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MASTER PLAN STUDY ON BRIDGE DEVELOPMENT IN

THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

FINAL REPORT

VOLUME III

APPENDICES



JULY 1996

JAPAN BRIDGE & STRUCTURE INSTITUTE, INC., TOKYO PACIFIC CONSULTANTS INTERNATIONAL, TOKYO



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JAPAN INTERNATIONAL COOPERATION AGENCY ROAD DEVELOPMENT AUTHORITY MINISTRY OF HEALTH, HIGHWAYS AND SOCIAL SERVICES

MASTER PLAN STUDY ON BRIDGE DEVELOPMENT IN

THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

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JAPAN BRIDGE & STRUCTURE INSTITUTE, INC., TOKYO PACIFIC CONSULTANTS INTERNATIONAL, TOKYO

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Appendix - A

MEMBER LISTS OF COMMITTEES AND TEAMS

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4.	Member of Japan International Cooperation Agengy (JICA)	A - 2
5.	Member of Advisory Committee	A - 3
6.	Member of JICA Study Team	A - 3

Position	Designation	Name of Person
Chairman	General Manager, Road Development Authority	Mr. P. B. L. Cooray
e e	(RDA)	
Member	Director,	Dr G. L. A. J. de Silva
: :	Engineering Services, RDA	
Member	Assistant Director,	Mr. M. G. E. Perera
	Engineering Services, RDA	
Member	Deputy Director,	Mr. R. G. Rajapakse
	Traffic & Planning, RDA	(~ 1995-7)
Member	Deputy Director,	Mrs. S. S. Senanayake
	Traffic & Planning, RDA	(1995. 6 ~)
Member	: Deputy Director,	Mrs. H. Y. Fernando
	Bridge Design, RDA	
Member of To	chnical Committee	
Position	Designation	Name of Person
Chairman	Director	Dr. G. L. A. J. de Silva
	Engineering Services, RDA	
Member	Assistant Director.	Mr. M. G. E. Perera
	Engineering Services, RDA	
Member	Deputy Director,	Mr. R. G. Rajapakse
	Traffic & Planning	(~ 1995.7)
Member	Deputy Director,	Mrs S S Senanayake
	Traffic & Planning, RDA	(1995. 6 ~)
	Deputy Director,	Mr. H. Y. Fernand
Member		
Member	Bridge Design, RDA	
Member Member	Bridge Design, RDA Chief Engineer,	Mr. H.M.K.G.G. Banda
		Mr. H.M.K.G.G. Banda

A - 1

Member of Counterpart Team

3.

4.

Position	Designation	Name of Person
Chief Counterpart	Director, Engineering Services, RDA	Dr. G. L. A. J. de Silva
Counterpart	: Engineer, Traflic & Planning, RDA	Mr. K. Sivanathan
Counterpart	: Engineer, RDA	Mr. L. V. S. Weerakoon
Counterpart	: Engineer, RDA	Mr. S. Bakeerathan
Counterpart	: Engineer, RDA	Mr. H. A. Wickramsinghe

Member of Japan International Cooperation Agency (JICA)

Positio	<u>n</u> :	Designation	Name of Person
Coordi	nator	Social Development Study Department, JICA Headquarters	Mr. Toshihisa Hasegawa (Mar. 1995 to Aug. 1995)
Coordi	nator	: Social Development Study Department, JICA Headquarters	Mr. Toru Naito (Sep. 1995 ~)
Coordi	nator	Personal Depertment JICA Headquarters	Mr. Takamitu Kinoshita (May 1996)
Coordi	nator	Assistant Resident Representative, JICA, Colombo Office	Mr. Shinji Yoshiura

A - 2

5.	Member of Advi	sory Committee		
•	Position	Designation	Name of Person	
	Chairman	: Road Planning Officer Road Department	Mr. Yasuhiro Ni	shimura
·		Tohoku Regional Construction Bu Ministry of Construction	ireau,	
. • •	Member	: Deputy Manager Research Division,	Mr. Seigo Nasu (~ Ma. 1996)	
- - - -		Planning & Development Dept. Honshu-Shikoku Bridge Authority	y	
Ŧ	Member	: Manager of Engineering	Mr. Shigeku Ya	namoto
		Management Division, First Maintenance Department Second Operation Bureau Honshu-Shikoku Bridge Authority	y	
		A Cut Ja Taana		
6.	Member of JIC.	A Study Leam		
	Designation	Name of I	<u>Person</u>	
,	Team Leader / R	ridge Planning Mr. Hiros	hi Namba	

Team Leader / Bridge PlanningMr. Hiroshi NambaTraffic Planning / Traffic DemandMr. Isamu GunjiBridge Rehabilitation PlanningMr. Akio KasugaBridge Design (1)Mr. Kazuo KataokaBridge Design (2)Mr. Kiyohisa HariyaMaintenance / Management PlanningMr. Yasuo FurukawaEconomistMr. Teruhiko Horie

Environmental

Mr. Masami Miyadera

Appendix - B

MINUTES OF MEETINGS

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).	Minutes of Meeting held on 6th April, 1995	B - 1
2.	Minutes of Meeting held on 19th October, 1995	B - 5
3.	Minutes of Meeting held on 20th May, 1996	B - 8

MINUTES OF MEETING ON THE INCEPTION REPORT FOR THE MASTER PLAN STUDY ON BRIDGE DEVELOPMENT IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA AGREED UPON BETWEEN ROAD DEVELOPMENT AUTHORITY

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

COLOMBO, 6TH APRIL, 1995

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Mr K.S.C. de Fonseka Chairman Road Development Authority Ministry of Health, Highways & Social Services

L. Chaulter

Mr Hiroshi Namba Team Leader JICA Study Team Japan International Cooperation Agency JICA Study Team submitted the Inception Report of the Master Plan Study on Bridge Development in the Democratic Socialist Republic of Sri Lanka to the Road Development Authority (RDA) on 31st of March, 1995. Joint meetings between the Sri Lankan and Japanese sides were held on 4th and 5th of April, 1995 for the presentation and discussion on the Inception Report. The attendants of the meetings appear in the Attendants list attached.

During the joint meetings, the Sri Lankan and the Japanese sides discussed and confirmed the following subjects:

1. Submission of the Inception Report

The Study Team submitted 20 copies of the Inception Reports to RDA. RDA acknowledged the receipt of the Reports and agreed to the contents therein in principle.

Main items agreed upon by both sides are as follows:

1)

2)

3)

4)

2.

The study area will cover the Northern and the Eastern Provinces, if the safety of these areas could be confirmed (Chapter 1, 1.4).

Considering the objectives of the Study, the Master Plan should cover all bridges on A routes and the selected bridges on B routes, which include the 28 bridges scheduled to be repaired/improved with aid from the Kuwaiti government. Eventually, the second sentence of Operation 6, Chapter 2 (page 7) should be deleted.

The Study Team and RDA agreed that bridge inspection forms and bridge rehabilitation record forms attached to the Inception Report should be reviewed and modified as required. (Chapter 2, Operation 7, page 9).

Since there is a variety of bridge design conditions and design records are not available for all the bridges, it is difficult to repair bridges under the same design standard. Therefore, the Study Team should consider an appropriate standard allowable for the Master Plan Study. As a consequence, the third and fourth sentences of Operation 9, Chapter 2 (page 18) should be deleted.

Are

B - 2

The Study Team requested Sri Lanka side to provide a complete list of bridges on A routes and to reconfirm every contents of inventory of selected bridges.

5)

6)

The Study Team requested Sri Lanka side to provide a suitable office space, office equipment and a permanent counterpart personnel. Sri Lanka side replied that the Study Team can choose the office space from two alternative places and RDA will provide a permanent counterpart personnel.

B - 3

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LIST OF ATTENDANTS

Road Development Authority

- 1. Mr K.S.C. de Fonseka, Chairman
- 2. Mr P.B.L. Cooray, General Manager
- 3. Dr G.L. Asoka de Silva, Director, Engineering Services
- 4. Mrs H.Y. Fernando, Deputy Director, Bridge Design

Advisor to RDA

1. Mr Takeo Kai, JICA Expert, Engineering Services/Advisor

JICA Advisory Committee

Mr Yasuhiro Nishimura, Chairman, Advisory Committee Mr Seigo Nasu, Member, Advisory Committee

JICA Coordinator

1.

2.

1.

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2.

1. Mr Toshihisa Hasegawa, JICA Headquarters

JICA Sri Lanka Office

Mr Shinji Yoshiura

Study Team

Mr H. Namba, Leader, Study Team Mr I. Gunji, Member, Study Team

B - 4

Am

MINUTES OF MEETING ON THE INTERIM REPORT FOR THE MASTER PLAN STUDY ON BRIDGE DEVELOPMENT IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

AGREED UPON BETWEEN

ROAD DEVELOPMENT AUTHORITY

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

COLOMBO, 19TH OCTOBER, 1995

Dr. G.L. Asoka de Silva for General Manager Road Development Authority Ministry of Health, Highways & Social Services

Mr. Hiroshi Namba Team Leader JICA Study Team Japan International Cooperation Agency JICA Study Team submitted the Interim Report of the Master Plan Study on Bridge Development in the Democratic Socialist Republic of Sri Lanka to the Road Development Authority (RDA) on 10th of October, 1995. Joint meetings between the Sri Lankan and Japanese sides were held on 18th and 19th of October, 1995 for the presentation and discussion on the Interim Report. The attendants of the meetings appear in the Attendants list attached.

During joint meetings, the Sri Lankan and Japanese sides discussed and confirmed the following subjects:

1. RDA accepted the selection of 101 bridges for the preliminary bridge inspection and the selection of 10 representative bridges for detailed survey.

2.

4.

5.

6.

The Study Team pointed out that the ten bridges selected for detailed survey are not bridges that are required urgently to be rehabilitated. They are selected mainly in consideration of different types of construction and also the age of the bridges. The selected bridges have no relation with respect to new projects proposed for the new future rehabilitation.

