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ROADS AND BRIDGES AUTHORITY

دراسة الجدوى لمشروع طريق القاهرة - أسيوط

CAIRO-ASSUIT HIGHWAY FEASIBILITY STUDY

FINAL REPORT

Appendix Volume 3

ASSESSMENTS OF THE EXISTING HIGHWAYS

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بواسطة
ويلبر سميث وشركاه
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FORWARD

This volume of appendices to the Final Report describes the engineering assessments of the existing highways, together with projects for improvements. Highway construction and maintenance costs are also presented.

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COSTS OF HIGHWAY CONSTRUCTION AND REHABILITATION

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Appendix 3A

COSTS OF HIGHWAY CONSTRUCTION AND REHABILITATION

This Appendix presents the unit costs assumed for highway construction. For the most part, financial costs (the prices actually paid to contractors) were derived from comparisons of recent bids. Some special costs, in particular for structures, were determined individually for each application. For economic evaluation purposes, it was necessary to convert these costs to economic resource costs, which adjust for taxes, import duties and subsidies, to obtain a truer measure of National resources consumed by construction.

Financial Costs of Construction

Table 3A-1 presents a review of recent bid prices for various items of contruction, together with the prices adopted for use in this Study. The table requires little explanation. The price values adopted were generally towards the higher end of the Roads and Bridges Authority sources, on the assumption that construction standards would be high and that good specifications would be written and enforced for new constuction of the major projects considered by this Study.

Financial Costs of Pavement Rehabilitation and Overlaying

The unit costs in Table 3A-1 were used to estimate the costs of pavement rehabilitation and overlaying.

An RBA "standard" rehabilitation applies to total paved area travelway plus shoulder:

WORK ITEM			
Tack Coat	LE	0.12	per m^2
Leveling course (Av depth 4 cm)		1.80	
Tack coat		0.15	
Premix course (6 cm)		2.52	
Wearing course (5 cm)		2.60	
Seal coat		0.75	
Total cost per m^2 = LE		7.94	

A minimum pavement strengthening overlay would be a tack coat on the old surface, plus a 5 cm overlay, and seal coat:

WORK ITEM			
Tack coat	LE	0.15	per m^2
5 cm wearing course		2.60	
Seal coat		0.75	
Total cost per m^2 = LE		3.50	

This translates to an average cost of LE 70 per m^3.

Table 3A-1

UNIT FINANCIAL CONSTRUCTION COSTS
(LE)

SOURCE	DATE	CUT /FILL	PIT RUN BASE	CRUSHED STONE BASE	PRIME COAT	BINDER COURSE	TACK COAT	WEARING COURSE	LINE STRIPING
		(cu m)	(cu m)	(cu m)	(sq m)	(cu m)	(sq m)	(cu m)	(line-km)
ENTS Phase III (updated)	1986		14.40	23.20		46.17	0.16	45.12	
Roads and Bridges Authority Sources									
Aiyat-Beni Suef bid	1984	3.25		9.00	0.14	40.83	0.08	45.00	
Beni Suef-Malatia bid	1984	3.25	9.00		0.14	35.00	0.08	40.00	223.00
Helwan-Saff estimate	1986	4.00		16.00	0.20	37.50	0.10	45.00	
Engineer estimate (1)	1986	2.00	12.00			41.67		52.00	
Engineer estimate (2)	1986		20.00		0.20	42.14	0.15	53.00	
Engineer estimate (3)						45.00			
Fayoum-Minia Inter-governorate Road (bids on 21 km section)									
Helwan Contracting (private co.)	1985	2.00	7.67		0.20	36.00	0.07	40.00	267.00
Mustafa Ismail (public co.)	1985	2.00	8.33		0.15	40.00	0.12	42.00	93.00
Nile Company (private co.)	1985	2.50	9.17		0.13	38.00	0.08	40.00	100.00
Abu Hemeid and Sons (public co.)	1985	2.50	9.00		0.15	40.00	0.15	40.00	100.00
Values adopted for Cairo-Assuit Study		3.00	12.00	20.00	0.20	45.00	0.15	5[illegible].00	260.00

Note: Values adopted by Study in LE 1985/86.

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In ordinary design and construction practice, reinforcement overlays from 6 cm to 9 cm thick would consist of dense-graded wearing course material only (with tack and seal coats), though perhaps in two lifts. This results in the following costs:

TOTAL OVERLAY THICKNESS		
6 cm	LE 3.99 per m^2	LE 66.50 per m^3
7 cm	4.51	64.43
8 cm	5.03	62.88
9 cm	5.55	61.67

The minimum thickness of wearing course in normal design is 5 cm, but at total overlay (or construction) thicknesses above 10 cm it becomes possible, and more economical, to substitute binder course for some of the thickness. At above 13 cm total, the thickness of the wearing course should begin to increase above 5 cm, until about 21 cm of total depth, at which the wearing course should be 10 cm and the binder course 11 cm. Following that the wearing course remains constant at 10 cm for all heavier designs, while the binder course continues to increase.

The above combinations result in gradually rising costs per m^2, and declining costs per m^3 as the binder course becomes a higher proportion of the total and the tack and seal coat costs are distributed relative to pavement thickness. Some indicative costs are:

TOTAL OVERLAY THICKNESS		
10 cm	LE 5.57 per m^2	LE 55.70 per m^3
15 cm	7.87	52.47
20 cm	10.17	50.85
25 cm	11.62	49.48
30 cm	14.47	48.23

For the estimation of costs of overlays on existing highways, it was assumed that 10 cm overlays would be placed, staged over time, at a unit cost of LE 55.7 per m^3

Economic and Foreign Exchange Costs

The components of unit financial construction costs set forth in the Egypt National Transport Study (ENTS) Phase III (Reference 1) were updated for inflation and converted to percentages. These proportional component factors were then multiplied by the adjustment factors given below and summed to produce economic and foreign exchange cost conversion factors, as set forth in Table 3A-2.

Derivation of Adjustment Factors - From the data available, it appeared that the overall financial unit cost of road construction and maintenance increased by about 6.4 - 9.0 percent per year from 1983 to 1986. Estimated annual rates of increase for each cost component (labor, equipment, fuel, materials and overhead) ranged from skilled labor (20.5 percent) to fuel (0.0%). By comparison, ENTS III estimated an overall unit cost growth factor of 8.3 percent per year for 1980 to 1983.

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Table 3A-2

HIGHWAY CONSTRUCTION COST COMPONENTS AND CONVERSION FACTORS

ACTIVITY	UNITS	COST CLASS	Skilled Labor	Unskilled Labor	Equipment	Fuel	Other	CONVERSION FACTOR
			COMPONENT					
Embankment	cu m	Financial	0.215	0.005	0.368	0.040	0.372	1.000
		Economic	0.215	0.002	0.407	0.285	0.372	1.281
		For Exch						0.334
Pit run gravel sub-base	cu m	Financial	0.101	0.088	0.466	0.060	0.285	1.000
		Economic	0.101	0.044	0.515	0.428	0.285	1.373
		For Exch						0.422
Crushed stone sub-base	cu m	Financial	0.118	0.012	0.500	0.051	0.319	1.000
		Economic	0.118	0.006	0.553	0.364	0.319	1.360
		For Exch						0.453
Prime coat	sq m	Financial	0.061	0.236	0.226	0.035	0.442	1.000
		Economic	0.061	0.118	0.250	0.250	0.442	1.121
		For Exch						0.205
Binder	cu m	Financial	0.098	0.027	0.458	0.059	0.358	1.000
		Economic	0.098	0.013	0.507	0.421	0.358	1.397
		For Exch						0.415
Tack coat	sq m	Financial	0.074	0.296	0.247	0.031	0.352	1.000
		Economic	0.074	0.148	0.273	0.221	0.352	1.068
		For Exch						0.224
Wearing course	cu m	Financial	0.081	0.032	0.386	0.052	0.449	1.000
		Economic	0.081	0.016	0.427	0.371	0.449	1.344
		For Exch						0.350
Line striping	km	Financial	0.010	0.005	0.088	0.005	0.892	1.000
		Economic	0.010	0.003	0.097	0.036	0.892	1.038
		For Exch						0.080
Overlay	cu m	Financial	0.092	0.039	0.431	0.057	0.381	1.000
		Economic	0.092	0.019	0.477	0.407	0.381	1.376
		For Exch						0.391
Seal coat	cu m	Financial	0.046	0.298	0.255	0.030	0.371	1.000
		Economic	0.046	0.149	0.282	0.214	0.371	1.062
		For Exch						0.231
Structures, major		Financial						1.000
		Economic						1.350
		For Exch						0.453
Structures, minor		Financial						1.000
		Economic						1.300
		For Exch						0.326

SOURCES: ENTS, Consultants

Economic cost calculations were based on the following accounting factors in relation to the financial costs:

1. Economic costs of skilled labor = 100% financial costs.
2. Economic costs of unskilled labor = 50% of financial costs.
3. Economic costs of equipment = 0.2 + (0.8 x 0.85 x 1.333) = 110.6% of financial costs where:

   - 20% of the financial cost represents locally produced spare parts and maintenance/repair labor.
   - 80% represents the foreign currency component.
   - 15% represents average taxes on imported equipment and spare parts.
   - 1.333 is the accounting factor for foreign currency.

4. Economic costs of fuel = 713.3% of financial cost.
5. Economic cost of oil, materials and overhead = financial costs.

The foreign exchange component of construction costs affects primarily equipment costs. Using the accounting factors defined above, 90.6 percent of equipment costs represent foreign exchange.

Land Costs

Land costs were established by discussions with RBA and with the different Governorates in the corridor. It was difficult to establish agricultural land costs with any certainty, since much depended on location and ownership. Generally, the prices adopted assumed that land would be expropriated by Government for construction, which implied much lower prices than, for example, if the land were to be used for industry. The issue was complicated by the general ban on further use of agricultural land for non-agricultural purposes; it was assumed that this would be dealt with as a policy issue for the development of the corridor.

The prices adopted were as follows:

Agricultural land:	
Existing road widening	LE 5.0 per m^2
Bypasses	3.6
Reclaimed land	1.4
Desert land	0.0

Appendix 3B

ASSESSMENT OF EXISTING HIGHWAY PAVEMENTS

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Appendix 3B

ASSESSMENT OF EXISTING HIGHWAY PAVEMENTS

This appendix describes the assessment of highway pavements for the existing main East Bank and West Bank Highways.

A visual rating of pavement surface conditions was undertaken early in the Study. Based on this, 20 locations were identified for field borings to establish pavement structure and to provided samples for laboratory analysis. This work is summarized in this appendix, but full details are available in separately produced Study documents.

An analysis was then made of the strength of the existing pavements, and this was used, together with projected traffic data, to establish future pavement overlay requirements.

Visual Rating Survey

This was undertaken in January 1986 by two engineers of the Study. Based on a preliminary inspection, the East and West Bank existing highways were divided into 11 sections, which were then subdided into 41 links. Locations of links are shown in Figure 3B-1. Each link was rated using the same procedures as used in ENTS Phase II (Reference 1). A detailed report was produced containing a link inventory, link ratings and photographs of each link. The results of the visual rating are summarised in Table 3B-1 and Figure 3B-2.

Pavement Borings

Based on the results of the visual rating, 20 locations were determined for taking samples of the pavement structure. Locations of borings are shown in Figure 3B-3.

Borings on the west bank existing highway were Nos. 7 through 16, located between Barnqua and Manquabad, plus 19 and 20, Matania to Bush. On the east bank highway were Nos. 1 to 6, between Helwan and Beni Suef, and 17 and 18, Abnub to Assuit. All were hand-dug within the travelway to 100 cm depth. They showed a variety of structures, generally consisting of A.C. wearing and binder courses over unbound granular base, the latter either crushed stone or pit-run gravel. Nine test holes showed old A.C. pavements at lower levels, sometimes with granular base intervening. Two incorporated old concrete pavements.

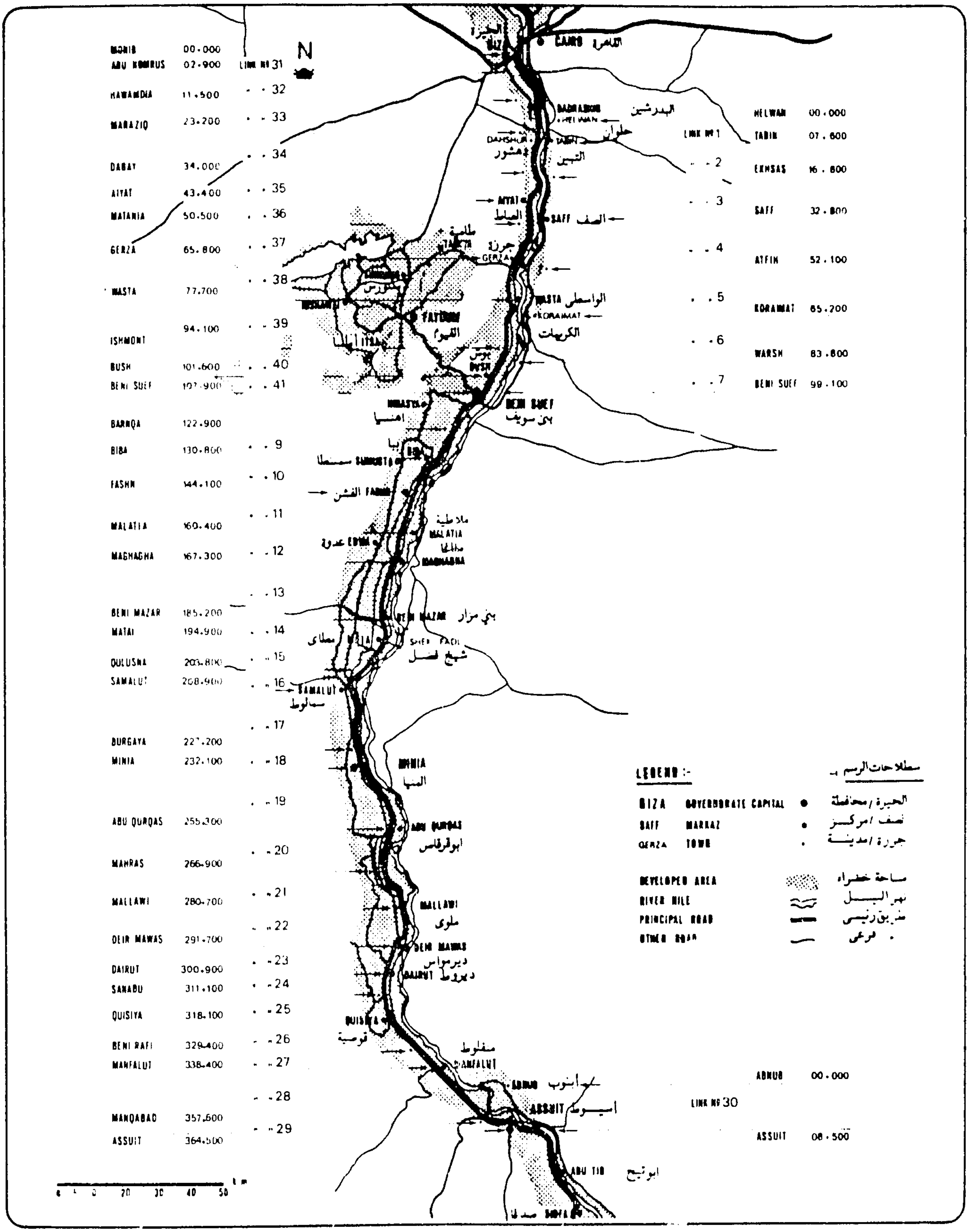
All final surfaces were found to be A.C. wearing course, one of which was 7 cm thick and two were of 10 cm. All others were combined with A.C. "Binder" or "Premix" layers to give total surface thicknesses of 10 cm to 25 cm. Sometimes they were laid directly over old A.C. pavements to give built-up thicknesses of up to 43 cm of surfacing.

Samples from the borings were analyzed by Sami Saad Laboratories who provided a detailed report on the tests carried out. A summary of the

Table 3B-1

SUMMARY OF THE EXISTING PAVEMENT VISUAL RATING

			CRACKING			SURFACE DAMAGE			DEFORMATIONS		MISCELLANEOUS				
LINK	LENGTH	SECT	Long Cracks	Transv Cracks	Map Cracks	Holes	Bleed-ing	Crumbl Edge	Ruts	Long. Uneven	Shoul Condit	Shoul Level	PAVE COND RATING	CONDITION	SECT WITH EXCES DAMAGE
1	7.6	1	1	1	1	2	0	2	0	3	0	0	64	Fair	No
2	9.2	1	3	3	3	1	0	3	0	3	4	4	107	Very poor	Yes
		2	3	3	3	1	0	3	0	3	4	4	107	Very poor	Yes
3	16	1	2	1	1	0	1	1	0	3	4	4	61	Fair	Yes
		2	3	3	3	1	0	3	0	3	4	4	107	Very poor	Yes
		3	3	3	3	0	0	3	0	3	4	4	92	Very poor	Yes
4	19.3	1	0	0	0	0	0	0	0	3	2	2	17	Very good	No
		2	0	0	0	0	2	0	0	2	2	2	19	Very good	No
		3	0	0	0	1	0	0	0	2	2	2	29	Very good	No
5	13.1	1	0	0	0	0	1	2	0	2	2	2	23	Very good	No
		2	0	0	0	0	1	2	0	2	2	2	23	Very good	No
6	18.6	1	0	0	0	0	0	0	0	2	3	3	19	Very good	No
		2	0	0	0	0	0	0	0	3	3	3	22	Very good	No
		3	0	0	0	0	0	0	0	3	3	3	22	Very good	No
		4	0	0	0	1	0	0	0	3	2	2	32	Good	No
		5	0	0	0	0	0	0	0	2	0	0	7	Very good	No
7	15.3	1	0	0	0	0	0	0	0	3	3	3	22	Very good	No
		2	0	0	0	0	0	0	0	2	3	3	19	Very good	No
8	15	1	2	3	3	1	0	2	2	2	4	4	101	Very poor	Yes
		2	3	2	2	1	0	2	3	3	4	4	98	Very poor	Yes
9	7.9	1	3	3	2	1	0	3	3	3	4	4	104	Very poor	Yes
10	13.3	1	3	3	2	1	0	3	3	3	4	4	104	Very poor	Yes
		2	0	0	0	1	2	3	3	3	4	4	59	Good	Yes
11	16.3	1	3	3	3	1	0	2	1	3	4	4	106	Very poor	Yes
		2	3	3	3	1	0	3	1	3	4	4	109	Very poor	Yes
12	6.9	1	3	3	3	1	0	3	2	3	4	4	112	Very poor	Yes
13	17.9	1	0	0	0	0	0	1	0	3	4	4	27	Very good	Yes
		2	0	0	0	0	0	3	0	3	4	4	32	Good	Yes
14	9.7	1	0	0	0	0	1	2	0	3	4	4	31	Good	Yes
15	8.9	1	0	0	0	0	1	2	1	3	4	4	33	Good	Yes
16	5.1	1	2	2	3	2	0	3	3	3	4	4	111	Very poor	Yes
17	18.3	1	1	1	1	1	0	3	2	3	4	4	79	Poor	Yes
		2	1	1	2	1	0	3	3	3	4	4	86	Very poor	Yes
		3	2	3	2	2	0	2	2	2	4	4	96	Very poor	Yes
18	4.9	1	3	3	2	1	0	1	2	2	4	4	94	Very poor	Yes
19	23.2	1	0	0	0	0	0	2	0	2	2	2	21	Very good	No
		2	3	3	3	3	0	3	2	3	4	4	122	Very poor	Yes
		3	0	0	0	0	0	1	0	3	4	4	27	Very good	Yes
		4	0	0	0	0	2	1	2	3	4	4	37	Good	Yes
20	11.6	1	0	0	0	0	0	0	0	2	2	2	14	Very good	No
		2	0	0	0	0	0	2	0	2	3	3	26	Very good	No
21	13.8	1	1	0	0	0	0	2	0	2	4	4	36	Good	Yes
		2	0	0	0	0	0	3	0	2	4	4	29	Very good	Yes
		3	0	0	0	0	0	2	0	2	4	4	26	Very good	Yes
22	11	1	0	0	0	0	0	2	0	2	2	2	21	Very good	No
		2	0	0	0	0	0	2	0	2	2	2	21	Very good	No
23	9.2	1	0	0	0	0	0	0	0	1	2	2	12	Very good	No
		2	0	0	0	0	0	0	0	1	2	2	12	Very good	No



Cairo – Assuit Highway Feasibility Study

VISUAL RATING LINKS

Wilbur Smith and Associates
Egyptian Consultants Consortium

Figure 3H 1

Table 3B-1 (cont)

SUMMARY OF THE EXISTING PAVEMENT VISUAL RATING

			CRACKING			SURFACE DAMAGE			DEFORMATIONS		MISCELLANEOUS				
LINK	LENGTH	SECT	Long Cracks	Transv Cracks	Map Cracks	Holes	Bleed-ing	Crumbl Edge	Ruts	Long. Uneven	Shoul Condit	Shoul Level	PAVE COND RATING	CONDITION	SECTS WITH EXCESS DAMAGE?
24	10.2	1	0	0	0	0	2	3	0	0	0	0	15	Very good	No
		2	0	0	0	0	2	3	0	0	0	0	15	Very good	No
		3	0	0	0	0	2	2	0	0	0	0	12	Very good	No
		4	0	0	0	0	0	2	0	1	4	4	24	Very good	Yes
25	7	1	0	0	0	0	1	3	0	1	4	4	29	Very good	Yes
		2	0	0	0	0	1	3	0	2	4	4	31	Good	Yes
26	11.3	1	0	0	0	0	2	2	0	2	4	4	31	Good	Yes
		2	0	0	0	0	1	2	0	2	4	4	28	Very good	Yes
27	9	1	0	0	0	0	1	1	3	2	4	4	33	Good	Yes
		2	0	0	0	0	1	1	2	2	4	4	31	Good	Yes
28	19.2	1	0	0	0	0	1	2	2	2	4	4	33	Good	Yes
		2	0	0	0	0	1	3	1	2	4	4	33	Good	Yes
		3	0	0	0	0	1	0	0	1	4	4	19	Very good	Yes
		4	0	1	0	0	1	0	0	1	4	4	26	Very good	Yes
29	6.9	1	0	0	1	0	0	0	0	2	4	4	29	Very good	Yes
		2	0	0	1	0	0	0	2	2	4	4	34	Good	Yes
30	8.5	1	0	0	0	0	0	1	0	1	4	4	22	Very good	Yes
		2	0	0	0	0	0	1	0	1	4	4	22	Very good	Yes
31	2.9	1	0	0	0	0	1	0	0	1	2	0	12	Very good	No
		2	0	0	0	0	0	0	0	0	0	0	0	Very good	No
32	8.6	1	0	0	0	0	0	0	0	0	1	0	0	Very good	No
		2	0	0	0	0	0	0	0	0	2	0	5	Very good	No
33	11.7	1	0	0	0	0	0	0	0	0	1	0	0	Very good	No
		2	0	0	0	0	0	0	0	0	1	0	0	Very good	No
		3	0	0	0	0	0	0	0	0	0	0	0	Very good	No
34	10.8	1	0	0	0	0	0	0	0	0	0	0	0	Very good	No
		2	0	0	0	0	0	0	0	1	0	0	5	Very good	No
		3	0	0	0	0	0	0	0	1	0	0	5	Very good	No
		4	0	0	0	0	1	0	0	0	0	0	2	Very good	No
35	9.4	1	0	0	0	0	1	0	0	1	1	2	9	Very good	No
		2	0	0	0	0	0	0	0	0	1	1	0	Very good	No
36	7.1	1	0	0	0	0	0	0	0	2	1	1	7	Very good	No
		2	3	3	2	1	0	3	0	3	3	4	97	Very poor	Yes
		3	2	2	3	1	0	3	3	3	4	4	106	Very poor	Yes
37	15.3	1	3	3	3	2	1	3	2	3	4	4	119	Very poor	Yes
		2	2	3	1	0	0	1	1	2	4	4	66	Fair	Yes
		3	3	3	3	3	0	3	2	3	4	4	122	Very poor	Yes
		4	3	3	3	3	0	3	3	3	4	4	124	Very poor	Yes
38	11.9	1	3	3	3	2	0	3	3	3	4	4	119	Very poor	Yes
		2	3	2	3	3	0	3	3	3	4	4	121	Very poor	Yes
39	16.4	1	3	3	3	2	0	3	1	3	4	4	114	Very poor	Yes
		2	3	3	3	3	0	3	2	2	4	4	119	Very poor	Yes
		3	3	3	3	2	0	3	2	3	4	4	117	Very poor	Yes
40	7.5	1	3	3	3	3	0	3	2	3	4	4	122	Very poor	Yes
		2	3	3	3	3	1	3	3	3	4	4	126	Very poor	Yes
41	6.3	1	2	3	3	3	0	3	2	3	4	4	117	Very poor	Yes
		2	2	3	3	3	0	1	0	3	0	0	95	Very poor	No

results is included in Annex 3B-1 to this Appendix, and diagrams showing pavement structure at each boring site are included in Annex 3B-2. Results of the laboratory tests are discussed below.

Asphalt Surfaces - Extraction tests were run on all final wearing courses, giving extracted bitumen contents of 3.1 percent to 8.6 percent, with an average of 5.9 percent for 20 samples. For 17 second A.C. courses (Binder or Premix) the range was 2.0 percent to 6.3 percent extracted bitumen, averaging 4.6 percent.

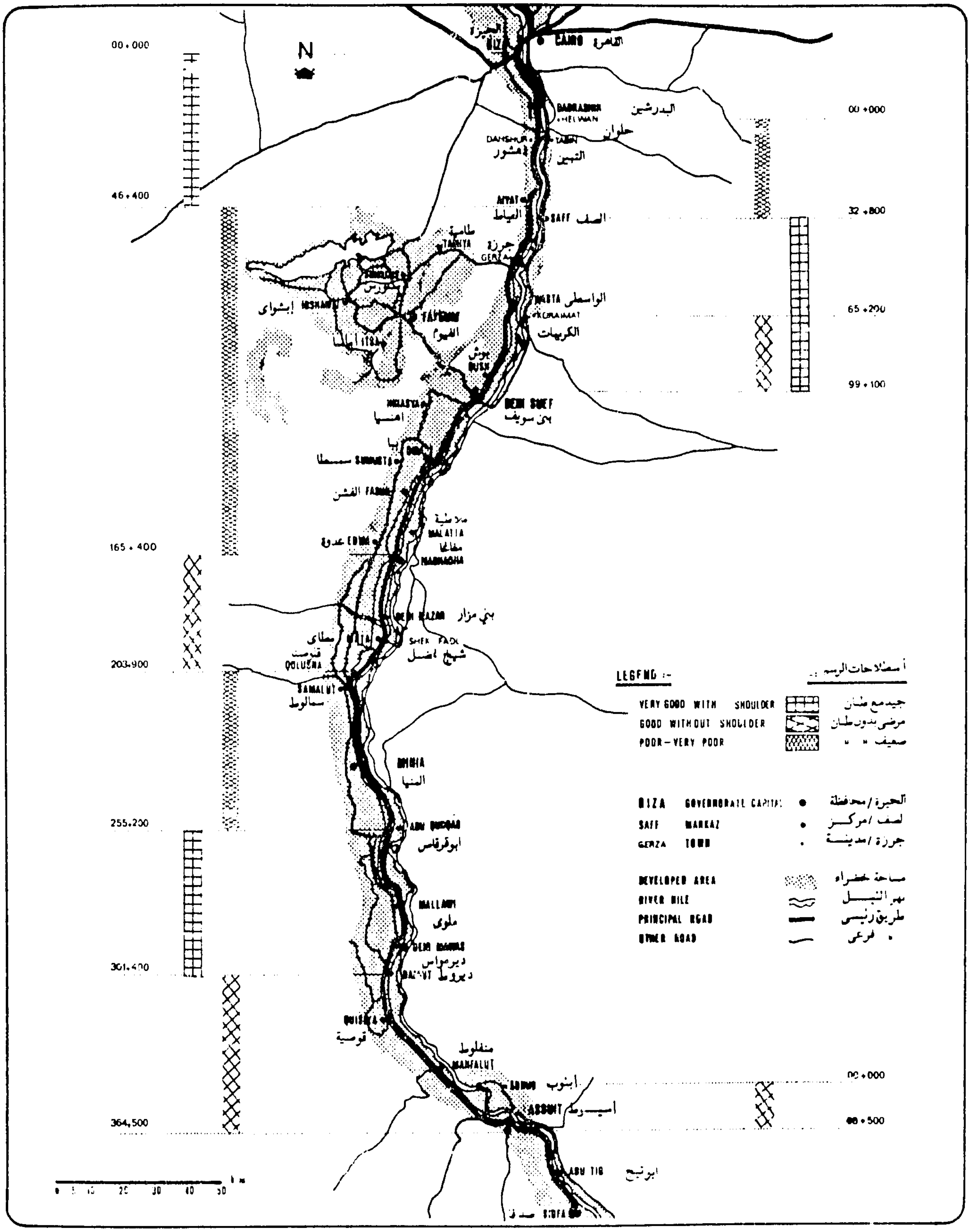
The aggregates from these 37 A.C. samples were fairly uniform and reasonably well graded, from 100 percent passing one and one-half inches (one exception, at 84 percent) to 1 percent or 2 percent passing the 200 sieve (exceptions: 1 at 6 percent, 2 at 3 percent, 2 at 0 percent). Therefore, the variations in bitumen content would seem to indicate poor control of plant-mixing. The range passing the No.4 screen was 29 percent to 65 percent for wearing course (average 50.2 percent), and 6 percent to 73 percent for second courses (average 31.2 percent), but the higher bitumen contents were not well correlated with the finer gradations.

Marshall tests on seven wearing course samples gave stabilities from 1500 to 2893 (AV. 2253) and associated flow values of 7 to 12. These seem to be satisfactory, though the pavements might be brittle. Two binder course Marshalls gave stability = 2207 (Flow 10) and stability = 2454 (Flow 8).

Granular Base - Regarding base materials, 25 samples were run (sieve analysis) since some tests sites had more than one base layer. About half the samples were identified as crushed limestone and half as natural (pit run) gravel. In three cases, old base layers were described as "limestone boulders". By inquiry, these were coarse crushed limestone, perhaps water-bound macadam. The sieved bases were reasonably uniform but rather open-graded, with only 1 percent to 3 percent passing the 200 sieve (maximum 5.2 percent). Obviously, they were generally non-plastic, with little indication of any clay or silt intrusion from the subsoil.

Thirteen base samples were subjected to Los Angeles Abrasion tests. Six were within the specification (50 percent after 500 Rev.) but seven were above, the highest being 75 percent. It appears that the requirement for durable aggregate is not being enforced, which implies costs for good materials higher than are now being bid, or some other adjustment required in design thickness or service life. Finally, CBR values were determined on four base samples, with values of 27, 42, 83 and 92. Three were for natural gravels. The fourth (CBR 42) was crushed limestone.

Bearing Values of the Basement Soils - This was considered a matter of importance in evaluating the existing pavements in the Nile Valley. Although the present grade lines are usually well above the adjacent irrigated fields (2 or 3 meters, or more) the ground water is ever-present and the soils are fine-grained. Of the 20 test pits dug in travelways, three did not reach the subgrade because they were still in base course at the 100 cm level. In 14 of the others the subsoil was classified as A-4 (silty soil), in one it was an A-6, and in two an A-7-6 (both of the latter clayey soil).



Cairo – Assuit Highway Feasibility Study

SUMMARY OF PAVEMENT RATINGS

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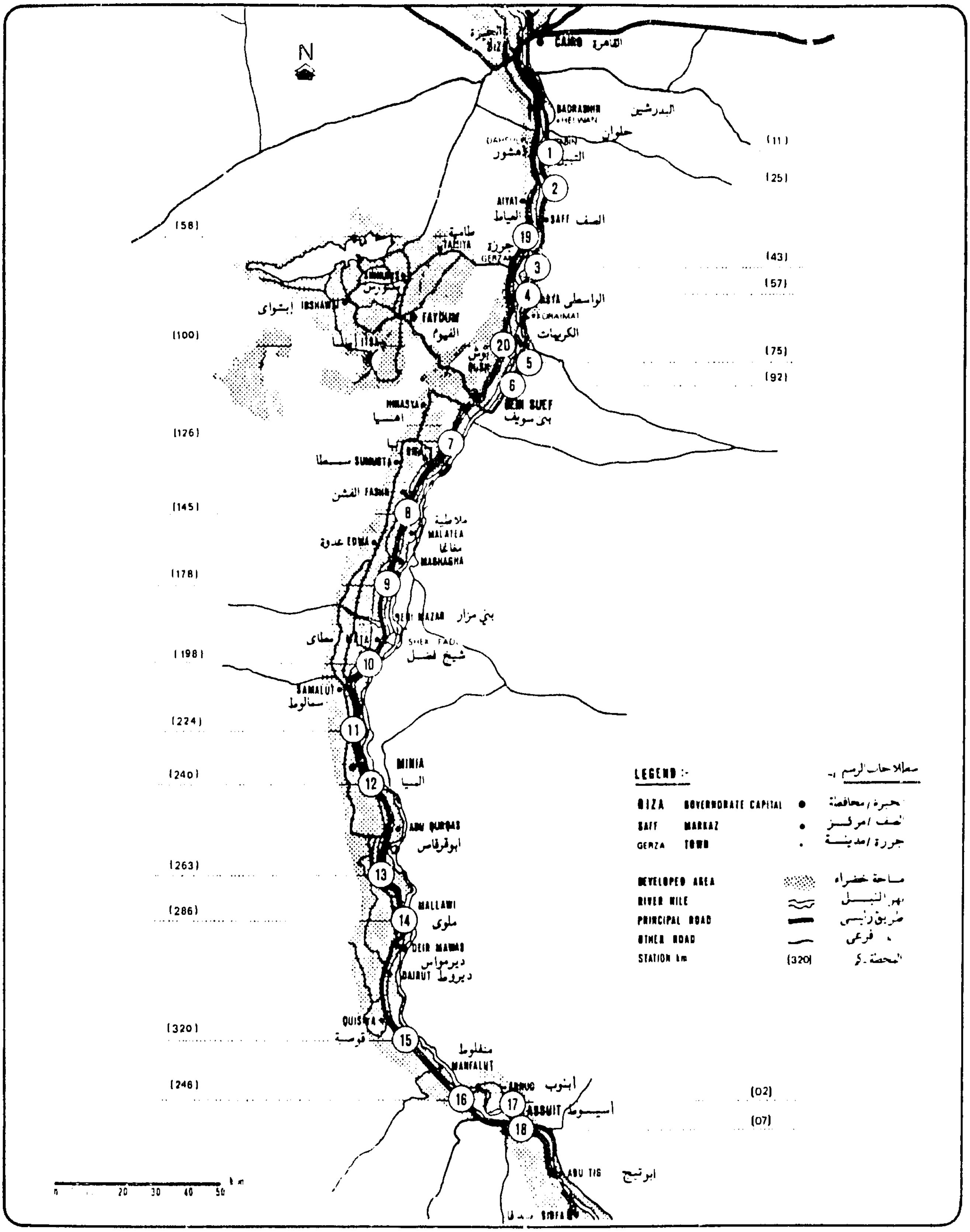
Figure 3B-2



Cairo – Assuit Highway Feasibility Study

LOCATIONS OF BORINGS

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Figure 3B-3

A laboratory CBR was run on the A-6 soil, giving a value of 6, and on one of the A-7-6 samples, which was 4. Only one CBR test was made on the A-4 classification, resulting in a value of 9. This provided no range to consider and a single value which seemed too high.

Although the Plasticity Indices were not excessive, from 2 to 10 for eleven samples (one other was N.P., and one L.L.24-P.L.24=0) these are soils with 42 percent to 98 percent passing the 200 sieve (Av. 73 percent), and they are alluvial materials.

The Phase II National Transport Study includes this discussion:

"The strength figures (CBR) derived from the usual 4 days soaking of the Delta and Nile Valley subsoils (predominantly clay) are rather optimistic; due to the soils' impermeability, 4 days of soaking is likely to be insufficient and the resulting CBR of about 5, equivalent to a Modulus of Elasticity (E) of 50 MN/sq., may in many cases actually be lower (30-40 Mn/sq.m. sometimes even 20 MN/sq.m.)."

The report goes on to suggest extending the soaking time to 14 days.

This presented some difficulty. The soak time used by the commercial laboratory for the three subgrade CBR tests made was four days. Egyptian pavements have a history of early failure. The Asphalt Institute manual on thickness design includes a chart showing approximate ranges of CBR for the different soils classifications. A-6 and A-7-6 types have CBR values from 0 to 15. The A-4 soil is shown in the CBR range from a little above three to about 25.

All things considered, it was decided to adopt a uniform CBR of 4 for all the A-4 type basement soils in agricultural areas, and also for the road section represented by boring site No.9, the A-6 subgrade. For the two borings with the A-7-6 soil, the same CBR of 4 could be used, avoiding complications in the evaluations.

Available Pavement and Overlay Design Procedures

Four principal methods of pavement design are those of the American Association of State Highway and Transportation Officials (AASHTO), Shell, the Asphalt Institute of the USA (AI) and the Transport and Road Research Laboratory of the UK (TRRL).

The AASHTO method was not considered suitable because it uses "structural numbers" and subsoil bearing values not familiar in Egypt. The Shell method was discarded for use in a feasibility study because of its complications.

Thus, the choices available were:

i) Employ the Asphalt Institute (AI) Manuals, or
ii) Use the charts of the TRRL Road Note No.29.

Both the A.I. and the TRRL Manuals take as basic inputs the bearing value of the foundation soil and traffic information on heavy trucks.

The AI overlay handbook (1977 Edition) (Reference 12) - This procedure converts raw traffic data to a "Design Traffic Number" (DTN) by means of tables and a nomograph, giving the "Average Daily Number of Equivalent 8,165 kg single-axle load applications for the selected design period..." The DTN is then used in a second nomograph across a line of CBR values to read out a total asphaltic concrete equivalent thickness for the design. The method has the advantage of allowing easy comparison of this design with the equivalent A.C. thickness of an existing pavement structure (from records or borings) and working back to remaining life or required reinforcement. On the negative side, the "DTN" is an artificial number inconvenient for use, the second nomograph seems quite sensitive to CBR values, and the upper limit of DTN shown on the nomograph (5000) is too low for the Cairo-Assuit traffic data.

The AI "Thickness Design" Charts - These use accumulated equivalent 80 kN single-axle load (EAL) values as abcissa, numbers which were be produced directly in the Study's traffic data, and were therefore much more convenient to use. However, the ordinates of the charts are "Subgrade Resilient Modulus" and although this can be converted to (or from) CBR, it is an additional step. The most serious deficiency of these charts, relative to needs, is that the upper limit of EAL is 20 million, while in the Study accumulations at least 5 to 6 times that were ecountered in extreme cases.

TRRL Road Note 29 (Reference 13) - The thickness charts of this manual also use cumulative EAL as abcissa, and the curves for subbase thickness are related directly to CBR, these factors being favorable. In addition, the EAL values go up to 100 million, and the configuration of the pertinent charts permits extrapolation for extreme EAL values with reasonable confidence. There is no specific provision for evaluating existing pavements, but usable approximations could can be made by a modified procedure.

The conclusion was reached that the TRRL manual would be the best choice for primary use, together with some factors from the AI hand-book on overlays.

Evaluation of the Strength of Existing Pavements

A common means for assessing the structural adequacy of existing pavements is to take deflection measurements annually or every two or three years. This procedure measures the deformation, or rebound, of the pavement under a standard loading. Other methods of determining pavement performance are also in use. All are intended to find weakness and potential failure in the pavement structure before the effects are visible on the surface, in order to quantify the remaining structural value. Regarding deflection measurements, no data was found for the highways of interest. The Egypt National Transport Study (NTS, Phase II, 1981) suggested that RBA start a pavement monitoring program using the Dynaflect or an alternate device, and provided a cost estimate. Such a program has not yet been adopted.

Lacking deflection or similar measurements, estimates of pavement strength were made from the results of the borings and visual rating. The adopted procedure was to estimate an equivalent asphalt thickness at each site investigated, which could then be taken as an indicator of pavement strength for adjacent sections of highway. Not much accuracy could be expected from this method, since 20 borings in a total of about 470 kilometers of highway, at sites selected with no real information about how typical the sites were, was a very limited sample to work from.

Using the boring data and the condition rating survey, it was possible to assign rough asphaltic concrete (A.C.) equivalent thicknesses to the different road construction layers in place, guided by the descriptions in the Asphaltic Institute (AI) manual on overlays. There was no way of judging the integrity of the old pavements now overlayed or buried, but it seemed safe (and conservative) to assume that they were substantially cracked and deformed. Extensive rehabilitation (overlay) of surfaces was in progress in the Study corridor in May, 1986, and it was also necessary to fix the limits of that work and the thickness of the new pavement layers.

The AI Manual on overlays discusses the expression of different kinds of road building materials in their equivalence to A.C. The manual provides a scale of values (factors) from 0.0 for native (unimproved) subgrade to 1.0 for A.C. pavement or base which is subtantially without cracks or deformations. There are written descriptions of the various materials and their characteristics or condition affecting strength. Assignment of equivalence factors is subjective, but the AI descriptions together with boring data and the Study Visual Rating Survey gave a fairly firm basis for making such assignments for the pavement structures of the existing highways of the Study corridor.

This exercise was done for the 20 borings on existing pavements, with an estimated total A.C. equivalent thickness in mm at each site, designated Te. These values were then modified to reflect rehabilitation and overlay work either in progress or committed to be completed by 1990. The detailed results are included in Annex 3B-3 and are summarized in Table 3B-2. Considering the high axle loads recorded in the Truck Weighing Survey conducted by this Study in February 1986, the results are not very encouraging. The survey indicated that a typical loading on the existing West Bank Highway was about 14,000 equivalent standard axles (EAL) per day, or about 5 million per year. At these axle loads, the pavement strengths in Table 3B-2 indicate the onset of pavement deterioration in less than a year in many locations, with few locations with an expected life of much more than 4 or 5 years.

Estimates of Overlay Needs

Estimates of overlay needs were based on pavement strength, estimated according to the process set out in the previous section, and expected traffic loadings. The methodology was based on design charts in TRRL Road Note 29.

Table 3B-2

ESTIMATED PAVEMENT STRENGTHS OF EXISTING HIGHWAYS
ON COMPLETION OF CURRENT REHABILITATION PROGRAM
(Equivalent asphalt thickness)

SECTION	DISTANCE	EST EQUIV ASPHALT THICKNESS Surveyed	EST EQUIV ASPHALT THICKNESS After Cur Rehab	ESTIMATED LIFE IN EAL (1)
	(kms)	(mm)	(mm)	(millions)
East Bank Highway				
Helwan-Saff	32	122-150	221-249	1-3
Saff-Koraimat	32	184-201	184-201	<1
Koraimat-Beni Suef	32	248-274	248-274	10-20
Beni Suef-Minia (2)	134	-	165	<1
Abnub-Assuit	8	200-242	200-242	1-3
West Bank Highway				
Monib-Aiyat	46	203-218	203-218	1-2
Aiyat-Wasta	34	150	249	3
Wasta-Beni Suef	30	266	365	50
Beni Suef-Maletia	50	120-195	219-280	1-8
Maletia-Qulusna	44	252-316	252-316	3-20
Qulusna-Minia	28	245	344	30
Minia-Abu Qurqas	23	177	222	1-2
Abu Qurqas-Deir Mawas	34	257-322	257-322	4-20
Deir Mawas-Assuit	76	257-304	257-304	4-12
Giza-Fayoum-Beni Suef (3)				
Giza-Dahshur Road	10	280	280	8
Dahshur Road-Edge Oasis	44	180	180	<1
Edge Oasis-Fayoum	27	141-150	141-150	<1
Fayoum-Beni Suef	47	141	141	<1

(1) Equivalent standard axle loads.
(2) Estimated from construction specification.
(3) Estimated from pavement structures indicated by RBA engineers.

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Axle Loadings - Using the traffic forecasts of the Study, estimates were made of the cumulative equivalent axle loadings (EAL) likely to be sustained by each road link over the entire period up to 2009. Since traffic varied by road network evaluated, separate estimates were required for each case. Three cases were evaluated for the Committed, Improved and Expressway Networks (See Appendix 6A for definitions).

Special adjustments were made for links under improvement (overlaying or rehabilitation) at the time of the Study, or which were committed for improvement in the period before 1990. In these cases, the value for EAL was estimated from the opening date of the improvement.

