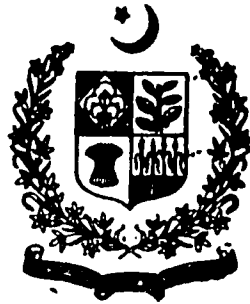


HASAN MASOOD  
01/02/87

**MINISTRY OF LOCAL GOVERNMENT  
AND RURAL DEVELOPMENT  
GOVERNMENT OF PAKISTAN  
ISLAMABAD**

PD-ABK-634

93586



## **PC—I PROFORMA**

**USAID ROAD RESOURCES MANAGEMENT PROJECT**

**March, 1987**

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PC-I PROFORMA  
USAID ROAD RESOURCES MANAGEMENT PROJECT

PART ' A '  
Project Digest

1. Name of Project: US AID Roads Resources Management Project
2. Authorities Responsible for:
  - i) Sponsoring: Ministry of Local Government and Rural Development, Government of Pakistan, Islamabad.  
  
United States Agency for International Development. (US AID)
  - ii) Execution: Government of Sind (GOS) / Provincial LGRD Department.
  - iii) Operation and Maintenance: Sind District Councils / Authorities.
3. Time required for completion of project (in months) 72 Months
4. Plan Provision

The Sixth Five Year Plan (1983-88) lays heavy emphasis on the development of the rural sector. The five point Social and Economic Development Programme announced by the Prime Minister in 1986 in line with the Sixth Five Year Plan, includes development of rural roads as a priority sub-sector.

As part of the economic assistance agreement existing between Government of Pakistan (GOP) and the U.S. Government, an amount of \$ 43 million (Rs. 731.00 million) have been allocated to fund this project. Rs. 264.588 Million (Equivalent of \$15.564 Million) is being provided by GOP in the form of already available staff time etc. The Project Cost is estimated at \$ 58.56 million or Rs. 995.59 million.

\* Assumed Currency Exchange rate US \$1 = Pak Rs.17.00

Note: The total project cost as cleared by concept committee meeting held on 30th January 1987 was Rs. 936.960 million including F.E.C. Rs. 246.40 million based at currency exchange rate of US \$ 1 = Pak Rs. 16.00 prevailing at the time of the said meeting. USAID commitment of US \$ 43.0 million remains firmed up.

The Federal Ministry of Finance and Economic Affairs, Government of Pakistan communicated its formal approval to USAID vide Secretary Economic Affairs Division's letter No.I(16)US-I/83, dated 20th July, 1986, stating that the Government of Pakistan recognises the necessity of placing maintenance ahead of expanding the rural roads network in order to preserve investments in the existing network. The US AID response was communicated vide Director US AID office Islamabad dated August 3rd, 1986, whereupon the subsequent actions are initiated.

The Government of Pakistan (GOP) and Government of Sind (GOS) have assured the United States Government of their full co-operation in carrying out the project. Necessary inputs required from GOP are being provided to expedite the project.

The project is focused in the province of Sind where Government officials estimate that 75 % of the officially recognised villages and more than 90 % of all villages do not have even a katcha (earthen) road connection. This reduced access to markets for goods and services, causes a generally slower integration of the remote areas into the national economy and is a major factor for the poor socio-economic conditions in the rural areas of Sind.

A Project Paper was formulated by USAID and was presented to the Concept Clearance Committee through MLGRD, and concept clearance was accorded to this Project on January 30th 1986, by the committee, chaired by Secretary General, Planning Commission, conveyed vide letter no: 7(6) DA/PC/83-FA dated 11th February 1986 recognising the need of the project on a pilot basis. The project agreement between GOP and USAID is under finalization and will be considered part of this PC-I.

##### 5. Relationship of the Project with the Objectives of the Sector.

Pakistan has a land area of 804,000 sq KM and a population of 93 million (mid 1984) of which over 70 per cent live in the rural areas. Agriculture (including livestock, fisheries and forestry) accounts for 30 per cent of the Gross Domestic Product (GDP). It employs 35 per cent of the labour force, and is the main source of income for most rural households.

At the time the Sixth Five-Year Plan was prepared in 1983, Pakistan had a total of about 87.7 thousand KM of provincial rural roads of which 28.5 thousand KM were paved and the remaining two thirds were gravel, brick-soled or earthen katcha roads. The rural roads thus accounted for approximately 80 per cent of the total national road system of about 113 thousand KM.

At present road resources are inadequately managed in Pakistan due to various constraints, while at all levels-national, provincial and district, a need for more and better roads is recognised. Due to financial constraints very little expansion of the rural road system is taking place, because the implementing

agencies use nearly all their resources to keep the existing system operational. There is an absence of adequate routine and periodic maintenance, which is causing a rapid deterioration of even existing roads.

The inadequacies of the road system have resulted in higher transport costs that are reflected in the economy. Notable effects are seen in higher prices for agriculture inputs and products, serious constraints on the delivery of agricultural inputs and the marketing of produce. There is a dire need to facilitate movement of inputs to farmlands for a sustained increase in food production.

Again the provision of health and educational services to the rural population is severely hampered because doctors and teachers are reluctant to serve in isolated areas without required physical amenities.

It is therefore established that in order to trigger off significant social and economic change in the rural areas, transportation infrastructure will have to be adequately improved, strengthened and maintained with utmost urgency.

The purposes of the project are to : (1) Establish a maintainable rural roads system in Sind and (2) Identify the policy, management and financial reforms needed to sustain maintainable national and provincial road systems. The objectives of the project shall be achieved through a combination of construction activities, technical assistance, training and equipment support.

This project also augments and supports the Asian Development Bank financed Farm-to-Market Roads project, and the Prime Minister's manifesto for rural roads as shown in Table 1.

6. <u>Cost of the Project.</u>	(Rs. Million)	
	F.E.C	L.C
US AID	261.8	469.2
Government of Pakistan	---	264.6 *
Total	----- Rs. 995.59 Million -----	

or \$58.56 Million (@ \$1 US = Pak Rs. 17.00)

\* in the form of already available staff time, etc.

Note: Total project cost as cleared by the concept clearance committee meeting held on 30th of January 1986 was Rs. 939.960 million including F.E.C. Rs. 246.40 million based at currency exchange rate of US \$ 1 = Pak Rs. 16.00 prevailing at the time of the said meeting. USAID commitment of US \$ 43.0 million remains firmed up.

TABLE 1

## RURAL ROADS - PAKISTAN

(Physical)

(In Kms)

S. No.	Description	Position of roads (1983)		Estimated Physical 4 Achievements (1983-86)	Estimated Targets			
		Overall	Rural Roads <sup>3</sup>		Provincial Programme			Prime Minister's Manifesto 1986-90
					1986-88	1988-90	1986-90 Cols. 6 & 7	
1.	2.	3.	4.	5.	6.	7.	8.	9.
1.	PUNJAB	39,211	34,901	3,766	2,510	2,800	5,310	3,958
2.	SIND	28,683	24,073	106	72	100	172	1,382
3.	NWFP	13,239	12,890	1,615	1,077	1,200	2,277	2,472
4.	BALUCHISTAN	22,396	21,835	241	160	200	360	3,930
5.	A.K.	3,163	3,163	N.A	N.A	N.A	N.A	N.A
6.	NORTHERN AREAS	2,129	2,129	N.A	N.A	N.A	N.A	N.A
7.	FATA	2,442	2,442	N.A	N.A	N.A	N.A	N.A
	Total :-	111,313 <sup>1,2</sup>	101,433	5,728	3,819	4,300	8,119	11,712

1. Track links not included
2. High Type roads around 42 percent
3. Excluding Municipal Committee/Corp. Roads
4. As per information obtained from the Provinces

Source: FRDEC

## 7. Annual Recurring Expenditure.

Paved Roads	Rs. 0.022 Million/KM.
Shingle Roads	Rs. 0.031 Million/KM.
Katcha Roads	Rs. 0.008 Million/KM.

Details are shown at para 17 of Part 'B'

## 8. Objectives of the Project Preferably in Quantitative Terms.

### A. Overview of Project Inputs:

The main inputs in support of the project may be summarised as follows:

i) Construction: Reconstruct or repair approximately 644 kilometres of paved roads, upgrade approximately 97 Kilometers to paved status and build 564 kilometres of improved katcha roads (or up to 3462 kilometers of minimal access roads).

ii) Commodities: Provision of an equipment component to carry out routine maintenance. Establish a maintenance equipment and support pool.

iii) Technical services: Maintenance Planning; Road System Improvement programme; Highway Policy and Finance component; in-country training.

iv) Training: Short-term in country training for provincial and district personnel; Study tours for senior personnel; long-term training in Transport and Financial Management.

v) Project operations: Operation of project offices in MLGRD and Sind LGRD divisions, road inventories in additional districts and project evaluations.

### B. National and Provincial Roads Policy Programme

The project provides a programme of policy analysis and training. The analysis will focus on:

- 1) Roads development policy.
- 2) Identification of the financial and institutional improvements needed to implement development of the road system consistent with Pakistan's needs and resources.
- 3) Developing a master plan for the Sind provincial network.

### C. Rural Roads Programme

The project will improve the system of planning and investment at the provincial/district level where Pakistan's rural

roads are managed. The rural roads programme is being implemented on a pilot basis in the 13 rural districts of Sind Province. The programme's three sub-components are as follows:

i) Road Maintenance Programming

Training and technical assistance will be provided to district council staff (including district engineers), and provincial personnel to increase: awareness of the role of maintenance in maximising road service capacity, understanding of basic maintenance principles and knowledge and use of techniques for planning; and, programming and monitoring rural roads maintenance and expansion activities.

ii) Road Maintenance and Management System

District Council Offices in Sind will receive assistance including intensive technical assistance, training and road maintenance equipment to enable them to establish a Maintenance Management System capable of adequately maintaining their road network.

iii) Road System Improvement

The rural road system will be upgraded to an acceptable technical standard to allow for efficient maintenance practices on the paved road network and priority sections of the remaining all-weather system. In some districts the katcha access network will also be expanded to serve villages now without a road.

It is estimated that upon completion of the project in 1992, there will be 1127 kilometres of maintained paved roads and 22540 kilometres of relatively unmaintained katcha roads.

Prepared by: Associated Consultancy Center (Pvt) Ltd. in consultation with MLGRD (FRDEC), GOS and USAID.

Checked by:

Approved by:

PART 'B'**PROJECT DESCRIPTION AND FINANCING****9A. Location of the Project**

The Indus Plains in Sind Province consist of sand, silt and clay alluviums hundreds to thousands of feet over their old sedimentary rocks. Existing vegetation consists of hardy grasses, bushes and scrub trees. Average rainfall is generally less than 10 inches per year.

The rural roads programme and the planning and training phase of the project will be implemented on a pilot basis in the thirteen districts of Sind Province (Figures 1 and 1.1).

The key element of the programme is the implementation / improvement of a Management System in the district engineering offices. A Road Maintenance Unit, with trained staff, equipment and other assistance will be established in each district.

There are 13 district councils in Sind with jurisdiction over the rural areas. Hyderabad and Sukkur Divisions each have six councils and one council exists to serve the needs of Karachi Division's 250,000 rural residents. Figure 2 shows the urban/rural population distribution pattern in the Sind.

Sind is essentially rural and agriculture in character. Fifty seven per cent of the population is rural, living in 67,000 settlements. The population is concentrated in the irrigated areas along the Indus, although 20 per cent of the rural population lives in the arid zone to the east where the Indus Valley gradually shades into the Thar Desert.

Rural roads are accorded a high priority by the rural population at all income levels in Pakistan. In a recent Gallop Poll conducted at the time of the 1985 elections, 22 per cent of the 10,000 rural voters polled identified "none or broken roads" as their main and first priority for action. This level greatly exceeded that of any other problem including power (14%), water (12%), health facilities (11%) and schools (10%).

The above priority was confirmed by officials at all levels of the Sind Provincial Government, who emphasise that improved communications are the first priority for rural development in the Sind province.

Presently the villagers, lacking a road link are unable to gain access to health services, schools and other social services clustered in the larger population centres. The Government's



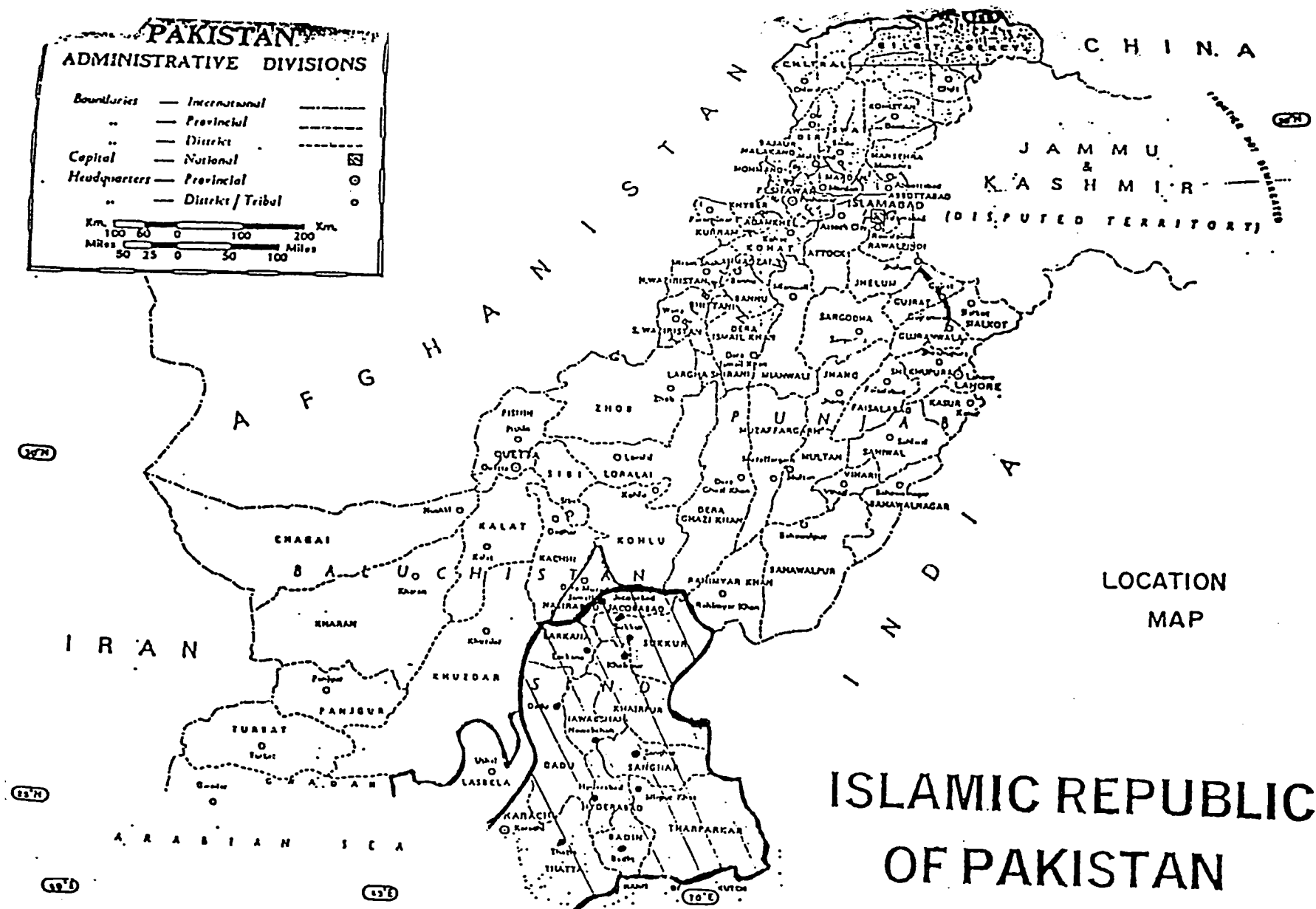
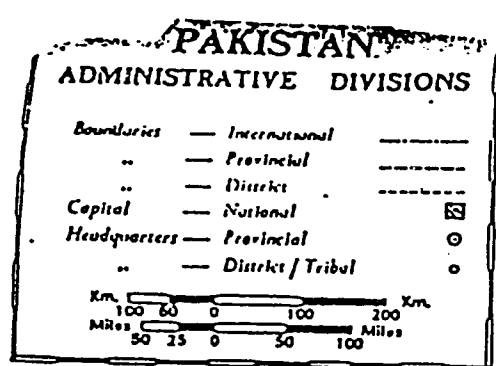


Figure 1

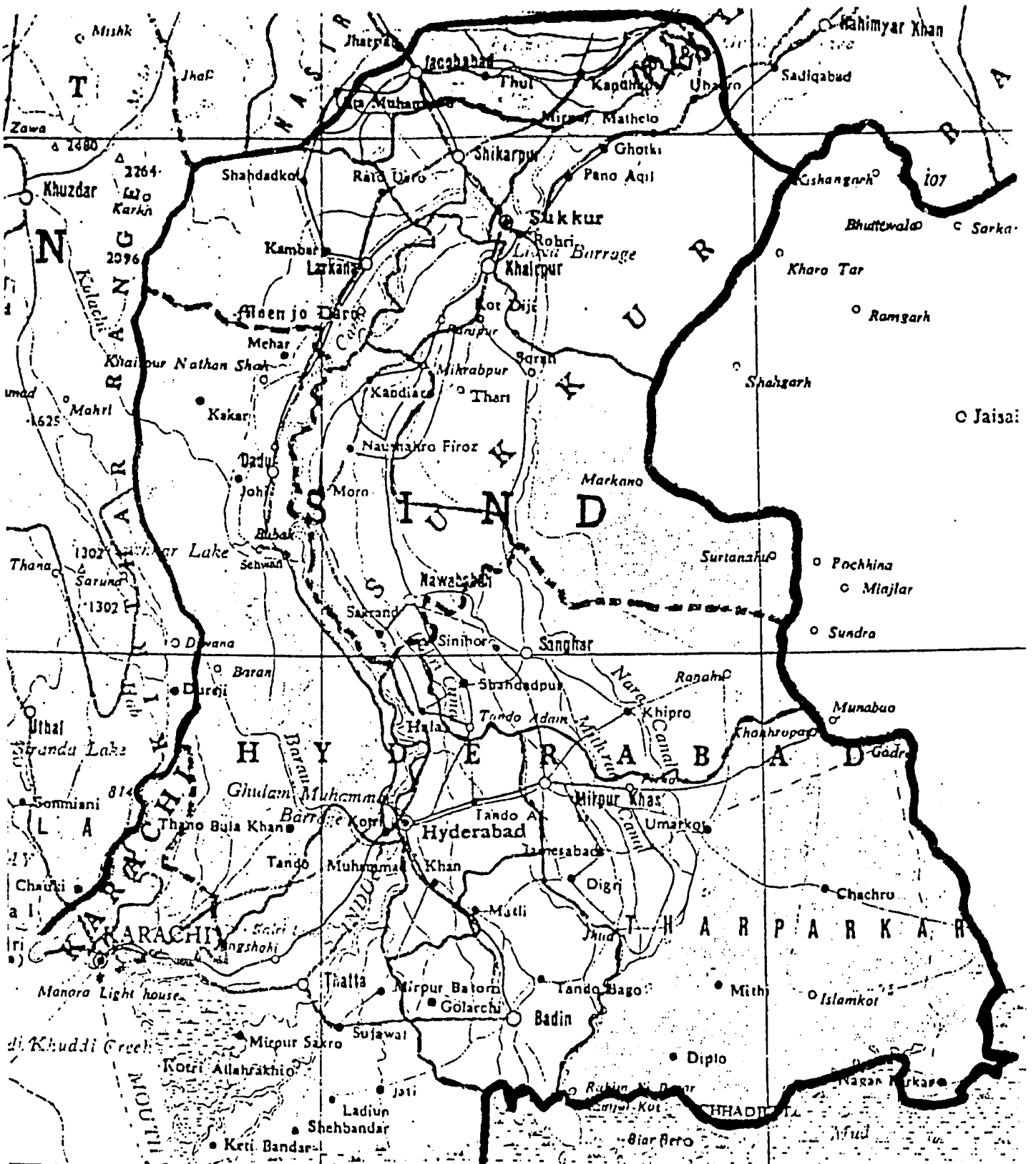


Figure 1-1 Location Map: Province of Sind

Figure 2

POPULATION DISTRIBUTION PATTERN IN THE PROVINCE OF SIND (000)

Sind	Urban	Rural	Total
Karachi East	1,697	188	1,885
Karachi South	1,396	--	1,396
Karachi West	2,114	42	2,156
Khairpur	247	734	981
Larkana	256	882	1,138
Nawabshah	266	1,381	1,647
Dadu	152	925	1,077
Sanghar	198	725	923
Tharparkar	257	1,245	1,502
Badin	82	694	777
Thatta	73	688	761
Shikarpur	115	505	620
Sukkur	319	779	1,098
Hyderabad	911	1,143	2,054
Jacobabad	158	854	1,012
Total	8,241	10,785	19,027

Source: 1981 Census

ability to bring these services to the villagers is also greatly reduced by the lack of a road. It has been experienced that it is practically impossible to post trained personnel in locations without a reliable road connection.

It is estimated that only about 26,000 of the Sind Province's 67,000 settlements are officially recognised villages. These typically have a population in the range of 1500-3000 inhabitants. The remaining settlements are villages that have not yet been given official sanction or are unauthorised hari settlements.

Even officially sanctioned villages are seriously lacking in social services including roads as well as basic utilities such as water, sewer and electricity and social facilities such as medical centres and schools. Provincial officials estimate that perhaps 25 per cent of the sanctioned villages are served by a road and virtually none of the other villages. In Jacobabad District for example, the Sixth Five Year Plan indicates that no village has sewerage and the few water systems are in the form of hand pumps. None have house connections or community water systems of a modern planned system level.

An improvement in the road system is also linked to a drop in the cost of transportation services used primarily by the low-income population. In a recent ADB study on rural roads, calculations of the economic costs of bus, pick-up and tonga services concluded that the actual fares are quite close to the economic levels and thus that "fares on most routes are competitive and set on the basis of short run marginal costs." Therefore it can be expected that fares will fall and the cost of passenger services reduced with provision of project benefits.

#### 10.A Existing Facilities

##### Description of Road System

The 1980 figures for national and provincial roads, broken down by province and type, and expressed in kilometres are as follows:

PROVINCE	UNPAVED	PAVED	TOTAL
Punjab	172	11,583	11,755
Sind	1,975	5,997	7,972
NWFP	3,700	3,543	7,243
Baluchistan	8,841	3,019	11,860
-----			
TOTALS	14,688	24,142	38,830

Source: NTRC, Planning Commission

Roads under the jurisdiction of the district councils; broken down in the same manner and expressed in kilometres, have the following totals:

PROVINCE	UNPAVED	PAVED	TOTAL
Punjab	16,823	3,856	20,679
Sind	13,172	193	13,365
NWFP	3,871	178	4,049
Baluchistan	4,596	99	4,695
-----			
TOTALS	38,462	4,326	42,788

Source: NTRC, Planning Commission

A large portion of the rural road network consists essentially of tracks that have been widened and built up but without proper alignment and other design considerations. They are rapidly deteriorating and have become unusable, causing the vehicle operating costs to be very high and thus the majority of the population is not able to contribute to the national economy.

Road lengths under maintenance responsibility of Sind district councils are shown in Table 2. The total lengths of existing metalled, brick paved and katcha roads are shown in Table 3. Table 4 indicates the main and link roads.

#### Sampling

An inventory of rural roads under all district councils in Sind is shown in Annexure 1. However very systematic and detailed data for road conditions, rehabilitation work requirements, traffic counts, etc., was available for the three sample districts of Sukkur, Shikarpur and Jacobabad only. This data was indexed with conditions in other districts and projections made for all districts in Sind. Most of the bituminous-treated (and pre-mix) and brick paved roads in the inventory are in fairly good condition. However, all road shoulders need to be fully rehabilitated and stabilised. Because of the instability of the shoulders on the brick paved roads, the bricks along the edges are getting dislodged. Since this work will require new material and major equipment, it is treated as rehabilitation.

The relatively few miles of existing gravel roads are not in a maintainable condition. These roads have been built with uncrushed, ungraded river gravels placed on an earthen base. Light compaction equipment have been used. The existing material could serve as a base course if deeply scarified, reshaped to a proper crown and thoroughly compacted. A 4" compacted layer of well graded (1" max) crushed rock could then be applied which would give a long lasting and maintainable surface. These are provincial felt needs and are subject to further improved designing.

**Table 2**  
**ROAD LENGTH UNDER MAINTENANCE**  
**RESPONSIBILITY OF SIND DISTRICT COUNCILS**  
**YEAR 1980**  
**(IN ROUNDED KILOMETRES)**

District	Low Type			High Type			Totals
	Earth	Gravel	Totals	Up to 12'	12' 1" to 18'	Over 18'	
Jacobabad	1157	0	1157	0	0	0	0
Larkana	640	40	680	9	0	0	9
Shikarpur	404	14	418	5	0	0	5
Sukkur	1500	64	1564	25	0	0	25
Khairpur	600	26	626	7	0	0	7
Nawabshah	1086	20	2006	36	0	0	36
Dadu	1474	0	1474	19	0	0	19
Hyderabad	459	0	459	0	48	0	48
Sanghar	1802	49	1851	26	0	0	26
Thatta	198	0	198	6	0	0	6
Badin	566	0	566	0	0	0	0
Tharparkur	3066	8	3074	13	0	0	13
Karachi East	243	0	243	94	0	0	94
Karachi West	0	0	0	-	-	-	-
Karachi South	0	0	0	-	-	-	-
<b>Sub-Totals</b>	<b>13195</b>	<b>221</b>	<b>13416</b>	<b>240</b>	<b>48</b>	<b>0</b>	<b>288</b>

Source: FRDEC / USAID

Table 3

LENGTH OF ALL KINDS OF ROADS (METALLED, BRICK PAVED AND EARTH WORK) IN ALL DISTRICT COUNCILS OF SIND PROVINCE

Name of Dist- rict Council	Type of Road			Total Length of Roads in each District Council.
	Metalled in KM	Brick Paved in KM	Earth Work in KM	
Jacobabad	13.5	3.8	606.0	623.3
Shikarpur	12.0	5.0	547.0	564.0
Sukkur	12.0	83.0	1221.0	1316.0
Khairpur	19.0	5.0	110.0	134.0
Sanghar	25.0	--	1923.0	1948.0
Nawabshah	83.4	41.7	1241.78	1366.88
Hyderabad	44.0	8.5	113.2	165.7
Tharparkar	21.0	--	4783.0	4804.0
Badin	18.0	23.0	272.0	313.0
Thatta	20.0	--	205.0	225.0
Dadu	35.0	10.0	1513.0	1558.0
Larkana	35.0	11.0	595.0	641.0
Karachi	95.0	--	242.0	337.0
Totals:	433.0	191.0	13372.0	13996.0 KM

Source: GOS (vide letter NO: RD/DIR(TECH)1-64/86/3181 dtd: 18/11/86)

**Table 4**

TOTAL LENGTH OF EXISTING METALLED, BRICK PAVED AND KATCHA ROADS  
IN SIND PROVINCE

1. Total Metalled Roads

a) Main Roads -----	189 KM
b) Link Roads -----	245 KM
Total -----	434 KM

2. Total Brick Paved Roads

a) Main Roads -----	37 KM
b) Link Roads -----	154 KM
Total -----	191 KM

3. Total Katcha Roads

a) Main Roads -----	7673 KM
b) Link Roads -----	5699 KM
Total -----	13372 KM

Grand Total: ----- 13997 KM  
For all types of Roads (Main and Link)

Source: GOS (vide letter no: RD./DIR(TECH)1-64/86/3181  
dtd: 18/11/86)



Currently the katcha (earthen) roads are all made of side borrow using farm tractors and no compaction is done. This has resulted in deterioration of major portions of the roads, to the extent that light vehicles cannot pass. However, most of the formations are stable and can be salvaged. The specific engineering requirements will be developed with the technical services teams' input of the project. Typical cross sections of existing Katcha link, Katcha main, Brick paved and Metalled roads are shown in figures 3, 4 and 5.

#### 10.B Present Maintenance Practices

Presently road maintenance practices consist of periodic resurfacing of paved roads, clearing and reopening roads after flooding etc. Work gangs also engage in minor repair work like patching, repair of shoulders, cleaning and repairing of drainage structures. The major portion of available funds is spent on work of non-maintenance nature which includes paving of earthen or gravel roads and even new construction.

#### National and Provincial Roads

The National Highway Board has defined the following maintenance activities:

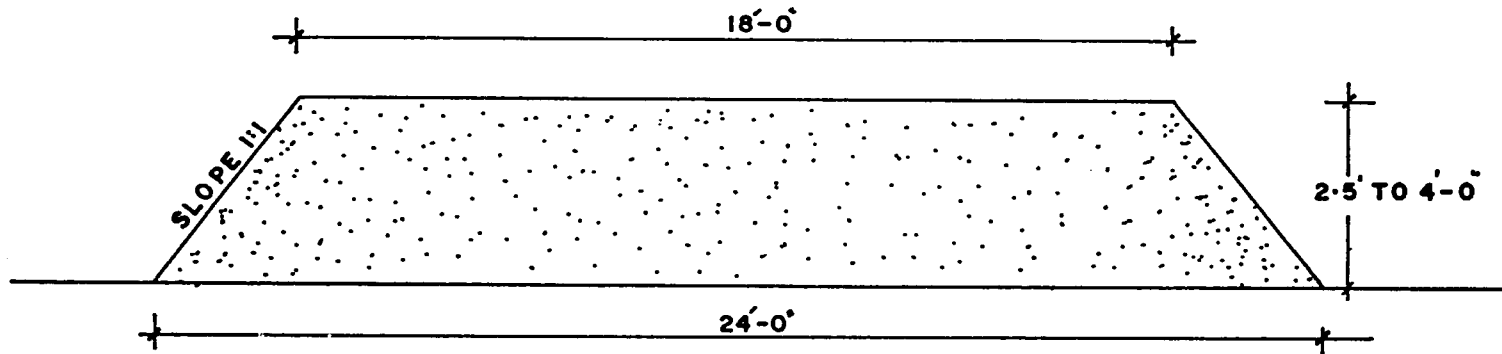
- Routine: Repair of potholes, structures, shoulders, retaining walls; repair/replacement of kilometre stones, painting and posting road signs, whitewashing boundary pillars; maintenance of tools and plant/workshop; and maintenance of railway crossings/rest houses.
- Periodic: Resurfacing (single, double or triple bituminous treatment).
- Emergency: Clearing of slide, flood and snow debris.

Due to resource constraints, only periodic and emergency work can be done on a regular basis. Resurfacing work is done by contractors because the provincial departments are not fully equipped to handle the work themselves. The province does have it's own work-gangs, but these are equipped with only the most basic hand-tools. This results in poor standard of work.

The resurfacing programme for national roads has set the target of resurfacing all roads every five years but the deterioration rate is much higher, and more effort will have to be made to prevent the roads from getting worse. Mere bituminous treatment will not perhaps suffice. An overlay of asphalt concrete may be considered which will cost more initially but the recurrent costs may be considerably lower.

The provincial C & W Department also maintains the provincial roads, but due to paucity of funds these roads receive scant attention compared to the national roads network.

