table 4-12	Personnel Hours and Costs	37
Table 4-13	Hourly Vehicle Cost Estimates	38
Table 4-14	Equipment Hours and Costs	39
Table 4-15	Material Quantities and Costs	41
Table 4-16	Total Annual Road Maintenance Quantities and Costs	42
Table 4-17	Bab I. and Bab II. Allocations and Expenses	45
Table 4-18	Resources Available to Local Governments	47
ECONOMIC COST-BENEFIT		50
Table 5-1	Suez Vehicle Fleet Size and Composition	51
Table 5-2	Basic VOC Data	53
Table 5-3	Depreciable Vehicle Value	53

Table 5-4	Enroute Crew Costs Per VKT	54
Table 5-5	Vehicle Consumption Factors - Cars	50
Table 5-6	Vehicle Consumption Factors - Mini-Bus and Taxis	57
Table 5-7	Vehicle Consumption Factors - Light Trucks	58
Table 5-8	Vehicle Consumption Factors - Heavy Trucks	59
Table 5-9	Vehicle Characteristics	61
Table 5-10	Vehicle Operating Costs per km - Cars	62
Table 5-11	Vehicle Operating Costs per km - Mini-Bus and Taxis	63
Table 5-12	Vehicle Operating Costs per km - Light Trucks	64
Table 5-13	Vehicle Operating Costs per km - Heavy Trucks	65
Table 5-14	Road Traffic VKT Estimates	66
Table 5-15	Vehicle Registration VKT Estimates	66
Table 5-16	VKT and VOC Comparisons	68
Table 5-17	Estimated Suez Road Network Age	69
Table 5-18	Resurfacing vs. Rehabilitation - VOC Benefits	70
Table 5-19	The Effects of Road Roughness on VOC	71
Table 5-20	Additional VOC Incurred With Little or No Maintenance	72
Table 5-21	Economic Benefits	74
Table 5-22	Costs per Vehicle: Road Maintenance vs. Little or No Road Maintenance	75

DEVELOPMENT OF SUEZ GOVERNORATE ROADS DIRECTORATE

STREET AND ROAD MAINTENANCE MANAGEMENT SYSTEM

1. INTRODUCTION

1.1 General

In August 1988, Wilbur Smith Associates submitted a **"Proposal for the Development of Suez Governorate Roads Directorate"** to H.E. Tahseen Shanan, Governor of the Suez Governorate. In this proposal it was recommended that a special project be implemented for the reorganization and training of personnel in the Suez Governorate Roads Directorate. The above mentioned proposal culminated from a study undertaken by Wilbur Smith Associates in October 1987 entitled **"Road and Street Maintenance - Suez Governorate"** submitted to the US Agency for International Development, Cairo.

The **"Proposal for the Development of Suez Governorate Roads Directorate"** detailed seven objectives that were necessary for the reorganization and training of the Suez Governorate Roads Directorate and the implementation of a Road and Street Maintenance Management System. The seven objectives were as follows:

1. Remove existing 10-year old hot-mix asphalt plant from present location next to Suez Road Directorate's garage and maintenance workshop and replace it with suitable fixed or mobile batch plants.

2. Construct new workshop, asphalt laboratory, storeroom, repair shed, and offices at present site according to the concept of figure (1).

3. Equip a small asphaltic-concrete and road materials testing laboratory.

4. Provide necessary workshop equipment and tools.

5. Repair inefficiently operating heavy equipment by contract through private sector firms.

6. Purchase spare parts as required for serviceable machines and heavy equipment.

7. Train and reorganize the Roads Directorate during a period of five months by means of one expatriate and one Egyptian national road maintenance specialist.

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An agreement was reached between the Suez Government, US AID and Wilbur Smith Associates to implement this special project. On November 8, 1989 a seminar was held in Suez to discuss the planning and execution of said project. Below is a list of the main points discussed during this seminar (Detailed "Seminar Conclusions and Outputs" are given in the Appendix A of this report).

1. Maintenance Management System
2. Staffing
3. Training
4. Road Equipment Needs
5. Road Maintenance Planning
6. Road Maintenance Budgets

This report covers the seven objectives outlined in the "Proposal for the Development of Suez Governorate Roads Directorate", street and road maintenance objectives, status of US AID funds, background of street maintenance activities of the Suez Roads Directorate and the implementation procedures for a Street and Road Maintenance Management System for the Suez Roads Directorate.

A Street and Road Maintenance Management System - OPERATIONS MANUAL, in English and Arabic, for the use of all field engineers and other personnel involved in street and road maintenance, has also been prepared in conjunction with this report.

1.2. STREET AND ROAD MAINTENANCE OBJECTIVES

The objective of a good street maintenance program is to provide smooth, safe, and durable streets for the most economical cost.

Many general studies have been undertaken in the past to evaluate the necessity and cost effectiveness of street and road maintenance. The conclusion always is - maintenance is essential. This subject, as it relates to Suez, is discussed in the economic evaluation section of this report.

The following are explanations of street and road conditions and maintenance definitions as used in this report. These definitions are also basically applicable for dirt streets, curbstone repairs, sidewalk repairs, etc. The words street and road are interchangeable terms throughout this report.

STREET & ROAD CONDITIONS

A. GOOD-Paved streets substantially free of defects and requiring only routine maintenance. Unpaved streets needing only routine grading and spot repairs.

B. FAIR - Paved streets having significant defects requiring extensive maintenance. Unpaved street needing extensive spot repairs and reshaping.

C. POOR - Paved streets with extensive defects, requiring immediate rehabilitation or reconstruction. Unpaved streets needing reconstruction.

MAINTENANCE DEFINITIONS

A. ROUTINE MAINTENANCE - For streets in good condition, routine maintenance is generally the most cost effective use of funds.
(1) Pothole patching
(2) Skin patching
(3) Leveling small depressions
(4) Crack repairs
(5) Utility cut repairs

B. PREVENTIVE MAINTENANCE-For streets in fair condition. This type of maintenance is necessary to prevent deterioration of the street before the street turns into one that is classified as poor condition.
(1) Pothole patching
(2) Short asphalt overlays

C. REHABILITATION-For streets that are between fair and poor condition but are still structurally strong. These streets can be rehabilitated to begin a new surface life.
(1) Pothole patching
(2) Leveling with asphalt
(3) Complete overlay with asphalt

D. RECONSTRUCTION-For streets in very poor condition and at the end of their life cycle. This involves the replacement of the entire pavement structure.
(1) Excavate existing street structure
(2) Place new base course
(3) New asphaltic concrete pavement

The overall objective for the street maintenance phase of this special project was to implement a street Maintenance Management System, train field personnel in the correct methods of street maintenance, recommend reorganization of the Roads

Directorate so as to obtain more efficiency, and instigate better utilization of maintenance equipment.

1.3. US AID FUNDS

The "Proposal for the Development of Suez Governorate Roads Directorate" recommended that the following funds be allocated for this special project.

A.	Equipment Cost (including spare parts)	LE 540,000
B.	Construction Cost	LE 200,000
C.	Heavy Equipment Repair Cost	LE 45,000
	Total	LE 785,000

The Governorate of Suez received LE 785,000 from USAID on September 9, 1989 and the allocation of these funds was distributed as follows:

A.	Equipment Cost	
(1)	Purchase asphalt batch plant	LE 502,000
(2)	Procurement of lab equipment	LE 28,000
(3)	Procurement-workshop tools & equip.	LE 10,000
	Subtotal	LE 540,000
B.	Construction of administration, garage and workshop buildings	LE 200,000
C.	Repair of heavy equipment	LE 45,000
	Total	LE 785,000

A. summary of expenditures to May 30, 1990 is as follows:

A.	Advertising in local paper for	
	Proposed work	LE 1,531
	Purchase of lab equipment	LE 23,063
	Procurement of tools & equipment	LE 5,690
B.	Soil investigations - buildings	LE 2,000
C.	Repair of heavy equipment	LE 24,951
	Total	LE 57,235

Balance remaining in fund = LE 727,765

2. OVERVIEW OF OBJECTIVES OUTLINED IN PROPOSAL

Each of the seven objectives from the "Proposal for the Development of Suez Governorate Roads Directorate" have been analyzed and evaluated as to the progress accomplished to date. They are listed below in sequence.

2.1 Asphalt Plant

Remove existing 10-year old hot-mix asphalt plant from present location next to Suez Road Directorate's garage and maintenance workshop and replace it with a suitable fixed or mobile batch plant (s).

This subject is covered comprehensively in appendix B to this report; the conclusion of which states 'the most cost effective and risk averse option is to buy two mobile asphalt plants, and scrap the old plant'.

2.2 Workshops, Laboratory, Stores and Offices

Construct new workshops, Asphalt laboratory, storeroom, repair shed, and offices at present site according to the concept of figure (1)

The original design done by the Suez Governorate and the Suez Roads Directorate was for a two story office building. The estimated cost was LE 410,000 and was not accepted. The next design was completed in March 1990 for a one story building at an estimate cost of LE 230,000. This design was revised and the building size was reduced in June 1990. The engineers estimate for construction of the buildings is now LE 200,000. Necessary bidding documents have been completed but it has not been put out for tender as of the writing of this report.

Allocation of funds for this item is LE 200,000. It is estimated that it will take 8 months to complete the buildings after the contract is let.

The following is the status of funds as of May 30, 1990.

Allocated funds	LE 200,000
Expended	LE 2,000

Balance remaining	LE 198,000

2.3 EQUIP A SMALL ASPHALTIC-CONCRETE AND ROAD MATERIALS TESTING LABORATORY

A list of the necessary laboratory equipment was made up by the Suez Roads Directorate personnel in cooperation with Wilbur Smith Associates engineers. On December 13, 1989 a tender was made and 9 suppliers provided prices. A committee made up of Suez Governorate and Suez Roads Directorate personnel evaluated all the proposals on January 14, 1990. The decision was made to purchase individual pieces of laboratory equipment from the supplier that quoted the lowest price for that item. Most of the equipment had been purchased by May 30, 1990. The following is the status of funds as of May 30, 1990.

Allocated funds	LE 28,000
Expended	LE 23,063

Balance remaining	LE 4,937

2.4 PROVIDE NECESSARY WORKSHOP EQUIPMENT AND TOOLS

Small tools have been purchased that were necessary for the street maintenance crews. These tools consisted of brooms, rakes, hand tampers, shovels, etc. The total amount spent to date is LE 1,700. A vibratory hand compactor was purchased for LE 3,990. The following is the status of funds as of May 30, 1990.

Allocated funds	LE 10,000
Expended	LE 5,690

Balance remaining	LE 4,310

2.5 REPAIR INEFFICIENTLY OPERATING HEAVY EQUIPMENT BY CONTRACT THROUGH PRIVATE SECTOR FIRMS

The following equipment has been repaired:

Crane	LE 2,370
Roller	LE 2,581
Motor Grader	LE 16,789
Pickup trucks	LE 3,211

Total	LE 24,951

Presently under contract for repair (not paid yet) are the following pieces of equipment.

Motor Grader/Bulldozer	LE 16,000
2 Trucks	LE 4,000

Total	LE 20,000

The following is the status of funds as of May 30, 1990 (including work under contract).

Allocated funds	LE 45,000
Expended	LE 44,951

Balance remaining	LE 49

The majority of the equipment in the Suez Roads Directorate is mechanically operable. Table 2.1 lists the present equipment at the Roads Directorate, estimated life and replacement costs.

2.6 PURCHASE SPARE PARTS AS REQUIRED FOR SERVICEABLE MACHINES AND HEAVY EQUIPMENT

There have been no spare parts purchased as of this date and there are none in stock. The spare parts that are essentially needed at this time are listed below.

Tires for most of the equipment	LE 122,000
Batteries for most of the equipment	LE 22,000
Spare parts	LE 130,000

Total	LE 274,000

It was anticipated that funds for these items might come from the repair of heavy equipment allocation but this money has been expended.

Table 2-1

Road Maintenance Vehicle and Equipment Inventory and Replacement Costs (LE 1,000)

Plate # (1)	Trucks and Pickups	Date of Recpt	Equip Life (2)	Purchaser	1990 Cost L.E	Present Value Cost in Replacement Year - LE 1,000 (3)																			
						1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
614	Pickup (Datsun 1800)	1980	12	GOE BAB III	25		25												25						
615	Pickup (Datsun 1800)	1980	12	GOE BAB III	25		25												25						
640	Pickup (Chevrolet)	1981	12	GOE BAB III	25			25												25					
641	Pickup (Chevrolet)	1981	12	GOE BAB III	25			25												25					
616	Dump Truck (Nasr 125)	1983	10	GOE BAB III	80			80										80							
617	Dump Truck (Nasr 125)	1983	10	GOE BAB III	80			80										80							
619	Dump Truck (Nasr 125)	1983	10	GOE BAB III	80			80										80							
624	Dump Truck (Nasr 125)	1983	10	GOE BAB III	80			80										80							
626	Dump Truck (Nasr 125)	1979	10	GOE BAB III	80	80										80									
627	Dump Truck (Nasr 125)	1979	10	GOE BAB III	80	80										80									
635	Dump Truck (Mgrs 22-	1985	10	GOE BAB III	80					80										80					
636	Dump Truck (Mgrs 22-	1985	10	GOE BAB III	80					80										80					
637	Dump Truck (Mgrs 22-	1985	10	GOE BAB III	80					80										80					
631	Dump Truck (Nasr 125)	1983	10	GOE BAB III	80			80										80							
632	Dump Truck (Nasr 125)	1979	10	GOE BAB III	80	80										80									
633	Dump Truck (Nasr 125)	1983	10	GOE BAB III	80			80										80							
634	Dump Truck (Nasr 125)	1983	10	GOE BAB III	80			80										80							
638	Dump Truck (Nasr 125)	1979	10	GOE BAB III	80	80										80									
630	Mobil Workshop (Intl)	1982	15	USAID	150							150													
625 *	Trans Tr 3 ts (Nasr)	1983	12	GOE BAB III	50					50												50			
613	Water Tank Veh. (Fiat)	1981	12	Italian	100			100												100					
	Equipment																								
658	Bulldozer (FIAT ALIS)	1976	12	Min of Renstr	50	50												50							
659	Bulldozer (FIAT ALIS)	1976	12	Min of Renstr	50	50												50							
660	Bulldozer (J Deere)	1979	12	GOE BAB III	50	50												50							
661 *	Bulldozer (J Deere)	1983	12	GOE BAB III	50					50												50			
680 *	Bulldozer (D126)	1988	12	GOE BAB III	50										50										
654	Grader (EFLING)	1979	15	GOE BAB III	50				50															50	
655	Grader (Frisch 145)	1981	15	Min of Renstr	50						50														
656 *	Grader (John Deere)	1982	15	USAID	50							50													
657	Grader (Frisch 145)	1977	15	Min of Renstr	50		50															50			
674 *	Grader (Frisch 155)	1986	15	Min of Renstr	50											50									

Table 2-1 (Continued)

Road Maintenance Vehicle and Equipment Inventory and Replacement Costs (LE 1,000)

Plate # (1)	Equipment (Cont...)	Date of Recpt	Equip Life (2)	Purchaser	1990 Cost LE	Present Value Cost in Replacement Year - LE 1,000 (3)																			
						1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
651	Loader (Frisch 150)	1977	8	Min of Renstr	50	50								50								50			
652	Loader (J Deere 55c)	1979	8	GOE BAB III	50	50								50								50			
653	Loader (Frish 1300)	1986	8	GOE BAB III	50				50								50								
672 *	Loader (OCB 410)	1985	8	GOE BAB III	50			50								50									
673	Loader (Frisch 2000)	1987	8	GOE BAB III	50					50								50							
663	Roller (Albare AT10)	1978	15	Min of Renstr	50			50															50		
664 *	Roller (Albare AT10)	1978	15	Min of Renstr	50			50															50		
666 *	Roller (Demag WZ.70)	1979	15	Min of Renstr	50				50															50	
677	Roller (DV 60)	1986	15	Min of Renstr	50											50									
678	Roller (DV 60)	1986	15	Min of Renstr	50											50									
Other Road Maintenance Equipment Replacement Ests.																									
668	Asphalt Cutter	1987	10	GOE BAB III	120							120										120			
669 *	Crane (Midland)	1980	na	GOE BAB III	na																				
670	Dumper	1983	8	Italian	30	30								30								30			
671 *	Dumper	1983	8	Italian	30	30								30								30			
—	Asphalt Batch Plant	na	na	na	na																				
—	Asphalt Boiler (5)	1980		GOE BAB III	na																				

Total Annual Road Maintenance Truck, Pickup and Equipment Replacement Costs:

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Pickup	0	50	50	0	0	0	0	0	0	0	0	0	0	50	50	0	0	0	0	0
Dump Truck	320	0	560	0	240	0	0	0	0	0	320	0	560	0	240	0	0	0	0	0
Bulldozer	150	0	0	0	50	0	0	0	0	50	0	0	150	0	0	0	50	0	0	0
Grader	0	50	0	50	0	50	50	0	0	0	50	0	0	0	0	0	50	0	50	0
Loader	100	0	50	50	50	0	0	0	100	0	50	50	50	0	0	0	100	0	0	0
Roller	0	0	100	50	0	0	0	0	0	0	100	0	0	0	0	0	0	100	50	0
Other	60	0	100	0	50	0	270	0	60	0	0	0	0	0	100	0	230	0	0	0
TOTAL	630	100	860	150	390	50	320	0	160	50	520	50	760	50	390	0	430	100	100	0

(1) "*" Signifies major repair required.

(2) Based on WSA Certification Training Report; Compiled from GOE records, and TAC and private contractor reports.

(3) Current, 1990, Costs - inflationary impacts are not included.

3 TRAINING AND REORGANIZATION

3.1 BACKGROUND

In response to the proposed requirement to train and reorganize the Road Directorate during a period of five months by means of one expatriate and one Egyptian national road maintenance specialist, a Wilbur Smith Associates expatriate engineer with expertise in street and road maintenance procedures and Maintenance Management Systems was stationed in Suez on February 14, 1990 . No maintenance of asphalt streets, curbs, or sidewalks was being undertaken at this time. No planning was being done and there was no money available to purchase asphalt concrete or sidewalk tiles. The essential equipment such as air compressor and dumpster were not operable and no small compactor was available to compact base course and asphalt mix in confined areas. Small tools necessary for asphalt street maintenance were worn out or non existent. The organization of the Suez Roads Directorate was not set up for street maintenance operations. Personnel in the Roads Directorate had very little knowledge of how to repair asphalt streets.

The Suez Roads Directorate has been reorganized to include a street maintenance department, training of engineers and foremen has been undertaken, equipment has been repaired and purchased, and the materials necessary to repair streets and sidewalks have been purchased. Actual street, curb and sidewalk repairs started on March 26, 1990. As mentioned above, no street maintenance was being undertaken when this special project started. Between March 26, 1990 and June 5, 1990 the following amount of work had been accomplished under the supervision of the expatriate Maintenance Management System specialist; asphalt pavement repairs - 428 m2, curbstone replacements - 955 lin. m, sidewalk tile replaced - 154 m2, streets cleaned - 8,542 m2, and dirt streets graded - 27,300 m2. In addition to this work, the Suez Roads Directorate continually carried out their program of building and grading streets in the New Cities.

The following sections will cover all the points mentioned above, problems met, accomplishments achieved and procedures used to set up a Street and Road Maintenance Management System in the Suez Roads Directorate.

3.2 REORGANIZATION OF THE SUEZ ROADS DIRECTORATE

Discussions and meetings were held with the Suez Governorate, Suez Roads Directorate and Wilbur Smith Associates to evaluate the best way to reorganize the Roads Directorate so as to include a separate section for street and road maintenance. The initial reorganization was predicated on using the present personnel and equipment available in the Roads Directorate. The original organization chart of the Roads Directorate when this special project started is shown on the organization chart dated January 1990. The revised organization that is now

being used is shown on the chart dated June 1990. Knowing that the Roads Directorate will need to be reorganized once an asphalt plants is in operation, recommendations for the future organization have been prepared. This chart is entitled 'Proposed Organization Chart'.