It was necessary to make some assumptions on vehicle weights and vehicle axle loadings. As reported in Appendix 2B, axle loads measured in the corridor in the Truck Weighing Survey were exceptionally high, with axles weighing as much as twice the legal limit. At the time of the Study, Roads and Bridges Authority were planning a campaign to enforce legal axle loads, and several weighing scales had been purchased for this purpose. However, given the prevalence of high axle loads, and the fact that many vehicles were licensed for loads in excess of axle load limits, it was assumed for the purposes of this evaluation that only the very highest axle loadings would be restricted, and that up to 50 percent overloads would persist. Even so, this would increase the number of trucks substantially (7 percent more single trucks and 25 percent more combination and articulated trucks), although still bringing about a reduction in overall axle loads.

Measured (surveyed) equivalent axles per vehicle, and values estimated assuming no more than 50 percent overloads, are compared below:

	MEASURED EAL/VEH	ADJUSTED EAL/VEH
Single Trucks	3.9	2.7
Combination Trucks	19.2	13.0
Articulated Trucks	14.9	9.6

Required Thickness of Overlay - Data from the TRRL Road Note 29 were analyzed to identify the road structure required to support different axle loadings. Considering the types of materials available in Egypt, Road Note 29 Figure 6 was selected for sub-bases, and No 7 for road base and surfacing. These charts are reproduced here as Figures 3B-4 and 3B-5.

The structure required for each value of cumulative EAL (range .01-100 million) was converted into a total equivalent asphalt thickness, designated Ta. The chart for sub-base design (Figure 3B-4) specifies thickness according to the CBR value of the sub-soil. For the purposes of this exercise, CBRs of 4 and 8 percent were assumed for agricultural area and desert area construction respectively. The sub-base thickness for each value of CBR and cumulative EAL were converted to equivalent asphalt thickness by dividing by 4. Thickness of the asphalt layers (base and wearing course) were taken directly from the chart in Figure 3B-5.

Equations were then derived, one for each CBR value, to express required asphalt thickness (Ta) in terms of cumulative EALs. These equations are as follows:

CBR = 4 percent	Ta = 209 + 83*log10(EAL)	for EAL = 1-10
	Ta = 166 + 122*log10(EAL)	for EAL = 10+
CBR > 8 percent	Ta = 184 + 71*log10(EAL)	for EAL = 1-10
	Ta = 141 + 110*log10(EAL)	for EAL = 10+

where Ta = Equivalent asphalt thickness in mm
EAL = Cumulative equivalent axle loads in millions

Graphs showing Ta required at each EAL are shown in Figure 3B-6.

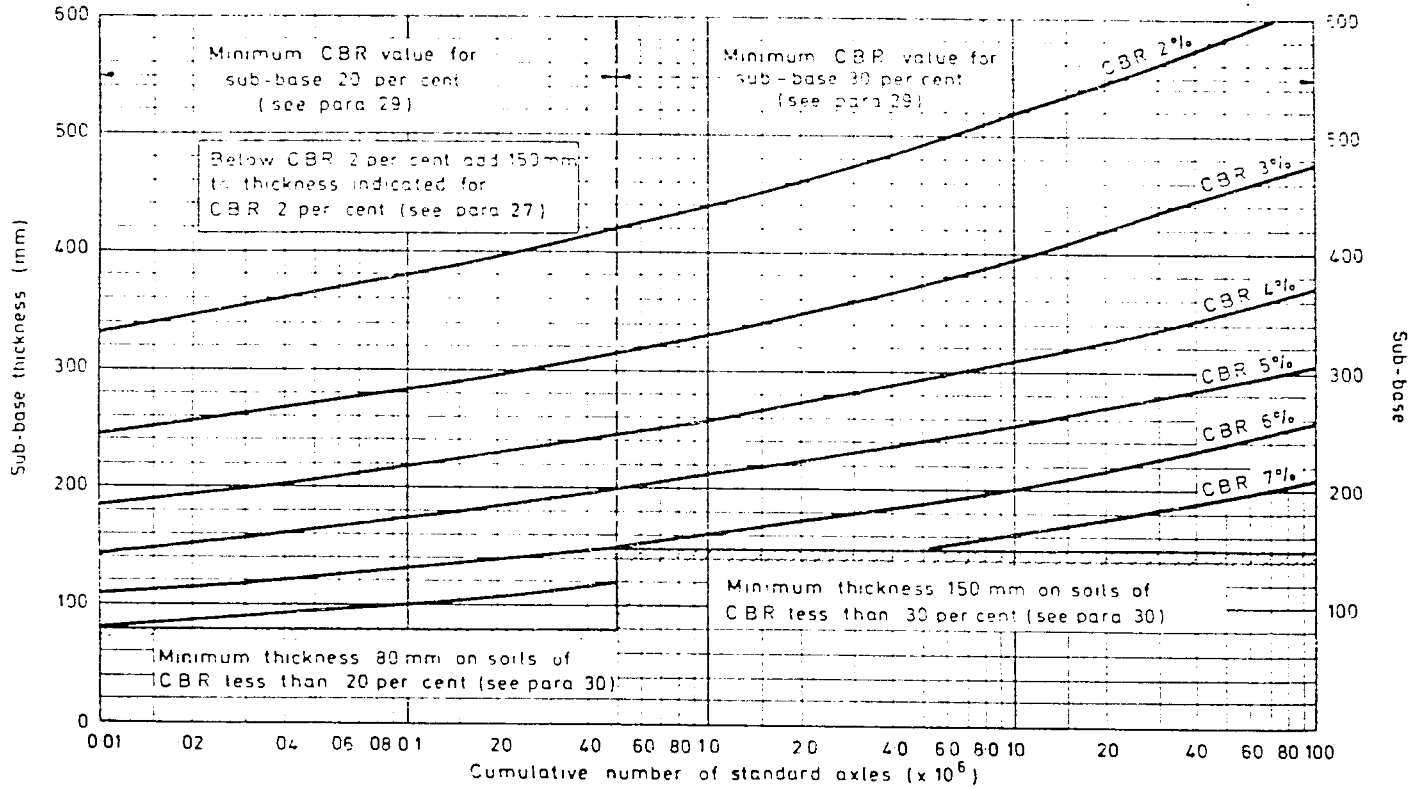
Link Calculations - For each link, the required asphaltic thickness Ta to withstand the estimated cumulative EAL for the period up to 2009 was computed using the above equations. This value was then compared with the asphaltic thickness Te of the link, as estimated from borings and modified by current and committed overlay and rehabilition works. Where borings were not available, existing pavement structures and Te values were estimated from discussions with engineers. The difference between the values for Ta and Te gave the total thickness of asphaltic overlay required on the link for the period up to 2009. Actual overlays would be in thinner layers staged over time, but the data available did not permit programming of overlays to be determined.

Assuming that overlays would be required to cover both pavement and shoulders, the total volume of asphalt was computed for each link, and summed for all existing roads in the corridor. The detailed calculations are included in Annex 3B-3 to this Appendix. Results are summarized in the next section.

Comment on Method - The methodology described for estimating overlay needs was the best that could be done with available data, and was thought adequate for estimating the total overlay requirements for existing roads for feasibility study purposes. However, the results depended on a few samples of the road structure and many assumptions were made. Therefore the results should not be taken as a program of overlaying, and actual overlay needs should be established from pavement condition and deterioration over time. As noted earlier, RBA would be well advised to investigate more scientific methods of estimating overlay needs than are now used.

Summary of Overlay Needs

The detailed results included in Annex 3B-3 were calculated on the basis of assumed maximum 50 percent overloading of axles. Results were



PRINTED FROM TRRL ROAD NOTE 29, FIGURE 6

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THICKNESS OF SUB- BASE

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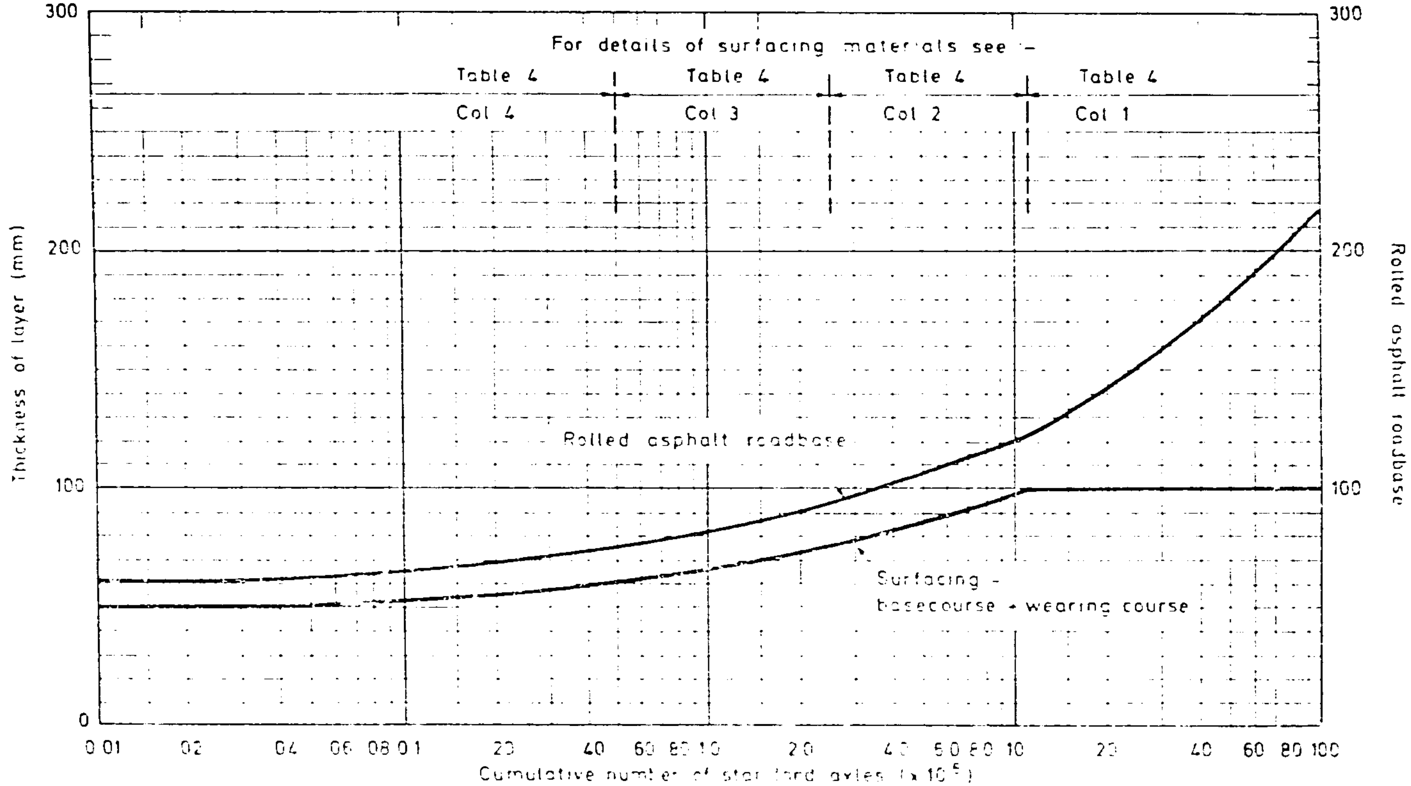
Figure 3B-4



PRINTED FROM TRRL ROAD NOTE 29, FIGURE 7

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THICKNESS OF SURFACING AND ROADBASE ROLLED ASPHALT

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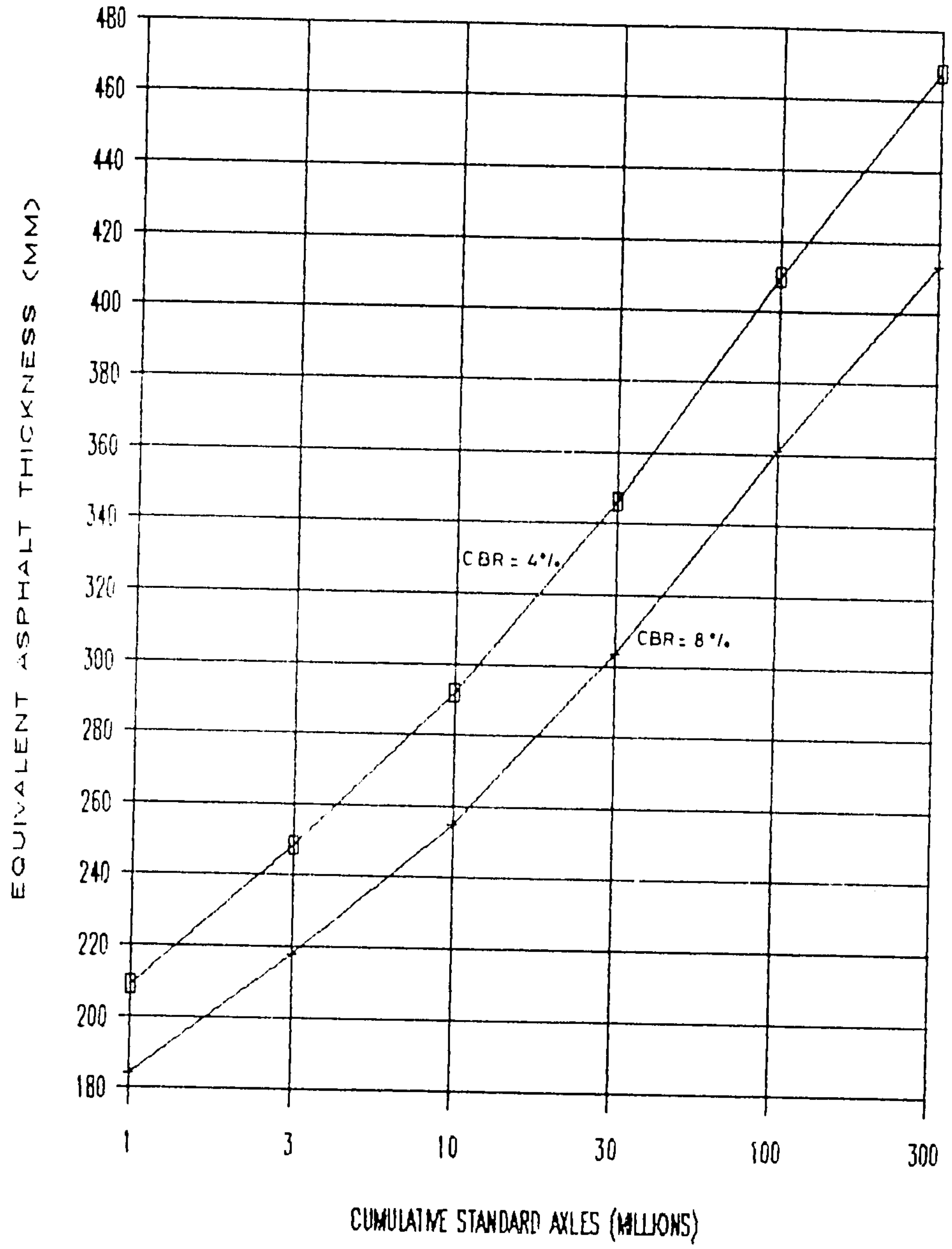
Figure 3B-5



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EQUIVALENT ASPHALT THICKNESS
REQUIRED AT DIFFERENT AXLE LOADINGS

Figure 3B-6

also calculated for legal axle loadings and for current axle loadings. The results are summarized in Table 3B-3.

Table 3B-3

PAVEMENT OVERLAY NEEDS
(thous cu m of asphalt, 1987-2009)

	TRANSPORT NETWORK ASSUMED		
AXLE LOAD POLICY	Committed	Improved	Expressway
Current axle loads (1)	1,327	1,211	1,157
Legal axle loads	870	797	706
Axles up to 50% overloaded	1,232	1,125	1,061

(1) Up to 100% overloaded

The policy of RBA since pavements were first placed in the 1940s and 50s has been to overlay pavements with about 6cms of base course plus 5cm of wearing course when the pavement showed advanced signs of distress -- potholes, severe cracking, rutting etc. A levelling course was also required which added, on average, about 4 cms of asphaltic material. The interval between overlays has been about 12 to 15 years.

It was estimated that an overlay of this type every 12 to 15 years would require about 1,500 thousand cubic meters of asphalt base and wearing course, and about 400 thousand cubic meters more of levelling course, over the period 1987-2009. This is considerably in excess of the volumes indicated above, which at first sight appears surprising since the program of reduced overlaying estimated by the Study is expected to produce better surfaces than the current RBA policy.

The reason for this is that the overlay policy recommended by this Study assumes that overlays are placed in advance of visible pavement deterioration. This has the key advantage tha the existing pavement being overlayed remains intact and contributes to the strength of the final pavement. It can be seen from Figure 3B-6 that 10 cm of asphalt added to a pavement of total equivalent asphalt thickness of 300 mm would add about 80 million EALs to the life of the pavement, but adding the same overlay to a pavement which has deteriorated to an equivalent asphalt thickness of 200 mm adds only about 9 million EALs to the life. Thus timely overlays reduce the need for later overlays, whereas delayed overlays require much more work and materials to make good the deteriorated surface and add sufficient strength to withstand further axle loads.

A further extemely important advantage of early pavement overlaying is that the road surface remains in good condition with associated lower vehicle operating costs.

Conlusions on Pavement Strengthening - Based on the assessment of pavement condition from the visual rating survey and the borings, and taking into account the current program of rehabilitation in the corridor, it was concluded that a proper program of overlaying could maintain these pavements in good condition, probably for less cost than a policy of overlaying and rehabilitation only when pavements become seriously deteriorated. However, action will be required early since, despite the present program, pavements in most sections of the corridor are weak and cannot withstand current or expected axle loadings, even with some form of axle weight control, for more than a few years.

Pavement Overlay Savings

Compared with the Committed Network, both the Improved and Expressway Networks showed less overlay requirements. This is because these two networks concentrate heavy traffic onto the stronger roads - the new highway in the case of the Expressway Network, and the improved West Bank Highway in the case of the Improved Network. Thus both these highway investments would lead to savings in pavement overlaying in other parts of the highway system, as could be expected.

Assuming that the quantity of overlaying required each year would rise according to the growth in equivalent standard axles forecast on the road system, it was possible to estimate the overlay quantity saved each year, and hence the cost saving each year, associated with the Improved and Expressway Networks. The estimates are set out in Table 3B-4 below.

Table 3B-4

ESTIMATED SAVINGS IN OVERLAY COSTS
(LE thousands, 1985/86)

YEAR	PROPORTION OF TOTAL OVERLAY REQ 1987-2009 (%)	EXPRESSWAY NETWORK Financial	EXPRESSWAY NETWORK Economic	IMPROVED NETWORK Financial	IMPROVED NETWORK Economic
1990	3.5	330	460	210	290
2000	6.0	570	790	360	490
2009	8.0	760	1,050	470	650

Hence by 2009, for example, construction of the new Cairo-Assuit highway would relieve the existing road system of heavy traffic sufficient to save about LE 1 million per year in pavement strengthening, measured in economic costs. This can be counted as a benefit to the new highway construction.

(I) Asphaltic Concrete Tests

Sample		1		2		3		4		5		6	7		8		9		10	
Type of Course		W	B	W	B	W	B	W	B	W	B	W	W	B	W	B	W	B	W	B
Type of Extracted Aggrs.		L.S		L.S		N.G		N.G		N.G		L.S	N.G		L.S		L.S		L.S	
Bitumen %		6.2	5.3	4.8	4.4	4.7	4.5	6.5	6	[illegible]	4.1	7.4	6.6	6.0	7.3	3.4	5.8	5.5	4.5	3.6
Sieve Analysis																				
Sieve size Designation		% Passed																		
inch	mm																			
1½	37.500	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1	25.000	91	50	96	82	100	100	98	100	100	100	100	100	100	100	75	100	100	100	96
¾	10.000	78	31	89	47	99	83	93	93	93	92	93	100	100	95	40	93	93	100	85
½	12.500	69	20	69	23	86	49	82	84	82	81	78	92	97	80	26	77	71	90	66
3/8	9.500	50	17	61	17	75	30	71	77	71	70	68	85	93	69	21	66	56	81	53
No 4	4.750	40	12	46	12	46	6	52	57	49	48	49	62	73	52	15	47	34	55	26
No 8	2.360	34	10	38	9	37	5	45	50	42	40	35	47	56	41	12	32	5	38	16
No 16	1.180	28	8	34	8	29	4	35	38	38	35	31	39	49	34	9	24	21	30	12
No 30	0.600	18	6	30	6	17	3	18	21	30	27	23	28	42	24	7	16	15	19	10
No 50	0.300	7	3	12	3	5	2	6	7	12	8	10	11	15	10	5	7	6	8	7
No 100	0.150	3	1	4	1	2	1	3	3	3	2	3	4	4	5	3	3	2	3	5
No 200	0.075	1	0	2	0	1	1	2	2	1	1	1	3	2	3	2	1	1	1	2
Marshall Results	Stability (lb)	2399						2500							2000			2207		
	Flow 1/100 inch	11						9							12			10		

ANNEX 3B-1 SUMMARY OF SOILS TESTS

ANNEX 3B-1 SUMMARY OF SOILS TESTS

(I) Asphaltic Concrete Tests

Sample		11		12		13		14		15		16		17	18	19		[illegible]	
Type of Course		W	B	W	B	W	B	W	B	W	B	W	B	W	W	W	B	W	B
Type of extracted Aggrs.		L.S		L.S		L.S		L.S		N.G		N.G		N.G	N.G	C.B		C.B	N.G
Bitumen %		6.5	5.9	8.6	5.1	6.3	2	7.3	4.0	7.4	6.3	5.5	5.7	4.6	5.0	3.1	3.7	4.2	2.8
Sieve Analysis																			
Sieve size Designation		% Passed																	
inch	mm																		
1½	37.500	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	[illegible]
1	25.000	100	100	100	100	100	61	100	65	100	100	100	100	100	100	100	94	93	[illegible]
¾	10.000	96	97	100	100	100	36	98	43	100	89	98	91	98	97	93	84	82	45
½	12.500	87	81	92	87	96	19	88	31	91	67	86	68	80	80	80	67	53	25
3/8	9.500	80	74	83	79	86	13	73	25	78	51	74	51	67	68	72	49	44	18
No 4	4.750	61	52	65	60	58	8	50	18	55	55	53	25	41	41	54	23	29	7
No 8	2.360	46	39	52	42	40	7	34	16	39	15	37	17	24	24	42	13	22	4
No 16	1.180	39	33	43	34	30	6	25	12	31	12	29	13	20	20	38	10	19	3
No 30	0.600	28	28	37	57	20	4	18	10	21	9	14	10	16	17	29	8	14	2
No 50	0.300	18	13	25	15	10	3	11	7	10	7	5	7	11	12	16	5	4	1
No 100	0.150	4	1	11	5	4	2	5	3	6	4	2	4	5	5	6	3	1	1
No 200	0.075	1	1	6	2	2	1	2	1	2	3	1	2	2	2	2	2	1	0
Mar Shall Results	Stability (lb)	2650	2454					2893				1828			1500				
	Flow 1/100" inch	7	8					9				8			13				

TEST — EXTRACTION

ANNEX 3B-1 SUMMARY OF SOILS TESTS

(1?) [illegible]

[illegible]		1	[illegible]	3	4	5		6		7	8	9	[illegible]		11	[illegible]	13	14	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	20
Kind of coarse agg.		L.S	L.S	G	G	G	L.S	L.S	L.S	L.S.B	L.S	L.S	[illegible]	[illegible]	L.S	L.S.B	L.S	[illegible]	G	[illegible]	L.S	[illegible]	L.S	G	[illegible]	L.S
TEST: Sieve Size Designation Inch	mm	% Passed																								
3	75.000	100	100	100	100	100	100	100	100		79	100	100	100	100		100	100	100	100	100	100	100	100	100	100
2½	63.000	100	100	93	100	100	100	100	100		62	100	100	100	100		100	100	100	100	100	100	100	100	100	100
2	50.000	95	97	92	94	96	100	99	95		58	72	62	92	100		95	79	74	93	92	97	66	97	99	77
1½	37.500	92	95	57	92	94	100	99	92		53	64	73	89	90		66	69	70	90	89	93	58	91	96	66
1	25.000	87	86	50	62	83	97	87	57		47	55	54	87	75		74	60	66	82	81	85	48	85	92	58
¾	19.000	83	76	76	76	78	100	95	82		44	50	44	85	68		66	54	63	76	73	51	40	80	86	51
½	12.500	77	64	70	69	71	99	89	74		41	43	36	74	60		58	47	59	70	64	71	33	74	78	44
⅜	9.500	72	56	66	63	66	95	84	69		33	39	29	65	54		52	43	56	65	56	64	29	69	70	39
No 4	4.750	59	39	57	51	51	82	67	52		34	30	21	46	41		38	34	50	49	42	50	22	57	56	28
No 10	2.000	47	29	39	44	42	69	54	41		30	25	15	34	25		27	29	45	36	36	40	16	47	48	21
No 40	0.425	21	15	15	25	21	35	21	22		22	16	7	19	10		14	21	28	23	19	20	9	26	25	8
No 200	0.075	15	2	2	13	1	1	1	5.2		1.8	26	0.4	0.7	24		3	1.8	2.2	2	5	0.5	3.7	1.7	0.8	1.7
SP.Gr. for Saturated dry surface		2.46	2.32					2.49	2.31	2.33	2.25	2.28			2.25	2.27	2.53				2.49		2.41			2.06
% Absorption		4.4	7.4					5.0	9	5.5	8.8	7.6			8.8	13	2.5				3.8		5.6			17
% Degradation after 24 Hrs in water		3.8	2.5					2.3	3	0.6	2.1	0.5			2.1	43	0.7				1.9		0.7			19.5
% Abrasion (100 rev.)		7	11					6.5	13	12	13	12			13	13	10				12		15			16
% Abrasion (500 rev.)		25	34					34	46	49	53	52			53	55	40				59		58			65
Liquid Limit			–	N.P	N.P	N.P	N.P						21	N.P				N.P	N.P	19		18		N.P	N.P	
Plastic Limit				N.P	N.P	N.P	N.P						16	N.P				N.P	N.P	18		16		N.P	N.P	
Plasticity Index				N.P	N.P	N.P	N.P						5	N.P				N.P	N.P	1		2		N.P	N.P	
Soil Classification				A.1.a	A.1.a	A.1.a	A.1.a						A.1.a	A.1.a				A.1.a	A.1.a	A.1.a		A.1.a		A.1.a	A.1.a	
Proctor Modified	O.M.C				7.12		9.5						4					5.5								
	M.D.D				2.27		2.0						2.1					2.2?								
% C.B.R					92		42						27					89								

ANNEX 3B-1 SUMMARY OF SOILS TESTS

(III) Soil Tests

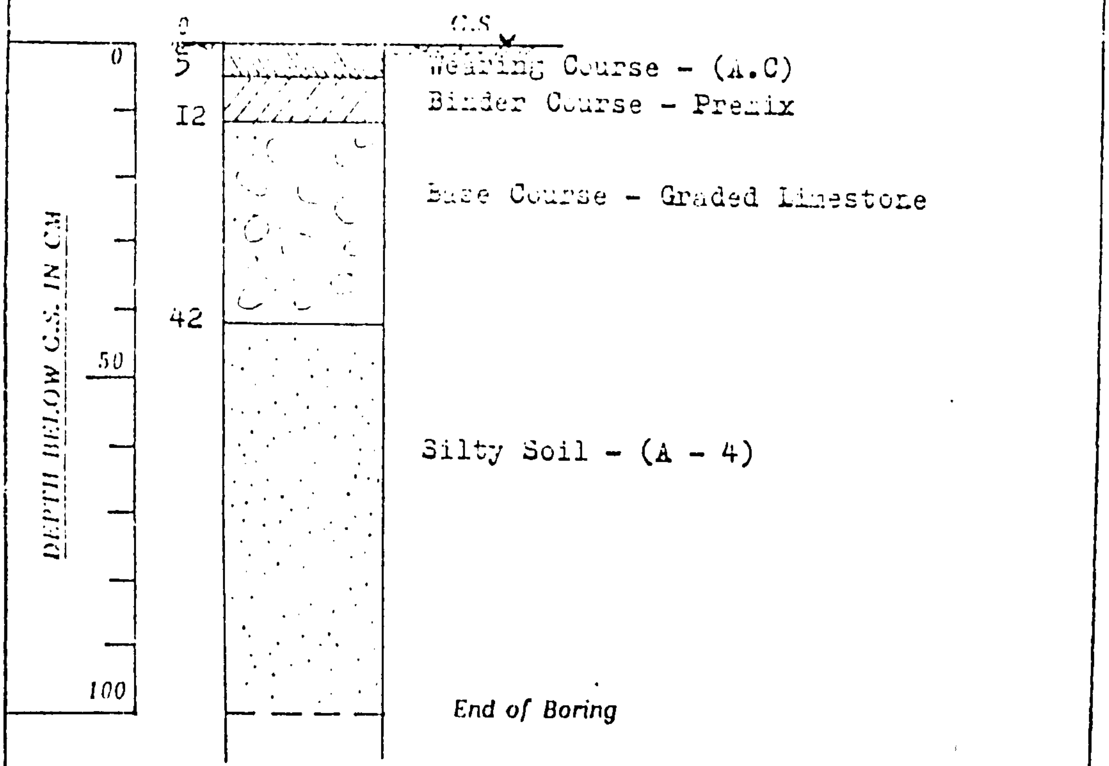
Test			I	2	3	4	5	6	7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9	20
Sieve Analysis	Sieve Size Designation NO	MM	% Passed																			
	I0	2	I00	99	I00	86			97	94	[illegible]	I00	I00	I00			[illegible]	97	[illegible]	95	98	I00
	40	425	97	99	98	95			92	86	[illegible]	[illegible]	99	I00			[illegible]	92	[illegible]	89	97	[illegible]
	200	75	76.5	4I	92.[illegible]	5I			79	47	[illegible]	[illegible]	48	4I			[illegible]	79	92	42	62	82
Liquid Limit			32	34	52	24			29	20	40	34	39	26			25	28	4I	22	32	N.P
Plastic Limit			27	32	23	24			23	I8	26	24	30	24			2I	I9	24	I8	23	N.P
Plasticity Index			5	2	29	0			6	2	I4	I0	9	2			4	9	I7	4	9	N.P
Soil Classification			A-4	A-4	A-7-6	A-4			A-4	A-4	A-6	A-4	A-4	A-4			A-4	A-4	A-7-6	A-4	A-4	A-4
Standard Proctor	M.D.D		I.72		I.5I						I.57											
	O.M.C		24		24.5						25											
C.B.R	% C.B.R		9		4						6											
	% Swell		0		3						0.9											

Sami Saad & Co.
9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 856636 - 857617 - 85[illegible]

MAIN LABORATORY

Lab Ref.	: ML/ /130/1986	Applicant	: Wilber Smith & Associates
Applicant Ref.:	Letter 29/1/1986		
Test No.	:	Samples	: I/20
Date	: [illegible]		Existing Cairo/Assiout High Way

BORING SECTION



M.L. Eng.:

M.L. Manager:

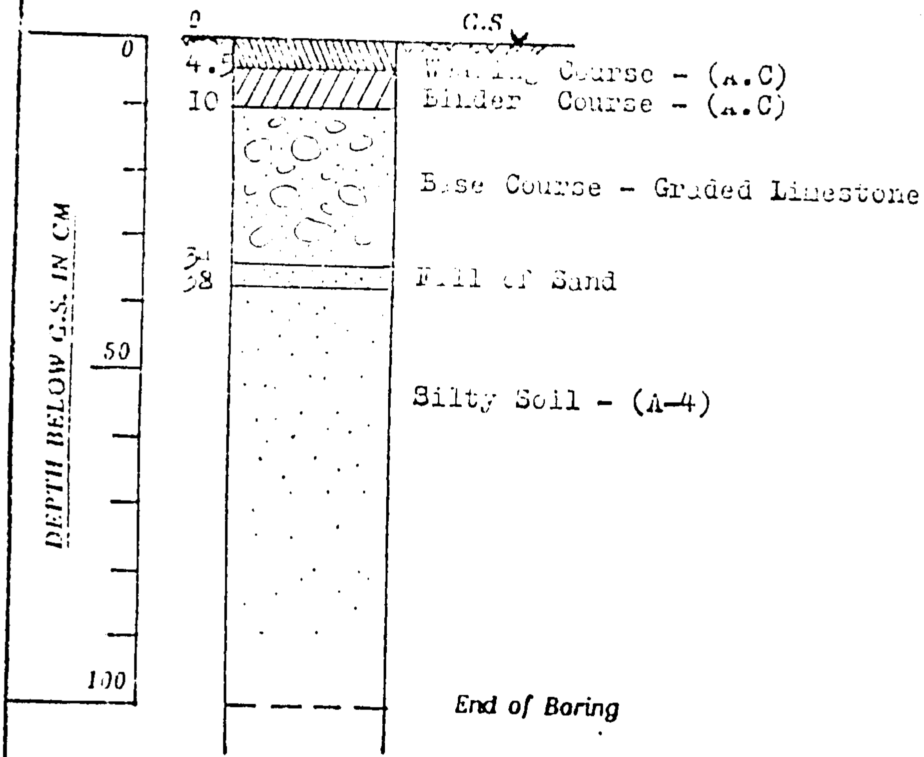
Sami Saad & Co.
9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ 730/1986
Applicant Ref.: Letter 29/1/1986
Test No. : ________
Date : 6/2/86

Applicant : Wilbur Smith & Associates
Samples : 2/2[illegible]
Existing Cairo / Assiout High Way

BORING SECTION



M.L. Eng.: [signature]

M.L. Manager: [signature]

Sami Saad & Co.

9 Mansouria St. Ahram, Giza, A.R.E.

Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ 130/1985

Applicant Ref.: Letter 28/1/1985

Test No. :

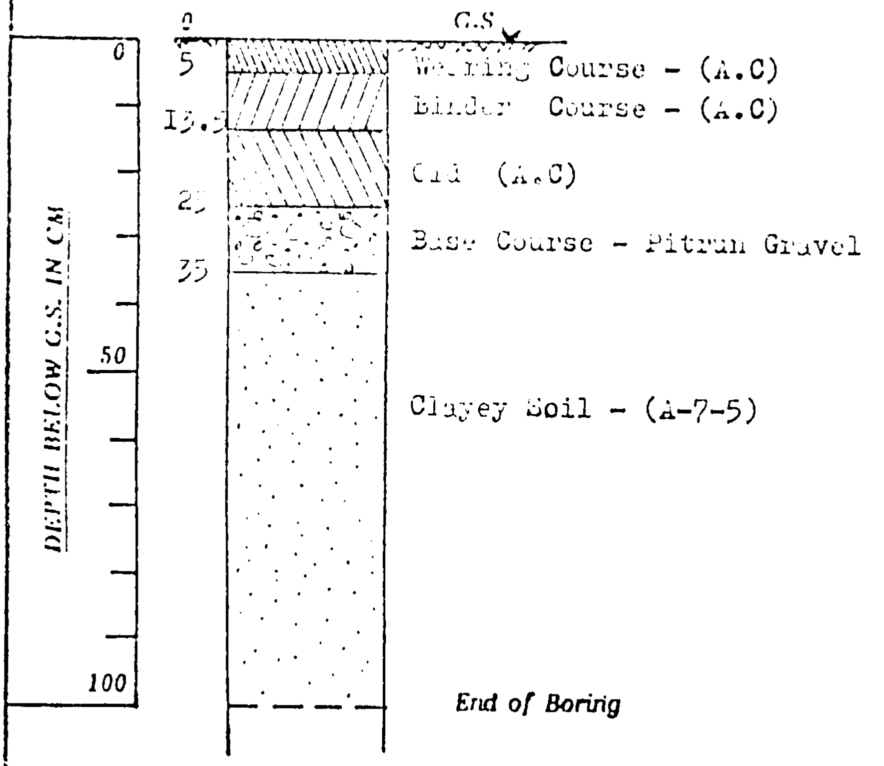
Date : 6/2/85

Applicant : Wilbur Smith & Associates

Samples : 3/20

Existing Cairo / Assiout High Way

BORING SECTION



M.L. Eng.:

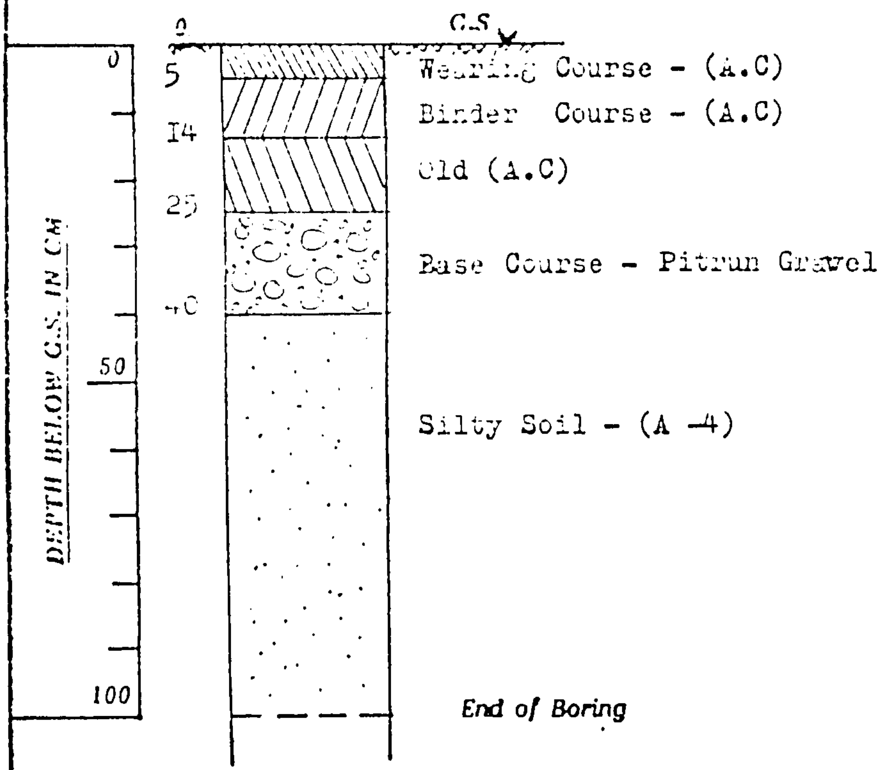
M.L. Manager:

Sami Saad & Co.
9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref.	: ML/ / /1986	Applicant	: Wilber [illegible] & [illegible]
Applicant Ref.	: Letter [illegible]/I/[illegible]	Samples	: [illegible]
Test No.	:		[illegible] / Assiut [illegible] Way
Date	: [illegible]/2/[illegible]		

BORING SECTION



M.L. Eng.:

M.L. Manager:

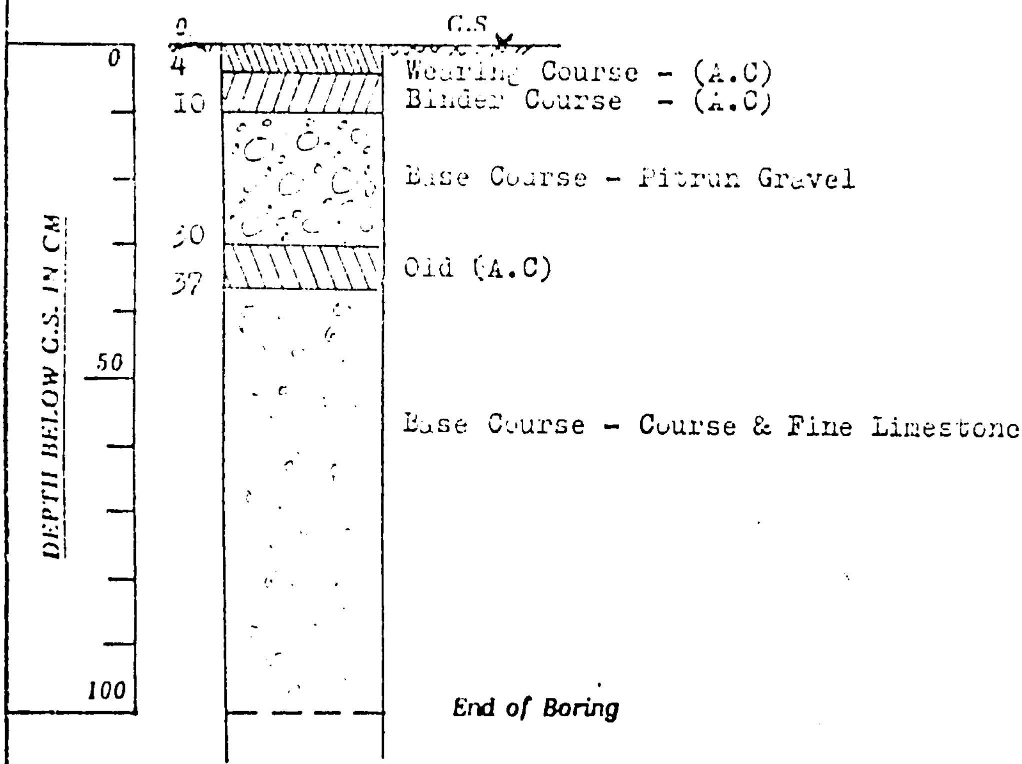
Sami Saad & Co.
9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /1986
Applicant Ref.: Letter 2./ /1986
Test No. :
Date : 15/2/86

Applicant : Wilbur Smith & Associates
Samples : 5/20
Existing Cairo / Assiout High Way

BORING SECTION



M.L. Eng.:

M.L. Manager:

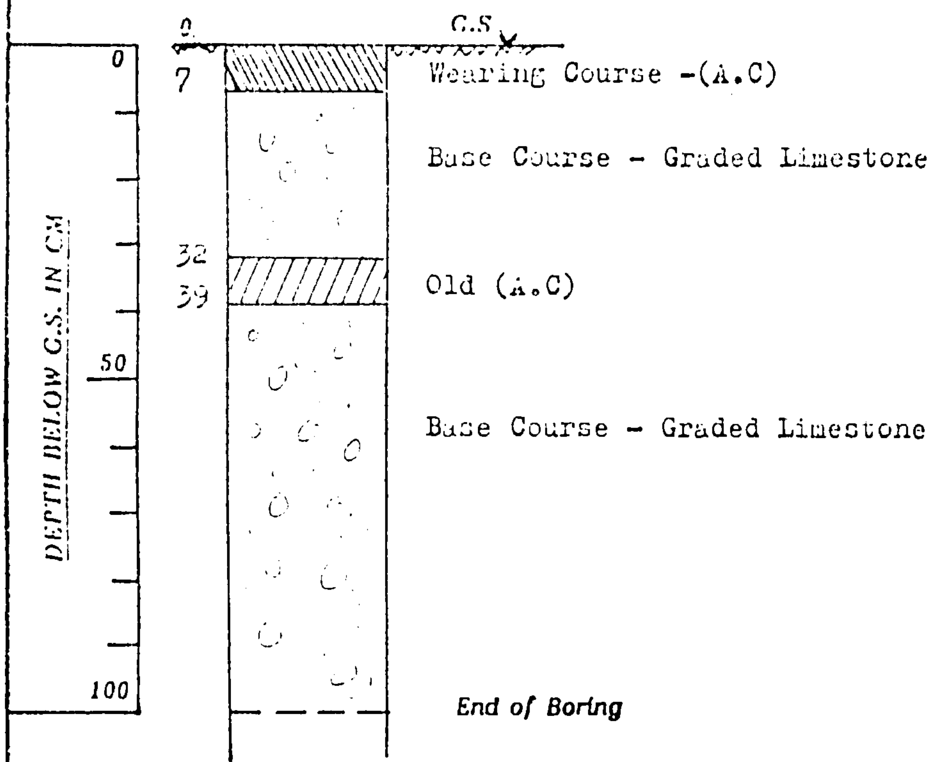
Sami Saad & Co.
9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /1985
Applicant Ref.: Letter 20/1/1986
Test No. :
Date : 18/2/86

Applicant : Wilber Smith & Associates
Samples : 6/20
Existing Cairo / Assiout High Way

BORING SECTION



M.L. Eng.:

M.L. Manager:

39

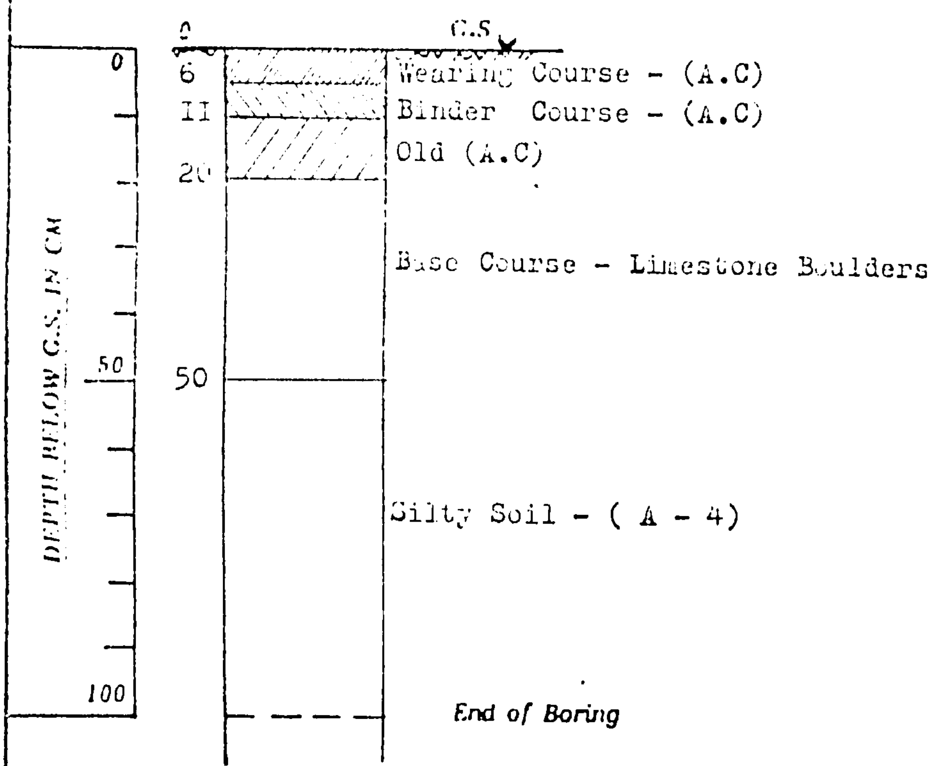
9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /1985
Applicant Ref.: Letter 29/1/1986
Test No. : ______
Date : 3/3/86

Applicant : Wilber Smith & Associates
Samples : 7/20
Existing Cairo / Assiout High Way

BORING SECTION



M.L. Eng.:

M.L. Manager:

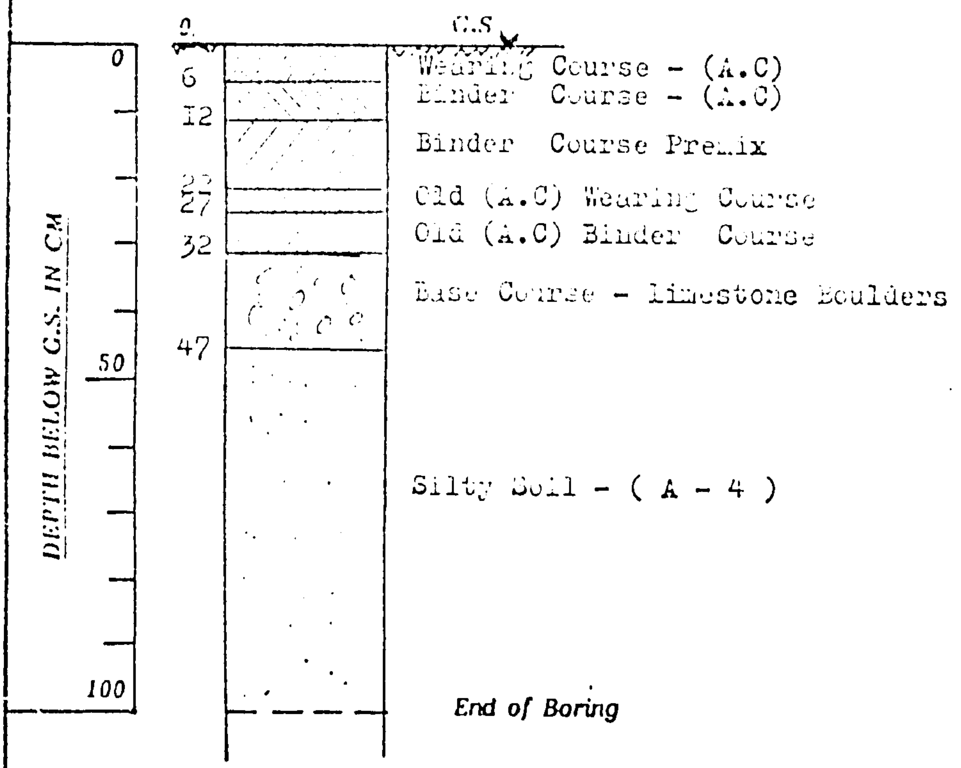
Sami Saad & Co.
9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /1986
Applicant Ref.: Letter 29/1/1986
Test No. :
Date : 24/2/86

Applicant : Wilbur Smith & Associates
Samples : 8/20
Existing Cairo / Assiout High Way

BORING SECTION



M.L. Eng.:

M.L. Manager:

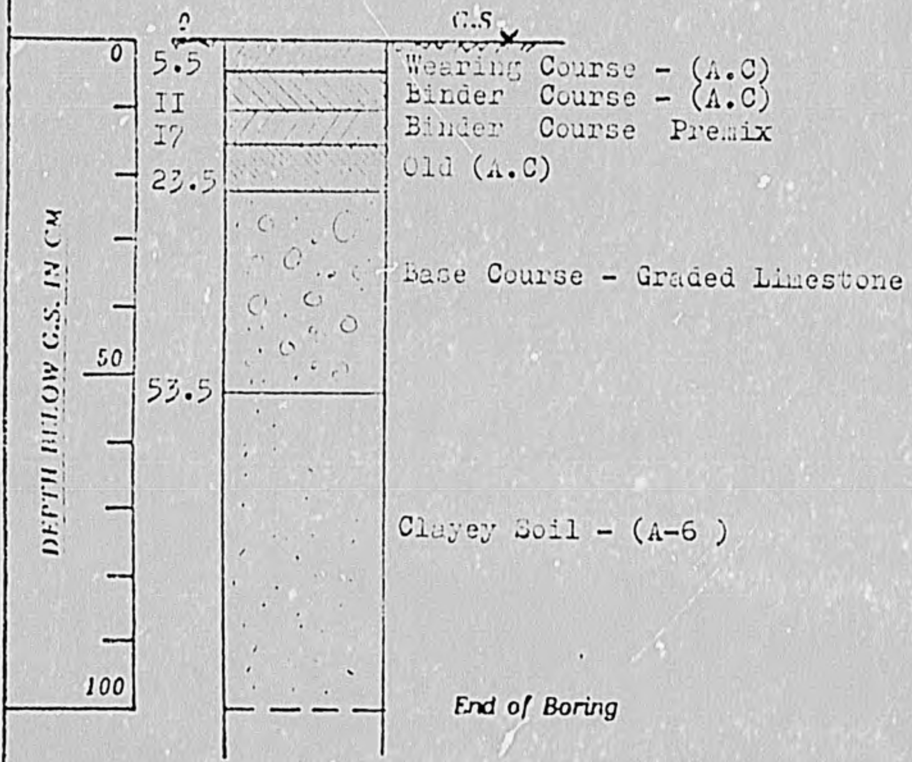
... & Co.
9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /1986
Applicant Ref.: Letter 29/1/1986
Test No. : ______
Date : 25/2/86

Applicant : Wilber Smith & Associates
Samples : 9/20 Existing Cairo Assiout High Way

BORING SECTION



M.L. Eng.:

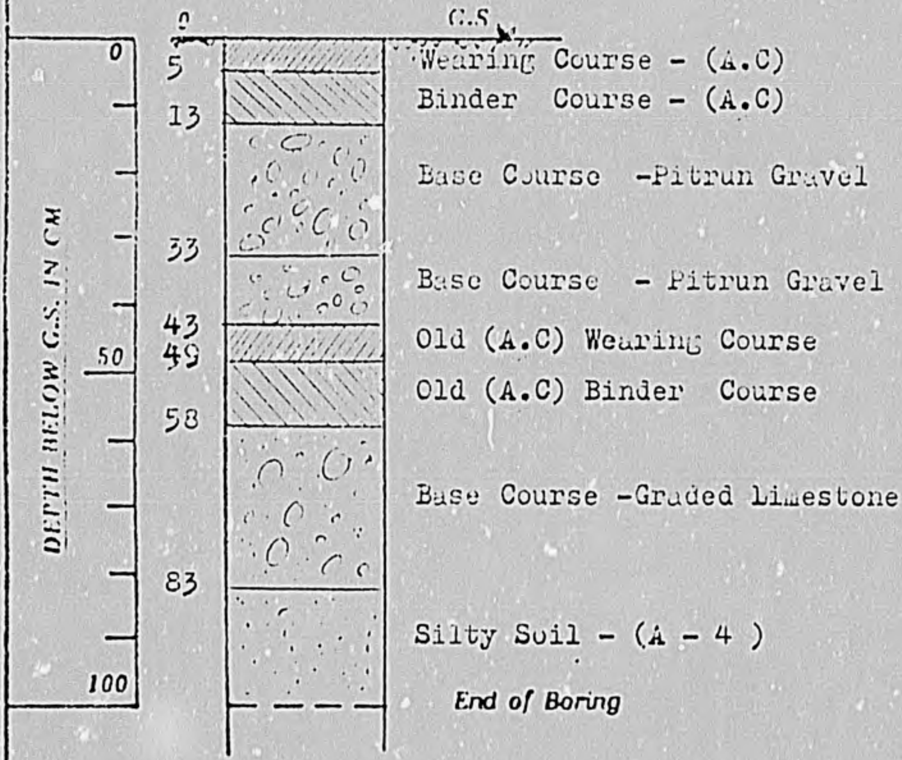
M.L. Manager:

9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref.	: ML/ / /1986	Applicant	: Wilber Smith & Associates
Applicant Ref.:	Letter 29/1/1986		
Test No.	:	Samples	: 10/20
Date	: 15/2/86		Existing Cairo Assiout High Way

BORING SECTION



M.L. Eng.:

M.L. Manager:

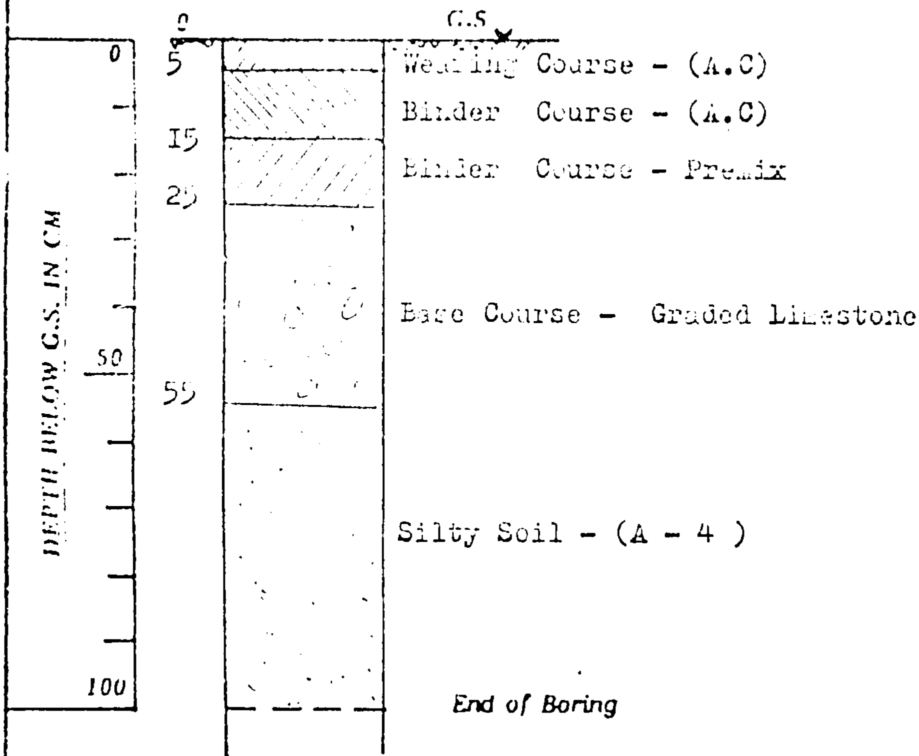
[illegible]
9 Mensouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /1985
Applicant Ref.: Letter [illegible]/1/1986
Test No. :
Date : 25/2/[illegible]

Applicant : Wilbur Smith & Associates
Samples : 11/20
Existing Cairo
Assiout High Way

BORING SECTION



M.L. Eng.:

M.L. Manager:

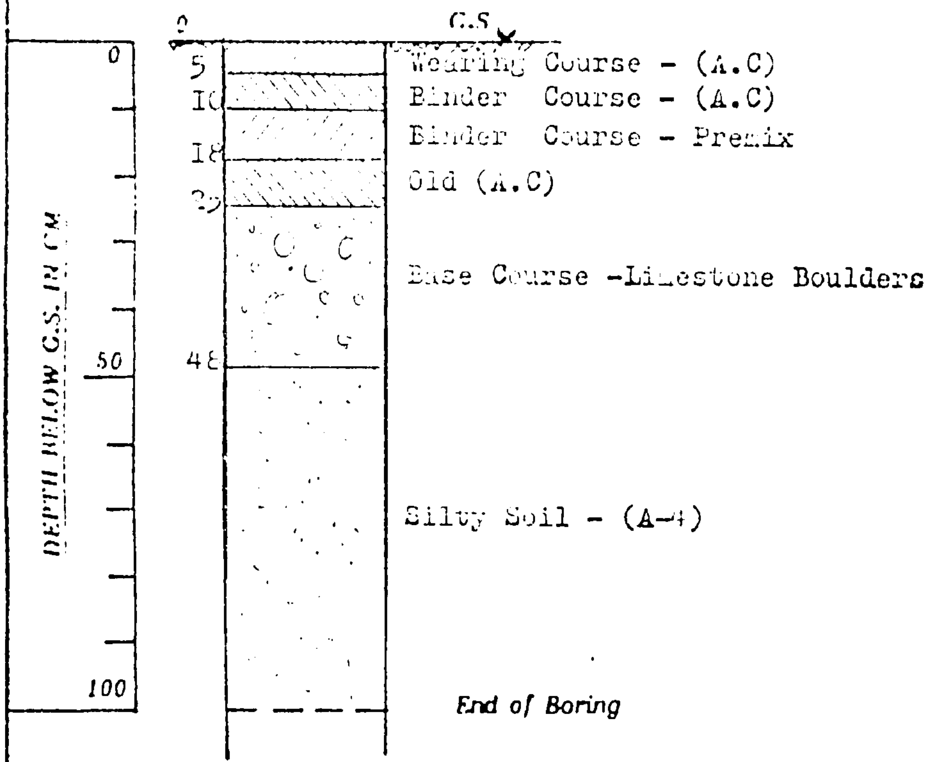
[illegible]
9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /1986
Applicant Ref.: Letter [illegible]
Test No. :
Date : 25/2/[illegible]

Applicant : Wilbur Smith & Associates
Samples : 12/20
Existing Cairo Assiout High Way

BORING SECTION



M.L. Eng.:

M.L. Manager:

45

9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /1985

Applicant Ref.: Letter 29/1/1985

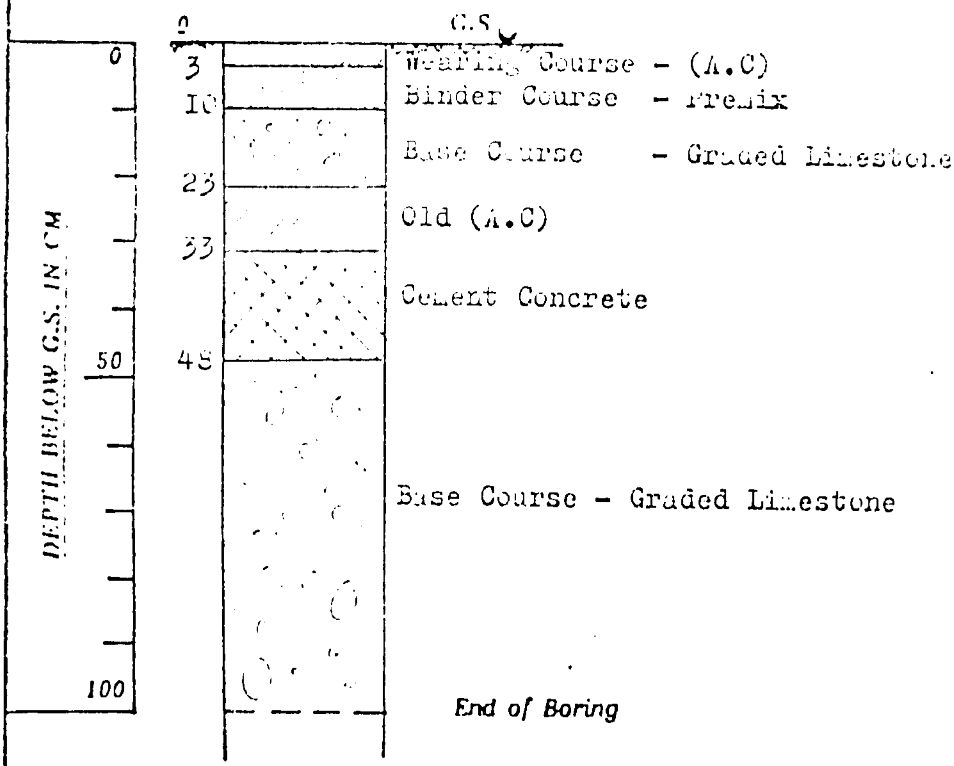
Test No. :

Date : 17/2/85

Applicant : Wilber Smith & Associates

Samples : 13/20 Existing Cairo Ashieat High Way

BORING SECTION



M.L. Eng.:

M.L. Manager:

Sami Saad & Co.

9 Mansouria St. Ahram, Giza, A.R.E.

Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /1985

Aplicant Ref.: Letter 2?/1/1986

Test No. :

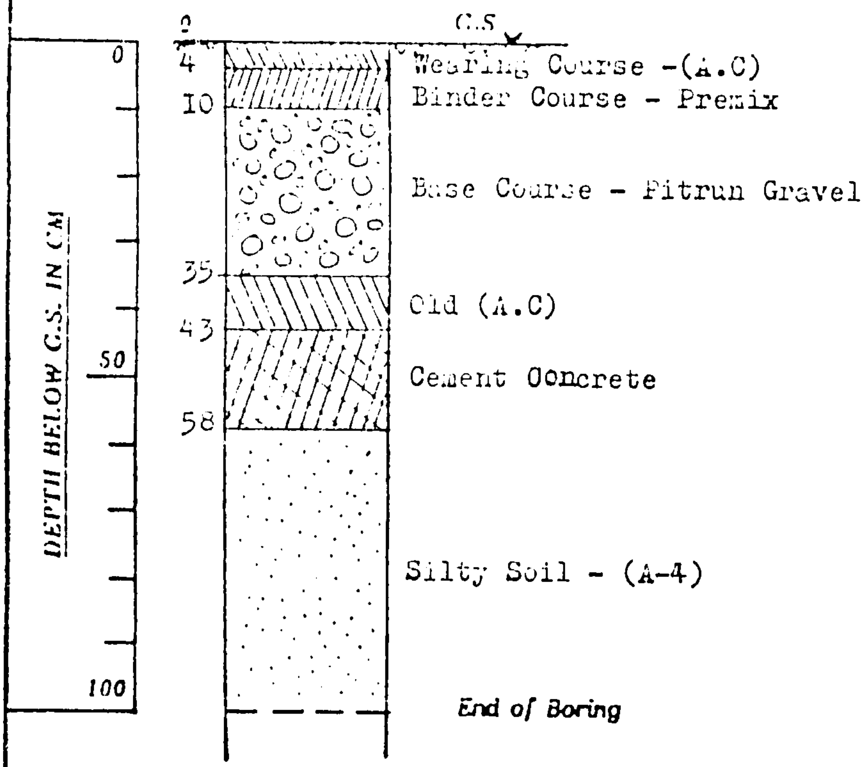
Date : 18/2/86

Applicant : Wilber Smith & Associates

Samples : 19/20

Existing Cairo Assiout High Way

BORING SECTION



M.L. Eng.:

M.L. Manager:

Sami Saad & Co.
9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /198[illegible]

Applicant Ref.: Letter [illegible]

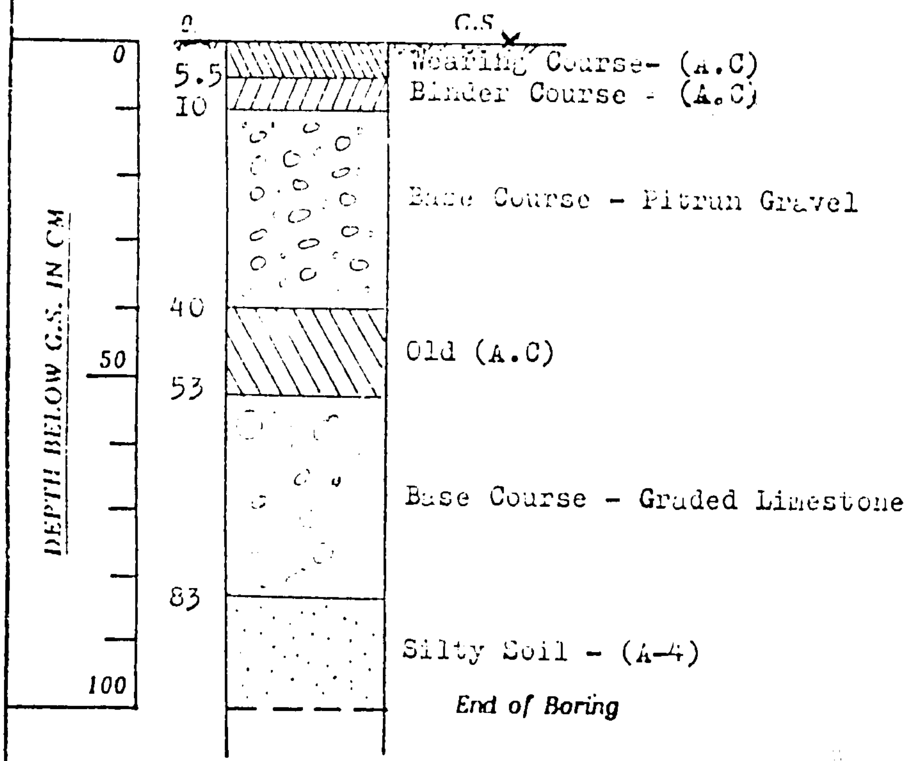
Test No. :

Date : [illegible]

Applicant : [illegible]

Samples : [illegible]

BORING SECTION



M.L. Eng.:

M.L. Manager:

9 Mansouria St. Ahram, Giza, A.R.E.

Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /198

Applicant Ref. :

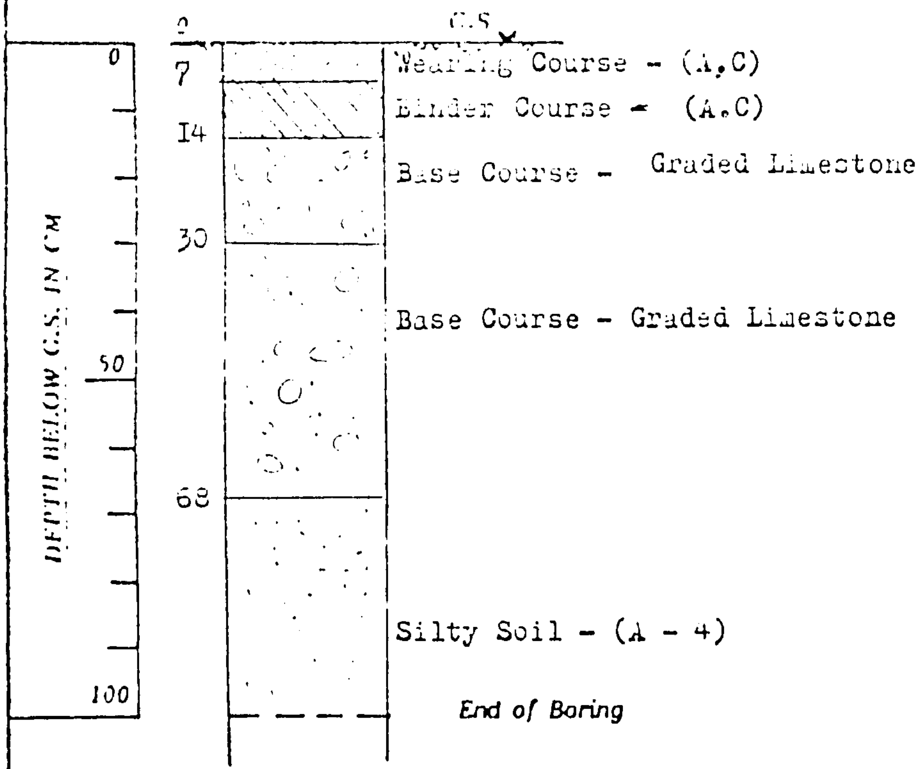
Test No. :

Date :

Applicant :

Samples :

BORING SECTION



M.L. Eng.:

M.L. Manager:

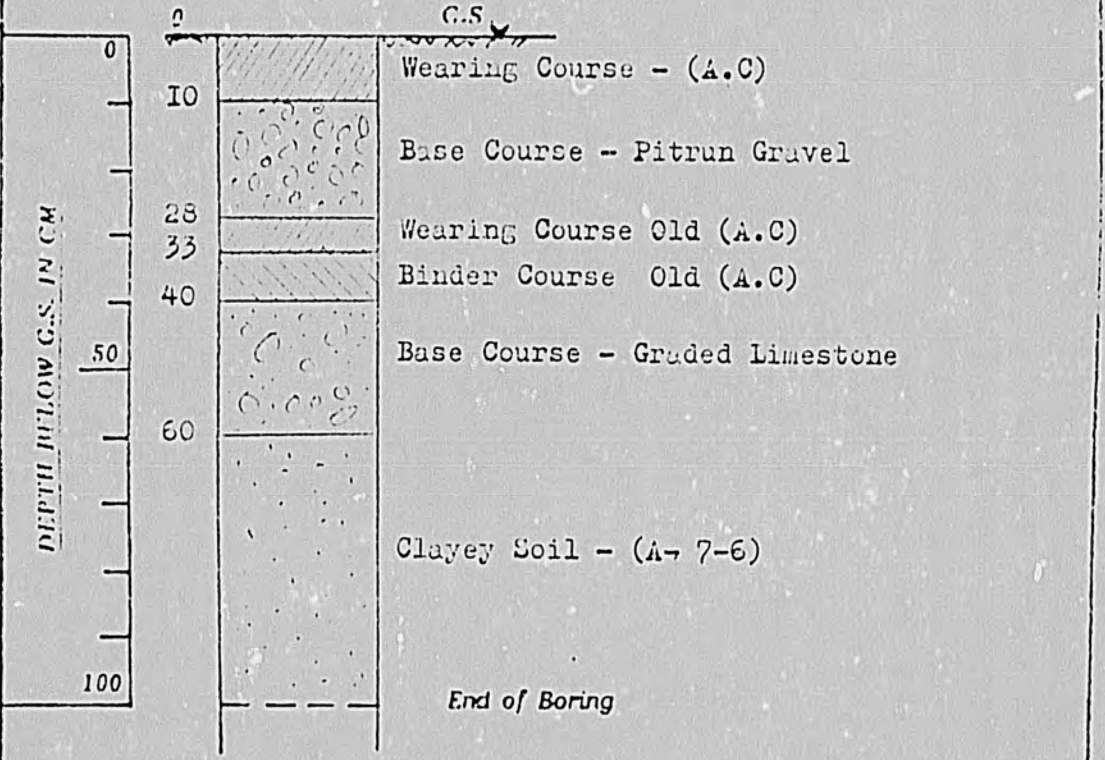
[illegible]
9 Mansouria St. Ahram, Giza, A.R.E.
Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /1986
Applicant Ref.: Letter 2?/1/1986
Test No. :
Date : 21/2/86

Applicant : Wilber Smith & Associates
Samples : 17/20 Existin[g] C[...] Assiout Highway

BORING SECTION



M.L. Eng.: M.L. Manager:

Sami Saad & Co.

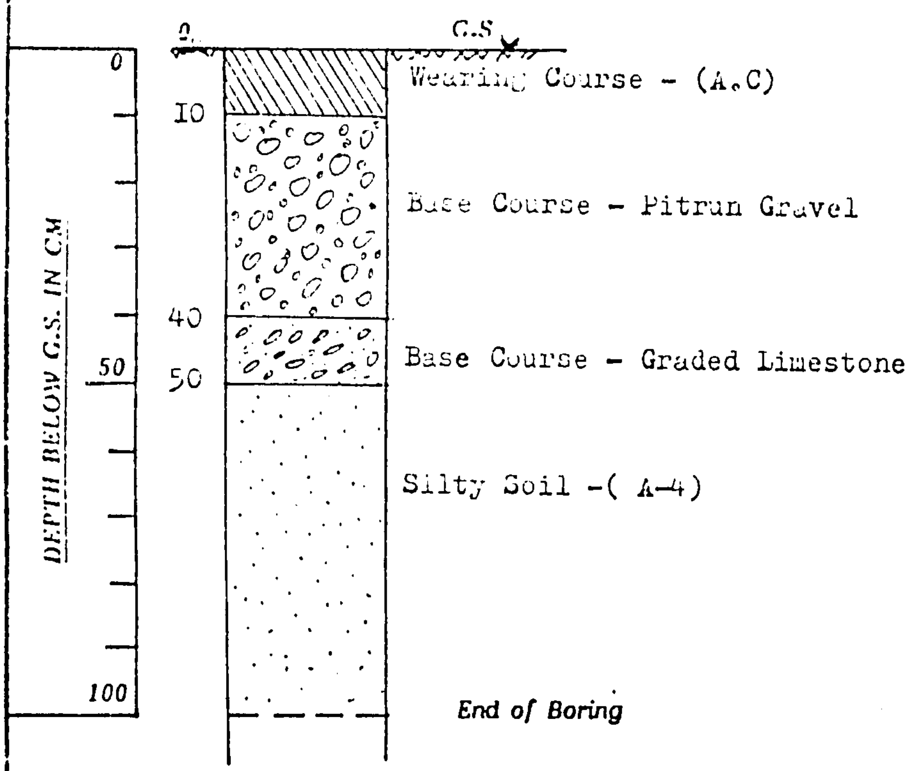
9 Mansouria St. Ahram, Giza, A.R.E.

Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref.	: ML/ / /198[illegible]	Applicant	: Wilber Smith & Associates
Applicant Ref.:	Letter [illegible]		
Test No.	:	Samples	: 16/[illegible] Existing C.[illegible] Assiout High Way
Date	: [illegible]/2/[illegible]		

BORING SECTION



M.L. Eng.:

M.L. Manager:

Sami Saad & Co.

9 Mansouria St. Ahram, Giza, A.R.E.

Tel.: 850636 - 850637 - 850618

MAIN LABORATORY

Lab Ref. : ML/ / /198[illegible]

Applicant Ref.: [illegible]

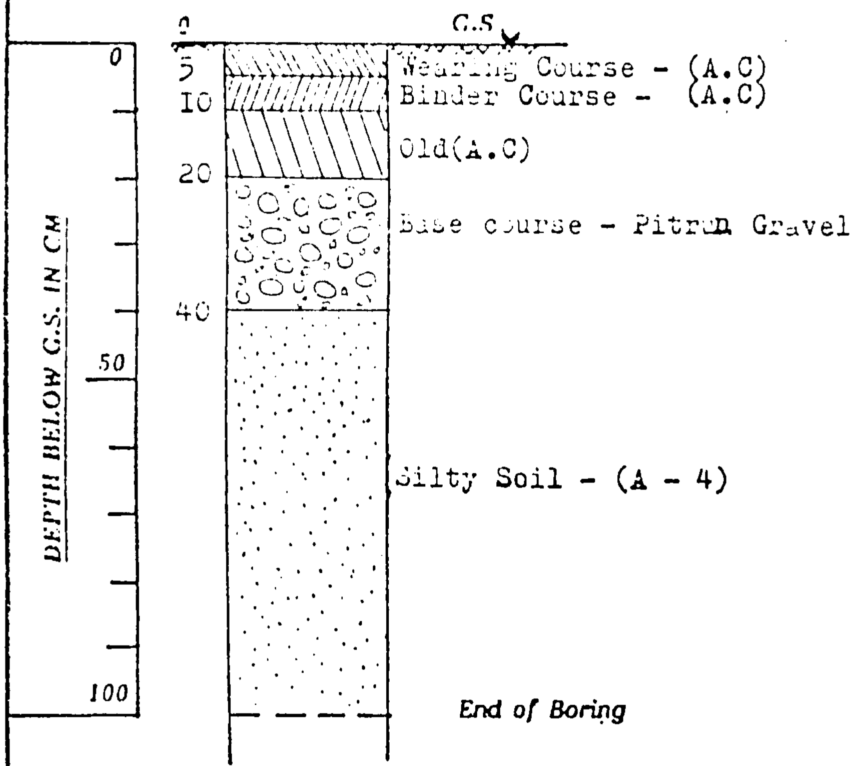
Test No. :

Date : [illegible]

Applicant : [illegible]

Samples : [illegible]

BORING SECTION



M.L. Eng.:

M.L. Manager:

9 Mansouria St. Ahram, Giza, A.R.E.

Tel.: 850636 - 850637 - 850638

MAIN LABORATORY

Lab Ref. : ML/ / /1986

Applicant Ref.: Letter 29/1/1986

Test No. : ____

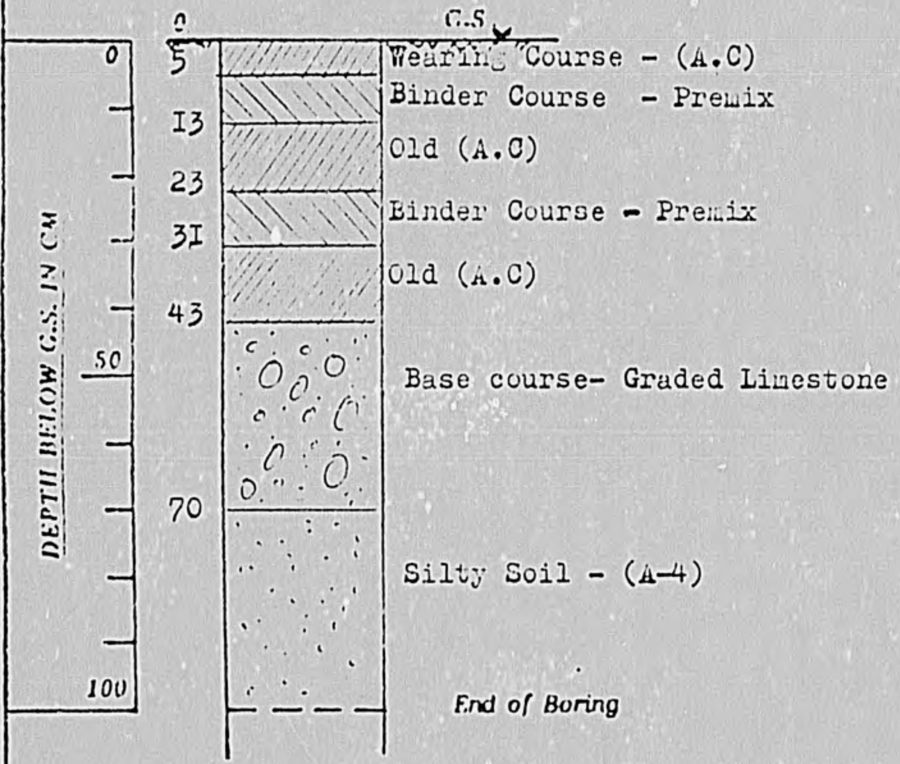
Date : 25/2/86

Applicant : Wilber Smith & Associates

Samples : 20/20

Existing Cairo Assiout High Way

BORING SECTION



M.L. Eng.: M.L. Manager:

ANNEX 3B-3 OVERLAY REQUIREMENTS -- 2-LANE EXPRESSWAY, [illegible]

START	FINISH	VISUAL RATING SEC	SUB-LINK	BOR-ING	LNTH	BYPASS LNGTH REDUC	TRAV WIDTH	SHOULDER 1=P 2=U	SHOULDER Width	SURVEYED Sub CBR	SURVEYED Last Ovly	SURVEYED Te	CURRENT REHAB? 1=Y 2=N	CURRENT REHAB? Compl Year	CURRENT REHAB? Final Te	BASE COND Year	BASE COND Te
					(km)	(km)	(m)		(m)	(%)		(mm)			(mm)		(mm)
East Bank Highway: Helwan-Beni Suef																	
Helwan	Tabin	1		1	7.6		20.8	3	0.0	4	1976	150	1	1987	249	1987	249
Tabin	Ekhsas	2		1	9.2		7.5	1	4.0	4	1976	150	1	1987	249	1987	249
Ekhsas	Saff.	3		2	16.0		7.5	1	4.0	4	1976	122	1	1987	221	1987	221
Saff	Atfih	4		3	19.3		7.5	1	4.0	4	1985	184	2			1985	184
Atfih	Koraimat	5		4	13.1		7.5	1	4.0	4	1985	201	2			1985	201
Koraimat	Warsh	6		5	18.6		7.5	1	4.0	12	1985	248	2			1985	248
Warsh	Beg 4-lane	7	A	6	11.7		7.5	1	4.0	12	1985	274	2			1985	274
Beg 4-lane	Beni Suef	7	B	6	3.6		15.0	1	4.0	4	1985	274	2			1985	274
East Bank Highway: Abnub-Assuit																	
Abnub	Chg.Bor.	30	A	17	5.0		7.6	1	3.0	4	1985	242	2			1985	242
Chg.Bor.	Assuit	30	B	18	3.5		7.6	1	3.0	4	1985	200	2			1985	200
East Bank Highway: Beni Suef-Minia																	
B.Suef Jt	Shk.Fadl		A	F4	74.0		7.5	1	5.0	12			1	1987	165	1987	165
Shk.Fadl	Minia		B	F4	60.0		7.5	1	5.0	12			1	1989	165	1988	165
West Bank Highway: Cairo-Assuit																	
Cairo	Monib																
Monib	Nomros	31		F1	2.9		14.2	1	2.4	4	1985	203	2			1985	203
Nomros	Hawamdia	32		F1	8.6		14.0	1	2.4	4	1985	203	2			1985	203
Hawamdia	Maraziq	33		F1	11.7		13.6	1	4.0	4	1985	203	2			1985	203
Maraziq	Dabay	34	A	F2,3	5.7		14.0	1	4.0	4	1985	208	2			1985	208
			B	F3	1.1		8.0	1	4.0	4	1985	218	2			1985	218
			C	F2,3	4.0		14.0	1	4.0	4	1985	209	2			1985	209
Dabay	Alyat	35	A	19	7.5		14.0	1	3.4	4	1985	208	2			1985	208
			B	19	1.9		8.8	1	5.0	4	1973	150	1	1987	249	1987	249
Alyat	Matania	36	A	19	4.2		8.8	1	5.0	4	1973	150	1	1987	249	1987	249
			B	19	2.9		7.5	1	4.0	4	1973	150	1	1987	249	1987	249
Matania	Gerza	37		19	15.3		7.5	1	4.0	4	1973	150	1	1987	249	1987	249
Gerza	Wasta	38		19	11.9		7.5	1	4.0	4	1973	150	1	1987	249	1987	249
Wasta	Ishmont	39		20	16.4		7.5	1	4.0	4	1973	266	1	1987	365	1987	365
Ishmont	Nasser	40		20	7.5		7.5	1	4.0	4	1973	266	1	1987	365	1987	365
Nasser	Beni-Suef	41	A	20	5.1	3.6	7.5	1	4.0	4	1973	266	1	1987	365	1987	365
		41	B	20	1.2		15.0	3		4	1973	266	1	1987	365	1987	365
Beni-Suef	Barnqua	8	A	7	3.2	3.2	15.0	3		4	1973	181	1	1987	280	1987	280
		8	B	7	11.8	0.4	7.5	1	4.0	4	1973	181	1	1987	280	1987	280
Barnqua	Biba	9		7	7.9		7.5	1	4.0	4	1973	181	1	1987	280	1987	280
Biba	Fashn	10		7	13.3	4.8	7.5	1	4.0	4	1973	181	1	1987	280	1987	280
Fashn	Bypass	11	A	F5	4.2		7.5	1	4.0	4	1973	120	1	1987	219	1987	219
Bypass	Malatea	11	B	8	12.1		7.5	1	4.0	4	1973	195	1	1987	294	1987	294
Malatea	Maghagha	12		9	6.9		7.5	1	4.0	4	1985	252	2			1985	252
Maghagha	Beni-Mazar	13		9	17.9	4.8	7.5	1	4.0	4	1985	252	2			1985	252
Beni-Mazar	Matai	14		9	9.7	4.9	7.5	1	4.0	4	1985	252	2			1985	252
Matai	Qulusna	15		10	8.9	3.8	7.5	1	4.0	4	1985	316	2			1985	316

START	FINISH	VISUAL RATING SEC	SUB-LINK	BOR-ING	LNTH	BYPASS LNGTH REDUC	TRAV WIDTH	SHOULDER 1=P 2=U	SHOULDER Width	SURVEYED Sub CBR	SURVEYED Last Ovly	SURVEYED Te	CURRENT REHAB? 1=Y 2=N	CURRENT REHAB? Compl Year	CURRENT REHAB? Final Te	BASE COND Year	BASE COND Te
					(km)	(km)	(m)		(m)	(%)		(mm)			(mm)		(mm)
Qulusna	Samalut	16		11	5.1		7.5	1	4.0	4	1974	245	1	1986	344	1986	344
Samalut	Burgaya	17		11	18.3	4.8	7.5	1	4.0	4	1974	245	1	1986	344	1986	344
Burgaya	Beg.4-lane	18	A	11	3.0		7.5	1	4.0	4	1974	245	1	1986	344	1986	344
Beg.4-lane	Minia		B	11	1.9		15.0	3		4	1974	245	1	1986	344	1986	344
Minia	End 4-lane	19	A	12	7.7	7.7	15.0	3		4	1974	177	1	1986	222	1986	222
End 4-lane	Abu Qurqas		B	12	15.5	3.3	7.5	1	4.0	4	1974	177	1	1986	222	1986	222
Abu Qurqas	Mahras	20		13	11.6	3.8	7.5	1	4.0	4	1984	322	2			1985	322
Mahras	Mallawi	21		14	13.8	2.5	7.0	1	4.0	4	1984	257	2			1985	257
Mallawi	Deir Mawas	22		14	11.0	6.4	7.4	1	4.0	4	1984	257	2			1985	257
Deir Mawas	Dairut	23		14	9.2	4.4	7.5	1	4.0	4	1984	257	2			1985	257
Dairut	Sanabu	24		15	10.2		7.5	1	4.0	4	1985	322	2			1985	322
Sanabu	Quisiya	25		15	7.0		7.5	1	4.0	4	1985	322	2			1985	322
Quisiya	Beni Rafi	26		15	11.3	4.3	7.5	1	4.0	4	1985	322	2			1985	322
Beni Rafi	Manfalut	27		16	9.0		7.5	1	4.0	4	1985	304	2			1985	304
Manfalut	Manqabad	28		16	19.2	3.8	7.5	1	4.0	4	1985	304	2			1985	304
Manqabad	Assuit	29		16	6.9		15.0	1	4.0	4	1985	304	2			1985	304
West Bank: Beni Suef-Fayoum-Giza																	
Beni Suef	End 4-lane			F6	1.0		15.0	3		4	1983	141	2			1985	141
End 4-lane	Bahr Yosef			F6	25.4		7.5	1	3.0	4	1983	141	2			1985	141
Town Section					1.4		7.0	3		4		141	2			1985	141
Bahr Yosef	Express				7.5		7.5	1	3.0	4	1983	141	2			1985	141
Express	Beg Fayoum			F6	10.4		7.5	1	3.0	4	1983	141	2			1985	141
Beg Fayoum	4-lane				3.0		10.0	3		4		141	2			1985	141
4-lane	End Fayoum				3.0		14.0	3		4		141	2			1985	141
End Fayoum	Jt to Lake				18.9		7.0	2	4.0	4	1985	150	2			1985	150
Jt to Lake	Jt to Gerza				5.6		7.0	2	3.0	4	1985	150	2			1985	150
Jt to Gerza	Beg Wide				44.2		7.0	2	4.0	12	1985	180	2			1985	180
Beg Wide	End Wide				5.2		11.5	3		12	1986	280	2			1985	280
End Wide	Jt Des.Rd				4.8		7.5	1	4.0	12	1985	180	1	1986	280	1986	280