TYPICAL CROSS SECTION OF  
EXISTING KATCHA LINK ROAD



TYPICAL CROSS SECTION OF  
EXISTING KATCHA MAIN ROAD

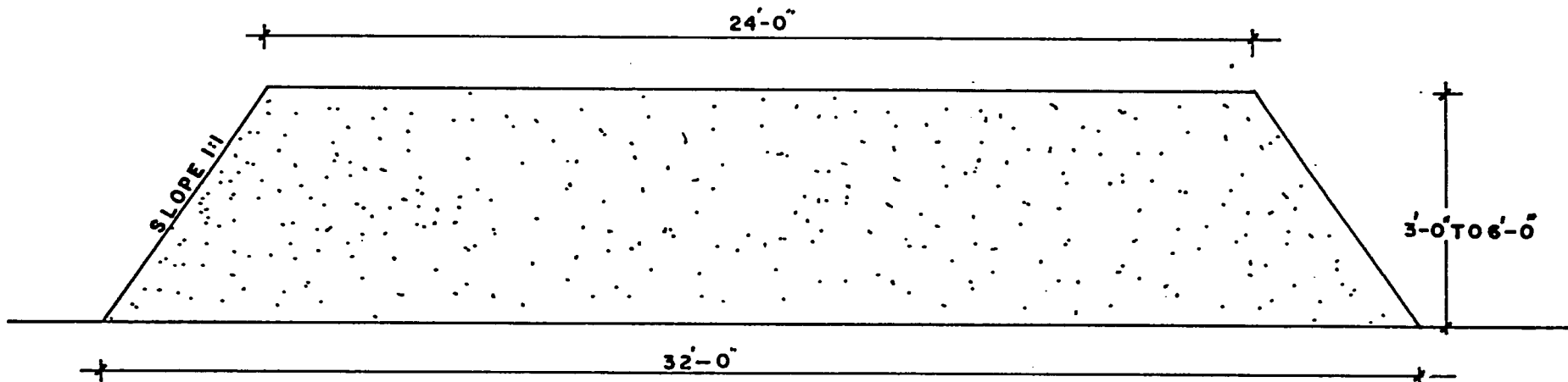
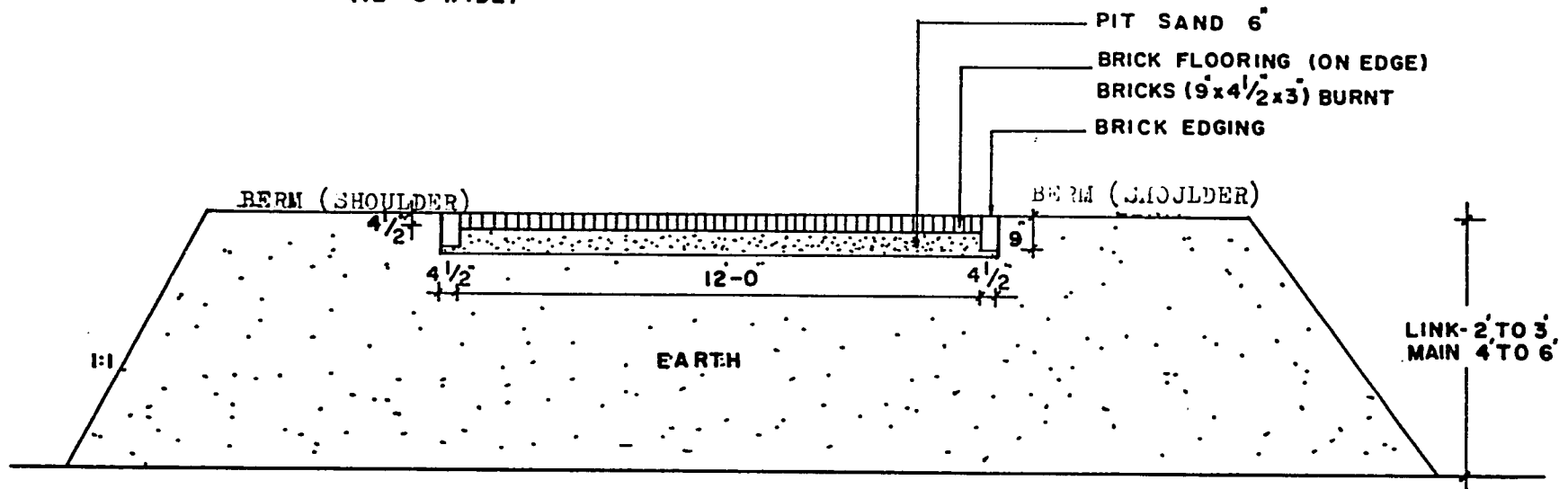


FIG. 3

Source: GOS (vide letter no.RD/DIR(TECH)1-64/86/3181 dtd.18/11/86)

# TYPICAL CROSS SECTION OF EXISTING BRICK PAVED ROADS

(12'-0" WIDE)

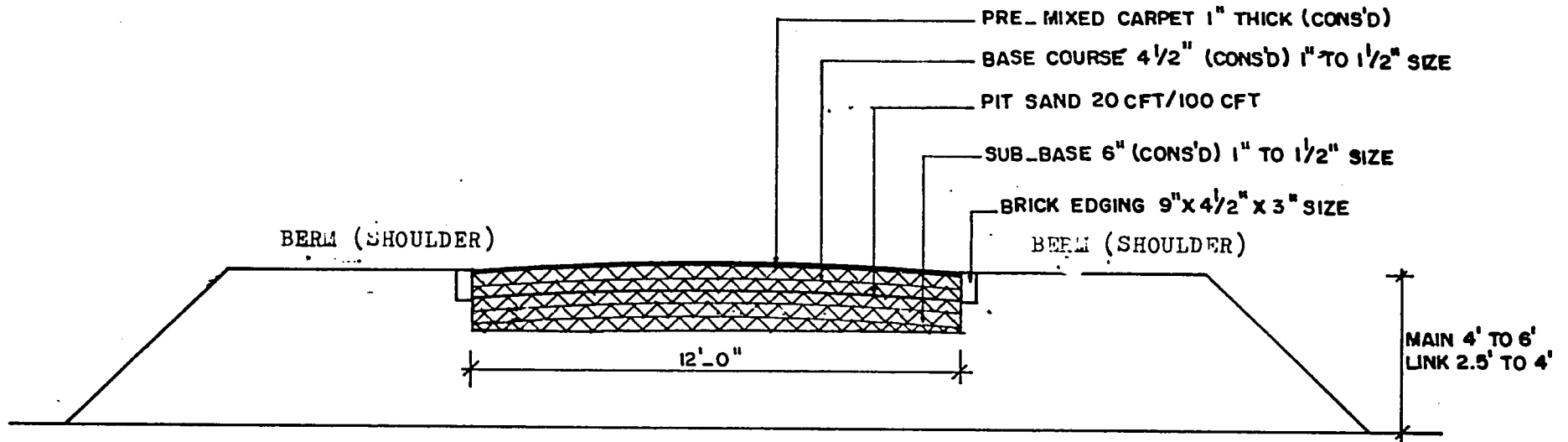


NOTE - BRICK PAVED ROADS ARE GENERALLY 12'-0" WIDE IN MAIN & LINK ROADS.  
BERMS ARE GENERALLY 3'-0" WIDE IN LINK ROADS & 6'-0" IN MAIN ROADS.

**FIG. 4**

Source: GOS (vide letter no.RD/DIR(TECH)1-64/86/3181ata.18/11/86)

**TYPICAL CROSS SECTION OF  
EXISTING METALLED ROAD 12'-0" WIDE**



**NOTE - METALLED ROADS ARE GENERALLY 12'-0" WIDE IN MAIN & IN LINK ROADS  
BERM ARE GENERALLY 3'-0" WIDE IN LINK ROADS & 6'-0" WIDE IN MAIN ROADS.**

**FIG. 5**

Source: GOS (vide letter no.RD/DIR(TECH)1-64/86/3181  
dtd.18/11/86)

Maintenance of almost all district roads is done by the District Councils, including construction work. LGRD is also involved in maintenance work. The districts own some equipment like dozers, asphalt heaters, rollers etc., but they are very few. The districts do not have permanent work gangs due to shortages of funds and hire labour on daily basis. The districts lack even rudimentary tools like, hand-operated asphalt sprayers, and compacters. None of the districts have facilities for servicing and repair of equipment. Equipment has to be taken to the agriculture departments' or to other private workshops for medium or higher level repairs.

There is no patterned management system applied wherein work activities are programmed, scheduled, accomplished and reported upon. Without such a system, there is no control over maintenance work and no basis from which to develop future resource needs.

#### 10 C. Technical Analysis of Existing Maintenance Practices

An intimate technical analysis carried out for the design of this project reached conclusions:

- i) The district engineers can benefit from further professional training and experience in order to carry out a sound program of road construction and maintenance. They are presently constrained by lack of funds, personnel, equipment and other non-technical constraints.
- ii) The current low standard of road construction methodology makes cost-effective maintenance difficult on rural roads.
- iii) If further training and technical support are provided to the existing system, construction and maintenance of rural roads to a higher standard can be accomplished. The current systems for planning, design, contracting, and supervising the work hardly promote completion of road works to the necessary standards. Improvements in these systems will require training and reorientation for both district personnel and private contractors, and an addition to the staff and equipment pool presently available to them. As an example the current strength of technical engineering staff is shown in Table 5.
- iv) Equipment and other inputs needed for road works are generally available except for heavy equipment, but better maintenance facilities have to be provided.
- v) The current mix of labor and machinery is highly labor-intensive and appropriate, but certain operations, such as compacting should be carried out on a semi-mechanized basis.
- vi) Major portion of the work to be performed under the project deals with existing roadways, where only minor corrections of alignments are necessary. This does not pose any technical problems.

TABLE - 5STATEMENT SHOWING STRENGTH OF TECHNICAL  
ENGINEERING STAFF IN RURAL DEVELOPMENT  
DEPARTMENT AND DISTRICT COUNCILS IN SIND

The present set-up of Technical Staff  
(Civil Engineers) in Rural Development Department  
and Local Government is as under:-

A. RURAL DEVELOPMENT DEPARTMENT

1. i)	Director (Tech) (Superintending Engineer) <u>B.S.P. 19</u>	1	Cn Sind Level
ii)	Executive Engineers <u>B.S.P.18</u>	2	Cn Divisional Level.
	a) For Hyderabad & Karachi Division		
	b) For Sukkur Division		
iii)	Assistant Engineers <u>B.S.P.17</u> (Generally for two Talukas)	36	Cn Taluka Level

B. LOCAL GOVERNMENT DEPARTMENT(DISTRICT COUNCILS)

i)	District Engineers <u>B.S.P.16 to 18</u>	13	On District Level (One for each District).
ii)	Sub-Divisional Officers <u>B.S.P.16</u>	5	For Five Districts only(Sukkur,Nawab- Shah,Shikarpur, Khairpur & Karachi)
iii)	Sub-Engineers <u>B.S.P.11</u>	40	On Taluka Level Averagely three in each District.

Source: GOS (vide letter no.RD/DIR(TECH)1-64/86/3181 dtd.18/11/86 )

vii) An important testing component needs to be included in the project's construction of katcha and shingle roads, to identify low-cost solutions to deal with the shortage of gravel, waterlogging, and flooding in some areas.

The purpose of the above testing is to identify low-cost measures using locally available resources that can substitute for the more costly techniques currently in use. Other factors are:

a). Standard of Performance by Construction Contractors

The standard of performance of contractors is not satisfactory due to the following:

- i) The contractors do not have personnel with formal training and sufficient engineering experience.
- ii) Low rates used to award contracts are not profitable and discourage the contractors from doing quality work.
- iii) In some cases the road design and specifications are not upto technical standards. Absence of proper supervision also leads to low standard of performance occasionally.

GOP's and USAID's experience with contractors indicate that if they are paid a fair rate based on specifications and a proper monitoring of their work is done there will be a marked improvement in their level of performance.

b). Availability of Equipment to Contractors

As a general practice contractors hire equipment from the public sector. Keeping in view the level of work that will be undertaken, more equipment will be necessary.

Without assurance of work contractors are reluctant to make large investments. During the project formulation, some contractors interviewed disclosed that they prefer to purchase their own equipment if the volume of work is enough as this assures them their resource availability.

The project involves a large volume of physical works in Sind requiring additional equipment needed for the work, which is being provided as a project component as earlier illustrated.

c). Soil and Water Conditions in the Sind

Some areas of Sind have severe water-logging and salinity rendering the road construction and maintenance difficult and expensive. Cost per KM of road is higher because formations have to be built to a greater height, drainage has to be given more attention. Failure in the past to undertake these measures has

resulted in swift deterioration of the roads, particularly during the monsoon seasons and when sugarcane and rice fields are flooded. Some farm areas occasionally undergo flooding of serious nature.

The soil in the eastern part of Sind is extremely sandy which makes adequate compaction difficult in the absence of additional material imported from other regions. Experiments have been carried out with oil or bitumen to stabilise the foundation of roads. However these methods need to be further refined.

Another problem in Sind is the lack of a reliable source of gravel which is generally procured from Baluchistan at sizable expenses. Lime stabilisation and crushed brick have been tried as substitutes but no conclusions have been arrived at as to their performance. Efforts are already in hand with C&W and LGRD departments which are very encouraging. Proven road building techniques suited to conditions in Sind exist and have been in use for years.

The project provides for a USAID technical services team to collaborate with local officials to experiment with several alternative design and construction techniques on stretches of district roads. Local engineers will be consulted while selecting design and construction methods after they have had an opportunity to observe conditions during one full year in the districts of Sind. In order to provide maximum time for observation of the experiments, the test sites will be completed during an early period of the project.

## 11. Description of the Project

### 11 A. Objectives

The primary goal of the Road Resource Management Project is to raise the productivity of public sector capital in the road sector, both financial capital generated from local and national sources and physical capital, in the form of the nation's large investment in public roads. The level of transport services provided to the rural areas by the existing road system will be increased, which in turn will promote a more rapid growth in national income and the standard of living in Pakistan.

The project will, on a model basis, promote and establish a maintainable rural roads system in Sind and identify the policy, management, and financial reforms needed to achieve a sustainable road system nationwide.

At the end of the project, the rural roads system will be characterised by the following key features:



- a. A network of paved rural roads will exist in each district which is built to a maintainable standard and is being maintained by the District Council Office. This system will provide the maximum level of all-weather service roads consistent with the financial and other resources of the district.
- b. A Road Maintenance Unit will be established in each District Council Office with the capacity to carry out an adequate program of routine, emergency, and periodic maintenance on the district's roads. The Road Maintenance Unit will have the trained staff, management systems, equipment, financial support, and linkages to local contractors needed to carry out this function both efficiently and effectively, as well as the support of facilities and staff in the Local Government Department.
- c. Sufficient resources to carry out road maintenance on the paved network will be allocated to this purpose on a priority basis, as a result of : i) increased recognition of maintenance in providing road services; ii) improvements in the generation and management of resources at the local level for roads and other purposes; and iii) adoption of policies at all levels which promote a more efficient overall allocations of the funds available for roads.

Table 6 shows the pre-project and post-project projections.

These targets are indicative, since they include roads to be constructed, rehabilitated and upgraded. Actual road activities will depend on districts own decisions regarding the use of their own project funds, the rate of traffic growth on rural roads and district maintenance performance.

Maintenance will not be on the entire rural road system at the end of the project, since districts do not have adequate funds to maintain all the katcha system. The project will set a realistic target of establishing a sustainable system on the entire paved network and as much as possible of the remaining network, particularly the brick and shingle roads.

These projections are discussed in more details in the Economic and Financial Analysis. Table 6 shows fewer miles of paved roads with the project than without, since resources will be directed toward maintenance and expansion of the katcha network. As the benefits of better maintenance and increased resource generation permit districts to expand their paved road system on a sound basis, this position will be reversed.

TABLE 6

Tentative Rural Rural Road Network in Sind,  
Pre-Project, With Project and Without Project  
 (Kilometers of road maintained, unmaintained  
 and total paved and katcha only)

Type of Road	Pre-project (1986)			Post-project (1992)			No Project (1992)		
	Main- tained	Unmain- tained	Total	Main- tained	Unmain- tained	Total	Main- tained	Unmaint- ained	Total
Paved (metaled)	0 *	689	689	1127	0	1127	0 *	1449	1449
Katcha (earthen)	0 *	16238	16238	0 *	22540	22540	0 *	18837	18837
TOTAL	0 *	16927	16927	1127	22540	23667	0 *	20286	20286

\* Beldar maintenance performed on these roads, both with and without project, but the requisite maintenance system is not in place.

\*\* Above figures are illustrative and necessary modifications would be undertaken on as-need be basis in consultation with GOP/GOS etc.

Source: FRDEC/USAID

Projecting the proposed district programme for the next 20 years, it is estimated that Sind Province would have 3542 kilometers of paved roads following the current maintenance strategy of rehabilitation every 3 to 5 years, versus 4830 kilometers following a sustainable well maintained road system strategy.

#### 11 B. Project Scope

The scope of the project is as follows:

- a. Construction: Reconstruct approximately 160 kilometres of paved roads, rehabilitate roughly 483 kilometres of paved roads (primarily shoulder rehabilitation), upgrade approximately 97 kilometers to paved status and build 564 kilometres of improved katcha roads (or up to 3462 kilometres of minimal access roads).
- b. Commodities: Provide each of the 13 districts with adequate equipment to carry out routine maintenance, assist the districts in construction of katcha access roads and, establish a maintenance equipment and support pool in Sukkur and Hyderabad.
- c. Training: District personnel will be given short-term in country training, study tours to Third World countries for selected senior personnel and long term training in transport planning and finance will be provided for five individuals at the national and provincial level.
- d. Technical services: Provide assistance in maintenance planning in Sind's 13 districts, assist the provincial LGRD to carry out the highway policy and finance component and to meet project needs in training and other areas.
- e. Project operations: Including the operation of project offices in participating divisions, road inventories in additional districts and project evaluations.

#### 11 C. Project Description

##### 1. Need for the Project

The national system of rural roads, national and provincial highways and other roads is central to Pakistan's transport system.

The rural and provincial roads account for approximately 80 per cent of the total national road system of about 113,000 KM. Further requirement of roads is estimated at 247,000 KM. Continued investment in the roads system of Pakistan has not resulted into

the rapid improvement originally assumed. Actually the inadequacies of the road system have resulted in higher prices for agricultural inputs and products, reduced access to markets for goods and services and a generally slower integration of remote areas into the national economy. The unserved population remains void of modern age benefits which are regarded as basic life needs. A large portion of the rural road network consists essentially of tracks that have been widened. Such roads fall rapidly into disrepair even where traffic volumes are low. This situation is assessed to be due to the following reasons:

- i. Inadequate financial resources are available to carry out the construction activities needed to achieve the government's stated goals for expansion of the major roads and the rural roads system, while maintaining the existing system at the minimum acceptable levels simultaneously.
- ii. Inadequate technical and managerial capacity, particularly at management levels, to plan and carry out an adequate responsible programme of road construction and maintenance.
- iii. The resources available are mislocated and greater emphasis is given to upgrading, reconstruction and major rehabilitation of existing roads at the expense of routine and periodic maintenance on the existing road system and new construction of rural roads to reach unserved villages. Monitoring of the national and provincial system is inadequate and there is inadequate planning or monitoring of the district's road programme. Resources are not generally used to assess the current status of roads, develop maintenance activities or determine present and future needs in order to allocate funds to their most productive use. Therefore it is recommended that there should exist a greater need to understand how we can manage our road resources more effectively.

This project will address these issues and will be conducted on a pilot basis in the province of Sind where Government officials estimate that as much as 75 percent of the officially recognised villages and more than 90 per cent of all villages do not even have a katcha road connection.

The priority for provision of roads has been confirmed by Sind Provincial Government officials who repeatedly state that improved communications are the first priority for rural development in the province. The presence of a road linking with a rural village particularly an all-weather connection, provides the following benefits:

- a. Expanded access to social services. Villagers lacking a road link are unable to gain access to health services, and the government's ability to bring these services to the villagers is reduced by the lack of a road. Trained personnel are generally unwilling to relocate to areas without a reliable road connection.

b. Better integration into the national society and economy. The rural population increasingly looks to non-agricultural employment to obtain a higher income and attain improved standards of life desired.

c. Improved market access. Access to markets for the purchase of consumer goods and agricultural inputs and for the sale of products is increased and the transportation costs associated with this economic activity are reduced.

## 2. Economic Evaluation

### i) Assumptions and Findings

The costs and benefits associated with rural roads have three basic components:

a. The cost to the government of building and maintaining the road (a financial cost that will be referred to as the fiscal cost to differentiate it from other financial costs);

b. The cost to road users of using the road, given its condition and amount of traffic; and

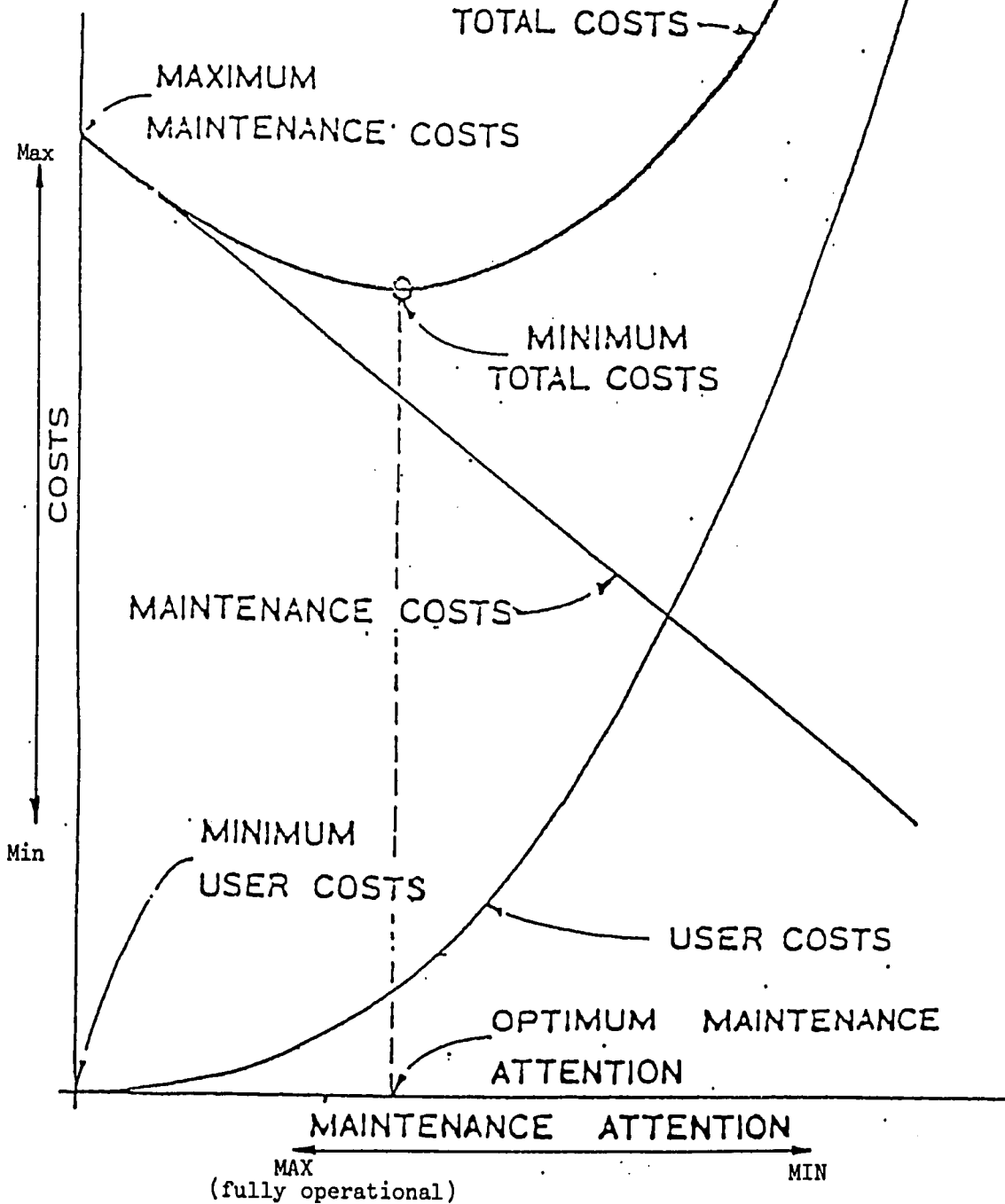
c. The benefit to the economy of expanded traffic, or lower costs and greater availability for goods and services.

More the government spends to build and maintain the roads, greater will be the financial savings in transport costs to road users. The relationship between maintenance expenditures and user costs is shown in Figure 6. As Figure 6 indicates, the lowest total financial cost is not achieved where user costs are lowest, but at a point that balances user costs against government's expenditures. The economic analysis of the project is based on projections of Sind district council revenues and expenditures for roads with and without the project over a 20 year period. This analysis has been prepared from a sample survey with more than 90% reliability status.

Benefits of road systems can be derived from two sources: a) reduced vehicle operating costs on additional roads upgraded to paved status and on other paved roads that are maintained, rather than rehabilitated periodically; and b) traffic generated on additional new katcha roads. This approach to estimating benefits is conservative since it excludes benefits from the following: a) increased economic activity due to expanded and improved paved network; b) benefits in other provinces from training and other assistance; c) benefits to the national and provincial highway system from the highways component; d) benefits generated in the non roads sector from increased district revenues; e) time savings due to improved road conditions; and f) social benefits from improved access to services.

Figure 6

# MAINTENANCE COSTS VS USER COSTS



Note: Horizontal and Vertical are equivalent scales. Source: FRDEC/USAID

The project costs are estimated as the sum of costs from two sources : a) additional expenditures by district councils on roads over the 20 year period; and b) AID's contribution to the project, measured as the project budget less inflation. In these projections traffic is assumed to be 25 vehicles per day on paved roads consisting of one bus and two trucks per day on katcha roads. A traffic growth rate of 3 per cent annually is assumed. Other modes of transportation are not accounted for. District revenues are projected to grow at 5 per cent annually without the project and 10 per cent with the project. District expenditures on roads are calculated as a percentage of total expenditures, based on the findings of the analysis of three sample districts of Sind.

In the with - project case, any district is assumed not to upgrade roads unless it has sufficient funds on a life-cycle basis and to devote about two-thirds of its construction funds to katcha roads. Without the project, districts are assumed to devote only one quarter of their road development funds to katcha construction. For both with- and without-project cases, district expenditures on roads are projected to continue at current level relative to total district resources. These assumptions are further discussed in Annexure 2. Tables 7 and 8 show the extracts of results of detailed analysis carried out with the assistance of GOS.

Even with extremely conservative assumption regarding traffic growth and benefit levels, the project is very attractive economically with an internal rate of return of 16 per cent. The high level of benefits is sufficient to cover the costs of the district expenditures and also the full cost of the project. A summary of project costs and benefits is provided in Table 9.

Projections made over a 20 year period indicate that the districts would be able to achieve a much greater expansion in their road network following the proposed strategy of upgrading and regular maintenance than continuing rehabilitation every three to five years. In the year 2006, Sind councils as a whole would have a total of about 87,123 kilometers of katcha roads and 5,068 kilometers of paved roads compared to only 33,408 kilometers of katcha roads and 3,623 kilometers of paved roads. In the former case this implies a five-fold increase in the katcha road network and a seven-fold increase in the paved network. With the project, since maintenance will be performed on all of the paved roads, there will be no need to reconstruct or rehabilitate these roads during the next 20 year period. Otherwise, without the project none of the paved roads would be maintained leading to an increasing expenditure on rehabilitation.

Under the project a surplus may remain in the maintenance budget, because districts cannot shift funds from the maintenance budget into construction. These funds would then be available for maintenance of katcha roads and construction of new katcha or

TENTATIVE DISTRICT EXPENDITURES ON THE ROADS WITH PROJECT

(IN Rs. Million and Miles)

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total Resources.	167885	175229	190652	207617	226279	246307	269387	294226	321549	351604	384664	421030	461033	505037	553440	606684	665253	729678	800546	878550	964251
Total Available for Roads Network			80725	88020	96044	104971	114581	125262	137011	149934	164150	179788	196939	215910	236724	259619	284803	312506	342979	376500	413372
Total Available for Paved Roads			34639	38239	42200	46557	51349	56621	62421	68300	75617	83536	92026	101366	111649	122941	135372	149016	164088	180634	198834
Deficit/Surplus in Maint. bug avail.			-249	265	831	1453	2138	2991	3719	4631	5633	6736	7949	9283	10750	12365	14140	16094	18242	20606	23206
Paved Roads at Year Start	428	512	600	600	600	659	723	794	873	961	1057	1163	1280	1409	1551	1708	1890	2070	2279	2509	2762
Total Paved Roads End of Year			600	600	658	723	794	873	961	1057	1163	1280	1409	1551	1708	1890	2070	2279	2509	2762	3041
Katcha Roads at Year Start	10096	10396	10712	11762	12884	13995	15162	16426	17799	19291	20913	22690	24605	26704	28995	31497	34231	37219	40488	44066	47934
Total Katcha Roads End of Year			11762	12881	13995	15162	16426	17799	19291	20913	22690	24605	26704	28995	31497	34231	37219	40428	44066	47934	52274
Paved Roads needing Rehabilitation			103	55	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paved Roads Not Maintained			331	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distt. Construction of Katcha Roads			922	996	1077	1166	1265	1373	1492	1623	1767	1925	2099	2291	2502	2734	2989	3269	3578	3917	4291
Distt. Upgrading to Paved (budget)						34058	37619	41529	45825	50546	55733	61435	67702	74592	82166	90494	99650	109718	120789	132963	146352

ASSUMPTIONS AND RATES OF GROWTH

Growth of District Income	0.1	Rate of growth in paved road construction	0.05
Growth in Provincial Grants	0	% of current roads budget available for construction	0
% of district revenue allocation to development	0.5	Reldar deadweight as % current, 1986	0.08
% of district revenue allocation to current	0.5	Paved roads built in 1986	51
% of district development allocation to roads	0.65	Frequency of rehabilitation for paved roads (years)	7
% of district current allocation to roads	0.21	% of construction after rehabilitation for paving	0.33
% of development grant allocation to roads	0.65	Annual maintenance cost, paved roads	19
Cost of paved rehabilitation per mile	290	Life-cycle cost, paved roads	54
Cost of upgrade to paved, district council	350	Cost of AID full-scale upgrade per mile	700
Cost of new katcha per mile	50	Cost of AID-built katcha road 20 ft.	300
		AID construction budget (Rs.)	52000

Table 7



TENTATIVE DISTRICT EXPENDITURES ON ROADS WITHOUT PROJECT

Projection of Rural Roads Financial Capacity, Sind Province District Councils without project  
Rs. '000 and miles

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total Resources	167865	175229	182941	191038	199540	208467	217840	227692	238016	248867	250260	272223	284784	297974	311822	326363	341632	357663	374496	392171	410730
Total avail. for road const., all sources	61388	63775	66281	68912	71675	74577	77623	80822	84180	87707	91410	95298	99330	103666	108167	112893	117855	123066	128536	134281	140312
Paved roads at start of year	428	512	600	693	791	896	1006	1123	1182	1243	1308	1375	1447	1522	1601	1672	1745	1823	1904	1990	2080
Rehab need for this year	60	60	62	62	62	62	62	144	149	154	160	166	172	179	202	210	219	228	237	247	258
Katcha roads at start of year	10086	10393	10712	11043	11388	11746	12119	12507	12911	13332	13771	14228	14704	15201	15719	16260	16825	17414	18029	18672	19343
Budget for rehab.	16800	16800	17248	17248	17248	17248	17248	40193	41625	43218	44797	46455	48196	50023	51931	53933	56033	58235	60543	62967	65505
Total katcha miles at year end	10393	10712	11043	11388	11746	12119	12507	12911	13332	13771	14228	14704	15201	15719	16260	16825	17414	18029	18672	19343	20045
Total paved roads at year end	512	600	693	791	896	1006	1123	1182	1243	1308	1375	1447	1522	1601	1672	1745	1823	1904	1990	2080	2174

Assumptions and Rates:

Growth of district income	0.05	Cost of paved const. per mile	350
Growth in provincial grants	0	Cost of new katcha per mile	50
% of dist. revenue alloc. to development	0.5	Rate of growth in paved road const.	0.05
% of dist. revenue alloc. to current	0.5	% of current roads budget avail. for const.	0
% of dist. development alloc. to roads	0.65	Fieldar deadweight as % current, 1986	0.11
% of dist. current alloc. to roads	0.21	Paved roads start of 1986	428
% of development grant alloc. to roads	0.65	Frequency of rehab for paved roads (years)	7
Cost of paved rehab per mile	280	% of const. for katcha roads	0.25

Table 8



paved roads. This further indicates that the road network could be increased within the available funds at a higher rate than assumed. These funds are not taken into consideration in the analysis, either as costs or benefits, introducing a further margin of conservatism into the analysis. The expansion of the katcha road system is responsible for nearly all of the net benefits accruing from the project. Benefits have been measured on the basis of the freight charges and passenger fares on truck and bus traffic. These costs are assumed to be at least equal to the value-added that the transport services generate for those using the road services.

ii) Methodology

Details of the methodology are shown in Annexure 2.

iii) Screening Procedure

The following illustrates the proposed selection of roads for construction and the operational system for its implementation. The system may be revised during project implementation if needed and as agreed to in writing between MLGRD, GOS and USAID.