3. The Study team pointed out that the substandard shown in Table 8.5 of the report can be applied only in respect of the width of bridges to be considered for Repair and Reinforcement (Chapter 8, 8 - 8).

As for the design live loading for repair and reinforcement, present specification used by RDA can not be applied as the design load that has been considered for the existing old bridges at the time of construction is unknown. As such, RDA has no objection for the application of the Japanese specification of 1973.

The Study Team again requested RDA to submit the list of about 3,700 bridges on A and B class roads which RDA is now preparing during the second site study term in order to prepare the guideline for the bridge maintenance and rehabilitation.

After the meeting had discussed and taken note of above points, RDA accepted, in principle, the Interim Report.

B - 6

An

LIST OF ATTENDANTS

Road Development Authority

1.	Mr. P.B.L. Cooray	General Manager
2.	Dr. G.L. Asoka de Silva	Director, Engineering Services
3.	Mrs. H.Y. Fernando	Deputy Director, Bridge Design Div.
4.	Mrs. S.S. Senanayake	Deputy Director, Traffic & Planning Div.
5.	Mr, D.K. Rohitha Swarna	Senior Engineer, Bridge Design Div.
6.	Mr. H.M.K.G.G. Bandara	Chief Engineer, Planning, Traffic & Planning Div.
	A Advisory Committee	

ommittee

1.	Mr. Yasuhiro Nishimura 🥂	Chairman, Advisory Committee
2.	Mr. Seigo Nasu	Member, Advisory Committee

JICA Study Team

- 1. Mr. Hiroshi Namba
- 2. Mr. Akio Kasuga Mr. Kiyohisa Hariya 3. Mr. Kazuo Kataoka 4.

Team Leader, Study Team Member, Study Team Member, Study Team Member, Study Team

the

MINUTES OF MEETING ON THE DRAFT FINAL REPORT FOR THE MASTER PLAN STUDY ON BRIDGE DEVELOPMENT IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

AGREED UPON BETWEEN

ROAD DEVELOPMENT AUTHORITY

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

COLOMBO, 20TH MAY, 1996

11

Mr. P. B. L. Cooray General Manager Road Development Authority Ministry of Health, Highways, & Social Services

Dunta

Mr. Hiroshi Namba Team Leader JICA Study Team Japan International Cooperation Agency

B - 8

The Study Mission consisting of the JICA Advisory Committee, JICA Coordinator and Study Team had a series of presentations and discussions on the Draft Final Report of the Master Plan Study on Bridge Development in Sri Lanka with the RDA from 16th to 17th May, 1996. The attendants of the meeting appear in the Attendants List attached.

During joint meetings, the Sri Lanka and Japanese sides discussed and confirmed the following subjects :-

- Submission of the Draft Final Report RDA acknowledged the receipt of the Reports on 2nd May.
- 2. Main items agreed upon by both sides are as follows :-
 - 1) RDA accepted the contents of the Report in principle.
 - 2) RDA requested the Study Team to submit the results of subletted works such as survey maps, soil investigation reports, loading test reports and strength test of steel samples. The Study Team replied that these data will be submitted to RDA after approval of JICA Headquarters.
 - 3) RDA agreed that the Final Report of the Study is to be opened to the public.
 - 4) As for the design live loading for repair and reinforcement, RDA accepted the design live loadings proposed by the Study Team in Chapter 3.8 of Summary of the Draft Final Report (ref. Clause 4 of the Minutes of Meeting on the Interim Report dated on 19th October, 1995).
 - 5) The Study Team requested to RDA to submit comments on the Draft Final Report to JICA Sri Lanka office by 19th of June, 1996. RDA agreed the matter.
 - 6) RDA informed that the total numbers of bridges of 4,720 managed by RDA shall be amended to about 4,430. RDA will give the data to the Study Team before the Study Team leaves for Japan.
 - 7) RDA informed that the word AB-class roads should be deleted as they are actually A-class roads. The Study Team agreed to amend the matter in the Report.
 - 8) RDA pointed out that the some of unit prices and project cost shall be reviewed on the part of profit and overhead. The Study Team agreed to review the matter and amend in the report if necessary.
 - 9) RDA informed that the ratio of foreign and local components of project cost shall be 67% and 33% respectively. The Study Team agreed to amend the ratio in the cost estimation.

B - 9

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LIST OF ATTENDANTS

Road Development Authority

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2:

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4

5. 6.

1.

Ι.

Mr. P.B.L. Cooray Dr. G.L. Asoka J. de Silva Mrs. H.Y. Fernando Mrs. S.S. Senanayake Mr. D.K. Robitha Swarna

Mr. H.M.K.G.G. Bandara

General Manager Director, Engineering Services Deputy Director, Bridge Design Div. Deputy Director, Traffic & Planning Div. Senior Engineer Design, Bridge Design Div. Chief Engineer, Planning, Traffic & Planning Div.

JICA Advisory Committee

Mr. Shigeki Yamamoto

Member, Advisory Committee

JICA Coordinator

1. Mr. Takamitsu Kinoshita

JICA Headquarters

JICA Sri Lanka Office

Mr. Shinji Yoshiura

JICA Study Team

Mr. Hiroshi Namba
 Mr. Akio Kasuga
 Mr. Kazuo Kataoka
 Mr. Yasuo Furukawa

ili

Team Leader, Study Team Member, Study Team Member, Study Team Member, Study Team

B - 10

Appendix - C

C - 9

LIST OF 206 BRIDGES TO BE REHABILITATED

Note: Attached List of 206 Bridges is a computer output of bridge database of RDA and was provided to the Study Team by RDA.

LIST OF CONTENTS

1. List of 206 Bridges to be Rehabilitated C - 1

3. List of 3 Additional Bridges to be Inspected

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Appendix - D

DATA OF SOCIO-ECONOMIC FRAMEWORK AND TRAFFIC DEMAND ANALYSIS

LIST OF CONTENTS

١.	Estimated Traffic Growth Ratio	D - 1
2.	Road Improvements Completed, Ongoing, and Proposed	D - 11
3.	Estimated Future Population by District	⁻ D - 15

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D-1 Estimated Vehicle - Km and Growth Ratio by Section Route A and AB

D - 1

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D-1 Estimated Vehicle - Km and Growth Ratio by Section Route A and AB

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D -1 Estimated Vehicle - Km and Growth Ratio by Section Route A and AB

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SVAD NAVE	Pelmadulla - Indilidituya - Nonagama Pelmadulla - Embilidituya - Nonagama	Polgahevela -Kegalle	Anurachapura - Ranbeva	Kegalle - Bulathkohugitiya - Karawanella Kegalle - Bulathkohugitiya - Karawanella Kegalle - Bulathkohugitiya - Karawanella	Passara * Moneragala	Yellavaya - Eila - Kumbalwela	Matara - Akuressa	Siyambalanduwa - Damana - Ampara	Kandy - Mahiyangana - Padiyatalawa Kandy - Mahiyangana - Padiyatalawa Kandy - Mahiyangana - Padiyatalawa	Kandy - Mahiyangana - Padiyatalawa Kandy - Mahiyangana - Padiyatalawa	Ampara - Uhana - KahaOya	Anuradhabura - Padeniya Anuradhabura - Padeniya	Vavuniya – Horowopotana	Vavuniya - Parayanalankulan	Karatiw - Ampara	Navathkuli - Karativu - Mannar	Ja-Ela - Ekala - Gampaha - Yakkala Ja-Ela - Ekala - Gampaha - Yakkala Terena - Ekala - Gampaha - Yakkala	a that I that I handle - Yakkala	אמנאראשע אמעדוגא	čaranthan - Kachchai - Mullaitivu	A Total	
Ser ROUTE	130 AA016 131 AA018	132 AADIS	133 AA020	134 AN021 135 A4021 136 A021	137 AA022	136 AA023	139 AA024		A4026 A4026 A4026	144 AA026 145 AA026		147 M028 146 M028	149 A4029		15014	152 M022	ISS MOSS ISS MOSS ISS MOSS	ALD'S		COUNT ICT	~	

D - 1 Estimated Vehicle - Km and Growth Ratio by Section Route A and AB

D-5

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revised VehXm 1995					823	0836	••	000	00	0 41165	0000	125786 93197 16220 34273	0 24272	00	000	sol3	2805 2805 2805
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TACIT OF LOCAT NO ROAD LON A		19.79	12.66 12.66 12.66 12.66 12.66 12.66 12.66 12.66 12.65 12.65	0.48	0.08 Center of t	2.46 1	0.05	1.13	0.51	2.40 2	24.94 2 24.94 9 24.94 9		.bb .61 Bridge	9.5	200	.39 .43 0	6.44 2 1.00 1.21 6.03 6.03
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Several Advances of the several s		kmpara - Inginiyegala	<pre>Anurachapura New Town Roads (4) Harrishchandra Nawatha (5) Naithripala Semanywire Mawatha (2) Dharmapala Nawatha (3) Yarket Junction To Lion Pillar (1) Jayanthi Nawatha (3) D.S.Semanayake Nawatha</pre>	Approach Road to Campola Bridge	Approach Road to Kadurela Bridge	Approach Road to Sri Jayewardenepura Hospital	Avissawella Town Road	Balangoda By Pass	Bandaravela By Pass	Canada Friend-ship Road	Colombo - Harwella Low-Level Road Colombo - Harwella Low Level Road Colombo - Harwella Low Level Road	Galle Road New Deviation (Cross Junc. to Egoda Uyana) Galle - Marine Drive Gampola - Navalapitiya Mospital - Esplande road Ratherner	Inner ring Road and Pelavatte Access Road Tathe - Kankeentum:	Jaffna - Manipay - Karainagar Jaffna - Palali	Jaffna - Panuai - Kayts Jaffna - Point Pedro	Jaina Tronnalal TPoint Pedro Jail Road, Rambantota Malattere - Viel T	Amatures - Astair Junction Link Road Dambuila Lion Pillar - Sri Maha Bochi Road Matale - Udupihilla
NOTE NOTE	Xoute A3	100EV 351	A3002 A3002 A3002 A3002 A3002 A3002 A3002 A3002	A3003	ABOOK	166. AB005	169 A3006	170 A3007	171 A3008	12009	AB010 AB010 AB010					13021	

