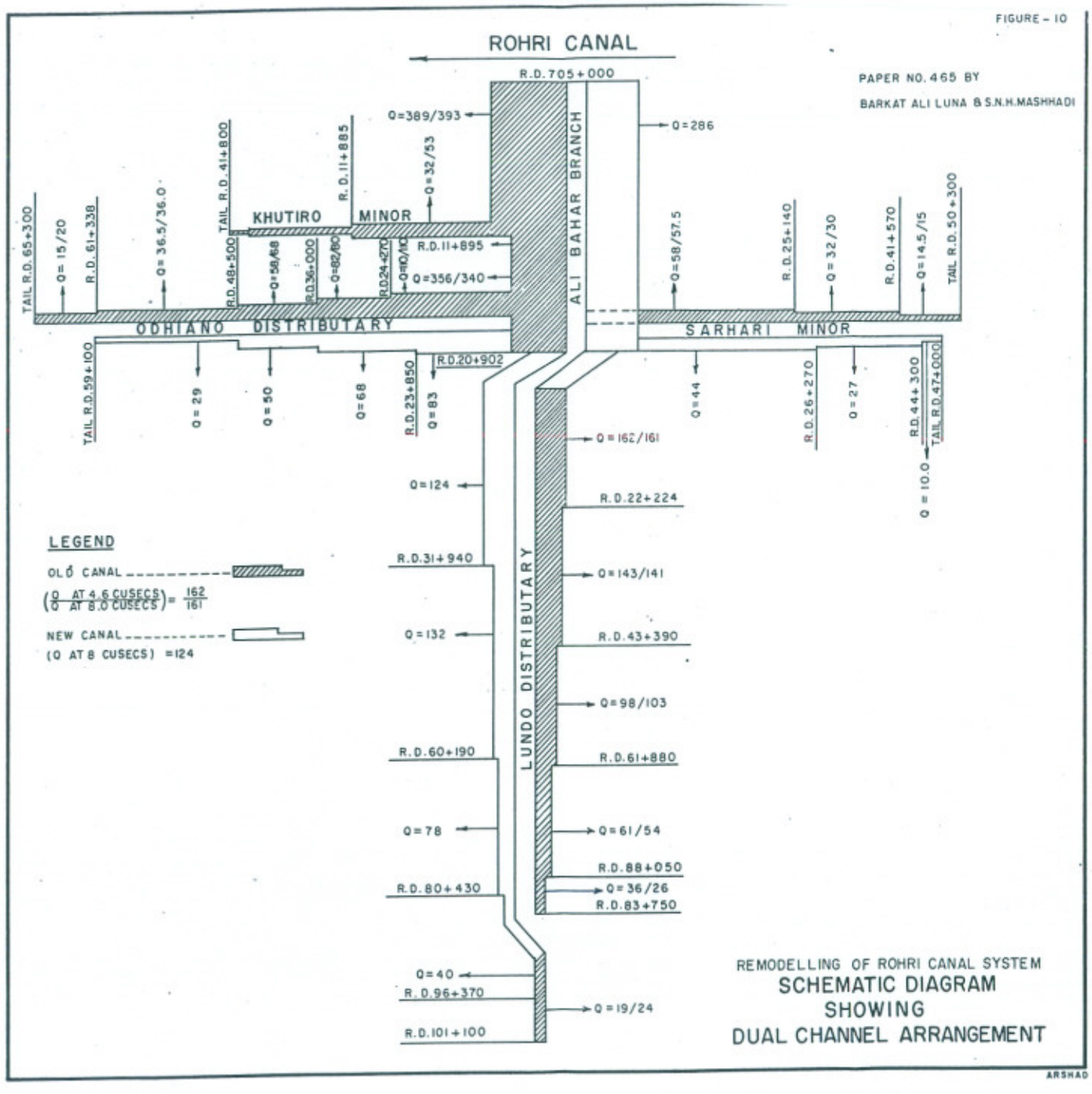
FIGURE – 10

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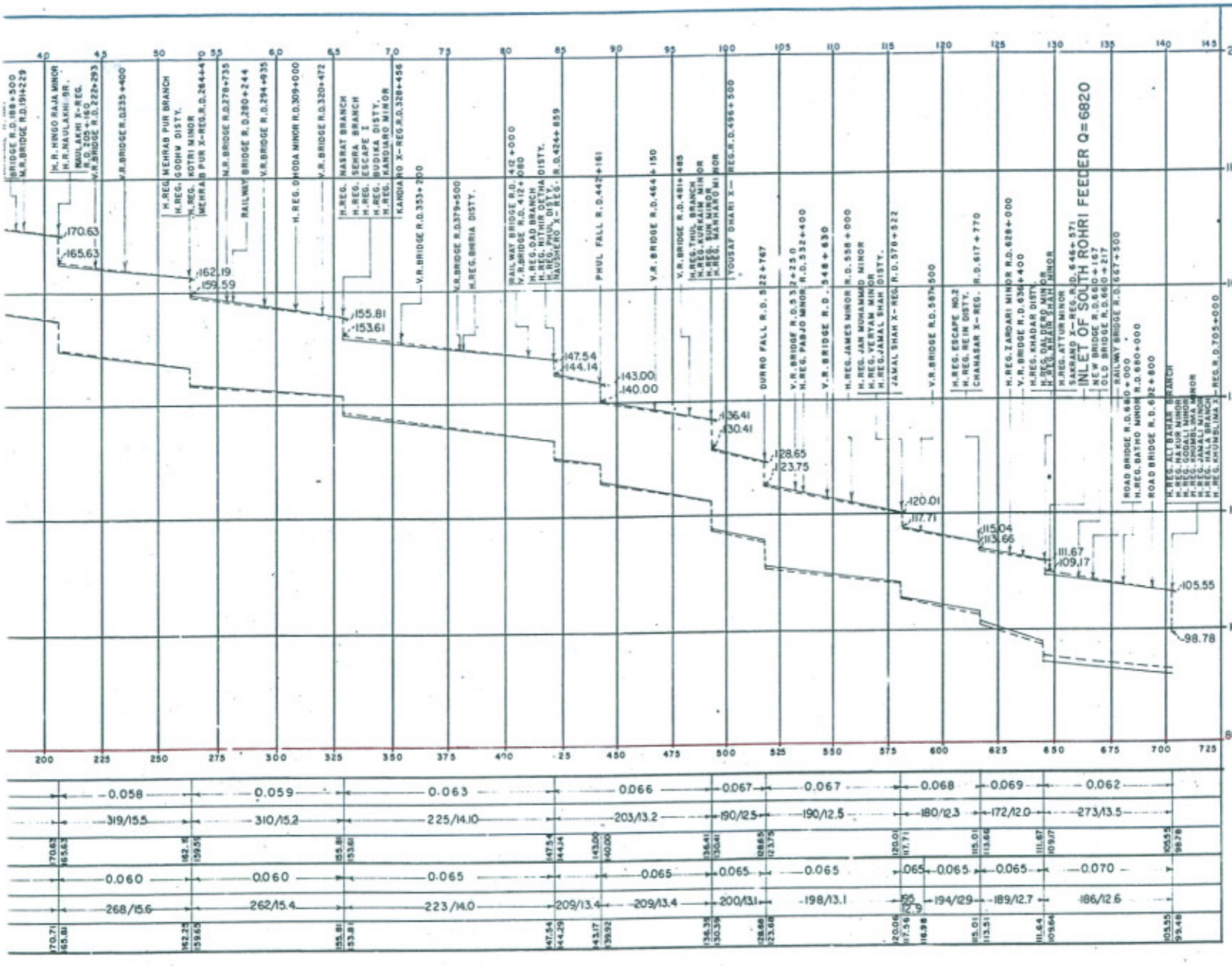
REMODELLING OF ROHRI CANAL SYSTEM