The rural road component of the project is presently being proposed on a pilot basis in the Province of Sind only. Within limits of the funds available for construction, the allocation among rehabilitation, upgrading, and construction of new roads is visualised to be as follows:

- Priority-1: Bring existing paved roads to maintainable condition.
- Priority-2: Pave existing roads if these are included in maintenance budget of the district.
- Priority-3 Construct at least new katcha access roads to serve additional villages, as the districts meet their maintenance commitment on the all-weather network agreed upon.

(above prioritisation is related to concurrent activities)

Selection of roads within categories will be based on traffic levels, as measured by the project-sponsored traffic counts and road inventories and, for new roads, on the basis of population served per mile of road. Each year the districts will identify the maintenance commitment they are willing to assume for the following year. Any potential for expansion of the all-weather network will then be identified on the basis of the difference between the currently maintainable network and the amount they are willing to maintain. This difference will then be translated into a construction budget for rehabilitation, reconstruction, and upgrading.

The construction budget for each district may be based on two factors: the population of the district and its performance in meeting its maintenance commitment for the previous year. The first year's construction budget will be determined on the basis of population alone. In subsequent years, districts meeting their maintenance commitments will receive the construction funds on the basis of population. The construction budget for districts meeting a lower percentage of their commitment will be proportionally reduced, and the funds thus released, redistributed among districts with better performance. District performance will be measured by the budget and expenditures of the Road Maintenance Unit in consultation with GOS in the first three quarters of the year. In addition, the construction programme in districts that fall short of their commitment will shift toward katcha roads. Upgrading of paved roads can therefore be funded in districts that have met their commitment on the existing maintainable paved network.

On the basis of these factors, each year, the GOS / LGRD assisted by MLGRD, USAID, and technical services contractor will calculate the construction budget for each district for the forthcoming year. The total budget will be divided into two "pools" on the basis of the district's proposed maintenance commitment for the following year.

The "Paved road Pool" will include sufficient funds to rehabilitate existing paved roads or, if this work has been completed, upgrade additional roads to paved status, up to the limit of the district's maintenance commitment. Additional funds remaining in the construction budget can go to the "katcha road pool", for construction of new katcha roads. A proposed list of paved roads to be rehabilitated, existing roads to be upgraded and new katcha roads to be constructed from the remaining funds will be prepared by the districts. Funds may be transferred from the paved road pool to the katcha construction pool. Priority roads will be identified by the district council itself, and the district engineer will then prepare rough estimates of the likely cost of such construction, and identify a preliminary set of road works with a total cost of 110-120 percent of the specified construction budgets. These proposals will also indicate the population to be served by each road, the length of the road, and the current level of vehicular traffic. The district proposals will be reviewed by the Divisional Coordination Committee and the provincial authorities assisted by the technical services team. Roads without sufficient vehicular traffic, new roads serving insufficient population and any road with an extremely high cost per mile will be excluded from the list.

A revised list will then be prepared and authorized by the Divisional Committee for final costing by the provincial LGRD assisted by the technical services team. Once the specifications and cost estimates have been approved, the final list will then be made up of the top priority roads in each category, subject to the

total budget available. Final selection will be according to the standard procedures currently used for selection of roads and development programmes in the Province of Sind which may include input from the elected representatives of the districts. The provincial LGRD will then proceed with tendering of works.

Following approval of the awards by the district council, construction will begin, according to standard GOP procedures. Payment will be made from the provincial LGRD Personal Ledger Account according to the GOP procedures after inspection by both the district engineer and the technical services contractor. If desired, USAID engineers and LGRD engineers may also inspect some of the roads prior to certification for payment. Amount of cost overruns is expected to be very small. The small size of each job will limit the impact of occasional underestimates.

iv) Sample Feasibility Studies

Conventional project evaluation methodology had been applied to systematic and complete data from the three sample districts of Sukkur, Shikarpur and Jacobabad. 40 per cent of all roads were surveyed and inventoried in these districts. A Life Cycle-cost Analysis for rural roads was undertaken including Recurrent Cost Analysis and Cost Benefit Analysis. Different maintenance strategies were evaluated to determine the optimal allocation of resources for maintenance. These data were then projected to cover the entire province of Sind. The results are indicative but clearly demonstrate the ranking of various strategies and savings accrued. A Sensitivity Analysis was also conducted on the data to further prove the validity of the Project concept and strategy.

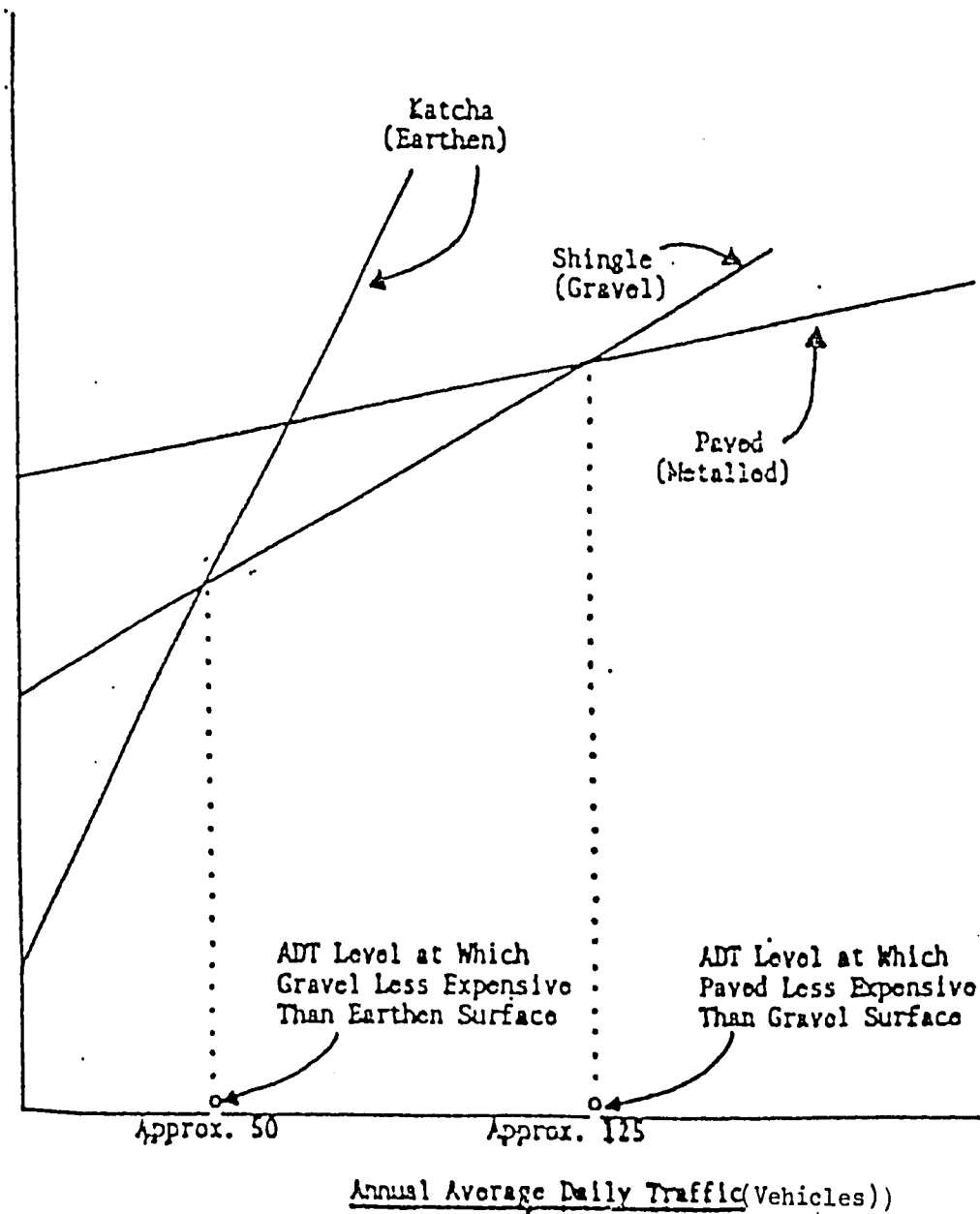
v) Traffic Growth

Annexure 3 shows the three sample district traffic count. The district council officials estimate that the 12-hour counts would be higher by at least 40 to 50 per cent during a harvest period. Again, these data are purely indicative. It has been ascertained that properly organised traffic surveys can be conducted to forecast traffic growth in order to prioritize selection of roads as discussed earlier. Figure 7 shows the relationship between road costs and traffic levels for different types of roads. In the projection, traffic is assumed to be 25 vehicles per day on paved roads and to consist of one bus and two trucks per day on katcha roads. Traffic is assumed to grow at 3 per cent annually. At the end of 20 years, traffic on paved roads is projected to reach 45 vehicles per day while katcha roads traffic is projected at slightly fewer than 4 trucks and 2 buses. These estimates are extremely conservative and still show that IRR of approximately 16 per cent is achieved.

Figure 7

Relationship Between Road Costs and Traffic Levels

Cost of Initial Construction  
Plus Regular Maintenance



Source: FRDEC/USAID

vi) Generated Passenger Traffic

Detailed survey can be carried out to forecast traffic data. However, despite not accounting for generated passenger traffic as such, the project is still very feasible and attractive economically.

vii) Vehicle Operating Costs

Vehicle operating cost savings for various conditions of roads were calculated as shown in Table 10. These savings were then applied to the projected traffic levels and mileage to derive total vehicle operating cost savings between with and without the project. This reinforces the view that in the current situation it is economically more attractive to build at least new katcha roads. The stream of benefits generated from new katcha road construction far exceed those from upgrading at any reasonable traffic level.

viii) Analysis of Implementation Approaches

Following approaches were analysed :

1. Build to a maintainable standard and then carry out both routine and periodic maintenance.
2. Build and then rehabilitate every three years.
3. Build and then rehabilitate every five years.
4. Build and then rehabilitate every eight years (this amounts virtually to reconstruction).
5. Build to a lower standard, and then upgrade in the third year to a maintainable standard and maintain regularly thereafter.

Only the first four approaches have been analysed for the Katcha road network since two-staged construction is not appropriate on katcha roads. The current practice lies between rehabilitating every 3 to 5 years. The full results of the analysis are attached in Annexure 4. In addition to the life cycle analyses, alternatives were also considered for treatment of an existing road that is currently in a condition requiring rehabilitation and for a road now requiring complete reconstruction. The results of these analyses are also provided in Annexure 4. A discount rate of 12 per cent was used to analyse all approaches in both discounted and undiscounted terms.

Financial costs rather than economic costs were used throughout the analysis. Although some of the inputs used for road construction and maintenance have an economic opportunity cost that differs from their financial cost, the mix of inputs is very

Table 10  
OPERATING COST SAVINGS PER VEHICLE-DAY  
ON PAVED ROADS

Road Condition	(Rs.) Vehicle Operating Cost Savings per Vehicle per day
Paved road in good condition compared to paved road in fair condition.	.14
Paved road in good condition compared to paved road in poor condition.	.54
Paved road in good condition compared to katcha road in average condition.	1.26

Source: NTRC, Planning Commission, FRDEC



similar across the various approaches for managing any given type of road. Hence this simplification does not distort the results.

Based on an estimated average ADT of 100, this analysis indicates that the current strategy of rehabilitation every 3 to 5 years, leads to an increase in Vehicle Operating Costs of roughly 20%. Over the 20 year life of the road, this produces an unnecessary cost to the economy that, discounted at 12% has a present worth of Rs. 632,000 per KM., or over Rs. 381 million for the country as a whole.

All rural roads have been assumed to have the same life span of 20 years, regardless of the maintenance strategy adopted. In reality, poorly maintained roads will not last nearly as long as well maintained ones, but this factor has been ignored, further biasing the analysis in favor of the existing approach. The analysis of life cycle and reconstruction/rehabilitation options demonstrates conclusively that a strategy of routine and periodic maintenance has a much lower cost per KM. for all three types of road and particularly for the paved roads, in both discounted and undiscounted terms. The results of the analysis for strategies 1, 2 and 3 are described in detail in Table 11. The overall findings of the analysis strongly confirm that the regular maintenance provides dramatic savings over the current practice for both paved and katcha roads. Thus regular maintenance is clearly superior to all other alternatives, even without considering the additional benefits to the rural economy from an improved road standard. However the need to construct new roads cannot be outrightly ignored. The total potential savings from a shift from rehabilitation every 3-5 years to regular maintenance are shown in Table 12 which summarises these savings in two forms: 1) discounted total saving over a 20 year period and 2) average annual savings in fiscal terms.

This analysis indicates that the current practices constitute misallocation of funds. By shifting to a more cost - effective approach, the districts could achieve a higher level of performance on the paved network, while also generating considerable savings for expansion to areas now unserved by a road of any kind. It has been estimated that a typical district with 15 Km of paved road wastes about Rs. 1.28 million annually if it follows rehabilitation every three years rather than maintenance. This is equal to approximately 50 per cent of the districts spending on roads from its own resources. Even the comparison of routine maintenance with the rehabilitation every five years shows that an estimated wastage of Rs. 570,000 per KM. occurs.

If the funds lost by following the three year rehabilitation approach on the paved roads were instead invested in construction of katcha access roads ( at Rs. 200,000 per Km ), the savings would allow the addition of 460 Km. of new katcha road per year or

Table 11  
 Summary of Recurrent Cost Analyses  
 Summary Comparison of Alternative Management Strategies  
 for Rural Roads  
 (Cost in 1985 Rupees '000)

Type of Road Strategy #	Paved			Shingle			Katcha		
	1	2	3	1	2	3	1	2	3
<b>1. Full Life Cycle (New Road)</b>									
Total Life Cycle Cost (discounted)	760	885	781	547	599	551	310	344	372
Total Life Cycle Cost (Financial)	1051	1574	1286	963	1053	921	421	494	572
Average Cost Per Year (Financial)	50.0	74.9	61.2	45.9	50.1	43.9	20	23.5	27.2
Average Cost Per Year Excluding Initial Investment (Financial)	21.6	53.7	39.3	30.9	35.4	28.8	8.1	11.7	15.6
<b>2. Rehabilitation Strategies</b>									
Total Life Cycle Cost (discounted)	318	564	543						
Total Life Cycle (Financial)	610	1253	1048						
Average Cost Per Year (Financial)	29.0	59.7	49.9						
<b>3. Alternative Reconstruction Strategies</b>									
Total Life Cycle Cost (discounted)	759	1005	901						
Total Life Cycle Cost (Financial)	1043	1694	1406						
Average Cost Per Year (Financial)	49.7	80.7	66.9						
				Notes:					
				A. All figures drawn from life cycle analysis tables Annexure 4					
				B. Strategies are:					
				1. Construction, rehabilitation or reconstruction to a maintainable standard followed by continued routine and periodic maintenance for 20 year life.					
				2. Construction followed by rehabilitation every three years for 20 years.					
				3. As in #2 but rehabilitation every 5 yrs for 20 yrs.					

Source: FRDEC/USAID

TABLE 12  
TENTATIVE SAVINGS FROM IMPROVED ROAD MANAGEMENT STRATEGIES  
 ( Rs. Thousand )

Strategy 1 compared to:	Strategy 2		Strategy 3	
	Per Km. Total		Per Km. Total	
<b>1. Total saving ( Discounted )</b>				
a. Paved Roads	125	462,426	21	78,810
b. Shingle Roads	51	229,680	3	15,120
c. Katcha Roads	34	1,152,000	62	2,094,000
Total:		1,844,106		2,187,930
<b>2. Annual Saving ( Undiscounted )</b>				
a. Paved Roads	25	92,130	11	41,403
b. Shingle Roads	4	20,250	- 2	- 9,450
c. Katcha Roads	3	117,300	7	243,780
Total		229,680		275,733

Source: NTRC, Planning Commission, FRDEC

9200 over 20 years, the equivalent of over one-quarter of the current katcha network. Table 13 shows that the districts have sufficient financing from their own and provincial sources to carry out periodic rehabilitation of all of the paved roads.

Using the district's tax revenues only, there are enough funds to maintain almost 95% of the paved roads, provided the funds are not used elsewhere. There are more than enough funds to maintain all of the district roads that are in a maintainable condition, however, these are estimated to amount to only 40 per cent of the current paved network.

The approach recommended is to offer the districts a choice between maintaining all of the paved roads and about half of the katcha roads with no expansion or upgrading of the system until revenues increase or to maintain all of the paved roads and use the remaining funds to expand the katcha roads to unserved areas or some combination of the two. Districts will be provided assistance in making this choice and in choosing the roads to be maintained and the new access roads to be constructed.

#### ix) Cost and Benefit Streams

Details have been shown under Economic Evaluation, item i and in Table 9.

### 3. Road Improvements / Construction

As noted under item 11 C, 2-iii, priorities will have to be established after detailed data is available during implementation. However tentative targets have been shown under 11 A, Table 6.

### 4. Construction / Maintenance Equipment

The main equipment being purchased under the project comprise of light graders, transport equipment, and other maintenance equipment to be provided to the districts to carry out routine and emergency maintenance. The cost of equipment purchased by contractors, including amortization and a reasonable profit margin is included in the estimate of new construction and periodic maintenance costs. Details are shown in Annexure 5. It is expected that most of the equipment will be procured from the U.S. and the cost estimates have been developed accordingly. The cost estimates also include a 15 per cent allowance for spare parts and an additional allowance has been included separately to allow for transportation and other charges related to procurement and delivery. Table 14 shows the tentative list of equipment to be provided to each district to support road construction.

Table 13  
Comparison of Life Cycle Road Needs and Funding Available

	Life Cycle Cost (Initial Construction) (and Maintenance)			Life Cycle Cost (Maintenance Costs Only)		
	Km.	Cost/ Km.	Total Cost	Cost/ Km.	Total Cost	Paved and gravel Only
<b>Approach 1: Maintenance</b>						
Type of Road	Km.	Cost/ Km.	Total Cost	Cost/ Km.	Total Cost	Paved and gravel Only
Paved- 20 ft	3700	50.05	185185	21.55	79735	79735
Shingle-20 ft	4500	47.75	214875	32.89	148005	148005
Katcha- 20 ft	34000	20.07	682380	8.07	274380	
Total	42200		1082440		502120	227740
<b>Approach 2: 3 Year Rehabilitation</b>						
Type of Road	Km.	Cost/ Km.	Total Cost	Cost/ Km.	Total Cost	Paved and gravel Only
Paved- 20 ft	3700	74.95	277315	53.7	198690	198690
Shingle-20 ft	4500	50.14	225630	35.4	159300	159300
Katcha- 20 ft	34000	23.52	799680	11.7	397800	
Total	42200		1302625		755790	357990
			Deficit/ Surplus		Deficit/ Surplus	Deficit/ Surplus
District Budget:	175000		-907440		-327120	-52740
LGRD Annual Development Plan Roads:	120000					
Total Available For Roads:	295000		-787440		-207120	67260
Km. of new roads that could be built annually with surplus:						108

Source: GOS/FRDEC/USAID

**Table 14**  
**Tentative Maintenance Equipment List**  
**(Rs. '000)**

Item	Unit Cost	Districts		Divisions	
		No.	Cost	No.	Cost
2.5 ton pick-up, double cab	210	2	410	-	
1.5 ton pick-up, single cab	160	1	160	2	320
Motor Grader, 120-130 HP	1200	1	1200	1	1200
Pneumatic-tired roller, 12-14 T	800	-		2	1600
Vibrating Roller (hand) 1 T	100	1	100	-	
Backhoe/Loader, 1 CY	1000	1	1000	-	
Front-end Loader, 1.5 CY	1200	-		1	1200
Low-Bed Tractor Trailer, 25 T	640	1	640	-	
Dump Truck, 8 T	600	1	600	2	1200
Water Tanker, Truck, 2000 Gal	350	-		1	350
Water Tanker, Trailer, 200 Gal	35	1	35	-	
Farm Tractor, Trolley, 60-80 HP	150	1	150	2	300
Jack-Hammer, Engine Driven	20	2	40	-	
Tamper-Compactor, Engine Driven	25	2	25	-	
Vibrating plate Compactor	40	2	80	-	
Asphalt Sprayer, (hand) 50-Gal	70	1	70	-	
Concrete Mixer, Engine Driven 1.3 CY capacity	60	1	60	-	
Hand Tools (total per crew)	10	8	80	-	
Shop Equipment & other related facilities				1	1700
<b>Total per districts/divisions</b>			<b>4755</b>		<b>7870</b>

**Total for 13 districts, 2 divisions**                      **Rs. 77.555 Million**

(Equivalent US dollars @ Rs. 17.00 per \$1.00 US = \$4.56 Million)

**Notes:**

1. Soil Testing Laboratory Equipment may be procured in lieu of motor graders if the latter are arranged by MLGRD.

2. Equipment already available with MLGRD, LGRD or District councils needing repairs may be repaired in lieu of certain items proposed to be procured under this list, thus saving in major procurements.

3. Actual equipment would be finalised with the consultation of GOS.

4. Some light vehicles may be provided with the above funds for operation of the project (at Federal/GOS levels)

Source: GOS/FRDEC/USAID

## 5. Consulting and Design Services

Under the project, upto about Rs. 170.00 million is estimated for consulting services and training to be provided by a technical services team to be contracted by USAID. The team will have maintenance advisors, design and supervisory engineers, a road planning and management specialist and a local government finance specialist. They will provide Pakistani and U.S. support and assistance for the National Highways Policy component and the Rural Roads Maintenance and Construction component on a need basis.

## 6. Administrative and Implementation Arrangement

### a: Project Organisation within the Government of Pakistan

The project is being established as a federal project within the Federal Rural Development Engineering Cell ( FRDEC) of the Ministry of Local Government and Rural Development. The FRDEC will have primary responsibility for supervising and coordinating implementation of the project with other parts of the Federal Government and with Sind Provincial departments and districts including a monitoring role as desired by federal P&D and EAD divisions.

Implementation of the national road policy component will be coordinated by the Planning Commission. Other sections of the Planning Commission in the Ministry of Finance, and Planning, as well as personnel from the Ministries of Communications, Finance, and Local Government, will also participate in this component. The provincial government ( particularly the P&D and C&W Departments ) will also participate in the analysis and training component.

With federal monitoring, supervision and coordination, the day-to day implementation of the rural roads component will rest with the participating districts councils and the Sind Department of Local Government and Rural Development. The provincial government will retain overall authority for the program in their respective jurisdiction including implementing policy and budgeting reforms.

The provincial P&D and LGRD Departments will issue guidelines to district councils on administrative and financial reforms, including modification of the Annual Development Plan budget preparation process. Although these reforms will have major implications for policy, they require only relatively minor shifts in the existing budgetary process. The technical services team will ensure that the information needed to monitor district performance is provided during the life of the project and will assist GOS to establish a system for continuing this monitoring after the project.

Responsibility for project implementation in each of the divisions will be with the GOS/Divisional Coordination Committee, chaired by a representative of the Sind LGRD. This organisation will provide coordination for the activities of the divisional office of the department of Local Government and Rural Development and the participating district councils. Detailed project execution responsibility will be as follows:

- i) Maintenance Planning and execution: District Engineering Office, under the leadership of the council chairman and the chief officer.
- ii) General Planning for transport and funds allocation: District Development ( or Project ) Committee ,with review by the GOS/Divisional Committee, FRDEC and USAID.
- iii) Road Rehabilitation, reconstruction, and construction of katcha access roads: Director of Sind provincial LGRD and Project staff under direction of GOS.
- iv) Monitoring and Administration of Finance: Sind provincial LGRD financial personnel and Project staff as spelled out by GOS policies.

The organisations identified are already carrying out the functions specified, the project will thus build on the capacities of existing organisations. The only new unit to be established is the Road Maintenance Unit to be created within each District Council Office but, as they already have the responsibility for road maintenance, this is just an internal reorganisation to give greater emphasis to maintenance and to add any necessary staff. The project will also assist the newly-formed equipment pools being established in the Sind provincial LGRD offices.

The project offices and all rehabilitation and construction work will be coordinated at the divisional level to achieve high level control over the expenditure of funds. These offices will not/may continue after the project is completed. The only function to continue at the divisional level will be technical and equipment support to the district councils which will be provided by the GOS/Sind provincial LGRD.

b. Project Implementation and Coordination

To facilitate close liaison etc; a USAID Project Manager will be contracted by USAID to coordinate with the Project Director in the MLGRD Federal Rural Development Engineering Cell and with the Planning Commission personnel. The technical services team, also contracted by USAID will be headed by a Chief of Party based in Karachi reporting jointly to the GOP Project Director and the USAID Project Manager including GOS. The technical services team members posted in the field will report to the Chief of Party, who



will coordinate their assignments and responsibilities with the provincial and district council authorities. The MLGRD Project Director in consultation with the Divisional Coordination Committee will have the authority to resolve any questions raised by the Districts regarding the teams duties, responsibilities or performance. The road planner, who will have the lead responsibility for the road policy component will work primarily with Planning Commission and other institutions participating in this activity and will be based in Islamabad. The project organisation is presented in Figure 8.

#### 11 D. Cost Estimates

The total cost of this project is estimated as Rs. 995.59 million of this Rs. 731.00 million is being provided by USAID and Rs. 264.59 million by GOP in the form of already available staff time etc. Detailed breakup is as shown in Table 15.

#### 11 E. Tentative Financing Plan

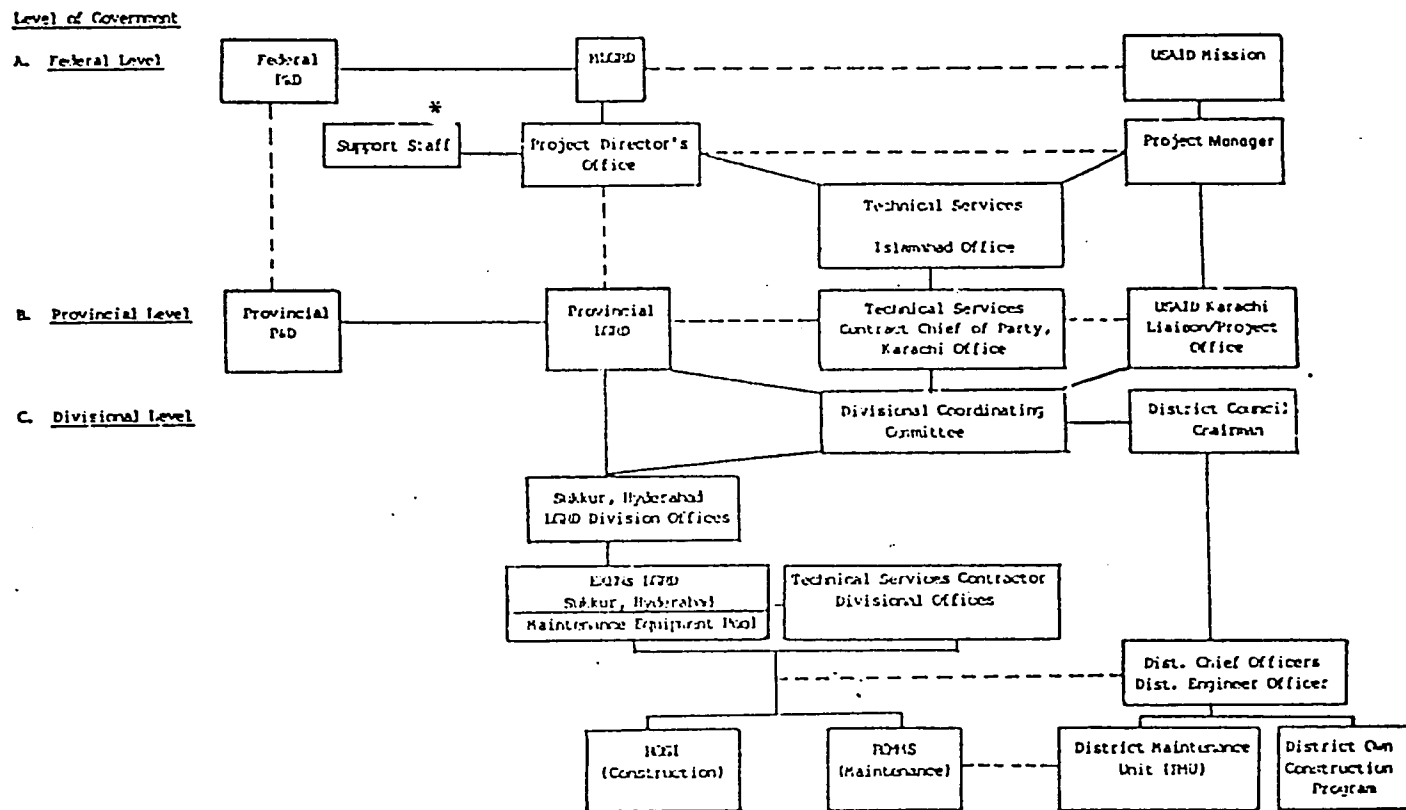
The total cost of the project including the GOP and USAID inputs is estimated at Rs. 995.59 million (Rs. 731.00 million being provided by USAID and Rs. 264.59 Million in the form of already available staff time etc., will be provided by GOP). Thus GOP financial input in currency inputs is Nil.