START	FINISH	VISUAL RATING SEC	SUB-LINK	BOR-ING	LNTH (km)	ACCUMULATED AXLES Com	ACCUMULATED AXLES Byp	ACCUMULATED AXLES Expr	Ta REQUIRED (mm) Com	Ta REQUIRED (mm) Byp	Ta REQUIRED (mm) Expr	OVERLAY REQUIRED (mm) Com	OVERLAY REQUIRED (mm) Byp	OVERLAY REQUIRED (mm) Expr	TOTAL VOLUME (cu m) Com	TOTAL VOLUME (cu m) Byp	TOTAL VOLUME (cu m) Expr
East Bank Highway: Helwan-Beni Suef																	
Helwan	Tabin	1		1	7.6	29.4	30.2	26.3	345	347	339	96	98	90	15,195	15,421	14,253
Tabin	Ekhsas	2		1	9.2	101.7	90.4	66.7	411	405	389	162	156	140	17,129	16,463	14,768
Ekhsas	Saff	3		2	16.0	101.7	90.4	66.7	411	405	389	190	184	168	34,941	33,794	30,835
Saff	Atfih	4		3	19.3	73.1	61.5	37.8	393	384	358	209	200	174	46,474	44,452	38,[illegible]
Atfih	Koraimat	5		4	13.1	73.1	61.5	37.8	393	384	358	192	183	157	28,904	27,611	23,722
Koraimat	Warsh	6		5	18.6	73.1	61.5	37.8	346	338	315	98	90	67	20,967	19,210	14,231
Warsh	Beg 4-lane	7	A	6	11.7	73.1	61.5	37.8	346	338	315	72	64	41	9,691	8,585	5,454
Beg 4-lane	Beni Suef	7	B	6	3.6	73.1	61.5	37.8	393	384	358	119	110	84	8,166	7,543	[illegible]
															181,547	173,085	147,762
East Bank Highway: Abnub-Assuit																	
Abnub	Chg.Bor.	30	A	17	5.0	15.1	15.1	15.2	310	310	310	68	68	68	3,601	3,603	3,615
Chg.Bor.	Assuit	30	B	18	3.5	15.1	15.1	15.2	310	310	310	110	110	110	4,079	4,080	4,[illegible]
															7,680	7,683	7,[illegible]
East Bank Highway: Beni Suef-Minia																	
B.Suef Jt	Shk.Fadl		A	F4	74.0	59.5	50.2	27.6	336	328	300	171	163	135	158,387	150,879	124,442
Shk.Fadl	Minia		B	F4	60.0	58.1	48.8	26.1	335	327	297	170	162	132	127,517	121,260	[illegible]
															265,904	272,138	22?,361
West Bank Highway: Cairo-Assuit																	
Cairo	Monib																
Monib	Nomros	31		F1	2.9	103.9	124.4	77.5	412	422	397	209	219	194	10,064	10,522	9,316
Nomros	Hawamdia	32		F1	8.6	103.9	124.4	77.5	412	422	397	209	219	194	29,485	30,828	27,293
Hawamdia	Maraziq	33		F1	11.7	103.9	129.0	82.3	412	424	400	209	221	197	43,043	45,407	40,499
Maraziq	Dabay	34	A	F2,3	5.7	100.8	128.7	84.4	410	423	401	202	215	193	20,766	22,097	19,805
			B	F3	1.1	100.8	128.7	84.4	410	423	401	192	205	183	2,540	2,711	2,416
			C	F2,3	4.0	100.8	128.7	84.4	410	423	401	201	214	192	14,501	15,435	13,826
Dabay	Aiyat	35	A	19	7.5	100.8	128.7	84.4	410	423	401	202	215	193	26,413	28,106	25,1[illegible]
			B	19	1.9	93.1	121.1	76.8	406	420	396	157	171	147	4,123	4,487	3,[illegible]
Aiyat	Matania	36	A	19	4.2	61.4	89.9	48.7	384	404	372	135	155	123	7,835	9,004	7,119
			B	19	2.9	61.4	89.9	48.7	384	404	372	135	155	123	4,508	5,181	4,097
Matania	Gerza	37		19	15.3	61.4	89.9	48.7	384	404	372	135	155	123	23,784	27,334	21,613
Gerza	Wasta	38		19	11.9	60.4	88.9	51.2	383	404	375	134	155	126	18,372	21,179	17,186
Wasta	Ishmont	39		20	16.4	53.9	82.2	43.6	377	400	366	12	35	1	2,307	6,524	196
Ishmont	Nasser	40		20	7.5	53.9	82.2	43.6	377	400	366	12	35	1	1,055	2,994	90
Nasser	Beni-Suef	41	A	20	5.1	60.5	88.9	50.3	383	404	374	18	39	9	1,079	668	502
		41	B	20	1.2	60.5	88.9	50.3	383	404	374	18	39	9	331	698	154
Beni-Suef	Barnqua	8	A	7	3.2	66.3	78.7	51.6	388	397	375	108	117	95	5,196	0	4,555
		8	B	7	11.8	66.3	78.7	51.6	388	397	375	108	117	95	14,689	15,379	12,877
Barnqua	Biba	9		7	7.9	66.3	78.7	51.6	388	397	375	108	117	95	9,834	10,657	8,621
Biba	Fashn	10		7	13.3	59.0	71.7	43.8	382	392	366	102	112	86	15,608	10,901	13,290
Fashn	Bypass	11	A	F5	4.2	51.8	64.1	43.4	375	386	366	156	167	147	7,540	8,088	7,088
Bypass	Malatea	11	B	8	12.1	51.8	64.1	37.4	375	386	358	81	92	64	11,287	12,865	8,890
Malatea	Maghagha	12		9	6.9	56.4	68.7	42.0	380	390	364	128	138	112	10,129	10,962	8,897
Maghagha	Beni-Mazar	13		9	17.9	62.4	75.0	49.6	385	395	373	133	143	121	27,372	21,502	24,891
Beni-Mazar	Matai	14		9	9.7	60.6	73.0	49.2	383	393	372	131	141	120	14,661	7,802	13,427
Matai	Qulusna	15		10	8.9	59.2	71.6	47.6	382	392	371	66	76	55	6,778	4,475	5,599

ANNEX 3B-3 OVERLAY REQUIREMENTS -- 2-LANE EXPRESSWAY, 50% AXLE OVERLOAD

START	FINISH	VISUAL RATING SEC	SUB-LINK	BOR-ING	LNTH	ACCUMULATED AXLES Com	Byp	Expr	Ta REQUIRED Com	Byp	Expr	OVERLAY REQUIRED Com	Byp	Expr	TOTAL VOLUME Com	Byp	Expr
					(km)					(mm)			(mm)			(cu m)	
Qulusna	Samalut	16		11	5.1	56.7	69.1	45.1	380	390	368	36	46	24	2,108	2,722	1,399
Samalut	Burgaya	17		11	18.3	68.8	78.5	61.7	390	397	384	46	53	40	9,717	8,258	8,503
Burgaya	Beg.4-lane	18	A	11	3.0	68.8	78.5	61.7	390	397	384	46	53	40	1,593	1,835	1,394
Beg.4-lane	Minia		B	11	1.9	68.8	78.5	61.7	390	397	384	46	53	40	1,316	1,516	1,151
Minia	End 4-lane	19	A	12	7.7	102.1	105.0	63.6	411	413	386	189	191	164	21,839	0	18,941
End 4-lane	Abu Qurqas		B	12	15.5	102.1	105.0	63.6	511	413	386	189	191	164	33,703	26,739	29,231
Abu Qurqas	Mahras	20		13	11.6	102.1	105.0	63.8	411	413	386	89	91	64	11,888	8,127	8,562
Mahras	Mallawi	21		14	13.8	102.1	105.0	63.8	411	413	386	154	156	129	23,395	19,341	19,611
Mallawi	Deir Mawas	22		14	11.0	101.6	104.3	64.9	411	412	387	154	155	130	19,291	8,141	16,317
Deir Mawas	Dairut	23		14	9.2	95.8	98.4	59.8	408	409	383	151	152	126	15,948	8,398	13,305
Dairut	Sanabu	24		15	10.2	99.6	102.3	63.4	410	411	386	88	89	64	10,299	10,461	7,495
Sanabu	Quisiya	25		15	7.0	99.6	102.3	63.4	410	411	386	88	89	64	7,068	7,179	5,144
Quisiya	Beni Rafi	26		15	11.3	96.8	99.4	60.2	408	410	383	86	88	61	11,211	7,058	7,943
Beni Rafi	Manfalut	27		16	9.0	96.8	99.4	60.2	408	410	383	104	106	79	10,792	10,938	8,189
Manfalut	Manqabad	28		16	19.2	102.7	105.4	66.6	411	413	388	107	109	84	23,716	19,266	18,657
Manqabad	Assuit	29		16	6.9	140.9	143.3	70.6	426	429	392	124	125	88	16,277	16,394	11,476
															--------	--------	--------
West Bank: Beni Suef-Fayoum-Giza															553,458	492,250	428,508
Beni Suef	End 4-lane			F6	1.0	27.1	15.5	29.8	341	311	346	200	170	205	2,997	2,553	3,072
End 4-lane	Bahr Yosef			F6	25.4	27.1	15.5	29.8	341	311	346	200	170	205	53,285	45,394	54,618
Town Section					1.4	27.1	15.5	29.8	341	311	346	200	170	205	1,958	1,669	2,097
Bahr Yosef	Express				7.5	27.1	15.5	29.8	341	311	346	200	170	205	15,734	13,404	16,127
Express	Beg Fayoum			F6	10.4	27.1	15.5	32.5	341	311	350	200	170	209	21,817	18,587	22,870
Beg Fayoum	4-lane				3.0	27.1	15.5	32.5	341	311	350	200	170	209	5,994	5,106	6,283
4-lane	End Fayoum				3.0	62.1	50.3	49.3	385	374	372	244	233	231	10,238	9,768	9,723
End Fayoum	Jt to Lake				18.9	59.2	47.3	46.2	382	370	369	232	220	219	30,720	29,157	28,988
Jt to Lake	Jt to Gerza				5.6	59.2	47.3	46.2	382	370	369	232	220	219	9,102	8,638	8,587
Jt to Gerza	Beg Wide				44.2	50.5	38.6	38.0	328	316	315	148	136	135	45,894	41,949	41,710
Beg Wide	End Wide				5.2	50.5	38.6	107.4	328	316	364	48	36	84	2,890	2,124	5,049
End Wide	Jt Des.Rd				4.8	49.6	37.7	106.6	328	314	364	48	34	84	2,623	1,902	4,639
															--------	--------	--------
															203,252	180,250	203,677
															1,231,840	1,125,406	1,061,007
													Exp-Com		170,833	13.9%	

Appendix 3C

HIGHWAY MAINTENANCE

TABLE OF CONTENTS

TABLES

ANNEXES

Appendix 3C

HIGHWAY MAINTENANCE

Once constructed, highways require maintenance throughout their lives, to preserve their utility for transport and to prevent loss of the investment. The necessary work can be considered in groups of activities related to:

1. The travelway and shoulders
2. Drainage elements
3. The right of way , or areas adjacent to the shoulders
4. Structures (bridges, tunnels and other)
5. Traffic service elements (signs and pavement markings), and
6. Emergency repairs or defenses

For asphalt paved highways with high volumes of traffic, the maintenance of the travelway is the dominant cost. This work includes patching holes and other small damaged areas, and leveling, overlay or reconstruction of localized failures, usually less than 500 meters in extent. Longer overlays to correct generalized failure can be considered as maintenance when the main purpose of the work is to restore an acceptable riding surface, or to keep a failing pavement in service for a limited number of years. Long overlays intended to strengthen pavement structures, and extend their service beyond their original designed lives, should be considered additional investment, though in some cases they may be done with maintenance funds or even by maintenance work forces. Widening and similar geometric improvements do not fall within the usual definitions of maintenance unless very limited in scope. Reconstruction of pavements, that is the removal and replacement of surface and/or base layers, should not be classed as maintenance if the work extends more than a few hundred meters. Such work, if major in scope, should be designed for projected future traffic, not just to replace the previously existing standard.

Review of Current Maintenance Practice

For the main route now in use to the south of Cairo, the Roads and Bridges Authority of Egypt (RBA) has followed a policy which reduces maintenance to a minimum. The asphaltic concrete pavements are a high-type, modern surfacing, plant-mixed and machine-laid. They are relatively massive pavements for most of the length, consisting usually of 6 cm open-graded "premix" or "binder" courses, followed by 5 cm wearing courses of denser gradation. Such heavy pavements do not develop potholes and breaks in the same way as thinner pavements and surface treatments, and if well-constructed they can withstand much use and overloading without requiring the constant small repairs which are typical of lighter surfacings under such conditions. They do fail, of course, if subjected to traffic in excess of the load capacities of the base and surface layers, and there is extensive failure of this kind evident in the corridor now.

It has not been the policy of RBA to do seal coats (surface dressing with stone aggregates) on these major road sections, so this maintenance activity is also absent. Seal coating is practised by most national highway agencies but it is not universal, and in Egypt two of the main reasons for the work are not fully pertinent, those of sealing against wetting and of providing a better braking surface under wet conditions. It is believed that other important benefits would justify the cost of surface dressings, and it is recommended that they be done in the future, but the justification will perhaps be uncertain until some careful studies are made.

The shoulders are often paved on the existing corridor highways, and where they are not paved this improvement is now in progress on almost all sections. This again reduces maintenance since the upkeep of paved shoulders is much less than that for soil or gravel shoulders, especially where they are used by non-vehicular traffic.

One serious problem of shoulder usage exists. Much of the length of the present Cairo-Assuit highway is closely parallel to main irrigation canals, and the channel and slopes of the canals have to be maintained constantly by the Irrigation Authority. The crawler-mounted draglines and other machines used for this work often occupy part of the shoulder, including even having one track on the edge of the travelway pavement, and the silt and organic matter dredged from the canals is frequently cast on or near the shoulder. This practice has several negative aspects:

(1) The dragline is an obstruction to and a danger to highway traffic.
(2) These operations are causing some damage to pavement edges and shoulders,
(3) The saturated dredged material puts large amounts of free water into unpaved shoulders and embankments, reducing the lateral support for the pavements and the stability of the slopes and perhaps even the base layers. Furthermore, the draglining sometimes leaves very steep embankment slopes.
(4) The dredged material is left to dry in place along the highway, sometimes, it appears, for months or even years. This nullifies the purpose of the shoulder for highway use, prevents shoulder maintenance, and obstructs highway drainage.
(5) The eventual removal of the spoil material may cause further damage to the shoulders and pavements, depending on how it is done.

There is no obvious solution to these problems, since the canal maintenance is a legitimate and necessary function and the working space available for it is often limited. Nevertheless, the effects on the highway are serious, and the dredged material, entirely bad for the road, should apparently be quite good for land reclamation and of considerable value if hauled to suitable disposal sites. It should be removed promptly from the highway shoulders, and wherever space permits, the embankments should be widened or lower terraces constructed to provide working platforms for the draglines.

Identification of Road Maintenance Activities

For the purposes of this feasibility study, travelway maintenance was estimated to include patching, smoothing overlays to correct local deficiencies, sealing over patches and any other repairs which may be susceptible to raveling, and periodic seal coating (surface dressing) for the roadway full width, at intervals of several years. The rates and frequency for all such work were estimated considering pavement age and traffic volumes, plus the initial observed condition of the pavement where applicable.

A separate estimate was made of total overlay quantities required to strengthen existing pavements. These overlay quantities were considered as additional highway investments (not as maintenance) with thicknesses similar to those now used by RBA in rehabilitations.

The maintenance of paved shoulders was considered; with minimum patching of pavement damage, along with periodic sealing of the surface. Unpaved shoulders need more attention. It is important to have a well-compacted, stable shoulder up to the level of the pavement edge, to minimize breakage of the edge. In addition, in agricultural zones, there is a need to replace the shoulder material worn away or displaced by pedestrian traffic, carts and animals.

Drainage maintenance was expected to be a major cost in the Cairo-Assuit corridor. In the desert areas it is necessary to keep channels cleared of encroachments, to check pipe and box culverts annually, and to re-shape dikes and channels after the infrequent storms. Cleaning of any ditches in cut sections is needed. The more numerous drainage crossings in agricultural zones impose a higher cost for checking and cleaning, even if they are maintained in part by irrigation authorities, but little ditch or channel work was expected.

Regarding the right of way, the principal concern was the stability of the embankment slopes in farm areas. Maintenance includes shaping and the replacement of eroded or settled slope material. Within the Nile Valley, some control of vegetation is needed along the highway shoulders.

Very little maintenance is required for bridges and other structures of reinforced concrete, but some minor cost can be expected for the repair of spalled concrete decks, damaged railings, and problems around piers and abutments.

The upkeep of pavement striping and the painting or replacement of signs can be a significant expense on high-volume highways. These traffic service elements are important for the safe and efficient use of the road.

It appears that emergency maintenance is a minor concern between Cairo and Assuit. However, some funds should be provided in overall maintenance costs for the repair of occasional damage caused by high-intensity rains, pavement clearing and repair after serious accidents, and the possible encroachment of dune sands during unusual desert storms.

Estimating Maintenance Quantities

The basis for estimating quantities of maintenance are described below for each type of maintenance activity.

Patching Asphalt Surface - In order to estimate the annual quantities (and costs) of paved surface maintenance of different types, three analysis cases were established for the corridor highways. In the first, it was assumed that the maintenance of existing roads would continue about as set by present RBA Policy, with rehabilitations at intervals of several years, consisting of standard overlays of a leveling course, (average depth of 3 cm), a binder or premix course (6 cm) and a new wearing course (5 cm). The interval was assumed to be ever 12-15 years, indicating one or two such standard overlays by the year 2009, depending on the year of completion of the last (or current) rehabilitation. It was also assumed that in all years of the analysis period there would be a need for small amounts of pothole patching and short smoothing overlays, and rates were set for these two activities.

In the second and third analysis cases for costing surface maintenance, lesser rates were set for hole patching and smoothing overlays. Both of these rates would quantify patching under a policy of placing reinforcement overlays on existing pavements with thicknesses (or timing) determined by the forecasts of cumulative standard axle loads (EAL) for different assignments of traffic. One set would give costs with the designed overlay policy and all traffic using the existing roads. The final set would give costs with the new expressway assumed to be open, and therefore with lower traffic volumes on the present roads. It was assumed that the overlaying policy recommended by the Study would result in overlays every 7-10 years.

In all three of the above cases the costs of the rehabilitation or reinforcement overlays themselves would be computed apart from maintenance. They are discussed in Appendix 3B. In the quantification of routine road maintenance it was only the patching rates for the three cases which were established.

Those rates for hole patching and smoothing overlays were chosen with care. Surface defects and roughness increase with time on asphalt pavements, and can reach high levels on light pavements after 10 years or more. However, on relatively thick pavements they develop more slowly, and when periodic overlays are placed to strengthen the pavements and maintain a good running surface, the rates of required surface maintenance will seldom advance very far. For the road data tabulations a set of four curves was established to predict quantities of hole patching and short, smoothing overlays on both older, rehabilitated pavements and those newly constructed, over long periods. The curves were examined to see what quantities would result, and it was found that under any policy calling for full-length overlays at intervals of seven to ten years the square meters of hole patching and smoothing overlays would not vary greatly in those early years of the curves. Calculation of surface repair quantities at different rates year by year would not be justified for the comparatively modest costs involved, and so the rates were averaged for

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the intervals between assumed, full length overlays. The averaged rates were then tabulated for the quantification of patching amounts (and costs) for each link and sub-link of existing highway, as follows:

ANNUAL PATCHING RATES, ANY YEAR, EXISTING HIGHWAYS
(Percent of Travelway Area)

PERIODIC REHABILITATION POLICY		REINFORCEMENT FOR EAL POLICY: Without Expressway		Expressway Open	
Holes	Smoothing Overlay	Holes	Smoothing Overlay	Holes	Smoothing Overlay
0.05	0.90	0.04	0.80	0.03	0.70

The corresponding rates for newly constructed highways, with adequate maintenance and timely overlays, were taken to be 0.025 percent for potholes and 0.60 percent for short smoothing overlays. In all cases, the two kinds of patching would be quantified in square meters per road section per year, as a patching rate in percent, times the length of the tabulated section in meters, times the width of the carriageway on that section.

Paved Shoulder Patching - Although the need for shoulder patching increases with age, a more important variable is the localized traffic on the paved shoulder at minor side roads, parking areas, commercial developments, and so on. It was considered sufficient to estimate shoulder patching uniformly at 0.03 percent of the total paved shoulder area in desert zones, and 0.10 percent in agricultural areas, for all highway sections in the corridor having paved shoulders. This work item was again calculated in m^2 per link per year, multiplying the appropriate rate times the section length in meters, times the total width of shoulder, both sides combined.

Routine Maintenance Sealing - This activity, distinct from periodic full-width seal-coating, consists of hand sealing over patches (both travelway and shoulder) and machine sealing over smoothing overlays, to prevent ravelling or the entrance of moisture. It was assumed that the work would be done using a suitable bitumen and a crushed stone cover aggregrate, at roughly the same application rates as for periodic sealing, but at higher costs per square meter.

Routine maintenance sealing over patches was calculated in m^2 per road section, at 1.5 times the patching area for the same highway section. This 50 percent increase provides for sealing beyond the edges of patches.

Routine seal coating of leveling overlays was caculated in m^2 per section, at 1.02 times the overlay area for the same highway section. The 2.0 percent increase provides for full application of seal coat at the edges and beyond the ends of smoothing overlays.

Periodic Seal Coating, or Surface Dressing - This work item, whether done by contract or by force account, consists of an application of hot bitumen followed immediately by spreading crushed stone aggregate, set quickly in place by rolling. The area of periodic seal coating per section is calculated in m^2 at 1000 times the length in km times the total width of pavement (and paved shoulders, where applicable), times 1.02. The 2.0 percent increase provides for full application of seal coat at the pavement edges, with a normal triple-lap nozzle spacing on an asphalt distributor.

The frequency of seal coating, and therefore the year in which the work is to be done on specific sections of road is assumed to be seven to ten years from last seal coat, because the staging of additional pavement thickness or overlay is expected at about those intervals. Therefore, seal coating is not called for on major routes of high traffic volume,but lower-volume routes which do not require overlays will be seal coated every eight years.

It is assumed that rehabilitated or overlayed surfaces would be seal coated as a part of that project's cost.

Unpaved Shoulder Maintenance - In desert areas, it was assumed that granular or soil shoulders should be re-shaped by grader every second year, and that any necessary make-up material could be pulled from the roadside. Watering would be needed to get adequate compaction at the pavement edge. It was estimated that an appropriate crew of men and machines would complete the shoulder re-shaping on four km of road sector length per day. The annual work quantity per km would then be , for a two-year cycle, 0.125 crew-days.

In farm areas, the increased traffic on unpaved shoulders by pedestrians and domestic animals make it desirable to grade the shoulders every year, and it was assumed that about six m^3 per km of make-up material would have to be hauled in at the time of grading. As an estimation, an appropriate crew of men and machines would complete the shoulder work on three km of road sector length per day. The annual work quantity per km would then be 0.33 crew-days.

Drainage Maintenance - The care of drainage facilities in desert zones was presumed to consist of three activities: checking and cleaning culverts; cleaning ditches in cut sections, and occasionallly clearing encroachments or deposits and re-shaping channels in the wadis near the highway.

(1) It was assumed that pipe and box culverts would be checked annually, with some cleaning of the inlets and outlets required. It was estimated that a small labor crew with a transport vehicle could cover 10 km of road sector length per day, making the annual work quantity per km 0.1 crew-days.

(2) It was apparent that cut sections would be kept to a minimum in the design of highways where drifting sand may be a problem, but some cuts, and consequently longitudinal ditch, must be

expected, especially near the Nile Valley and on the connector roads. Assuming a total of 150 m of ditch per km of road length, and annual cleaning by a labor crew (with a transport vehicle), it was estimated that the yearly work quantity per km would be one crew-day.

(3) The clearing of major drainage channels in dry areas may only be needed at long intervals, following storms or after the slow accumulation of obstructions of different kinds. Assuming the work would be done every five years, with one major channel about every 10 km and two days work at each site, then the annual quantity per km would be 0.04 crew-days. A crew was assumed to consist of one crawler tractor, one large loader and one transport vehicle, with appropriate operators, a driver and a small labor crew.

Drainage maintenance in farm areas should consist only of checking culverts annually, cleaning the inlets and outlets as needed. It was estimated that a small labor crew (with a transport vehicle) could cover five km of road length in a day, making the work quantity per km per year 0.2 crew-days.

Right of Way Maintenance - No significant cost was expected in desert zones for the care of areas outside the road shoulders. However, the conditions in cultivated areas would cause some settlement and loss of material from the embankment slopes. Several kinds of simple activities could be needed to correct these problems, but it was believed sufficient to express all anticipated costs in terms of a small labor crew, a small dump truck, and a modest quantity of make-up material, to be obtained near the sites of work. Assuming work on about $50m^2$ per km of road length per year, requiring 0.5 crew-days plus $5m^3$ of material, and an equivalent amount of labor time for trimming vegetation, repairing slope facings, walls, etc., the annual work quantity per km was estimated at 1.0 crew-days.

Structure Maintenance - Only a broad estimation of this activitiy was possible at 0.1 labor crew-day per km annually. The work would consist of cleaning bridge connections and drains, patching cement or stone work, repair of guard rails, and so on.

Pavement Markings and Signs - Centerline striping was considered necessary on all categories of highway to be included in the feasibility study. Re-painting every three years was assumed, using a group consisting of one self-propelled striping machine, one transport vehicle, one pilot vehicle, and appropriate operators and labor. In the traffic conditions anticipated for the corridor, such a group might complete 10 km of single line per day, either solid or dashed line. For a single solid line the paint quantity would be about 50 liters per km(70 kg). Two-lane highways were assumed to require one centerline stripe and two shoulder stripes. Each carriageway of a four-lane route would need a lane-divider stripe and one edge or shoulder stripe. Where centerlines and lane-divider lines are intermittent (dashed) they would only need about one-third of the paint quantity for a solid line. Also, for the lower traffic of connector roads, repainting may only be necessary every fifth year. For estimating purposes, these reductions to lower cost were ignored.

Information, warning and control signs were estimated to need repainting or replacement on about a five-year cycle but the options for numbers, types and sizes of signs varied. For the purpose of costing this maintenance item, a lump sum per km per year was estimated, related generally to traffic volume and adjacent population. In descending order of cost, urban areas were called Class 1, main routes in farm areas Class 2, main highways in desert zones Class 3, and all lesser roads Class 4.

Emergency Maintenance - This cost was estimated on a lump sum basis, per km per year, at about 1.0 percent of all other normal maintenance costs combined.

Maintenance Overhead - The annual work quantities estimated for the various maintenance activities were costed according to 1986 labor rates, materials prices and other elements. The unit costs derived (per m^2 or per crew-day) include a substantial percentage of other costs as overhead, usually 25 percent. This is intended to cover part of the necessary expenses for maintenance inspections, engineering and laboratory services, and supervision of contracted maintenance, as well as a pro-rata share of general administration costs.

Unit Costs for Maintenance

Maintenance cost estimates for feasibility studies are usually limited to generalized annual costs per kilometer. However, in the case of the Cairo-Assuit corridor there were several different existing and proposed routes, some in desert and some in farm areas. Parts of the highway sections were 4-lane, and there were large variations in traffic volumes. In these circumstances it was throught preferable to generate approximate maintenance costs in a simple computer program which took the most important variables into account. The procedure was to divide the routes into relatively short sections for analysis, and to enter these in the program with their characteristics affecting maintenance (length, width, surface type, climate region, etc). Using these in conjunction with the maintenance activities and their annual rates, set forth in the previous sections, annual maintenance quantities were derived in terms of square meters of patching, crew-days of shoulder grading, and so on. These quantities were then multiplied by their estimated unit costs, or costs per kilometer, to arrive at a total annual maintenance cost for each of the individual analysis sections. These were summed for any combination of sections to get one-year maintenance cost for that part of the route.

Basic Costs - The most fundamental level for costs is at the basic rates for labor, equipment and materials. The appropriate personnel classifications were taken from the Egypt National Transport Study (ENTS) (Reference 1) and current annual salaries were determined. In order to convert these to costs per hour, enquiries were made and a figure of 3,000 working hours per year was established. The result were:

LABOR COSTS

PERSONNEL CLASSIFICATION	WAGE RATE ANNUAL (LE	PER HOUR 1986)
Mechanic/truck driver	3,125	1.04
Operator(small equipment)	2,500	0.83
Foreman	2,500	0.83
Labourer	1,000	0.33

A short list was made up of equipment types which would be needed in maintenance. Hourly rates were estimated for these, intended to include the costs of owning and operating the machines, except for driver or operator wages. The elements of cost were amortization of purchase, fuel and lubricants, tires when applicable, and repairs. The rates adopted were:

EQUIPMENT COSTS

DESCRIPTION	L.E. PER HOUR, 1986
Pickup truck	5.00
Dump truck (4 to 5 m^3)	15.00
Loader (125 h.p., approx.)	50.00
Grader (3.6m. moldboard)	35.00
Water truck	15.00
Crawler tractor (150 h.p. approx.)	90.00
Steel-wheel roller (8-10 ton)	20.00
Striping machine (small, self-propelled)	20.00

A few basic materials prices were needed for secondary calculations. These were estimated to be:

MATERIALS COSTS

DESCRIPTION	UNIT	COST PER UNIT, L.E., 1986
Bitumen, pen.grade 60-70	Ton	70.00
Liquid bitumen (Rc or Mc)	Ton	100.00
Crushed stone base (1)	m^3	16.00
Seal coat chips (1)	m^3	20.00
Unclassified borrow (loaded)	m^3	0.70
Highway striping paint	kg	2.55

(1) Cost estimated for aggregates meeting all specifications for gradation, percent fracture, hardness, etc.

Use of Basic Costs - The above rates for labor, equipment and materials were used in some computations of crew-day costs for maintenance activities, and in checking the prices of other activities obtained by different methods. The computations of most interest are shown in Annex 3C-1.

Other Unit Costs for Maintenance - Prices per m^2 for pothole patching, sealing over patches, sealing over short overlays and periodic, full-width seal coating were adopted after considering the limited data available in Egypt, and after considering other sources. The figures chosen were rather arbiatrary, but sufficiently sound for estimating purposes. The price per m^2 for short, smoothing overlays in maintenance was based primarily on bid information from RBA rehabilitation contracts and contract estimates, increased somewhat for lower volumes of work.

List of Maintenance Unit Costs - Table 3C-1 summarizes the estimated costs per unit of work or per km annually for maintenance of highways in the Cairo-Assuit corridor. As listed, they are financial costs (not economic) and are all expressed in Egyptian pounds as of May, 1986.

Application of Unit Costs - It is emphasized that the unit costs of the table are not all applied in the same way. Those for the first four work items are multiplied by the annual work quantities derived from the estimated patching and overlay rates (discussed previously). The price for periodic seal coating is applied to the whole pavement area, including paved shoulders, but the work is only called for every eight years on certain roads, as a maintenance activity. The cost in such cases has to be put in on a specific year schedule, or pro-rated to annual cost. All unit costs per km are annualized, sometimes prorated for a frequency of two or more years. The striping price is for painting one line one kilometer; that unit cost must be multiplied by the number of lines required. Sign maintenance is the annual cost per kilometer, for the appropriate highway class. All of these adjustments are provided for in the maintenance cost computer program.

Economic and Foreign Exchange Component

Conversion factors to adjust maintenance costs to economic resource costs and foreign exchange costs were estimated using the methodology described in Appendix 3A. Table 3C-2 summarizes the cost factors developed.

Detailed Maintenance Cost Calculation

Maintenance costs were calculated for a number of different combination of cost class and construction. Annex 3C-2 and 3C-3 show calculations for financial and economic costs respectively, assuming the new Cairo-Assuit Highway is constructed to 2-lane standard, and that the existing West Bank Highway is not widened. Maintenance costs for bypasses are also included, but the main road costs assume no bypasses.

Table 3C-1

UNIT FINANCIAL MAINTENANCE COSTS
(LE 1986)

IDENTIFICATION	DESCRIPTION	UNIT	COST L.E.
M1a, M2a, M2b	Asphalt patching, travelway and paved shoulder	m^2	8.00
M1b	Asphalt smoothing overlay	m^2	2.50
M3a	Hand seal over patches	m^2	1.50
M3b	Seal over smoothing overlays	m^2	1.50
M4	Periodic seal coating	m^2	0.75
M5a	Desert shoulder grading	km/year	85.50
M5b	Ag. zone shoulder grading	km/year	205.00
M6a	Desert drainage maint.(combined)	km/year	137.40
M6b	Ag. zone and urban drainage maint.	km/year	14.80
M7	Ag. zone embankment maint.	km/year	193.00
M8	Bridge and structure maint.	km/year	9.40
M9a	Pavement striping	Line-km/year	260.00
M9b	Sign maintenance		
	Class 1 - Main hwys, urban areas	km/year	200.00
	2 - Main hwys, Ag. zones	km/year	150.00
	3 - Main hwys, desert	km/year	120.00
	4 - Connector, access and other roads	km/year	90.00

Table 3C-2

MAINTENANCE COST COMPONENTS AND CONVERSION FACTORS

ACTIVITY	UNITS	COST CLASS	COMPONENT Skilled Labor	Unskilled Labor	Equipment	Other	FACTOR
Shoulder grading - desert	km	Financial	0.036	0.004	0.760	0.200	1.000
		Economic	0.036	0.002	1.117	0.200	1.355
		For Exch					0.689
Shoulder grading - valley	km	Financial	0.034	0.009	0.750	0.207	1.000
		Economic	0.034	0.004	1.106	0.207	1.351
		For Exch					0.680
Culvert cleaning	km	Financial	0.113	0.144	0.543	0.200	1.000
		Economic	0.113	0.072	0.877	0.200	1.262
		For Exch					0.492
Ditch cleaning, hand	km	Financial	0.118	0.113	0.569	0.200	1.000
		Economic	0.118	0.057	0.906	0.200	1.281
		For Exch					0.516
Ditch cleaning, machine	km	Financial	0.017	0.003	0.780	0.200	1.000
		Economic	0.017	0.002	1.134	0.200	1.353
		For Exch					0.707
Valley drainage	km	Financial	0.113	0.144	0.543	0.200	1.000
		Economic	0.113	0.072	0.874	0.200	1.259
		For Exch					0.492
Valley embankment	km	Financial	0.078	0.082	0.622	0.218	1.000
		Economic	0.078	0.041	0.959	0.218	1.296
		For Exch					0.564
Structures	km	Financial	0.158	0.112	0.424	0.306	1.000
		Economic	0.158	0.056	0.740	0.306	1.260
		For Exch					0.384
Line Striping	km	Financial	0.010	0.005	0.093	0.892	1.000
		Economic	0.010	0.003	0.133	0.892	1.038
		For Exch					0.084
Hand patching	sq m	Financial	0.049	0.052	0.396	0.503	1.000
		Economic	0.049	0.026	0.709	0.503	1.287
		For Exch					0.359
Signing	km	Financial	0.107	0.057	0.286	0.550	1.000
		Economic	0.107	0.029	0.497	0.550	1.183
		For Exch					0.259

SOURCES: ENTS, Consultants

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ANNEX 3C-1 ROUTINE MAINTENANCE COSTS

Desert Shoulder Grading

Units	Cost Item	L.E. per Unit		Cost
8 Hours	Grader	@ 35.00		280.00
8 Hours	Water truck	15.00		120.00
8 Hours	Dump truck	15.00		120.00
8 Hours	Grader operator	1.04		8.32
16 Hours	Drivers	1.04		16.64
8 Hours	Labourer	0.33		2.64
				547.60
	Overhead @ 25%			136.90
			L.E.	684.50
	Cost per crew-day, rounded =		L.E.	684.00
	Annual, per km (x 0.125) =		L.E.	85.50

Valley Shoulder Grading

Units	Cost Item	L.E. per Unit		Cost
8 Hours	Grader	@ 35.00		280.00
8 Hours	Dump truck	15.00		120.00
4 Hours	Water truck	15.00		60.00
8 Hours	Grader operator	1.04		8.32
12 Hours	Drivers	1.04		12.48
16 Hours	Labourers	0.33		5.28
6 m^3	Soil	0.70		4.20
				490.28
	Overhead @ 25%			122.57
				612.85
	Cost per crew-day, Rounded = L.E.			615.00
	Annual, per km (x 0.33) =		L.E.	205.00

DESERT DRAINAGE MAINTENANCE

(1) Culvert Cleaning, Hand

Units	Cost Item	L.E. per Unit		Cost
8 Hours	Pickup truck	@ 5.00		40.00
8 Hours	Driver	1.04		8.32
32 Hours	Labourers	0.33		10.56
				58.88
		Overhead @ 25%		14.72
				73.60
		Cost per crew-day, rounded =	L.E.	74.00
		Annual, per km (x0.10) =	L.E.	7.40

(2) Ditch Cleaning, Hand

Units	Cost Item	L.E. per Unit		Cost
8 Hours	Pickup truck	@ 5.00		40.00
8 Hours	Driver	1.04		8.32
24 Hours	Labour	0.33		7.92
				56.24
		Overhead @ 25%		14.06
				70.30
		Cost per crew-day, rounded =	L.E.	70.00
		Annual, per km (x 1.0) =	L.E.	70.00

(3) Channel Cleaning, Machine

Units	Cost Item	L.E. per Unit		Cost
8 Hours	Crawler tractor	@ 90.00		720.00
8 Hours	Loader (med.)	50.00		400.00
8 Hours	Pickup truck	5.00		40.00
24 Hours	Operators/driver	1.04		24.96
16 Hours	Labour	0.33		5.28
				1,190.24
		Overhead @ 25%		297.56
				1,487.80
		Cost per crew-day, rounded =	L.E.	1,500.00
		Annual, per km (x 0.04) =	L.E.	60.00

VALLEY DRAINAGE MAINTENANCE

Culvert Cleaning, Hand

Units	Cost Item	L.E. per Unit		Cost
8 Hours	Pickup truck	@ 5.00		40.00
8 Hours	Driver	1.04		8.32
32 Hours	Labour	0.33		10.56
				58.88
		Overhead @ 25%		14.72
		L.E.		73.60
		Cost per crew-day, rounded =	L.E.	74.00
		Annual, per km (x0.2) =	L.E.	14.80

Embankment Maintenance (Valley)

Units	Cost Item	L.E. per Unit		Cost
8 Hours	Dump truck	@ 15.00		120.00
8 Hours	Driver	1.04		8.32
8 Hours	Foreman	0.83		6.64
48 Hours	Labour	0.33		15.84
5 m^3	Soil	.70		3.50
				154.30
		Overhead @ 25%		38.58
			Total	192.88
		Cost per crew-day, rounded =	L.E.	193.00
		Annual, per km (x1.0) =	L.E.	193.00

Structure Maintenance

Units	Cost Item	L.E. per Unit		Cost
8 Hours	Pickup truck	@ 5.00		40.00
8 Hours	Driver	1.04		6.64
8 Hours	Mason	0.83		6.64
32 Hours	Labour	0.33		10.56
Lump Sum	Materials			10.00
			Subtotal	75.52
		Overhead @ 25% =		18.88
			Total	94.40
		Rounded =	L.E.	94.00
		Annual, per km (x 0.10) =	L.E.	9.40

Pavement Markings (Striping)

Units	Cost Item	L.E. per Unit		Cost
8 Hours	Self-propelled Striping machine	@ 20.00		160.00
8 Hours	Pilot vehicle	5.00		40.00
8 Hours	Pickup truck	5.00		40.00
24 Hours	Operator/Drivers	1.04		24.96
40 Hours	Labour	0.33		13.20
700 kg	Striping paint	2.55		1,785.00
			Subtotal	2,063.16
	Overhead @ 25%			515.79
			Total	2,578.95
	Cost crew-day, rounded =		L.E.	2,600.00
	Annual, per km per line(x 0.1)=		L.E.	260.00

SIGN MAINTENANCE (ESTIMATED)

			Annual, per km L.E, 1986
Class	1	Highway in urban area	200
Class	2	Main routes, farm areas	150
Class	3	Main routes, desert	120
Class	4	Connector roads, access, feeder, etc	90

Policy 3
1=Current
2=CAS w/o expressway
3=CAS w expressway

Expr 4-lane? 0
Econ costs? 0
Bypasses? 0
Widening? 0
(0=N,1=Y)

Shoulder Class:
1=Paved
2=Unpaved
3=None
Region:
1=Urban
2=Agriculture
3=Desert

PATCHING AND SMOOTHING RATES
(percent area per year)

	Pol	Holes	Smth
Current	1	0.05%	0.90%
CAS w/o Expres	2	0.04%	0.80%
CAS w Express	3	0.03%	0.70%
Expressway		0.025%	0.60%

FROM	TO	REG	LNGTH (kms)	LANES	T'WAY WIDTH (m)	SHOULDER Class	SHOULDER Width (m)	SIGN CLASS	NO OF LINES	ANNUAL QUANTITIES: Road Patch (sq m)	Smth Ovly (sq m)	Shld Patch (sq m)	Patch Seal (sq m)	Smth Seal (sq m)	Strip -ing (kms)
		East Bank Highway: Helwan-Beni Suef (Existing)													
Helwan	Tabin	1	7.6	4	21	3		1	4	47	1,107	0	71	1,12[illegible]	10
Tabin	Ekhsas	2	9.2	2	8	1	4.0	2	3	21	483	37	86	493	9
Ekhsas	Saff	2	16.0	2	8	1	4.0	2	3	36	840	64	150	857	16
Saff	Atfih	2	19.3	2	8	1	4.0	2	3	43	1,013	77	181	1,034	19
Atfih	Koraimat	2	13.1	2	8	1	4.0	2	3	29	688	52	123	702	13
Koraimat	Warsh	3	18.6	2	8	1	4.0	3	3	42	977	22	96	996	19
Warsh	Beg 4-lane	3	11.7	2	8	1	4.0	3	3	26	614	14	61	627	12
Beg 4-lane	Beni Suef	1	3.6	4	15.0	1	4.0	1	4	16	378	14	46	386	5
			99.1							261	6,099	281	814	6,221	103
		East Bank Highway: Abnub-Assuit (existing)													
Abnub	Chg.Bor.	2	5.0	2	8	1	3.0	2	3	11	266	15	40	271	5
Chg.Bor.	Assuit	2	3.5	2	8	1	3.0	2	3	8	166	11	28	190	4
			8.5							19	452	26	67	461	9
		East Bank Highway: Beni Suef-Minia (Under Construction)													
B.Suef Jt	Shk.Fadl	3	74.0	2	8	1	5.0	3	3	166	3,885	111	416	3,963	74
Shk.Fadl	Minia	3	60.0	2	8	1	5.0	3	3	135	3,150	90	338	3,213	60
			134.0							302	7,035	201	754	7,176	134
		West Bank Highway: Cairo-Assuit (Existing)													
Monib	Nomros	1	2.9	4	14.2	1	2.4	1	4	12	288	7	29	294	4
Nomros	Hawamdia	1	8.6	4	14.0	1	2.4	1	4	36	843	21	85	860	11
Hawamdia	Maraziq	1	11.7	4	13.6	1	4.0	1	4	48	1,114	47	142	1,136	16
Maraziq	Dabay	1	5.7	4	14.0	1	4.0	1	4	24	559	23	70	570	8
		1	1.1	2	8.0	1	4.0	1	3	3	62	4	11	63	1
		1	4.0	4	14.0	1	4.0	1	4	17	392	16	49	400	5
Dabay	Aiyat	2	7.5	4	14.0	1	3.4	1	4	31	735	26	86	750	10
		2	1.9	2	8.8	1	5.0	2	3	5	117	10	22	119	2
Aiyat	Matania	2	4.2	2	8.8	1	5.0	2	3	11	259	21	48	264	4
		2	2.9	2	7.5	1	4.0	2	3	7	152	12	27	155	3
Matania	Gerza	2	15.3	2	7.5	1	4.0	2	3	34	803	61	143	819	15
Gerza	Wasta	2	11.9	2	7.5	1	4.0	2	3	27	625	48	112	637	12

Policy 3
1=Current
2=CAS w/o expressway
3=CAS w expressway

Expr 4-lane? 0
Econ costs? 0
Bypasses? 0
Widening? 0
(0=N,1=Y)

Shoulder Class:
1=Paved
2=Unpaved
3=None

Region:
1=Urban
2=Agriculture
3=Desert

PATCHING AND SMOOTHING RATES
(percent area per year)

	Pol	Holes	Smth
Current	1	0.05%	0.90%
CAS w/o Expres	2	0.04%	0.80%
CAS w Express	3	0.03%	0.70%
Expressway		0.025%	0.60%