SCHEMATIC DIAGRAM SHOWING DUAL CHANNEL ARRANGEMENT

ARSHAD

FIGURE – 11

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REMODELLING OF ROHRI CANAL SYSTEM
LONGITUDINAL SECTION
OF
NORTH ROHRI CANAL
R.D. 0+000 TO R.D. 705+000
SECOND STAGE PROJECT

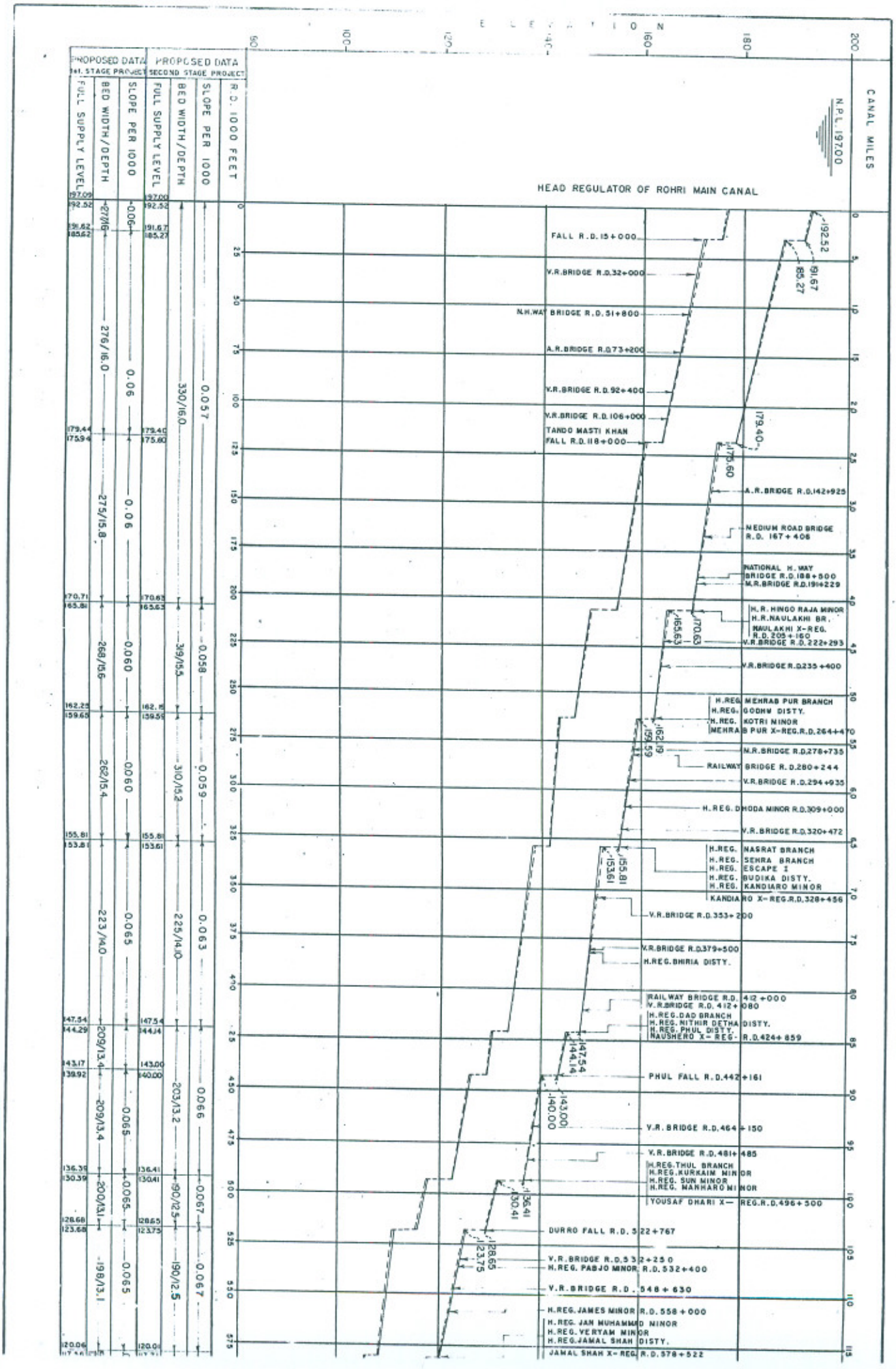
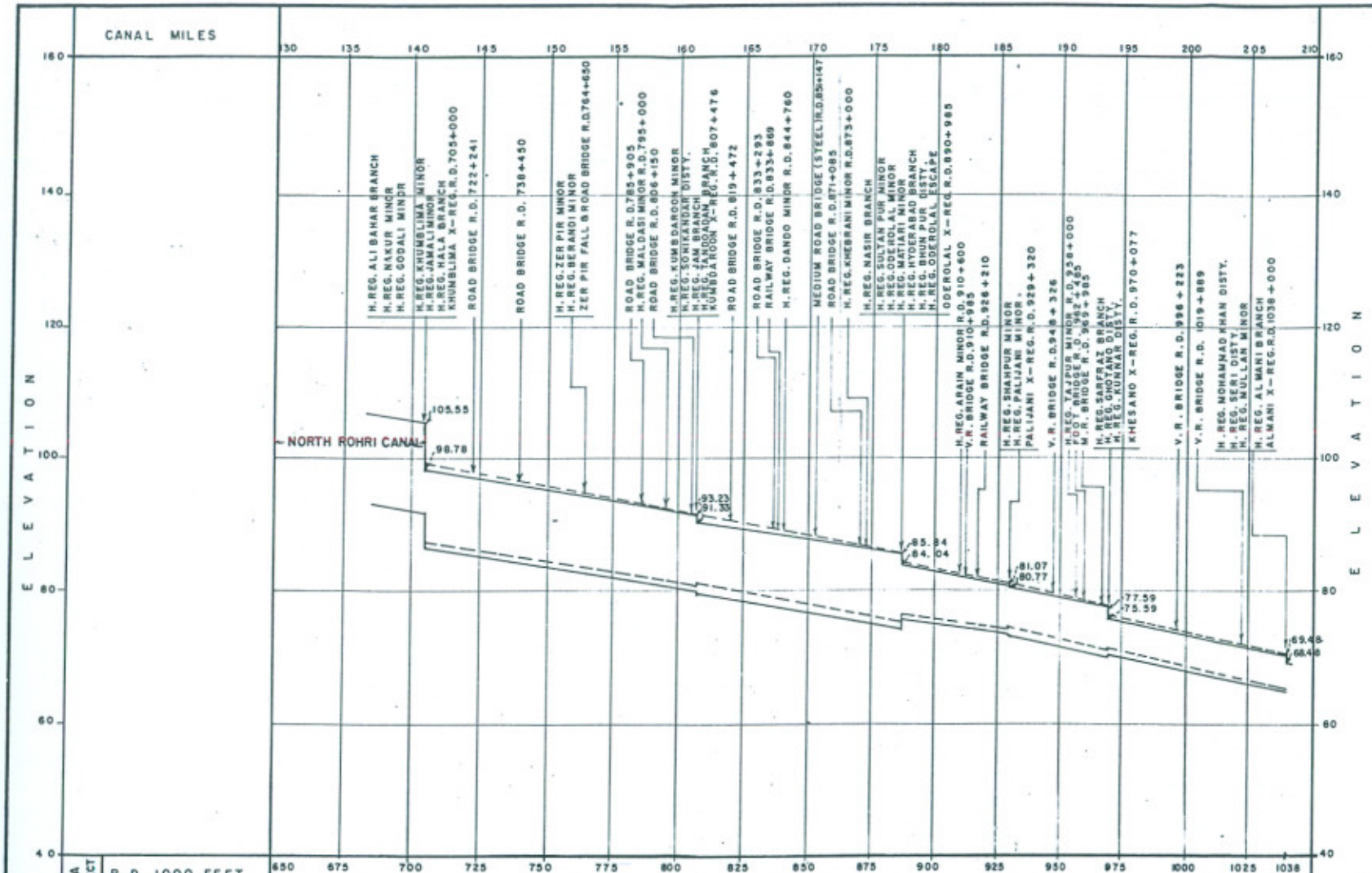