3.3 TRAINING

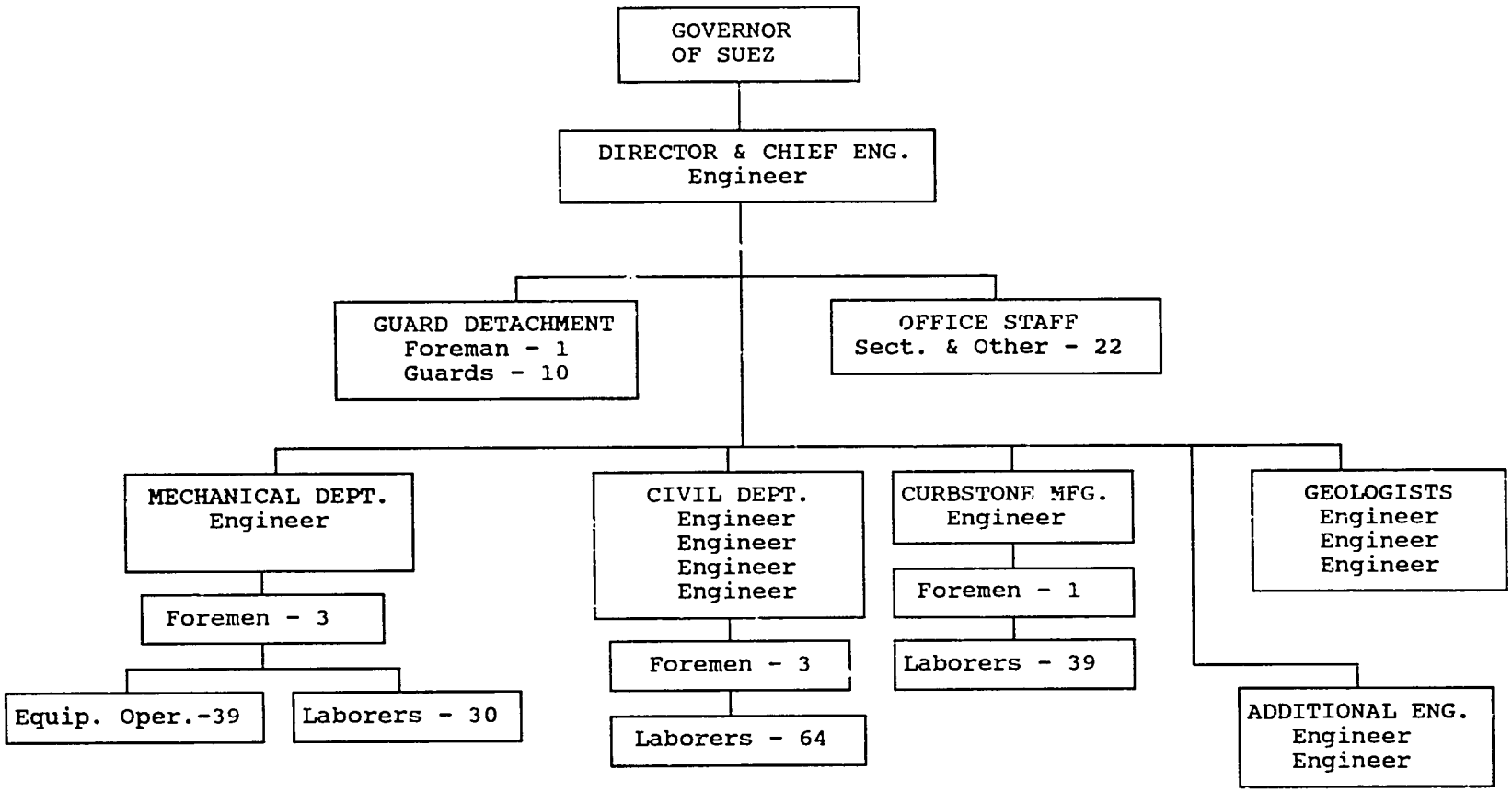
Training of engineers and foremen in the correct methods of street repairs and maintenance was a continuous operation throughout this special project. Instructions in the field on the correct methods of patching potholes, alligator cracks, depressions, utility cuts, etc. was extensive. Class instruction and critiques of work methods used were carried out in the Roads Directorate field office using a blackboard and handouts. The field training on the correct methods of repairing asphalt streets by patching potholes and repairing surface defects was undertaken in the Suez District at Baladia street, Amro Ben El Ess street, and Sayed Glool street. In the Arbeen district, training was carried out on Ahmed Orabe street. Eben el Garah street in the Arbeen district was chosen for the little training that was necessary for grading operations for an unpaved street. Curbstone replacement and sidewalk tile replacement was carried out at Sayed Zaglol street, Baladia street, Osama Street, and around the old Suez Governorate building.

International Road Federation videotapes -- 18 modules of the Road Maintenance Series were shown to engineers, foremen and equipment operators at the Suez Information Complex. These showings took place on April 17 and May 2, 8, and 15. Modules directly pertaining to asphalt pavement repair and maintenance were shown three times in order to emphasize the importance of correct methods of patching and repairing asphalt streets. All participants were very interested and involved themselves in the discussions after each module was shown.

3.4 MATERIALS NEEDED FOR STREET MAINTENANCE

Curbstones were fabricated at the Suez Roads Directorate yard so there were no problems with their supply. Sidewalk tiles and asphaltic concrete had to be purchased. On March 13th, an agreement was reached between the Suez Governorate and Arbeen District in which Arbeen District agreed to provide LE 25,000 for the purchase of asphaltic concrete and sidewalk tiles. A meeting was held in the Arbeen Districts offices with Suez Roads Directorate engineers and Wilbur Smith Associates to finalize procedures on this matter. Three contractors capable of supplying asphalt mix were visited by Roads Directorate engineers and Wilbur Smith Associates to determine the quality of their mixes and supply capabilities. The three suppliers were - Him Don Co., Nile Construction Co., and Arab Contractors. The decision was made to purchase the mix from Arab Contractors and Arbeen District formalized a contract with them. On March 26th the Suez Roads Directorate received their first load of asphaltic concrete for street repairs.

SUEZ ROADS DIRECTORATE
ORGANIZATION CHART
(JANUARY 1990)



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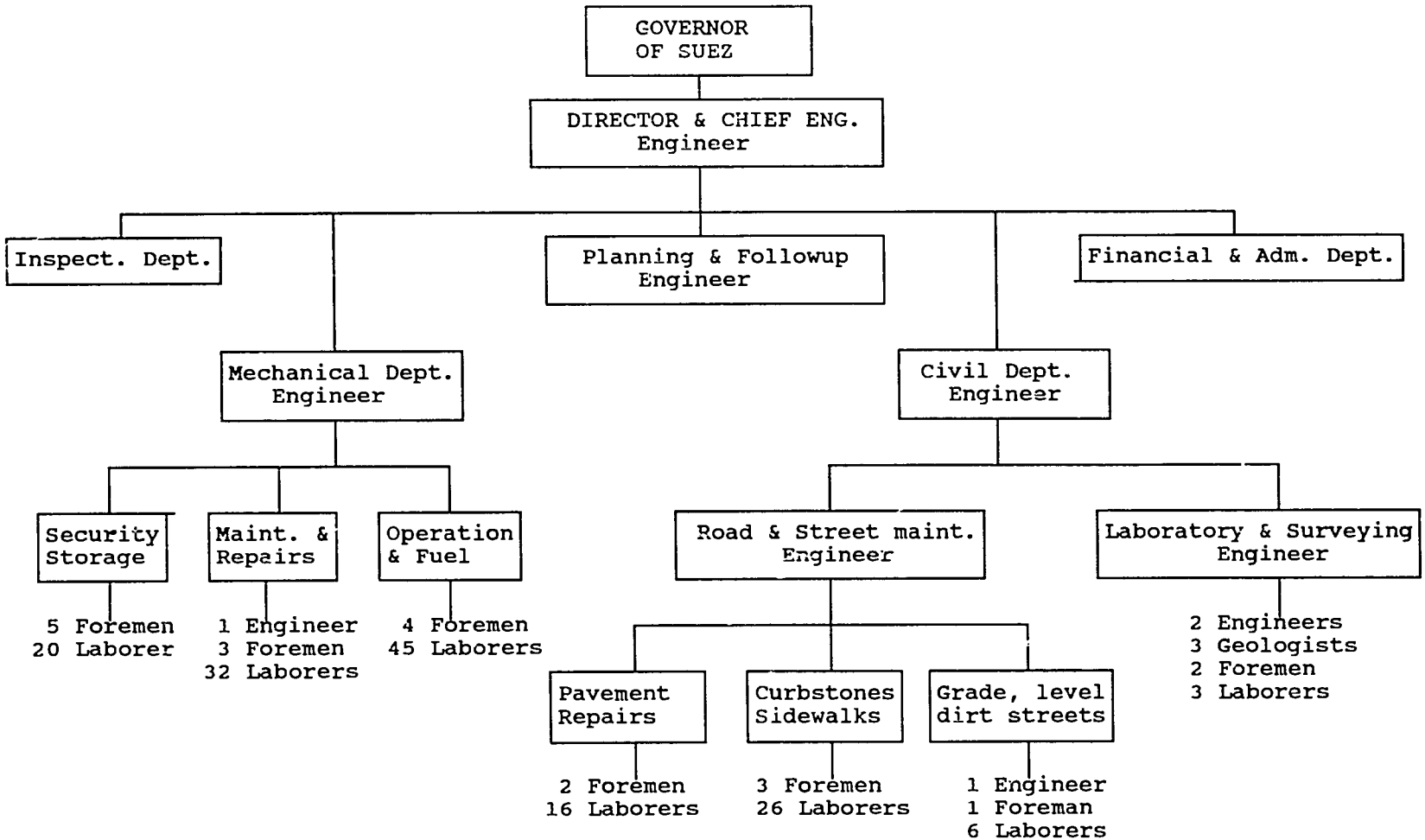
SUEZ ROADS DIRECTORATE
ORGANIZATION CHART
(JUNE 1990)



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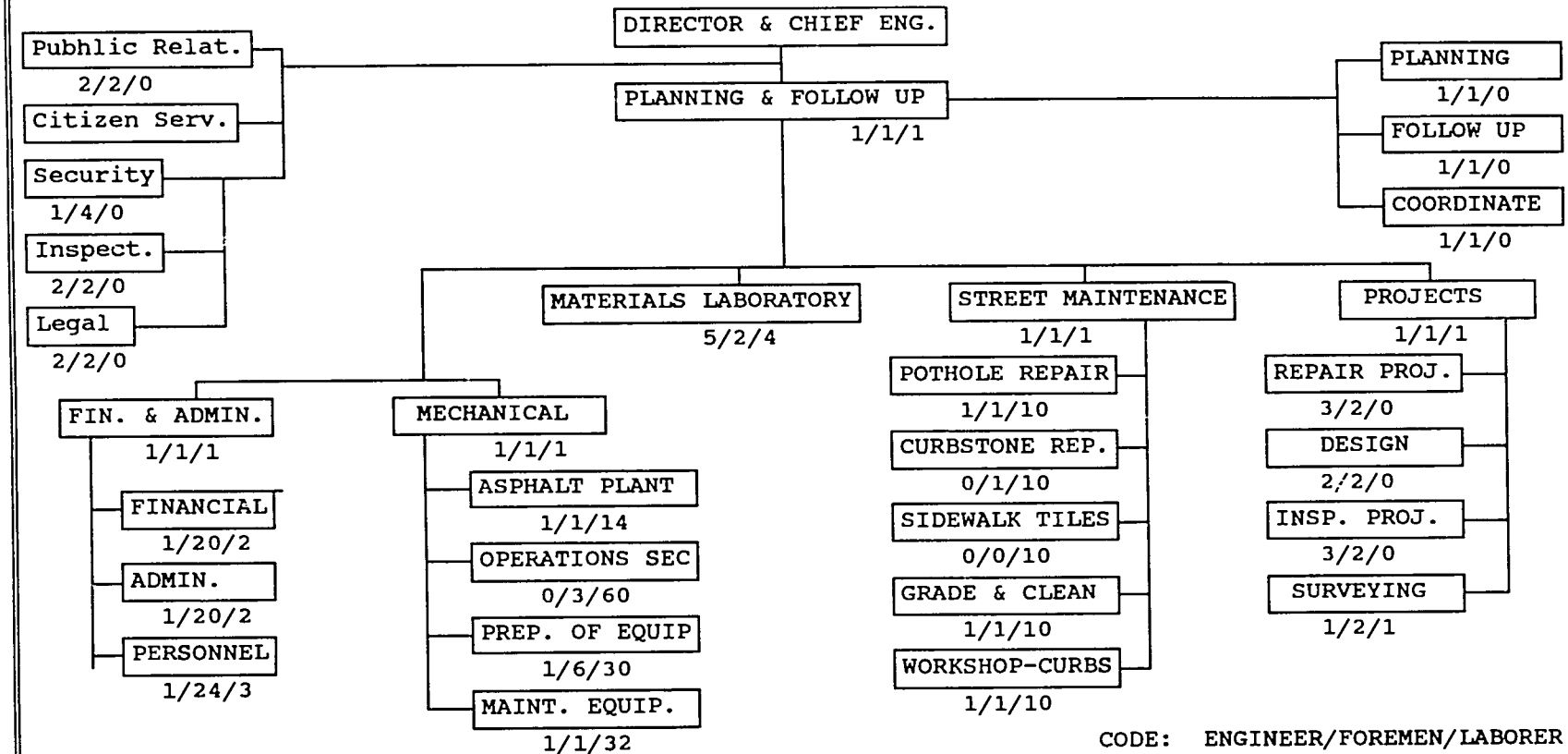
SUEZ ROADS DIRECTORATE PROPOSED ORGANIZATION CHART



/OCHT-PRP

3.5 EQUIPMENT NECESSARY FOR ROAD MAINTENANCE

By the middle of March, both the air compressor and the dumpster were in operation as well as the heavy equipment necessary for road grading and leveling. The small tools necessary for street repairs had been purchased. A power sweeper would have been beneficial, but there was not one available during the training period. When the problem of the supply of asphalt concrete was solved, street repairs commenced. For better quality work, two pieces of equipment were still needed - a hand vibratory compactor and a small spray distributor. The hand vibratory compactor arrived late May and the purchase of a small distributor is still being investigated at the time of writing this report.

3.6 REPAIR OF UTILITY CUTS

At the present time there is very little information transfer between the utility companies and the Suez Roads Directorate. The Roads Directorate do not know when utility cuts have been made and consequently they do not get repaired expeditiously. The Utility companies presently deal directly with the Districts who receive the money that the utility company pay. This procedure is now in the process of being revised. The Suez Roads Directorate is to request the General Secretary in writing to have all funds from the utility company sent directly to the Roads Directorate. Wilbur Smith Associates has advised that a meeting be held with all utility companies, District Engineers, Suez Governorate personnel, Suez Roads Directorate Engineers and Wilbur Smith Associates to set up procedures in writing between all parties concerned so that the Roads Directorate and Districts know before hand when and where utility cuts will be made. If this procedure is followed, there should be no delay in the repair of utility cuts.

3.7 STREET & ROAD MAINTENANCE MANAGEMENT SYSTEM

A Street & Road Maintenance Management System provides Roads Directorate engineers with a logical approach to planning, organizing, scheduling and controlling maintenance work. The key elements of this Maintenance Management System are to:

A. Develop a prioritised Annual Work Program.
B. Adjust the Annual Work Program within budget allocations.
C. Detail Weekly Work Schedules for a full month in advance, rescheduling where necessary.
D. Complete Daily Work Orders at least two days in advance (preferably one week in advance).
E. Record the work performed on the Daily Work Order and the Work Accomplished Summary sheets.

" Examples of A, C, & D are given on the following pages."

SUEZ ROADS DIRECTORATE
ANNUAL WORK PROGRAM

Date Revised: 2 May 1990
Anticipated Work Time - 8 months

Priority Sequence	District	Street	Total Length in mtrs.	Average Width in mtrs.	Area in sq. mtrs.	Estmated Area for Repairs	Estimated Crew Days for Repairs	Notes
1	Arbeen	Ahmed Orabi	750	14	10,500	500	19	
2	Arbeen	Sedkey	700	10	7,000	500	19	
3	Suez	Baladiea	500	20	1,000	300	11	
4	Suez	Port Sayed	2,500	12	30,000	300	11	
5	Arbeen	Army	2,000	16	32,000	200	7	
6	Arbeen	Maher	700	10	7,000	250	9	
7	Arbeen	Tal el Kalzem	650	10	6,500	300	11	
8	Suez	El Galoa	400	15	6,000	125	5	
9	Suez	Amro Benel Asa	300	16	4,800	80	3	
10	Suez	Abdel Khalek Sarwat	250	10	2,500	250	9	
11	Suez	El Shohada	700	12	8,400	120	4	
12	Arbeen	Abdel el Hady	250	10	2,500	125	5	
13	Arbeen	Ataka	160	12	1,920	100	4	
14	Suez	Khaled ben el Walied	200	8	1,600	60	2	
15	Arbeen	El Menieo	120	12	1,440	100	4	
16	Arbeen	Howdel Road	300	8	2,400	50	2	
17	Suez	Bank Misr.	500	6	3,000	250	9	
18	Suez	Saad Zaglool	250	10	2,500	75	3	
19	Ataka	Fiasal el Sabah	4,000	10	40,000	1,000	37	

/AWP1

GOVERNORATE OF SUEZ

ROAD & STREET MAINTENANCE
** WEEKLY WORK SCHEDULE **

SUEZ ROADS DIRECTORATE

Starting date 4 / 14 /90 Ending date 4 / 30 /90 Date compiled 4 / 12 /90 Sheet 2 of 5

Work Day	Work Date	Districts	Streets	Detailed Locations	Activity Codes	Work Activities
Wed.	4-18-90	ARBHIN	Ahmed Orabe	Beside El dade st.	03	Pothole, utility cut repairs
- - -	- - - -	Arbhin	Osama	After 40 m from the start	04	Curbstone resetting or replacement
- - -	- - - - - -	Suez	Saad Zaglol	Beside the old Gov. Buil.	08	Footpathe Repair (tile surface)
- - -	- - - - - -	Suez	Saad Zaglol	" " " " "	07	Cleaning
Thur.	4-19-90	Arbhin	Ahmed Orabe	Between Cross of Nadee & el Genuie sts.	03	Pothole utility cut repairs
- - -	- - - - - -	"	Osama	After 70 m from the start	04	Curbstone resetting or replacement
- - -	- - - - - -	Suez	El Galaa	Beside the new Gov. Buil.	07	Cleaning
- - -	- - - - - -	"	Saad Zaglol	Beside the old Gov. Buil.	08	Footpathe repair (tile surface)
Sat.	4-21-90	Arbhin	Ahmed Orabe	Beside el Nagdi st.	03	Pothole utility cut repairs
- - -	- - - - - -	"	Osama	at the middle of st.	04	Curbstone resetting or replacement
- - -	- - - - - -	Suez	El Galaa	Beside the old Gov. Buil.	07	Cleaning
- - -	- - - - - -	"	Salah Salem	" " " " "	08	Footpathe repair (tile surface)

NOTES: Work under each Activity Code is to be listed separately.
The "WEEKLY WORK SCHEDULES" are to be updated whenever any changes occur.
At least one months of "WEEKLY WORK SCHEDULES" are to be posted on the Roads Directorate bulletin board.

WMS1

GOVERNORATE OF SUEZ — SUEZ ROADS DIRECTORATE

ROAD & STREET MAINTENANCE
** DAILY WORK ORDER **

DATE 22/5/90 — Sheet 1 of 3

Refer to PERFORMANCE STANDARDS - Activity Codes - for Crew sizes, Equipment needs, materials needs and Work Methods. Use a seperate sheet for each "Work Activity". List the crew, equipment, materials, and production you have planned to use on the left side of this form. Upon completion of the work day, you complete the right side of this form and show the actual crew, equipment, materials, and production that was accomplished for this "Work Activity".

WORK ACTIVITY Pothole & Utility cut Repairs — ACTIVITY CODE 03

District SUEZ — Street ELBALADYA
Location on street in medium street

Crew Planned				Crew Used			
Foremen	1	Skilled Laborer	3	Foremen	1	Skilled Laborer	3
Laborer	9	Equipment Oper.	4	Laborer	9	Equipment Oper.	4

Equipment Planned				Equipment Used			
Dump truck	1	Shovels	4	Dump truck	1	Shovels	4
Tractor w/d	1	Rakes	3	Tractor w/d	1	Rakes	3
Compressor	1	Hand Tampers	2	Compressor	1	Hand Tampers	2
Roller		paint brushes	3	Roller	1	paint brushes	2
Barrel w/wa		Straight edge	1	Barrel w/wa		Straight edge	1
Buckets	4	Cones	5	Buckets	3	Cones	5
Brooms	4			Brooms	3		
picks	3			picks	3		

Materials Planned			Materials Used		
Bitum. Tack	30	ltr.	Bitum. Tack	20	ltr.
Diesel	20	ltr.	Diesel	10	ltr.
Asphalt Mix	4	m3	Asphalt Mix	4	m3
Tiles		ea.	Tiles		ea.
Curbstones		ea.	Curbstones		ea.
Bedding sand		m3	Bedding sand		m3
Mortar sand		m3	Mortar sand		m3
Cement		bags	Cement		bags
Mortar		m3	Mortar		m3

Production Planned			Production Actual		
Asphalt mix	4	m3	Asphalt mix	4	m3
Potholes	51	m2	Potholes	24	m2
Surface Repair		m2	Surface Repair		m2
Curbstones		ea.	Curbstones		ea.
Curbstone placing		lin. m.	Curbstone placing		lin. m
Sidewalk tiles		ea.	Sidewalk tiles		ea.
Sidewalk placing		m2	Sidewalk placing		m2
Street cleaning			Street cleaning		
Street grading			Street grading		

Work Hours Planned 4.__ hrs. — Work Hours Actual 3.5 hrs.
CWO

GOVERNORATE OF SUEZ — SUEZ ROADS DIRECTORATE

ROAD & STREET MAINTENANCE
** DAILY WORK ORDER **

DATE 22/5/90 — Sheet 2 of 3

Refer to PERFORMANCE STANDARDS - Activity Codes - for Crew sizes, Equipment needs, materials needs and Work Methods. Use a seperate sheet for each "Work Activity". List the crew, equipment, materials, and production you have planned to use on the left side of this form. Upon completion of the work day, you complete the right side of this form and show the actual crew, equipment, materials, and production that was accomplished for this "Work Activity".

WORK ACTIVITY Curbstone Re-setting or Replacement — ACTIVITY CODE 04

District SUEZ — Street ELBALADYA
Location on street Beside SUEZ Centeral station

Crew Planned				Crew Used			
Foremen	1	Skilled Laborer		Foremen	1	Skilled Laborer	
Laborer	4	Equipment Oper.	1	Laborer	4	Equipment Oper.	1
masons	2			masons	2		

Equipment Planned				Equipment Used			
Dump truck	1	shovels	2	Dump truck	1	shovels	2
Tractor w/d		Buckets	2	Tractor w/d		Buckets	2
Compressor				Compressor			
Roller				Roller			
Barrel w/wa				Barrel w/wa			
picks	2			picks	2		
straightedge	1			straightedge	1		
stringline	1			stringline	1		

Materials Planned			Materials Used		
Bitum. Tack		ltr.	Bitum. Tack		ltr.
Diesel		ltr.	Diesel		ltr.
Asphalt Mix		m3	Asphalt Mix		m3
Tiles		ea.	Tiles		ea.
Curbstones	60	ea.	Curbstones	60	ea.
Bedding sand		m3	Bedding sand		m3
Mortar sand	0.2	m3	Mortar sand	0.1	m3
Cement	0.5	bags	Cement	0.5	bags
Mortar		m3	Mortar		m3

Production Planned			Production Actual		
Asphalt mix		m3	Asphalt mix		m3
Potholes		m2	Potholes		m2
Surface Repair		m2	Surface Repair		m2
Curbstones	60	ea.	Curbstones	60	ea.
Curbstone placing	30	lin. m.	Curbstone placing	30	lin. m
Sidewalk tiles		ea.	Sidewalk tiles		ea.
Sidewalk placing		m2	Sidewalk placing		m2
Street cleaning			Street cleaning		
Street grading			Street grading		

Work Hours Planned 3.5 hrs. — Work Hours Actual 3.— hrs.