D-1 Estimated Vehicle - Km and Growth Ratio by Section Route A and AB

1.130 0	Sec ROUTE No. ROUTE NO.	EVAN GAOA	SITE NO	OF LOCAT	A NODE	B WODE	revised VehKa 1995	revised VehKu 2000	revised VehKn 2005	revised VehKa 2010	Crow 2000/1993	Crowth 2005/2000	2010/200
Old Colondo - Pretalua Ruad, ja Fila 0.35 0	12 AB027 13 AB027 14 AB027	016 Colombo - Calle Road, Panadura 016 Colombo - Calle Road, Panadura 014 Colombo - Calle Road, Panadura		1.90		-	00		00	00		00	
Pasyala - Circlulla 113 <td>5 AB028 6 AB028</td> <td>01d Colombo - Puttalar Road, ja Ela 01d Colombo - Puttalar Road, ja Ela</td> <td></td> <td>a (1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997</td> <td></td> <td></td> <td>8504 O</td> <td>0 11357 0</td> <td>0 14992 0</td> <td>0 19783 0</td> <td></td> <td>030</td> <td>1.32 0</td>	5 AB028 6 AB028	01d Colombo - Puttalar Road, ja Ela 01d Colombo - Puttalar Road, ja Ela		a (1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997) - 1997			8504 O	0 11357 0	0 14992 0	0 19783 0		030	1.32 0
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District - Mecalai 0	1202V 0	Poonakary - Sangupiddy Puloly - Kodikanam - Kachchai			· · · ·		10201	134734		0 234761 0	H	0.22 0	0 22 0
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Valachchemai - Nasamriv - Nwaladi 2.17 1 1.37 1.37 1.37 Valachchemai - Nasamriv - Nwaladi 2.15 0	4 AB035 5 AB036 5 AB037	Section A - B NEW TOWN ROAD, Ratnapura Thalapitiya road, Galle Upper Gampola Road		2.58 2.88 2.88 2.89 2.89 2.99 2.99 2.99 2.9	1		000	000	000	000	000	000	000
Ratelia Deviation 0.64 1 23540 3107 41016 54141 1.22 Religans N Pass 2.16 2 1555 21555 27555 11.22 11.22 Religans N Pass 3.80 2 33312 46532 58915 77767 1.22 1.22 Waliyangana - Dimbulacala - Daluktane 72.60 5 94050 124139 163922 216403 1.22 1.2	7 A3038 8 A5039	Valachchenai - Nasavantiwu - Nawaladi Valukkairaru - Pungudutiwu - Kurikadduwan		5.12 5.12 24.54		- - - - - -	14975	19765 0	26063 26063	34443	1.32	1.32	1-32
Mahiyangara - Diabulagala - Palukkare 1.15 94050 124198 153942 216403 1.32 Avissauela By pass 0 0 0 0 0 0 0 0 Base Line Rd(Between Dematagoda to Level Cross) 2 0	2 V3042	Mattala Deviation Weligama By Pass Getable Kandy By Pass Weliawawa Ry Pace		0.64 4.18 3.80 2.80 2 2		· .	23540 16390 33812	31072 21635 44632	41016 28558 58915	54141 37695 77767	°22220	2838 113	°828
Base Line Rd(Between Dematagoda to Level Cross) 2 0 <	3 AB046 * AB045 * A	Nahiyangana - Dimbulagala - Dalukkane Avissavela By pass		72.60 0.88 0.88			0 0 0 0 0 0 0	0 124198 0	0 163942 0	0 216403 0	1.32	0 22 0	
Maradana Road Maradana Road Maradana Road MC MC MC MC MC MC MC MC MC MC MC MC MC	5 ACOOS	Base Line Rd(Between Dematagoda to Level Cro Lotus Road		69		· · ·	O ,C	00		000	000	000	200
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	-	5 West	1 F. W	2818	3	51675		607/07	CC1504	1,41	1.40	021
	Nuttetugala - Hiriplaya	10 /111	01.11		ŗş	77010	07997	200001	145249	1.41	 	95.1
570 8704	Nacoda - Kalaweilawa - Bellanatiwa					40001	24021	22449	26874	1.20	61.1	1.19
571 B304	Nanoda - Kalawellawa - Bellaning		E Yo	717	3	16-76	230480	522368	118218	97. I	67.1	1.38
572 B304	Naooda - Valaurationa - Dattering	DO WORL	8 4 B	2000	91	153858	216545	502874	11114 -	07-1	02	\$2.5
		56 West	28 X.H	2100	8	175283	246696	345049	479754	1 40		
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608 8552	Nuwara Elivo - Uda Pussellavva					+>+>+	44007	220204	290010	1.40	6E.I	1.38
609 B332	Nuvera Elive - Ude Pussellawa		E - A - C	22	x 8	01839	87033	121731	169254	1.40	9 <u>5</u> .1	1.38
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707 8419	Thoppu - Madampe	12 N 12			K a	0#CDCT	158184	067061	228036	1.20	1.19	61.1
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	Toninala - Kalawewa - Galewela	00 WGI	6.X.7	1452	2	107097	150730	210823	293128	1.40	1.39	1.38
714 8424	Trincomalec - Pulmoddai	40 769	E 7 4	320	6	20679	29781	:2623	60640	1.43	1.42	1.41
715 B423	Tudella Pamuninama Talakan Namaha		CIEX						•			
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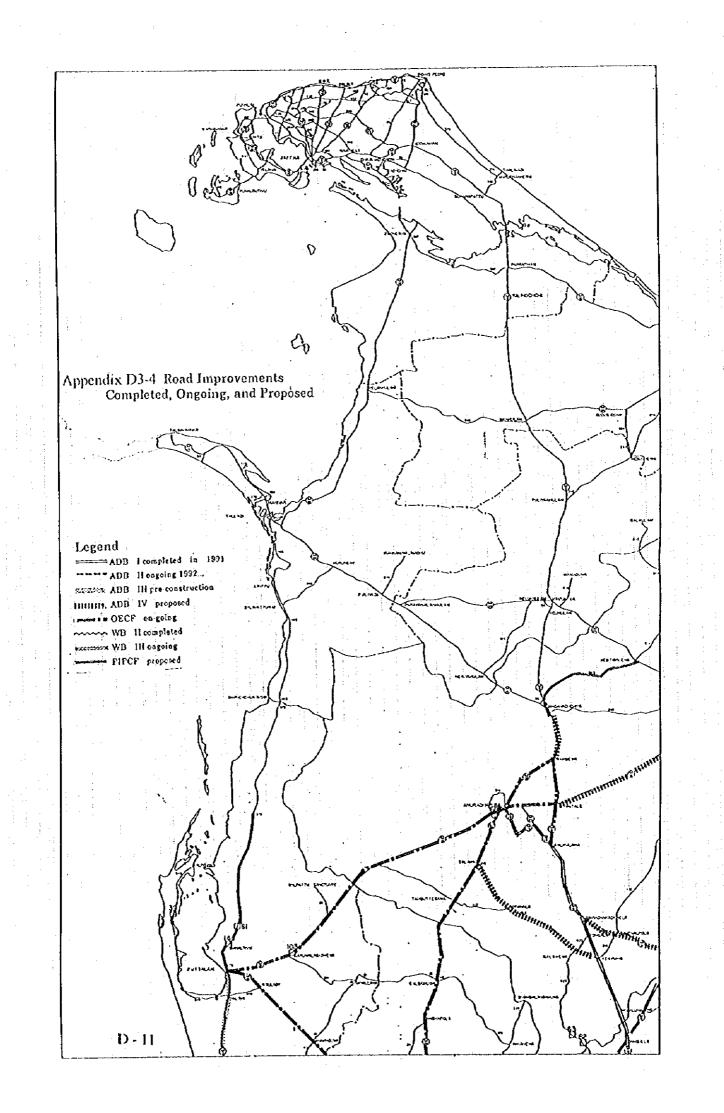
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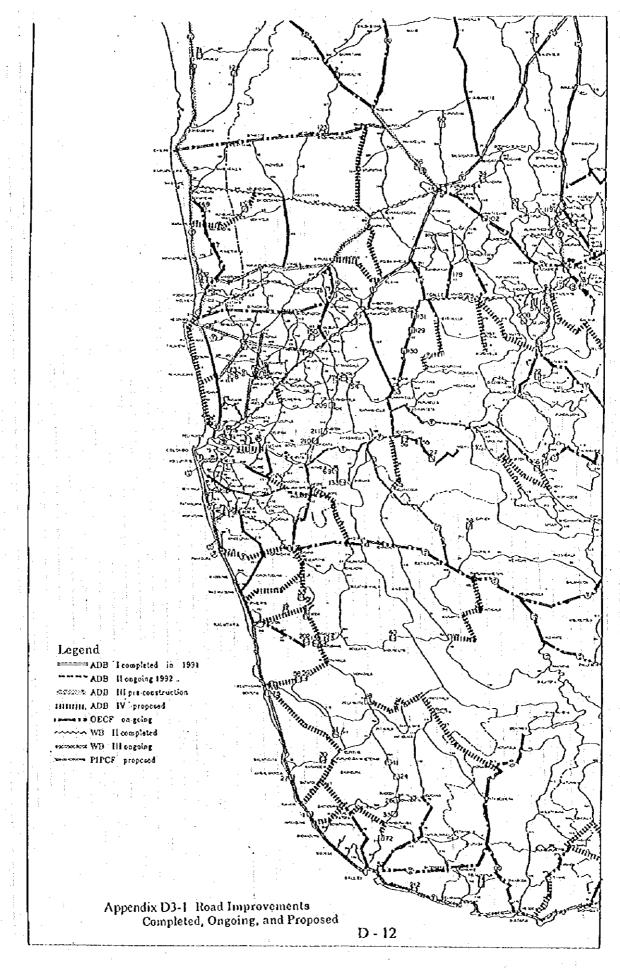
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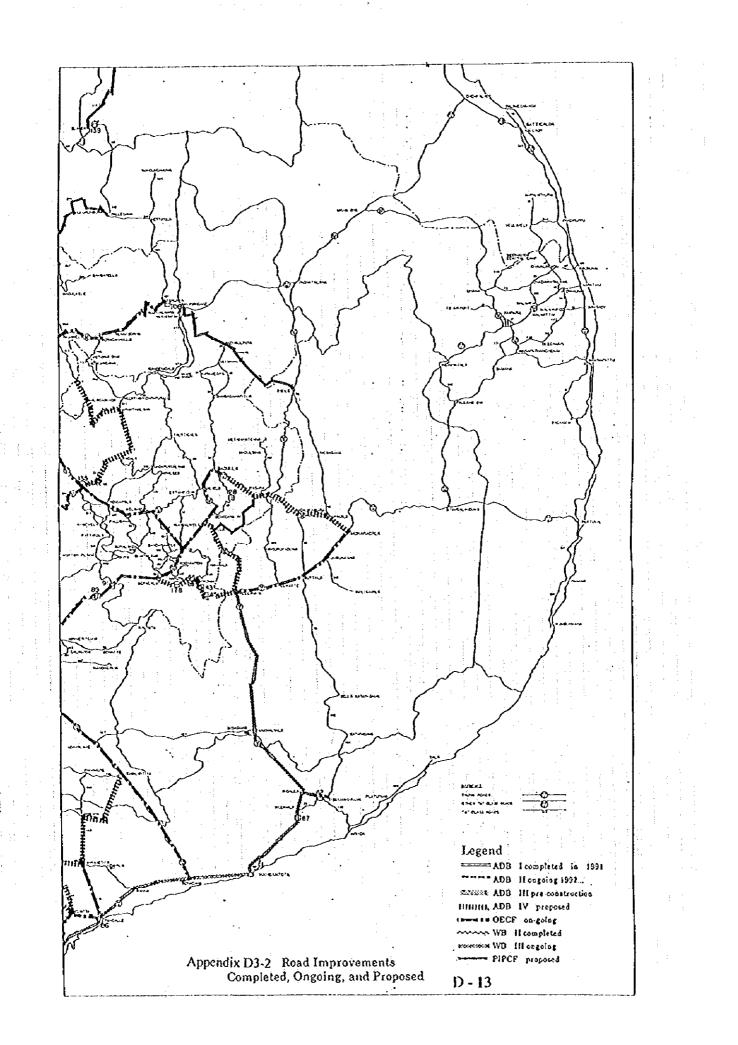
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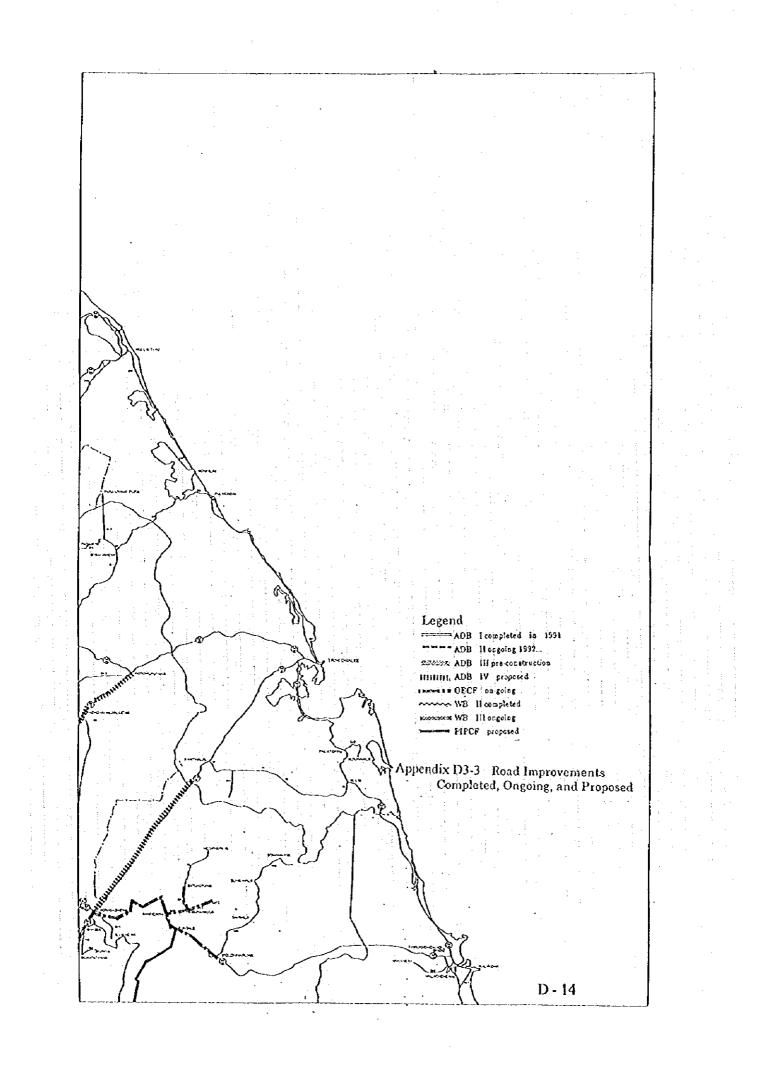
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Appendix D - 4 Estimated Future Population by District