The main project inputs can be listed as follows:

a. Construction	Rs. 306.00 Million
b. Commodities	Rs. 109.00 Million
c. Project Operations	Rs. 79.00 Million
d. Training	Rs. 59.00 Million
e. Technical Services	Rs. 112.00 Million
f. Contingencies	Rs. 66.00 Million
	-----
Total	Rs. 731.00 Million
	-----

A currency exchange rate of US \$ 1.00 = Pak Rs. 17.00 is assumed. In the budget, contingency allowances have been included at 10% of all costs as per procedures in vogue with GOP/GOS, excluding inflation. Inflation has been estimated at 5% of foreign exchange costs, 10% for non construction local currency costs and 12% for construction in the budget. The cost factors for road inputs reflect the full financial cost of under-costed items and were used to estimate the financial cost of constructing a new road to maintainable technical standards. The costs for rehabilitating a road built to acceptable standards were then calculated on the basis of the work required for these operations. Annexure 6 shows the detailed workings. The calculated costs were

TENTATIVE PROJECT ORGANISATION



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\* To be provided by US AID in collaboration with GOP/GOS to facilitate smooth and efficient operations.

FIGURE-8

TABLE 15  
SUMMARY TENTATIVE PROJECT BUDGET  
USAID CONTRIBUTION  
 (Rs. Million )

Input Year	1		2		3		4		5		Total	
	FX	LC	FX	LC	FX	LC	FX	LC	FX	LC	FX	LC
Technical Services			8.3	8.5	9.5	19.6	9.6	21.4	8.7	26.3	36.1	75.9
Training			10.6	1.7	13.0	4.0	10.2	4.4	9.7	4.9	43.5	15.0
Equipment, etc	6.0	0.9	44.6	1.4	46.9	1.5	1.5	2.3	1.5	2.5	100.5	8.6
Construction				9.5		77.6		88.2		130.3		305.6
Operations	1.7	0.9	7.6	4.3	13.6	8.9	10.3	8.1	14.0	10.1	47.2	32.2
Contingency Allowance											22.7	43.7
Total Rs. Million	7.7	1.8	71.1	25.4	83	111.6	31.6	124.4	33.9	174.1	250	481

Source: GOS/FRDEC/USAID

were compared to the actual construction costs reported by district engineers and were found to be very similar to the reported costs. Projected costs for upgrading to paved are Rs. 420,000 per kilometre, Rs. 180,000 per kilometer for a low maintenance katcha road and Rs. 30,000 per kilometre for a katcha access road keeping all factors in mind. Technical services have been costed in accordance with recent experience of professional service firms. Allowances have been included for upgrading and furnishing.

#### 11 F. Environmental Aspects

Road construction and improvements will essentially follow pre-existing pathways and roadbeds and therefore will be located within areas already controlled by man for agricultural purposes. For this same reason, roads will not take a significant amount of land out of production or significantly negatively impact mineral deposits, archaeological sites, timberland or other resources. The proposed construction is expected to increase activity along these corridors with concomitant socio-cultural impacts. The Indus Plains in Sind Province consist of sand, silt and clay alluviums, hundreds to thousands of feet over their old sedimentary rocks. Existing vegetation consists of hardy grasses, bushes and scrub trees, rainfall is generally less than 10 inches per year. The proposed project will not pose any significant long term negative impacts on the environment.

#### 11 G. Cost Evaluation

The tentative costs and proposed arrangement for USAID financing of each component have been shown in Table 16.

#### 11 H. Federal Role in Project Execution

The project will be implemented in the Sind Provincial District Councils but the FRDEC, MLGRD, will provide overall coordination and technical assistance. Details have been provided already.

#### 11 I. Organisational Management and Implementation Schedule

During the first phase, the Road Maintenance Programming component will be implemented in all of Sind's 13 districts. The component entails:

- i. Rural Roads Inventories
- ii. Preliminary financial assessment
- iii. Training for engineering personnel
- iv. Training for management personnel

TABLE 16  
TENTATIVE METHODS OF USAID FINANCING AND IMPLEMENTATION

Method of Implementation	Method of Financing	Approx. Amount (Rs. Million)
<b>Construction:</b>		
	Payment by LGRD	305.643
	Reimbursement by USAID through MLGRD	
<b>Commodities:</b>		
- Project funded: Computers, Vehicles, etc.	Direct Payment by GOP or USAID	6.8
- Construction and Maintenance Equipment	GOP/GOS Payment with Reimbursement by USAID	102.204
<b>Technical Services (AID Inst. Competitive Contract ) to include:</b>		
-US Technical Assistance	Direct Payment by USAID	112.048
-Local Technical Assistance		
-Local Admin Support Staff.		
-Local Tech and Admr. staff for Sind LGRD Divisions *		
<b>Training:</b>		
Local Training **	Direct Payment by USAID or Reimbursement to GOP/GOS	14.960
Overseas Training	"	43.469
<b>Project Operations and Other Costs:</b>		
Project Manager/Support Staff, Road Inventories, Evaluations	Direct Payment by USAID or Reimbursement to GOP/GOS	79.390
Total		664.514
Contingency	Direct Payment or GOP/GOS Reimbursement	66.451
Grand Total		730.965

**Notes:**

\* The local technical staff for Sind LGRD may be hired by a local private contractor under direct AID contract, or may be included in the long term direct Technical Assistance contract with a US institution. Direct payment would be the method of financing.

\*\* These funds may be included in the long term US contract, in which case the method of financing would be direct reimbursement to the contractor.

The methods of implementation above apply to both components of the project, with the exception of construction, construction equipment, and support for Sind LGRD which apply only to the rural roads components and not to the policy components. (GOP/GOS)

On the basis of above information, the project will work with each district to define a feasible construction/maintenance program. This program will be based on a calculation of:

1. The Maximum Sustainable Service Level given current financial resources, that is, the maximum network that the district has the financial resources to maintain and no resources were developed to expand the road network except as need arises.
2. The Existing Sustainable Service Level given the existing condition of the roads and assuming no increase in real funding for roads.

These calculations will then make it possible to define the following, which will be the basis of the Phase II Programme:

- i. The priorities for expansion of the katcha road system.
- ii. The additional mileage of paved roads that the district would be able to maintain on a life-cycle cost basis, given current and projected revenues.
- iii. An initial maintenance program, based on the mileage of maintainable roads and the district's currently available funds for roads.
- iv. The mileage of paved roads needing rehabilitation before maintenance can begin, up to the limit of the district's financial capability to carry out such maintenance.

The second phase of the project will then begin in those districts that agree to establish a Road Maintenance Unit and initially fund the maintenance program in the following year.

As Phase II Activities commence in the Sind, Phase-I training and analysis defined above may be carried out in the remaining three provinces. Phase II involves the Road Maintenance Management System program and the Road System Improvement program.

Participating districts will receive the following assistance under the first year of the Road Maintenance Management System components:

- a. Equipment and other commodities
- b. Intensive technical Assistance
- c. Training and Other Assistance to Local Contractors
- d. Assistance to the Financial and Management Staff

Under the Road System Improvement component a program of road

reconstruction, upgrading, and, where appropriate, new construction will be carried out in each district. The first-year program is designed to close 20 per cent of the deficit between the Existing Sustainable Service Level and the Maximum Sustainable Service Level in the district.

Funds remaining in the construction budget for the first year of Phase II may be allocated to expansion of the katcha network to unserved villages. The construction program will also incorporate experiments with a variety of low-cost and/or maintenance - requirement construction methods and designs, in order to identify technologies suited to the special conditions of the Sind. To the extent possible, these experimental designs will be used on katcha roads constructed in the first year of Phase II, in order to provide the maximum possible period of observation. Short experimental roads may be constructed in the second year for purpose of observation and improvement of cost estimates for alternative designs. Table 17 shows indicative targets for the three years of Phase-II.

In the situation where less than half of the roads are in a maintainable condition at the start of the program the district's target would be based on 33% of the projected end-of-project road network and the district maintenance target for each year would in general be the full network of maintainable roads under its control at that time.

During final year of the project, emphasis will be placed on establishing a maintenance budget for the following year that is sufficient to cover about 100 % of the paved network, and additional roads. These targets are indicative and may be adjusted during implementation as information is gathered on roads inventory and preliminary financial assessment in individual districts. USAID will not finance expansion of the road network beyond the level that the district has agreed to include in the Road Maintenance Units' maintenance program by the end of the project. Roads will be brought to a sustainable paved standard when the district will be able to perform at least primary maintenance on the Existing Sustainable Service Level network, including the upgraded roads, in the following year.

The sustainability of the maintenance system established by the project will require continued GOS support for the improvements adopted by the districts. Consequently, the technical services team will work with provincial personnel in the Planning and Development and Local Government and Rural Development Department to establish the policies and system that support maintenance and efficient allocation of investment resources, including planned new construction.

Tentative summary schedules of activities for the rural roads component and the policy component are presented in Annexure 7.

TABLE 17

TENTATIVE TARGETS FOR PHASE - II IMPLEMENTATION UNDER THE  
ROAD MAINTENANCE MANAGEMENT SYSTEM AND ROAD SYSTEM  
IMPROVEMENT COMPONENT

	Road Maintenance Management System Targets as a Percentage of Existing Sustainable Service Level	Road System Improvement Construction Program as a Percentage of deficit in Sustainable Service Level	
		This Year	Accumulative
Year 3:	33%	33%	33%
Year 4:	67%	33%	66%
Year 5:	100%	34%	100%

Note:

Above are illustrative targets and are subject to change on an as need basis during implementation.



The rural roads component is being implemented in two phases:

1. Phase-I: This phase constitutes a two-year preparatory period. Year 1 will involve: (a) preparing start up documentation; (b) contracting for a technical services team; (c) procuring equipment; and , (d) limited training activities.

During year 2, the team will: (a) work with personnel of the two Sind divisions to carry out a roads inventory of each district and to collect other baseline information; (b) Continue the training of district personnel in maintenance planning and management; and (c) identify current district maintenance needs and capabilities. Maintenance equipment needed for Phase II will be procured during year 2.

2. Phase-II: This phase will cover the remaining three years of the project. The technical assistance team will: a) assist the Sind districts to establish Road Maintenance Units in each DCO; b) Supervise a program of road construction and rehabilitation carried out under the supervision of the Divisional Coordinating Committees; c) analyse the financial management systems and assist the districts to make improvements.

These programmes can be accelerated if desired by GOP/GOS.

Project evaluations will focus on the following issues:

1. Project implementation concerns, including timing, level, and quality of major inputs, including particularly technical services, commodities, and construction (GOP/GOS/USAID).
2. Achievement of outputs, including both immediate and readily measured outputs, such as kilometres of road rehabilitated, and progress toward institutionalization of the road planning and maintenance functions in the district councils (GOP/GOS/USAID).
3. Project impact on the road system, including the extent of the system and the level of maintenance services on the road (GOP/GOS).
4. Socio-Economic impact on the project area, in terms of increased availability of social services, greater exports of goods and services from the project area, increased trade with other regions, expanded mobilization of local resources for provision of public services, etc (GOP/GOS).

The project's evaluation schedule includes both internal and external evaluations as shown in Table 18.

TABLE 18  
TENTATIVE EVALUATION CALENDAR

Evaluation Event	<u>Project Month</u> (Estimated)	<u>Timing</u>	<u>Participants</u>
Inception Report Service (Baseline)	15	4 months after TST arrives	Technical Services Team (TST), Distr- ict Council, GOP/ GOS.
Phase I Evaluation (Internal)	27	3 months after Phase-I completed	TST, District Council, GOS, MGLRD, USAID
Mid-term Evaluation (External)	30	2 months after internal evaluation	GOS/GOP/AID
Final Evaluation (External)	59	End of 3rd Yr./Phase. II	GOS/GOP/AID

Note:

Above estimates are subject to adjustments on as desired basis (GOP/GOS).

Source: GOS/FRDEC/USAID

The primary responsibility for internal evaluation will rest with the technical services team, assisted by the appropriate GOP/GOS officials at all levels and the USAID Project Manager. External evaluations will be joint GOP/AID exercises, with the technical services team providing a supporting role as requested but not participating directly in the evaluation.

The evaluation events include:

- i. Inception Report: Current status of the roads, current maintenance program, current levels of tax collected, current levels of social services.
- ii. Phase I (Internal): Delivery of Inputs ( timing, etc.), success of initial program of training and inventories, district acceptance of Phase II program and modifications necessary, status of national rural roads policy, and results of initial study of highways policy and financing.
- iii. Mid-term Evaluation: In addition to providing an independent review of the findings of the internal evaluation, the mid-term evaluation will examine the validity of the project concept, in view of phase I results, particularly with respect to district willingness to accept the proposed maintenance and construction program, the severity of fiscal limits on district maintenance activities, and the success to date in achieving desired policy changes, especially at the provincial level (GOS).
- iv. Final Evaluation: In this instance an assessment of social and economic changes in the project area and a determination of project implications for future programming in Pakistan's roads sector and the potential replicability of the project or its approach will be made in addition to the mid-term evaluation issues.

A summary of the information required and its source is shown in Figure 9. The project will generate most of the data necessary to provide a suitable information base for evaluating the project and its impact. The detailed road inventories conducted in Phase I will serve as baselines against which the status of project roads during Phase II can be compared. The inception report will also provide basic information on the level of social services in project districts ( schools, health centres etc. ), the levels of taxes being presently collected in the districts and subsequent reports will permit the evaluators to track any improvement.

#### 11 J. Provincial Programmes (GOS)

The rural road programme is being carried out only in the Sind Province on a Pilot Basis, whereas the Highway Policy component will be on Nationwide basis. The Sind Provincial

Figure 9

**Expected Sources of Information for Project Evaluation**

Type of Information	Source	Type of Document
Baseline information on condition of roads, traffic levels, district finances, and general economic condition.	TST	Inception Reports and analyses, road inventories, etc. completed in phase 1
Delivery of project inputs	TST	TST and USAID records
Achievement of planned levels of road work	LGRD & TST	Quarterly reports
Achievement of maintenance programme	DC and TST	TST Reports DC records
Establishment of improved financial and managerial practices by DCs	TST	Quarterly reports
Establishment of improved planning procedures	TST	Official documents Quarterly reports
Improvement of roads policies	TST & USAID	Official Policy Statements.
Change in condition of the Road.	Distt.Eng.	Road Inventory and inspection records
Change in economic activity	Distt.Council Distt.Eng.	Tax receipts from export tax. Passenger and goods traffic counts.
Change in traffic	Distt.Eng. Distt.Council	Traffic counts Toll Receipts.
Changes in socio-economic conditions ( major )	TS Contractor	Quarterly reports(narrative)
Agricultural production	Dist. Council	Export tax receipts
Increase in district revenues	Dist. Council	Tax records.
Establishment of user Charges	Dist.Council	Tax records.

**Note:**

TST performance will be related to procedural requirements of GOP/GOS.

Source: GOS/FRDEC/USAID

Government will be assisted by the technical services team to implement the following:

- a. Better guidance on construction costs and procedures, including cost guidances that permit high construction standards to be followed and encourage maximum development of the private sector.
- b. Budgetary and policy guidance to the district councils regarding appropriate resource allocations for rural roads.
- c. Improved systems to monitor district council performance in resources generation, maintenance, construction, and provision of services (GOS/GOP).
- d. Tax Policies and Procedures that encourage districts to increase revenue generation and ensure that districts receive their allotted share of taxes collected by the Province on their behalf.
- e. Administrative guidance to encourage districts to establish accounting and disbursement procedures to control costs and ensure adequate safe guarding of public resources.

Although the Sind Local Government Ordinance has been issued relatively recently, the province has made considerable strides during the past two years in improving assistance provided to local councils. The relatively minor policy changes identified above are expected to yield the desired improvement in district performance; major changes will not be needed.

#### 11 K. Linkage between Programme Objectives and Project Components

The link between programme objectives and project components is that without a proper road resources management policy it is futile to spend millions of rupees on new roads because older roads deteriorate to a point where they have to be replaced, which is not cost effective. It is essential that steps be taken to protect the investments made in roads by adopting suitable road maintenance. The Project also entails construction of new roads at a maintainable pace which provides economic and social benefits to the province, training District Council personnel in maintenance management, supply of construction machinery etc. and will establish an infrastructure for road resources management, which is much needed in Sind.

#### 12. Annual Financial Phasing

The annual financial phasing has been shown in Table 19 and 20, broken by GOP and USAID contributions for the duration of the

**Table 19**  
**Tentative Annual Financial Phasing**  
**Government of Pakistan Contribution**  
**Road Resources Management Project**

Year	(Rs. Million)					Total
	'87	'88	'89	'90	'91	
<b>INPUT AND SOURCE</b>						
1. District Councils			53.26	60.26	69.82	182.77
Construction funds katcha			49.92	52.89	57.21	160.02
Maint. funds, excl. beldars			3.34	7.37	1.20	22.74
2. Sind Prov. Govt.	.120	1.31	2.47	2.49	2.49	8.89
a Rural Roads Prog.	.120	1.22	2.33	2.33	2.33	8.35
Project Management	.120	.240	.360	.360	.360	1.44
LGRD Div. Offices	-	.987	1.97	1.97	1.97	6.90
b Highways Prog.	0	.103	.137	.160	.160	.542
Project Management	-	.061	.090	.090	.090	.330
Analysis Prog. (C&W, FWD)	-	.023	.047	.070	.070	.211
3. Other Provincial Governments	0	.430	.502	.572	.572	2.075
Rural Roads Program		.360	.360	.360	.360	1.441
Highways Program		.701	.141	.211	.211	.634
4. Federal Govt.	.274	.356	.642	.642	.642	2.556
Mins. of LGRD	.181	.181	.360	.360	.360	1.441
Mins. of Finance (inc. NTRC)	.070	.141	.211	.211	.211	.846
Mins. of C&W (inc. NHB)	.023	.035	.070	.070	.070	.270
<b>SUB TOTAL</b>	.394	2.10	56.88	63.97	72.95	196.29
Inflation	0	.209	11.94	21.17	33.86	67.22
Contingency (Prov. & fed.)	.015	.177	.301	.310	.310	1.11
<b>TOTAL (Rupees)</b>	.409	2.49	69.12	85.46	107.12	264.60
<b>TOTAL (Dollar equiv.)</b>	.024	.146	4.07	5.03	6.30	15.57
(@1 \$US = Pak Rs. 17.00)						

**SUMMARY BUDGET TABLE, GOP AND AID INPUTS**  
(Rs. Million)

SOURCE	YEAR	'87	'88	'89	'90	'91	CONT	TOTAL	PERCENT
AID		9.2	98.3	207.1	167.5	102.5	66.5	731.0	73
GOP		.41	2.5	69.1	85.5	107.2	--	264.59	27
<b>TOTAL</b>		9.61	100.8	276.2	253.0	209.7	66.5	995.59	100

Source: GOS/FRDEC/USAID

**Note:** The total project cost as cleared by concept committee meeting held on 30th January 1987 was Rs. 936.960 million including F.E.C. Rs. 246.40 million based at currency exchange rate of US \$ 1 = Pak Rs. 16.00 prevailing at the time of the said meeting. USAID commitment of US \$ 43.0 million remains firmed up.

**Table 20**  
**Tentative Financial Phasing**  
**USAID Contribution**  
**For**  
**Road Resources Management Project in Sind**

(Rs. Million)

No. Inputs	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1. Technical Services	--	16.8	29.1	31.00	35.0	111.90
2. Training	--	12.3	17.0	14.6	14.6	58.50
3. Commodities	6.9	46.0	48.4	3.8	4.0	109.10
4. Construction	--	9.5	77.6	88.2	130.3	305.60
5. Operations and Others	2.6	11.9	22.5	18.4	24.1	79.50
<b>Totals:</b>	<b>9.50</b>	<b>96.50</b>	<b>194.6</b>	<b>156.0</b>	<b>208.0</b>	<b>664.60</b>
						<b>Contingencies at 10%</b>
						<b>66.460</b>

Grand Total      Rs. 731.06    or 731.00 million

Source: FRDEC/USAID

project. Project components are also detailed in the table year wise.

### 13. Source of Foreign Exchange Components

USAID is providing \$43.00 million (Rs. 731.00 million) for the project. It is the policy of US AID that all funds for reconstruction, rehabilitation and new construction are made available only to the federal government. As such this project will have to be established as federal project although the project will be executed at provincial and district levels. The flow of AID funds is shown in Figure 10.

### 14. Annual Phasing of Physical Works

There are two components of the project. A) Rural Road Component which involves construction, rehabilitation and upgrading and B) Policy Component which involves analysis and training. The annual phasing of both of the components is shown in Annexure 7.

### 15. Date of Estimates

December 1985 (during appraisal/surveys/project paper compilation).

### 16. Unit Cost for the Output

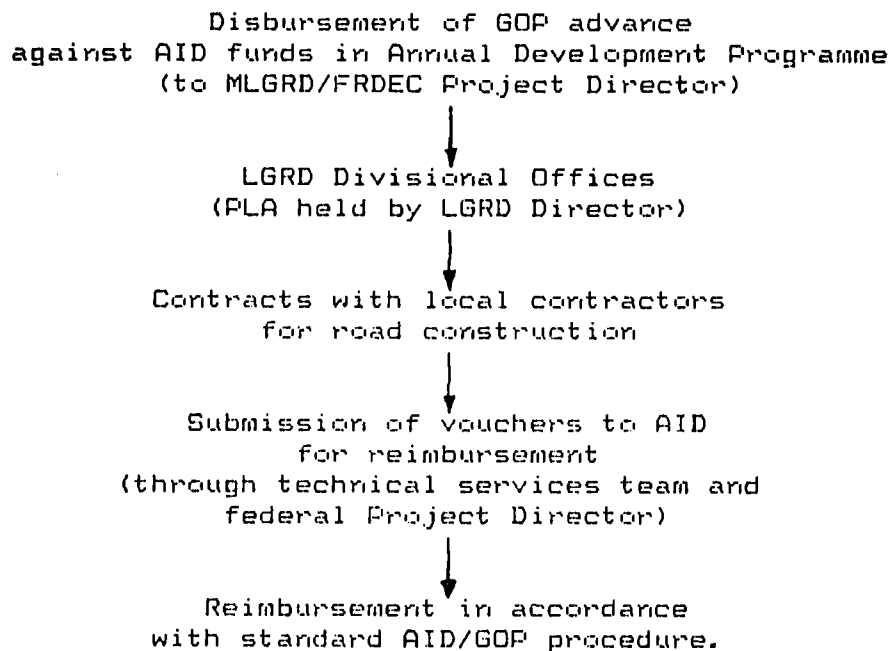
The item is applicable only to the road construction component of the project. Unit costs for improvement/construction of the roads are based on acceptable engineering standards and are prepared from on site information, costs reported by district engineers and estimated costs based on road inventories conducted in the three sample districts of Sind duly indexed for the remaining districts. The construction cost for a katcha road assumes that it is built to a maintainable standard i.e. built on a 3-ft compacted formation with 20-ft road surface. Katcha access roads will be built to a lower standards because funds will not be available to maintain them for several years. Costs for upgrading to paved road are Rs. 420,000 per kilometre, Rs. 180,000 per kilometre for a low-maintenance katcha road and Rs. 30,000 per kilometre for katcha access. All above roads are planned for proper designs and costs are indicative as in November 1986.

### 17. Annual Recurring Expenditure After Completion

Annual recurring expenditure projected for 20 years is shown in the life cycle cost analysis discussed earlier. Average cost



Figure 10

TENTATIVE FLOW OF AID FUNDS

Source: GOS/FRDEC/USAID

per year (excluding initial investment) is as follows:

Type of Road	Average Cost/Year per KM (Excluding Initial Inv.) (Rs. '000)
Paved	22.55
Shingle	30.90
Katcha	8.10

These costs are recommended for construction, rehabilitation, or reconstruction of roads to maintainable standards.

#### 18. Benefits to the National Economy

Benefits to the national economy from this pilot project comprise of cost savings in the transportation of farm produce (marketable surplus) and farm inputs (fertiliser etc.) resulting from construction/improvement of rural roads and establishing a road resources management system, maintenance/road construction equipment pool etc., other indirect benefits are:

1. Significant increase in educational opportunities and health facilities.
2. Increased flow of information to rural areas.
3. Incremental production of crops resulting from the enhanced delivery of agricultural inputs.
4. Reduction in the wastage of perishable farm products such as fruits and vegetables.
5. Significant Decrease in the wear and tear of motorised vehicles.
6. Added value to the produce of the farmers which the project is expected to generate on the basis of the economic value of inputs and outputs.
7. Generation of off-farm job opportunities.
8. Stimulation of small scale enterprises such as agricultural processing.
9. Saving in travel time.

#### 19. Approximate Number of Job Opportunities to be Created

The approximate number of jobs to be created by this project is 1263 man-months of professional level input and 2483 man-months of sub-professional input. There is scope of employment of 62,000 man-months of unskilled labor.

20. Economic Life of the Roads

20 years with the recommended maintenance adopted and further improvements incorporated based on implementation experience..

21. Loan Effectiveness and Operation of Loan

Not Applicable

PART ' C 'PROJECT REQUIREMENTS22(a) Manpower for Execution, Supervision and Technical Control

The tentative details of staff and manpower requirements in person-months is shown in Figure 11.

The tentative schedule for technical and engineering services for this pilot Road Resources Management Project are shown in Table 21.

22(b) Likely Shortage of Manpower

Nil

23. Physical and other facilities Required for this Project

a)	Access Road	NIL
b)	Railway Siding	NIL
c)	Water and other utilities	NIL
d)	Fuel and Power	NIL
e)	Education Facilities	NIL
f)	Public Health Requirements	NIL
g)	Housing by type	NIL
h)	Others	NIL

24. Material, Supplies and Equipment Requirement

As per details in item 11 C, Sub para 4 of Part-B

**FIGURE II**  
**TENTATIVE LEVEL OF EFFORT OF**  
**TECHNICAL ASSISTANCE STAFF \***  
**(PERSON MONTHS)**

POSITIONS	87	88	89	90	91	92	LOCATIONS
<b>EXPATRIATE</b>							
1 CHIEF OF PARTY			54 MANMONTHS				KARACHI
2 ROADS PLANNER AND MANAGEMENT SPECIALIST			54 MANMONTHS				ISLAMABAD
3 LOCAL GOVT. FINANCE SPECIALIST			24 MANMONTHS				ISLAMABAD
4 SHORT TERM U.S.			30 MANMONTHS				SUCH AS EQUIPMENT PROC. SPECIALIST, STATISTICIANS FOR MASTER PLANNING OF ROADS, EQUIPMENT ENGINEER/ TRAINING SPECIALIST. E.T.C.
<b>PAKISTANI (PROFESSIONALS)</b>							
1 GENERAL MANAGER			51 MANMONTHS				KARACHI
2 ASSISTANT MANAGER FOR LOGISTICS			51 MANMONTHS				=
3 ASSISTANT MANAGER FOR PROC. & TRAINING			51 MANMONTHS				=
4 ACCOUNTANT (3)			153 MANMONTHS				ONE EACH AT KARACHI, SUKKUR & HYDERABAD.
5 SENIOR ENGINEERS (EQUIPMENT) (2)			72 MANMONTHS				ONE EACH IN SUKKUR & HYDERABAD MACHINERY POOLS.
6 SENIOR ENGINEERS (CIVIL) (8)			288 MANMONTHS				FOUR EACH IN SUKKUR & HYDERABAD PROJECT OFFICES.
7 JUNIOR ENGINEER (8)			288 MANMONTHS				FOUR EACH IN SUKKUR & HYDERABAD PROJECT OFFICES.
8 SURVEYORS (2)			72 MANMONTHS				ONE EACH AT SUKKUR & HYDERABAD.
9 DRAFTSMAN (6)			216 MANMONTHS				THREE EACH AT SUKKUR & HYDERABAD.
TOTAL 1-9			1242 MANMONTHS				
10 SHORT TERM PAKISTAN			21 MANMONTHS				PROFESSIONAL SUPPORT SUCH AS ECONOMIST, STATISTICIAN, ROAD GEOLOGIST, EVALUATION & MONITORING SPECIALISTS, TRAINING SPECIALIST E.T.C.
<b>PAKISTANI (SUB-PROFESSIONALS)</b>							
11 ASSISTANT SURVEYORS (2)			72 MANMONTHS				ONE EACH OF SUKKUR & HYDERABAD.
12 SECRETARIES (5)			225 MANMONTHS				ONE FOR PROJECT OFFICE, KARACHI & TWO EACH AT SUKKUR & HYDERABAD.
13 CLERKS (8)			360 MANMONTHS				TWO AT PROJECT OFFICE, KARACHI & THREE EACH AT SUKKUR & HYDERABAD.
14 DRIVERS (14)			602 MANMONTHS				ONE EACH AT KARACHI & ISLAMABAD & SIX EACH AT SUKKUR & HYDERABAD.
15 CUSTODIAL STAFF (2) (GUARDS, MALIS, SWEEPERS)			1224 MANMONTHS				SIX EACH FOR PROJECT OFFICES AT SUKKUR & HYDERABAD.
* SUBJECT TO ADJUSTMENTS ON NEED BE BASIS AS MUTUALLY AGREED UPON BETWEEN GOS AND USAID							

Table 21  
Tentative Schedule For Technical  
And Engineering Services  
Road Resources Management Project

	1st Year	2nd Year	3rd Year	4th Year	5th Year
Half: 1	2	1	2	1	2
Personnel:					
Chief of Party	XX				
Roads Planner	XX				
Local Government Finance Specialist		XXXXXXXXXXXXXXXXXXXX			
Engineering Supervision		XX			
Local Support	XX				

Source: GOS/FRDEC/USAID

ANNEXURE 1

ROAD INVENTORIES IN SIND

P R O F O R M A

POSITION OF VARIOUS TYPES OF EXISTING ROADS UNDER ALL DISTRICT COUNCILS IN SIND

S. NO.	NAME OF DISTT: COUNCIL.	EXISTING MAIN ROADS IN K.M.						EXISTING LINK ROADS IN K.M.					
		METALLED ROADS.		BRICK PAVED ROADS.		KATCHA ROADS.		METALLED ROADS.		BRICK PAVED ROADS.		KATCHA ROADS.	
		Require major repairs. in K.M	Require minor repairs. K.M	Require major repairs. K.M	Req. minor rep. K.M	Require major repairs. K.M	Require minor repairs. K.M	Req. major repairs. K.M	Req. minor repairs. K.M	Req. major repairs. K.M	Req. minor repairs. K.M	Require major repairs. K.M	Require minor repairs. K.M
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1.	Sukkur	-	-	10.0	-	212.0	100	5.0	7.0	41.0	32.0	605.0	304.0
2.	Dadu	7.0	15.0	-	-	500.0	903.0	13.0	-	10.0	-	60.0	50.0
3.	Hyderabad	17.60	4.8	8.5	-	25.0	43.2	-	21.6	-	-	-	45.0
4.	Navabshah	36.80	8.0	-	-	841.0	-	16.0	22.6	41.7	-	400.78	-
5.	Shikarpur	5.0	-	-	-	150.0	120.0	2.0	5.0	-	5.0	160.0	117.0
6.	Jacobabad	13.50	-	3.80	-	406.0	-	-	-	-	-	200.0	-
7.	Badin	4.0	-	10.0	-	50.0	50.0	1.0	13.0	-	13.0	72.0	100.0
8.	Khairpur	17.0	-	-	5.0	91.0	4.0	2.0	-	-	-	15.0	-
9.	Sanghar	-	-	-	-	500.0	700.0	25.0	-	-	-	523.0	200.0
10.	Thatta	-	-	-	-	-	-	20.0	-	-	-	205.0	-
11.	Larkana	-	-	-	-	316.0	-	35.0	-	11.0	-	279.0	-
12.	Tharparkar	7.0	-	-	-	1683.0	900.0	14.0	-	-	-	1300.0	900.0
13.	Karachi	41.0	11.0	-	-	79.0	-	13.0	30.0	-	-	51.0	112.0
TOTAL:-		148.9	38.8	32.3	5.0	4853.0	2820.2	146.0	99.2	103.7	50.0	3870.78	1828.0

Note:- Detail inventory will be carried out as per implementation schedule.