OWO

GOVERNORATE OF SUEZ — SUEZ ROADS DIRECTORATE

ROAD & STREET MAINTENANCE

** DAILY WORK ORDER **

DATE 22/5/90 — Sheet 3 of 3

Refer to PERFORMANCE STANDARDS - Activity Codes - for Crew sizes, Equipment needs, materials needs and Work Methods. Use a seperate sheet for each "Work Activity". List the crew, equipment, materials, and production you have planned to use on the left side of this form. Upon completion of the work day, you complete the right side of this form and show the actual crew, equipment, materials, and production that was accomplished for this "Work Activity".

WORK ACTIVITY Footpaths Repair (Tiles surface) — ACTIVITY CODE 08

District SUEZ — Street So Rd. Zaglol

Location on street Behind Governorate of SUEZ Building old

Crew Planned				Crew Used			
Foremen	1	Skilled Laborer		Foremen	1	Skilled Laborer	
Laborer	4	Equipment Oper.	1	Laborer	4	Equipment Oper.	1
masons	2			masons	2		

Equipment Planned				Equipment Used			
Dump truck	1			Dump truck	1		
Tractor w/d				Tractor w/d			
Compressor				Compressor			
Roller				Roller			
Barrel w/wa				Barrel w/wa			
picks	2			picks	2		
shovels	2			shovels	2		
straightedge	1			straightedge	1		

Materials Planned			Materials Used		
Bitum. Tack		ltr.	Bitum. Tack		ltr.
Diesel		ltr.	Diesel		ltr.
Asphalt Mix		m3	Asphalt Mix		m3
Tiles	250	ea.	Tiles	250	ea.
Curbstones		ea.	Curbstones		ea.
Bedding sand	0.1	m3	Bedding sand	0.1	m3
Mortar sand	0.2	m3	Mortar sand	0.2	m3
Cement	0.5	bags	Cement	0.5	bags
Mortar		m3	Mortar		m3

Production Planned			Production Actual		
Asphalt mix		m3	Asphalt mix		m3
Potholes		m2	Potholes		m2
Surface Repair		m2	Surface Repair		m2
Curbstones		ea.	Curbstones		ea.
Curbstone placing		lin. m.	Curbstone placing		lin. m
Sidewalk tiles	250	ea.	Sidewalk tiles	250	ea.
Sidewalk placing	10	m2	Sidewalk placing	10	m2
Street cleaning			Street cleaning		
Street grading			Street grading		

Work Hours Planned 4 hrs. — Work Hours Actual 3 hrs.

DWO

A Street & Road Maintenance Management System has been implemented at the Suez Roads Directorate. This system is tailored to meet the needs of the Suez Road Directorate and other Roads Directorates that might have similar maintenance operations. The five key elements are discussed below in more detail and their relationship in implementing the Street & Road Maintenance System for the Suez Roads Directorate is given.

A. An eight month work program has been developed by the Roads Directorate for asphalt street pavement repairs, curbstone realignment and replacement and sidewalk repairs. Priorities of work have been set taking into consideration the amount of repairs necessary and the traffic volume using the streets. See sample sheet for full details on this work program. A map of Suez is on the wall in the Roads Directorate office showing the streets designated for repairs.

B. The overall budgeting allocations cannot be addressed at this time because of unknown factors concerning the budget. In order to adjust the work program within budget constraints, it is necessary to know the prices of materials as well as equipment and labor costs. Suez Roads Directorate materials costs (MATCOST) as of May 30, 1990 are shown on table 3-1. The economic evaluation and interrelationship between materials, equipment and labor costs is covered later in this report.

C. It is essential that Weekly Work Schedules be completed for at least one month in advance of when the work is to be accomplished. In this way, planning of work in advance can anticipate personnel, equipment and materials needs. If equipment is in need of repair, time is available for repair, if personnel are on vacation, time is available to find substitutes; and by scheduling in advance time is available to order the materials that are necessary to do the work. However, because of unforseen circumstances, rescheduling of the work may be necessary and, this should be considered as an ongoing operation. Schedules of work for a one month period should be posted on the Roads Directorate bulletin board. Each 'Weekly Work Schedule" sheet has space for three days work. All items on this form are filled in and revised when necessary.

D. A "Daily Work Order" form should be filled in for each activity that is to be undertaken on any particular day. This form is the backbone of the daily work, in that it details all information necessary to carry out the activity planned. The 'Daily Work Order' references the 'Performance Standard', which is be discussed below, for each activity. The first section of the Daily Work Order lists the date the work is to be done, the work activity, the activity code and the exact location of the work. The main part of the form is divided into two sections - the first one lists the crew, equipment, materials, production and hours planned and the second section is used to record what actually took place. This completed form enables the Roads Directorate engineers to compare

Table 3-1

SUEZ ROADS DIRECTORATE

MATERIALS PRICES 23 May 1990

Compiled from Suez Roads Directorate

'Prices in Egyptian Pounds'

Asphalt Mix		
A. Surface-purchased from supplier	32.00	m3
B. Surface-aggreg. & bit. @ Rds. Dir.	14.05	m3
C. Surface-asph. plant cost at Rds. Dir. (present plant repaired)	1.36	m3
D. Surface-total cost @ Rds. Dir. (labor costs not included)	15.41	m3
Aggregates		
A. #1 - 3 mm to 10 mm	15.00	m3
B. #2 - 10 mm to 20 mm	12.00	m3
C. #3 - 20 mm to 30 mm	10.00	m3
D. #6 - 30 mm to 60 mm	6.00	m3
E. Sand	3.00	m3
F. Powder	20.00	ton
Crushed Base Course		
A. Material @ Rds. Dir.	3.00	m3
Bitumen		
A. 60/70 pen. Tanker	50.00	ton
	0.06	ltr
Curbstones		
A. Material @ Rds.Dir.	0.88	ea.
Tiles		
A. Material @ Rds. Dir.	0.16	ea.
Cement		
A. Material @ Rds Dir.	5.00	bag
Mortar		
A. Cement-5 bags + Sand-1 m3	28.00	m3

the amount of work planned with the amount of work accomplished. Examples of Daily Work Orders for Pothole and Utility Cut Repairs, Curbstone Setting and Replacement and Footpath Repairs are given in the section 3.7.

"Performance Standards" were written for all work activities that the Suez Roads Directorate has undertaken since the start of this special project. An additional "Performance Standard" was compiled for asphalt overlays in the anticipation that this work will be undertaken as soon as the Roads Directorate has its own asphalt plant producing asphaltic concrete. The Performance Standards were compiled from actual results of work undertaken by the Roads Directorate since March 26th. They have been revised continually so as to portray actual conditions in the Roads Directorate. They name the work activity, give a code number, state the description and purpose of the work, detail performance guidelines, outline the work methods in sequence, recommend a typical crew size, list the probable equipment needed, and the materials needed for the estimated daily production. Copies of the Performance Standards (PS 02 thru 08) are given in appendix C to this report.

E. The information on the right hand side of the Daily Work Order shows the work accomplished and is recorded on the 'Work Accomplished Summary' sheet and plotted on street maps that are on the walls of the Suez Roads Directorate field office. This is a necessary part of the Street and Road Maintenance Management System since it enables engineers and all others concerned to visually see what work has been accomplished to date.

The Work Accomplished Summary Sheets (WAS) detail on one sheet all aspects of a work activity accomplished. These should be evaluated every six months and the 'Performance Standards' updated accordingly. They should also be used to determine the work capabilities when planning the coming years budget. WAS01 to WAS12 are given in appendix C to this report to show the period from March 26, 1990 to May 20, 1990.

<u>NOTE:</u>

'As a supplement to this report, Wilbur Smith Associates has compiled a "Roads Maintenance Management System - OPERATIONS MANUAL". This Operations Manual is adaptable for all Roads Directorates within the Republic of Egypt. Procedures are fully detailed on how to set up a Street and Road Maintenance Management System, including examples and blank forms to be used by any Roads Directorate for adaptation to their particular maintenance requirements'.

4. FINANCIAL ROAD MAINTENANCE COSTS & PROGRAM BUDGETS

Establishing maintenance quality levels is a matter of economic compromise and practical feasibility. If adequate funds are available then high standards can be adopted, such that the public will enjoy safer and more comfortable travel at low vehicle operating costs. If money and resources are severely limited, then the emphasis must be placed on keeping the streets open, and preventing destruction of the investment. This section addresses the financial costs associated with the proposed road maintenance program and program budgets. In the first section, the methodology for determining the annual financial costs associated with the proposed road maintenance program is outlined. The second section addresses the state of the Roads Directorate's program budget.

4.1 ROAD MAINTENANCE FINANCE

The methodology used in determining the costs associated with the tasks prescribed in the road maintenance program is based on required crew days, performance standards and unit costs. To determine the total number of crew days, the type of work outlined in the performance standards is applied to the current Suez road network. The total number of crew days required are then multiplied by the unit personnel, equipment and raw material costs.

4.1.1 **Road Network** - The inventories of the streets, curbing and side-walk area compiled in the 1987 Road and Street Maintenance Report are used. These inventories are presented in Tables 4-1 to 4-4.

4.1.2 **Derivation of Work Quantities and Crew Days** - To estimate the work quantities and crew days required to maintain the Suez roads, the performance standards presented in Figures PS-02 to PS-08 (in the appendix) have been used. The percentages of road area to be repaired for each performance standard and the maintenance levels are presented in table 4-5. These levels are estimated according to road conditions, e.g. good, fair and poor. The annual work quantities are obtained by mutliplying the maintenance levels by the road and street inventories. These work quantities are then applied to the daily production rates listed in the performance standards to derive the annual crew days. The results, broken down by district, are shown in Tables 4-6 through 4-9, and the summary of crew days required is shown in Table 4-10.

4.1.3 **Resource Needs and Costs** - The resource needs are obtained by applying the number of crew days to the personnel, equipment and material quantities data from the performance standards. Specifically, the resource needs are the total annual personnel, equipment and material amounts needed to perform the prescribed maintenance.

a. Personnel Costs - Before determining the total personnel hours and costs, it is necessary to calculate the total annual hours of work available per employee. The

Table 4-1

Roadway Length in Kilometers

District	Pavement Condition: Good			Medium			Poor			Unpaved			Total	
	No. of Streets	Length (km)	Percent	No. of Streets	Length (km)	Percent	No. of Streets	Length (km)	Percent	No. of Streets	Length (km)	Percent	No. of Streets	Total Length
Arbeen	11	11.2	11.0%	35	6.1	6.0%	9	4.4	4.3%	306	80.4	78.7%	361	102.2
Ataka	0	0.0		26	13.0	55.7%	69	7.1	30.3%	6	3.3	14.0%	101	23.3
Suez	12	15.9	32.7%	37	17.4	35.8%	34	11.7	24.0%	33	3.6	7.4%	116	48.6
Ganaen	0	0.0		2	30.0	100.0%	0	0.0		0	0.0		2	30.0
	23	27.1	13%	100	66.5	33%	112	23.2	11%	345	87.3	43%	580	204.1

Table 4-2

Roadway Area in Kilometers

	Pavement Condition													
	Good			Medium			Poor			Unpaved			Total	
District	No. of Streets	Area (m2)	Percent	No. of Streets	Area (m2)	Percent	No. of Streets	Area (m2)	Percent	No. of Streets	Area (m2)	Percent	No. of Streets	Total Area
Arbeen	11	119,732	15.9%	35	64,294	8.5%	9	31,196	4.1%	306	540,050	71.5%	361	755,272
Ataka	0	0		26	194,640	66.0%	69	64,420	21.8%	6	35,880	12.2%	101	294,940
Suez	12	291,125	46.8%	37	198,347	31.9%	34	111,252	17.9%	33	21,035	3.4%	116	621,759
Ganaen	0	0		2	258,000	100.0%	0	0		0	0		2	258,000
	23	410,857	21%	100	715,281	37%	112	206,868	11%	345	596,965	31%	580	1,929,971

Table 4-3
Curbstone Condition
Curb Length in Linear Meters

	Pavement Condition														
	Good			Medium			Poor			Non-Existent			Total		
District	No. of Streets	Length (km)	Percent	No. of Streets	Length (km)	Percent	No. of Streets	Length (km)	Percent	No. of Streets	Length (km)	Percent	No. of Streets	Total Length	% of Total
Arbeen	16	23,521	11.5%	33	15,529	7.6%	8	8,572	4.2%	304	156,683	76.7%	361	204,305	50%
Ataka	0	0		80	28,340	60.7%	14	15,560	33.3%	7	2,780	6.0%	101	46,680	11%
Suez	3	8,440	8.7%	30	45,460	46.8%	44	32,930	33.9%	39	10,400	10.7%	116	97,230	24%
Ganaen	0	0		0	0		0	0		2	60,000	100.0%	2	60,000	15%
	19	31,961	8%	143	89,329	22%	66	57,062	14%	352	229,863	56%	580	408,215	100%

Table 4-4

Sidewalk Condition

Sidewalk Area in Square Meters

	Sidewalk Condition														
	Good			Medium			Poor			Non-Existent					
District	No. of Streets	Area (m2)	Percent	No. of Streets	Area (m2)	Percent	No. of Streets	Area (m2)	Percent	No. of Streets	Area (m2)	Percent	Total No. of Walks	Total Area	% of Total
Arbeen	93	68,282	33.7%	0	0		30	1,885	0.9%	599	132,551	65.4%	722	202,718	34%
Ataka	2	900	0.6%	130	18,360	12.2%	55	115,620	77.1%	15	15,140	10.1%	202	150,020	25%
Suez	32	60,483	31.5%	2	7,500	3.9%	144	119,342	62.1%	54	4,877	2.5%	232	192,202	32%
Ganaen	0	0		0	0		0	0		4	60,000	100.0%	4	60,000	10%
	127	129,665	21%	132	25,860	4%	229	236,847	39%	672	212,568	35%	1,160	604,940	100%

Table 4-5

Maintenance Level Input

Code	Description	Road Element Name	Road Element Condition	Yearly % of Area or Length	Frequency
02	Short Overlays	Paved Streets	Good	5.00% Area	Continuous
			Medium	7.00% Area	Continuous
			Poor	13.00% Area	Continuous
03	Small Pavement Repair	Paved Surface	Good	0.50% Area	Continuous
			Medium	1.00% Area	Continuous
			Poor	4.00% Area	Continuous
04	Curb Stone Repair	Sectional Curb	Good	1.00% Length	Continuous
			Medium	5.00% Length	Continuous
			Poor	6.00% Length	Continuous
05	Leveling Unpaved Streets	Unpaved Surface		100.00% Length	4 months
06	Grading Unpaved Streets	Unpaved Surface		100.00% Length	Annual
07	Cleaning Paved Streets	Paved Surface		10.00% Area	Annual
08	Footpath Repair	Paved or Tiled		5.00% Area	Annual

Table 4-6

Derivation of Work Quantities and Crew Days

Arbeen District

Code	Description	Type	Condt. Rating	Annual % of Area or Length	Invty Quant	Annual Work Qntys	Daily Prod Rate	Crew Days Rounded-Up
02	Short Overlays	Paved Surf.	Good	5.00%	119,732 m2	5,987 m2	830 m2	
	Short Overlays	Paved Surf.	Med.	7.00%	64,294 m2	4,501 m2	830 m2	18
	Short Overlays	Paved Surf.	Poor	13.00%	31,196 m2	4,055 m2	830 m2	
03	Small Pave Repairs	Paved Surf.	Good	0.50%	119,732 m2	599 m2	70 m2	
	Small Pave Repairs	Paved Surf.	Med.	1.00%	64,294 m2	643 m2	70 m2	32
	Small Pave Repairs	Paved Surf.	Poor	4.00%	31,196 m2	1,248 m2	70 m2	
04	Curb Repair	Sect. Curb	Good	1.00%	23,521 m	235 m	50 m	
	Curb Repair	Sect. Curb	Med.	5.00%	15,529 m	776 m	50 m	31
	Curb Repair	Sect. Curb	Poor	6.00%	8,572 m	514 m	50 m	
05	Grading	Unpaved		100.00%	80,440 m	80.4 km	0.3 km	269
06	Shaping	Unpaved		100.00%	80,440 m	80.4 km	0.5 km	161
07	Cleaning	Paved Surf.		10.00%	215,222 m2	21,522 m2	2,000 m2	11
08	Footpath Repair	Sidewalk		0.50%	70,167 m2	351 m2	12.0 m2	30
Total Crew Days Required								556

Table 4-7

Derivation of Work Quantities and Crew Days

Ataka District

Code	Description	Type	Condt. Rating	Annual % of Area or Length	Invty Quant	Annual Work Qntys	Daily Prod Rate	Crew Days Rounded-Up
02	Short Overlays	Paved Surf.	Good	5.00%	0 m2	0 m2	830 m2	
	Short Overlays	Paved Surf.	Med.	7.00%	194,640 m2	13,625 m2	830 m2	27
	Short Overlays	Paved Surf.	Poor	13.00%	64,420 m2	8,375 m2	830 m2	
03	Small Pave Repairs	Paved Surf.	Good	0.50%	0 m2	0 m2	70 m2	
	Small Pave Repairs	Paved Surf.	Med.	1.00%	194,640 m2	1,946 m2	70 m2	65
	Small Pave Repairs	Paved Surf.	Poor	4.00%	64,420 m2	2,577 m2	70 m2	
04	Curb Repair	Sect. Curb	Good	1.00%	0 m	0 m	50 m	
	Curb Repair	Sect. Curb	Med.	5.00%	28,340 m	1,417 m	50 m	48
	Curb Repair	Sect. Curb	Poor	6.00%	15,560 m	934 m	50 m	
05	Grading	Unpaved		100.00%	3,270 m	3.3 km	0.3 km	11
06	Shaping	Unpaved		100.00%	3,270 m	3.3 km	0.5 km	7
07	Cleaning	Paved Surf.		10.00%	259,060 m2	25,906 m2	2,000 m2	13
08	Footpath Repair	Sidewalk		0.50%	134,880 m2	674 m2	12.0 m2	57
Total Crew Days Required								228

Table 4-8
Derivation of Work Quantities and Crew Days
Suez District

Code	Description	Type	Condt. Rating	Annual % of Area or Length	Invty Quant	Annual Work Qntys	Daily Prod Rate	Crew Days Rounded-Up
02	Short Overlays	Paved Surf.	Good	5.00%	291,125 m2	14,556 m2	830 m2	
	Short Overlays	Paved Surf.	Med.	7.00%	198,347 m2	13,884 m2	830 m2	52
	Short Overlays	Paved Surf.	Poor	13.00%	111,252 m2	14,463 m2	830 m2	
03	Small Pave Repairs	Paved Surf.	Good	0.50%	291,125 m2	1,456 m2	70 m2	
	Small Pave Repairs	Paved Surf.	Med.	1.00%	198,347 m2	1,983 m2	70 m2	113
	Small Pave Repairs	Paved Surf.	Poor	4.00%	111,252 m2	4,450 m2	70 m2	
04	Curb Repair	Sect. Curb	Good	1.00%	8,440 m	84 m	50 m	
	Curb Repair	Sect. Curb	Med.	5.00%	45,460 m	2,273 m	50 m	87
	Curb Repair	Sect. Curb	Poor	6.00%	32,930 m	1,976 m	50 m	
05	Grading	Unpaved		100.00%	3,620 m	3.6 km	0.3 km	13
06	Shaping	Unpaved		100.00%	3,620 m	3.6 km	0.5 km	8
07	Cleaning	Paved Surf.		10.00%	600,724 m2	60,072 m2	2,000 m2	31
08	Footpath Repair	Sidewalk		0.50%	187,325 m2	937 m2	12.0 m2	79
Total Crew Days Required								383

Table 4-9
Derivation of Work Quantities and Crew Days
Ganaen District

Code	Description	Type	Condt. Rating	Annual % of Area or Length	Invty Quant	Annual Work Qntys	Daily Prod Rate	Crew Days Rounded-Up
02	Short Overlays	Paved Surf.	Good	5.00%	0 m2	0 m2	830 m2	
	Short Overlays	Paved Surf.	Med.	7.00%	258,000 m2	18,060 m2	830 m2	22
	Short Overlays	Paved Surf.	Poor	13.00%	0 m2	0 m2	830 m2	
03	Small Pave Repairs	Paved Surf.	Good	0.50%	0 m2	0 m2	70 m2	
	Small Pave Repairs	Paved Surf.	Med.	1.00%	258,000 m2	2,580 m2	70 m2	37
	Small Pave Repairs	Paved Surf.	Poor	4.00%	0 m2	0 m2	70 m2	
04	Curb Repair	Sect. Curb	Good	1.00%	0 m	0 m	50 m	
	Curb Repair	Sect. Curb	Med.	5.00%	0 m	0 m	50 m	0
	Curb Repair	Sect. Curb	Poor	6.00%	0 m	0 m	50 m	
05	Grading	Unpaved		100.00%	0 m	0.0 km	0.3 km	0
06	Shaping	Unpaved		100.00%	0 m	0.0 km	0.5 km	0
07	Cleaning	Paved Surf.		10.00%	258,000 m2	25,800 m2	2,000 m2	13
08	Footpath Repair	Sidewalk		0.50%	0 m2	0 m2	12.0 m2	0
Total Crew Days Required								72

Table 4-10

Summary of Crew Days

Code	Districts				Gov't Total
	Arbeen	Ataka	Suez	Ganaen	
02	18	27	52	22	119
03	36	65	113	37	251
04	31	48	87	0	166
05	269	11	13	0	293
06	161	7	8	0	176
07	11	13	31	13	68
08	30	57	79	0	166
Total	556	228	383	72	1,239

total production days figure of 260 is obtained by deducting from 365, the number of non-working days per year, eg weekends, legal holidays and other leave time. These calculations are presented in Table 4-11.