No.	District	Land Area*	1995	2000	2005	2010
1	Čolombo	656.7	1791.7	2266.3	2558.8	2823.3
2	Gampaha	1597.6	485.7	567.0	751.1	963.6
3	Kalutara	1377.6	230.7	277.6	388.8	517.5
- 4	Kandy	1906.3	193.7	215.4	239.2	265.3
5	Matale	1993.3	52.0	58.1	64.8	72.1
6	Nuwara-Eliya	1720.5	38.4	43.6	50.3	58.0
7	Galle	1635.6	206.1	252.2	298.6	347.8
8	Malara	1282.5	85.7	100.4	115.4	131.5
- 9	Hambaniola	2579.3	60.2	86.3	112.0	138.4
10	Jallna	983.6	332.9	364.4	425.9	491.7
ារ	Kilinochchi	1235.0	9.6	14.5	24.1	33.9
12	Mannar	1985.2	19.9	23.5	31.5	40.1
13	Vavuniya	1966.9	26.0	30.4	40.0	50.2
14	Mullaitivu	2516.9	10.3	12.1	16.1	20.3
15	Batticaloa	2686.3	104.3	113.8	131.9	152.4
16	Amparai	4318.2	70.9	78.9	94.2	111.3
17	Trincomalee	2630.8	118.9	144.0	191.1	242.9
18	Kurunegara	4812.8	55.5	69.5	84.0	99.5
19	Puttalam	3013.4	81.1	103.0	125.3	149.3
- 20	Anuradhapura	7034.3	49.4	50.7	59.9	80.7
- 21	Polonnaruwa	3224.2	43.4	59.7	71.5	75.6
22	6lube8	2802.8	68.7	78.8	90.2	103.1
23	Moneragala	5545.6	9.9	11.1	12.6	14.6
24	Ratnapura	3255.4	77.1	84.5	94.0	106.6
25	Kegalle	1692.8	84.1	104.2	126.8	151.8
	Tolal	64453.6	4306.0	5210.0	6197.9	7241.6

Estimated Future Urban Population by District (x 1000)

Note": Square kilometers excluding large inland water areas SOurce: Study Team

Estimated Future Population by District (x 1000)

No.	Olstrict	Land Area*	1995	2000	2005	2010
1	Colombo	656.7	2069.4	2302.7	2558.8	2823.3
2	Gampaha	1597.6	1571.1	1682.0	1799.1	1915.6
3	Kalutara	1377.6	972.2	1063.3	1161.4	1261.1
4	Kandy	1906.3	1289.7	1319.9	1350.6	1373.5
5	Malale	1993.3	444.2	454.1	464.2	471.7
6	Nuwara Eliya	1720.5	523.9	527.7	531.4	534.2
1 7	Galle	1635.6	991.3	1013.8	1099.7	1154.2
8	Malara	1282.5	814.0	866.9	923.8	979.9
9	Hambaniola	2579.3	542.4	579.4	619.5	659.1
10	Jalina	983.6	886.9	908.7	930.9	950.9
- 11	Kilinochchi	1235.0	113.2	116.0	118.9	121.4
12	Mannar	1985.2	142.1	158.4	176.6	194.4
13	Vavuniya	1966.9	120.0	131.0	142.9	154.3
14	Mullaitivu	2516.9	100.1	109.9	120.6	130.9
15	Batticaloa	2685.3	445.7	464.8	485.0	503.9
16	Amparai	4318.2	516.1	536.6	558.5	578.7
17	Trincomalee	2630.8	329.3	341.3	354.0	365.7
18	Kurunegára	4812.8	1490.0	1545.8	1604.7	1659.0
19	Putlalam	3013.4	632.8	661.4	691.9	720.3
20	Anuradhapura	7034.3	759.8	792.8	827.8	860.7
- 21	Polonnaruwa	3224.2	336.5	350.9	365.3	380.7
- 22	Badulla	2802.8	731.3	723.2	713.3	693.1
23	Moneragala	5545.6	373.3	363.6	352.0	335.4
- 24	Ratnapura	3255.4	979.6	1008.6	1038.5	1062.7
25	Kegalle	1692.8	765.2	777.2	789.6	799.4
	Tolal	64453.6	17940.0	18830.0	19780.0	20690.0