Source: GOS (vide letter no. RD/DIR(TECH)1-64/86/3181 dtd.18/11/86



The total mileage inventoried in each district, by type of road encountered, is shown in Table II-1

Table II-1  
DISTRICT ROAD MILEAGE -- TOTALS AND AMOUNT INVENTORIED

District	Paved AC		Paved Brick		Shingle		Katcha	
	Total	Inv	Total	Inv	Total	Inv	Total	Inv
Sukkur	21	9	55	27	0	0	1172	354
Jacobabad	3	2	4	3	0	0	627	424
Shikarpur	13	3	4	0	0	0	366	84
Totals	37	14	63	30	0	0	2165	862
% Inventoried		38		48		NA		40

Source: Road inventory data and information is obtained from the three sample districts.

### III. REHABILITATION/UP-GRADING

Within the three districts investigated, the rehabilitation needs (termed "major maintenance" by the districts) involve the following work:

**Paved Roads:** Replacement of failed or failing bituminous-treated or A/C sections, installation of necessary culverting, and the complete refurbishing of the shoulders. The same would apply to the brick-paved roads except that, in addition, the reparation of any edge ravelling should be included in the shoulder rehabilitation contract. The shoulder rehabilitation will be assumed to consist of adding and mixing into the existing material approximately 1/6 CF/SF of 1-1/2"-max aggregate and compacting it flush with the edge of pavement.

**Unpaved Roads:** Several types of work will be considered. First, where formations have eroded, they will be widened to 22 feet, the usual normal standard, or to 18 feet if they are presently less than that width. This work will be considered rehabilitation. Second, the surface material, usually a side-borrow of earth, sand and/or silt, will be reinforced with crushed rock (approximately 1/6 CF/SF of 2"-max) and compacted to form a sound base course. Third, a 4" carpet (5" loose) of well-graded, crushed stone (1"-max) will be placed and compacted to provide a maintainable surface. Fourth, new culverting will be provided where needed. The latter three operations will be considered up-grading.

The above quantities were assumed for costing purposes; actual quantities will depend on the soil investigation of the existing surface material and available borrow, during implementation.

In each of the districts surveyed (including those in the preceding study) there is a philosophy that gravel-surfaced roads are expensive to maintain; that it is more economical to go directly to a paved surface if a katcha road is to be improved. This does not agree with the historical evolution of roads in most countries where an earthen road is gravelled when the traffic reaches about 25-50 vpd, is given a bituminous treatment at 150-250 vpd, and an asphalt concrete carpet at about 800 vpd. What the above philosophy fails to take into account is overall economics wherein both first costs and user costs are considered, not just those for maintenance. It would normally be difficult to prove the economic viability of paving a road which served only 25 or 50 vpd; however, in Sind Province the high cost of crushed material and its transport could add credence to the philosophy. When specific rehabilitation/up-grading projects are identified, a brief, preliminary feasibility study might be warranted. However, opinion of GOS/GOP will be predominant.

## A. SELECTION PRIORITY PROCEDURES

Recommended priority procedures for the selection of roads which are the most deserving of rehabilitation and/or up-grading are as follows: First priority should be given to drainage; i.e., any all-weather road in danger due to the lack of proper drainage, should be supplied with the necessary culverting. Second priority should be given to any paved surface requiring replacement and to the rebuilding of shoulders over the entire paved network; clearly, this work is of high priority if only because of the major cost of the original investment. Third priority must apply to the rehabilitation (and up-grading, including any necessary drainage improvements) of those unpaved roads with a salvageable formation, which carry sufficient traffic (at least 25 vpd), and which connect the largest concentrations of population -- provided that the financial resources are available to maintain these roads. The fourth priority, if there are available funds, should go into the construction of new katcha access roads, built to a somewhat higher construction standard, providing proper compaction and drainage.

The third and fourth priorities above will constitute the major effort and the maximum financial involvement. The cost to bring all the salvageable roads up to a maintainable condition, however, would far exceed both the USAID funds available, and the districts' maintenance capacity. For that reason, priorities will have to be set between these two classes of roads. The bases for this selection should be population served and forecasted traffic, with the total devoted to priority three limited by the districts' technical and financial capacity for maintenance. Population figures (by village) are available from the 1981 census; traffic data will come from the recommended traffic surveys. Initial identification of roads in each category should be made by the councils themselves. Traffic and population data can then be used for a final selection.

The traffic surveys (origin and destination plus periodic classification counts over 12 consecutive months) and analyses will probably require 15 months to accomplish. This does not mean, however, that rehabilitation and/or up-grading work cannot be started during the first year; necessary drainage improvements will be apparent, all shoulders require refurbishing, all failed paved sections will require replacing and, inevitably, a few katcha rehabilitation projects worthy of attention will be clearly obvious at the outset.

## B. QUANTITIES

Improvement quantities were calculated using the inventory data collected on each of the roads reconnoitered. The results of those calculations, and per-mile averages, are shown in Tables III-1a, b and c, for the Districts of Sukkur, Jacobabad and Shikarpur, respectively.

Table III-1a  
 TENTATIVE REHABILITATION QUANTITIES FOR INVENTORIED ROADS  
 SUAKUR DISTRICT

Dist ID No	From:	To:	Length (Mi)	Surface	Type	Req'd Formation Widening			Shoulder Rehabilitation			Culvts Req'd (18" RCP)
						Height (Ft)	Width (Ft)	Quant (CY)	Req'd Z/100	Width (Ft)	Quant (CY)	
						3.5	0	0	1	10	1369	0
None	Nat Hwy to Sirdar Mohammed Khan Ghoto - Km 0 - 4.2		4.2	5'-12'-5'	Pre-Mix	3	0	0	1	10	130	0
205	Mirpur-Dadleghari Rd to Khatian		.4	5'-12'-5'	Pre-Mix	3	0	0	1	10	1076	0
49	Kathpul to Hayat Pitafi Km 0 to Km 5.3		3.3	5'-12'-5'	Pre-Mix	1	0	0	1	8	365	0
212			1.4	4'-12'-4'	Pre-Mix	.5	0	0	1	0	0	0
207	Ghotki-Khanpur Rd to Adilpur-Salen Mahar Rd		.4	0'-12'-0'	Pre-Mix	2.5	0	0	1	10	326	0
None	Nat Hwy to Sardar Haqi Khan Chacher		1	5'-12'-5'	Pre-Mix	3.5	0	0	1	10	261	0
None	Nat Hwy to Sirdar Mohammed Khan Ghoto - Km 4.2 - 5.0		.8	5'-12'-5'	Pav Rehab	3	0	0	1	10	359	0
49	Kathpul to Hayat Pitafi Km 5.3 to Km 7.0		1.1	5'-12'-5'	Brick	3	0	0	1	8	391	0
200	Daharki-Mahamadpur Rd to Sui Shareef		1.5	4'-12'-4'	Brick	1	0	0	1	4	78	0
213			.6	2'-12'-2'	Brick	2	0	0	1	10	717	0
206	Yaro Lund to Peer Pakhrai Km 0 - Km 3.5		2.2	5'-12'-5'	Brick	.5	0	0	1	10	815	0
144	Ali Mahar to Ghotki-Khanpur Rd		2.5	5'-12'-5'	Brick	3	0	0	1	10	456	0
192	Adilpur-Saleh Mahar to Dera		1.4	5'-12'-5'	Brick	2	0	0	1	8	574	0
199	Khanpur Shahpur Rd to Naro		2.3	5'-12'-5'	Brick	2	0	0	1	8	365	0
56	Shahpur to Rhetoor Km 0 to Km 3.5		2.2	4'-12'-4'	Brick	3	0	0	1	10	391	4
194	Sangrar to Tighatti		1.4	4'-12'-4'	Brick	3	0	0	1	10	293	0
51	Makankori to Shahpur Village		1.2	5'-12'-5'	Brick	3.5	0	0	0	0	0	8
None	Nat Hwy to Sirdar Mohammed Khan Ghoto - Km 5.0 - 5.9		.9	5'-12'-5'	Brick	3	0	0	0	0	0	9
29	Sultanpur to Thekratho		6.8	22'	Katcha	2.6	0	0	0	0	0	1
122	Wass to Thekratho via Nagore		8.1	22'	Katcha	2	0	0	0	0	0	25
149	Ghotki-Khanpur Rd to Haji Abdul Maseed Khushk		1.3	22'	Katcha	2.8	0	0	0	0	0	0
45	Ghotki-Khanpur Rd to Khan Mohammed Qureshi		7.3	22'	Katcha	2	0	0	0	0	0	2
42	Nat Hwy to Bihisti Arbab Shah		3	22'	Katcha	2	0	0	0	0	0	5
4	Garhi Chakar to Abul Ji Garhi		8.2	22'	Katcha	3	0	0	0	0	0	3
46	Jarwar to Hayat Pitafi		6.9	22'	Katcha	2	0	0	0	0	0	9
88	Bago Daho to Mirpur Mathelo		6.8	22'	Katcha	2	0	0	0	0	0	0
87	Umer Daho to Sarhad		2.2	22'	Katcha	2	0	0	0	0	0	0
None	Daharki-Khenjoo Rd to Narli Shakh		1.9	22'	Katcha	1.1	0	0	0	0	0	6
112	Khobhar Station to Sainev Jo Goth		5.6	22'	Katcha	1.8	0	0	0	0	0	11
67	Daharki to Khenjoo		11.1	22'	Katcha	2	0	0	0	0	0	0
147	Mathelo to Moulvi Jo Goth		2.8	22'	Katcha	2	0	0	0	0	0	5
150	Ghotki to Yando via Jung (to Bachao Bund)		3	22'	Katcha	2	0	0	0	0	0	0
140	Ruk Farm to Gahi Khan Abro via Allahvar Chacher		1.9	22'	Katcha	2	0	0	0	0	0	0
71	Daharki to Dadleghari		7.1	22'	Katcha	2	0	0	0	0	0	0
60	Yaro Lund to Peer Pakhrai Km 3.5 - Km 9.2		3.5	22'	Katcha	1.6	0	0	0	0	0	3
58	Suhanjoro to Yaro Lund via Kander Shakh		10.5	22'	Katcha	2	0	0	0	0	0	0

TENTATIVE REHABILITATION QUANTITIES FOR INVENTORIED ROADS  
SUKKUR DISTRICT  
(Continued)

Dist ID No	From:	to:	Length (Mi)	Surface	Type	Req'd Formation Widening			Shoulder Rehabilitation			Culvts Req'd (18" RCP)
						Height (Ft)	Width (Ft)	Quant (CY)	Req'd %/100	Width (Ft)	Quant (CY)	
104	Khanpur-Wahi Ghoto Rd to Mashghool Gadni		3	22'	Katcha	3	0	0	0	0	0	0
2	Mohammadpur to Adilour via khadwari		6.8	22'	Katcha	2	0	0	0	0	0	3
92	Sultanpur to Saleh Mahar Laniari		6	22'	Katcha	2	0	0	0	0	0	14
28	Heleji to Adh Lakho via Junas		7.4	22'	Katcha	2	0	0	0	0	0	10
185	Nat Hwy to Sorho		2.9	22'	Katcha	2.6	0	0	0	0	0	0
None	Paved Rd above to Canal link		1.4	22'	Katcha	2.5	0	0	0	0	0	0
4	Dadlaqhari to Garhi Chakar		10.2	21'	Katcha	2.5	1	4987	0	0	0	15
167	Nat Hwy to Wasti Invat Shah		4	21'	Katcha	2.5	1	1956	0	0	0	3
24	RR link to Sultanpur Cheezhro		6.4	20'	Katcha	2.2	2	5507	0	0	0	6
42	Nat Hwy to Bihisti arbab Shah		.9	20'	Katcha	2.4	2	845	0	0	0	0
176	Bhir to Jarwar-Khanpur Rd		2.7	20'	Katcha	2.8	2	2957	0	0	0	5
30	Mubarakpur to Uchihar		2	20'	Katcha	2	2	1564	0	0	0	2
144	Ali Mahar to Ghotki-Khanpur Rd		7.8	20'	Katcha	2.7	2	8237	0	0	0	11
15	Nat Hwy to Dubar		3.5	20'	Katcha	2.9	2	3970	0	0	0	0
109	Daharki-khenico Rd to Mir Khan Mahar		1.6	20'	Katcha	1.2	2	751	0	0	0	0
None	Soofi to Nat Hwy		1.4	20'	Katcha	1.1	2	602	0	0	0	0
41	Qadirpur to Miranpur		4.1	20'	Katcha	2	2	3207	0	0	0	0
110	New Rd to Betha Shava Chak Hazarev Shah		4.7	20'	Katcha	1.4	2	2574	0	0	0	0
142	Adilour-Mathelo Rd to Ghulam Mohammad Kaladi		1.2	20'	Katcha	2	2	939	0	0	0	0
167	Nat Hwy to Kazi Mah Pul Wasti Inavat Shah		5.8	20'	Katcha	1.2	2	2722	0	0	0	0
28	Bago Shutto to Baharki		1.2	20'	Katcha	2	2	939	0	0	0	0
None	Reti to Daharki		5.2	20'	Katcha	1	2	2034	0	0	0	0
69	Reti to Kahu Shaheed		8.8	20'	Katcha	1	2	3442	0	0	0	11
91	Ghotki-Mathelo Rd to Arbab kaladi		1.3	20'	Katcha	2	2	1017	0	0	0	0
121	Dubar to Chousool		5.7	20'	Katcha	2	2	4459	0	0	0	9
37	Mathelo-Mithri to Ali Mahar Sher Mahar		10.2	20'	Katcha	2.9	2	11569	0	0	0	0
56	Shahpur to Bhetoor km 3.5 to km 12.5		5.6	20'	Katcha	2	2	4380	0	0	0	0
38	Paved Rd above to Ghotki via Hussain Belli		5.2	20'	Katcha	2.5	2	5084	0	0	0	5
None	km 9.3 Rt 52 to Giwan Garh		5.8	20'	Katcha	2.5	2	5671	0	0	0	11
1	Shahpur Village to Nat Hwy km 20.4 to km 25.6		3.2	20'	Katcha	2.5	2	3129	0	0	0	2
1	Shahpur Village to Nat Hwy km 9.8 to km 20.4		6.6	20'	Katcha	2.5	2	6453	0	0	0	19
11	Dubar to Sanqi		3.7	19'	Katcha	1.5	3	3256	0	0	0	2
71	Daharki to Dadlaqhari		8.1	19'	Katcha	2.5	3	11880	0	0	0	9
51	End Rd above to Makankori via Lohi		1.6	18'	Katcha	2	0	0	0	0	0	2

Table III-1a  
TENTATIVE REHABILITATION QUANTITIES FOR INVENTORIED ROADS  
SUKKUR DISTRICT  
(Continued)

Dist ID No	From	To	Length (Mi)	Surface	Type	Req'd Formation Widening			Shoulder Rehabilitation			Culvts Req'd (18' RCP)
						Height (Ft)	Width (Ft)	Quant (CY)	Req'd Z/100	Width (FL)	Quant (CY)	
1	Shahour Village	to Nat Hwy Km 0 to Km 9.8	6.1	IS	Katcha	2	0	0	0	0	0	4
9	Nat Hwy	to Patni	.8	IS	Katcha	3	0	0	0	0	0	1
43	Berria-Muharo Mah	to Mirpur Malhelo	8.4	IS	Katcha	1.6	0	0	0	0	0	0
54	Matheie-Mirour Pul Wah	to Hayat Pitafi Ruston Korai	1.2	IS	Katcha	2	0	0	0	0	0	0
54	Nat Hwy	to Saeed Khan Chandio	1.2	IS	Katcha	2	0	0	0	0	0	0
27	Hingoro	to Bv-Pass Sanqi	.6	IS	Katcha	2	0	0	0	0	0	0
149	Adilour-Saleh Mahar Rd	to Kazi Badal	1.5	IS	Katcha	2	0	0	0	0	0	0
14	Bassi	to Bachao Pund	6.9	IS	Katcha	2.1	0	0	0	0	0	13
30	Ghotia-Khanour Rd	to Shahal Gadani	1.2	IS	Katcha	3	0	0	0	0	0	2
35	Ruk	to Akhadwari	6.2	IS	Katcha	2.3	0	0	0	0	0	4
124	Peer Bux Pitafi	to Thahrio Malik	1.7	IS	Katcha	2	0	0	0	0	0	0
39	Shahour-Saleh Mahar Rd	to Hamzo Mahar Wadhan Mahar	1.4	IS	Katcha	2	0	0	0	0	0	0
53	Nat Hwy Lothe	to Uear Buriro	5.2	IS	Track	1.8	18	32947	0	0	0	8
2	Patni	to Khandri via Khandra	12.3	IS	Katcha	2	2	9621	0	0	0	0
151	Uain Mahar	to Pir Bux Pitafi via Sajawal Mahar	21.4	IS	Katcha	2.8	2	23435	0	0	0	1
152	Ahenico-Beruta Rd	to Haji Karindad Mahar	4	IS	Katcha	2	2	3129	0	0	0	8
129	Badlo	to Mohammadpur via Mauloodi	2.9	IS	Katcha	1	2	1134	0	0	0	10
125	Mahsero Bus Stop	to Haji Mauloodi	.9	IS	Katcha	1	2	352	0	0	0	0
44	Gari	to Mahesro	4.7	IS	Katcha	2	2	3676	0	0	0	4
102	Phanour Yaro Lund	to Pir Bari	12.1	IS	Katcha	2	2	9465	0	0	0	46
175	Phanour Yaro Lund Rd	to Kalatani Gabolan-Jo-Goth	1.2	IS	Katcha	3	2	1408	0	0	0	0
11	Karapri	to Frov Rd at Duber	8.9	IS	Katcha	2.5	4	17404	0	0	0	2
103	Yaro Lund Peer Fakhrai Rd	to Dost Mohammad Khan Lund	1.2	IS	Katcha	2	4	1877	0	0	0	0
18	Bv-Pass Sanqi	to Baghpai	1.6	IS	Katcha	2.7	6	5069	0	0	0	0
None	La 2.3 Rt 52	to Giwan Garh Km 9.3 to 11.0	1.1	0	Track	2	22	9465	0	0	0	2

Total Lengths:

CY Rehabilitation:

Average Quantities/Mile:

Fre-Mix Paved	11.5 Miles	3527 Shoulders	307
Brick Paved	17.3 Miles	5189 Shoulders	300
Katcha <20' Width	128.1 Miles	129051 Formation Widening	1007
Katcha >20' Width	237.9 Miles	88993 Formation Widening	374

Total Inventoried 394.8 Miles Average number RCP culverts required/mile of --

Unpaved Network: 0.90  
Paved Network 0.14

Table III-1b  
TENTATIVE REHABILITATION QUANTITIES FOR INVENTORIED ROADS  
JACOBABAD DISTRICT

Dist ID No	From:	to:	Length (Mi)	Surface	Type	Req'd Formation Widening			Shoulder Rehabilitation			Cusvts Req'd (15' RCP)
						Height (Ft)	Widths (Ft)	Quant. (CY)	Req'd 2/100	Widths (Ft)	Quant. (CY)	
73	Thul Saifal Rd to Dinpur		2	5'-12'-5'	Pre-Mix	3	0	0	1	10	652	3
121C	K.Kot Shikarpur Rd to Sheran Bhavo		.3	5'-12'-5'	Pre-Mix	3	0	0	1	10	98	0
121b	K.Kot Shikarpur Rd to Dari Mir Sundar Khan Sundrani		.5	5'-12'-5'	Pre-Mix	3	0	0	1	10	163	0
70	Thul Hamavoon Rd to Chandran		.5	6'-10'-6'	Pre-Mix	3	0	0	1	12	196	0
121a	K.Kot Shikarpur Rd to Mir Walait Sera Bijarani		1.2	5'-12'-5'	Brick	3	0	0	1	10	391	0
73	Thul Saifal Rd to Dinpur		2	22'	Katcha	2	0	0	0	0	0	0
75	Joungal to Khan Mohd Pahore		12.4	20'	Katcha	3	2	14549	0	0	0	0
14	Garhi Khairo to Rundle Daro		1	20'	Katcha	2.6	2	1017	0	0	0	1
45	Bahadarpur to Karim Bux		5	18'	Katcha	2.2	.2	430	0	0	0	15
30	Jacobabad to old Janidero		5	18'	Katcha	2.5	0	0	0	0	0	4
76b	Madadpur to Mehepur upto Dist. boundary		10.9	16'	Katcha	2.1	.2	895	0	0	0	28
55	Thul Jcd:Facca Road to Bahadurpur via Zangipur		7.9	18'	Katcha	3	0	0	0	0	0	7
68	Thul Saifal Rd to Shah Nawaz Khan Bungalani		6.5	18'	Katcha	1.1	1	1358	0	0	0	7
49	Mubarkpur to Old Miral		4	18'	Katcha	.9	1	704	0	0	0	1
21	Jacobabad to Bagapur		7.9	18'	Katcha	2.5	0	0	0	0	0	4
20	Jacobabad to Shahpur		4	18'	Katcha	.5	2	587	0	0	0	4
108	Shahi Wah to Mir Gul Hasan Khan Donki		2	18'	Katcha	2.6	.5	508	0	0	0	3
67	Mirza Wah to Sanhari Sarak		3	18'	Katcha	2	0	0	0	0	0	2
56	Unhhar Railway Station to Bahoo Khoso via Taqio Khoso		8	18'	Katcha	2.4	0	0	0	0	0	15
74	Thul Unhhar Rd to Dinpur		2	18'	Katcha	.8	.1	31	0	0	0	3
27	Mouladad to Raihan		5.9	18'	Katcha	2.4	0	0	0	0	0	6
21	Jacobabad Bagapur		7.9	17'	Katcha	2	1	3090	0	0	0	9
127	Badani Rd to S. Mustafa Khan Donki		1	17'	Katcha	2.1	1	411	0	0	0	0
69	Thul Saifal Rd to Rashirabad		2	17'	Katcha	2.3	1	900	0	0	0	3
78	Tangwani to Shahi Wah 36 mile		9.4	17'	Katcha	2.3	1	4228	0	0	0	0
78	Tangwani to Shahi Wah 36 mile		9.4	17'	Katcha	2.5	1	4596	0	0	0	2
17b	Dau to Chowk Harri		9.9	17'	Katcha	2.5	1	4840	0	0	0	4
47	Talani Mutam to Ghora Harri		7.9	17'	Katcha	1.8	1	2781	0	0	0	5
40	Jacobabad-Mouladad Rd to Haji Lakhair Brohi		1.3	17'	Katcha	2.1	1	534	0	0	0	0
32	Jacobabad to old Raihan		7.9	17'	Katcha	2	1	3090	0	0	0	8
52	Abad to Mubarakpur		7.7	16'	Katcha	1.3	2	3915	0	0	0	3
75	Thul Bahoo Rd to Gul Sher Khan Kandrani		2	16'	Katcha	2	2	1564	0	0	0	2
172	Dodapur-G.Khairo Rd to ???		3	16'	Katcha	1.5	2	1760	0	0	0	7
59	Moor Wah to Thul Town		18	16'	Katcha	.7	2	4928	0	0	0	6
63	Maharabad to Mir Hassan Khoso Railway Station		3	15'	Katcha	2	3	3520	0	0	0	9
64	Thul Saifal Rd to satn Dino Moorani		1.5	15'	Katcha	1.6	3	1408	0	0	0	4

Table III-1b  
TENTATIVE REHABILITATION QUANTITIES FOR INVENTORIED ROADS  
JACOBABAD DISTRICT  
(Continued)

Dist ID No	From:	To:	Length (Mi)	Surface	Type	Req'd Formation Widening			Shoulder Rehabilitation			Culvts Req'd ----- (18" RCP)
						Height (Ft)	Widths (Ft)	Quant. (CY)	Req'd Z/100	Widths (Ft)	Quant. (CY)	
138	Kashmore to Bahnnar		19.8	15	Katcha	2	3	22070	0	0	0	1
140	Buzapur to Pacca Mahar		1	15	Katcha	1.5	3	880	0	0	0	4
111	Karampur to Sher Garh		4	15	Katcha	1.4	3	3285	0	0	0	6
72	Saifal Rd to Abdul Ghani Shah		2	15	Katcha	1.5	3	1760	0	0	0	0
48	Sher Khan Bhangar to Arz Mohammad Tanwari		3	15	Katcha	2.5	3	4400	0	0	0	4
54	Odhano to Pul Shujra		4	15	Katcha	1.6	3	3755	0	0	0	5
50	Mirpur to Dilaaurad		11.9	15	Katcha	1.6	3	11170	0	0	0	6
75a	Mcormah to Dilaaurad via Mubarakpur		6	15	Katcha	1.6	3	5632	0	0	0	8
121	Uchhar Railway Station to Tharri		6	15	Katcha	1.2	3	4224	0	0	0	8
66	Bahadurpur to Dil Murad Railway Station		1.5	15	Katcha	1.6	3	1408	0	0	0	4
61	Thul Town to Tangwani via Unhhar		15	15	Katcha	.9	3	7920	0	0	0	4
41	Mirpur to Sasan Laro via Uddi		7.4	15	Katcha	1.4	3	6078	0	0	0	1
2	Pul Jaffarabad to Dau		5.5	15	Katcha	1.4	3	4517	0	0	0	5
19	Jacobabad to Hyderabad		5.9	15	Katcha	1.6	3	5538	0	0	0	7
22	Jacobabad to Nawazo Jagir via Garhi Chand		5.2	15	Katcha	1.1	3	3356	0	0	0	2
24	Nawazo Jagir to Koreia		3.5	14	Katcha	.8	4	2190	0	0	0	0
125	K. Kot Kasmore pacca Rd to Pat Feeder		2.2	14	Katcha	1.5	4	2581	0	0	0	0
63	Maharabad to Mir Hassan Khoso Railway Station		3	14	Katcha	1.7	4	3989	0	0	0	6
46	Thul to Garhi Hasan Shakh		6	14	Katcha	1.2	4	5632	0	0	0	10
57	Jacobabad to Mubarkpur via Pnhwar		8.9	14	Katcha	2.5	4	17404	0	0	0	7
9	Dodapur E. Khairo to Lal Shah		4.3	14	Katcha	2	4	6727	0	0	0	6
7	Garhi Khairo to Dad Muhammad Lohar		4	14	Katcha	2.1	4	6571	0	0	0	4
1	Dodapur Miranpur to Amirabad		2	14	Katcha	2.1	4	3285	0	0	0	5
25	Abad to Raacampur via Koreia		6.9	13	Katcha	1.8	5	12144	0	0	0	1
43	Mirpur Burriro to Mubarkpur via Chana		6.9	13	Katcha	1	5	6747	0	0	0	3
109	Thul Saifal Rd to Jaloo		2.6	13	Katcha	1.5	5	3813	0	0	0	0
51	Garhi Bhutto to Garhi Hassan		8.4	13	Katcha	1.1	5	9035	0	0	0	9
122	Badani to Gandhar		4.1	13	Katcha	1.4	5	5612	0	0	0	7
42	Thul to Ghouspur via Nasir Shakh		16.9	13	Katcha	1.6	5	26439	0	0	0	16
123	Badni to A. Razak Bhutto		1.6	13	Katcha	1.3	5	2034	0	0	0	1
138	Kashmore to Bahnnar		19.8	13	Katcha	2	5	38720	0	0	0	12
141	Toi Shakh to Bahaduran Pacca		13.9	13	Katcha	2.2	5	29900	0	0	0	6
112	Kayli to Jaffarabad		10.9	13	Katcha	2.1	5	22381	0	0	0	8
53	Thul-JCO Rd to Chandran via Sikandarabad		6	13	Katcha	2.3	5	13493	0	0	0	4



Table III-1b  
**TENTATIVE REHABILITATION QUANTITIES FOR INVENTORIED ROADS**  
**JACOBABAD DISTRICT**  
(Continued)

Dist 10 No	From:	To:	Length (Mi)	Surface	Type	Req'd Formation Widening			Shoulder Rehabilitation			Culvts Req'd ----- (18" RCP)
						Height (Ft)	Widths (Ft)	Quant. (CY)	Req'd Z/100	Widths (Ft)	Quant. (CY)	
4	Dodapur to Ratodero		9.9	13'	Katcha	2	5	19360	0	0	0	9
139	Phaks to Badani		4.5	13'	Katcha	1.7	5	7480	0	0	0	8
117	Tanwani Rd to Bahadur Khan cheso		1.5	13'	Katcha	1.8	5	2640	0	0	0	5
11	Ful Jaffarabad to Jaffarabad Buledi		7	13'	Katcha	2.2	5	15058	0	0	0	2
10	Dodapur to Punhoo Bhatti		6	13'	Katcha	2.4	5	14080	0	0	0	30
58	Inul Saifal Rd to karpur via Moji pul		9.9	13'	Katcha	1.6	5	15488	0	0	0	10
98	Inul Saifal Rd to Ali Krakhan via Jumo Drakhan		3	13'	Katcha	1.4	5	4107	0	0	0	6
12	Jaffarabad to Hameedullah Khan Buladi		7.4	12'	Katcha	2	6	17365	0	0	0	0
3	Chachar RR Station to Jaffarabad		6.3	11'	Katcha	1.4	7	12074	0	0	0	9
114	Sher Wah to Choi		5.9	11'	Katcha	1.6	7	12922	0	0	0	12
115	Ghouspur to Haibat		10.9	11'	Katcha	1.6	7	23873	0	0	0	18
77	Shikarpur Mandhtot Rd to Bacaravad		1.2	10'	Katcha	2.5	8	4693	0	0	0	0
62	Inul Bahoo Road to Wah Mistrs		3	9	Katcha	2	9	10560	0	0	0	3
Total Lengths:						CY Rehabilitation:			Average Quantities per Mile:			
						Pre-Mix Paved 3.3 Miles			1108 Shoulders			336
						Brick Paved 1.2			391 Shoulders			326
						Katcha <20' Width 470.6			510511 Formation Widening			1085
						Katcha >20' Width 15.4			15566 Formation Widening			1011
Total Inventoried 490.5 Miles						Average number RCP culverts required/mile of --						
						Unpaved Network: 0.92						
						Paved Network: 0.67						

Table III-1c  
TENTATIVE REHABILITATION QUANTITIES FOR INVENTORIED ROADS  
SHIKARPUR DISTRICT

Dist ID No	From:	To:	Length (Mi)	Surface	Type	Req'd Formation Widening			Shoulder Rehabilitation			Culvts Req'd (18" RCP)
						Height (Ft)	Widths (Ft)	Quant. (CY)	Req'd Z/100	Widths (Ft)	Quant. (CY)	
1	Shikarpur to Abdu via Jano and Buja Napar		9.9	5'-10'-5'	Pre-Mix	2	0	0	1	10	3227	2
55	Main Rd to Abdul via Bado Goth		3.1	18'	Katcha	2.4	0	0	0	0	0	2
2	Shikarpur to Jagan		11.8	18'	Katcha	2.4	0	0	0	0	0	22
6	Lodra to Shrine of Budhal Fakir		1.9	18'	Katcha	3	0	0	0	0	0	9
100	Nim to Mir Daho		11.8	18'	Katcha	2.7	0	0	0	0	0	10
29	Khanpur to Thahirio via noon		6.2	18'	Katcha	2.6	0	0	0	0	0	5
46	Main Rd to Abdul via Sobho Goth		3.1	17'	Katcha	2.6	1	1576	0	0	0	8
13			1.2	17'	Katcha	2	1	469	0	0	0	3
3	Sultankot to Zerkhail		6.2	16'	Katcha	2.2	2	5335	0	0	0	2
5	Larkana-Maudero-Shikarpur via Habib-Sherkot & Hajana		7.4	16'	Katcha	2.4	2	6946	0	0	0	5
17			5	16'	Katcha	1.8	2	3520	0	0	0	6
194			13	16'	Katcha	2.2	2	11186	0	0	0	6
4	Shah Pisand to Thahir Mah		4	14'	Katcha	2.1	4	6571	0	0	0	3
16			2.2	14'	Katcha	1.5	4	2581	0	0	0	4
None			.6	13'	Katcha	1.4	5	821	0	0	0	1
Total Lengths:						CY Rehabilitation:			Average Quantities per Miles:			
Pre-Mix Paved						9.9 Miles	3227 Shoulders			326		
Brick Paved						0	0 Shoulders			N/A		
Katcha <20' Width						77.5	39006 Formation Widening			503		
Katcha >20' Width						0	0 Formation Widening			N/A		
Total Inventoried						87.4 Miles	Average number RCP culverts required/mile of --					
							Unpaved Network: 1.11					
							Paved Network: 0.20					

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ANNEXURE 2

BACKGROUND INFORMATION FOR ECONOMIC AND  
FINANCIAL ANALYSIS / METHODOLOGY

**Supplementary Information on Economic and  
Financial Analysis and Plan**

**I. Overview**

This annex provides additional information on the methodology used in completing the financial and economic analyses for the Project design, in particular the assumptions used and the sources of the estimates underlying the analysis.