The personnel costs developed in Table 4-12 are comprised of four basic types of employees that work on Suez roads; foremen, equipment operators, skilled laborers and laborers. The personnel hours per crew day are determined by consulting the performance standards to obtain the number of personnel required and multiplying these levels by the hours required per task. Total personnel hours required are a by product of personnel hours per crew day and total crew days.

The total employee production hours developed in table 4-11 are used here to determine the actual personnel needed. The annual wage figure is divided by payroll time to obtain personnel cost per hour; this hourly cost is multiplied by the personnel hours required to yield total annual personnel costs of LE 36,069. Note - this estimate is exclusive of overhead costs.

b. Equipment Costs - Table 4-13 develops the hourly vehicle cost estimates, which are then applied to the total equipment costs which are derived in Table 4-14.

To anticipate the total equipment cost it is necessary to first forecast the total hours of each equipment type required. Crew days are multiplied by the hours required per crew day. The by-product is then multiplied by total crew days. Note - it has been assumed that no bulldozer activity is required for normal road maintenance operations.

To determine the total hours to be costed the total equipment hours required are multiplied by a running time factor. The reason for this is that most maintenance machines do not operate through all hours of the work-day, since time is lost at the beginning and end of the day as well as during idle time. In computing equipment time on the performance standards, the machines are almost always shown as being needed for six hours. This is because the machines must be at the work site of the assigned activity, and are therefore unavailable for any other work site or crew. So, to determine the actual expense of operating the equipment, the time factors, are multiplied by the total equipment hours.

The resulting program hours to be casted are then multiplied by the cost per hour to determine the total equipment costs. The total annual equipment cost is estimated to be LE 117,141.

Table 4-11

Annual Work Hours Available Per Employee

	Days	Hours Per Day	Total Hours
Payroll Time (1)	300	6	1,800
Less:			
Annual Leave Days	18	6	108
Sick Leave Days	15	6	90
Casual Leave Days	7	6	42
Annual Production Units p/ Emply	260		1,560

(1) Payroll Time: 365 days less weekends and legal holidays

Table 4-12

Personnel Hours & Costs

Code	Personnel Hours Per Crew Day: Foreman	Equip Operator	Skill Labor	Laborer
02	6	48	24	72
03	6	30	24	36
04	6	6	12	24
05	0	18	0	18
06	0	18	0	18
07	6	24	0	36
08	6	6	12	24

Code	Total Crew Days	Total Personnel Hours Required: Foreman	Equip Operator	Skill Labor	Laborer	Total Cost
02	119	714	5,712	2,856	8,568	
03	251	1,506	7,530	6,024	9,036	
04	166	996	996	1,992	3,984	
05	293	0	5,274	0	5,274	
06	176	0	3,168	0	3,168	
07	68	408	1,632	0	2,448	
08	166	996	996	1,992	3,984	

Total Personnel Hours Required		4,620	25,308	12,864	36,462	
Annual Work Hours	(/)	1,560	1,560	1,560	1,560	
Number of Personnel Needed (Rounded Up)	(=)	3	17	9	24	
Monthly Wage		130.00	80.00	60.00	55.00	
Annual Wage		1,560	960	720	660	
Payroll Time (Hours)	(/)	1,800	1,800	1,800	1,800	
Personnel Cost Per Hour	(=)	0.87	0.53	0.40	0.37	
Personnel Hours Required	(*)	4,620	25,308	12,864	36,462	
Total Personnel Cost	(=)	4,019	13,413	5,146	13,491	36,069

Table 4-13

Hourly Vehicle Cost Estimates

Actual Work Hours p/day	6	Gasoline Price p/Liter	0.50
Days p/year	300	Diesel Price p/Liter	0.10
Hours p/year	1,800		

			Hourly Cost						
				Fuel			Maintenance		
	1990 Equip Cost LE	Equip Life (1) (years)	Equip Cost (2)	Liters p/Hr	Type	Cost p/Hr	Cost p/Day	Cost p/Hr	Total Hourly Cost LE
Pickup	25,000	12	1.16	5.0	Gas	2.50	2.25	0.38	4.03
Truck	95,000	10	5.28	5.0	Dies	0.50	2.50	0.42	6.19
Water Tanker	120,000	12	5.56	5.0	Dies	0.50	2.50	0.42	6.47
Bulldozer	430,000	12	19.91	5.0	Dies	0.50	3.00	0.50	20.91
Compressor	85,000	8	5.90	5.0	Dies	0.50	3.00	0.50	6.90
Grader	250,000	15	9.26	3.0	Dies	0.30	3.00	0.50	10.06
Loader	235,000	8	16.32	3.0	Dies	0.30	3.00	0.50	17.12
Roller	70,000	15	2.59	5.0	Dies	0.50	3.00	0.50	3.59
Vibr Compactor	6,000	6	0.56	--	Dies	0.00	2.25	0.38	0.93
Dumpster	40,000	8	2.78	3.0	Dies	0.30	2.25	0.38	3.45
Asphalt Finisher	95,000	12	4.40	4.0	Gas	2.00	25.00	4.17	10.56

(1) WSA, Certification Training Report, Compiled from GOE records, TAC contractor reports, visits to GOE facilities and private contractors; namely Frucon, General Dynamics, Grumman, Ambric and Elektensadia. Also, based on Consultant's observations in Suez.

(2) Hourly Equip Cost = 1990 Equip Cost divided by Equip Life (years) divided by Hours per year.

Table 4-14

Equipment Hours & Costs

Hours Per Crew Day

Code	Pickup	Truck	Water Tanker	Bull-dozer	Compress	Grader	Loader	Roller	Vibr Compact	Dumpster	Asphalt Finisher	Total Cost
02	6	18	0	0	6	0	0	6	0	0	6	
03	6	6	0	0	6	0	0	6	6	0	0	
04	0	6	0	0	0	0	0	0	0	0	0	
05	0	0	6	0	0	6	0	6	0	0	0	
06	0	0	6	0	0	6	0	6	0	0	0	
07	0	6	0	0	6	0	6	0	0	6	0	
08	6	0	0	0	6	0	0	0	0	0	0	

Code	Total Crew Days	Pickup	Truck	Water Tanker	Bull-dozer	Compress	Grader	Loader	Roller	Vibr Compact	Dumpster	Asphalt Finisher
02	119	714	2,142	0	0	714	0	0	714	0	0	714
03	251	1,506	1,506	0	0	1,506	0	0	1,506	1,506	0	0
04	166	0	996	0	0	0	0	0	0	0	0	0
05	293	0	0	1,758	0	0	1,758	0	1,758	0	0	0
06	176	0	0	1,056	0	0	1,056	0	1,056	0	0	0
07	68	0	408	0	0	408	0	408	0	0	408	0
08	166	996	0	0	0	996	0	0	0	0	0	0
Total Equipment Hours Required		3,216	5,052	2,814	0	3,624	2,814	408	5,034	1,506	408	714
Running Time Factor	(*)	50%	80%	80%	90%	90%	90%	80%	50%	50%	70%	90%
Program Hours To Be Costed		1,608	4,042	2,251	0	3,262	2,533	326	2,517	753	286	643
Cost Per Hour	(*)	4.03	6.19	6.47	20.91	6.90	10.06	17.12	3.59	0.93	3.45	10.56
Total Equipment Cost		6,480	25,018	14,565	0	22,505	25,478	5,588	9,036	700	985	6,786

117,141

c. Material Cost - The material quantities per crew day, developed in Table 4-15, are determined by multiplying the crew days required by the material units per task (see performance standards). Total quantities required are a by product of materials per crew day and total crew days. Material cost per unit is estimated by the consultant on a unit basis according to interviews with the road engineers and foremen at the Suez Roads Directorate. This material cost is then multiplied by the total materials required to derive a total annual material cost of LE 249,083.

d. Overhead Cost - In addition to the direct costs of work forces, equipment, and materials, operational programs must have the support represented by the administrative salaries, engineering control and office functions. A part of this is supplied through the funding of the Annual Bab I Budget. Most of the remainder would fall into the broad classification termed "Overhead", consisting of rents, utilities, office supplies, etc. These costs are covered in the Bab II Budget. To estimate the total overhead expenses required to adequately support the proposed road maintenance program a factor of 100% is applied to the total estimated personnel cost.

e. Total Road Maintenance Program Costs - The total annual cost of LE 438,362 associated with the prescribed road maintenance program is presented in Table 4-16. These costs are broken down by the various resource types and their components.

Table 4-15

Material Quantities & Costs

Material Quantities Per Crew Day

Code	Hot-Mix Asphalt (m3)	Crushed Aggr (m3)	Sand (m3)	Mortar (m3)	Bitimen (m3)	Pre-Cast Curbstn (Liters)	Pre-Cast Tiles (Liters)
02	75	0	0	0	280	0	0
03	7	0	0	0	30	0	0
04	0	0	0	0	0	100	0
05	0	15	0	0	0	0	0
06	0	0	0	0	0	0	0
07	0	0	0	0	0	0	0
08	0	0	0	0	0	0	300

Total Quantities Required per Crew Day

Code	Total Crew Days	Hot-Mix Asphalt (m3)	Crushed Aggr (m3)	Sard (m3)	Mortar (m3)	Bitimen (m3)	Pre-Cast Curbstn (Liters)	Pre-Cast Tiles (Liters)	Total Cost
02	119	8,925	0	0	0	33,320	0	0	
03	251	1,757	0	0	0	7,530	0	0	
04	166	0	0	17	25	0	16,600	0	
05	293	0	4,395	0	0	0	0	0	
06	176	0	0	0	0	0	0	0	
07	68	0	0	0	0	0	0	0	
08	166	0	0	17	23	0	0	49,800	
Total Material Quantities Required		10,682	4,395	33	48	40,850	16,600	49,800	
Material Unit Costs	(*)	15.41	13.50	3.00	0.28	0.06	0.88	0.16	
Total Material Cost	(=)	164,610	59,333	100	13	2,451	14,608	7,968	249,083

Table 4-16

Total Annual Road Maintenance Program Costs

	Foreman	Equip Operator	Skill Labor	Laborer	Personnel Total
Personnel:	4,019	13,413	5,146	13,491	36,069

	Pickup	Truck	Water Tanker	Bull-dozer	Compress	Grader	Loader	Roller	Vibr Compact	Dumpster	Asphalt Finisher	Equipment Total
Equipment:	6,480	25,018	14,565	0	22,505	25,478	5,588	9,036	700	985	6,786	117,141

	Hot-Mix Asphalt	Crushed Aggr	Sand	Mortar	Bitimen	Pre-Cast Curbstn	Pre-Cast Tiles	Material Total
Materials:	164,610	59,333	100	13	2,451	14,608	7,968	249,083

	Overhead Total
Overhead:	36,069

Total Program Costs	438,362

4.2 PROGRAM BUDGETS

4.2.1 Past and Present Bab Allocations

The specific classification of governmental expenditures and revenues by the Ministry of Finance is divided into four sections called "Babs." (For a detailed explanation of the process see the Neighborhood Urban Services Project Report on the Suez Governorate Road and Street Maintenance, October 1987.)

Bab I. Budget for Wages

Bab II. Current Expenditures and Remittances

Bab III. Investments

Bab IV. Capital Remittances

Typically, the Suez Roads Directorate receives funding for road maintenance from the Bab I and II allocations. Table 4-17 shows these Bab I and II expenditures over the last 5 years. In addition, there are Bab III allocations made, which are reserved for special projects. These allocations are designed to improve the governorate's infrastructure, such as overlays on existing streets and paving on new streets.

4.2.2 **Current Year** - The FY 1989/1990 Operations Budget (Bab 1 and Bab II) for the roads directorate is LE 427,000. The Consultant's estimate for equipment operation and materials is LE 366,224. Although the quantified road maintenance work could be done within the existing resource constraints for personnel, it appears that the repair of the equipment and the purchase of maintenance materials could not be funded. Specifically, estimated personnel cost is LE 36,069, and the amount budgeted under Bab I is LE 397,000. This yields a huge Bab I surplus of LE 360,931 (exclusive of overhead personnel costs). However, a budgetary shortfall arises in Bab II where only LE 30,000 is allocated. This amount is unable to cover the remaining equipment, material and overhead costs of LE 402,293.

4.2.3 **Future Years** - It is apparent that the degree of success with which local governments can deliver services will depend largely on the amount of resources generated by the local government for its own use. In this section of the report, the sources which are available to local governments for financing local undertakings are outlined below.

Table 4-17

BAB I. and BAB II. Allocations and Expenses

Fiscal Years 1985-1990

BAB I.	85/86	86/87	87/88	88/89	89/90
Group 1:					
Pernament Jobs	184,224	181,064	192,564	217,708	233,508
Incentives	5,800	6,760	7,760	7,760	15,760
Add. Salaries	2,482	2,482	2,480	3,010	3,010
Expenses	30,245	30,245	30,245	73,887	105,387
Subtotal	222,751	220,551	233,049	302,365	357,665
Group 2:					
Clothing	3,800	3,800	3,800	3,800	3,800
Subtotal	3,800	3,800	3,800	3,800	3,800
Group 3:					
Insurance: Gov't	34,043	33,158	35,116	45,827	53,148
Sickness	3,035	2,956	3,126	4,147	4,863
Accidents	2,021	1,971	2,084	2,765	3,240
Subtotal	39,099	38,085	40,326	52,739	61,251
Total Bab I Funds	265,650	262,436	277,175	358,904	422,716
Unused Bab I. Funds	7,650	10,436	11,177	18,904	25,716
Net Bab I. Expenditures	258,000	252,000	265,998	340,000	397,000

BAB II.	85/86	86/87	87/88	88/89	89/90
Group 1:					
Fuel & Oil	12,500	11,500	11,000	11,000	12,000
Spare Parts	7,100	6,115	6,000	7,000	7,000
Writing	170	145	150	150	650
Water & Lights	20	15	15	40	40
Small Equipment	260	225	300	10	60
Subtotal	20,050	18,000	17,465	18,200	19,750
Group 2:					
Maintenance	12,350	11,005	8,120	9,120	9,120
Publishing (?)	20	20	20	20	20
Printing	110	100	50	50	550
Transportation	400	355	250	250	250
Services	70	60	55	60	260
Subtotal	12,950	11,540	8,495	9,500	10,200
Group 4:					
Rent	200	200	40	50	50
Subtotal	200	200	40	50	50
Total Bab I and Bab II Funds	291,200	281,740	291,998	367,750	427,000

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a. Resources Available to Local Governments

Article 62 Law 43 (1979), modified by Law 50 (1981), states that each neighborhood in the local government should collect those resources enumerated in Article 51 for the local governorates own expenses, except for those resources which the Local Popular Council designates other local governorate organizations to collect. The Local Popular Council determines how the collections will be disbursed.

Although the laws noted above authorize local governments to generate income and to disburse the income in accordance with the decisions made by local councils, the central government retains the authority to determine which revenues are for local government consumption, the size of fees and taxes charged the local community, who can be exempt and the size of increases or decreases in the fees and taxes. In addition, the central government, in accordance with Law 57 (1982), retains the right to collected taxes and duties on imports, exports, capital and industrial profits.

Although laws have been passed to encourage the generation of revenues by local governments, most of the local taxes and fees were established by decisions and laws promulgated many years ago. Therefore, the amounts assessed do not account for inflationary increases that have taken place over the years. Some of the fees do not even cover the expense of collection. Below are some fees imposed by laws issued over 25 years ago.

- License Fees: Law No. 66 for the year 1956.
- Vehicle Licenses: Law No. 140 for the year 1956.
- Licenses of Public Shops: Law No. 371 for the year 1956.
- License of Commercial Installation: Law No. 453 for the year 1954.
- Land Development Licenses: Law No. 222 for the year 1955.

As noted above, increases in these fees must be approved by the central government. In addition, the laws outlining collection procedures and penalties are weak and the apparatus for collection is almost non-existent.

Nevertheless, a framework for local revenue generation is in place and those sources are described in table 4-18.

b. Local Resources Available for the Improvement and Maintenance of Roads and Streets

TABLE 4-18

RESOURCES AVAILABLE TO LOCAL GOVERNMENTS

RESOURCES	VILLAGE	CITY NEIGHBORHOOD	MARKAZ	GOVERNORATE
SOVEREIGN REVENUES				
Original and additional taxes on agricultural land	75%	75%		75%
Original and additional taxes on buildings		X		
Entertainment and gambling	X			
Taxes and fees on cars & motorcycles		X		
JOINT REVENUES				
1st: Additional tax on imports and exports			50%	50%
2nd: Additional tax on the tax of movable assests and the tax of commercial profits			50%	50%
LOCAL REVENUES				
Taxes and fees assigned for the benefit of the governorate				X
Income versus improvement of property		X		
Fees assigned by local councils				
1. Fees on birth certificates and health procedures	X	X		
2. Fees on licenses of mines, quarries and hunting	X	X		
3. Fees for organizational works, sanitation, and gardens and road construction	X	X		
4. Fees on public shops, clubs, and industrial and commercial shops	X	X		
5. Fees on services animals, dogs and farm animals				
6. Fees on commercial ships, hunting ships and Fairy Boats.	X	X		
7. Fees on slaughtering cattle in slaughter houses and in sepcialized areas	X	X		
8. Fees on markets licensed for individual	X	X		
9. Fees on electricity, water and gas consumption	X	X		
10. Tax on rents subject to building tax		X		
11. Fees on exploitation of shores or public utilities and property.	X	X		
Income on rent, buildings and vacant building land		X		
Revenues from investment of public funds and utilities.	X	X	X	X
Grants, wills, and donations	X	X	X	
Whatever the local council allocates to the governorate	X	X	X	

nm/Resource

Petrol Price Increases Presidential Resolution 158 (1980) established a special account for income from the increase in the price of petrol. This is allocated for construction and maintenance of public roads.

This income, added to the fund for road construction, is kept by the General Secretariat for Local Government and the General Organization for Roads and Bridges, in the proportions of 70% and 30% respectively. The income allocated for the General Secretariat, distributed among the governorates, is decided by the Minister of Local Government. These sums are considered to be public funds and are subject to control by different state organizations, and the surplus is accumulated from one fiscal year to another.

The General Secretariat collects this income from the Ministry of Petrol and deposits it in a special account in the National Central Bank. It is distributed among the governorates according to their needs. Roads construction and maintenance plans, together with the funds allocated for this purpose are included in the budget of each governorate.

Estimates of this income are incorporated in the second category, "current expenditures", in the budget of the Secretariat of Local Government under the heading "collective allocations". It is also included with the revenues to prepare for its distribution among the governorates.

Local Service and Development Account Law 45 (1979) modify by Law 50 (1980) stipulates that an account should be established to provide funds for required local services and/or local projects. The funds are to be obtained from.

- Fees imposed by the local government people's council.
- Profits from projects financed by funds taken from this account.
- Grants, donations and requests made to a local government unit.
- Resources obtained by the Governorate which exceed the Governorates' estimate of funds the Governorates planned to collect. Of the excess, 50% is assigned to the Services and Development Account.

These funds are earmarked for utilization by the Governorate and any surplus in the fund at the end of the year remains in the Governorate account. The local Popular Council determines how the resources are to be used. Consequently, these funds may be used for local projects, local general services and local emergency services. Most governments have used these funds for equipment and road maintenance when the Popular Council decided to use the funds for such purposes.

Experience indicates that the Service and Development Account is managed badly. Projects are too frequently influenced by political rather than social concerns and as a result planning and budgeting are not performed by professionals. A recent report by the Central Agency for Control revealed that funds were used to purchase cars for individuals and for local celebrations. <1>

Cleaning Fund Law 38 (1967) requires each governorate to establish a cleaning fund. The law provides for the formation of an administrative council. The council is responsible for establishing policies and procedures that will keep local roads, streets, squares and local public thoroughfares clean and passable. The income for this fund is to be obtained form:

- Fees paid by residents to clean their neighborhoods.
- Governorate appropriations for cleaning roads, streets, etc.
- Fees paid by ministries, departments, general organizations and institutions to local government units for cleaning services.
- Payments by garbage collection organizations who obtain licenses to collect garbage.

5. ECONOMIC COST-BENEFIT

This economic benefit analysis evaluates the benefits that the proposed road maintenance project confers on the community. These community benefits are considered to be the reduced vehicle operating costs (VOC) incurred by the people who drive on (use) the Suez roads. To determine these benefits the current road network is compared in a future environment of well maintained roads versus an environment of poorly maintained roads. For the project to be economically beneficial, the quantified road user benefits of the well maintained roads must exceed the costs of the road maintenance program. In addition, the benefits arising from a reduction in road rejuvenation costs are also considered.

In this study, it was decided to initially attempt to demonstrate the economic benefit of road maintenance using easily definable, conservative parameters without conducting an exhaustive study. Therefore, the nature of this report is to address the major and easily quantifiable VOC costs in a very conservative manner. For this reason, the more detailed cost savings associated with passenger time, truck cargo inventory savings and vehicle accidents are considered beyond the scope of the study and are not included in the analysis.

Specifically, this study adopts an abbreviated form of the prevailing methodology of assigning vehicle operating costs (VOC) per vehicle kilometer traveled (VKT). <2> These costs are evaluated and summarized according to vehicle type and road condition. The costs that are compiled are based on the average vehicle running speeds. The marginal VOC associated with changes in vehicle speeds, and road gradients and curvatures are not included.

The first section explains the methodology for determining how the annual VOC are evaluated. The second section compares the economic costs and benefits resulting from the recommended road maintenance program compared to a program of little or no maintenance over an analysis period of twenty years. All costs are in present day Egyptian pounds.

5.1 METHODOLOGY FOR DETERMINING VOC

The following discussion develops hybrid vehicles whose characteristics approximate those of the current Suez fleet, together with their associated average per mile VOC. The categories of vehicles included are the (1.) passenger car; (2.) mini-bus and taxi; (3.) light trucks; and (4.) heavy trucks.