Note': Square kilometers excluding large inland water areas SOurce: Study Team

Appendix - E

PRELIMINARY INSPECTION RESULTS

LIST OF CONTENTS

1.	List of Types of Bridges for Preliminary Inspection	E - 1
2	List of Location of Bridges for Preliminary Inspection	E - 3

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A AOL	247K Mandankadawela - Habarana - Tirikkondiadi	Anuradhanun	Yan Ova Bindge	Yan Oya	
210AA	16/1K Puttalam - Trincomalee	Chilaw	-	Tabbowa Wewa	
AA017	2/2/K Galle - Denivava - Madampe	Galle	Rambagala Bridge	Rambagala Ela	
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AA021	36/3K [Kegalle - Bulathkohupitiva - Karawanella	Kezalle	Ruyaha Oya Bridge	Ritigaha Ova	
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AA073	S/3K Ja Eia - Ekala - Campaha - YaWala	Gempeha		Usseyadana Ela	
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AB077	1/2/M [Old Galle Road Panadura	Kalutara	Susantha Mawatha Bridge	Garbage	
A ROTO	12/2K Parvala - Chrulla	Crampaha		Tarigodiou Channel	
B014	8/1 K Amhalanyoda - Elpitova - Pitigala	Calle	•	Aluwarha Cya	
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R070	23/2/Mi Chulaw - Wanyapola	Kurmegala	Thomagala Rudge	Kalamunu Ova	
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P127	2/7X Calicamuwa - Ruwanwella	. Chitaw	Balaptawa Bridge	Balaptawa Ela	
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E Name of Rond	12/3K Morana - Ancuruwatola - Alutheama	++/3K Horana - Anguruwatota - Alutheama	43/4K Horana - Angunawatota - Aluthgama	23/2K Horana - Anguruwatota - Alutheama	16/7K Horawela - Pelewatta - Miyaia		11/44 A AGUNTOWA - CRATTONA SJAN Kaltoorala - Eablucama	SZM [Katuryala - Labuvama	S/5K fLarandurone - Rambukkana	10/3K Katokurunda - Neboda	1/5M Keenankalli - Andagama	9/4K [Lahuduwa - Wanduramba - Sandarawela	SASK [Lady Massalum Drive	25/7K Mallawapitrua - Rambodavaila - Keppengoil	7/3 K Mallawapittya - Kambodagalia - Keppetuoli 2715 - Kehini	nt Navanwas - carney 15 fr Marnush Ridubeddewa	10/2K (Minuwancoda - Campaba - Minimutta	10.9K [Minuwangoda - Gampaha - Minxwatta	10/5K Minuwangoda - Gampaha - Miniswatta	3/5K Moratuwa - Pilwandala	15/6K Muttetugala - Hiripitiya	25/3K Nagoda - Kalawellawa - Bellapitiya	17/1K Navoda - Kalawellawa - Bellapitiva	14/5K Nagoda - Kalaweliawa - Bellapativa	SADATA NAULA - FLANDERA - NAURANEA	2005. Puttalam - Manchchikade	1/1K Puttalam • Manchchikade	6/2/ (Thopy - Madampe	24/2K Thoppu - Madampe	N/1K Tiruwapaketiya - Agalawatta	66.2K Tiruwanaketiva - Agalawaita	29/3K Tonigala - Kalawewa - Galewela	CK Tonigata - Kalawewa - Galewela	44/3K 1.00192414 - Kalawewa - Calevela 201151 T. 146115 - Doministrati - Talabara - Nationalis	2366 (Ulanana - Puscellawa	3/1K Gin Ova - Piolawatta - Dankotuwa	2/1K Cnn Ova - Bolawatta - Dankotuwa	45K Vevaneda - Kaleliva	1-2K Vernngoda - Ruwanwella	1-13K Vevanenda - Ruwanwella	1905k Wanduramha - Etumale - Yakkatuwa	6/6K Wanduramba - Etumale - Yakkatuwa	3/1 K Warduramba . Frumale . Valstanuwa		15.5K Wanduramba - Etumale - Yakutuwa
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Appendix - F

DATA OF TOPOGRAPHIC SURVEY

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1.	Reference to MSL Datum	F- 1
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2.	Bench Mark Location Sketch	F - 2

REFERENCES TO MSL DATUM

<u>Bridge Serlal</u> <u>No</u> .	Old BM Reference, Elevation and approx. distance to Site
85	- SD BM No.45 of Primary Level Line No.XVI - Elv. 216.851m Distance 150m
77	- SD BM Nos.6 & 7 of Primary Level Line No.XCV - Elvs. 68.899m & 69.038m respectively within the site area.
53	- Not on MSL Datum.
33	- SD BM No.19 of Secondary Level line No.CXXXIII - Elv. 3.338m. Distance 1.6 Km.
59	- BM No.44 established for the proposed Bandaragama - Matara Highway Project. Elv.1.118m. (Within site area).
20	- Not on MSL Datum.
70	- SD BM No.4 of Minor Level line No.9/1966 Elv .5.322m. Distance 2.5 Km.
7	- Negombo Town Survey BM (SD) near New Rest House. Elv. 2.104m .Distance 2 Km.
211	- SD BM No. 10 of Secondary Level Line No.CXXVI Elv. 24.873m. Distance 4 Km.
212	- SD BM No.3 (Secondary Traverse No.1/94 Stn.13) Elv. 2.585m. Distance 4 Km.

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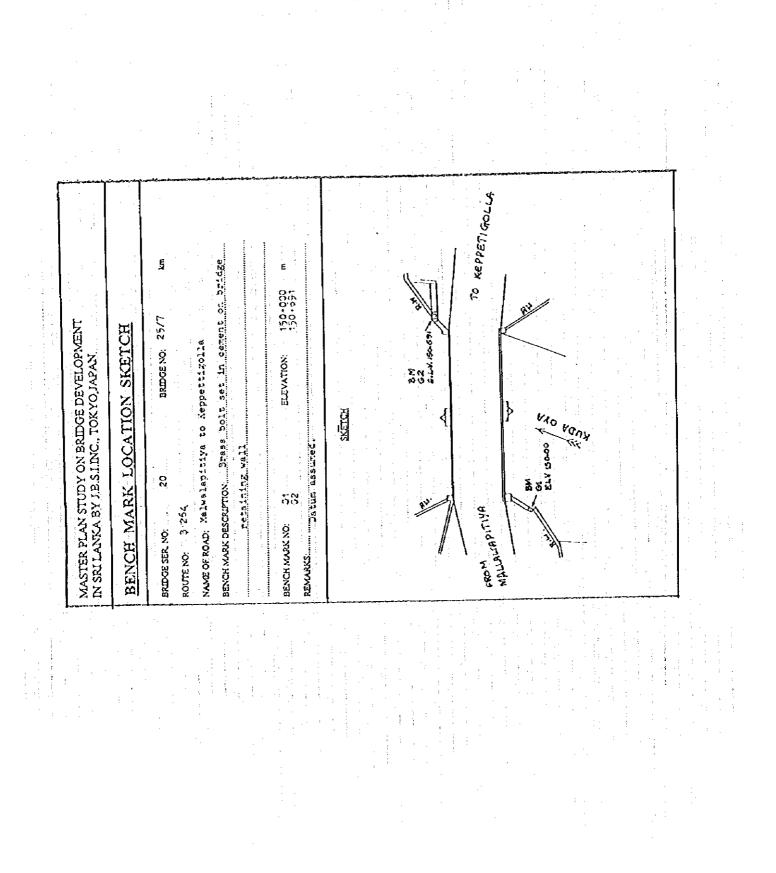
TO KANDY BENCH MARK DESCRIPTION. 378.85% 30.1 Let in cenent on bridge Ş E 91/2 ELEVATION: 202-953 MASTER PLAN STUDY ON BRIDGE DEVELOPMENT IN SRI LANKA BY J.B.S.I.INC., TOKYO, JAPAN. BENCH MARK LOCATION SKETCH BRIDGE NO: BM.G2 ELV. 202.953 NAME OF ROAD: Colombo to Kandy SKETCH CPLONOO Recalizing Wall. ROUTE NO: AA OOT BENCH MARK NO: 02 BRIDGE SER, NO: 85 605th TO KANDY what oth BENCH MARK DESCRIPTION 5 E 203.185 BRIDGE NO: 91/2 MASTER PLAN STUDY ON BRIDGE DEVELOPMENT **BENCH MARK LOCATION SKETCH** IN SRI LANKA BY J.B.S.I.INC., TOKYO, JAPAN. **ELEVATION:** NAME OF ROAD: Colombo to Kandy SNELCE 0 M 61 ELV 203.185 REMARKS De cum. K. S. L. uRebaindnaufaili frey Colongo AA 001 5 BRIDGE SER NO: 85 BENCH MARK NO. ROUTE NO:

TO REGALE 111 Jac ELV 68.968 1 8M 62 ø, Ę ε 400101V 68-963 01 авоя BRIDGE NO: 3/2 MASTER PLAN STUDY ON BRIDGE DEVELOPMENT. BENCH MARK LOCATION SKETCH IN SRI LANKA BY J.B.S.I.INC., TOKYO, JAPAN. ELEVATION: NAME OF ROAD: Polgehawela to Kegalle SKETCH REMARKS. Detur N.S.L. ROUTE NO: C. A. 019 BENCH MARK NO: 3 2 BRIDGE SER, NO: 77 BANK YAYA POLGAHA -FROM TO KEGALLE Ę ε 601-69 212 3/2 MASTER PLAN STUDY ON BRIDGE DEVELOPMENT BENCH MARK LOCATION SKETCH IN SRI LANKA BY J.B.S.I.INC., TOKYO, JAPAN. BRIDGE NO: ELEVATION NAME OF ROAD: Polgehavela to Kegalle 84 GI 97-10-SKETCH Ę L REMARKS De tum ... X. S. L. ₹Ū, ROAD BENCH MARK NO: 01 BRIDGE SER, NO: 77 ROUTENO: A 019 POLGAMALELA concrete. . ମୁହନ୍ତୁ