ELEVATION
CANAL MILES
N.P.L. 197.00
HEAD REGULATOR OF ROHRI MAIN CANAL
PROPOSED DATA 1st. STAGE PROJECT
PROPOSED DATA SECOND STAGE PROJECT
R.D. 1000 FEET
FULL SUPPLY LEVEL
BED WIDTH/DEPTH
SLOPE PER 1000
FALL R.D. 15+000
V.R.BRIDGE R.D.32+000
N.H.WAY BRIDGE R.D.51+800
A.R.BRIDGE R.D.73+200
V.R.BRIDGE R.D.92+400
V.R.BRIDGE R.D.106+000
TANDO MASTI KHAN FALL R.D.118+000
A.R.BRIDGE R.D.142+925
MEDIUM ROAD BRIDGE R.D. 167+406
NATIONAL H. WAY BRIDGE R.D.188+500
M.R.BRIDGE R.D.191+229
H.R. HINGO RAJA MINOR
H.R.NAULAKHI BR.
NAULAKHI X-REG. R.D.205+160
V.R.BRIDGE R.D.222+293
V.R.BRIDGE R.D.235+400
H.REG. MEHRAB PUR BRANCH
H.REG. GODHI DISTY.
H.REG. KOTRI MINOR
MEHRAB PUR X-REG.R.D.264+470
N.R.BRIDGE R.D.278+735
RAILWAY BRIDGE R.D.280+244
V.R.BRIDGE R.D.294+935
H.REG. DHODA MINOR R.D.309+000
V.R.BRIDGE R.D.320+472
H.REG. NASRAT BRANCH
H.REG. SEHRA BRANCH
H.REG. ESCAPE I
H.REG. BUDIKA DISTY.
H.REG. KANDIARO MINOR
KANDIARO X-REG.R.D.328+456
V.R.BRIDGE R.D.353+200
V.R.BRIDGE R.D.379+500
H.REG.BHIRIA DISTY.
RAILWAY BRIDGE R.D. 412+000
V.R.BRIDGE R.D. 412+080
H.REG.DAD BRANCH
H.REG.NITHIR DETHA DISTY.
H.REG.PHUL DISTY.
NAUSHERO X-REG- R.D.424+859
PHUL FALL R.D.442+161
V.R.BRIDGE R.D.464+150
V.R.BRIDGE R.D.481+485
H.REG.THUL BRANCH
H.REG.KURKAIN MINOR
H.REG. SUN MINOR
H.REG. MANHARO MINOR
YOUSAF DHARI X-REG.R.D.496+500
DURRO FALL R.D.522+767
V.R.BRIDGE R.D.532+250
H.REG. PABJO MINOR R.D.532+400
V.R.BRIDGE R.D. 548+630
H.REG. JAMES MINOR R.D.558+000
H.REG. JAN MUHAMMAD MINOR
H.REG. VERYAM MINOR
H.REG.JAMAL SHAH DISTY.
JAMAL SHAH X-REG. R.D.578+522
192.52
191.67
185.27
179.44
179.40
175.94
175.80
170.71
170.63
165.84
165.63
162.25
162.19
159.65
159.59
155.81
155.81
153.81
153.61
147.54
147.54
144.29
144.14
143.17
143.00
139.92
140.00
136.38
136.41
130.39
130.41
128.68
128.65
123.68
123.75
120.06
27/16
276/16.0
0.06
275/15.8
0.06
268/15.6
0.060
262/15.4
0.060
223/14.0
0.065
209/13.4
209/13.4
0.065
200/13.1
198/13.1
0.065
330/16.0
0.057
319/15.5
0.058
310/15.2
0.059
225/14.0
0.063
203/13.2
0.066
190/12.5
190/12.5
0.067
0.067

FIGURE-12


CANAL MILES
ELEVATION
NORTH ROHRI CANAL
105.55
98.78
93.23
91.33
85.84
84.04
81.07
80.77
77.59
75.59
69.48
68.48
H.REG. ALI BAHAR BRANCH
H.REG. NAKUR MINOR
H.REG. GODALI MINOR
H.REG. KHUNBLIMA MINOR
H.REG. JAWALI MINOR
H.REG. HALA BRANCH
KHUNBLIMA X-REG. R.D. 705+000
ROAD BRIDGE R.D. 722+241
ROAD BRIDGE R.D. 738+450
H.REG. ZER PIR MINOR
H.REG. BERANDI MINOR
ZER PIR FALL & ROAD BRIDGE R.D. 764+650
ROAD BRIDGE R.D. 785+905
H.REG. MALDASI MINOR R.D. 795+000
ROAD BRIDGE R.D. 806+150
H.REG. KUMBDAROON MINOR
H.REG. SOHIKANDARI DISTY.
H.REG. JAM BRANCH
KUMBDAROON X-REG. R.D. 807+476
ROAD BRIDGE R.D. 819+472
ROAD BRIDGE R.D. 833+293
RAILWAY BRIDGE R.D. 833+869
H. REG. DANDO MINOR R.D. 844+760
MEDIUM ROAD BRIDGE (SYEEL) R.D. 854+147
ROAD BRIDGE R.D. 871+985
H.REG. KHEBRANI MINOR R.D. 873+000
H.REG. NASIR BRANCH
H.REG. SULTAN PUR MINOR
H.REG. ODEROLAL MINOR
H.REG. MATIARI MINOR
H.REG. HYDERABAD BRANCH
H.REG. BHUN PUR DISTY.
H.REG. ODEROLAL ESCAPE
ODEROLAL X-REG. R.D. 890+985
H.REG. ARAIN MINOR R.D. 910+600
V.R. BRIDGE R.D. 910+985
RAILWAY BRIDGE R.D. 926+210
H.REG. SHAMPUR MINOR
H.REG. PALIJANI MINOR.
PALIJANI X-REG. R.D. 929+320
V.R. BRIDGE R.D. 948+326
H.REG. TAJPUR MINOR R.D. 956+000
FOOT BRIDGE R.D. 962+485
M.R. BRIDGE R.D. 969+985
H.REG. SARFRAZ BRANCH
H.REG. GHOTANO DISTY.
H.REG. KUNNAR DISTY.
KHESANO X-REG. R.D. 970+077
V.R. BRIDGE R.D. 998+223
V.R. BRIDGE R.D. 1019+889
H.REG. MOHAMMAD KHAN DISTY.
H.REG. SERI DISTY.
H.REG. MULLAN MINOR
H.REG. ALMANI BRANCH
ALMANI X-REG. R.D. 1038+000