5.1.1 **Vehicle Characteristics** - In developing typical vehicles for this study, vehicles traveling on Suez roads are categorized into four broad groups based on similar VOC per VKT, and vehicle driving habits.

Cars: Although large automobiles do exist in Suez, the vast majority of automobiles are small (under 2,000 cc). For this reason, the VOC table for a small 4 cylinder automobile is used. The weight of the study vehicle is estimated at 1100 kg.

Mini-bus and Taxi (B/T): Past studies indicate that taxi VOC are traditionally higher than those of private cars, and more closely follow the pattern of small mini-buses and vans. Therefore, VKT by taxis and mini-buses are evaluated together. In addition, the vehicles are driven in a similar manner; frequently starting and stopping to load and unload passengers. The typical vehicle is assumed to have an engine capacity of 3370 cc, and weigh 1500 kg.

Light Trucks: These vehicles are categorized as those trucks larger than pickups and smaller than heavy two-axle or greater trucks. These trucks are assumed to weigh less than 3 metric tons with an engine capacity of 5732 cc. In Suez, these trucks are predominantly local trucks transporting goods within the city.

Heavy Trucks: The bulk of these vehicles are non-Suez vehicles that are either entering, leaving or merely passing through Suez. The hybrid vehicle was considered to have 3 axles and weigh 6.8 metric tons with an engine capacity of 6548 cc.

5.1.2 **Vehicle Fleet Size and Composition** - The current vehicle fleet composition used for analysis purposes is outlined in table 5-1 and is based on vehicle registration data provided by the Suez Safety Directorate Traffic Section and consultant traffic observations. Motorcycles and agricultural vehicles are not evaluated in the study due to their negligible VOC on Suez roads.

Table 5-1
Suez Vehicle Fleet Size and Composition

Cars	7,500
Buses & Taxies	3,700
Light Trucks	1,900
Heavy Trucks	1,100

Total Suez Vehicles	14,200

Source: Suez Safety Directorate Traffic Section and consultant observations.

5.1.3 **Basic VOC Data** - The basic data from which the vehicle operating cost was developed are shown in Table 5-2. These costs are evaluated as the economic costs. Economic cost is the market price less taxes, import duties and other transfer costs. Several points are notable from this data. First, the price of cars is considered to be that a small under 2000 cc Egyptian assembled automobile. Second, the mini-bus/taxi price is skewed to more closely reflect the price of the mini-bus due to the higher proportion of mini-bus VKT in the vehicle class as observed by the consultants. Third, the hybrid light truck price is that of a two-axle Ford flat bed truck. Lastly, the heavy truck price is based on data obtained from the USAID procurement office.

5.1.4 **Depreciable Value** - For the purposes of study calculations, the depreciable value of a vehicle is its economic value, less the economic cost of the tires and tubes since wear and tear on these items is calculated separately. Depreciable values for the vehicle categories used in this study are shown by Table 5-3. The table also includes the items used in developing depreciable value, e.g. annual and lifetime kilometers, years of vehicle life, etc.

5.1.5 **VOC By Vehicle Type** - The remainder of this portion of the report describes the manner in which VOC are developed for each of the four vehicle types. Basic reliance is placed upon the FHWA (Federal Highway Administration, U.S. Department of Transportation) publication for technical costing factors used in the analysis. <3>

This reference (which is hereafter referred to as "FHWA Factors") builds upon the pioneering work done by analysts such as Winfrey <4> and de Weille <5>, and improves upon the latter works such as the AASHTO Red Book <6>. In addition, the World Bank Policy Study on Road Deterioration in Developing Counties <7>, and the Highway Design and Maintenance Standards Model <8> are used to help adapt the FHWA Factors to the Egyptian road environment. Due to Suez's flat topography, factors for paved tangent roads are used in all cases. Costs were calculated in increments of eight kilometers per hour, from 8 to 80 kph.

Also, the enroute driver costs for mini-bus, taxis, light trucks and heavy trucks are calculated based upon consultant estimates of the driver costs per hour. Table 5-4 details these costs in eight kilometer increments.

5.1.6 **Consumption Factors** - The basic FHWA consumption factors upon which the VOC calculations are based, are shown in Tables 5-5 through 5-8. For convenience, these factors are expressed in terms of usage per 1000 kilometers. If stated on a per kilometer basis, these factors would represent very small quantities.

Table 5-2
Basic VOC Data

Item	Unit	Vehicle Type: Car	Mini-bus & Taxi	Light Truck	Heavy Truck
New Vehicle	each	20,000	40,000	150,000	250,000
Gasoline/Diesel	litre	0.50	0.50	0.50	0.10
Engine Oil	litre	2.50	2.50	2.50	2.50
Tires	each	100	100	150	460
Crew	hour	--	5.00	10.00	15.00
Annual Overhead	%/yr	13%	18%	15%	15%

Table 5-3
Depreciable Vehicle Value

Item	Unit	Vehicle Type: Car	(taxi) Van	Light Truck	Heavy Truck
Annual Kilometers	km	19,200	48,000	32,000	27,200
Vehicle Life	Years	8	10	10	10
Lifetime Kilometers		153,600	480,000	320,000	272,000
Avg Persons/Veh		1.61	1.85	1.68	1.32
Econ Vehicle Cost	LE	19,600	39,600	149,400	245,400
Tires, Each	LE	100	100	150	460
No. Tires/Vehicle		4	4	4	10
Tire Cost	LE	400	400	600	4,600

Table 5-4

Enroute Crew Costs per Vehicle Kilometer Traveled
Mini-Bus/Taxi, Light Truck, and Heavy Truck

Average Driver Costs per Hour:

Mini-Bus/Taxi	5.00
Light Truck	10.00
Heavy Truck	15.00

Speed		Travel Time	Crew Costs		
			Mini-Bus & Taxi	Light Truck	Heavy Truck
(mph)	(kph)	(Minutes)	(p/km)	(p/km)	(p/km)
5	8	12.00	1.00	2.00	3.00
10	16	6.00	0.50	1.00	1.50
15	24	4.00	0.33	0.67	1.00
20	32	3.00	0.25	0.50	0.75
25	40	2.40	0.20	0.40	0.60
30	48	2.00	0.17	0.33	0.50
35	56	1.71	0.14	0.29	0.43
40	64	1.50	0.13	0.25	0.38
45	72	1.33	0.11	0.22	0.33
50	80	1.20	0.10	0.20	0.30

Table 5-5
Vehicle Consumption Factor Tables
Cars

Speed		Use Per 1,000 Miles (1)				
		Fuel (2)	Oil (3)	Tires (4)	Depr (5)	Maint (6)
(mph)	(kph)	(litres)	(litres)	(% wear)	(% depr v)	(% avg c)
5	8	253.6	3.8	0.06	1.59	46.7
10	16	242.2	2.4	0.07	1.34	47.7
15	24	189.3	1.8	0.08	1.20	49.3
20	32	136.3	1.6	0.10	1.10	51.5
25	40	111.7	1.5	0.12	1.02	54.3
30	48	102.2	1.4	0.14	0.95	57.3
35	56	93.9	1.4	0.18	0.90	60.6
40	64	90.8	1.4	0.23	0.85	63.9
45	72	93.9	1.4	0.29	0.82	67.5
50	80	94.6	1.3	0.37	0.79	71.2

(1) At constant speed, zero grade.
(2) FHWA VOC Factors, pg. B-2, data in litres.
(3) Ibid., pg B-10, data in litres.
(4) Ibid., pg B-18.
(5) Ibid., pg B-34.
(6) Ibid., pg B-26.

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Table 5-6

Vehicle Consumption Factor Tables

Mini-Bus and Taxi

Speed (mph)	Speed (kph)	Use Per 1,000 Miles: Fuel (2) (litres)	Oil (3) (litres)	Tires (4) (% wear)	Depr (5) (% depr v)	Maint (6) (% avg c)
5	8	209.7	3.8	0.08	1.22	46.9
10	16	209.7	2.4	0.08	1.03	47.8
15	24	179.0	1.8	0.09	0.93	49.4
20	32	146.5	1.6	0.11	0.85	51.6
25	40	143.8	1.5	0.13	0.79	54.4
30	48	141.2	1.4	0.16	0.73	57.4
35	56	142.3	1.4	0.20	0.66	60.6
40	64	143.8	1.4	0.26	0.63	64.0
45	72	153.3	1.4	0.32	0.61	67.6
50	80	162.8	1.3	0.41	0.59	71.3

(1) At constant speed, zero grade.
(2) FHWA VOC Factors, pg. B-3, data in litres
(3) Ibid., pg B-11, data in litres.
(4) Ibid., pg B-19.
(5) Ibid., pg B-34.
(6) Ibid., pg B-27.

Table 5-7

Vehicle Consumption Factor Tables

Light Trucks

Speed (mph)	Speed (kph)	Use Per 1,000 Miles: Fuel (2) (litres)	Oil (3) (litres)	Tires (4) (% wear)	Depr (5) (% depr v)	Maint (6) (% avg c)
5	8	802.4	6.5	0.10	1.22	45.7
10	16	783.5	4.1	0.12	1.03	44.7
15	24	632.1	3.4	0.14	0.93	45.5
20	32	499.6	3.0	0.18	0.85	47.6
25	40	458.0	2.8	0.22	0.79	50.6
30	48	423.9	2.7	0.28	0.73	54.3
35	56	427.7	2.5	0.36	0.66	58.7
40	64	435.3	2.3	0.46	0.63	63.7
45	72	465.6	2.1	0.57	0.61	69.1
50	80	503.4	2.0	0.72	0.59	74.7

(1) At constant speed, zero grade.
(2) FHWA VOC Factors, pg. B-3, data in litres.
(3) Ibid., pg B-11, data in litres.
(4) Ibid., pg B-19.
(5) Ibid., pg B-34.
(6) Ibid., pg B-27.

Table 5-8

Vehicle Consumption Factor Tables

Heavy Trucks

Speed (mph)	Speed (kph)	Use Per 1,000 Miles: Fuel (2) (litres)	Oil (3) (litres)	Tires (4) (% wear)	Depr (5) (% depr v)	Maint (6) (% avg c)
5	8	893.3	9.6	0.10	0.74	46.1
10	16	821.3	6.2	0.11	0.59	47.1
15	24	749.4	4.9	0.13	0.50	48.2
20	32	677.5	4.4	0.15	0.44	49.7
25	40	635.9	4.1	0.18	0.40	51.4
30	48	590.5	3.8	0.21	0.37	53.4
35	56	579.1	3.6	0.25	0.34	55.7
40	64	564.0	3.4	0.29	0.33	58.5
45	72	564.0	3.1	0.34	0.31	61.7
50	80	564.0	3.0	0.40	0.30	65.4

(1) At constant speed, zero grade.
(2) FH'' 'OC Factors, pg. B-7, data in litres.
(3) Ibid., pg B-15, data in litres.
(4) Ibid., pg B-23.
(5) Ibid., pg B-34.
(6) Ibid., pg B-31.

5.1.7 **Basic Test Vehicle Characteristics** - Table 5-9 indicates the characteristics of the FHWA test vehicles which are considered most compatible to the four hybrid study vehicles. The following discussion covers the development of VOC for each typical vehicle which has been selected.

5.1.8 **Per Kilometer Vehicle Operating Costs** - The per mile VOC figures (in LE) for the four vehicle types are detailed in Tables 5-10 through 5-13. These costs are developed by applying the FHWA consumption factors to the Suez environment as outlined in the basic VOC data and depreciable vehicle values, Tables 5-2 and 5-3, respectively.

5.1.9 **VKT by Vehicle Class and Road Condition** - To arrive at the total VOC in Suez, the estimated VKT are multiplied by the per mile VOC. These VKT are categorized by vehicle type and road condition. The objective of doing so is to enable the measurement of the different VOC incurred between the two road maintenance policy options during the 20 year analysis period. The Suez road network inventory used as a basis in this analysis was taken from the Road and Street Maintenance; Suez Governorate Report. <9> This report classified the Suez roads as: good, fair, poor and unpaved. The VKT developed in this analysis were done in the same manner through consultant traffic counts. These traffic counts were conducted between May 7 and May 17, 1990. The annual VKT by vehicle estimates made from the traffic counts are presented in Table 5-14. To test the validity of these results a second method of assessing VKT was used. This method estimated the annual VKT by vehicle type and multiplied the numbers by the estimated average VKT per day. The estimates were then factored up to an annual basis. The results of this alternative method are presented in Table 5-15.

Table 5-9

Vehicle Characteristics

FHWA Test Vehicles vs Study Vehicles

		FHWA Vehicles			
		"A"	"B"	"C"	"D"
		Study Vehicles			
Vehicle Char.	Unit	Car	B/T	LT	HT
Engine Cap.	cc	1967	3370	5732	6548
Tare Weight	kg	1100	1500	2600	6800
Loaded Weight	kg	1300	1850	5400	15900
No. of Axles	each	2	2	2	3
No. of Cylinders	each	4	6	8	8
Body Style	--	Sedan	Sedan	Flatbed	Flatbed
Fuel Type	--	Gasoline	Gasoline	Gasoline	Diesel

Table 5-10

Vehicle Operating Costs - per km

Car

Speed (mph)	Speed (kph)	Fuel	Eng Oil	Tires	Depr	Maint	Overhead	Total
5	8	0.13	0.01	0.02	0.20	0.17	0.07	0.60
10	16	0.12	0.01	0.03	0.17	0.15	0.06	0.54
15	24	0.09	0.00	0.03	0.15	0.14	0.05	0.47
20	32	0.07	0.00	0.04	0.14	0.13	0.05	0.43
25	40	0.06	0.00	0.05	0.13	0.13	0.05	0.41
30	48	0.05	0.00	0.06	0.12	0.13	0.05	0.41
35	56	0.05	0.00	0.07	0.11	0.14	0.05	0.43
40	64	0.05	0.00	0.09	0.11	0.16	0.05	0.46
45	72	0.05	0.00	0.12	0.10	0.18	0.06	0.51
50	80	0.05	0.00	0.15	0.10	0.21	0.07	0.58

Table 5-11

Vehicle Operating Costs - per km

Mini-Bus and Taxi

Speed (mph)	Speed (kph)	Fuel	Eng Oil	Tires	Depr	Maint	Crew	Overhead	Total
5	8	0.07	0.01	0.03	0.10	0.10	1.00	0.24	1.55
10	16	0.07	0.01	0.03	0.08	0.09	0.50	0.14	0.93
15	24	0.06	0.00	0.04	0.08	0.09	0.3[illegible]	0.11	0.71
20	32	0.05	0.00	0.04	0.07	0.09	0.25	0.09	0.60
25	40	0.05	0.00	0.05	0.06	0.09	0.20	0.08	0.55
30	48	0.05	0.00	0.06	0.06	0.10	0.17	0.08	0.52
35	56	0.05	0.00	0.08	0.05	0.11	0.14	0.08	0.52
40	64	0.05	0.00	0.10	0.05	0.13	0.13	0.08	0.55
45	72	0.05	0.00	0.13	0.05	0.16	0.11	0.09	0.59
50	80	0.06	0.00	0.16	0.05	0.19	0.10	0.10	0.67

Table 5-12
Vehicle Operating Costs · per km
Light Truck

Speed (mph)	Speed (kph)	Fuel	Eng Oil	Tires	Depr	Maint	Crew	Overhead	Total
5	8	0.28	0.02	0.06	0.57	0.42	2.00	0.50	3.84
10	16	0.27	0.01	0.07	0.48	0.37	1.00	0.33	2.53
15	24	0.22	0.01	0.08	0.43	0.34	0.67	0.26	2.01
20	32	0.17	0.01	0.11	0.40	0.33	0.50	0.23	1.73
25	40	0.16	0.01	0.13	0.37	0.34	0.40	0.21	1.61
30	48	0.15	0.01	0.17	0.34	0.36	0.33	0.20	1.56
35	56	0.15	0.01	0.22	0.31	0.40	0.29	0.20	1.56
40	64	0.15	0.01	0.28	0.29	0.46	0.25	0.22	1.65
45	72	0.16	0.01	0.34	0.28	0.55	0.22	0.23	1.79
50	80	0.17	0.01	0.43	0.27	0.66	0.20	0.26	2.01

Table 5-13
Vehicle Operating Costs - per km
Heavy Truck

Speed (mph)	Speed (kph)	Fuel	Eng Oil	Tires	Depr	Maint	Crew	Overhead	Total
5	8	0.31	0.02	0.46	0.66	0.67	3.00	0.77	5.88
10	16	0.28	0.02	0.51	0.52	0.63	1.50	0.52	3.97
15	24	0.26	0.01	0.60	0.44	0.63	1.00	0.44	3.39
20	32	0.23	0.01	0.69	0.39	0.66	0.75	0.41	3.14
25	40	0.22	0.01	0.83	0.35	0.73	0.60	0.41	3.15
30	48	0.20	0.01	0.97	0.33	0.80	0.50	0.42	3.23
35	56	0.20	0.01	1.15	0.30	0.92	0.43	0.45	3.46
40	64	0.19	0.01	1.33	0.29	1.07	0.38	0.49	3.77
45	72	0.19	0.01	1.56	0.27	1.26	0.33	0.54	4.18
50	80	0.19	0.01	1.84	0.27	1.51	0.30	0.62	4.73

Table 5-14

Road Traffic Survey Vehicle Kilometers Traveled (VKT) Estimates

TOTAL ROADS:	Vehicle Type				
Road System	Car	Mini-bus/Taxi	Light Truck	Heavy Truck	Total
Daily VKT	300,898	560,701	50,260	35,540	947,399
Total Road Km					204
Total Annual VKT	90,269,462	168,210,216	15,078,053	10,662,082	284,219,813

Table 5-15

Vehicle Registration VKT Estimates

		Vehicle Type				
		Car	Mini-bus/Taxi	Light Truck	Heavy Truck	Total
Suez Vehicles						
Registered Vehicles		7,500	3,700	1,896	1,089	14,185
Avg VKT p/day	x	40	150	25	30	
Days p/yr	x	300	300	300	300	
Avg VKT p/yr	=	90,000,000	166,500,000	14,220,000	9,801,000	280,521,000
Non-Suez Vehicles						
Vehicles		315	150	150	150	765
Avg VKT p/day	x	20	20	20	20	
Days p/yr	x	300	300	300	300	
Avg VKT p/yr	=	1,890,000	900,000	900,000	900,000	4,590,000
Total VKT		91,890,000	167,400,000	15,120,000	10,701,000	285,111,000

5.2 ECONOMIC COSTS AND BENEFITS

In this section, the annual VKT and VOC developed above are evaluated, and the costs and benefits of maintaining the current Suez road network under the prescribed road maintenance program are compared to that of a program with little (eg cleaning streets of debris) or no maintenance over a 20 year period. To avoid the complications of forecasting the additional cost of maintaining new Suez roads, this analysis only evaluates the road maintenance costs of the existing road network.

5.2.1 **Annual VKT and VOC** - Table 5-16 breaks down and analyzes the estimated VKT and VOC in Suez. First, the table develops VKT per vehicle. It is important to recognize that the VKT are only those experienced on Suez roads. For this reason, VKT by large trucks are relatively low in comparison to mini-buses and taxis, because the large trucks basically travel through Suez to either the Sinai or Cairo. Whereas the high VKT by the mini-buses and taxis is understandable when the long hours of operation within Suez of the vehicle class is taken into account. Secondly the table develops VOC per vehicle. The relatively high VOC per vehicle for mini-buses and taxis is due to the high level of annual VKT by the vehicle class. Lastly, the VOC per VKT shows a more gradual increase in costs by the larger vehicle classes.

5.2.2 **Repaving vs Reconstruction** - A road's life-span varies considerably depending on the climate, road construction, traffic volume, and vehicle loadings. In Suez, the arid climate, average traffic volumes, and reasonable vehicle loadings are conducive to a longer road life-span.

For this reason, the average road life-span is estimated to be 20 years. In the early years of a roads life there is little or no deterioration. Instead, visible signs of deterioration appear after about six years and grow exponentially. This deterioration can be significantly retarded through preventive maintenance.

Nevertheless, within 20 years, a road will require some form of rejuvenation. For a well maintained road this would be resurfacing; conversely, an unmaintained road would require reconstruction [1]. Resurfacing are those costs incurred to lay an asphalt overcoat on a well maintained, structurally sound road. Reconstruction costs go far beyond those of simple resurfacing. Instead, a major overhaul of the road is required. In Suez, the estimated material cost of resurfacing a road is LE 12,810 per km, versus LE 30,035 per km for reconstruction. Figure 5-1 shows the rate of road deterioration between the two road maintenance options.

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1 If there is no road maintenance, a road's life-span will be significantly reduced. This will result in a need to rehabilitate the road earlier in its life, for it will otherwise become impassable.

Figure 5-1
Road Life Deterioration
Under Different Road Maintenance Policies

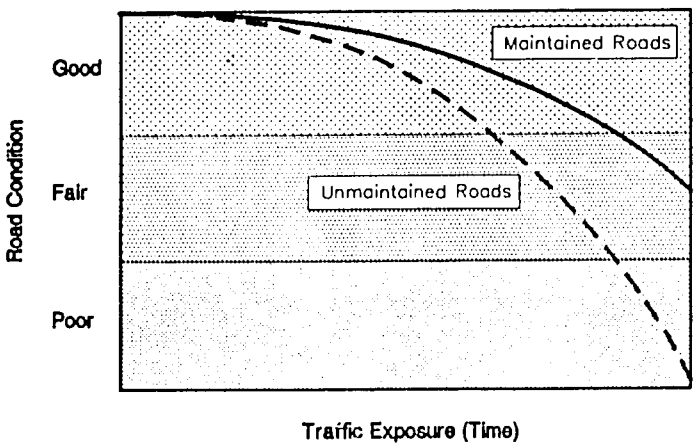

Table 5-16

VKT and VOC Comparisons

Annual VKT:	Car	Mini-bus & Taxi	Light Truck	Heavy Truck
VKT (1,000)	90,269	168,210	15,079	10,663
Vehicles	7,500	3,700	1,900	1,100
VKT per Vehicle	12,036	45,462	7,936	9,694

Annual VOC:	Car	Mini-bus & Taxi	Light Truck	Heavy Truck
VOC (1,000)	43,876	116,664	32,185	40,335
Vehicles	7,500	3,700	1,900	1,100
VOC per Vehicle	5,850	31,531	16,939	36,668

Annual VOC per VKT:	Car	Mini-bus & Taxi	Light Truck	Heavy Truck
VOC (1,000)	43,876	116,664	32,185	40,335
VKT (1,000)	90,269	168,210	15,079	10,663
VOC per Vehicle	0.49	0.69	2.13	3.78

Since each road deteriorates at a different rate, it is difficult to gauge exactly when a road will need to be rejuvenated. Nevertheless, it is assumed that over the 20 year analysis period all roads will require at least one rejuvenation. Table 5-17 gives an approximation of the Suez roads' age based on the road inventory data.