FROM	TO	REG	LNGTH (kms)	LANES	T'WAY WIDTH (m)	SHOULDER Class	SHOULDER Width (m)	SIGN CLASS	NO OF LINES	ANNUAL QUANTITIES Road Patch (sq m)	Smth Ovly (sq m)	Shld Patch (sq m)	Patch Seal (sq m)	Smth Seal (sq m)	Strip-ing (kms)
Wasta	Ishmont	2	16.4	2	7.5	1	4.0	2	3	37	861	66	154	878	16
Ishmont	Nasser	2	7.5	2	7.5	1	4.0	2	3	17	394	30	70	402	8
Nasser	Beni-Suef	2	5.1	2	7.5	1	4.0	2	3	11	268	20	48	273	5
		1	1.2	4	15.0	3		1	4	5	126	0	8	129	2
Beni-Suef	Barnqua	1	3.2	4	15.0	3		1	4	14	336	0	22	343	4
		2	11.8	2	7.5	1	4.0	2	3	27	620	47	111	632	12
Barnqua	Biba	2	7.9	2	7.5	1	4.0	2	3	18	415	32	74	423	8
Biba	Fashn	2	13.3	2	7.5	1	4.0	2	3	30	698	53	125	712	13
Fashn	Bypass	2	4.2	2	7.5	1	4.0	2	3	9	221	17	39	225	4
Bypass	Malatea	2	12.1	2	7.5	1	4.0	2	3	27	635	48	113	648	12
Malatea	Maghagha	2	6.9	2	7.5	1	4.0	2	3	16	362	28	65	369	7
Maghagha	Beni-Mazar	2	17.9	2	7.5	1	4.0	2	3	40	940	72	168	959	18
Beni-Mazar	Matai	2	9.7	2	7.5	1	4.0	2	3	22	509	39	91	519	10
Matai	Qulusna	2	8.9	2	7.5	1	4.0	2	3	20	467	36	83	477	9
Qulusna	Samalut	2	5.1	2	7.5	1	4.0	2	3	11	268	20	48	273	5
Samalut	Burgaya	2	18.3	2	7.5	1	4.0	2	3	41	961	73	172	980	18
Burgaya	Beg.4-lane	2	3.0	2	7.5	1	4.0	2	3	7	158	12	28	161	3
Beg.4-lane	Minia	1	1.9	4	15.0	3		1	4	9	200	0	13	203	3
Minia	End 4-lane	1	7.7	4	15.0	3		1	4	35	809	0	52	825	10
End 4-lane	Abu Qurqas	2	15.5	2	7.5	1	4.0	2	3	35	814	62	145	830	16
Abu Qurqas	Mahras	2	11.6	2	7.5	1	4.0	2	3	26	609	46	109	621	12
Mahras	Mallawi	2	13.8	2	7.0	1	4.0	2	3	29	676	55	126	690	14
Mallawi	Deir Mawas	2	11.0	2	7.4	1	4.0	2	3	24	570	44	103	581	11
Deir Mawas	Dairut	2	9.2	2	7.5	1	4.0	2	3	21	483	37	86	493	9
Dairut	Sanabu	2	10.2	2	7.5	1	4.0	2	3	23	536	41	96	546	10
Sanabu	Quisiya	2	7.0	2	7.5	1	4.0	2	3	16	368	28	66	375	7
Quisiya	Beni Rafi	2	11.3	2	7.5	1	4.0	2	3	25	593	45	106	605	11
Beni Rafi	Manfalut	2	9.0	2	7.5	1	4.0	2	3	20	473	36	84	482	9
Manfalut	Manqabad	2	19.2	2	7.5	1	4.0	2	3	43	1,008	77	180	1,028	19
Manqabad	Assuit	1	6.9	4	15.0	1	4.0	1	4	31	725	28	88	739	9
			364.5							945	22,046	1,385	3,405	22,487	385

West Bank Secondary Route: Beni Suef-Fayoum-Giza (Existing)

FROM	TO	REG	LNGTH (kms)	LANES	T'WAY WIDTH (m)	SHOULDER Class	SHOULDER Width (m)	SIGN CLASS	NO OF LINES	Road Patch (sq m)	Smth Ovly (sq m)	Shld Patch (sq m)	Patch Seal (sq m)	Smth Seal (sq m)	Strip-ing (kms)
Beni Suef	End 4-lane	1	1.3	4	15.0	3		1	4	5	105	0	7	107	1
End 4-lane	Bahr Yosef	2	25.4	2	7.5	1	3.0	2	3	57	1,334	76	200	1,360	25
Town Section		1	1.4	2	7.0	3		1	0	3	69	0	4	70	0
Bahr Yosef	Express	2	7.5	2	7.5	1	3.0	2	3	17	394	23	59	402	8
Express	Beg Fayoum	2	10.4	2	7.5	1	3.0	2	3	23	546	31	82	557	10
Beg Fayoum	4-lane	1	3.0	2	10.0	3		1	0	9	210	0	14	214	0

Policy 3
1=Current
2=CAS w/o expressway
3=CAS w expressway

Expr 4-lane? 0
Econ costs? 0
Bypasses? 0
Widening? 0
(0=N,1=Y)

Shoulder Class:
1=Paved
2=Unpaved
3=None
Region:
1=Urban
2=Agriculture
3=Desert

PATCHING AND SMOOTHING RATES
(percent area per year)

	Pol	Holes	Smth
Current	1	0.05%	0.90%
CAS w/o Expres	2	0.04%	0.80%
CAS w Express	3	0.03%	0.70%
Expressway		0.025%	0.60%

FROM	TO	REG	LNGTH	LANES	T'WAY WIDTH	SHOULDER Class	SHOULDER Width	SIGN CLASS	NO OF LINES	ANNUAL QUANTITIES Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Striping
			(kms)		(m)		(m)			(sq m)	(sq m)	(sq m)	(sq m)	(sq m)	(kms)
4-lane	End Fayoum	1	3.0	4	14.0	3		1	0	13	294	0	19	300	0
End Fayoum	Jt to Lake	2	18.9	2	7.0	2	4.0	2	1	40	926	0	60	945	6
Jt to Lake	Jt to Gerza	2	5.6	2	7.0	2	3.0	2	1	12	274	0	18	280	2
Jt to Gerza	Beg Wide	3	44.2	2	7.0	2	4.0	2	1	93	2,166	0	139	2,209	15
Beg Wide	End Wide	3	5.2	2	11.5	3		2	3	18	419	0	27	4[illegible]	5
End Wide	Jt Des.Rd	3	4.8	2	7.5	1	4.0	2	1	11	252	6	25	257	2
			130.4							299	6,988	136	653	7,128	74
New Cairo-Assuit Highway (Expressway)															
Faiyoum Rd	Aiyat	3	24.0	2	8	1	6.0	3	3	45	1,080	43	132	1,102	24
Aiyat	Gerza	3	22.5	2	8	1	6.0	3	3	42	1,013	41	124	1,033	23
Gerza	Beni Suef	3	34.8	2	8	1	6.0	3	3	65	1,566	63	192	1,597	35
Beni Suef	Fashn	3	42.3	2	8	1	6.0	3	3	79	1,904	76	233	1,942	42
Fashn	Maghagha	3	14.9	2	8	1	6.0	3	3	28	671	27	82	684	15
Maghagha	Beni Mazaar	3	29.2	2	8	1	6.0	3	3	55	1,314	53	161	1,340	29
Beni Mazaar	Samalut	3	28.8	2	8	1	6.0	3	3	54	1,296	52	159	1,322	29
Samalut	Minia	3	28.0	2	8	1	6.0	3	3	53	1,260	50	154	1,285	28
Minia	Mallawi	3	34.2	2	8	1	6.0	3	3	64	1,539	62	189	1,570	34
Mallawi	Dairut	3	24.6	2	8	1	6.0	3	3	46	1,107	44	136	1,129	25
Dairut	Qusiya	3	18.0	2	8	1	6.0	3	3	34	810	32	99	826	18
Qusiya	Manfalut	3	31.2	2	8	1	6.0	3	3	59	1,404	56	172	1,432	31
Manfalut	Assuit	3	11.5	2	8	1	6.0	3	3	22	518	21	63	528	12
			344.0							645	15,480	619	1,896	15,790	344
Expressway Access Roads															
Aiyat		3	12.2	2	8	1	3.0	4	3	27	641	11	58	653	12
		2	3.0	2	8	1	3.0	4	3	7	158	9	24	161	3
Gerza		3	5.2	2	8	1	3.0	4	3	12	273	5	25	278	5
		2	1.0	2	8	1	3.0	4	3	2	53	3	8	54	1
Fashn		3	6.2	2	8	1	3.0	4	3	14	326	6	29	332	6
		2	15.4	2	8	1	3.0	4	3	35	809	46	121	825	15
Maghagha		3	2.5	2	8	1	3.0	4	3	6	131	2	12	134	3
		2	22.1	2	8	1	3.0	4	3	50	1,160	66	174	1,183	22
Beni Mazaar		3	5.5	2	8	1	3.0	4	3	12	289	5	26	295	6
		2	15.7	2	8	1	3.0	4	3	35	824	47	124	841	16
Samalut		3	2.5	2	8	1	3.0	4	3	6	131	2	12	134	3
		2	14.1	2	8	1	3.0	4	3	32	740	42	111	755	14

Policy	3
1=Current	
2=CAS w/o expressway	
3=CAS w expressway	
Expr 4-lane?	0
Econ costs?	0
Bypasses?	0
Widening?	0
(0=N,1=Y)	

Shoulder Class:
1=Paved
2=Unpaved
3=None

Region:
1=Urban
2=Agriculture
3=Desert

PATCHING AND SMOOTHING RATES
(percent area per year)

	Pol	Holes	Smth
Current	1	0.05%	0.90%
CAS w/o Expres	2	0.04%	0.80%
CAS w Express	3	0.03%	0.70%
Expressway		0.025%	0.60%

FROM	TO	REG	LNGTH	LANES	T'WAY WIDTH	SHOULDER Class	SHOULDER Width	SIGN CLASS	NO OF LINES	ANNUAL QUANTITIES Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip-ing
			(kms)		(m)		(m)			(sq m)	(sq m)	(sq m)	(sq m)	(sq m)	(kms)
Minia		3	8.9	2	8	1	3.0	4	3	20	467	8	42	477	9
		2	7.4	2	8	1	3.0	4	3	17	389	22	58	390	7
Mallawi		3	1.4	2	8	1	3.0	4	3	3	74	1	7	75	1
		2	13.7	2	8	1	3.0	4	3	31	719	41	108	734	14
Dairut		3	2.0	2	8	1	3.0	4	3	5	105	2	9	107	2
		2	11.8	2	8	1	3.0	4	3	27	620	35	93	632	12
Qusiya		3	1.4	2	8	1	3.0	4	3	3	74	1	7	75	1
		2	10.5	2	8	1	3.0	4	3	24	551	32	83	562	11
Manfalut		3	1.4	2	8	1	3.0	4	3	3	74	1	7	75	1
		2	9.0	2	8	1	3.0	4	3	20	473	27	71	482	9
Assuit		2	8.0	2	8	1	3.0	4	3	18	420	24	63	428	8
			180.9							407	9,497	439	1,270	9,687	181
Bypasses															
Nasser		2	5.2	2	7.5	1	2.5	2	3	12	273	13	37	278	5
Beni Suef		2	3.2	2	7.5	1	2.5	2	3	7	168	8	23	171	3
Biba		2	4.9	2	7.5	1	2.5	2	3	11	257	12	35	262	5
Maghagha		2	5.3	2	7.5	1	2.5	2	3	12	278	13	38	284	5
Beni Mazaar		2	6.0	2	7.5	1	2.5	2	3	13	312	15	42	319	6
Matai		2	4.5	2	7.5	1	2.5	2	3	10	236	11	32	241	5
Samalut		2	8.5	2	7.5	1	2.5	2	3	19	446	21	61	455	9
Minia		2	12.2	2	7.5	1	2.5	2	3	27	641	31	87	653	12
Abu Qurquas		2	4.1	2	7.5	1	2.5	2	3	9	215	10	29	220	4
Mahras		2	2.8	2	7.5	1	2.5	2	3	6	147	7	20	150	3
Mallawi		2	9.4	2	7.5	1	2.5	2	3	21	491	23	67	501	9
Deir Mawas		2	4.2	2	7.5	1	2.5	2	3	9	221	11	30	225	4
Quisiya		2	7.6	2	7.5	1	2.5	2	3	17	399	19	54	407	8
Manfalut		2	5.1	2	7.5	1	2.5	2	3	11	268	13	36	273	5
			82.9							187	4,352	207	591	4,439	83
TOTAL, NO BYPASS. NO EXPRESS			737							1,827	42,621	2,029	5,783	43,473	705
TOTAL, NO EXPRESSWAY/ACCESS			819							2,013	46,973	2,236	6,373	47,912	788
TOTAL, NO BYPASSES			1,261							2,879	67,598	3,087	8,949	68,950	1,230

Policy	3
1=Current	
2=CAS w/o expressway	
3=CAS w expressway	
Expr 4-lane?	0
Econ costs?	0
Bypasses?	0
Widening?	0
(0=N,1=Y)	

UNIT PRICES (financial)	REG	1 Road Patch	2 Smth Ovly	3 Shld Patch	4 Patch Seal	5 Smth Seal	6 Strip -ing	7 Unpvd Shlds	8 Drain	9 Embnk	10 Struc
Urban	1	8.0	2.5	8.0	1.5	1.5	260.0	0.0	14.8	193.0	9.4
Agric	2	8.0	2.5	8.0	1.5	1.5	260.0	205.0	14.8	193.0	9.4
Desert	3	8.0	2.5	8.0	1.5	1.5	260.0	85.5	137.4	0.0	9.4
Units		sq m	sq m	sq m	sq m	sq m	km	km/yr	km/yr	km/yr	km/yr
Eco Facs		1.28	1.38	1.28	1.06	1.06	1.04	1.35	1.25	1.30	1.26

SIGNING COSTS

CLASS	PRICE
1	200
2	150
3	120
4	90
Eco fac	1.18

ANNUAL COSTS (THOUSANDS OF L.E)

FROM	TO	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing	Unpvd Shlds	Drain	Embnk	Struc	Signs	Total	Emerg @ 1%	Grand Total
East Bank Highway: Helwan-Beni Suef (Existing)															
Helwan	Tabin	0.38	2.77	0.00	0.11	1.69	2.63	0.00	0.11	1.47	0.07	1.52	10.75	0.11	10.86
Tabin	Ekhsas	0.17	1.21	0.29	0.13	0.74	2.39	0.00	0.14	1.78	0.09	1.38	8.31	0.08	8.39
Ekhsas	Saff	0.29	2.10	0.51	0.23	1.29	4.16	0.00	0.24	3.09	0.15	2.40	14.45	0.14	14.59
Saff	Atfih	0.35	2.53	0.62	0.27	1.55	5.02	0.00	0.29	3.72	0.18	2.90	17.42	0.17	17.60
Atfih	Koraimat	0.24	1.72	0.42	0.18	1.05	3.41	0.00	0.19	2.53	0.12	1.96	11.83	0.12	11.95
Koraimat	Warsh	0.33	2.44	0.18	0.14	1.49	4.84	0.00	2.56	0.00	0.17	2.23	14.39	0.14	14.54
Warsh	Beg 4-lane	0.21	1.54	0.11	0.09	0.94	3.04	0.00	1.61	0.00	0.11	1.40	9.05	0.09	9.14
Beg 4-lane	Beni Suef	0.13	0.95	0.12	0.07	0.58	1.25	0.00	0.05	0.69	0.03	0.72	4.59	0.05	4.63
		2.1	15.2	2.2	1.2	9.3	26.7	0.0	5.2	13.3	0.9	14.5	90.8	0.9	91.7
East Bank Highway: Abnub-Assuit (existing)															
Abnub	Chg.Bor.	0.09	0.67	0.12	0.06	0.41	1.30	0.00	0.07	0.97	0.05	0.75	4.48	0.04	4.52
Chg.Bor.	Assuit	0.06	0.47	0.08	0.04	0.28	0.91	0.00	0.05	0.68	0.03	0.53	3.14	0.03	3.17
		0.2	1.1	0.2	0.1	0.7	2.2	0.0	0.1	1.6	0.1	1.3	7.6	0.1	7.7
East Bank Highway: Beni Suef-Minia (Under Construction)															
B.Suef Jt	Shk.Fadl	1.33	9.71	0.89	0.62	5.94	19.24	0.00	10.17	0.00	0.70	8.88	57.48	0.57	58.06
Shk.Fadl	Minia	1.08	7.88	0.72	0.51	4.82	15.60	0.00	8.24	0.00	0.56	7.20	46.61	0.47	47.07
		2.4	17.6	1.6	1.1	10.8	34.8	0.0	18.4	0.0	1.3	16.1	104.1	1.0	105.1
West Bank Highway: Cairo-Assuit (Existing)															
Monib	Nomros	0.10	0.72	0.06	0.04	0.44	1.01	0.00	0.04	0.56	0.03	0.58	3.57	0.04	3.61
Nomros	Hawamdia	0.29	2.11	0.17	0.13	1.29	2.98	0.00	0.13	1.66	0.08	1.72	10.55	0.11	10.65
Hawamdia	Maraziq	0.38	2.78	0.37	0.21	1.70	4.06	0.00	0.17	2.26	0.11	2.34	14.40	0.14	14.54
Maraziq	Dabay	0.19	1.40	0.18	0.11	0.85	1.98	0.00	0.08	1.10	0.05	1.14	7.08	0.07	7.16
		0.02	0.15	0.04	0.02	0.09	0.29	0.00	0.02	0.21	0.01	0.22	1.07	0.01	1.08
		0.13	0.98	0.13	0.07	0.60	1.39	0.00	0.06	0.77	0.04	0.80	4.97	0.05	5.02
Dabay	Aiyat	0.25	1.84	0.20	0.13	1.12	2.60	0.00	0.11	1.45	0.07	1.50	9.28	0.09	9.37
		0.04	0.29	0.08	0.03	0.18	0.49	0.00	0.03	0.37	0.02	0.29	1.81	0.02	1.83
Aiyat	Matania	0.09	0.65	0.17	0.07	0.40	1.09	0.00	0.06	0.81	0.04	0.63	4.01	0.04	4.05
		0.05	0.38	0.09	0.04	0.23	0.75	0.00	0.04	0.56	0.03	0.44	2.62	0.03	2.64
Matania	Gerza	0.28	2.01	0.49	0.22	1.23	3.98	0.00	0.23	2.95	0.14	2.30	13.81	0.14	13.95
Gerza	Wasta	0.21	1.56	0.38	0.17	0.96	3.09	0.00	0.18	2.30	0.11	1.79	10.74	0.11	10.85

Policy 3
1=Current
2=CAS w/o expressway
3=CAS w expressway

Expr 4-lane? 0
Econ costs? 0
Bypasses? 0
Widening? 0
(0=N,1=Y)

UNIT PRICES (financial)	REG	1 Road Patch	2 Smth Ovly	3 Shld Patch	4 Patch Seal	5 Smth Seal	6 Strip -ing	7 Unpvd Shlds	8 Drain	9 Embnk	10 Struc
Urban	1	8.0	2.5	8.0	1.5	1.5	260.0	0.0	14.8	193.0	9.4
Agric	2	8.0	2.5	8.0	1.5	1.5	260.0	205.0	14.8	193.0	9.4
Desert	3	8.0	2.5	8.0	1.5	1.5	260.0	85.5	137.4	0.0	9.4
Units		sq m	sq m	sq m	sq m	sq m	km	km/yr	km/yr	km/yr	km/yr
Eco Facs		1.28	1.38	1.28	1.06	1.06	1.04	1.35	1.25	1.30	1.26

SIGNING COSTS

CLASS	PRICE
1	200
2	150
3	120
4	90
Eco fac	1.18

ANNUAL COSTS (THOUSANDS OF LE)

FROM	TO	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing	Unpvd Shlds	Drain	Embnk	Struc	Signs	Total	Emerg @ 1%	Grand Total
Wasta	Ishmont	0.30	2.15	0.52	0.23	1.32	4.26	0.00	0.24	3.17	0.15	2.46	14.81	0.15	14.95
Ishmont	Nasser	0.14	0.98	0.24	0.11	0.60	1.95	0.00	0.11	1.45	0.07	1.13	6.77	0.07	6.84
Nasser	Beni-Suef	0.09	0.67	0.16	0.07	0.41	1.33	0.00	0.08	0.98	0.05	0.76	4.60	0.05	4.65
		0.04	0.32	0.00	0.01	0.19	0.47	0.00	0.02	0.23	0.01	0.24	1.48	0.01	1.49
Beni-Suef	Barnqua	0.12	0.84	0.00	0.03	0.51	1.11	0.00	0.05	0.62	0.03	0.64	3.95	0.04	3.99
		0.21	1.55	0.38	0.17	0.95	3.07	0.00	0.17	2.28	0.11	1.77	10.65	0.11	10.76
Barnqua	Biba	0.14	1.04	0.25	0.11	0.63	2.05	0.00	0.12	1.52	0.07	1.19	7.13	0.07	7.20
Biba	Fashn	0.24	1.75	0.43	0.19	1.07	3.46	0.00	0.20	2.57	0.13	2.00	12.01	0.12	12.13
Fashn	Bypass	0.08	0.55	0.13	0.06	0.34	1.09	0.00	0.06	0.81	0.04	0.63	3.79	0.04	3.83
Bypass	Malatea	0.22	1.59	0.39	0.17	0.97	3.15	0.00	0.18	2.34	0.11	1.82	10.92	0.11	11.03
Malatea	Maghagha	0.12	0.91	0.22	0.10	0.55	1.79	0.00	0.10	1.33	0.06	1.04	6.23	0.06	6.29
Maghagha	Beni-Mazar	0.32	2.35	0.57	0.25	1.44	4.65	0.00	0.26	3.45	0.17	2.68	16.16	0.16	16.32
Beni-Mazar	Matai	0.17	1.27	0.31	0.14	0.78	2.52	0.00	0.14	1.87	0.09	1.45	8.76	0.09	8.85
Matai	Qulusna	0.16	1.17	0.28	0.13	0.71	2.31	0.00	0.13	1.72	0.08	1.34	8.04	0.08	8.12
Qulusna	Samalut	0.09	0.67	0.16	0.07	0.41	1.33	0.00	0.08	0.98	0.05	0.76	4.60	0.05	4.65
Samalut	Burgaya	0.33	2.40	0.59	0.26	1.47	4.76	0.00	0.27	3.53	0.17	2.75	16.52	0.17	16.69
Burgaya	Beg.4-lane	0.05	0.39	0.10	0.04	0.24	0.78	0.00	0.04	0.58	0.03	0.45	2.71	0.03	2.74
Beg.4-lane	Minia	0.07	0.50	0.00	0.02	0.31	0.66	0.00	0.03	0.37	0.02	0.38	2.34	0.02	2.37
Minia	End 4-lane	0.28	2.02	0.00	0.08	1.24	2.67	0.00	0.11	1.49	0.07	1.54	9.50	0.09	9.59
End 4-lane	Abu Qurqas	0.28	2.03	0.50	0.22	1.25	4.03	0.00	0.23	2.99	0.15	2.33	13.99	0.14	14.13
Abu Qurqas	Mahras	0.21	1.52	0.37	0.16	0.93	3.02	0.00	0.17	2.24	0.11	1.74	10.47	0.10	10.58
Mahras	Mallawi	0.23	1.69	0.44	0.19	1.03	3.59	0.00	0.20	2.66	0.13	2.07	12.24	0.12	12.37
Mallawi	Deir Mawas	0.20	1.42	0.35	0.15	0.87	2.86	0.00	0.16	2.12	0.10	1.65	9.90	0.10	10.00
Deir Mawas	Dairut	0.17	1.21	0.29	0.13	0.74	2.39	0.00	0.14	1.78	0.09	1.38	8.31	0.08	8.39
Dairut	Sanabu	0.18	1.34	0.33	0.14	0.82	2.65	0.00	0.15	1.97	0.10	1.53	9.21	0.09	9.30
Sanabu	Quisiya	0.13	0.92	0.22	0.10	0.56	1.82	0.00	0.10	1.35	0.07	1.05	6.32	0.06	6.38
Quisiya	Beni Rafi	0.20	1.48	0.36	0.16	0.91	2.94	0.00	0.17	2.18	0.11	1.70	10.20	0.10	10.30
Beni Rafi	Manfalut	0.16	1.18	0.29	0.13	0.72	2.34	0.00	0.13	1.74	0.08	1.35	8.13	0.08	8.21
Manfalut	Manqabad	0.35	2.52	0.61	0.27	1.54	4.99	0.00	0.28	3.71	0.18	2.88	17.33	0.17	17.51
Manqabad	Assuit	0.25	1.81	0.22	0.13	1.11	2.39	0.00	0.10	1.33	0.06	1.38	8.79	0.09	8.88
		7.6	55.1	11.1	5.2	33.7	100.1	0.0	5.4	70.3	3.4	57.8	349.8	3.5	353.3

West Bank Secondary Route: Beni Suef-Fayoum-Giza (Existing)

FROM	TO	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing	Unpvd Shlds	Drain	Embnk	Struc	Signs	Total	Emerg @ 1%	Grand Total
Beni Suef	End 4-lane	0.04	0.26	0.00	0.01	0.16	0.35	0.00	0.01	0.19	0.01	0.20	1.23	0.01	1.25
End 4-lane	Bahr Yosef	0.46	3.33	0.61	0.30	2.04	6.60	0.00	0.38	4.90	0.24	3.81	22.67	0.23	22.90
Town Section		0.02	0.17	0.00	0.01	0.10	0.00	0.00	0.02	0.27	0.01	0.28	0.89	0.01	0.90
Bahr Yosef	Express	0.14	0.98	0.18	0.09	0.60	1.95	0.00	0.11	1.45	0.07	1.13	6.69	0.07	6.76
Express	Beg Fayoum	0.19	1.37	0.25	0.12	0.84	2.70	0.00	0.15	2.01	0.10	1.56	9.28	0.09	9.38
Beg Fayoum	4-lane	0.07	0.53	0.00	0.02	0.32	0.00	0.00	0.04	0.58	0.03	0.60	2.19	0.02	2.21

Policy	3
1=Current	
2=CAS w/o expressway	
3=CAS w expressway	
Expr 4-lane?	0
Econ costs?	0
Bypasses?	0
Widening?	0
(0=N,1=Y)	

UNIT PRICES (financial)	REG	1 Road Patch	2 Smth Ovly	3 Shld Patch	4 Patch Seal	5 Smth Seal	6 Strip -ing	7 Unpvd Shlds	8 Drain	9 Embnk	10 Struc
Urban	1	8.0	2.5	8.0	1.5	1.5	260.0	0.0	14.8	193.0	9.4
Agric	2	8.0	2.5	8.0	1.5	1.5	260.0	205.0	14.8	193.0	9.4
Desert	3	8.0	2.5	8.0	1.5	1.5	260.0	85.5	137.4	0.0	9.4
Units		sq m	sq m	sq m	sq m	sq m	km	km/yr	km/yr	km/yr	km/yr
Eco Facs		1.28	1.38	1.28	1.06	1.06	1.04	1.35	1.25	1.30	1.26

SIGNING COSTS

CLASS	PRICE
1	200
2	150
3	120
4	90
Eco fac	1.18

ANNUAL COSTS (THOUSANDS OF LE)

FROM	TO	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing	Unpvd Shlds	Drain	Embnk	Struc	Signs	Total	Emerg @ 1%	Grand Total
4-lane	End Fayoum	0.10	0.74	0.00	0.03	0.45	0.00	0.00	0.04	0.58	0.03	0.60	2.57	0.03	2.59
End Fayoum	Jt to Lake	0.32	2.32	0.00	0.09	1.42	1.64	3.87	0.28	3.65	0.18	2.84	16.59	0.17	16.76
Jt to Lake	Jt to Gerza	0.09	0.69	0.00	0.03	0.42	0.49	1.15	0.08	1.08	0.05	0.84	4.92	0.05	4.97
Jt to Gerza	Beg Wide	0.74	5.41	0.00	0.21	3.31	3.83	3.78	6.07	0.00	0.42	6.63	30.41	0.30	30.71
Beg Wide	End Wide	0.14	1.05	0.00	0.04	0.64	1.35	0.00	0.71	0.00	0.05	0.78	4.77	0.05	4.81
End Wide	Jt Des.Rd	0.09	0.63	0.05	0.04	0.39	0.42	0.00	0.66	0.00	0.05	0.72	3.03	0.03	3.06
		2.4	17.5	1.1	1.0	10.7	19.3	8.8	8.6	14.7	1.2	20.0	105.2	1.1	106.3
New Cairo-Assuit Highway (Expressway)															
Faiyoum Rd	Aiyat	0.36	2.70	0.35	0.20	1.65	6.24	0.00	3.30	0.00	0.23	2.88	17.90	0.18	18.08
Aiyat	Gerza	0.34	2.53	0.32	0.19	1.55	5.85	0.00	3.09	0.00	0.21	2.70	16.78	0.17	16.95
Gerza	Beni Suef	0.52	3.92	0.50	0.29	2.40	9.05	0.00	4.78	0.00	0.33	4.18	25.95	0.26	26.21
Beni Suef	Fashn	0.63	4.76	0.61	0.35	2.91	11.00	0.00	5.81	0.00	0.40	5.08	31.55	0.32	31.86
Fashn	Maghagha	0.22	1.68	0.21	0.12	1.03	3.87	0.00	2.05	0.00	0.14	1.79	11.11	0.11	11.22
Maghagha	Beni Mazaar	0.44	3.29	0.42	0.24	2.01	7.59	0.00	4.01	0.00	0.27	3.50	21.78	0.22	22.00
Beni Mazaar	Samalut	0.43	3.24	0.41	0.24	1.98	7.49	0.00	3.96	0.00	0.27	3.46	21.48	0.21	21.69
Samalut	Minia	0.42	3.15	0.40	0.23	1.93	7.28	0.00	3.85	0.00	0.26	3.36	20.88	0.21	21.09
Minia	Mallawi	0.51	3.85	0.49	0.28	2.35	8.89	0.00	4.70	0.00	0.32	4.10	25.51	0.26	25.76
Mallawi	Dairut	0.37	2.77	0.35	0.20	1.69	6.40	0.00	3.38	0.00	0.23	2.95	18.35	0.18	18.53
Dairut	Qusiya	0.27	2.03	0.26	0.15	1.24	4.68	0.00	2.47	0.00	0.17	2.16	13.42	0.13	13.56
Qusiya	Manfalut	0.47	3.51	0.45	0.26	2.15	8.11	0.00	4.29	0.00	0.29	3.74	23.27	0.23	23.50
Manfalut	Assuit	0.17	1.29	0.17	0.10	0.79	2.99	0.00	1.58	0.00	0.11	1.38	8.58	0.09	8.66
		5.2	38.7	5.0	2.8	23.7	89.4	0.0	47.3	0.0	3.2	41 3	256.6	2.6	259.1
Expressway Access Roads															
Aiyat		0.11	0.80	0.09	0.09	0.98	1.59	0.00	0.84	0.00	0.06	0.55	5.10	0.05	5.15
		0.03	0.20	0.07	0.04	0.24	0.39	0.00	0.02	0.29	0.01	0.14	1.42	0.01	1.44
Gerza		0.05	0.34	0.04	0.04	0.42	0.68	0.00	0.36	0.00	0.02	0.23	2.17	0.02	2.19
		0.01	0.07	0.02	0.01	0.08	0.13	0.00	0.01	0.10	0.00	0.05	0.47	0.00	0.48
Fashn		0.06	0.41	0.04	0.04	0.50	0.81	0.00	0.43	0.00	0.03	0.28	2.59	0.03	2.62
		0.14	1.01	0.37	0.18	1.24	2.00	0.00	0.11	1.49	0.07	0.69	7.31	0.07	7.38
Maghagha		0.02	0.16	0.02	0.02	0.20	0.33	0.00	0.17	0.00	0.01	0.11	1.04	0.01	1.05
		0.20	1.45	0.53	0.26	1.78	2.87	0.00	0.16	2.13	0.10	0.99	10.48	0.10	10.59
Beni Mazaar		0.05	0.36	0.04	0.04	0.44	0.72	0.00	0.38	0.00	0.03	0.25	2.30	0.02	2.32
		0.14	1.03	0.38	0.19	1.26	2.04	0.00	0.12	1.52	0.07	0.71	7.45	0.07	7.52
Samalut		0.02	0.16	0.02	0.02	0.20	0.33	0.00	0.17	0.00	0.01	0.11	1.04	0.01	1.05
		0.13	0.93	0.34	0.17	1.13	1.83	0.00	0.10	1.36	0.07	0.63	6.69	0.07	6.76

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Policy	3
1=Current	
2=CAS w/o expressway	
3=CAS w expressway	
Expr 4-lane?	0
Econ costs?	0
Bypasses?	0
Widening?	0
(0=N,1=Y)	

UNIT PRICES (financial)	REG	1 Road Patch	2 Smth Ovly	3 Shld Patch	4 Patch Seal	5 Smth Seal	6 Strip -ing	7 Unpvd Shlds	8 Drain	9 Embnk	10 Struc
Urban	1	8.0	2.5	8.0	1.5	1.5	260.0	0.0	14.8	193.0	9.4
Agric	2	8.0	2.5	8.0	1.5	1.5	260.0	205.0	14.8	193.0	9.4
Desert	3	8.0	2.5	8.0	1.5	1.5	260.0	85.5	137.4	0.0	9.4
Units		sq m	sq m	sq m	sq m	sq m	km	km/yr	km/yr	km/yr	km/yr
Eco Facs		1.28	1.38	1.28	1.06	1.06	1.04	1.35	1.25	1 [illegible]	1.26

SIGNING COSTS

CLASS	PRICE
1	200
2	150
3	120
4	30
Eco fac	1.18

ANNUAL COSTS (THOUSANDS OF LE)

FROM	TO	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing	Unpvd Shlds	Drain	Embnk	Struc	Signs	Total	Emerg @ 1%	Grand Total
Minia		0.08	0.58	0.06	0.06	0.71	1.16	0.00	0.61	0.00	0.04	0.40	3.72	0.04	3.75
		0.07	0.49	0.18	0.09	0.59	0.96	0.00	0.05	0.71	0.03	0.33	3.51	0.04	3.55
Mallawi		0.01	0.09	0.01	0.01	0.11	0.18	0.00	0.10	0.00	0.01	0.06	0.58	0.01	0.59
		0.12	0.90	0.33	0.16	1.10	1.78	0.00	0.10	1.32	0.06	0.62	6.50	0.06	6.56
Dairut		0.02	0.13	0.01	0.01	0.16	0.26	0.00	0.14	0.00	0.01	0.09	0.84	0.01	0.84
		0.11	0.77	0.28	0.14	0.95	1.53	0.00	0.09	1.14	0.06	0.53	5.60	0.06	5.65
Qusiya		0.01	0.09	0.01	0.01	0.11	0.18	0.00	0.10	0.00	0.01	0.06	0.58	0.01	0.59
		0.09	0.69	0.25	0.12	0.84	1.37	0.00	0.08	1.01	0.05	0.47	4.98	0.05	5.03
Manfalut		0.01	0.09	0.01	0.01	0.11	0.18	0.00	0.10	0.00	0.01	0.06	0.58	0.01	0.59
		0.08	0.59	0.22	0.11	0.72	1.17	0.00	0.07	0.87	0.04	0.41	4.27	0.04	4.31
Assuit		0.07	0.53	0.19	0.09	0.64	1.04	0.00	0.06	0.77	0.04	0.36	3.79	0.04	3.83
		1.6	11.9	3.5	1.9	14.5	23.5	0.0	4.4	12.7	0.9	8.1	83.0	0.8	83.9
Nasser		0.09	0.68	0.10	0.06	0.42	1.35	0.00	0.08	1.00	0.05	0.78	4.61	0.05	4.66
Beni Suef		0.06	0.42	0.06	0.03	0.26	0.83	0.00	0.05	0.62	0.03	0.48	2.84	0.03	2.87
Biba		0.09	0.64	0.10	0.05	0.39	1.27	0.00	0.07	0.95	0.05	0.74	4.35	0.04	4.39
Maghagha		0.10	0.70	0.11	0.06	0.43	1.38	0.00	0.08	1.02	0.05	0.79	4.70	0.05	4.75
Beni Mazaar		0.11	0.78	0.12	0.06	0.48	1.55	0.00	0.09	1.15	0.06	0.89	5.28	0.05	5.33
Matai		0.08	0.59	0.09	0.05	0.36	1.17	0.00	0.07	0.87	0.04	0.68	3.99	0.04	4.03
Samalut		0.15	1.12	0.17	0.09	0.68	2.21	0.00	0.13	1.64	0.08	1.28	7.54	0.08	7.62
Minia		0.22	1.60	0.24	0.13	0.98	3.17	0.00	0.18	2.35	0.11	1.83	10.83	0.11	10.94
Abu Qurquas		0.07	0.54	0.08	0.04	0.33	1.07	0.00	0.06	0.79	0.04	0.62	3.64	0.04	3.67
Mahras		0.05	0.37	0.06	0.03	0.22	0.73	0.00	0.04	0.54	0.03	0.42	2.48	0.02	2.51
Mallawi		0.17	1.23	0.19	0.10	0.75	2.43	0.00	0.14	1.80	0.09	1.40	8.30	0.08	8.38
Deir Mawas		0.08	0.55	0.08	0.04	0.34	1.09	0.00	0.06	0.81	0.04	0.63	3.73	0.04	3.76
Quisiya		0.14	1.00	0.15	0.08	0.61	1.98	0.00	0.11	1.47	0.07	1.14	6.74	0.07	6.81
Manfalut		0.09	0.67	0.10	0.05	0.41	1.33	0.00	0.08	0.98	0.05	0.76	4.53	0.05	4.57
		1.5	10.9	1.7	0.9	6.7	21.6	0.0	1.2	16.0	0.8	12.4	73.6	0.7	74.3
TOTAL, NO BYPASS, NO EXP		15	107	16	9	65	183	9	38	100	7	110	658	7	664
TOTAL, NO EXPRESSWAY/ACC		16	117	18	10	72	205	9	39	116	8	122	731	7	738
TOTAL, NO BYPASSES		21	157	25	13	103	296	9	89	113	11	159	997	10	1,007

Policy 3
- 1=Current
- 2=CAS w/o expressway
- 3=CAS w expressway

Expr 4-lane? 0
Econ costs? 1
Bypasses? 0
Widening? 0
(0=N,1=Y)

Shoulder Class:
- 1=Paved
- 2=Unpaved
- 3=None

Region:
- 1=Urban
- 2=Agriculture
- 3=Desert

PATCHING AND SMOOTHING RATES
(percent area per year)

	Pol	Holes	Smth
Current	1	0.05%	0.90%
CAS w/o Expres	2	0.04%	0.80%
CAS w Express	3	0.03%	0.70%
Expressway		0.025%	0.60%

FROM	TO	REG	LNGTH	LANES	T'WAY WIDTH	SHOULDER Class	SHOULDER Width	SIGN CLASS	NO OF LINES	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip-ing
			(kms)		(m)		(m)			(sq m)	(sq m)	(sq m)	(sq m)	(sq m)	(kms)
East Bank Highway: Helwan-Beni Suef (Existing)															
Helwan	Tabin	1	7.6	4	21	3		1	4	47	1,107	0	71	1,129	10
Tabin	Ekhsas	2	9.2	2	8	1	4.0	2	3	21	483	37	86	493	9
Ekhsas	Saff	2	16.0	2	8	1	4.0	2	3	36	840	64	150	857	16
Saff	Atfih	2	19.3	2	8	1	4.0	2	3	43	1,013	77	181	1,034	19
Atfih	Koraimat	2	13.1	2	8	1	4.0	2	3	29	688	52	123	702	13
Koraimat	Warsh	3	18.6	2	8	1	4.0	3	3	42	977	22	96	996	19
Warsh	Beg 4-lane	3	11.7	2	8	1	4.0	3	3	26	614	14	61	627	12
Beg 4-lane	Beni Suef	1	3.6	4	15.0	1	4.0	1	4	16	378	14	46	[illegible]	5
			99.1							261	6,099	251	814	6,221	103
East Bank Highway: Abnub-Assuit (existing)															
Abnub	Chg.Bor.	2	5.0	2	8	1	3.0	2	3	11	266	15	40	271	5
Chg.Bor.	Assuit	2	3.5	2	8	1	3.0	2	3	8	186	11	28	190	4
			8.5							19	452	26	67	461	9
East Bank Highway: Beni Suef-Minia (Under Construction)															
B.Suef Jt	Shk.Fadl	3	74.0	2	8	1	5.0	3	3	166	3,885	111	416	3,963	74
Shk.Fadl	Minia	3	60.0	2	8	1	5.0	3	3	135	3,150	90	338	3,213	60
			134.0							307	7,035	201	754	7,176	134
West Bank Highway: Cairo-Assuit (Existing)															
Monib	Nomros	1	2.9	4	14.2	1	2.4	1	4	12	288	7	29	294	4
Nomros	Hawamdia	1	8.6	4	14.0	1	2.4	1	4	36	843	21	85	860	11
Hawamdia	Maraziq	1	11.7	4	13.6	1	4.0	1	4	48	1,114	47	142	1,136	16
Maraziq	Dabay	1	5.7	4	14.0	1	4.0	1	4	24	559	23	70	570	8
		1	1.1	2	8.0	1	4.0	1	3	3	62	4	11	63	1
		1	4.0	4	14.0	1	4.0	1	4	17	392	16	49	400	5
Dabay	Aiyat	2	7.5	4	14.0	1	3.4	1	4	31	735	26	86	750	10
		2	1.9	2	6.8	1	5.0	2	3	5	117	10	22	113	2
Aiyat	Matania	2	4.2	2	8.8	1	5.0	2	3	11	259	21	48	264	4
		2	2.9	2	7.5	1	4.0	2	3	7	152	12	27	155	3
Matania	Gerza	2	15.3	2	7.5	1	4.0	2	3	34	803	61	143	819	15
Gerza	Wasta	2	11.9	2	7.5	1	4.0	2	3	27	625	48	112	637	12

Policy	3	
	1=Current	
	2=CAS w/o expressway	
	3=CAS w expressway	
Expr 4-lane?	0	
Econ costs?	1	
Bypasses?	0	
Widening?	0	
(0=N,1=Y)		

Shoulder Class:
1=Paved
2=Unpaved
3=None

Region:
1=Urban
2=Agriculture
3=Desert

PATCHING AND SMOOTHING RATES
(percent area per year)

	Pol	Holes	Smth
Current	1	0.05%	0.90%
CAS w/o Expres	2	0.04%	0.80%
CAS w Express	3	0.03%	0.70%
Expressway		0.025%	0.60%