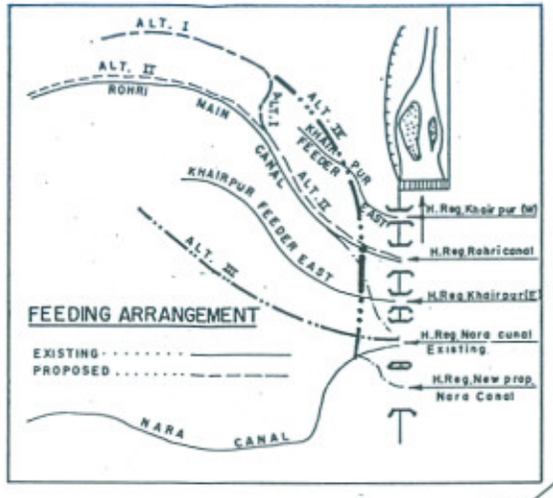
| | | |

FIGURE– 13

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NOTES

1. ALTERNATIVE I & II
   To be Fed from Present Head Rohri and Rohri Canal from Head Nara.
2. ALTERNATIVE III
   To be Fed from Existing Nara Head and Nara Provided with New Head.
3. ALTERNATIVE IV
   To be Fed from R.D.13+000 of Nara Canal.



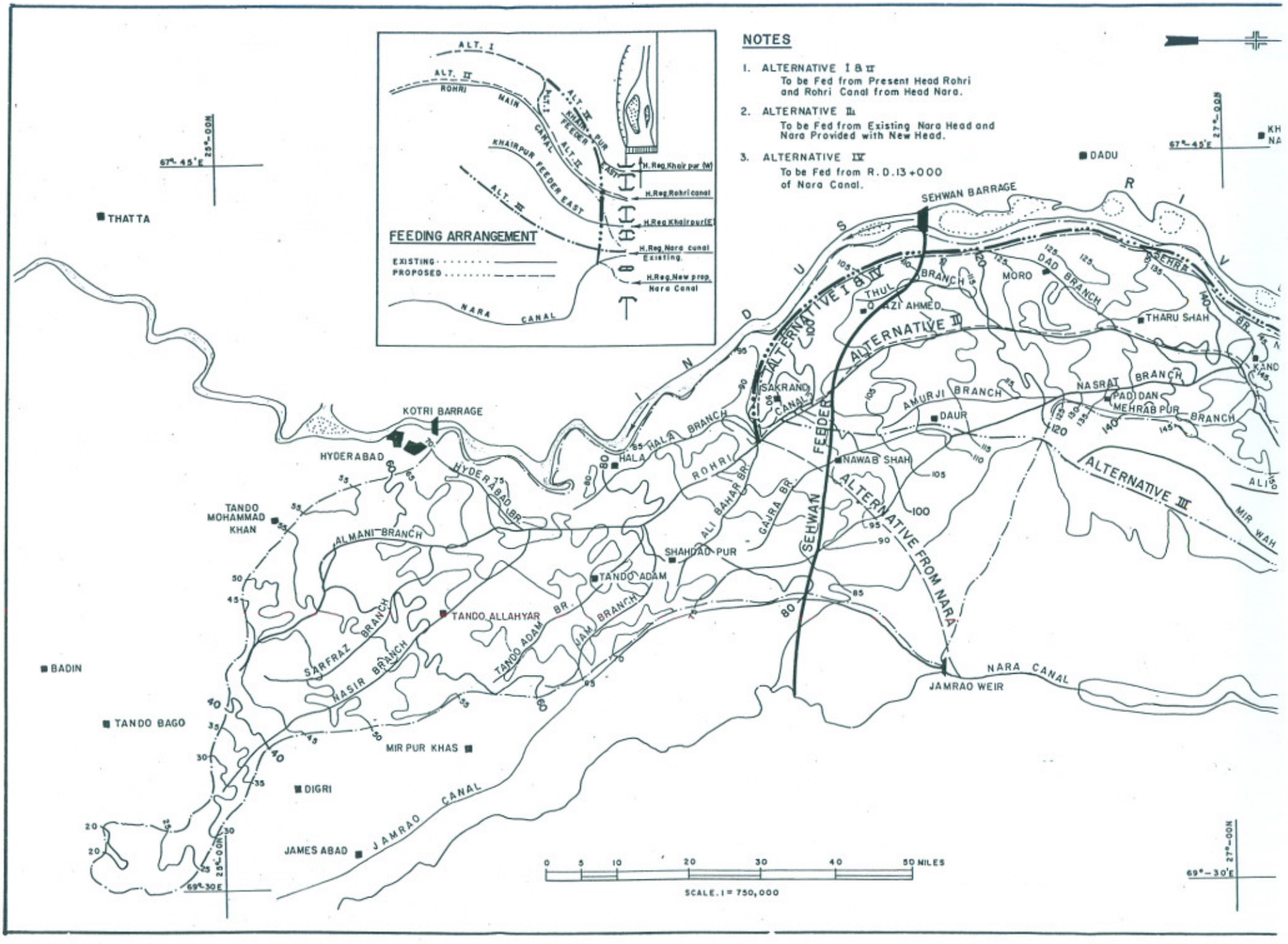
LEGEND

- CONTOURS
- RIVER
- BARRAGE
- MAIN CANAL AND BRANCHES
- PROJECT BOUNDARY
- ALTERNATIVES I, II, III, IV.
- CITY AND TOWN
- ALTERNATIVE – I
- ALTERNATIVE – II
- ALTERNATIVE – III
- ALTERNATIVE – IV
- ALTERNATIVE FROM NARA
- SEHWAN FEEDER

REMODELLING OF ROHRI CANAL SYSTEM

VARIOUS ALTERNATIVES FOR FEEDING SOUTH ROHRI CANAL (AND SURFACE CONTOURS)

ARSH


NOTES
1. ALTERNATIVE I & II
To be Fed from Present Head Rohri and Rohri Canal from Head Nara.
2. ALTERNATIVE II
To be Fed from Existing Nara Head and Nara Provided with New Head.
3. ALTERNATIVE IV
To be Fed from R.D.13+000 of Nara Canal.
FEEDING ARRANGEMENT
EXISTING
PROPOSED
ALT. I
ALT. II
ROHRI MAIN CANAL
ALT. IV KHAIRPUR FEEDER
ALT. II
KHAIRPUR FEEDER EAST
ALT. III
H.Reg.Khairpur (W)
H.Reg.Rohri canal
H.Reg.Khairpur (E)
H.Reg.Nara canal Existing.
H.Reg.New prop. Nara Canal
NARA CANAL
INDUS RIVER
SEHWAN BARRAGE
KOTRI BARRAGE
THATTA
HYDERABAD
TANDO MOHAMMAD KHAN
BADIN
TANDO BAGO
MIR PUR KHAS
DIGRI
JAMES ABAD
JAMRAO CANAL
HALA
SAKRAND
DADU
THUL
KAZI AHMED
MORO
THARU SHAH
DAUR
NAWAB SHAH
SHAHDAD PUR
TANDO ADAM
TANDO ALLAHYAR
JAMRAO WEIR
NARA CANAL
ALTERNATIVE I & IV
ALTERNATIVE II
ALTERNATIVE III
ALTERNATIVE FROM NARA
SEHWAN FEEDER
HALA BRANCH
ROHRI
HYDERABAD BR.
ALI BAHAR BR.
GAJRA BR.
ALMANI BRANCH
SARFRAZ BRANCH
NASIR BRANCH
TANDO ADAM BR.
JAM BRANCH
AMURJI BRANCH
DAD BRANCH
NASRAT (PADIDAN) BRANCH
MEHRAB PUR BRANCH
67°-45'E 25°-00N
67°-45'E 27°-00N
69°-30E 25°-00N
69°-30'E 27°-00N
0 5 10 20 30 40 50 MILES
SCALE. 1 = 750,000