Table 5-17

Estimated Suez Road Network Age

	Good	Fair	Poor
Current Age (yrs)	5	10	15
Length (km)	27.1	66.5	23.2

Table 5-18 applies the reconstruction and resurfacing material costs to the current Suez road network. These costs are based on consultant estimates of the raw material costs required to perform road rejuvenation. The other costs associated with personnel, equipment and overhead are not included in these cost estimates.

5.2.3 **VOC savings over 20 years** - In addition to the high costs of reconstruction incurred under a system of little or no maintenance, VOC also increase. Table 5-19 shows the increase in these VOC on different road conditions. These costs are direct out-of-pocket costs to the driver who operates and maintains the vehicle such as blow outs, front end alignments, shock absorbers and traffic accidents - not to mention increased travel time.

By applying VOC adjustment factor to the existing Suez road network, the additional VOC of traveling on unmaintained roads is determined. Table 5-20 show the additional VOC. The adjustment factor in the table are based on data in table 5-19 and the estimated decline in the condition of the Suez road network. Note that the adjustment factor are not exceptionally high. Nevertheless, when applied to the VKT on the Suez road network, the VOC of travel on the poorly maintained roads is significant. Figure 5-2 illustrates the VOC of the two road maintenance program and demonstrates the VOC savings gleaned from a good road maintenance program.

Figure 5-2

Additional VOC Incurred on Unmaintained Roads

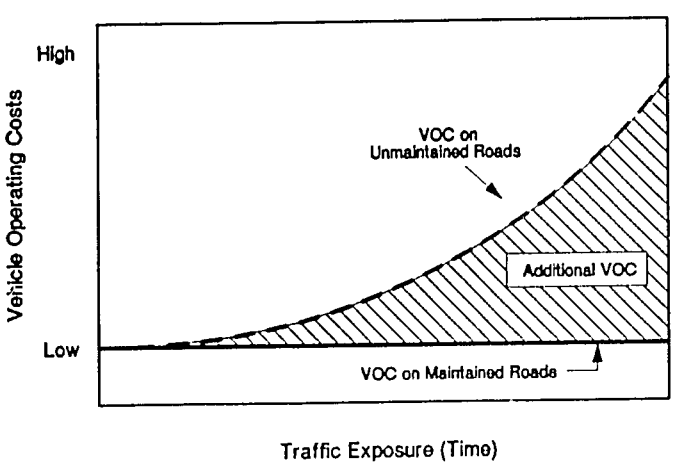

Table 5-18

Resurfacing vs Reconstruction

Road Rejuvenation Material Cost Savings Over 20 Year Period (LE)

Total Paved Roads (km)	116.8
Reconstruction Cost per km	30,035
Total Network Reconstruction Cost (A)	3,508,088
Total Paved Roads (km)	116.8
Resurfacing Cost per km	12,810
Total Network Resurfacing Cost (B)	1,496,208
Rejuvenation Cost Savings (A)-(B)	2,011,880
Average Annual Cost Savings	100,594

Table 5-19

The Effects of Road Roughness on VOC

(Index of VOC: good = 100, at 2.3 IRI)

Vehicle Class	Road Condition: Fair (1)	Poor (2)	Unpaved (3)
Small Car	106	114-26	108-26
Bus/Taxi	106	114-26	108-26
Light Truck	112	124-38	114-38
Heavy Truck	114	129-46	117-44

(1) IRI 4.6
(2) IRI 6.9 to 9.2
(3) IRI 5.0 to 9.0

Notes: Data are based on 1984 economic costs for Costa Rica. The dominant effect of road condition on vehicle operating costs is through "roughness," a measure of road surface irregularities standardized by the International Roughness Index (IRI).

Source: From application of the VOC submodel of the Highway Design and Maintenance Standards Model (HDM-III). For the Costa Rican context, see Bhandari and others (1987).

Table 5-20

Additional VOC Incurred With No Road Maintenance

	Vehicle Operating Costs (1,000 LE)								
	Cars		B/V/T		Light Truck		Heavy Truck		Total Additional VOC
Year	Adj Factor	VOC	Adj Factor	VOC	Adj Factor	VOC	Adj Factor	VOC	
1	1.003	110	1.003	292	1.003	80	1.009	363	845
2	1.006	270	1.006	718	1.006	205	1.018	729	1,922
3	1.010	458	1.010	1,217	1.020	644	1.030	1,210	3,529
4	1.015	665	1.015	1,768	1.060	1,931	1.040	1,613	5,977
5	1.020	889	1.020	2,363	1.040	1,287	1.060	2,420	6,959
6	1.026	1,127	1.026	2,996	1.060	1,931	1.070	2,823	8,877
7	1.031	1,377	1.031	3,660	1.060	1,931	1.080	3,227	10,195
8	1.037	1,638	1.037	4,354	1.070	2,253	1.080	3,227	11,472
9	1.043	1,908	1.043	5,074	1.080	2,575	1.090	3,630	13,187
10	1.050	2,189	1.050	5,819	1.090	2,897	1.091	3,672	14,577
11	1.056	2,477	1.056	6,587	1.100	3,219	1.100	4,041	16,324
12	1.063	2,774	1.063	7,376	1.120	3,862	1.109	4,411	18,423
13	1.070	3,078	1.070	8,185	1.120	3,862	1.119	4,780	19,905
14	1.077	3,389	1.077	9,012	1.130	4,184	1.140	5,647	22,232
15	1.085	3,708	1.085	9,858	1.130	4,184	1.137	5,519	23,269
16	1.092	4,032	1.092	10,721	1.130	4,184	1.146	5,889	24,826
17	1.099	4,363	1.099	11,600	1.130	4,184	1.155	6,259	26,406
18	1.107	4,699	1.107	12,495	1.124	3,983	1.164	6,629	27,806
19	1.115	5,041	1.115	13,405	1.140	4,506	1.174	7,000	29,952
20	1.123	5,389	1.123	14,329	1.143	4,592	1.170	6,857	31,167
Total Costs		49,581		131,829		56,494		79,946	317,850

5.2.4 **Economic Benefits derived from Road Maintenance** - The economic benefits gained by pursuing the recommended road maintenance policy over one of disregarding maintenance are significant. Table 5-21 compares the costs of the road maintenance program to that of the VOC savings (referred to as VOC Benefits) and the reduction in road rejuvenation costs (Road Rejuvenation Benefits). Total economic savings - LE 311,094,640. This is due to the high total cost of operating all cars, mini-buses, taxis, and small and large trucks on a road network.

In addition, what may be regarded as more pertinent to the Roads Directorate, is the fact that the Road Maintenance Program is estimated to save LE 2,011,880 in road rejuvenation costs over the 20 year analysis period.

Finally, table 5-22 compares the average cost per registered Suez Vehicle of the proposed road maintenance program to the additional VOC incurred if no road maintenance were conducted. The table shows that the average annual cost of the program translates to LE 31 per vehicle per year, and LE 617 over 20 years. The additional VOC per vehicle of not doing the work starts at LE 60 in the first year and risers to a dramatic LE 2,195 in year 20. The total additional VOC per vehicle to drive on the neglected roads over the 20 years would be LE 22,384.

Clearly this demonstrates the necessity to maintain roads. In addition it shows that it is more cost effective for the road user (vehicle owners) to pay higher user taxes on roads than to not pay taxes and suffer the consequences of high VOC.

Table 5-21

Economic & Financial Benefits

Suez Governorate Road Maintenance Study

Year	Road Maint Costs	VOC Benefits	Road Rejuvenation Benefits	Total Savings
1	438,362	845,000	100,594	507,232
2	438,362	1,922,000	100,594	1,584,232
3	438,362	3,529,000	100,594	3,191,232
4	438,362	5,977,000	100,594	5,639,232
5	438,362	6,959,000	100,594	6,621,232
6	438,362	8,877,000	100,594	8,539,232
7	438,362	10,195,000	100,594	9,857,232
8	438,362	11,472,000	100,594	11,134,232
9	438,362	13,187,000	100,594	12,849,232
10	438,362	14,577,000	100,594	14,239,232
11	438,362	16,324,000	100,594	15,986,232
12	438,362	18,423,000	100,594	18,085,232
13	438,362	19,905,000	100,594	19,567,232
14	438,362	22,232,000	100,594	21,894,232
15	438,362	23,269,000	100,594	22,931,232
16	438,362	24,826,000	100,594	24,488,232
17	438,362	26,406,000	100,594	26,068,232
18	438,362	27,806,000	100,594	27,468,232
19	438,362	29,952,000	100,594	29,614,232
20	438,362	31,167,000	100,594	30,829,232
	8,767,240	317,850,000	2,011,880	311,094,640

Table 5-22
Cost Per Vehicle (LE)
Road Maintenance vs. Little or No Road Maintenance
Suez Governorate Road Maintenance Study

Road Maintenance:	Year 1	Year 20	Total
Program Costs (1)	438,362	438,362	8,767,240
Vehicles (2)	14,200	14,200	14,200
Program Costs per Vehicle	31	31	617

No Road Maintenance:	Year 1	Year 20	Total
Additional VOC (3)	845,000	31,167,000	317,850,000
Vehicles (2)	14,200	14,200	14,200
Additional VOC per Vehicle	60	2,195	22,384

(1) Annual costs of proposed road maintenance program.
(2) Total Suez registered vehicles, Suez Safety Directorate Traffic Section and Consultant observations.
(3) Table 4-3.

References

<1> 1987 Road and Street Maintenance Report: Suez Governorate, October, 1987; Neighborhood Urban Services Project.

<2> See FHWA Vehicle Operating Costs, Fuel Consumption and Pavement Type and Condition Factors, 1982; A Manual on User Benefit Analysis of the Highway and Bus Transit Improvements, 1977; and The Highway Design and Maintenance Standard Model, 1987.

<3> FHWA Vehicle Operating Costs, Fuel Consumption and Pavement Type and Condition Factors, 1982.

<4> Robley Winfrey, Economic Analysis of Highways, 1968, International Textbook Co., Scraton, PA U.S.A.

<5> Jan de Weille, Quantification of Road User Savings, World Bank Occasional Paper No.2, The International Bank for Reconstruction and Development.

<6> American Association of State Highway and Transportation Officials, A Manual on User Benefit Analysis of Highway and Bus-Transit Improvements, 1977; AASHTO, Washington, D.C.

<7> Road Deterioration in Developing Countries, A World Bank Study, 1988; The International Bank for Reconstruction and Development.

<8> The Highway Design and Maintenance Standards Model, 1987; The International Bank for Reconstruction and Development.

<9> Road and Street Maintenance; Suez Governorate, October,1987; Neighborhood Urban Services Project.

APPENDICES

Appendix A : Seminar Conclusions and Outputs

Appendix B : Road Maintenance Asphalt Requirements

Appendix C : Performance Standards PS02 thru PS08

Appendix D : Work Accomplished Summaries WAS01 thru WAS12

APPENDIX A

SEMINAR CONCLUSIONS AND OUTPUTS

SEMINAR CONCLUSIONS AND OUTPUTS

The following is a summary of the conclusions and recommendations of the Seminar to which all participants agreed.

1. Maintenance Management System

1.1 The main objective of the seminar is to assist the Road Directorate or Road Department in each of the six governorates, in establishing a more effective and efficient road maintenance management system to keep the pavements, under normal conditions of traffic, in good condition or to the standard to which they were built.

2.1 To achieve an effective maintenance management system, the following issues should be addressed:

- most of the existing organizations of the Road Directorate or Road Departments and Road Sections in districts are not effective for road maintenance by force account and need to be reviewed for appropriate organization;

- levels of responsibilities for road repairs and maintenance as defined in the reports of road maintenance for Suez, Port Said and Shoubra El Kheima city, developed by TAC, should be adopted;

- coordination and experience exchange between Road Directorates in Urban Governorates is needed and periodic seminars, every 2-3 months, should be held in Governorates on a rotational basis; and

- monthly meetings should be held between Road Directorates or Road Department and different Utility Departments in Governorate to emphasise coordination between them for road maintenance and utility works.

2. Staffing

2.1 Staffing of Road Directorates or Road Departments in governorates and Road Sections in districts is inadequate for road maintenance by force account. They are short in engineers, technicians, foremen, equipment operators and skilled labor.

2.2 Because of the low salary and incentive wage scale, Road Directorates are short in qualified engineers, technicians and skilled labor. An improved incentive pay plan is needed.

3. Training

All road maintenance staff in Road Directorates or Road Department and Road Sections in districts would benefit by training to develop their knowledge and skills. A training program should be developed and implemented. The following courses are proposed which will be available in the National Road Authority Training Center in Cairo.

- For engineers and technicians a 15 days course on road maintenance and repair of asphaltic concrete pavement. This course will cover all topics related to causes of road failures, types of failures and the required remedies.

- For road equipment operators a 15 day course to train operators on the correct use of road equipment is desirable. Practical training is most important to upgrade operators skills. Operator equipment maintenance should be a major topic in the training.

- A 15 days course to train two engineers and two technicians from each directorate on department on field tests and experiments needed for soil and road materials to check required quality control. The program will be implemented in road training center in Cairo.

4. Road Equipment Needs

- Road maintenance equipment in Road Directorates or Road Departments and Road Sections are not sufficient to carry out road maintenance by force account. The required road equipment for each Road Directorate as developed by TAC needs to be procured.

- It is recommended that each Road Directorate or Road Department be supplied with a test laboratory to control different road materials and asphalt mixtures.

5. Road Maintenance Planning

Five year and annual road maintenance plans defining the required work, materials, equipment and funds need to be prepared. The annual plans must be prepared and approved by November to be put on implementation at the beginning of the fiscal year.

6. Road Maintenance Budgets

6.1 Resources

Road maintenance resources in Governorates and Districts are obtained from different sources, namely:

- Bab I for salaries, overtime and incentives;
- Bab II for maintenance needs (road maintenance, fuels, lubricants, and spare parts);
- Benzine revenue for road maintenance and construction;
- Governorate service treasury;
- Free zone revenue for Port Said governorate only; and
- USAID allocation for O&M support.

It is recommended to raise percentage of road maintenance allocations from benzine revenues to develop road maintenance resources and implement road maintenance programs.

Allocate road maintenance funds for both Road Directorates or Road Departments in Governorates and Road Sections in Districts.

6.2 Budget Limitation

The current amount of allocation from Bab I cannot cover a reasonable effective incentive pay plan. Bab II allocations are very low.

6.3 Budget Preparation

Budget proposals are not worked out precisely and in time. Annual operations, maintenance and repair plans are not well prepared in most Road Directorate. Estimates are not based on actual experience and projected needs. It is recommended that annual budget proposals be prepared and submitted not later than November each year. By well developed plans and budget proposals, Districts and Road Directorates must convince financial and planning authorities of their needs. In case Road Directorates receive less fund allocations through Bab I and II than realistic budget proposals, other resources must be found to support road maintenance activities.

7. Streets, footpaths and curbing inventory and conditions must be prepared after detailed reconnaissance. This will assist in preparing precise road maintenance plans.

8. The cost of rehabilitation and repair of roads due to utility installation or repair must be paid to the Road Directorate in advance. Participants agreed that cost of repair was about LE 25 per square meter.

9. Detailed as built maps for roads, streets and utilities need to be prepared in each governorate. Special teams have to be assigned to accomplish this work within a defined period of time.

10. Road Sections in districts should be put under direct technical supervision of the Road Directorates.

11. It is recommend that at least 5-7% of the cost of construction of new streets should be allocated for road maintenance in the BAB II budget.

APPENDIX B

ROAD MAINTENANCE ASPHALT REQUIREMENTS

ROAD MAINTENANCE ASPHALT REQUIREMENTS

To meet the asphalt needs of the Suez road maintenance department, the Suez Governorate has four options: (1) Build a new asphalt plant; (2) Purchase the asphalt from a local producer; (3) Repair the existing asphalt plant; and (4) Buy new mobile asphalt plant(s). All costs are evaluated in present day Egyptian pounds (LE) over a 15 year period.

It is estimated that the maximum possible asphalt requirements for road maintenance purposes by the current Suez road maintenance crew is 2,000 tons per year. A 14.05 LE per cubic meter raw material cost is used in the analysis based on consultant raw material estimates.

I. Build New Asphalt Plant

Asphalt Plant Production:

- The new asphalt plant tendered by the Suez governorate should be able to produce approximately 20 metric tons per hour (conservative estimate).
- An asphalt plant requires at least 1 hour of preventive maintenance per day; there are 6 hours in a normal workday; this yields 5 hours of actual asphalt production per day.
- In 1991, this would result in an estimated 20 asphalt plant production days to meet the Suez road maintenance needs:

2,000	metric tons required per year
/ 20	metric tons produced per hour

100	production hours
/ 5	production hours per day

20	production days required to meet the Suez road maintenance needs

- There are an estimated 275 workdays per year, which means that the proposed new asphalt plant would only be required to operate a maximum of 7% of the time to meet the Suez road maintenance needs.

Asphalt Plant Price:

- The original LE 600,000 estimate may rise to 1,000,000 or more depending on which asphalt plant is purchased.
- A LE 870,000 new plant cost is used in this analysis. This cost is based on a plant cost of LE 725,000 plus 20% to purchase the manufacturer's recommended spare parts inventory.

Asphalt Plant Maintenance Cost:

- Plant maintenance costs are assumed to run cyclically: LE 25,000 in year 2 rising gradually at 15% annually for 3 years, then repeating.

Labor Cost:

- A total labor cost of 10,680 LE in 1991 is estimated to cover the wages of the foreman, operators and laborers required to operate the plant.

1 foreman	•	130 LE monthly salary	=	130 LE p/month
4 operators	•	80 LE monthly salary	=	320 LE p/month
8 laborers	•	55 LE monthly salary	=	440 LE p/month
				---
				890 LE p/month
			x	12 months

				10,680 LE p/year

II. <u>Purchase Asphalt From Local Producer</u>

Asphalt Availability:

- There are currently 2 publicly owned and 1 privately owned asphalt plants in Suez.

Asphalt Price:

- 32 LE per cubic meter.

III. <u>Repair the Existing Asphalt Plant</u>

Old Plant Production:

- In addition to meeting the Suez "New Cities" asphalt needs, the repaired plant could also supply the road maintenance requirements.
- In consultant discussions in Suez, it was understood that the old plant will probably be repaired regardless of any decision made by the road maintenance department regarding the purchase of asphalt plant(s).
- To date, there has been approximately only 11,000 metric tons of asphalt produced by the old asphalt plant, which is 7 years old.
- The plant has the estimated capability of producing 27,500 tons per year with normal routine maintenance.

20 tons per hour
x 5 hours per day
---
100 tons per day
x 275 workdays per year

27,500 tons per year

- The total output from the old plant over its 7 year life is, thus far, equal to well under half a year of estimated capacity output. The plant has been severely under utilized.

11,000 actual tons of asphalt produced
/ 27,500 annual capacity - tons per year

40% level of annual asphalt produced

Old Plant Repair Cost:

- It is estimated that the plant can be repaired for 270,000 LE.
- There are, currently, 3 firms submitting bids to repair the plant.
- A one year service guarantee is stipulated in the RFP.

Old Plant Maintenance Cost:

- Plant maintenance costs are assumed to run cyclically: LE 15,000 in year 2 rising gradually at 20% annually for 3 years, then repeating.

Labor Cost:

- Same as new plant labor cost.

IV. <u>Buy New Mobile Plant</u>

Mobile Plant Production:

- The mobile plant envisaged would be able to produce 10 metric tons p/hour, which is enough to supply the estimated Suez road department's annual asphalt requirements of 2,000 metric tons.

10 tons per hour
x 5 hours per day
---
50 tons per day
x 275 workdays per year

13,750 tons per year

Mobile Plant Cost:

- Total new mobile plant cost is LE 180,000. This cost is based on a mobile plant cost of LE 150,000 plus a 20% cost to purchase the manufacturer's recommended spare parts inventory.

Mobile Plant Maintenance Cost:

- Plant maintenance costs are assumed to run cyclically: LE 7,500 in year 2 rising gradually at 15% annually for 3 years, then repeating.

Labor Cost:

- A total labor cost of 16,800 LE in 1991 is estimated to cover the wages of the foreman, operators and laborers required to operate the plant.

1 foreman	•	130 LE monthly salary	=	130 LE p/month
3 operators	•	80 LE monthly salary	=	240 LE p/month
6 laborers	•	55 LE monthly salary	=	330 LE p/month
				---
				700 LE p/month
				12 months

				8,400 LE p/year

Financial Analysis - The financial analysis results of the four options are tabulated below. The spreadsheet from which they are derived is Table B-1.

Option	Total Cost p/Ton - 1991	Total 15 yr Cost
I Buy New Plant	LE 44.67	LE1,801,956
II Purchase Asphalt	23.52	705,600
III Repair Old Plant	24.00	1,023,771
IV Buy Mobile Plant	20.53	788,100

Evaluation:

Considering the cost of operation, maintenance, raw materials, labor, and parts inventory, combined with the fact that the Suez road maintenance asphalt needs are low, it would be extremely cost ineffective to buy the new asphalt plant. Instead, it is recommended that the Suez road maintenance asphalt needs be filled through buying a less expensive mobile plant, or purchasing asphalt from a local producer, or by repairing the existing plant.