TO KARAMANELLA BENCH MARK DESCRIPTION. Survey Dept. BM. Brass bolt set in carent NAME OF ROAD: Kerslie to Karawanells vis Bulathkohipitiya 5 E 28-156 BREDCE NO: 36/3 å MASTER PLAN STUDY ON BRIDGE DEVELOPMENT BENCH MARK LOCATION SKETCH S.C.S ġ 508M 64 28.156 IN SRI LANKA BY J.B.S.I.INC., TOKYO JAPAN. ELEVATION SKETCH RENURKS.......Ch..an..assured Datum. on hridge reseining wall. BRIDGE SER NO: 53 ROUTE NO: AA. 021. . : FROM KEGALLE BENCH MARK NO: AHADITIA AYO KREALANELLA NAME OF ROAD: Kegalle to Karawanella via Bulathkonupitiya. g Ē ٩ 410 SILI CUHU 36.73 27-943 MASTER PLAN STUDY ON BRIDGE DEVELOPMENT BENCH MARK LOCATION SKETCH BRIDGE NO: IN SRI LANKA BY J.B.S.I.INC., TOKYO, JAPAN, FLEVATIONS skerch REMARKS...... ASSURED Datum 71 BM G 1 ELV 27.948 Tetaining wall ROUTENO: AA 024 ---5 BREDGE SER NO: 53 BENCH MARK NO. ģ. ũ. FROM KEGAUS

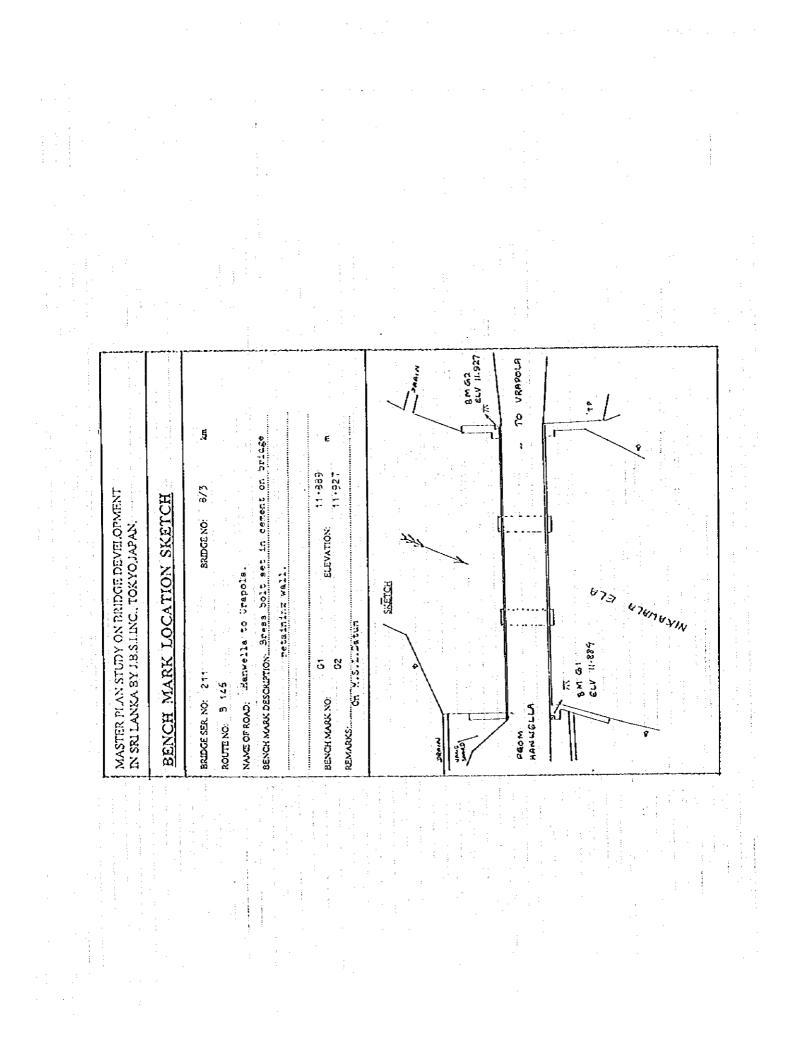
MASTER PLAN STUDY ON RRIDGE DEVELOPMENT IN SRI LANKA BY J.B.S.I.INC., TOKYO,JAPAN.	BENCH MARK LOCATION SKETCH	RELIDEE RO. 13 BRIDGE NO. 12/3 KA ROUTE NO. 3 157 BRIDGE NO. 12/3 KA ROUTE NO. 3 157 NAME OF ROAD: HOT ALL THERE AL A ANGUTUWA EDTA. NAME OF ROAD: HOT ALL THE ANGUTUWA EDTA. BENCH MANK DESCRIPTION BILLS LEEVATION: 9-185 M REVAINS. OF M.S. L. DALLT REVAINS. OF M.S. C. R.S.	
MASTER PLAN STUDY ON PRIDGE DEVELOPMENT IN SRI LANKA BY J.B.S.I.INC, TOKYO,JAPAN.	BENCH MARK LOCATION SKETCH	RELIDCE SER NO: 33 BUEDGE NO: 1275- LA ROUTENO. 3 157 NUME OF ROLO. HOFMAN LO ALULHGARA VIE ANGUTHWAICEA NUME OF ROLO. HOFMAN LO ALULHGARA VIE ANGUTHWAICEA RENAMEN OF DISTING WALL RENAMEN OF DISTING WALL RENAMEN OF DISTING WALL RENAMEN OF DISTING OF ALL RENAMEN PORTHA FROM HORANA FROM HORANA	

ACUTISAMA GANGA E BENCH MARN DESCRUPTION. BITESS DOLT SEC 11 CENERS ON DIJCE £ JELPENNA NAME OF ROAD . "GOTANA TO ALUTINGAMA VIA ANGUTUWATOTA. ę 43/4 5-2.58 MASTER PLAN STUDY ON BRIDGE DEVELOPMENT BENCH MARK LOCATION SKETCH BM G1 EU 3.238 Æ BRIDGE NO: IN SRI LANKA BY J.B.S.I.INC., TOKYO, JAPAN. ELEVATION ł÷ SKETCH retaining wall. REMARKS. OL. M.S.L. CALUE WASER HOLE 5 BRIDGESER NO: 59 ROUTENO: 3 157 FROM HORANA BENCH MARK NO: TO ALUTHGRAMA Ę BENCH MARN DESCRIPTION ... BIASS DOLT SET IN COMPAN ON DRIGGE ε NAME OF ROAD: Horman to Aluth Jama via Anguruvatota 43/4 3+374 MASTER PLAN STUDY-ON BRIDGEDEVEL OPMENT BENCH MARK LOCATION SKETCH BRIDGE NO: IN SNI LANKA BY J.B.S.J.INC., TOKYO, JAPAN. ELEVATIONS GRACE CRACE SKETCH -13 Lenne retains 2 walk. 1 BM 62 ELV 3-374 : |< ROUTENO: 3 157 ... BRIDGE SER NO: 59 BENCH MARK NO: 02 FROM HORANA



PUPOWAYLIN OF 5 BENCH MARK DESCRIPTION. STRARS DOLL SEC. In CERENT OR DESCRIPTION. Ę BREDGE NO: 3/6 ELEVATION: 3.661 Section 2 MASTER PLAN STUDY ON BRIDGE DEVELOPMENT IN SRI LANKA BY J.B.S.I.INC., TOKYO,JAPAN BENCH MARK LOCATION SKETCH NAME OF ROAD: ... Norstuwa to Piliyandala. BM 62 SNETCH "retaindrates wall BOLGODA LAICE BOLGOJA LAKE REMARKS MS.L. Gabun. FROM MORATUNA 3 33 ROUTENO: 3 295 BENCH MARK NO: ERIDGE SER NO: TO PLUYMUTH 5 BENCH MARK DESCRIPTION Brass bolt set in cerent on bridge LAKE Е BOLGODA LAICE Add Park ELEVATION: 3.771 BOLGODA MASTER PLAN STUDY ON BRIDGE DEVELOPMENT BRIDGE NO: 3/6 BENCH MARK LOCATION SKETCH IN SRI LANKA BY J.B. S.I.INC., TOKYO, JAPAN NAME OF ROAD: Nora tuwa to Piliyandala. **NETO** 814.61 Ch K.S.L. Datur. FROM MORATUWA. BENCH MARK NO. 31 1 27-04 2 ROUTENO: B 295 BRIDGE SER NO: SVILING REMARKS