FROM	TO	REG	LNGTH	LANES	T'WAY WIDTH	SHOULDER Class	SHOULDER Width	SIGN CLASS	NO OF LINES	ANNUAL QUANTITIES Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip-ing
			(kms)		(m)		(m)			(sq m)	(sq m)	(sq m)	(sq m)	(sq m)	(kms)
Wasta	Ishmont	2	16.4	2	7.5	1	4.0	2	3	37	861	66	154	878	16
Ishmont	Nasser	2	7.5	2	7.5	1	4.0	2	3	17	394	30	70	402	8
Nasser	Beni-Suef	2	5.1	2	7.5	1	4.0	2	3	11	268	20	48	273	5
		1	1.2	4	15.0	3		1	4	5	126	0	8	129	2
Beni-Suef	Barnqua	1	3.2	4	15.0	3		1	4	14	336	0	22	342	4
		2	11.8	2	7.5	1	4.0	2	3	27	620	47	111	632	12
Barnqua	Biba	2	7.9	2	7.5	1	4.0	2	3	18	415	32	74	423	8
Biba	Fashn	2	13.3	2	7.5	1	4.0	2	3	30	698	53	125	712	13
Fashn	Bypass	2	4.2	2	7.5	1	4.0	2	3	9	221	17	39	225	4
Bypass	Malatea	2	12.1	2	7.5	1	4.0	2	3	27	635	48	113	649	12
Malatea	Maghagha	2	6.9	2	7.5	1	4.0	2	3	16	362	28	65	369	7
Maghagha	Beni-Mazar	2	17.9	2	7.5	1	4.0	2	3	40	940	72	168	959	18
Beni-Mazar	Matai	2	9.7	2	7.5	1	4.0	2	3	22	509	39	91	519	10
Matai	Qulusna	2	8.9	2	7.5	1	4.0	2	3	20	467	36	83	477	9
Qulusna	Samalut	2	5.1	2	7.5	1	4.0	2	3	11	268	20	48	273	5
Samalut	Burgaya	2	18.3	2	7.5	1	4.0	2	3	41	961	73	172	980	18
Burgaya	Beg.4-lane	2	3.0	2	7.5	1	4.0	2	3	7	158	12	28	161	3
Beg.4-lane	Minia	1	1.9	4	15.0	3		1	4	9	200	0	13	203	3
Minia	End 4-lane	1	7.7	4	15.0	3		1	4	35	809	0	52	825	10
End 4-lane	Abu Qurqas	2	15.5	2	7.5	1	4.0	2	3	35	814	62	145	830	16
Abu Qurqas	Mahras	2	11.6	2	7.5	1	4.0	2	3	26	609	46	109	621	12
Mahras	Mallawi	2	13.8	2	7.0	1	4.0	2	3	29	676	55	126	690	14
Mallawi	Deir Mawas	2	11.0	2	7.4	1	4.0	2	3	24	570	44	103	561	11
Deir Mawas	Dairut	2	9.2	2	7.5	1	4.0	2	3	21	483	37	86	493	9
Dairut	Sanabu	2	10.2	2	7.5	1	4.0	2	3	23	536	41	96	546	10
Sanabu	Quisiya	2	7.0	2	7.5	1	4.0	2	3	16	368	28	66	375	7
Quisiya	Beni Rafi	2	11.3	2	7.5	1	4.0	2	3	25	593	45	106	605	11
Beni Rafi	Manfalut	2	9.0	2	7.5	1	4.0	2	3	20	473	36	84	482	9
Manfalut	Manqabad	2	19.2	2	7.5	1	4.0	2	3	43	1,008	77	180	1,028	19
Manqabad	Assuit	1	6.9	4	15.0	1	4.0	1	4	31	725	28	88	739	9
			364.5							945	22,046	1,305	3,495	22,487	385

West Bank Secondary Route: Beni Suef-Fayoum-Giza (Existing)

FROM	TO	REG	LNGTH	LANES	T'WAY WIDTH	SHOULDER Class	SHOULDER Width	SIGN CLASS	NO OF LINES	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip-ing
Beni Suef	End 4-lane	1	1.0	4	15.0	3		1	4	5	105	0	7	107	1
End 4-lane	Bahr Yosef	2	25.4	2	7.5	1	3.0	2	3	57	1,334	76	200	1,360	25
Town Section		1	1.4	2	7.0	3		1	0	3	69	0	4	70	0
Bahr Yosef	Express	2	7.5	2	7.5	1	3.0	2	3	17	394	23	59	402	8
Express	Beg Fayoum	2	10.4	2	7.5	1	3.0	2	3	23	546	31	82	557	10
Beg Fayoum	4-lane	1	3.0	2	10.0	3		1	0	9	210	0	14	214	0

Policy 3
1=Current
2=CAS w/o expressway
3=CAS w expressway

Expr 4-lane? 0
Econ costs? 1
Bypasses? 0
Widening? 0
(0=N,1=Y)

Shoulder Class:
1=Paved
2=Unpaved
3=None

Region:
1=Urban
2=Agriculture
3=Desert

PATCHING AND SMOOTHING RATES
(percent area per year)

	Pol	Holes	Smth
Current	1	0.05%	0.90%
CAS w/o Expres	2	0.04%	0.80%
CAS w Express	3	0.03%	0.70%
Expressway		0.025%	0.60%

ANNUAL QUANTITIES

FROM	TO	REG	LNGTH	LANES	T'WAY WIDTH	SHOULDER Class	SHOULDER Width	SIGN CLASS	NO OF LINES	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing
			(kms)		(m)		(m)			(sq m)	(sq m)	(sq m)	(sq m)	(sq m)	(kms)
4-lane	End Fayoum	1	3.0	4	14.0	3		1	0	13	294	0	19	300	0
End Fayoum	Jt to Lake	2	18.9	2	7.0	2	4.0	2	1	40	926	0	60	945	6
Jt to Lake	Jt to Gerza	2	5.6	2	7.0	2	3.0	2	1	12	274	0	18	280	2
Jt to Gerza	Beg Wide	3	44.2	2	7.0	2	4.0	2	1	93	2,166	0	139	2,209	15
Beg Wide	End Wide	3	5.2	2	11.5	3		2	3	18	419	0	27	427	5
End Wide	Jt Des.Rd	3	4.8	2	7.5	1	4.0	2	1	11	252	6	25	257	2
			130.4							299	6,988	136	653	7,129	74
New Cairo-Assuit Highway (Expressway)															
Faiyoum Rd	Aiyat	3	24.0	2	8	1	6.0	3	3	45	1,080	43	132	1,102	24
Aiyat	Gerza	3	22.5	2	8	1	6.0	3	3	42	1,013	41	124	1,033	23
Gerza	Beni Suef	3	34.8	2	8	1	6.0	3	3	65	1,566	63	192	1,597	35
Beni Suef	Fashn	3	42.3	2	8	1	6.0	3	3	79	1,904	76	233	1,942	42
Fashn	Maghagha	3	14.9	2	8	1	6.0	3	3	28	671	27	82	684	15
Maghagha	Beni Mazaar	3	29.2	2	8	1	6.0	3	3	55	1,314	53	161	1,340	29
Beni Mazaar	Samalut	3	28.8	2	8	1	6.0	3	3	54	1,296	52	159	1,322	29
Samalut	Minia	3	28.0	2	8	1	6.0	3	3	53	1,260	50	154	1,285	28
Minia	Mallawi	3	34.2	2	8	1	6.0	3	3	64	1,539	62	189	1,570	34
Mallawi	Dairut	3	24.6	2	8	1	6.0	3	3	46	1,107	44	136	1,129	25
Dairut	Qusiya	3	18.0	2	8	1	6.0	3	3	34	810	32	99	826	18
Qusiya	Manfalut	3	31.2	2	8	1	6.0	3	3	59	1,404	56	172	1,432	31
Manfalut	Assuit	3	11.5	2	8	1	6.0	3	3	22	518	21	63	528	12
			344.0							645	15,480	619	1,896	15,790	344
Expressway Access Roads															
Aiyat		3	12.2	2	8	1	3.0	4	3	27	641	11	58	653	12
		2	3.0	2	8	1	3.0	4	3	7	158	9	24	161	3
Gerza		3	5.2	2	8	1	3.0	4	3	12	273	5	25	278	5
		2	1.0	2	8	1	3.0	4	3	2	53	3	8	54	1
Fashn		3	6.2	2	8	1	3.0	4	3	14	326	6	29	332	6
		2	15.4	2	8	1	3.0	4	3	35	809	46	121	825	15
Maghagha		3	2.5	2	8	1	3.0	4	3	6	131	2	12	134	3
		2	22.1	2	8	1	3.0	4	3	50	1,160	66	174	1,183	22
Beni Mazaar		3	5.5	2	8	1	3.0	4	3	12	289	5	26	295	6
		2	15.7	2	8	1	3.0	4	3	35	824	47	124	841	16
Samalut		3	2.5	2	8	1	3.0	4	3	6	131	2	12	134	3
		2	14.1	2	8	1	3.0	4	3	32	740	42	111	755	14

Policy	3	
	1=Current	
	2=CAS w/o expressway	
	3=CAS w expressway	
Expr 4-lane?	0	
Econ costs?	1	
Bypasses?	0	
Widening? (0=N,1=Y)	0	

Shoulder Class:
1=Paved
2=Unpaved
3=None

Region:
1=Urban
2=Agriculture
3=Desert

PATCHING AND SMOOTHING RATES
(percent area per year)

	Pol	Holes	Smth
Current	1	0.05%	0.90%
CAS w/o Expres	2	0.04%	0.80%
CAS w Express	3	0.03%	0.70%
Expressway		0.025%	0.60%

ANNUAL QUANTITIES

FROM	TO	REG	LNGTH	LANES	T'WAY WIDTH	SHOULDER Class	SHOULDER Width	SIGN CLASS	NO OF LINES	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing
			(kms)		(m)		(m)			(sq m)	(sq m)	(sq m)	(sq m)	(sq m)	(kms)
Minia		3	8.9	2	8	1	3.0	4	3	20	467	8	42	477	9
		2	7.4	2	8	1	3.0	4	3	17	389	22	58	396	7
Mallawi		3	1.4	2	8	1	3.0	4	3	3	74	1	7	75	1
		2	13.7	2	8	1	3.0	4	3	31	719	41	108	734	14
Dairut		3	2.0	2	8	1	3.0	4	3	5	105	2	9	107	2
		2	11.8	2	8	1	3.0	4	3	27	620	35	93	632	12
Qusiya		3	1.4	2	8	1	3.0	4	3	3	74	1	7	75	1
		2	10.5	2	8	1	3.0	4	3	24	551	32	83	562	11
Manfalut		3	1.4	2	8	1	3.0	4	3	3	74	1	7	75	1
		2	9.0	2	8	1	3.0	4	3	20	473	27	71	482	9
Assuit		2	8.0	2	8	1	3.0	4	3	18	420	24	63	428	8
			180.9							407	9,497	439	1,270	9,687	181
		Bypasses													
Nasser		2	5.2	2	7.5	1	2.5	2	3	12	273	13	37	278	5
Beni Suef		2	3.2	2	7.5	1	2.5	2	3	7	168	8	23	171	3
Biba		2	4.9	2	7.5	1	2.5	2	3	11	257	12	35	262	5
Maghagha		2	5.3	2	7.5	1	2.5	2	3	12	278	13	38	284	5
Beni Mazaar		2	6.0	2	7.5	1	2.5	2	3	13	312	15	42	319	6
Matai		2	4.5	2	7.5	1	2.5	2	3	10	236	11	32	241	5
Samalut		2	8.5	2	7.5	1	2.5	2	3	19	446	21	61	455	9
Minia		2	12.2	2	7.5	1	2.5	2	3	27	641	31	87	653	12
Abu Qurquas		2	4.1	2	7.5	1	2.5	2	3	9	215	10	29	220	4
Mahras		2	2.8	2	7.5	1	2.5	2	3	6	147	7	20	150	3
Mallawi		2	9.4	2	7.5	1	2.5	2	3	21	491	23	67	501	9
Deir Mawas		2	4.2	2	7.5	1	2.5	2	3	9	221	11	30	225	4
Quisiya		2	7.6	2	7.5	1	2.5	2	3	17	399	19	54	407	8
Manfalut		2	5.1	2	7.5	1	2.5	2	3	11	268	13	36	273	5
			82.9							187	4,352	207	591	4,439	83
TOTAL, NO BYPASS, NO EXPRESS			737							1,827	42,621	2,029	5,783	43,473	705
TOTAL, NO EXPRESSWAY/ACCESS			819							2,013	46,973	2,236	6,373	47,912	788
TOTAL, NO BYPASSES			1,261							2,879	67,598	3,087	8,949	68,950	1,230

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Policy	3
1=Current	
2=CAS w/o expressway	
3=CAS w expressway	
Expr 4-lane?	0
Econ costs?	1
Bypasses?	0
Widening? (0=N,1=Y)	0

UNIT PRICES (financial)	REG	1 Road Patch	2 Smth Ovly	3 Shld Patch	4 Patch Seal	5 Smth Seal	6 Strip -ing	7 Unpvd Shlds	8 Drain	9 Embnk	10 Struc
Urban	1	8.0	2.5	8.0	1.5	1.5	260.0	0.0	14.8	193.0	9.4
Agric	2	8.0	2.5	8.0	1.5	1.5	260.0	205.0	14.8	193.0	9.4
Desert	3	8.0	2.5	8.0	1.5	1.5	260.0	85.5	137.4	0.0	9.4
Units		sq m	sq m	sq m	sq m	sq m	km	km/yr	km/yr	km/yr	km/yr
Eco Facs		1.28	1.38	1.28	1.06	1.06	1.04	1.35	1.25	1.30	1.26

SIGNING COSTS

CLASS	PRICE
1	200
2	150
3	120
4	90
Eco fac	1.18

ANNUAL COSTS (THOUSANDS OF LE)

FROM	TO	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing	Unpvd Shlds	Drain	Embnk	Struc	Signs	Total	Emerg @ 1%	Grand Total
		East Bank Highway: Helwan-Beni Suef (Existing)													
Helwan	Tabin	0.49	3.82	0.00	0.11	1.79	2.74	0.00	0.14	1.91	0.09	1.79	12.89	0.13	13.01
Tabin	Ekhsas	0.21	1.67	0.38	0.14	0.78	2.49	0.00	0.17	2.31	0.11	1.63	9.88	0.10	9.98
Ekhsas	Saff	0.37	2.90	0.66	0.24	1.36	4.33	0.00	0.30	4.01	0.19	2.83	17.18	0.17	17.35
Saff	Atfih	0.44	3.50	0.79	0.29	1.64	5.22	0.00	0.36	4.84	0.23	3.42	20.72	0.21	20.93
Atfih	Koraimat	0.30	2.37	0.54	0.20	1.12	3.54	0.00	0.24	3.29	0.16	2.32	14.07	0.14	14.21
Koraimat	Warsh	0.43	3.37	0.23	0.15	1.58	5.03	0.00	3.19	0.00	0.22	2.63	16.84	0.17	17.01
Warsh	Beg 4-lane	0.27	2.12	0.14	0.10	1.00	3.16	0.00	2.01	0.00	0.14	1.66	10.59	0.11	10.70
Beg 4-lane	Beni Suef	0.17	1.30	0.15	0.07	0.61	1.30	0.00	0.07	0.90	0.04	0.85	5.46	0.05	5.52
		2.7	21.0	2.9	1.3	9.9	27.8	0.0	6.5	17.3	1.2	17.1	107.6	1.1	108.7
		East Bank Highway: Abnub-Assuit (existing)													
Abnub	Chg.Bor.	0.12	0.92	0.15	0.06	0.43	1.35	0.00	0.09	1.25	0.06	0.89	5.33	0.05	5.38
Chg.Bor.	Assuit	0.08	0.64	0.11	0.04	0.30	0.95	0.00	0.06	0.88	0.04	0.62	3.73	0.04	3.77
		0.2	1.6	0.3	0.1	0.7	2.3	0.0	0.2	2.1	0.1	1.5	9.1	0.1	9.1
		East Bank Highway: Beni Suef-Minia (Under Construction)													
B.Suef Jt	Shk.Fadl	1.70	13.40	1.14	0.66	6.30	20.01	0.00	12.71	0.00	0.88	10.48	67.28	0.67	67.95
Shk.Fadl	Minia	1.38	10.87	0.92	0.54	5.11	16.22	0.00	10.31	0.00	0.71	8.50	54.55	0.55	55.10
		3.1	24.3	2.1	1.2	11.4	36.2	0.0	23.0	0.0	1.6	19.0	121.8	1.2	123.1
		West Bank Highway: Cairo-Assuit (Existing)													
Monib	Nomros	0.13	0.99	0.07	0.05	0.47	1.05	0.00	0.05	0.73	0.03	0.68	4.25	0.04	4.29
Nomros	Hawamdia	0.37	2.91	0.21	0.14	1.37	3.10	0.00	0.16	2.16	0.10	2.03	12.54	0.13	12.67
Hawamdia	Maraziq	0.49	3.84	0.48	0.23	1.81	4.22	0.00	0.22	2.94	0.14	2.76	17.11	0.17	17.28
Maraziq	Dabay	0.25	1.93	0.23	0.11	0.91	2.06	0.00	0.11	1.43	0.07	1.35	8.43	0.08	8.51
		0.03	0.21	0.05	0.02	0.10	0.30	0.00	0.02	0.28	0.01	0.26	1.27	0.01	1.28
		0.17	1.35	0.16	0.08	0.64	1.44	0.00	0.07	1.00	0.05	0.94	5.91	0.06	5.97
Dabay	Aiyat	0.32	2.54	0.26	0.14	1.19	2.70	0.00	0.14	1.88	0.09	1.77	11.03	0.11	11.14
		0.05	0.40	0.10	0.03	0.19	0.51	0.00	0.04	0.48	0.02	0.34	2.16	0.02	2.18
Aiyat	Matania	0.11	0.89	0.22	0.08	0.42	1.14	0.00	0.08	1.05	0.05	0.74	4.78	0.05	4.83
		0.07	0.53	0.12	0.04	0.25	0.78	0.00	0.05	0.73	0.03	0.51	3.11	0.03	3.15
Matania	Gerza	0.35	2.77	0.63	0.23	1.30	4.14	0.00	0.28	3.84	0.18	2.71	16.43	0.16	16.59
Gerza	Wasta	0.27	2.16	0.49	0.18	1.01	3.22	0.00	0.22	2.99	0.14	2.11	12.78	0.13	12.91

Policy	3
1=Current	
2=CAS w/o expressway	
3=CAS w expressway	
Expr 4-lane?	0
Econ costs?	1
Bypasses?	0
Widening?	0
(0=N,1=Y)	

UNIT PRICES (financial)	REG	1 Road Patch	2 Smth Ovly	3 Shld Patch	4 Patch Seal	5 Smth Seal	6 Strip -ing	7 Unpvd Shlds	8 Drain	9 Embnk	10 Struc
Urban	1	8.0	2.5	8.0	1.5	1.5	260.0	0.0	14.8	193.0	9.4
Agric	2	8.0	2.5	8.0	1.5	1.5	260.0	205.0	14.8	193.0	9.4
Desert	3	8.0	2.5	8.0	1.5	1.5	260.0	85.5	137.4	0.0	9.4
Units		sq m	sq m	sq m	sq m	sq m	km	km/yr	km/yr	km/yr	km/yr
Eco Facs		1.28	1.38	1.28	1.06	1.06	1.04	1.35	1.25	1.30	1.26

SIGNING COSTS CLASS	PRICE
1	200
2	150
3	120
4	90
Eco fac	1.18

ANNUAL COSTS (THOUSANDS OF LE)

FROM	TO	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing	Unpvd Shlds	Drain	Embnk	Struc	Signs	Total	Emerg @ 1%	Grand Total
Wasta	Ishmont	0.38	2.97	0.67	0.24	1.40	4.43	0.00	0.30	4.11	0.19	2.90	17.61	0.18	17.79
Ishmont	Nasser	0.17	1.36	0.31	0.11	0.64	2.03	0.00	0.14	1.88	0.09	1.33	8.05	0.08	8.13
Nasser	Beni-Suef	0.12	0.92	0.21	0.08	0.43	1.38	0.00	0.09	1.28	0.06	0.90	5.48	0.05	5.53
		0.06	0.43	0.00	0.01	0.20	0.43	0.00	0.02	0.30	0.01	0.28	1.76	0.02	1.78
Beni-Suef	Barnqua	0.15	1.16	0.00	0.03	0.54	1.15	0.00	0.06	0.80	0.04	0.76	4.69	0.05	4.74
		0.27	2.14	0.48	0.18	1.00	3.19	0.00	0.22	2.96	0.14	2.03	12.67	0.13	12.80
Barnqua	Biba	0.18	1.43	0.32	0.12	0.67	2.14	0.00	0.15	1.98	0.09	1.40	8.48	0.08	8.57
Biba	Fashn	0.31	2.41	0.54	0.20	1.13	3.60	0.00	0.25	3.34	0.16	2.35	14.28	0.14	14.42
Fashn	Bypass	0.10	0.76	0.17	0.06	0.36	1.14	0.00	0.08	1.05	0.05	0.74	4.51	0.05	4.56
Bypass	Malatea	0.28	2.19	0.50	0.18	1.03	3.27	0.00	0.22	3.04	0.14	2.14	12.99	0.13	13.12
Malatea	Maghagha	0.16	1.25	0.28	0.10	0.59	1.87	0.00	0.13	1.73	0.08	1.22	7.41	0.07	7.48
Maghagha	Beni-Mazar	0.41	3.24	0.73	0.27	1.52	4.84	0.00	0.33	4.49	0.21	3.17	19.22	0.19	19.41
Beni-Mazar	Matai	0.22	1.76	0.40	0.14	0.83	2.62	0.00	0.18	2.43	0.11	1.72	10.42	0.10	10.52
Matai	Qulusna	0.21	1.61	0.36	0.13	0.76	2.41	0.00	0.16	2.23	0.11	1.58	9.56	0.10	9.65
Qulusna	Samalut	0.12	0.92	0.21	0.08	0.43	1.38	0.00	0.09	1.28	0.06	0.90	5.48	0.05	5.53
Samalut	Burgaya	0.42	3.31	0.75	0.27	1.56	4.95	0.00	0.34	4.59	0.22	3.24	19.65	0.20	19.85
Burgaya	Beg.4-lane	0.07	0.54	0.12	0.04	0.26	0.81	0.00	0.06	0.75	0.04	0.53	3.22	0.03	3.25
Beg.4-lane	Minia	0.09	0.69	0.00	0.02	0.32	0.69	0.00	0.04	0.48	0.02	0.45	2.79	0.03	2.82
Minia	End 4-lane	0.35	2.79	0.00	0.08	1.31	2.78	0.00	0.14	1.93	0.09	1.82	11.30	0.11	11.41
End 4-lane	Abu Qurqas	0.36	2.81	0.63	0.23	1.32	4.19	0.00	0.29	3.89	0.18	2.74	16.64	0.17	16.81
Abu Qurqas	Mahras	0.27	2.10	0.48	0.17	0.99	3.14	0.00	0.21	2.91	0.14	2.05	12.46	0.12	12.58
Mahras	Mallawi	0.30	2.33	0.57	0.20	1.10	3.73	0.00	0.26	3.46	0.16	2.44	14.55	0.15	14.69
Mallawi	Deir Mawas	0.25	1.97	0.45	0.16	0.92	2.97	0.00	0.20	2.76	0.13	1.95	11.77	0.12	11.89
Deir Mawas	Dairut	0.21	1.67	0.38	0.14	0.78	2.49	0.00	0.17	2.31	0.11	1.63	9.88	0.10	9.98
Dairut	Sanabu	0.24	1.85	0.42	0.15	0.87	2.76	0.00	0.19	2.56	0.12	1.81	10.95	0.11	11.06
Sanabu	Quisiya	0.16	1.27	0.29	0.10	0.60	1.89	0.00	0.13	1.76	0.08	1.24	7.52	0.08	7.59
Quisiya	Beni Rafi	0.26	2.05	0.46	0.17	0.96	3.06	0.00	0.21	2.84	0.13	2.00	12.13	0.12	12.26
Beni Rafi	Manfalut	0.21	1.63	0.37	0.13	0.77	2.43	0.00	0.17	2.26	0.11	1.59	9.66	0.10	9.76
Manfalut	Manqabad	0.44	3.48	0.79	0.29	1.63	5.19	0.00	0.35	4.82	0.23	3.40	20.62	0.21	20.82
Manqabad	Assuit	0.32	2.50	0.28	0.14	1.17	2.49	0.00	0.13	1.73	0.08	1.63	10.47	0.10	10.58
		9.7	76.1	14.2	5.6	35.8	104.1	0.0	6.7	91.5	4.3	68.2	416.0	4.2	420.2

West Bank Secondary Route: Beni Suef-Fayoum-Giza (Existing)

FROM	TO	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing	Unpvd Shlds	Drain	Embnk	Struc	Signs	Total	Emerg @ 1%	Grand Total
Beni Suef	End 4-lane	0.05	0.36	0.00	0.01	0.17	0.36	0.00	0.02	0.25	0.01	0.24	1.47	0.01	1.48
End 4-lane	Bahr Yosef	0.59	4.60	0.78	0.32	2.16	6.87	0.00	0.47	6.37	0.30	4.50	26.95	0.27	27.22
Town Section		0.03	0.24	0.00	0.01	0.11	0.00	0.00	0.03	0.35	0.02	0.33	1.11	0.01	1.12
Bahr Yosef	Express	0.17	1.36	0.23	0.09	0.64	2.03	0.00	0.14	1.88	0.09	1.33	7.96	0.08	8.04
Express	Beg Fayoum	0.24	1.88	0.32	0.13	0.89	2.81	0.00	0.19	2.61	0.12	1.84	11.04	0.11	11.15
Beg Fayoum	4-lane	0.09	0.72	0.00	0.02	0.34	0.00	0.00	0.06	0.75	0.04	0.71	2.73	0.03	2.76

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Policy 3
1=Current
2=CAS w/o expressway
3=CAS w expressway

Expr 4-lane? 0
Econ costs? 1
Bypasses? 0
Widening? 0
(0=N,1=Y)

UNIT PRICES (financial)	REC	1 Road Patch	2 Smth Ovly	3 Shld Patch	4 Patch Seal	5 Smth Seal	6 Strip -ing	7 Unpvd Shlds	8 Drain	9 Embnk	10 Struc
Urban	1	8.0	2.5	8.0	1.5	1.5	260.0	0.0	14.8	193.0	9.4
Agric	2	8.0	2.5	8.0	1.5	1.5	260.0	205.0	14.8	193.0	9.4
Desert	3	8.0	2.5	8.0	1.5	1.5	260.0	85.5	137.4	0.0	9.4
Units		sq m	sq m	sq m	sq m	sq m	km	km/yr	km/yr	km/yr	km/yr
Eco Facs		1.28	1.38	1.28	1.06	1.06	1.04	1.35	1.25	1.30	1.26

SIGNING COSTS

CLASS	PRICE
1	200
2	150
3	120
4	90
Eco fac	1.18

ANNUAL COSTS (THOUSANDS OF LE)

FROM	TO	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing	Unpvd Shlds	Drain	Embnk	Struc	Signs	Total	Emerg @ 1%	Grand Total
4-lane	End Fayoum	0.13	1.01	0.00	0.03	0.48	0.00	0.00	0.06	0.75	0.04	0.71	3.20	0.03	3.23
End Fayoum	Jt to Lake	0.41	3.20	0.00	0.09	1.50	1.70	5.23	0.35	4.74	0.22	3.35	20.79	0.21	21.00
Jt to Lake	Jt to Gerza	0.12	0.95	0.00	0.03	0.45	0.50	1.55	0.10	1.41	0.07	0.99	6.16	0.06	6.22
Jt to Gerza	Beg Wide	0.95	7.47	0.00	0.22	3.51	3.98	5.10	7.59	0.00	0.52	7.87	37.18	0.37	37.55
Beg Wide	End Wide	0.18	1.44	0.00	0.04	0.68	1.41	0.00	0.89	0.00	0.06	0.92	5.63	0.06	5.69
End Wide	Jt Des.Rd	0.11	0.87	0.05	0.04	0.41	0.43	0.00	0.82	0.00	0.06	0.85	3.65	0.04	3.69
		3.1	24.1	1.4	1.0	11.3	20.1	11.9	10.7	19.1	1.5	23.6	127.9	1.3	[illegible]

New Cairo-Assuit Highway (Expressway)

FROM	TO	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing	Unpvd Shlds	Drain	Embnk	Struc	Signs	Total	Emerg @ 1%	Grand Total
Faiyoum Rd	Aiyat	0.46	3.73	0.44	0.21	1.75	6.49	0.00	4.12	0.00	0.28	3.40	20.89	0.21	21.09
Aiyat	Gerza	0.43	3.49	0.41	0.20	1.64	6.08	0.00	3.86	0.00	0.27	3.19	19.58	0.20	19.78
Gerza	Beni Suef	0.67	5.40	0.64	0.31	2.54	9.41	0.00	5.98	0.00	0.41	4.93	30.28	0.30	30.59
Beni Suef	Fashn	0.81	6.57	0.78	0.37	3.09	11.44	0.00	7.27	0.00	0.50	5.99	36.81	0.37	37.18
Fashn	Maghagha	0.29	2.31	0.27	0.13	1.09	4.03	0.00	2.56	0.00	0.18	2.11	12.97	0.13	13.10
Maghagha	Beni Mazaar	0.56	4.53	0.54	0.26	2.13	7.90	0.00	5.02	0.00	0.35	4.15	25.41	0.25	25.66
Beni Mazaar	Samalut	0.55	4.47	0.53	0.25	2.10	7.79	0.00	4.95	0.00	0.34	4.08	25.06	0.25	25.31
Samalut	Minia	0.54	4.35	0.52	0.25	2.04	7.57	0.00	4.81	0.00	0.33	3.96	24.37	0.24	24.61
Minia	Mallawi	0.66	5.31	0.63	0.30	2.50	9.25	0.00	5.87	0.00	0.41	4.84	29.76	0.30	30.06
Mallawi	Dairut	0.47	3.82	0.45	0.22	1.80	6.65	0.00	4.23	.00	0.29	3.48	21.41	0.21	21.62
Dairut	Qusiya	0.35	2.79	0.33	0.16	1.31	4.87	0.00	3.09	0.00	0.21	2.55	15.66	0.16	15.82
Qusiya	Manfalut	0.60	4.84	0.58	0.27	2.28	8.44	0.00	5.36	0.00	0.37	4.42	27.15	0.27	27.42
Manfalut	Assuit	0.22	1.79	0.21	0.10	0.84	3.11	0.00	1.98	0.00	0.14	1.63	10.01	0.10	10.11
		6.6	53.4	6.3	3.0	25.1	93.0	0.0	59.1	0.0	4.1	48.7	299.4	3.0	302.3

Expressway Access Roads

FROM	TO	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing	Unpvd Shlds	Drain	Embnk	Struc	Signs	Total	Emerg @ 1%	Grand Total
Aiyat		0.14	1.10	0.11	0.09	1.04	1.65	0.00	1.05	0.00	0.07	0.65	5.91	0.06	5.96
		0.03	0.27	0.09	0.04	0.26	0.41	0.00	0.03	0.38	0.02	0.16	1.68	0.02	1.69
Gerza		0.06	0.47	0.05	0.04	0.44	0.70	0.00	0.45	0.00	0.03	0.28	2.52	0.03	2.54
		0.01	0.09	0.03	0.01	0.09	0.14	0.00	0.01	0.13	0.01	0.05	0.56	0.01	0.56
Fashn		0.07	0.56	0.06	0.05	0.53	0.84	0.00	0.53	0.00	0.04	0.33	3.00	0.03	3.03
		0.18	1.39	0.47	0.19	1.31	2.08	0.00	0.14	1.93	0.09	0.82	8.61	0.09	8.70
Maghagha		0.03	0.23	0.02	0.02	0.21	0.34	0.00	0.21	0.00	0.01	0.13	1.21	0.01	1.22
		0.25	2.00	0.68	0.28	1.88	2.99	0.00	0.20	2.77	0.13	1.17	12.36	0.12	12.49
Beni Mazaar		0.06	0.50	0.05	0.04	0.47	0.74	0.00	0.47	0.00	0.03	0.29	2.66	0.03	2.69
		0.18	1.42	0.48	0.20	1.34	2.12	0.00	0.15	1.97	0.09	0.83	8.78	0.09	8.87
Samalut		0.03	0.23	0.02	0.02	0.21	0.34	0.00	0.21	0.00	0.01	0.13	1.21	0.01	1.22
		0.16	1.28	0.43	0.18	1.20	1.91	0.00	0.13	1.77	0.08	0.7[illegible]	7.89	0.08	7.97

Policy	3
1=Current	
2=CAS w/o expressway	
3=CAS w expressway	
Expr 4-lane?	0
Econ costs?	1
Bypasses?	0
Widening?	0
(0=N,1=Y)	

UNIT PRICES (financial)	REG	1 Road Patch	2 Smth Ovly	3 Shld Patch	4 Patch Seal	5 Smth Seal	6 Strip -ing	7 Unpvd Shlds	8 Drain	9 Embnk	10 Struc
Urban	1	8.0	2.5	8.0	1.5	1.5	260.0	0.0	14.8	193.0	9.4
Agric	2	8.0	2.5	8.0	1.5	1.5	260.0	205.0	14.8	193.0	9.4
Desert	3	8.0	2.5	8.0	1.5	1.5	260.0	85.5	137.4	0.0	9.4
Units		sq m	sq m	sq m	sq m	sq m	km	km/yr	km/yr	km/yr	km/yr
Eco Facs		1.28	1.38	1.28	1.06	1.06	1.04	1.35	1.25	1.30	1.26

SIGNING COSTS CLASS	PRICE
1	200
2	150
3	120
4	90
Eco fac	1.18

ANNUAL COSTS (THOUSANDS OF LE)

FROM	TO	Road Patch	Smth Ovly	Shld Patch	Patch Seal	Smth Seal	Strip -ing	Unpvd Shlus	Drain	Embnk	Struc	Signs	Total	Emerg @ 1%	Grand Total
Minia		0.10	0.61	0.08	0.07	0.76	1.20	0.00	0.76	0.00	0.05	0.47	4.31	0.04	4.35
		0.09	0.67	0.23	0.09	0.63	1.00	0.00	0.07	0.93	0.04	0.39	4.14	0.04	4.18
Mallawi		0.02	0.13	0.01	0.01	0.12	0.19	0.00	0.12	0.00	0.01	0.07	0.68	0.01	0.68
		0.16	1.24	0.42	0.17	1.17	1.85	0.00	0.13	1.72	0.08	0.73	7.66	0.08	7.74
Dairut		0.02	0.18	0.02	0.02	0.17	0.27	0.00	0.17	0.00	0.01	0.11	0.97	0.01	0.98
		0.14	1.07	0.36	0.15	1.00	1.60	0.00	0.11	1.48	0.07	0.63	6.60	0.07	6.67
Qusiya		0.02	0.13	0.01	0.01	0.12	0.19	0.00	0.12	0.00	0.01	0.07	0.68	0.01	0.68
		0.12	0.95	0.32	0.13	0.89	1.42	0.00	0.10	1.32	0.06	0.56	5.87	0.06	5.93
Manfalut		0.02	0.13	0.01	0.01	0.12	0.19	0.00	0.12	0.00	0.01	0.07	0.68	0.01	0.68
		0.10	0.82	0.28	0.11	0.77	1.22	0.00	0.08	1.13	0.05	0.48	5.03	0.05	5.08
Assuit		0.09	0.72	0.25	0.10	0.68	1.08	0.00	0.07	1.00	0.05	0.42	4.48	0.04	4.52
		2.1	16.4	4.5	2.0	15.4	24.5	0.0	5.4	16.5	1.1	9.6	97.5	1.0	98.5
Nasser		0.12	0.94	0.13	0.06	0.44	1.41	0.00	0.10	1.30	0.06	0.92	5.49	0.05	5.54
Beni Suef		0.07	0.58	0.08	0.04	0.27	0.87	0.00	0.06	0.80	0.04	0.57	3.38	0.03	3.41
Biba		0.11	0.89	0.13	0.06	0.42	1.32	0.00	0.09	1.23	0.06	0.87	5.17	0.05	5.22
Maghagha		0.12	0.96	0.14	0.06	0.45	1.43	0.00	0.10	1.33	0.06	0.94	5.59	0.06	5.65
Beni Mazaar		0.14	1.08	0.15	0.07	0.51	1.61	0.00	0.11	1.49	0.07	1.05	6.28	0.06	6.34
Matai		0.10	0.82	0.12	0.05	0.38	1.22	0.00	0.08	1.13	0.05	0.80	4.75	0.05	4.79
Samalut		0.20	1.54	0.22	0.10	0.72	2.30	0.00	0.16	2.13	0.10	1.50	8.97	0.09	9.06
Minia		0.28	2.21	0.31	0.14	1.04	3.30	0.00	0.23	3.06	0.14	2.16	12.87	0.13	13.00
Abu Qurquas		0.09	0.74	0.10	0.05	0.35	1.11	0.00	0.08	1.03	0.05	0.73	4.33	0.04	4.37
Mahras		0.06	0.51	0.07	0.03	0.24	0.76	0.00	0.05	0.70	0.03	0.50	2.95	0.03	2.98
Mallawi		0.22	1.69	0.24	0.11	0.80	2.53	0.00	0.17	2.35	0.11	1.65	9.86	0.10	9.96
Deir Mawas		0.10	0.76	0.11	0.05	0.36	1.14	0.00	0.08	1.05	0.05	0.74	4.43	0.04	4.47
Quisiya		0.18	1.38	0.19	0.09	0.65	2.06	0.00	0.14	1.91	0.09	1.35	8.02	0.08	8.10
Manfalut		0.12	0.92	0.13	0.06	0.43	1.38	0.00	0.09	1.28	0.06	0.90	5.36	0.05	5.43
		1.9	15.0	2.1	0.9	7.1	22.4	0.0	1.5	20.8	1.0	14.7	87.4	0.9	88.3
TOTAL, NO BYPASS, NO EXP		19	147	21	9	69	191	12	47	130	9	129	782	8	790
TOTAL, NO EXPRESSWAY/ACC		21	162	23	10	76	213	12	49	151	10	144	870	9	879
TOTAL, NO BYPASSES		27	217	32	14	110	308	12	112	146	14	188	1,179	12	1,191

Appendix 3D

IMPROVEMENTS TO THE EXISTING HIGHWAY

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Appendix 3D

IMPROVEMENTS TO THE EXISTING HIGHWAY

This appendix describes the major projects considered for improving the existing West Bank Highway; constructing bypasses around 14 of the major towns along the highway, and widening the highway to 4-lane standard. These improvements were incorporated in the Improved Network evaluated by the Study (See Appendix 6A).

Construction of Bypasses

Bypasses were located around all towns on the existing West Bank Highway where conditions in the center of the town seriously impeded through traffic, a condition which could be expected to get worse over time. A total of 14 towns where identified as requiring bypasses as follows:

- Nasser (Bush)
- Beni Suef
- Biba
- Maghagha
- Beni Mazar
- Matai
- Samalut
- Minia
- Abu Qurqas
- Mahras
- Mallawi
- Deir Mawas
- Quisiya
- Manafalut

Locations of the bypasses are shown in Figure 3D-1.

Within the limits of this Study, it was not possible to undertake a full engineering design of each bypass. The procedure adopted, therefore, was to examine aerial photographs of the highway (at scale 1:10,000 taken in August 1984) and plot an appropriate line for a bypass, avoiding urban development and taking account of features such as irrigation canals and other obstacles. The length of bypasses, and the distance bypassed, were estimated for traffic modelling purposes. Engineering cost estimates were prepared based on a standard cross section, plus estimates for particular structures identified.

The alignments of each bypass are discussed below; cost estimates are presented later in this appendix.

Bypass Around Nasser (Bush) - The suggested bypass length around Nasser is 5.2 kilometers, while the length of the existing road passing through the town is 3.6 kilometers. This would increase the total length of Cairo-Assuit road by 1.6 kilometers for through traffic. The bypass is composed of two reverse curves outside the limits of the existing buildings (See Figure 3D-2). The horizontal curves were chosen based on the design speed of the existing road and the intersection angle. The line of the bypass crosses seven water channels (canal & drains) where pipe culverts would be needed.

Bypass around Beni Suef - The bypass length around Beni Suef is 3.2 kilometers, (in addition to 900 meters existing and widened), while the length of the existing road passing through Beni-Suef is 3.35 kilometers. This would decrease the length of the existing road by 150 meters for the through traffic. The plan of the bypass was designed to complete the existing part of the ring road around Beni Suef, as could be seen from Figure 3D-3. The bypass is composed of three straight roads connected by two horizontal curves. The line of the bypass crosses four water channels where pipe culverts would be needed.

Bypass around Biba - The suggested bypass length around Biba is 4.9 kilometers. This would increase the existing road by 100 meters for the through traffic as its original length passing through Biba is 4.8 kilometers (See Figure 3D-4). The bypass is composed of two reverse curves. The four horizontal curves are simple curves with large radius. The line of the bypass crosses two water channels where pipe culverts would be needed.

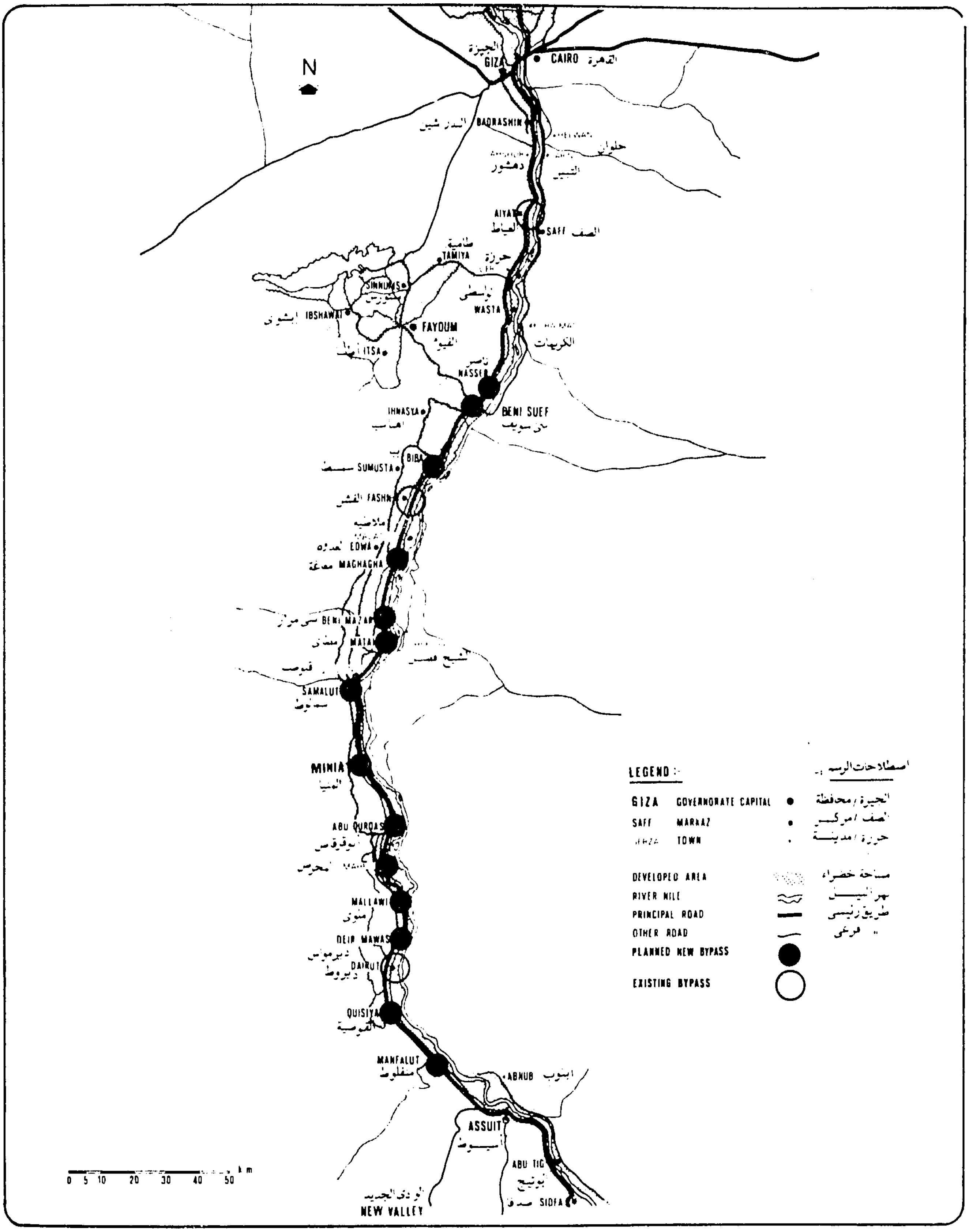
Bypass around Maghagha - The bypass length around Maghagha is 5.3 kilometers, composed with 4.8 kilometers passing through Maghagha. The bypass is composed of two reverse curves (See Figure 3D-5). The line of the bypass crosses one water channel where a pipe culvert would be needed.

Bypass around Beni Mazar - The bypass length around Beni Mazar is 5.95 kilometers while the length of the existing road through Beni Mazar is 4.9 kilometers. This would increase the total length of Cairo-Assuit road by 1.05 kilometers for the through traffic. The bypass is composed of two reverse curves as shown in Figure 3D-6. The line of the bypass crosses five water channels where pipe culverts would be needed.

Bypass Around Matai - The bypass around Matai is 4.5 kilometer compared with 3.8 kilometers through the town. The bypass is composed of two reverse curves as shown in Figure 3D-7. The second reverse curve is very sharp to avoid some existing buildings. The line of the bypass crosses two water channels where pipe culverts would be needed.

Bypass around Samalut - The bypass length around Samalut is 8.5 kilometers while the length of the existing road passing through Samalut is 6.75 kilometers. This would increase the total length of Cairo-Assuit road by 1.75 kilometers for the through traffic. The bypass is composed of two reverse curves connected by a horizontal curve as shown in Figure 3D-8. The line of the bypass crosses three water channels where pipe culverts would be needed.