**II. The District Road Network in the Sind**

The projection of the extent of the district road network at the time of project start-up in 1986 is derived from the official NTRC (Planning Commission) statistics on the road network under district councils in the Sind in 1980 and 1983. The absolute growth in the road system between 1980 and 1983 was calculated and it was assumed that atleast an equal amount would be added to the system between 1983 and 1986 (FRDEC/NTRC).

Since this clearly implies a slight decline in the rate of growth, it is regarded as a conservative estimate.

The summary figures are as follows:

**TABLE NO. II-1  
CALCULATION OF 1986 ROAD NETWORK - SIND**

( MILES )

	Paved	Shingle	Katcha *
Road in 1980	120.3	137.2	8030.2
Roads in 1983	274.3	215.4	9019.3
Mileage added, 1980-83	154.0	92.4	1067.2
Estimated mileage, 1986	428.3	307.8	10086.5

\*  
Not totally built to desired standards.  
Source: GOS/FRDEC/USAID

To calculate the need for rehabilitation on the paved roads, it was assumed that 60 percent of the roads built prior to 1980, 20 per cent of the roads built between 1980 and 1983, and none of the roads built since 1983 would need rehabilitation. Applying these percentages to the figures above yields an estimate of 103 miles total needing rehabilitation.

In the three sample districts of Sind inventoried, almost no roads were found needing major rehabilitation, but all roads needed shoulder work. The roads in the districts further south are older and, therefore, more likely to need rehabilitation, and thus an intermediate figure was used. The estimate of 103 miles may thus be viewed as extremely conservative. The cost of this work was taken as Rs. 280,000 per mile, as cited by local engineers, but is substantially above the figure developed for the Sind based on the inventories ( Rs. 115,000 per mile ). It was decided to provide a separate cost estimate for shoulder work on paved roads.

In addition to the rehabilitation cost in the budget, to ensure against overstatement on the Katcha road construction program, the cost of the rehabilitation alone was used in the economic analysis, as being more representative of the expected expenditure on paved road rehabilitation.

It is assumed that roads needing only shoulder work are maintainable, and thus included in the projected Existing Sustainable Service Level ( ESSL ) for 1986. Thus the 1986 ESSL is 325 mi. ( 428-103 ). It was further assumed in the economic analysis that the mileage needing rehabilitation would remain constant between 1986 and the start of project road rehabilitation in 1988.

### III. District Resources for Roads

District council resources for roads are calculated on the basis of data provided by the Sind Department of Local Government and Rural Development on district council revenues in 1983/84 . This data tallies with the detailed information gathered in the three districts. The rate of growth in revenues was arbitrarily assumed to be 5 per cent per year, which is extremely conservative in view of the much higher growth in council incomes which grew at a compound rate of roughly 65 per cent since 1978/79. Since a primary emphasis of the project is expansion of local council resource generation , it was assumed that the council revenues under the project would grow at 10 per cent annually, beginning in 1988, in the with project case. In both estimates, it was assumed that provincial grant revenues would remain frozen at the 1984 level of Rs. 21 million, in real terms.

The analysis of district council expenditures in the three districts formed the basis for the projections of expenditures on roads in both the current and development ( investment ) accounts. Table No.II-2, and II-3 summarise these assumptions.

TABLE NO. II-3  
ASSUMPTIONS ON DISTRICT EXPENDITURE BREAKDOWN  
( Percentages )

	Road-related	Other	Total
Development budget	.325	.175	.50
Operating budget	.105	.395	.50
of which belders on Katcha roads and not transferable to other uses:	.040		
		Total:	1.00

Source: GOS/FRDEC/USAID

#### IV Road Construction and Maintenance Costs

In general, the costs used for road construction and maintenance were derived from USAID sources. For the economic analysis, the cost of amortization was deducted from the hourly cost of equipment. Depreciation, however, was not deducted, since it was not possible to perform a parallel exercise in the case of current expenditures, nor were shadow prices used to reflect the opportunity cost of unskilled labor ( which may be close to zero in the Sind during most of the year ), diesel, etc.

These assumptions do not have a material impact on the outcome of the analysis, since in most cases they would tend to cancel each other out. For example, the inclusion of depreciation when the capital cost of the equipment is also included ( in the AID budget ) results in a degree of double counting ( less than 100 percent, since all equipment is not used full time in road maintenance ), which would tend to balance the failure to consider shadow-price diesel and other imported inputs.

Table No. II-4 summarizes the life-cycle costs on an annualized basis for paved roads and shingle roads in the Sind. The costs shown are annualized financial costs ( undiscounted ), assuming a 20 year life. In the case of the gravel roads, it is assumed that the 22-foot road ( ADT of approximately 50 ) is regravelled on the average five years after initial construction and then every 10 years ( 1.5 gravellings over the 15 year period ) and that the 18-foot road ( ADT approximately 25 ) is regravelled on the average 8 years after construction, and then every 16 years (.75 gravellings over the 12-year period ).

As shown in the table, the annualized financial cost of a paved road is less than that of a 22-ft. shingle road and only slightly higher than that of an 18-ft. shingle road. Moreover, the shingle road has a much higher maintenance cost, creating a larger recurrent cost burden, which is relatively more difficult for the districts to finance than initial construction costs.

This analysis was also carried out in economic terms, taking into consideration vehicle operating cost savings, discounting the stream of costs at 12 per cent, and taking the initial cost as the cost to upgrade from katcha, rather than the full construction cost. This analysis shows that a paved road has a discounted average life-cycle cost of Rs. 42,568, compared to a cost of Rs. 44,538 on a shingle road, assuming an ADT of 25 vehicles per day.

TABLE NO. II-4

COMPARISON OF PAVED ROAD AND SHINGLE ROAD COSTS, SIND PROVINCE  
( Rs. per year, over 20 years )

	Paved Road	22-ft. Shingle	18-ft. Shingle
Initial construction	51693	38306	38306
Annual direct costs	17933	7130	5130
Overhead	2331	927	667
Contract maintenance	--	30197	23139
Total	71957	76560	67241

Note: Separate estimates of construction cost not available for 22 foot and 18 ft. shingle road.

Source: GOS/FRDEC/USAID

On the basis of these findings, it was determined that it would not be appropriate to encourage the districts to choose shingling over paving when it becomes necessary to upgrade a road due to increasing traffic. Consequently, only paved and katcha roads were considered in the economic and financial analysis.

This finding is believed to apply only to the Sind, which has virtually no sources of gravel within its borders. The gravel roads that have been constructed in the past have not been regravelled, due to the high cost involved, and have therefore reverted to katcha road. Brick-soled roads however are also classified as gravel roads for purposes of the national statistics and are fairly extensive in Sind. These are expected to prove to be a more economic form of staged construction than use of gravel roads. In the economic analysis, only paved and katcha roads are taken into consideration. This issue will be further looked into after additional information on the costs and performance of brick roads, and appropriate maintenance practices on this type of surface is gathered.

#### V. Roads Program With and Without the Project

District council road construction and maintenance activities in the absence of the project are modelled by projecting the current situation forward without modification. The mileage constructed each year is projected by estimating the total budget, and the roads development budget as a proportion of the latter. This total budget is then divided between katcha road construction and paved works, with the relative proportions chosen based on information from Sukkur District in the last year available ( 1984/85 ). In this year, sample Sukkur District spent 18 percent of its road development budget on katcha roads and 82 percent on metalled and brick-paved roads. To be conservative a split of 25 per cent katcha / 75 per cent paved was used. These budget figures were then translated into mileage by dividing by typical construction costs for district council works ( Rs. 30,000 per kilometer for a new katcha and Rs. 210,000 for a "new" paved road, that is, an upgrade of an existing katcha road to pavement ).

In the no-project situation, however, it is assumed that paved roads would need rehabilitation every seven years, at a cost (approximately) of Rs. 168,000 per kilometer. The cost of this work, based on the mileage built or rehabilitated seven years previously, was deducted from the funds available for new paved construction.

In the with-project situation, it was assumed that districts would continue to use the same proportions in allocating funds to development and, within development, to roads. It was assumed, however, that districts would shift construction funds toward katcha roads, spending 67 percent of their funds on katcha roads and 33 percent on paved roads. It was further assumed that rehabilitation would not be necessary during the 20 year time horizon of the analysis, given an adequate maintenance program on the paved roads.

To determine the mileage of paved roads that could be built following the life-cycle cost principle, the total funds available for paved roads were calculated. These consisted of the sum of the construction funds ( less funds reserved for katcha roads ) and the operating budget for roads. the latter was adjusted to reflect an expectation that a portion of the beldars currently employed will continue to focus on the katcha roads, and thus the cost associated with them is not transferable to paved road maintenance. This total was then divided by the life-cycle cost of a paved road to arrive at the Maximum Sustainable Service Level ( MSSL), given district resources.



To be conservative, it is not assumed that districts could freely transfer resources between construction and maintenance to reach the Maximum Sustainable Service Level, however. Instead, the mileage of paved roads constructed each year was calculated by dividing the construction budget available for paved roads by the cost of upgrading one mile to paved status.

As shown in the with-project projection ( see Table 6 in the Economic Analysis Section ), this results in construction of less than the MSSL mileage each year. In fact, the districts have more than sufficient funds to maintain more paved roads than they are "allowed" to build in the model, which requires concentration on katcha roads. As shown in the table, there are sufficient funds to maintain the MSSL paved road network in all years but 1988, but the districts do not have sufficient construction funds to reach this level. As a result, there is a "surplus" of funds in the maintenance budget for paved roads. In the analysis, this surplus is simply ignored. That is, it is assumed that it is used by the districts for activities other than paved road construction, Katcha road construction, or paved road maintenance. The benefits of this activity are not included in the analysis, nor is the surplus counted as a cost. These funds would in theory be available for maintenance of katcha roads, recycling into the construction budget or non-road-related uses. In effect, this introduced an additional margin of conservatism into the projection.

#### VI Benefits from District Council Roads

As discussed previously in the text, benefits are derived from two sources: benefits on the paved network are defined as vehicle cost savings, compared to the situation that would prevail in the without-project case, while benefits from katcha roads are defined as the value-added from additional transport, using freight rates and passenger fares as a proxy for net economic benefits to the users of these services.

In the case of paved roads, the benefits may be further broken down into two categories. Where the total paved road network is larger in one case than another, it is assumed that the additional mileage of paved roads is in good condition and generates the vehicle operating cost savings associated with driving on a paved road in good condition, compared to driving on a katcha road in average condition.

In the case of the remaining mileage ( the "overlap between the two projections " ), it is assumed that vehicle operating cost savings accrue only in the with-project case and are due to the improved condition of paved roads that would exist in either case. Thus it is assumed that these paved roads remain in good condition in the with-project case, but vary from good to poor in the without project case, depending on when they were built or last rehabilitated. Thus, a road is assumed to be in good condition for

the first two years after construction or rehalitation, in fair condition for the next two years, and in poor condition for the following three years, after which it is rehabilitated again.

Table II-5 shows the cost savings associated with each of these differentials as calculated from information from NTRC and MLGRD.

TABLE II-5  
OPERATING COST SAVINGS PER VEHICLE-DAY  
ON PAVED ROADS ( Rs. )

Road Condition	Vehicle operating cost saving per vehicle per day
Paved road in good condition compared to paved road in fair condition	.14
Paved road in good condition compared to paved road in poor condition	.54
Paved road in good condition compared to katcha road in average condition	1.26

Source: NTRC (Planning Commission)/FRDEC/USAID

These savings were then applied to the projected traffic levels and mileage to derive total vehicle operating cost savings in the with- and without-project cases. It should be noted that there are more paved roads in the without project case in the early years of the projected period and thus the net vehicle operating costs savings from additional paved roads are negative. In addition, the savings in the with-project case due to better maintenance are negligible at the traffic rates assumed. This reinforces the view that in the current situation it is more economically attractive to build new katcha roads than to upgrade existing roads to paved.

The vehicle operating costs begin to exceed the cost of the upgrading at a traffic level of 85 ( assuming an initial katcha road construction cost of Rs. 30,000 and no subsequent expenditures; if a low-maintenance requirement katcha road costs Rs. 180,000, then the break-even ADT where the additional cost of upgrading to paved equals the vehicle operating costs would be 60 vehicles per day ). In either case, however, the stream of benefits generated from new katcha road construction far exceed those from upgrading at any reasonable traffic level.

Benefits from new proper katcha roads are calculated on the basis of freight rates and passenger fares, the source for both rates is the report on farm to market roads in Pakistan prepared for the Asian Development Bank.

#### VII Total Road Costs and Calculation of Net Benefits

The net costs in the with-project case are taken as the sum of AID's input to the project ( including contingencies but not including inflation ) and the additional expenditures on roads made by the district council. Other expenditures by the Government of Pakistan are not expected to be additional to expenditures without the project and are therefore not treated as a cost.

District costs with and without the project are taken as the sum of expenditures on paved and katcha roads, including construction and maintenance ( which is limited to beldars in the case of the katcha roads ). In the with-project case, this sum is somewhat less than the total funds estimated to be available for roads, as discussed above. The excess of expenditures with the project over the without-project case ( over the 20-year period ) is taken as the net cost of the project.

These net costs are then compared to the benefits calculated as described above to generate the net benefits in each year of the 20-year time horizon for the analysis. These net benefits are then discounted and summed following standard procedures to produce the undiscounted net benefits, the net benefits discounted at 12 percent, and the internal rate of return.

Table No 7,8 and 9 in the main text show the calculation of the net benefits and costs in the with-project and without project cases.

- 91'

ANNEXURE 3

TRAFFIC SURVEYS ON THREE SAMPLE  
DISTRICTS IN SIND





STATEMENT SHOWING THE DETAILS OF TRAFFIC DENSITY OVER THE DISTRICT  
COUNCIL ROADS AT SHIKARPUR.

S.NO	NAME OF ROAD	TRAFFIC DETAILS											TOTAL	
		Jeep	Car	Suzuki	Bus	M.Cycle	Cycle	Tan ga	Bullock cart	Dat san	Donky Gara	Trukk		Tractor
16.	Thahirio to Sojhro Khan Jatoi.	12	5	7	9	15	17	4	18	9	5	4	11	116
20	Fharpur Road to Noor Mohd Suj-rah	7	4	5	-	9	13	-	14	6	7	-	6	71
20	Pir Bux Shujrah to Bhatti Shakha.	7	-	6	5	7	15	-	15	8	5	-	9	77
25 & 26.	Panhwar to Panah Sujrah. Panhwar to Kakra.	10	5	4	4	7	14	-	18	7	5	-	10	84
47	Kandhkot road to Qutib Ali Jatoi.	5	-	2	2	8	8	-	16	6	4	4	5	58
3	Sultan Kot to Zerkhail.	14	11	13	1	44	69	19	22	20	16	10	48	337
6	Lodra to Shrine of Budhal Fakir.	6	6	6	5	14	15	16	50	6	10	4	7	145
1.	Shikarpur to Abdu via Jano & Buja Napar.	7	5	14	2	29	32	17	20	10	31	9	18	194
2.	Shikarpur to Jagan.	3	-	-	-	23	30	20	29	3	33	2	15	158
9.	Sultan Kot to Mian Jo Goth.	12	10	10	-	28	61	15	23	20	19	11	45	290

STATEMENT SHOWING AVERAGE NUMBERS OF VEHICLES  
PER DAY ON DISTRICT COUNCIL ROADS.

From- 8.

to P.M.

Name of District Council Roads	Buses	Trucks	Tractors	Cars	Motor Cycles	Cycles	Bullock Carts	Donkey Carts	Total	
1	2	3	4	5	6	7	8	9	10	
1. Dodapuz Miranpur Pacca Road to Village Amirabad. (1)	4	16	26	9	30	20	30	24	6	184
2. Das to Village Chok Marri. (17-88)-	6	12	20	12	16	20	38	20	16	122
3. Jacobabad Town to Village Bazar- pur. (21)-	4	14	21	13	21	25	40	28	12	178
4. Road from Roer wad to Thul Town Via Sunjial (59)-	7	15	31	10	30	37	30	42	14	216
5. Road from Thul Town to Tangwan via Unhhar wab. (61)-	4	20	30	12	40	140	200	100	26	572
6. Road from Pul Jaffarabad to village Gau. (2)-	4	20	50	20	50	60	100	20	6	330
7. Road from Chacher Railway Station to Village Jaffarabad. (3)-	2	5	20	10	30	30	50	10	2	159
8. Road from Dodapuz to Ratodero. (4)	2	4	30	10	40	20	50	10	2	168
9. Garhi Khairo Pacca Road to village Dad Muhammad Khan Lohar (7)	-	5	20	10	30	20	50	10	3	148
10. Dodapuz Garhi Khairo pacca Road to village Lal Shah (9)-	2	3	20	10	30	30	60	10	2	169
11. Road from Pul Jaffarabad to village Jaffarabad Buledi. (11)-	2	3	30	10	25	20	50	5	2	147
12. Road from Tangwan to 36 Mile Shahi Mah (78)-	-	5	50	15	50	30	60	10	5	229
13. Kandkot Mulguzar pacca Road to Chool-ah Tattapur via village Rahim Bux Khoco. (86)	-	3	20	12	30	20	40	3	2	132



TABLE III-5

Name of District Council Road	Buses	Trucks	Tractors	Cars	Motor Cycles	Wagons	Bullock Carts	Donkey Carts	Total	
1	2	3	4	5	6	7	8	9	10	
14. Road from Scheme to Pul Shujra (54)-	4	5	40	10	40	100	100	5	4	308
15. Road from Garhi Dutto to Garhi Hassan. (51)-	2	8	30	8	30	50	80	4	10	226
16. Thul Jeds patta Road to Bahadurpur via Langipur. (55)-	4	4	50	12	50	70	100	2	10	282
17. Road from Abad to Mubarakpur. (52)-	2	3	50	5	20	60	100	2	4	246
18. Road from Maharabad to Milling Mir Hassan Khoso Railway Station. (63)-	-	3	40	10	20	50	50	5	10	200
19. Road from Garhi Hassan to village Allahabad. (60)-	4	5	50	12	60	100	100	2	8	341
20. Road from Abad to Ramzanpur via Korja. (25)-	2	5	30	10	40	50	50	5	5	171
21. Road from Badani to Gandhar (122)	2	5	50	10	30	40	50	2	15	204
22. Kandhket Kashaore Patta Road to Pak Fodur. (125)-	2	5	30	8	40	20	40	5	10	160
23. Road from Village Khichi to Badani. (139)-	2	5	50	10	30	40	50	5	15	207

BACKGROUND INFORMATION TABLES FOR  
LIFE CYCLE COST ANALYSIS

Background Tables for Life-Cycle Cost Analysis

Type of Road: Existing Paved  
 Strategies: 1) Maintain; 2) 3-Yr. Rehab; 3) 5-Yr. Rehab; 4) 8-Yr. Rehab; 5) Upgrade  
 Discount Rates .12  
 File Name: Paved  
 Periodic maint. cost in year 0 is capital cost.

Year:	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		Rout&Emr	Periodic	Total	Rout&Emr	Periodic	Total	Rout&Emr	Periodic	Total	Rout&Emr	Periodic	Total	Rout&Emr	Periodic	Total
0	1		620.00	620.00		500.00	500.00		500.00		500.00					500.00
1.00	.892357143	7.10		6.34		.00	.00		.00		.00					.00
2.00	.797193879	7.10		5.64		.00	.00		.00		.00					.00
3.00	.711780248	7.10		5.05		179.00	127.41		.00		.00			179.00		127.41
4.00	.635518078	7.10		4.51		.00	.00		.00		.00		7.10			4.51
5.00	.567426956	7.10	57.80	36.83		.00	.00	262.00	148.67		.00		7.10			4.03
6.00	.506631121	7.10		3.60		179.00	90.69		.00		.00		7.10			3.60
7.00	.452349215	7.10		3.21		.00	.00		.00		.00		7.10			3.21
8.00	.403883228	7.10		2.87		.00	.00		.00		370.00	149.44	7.10	57.80		26.21
9.00	.360618925	7.10	57.80	23.40		179.00	64.55		.00		.00		7.10			2.56
10.00	.321973237	7.10		2.29		.00	.00	262.00	84.36		.00		7.10			2.29
11.00	.287476104	7.10		2.04		.00	.00		.00		.00		7.10			2.04
12.00	.256675093	7.10	57.80	16.66		179.00	45.94		.00		.00		7.10	57.80		16.66
13.00	.229174190	7.10		1.63		.00	.00		.00		.00		7.10			1.63
14.00	.204619813	7.10		1.45		.00	.00		.00		.00		7.10			1.45
15.00	.182696261	7.10	57.80	11.86		179.00	32.70		262.00	47.87		.00				1.30
16.00	.163121662	7.10		1.16		.00	.00		.00		370.00	60.34	7.10	57.80		10.39
17.00	.145644341	7.10		1.03		.00	.00		.00		.00		7.10			1.03
18.00	.130039590	7.10	57.80	8.44		179.00	23.28		.00		.00		7.10			.92
19.00	.116106777	7.10		.82		.00	.00		.00		.00		7.10	57.80		7.54
20.00	.103466765	7.10		.74		.00	.00		.00		.00		7.10			.74
Totals:				759.59			684.57			780.89			709.79			717.71
				36.17			42.12			37.19			33.80			34.18

Life Cycle Costing

Type of Road: Existing Paved

Strategies: 1) Maintain; 2) 3-Yr. Rehab; 3) 5-Yr. Rehab; 4) 8-Yr. Rehab; 5) Upgrade

Discount Rate: .15

File Name: Paved

Periodic maint. cost in year 0 is capital cost.

Years	Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5			
		Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	
0	1		620.00	620.00		500.00	500.00		500.00	500.00		500.00	500.00		500.00	500.00	
1.00	.869565217	7.10		6.17		.00			.00							.00	
2.00	.756143667	7.10		5.37		.00			.00							.00	
3.00	.657316232	7.10		4.67		.00		179.00	117.70							.00	
4.00	.571753246	7.10		4.06		.00			.00						179.00	117.70	
5.00	.497176735	7.10	57.80	32.27		.00			.00					7.10		4.06	
6.00	.432327596	7.10		3.07		.00			.00					7.10		3.53	
7.00	.375937040	7.10		2.67		.00	179.00	77.39	.00					7.10		3.07	
8.00	.326901774	7.10		2.32		.00		.00	.00					7.10		2.57	
9.00	.284262412	7.10	57.80	18.45		.00			.00			370.00	120.95	7.10	57.80	21.22	
10.00	.247184706	7.10		1.76		.00			.00				.00	7.10		2.02	
11.00	.214943223	7.10		1.53		.00			.00	262.00	64.76		.00	7.10		1.76	
12.00	.186907150	7.10	57.80	12.13		.00			.00				.00	7.10		1.53	
13.00	.162527957	7.10		1.15		.00	179.00	33.46	.00				.00	7.10	57.80	12.13	
14.00	.141328658	7.10		1.00		.00		.00	.00				.00	7.10		1.15	
15.00	.122994485	7.10	57.80	7.98		.00			.00				.00	7.10		1.00	
16.00	.106864770	7.10		.76		.00	179.00	22.00	.00	262.00	32.29		.00	7.10		.87	
17.00	.092925887	7.10		.66		.00		.00	.00				370.00	39.54	7.10	57.80	6.94
18.00	.080805119	7.10	57.80	5.24		.00			.00				.00	7.10		.66	
19.00	.070265321	7.10		.50		.00	179.00	14.46	.00				.00	7.10		.57	
20.00	.061100279	7.10		.43		.00		.00	.00				.00	7.10	57.80	4.56	
Totals:				732.19			815.88			727.22			660.49			685.86	
				34.87			38.85			34.63			31.45			37.66	

Life Cycle Costing

Type of Road: Existing Paved

Strategies: 1) Maintain; 2) 3-Yr. Rehab; 3) 5-Yr. Rehab; 4) 8-Yr. Rehab; 5) Upgrade

Discount Rate: .12

File Name: Paved

Periodic maint. cost in year 0 is capital cost.

Year:	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total
0	1		620.00	620.00		500.00	500.00		500.00		500.00	500.00				
1.00	.892857143	7.10		6.34		.00	.00		.00		.00	.00				.500.00
2.00	.797193878	7.10		5.66		.00	.00		.00		.00	.00				.00
3.00	.711780248	7.10		5.05		.00	.00		.00		.00	.00				.00
4.00	.635518078	7.10		4.51		179.00	127.41		.00		.00	.00				.00
5.00	.567426856	7.10	57.80	36.83		.00	.00		.00		.00	.00				179.00
6.00	.506631121	7.10		3.60		.00	.00		.00		.00	.00				127.41
7.00	.452349215	7.10		3.21		179.00	90.69		262.00	148.57	.00	.00				4.51
8.00	.403883228	7.10		2.87		.00	.00		.00		.00	.00				4.03
9.00	.360610025	7.10	57.80	23.40		.00	.00		.00		.00	.00				3.60
10.00	.321973237	7.10		2.29		179.00	64.55		.00		370.00	149.14				3.21
							.00		262.00	84.36		.00				2.29
Totals:				713.76			782.64			733.02		649.44				873.82
				64.89			71.15			66.64		59.04				61.26

Rural roads life cycle costing

Type of Road: Shingle 20 ft.

Strategies: 1) Maintain; 2) 3-yr. Rehab; 3) 5-yr. Rehab; 4) 8-Yr. Rehab; 5) Upgrade

Discount Rate: 0 fiscal analysts

Filename: Shing120

Periodic maint. cost in year 0 is capital cost.

Year:	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total
0	1		345.00	345.00		345.00	345.00		345.00	345.00		345.00				
1	1	6.60		6.60			.00			.00						
2	1	6.60	3.20	9.80			.00			.00						.00
3	1	6.60		6.60		118.00	118.00			.00						.00
4	1	6.60	94.00	100.60			.00			.00					118.00	118.00
5	1	6.60		6.60			.00			.00			6.60			6.60
6	1	6.60	3.20	9.80		118.00	118.00		192.00	192.00			6.60		3.20	9.80
7	1	6.60		6.60			.00			.00			6.60			6.60
8	1	6.60	94.00	100.60			.00			.00			6.60	94.00	100.60	100.60
9	1	6.60		6.60		118.00	118.00			.00		291.00	291.00	6.60		6.60
10	1	6.60	3.20	9.80			.00		192.00	192.00			6.60		3.20	9.80
11	1	6.60		6.60			.00			.00			6.60			6.60
12	1	6.60	94.00	100.60		118.00	118.00			.00			6.60	94.00	100.60	100.60
13	1	6.60		6.60			.00			.00			6.60			6.60
14	1	6.60	3.20	9.80			.00			.00			6.60	3.20	9.80	9.80
15	1	6.60		6.60		118.00	118.00		192.00	192.00			6.60			6.60
16	1	6.60	94.00	100.60			.00			.00			6.60	94.00	100.60	100.60
17	1	6.60		6.60			.00			.00		291.00	291.00	6.60		6.60
18	1	6.60	3.20	9.80		118.00	118.00			.00			6.60		3.20	9.80
19	1	6.60		6.60			.00			.00			6.60			6.60
20	1	6.60	94.00	100.60			.00			.00			6.60	94.00	100.60	100.60
Totals:				963.00			1653.00			921.00			927.00			884.00
Annual Average				45.86			50.14			43.85			44.14			42.10
Average annual cost excluding initial investments:				30.90			35.40			28.50			29.10			30.95

Rural roads life cycle costing

Type of Road: Shingle 20 ft.

Strategies: 1) Maintain; 2) 3-yr. Rehab; 3) 5-Yr. Rehab; 4) 8-Yr. Rehab; 5) Upgrade

Discount Rate: .12

Filename: Shing129

Periodic maint. cost in year 0 is capital cost.