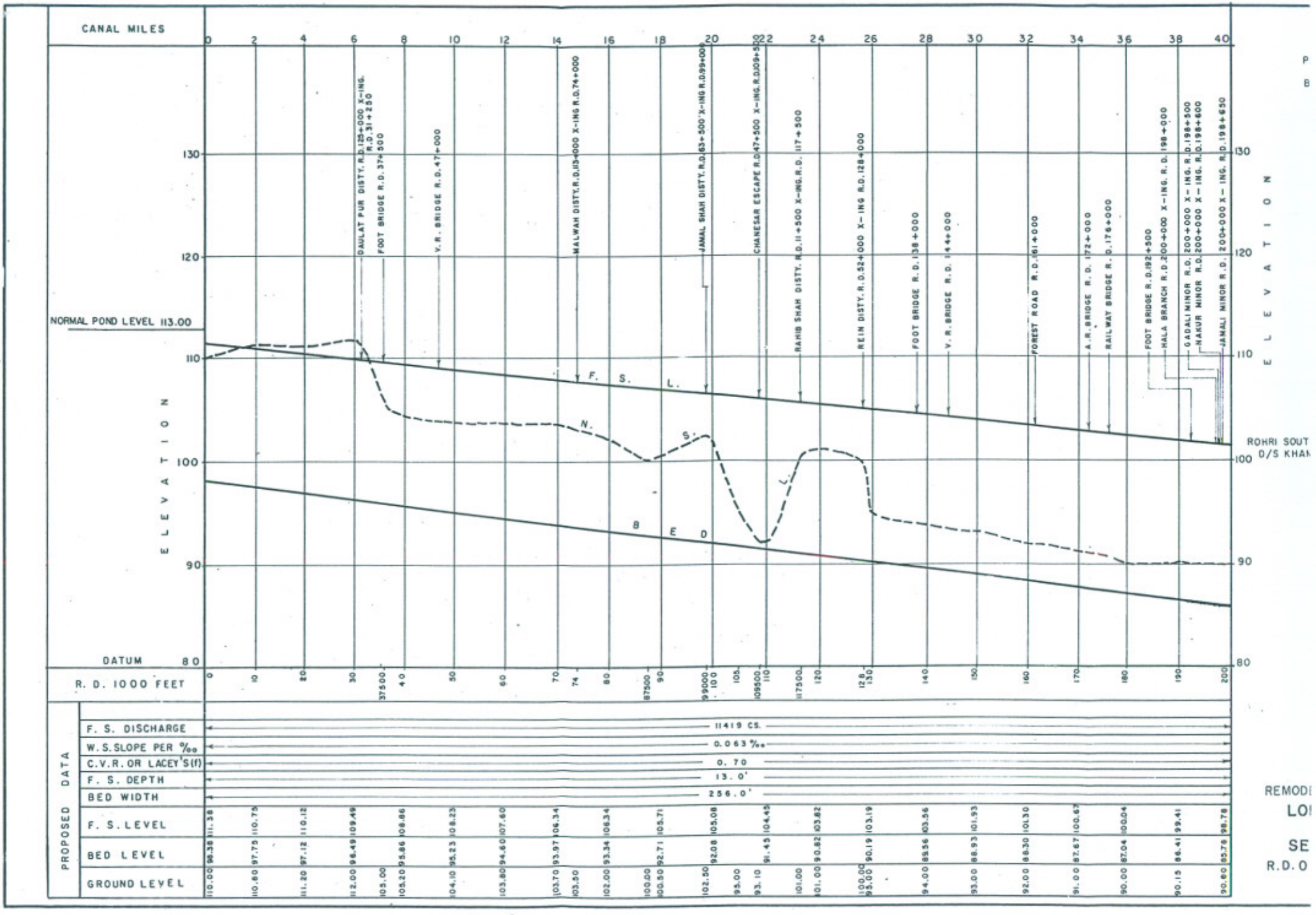
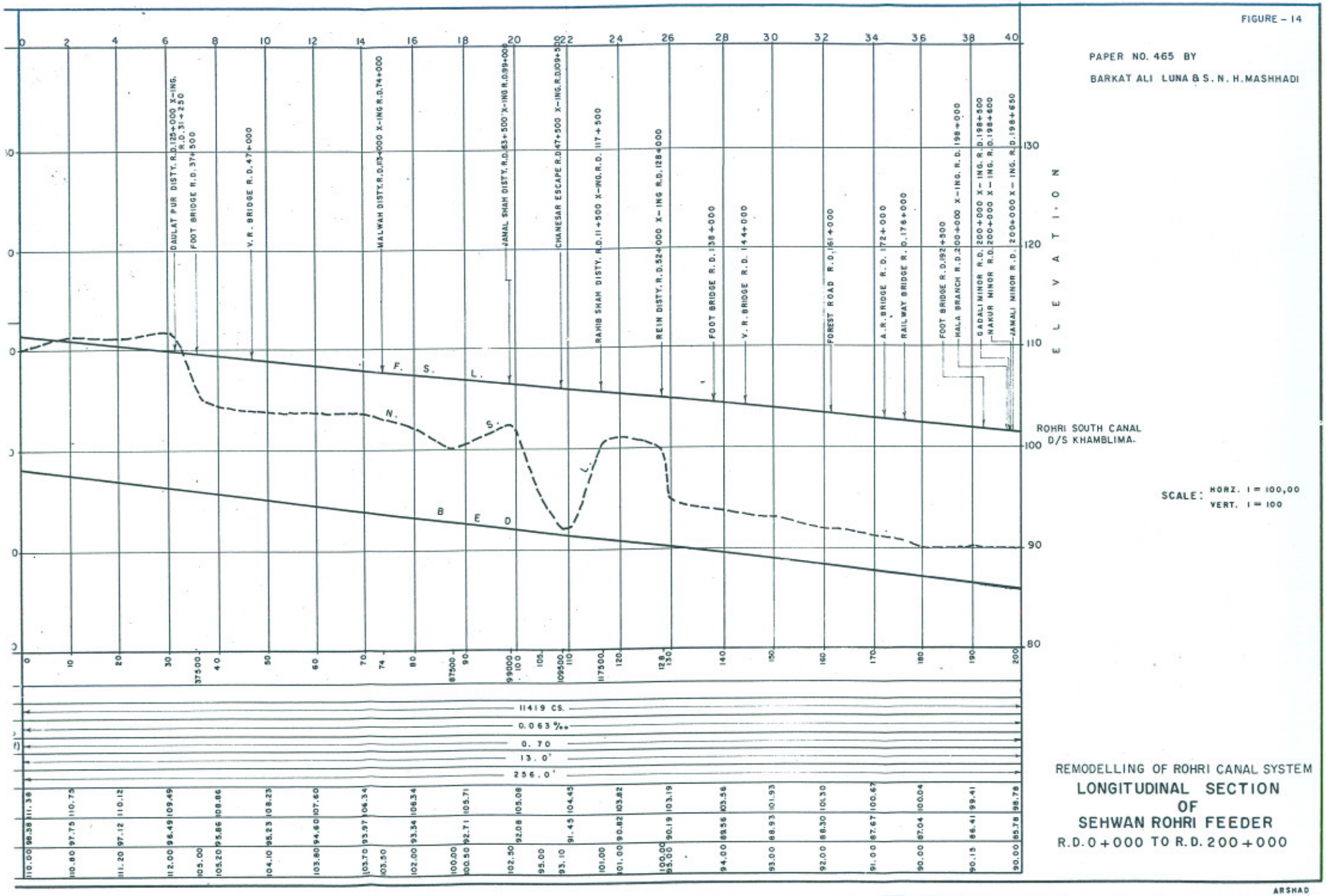