Bypass around Minia - The bypass length around Minia is 12.2 kilometers while the length of the existing road passing through Minia is 10.95 kilometers. This would increase the length of Cairo-Assuit road by



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LOCATIONS OF BYPASSES

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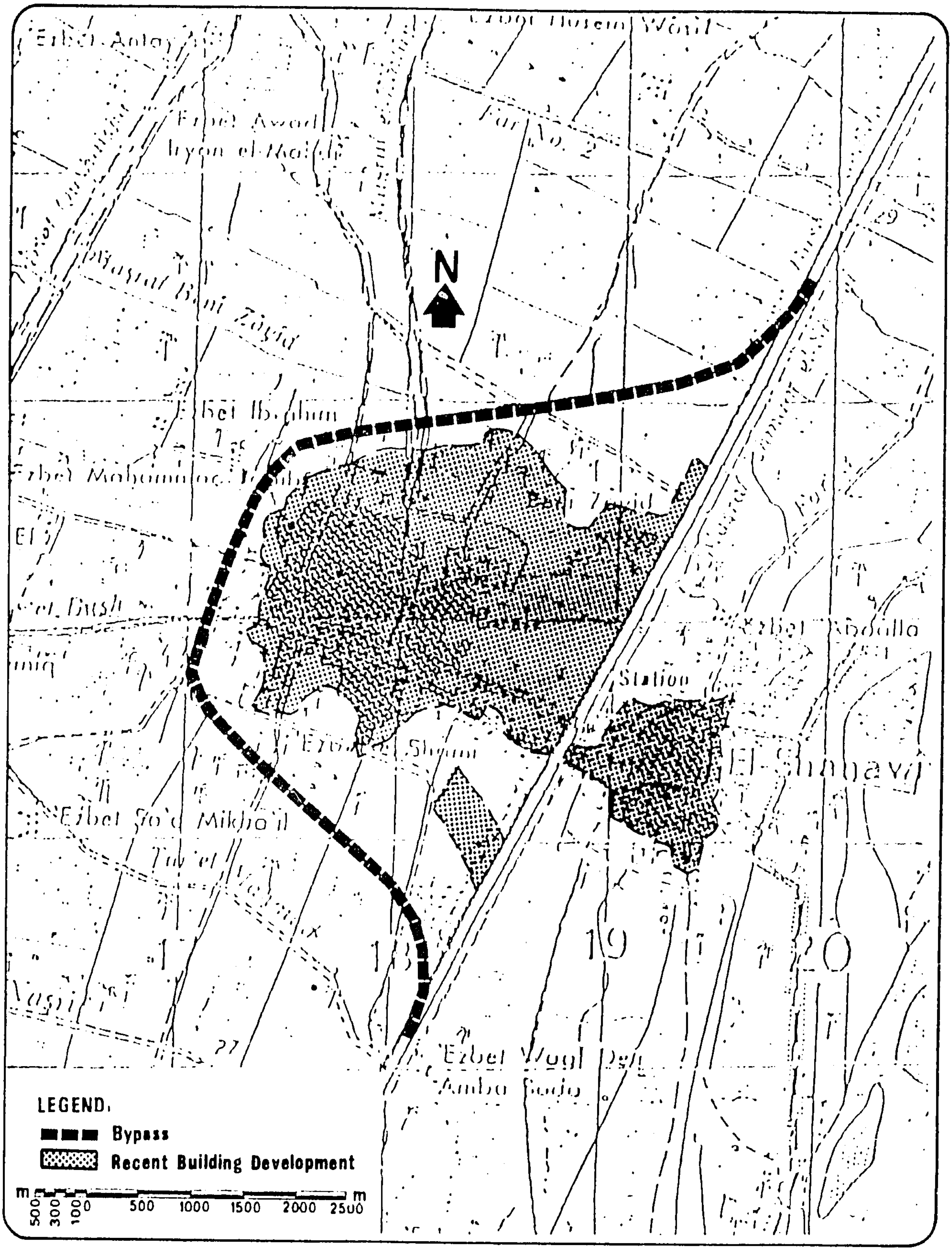
3D - 1



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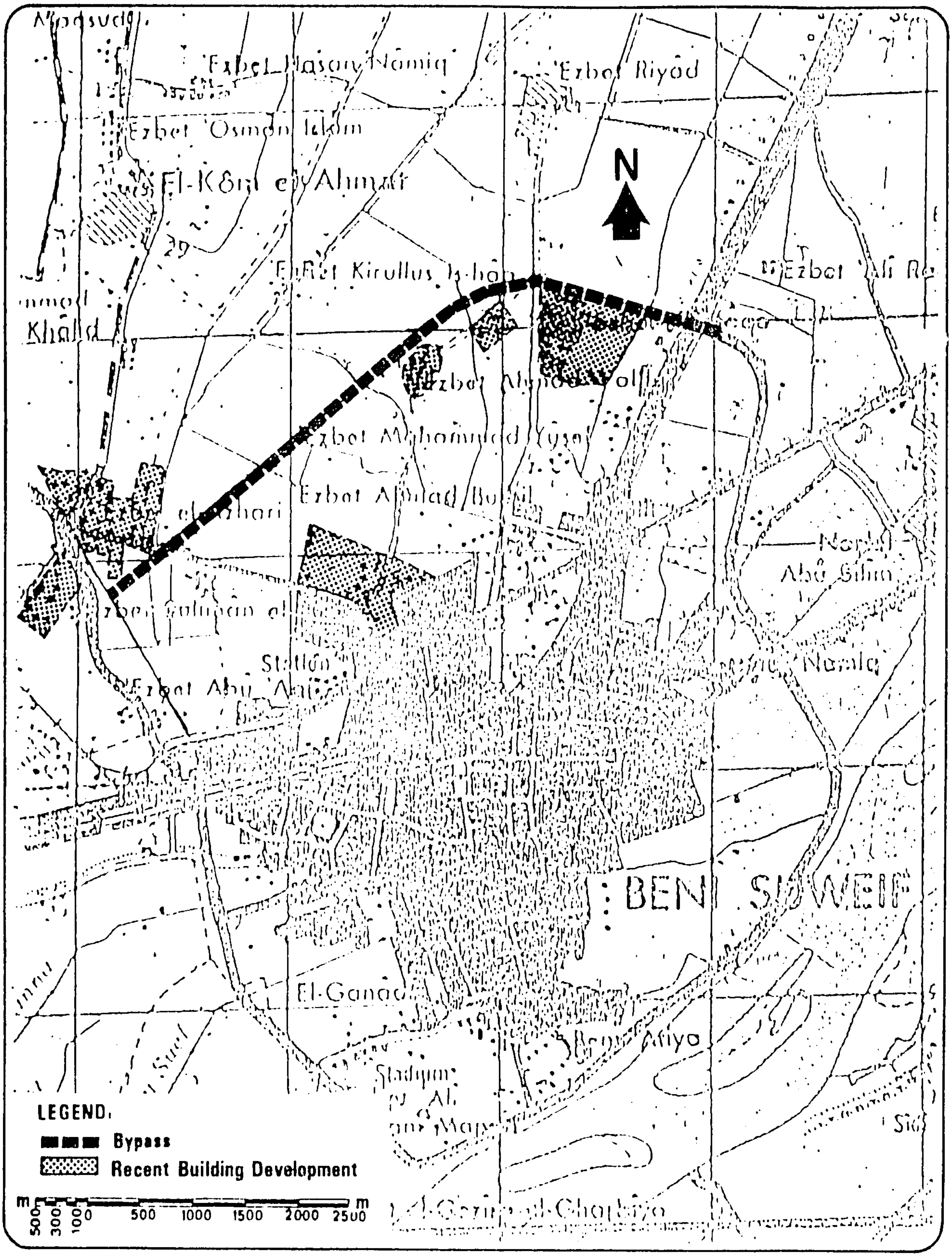
NASSER (BUSH) BYPASS

Figure 3D-2



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BENI SUEF BYBASS

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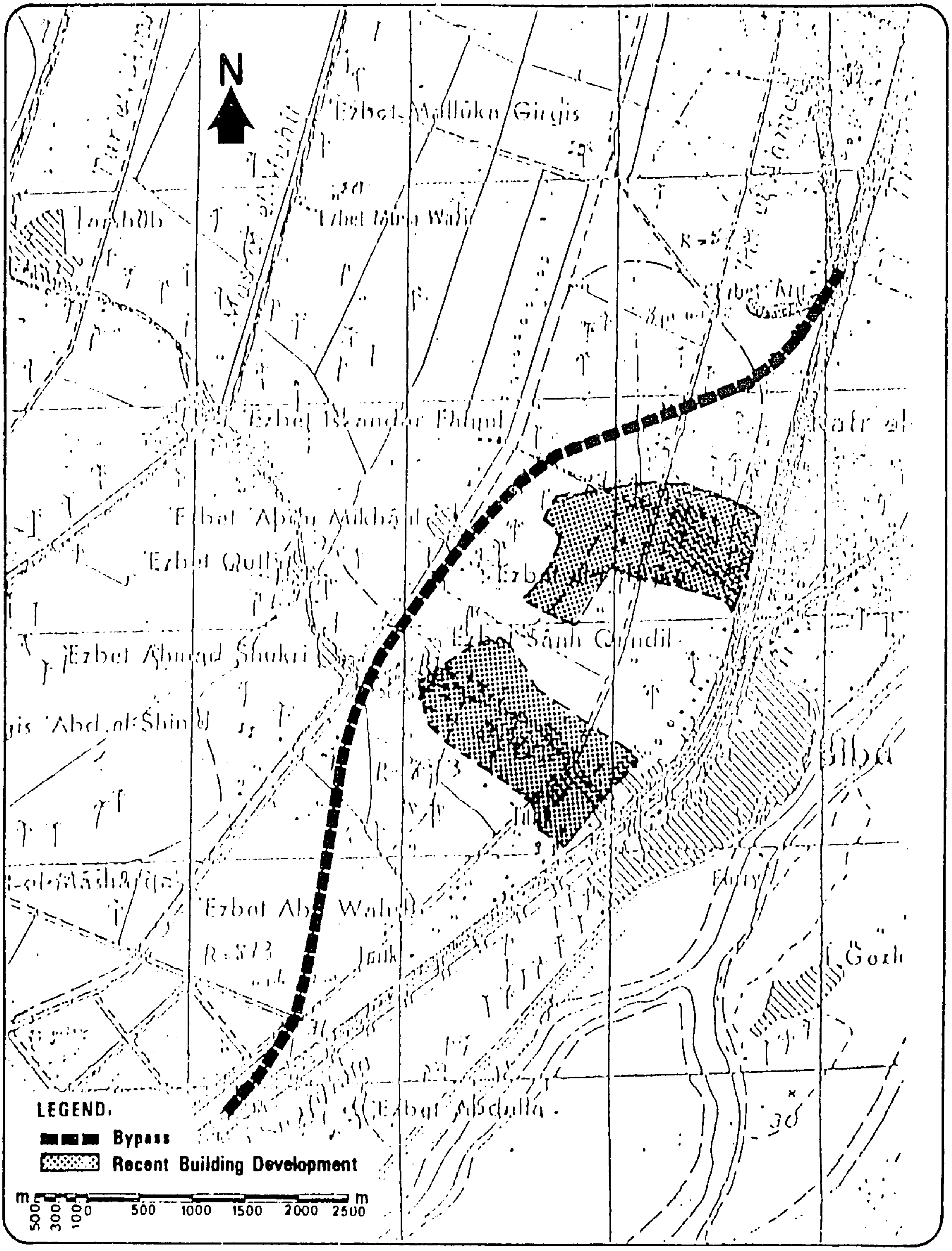
Figure 3D-3



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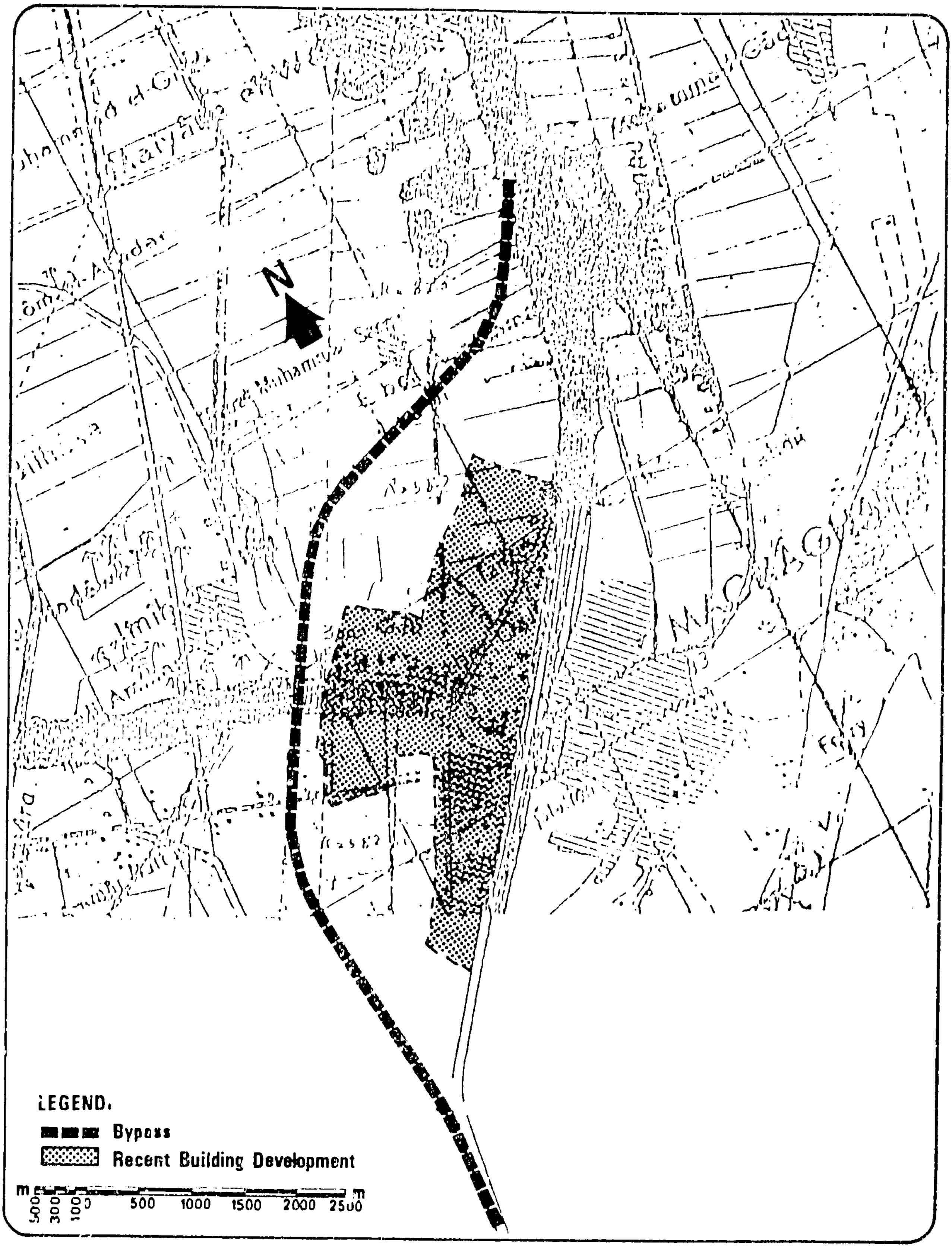
BIBA BYPASS

Figure 3D-4



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MAGHAGHA BYPASS

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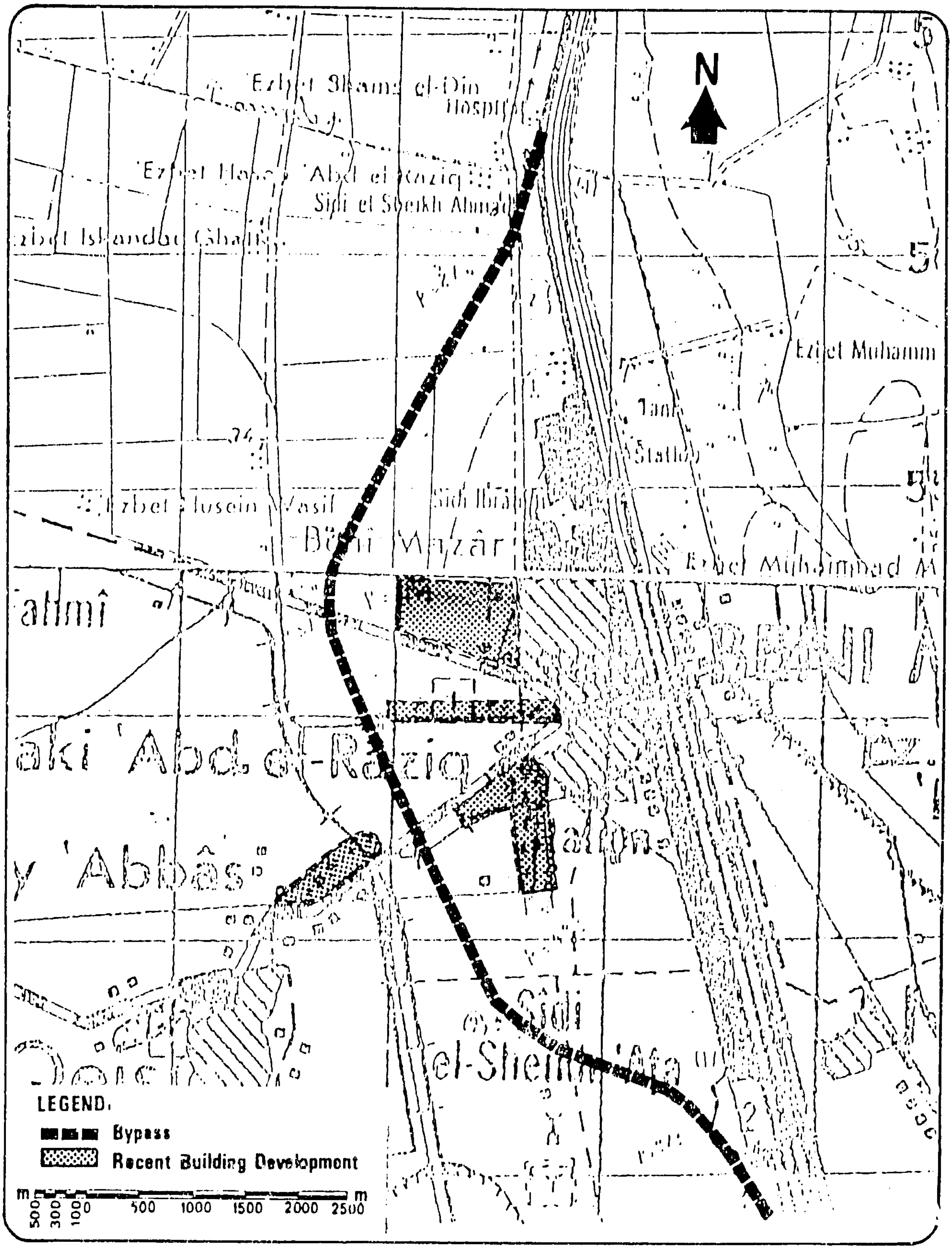
Figure 3D-5



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BENI MAZAR BYPASS

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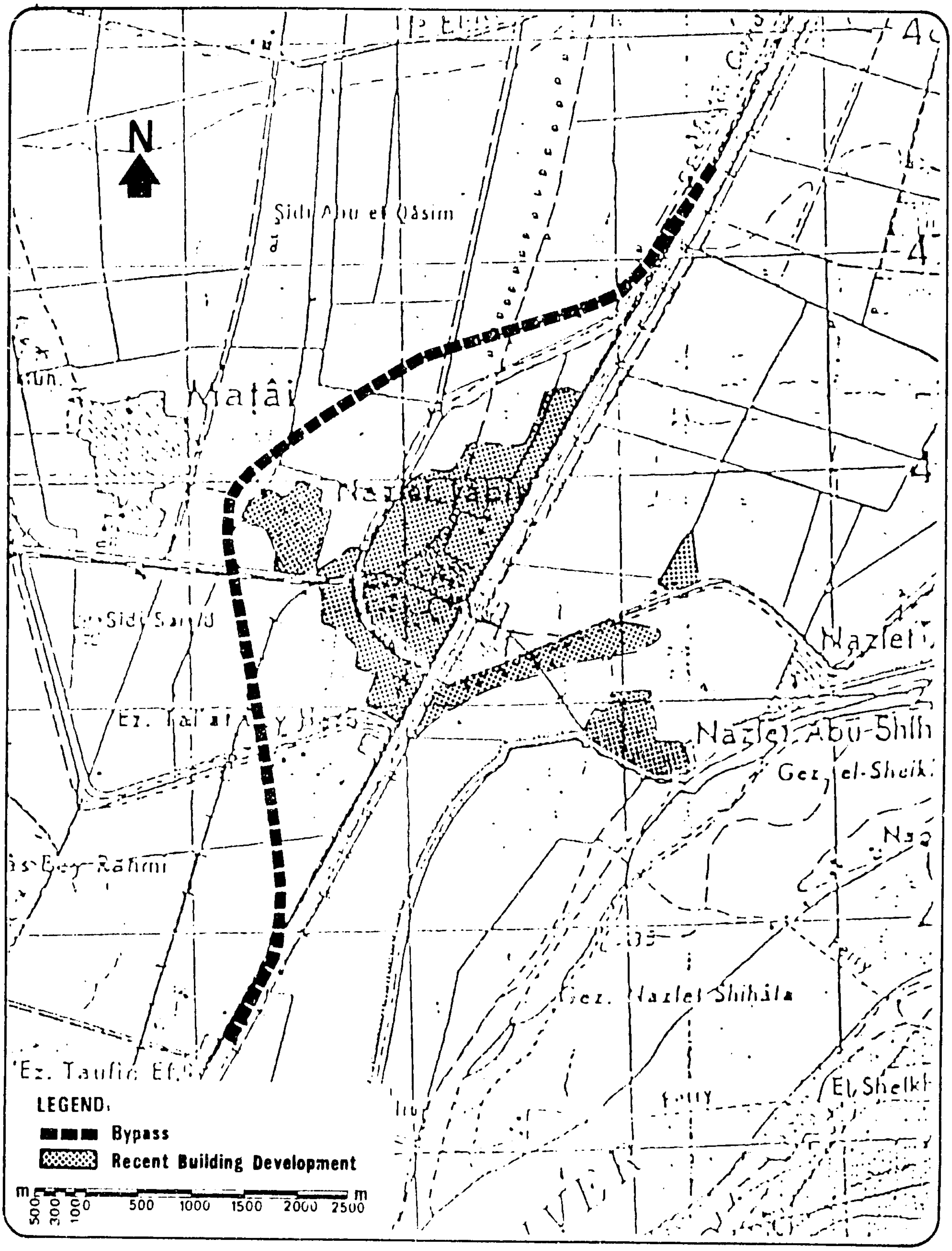
Figure 3D-6



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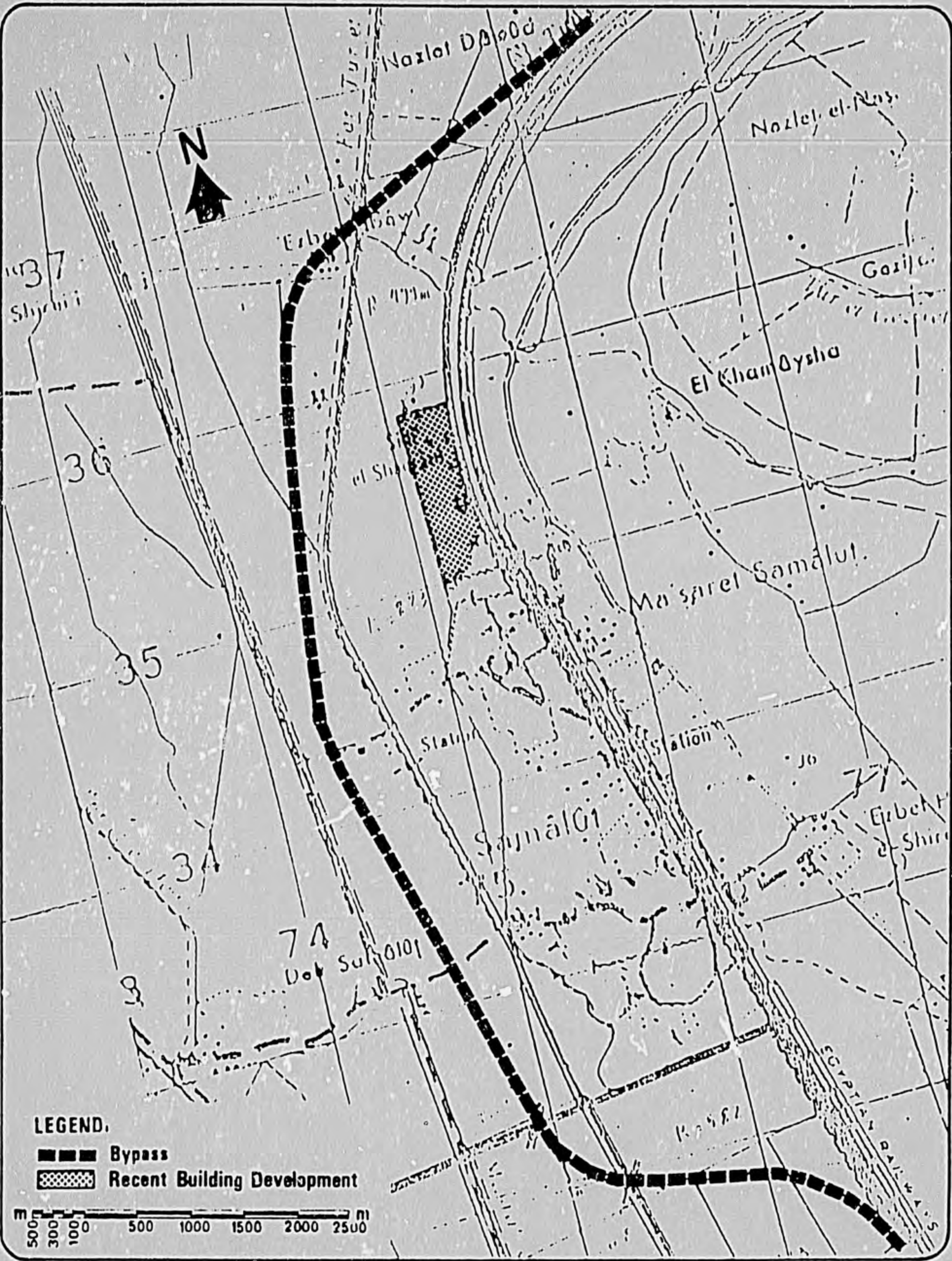
MATAI BYPASS

Figure 3D-7



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SAMALUT BYPASS

Figure 3D-8

1.25 kilometers for the through traffic. The bypass is composed of a new road almost straight and parallel to the existing road with a horizontal curve having a very small angle of turn. It is ended by two reverse curves, as seen in Figure 3D-9. The line of the bypass crosses three water channels where pipe culverts would be needed.

Bypass around Abu Qurqas - The bypass length around Abu Qurqas is 4.05 kilometers while the length of the existing road passing through Abu Qurqas is 3.75 kilometers. This would increase the total length of Cairo-Assuit by 300 meters for the through traffic. The bypass is composed of a common horizontal curve where the tangents are reversed from both sides to join the existing road (See Figure 3D-10). The line of the bypass crosses four water channels were pipe culverts would be needed.

Bypass around Mahras - The bypass length around Mahras is 2.8 kilometers while the length of the existing road passing through Mahras is 2.5 kilometers. Thus the total length of Cairo-Assuit road would increase by 300 meters. The bypass is ended by a reverse curve, as shown in Figure 3D-11 All the radii of horizontal curves were taken based on the design speed and the angle of turn. The line of the bypass crosses four water channels where pipe culverts would be needed.

Bypass around Malawi - The bypass length around Malawi is 9.35 kilometers while the length of the exising road passing through Malawi is 6.4 kilometers.Thus the total length of Cairo-Assuit road would increase by 2.95 kilometers for the through traffic. The bypass is composed of 4 successive horizontal curves due to the presence of building at Sidi Allam (See Figure 3D-12). The line of the bypass crosses nine water channels, where pipe culverts would be needed.

Bypass around Deir Mawas - The bypass length around Deir Mawas is 4.2 kilometers, and has approximately the same length as the existing road passing through Deir Mawas. The bypass is composed of two reverse curves connected by a common horizontal curve (See Figure 3D-13). The radii of the horizontal curves were taken based on the design speed and the degree of turning angles. The line of the bypass crossing four water channels where pipe culverts would be needed.

Bypass around Quisiya - The bypass length around Quisiya is 7.6 kilometers while the length of the existing road passing through Quisiya is 4.25 kilometers. Thus the length of the existing road would increase by 335 kilometers for the through traffic. The bypass is composed of two reverse curves connected by a straight road, as seen from Figure 3D-14. The line of the bypass crosses seven water channels where pipe culverts would be needed.

Bypass around Manfalut - The bypass length around Manfalut is 5.1 kilometers while the length of the existing road passing through Manfalut is 4.8 kilometers. Thus the length of the existing road would increase by 300 meters for the through traffic. The bypass is composed of two reverse curves connected by a straight road as could be seen from Figure 3D-15. The line of the bypass crosses five water channels where pipe culverts would be needed.

Bypass Cross-section and Costing

Figure 3D-16 shows the pavement cross-section assumed for a 2-lane design, based on axle loadings which were expected to be in the range 60-95 million equivalent axle loads (EAL) over the period 1990-2009. The design method is described in Appendix 4D.

The main structural elements include a 38 cm crushed stone sub-base, a 22 cm bituminous base course, and an initial wearing course of 5 cm. Shoulders would have a 15 cm sub-base surfaced by 5cm of premix. This pavement structure would be built on a 50 cm embankment with cross-sectional area of 8 sq meters, built of imported natural granular materials; generally pit run gravel mixed with sand of ASHTO classification A-1, A-2 and A-3 with a CBR greater than 10 percent. The right-of-way was taken as 18 meters.

A 4-lane design would require a similar pavement and embankment design but with two 7.5 meter carriageways and a 1.2 meter median. The cross sectional area of the embankment would increase to 12.5 square meters, and right of way to 26 meters.

Four estimates were made, assuming 2-lane and 4-lane designs, and assuming financial and economic costs. Total costs are summarized in Table 3D-1 below.

Table 3D-1

COST OF CONSTRUCTION OF BYPASSES
(LE millions, 1986)

DESIGN STANDARD	FINANCIAL COSTS	ECONOMIC COSTS
2-lane	24.8	31.6
4-lane	42.6	55.0

Detailed costs of construction are included in Annex 3D-1 to this appendix.

Widening the Existing Highway

Costs were estimated for widening all sections of the existing West Bank Highway between bypasses to 4-lane standard. A total of 246.3 kilometers of highway were involved from Aiyat, where the existing 4-lane construction out of Cairo ends, to Manqabad where the existing 4-lane construction into Assuit begins.

The construction cross-section is illustrated in Figure 3D-17, with pavement structure similar to that established for the bypasses. The additional embankment cross-sectional area was estimated at 5.7 sq meters

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MINIA BYPASS

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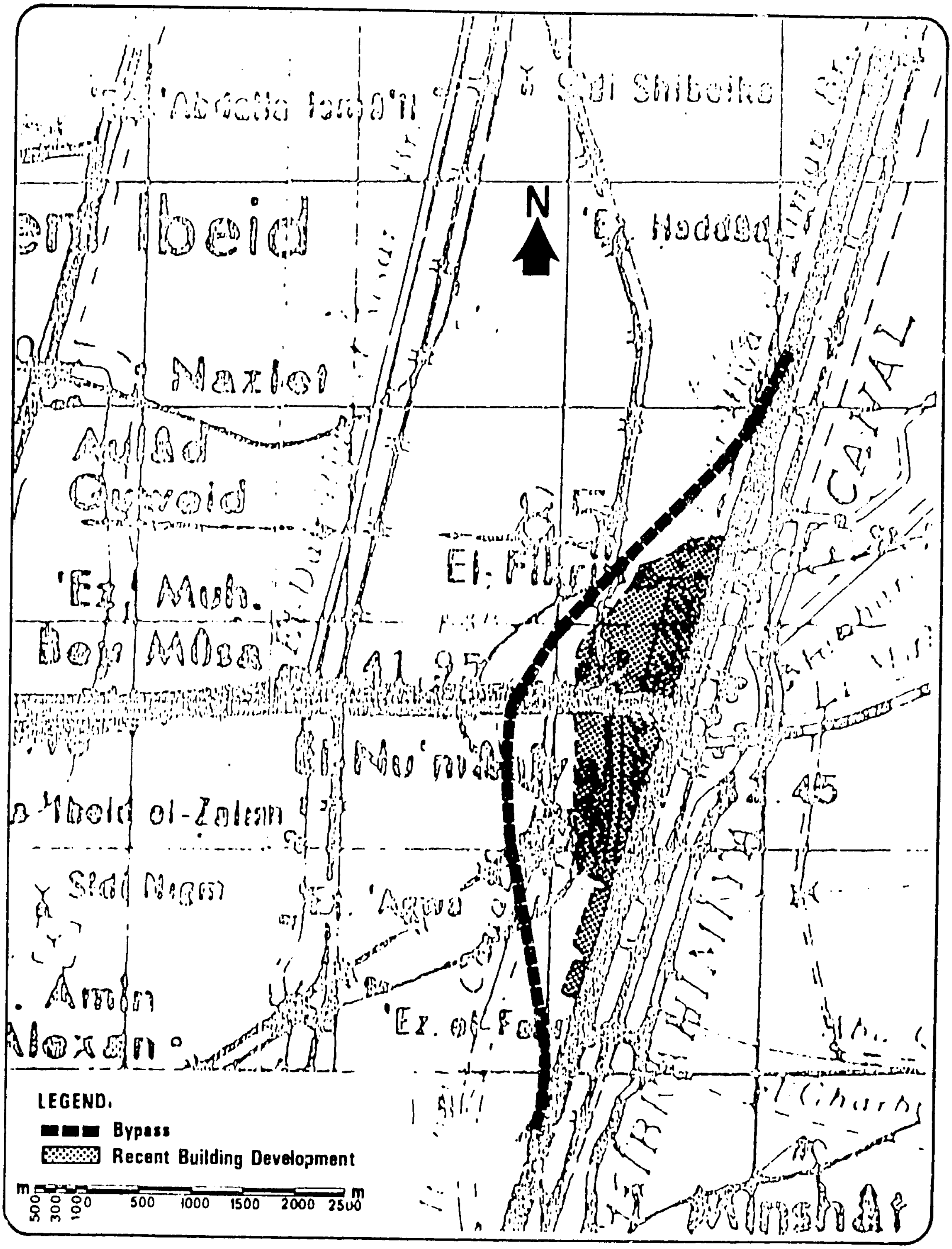
Figure 3D-9



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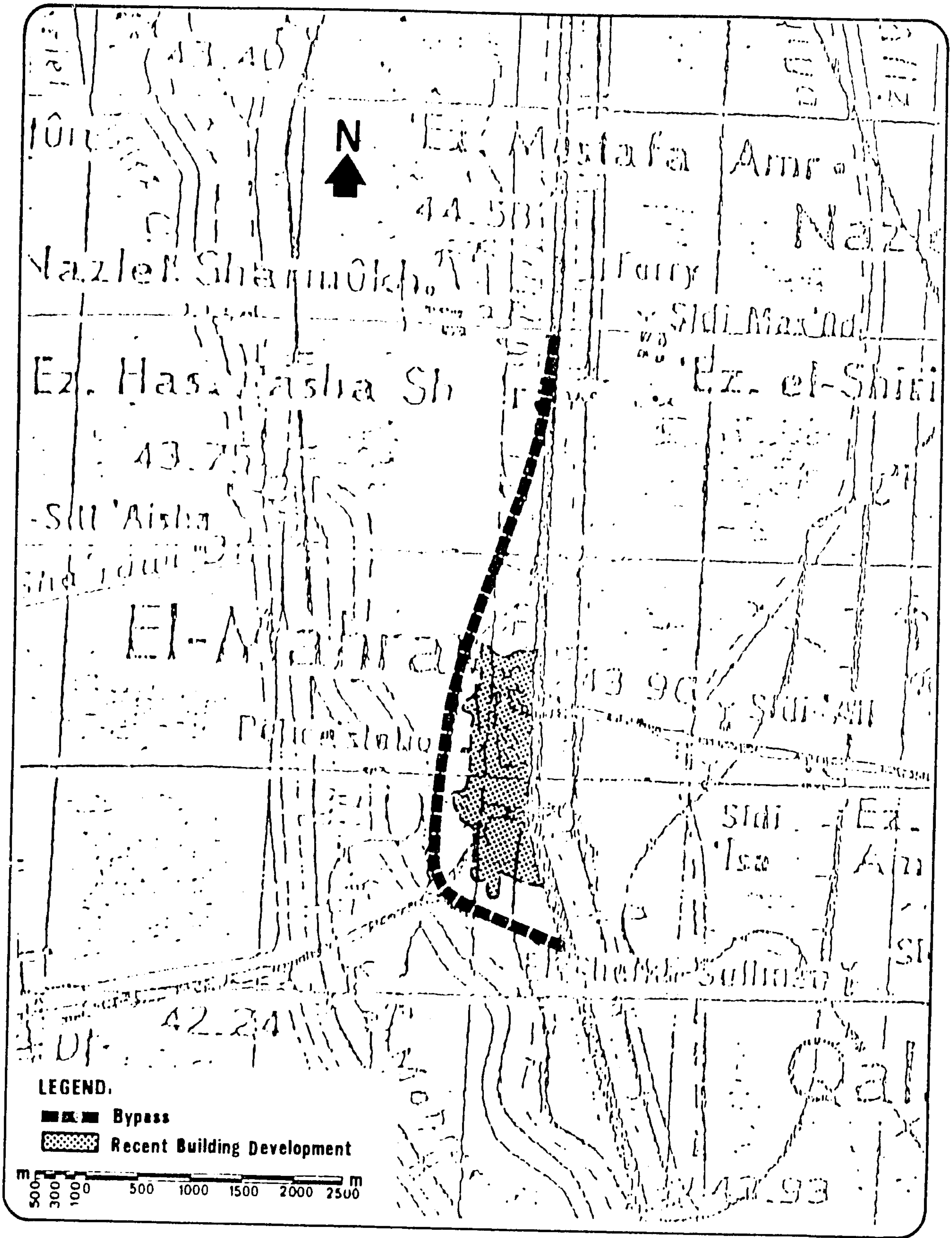
ABU QURQAS BYPASS

Figure 3D-10



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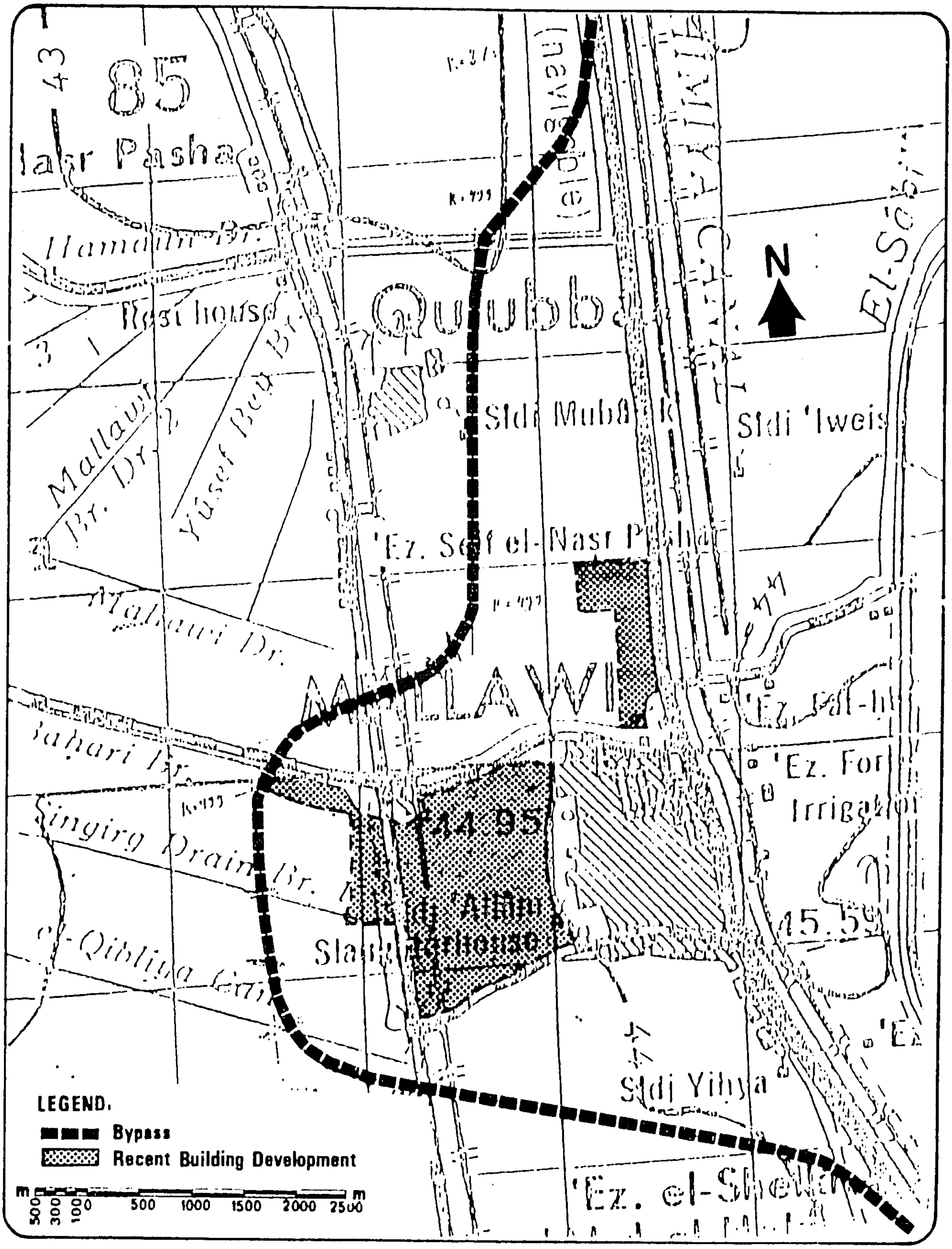
MAHRAS BYPASS

Figure 3D-11



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MALLAWI BYPASS

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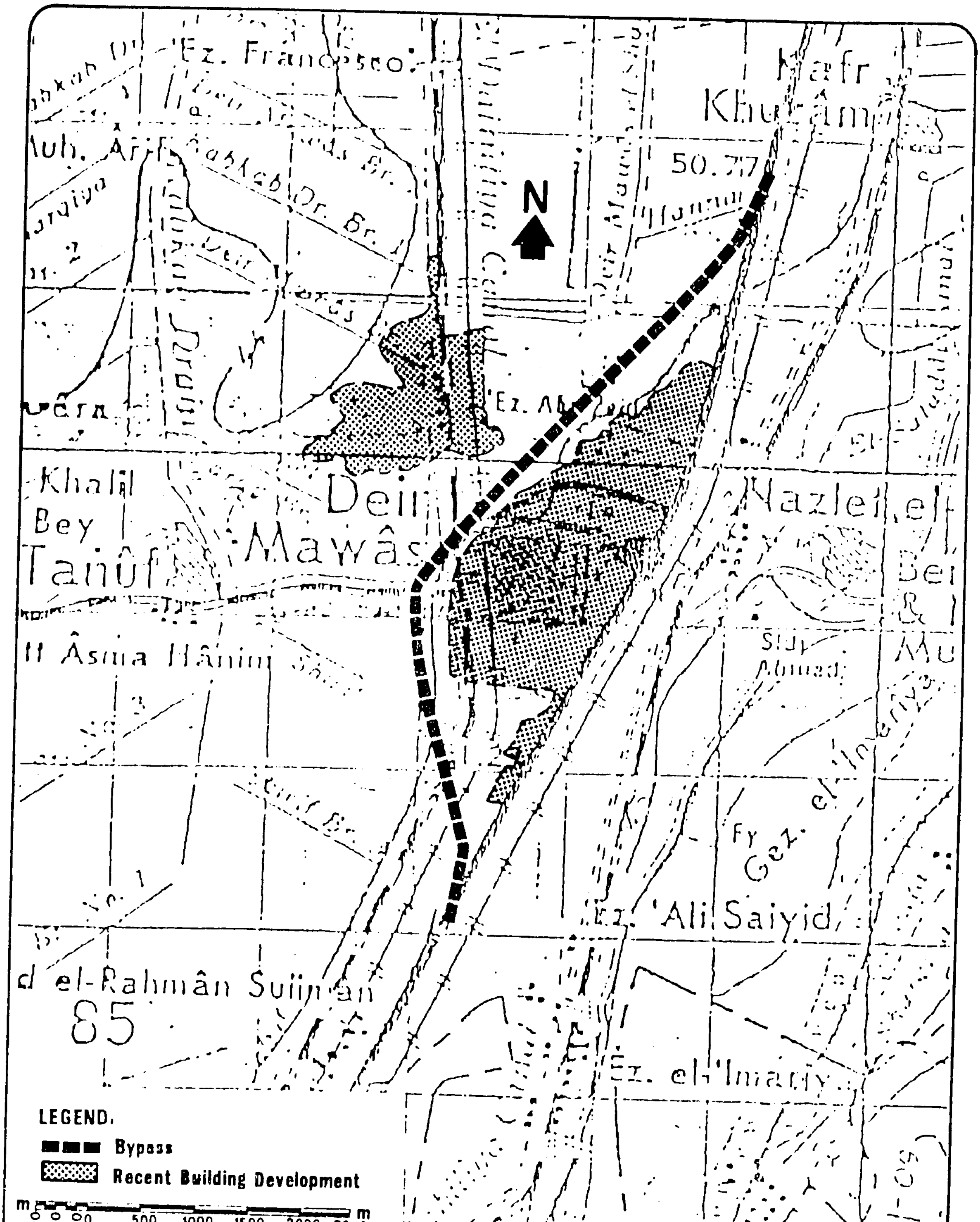
Figure 3D-12