MASTER PLAN STUDY ON BRIDGE DEVELOPN IN SRI LANKA BY J.B.S.I.D.C., TOKYO, JAPAN BRIDGE SER NO: 7 BRIDGE NO: BRIDGE SER NO: 3 425 NAME OF ROAD: 24621a to Negombo. BENCH MARK NO: 3 425 NAME OF ROAD: 24621a to Negombo. BENCH MARK NO: C1 BENCH MARK N	MASTER PLAN STUDY ON BRIDGE DEVELOPMENT IN SRI LANKA BY J.B.S.I.INC., TOKYO, JAPAN, IN SRI LANKA BY J.B.S.I.INC., TOKYO, JAPAN,	BENCH MARK LOCATION SKETCH BENCH MARK LOCATION SKETCH	BRIDGE SER NO: 7 BRIDGE NO: 20/4 km ROUTE NO: 3 425 ROUTE NO: 3 425 NAME OF ROAD: Tudella to Negombo. BENCH MARK DESCUPTION. BEase boly set in cerent on bridge BENCH MARK DESCUPTION. Brass boly set in cerent on bridge BENCH MARK DESCUPTION. Brass boly set in cerent on bridge	ELEVATION: 2 • 528 m RENCH MARK NO: C 2 ELEVATION: 2 • 543 m RENARKS: 2 M.S.L. CETTON: 2 • 543 m	
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TO WELLAWAYA BENCH MARK DESCRIPTION ... Rebar, with a rounded top, ant in concrete. 5 ٤ 3 1 1 2 0 7 7 7 0-51 BM 62 138/1 2.853 MASTER PLAN STUDY ON BRIDGE DEVELOPMENT IN SRI LANKA BY J.B.S.I.INC., TOKYO,JAPAN BENCH MARK LOCATION SKETCH T CURDEN BREDGE NO: ELEVATION NAME OF ROAD: 0 Colombo towellawaya. SKETCH REMARKS. On K. S. L. Jatun. 8 BRIDGE SER, NO: 212 ROUTE NO: AA 002 BENCH MARK NO: FROM COLOMBO 83118 勜 TO VELLAUAYA BENCH MARK DESCRIPTION. Rebar with a rounded top set in concrete. RIVER 5 E ȓ 2-643 BRIDGE NO: 138/1 MASTER PLAN STUDY ON BRIDGE DEVELOPMENT IN SRI LANKA BY J.B.S.LINC., TOKYO,JAPAN. BENCH MARK LOCATION SKETCH ELEVATION NAME OF ROAD: Colombo to Vellavaya SNETCH ii 10-10-Cr. Y.S.L. Satua A THE ADDRESS OF A 1--5 Į, 5 COLO M80 BRIDGE SER NO: 212 ROUTENO: AA 002 BENCH MARK NO: FROM REMARKS

Appendix - G

DATA OF HYDROLOGICAL ANALYSIS

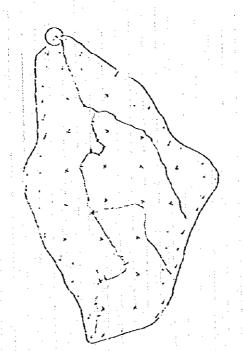
LIST OF CONTENTS

1.	Backup Data for Hydrological Analysis	G - 1
2.	Calculation Sample, SER No. 20	G - 10

<u>SER NO. 85</u>

Scale = 1:250,000

2822 mm²

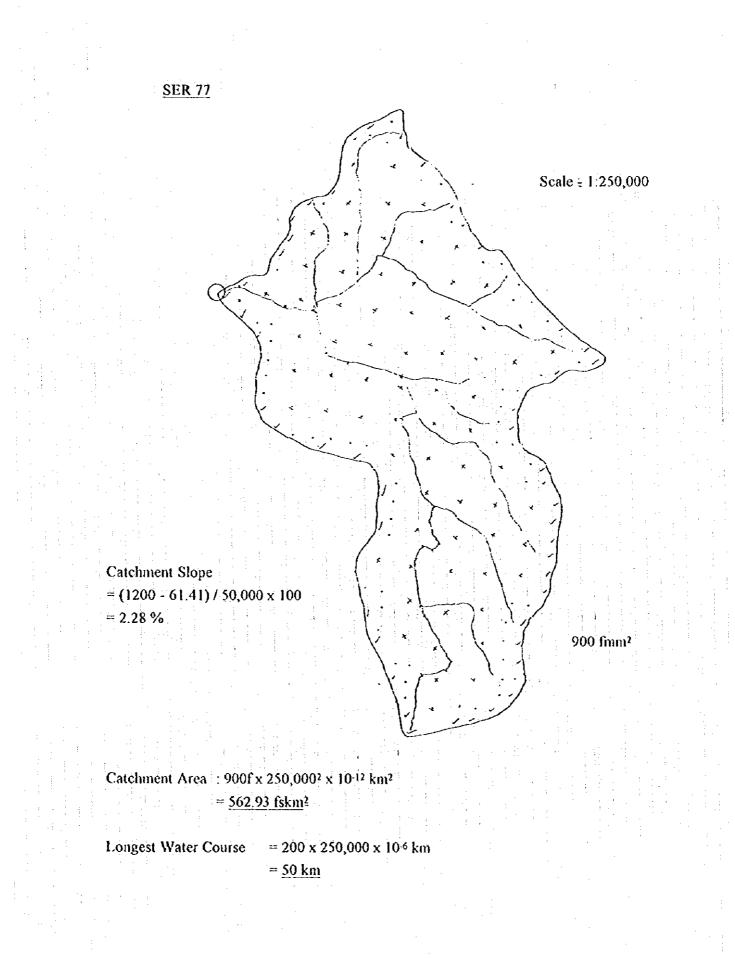


Catchment Area = $2822 \times 250,000^2 \times 10^{-12} \text{ km}^2$ = $\underline{176.375 \text{ km}^2}$

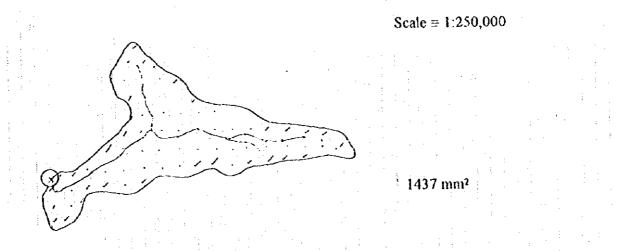
Longest Water Course = $100 \times 250,000 \times 10^{-6} \text{ km}$ = 25 km

Catchment Slope = (1200 - 190.6) / 25,000 x 100 = 4.04 %

6 - 1



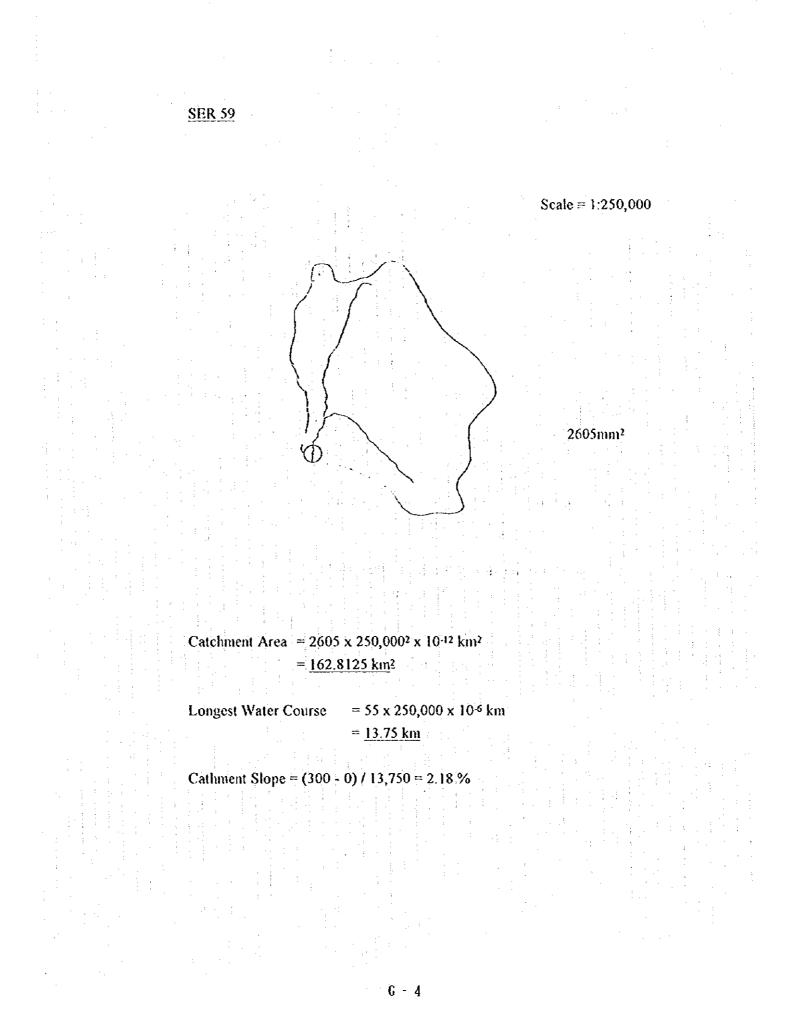
<u>SER 53</u>

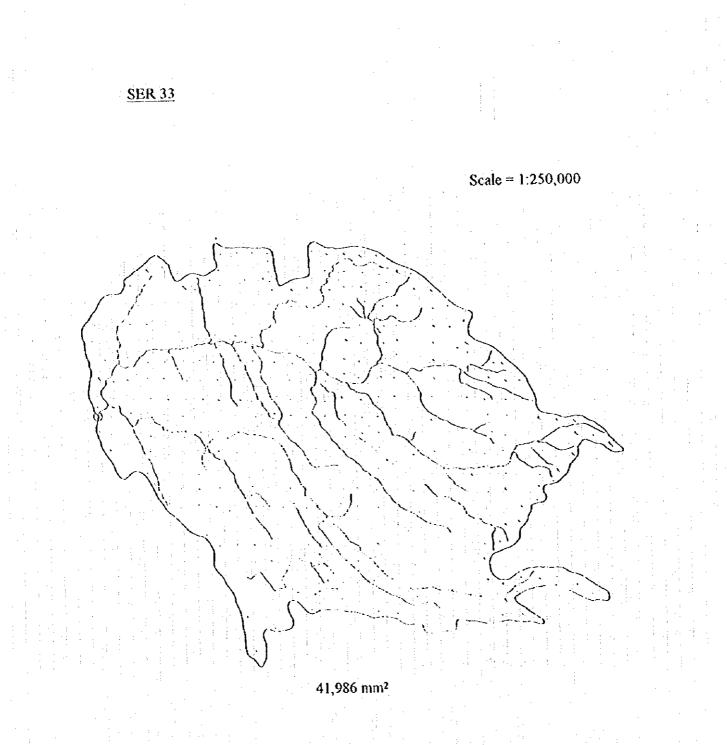


Catchment Area = $1437 \times 250,000^2 \times 10^{-12} \text{ km}^2$ = 89.8125 km^2