Years	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total
0	1		345.00	345.00		345.00	345.00		345.00	345.00		345.00	345.00		345.00	345.00
1	.892857143	6.60		5.89		.00			.00							.00
2	.797193278	6.60	3.20	7.81		.00			.00							.00
3	.711786248	6.60		4.70	118.00	.00	83.99		.00							.00
4	.635518079	6.60	94.00	63.93		.00	.00		.00						118.00	83.99
5	.567426257	6.60		3.75		.00	.00	192.00	109.95				6.60			4.19
6	.506631121	6.60	3.20	4.96	118.00	.00	59.78		.00				6.60	3.20		5.56
7	.452349215	6.60		2.99		.00	.00		.00				6.60			3.34
8	.403893228	6.60	94.00	46.63		.00	.00		.00				6.60	94.00		45.51
9	.360619025	6.60		2.38	118.00	.00	42.55		.00		291.00	117.53	6.60			2.67
10	.321973237	6.60	3.20	3.16		.00	.00	192.00	61.22				6.60	3.20		3.53
11	.287476104	6.60		1.90		.00	.00		.00				6.60			2.13
12	.256675093	6.60	94.00	25.82	118.00	.00	30.29		.00				6.60	94.00		28.92
13	.229174190	6.60		1.51		.00	.00		.00				6.60			1.69
14	.204619813	6.60	3.20	2.01		.00	.00		.00				6.60	3.20		2.25
15	.182696261	6.60		1.21	118.00	.00	21.55	192.00	35.08				6.60			1.35
16	.163121662	6.60	94.00	16.41		.00	.00		.00				6.60	94.00		19.38
17	.145644341	6.60		.95		.00	.00		.00		291.00	47.47	6.60			1.02
18	.130039590	6.60	3.20	1.27	118.00	.00	15.34		.00				6.60	3.20		1.45
19	.116106777	6.60		.77		.00	.00		.00				6.60			.86
20	.103666763	6.60	94.00	10.43		.00	.00		.00				6.60	94.00		11.68
Totals:				547.48			598.52		550.94			510.00				484.24
Annual Average				26.07			28.50		26.23			24.29				23.06
Average annual cost excluding initial investment:				10.12			12.68		10.29			8.25				10.96

Life cycle costing

Type of Road: Shoulder 20 ft.

Strategies: 1) Maintain; 2) 3-yr. Rehab; 3) 5-yr. Rehab; 4) 8-yr. Rehab; 5) Upgrade

Discount Rate: .15

Filename: SH20L20

Periodic maint. cost in year 0 is capital cost.

Years	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		Rout&Eer	Periodic	Total	Rout&Eer	Periodic	Total	Rout&Eer	Periodic	Total	Rout&Eer	Periodic	Total	Rout&Eer	Periodic	Total
0	1		345.00	345.00		345.00	345.00		345.00	345.00		345.00	345.00		345.00	345.00
1	.869565217	6.60		5.74		.00			.00			.00			.00	.00
2	.756147667	6.60	3.20	7.41		.00			.00			.00			.00	.00
3	.657516232	6.60		4.34	118.00	77.59			.00			.00			.00	77.59
4	.571753246	6.60	94.00	57.52		.00			.00			.00	6.60		.00	3.77
5	.492176735	6.60		3.28		.00		192.00	95.46			.00	6.60	3.20	.00	4.87
6	.432327596	6.60	3.20	4.24	118.00	51.01			.00			.00	6.60		.00	2.85
7	.375937040	6.60		2.48		.00			.00			.00	6.60	94.00	.00	37.82
8	.326931774	6.60	94.00	32.89		.00			.00		291.00	95.13	6.60		.00	2.16
9	.284362412	6.60		1.88	118.00	33.54			.00			.00	6.60	3.20	.00	2.79
10	.247164706	6.60	3.20	2.42		.00		192.00	47.46			.00	6.60		.00	1.63
11	.214943223	6.60		1.42		.00			.00			.00	6.60	94.00	.00	21.62
12	.186937150	6.60	94.00	18.80	118.00	22.06			.00			.00	6.60		.00	1.23
13	.162527957	6.60		1.07		.00			.00			.00	6.60	3.20	.00	1.59
14	.141238358	6.60	3.20	1.38		.00			.00			.00	6.60		.00	.93
15	.122891185	6.60		.81	118.00	14.50		192.00	23.60			.00	6.60	94.00	.00	12.36
16	.106881170	6.60	94.00	10.75		.00			.00		291.00	31.10	6.60		.00	.71
17	.092925887	6.60		.61		.00			.00			.00	6.60	3.20	.00	.91
18	.080995119	6.60	3.20	.79	118.00	8.54			.00			.00	6.60		.00	.53
19	.070265321	6.60		.46		.00			.00			.00	6.60	94.00	.00	7.07
20	.061100279	6.60	94.00	6.15		.00			.00			.00	6.60		.00	.40
Totals:				509.45			553.24			511.51				471.23		445.85
Annual Average				24.38			26.34			24.36				22.44		21.23



Life cycle costing

Type of Road: Shingle 20 ft.

Strategies: 1) Maintain; 2) 5-yr. Rehab; 3) 5-yr. Rehab; 4) 8-yr. Rehab; 5) Upgrade

Discount Rate: .12

Filename: SHINEL20

Periodic maint. cost in year 0 is capital cost.

Years	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Post&Emer	Periodic	Total
0	1		345.00	345.00		345.00	345.00		345.00	345.00		345.00			245.00	245.00
1	.892557143	6.60		5.89		.00	.00		.00	.00		.00				.00
2	.797193378	6.60	3.20	7.81		.00	.00		.00	.00		.00				.00
3	.711786248	6.60		4.70	118.00	83.99			.00	.00		.00				.00
4	.635518078	6.60	94.00	63.93		.00	.00		.00	.00		.00		118.00	83.99	
5	.567425859	6.60		3.75		.00	192.00	108.95		.00		.00	6.60		4.19	
6	.506631121	6.60	3.20	4.96	118.00	59.78		.00	.00	.00		.00	6.60	3.20	3.56	
7	.452349215	6.60		2.99		.00		.00	.00	.00		.00	6.60		3.34	
8	.403883228	6.60	94.00	40.63		.00		.00	.00	291.00	117.53	6.60		94.00	45.51	
9	.360619925	6.60		2.38	118.00	42.55		.00	.00		.00	6.60			2.67	
10	.321973237	6.60	3.20	3.16		.00	192.00	61.82		.00		.00	6.60	3.20	3.53	
															2.13	
Totals:				485.20		531.32		515.76		462.53		415.92				
Annual Average				44.11		48.30		46.89		42.05		37.81				

Strategies 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Discount Rate: .12

Facilities: Katcha6

Periodic maint. cost in year 0 is capital cost.

Years	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		RoutlEser	Periodic	Total	RoutlEser	Periodic	Total	RoutlEser	Periodic	Total	RoutlEser	Periodic	Total	1.00	Periodic	Total
0	1		260.00	260.00		260.00	260.00		260.00	260.00		260.00	260.00			.00
1	.892857143	3.20		2.26		.00			.00			.00				.00
2	.797195872	3.20		2.55		.00			.00			.00				.00
3	.711759249	3.20	3.60	4.48	39.00	27.75			.00			.00				.00
4	.635515079	3.20		2.93		.00			.00			.00				.00
5	.567423256	3.20		1.82		.00		104.00	59.01			.00				.00
6	.50631121	3.20	3.10	3.19	39.00	19.76			.00			.00				.00
7	.452349215	3.20		1.45		.00			.00			.00				.00
8	.403283229	3.20		1.27		.00			.00		195.00	78.76				.00
9	.36019025	3.20	42.50	16.48	39.00	14.06			.00			.00				.00
10	.321773237	3.20		1.03		.00		104.00	33.47			.00				.00
11	.287479194	3.20		.92		.00			.00			.00				.00
12	.256675093	3.20	3.20	1.54	39.00	10.01			.00			.00				.00
13	.229174199	3.20		.75		.00			.00			.00				.00
14	.204613913	3.20		.65		.00			.00			.00				.00
15	.182594251	3.20	3.10	1.15	39.00	7.13		104.00	19.00			.00				.00
16	.163121662	3.20		.52		.00			.00		195.00	31.91				.00
17	.145644241	3.20		.47		.00			.00			.00				.00
18	.129937599	3.20	42.50	5.94	39.00	5.07			.00			.00				.00
19	.115966777	3.20		.37		.00			.00			.00				.00
20	.103666765	3.20		.33		.00			.00			.00				.00
Totals:				309.92		343.77			371.50			370.57				.00
Annual Average				14.76		16.37			17.49			17.65				.00

Life Cycle Costing

Type of Road: Katcha B

Strategies: 1) Maintain; 2) 3-yr. Rehab; 3) 5-yr. Rehab; 4) 8-yr. Rehab; 5) Upgrade

Discount Rate: 0 Fiscal analysis

Filename: KatchaB

Periodic maint. cost in year 0 is capital cost.

Years	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		Rout&Eser	Periodic	Total	Rout&Eser	Periodic	Total	Rout&Eser	Periodic	Total	Rout&Eser	Periodic	Total	1.00	Periodic	Total
0	1		260.00	260.00		260.00	260.00		260.00	260.00		260.00	260.00			.00
1	1	3.20		3.20			.00			.00			.00			.00
2	1	3.20		3.20			.00			.00			.00			.00
3	1	3.20	3.10	6.30		39.00	39.00			.00			.00			.00
4	1	3.20		3.20			.00			.00			.00			.00
5	1	3.20		3.20			.00	104.00	104.00				.00			.00
6	1	3.20	3.10	6.30		39.00	39.00			.00			.00			.00
7	1	3.20		3.20			.00			.00			.00			.00
8	1	3.20		3.20			.00			.00	195.00	195.00				.00
9	1	3.20	42.50	45.70		39.00	39.00			.00			.00			.00
10	1	3.20		3.20			.00	104.00	104.00				.00			.00
11	1	3.20		3.20			.00			.00			.00			.00
12	1	3.20	3.20	6.40		39.00	39.00			.00			.00			.00
13	1	3.20		3.20			.00			.00			.00			.00
14	1	3.20		3.20			.00			.00			.00			.00
15	1	3.20	3.10	6.30		39.00	39.00		104.00	104.00			.00			.00
16	1	3.20		3.20			.00			.00	195.00	195.00				.00
17	1	3.20		3.20			.00			.00			.00			.00
18	1	3.20	42.50	45.70		39.00	39.00			.00			.00			.00
19	1	3.20		3.20			.00			.00			.00			.00
20	1	3.20		3.20			.00			.00			.00			.00
Totals:				421.50			494.00			572.00			650.00			.00
Annual Average				20.07			23.52			27.24			30.95			.00

Life Cycle Costing

Type of Road: Patcha B

Strategies: 1) Maintain; 2) 3-yr. Rehab; 3) 5-yr. Rehab; 4) 8-yr. Rehab; 5) Upgrade

Discount Rate: .15

Filename: PatchaE

Periodic maint. cost in year 0 is capital cost.

Year:	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	1.00	Periodic	Total
0	1		260.00	260.00		260.00	260.00		260.00	260.00		260.00				
1	.859565217	3.20		2.78												.00
2	.756145867	3.20		2.42												.00
3	.657516232	3.20	3.10	4.14												.00
4	.571753246	3.20		1.83		39.00	25.64									.00
5	.497176735	3.20		1.59			.00									.00
6	.432327596	3.20	3.10	2.72			.00		104.00	51.71						.00
7	.375937040	3.20		1.20		39.00	16.86			.00						.00
8	.326701774	3.20		1.05			.00			.00						.00
9	.284262412	3.20	42.50	12.99			.00			.00	195.00	63.75				.00
10	.247184706	3.20		.79		39.00	11.09			.00						.00
11	.214743223	3.20		.69			.00		104.00	25.71						.00
12	.186707150	3.20	3.20	1.20		39.00	7.29			.00						.00
13	.162527757	3.20		.52			.00			.00						.00
14	.141228658	3.20		.45			.00			.00						.00
15	.122674425	3.20	3.10	.77		39.00	.00			.00						.00
16	.106864770	3.20		.34			4.79		104.00	12.78						.00
17	.092925627	3.20		.30			.00			.00			195.00	20.24		.00
18	.080805119	3.20	42.50	3.69		39.00	.00			.00				.00		.00
19	.070365321	3.20		.22			.00			.00				.00		.00
20	.061100000	3.20		.20			.00			.00				.00		.00
Totals:				297.90			328.82			350.19			344.58			.00
Annual Average				14.28			15.66			16.68			15.41			.00

Life Cycle Costing

Type of Road: Katcha B

Strategies: 1) Maintain; 2) 3-Yr. Rehab; 3) 5-Yr. Rehab; 4) 8-Yr. Rehab; 5) Upgrade

Discount Rate: .12

Filename: KatchaB

Periodic maint. cost in year 0 is capital cost.

Years	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	1.00	Periodic	Total
0	1		260.00	260.00		260.00	260.00		260.00	260.00		260.00				
1	.892657143	3.20		2.86				260.00								.00
2	.797193678	3.20		2.55												.00
3	.711780249	3.20	3.10	4.48												.00
4	.635513078	3.20		2.03			39.00		27.76							.00
5	.567426856	3.20		1.82												.00
6	.506631121	3.20	3.10	3.19				104.00		59.01						.00
7	.452345215	3.20		1.45			39.00		19.76							.00
8	.403893228	3.20		1.29												.00
9	.360616925	3.20	42.50	16.48			39.00		14.06				195.00		78.76	.00
10	.321973237	3.20		1.03												.00
									104.00							.00
										33.49						.00
Totals:				297.18			321.58			352.50			338.76			.00
Annual Average				27.02			29.23			32.05			30.80			.00

Life Cycle Costing      Alternative Rehabilitation Strategies  
 Type of Road:            Existing Paved  
 Strategies: 1) Maintain; 2) 3-yr. Rehab; 3) 5-yr. Rehab; 4) 8-yr. Rehab; 5) Delayed 5-yr.  
 Discount Rate:            0 Fiscal analysis  
 File Name: Paved

Periodic maint. cost in year 0 is capital cost.

Years	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5			
		Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	Rout&Emer	Periodic	Total	
0	1		179.00	179.00		179.00	179.00										
1.00	1	7.10		7.10			.00									.00	
2.00	1	7.10		7.10			.00									.00	
3.00	1	7.10		7.10			.00		262.00	262.00						.00	
4.00	1	7.10		7.10		179.00	179.00									.00	
5.00	1	7.10	57.80	64.90			.00					370.00	370.00	7.10		7.10	
6.00	1	7.10		7.10			.00							7.10		7.10	
7.00	1	7.10		7.10		179.00	179.00							7.10		7.10	
8.00	1	7.10		7.10			.00		260.00	260.00				7.10		7.10	
9.00	1	7.10	57.80	64.90			.00							7.10	57.80	64.90	
10.00	1	7.10		7.10		179.00	179.00							7.10		7.10	
11.00	1	7.10		7.10			.00							7.10		7.10	
12.00	1	7.10	57.80	64.90			.00							7.10		7.10	
13.00	1	7.10		7.10		179.00	179.00		260.00	260.00			370.00	370.00	7.10	57.80	64.90
14.00	1	7.10		7.10			.00							7.10		7.10	
15.00	1	7.10	57.80	64.90			.00							7.10	57.80	64.90	
16.00	1	7.10		7.10			.00							7.10		7.10	
17.00	1	7.10		7.10		179.00	179.00		260.00	260.00				7.10		7.10	
18.00	1	7.10	57.80	64.90			.00							7.10	57.80	64.90	
19.00	1	7.10		7.10			.00							7.10		7.10	
20.00	1	7.10		.00			.00					370.00	370.00	7.10		7.10	
Totals:				602.90			1253.00			1042.00			1110.00			621.08	
Annual averages:				28.71			59.67			49.62			52.86			29.57	
Annual averages (excluding initial construction):				21.20			53.70			52.10			55.50			31.05	

Life Cycle Costing Alternative Rehabilitation Strategies

Type of Road: Existing Paved

Strategies: 1) Maintain; 2) 3-Yr. Rehab; 3) 5-Yr. Rehab; 4) 8-Yr. Rehab; 5) Delayed 5-Yr.

Discount Rate: .12

File Name: Paved

Periodic maint. cost in year 0 is capital cost.

Year:	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		Rout&Eser	Periodic	Total	Rout&Eser	Periodic	Total	Rout&Eser	Periodic	Total	Rout&Eser	Periodic	Total	Rout&Eser	Periodic	Total
0	1		179.00	179.00		179.00	179.00									
1.00	.892857143	7.10		6.34		.00										.00
2.00	.797193878	7.10		5.66		.00										.00
3.00	.711750249	7.10		5.05		.00		262.00		208.86						.00
4.00	.635518079	7.10		4.51		.00	127.41			.00					262.00	268.86
5.00	.567426856	7.10		4.03		.00	.60			.00				7.10		5.05
6.00	.506631121	7.10	57.80	36.83		.00	.00			.00	370.00	235.14	7.10			4.51
7.00	.452349215	7.10		3.60		.00	90.69			.00		.00	7.10			4.03
8.00	.403893229	7.10		3.21		.00	.00			.00		.00	7.10			3.60
9.00	.360419025	7.10		2.87		.00	.00	260.00		117.61		.00	7.10	57.80		29.36
10.00	.321773237	7.10	57.80	25.40		.00	64.55			.00		.00	7.10			2.87
11.00	.287476104	7.10		2.29		.00	.00			.00		.00	7.10			2.56
12.00	.256675093	7.10		2.04		.00	.00			.00		.00	7.10			2.29
13.00	.229174190	7.10	57.80	16.66		.00	45.94		260.00	66.74		.00	7.10	57.80		19.66
14.00	.204619813	7.10		1.63		.00	.00			.00		370.00	94.97			1.82
15.00	.182696241	7.10		1.45		.00	.00			.00		.00	7.10			1.63
16.00	.163121662	7.10	57.80	11.86		.00	32.70			.00		.00	7.10	57.80		13.29
17.00	.145644341	7.10		1.16		.00	.00			.00		.00	7.10			1.30
18.00	.130039599	7.10		1.03		.00	.00		260.00	37.87		.00	7.10			1.16
19.00	.116106777	7.10	57.80	8.44		.00	23.28			.00		.00	7.10	57.80		9.45
20.00	.103666765	7.10		.82		.00	.00			.00		370.00	42.96			.92
				.00		.00	.00			.00		.00	7.10			.82
Totals:				317.85			563.57			431.08			373.07			312.91
Annual averages:				15.14			26.84			20.53			17.77			14.90
Annual averages (excluding initial construction):				6.94			19.23			15.55			18.65			15.65

Life Cycle Costing Alternative Reconstruction Strategies

Type of Road: Existing Paved

Strategies: 1) Maintain; 2) 3-Yr. Rehab; 3) 5-Yr. Rehab; 4) 2-Yr. Rehab; 5) Delayed 5-Yr.

Discount Rate: 0 Fiscal analysis

File Name: Paved

Periodic maint. cost in year 0 is capital cost.

Year:	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		Rout&Eser	Periodic	Total	Rout&Eser	Periodic	Total	Rout&Eser	Periodic	Total	Rout&Eser	Periodic	Total	Rout&Eser	Periodic	Total
0	1		620.00	620.00		620.00	620.00		620.00	620.00		620.00			179.00	179.00
1.00	1	7.10		7.10		.00			.00			.00				.00
2.00	1	7.10		7.10		.00			.00			.00				.00
3.00	1	7.10		7.10		179.00	179.00		.00			.00			620.00	620.00
4.00	1	7.10		7.10		.00			.00			.00	7.10			7.10
5.00	1	7.10	57.80	64.90		.00		262.00	262.00			.00	7.10			7.10
6.00	1	7.10		7.10		179.00	179.00		.00			.00	7.10			7.10
7.00	1	7.10		7.10		.00			.00			.00	7.10			7.10
8.00	1	7.10		7.10		.00			.00		370.00	370.00	7.10	57.80		64.90
9.00	1	7.10	57.80	64.90		179.00	179.00		.00			.00	7.10			7.10
10.00	1	7.10		7.10		.00		262.00	262.00			.00	7.10			7.10
11.00	1	7.10		7.10		.00			.00			.00	7.10			7.10
12.00	1	7.10	57.80	64.90		179.00	179.00		.00			.00	7.10	57.80		64.90
13.00	1	7.10		7.10		.00			.00			.00	7.10			7.10
14.00	1	7.10		7.10		.00			.00			.00	7.10			7.10
15.00	1	7.10	57.80	64.90		179.00	179.00		262.00	262.00		.00	7.10	57.80		64.90
16.00	1	7.10		7.10		.00			.00		370.00	370.00	7.10			7.10
17.00	1	7.10		7.10		.00			.00			.00	7.10			7.10
18.00	1	7.10	57.80	64.90		179.00	179.00		.00			.00	7.10	57.80		64.90
19.00	1	7.10		7.10		.00			.00			.00	7.10			7.10
20.00	1	7.10		.00		.00			.00			.00	7.10			7.10
Totals:				1043.90			1694.00			1406.00			1360.00			1150.90
Annual averages:				49.71			80.67			66.95			64.76			54.90
Annual averages (excluding initial construction):				21.20			53.70			39.30			37.00			48.60



Life Cycle Costing Alternative Reconstruction Strategies

Type of Road: Existing Paved

Strategies: 1) Maintain; 2) 3-Yr. Rehab; 3) 5-Yr. Rehab; 4) 8-Yr. Rehab; 5) Delayed 5-Yr.

Discount Rate: .12

File Name: Paved

Periodic maint. cost in year 0 is capital cost.

Year:	Disc. Factor	Strategy 1			Strategy 2			Strategy 3			Strategy 4			Strategy 5		
		Rout&Eer	Periodic	Total	Rout&Eer	Periodic	Total	Rout&Eer	Periodic	Total	Rout&Eer	Periodic	Total	Rout&Eer	Periodic	Total
0	1		620.00	620.00		620.00	620.00		620.00	620.00		620.00	620.00		179.00	179.00
1.00	.892957143	7.10		6.34		.00		.00		.00		.00				.00
2.00	.797193878	7.10		5.66		.00		.00		.00		.00				.00
3.00	.711780248	7.10		5.05	179.00	127.41		.00		.00		.00			620.00	441.30
4.00	.635513078	7.10		4.51		.00		.00		.00		.00	7.10			4.51
5.00	.567425856	7.10	57.80	36.83		.00		.00	262.00	148.67		.00	7.10			4.03
6.00	.505621121	7.10		3.60	179.00	90.69		.00		.00		.00	7.10			3.60
7.00	.452347215	7.10		3.21		.00		.00		.00		.00	7.10			3.21
8.00	.403883228	7.10		2.87		.00		.00		.00	370.00	.00	7.10	57.80		26.21
9.00	.360619025	7.10	57.80	23.40	179.00	61.55		.00		.00		.00	7.10			2.56
10.00	.321973237	7.10		2.29		.00		.00	262.00	84.36		.00	7.10			2.29
11.00	.287476164	7.10		2.04		.00		.00		.00		.00	7.10			2.04
12.00	.256675093	7.10	57.80	16.66	179.00	45.94		.00		.00		.00	7.10	57.80		16.66
13.00	.229174190	7.10		1.63		.00		.00		.00		.00	7.10			1.63
14.00	.204619813	7.10		1.45		.00		.00		.00		.00	7.10			1.45
15.00	.182995261	7.10	57.80	11.86	179.00	32.70		.00	262.00	47.87		.00	7.10	57.80		11.86
	.163121662	7.10		1.16		.00		.00		.00		.00	370.00			1.16
	.145644341	7.10		1.03		.00		.00		.00		.00	7.10			1.03
	.130029590	7.10	57.80	9.44	179.00	23.28		.00		.00		.00	7.10	57.80		9.44
	.116105777	7.10		.82		.00		.00		.00		.00	7.10			.82
20.00	.102666765	7.10		.99		.00		.00		.00		.00	7.10			.74
Totals:				758.85		1004.57			900.99		829.79				712.54	
Annual averages:				36.14		47.84			42.90		39.51				33.93	
Annual averages (excluding initial construction):				6.94		19.23			14.04		10.49				26.68	

113'

ANNEXURE-5

ASSESSED EQUIPMENT AND ORGANISATIONAL  
REQUIREMENT

Note:- This sample study is only for analysis and does not highlight the actual requirement, which will be finalised during commencement and implementation stages.

### Actual Equipment Needs

Actual needs, and purchase requirements, for each district, and for the three districts as a whole, are shown in Table IV-9 (assuming all katcha roads have been rehabilitated and up-graded to at least gravel standard). In developing this table, the following rationale was used. First, the absolute minimum number of units required is that number needed on any given day (usually the maximum number required by a crew for one day's work, but it is also possible to have two such crews working on the same activity on the same day, doubling the need). Second, equipment will not function 100% of the time -- downtime should be taken into account (20% was used herein); hence, if the required number of units works out to be 1.6, two units will suffice. If the number is 1.9, however, thought should be given to keeping three units available. This would be particularly true for the less expensive, hand-operated units. Not having a given unit available when it is needed can cause unwanted inefficiencies, unnecessary downtime for the other units on the crew and reduced production rates which could effect annual maintenance objectives.

The comparison between the three-fleet and the single-fleet needs and purchase requirements (Table IV-9) is indeed enlightening; the possible savings is considerable, and clearly, consideration should be given to some sort of "central" equipment fleet, to be shared by several districts. This would also set up the opportunity for a "central" workshop for equipment maintenance (see section H, below). It is recognized that any program involving sharing between districts, without a higher-agency control, will create problems, particularly managerial ones; however, the situation is such that it does deserve consideration and a proper investigation when the project gets underway.

#### sample

There is a possibility that Sukkur Division (with six districts) could become the "agency" mentioned above; consideration is presently being given to the addition of an engineering office in divisional headquarters. This development, should it become fact, could be ideal; a divisional fleet (and a divisional maintenance capability for that fleet) would be much more economical than six district fleets.

At the outset of the project, equipment needs will center around that required for maintaining the paved (bituminous) network, and for field inspection. A typical minimum equipment list could be as follows:

- 1, 2.5-Ton Pick-Up Truck, Double Cab (to haul equipment and personnel to the work site)
- 1, 1.5-Ton Pick-Up Truck, Single Cab (field inspection)
- 2, Jack Hammers w/assorted bits (pothole patching)
- 2, Tamper-Compactors (pothole patching)
- 1, Vibrating Plate Compactor (pothole patching and spot sealing)
- 1, 50-Gallon Asphalt Sprayer, Hand-Operated (pothole patching and spot sealing)
- 5, Lots. Hand tools
- 6, Some light vehicles to ensure operation.

In addition, the purchase of a 1-Ton Vibratory Roller,

Table IV-9  
EQUIPMENT NEEDS AND PURCHASE REQUIREMENTS

Code		Sukkur District			Jacobabad District			Shikarpur District			Separate Fleets		Single Fleet	
		Needs	On-Hand	Purchase	Needs	On-Hand	Purchase	Needs	On-Hand	Purchase	Total Needs	Total Purchase Req'ts	Total Needs	Total Purchase Req'ts
				Req'ts			Req'ts			Req'ts				
E-01	2.5-Ton Pick-Up Truck, Double Cab	9	1(4)	8	4	0	4	3	0	3	16	15	14	13
E-02	1.5-Ton Pick-Up Truck, Single Cab	1	0	1	1	0	1	1	0	1	3	3	1	1
E-03	Motor Grader, 120-130 hp	3	2	1	1	0	1	1	0	1	5	3	4	2
E-04	Pneumatic Roller, 10-to-14 Tons	2(1)	0	2	2(1)	0	2	2(1)	0	2	6	6	2	2
E-05	1-Ton Vibrating Roller, Hand-Operated	1	0	1	1	0	1	1	0	1	3	3	1	1
E-06	Backhoe/Loader, 1 CY	1	0	1	1	0	1	1	0	1	3	3	2	2
E-07	Front-End Wheeled Loader, 1.5 CY	0(2)	0	0	0(2)	0	0	0(2)	0	0	0(2)	0	1(6)	1
E-08	Low-Bed Tractor-Trailer, 25 Tons	0(3)	0	0	0(3)	0	0	0(3)	0	0	0(3)	0	0(7)	0
E-09	8-Ton Dump Truck	2	0	2	2	0	2	2	0	2	6	6	2	2
E-10	2,000-Gal Water Tanker, Truck	1	0	1	1	0	1	1	0	1	3	3	1	1
E-11	200-Gal Water Tanker, Trailer	3	0	3	1	0	1	1	0	1	5	5	4	4
E-12	Farm Tractor/Trolley, 60-80 hp	3	0	3	2	0	2	1	0	1	6	6	4	4
E-13	Jack Hammer, Engine-Driven	4	0	4	2	0	2	2	0	2	8	8	5	5
E-14	Tamper-Compactor, Engine-Driven	4	0	4	2	0	2	2	0	2	8	8	5	5
E-15	Vib Plate Compactor, Engine-Driven	1	0	1	1	0	1	1	0	1	3	3	1	1
E-16	Asphalt Sprayer, 50-Gal, Hand-Operated	1	0	1	1	0	1	1	0	1	3	3	1	1
E-17	1/3-CY Concrete Mixer, Engine-Driven	1	0	1	1	0	1	1	0	1	3	3	1	1
E-18	Hand Tools (Average per Crew)	12	0(5)	12	6	0(5)	6	3	0(5)	3	21	21	18	18

- Notes: (1) In each district, one unit could handle the work; however, two units are required for the regravelling operation to keep other equipment operating efficiently.
- (2) Not sufficient need, although the stockpiling of materials has not been considered in the analysis and one unit could be effectively used for that operation and others as well.
- (3) Not sufficient need; renting would be more economical (if dozers are not to be moved, a 15-ton rig would be sufficient).
- (4) Sukkur District has a flat-bed truck which could be used in place of a pick-up.
- (5) Some of these tools undoubtedly exist, but no figures were available.
- (6) Although not warranted for the activities listed, one unit should be considered in a three-district, single fleet.
- (7) Even with the demands of the larger fleet, it would be more economical to rent.

Hand-Operated, should be seriously considered so that training can begin early on the maintenance of shoulders.

#### D. PERSONNEL ANALYSIS BY DISTRICT

Once a reasonable balance of equipment has been reached, the same Work Activity spread is used to check personnel resource requirements. This was done for all three districts. As is usually the case, a good equipment balance will yield a good balance of personnel, at least for the semi-skilled labor classification and higher; any temporary shortage in unskilled labor needs can be filled with short-term day labor.

The theoretical personnel requirements for each of the districts are shown in Tables IV-10a, IV-10b and IV-10c. The actual requirements, for all districts, are shown in Table IV-10d. These numbers were derived using the same reasoning as that used for the equipment requirements; i.e., in arriving at the required number of people for each classification, scheduled and unscheduled absences were taken into account by, in this case, increasing the theoretical needs by 15% for the classifications of skilled labor and higher, and by 25% for semi-skilled and unskilled labor.

#### E. ORGANIZATIONAL REQUIREMENTS

Under the District Engineer, three separate major Divisions will eventually be required in his Roads Department: Road Construction, Road Maintenance and Equipment Maintenance. This advent was discussed with district officials and all agreed to the necessity and showed a willingness to form them. In no case did staffing appear to be a problem; however, training was brought up in each of the three districts as a very important need in each category.

The Road Maintenance Division will require several Sub-Divisions to cover the various facets of the work -- such as Planning, Programming, Scheduling, FA Maintenance, Contract Maintenance, Materials, Budgeting, Accounting, etc. Some of these could, and probably should, be combined, at least until such time as the workload warrants or requires separate offices.

The Equipment Maintenance Division will also have the need for several Sub-Divisions, such as for Equipment Maintenance, Purchasing, Stores and Spare Parts, Disbursement, Inventory, etc.