CANAL MILES
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
DAULAT PUR DISTY. R.D.125+000 X-ING. R.D.31+250
FOOT BRIDGE R.D. 37+500
V. R. BRIDGE R. D. 47+000
MALWAH DISTY. R.D.103+000 X-ING R.D.74+000
JAMAL SHAH DISTY. R.D.163+500 X-ING R.D.99+000
CHANESAR ESCAPE R.D.147+500 X-ING. R.D.109+500
RAHIB SHAH DISTY. R.D.11+500 X-ING. R.D. 117+500
REIN DISTY. R.D.52+000 X-ING R.D.128+000
FOOT BRIDGE R.D.138+000
V. R. BRIDGE R.D. 144+000
FOREST ROAD R.D.161+000
A.R. BRIDGE R. D. 172+000
RAILWAY BRIDGE R. D.176+000
FOOT BRIDGE R. D.192+500
HALA BRANCH R.D.200+000 X-ING. R. D. 198+000
GADALI MINOR R.D.200+000 X-ING. R. D.198+500
MAKUR MINOR R.D.200+000 X-ING. R.D.198+600
JAMALI MINOR R.D. 200+000 X-ING. R.D.198+650
NORMAL POND LEVEL 113.00
ELEVATION
130 120 110 100 90 80
F. S. L.
N. S. L.
BED
DATUM 80
R. D. 1000 FEET
0 10 20 30 37500 40 50 60 70 74 80 87500 90 99000 100 105 109500 110 117500 120 128 130 140 150 160 170 180 190 200
ROHRI SOUT
D/S KHA
REMODE
LOI
SE
R.D.0
PROPOSED DATA
F. S. DISCHARGE 11419 CS.
W. S. SLOPE PER ‰ 0.063 ‰
C.V.R. OR LACEY'S (f) 0.70
F. S. DEPTH 13.0'
BED WIDTH 256.0'
F. S. LEVEL 111.38 110.75 110.12 109.49 108.86 108.23 107.60 106.34 106.34 105.71 105.08 104.45 103.82 103.19 103.19 103.56 101.93 101.30 100.67 100.04 99.41 98.78
BED LEVEL 98.38 97.75 97.12 96.49 95.86 95.23 94.60 93.97 93.34 92.71 92.08 91.45 90.82 90.19 90.19 88.56 88.93 88.30 87.67 87.04 86.41 85.78
GROUND LEVEL 110.00 110.80 111.20 112.00 103.00 105.20 104.10 103.80 103.70 103.50 102.00 100.00 100.50 102.50 95.00 93.10 101.00 101.00 100.00 95.00 94.00 93.00 92.00 91.00 90.00 90.15 90.60

FIGURE – 14

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SCALE: HORZ. 1 = 100.00
VERT. 1 = 100

REMODELLING OF ROHRI CANAL SYSTEM

LONGITUDINAL SECTION OF SEHWAN ROHRI FEEDER

R.D. 0+000 TO R.D. 200+000

ARSHAD

REMODELLING OF ROHRI CANAL SYSTEM

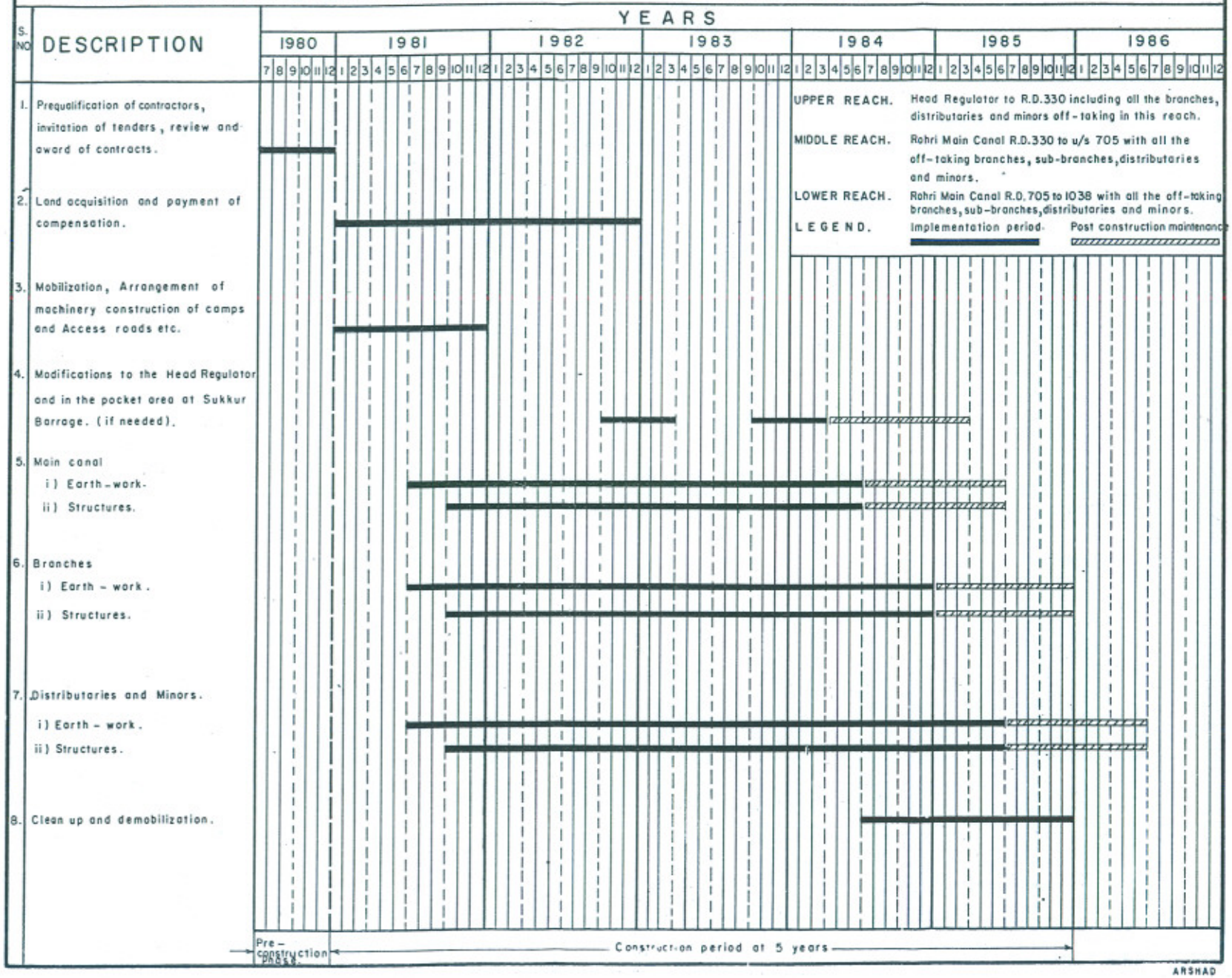
IMPLEMENTATION SCHEDULE - FIRST STAGE PROJECT