Despite the total cost of the new mobile plant, option IV, being higher than that of repairing the old plant, option IV is still more attractive. As the age of the old plant raises some doubts that it may not be adequately repaired.

The most cost effective option at first glance, option II, may however not be the best option if one considers the total Suez asphalt requirements including that of the "New City". For this reason a second analysis was developed to evaluate the project from the perspective of total asphalt requirements for both the Suez road maintenance department and the "New City". An additional 14,500 metric tons are estimated to be required annually by the new city, for a total Suez governorate asphalt demand of 16,500 metric tons.

In the second analysis, two mobile asphalt plants are considered to meet the total Governorate requirements. The results of Table 8-2 are summarized below:

Option	Total Cost p/Ton - 1991	Total 15 yr Cost
I. Buy New Plant	LE 14.49	LE 4,048,551
II. Purchase Asphalt	23.52	5,882,400
III. Repair Old Plant	11.99	3,270,366
IV. Buy Two Mobile Plants [2]	12.80	3,378,146

Under this scenario, purchasing asphalt from the local producers is the least attractive option. Repairing the old plant or buying two small mobile plants are clearly more cost effective. It is important to realize though, that if option IV, buying two mobile asphalt plants, is chosen, then the Suez governorate will be able to supply all asphalt requirements and should not repair the old plant.

Conclusion:

The most cost effective and risk averse option is to buy two mobile asphalt plants, and scrap the old plant.

[2] Note that both the Labor and Maintenance & Parts costs were doubled to reflect the additional operating costs incurred by buying the second mobile plant.

Suez Road Maintenance Asphalt Requirements & Costs

Asphalt Raw Material Cost - p/m3:			$14.05												
Local Asphalt Producer Cost - p/m3:			$32.00												
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Cubic Meters p/Year	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470
Metric Tons p/Year	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
I. BUY NEW ASPHALT PLANT															
Cost of New Plant	$870,000														
Ammortized Plant	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000
Operating Costs:															
Maint & Parts	0	25,000	28,750	33,062	38,022	25,000	28,750	33,062	38,022	43,725	25,000	28,750	33,062	38,022	43,725
Raw Material	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654
Labor	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680
Annual Cost	89,334	114,334	118,084	122,396	127,355	114,334	118,084	122,396	127,355	133,059	114,334	118,084	122,396	127,355	133,059
Cost p/Ton	44.67	57.17	59.04	61.20	63.68	57.17	59.04	61.20	63.68	66.53	57.17	59.04	61.20	63.68	66.53
Total Cost	1,801,956														
II. PURCHASE ASPHALT FROM LOCAL MANUFACTURER															
Asphalt Cost	$47,040	$47,040	$47,040	$47,040	$47,040	$47,040	$47,040	$47,040	$47,040	$47,040	$47,040	$47,040	$47,040	$47,040	$47,040
Cost p/Ton	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52
Total Cost	705,600														
III. REPAIR & USE OLD ASPHALT PLANT															
Old Plant Repair	$250,000														
Ammortized Plant	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667
Operating Costs:															
Maint & Parts	0	15,000	18,000	21,600	25,920	15,000	18,000	21,600	25,920	31,104	15,000	18,000	21,600	25,920	31,104
Raw Material	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654
Labor	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680
Annual Cost	48,000	63,000	66,000	69,600	73,920	63,000	66,000	69,600	73,920	79,104	63,000	66,000	69,600	73,920	79,104
Cost p/Ton	24.00	31.50	33.00	34.80	36.96	31.50	33.00	34.80	36.96	39.55	31.50	33.00	34.80	36.96	39.55
Total Cost	1,023,771														
IV. BUY TWO MOBIL ASPHALT PLANTS															
Mobil Plant Cost	$180,000														
Ammortized Plant	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000
Operating Costs:															
Maint & Parts	0	7,500	8,625	9,919	11,407	10,000	11,500	13,225	15,209	17,490	10,000	11,500	13,225	15,209	17,490
Raw Material	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654	20,654
Labor	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400
Annual Cost	41,054	48,554	49,679	50,973	52,460	51,054	52,554	54,279	56,262	58,544	51,054	52,554	54,279	56,262	58,544
Cost p/Ton	20.53	24.28	24.84	25.49	26.23	25.53	26.28	27.14	28.13	29.27	25.53	26.28	27.14	28.13	29.27
Total Cost	788,100														

Suez Road Maintenance & New Paving Asphalt Requirements & Costs

Asphalt Raw Material Cost – p/m3:			$14.05												
Local Asphalt Producer Cost – p/m3:			$32.00												
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Cubic Meters p/Year	12,130	12,130	12,130	12,130	12,130	12,130	12,130	12,130	12,130	12,130	12,130	12,130	12,130	12,130	12,130
Metric Tons p/Year	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500
I. BUY NEW ASPHALT PLANT															
Cost of New Plant	$870,000														
Ammortized Plant	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000	58,000
Operating Costs:															
Maint & Parts	0	25,000	28,750	33,062	38,022	25,000	28,750	33,062	38,022	43,725	25,000	28,750	33,062	38,022	43,725
Raw Material	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427
Labor	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680
Annual Cost	239,107	264,107	267,857	272,169	277,128	264,107	267,857	272,169	277,128	282,832	264,107	267,857	272,169	277,128	282,832
Cost p/Ton	14.49	16.01	16.23	16.50	16.80	16.01	16.23	16.50	16.80	17.14	16.01	16.23	16.50	16.80	17.14
Total Cost	4,048,551														
II. PURCHASE ASPHALT FROM LOCAL MANUFACTURER															
Asphalt Cost	$388,160	388,160	388,160	388,160	388,160	388,160	388,160	388,160	388,160	388,160	388,160	388,160	388,160	388,160	388,160
Cost p/Ton	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52	23.52
Total Cost	5,822,400														
III. REPAIR & USE OLD ASPHALT PLANT															
Old Plant Repair	$250,000														
Ammortized Plant	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667	16,667
Operating Costs:															
Maint & Parts	0	15,000	18,000	21,600	25,920	15,000	18,000	21,600	25,920	31,104	15,000	18,000	21,600	25,920	31,104
Raw Material	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427
Labor	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680
Annual Cost	197,773	212,773	215,773	219,373	223,693	212,773	215,773	219,373	223,693	228,877	212,773	215,773	219,373	223,693	228,877
Cost p/Ton	11.99	12.90	13.08	13.30	13.56	12.90	13.08	13.30	13.56	13.87	12.90	13.08	13.30	13.56	13.87
Total Cost	3,270,366														
IV. BUY TWO MOBIL ASPHALT PLANTS															
Mobil Plant Cost	$360,000														
Ammortized Plant	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000
Operating Costs:															
Maint & Parts	0	15,000	17,250	19,838	22,813	10,000	11,500	13,225	15,209	17,490	10,000	11,500	13,225	15,209	17,490
Raw Material	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427	170,427
Labor	16,800	16,800	16,800	16,800	16,800	16,800	16,800	16,800	16,800	16,800	16,800	16,800	16,800	16,800	16,800
Annual Cost	211,227	226,227	228,477	231,064	234,040	221,227	222,727	224,452	226,435	228,717	221,227	222,727	224,452	226,435	228,717
Cost p/Ton	12.80	13.71	13.85	14.00	14.18	13.41	13.50	13.60	13.72	13.86	13.41	13.50	13.60	13.72	13.86
Total Cost	3,378,146														

APPENDIX C

PERFORMANCE STANDARDS PS02 THRU PS08

GOVERNORATE OF SUEZ | SUEZ ROADS DIRECTORATE

ROAD & STREET MAINTENANCE

** PERFORMANCE STANDARD **

WORK ACTIVITY: Short Asphalt Overlays | ACTIVITY CODE: 02

DESCRIPTION & PURPOSE: Placing a layer of hot-mix asphaltic concrete over an existing asphalt roadway to correct settlements, restore smoothness, and in turn prolong the useful life of the roadway.

PERFORMANCE GUIDLINES: Before doing an asphalt overlay, the roadway must be repaired as per Performance Standards (Activity Codes 03 & 03A). This work is to be undertaken when the base course is structualy sound and the asphalt pavement has deteriorated and become excessively rough.

TYPICAL CREW

Foreman	1
Equipment Operators	8
Skilled laborers	4
Laborers	12

EQUIPMENT

Dump trucks	3
Asphalt finisher	1
Air Compressor	1
Tractor w/bed	1
Rollers	1
Asphalt distributor with sprayer	1

MATERIALS

Asphalt mix	75 m3
Bitumen tack coat	190 to 374 ltr
Diesel for cleaning tools	30 ltr

WORK METHOD

1. Make sure all necessary repairs have been completed using Activity Codes 03 & 03A.
2. Place cones, barrels and/or other safety devices to protect personnel and area.
3. Clean thoroughly removing all dirt by using shovels, picks, brooms and compressed air.
4. Spray a bitumen tack coat evenly over the existing pavement. Application rate will vary between 0.23 liters and 0.45 liters per sq. meter depending on the condition of the existing road surface. Use as little as possible to "tack" the new asphalt mix to the old pavement.
5. Lay the new asphalt mix with the asphalt finisher at a depth so that you get a 6 cm. depth after rolling is completed.
6. Roll the mix as soon as it is laid by the finisher in order to obtain maximum compaction. The drive wheel of the roller is to be next to the finisher. Roll from outside edges towards the center of the roadway. Overlay each pass of the roller by one-half of the cylinder width.
7. Check the surface before the final rolling with a long straightedge for depressions or high spots and correct while the mix is very hot.
8. Do the final rolling after the mix has cooled some, but you can still roll out the roller marks left by the initial rolling.

ESTIMATED DAILY PRODUCTION

830 m2 at a compacted depth of 6 cm.

NOTES:

/PS02

GOVERNORATE OF SUEZ | SUEZ ROADS DIRECTORATE

ROAD & STREET MAINTENANCE

** PERFORMANCE STANDARD **

WORK ACTIVITY: Pothole & Utility Cut Repairs | ACTIVITY CODE: 03

DESCRIPTION & PURPOSE: Damaged areas can be any of the following: Potholes, utility cuts, raveling, depressions, edge breaks, etc. Restoration of the roadway to a smooth and uniform surface reduces vehicle maintenance costs and reduces future road maintenance costs.

PERFORMANCE GUIDLINES: It is necessary to repair all damaged areas as soon as possible. If damaged areas are not repaired in their early stages, they increase in size and soon the pavement requires complete rebuilding.

TYPICAL CREW

Foreman	1
Equipment Operators	5
Skill laborers	4
Laborers	6

EQUIPMENT

Dump Truck	1
Tractor w/bed	1
Air Compressor	1
Roller	1
Vib. Compactor	1

SMALL TOOLS

(a) Buckets	4
(b) Buckets w/holes	2
(c) Brooms	4
(d) Picks	2
(e) Shovels	4
(f) Rakes	3
(g) Hand Tampers	4
(h) Paint Brushes	4
(i) Straight Edge	1
(j) Cones or barrels	

MATERIALS

Asphalt Mix	3 to 5 m3
Bitumen Tack & Prime	10 to 20 ltr.
Diesel (cleaning)	5 ltr.

WORK METHOD

1. Place cones, barrels and/or other safety devices to protect personnel and area.
2. Mark area to be repaired at least 10 cm. outside area to be repaired.
3. Excavate area to be repaired. Use Compressor with cutter to form verticle edges. Excavate to a depth where the underlying asphalt layer is undisturbed or the base course is solid.
4. Thoroughly clean the bottom of the hole so there is no loose material.
5. If bottom of hole is asphalt concrete, put a light tack coat on and let it dry.
6. If bottom of hole is base course material, dampen with water and compact using hand tampers & vibrating compactor. Apply a light prime coat to the bottom of the hole.
7. Paint the sides of the hole with tack coat material using paint brushes.
8. Lay asphalt mix in hole not more than 7.5 cm. thick per layer. Compact each lift thoroughly using the vibratory compactor. Use hand tampers only where necessary.
9. The last layer of asphalt mix (top) must be very level and be slightly higher than the existing road. Use the 'Wooden Straightedge to check the level and height. Asphalt concrete must not extend past the edges of the hole.
10. Compact the top layer with roller using a small amount of water on the rollers.

ESTIMATED DAILY PRODUCTION

4 m3 = 34 m2 (approx.) @ 8 cm. compacted depth
4 m3 = 27 m2 (approx.) @ 10 cm. compacted depth
4 m3 = 23 m2 (approx.) @ 12 cm. compacted depth

NOTES:

/PS03

GOVERNORATE OF SUEZ — SUEZ ROADS DIRECTORATE

ROAD & STREET MAINTENANCE

** PERFORMANCE STANDARD **

WORK ACTIVITY: Pavement Repairs - Alligator cracks, depressions, raveling, small potholes — ACTIVITY CODE: 03A

DESCRIPTION & PURPOSE: This type of repair is to be done on areas that that do not need to be cut or excavated. Engineering judgement is to be used to determine if the distressed area should be repaired using Performance Standard with Activity Code 03 or this one.

PERFORMANCE GUIDLINES: Repairs are to be done as soon as Alligator cracks, depressions, raveling, or small damaged areas are observed.

TYPICAL CREW

Foreman	1
Equipment Operators	5
Skill laborers	4
Laborers	6

EQUIPMENT

Dump truck	1
Tractor w/bed	1
Air Compressor	1
Roller	1
Vib. Compactor	1

SMALL TOOLS

(a) Hand tampers	4
(b) Shovels	4
(c) Rakes	3
(d) Brooms	4
(e) Picks	4
(f) Bucket w/holes	2
(g) Buckets	4
(h) Paint brushes	4
(i) Straight edge	1
(j) Cones or Barrels	

MATERIALS

Asphalt mix	6 to 12 m3
Bitumen	
Tack coat	30 to 60 ltr
Diesel for cleaning tools	5 ltr

WORK METHOD

1. Place cones, barrels or other safety devices to protect personnel and area.
2. Mark area to be repaired at least 10 cm. outside of damaged area.
3. Clean thoroughly with picks, shovels, brooms and air so that all of damaged area is showing and very clean.
4. Use picks or air compressor cutter to cut a notch 2 cm. deep and 8 cm. wide around the outside edge of the area to be patched. This ensures that the edge of the patch is well bonded to the existing pavement.
5. Use pick to make many small chips on the complete area that is to be repaired.
6. Thoroughly clean again as in number three above.
7. Apply a tack coat to the area that is being repaired.
8. Wait untill the tack coat has 'cured' before filling with asphalt concrete.
9. While waiting for the tack coat to 'cure' got to the next spot to be repaired. Start the proceedure over by starting with Item No. 1 above.
10. Use "straightedge" to make sure that the asphalt mix is level and slightly higher than the existing pavement.
11. Use roller (preferred) or vibrating compactor to thoroughly compact the asphalt mix. Start from the outside edges and work towards the center.

ESTIMATED DAILY PRODUCTION

6 m3 = 81 m2(approx.) @ 5 cm. compacted depth
9 m3 = 121 m2(approx.) @ 5 cm. compacted depth
12 m3 = 162 m2(approx.) @ 5 cm. compacted depth

NOTES:

/PS03A

GOVERNORATE OF SUEZ — SUEZ ROADS DIRECTORATE

ROAD & STREET MAINTENANCE

** PERFORMANCE STANDARD **

WORK ACTIVITY: Curbstone Re-setting or Replacement — ACTIVITY CODE: 04

DESCRIPTION & PURPOSE: Re-set or replace curbstones that are loose, tilted, broken or missing.

PERFORMANCE GUIDLINES: A survey of the necessary curbstone repairs is to be undertaken along with the survey for street and footpath repairs. Curbstone repairs are to be done using the same type of curbstone and lined up with the existing curbstone alignment using a stringline.

TYPICAL CREW

Foreman	1
Masons	2
Equip. Operator	1
Laborers	4

EQUIPMENT

Dump truck (or tractor w/trailer)	1
Small Tools	
(a) Picks	2
(b) Straightedge	1
(c) Stringline	1
(d) Shovels	2
(e) Buckets	2
(f) Trowels	2

MATERIALS

Curbstones	100 ea.
Sand	0.20 m3
Cement	0.75 bag

(mortar=0.15 m3)

WORK METHOD

1. Place cones, barrels and/or other safety devices to protect personnel and area.
2. Remove and dispose of broken and damaged curbstone sections and other unusable materials.
3. Compact underlying surface & new bedding sand, adding water for maximum compaction.
4. Make sure area is level using wooden straightedge.
5. Place mortar material on base and check level with straightedge.
6. Set curbstone and line up using stringline.
7. Fill all joints with mortar.
8. Smooth all joints flush with the curbstones.
9. Clean up area.

ESTIMATED DAILY PRODUCTION

50 meters

NOTES:

/PS04

GOVERNORATE OF SUEZ | SUEZ ROADS DIRECTORATE

ROAD & STREET MAINTENANCE

** PERFORMANCE STANDARD **

WORK ACTIVITY: Grading & Shaping Unpaved Streets | ACTIVITY CODE: 05 & 06

DESCRIPTION & PURPOSE: Grade, shape and smooth earth street surfaces with motorgrader and roller to restore proper crown and smooth riding surface.

ACTIVITY CODE: 05 To be used when material is needed for leveling.
ACTIVITY CODE: 06 To be used when no material is needed.

PERFORMANCE GUIDLINES: This work is to be performed when the street has developed corrugations, traffic ruts, holes, uneven settlements, or accumulation of debris that obstructs vehicular use.

TYPICAL CREW

Equipment operators	3
Laborers	3

EQUIPMENT

Motorgrader	1
Roller	1
Water tanker	1
Picks	2
Shovels	2
Rakes	2

MATERIALS

Activity Code: 05
Gravel and/or earth fill material when necessary.

Activity Code: 06 - None

WORK METHOD

1. Place cones, barrels and/or other safety devices to protect personnel and area.
2. Use laborers to remove large stones and other materials that should not be graded into street.
3. Use motorgrader to cut high areas and fill low areas, starting at the outside edges of street and working towards the center of the street.
4. Shape the street with a slight crown in center making sure the complete street is smooth.
5. Add water as necessary for proper compaction.
6. Roll street to a smooth surface and to a compacted state.

ESTIMATED DAILY PRODUCTION

2000 to 5000 m2

NOTES:

/PS0506

GOVERNORATE OF SUEZ | SUEZ ROADS DIRECTORATE

ROAD & STREET MAINTENANCE

** PERFORMANCE STANDARD **

WORK ACTIVITY: Street Cleaning before pavt. repairs ACTIVITY CODE: 07

DESCRIPTION & PURPOSE: Thorough cleaning of street area is necessary so that a detailed inspection can be undertaken before starting pothole, alligator crack, etc. repairs. All dirt, trash and other debris is to be removed so that the existing asphalt pavement is fully exposed and cleaned.

PERFORMANCE GUIDLINES: The method and equipment used for cleaning is to be determined by the Engineer. The crew, equipment and work methods listed below are guides to assist the Engineer in his decisions.
A "Daily Work Order" form is to be completed before work begins and upon completion of the work the right side of the form is to be filled in.

TYPICAL CREW

Foreman	1
Equipment Operators	4
Laborers	6

EQUIPMENT

Grader	1
Loader	1
Tractor w/bed	1
Dumpster	1
Air Compressor	1

Small tools
(as necessary)

MATERIALS

None

WORK METHOD

1. Place cones, barrels and/or other safety devices to protect personnel and area.
2. Clean the existing asphalt pavement using personnel and equipment necessary so that the pavement is very clean.
3. Load the dirt, trash and other debris into the vehicle that is to transport it for disposal.
4. Inspect the cleaned pavement thoroughly and record locations that need repaired.
5. Fill out "Daily Work Order" forms using "Activity Codes" for the work to be undertaken.
6. Complete the "Weekly Work Schedule" using the information from the "Daily Work Orders". The "Weekly Work Schedules" must be coordinated with other work that is planned. In this way you are scheduling all maintenance work that is to be accomplished within the next month.

ESTIMATED DAILY PRODUCTION

m2 Cleaned to be recorded after completion.

NOTES:

/PS07

GOVERNORATE OF SUEZ | SUEZ ROADS DIRECTORATE

ROAD & STREET MAINTENANCE

** PERFORMANCE STANDARD **

WORK ACTIVITY: Footpaths Repair (Tile Surface) ACTIVITY CODE: 08

DESCRIPTION & PURPOSE: Repair of footpaths (sidewalks) using the same design of tiles as were originaly used. Restore footpath to its original smooth condition.

PERFORMANCE GUIDLINES: Survey of necessary footpath repairs are to be done along with the survey for necessary street repairs. Repair work on the footpaths is to be scheduled so that all repairs are completed as soon as possible after completion of street repairs.

TYPICAL CREW

Foreman	1
Masons	2
Equip. Operators	1
Laborers	4

EQUIPMENT

Truck (or tractor w/trailer)	1
Small Tools	
(a) Picks	2
(b) Shovels	2
(c) Straightedge	1
(d) Bucket	1
(e) Trowels	2

MATERIALS

Tiles	300 ea.
Sand	0.30 m3
Cement	0.70 bag

(mortar = 0.14 m3)

WORK METHOD

1. Remove damaged tiles and loose material.
2. Compact underlying surface & new bedding sand adding water for maximum compaction.
3. Level area using wooden straightedge.
4. Place mortar and and make sure it is level.
5. Place tiles using straightedge to make sure they are level.
6. Broom area to make sure that the mortar fully fills all spaces between tiles.
7. Block off area for a period of at least 24 hours to make sure that tiles are not disturbed during curing period.
8. Return after 24 hours, remove barricades and clean up area.