Longest Water Course = 91 x 250,000 x 10-6 km = 22.75 km

Catchment Slope = (900-75) / 22,750 x 100 = 3.63 %





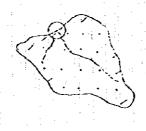
Catchment Area = 41,986 x 250,000² x 10⁻¹² km² = 2624.125 km²

Longest Water Course = 97.5 km

Catchment Slope = $(1300-8.00) / 97,500 \times 100$ = 1.33% <u>SER 20</u>

Scale = 1:250,000

461 mm²



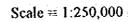
Catchment Area = $461 \times 250,000^2 / 10^{12} \text{ km}^2$ = 28.8125 km^2

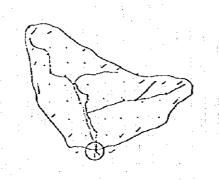
Longest Water Course = 7.5 km

Catchment Slope = $(700 - 225) / 7,500 \times 100$

= 6.33 %

<u>SER 70</u>







Catchment Area = $865 \times 250,000^2 \times 10^{-12} \text{ km}^2$ = 54.0625 km^2

Longest Water Course = $41 \times 250,000 \times 10^{-6} \text{ km}$ = 10.25 km

Catchment Slope = (50 - 0) / 10,250 = 0.49 %

SER 211

Scale = 1:250,000



734 mm²

Catchmen Area = $734 \times 250,000^2 \times 10^{-12} \text{ km}^2$ = <u>45.875 km</u>²

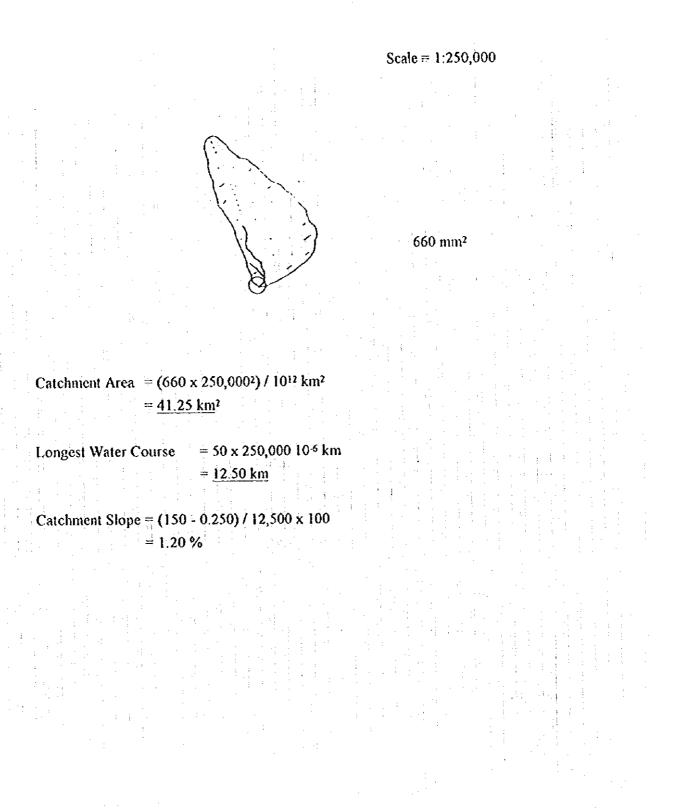
Longest Water Course = 55 x 250,000 x 10⁻⁶ km

= <u>13fskm</u>

Catchment Slope = (140 - 7.50) / 13,750

= 0.96 %

<u>SER 212</u>



	Reference	Calculation	Out put
	1	Waterway Calculation for Bridge	
		SER No. Route No. Bridge No 20 B264 25/7 km	
	Survey of map	DataA =Catchment AreaA =Longest water coursesL =Catchment slope $s =$ 6.33%	
•		AssumptionsReturned PeriodSlope of streami = 0.2 %Design Discharge : Q	
		Empirical formula method	
3 - 13 - 13	Essential of Bridge	The flood discharge is given by	
	Engineering cl: 2.5.2	$Q = C A^{23}$ where; $Q = Max$ flood discharge in m3/sec	
		 A = Catchment Area in km2 C = Constant depending on the nature of catchment location. 	
		In this case, $C = \begin{bmatrix} limited area near hills \\ 10.0 \end{bmatrix}$	
		$Ql = 94.0 \text{ m}^3/\text{sec}$	Q1= 94.0
		Rational formula method	m ³ /sec
	Irrig. Head works	Time of concentrating, "Te" is given by;	
	cl: 4.2.6	Tc = $L/60V + 15$ min. where; $L =$ tongest water course in feet V = velocity in feet/see corresponds to stream gradient.	
	Irrig. Head works T. 4.2.6	In this case; L = 7.5 km V = 5.0 fcet/sec	
-		Tc = 22.62 min ic; Duration of Storm " D " = " Tc"	
		Intensity of Rainfall " I " is given by;	
	Irrig. Head works cl: 4.1.2	I = X D ^{-Y} where: X,Y are constant in relation to the flood return period and zone in which the site located. I = Intensity of rainfall in In/hr	
	lrrig. Head works T. 4.1.2	Located in zone 3 For Return period = 50 yrs. X = 167.77 $Y = 0.844$	

Reference

Calculation

0ut∘put

Reference	Calculation	
ci: 5.2		
UL J.L	$I = 12.06 \ln/hr$	
	The value of Dunoff is given by	
	The value of Runoff is given by	
Irrig. Head	Q = CIA	
works	where; $C = Runoff coefficient which is depending on the$	
cl: 4.2.2	catchment slope. I = Rainfall Intensity in In/hr	
	A = Catchment Area in Acres	
· · ·		
Irrig. Head	In this case;	
works	s = 6.33 % therefore, C = 0.5	
T. 4.2.4		
	$Q2 = 42945.5 \ R^3/scc = 1216.0 \ m^3/scc$	Q2=
		1216.0 m ³ /sec
	Design Discharge : Qd	MI 7500
	Q1 (m^3 /sec) Q2 (m^3 /sec) Qd (m^3 /sec)	
	Empirical Method Rational Method Design Discharge	
	Q1 x 1.5	
	94.0 1216.0 141.0	Qd=
		m ³ /scc
	Area - Velocity Method	
Survey map	Elevation of road surface $ELr = 150.48$ m	
of Study	Depth of road surface to solit of the beam $DI = 0.52$ m Free board $Fr = -1.74$ m	
	Free board Elevation of river bed $Fr = -1.74 \text{ m}$ EL rb = 146.5 m	
	Assumed water level ELwl = 151.70 m	ELwl=
	High flood level Record HFL = 152.88 m	151.7 m
	(150.48+2.4)	
	River cross section at centre of the Bridge (Ignored pier thickness)	
	Width of the river Wr = 13.42 m	
	Width of river bed $Wb = 13.42 \text{ m}$	
	Height of slope Height of vertical $hs = \frac{0.0}{hv} = \frac{5.2}{m}$	
	Height of vertical $hv = [5.2]m$	
	Area $A = 69.784 \text{ m}^2$	
	Wetted Perimeter $P = 23.82$ 142.0	
	And also; Velocity of flow is given by;	
Essential of Bridge	And also, velocity of now is given by,	
Engineering	$v = 1/n * R^{23} * S^{1/2}$	
cl: 2.5.4	where: $v = velocity of flow in n/sec$	
	n = coefficient of roughness which can be taken from Table 2.2	
	Table 2.3 $s = slope of stream$	
	R = mean hydraulic radius, (A/P) in metre	
Essential	In this case;	
of Bridge	n = 0.045 s = 0.2%	and the second second
Benningering	s = 0.2%	e la substantia la companya de la companya de la companya de la companya de la companya de la companya de la co
Engineering T. 2.3		

Reference	Calculation	Out put
	$Q3 = A * v =$ 142.0 m ³ /sec $\ge Qd =$ 141.0 m ³ /sec	2.03 m/scc Q3= 142.0 m ³ /scc
	Rehabilitation PlanElevation of road surface $ELr = 152.00 \text{ m}$ Depth of road surface to sofit of the beam $D1 = 0.60 \text{ m}$ Free board $Fr = 0.60 \text{ m}$ Elevation of river bed $EL rb = 146.5 \text{ m}$ Assumed water level $ELwl = 150.80 \text{ m}$ High flood levelRecordH50.48+2.4)	ELw1= 150.8 m
	River cross section at centre of the Bridge (Ignored pier thickness)Width of the river $Wr = 17.00 \text{ m}$ Width of river bed $Wb = 17.00 \text{ m}$ Height of slope $hs = 0.0 \text{ m}$ Height of vertical $hv = 4.3 \text{ m}$	
Essential of Bridge Engineering cl: 2.5.4	Wetted Perimeter $P = 25.60$ And also; Velocity of flow is given by; $v = 1/n * R^{2/3} * S^{1/2}$ where; $v =$ velocity of flow in m/sec n = coefficient of roughness which can be taken from Table 2.3 s = slope of stream	
Essential of Bridge Engineering T. 2.3	R = mean hydraulic radius, (A/P) in metre In this case; $n = \boxed{0.045}$ s = 0.2 % v = 2.00 m/sec $Q3 = A * v = 146.2 \text{ m}^3/\text{sec} \ge Qd = 141.0 \text{ m}^3/\text{sec}$	v= 2.00 m/sec

Appendix - H

DATA OF GEOLOGICAL SURVEY

LIST OF CONTENTS

Logs of Boreholes for the 8 Bridges 1.

H - 1