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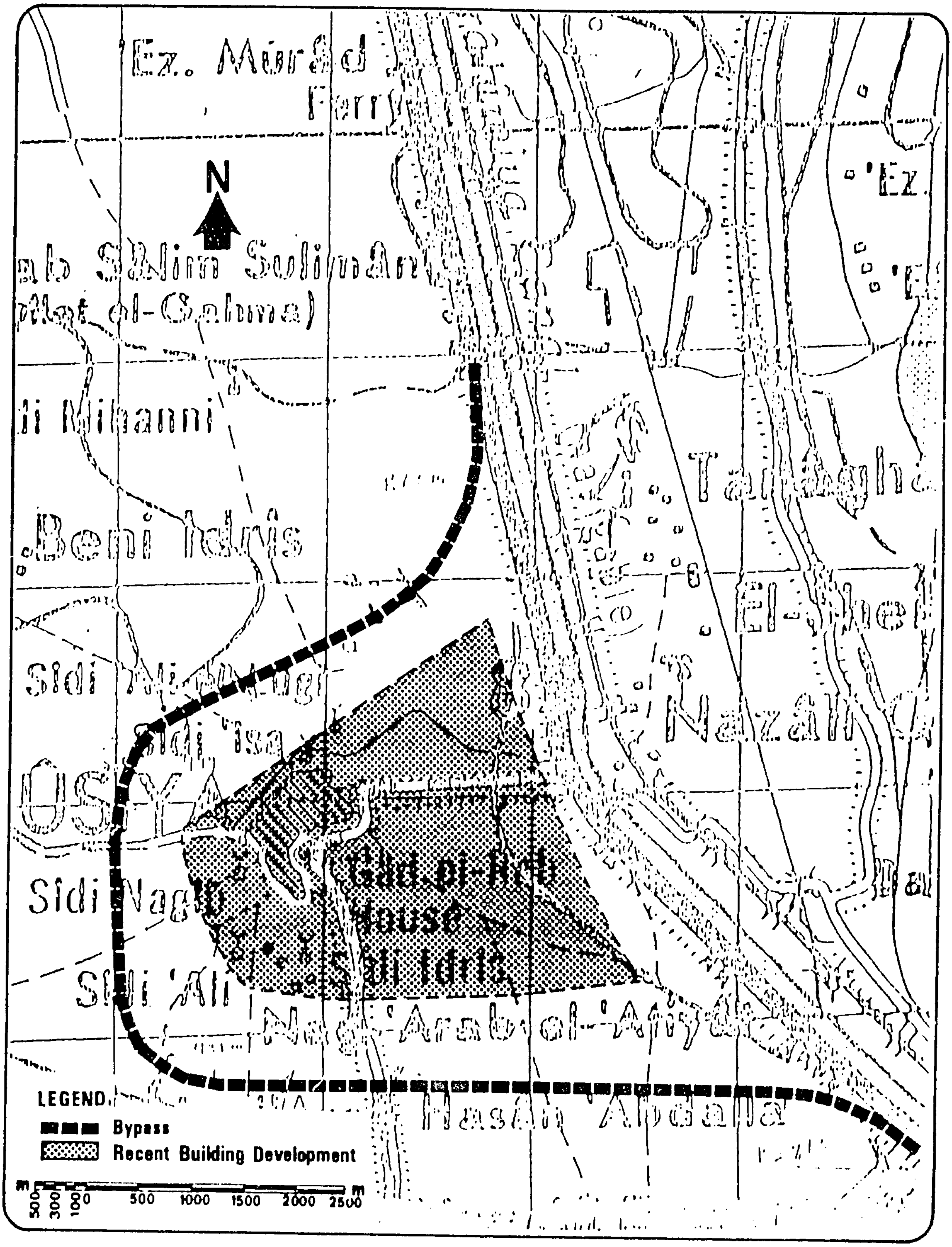
DEIR MAWAS BYPASS

Figure 3D-13



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QUISIYA BYPASS

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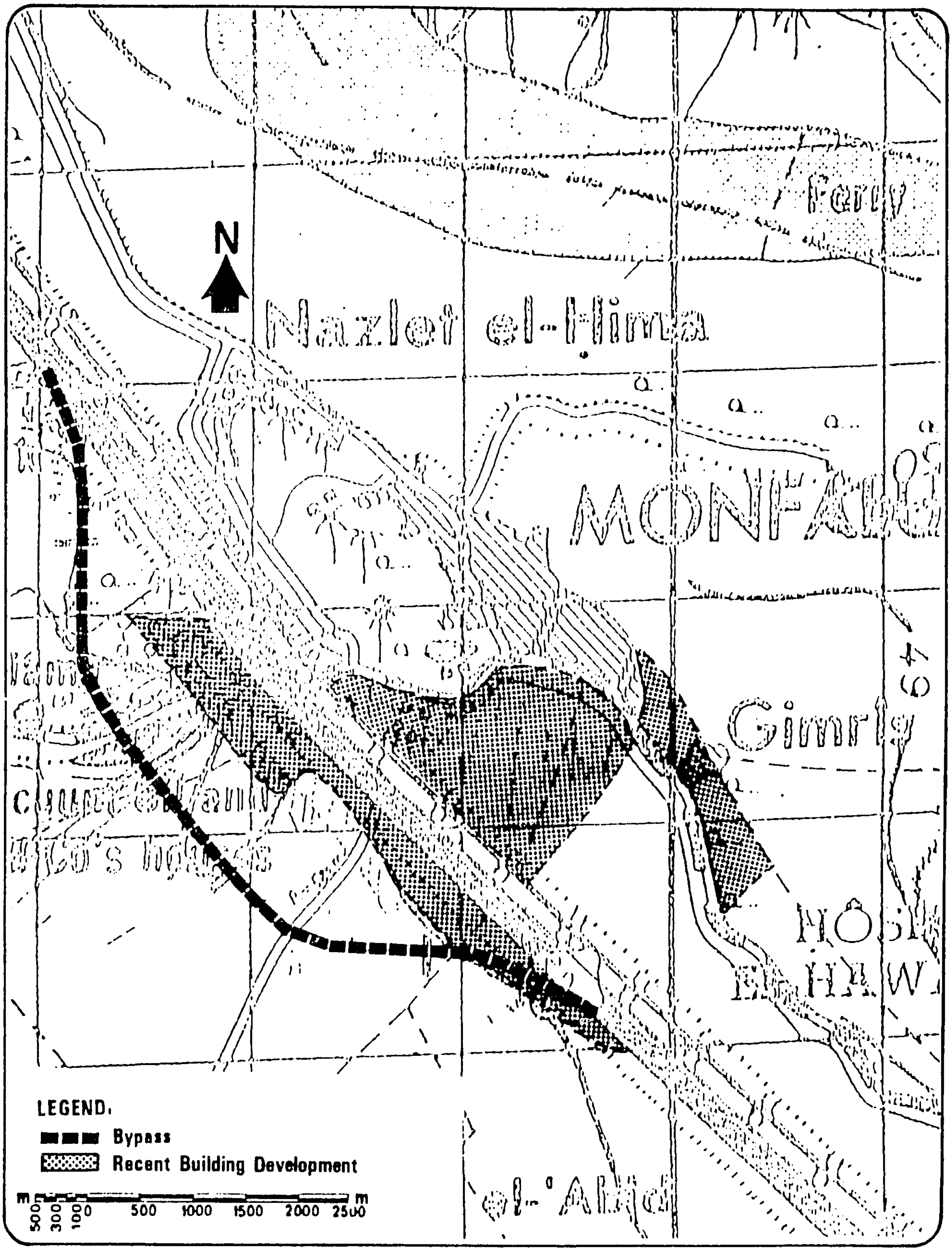
Figure 3D-14



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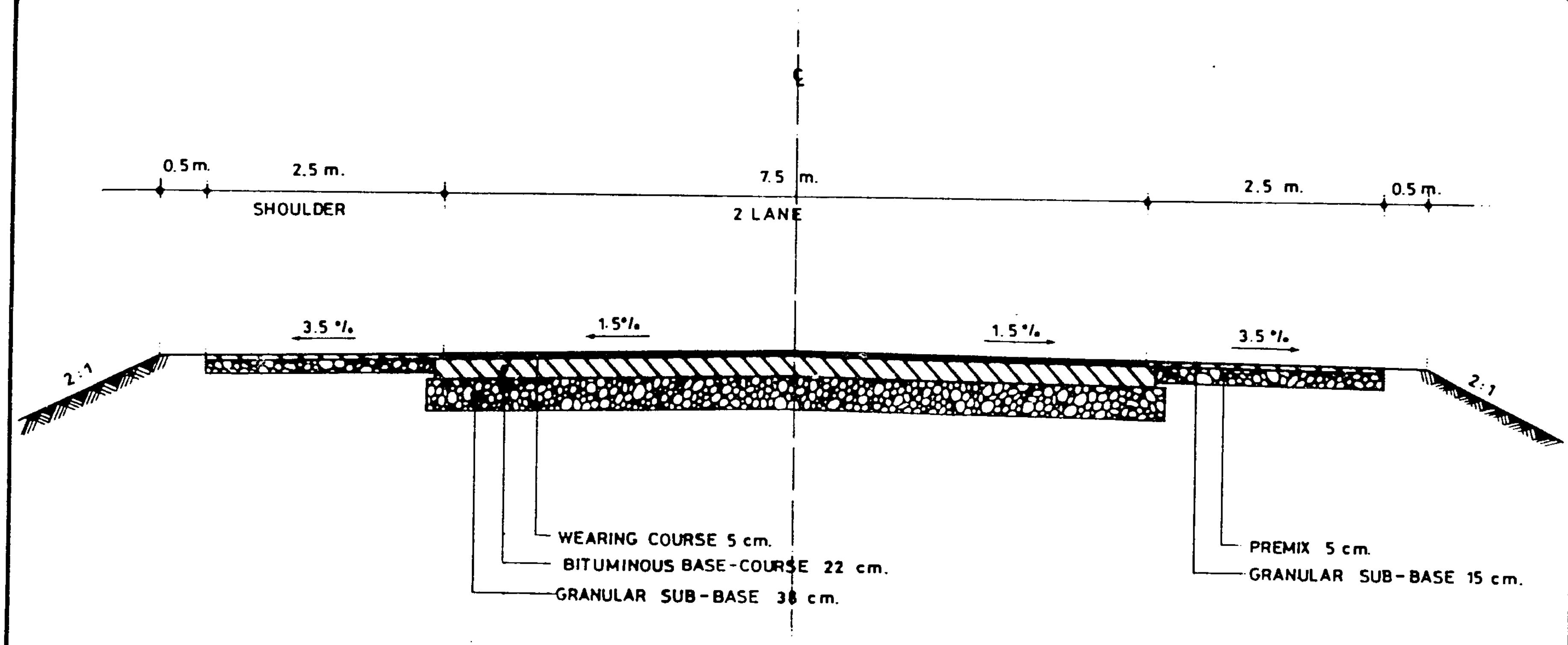
MANFALUT BYPASS

Figure 3D-15



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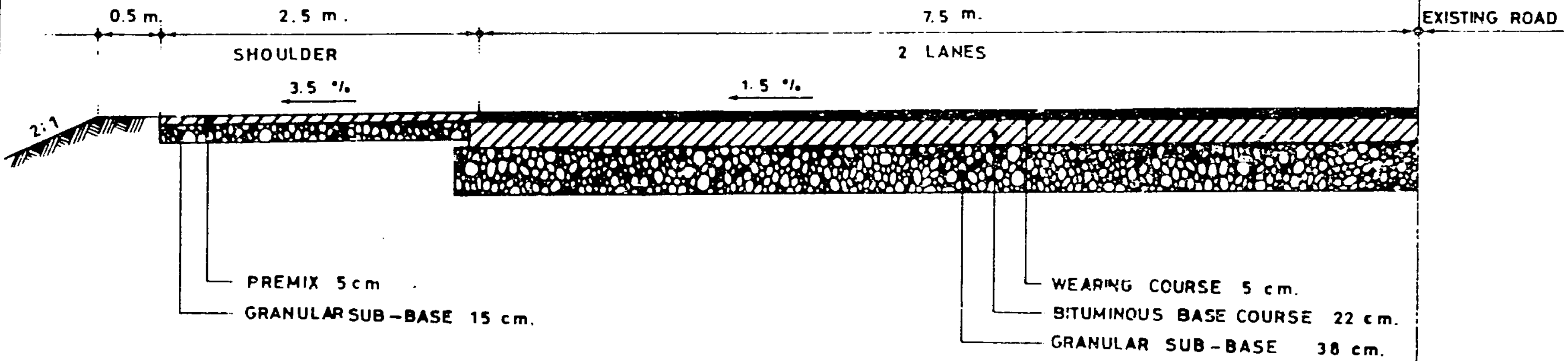
CROSS SECTION FOR BYPASSES
(2 – LANE CONFIGURATION)

Figure 3D – 16



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CROSS SECTION FOR WIDENING

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Figure 3D-17

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for normal roadway with drainage or irrigation canals on one side of the road only. However, significant sections of the existing highway had canals on both sides of the road, one being the main canal and the other being a smaller feeder canal. Widening the road would mean relocating the smaller canal. For these sections, totalling nearly 75 kilometers of route, an additional cross-sectional area of embankment of 16 sq meters was estimated. In costing, a higher price of LE 8 per cubic meter (compared with LE 5 for normal embankment earthworks) was allowed to deal with additional problems in canal relocation. A cost of LE 10,000 per km was allowed for widening of structures such as culverts and bridges.

Total costs of widening, was estimated at LE 76.8 million financial cost, and LE 97.7 million economic cost, using unit prices set out in Appendix 3A. Detailed cost estimates are included in Annex 3D-2.

Eco cost? (0=N,1=Y) 0

LAYER THICKNESSES	
Road sub-base	38.0 cms
Shoulder sub-base	15.0
Road base (binder)	22.0
Wearing course	5.0
Shoul base (premix)	5.0
No. of tack coats	1

ROADWAY	
No carriageways	1
No shoulders	2
Carriage width	7.5 meters
Shoulder width	2.5 meters
Paint lines/car	3
2-car culv fac	1.7

UNIT PRICES	FIN	ECO FAC	UNIT
Embankment	5.00	1.281	per m3
Crushed stone sub-base	20.00	1.300	per m3
Prime coat	0.20	1.121	per m2
Binder/Premix base	45.00	1.397	per m3
Tack coat	0.15	1.068	per m2
Wearing course	52.00	1.344	per m3
Striping	260.00	1.028	per km
Minor structures	12,500	1.300	each
Land	3.60	1.000	per m2

Right of way 18 meters
Cross-section Area 8.0 sq meters

Quantities (thousands, except kilometers)

LOCATION	LENGTH (kms)	EMBANK (m3)	SUB-BASE Road (m3)	SUB-BASE Should (m3)	PRIME COAT (m2)	ROAD BASE (m3)	TACK COAT (m2)	WEARING COURSE (m3)	SHOULD BASE (m3)	STRIPE MARKING (kms)	PIPE CULVERTS (no.)	AREA LAND (m2)
Nasser	5.20	41.6	15.8	3.9	65.0	8.6	39.0	2.0	1.3	15.6	7	93.6
Beni Suef	3.20	25.6	9.7	2.4	40.0	5.3	24.0	1.2	0.8	9.6	4	57.6
Biba	4.90	39.2	14.9	3.7	61.3	8.1	36.8	1.8	1.2	14.7	2	88.2
Maghagha	5.30	42.4	16.1	4.0	66.3	8.7	39.8	2.0	1.3	15.9	1	95.4
Beni Mazar	5.95	47.6	18.1	4.5	74.4	9.8	44.6	2.2	1.5	17.9	5	107.1
Matai	4.50	36.0	13.7	3.4	56.3	7.4	33.8	1.7	1.1	13.5	2	81.0
Samalut	8.50	68.0	25.8	6.4	106.3	14.0	63.8	3.2	2.1	25.5	3	153.0
Minia	12.20	97.6	37.1	9.2	152.5	20.1	91.5	4.6	3.1	36.6	3	219.6
Abu Qurqas	4.05	32.4	12.3	3.0	50.6	6.7	30.4	1.5	1.0	12.2	4	72.9
Mahrass	2.80	22.4	8.5	2.1	35.0	4.6	21.0	1.1	0.7	8.4	4	50.4
Mallawi	9.35	74.8	28.4	7.0	116.9	15.4	70.1	3.5	2.3	28.1	9	168.3
Deir Mawas	4.20	33.6	12.8	3.2	52.5	6.9	31.5	1.6	1.1	12.6	4	75.6
Quisiya	7.60	60.8	23.1	5.7	95.0	12.5	57.0	2.9	1.9	22.8	7	136.8
Manfalut	5.10	40.8	15.5	3.8	63.7	8.4	38.3	1.9	1.3	15.3	5	91.8
	82.9	663	252	62	1,036	137	621	31	21	249	60	1,491

Costs of Construction (LE thousands)

LOCATION	EMBANK	SUB-BASE Road	SUB-BASE Should	PRIME COAT	ROAD BASE	TACK COAT	WEARING COURSE	SHOULD BASE	STRIPE MARKING	PIPE CULVERTS	AREA LAND	TOTAL COST
Nasser	208	316	78	13	386	6	101	59	4	88	337	1,596
Beni Suef	128	195	48	8	238	4	62	36	2	50	207	978
Biba	196	298	74	12	364	6	96	55	4	25	318	1,446
Maghagha	212	322	80	13	394	6	103	60	4	13	343	1,550
Beni Mazar	238	362	89	15	442	7	116	67	5	63	386	1,788
Matai	180	274	68	11	334	5	88	51	4	25	292	1,330
Samalut	340	517	128	21	631	10	166	96	7	38	551	2,503
Minia	488	742	183	31	906	14	238	137	10	38	791	3,576
Abu Qurqas	162	246	61	10	301	5	79	46	3	50	262	1,225
Mahrass	112	170	42	7	208	3	55	31	2	50	181	862
Mallawi	374	568	140	23	694	11	182	105	7	113	606	2,824
Deir Mawas	168	255	63	11	312	5	82	47	3	50	272	1,268
Quisiya	304	462	114	19	564	9	148	86	6	88	492	2,292
Manfalut	204	310	77	13	379	6	99	57	4	63	330	1,542
	3,314	5,037	1,243	207	6,152	93	1,616	932	65	750	5,369	24,777

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ANNEX 3D-1 2-LANE BYPASS QUANTITIES AND COSTS (ECONOMIC)

Eco cost? (0=N,1=Y)   1

LAYER THICKNESSES	
Road sub-base	38.0 cms
Shoulder sub-base	15.0
Road base (binder)	22.0
Wearing course	5.0
Shoul base (premix)	5.0
No. of tack coats	1
Right of way	18 meters
Cross-section Area	8.0 sq meters

ROADWAY	
No carriageways	1
No shoulders	2
Carriage width	7.5 meters
Shoulder width	2.5 meters
Paint lines/car	3
2-car culv fac	1.7

UNIT PRICES	FIN	ECO FAC	UNIT
Embankment	5.00	1.281	per m3
Crushed stone sub-base	20.00	1.360	per m3
Prime coat	0.20	1.121	per m2
Binder/Premix base	45.00	1.397	per m3
Tack coat	0.15	1.068	per m2
Wearing course	52.00	1.344	per m3
Striping	260.00	1.036	per km
Minor structures	12,500	1.300	each
Land	3.60	1.000	per m2

Quantities (thousands, except kilometers)

LOCATION	LENGTH	EMBANK	SUB-BASE Road	SUB-BASE Should	PRIME COAT	ROAD BASE	TACK COAT	WEARING COURSE	SHOULD BASE	STRIPE MARKING	PIPE CULVERTS	AREA LAND
	(kms)	(m3)	(m3)	(m3)	(m2)	(m3)	(m2)	(m3)	(m3)	(kms)	(no.)	(m2)
Nasser	5.20	41.6	15.8	3.9	65.0	8.6	39.0	2.0	1.3	15.6	7	93.6
Beni Suef	3.20	25.6	9.7	2.4	40.0	5.3	24.0	1.2	0.8	9.6	4	57.6
Biba	4.90	39.2	14.9	3.7	61.3	8.1	36.8	1.8	1.2	14.7	2	88.2
Maghagha	5.30	42.4	16.1	4.0	66.3	8.7	39.8	2.0	1.3	15.9	1	95.4
Beni Mazar	5.95	47.6	18.1	4.5	74.4	9.8	44.6	2.2	1.5	17.9	5	107.1
Matai	4.50	36.0	13.7	3.4	56.3	7.4	33.8	1.7	1.1	13.5	2	81.0
Samalut	8.50	68.0	25.8	6.4	106.3	14.0	63.8	3.2	2.1	25.5	3	153.0
Minia	12.20	97.6	37.1	9.2	152.5	20.1	91.5	4.6	3.1	36.6	3	219.6
Abu Qurqas	4.05	32.4	12.3	3.0	50.6	6.7	30.4	1.5	1.0	12.2	4	72.9
Mahrass	2.80	22.4	8.5	2.1	35.0	4.6	21.0	1.1	0.7	8.4	4	50.4
Mallawi	9.35	74.8	28.4	7.0	116.9	15.4	70.1	3.5	2.3	28.1	9	168.3
Deir Mawas	4.20	33.6	12.8	3.2	52.5	6.9	31.5	1.6	1.1	12.6	4	75.6
Quisiya	7.60	60.8	23.1	5.7	95.0	12.5	57.0	2.9	1.9	22.8	7	136.8
Manfalut	5.10	40.8	15.5	3.8	63.7	8.4	38.3	1.9	1.3	15.3	5	91.8
	82.9	663	252	62	1,036	137	621	31	21	249	60	1,491

Costs of Construction (LE thousands)

LOCATION	EMBANK	SUB-BASE Road	SUB-BASE Should	PRIME COAT	ROAD BASE	TACK COAT	WEARING COURSE	SHOULD BASE	STRIPE MARKING	PIPE CULVERTS	AREA LAND	TOTAL COST
Nasser	266	430	106	15	539	6	136	82	4	114	337	2,036
Beni Suef	164	265	65	9	332	4	84	50	3	65	207	1,248
Biba	251	405	100	14	508	6	128	77	4	33	318	1,844
Maghagha	272	438	108	15	550	6	139	83	4	16	343	1,975
Beni Mazar	305	492	121	17	617	7	156	94	5	81	386	2,280
Matai	231	372	92	13	467	5	118	71	4	33	292	1,696
Samalut	436	703	173	24	882	10	223	134	7	49	551	3,190
Minia	625	1,009	249	34	1,265	15	320	192	10	49	791	4,558
Abu Qurqas	208	335	83	11	420	5	106	64	3	65	262	1,562
Mahrass	143	232	57	8	290	3	73	44	2	65	181	1,100
Mallawi	479	773	191	26	970	11	245	147	8	146	606	3,602
Deir Mawas	215	347	86	12	436	5	110	66	3	65	272	1,617
Quisiya	389	628	155	21	788	9	199	119	6	114	492	2,923
Manfalut	261	422	104	14	529	6	134	80	4	81	330	1,966
	4,245	6,851	1,690	232	8,594	100	2,171	1,302	67	975	5,369	31,596

Eco cost? (0=N,1=Y) 0

LAYER THICKNESSES		ROADWAY	
Road sub-base	38.0 cms	No carriageways	2
Shoulder sub-base	15.0	No shoulders	2
Road base (binder)	22.0	Carriage width	7.5 meters
Wearing course	5.0	Shoulder width	2.5 meters
Shoul base (premix)	5.0	Paint lines/car	3
No. of tack coats	1	2-car culv fac	1.7

Right of way 26 meters
Cross-section Area 12.5 sq meters

UNIT PRICES	FIN	ECO FAC	UNIT
Embankment	5.00	1.281	per m3
Crushed stone sub-base	20.00	1.360	per m3
Prime coat	0.20	1.121	per m2
Binder/Premix base	45.00	1.397	per m3
Tack coat	0.15	1.069	per m2
Wearing course	52.00	1.344	per m3
Striping	260.00	1.039	per km
Minor structures	12,500	1.300	each
Land	3.60	1.000	per m2

LOCATION	LENGTH	EMBANK	SUB-BASE Road	SUB-BASE Should	PRIME COAT	ROAD BASE	TACK COAT	WEARING COURSE	SHOULD BASE	STRIPE MARKING	PIPE CULVERTS	AREA LAND	TOTAL COST
	(kms)	(m3)	(m3)	(m3)	(m2)	(m3)	(m2)	(m3)	(m3)	(kms)	(no.)	(m2)	
Quantities (thousands, except kilometers)													
Nasser	5.20	65.0	31.6	3.9	104.0	17.2	78.0	3.9	1.3	31.2	7	135.2	
Beni Suef	3.20	40.0	19.5	2.4	64.0	10.6	48.0	2.4	0.8	19.2	4	83.2	
Biba	4.90	61.3	29.8	3.7	98.0	16.2	73.5	3.7	1.2	29.4	2	127.4	
Maghagha	5.30	66.3	32.2	4.0	106.0	17.5	79.5	4.0	1.3	31.8	1	137.8	
Beni Mazar	5.95	74.4	36.2	4.5	119.0	19.6	89.3	4.5	1.5	35.7	5	154.7	
Matai	4.50	56.3	27.4	3.4	90.0	14.9	67.5	3.4	1.1	27.0	2	117.0	
Samalut	8.50	106.3	51.7	6.4	170.0	28.1	127.5	6.4	2.1	51.0	3	221.0	
Minia	12.20	152.5	74.2	9.2	244.0	40.3	183.0	9.2	3.1	73.2	3	317.2	
Abu Qurqas	4.05	50.6	24.6	3.0	81.0	13.4	60.8	3.0	1.0	24.3	4	105.3	
Mahrass	2.80	35.0	17.0	2.1	56.0	9.2	42.0	2.1	0.7	16.8	4	72.8	
Mallawi	9.35	116.9	56.8	7.0	187.0	30.9	140.3	7.0	2.3	56.1	9	243.1	
Deir Mawas	4.20	52.5	25.5	3.2	84.0	13.9	63.0	3.2	1.1	25.2	4	109.2	
Quisiya	7.60	95.0	46.2	5.7	152.0	25.1	114.0	5.7	1.9	45.6	7	197.6	
Manfalut	5.10	63.7	31.0	3.8	102.0	16.8	76.5	3.8	1.3	30.6	5	132.6	
	82.9	1,036	504	62	1,657	273	1,243	62	21	497	60	2,154	
Costs of Construction (LE thousands)													
Nasser		325	632	78	21	772	12	203	59	8	149	487	2,745
Beni Suef		200	389	48	13	475	7	125	36	5	85	300	1,683
Biba		306	596	74	20	728	11	191	55	8	43	459	2,489
Maghagha		331	644	80	21	787	12	207	60	8	21	496	2,667
Beni Mazar		372	724	89	24	884	13	232	67	9	106	557	3,077
Matai		281	547	68	18	668	10	176	51	7	43	421	2,289
Samalut		531	1,034	128	34	1,262	19	332	96	13	64	796	4,307
Minia		763	1,484	183	49	1,812	27	476	137	19	64	1,142	6,155
Abu Qurqas		253	492	61	16	601	9	158	46	6	85	379	2,107
Mahrass		175	340	42	11	416	6	109	31	4	85	262	1,483
Mallawi		584	1,137	140	37	1,388	21	365	105	15	191	875	4,859
Deir Mawas		263	511	63	17	624	9	164	47	7	85	393	2,182
Quisiya		475	924	114	30	1,129	17	296	86	12	149	711	3,943
Manfalut		319	620	77	20	757	11	199	57	8	106	477	2,652
		5,178	10,075	1,243	331	12,303	186	3,231	932	129	1,275	7,755	42,639

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Eco cost? (0=N,1=Y) 1

LAYER THICKNESSES		ROADWAY	
Road sub-base	38.0 cms	No carriageways	2
Shoulder sub-base	15.0	No shoulders	2
Road base (binder)	22.0	Carriage width	7.5 meters
Wearing course	5.0	Shoulder width	2.5 meters
Shoul base (premix)	5.0	Paint lines/car	3
No. of tack coats	1	2-car culv fac	1.7

Right of way 26 meters
Cross-section Area 12.5 sq meters

UNIT PRICES	FIN	ECO FAC	UNIT
Embankment	5.00	1.291	per m3
Crushed stone sub-base	20.00	1.360	per m3
Prime coat	0.20	1.121	per m2
Binder/Premix base	45.00	1.337	per m3
Tack coat	0.15	1.068	per m2
Wearing course	52.00	1.344	per m3
Striping	260.00	1.038	per km
Minor structures	12,500	1.300	each
Land	3.60	1.000	per m2

Quantities (thousands, except kilometers)

LOCATION	LENGTH (kms)	EMBANK (m3)	SUB-BASE Road (m3)	SUB-BASE Should (m3)	PRIME COAT (m2)	ROAD BASE (m3)	TACK COAT (m2)	WEARING COURSE (m3)	SHOULD BASE (m3)	STRIPE MARKING (kms)	PIPE CULVERTS (no.)	AREA LAND (m2)
Nasser	5.20	65.0	31.6	3.9	104.0	17.2	78.0	3.9	1.3	31.2	7	135.2
Beni Suef	3.20	40.0	19.5	2.4	64.0	10.6	48.0	2.4	0.8	19.2	4	83.2
Biba	4.90	61.3	29.8	3.7	98.0	16.2	73.5	3.7	1.2	29.4	2	127.4
Maghagha	5.30	66.3	32.2	4.0	106.0	17.5	79.5	4.0	1.3	31.8	1	137.8
Beni Mazar	5.95	74.4	36.2	4.5	119.0	19.6	89.3	4.5	1.5	35.7	5	154.7
Matai	4.50	56.3	27.4	3.4	90.0	14.9	67.5	3.4	1.1	27.0	2	117.0
Samalut	8.50	106.3	51.7	6.4	170.0	28.1	127.5	6.4	2.1	51.0	3	221.0
Minia	12.20	152.5	74.2	9.2	244.0	40.3	183.0	9.2	3.1	73.2	3	317.2
Abu Qurqas	4.05	50.6	24.6	3.0	81.0	13.4	60.8	3.0	1.0	24.3	4	105.3
Mahrass	2.80	35.0	17.0	2.1	56.0	9.2	42.0	2.1	0.7	16.8	4	72.8
Mallawi	9.35	116.9	56.8	7.0	187.0	30.9	140.3	7.0	2.3	56.1	9	243.1
Deir Mawas	4.20	52.5	25.5	3.2	84.0	13.9	63.0	3.2	1.1	25.2	4	109.2
Quisiya	7.60	95.0	46.2	5.7	152.0	25.1	114.0	5.7	1.9	45.6	7	197.6
Manfalut	5.10	63.7	31.0	3.8	102.0	16.8	76.5	3.8	1.3	30.6	5	132.6
	82.9	1,036	504	62	1,657	273	1,243	62	21	497	60	2,154

Costs of Construction (LE thousands)

LOCATION	EMBANK	SUB-BASE Road	SUB-BASE Should	PRIME COAT	ROAD BASE	TACK COAT	WEARING COURSE	SHOULD BASE	STRIPE MARKING	PIPE CULVERTS	AREA LAND	TOTAL COST
Nasser	416	860	106	23	1,079	12	273	82	8	193	487	3,540
Beni Suef	256	529	65	14	664	8	168	50	5	111	300	2,170
Biba	392	810	100	22	1,017	12	257	77	8	55	459	3,209
Maghagha	424	876	108	24	1,100	13	278	83	9	28	496	3,438
Beni Mazar	476	984	121	27	1,234	14	312	94	10	138	557	3,967
Matai	360	744	92	20	934	11	236	71	7	55	421	2,951
Samalut	681	1,406	173	38	1,763	20	446	134	14	83	796	5,553
Minia	977	2,018	249	55	2,531	29	639	192	20	83	1,142	7,934
Abu Qurqas	324	670	83	18	840	10	212	64	7	111	379	2,717
Mahrass	224	463	57	13	581	7	147	44	5	111	262	1,912
Mallawi	749	1,546	191	42	1,940	22	490	147	15	249	875	6,266
Deir Mawas	336	695	86	19	871	10	220	66	7	111	393	2,813
Quisiya	608	1,257	155	34	1,577	18	398	119	12	193	711	5,084
Manfalut	408	843	104	23	1,058	12	267	80	8	138	477	3,420
	6,633	13,701	1,690	371	17,188	199	4,343	1,302	134	1,658	7,755	54,974

LAYER THICKNESSES		ROADWAY		UNIT PRICES	FIN	ECO FAC	UNIT		FIN	ECO FAC	UNIT
Road sub-base	38.0 cms	Carriage width	7.5 m	Embank	5.00	1.281	per m3	Tack	0.15	1.068	per m2
Shoulder sub-base	15.0	Shoulder width	2.5 m	Can emb	8.00	1.281	per m3	Surface	52	1.344	per m3
Road base (binder)	22.0	Stripes/carr	3	Sb-base	20.00	1.360	per m3	Stripes	260	1.038	per km
Wearing course	5.0	Right of way	13.0 m	Prime	0.20	1.121	per m2	Struct	10,000	1.300	per km
Shoul base (premix)	5.0	Cross-section	5.7 sq m	Base	45.00	1.397	per m3	Land	5	1.000	per m2
Eco cost? (0=N,1=Y)	0	Add can cr-sec	16.0 sq m								

FROM	TO	LNTH (kms)	CANAL LNTH	EMBANK EARTH (m3)	CANAL EARTH	SUB-BASE Road (m3)	SUB-BASE Should (m3)	PRIME COAT (m2)	ROAD BASE (m3)	TACK COAT (m2)	WEAR COURSE (m3)	SHOULD BASE (m3)	STRIPE MARKNG (kms)	STRUC (kms)	AREA LAND (m2)
Quantities (thousands, except kilometers)															
Aiyat	Gerza	22.4	3.3	128	53	66	8	224	37	168	8	3	67	22.4	291
Gerza	Nasser	33.7	25.0	192	400	99	13	337	56	253	13	4	101	33.7	438
Nasser	Beni Suef	3.7		21	0	11	1	37	6	28	1	0	11	3.7	48
Beni Suef	Biba	18.0	5.8	103	93	53	7	180	30	135	7	2	54	18.0	234
Biba	Fashn	11.1	4.5	63	72	33	4	111	18	83	4	1	33	11.1	144
Fashn	Maghagha	20.7	2.8	118	45	61	8	207	34	155	8	3	62	20.7	269
Maghagha	Beni Mazar	13.1	8.6	75	138	39	5	131	22	98	5	2	39	13.1	170
Beni Mazar	Matai	5.5	5.2	31	83	16	2	55	9	41	2	1	17	5.5	72
Matai	Samalut	8.2	1.9	47	30	24	3	82	14	61	3	1	25	8.2	107
Samalut	Minia	14.0	11.5	80	184	41	5	140	23	105	5	2	42	14.0	182
Minia	Abu Qurqas	16.7	2.0	95	32	49	6	167	28	125	6	2	50	16.7	217
Abu Qurqas	Mahras	8.3		47	0	24	3	83	14	62	3	1	25	8.3	108
Mahras	Mallawi	8.4	4.0	48	64	25	3	84	14	63	3	1	25	8.4	109
Mallawi	Deir Mawas	6.7		38	0	20	3	67	11	50	3	1	20	6.7	87
Deir Mawas	Quisiya	22.1		126	0	65	8	221	36	166	8	3	66	22.1	287
Quisiya	Manfalut	16.3		93	0	48	6	163	27	122	6	2	49	16.3	212
Manfalut	Manqabad	17.4		99	0	51	7	174	29	131	7	2	52	17.4	226
		246.3	74.6	1,404	1,194	725	92	2,463	406	1,847	92	31	739	246	3,702

FROM	TO	EMBANK EARTH	CANAL EARTH	SUB-BASE Road	SUB-BASE Should	PRIME COAT	ROAD BASE	TACK COAT	WEAR COURSE	SHOULD BASE	STRIPE MARKNG	STRUC	AREA LAND	TOTAL COST
Costs of Construction (LE thousands)														
Aiyat	Gerza	638	422	1,319	168	45	1,663	25	437	126	17	224	1,456	6,542
Gerza	Nasser	960	3,200	1,985	253	67	2,502	38	657	190	26	337	2,191	12,406
Nasser	Beni Suef	105	0	218	28	7	275	4	72	21	3	37	241	1,011
Beni Suef	Biba	513	742	1,060	135	36	1,337	20	351	101	14	180	1,170	5,660
Biba	Fashn	316	576	654	83	22	824	12	216	62	9	111	721	3,608
Fashn	Maghagha	590	358	1,219	155	41	1,537	23	404	116	16	207	1,345	6,013
Maghagha	Beni Mazar	373	1,101	772	98	26	973	15	255	74	10	131	851	4,679
Beni Mazar	Matai	157	666	324	41	11	408	6	107	31	4	55	358	2,168
Matai	Samalut	234	243	483	61	16	609	9	160	46	6	82	533	2,483
Samalut	Minia	399	1,472	825	105	28	1,040	16	273	79	11	140	910	5,297
Minia	Abu Qurqas	476	256	984	125	33	1,240	19	326	94	13	167	1,086	4,818
Abu Qurqas	Mahras	237	0	489	62	17	616	9	162	47	6	83	540	2,267
Mahras	Mallawi	239	512	495	63	17	624	9	164	47	7	84	546	2,507
Mallawi	Deir Mawas	191	0	395	50	13	497	8	131	38	5	67	436	1,830
Deir Mawas	Quisiya	630	0	1,302	166	44	1,641	25	431	124	17	221	1,437	6,037
Quisiya	Manfalut	465	0	960	122	33	1,210	18	318	92	13	163	1,060	4,453
Manfalut	Manqabad	496	0	1,025	131	35	1,292	20	339	98	14	174	1,131	4,753
		7,020	9,549	14,507	1,847	493	18,288	277	4,803	1,385	192	2,463	16,010	76,833

LAYER THICKNESSES		ROADWAY		UNIT PRICES	FIN	ECO FAC	UNIT		FIN	ECO FAC	UNIT
Road sub-base	38.0 cms	Carriage width	7.5 m	Embank	5.00	1.281	per m3	Tack	0.15	1.068	per m2
Shoulder sub-base	15.0	Shoulder width	2.5 m	Can emb	8.00	1.281	per m3	Surface	52	1.344	per m3
Road base (binder)	22.0	Stripes/carr	3	Sb-base	20.00	1.360	per m3	Stripes	260	1.038	per km
Wearing course	5.0	Right of way	13.0 m	Prime	0.20	1.121	per m2	Struct	10,000	1.300	per km
Shoul base (premix)	5.0	Cross-section	5.7 sq m	Base	45.00	1.397	per m3	Land	5	1.000	per m2
Eco cost? (0=N,1=Y)	1	Add can cr-sec	16.0 sq m								

Quantities (thousands, except kilometers)

FROM	TO	LNTH (kms)	CANAL LNTH	EMBANK EARTH (m3)	CANAL EARTH	SUB-BASE Road (m3)	SUB-BASE Should (m3)	PRIME COAT (m2)	ROAD BASE (m3)	TACK COAT (m2)	WEAR COURSE (m3)	SHOULD BASE (m3)	STRIPE MARKNG (kms)	STRUC (kms)	AREA LAND (m2)
Aiyat	Gerza	22.4	3.3	128	53	66	8	224	37	168	8	3	67	22.4	291
Gerza	Nasser	33.7	25.0	192	400	99	13	337	56	253	13	4	101	33.7	438
Nasser	Beni Suef	3.7		21	0	11	1	37	6	28	1	0	11	3.7	48
Beni Suef	Biba	18.0	5.8	103	93	53	7	180	30	135	7	2	54	18.0	234
Biba	Fashn	11.1	4.5	63	72	33	4	111	18	83	4	1	33	11.1	144
Fashn	Maghagha	20.7	2.8	118	45	61	8	207	34	155	8	3	62	20.7	269
Maghagha	Beni Mazar	13.1	8.6	75	138	39	5	131	22	98	5	2	39	13.1	170
Beni Mazar	Matai	5.5	5.2	31	83	16	2	55	9	41	2	1	17	5.5	72
Matai	Samalut	8.2	1.9	47	30	24	3	82	14	61	3	1	25	8.2	107
Samalut	Minia	14.0	11.5	80	184	41	5	140	23	105	5	2	42	14.0	182
Minia	Abu Qurqas	16.7	2.0	95	32	49	6	167	28	125	6	2	50	16.7	217
Abu Qurqas	Mahras	8.3		47	0	24	3	83	14	62	3	1	25	8.3	108
Mahras	Mallawi	8.4	4.0	48	64	25	3	84	14	63	3	1	25	8.4	109
Mallawi	Deir Mawas	6.7		38	0	20	3	67	11	50	3	1	20	6.7	87
Deir Mawas	Quisiya	22.1		126	0	65	8	221	36	166	8	3	66	22.1	287
Quisiya	Manfalut	16.3		93	0	48	6	163	27	122	6	2	49	16.3	212
Manfalut	Manqabad	17.4		99	0	51	7	174	29	131	7	2	52	17.4	226
		246.3	74.6	1,404	1,194	725	92	2,463	406	1,847	92	31	739	246	3,202

Costs of Construction (LE thousands)

FROM	TO	EMBANK EARTH	CANAL EARTH	SUB-BASE Road	SUB-BASE Should	PRIME COAT	ROAD BASE	TACK COAT	WEAR COURSE	SHOULD BASE	STRIPE MARKNG	STRUC	AREA LAND	TOTAL COST
Aiyat	Gerza	818	541	1,794	228	50	2,323	27	597	176	18	291	1,456	8,311
Gerza	Nasser	1,230	4,099	2,700	344	76	3,496	40	883	265	27	438	2,191	15,788
Nasser	Beni Suef	135	0	296	38	8	384	4	97	29	3	48	241	1,283
Beni Suef	Biba	657	951	1,442	184	40	1,867	22	472	141	15	234	1,170	7,194
Biba	Fashn	405	738	889	113	25	1,151	13	291	87	9	144	721	4,588
Fashn	Maghagha	756	459	1,658	211	46	2,147	25	543	163	17	269	1,345	7,639
Maghagha	Beni Mazar	478	1,410	1,049	134	29	1,359	16	343	103	11	170	851	5,954
Beni Mazar	Matai	201	853	441	56	12	570	7	144	43	4	72	358	2,760
Matai	Samalut	299	312	657	84	18	851	10	215	64	7	107	533	3,156
Samalut	Minia	511	1,886	1,121	143	31	1,452	17	367	110	11	182	910	6,742
Minia	Abu Qurqas	610	328	1,338	170	37	1,732	20	438	131	14	217	1,086	6,120
Abu Qurqas	Mahras	303	0	665	85	19	861	10	218	65	7	108	540	2,879
Mahras	Mallawi	307	656	673	86	19	871	10	220	66	7	109	546	3,569
Mallawi	Deir Mawas	245	0	537	68	15	695	8	176	53	5	87	436	2,324
Deir Mawas	Quisiya	807	0	1,770	225	50	2,292	27	579	174	18	287	1,437	7,666
Quisiya	Manfalut	595	0	1,306	166	37	1,691	20	427	128	13	212	1,060	5,654
Manfalut	Manqabad	635	0	1,394	177	39	1,805	21	456	137	14	226	1,131	6,035
		8,992	12,232	19,730	2,512	552	25,548	296	6,455	1,935	199	3,202	16,010	97,663

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