ESTIMATED DAILY PRODUCTION

12 m2

NOTES:

/PS08

APPENDIX D

K ACCOMPLISHED SUMMARIES WAS01 THRU WAS12

SUEZ ROADS DIRECTORATE
WORK ACCOMPLISHED SUMMARY

DATE	HOURS* WORKED	ENG.	FOR MAN	SKILL LABOR	LAB ORER	EQUIP OPER.	EQUIPMENT USED		MAT. USED TYPE & AMT.	WORK ACCOMP M3-M2-L.M.	ACT. CODE	ACTIVITY DETAILS	LOCATION WORK ACCOMPLISHED
3/26	4.5	3	1	0	12	5	Roller Truck Tract/bed Air Comp. Water tnk	1 1 1 1 1	Asph. mix 0.5 m3 Tack 20 ltr Diesel 5 ltr	1.5 m2 4.0 m2	03 03A	Pothole Surface repair	Around Govt. bldg.
3/27	4.5	3	1	0	12	5	same		Asph. mix 1.0 m3 Tack 30 ltr Diesel 5 ltr	25.0 m2	03	Pothole	Around Govt. bldg.
3/28	Training of Engineers & foremen in field office.												
3/29	No asphalt mix available										Cut hole around Govt. bldg		
3/31	4.0	2	1	0	12	4	Roller Truck Tract/bed Air Comp	1 1 1 1	Asph. mix 1.0 m3 Tack 20 ltr Diesel 5 ltr	5.0 m2 2.2 m2 2.4 m2	03 03 03	Pothole " "	Around Govt. bldg.
4/1	4.3	2	1	0	12	4	same		Asph. mix 2.5 m3 Tack 30 ltr Diesel 5 ltr	4.2 m2 12.0 m2	03 03	Pothole "	Around Govt. bldg.

* Includes 1 hr. total travel to & from site.

/WAS01

SUEZ ROADS DIRECTORATE
WORK ACCOMPLISHED SUMMARY

DATE	HOURS* WORKED	ENG.	FOR MAN	SKILL LABOR	LAB ORER	EQUIP OPER.	EQUIPMENT USED		MAT. USED TYPE & AMT.	WORK ACCOMP M3-M2-L.M.	ACT. CODE	ACTIVITY DETAILS	LOCATION WORK ACCOMPLISHED
4/2	No asphalt mix available												
4/3	4.2	2	1	0	12	4	Roller Truck Tract/bed Air Comp.	1 1 1 1	Asph. mix 1.0 m3 Tack 30 ltr Diesel 5 ltr	10.8 m2	03	Pothole	Around Govt. bldg.
4/4	3.8	2	1	0	12	4	same		Asph. mix 1.0 m3 Tack 35 ltr Diesel 5 ltr	18.0 m2	03	Pothole	Around Govt. bldg.
4/7	?	2	1	0	12	4	same		same	7.0 m2 7.0 m2	03 03	Pothole "	Around Govt. bldg.
4/8	?	2	1	0	12	4	same		same	6.0 m2 11.0 m2	03 03	" "	Around Govt. bldg.
4/9	3.3	2	1	0	12	4	same		Asph. mix 2.0 m3 same	2.0 m2 10.7 m2	03A 03	Surfuce repair Pothole	Around Govt. bldg. " "
4/10	2.5	1	1	0	12	2	Tractor w/bed Air Comp.	1 1	(No Asphalt mix avail.)	Cut remain. 4m2 of hole # 12	03	Pothole	Around Govt. bldg.

* Includes 1 hr. total travel to & from site.

/WAS02

SUEZ ROADS DIRECTORATE
WORK ACCOMPLISHED SUMMARY

DATE	HRS.* WORK	ENG.	FOR MAN	SKILL LABOR	LAB ORER	EQUP OPER	EQUIPMENT USED		MATERIAL USED TYPE & AMOUNT	WORK ACCOMP m2-m3-lin.m	ACT. CODE	ACTIVITY DETAILS	LOCAT. WORK ACCOMP.
4/11	3.0	1	1	0	12	2	Tractor w/bed Dumpster	1 1	-------	16 m2 (no asphalt mix avail)	07	Cleaning street	Osama St.
4/12	3.0	1	1	0	12	2	same		--------	12 m2 (no asphalt mix avail)	07	Cleaning street	Osama St.
4/14	3.0	1	1	0	12	2	same		---------	14 m2 (no asphalt mix avail)	07	Cleaning street	Osama St.
4/15	4.0	1	1	0	12	4	Roller Truck Air Comp Tractor w/bed	1 1 1 1	Asph. mix 0.5 m2 Tack coat 10 ltr Diesel 5 ltr --- Asph. mix 0.25 m2 Tack coat 10 ltr	4 m2 --- 14 m2	03 --- 03A	Pothole --- Depress-ions & Allig. cracks	Around Govt bldg. --- Aroung Govt bldg.
	4.0	1	1	3	6	1	Truck	1	Curbstones 40 ea. Bedding sand .5 m3 Cement .5 bag	20 lin.m.	04	Place Curbston	Osama st.
4/17	5.0	1	1	3	6	1	Truck	1	Curbstones 50 ea. Bedding sand .5 m3 Cement .5 bag	25 lin m. (no asphalt mix avail)	04	Placing curbston	Osama St.

SHOWED IRF ROAD MAINTENANCE MODULES 1,3,5,6 TO 11 ENGINEERS, 3 FOREMEN & 8 EQUIPMENT OPERATORS & LABORERS

* Includes 1 hr. total travel to & from site.

/WAS03

SUEZ ROADS DIRECTORATE
WORK ACCOMPLISHED SUMMARY

DATE	HRS.* WORK	ENG.	FOR MAN	SKILL LABOR	LAB ORER	EQUP OPER	EQUIPMENT USED		MATERIAL USED TYPE & AMOUNT	WORK ACCOMP m2-m3-lin.m	ACT. CODE	ACTIVITY DETAILS	LOCAT. WORK ACCOMP.
4/18	4.0	1	1	4	10	4	Truck Air Comp Roller Tractor w/bed	1 1 1 1	Asph. mix 2.1 m3 Tack coat 20 ltr Diesel 10 ltr	11 m2	03	Potholes	Arbien Dist Ahmed Orabi (near Elded st.)
	4.5	1	1	3	6	1	Truck	1	Curbstones 50 ea. Bed sand .25 m3 Cement .5 bag	25 lin. m.	04	Placing curbston	Osama st.
4/19	4.5	1	1	3	6	1	Truck	1	Curbstones 60 ea. Bed sand .50 m3 Cement .5 bag	30 lin. m. (no asphalt mix avail)	04	same	Osama st.
	NOTE: There will be no asphalt mix available from any supplier between April 21st and May 5th.												
4/21	3.5	1	1	3	6	1	Truck	1	Curbstones 40 ea. Bed Sand .25 m3 Cement .5 bag	20 lin m.	04	same	Osama st.
	3.0	1	1	0		1	Grader	1	None	4,800 m2	06	Grading unpaved street	Suez Dist. Eben El Garah St.

* Includes 1 hr. total travel to & from site.

/WAS04

SUEZ ROADS DIRECTORATE
WORK ACCOMPLISHED SUMMARY

DATE	HRS.* WORK	ENG.	FOR MAN	SKILL LABOR	LAB ORER	EQUP OPER	EQUIPMENT USED		MATERIAL USED TYPE & AMOUNT	WORK ACCOMP m2-m3-lin.m	ACT. CODE	ACTIVITY DETAILS	LOCAT. WORK ACCOMP.
4/22	3.0	1	1	3	6	2	Truck Water truck	1 1	Curbstones 50 ea Bed sand .25 m3 Cement .5 bag	25 lin.m	04	Placing curbston	Arbeen dist Osama st.
	4.0	1	1	1	2	1	Truck	1	Sidewlk tile 50 ea Bed sand .02 m3 Cement .25 bag	Area 2 m2	08	Replace footpath tiles	Around Govt office bldg
	3.0	1	1	2	4	4	Grader Roller Trucks	1 1 2	Dirt backfil 32 m3	800 lin. m.	05	Grading, leveling unpaved street	Suez dist. Eben El Garah st.
4/23	3.5	1	1	2	3	1	Tractor w/bed	1	Sidewalk tiles 125 ea Bed sand 1 m3 Cement 1 bag	Sidewalk tiles 125ea Area 5 m2	08	Replace footpath tiles	Suez dist. Around Govt bldg.
	3.5	1	1	0	5	2	Tractor w/bed Grader	1 1	None	500 lin.m	06	Grading unpaved street	Arbien dist Elkamayine street
	3.5	1	1	2	4	1	Truck	1	Curbstones 30 ea Bed sand .25 m3 Cement .25 bag	None - car obstructing area	04	Placing curbston	Suez dist. behind Gov. office
4/24 to 4/28 No Work													

* Includes 1 hr. total travel to & from site.

/WAS05

SUEZ ROADS DIRECTORATE
WORK ACCOMPLISHED SUMMARY

DATE	HRS.* WORK	ENG.	FOR MAN	SKILL LABOR	LAB ORER	EQUP OPER	EQUIPMENT USED		MATERIAL USED TYPE & AMOUNT	WORK ACCOMP m2-m3-lin.m	ACT. CODE	ACTIVITY DETAILS	LOCAT. WORK ACCOMP.
4/29	5.0	1	1	0	3	2	Grader Roller	1 1	None	3000 m2	06	Grading Shaping	Arbeen dist Ahmed Orabi st.
	5.0	1	1	2	4	1	Pickup	1	Sidewlk Tiles 250 ea. Bed sand .25 m3 Cement .5 bag	10 m2	08	Replace footpath tiles	Suez dist. Around Govt.bldg
4/30	5.0	1	1	0	4	1	Grader	1	None	1500 m2	06	Grading Shaping	Arbeen dist Ahmed Orabi st.
	5.0	1	1	2	4	1	Pickup	1	Sidewalk tiles 250 ea. Bed sand .50 m3 Cement 1.0 bag	10 m2	08	Replace footpath tiles	Suez dist. aroung Govt.bldg
	4.5	1	1	3	6	1	Truck	1	Curbstones 70 ea Bed sand .30 m3 Cement .50 bag	35 lin. m.	04	Placing curbston	Etaka dist. Elarays City
5/2	2.5	1	1	0	4	2	Grader Tractor w/bed	1 1	None	1000 m2	06	Grading Shaping	Arbien dist Orabi st.
	5.0	1	1	2	6	1	Truck	1	Curbstones 80 ea Bed sand .20 m3 Cement .50 bag	40 lin. m.	04	Placing curbston	Etaka dist. Elarays City
	4.0	1	1	2	4	1	Pickup	1	Sidewalk tiles 250 ea. Bed sand .40 m3 Cement .50 bag	10 m2	08	Replace footpath tiles	Suez dist. Around Govt. bldg

* Includes 1 hr. total travel to & from site.

/WAS06

SUEZ ROADS DIRECTORATE
WORK ACCOMPLISHED SUMMARY

DATE	HRS.* WORK	ENG.	FOR MAN	SKILL LABOR	LAB ORER	EQUP OPER	EQUIPMENT USED		MATERIAL USED TYPE & AMOUNT	WORK ACCOMP m2-m3-lin.m	ACT. CODE	ACTIVITY DETAILS	LOCAT. WORK ACCOMP.
5/3	5.0	1	1	2	4	1	Truck	1	Tiles 250 ea Sand 0.4 m3 Cement 0.5 bag	10 m2	08	Replace footpath tiles	Suez dist. Around Govt. bldg
	5.0	1	1	0	4	1	Grader	1	None	2000 m2	06	Grade & shape	Arbien dist Oraby st.
	4.0	1	1	2	6	1	Truck	1	Curbstones 100 ea Sand 0.2 m3 Cement 0.5 bag	50 lin. m	04	Place curbston	Etaqa dist Elary city
5/5	5.5	1	1	2	4	1	Truck	1	Curbstones 100 ea Sand 0.2 m3 Cement 1.0 bag	50 lin. m	04	Place curbston	"
	5.0	1	1	2	4	1	Truck	1	Tiles 250 ea. Sand .25 m3 Cement .50 bag	10 m2	08	Replace footpath tiles	Suez dist around Govt. bldg
	5.0	1	1	0	4	1	Grader	1	None	2000 m2	06	Grade & shape	Arbien Oraby st
5/6	5.0	1	1	2	4	1	Truck	1	Tiles 250 ea Sand .20 m3 Cement .50 bag	10 m2	08	Replace footpath tiles	Suez dist around Govt. bldg
	3.5	1	1	2	5	1	Truck	1	Curbstones 50 ea Sand 0.1 m3 Cement .25 bag	25 lin. m	04	Place curbston	Etaka dist Elaray City

* Includes 1 hr. total travel to & from site.

/WAS07

SUEZ ROADS DIRECTORATE

WORK ACCOMPLISHED SUMMARY

DATE	HRS.* WORK	ENG.	FOR MAN	SKILL LABOR	LAB ORER	EQUP OPER	EQUIPMENT USED		MATERIAL USED TYPE & AMOUNT	WORK ACCOMP m2-m3-lin.m	ACT. CODE	ACTIVITY DETAILS	LOCAT. WORK ACCOMP.
5/7	5.0	1	1	2	4	1	Truck	1	Tiles 250 ea. Sand 0.2 m3 Cement .5 bag	10 m2	08	Replace footpath tiles	Suez dist behind Govt. bldg
	4.0	1	1	2	4	1	Truck	1	Curbstones 100 ea Sand .2 m3 Cement 1.0 bag	50 lin. m.	04	Place curbston	Etaka dist Elaray City
	5.0	ASPHALT MIX STILL NOT AVAILABLE - ALTERNATIVE WORK-								CLEAN	07	Street Cleaning	Arbien dist Ahmed Orabi
5/8	5.0	1	1	3	5	1	Truck	1	Curbstones 80 ea Sand .2 m3 Cement .5 bag	40 lin. m.	04	Place Curbston	Etaka dist Elaray City
	4.0	1	1	2	4	1	Truck	1	Tiles 125 ea Sand .2 m3 Cement .5 bag	5 m2	08	Replace footpath tiles	Suez dist behind Govt. bldg
	5.0	1	1	2	6	3	Grader Dumpster Roller	1 1 1	None	1000 m2	07	Street cleaning	Suez dist. Seket El Baladya st
5/9	4.0	1	1	3	6	1	Truck	1	Curbstones 100 ea Sand .2 m3 Cement .5 bag	50 lin m.	04	Placing curbston	Etaka dist Elaray City
	5.0	1	1	2	4	1	Truck	1	Tiles 375 ea Sand .4 m3 Cement 1.0 bag	15 m2	08	Replace footpath tiles	Suez dist behind Govt. bldg
	4.0	1	1	2	5	4	Truck Roller Grader Tract/be	1 1 1 1	None	1500 m2	07	Street cleaning	Suez dist Seket El Baladya st

* Includes 1 hr. total travel to & from site.

/WAS08

SUEZ ROADS DIRECTORATE
WORK ACCOMPLISHED SUMMARY

DATE	HRS.* WORK	ENG.	FOR MAN	SKILL LABOR	LAB OREK	EQUP OPER	EQUIPMENT USED		MATERIAL USED TYPE & AMOUNT	WORK ACCOMP m2-m3-lin.m	ACT. CODE	ACTIVITY DETAILS	LOCAT. WORK ACCOMP.
5/10	4.0	1	1	2	2	1	Truck	1	Curbstones 60 ea Sand 0.2 m3 Cement .5 bag	30 lin m.	04	Place curbston	Etaka dist Elewah City
	4.0	1	1	1	3	1	Truck	1	Tiles 125 ea Sand 0.2 m3 Cement .5 bag	5 m2	08	Footpath repair	Suez dist behind Govt. bldg
	5.0	1	1	2	6	3	Truck Grader Dumpster	1 1 1	None	500 m2	07	Street cleanin	Suez dist Elbaladeya st.
5/12	5.0	1	1	2	4	1	Truck	1	Curbstones 120 ea Sand 0.2 m3 Cement .75 bag	60 lin m.	04	Place curbston	Etaka dist Elewah City
	5.0	1	1	2	4	1	Truck	1	Tiles 250 ea Sand 0.3 m3 Cement .75 bag	10 m2	08	Footpath repair	Suez dist behind Gov. bldg.
	7.5 (mix arrived late-pd.overtime?)	1	1	3	7	4	Truck Roller Tractor w/bed Air Comp	1 1 1 1	Asph. mix 2 m3 Tack coat 20 ltr Diesel 10 ltr	17 m2	03	Potholes	Suez dist Amro Ben Elahas st
5/13	5.0	1	1	2	4	1	Truck	1	Curbstones 100 ea Sand .2 m3 Cement .75 bag	50 lin. m	04	Placing curbston	Etaka dist Elewah City
	4.0	1	1	1	2	1	Truck	1	Tiles 125 ea Sand 0.2 m3 Cement .3 bag	5 m2	08	Replacin Tiles	Suez dist Behind Gov. bldg
	5.0	1	1	2	3	1	Grader	1	None	3000 m2	07	Street cleaning	Arbeen dis El Rowad st

/WAS09

SUEZ ROADS DIRECTORATE

WORK ACCOMPLISHED SUMMARY

DATE	HRS.* WORK	ENG.	FOR MAN	SKILL LABOR	LAB ORER	EQUP OPER	EQUIPMENT USED		MATERIAL USED TYPE & AMOUNT	WORK ACCOMP m2-m3-lin.m	ACT. CODE	ACTIVITY DETAILS	LOCAT. WORK ACCOMP.
5/14	6.0	1	1	2	9	4	Truck Tractor w/bed Air comp Roller	1 1 1 1	Asphalt mix 3 m3 Tack coat 20 ltr Diesel 5 ltr	20 m2	03	Potholes	Suez dist Amro Ben Elahas st
	3.5	1	1	1	2	1	Truck	1	Curbstones 30 ea Sand 0.1 m3 Cement .05 bag	15 lin m	04	Placing curbston	Suez dist Salah Salem st
	5.0	1	1	2	4	1	Truck	1	Tiles 175 ea Sand 0.3 m3 cement .25 bag	7 m2	08	Footpath repair	Suez dist behind Gov. bldg
5/15	4.5	1	1	2	4	1	Truck	1	Curbstones 60 ea Sand .2 m3 Cement .25 bag	30 lin m	04	Place curbston	Etaka dist Elewah city
	3.0	1	1	2	4	1	Truck	1	Tiles 150 ea Sand .3 m3 Cement .75 bag	6 m2	08	Footpath repair	Suez dist behind Gov. bldg
	3.0	same crew							None	1000 m2	07	Street cleaning	Suez dist ElBuladeya
5/16	4.0	1	1	2	4	1	Truck	1	Tiles 200 ea Sand .3 m3 Cement 1.0 bag	8 m2	08	Footpath repair	Suez dist behind Gov. bldg
	4.0	1	1	2	4	1	Truck	1	Curbstones 40 ea Sand .2 m3 Cement .25 bag	20 lin m	04	Place curbston	Suez dist El Baladeya
	4.5	1	1	2	10	4	Truck Tract/b Air Comp Roller	1 1 1 1	Asphalt mix 3 m3 Bit. tack 20 ltr Diesel 10 ltr	14 m2	03	Potholes	Suez dist El Baladeya st.

/WAS10

SUEZ ROADS DIRECTORATE
WORK ACCOMPLISHED SUMMARY

DATE	HRS.* WORK	ENG.	FOR MAN	SKILL LABOR	LAB ORER	EQUP OPER	EQUIPMENT USED		MATERIAL USED TYPE & AMOUNT	WORK ACCOMP m2-m3-lin.m	ACT. CODE	ACTIVITY DETAILS	LOCAT. WORK ACCOMP.
5/17	5.0	1	1	3	12	5	Truck Tractor w/bed Air comp Roller Dumpster	1 1 1 1 1	Asph. mix 2 m3 Tack coat 20 ltr Diesel 10 ltr	11 m2	03	Potholes	Suez dist Elbaladeya st. Beside Hosp
	5.0	1	1	2	4	1	Truck	1	Curbstones 50 ea Mortar sand .1 m3 Cement .5 bag	25 lin. m.	04	Place curbston	Suez dist Elbaladya st. @ Cen.Sta.
	5.0	1	1	2	4	1	Truck	1	Tiles 250 ea Bedding sand .05 m3 Mortar sand .20 m3 Cement .2 bag	10 m2	08	Replace sidewalk tiles	Suez dist behind Govt. bldg
5/19	4.5	1	1	2	4	1	Truck	1	Curbstones 60 ea Mortar sand .1 m3 Cement .5 bag	30 lin m.	04	Place curbston	Suez dist Elbaladya st. @ Cen.Sta.
	5.0	1	1	1	2	1	Truck	1	Tiles 175 ea Bed sand .3 m3 Mortar sand .3 m3 Cement .2 bag	7 m3	08	Replace sidewalk tiles	Arbeen dist The Ways section
	4.5	1	1	3	9	3	Tractor w/bed Air comp Dumpster	1 1 1	None (no mix availabl)	10 m2	03	Cutting potholes	Suez dist Elbaladya st.

* Includes 1 hr. total travel to & from site.

/WAS11

SUEZ ROADS DIRECTORATE
WORK ACCOMPLISHED SUMMARY

DATE	HRS.* WORK	ENG.	FOR MAN	SKILL LABOR	LAB ORER	EQUP OPER	EQUIPMENT USED		MATERIAL USED TYPE & AMOUNT	WORK ACCOMP m2-m3-lin.m	ACT. CODE	ACTIVITY DETAILS	LOCAT. WORK ACCOMP.
5/20	4.0	1	1	3	8	5	Truck Tractor w/bed Dumpster Air comp Roller	1 1 1 1 1	Asphalt mix 2 m3 Tack coat 30 ltr Diesel 10 ltr	11 m2	03	Potholes	Suez dist Elbaladaya st. Beside Hosp
	4.5	1	1	2	4	1	Truck	1	Curbstones 60 ea Mortar sand .1 m3 Cement .5 bag	30 lin m.	04	Place curbston	Suez dist Elbaladaya st.
	5.0	1	1	2	4	1	Truck	1	Tiles 250 ea Bed sand .4 m3 Mortar sand .2 m3 Cement .5 bag	10 m2	08	Footpath repair	Suez dist beside Govt bldg.

* Includes 1 hr. total travel to & from site.

/WAS12