The single most important objective, however, is the <sup>recommended</sup> separation of road construction and road maintenance activities. Except on paper, no separate divisions currently exist; the District Engineer has the overall responsibility for all engineering activities within his district, including road construction, road maintenance, buildings and lands, water, sewerage, etc. A separate road maintenance division must

## SUKKUR DISTRICT

Table IV-10a  
THEORETICAL NUMBER OF PERSON-DAYS  
REQUIRED BY MONTH

Code	Classification	Month	Jan	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		Work Days	19	23	25	24	24	25	18	18	22	25	25	20
P-01	Engineer		0.37	0.30	0.28	0.33	0.33	0.32	0.44	0.39	0.32	0.28	0.28	0.35
P-02	*Sub-Engineer		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-03	*S.D.O.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-04	Foreman		2.87	2.68	2.63	2.81	3.31	3.44	2.81	2.75	3.10	2.93	2.85	2.55
P-05	Operator		4.37	3.70	3.52	3.63	3.79	4.20	4.28	4.11	3.45	3.40	3.48	4.10
P-06	Operator Assistant		2.95	2.43	2.36	2.42	2.58	3.04	3.00	3.06	2.41	2.36	2.40	2.90
P-07	Driver, Heavy Veh		0.58	0.61	0.56	0.58	1.00	1.00	0.72	0.83	0.59	0.56	0.56	0.50
P-08	Driver, Farm Tract		2.37	2.22	2.12	2.25	2.42	2.40	2.11	2.11	2.55	2.40	2.40	2.20
P-09	Driver, Light Veh		5.61	5.47	5.39	5.60	6.10	6.24	5.75	5.64	5.88	5.69	5.61	5.40
P-10	Crew Leader		5.74	5.22	5.12	5.17	5.17	5.64	5.83	5.61	5.05	5.00	5.08	5.80
P-11	Skilled Laborer		1.63	1.43	1.36	1.42	1.42	1.36	1.72	1.28	1.14	1.04	1.08	1.30
P-12	Semi-Skill Laborer		5.53	5.78	5.72	6.21	7.88	8.12	5.28	5.06	7.41	6.88	6.68	5.00
P-13	Unskilled Laborer		17.74	16.65	16.36	16.96	18.04	19.00	17.61	17.61	17.59	17.08	17.00	17.30

\* Will share supervision and inspection load with Engineer.

## JACCSABAD DISTRICT

Table IV-10b  
THEORETICAL NUMBER OF PERSON-DAYS  
REQUIRED BY MONTH

Code	Classification	Month	Jan	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		Work Days	19	23	25	24	24	25	18	18	22	25	25	20
P-01	Engineer		0.05	0.09	0.04	0.08	0.04	0.12	0.11	0.17	0.05	0.08	0.04	0.15
P-02	*Sub-Engineer		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-03	*S.D.O.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-04	Foreman		0.87	1.25	1.11	1.24	0.77	0.76	0.86	1.03	1.20	1.12	0.60	0.79
P-05	Operator		1.11	2.43	2.24	2.33	0.83	0.84	1.11	1.44	2.50	2.24	0.80	1.00
P-06	Operator Assistant		0.89	1.17	1.08	1.13	0.63	0.64	0.83	0.94	1.18	1.08	0.60	0.75
P-07	Driver, Heavy Veh		0.11	0.61	0.56	0.63	0.21	0.12	0.11	0.33	0.64	0.56	0.00	0.00
P-08	Driver, Farm Tract		0.42	1.39	1.28	1.33	0.33	0.32	0.44	0.67	1.45	1.28	0.32	0.40
P-09	Driver, Light Veh		2.18	2.51	2.33	2.45	1.94	2.08	2.25	2.42	2.43	2.40	1.84	2.14
P-10	Crew Leader		2.32	2.09	2.04	2.00	1.96	2.04	2.39	2.33	2.14	2.04	2.04	2.25
P-11	Skilled Laborer		0.74	0.74	0.60	0.71	0.63	0.72	0.83	0.94	0.68	0.72	0.64	0.85
P-12	Semi-Skill Laborer		1.89	1.65	1.44	1.83	2.17	1.75	1.89	2.00	1.55	1.44	1.36	1.80
P-13	Unskilled Laborer		6.11	7.43	7.04	7.29	5.38	5.52	6.22	6.72	7.55	7.08	5.04	5.65

\* Will share supervision and inspection load with Engineer.

## SHIKARPUR DISTRICT

Table IV-10c  
THEORETICAL NUMBER OF PERSON-DAYS  
REQUIRED BY MONTH

Code	Classification	Month	Jan	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		Work Days	19	23	25	24	24	25	18	18	22	25	25	20
P-01	Engineer		0.11	0.09	0.04	0.08	0.04	0.04	0.06	0.06	0.14	0.08	0.12	0.05
P-02	*Sub-Engineer		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-03	*S.D.O.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-04	Foreman		0.84	0.59	0.58	0.69	0.67	0.52	0.68	0.68	0.61	0.58	0.64	0.79
P-05	Operator		1.53	0.87	0.84	0.88	0.92	0.52	1.06	1.06	0.77	0.72	0.72	1.50
P-06	Operator Assistant		0.89	0.52	0.52	0.54	0.58	0.44	0.72	0.72	0.50	0.48	0.44	0.80
P-07	Driver, Heavy Veh		0.42	0.26	0.36	0.38	0.38	0.16	0.39	0.39	0.23	0.32	0.24	0.40
P-08	Driver, Farm Tract		0.95	0.57	0.48	0.50	0.50	0.24	0.67	0.67	0.45	0.40	0.44	0.95
P-09	Driver, Light Veh		1.68	1.37	1.38	1.52	1.46	1.28	1.51	1.51	1.52	1.38	1.52	1.59
P-10	Crew Leader		1.37	1.26	1.28	1.29	1.33	1.28	1.33	1.33	1.36	1.24	1.32	1.45
P-11	Skilled Laborer		0.32	0.30	0.28	0.38	0.33	0.32	0.17	0.17	0.41	0.28	0.44	0.35
P-12	Semi-Skill Laborer		1.21	1.30	1.28	1.50	1.42	1.36	1.17	1.17	1.36	1.52	1.64	1.20
P-13	Unskilled Laborer		5.26	4.17	4.20	4.50	4.63	3.88	4.72	4.72	4.41	4.16	4.32	5.20

\* Will share supervision and inspection load with Engineer.

Table IV-10d  
ACTUAL PERSONNEL REQUIREMENTS BY DISTRICT

Code	Classification	Suġkur	Jacobabad	Shikarpur
P-01	*Engineer			
P-02	*Sub-Engineer			
P-03	*S.D.O.			
P-04	Foreman	4	2	2
P-05	Operator	5	3	3
P-06	Operator Assistant	3	2	1
P-07	Driver, Heavy vehicle	2	2	2
P-08	Driver, Farm Tractor	3	2	2
P-09	Driver, Light Vehicle	6	3	3
P-10	Crew Leader	10	5	3
P-11	Skilled Laborer	2	2	2
P-12	Semi-Skilled Laborer	8	3	2
P-13	Unskilled Laborer	24	12	8

\* Requirements will depend on organization, see text.

be established early in the project, and headed by a maintenance engineer, responsible to the District Engineer.

Should divisional authority come into the picture, that would, of course, influence the ultimate district organizations. Hopefully, this decision will be made early in the project.

## F. RESOURCE COSTS

For the most part, all resource costs were taken from the previous LBII report; however, when better, more recent information was available, it was incorporated into this document.

### 1. Equipment

The hourly and daily equipment costs are shown in Table IV-11 (this data was taken directly from the LBII March report, and appears on the following page).

### 2. Personnel

The wages for the various labor classifications were calculated based on information supplied by the Accounting Officer for Sukkur District Council. They should not vary appreciably in the other two districts. They are shown in Table IV-12.

Table IV-12  
MONTHLY SALARIES & DAILY WAGE CHARGES BY LABOR CLASSIFICATION

Labor Classification	Permanent Staff		Day Labor
	Monthly Salary	Daily (1) Wages	Daily Wages
S.D.O.	1400	103	N/A
Sub-Engineer	1600	118	N/A
Mechanic	1400	103	N/A
Foreman (2)	1500	110	N/A
Operator	1200	87	N/A
Operator Assistant	800	61	N/A
Driver (Heavy Truck)	1200	87	N/A
Driver (Farm Tractor)	1200	87	N/A
Driver (Light Vehicle)	900	68	N/A
Crew Leader (2)	1000	75	N/A
Skilled Laborer (3)	900	68	70
Semi-Skilled Laborer (4)	650	51	50
Unskilled Laborer	600	47	40

(1) Includes all fringe benefits; (2) Newly created position;  
(3) Carpenter, Mason, etc.; (4) Power tools, etc.



Table IV-11  
EQUIPMENT COSTS

No	Unit	Purchase Prices (Rs)	Estimated Life (Yr)	Total Costs Including Amortization	Hourly Fuel Consump. (Lt)	Hourly Costs (Rs)			Daily Costs (Rs)
						POL	Own & Op	Total	
E-01	2.5-Ton Pick-Up Truck, Double Cab	210000	7	322098	3	25	48	72	579
E-02	1.5-Ton Pick-Up Truck, Single Cab	160000	7	245408	3	25	36	61	488
E-03	Motor Grader, 120-130 hp	1200000	10	2123760	21	174	219	393	3146
E-04	Pneumatic-Tired Roller, 10-14 tons	800000	12	1549840	17	141	133	274	2193
E-05	1-Ton Vibrating Roller, Hand Operated	100000	10	176980	8	66	18	84	672
E-06	Backhoe/Loader, 1 CY	1000000	10	1769800	22	182	183	365	2919
E-07	Front-End Wheeled Loader, 1.5 CY	1200000	10	2123760	22	182	219	402	3212
E-08	Low-Bed Tractor-Trailer, 25 Tons	640000	10	1132672	15	124	117	241	1929
E-09	8-Ton Dump Truck	600000	10	1061880	15	124	110	234	1871
E-10	2,000-Gal Water Tanker, Truck	350000	12	678055	17	141	58	199	1593
E-11	200-Gal Water Tanker, Trailer	35000	12	67806	0	0	6	6	47
E-12	Farm Tractor/Trolley, 60-80 hp	150000	10	265470	8	66	27	94	749
E-13	Jack Hammer, Engine-Driven	20000	7	30676	1	8	5	13	102
E-14	Tamper-Compactor, Engine-Driven	25000	7	38345	1	8	6	14	111
E-15	Vibrating Plate Compactor, Engine-Dr	40000	7	61352	1	8	9	17	139
E-16	Asphalt Sprayer, 50-Gal, Hand-Operat	70000	7	107366	0	0	16	16	127
E-17	1/3-CY Concrete Mixer, Engine-Driven	60000	7	92028	1	8	14	22	175
E-18	Hand Tools (per crew)	10000	2	11834	0	0	6	6	49

Source: NTRC (Planning Commission)/FRDEC/ USAID

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ANNEXURE 6

COST ANALYSES FOR ROADWORKS

Unit cost figures were taken, for drainage works, from the Government of Sind's Schedule of Rates for Public Health Engineering Works (Publication #19), Standing Rates Committee, 1980 (still in effect); for road construction, from the Irrigation and Power Departments Schedule of Rates (Publication #13), Standing Rates Committee, 1982 (also still in effect). Other figures were given by the District Engineers and by local contractors interviewed in each of the districts. Works for which no information was available had to be estimated. Maximum government-allowed unit costs were reported to be derived by adding 20% to the figures of the Standing Rates Committee. Each contractor has a copy of these rates; his own final unit bid amount, however, will depend on his own analysis of the work to be done (and on how badly he wants the job). To be realistic, the Consultant has used unit costs which are 10% lower than the maximums reportedly allowed; this is still considered conservative for this analysis.

(Some inconsistencies were discovered in the process of establishing reasonable unit costs. For example, The Irrigation & Power Department, Government of Sind, in a July 1983 publication, set the rate for spreading and compacting a base course with crushed rock (1-1/2"-max) as Rs 280.15 per 100 cubic feet, while the at-quarry price (near Sukkur Town) for the same material was quoted (and confirmed by telephone) by the Sukkur District Engineer as Rs 275 per 100 cubic feet. This study has used the latter figure in the costing calculations.)

The hauling of some materials will be a substantial cost component, particularly for the crushed rock. The established scale (Standing Rates Committee) can be seen in Table III-3. For a 50-mile haul, a Rs 75/CY purchase price quoted for 2"-max crushed rock would be increased to Rs 147 at the delivery site -- nearly double.

Table III-3  
CONTRACTOR HAULING RATES FOR CRUSHED ROCK  
(Sind Province)

Unit	Over Paved Roads		Over Katcha Roads
	Standing Committee Rates (Rs/100 CF)	(1) (Rs/CY)	(2) (Rs/CY)
1st Mile	44.15	12.87	12.87
2nd Mile	8.65	2.52	3.15
3rd Mile	6.15	1.79	2.24
4th Mile	5.95	1.74	2.17
5th Mile	5.35	1.56	1.95
6th Mile(3)	4.40	1.28	1.60

- (1) Standing Committee Rates, converted to CY and increased by 90% of 20% (see text)  
 (2) Standing Committee Rates as in (1) but further increased by 25% to reflect higher costs of operating on katcha roads  
 (3) And all subsequent miles

Source: Sukkur District Council

The haul-cost figures in the table assume the use of hand-loaded farm tractor-trolleys (capacity 3.7 CY, running speed of 20mph on paved roads and 5 mph on katcha roads). For comparative purposes, the following analysis has been made with a more mechanized approach:

- Assumptions:
- o 8-ton truck (capacity = 5 CY); running speed = 40 mph for paved roads, 10 mph for katcha roads; turn-around time, including loading = 5 minutes; Rs 250/hr including driver.
  - o 1-1/2-CY front-end loader, loading time = 3 min (loader to be otherwise occupied in the quarry operation when not in the loading process); Rs 418/hr including operator.

Loading:	Loader --	$(3/60) \times 418 =$	Rs 20.90
	Truck ---	$(5/60) \times 250 =$	20.83
Running:	Truck ---	$(60/40) \times (250/60) =$	6.25
-----			
Total (loading + 1 mile, paved road):			Rs 47.98

Including 10% profit:

Over all Roads: Loading + 1st Mile =  $(47.98 \times 1.1) / 5 =$  Rs 10.56/CY  
 Running over Paved Roads =  $(6.25 \times 1.1) / 5 =$  Rs 1.38/CY-Mile  
 Running over Katcha Roads =  $1.38 \times 1.25 =$  Rs 1.72/CY-Mile

Note: A loading charge, plus a flat unit rate/CY-mile for the hauling would be more reasonable than the official sliding scale for the first six miles quoted in Table III-3.

In comparing the mechanized effort with the hand-loaded tractor-trolley approach, it would appear that the rates are nearly equal. There is a profound difference, however, when looking at it from the job site: 2.7 times as much material --  $(5/3.7) \times 2$  (twice the running speed) -- is reaching the site in the same amount of time or, to put it another way, it would take 2.7 tractor-trolleys to supply the same amount of material as one 8-ton truck, and this assumes, unrealistically, that the trolley can be hand-loaded in the same three minutes as the truck. It should also be noted that whereas the Consultant's hourly costs for equipment include both operating and full ownership costs (including interest and depreciation), it is not known if the government figures do.

(For hauls of more than ten miles, larger trucks would operate at lesser CY-mile rates.)

For other items, haul costs do not have such a profound effect on total costs. Maximum haul charges for liquid asphalt have also been set: Rs 7.16 for the 1st mile, Rs 2.73 for the 2nd and Rs 1.47 for the 3rd and ensuing miles. These figures are for one metric ton (2,240 lbs). For the haul to Sukkur from Karachi (304 miles), for example, this would translate into Rs 2.20 per gallon, or 11% of the total cost in Sukkur.

Costing the various rehabilitation/up-grading works was done as follows.

#### 1. Bituminous Pre-Mix Overlay

The Standing Rate for applying a 1"-layer of pre-mix (3/4"-max) to an existing pavement is Rs 72.95 per 100 square feet. This translates into Rs 236 per cubic yard, in place.

#### 2. Shoulder Rehabilitation

This work entails, as envisaged by the Consultant, the scarifying of the existing shoulder, the spreading, watering and mixing-in of approximately 1/4 cubic foot per square foot of 1 1/2"

aggregate, shaping and compacting it to be flush with the edge of pavement. There is no Standing Rate for this work, and it was calculated (assuming a labor-intensive effort) as follows:

Equipment: 1, 2.5-Ton Pick-Up Truck, Double Cab  
 1, 1.5-Ton Pick-Up Truck, Single Cab (1/4-time)  
 1, 1-Ton Vibrating Roller, Hand-Operated  
 1, 200-Gallon Water Tanker, Trailer  
 Hand Tools

Personnel: 1, Foreman  
 1, Driver, Light Vehicle  
 1, Semi-Skilled Laborer  
 20, Unskilled Laborers

Materials: 25, CY Crushed Rock, 1-1/2"-max  
 (30-mile haul)

Production Rate: 25 CY/Day (4000 SF/Day)

Using the unit costs cited elsewhere herein for equipment, personnel, materials and haulage, the daily cost = Rs 5,367/25CY = Rs 215/CY. The production rate used was 1 mile/day. (All figures are indicative)

### 3. Gravel Surface Course

This work consists of supplying, spreading, watering, shaping and compacting a 5"-loose-layer (4" compacted) of 1"-max, crushed, graded aggregate over a pre-shaped and compacted surface (18 or 22 feet wide). Materials cost, at the at-quarry rate quoted for 1"-max in Sukkur, is Rs 95/CY. Costs for a 30-mile haul has been calculated as Rs36/CY. Using 100% of the (high) materials cost as the cost of equipment labor, the total cost for this work would approximate Rs 226/CY.

### 4. Existing Surface Rehabilitation

While this work is very similar to that of rehabilitating the shoulders, it is a much larger operation (and will be disruptive to traffic) and should be more mechanized. The following crew make-up has been assumed:

Equipment: 1, 1.5-Ton Pick-Up Truck, Single Cab  
 1, Motor Grader, 120-130 hp (w/scarifier blade)  
 2, Pneumatic-Tired Rollers, 10-14t  
 1, 2,000-Gal Water Tanker, Truck

Personnel: 1, Foreman  
 3, Operators  
 1, Operator Assistant  
 1, Driver, Heavy Vehicle  
 1, Driver, Light Vehicle  
 4, Unskilled Laborers

Materials: 1075, CY Crushed Rock, 2"-max (30-mile Haul)

Using the unit costs cited elsewhere herein for equipment, personnel, materials and haulage, the daily cost = Rs 128,600/1075 CY = Rs 120/CY. The production rate used was 1.5 miles/day.

### 5. Formation Widening

The Standing Rate for simple earthwork for roads (from side-borrow within 100 feet of the roadway), including compaction to 95% (modified AASHTO), is Rs 20.4/CY. Road widening, however, means working under constricted conditions, and the figure has been increased to RS 30/CY for this estimate.

Table III-4 summarizes the basic unit costs for the rehabilitation and/or up-grading works considered in this study; Table III-5 cites the per-mile unit costs.

Table III-4  
AVERAGE BASIC UNIT COSTS  
for  
REHABILITATION/UP-GRADING WORKS  
(1985 Rupees)

	In-Place
Bituminous Pre-Mix Overlay (1" Thickness)	236/CY
Shoulder Rehabilitation, Crushed Rock, 1-1/2"-max	215/CY
Surfacing Course, Crushed Rock, 1"-max	226/CY
Existing Surface Rehab., Crushed Rock, 2"-max	120/CY
Formation Widening, Side-Borrow	30/CY
18" RCP Culverts	2.040/ea

Source: Standing Rates Committee, GOS.

Table III-5  
PER-MILE UNIT COSTS  
for  
REHABILITATION/UP-GRADING WORKS  
(1985 Rupees)

	In-Place
Shoulder Rehabilitation, Paved Surfaces (1)	66,650/mile
4" Surfacing, Unpaved Surfaces (2)	350,300/mile
Exist Surface Rehabilitation, Unpaved Surfaces(2)	75,000/mile
Formation Widening, Unpaved Surfaces (2)	25,200/mile
18" RCP Culverts, in place (3)	2,040/mile

Notes: (1) Cost includes both shoulders: (2) Average for ALL UNPAVED roads: (3) Average for ALL roads.

Cost for a 1"-thick bituminous overlay will be Rs 46,200/mile

For Category (3) roads (22-foot surface width), the quantity of surface aggregate (well-graded, crushed 1"-max) will be as follows (use 5" loose thickness, to be compacted to 4"):  $(22' \times 5,280' \times 5"/12")/27 = 1,790$  CY/mile. For Category (4) roads (18-foot surface width):  $(18' \times 5,280' \times 5"/12")/27 = 1,475$  CY/mile.

The Sind Provincial Government's "Standing Rates Committee" has set the purchase price (in 1985 rupees) for crushed stone, 1"-max, to a grading specification, at Rs 95/CY, which includes the first 15 miles of haul. An average unit rate for additional haulage, including dumping and an allowance for the 25% higher rate while traveling over katcha roads, is Rs 1.30/CY-mile, and includes overhead and profit. Haul distances will average 30, 50 and 30 miles, respectively, for Sukkur, Jacobabad and Shikarpur Districts.

The work to be done includes the following:

- o The preparation of the existing surface, including scarifying, shaping, watering and compacting
- o The delivery of the aggregate
- o The spreading, watering, shaping and compacting of the aggregate

Since this work will not be done for some years, it will be assumed that the successful contractors will be equipped to do the work in a mechanized way; i.e., with modern equipment, designed for that kind of operation.

- o Assumptions (for either road category):

- Working Day = 6 hours
- Motor Grader will work at 3 mph spreading or shaping  
- at 2 mph scarifying
- Pneumatic-Tired Roller will work at 3 mph
- Scarifying will take 4 passes
- Shaping existing surface will take 3 passes
- Spreading and Shaping new surface will take 6 passes
- Compacting old surface will take 3 passes x 4
- Compacting new surface will take 6 passes x 4

	Equipment	Days/Mile
Scarifying Existing Surface	Motor Grader	1/3
Shaping Existing Surface	Motor Grader	1/6
Compacting Existing Surface	Roller	1/2
Spreading & Shaping New Surface	Motor Grader	1/3
Compacting New Surface	Roller	1
Watering	Water Tanker	1
Supurvision	Pick-Up Truck	1/2

With the existing surface operation, clearly one motor grader and one roller are compatible and that the production rate would be 2 miles a day. For the new surface operation, however, there is an imbalance; ideally, two additional rollers should be added and the crew would be entirely compatible. However, by adding just one additional unit, the same production rate as for the old surface is attained and the somewhat inefficient use of the motor grader can be tolerated. The production rate for these crews is two miles per day.

The crews, then:

Existing Surface Preparation		Rs/Day
1, Motor Grader		3146
1, Roller		4386
1, Water Tanker Truck (1/2-time)		796
1, Pick-Up Truck (1/2-time)		290
		(8618)
New Surface Application		Rs/Day
1, Motor Grader		3146
2, Rollers		8872
1, Water Tanker Truck (1/2-time)		796
1, Pick-Up Truck (1/2-time)		290
		(13104)

Total Equipment Costs:  $8,618 + 13,104 = 21,772/2 = \text{Rs } 10,861/\text{mile}$

In total, these two crews will require staffing as follows:

	Rs/Day
1, Foreman	110
5, Operators	435
4, Operator Assistants	244
1, Driver, Heavy Vehicle	87
1, Driver, Light Vehicle	68
4, Unskilled Laborers	188
	(1132)

Total Personnel Costs per Mile:  $1,132/2 = \text{Rs } 566/\text{mile}$

The materials cited above total:

Road Category (3):  $1,790 \text{ CY/mile at Rs } 95/\text{CY} = \text{Rs } 170,050/\text{mile}$   
 Road Category (4):  $1,475 \text{ CY/mile at Rs } 95/\text{CY} = \text{Rs } 140,125/\text{mile}$

Total Haul Costs:

Sukkur District (3):  $1,790 \times (30-15) \times 1.30 = \text{Rs } 34,905/\text{mile}$   
 (4):  $1,475 \times (30-15) \times 1.30 = \text{Rs } 28,760/\text{mile}$   
 Jacobabad Distr (3):  $1,790 \times (50-15) \times 1.30 = \text{Rs } 81,445/\text{mile}$   
 (4):  $1,475 \times (50-15) \times 1.30 = \text{Rs } 67,110/\text{mile}$   
 Shikarpur Distr (3):  $1,790 \times (30-15) \times 1.30 = \text{Rs } 34,905/\text{mile}$   
 (4):  $1,475 \times (30-15) \times 1.30 = \text{Rs } 28,760/\text{mile}$

Total Basic Per-Mile Costs:

	Equip	Pers	Mats	Haul	Totals
Sukkur and Shikarpur---					
Category (3)	10,570	566	170,050	34,905	216,090
Category (4)	10,570	566	140,125	28,760	180,020
Jacobabad---					
Category (3)	10,570	566	170,050	81,445	262,630
Category (4)	10,570	566	140,125	67,110	218,370

The equipment and personnel costs were taken directly from Tables IV-11 and IV-12 and do not include any overhead or profit. The final



average per-mile costs in Table V-1 reflect a 20% increase in those two items.

Table V-1  
AVERAGE PER-MILE COSTS FOR RESURFACING GRAVEL ROADS BY DISTRICT  
CONTRACT MAINTENANCE  
(1985 Rupees)

	Category (3)	Category (4)
Sukkur & Shikarpur	218,315	182,245
Jacobabad	254,855	220,595

### C. FREQUENCY OF ATTENTION

Gravel roads lose their surfacing over time and, periodically, the material must be replaced. This is caused primarily by traffic, but the elements also play a role -- particularly wind and rain. The rate of loss, however, can only be equated to the number of vehicles using the road; once an equation has been accepted, a factor can then be applied in order to bring the elements into play. Since the action of the elements will be fairly constant in a given area, clearly the higher the traffic, the less of a factor are the elements.

The Road Research Laboratory in England years ago adopted a simple formula for material loss, and has used it ever since: Annual loss,  $Q = 1"/100$  AADT. That is, with an AADT of 100, 1" would be lost per year; for an AADT of 25, it would take four years to lose the same amount. In the latter case, however, a factor should be applied to take into account the effect of the elements. The following equations have been used in this analysis:

AADT of 100	$Q = 1.00"/100$ AADT
AADT of 50	$Q = 1.25"/100$ AADT
AADT of 25	$Q = 1.50"/100$ AADT

Since the up-grading from katcha to gravel envisages only a four-inch gravel carpet, when a road has lost two inches, it will require resurfacing, again of four-inch thickness (bringing its total thickness, then, to six inches). The above formulae would establish a frequency of operation on their own; however, they do not take into account the routine patching of potholes (which adds material), the routine light grading (which brings displaced material back onto the roadway) or the periodic heavy grading (which adds material). The first, and subsequent, resurfacing attention required, by selected AADTs, is estimated as follows:

AADT of 100	1st resurfacing after 3 years, then every 6
AADT of 50	1st resurfacing after 5 years, then every 10
AADT of 25	1st resurfacing after 8 years, then every 16

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ANNEXURE 7

TENTATIVE ANNUAL PHASING OF  
RURAL ROADS COMPONENT

**TENTATIVE ANNUAL PHASING OF  
RURAL ROADS COMPONENT**

S. NO.	ITEM OF WORK	1986-87												1987-88												1988-89												1989-90												1990-91											
		YEAR MONTH												YEAR MONTH												YEAR MONTH												YEAR MONTH												YEAR MONTH											
1	SIGNING OF PROJECT AGREEMENT ANTICIPATORY APPROVAL OF P.C.I. (FEDERAL)	█																																																											
2	ISSUANCE OF RFP FOR TECHNICAL SERVICES.													█																																															
3	PROCUREMENT OF INITIAL SET OF COMMODITIES (VEHICLES, E.T.C)	█																																																											
4	AWARD OF TECHNICAL SERVICES CONTRACT	█																																																											
5	SHORT TERM TRAINING COURSES FOR DISTRICT PERSONNEL BEGIN.													█																																															
6	ESTABLISHMENT OF PROJECT OFFICE ESTABLISHMENT OF SMD PROJECT COMMITTEE.													█																																															
7	FIRST COURSE IN MAINTENANCE FOR DISTRICT PERSONNEL.													█																																															
8	PROCUREMENT OF PRELIMINARY SET OF COMMODITIES.													█																																															
9	TECHNICAL SERVICES TEAM FIELDED AND INVENTORIES FOR MAINTENANCE AND MASTER PLANNING BEGIN AND COMPLETED.													█																																															
10	DISTRICT DECISION ON PARTICIPATION IN PHASE 2 AND ESTABLISHMENT OF RMUS.													█																																															
11	PROGRAMMING OF MAINTENANCE WORK FOR FIRST YEAR OF PHASE 2													█																																															
12	SELECTION OF ROADS FOR UPGRADING. A & E COMPLETED FOR SELECTED ROADS.													█																																															
13	SECOND TRAINING COURSE FOR DISTRICT MAINTENANCE PERSONNEL.													█																																															
14	MAINTENANCE PROGRAM BEGINS IN RMUS.																									█																																			
15	CONSTRUCTION BEGINS ON SELECTED ROADS.																									█																																			
16	INITIAL ANALYSIS OF DISTRICT FINANCES COMPLETED.																									█																																			
17	TRAINING COURSES CONTINUE FOR DISTRICT MAINTENANCE PERSONNEL. INITIAL TRAINING AND ROAD INVENTORIES COMPLETED IN ALL DISTRICTS.																									█																																			
18	EVALUATION OF ACHIEVEMENTS IN FIRST YEAR OF PHASE 2.																									█																																			
19	PROGRAMMING OF ROADS AND MAINTENANCE ACTIVITIES FOR YEAR 4.																									█																																			
20	FIRST TRAINING COURSE IN LOCAL FINANCIAL MANAGEMENT.																									█																																			
21	SELECTION OF SECOND GROUP OF ROADS A & E WORK COMPLETED ON SECOND GROUP OF ROADS.																									█																																			
22	MID-TERM EVALUATION OF PROJECT.																									█																																			
23	FINAL SET OF EQUIPMENT PROCURED.																									█																																			
24	EVALUATION OF ACHIEVEMENTS IN SECOND YEAR OF PHASE 2.																									█																																			
25	PROGRAMMING OF RESOURCES FOR THIRD YEAR OF PHASE 2.																									█																																			
26	SELECTION OF ROADS FOR FINAL REHABILITATION PROGRAM A & E WORK COMPLETED ON SELECTED ROADS.																									█																																			
27	TRAINING COURSES CONTINUE FOR DISTRICT COUNCILS PERSONNEL TRAINING IN FINANCIAL MANAGEMENT CONTINUES FOR PERSONNEL.																									█																																			
28	FINAL EVALUATION.																									█																																			

ARCHITECTURAL & ENGINEERING SERVICES

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### Summary of Project Results

The project is the first model project of its kind in Pakistan, as such it takes on an extremely important role since it is envisaged to result in the establishment of a maintained paved network of roads and to provide katcha access to many of the villages which are currently without any link at all.

The project will also result in identifying the policy and institutional reforms necessary to establish an infrastructure for Road Resources Management. It will establish properly equipped Road Maintenance equipment pools, provide training to provincial district authorities in many facets of Resource Management including technical training and finance.

As such, this is the first project whose objective is to invest in protecting the huge investments made by the Government on our road network, and in determining the optimal allocation of financial resources for road systems.

At the end of the project, besides the above benefits, there will also be much needed socio-economic benefits to the rural areas of Sind which are currently without access roads and, beyond the reach of basic social services like health, education etc., which are prime goals set in the Sixth plan and the Prime Minister's Five Point Manifesto.