(SIMULTANEOUS IMPLEMENTATION IN UPPER, MIDDLE AND LOWER REACHES)

FIGURE - 15

PARER NO. 465 BY

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ARSHAD

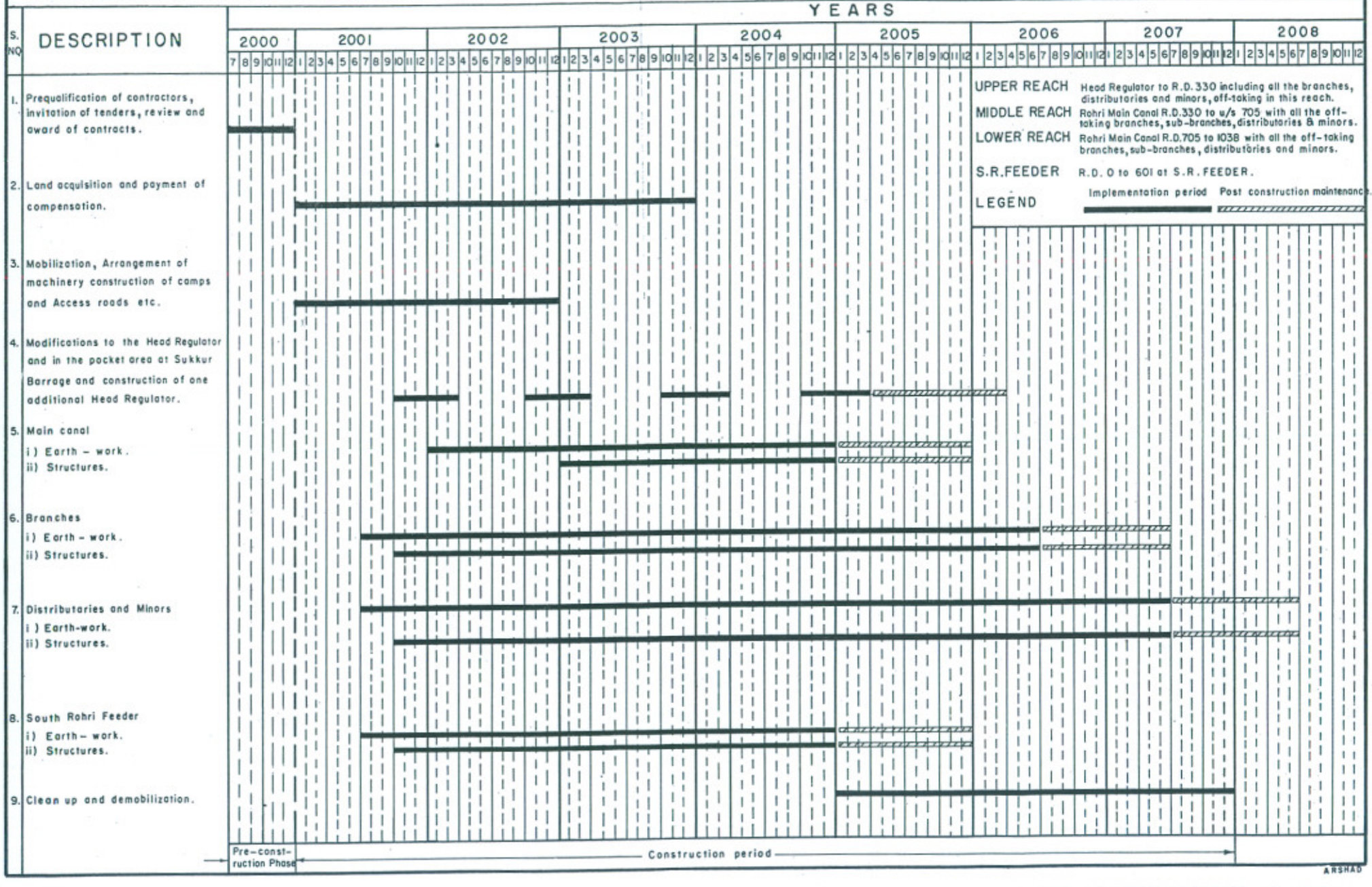
FIGURE – 16

REMODELLING OF ROHRI CANAL SYSTEM

IMPLEMENTATION SCHEDULE-SECOND STAGE PROJECT

(SIMULTANEOUS OPERATION IN UPPER, MIDDLE AND LOWER REACHES OF R.M.C. & S.R.FEEDER)

PAPER NO. 465 BY
BARKAT ALI LUNA & S. N. H. MASHHADI



from 5,000 to 10,000 persons. These schemes will depend either an percolation wells or tubewells in the sweet water zone and barani areas and shall be based upon canal water in the brakish zone. Such schemes would have sufficient distribution network and will provide house connections so that the schemes become self-sufficient for its operation and maintenance. For sanitation purpose R.C.C. pipe sewers and surface drains will also be provided to dispose of waste water.

4) Urban Water Supply Schemes

All towns having population of 10,000 and above have been classified as Urban Areas where water supply is to be provided for the entire area through house connections. Such schemes would be based upon percolation wells or deep tubewells in sweet water zone and canal water in the brakish zone.

The assumed per capita per day supply of drinking water in Punjab is as follows:

For population upto 5000 persons (Rural) - 8 Imp. Gallons.
Population from 5000 to 10,000 (Rural) - 10 Imp. Gallons.
Population from 10,000 to 15,000 (Urban) - 15 Imp.Gallons.
Population from 15,000 to 25,000 (Urban) - 25 Imp.Gallons.
Population above 25,000 (Urban) - 30/40 Imp. Gallons.

While calculating the cost of water supply systems to all the rural and urban population of Punjab, the year 1981 has been kept as the base year and the rate of escalation has been assumed as 13% which has been established by Planning and Development Division, Government of Pakistan. In case drinking water facility is provided to all the population of Punjab by 1990, the rate of escalation in

the year 1990 would be 13 x 10 = 130% more of the price of the year 1981.

While calculating the total cost involved, per capita cost based upon the average cost of similar schemes completed during the recent past has been applied. The average per head cost of different types of water supply systems completed by 1981 has been computed and found to be as follows:

a)	For hand pump schemes	Rs. 35 per head
b)	Modest water supplies	Rs. 300 per head
c)	Rural piped public water supply schemes.	Rs. 225 per head
d)	Urban water supply schemes.	Rs. 200 per head

The total cost of supplying water to unserved population of 1990 has been calculated and reflected in Table-1.

Similarly total cost for providing sewerage/drainage facilities to the unserved population of Punjab Province have been calculated and reflected in Table-II.

TABLE NO.I

FINANCIAL REQUIREMENTS FOR PROVIDING WATER SUPPLY FACILITIES TO UNSERVED POPULATION OF PUNJAB BY THE YEAR 1990.

Type of Population	Population (in millions) In 1981	Served upto 1981	Unserved upto 1981	Projec-* ted po- pulation for 1990 (in Mln.)	Net popu- lation to be served by 1990 (in Mln)	Rate per head (in Rs.) In 1981	In 1990	Average 1981-90	Estimated Cost (in Mln. Rs.)	Fund re- quired per year 1981-90 (in Mln. Rs.)
URBAN	13.2	7.2	6	17.0	9.8	200	460	330	3234	323
RURAL										
a) Regular				11.0]**	9.4]**	225	518	372	3497]	350]
				]	]				]12513	]1252
b) Modest	33.8	6.5	27.3	19.8]	16.9]	300	690	495	8366]	837]
				]44.0	]37.5				]	]
c) Handpumps				13.2]	11.2]	35	81	58	650]	65]
TOTAL:	47.00	13.7	33.3	61.0	47.3				15747	1575 SAY 1580

* Increase @ 3% per year.

** Ratio being 5:9:6

TABLE NO. II

FINANCIAL REQUIREMENTS FOR PROVIDING SEWERAGE/DRAINAGE FACILITIES TO UNSERVED POPULATION OF PUNJAB BY THE YEAR 1990

Type of Population	Population (in millions) In 1981	Served upto 1981	Unserved upto 1981.	Projected population for 1990 (in Mln.)	Net population to be served by 1990 (in Mln.)	Average rate per head (1981-90) Rs.	Estimated cost (in Mln.) Rs.	Funds required per year 1981-90 (in Mln.) Rs.
URBAN	13.2	2.6 (20%)	10.6	17.0	14.4	410	5904	590
RURAL								
a) Regular				11.00]**	10.9]**	330	3597]	360]
b) Modest	33.8	0.2	33.6	20.00] 44.0	19.7] 43.8	250	4925] 11822	492] 1182
c) Handpumps		(0.5%)		13.0]	13.2]	250	3300]	330]
TOTAL:	47.0	2.8	44.2	61.00	58.2		17726	1772 SAY 1770

* Increase @ 3% per year.

** Ratio being 5:9:6

It can be seen from Table-I, that the total popula- of Punjab Province could have been served with potable water, had a sum of Rs 1580 millions per year been provided from 1981 to 1990. Unfortunately due to poor resources, the programme was not implemented. It can also be appreciated from Table-II, that Rs 1,770 millions per year, were required to provide sewerage/drainage facilities to the entire unserved population of the Province of Punjab from 1981 to 1990. This programme was likewise not taken of due to poor resources. In nut-shell, to provide water supply and sewerage facilities to all within the period of decade a sum of Rs. 3350 millions per year was required totalling to Rs.33,500 millions.

It would not be possible to provide water supply and sewerage facilities to all in Punjab by the year 1990 even if the required amount of Rs. 33,500 millions is provided in 1984 as such a huge amount cannot be spent in the remaining period of six years of the decade. Effort has, therefore, been made to chalk out a feasible programme to provide these facilities by the year 2000. Financial analysis has been made to provide these facilities in next 16 years and are indicated in Table-III and Table-IV.

It can be seen from Table-I, that the total popula- of Punjab Province could have been served with potable water, had a sum of Rs 1580 millions per year been provided from 1981 to 1990. Unfortunately due to poor resources, the programme was not implemented. It can also be appreciated from Table-II, that Rs 1,770 millions per year, were required to provide sewerage/drainage facilities to the entire unserved population of the Province of Punjab from 1981 to 1990. This programme was likewise not taken of due to poor resources. In nut-shell, to provide water supply and sewerage facilities to all within the period of decade a sum of Rs. 3350 millions per year was required totalling to Rs.33,500 millions.

It would not be possible to provide water supply and sewerage facilities to all in Punjab by the year 1990 even if the required amount of Rs. 33,500 millions is provided in 1984 as such a huge amount cannot be spent in the remaining period of six years of the decade. Effort has, therefore, been made to chalk out a feasible programme to provide these facilities by the year 2000. Financial analysis has been made to provide these facilities in next 16 years and are indicated in Table-III and Table-IV.

TABLE NO. IV

FINANCIAL REQUIREMENTS FOR PROVIDING SEWERAGE/DRAINAGE FACILITIES TO THE UNSERVED POPULATION OF PUNJAB BY THE YEAR 2000.

Type of population.	POPULATION (IN MILLIONS) In 1981	Served upto 1981	Unserved upto 1981.	Projected population for 2000 (in millions)	* Net population to be served by 2000 (in Mln.)	RATE PER HEAD In Rs. average 1981-2000	Estimated cost (in Mln. Rs.)	Funds required per year 1984-1990 (in Mln.Rs.)
URBAN	13.2	2.64	10.56	22.10	19.46	945	18390	1149
RURAL								
a) Regular				14.20 **	14.20 **	756	10735	671
				56.90	56.73		38294	2394
b) Modest.	33.8	0.17	33.63	25.60	25.50	648	16524	1033
c) Hand Pumps				17.10	17.03	648	11035	690
TOTAL:	47.0	2.81	44.19	79.00	76.19		56684	3543 SAY 3540

* Increase @ 3% per year.

** Ratio being 5:9:6

According to these Tables Rs.1890 millions and Rs. 3540 millions per year would be required to provide drinking water and sewerage/drainage facilities respectively to all in Punjab by 2000. It amounts to Rs. 5430 millions per year for next 16 years totalling to Rs.86880 millions.

There are four provinces in Pakistan with total population of of 84 millions. The figures given in Table-III and Table-IV cater for the population of Punjab Province only which is 47 millions. If design criteria, unit costs, and all other conditions are assumed to be identical in other three provinces as those of Punjab, then the total amount required to fulfill the wishes of United Nations, by providing water supply and sanitation to all by the year 2000, would be as 87/47 x 86880 = Rs 160900 millions which works out to Rs. 10,050 millions per year for next 16 years.

In order to achieve the goal of U.N. to provide water to all in Pakistan within the Water Supply and Sanitation Decade a colossal amount of Rs.10050 millions will be required from the year 1984 to 2000. A developing country like Pakistan cannot afford to finance this huge project from its own resources, as such new approaches both in National and International strategies would be required. It is, therefore, strongly suggested that international financial agencies and donors like W.H.O., US AID, UNICEF and CIDA and other aid-giving agencies should come forward and give a supporting hand to Pakistan in order to provide basic amenities of water supply and sanitation to the entire population of Pakistan.

RECOMMENDATIONS

1. It is recommended that, where human needs have not yet been satisfied, national development policies and plan should give priority to supplying of drinking water for the entire population of Pakistan and to the final disposal of waste water.

2. Action must focus on promoting increased awareness of the problems, commitment of national Government to provide all people with water of safe quality and with adequate quantity and basic sanitary facilities by 2000.

3. New approaches should be developed which will result in larger flow of national, international and bilateral funds on more favourable and flexible conditions, so as to enable Pakistan to increase the speed of implementation, and more important, to enable the more effective use of the additional resources.

4. Communities must be provided with effective education on domestic hygiene and must be motivated and involved as appropriate at every level of the programme including planning, construction, operation, maintenance and financing of services and the monitoring and safeguarding of the quality of water supplied.

5. Financial contribution be increased to strengthen the capabilities of International bilateral agencies, co-operating with Government in the extension of community water supply and sanitation.

6. International aid-giving agencies shall be approached to grant adequate funds every year to achieve the

target of supplying water to all by year 2000.

7. Modest and inexpensive water supply systems shall be planned and executed particularly in barani and Cholistan desert areas of Pakistan.