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No. 22

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NATIONAL WATER SUPPLY AND DRAINAGE BOARD
MINISTRY OF URBAN DEVELOPMENT, CONSTRUCTION AND PUBLIC UTILITIES
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

THE DETAILED DESIGN STUDY ON THE PROJECT FOR REDUCTION OF NON-REVENUE WATER IN THE GREATER COLOMBO AREA IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

FINAL REPORT

APPENDICES TO MAIN REPORT

MARCH 2001

NIHON SUIDO CONSULTANTS CO., LTD.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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CURRENCY EQUIVALENTS

(As of August, 2000)

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CHAPTER 2

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LANGELIER SATURATION INDEX

Appendix 2A - Langelier Saturation Index

Source of NWSDB data: Treatment Plant Laboratory at Mulleriyawa

Location	Date	Total Dissolved Solids mg/l	Temperature °C	Calcium Hardness as $CaCO_3$ mg/l *	Total Alkalinity as $CaCO_3$ mg/l	A	B	C	D	pH_s	pH	LI	RI	Test Carried out by
Maligakanda														
Inlet	13-Jan-00	32	28	20	22	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
109/7 Gothami Rd Co 8	13-Jan-00	28	28	20	22	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
Inlet	21-Jan-00	41	28	20	22.9	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
109/7 Gothami Rd Co 8	21-Jan-00	38	28	20	22.9	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
Inlet	10-Feb-00	19	29	24	20	0.1	1.9	1	1.3	9	6.9	**-2.1**	11.1	NWSDB
109/7 Gothami Rd Co 8	10-Feb-00	21	29	24	20	0.1	1.9	1	1.3	9	6.9	**-2.1**	11.1	NWSDB
Inlet	17-Feb-00	54	29	20	20	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
109/7 Gothami Rd Co 8	17-Feb-00	49	29	20	20	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
Inlet	25-Feb-00	26	29	18	20	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
109/7 Gothami Rd Co 8	25-Feb-00	30	29	18	20	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
Inlet	02-Mar-00	59	29	20	20	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
109/7 Gothami Rd Co 8	02-Mar-00	54	29	20	20	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
Inlet	09-Mar-00	23	29	18	24	0.1	1.9	0.9	1.4	9	6.8	**-2.2**	11.2	NWSDB
109/7 Gothami Rd Co 8	09-Mar-00	21	29	18	24	0.1	1.9	0.9	1.4	9	6.6	**-2.4**	11.4	NWSDB
Inlet	16-Mar-00	34	29	30	14	0.1	1.9	1.1	1.2	9	6.8	**-2.2**	11.2	NWSDB
109/7 Gothami Rd Co 8	16-Mar-00	28	29	24	14	0.1	1.9	1	1.2	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	23-Mar-00	18	29	20	18	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
109/7 Gothami Rd Co 8	23-Mar-00	24	29	20	18	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	06-Apr-00	12	30	20	26	0.1	1.9	0.9	1.4	9	7	**-2.0**	11	NWSDB
109/7 Gothami Rd Co 8	06-Apr-00	18	30	20	26	0.1	1.9	0.9	1.4	9	7	**-2.0**	11	NWSDB
Inlet	20-Apr-00	54	30	18	30	0.1	1.9	0.9	1.5	8.9	6.8	**-2.1**	11	NWSDB
109/7 Gothami Rd Co 8	20-Apr-00	46	30	18	28	0.1	1.9	0.9	1.5	8.9	6.8	**-2.1**	11	NWSDB
Inlet	27-Apr-00	43	30	20	20	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
109/7 Gothami Rd Co 8	27-Apr-00	28	30	18	18	0.1	1.9	0.9	1.3	9.1	6.7	**-2.4**	11.5	NWSDB
Inlet	04-May-00	51	30	20	22	0.1	1.9	0.9	1.3	9.1	7	**-2.1**	11.2	NWSDB
109/7 Gothami Rd Co 8	04-May-00	48	30	20	24	0.1	1.9	0.9	1.4	9	7	**-2.0**	11	NWSDB
Inlet	11-May-00	61	30	18	16	0.1	1.9	0.9	1.2	9.2	7	**-2.2**	11.4	NWSDB
109/7 Gothami Rd Co 8	11-May-00	51	30	18	16	0.1	1.9	0.9	1.2	9.2	7	**-2.2**	11.4	NWSDB
Inlet	19-May-00	36	30	14	24	0.1	1.9	0.8	1.4	9.1	6.6	**-2.5**	11.6	NWSDB
109/7 Gothami Rd Co 8	19-May-00	32	30	14	24	0.1	1.9	0.8	1.4	9.1	6.6	**-2.5**	11.6	NWSDB
Inlet	25-May-00	19	30	20	20	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
109/7 Gothami Rd Co 8	25-May-00	41	30	20	20	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
Inlet	01-Jun-00	52	28	16	24	0.1	1.9	0.8	1.4	9.1	6.8	**-2.3**	11.4	NWSDB
109/7 Gothami Rd Co 8	01-Jun-00	48	28	16	24	0.1	1.9	0.8	1.4	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	08-Jun-00	32	28	16	24	0.1	1.9	0.8	1.4	9.1	6.9	**-2.2**	11.3	NWSDB
109/7 Gothami Rd Co 8	08-Jun-00	36	28	16	24	0.1	1.9	0.8	1.4	9.1	6.9	**-2.2**	11.3	NWSDB
Inlet	29-Jun-00	40	28	14	22	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
109/7 Gothami Rd Co 8	29-Jun-00	42	28	14	22	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
Inlet	13-Jul-00	57	28	16	20	0.1	1.9	0.8	1.3	9.2	6.9	**-2.3**	11.5	NWSDB
109/7 Gothami Rd Co 8	13-Jul-00	46	28	16	20	0.1	1.9	0.8	1.3	9.2	6.9	**-2.3**	11.5	NWSDB
Inlet	20-Jul-00	58	28	16	24	0.1	1.9	0.8	1.4	9.1	6.8	**-2.3**	11.4	NWSDB
109/7 Gothami Rd Co 8	20-Jul-00	55	28	20	27	0.1	1.9	0.9	1.4	9	6.8	**-2.2**	11.2	NWSDB
Inlet	27-Jul-00	63	28	18	18	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
109/7 Gothami Rd Co 8	27-Jul-00	58	28	18	18	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	03-Aug-00	29	28	22	22	0.1	1.9	0.9	1.3	9.1	6.7	**-2.4**	11.5	NWSDB
109/7 Gothami Rd Co 8	03-Aug-00	36	28	22	22	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	09-Aug-00	48	28	18	14	0.1	1.9	0.9	1.2	9.2	6.8	**-2.4**	11.6	NWSDB
109/7 Gothami Rd Co 8	09-Aug-00	51	28	18	14	0.1	1.9	0.9	1.2	9.2	6.8	**-2.4**	11.6	NWSDB
Inlet	16-Aug-00	46	28	20	24	0.1	1.9	0.9	1.4	9	6.9	**-2.1**	11.1	NWSDB
109/7 Gothami Rd Co 8	16-Aug-00	52	28	20	24	0.1	1.9	0.9	1.4	9	6.8	**-2.2**	11.2	NWSDB
Inlet	23-Aug-00	30	28	24	20	0.1	1.9	1	1.3	9	6.8	**-2.2**	11.2	NWSDB
109/7 Gothami Rd Co 8	23-Aug-00	26	28	24	20	0.1	1.9	1	1.3	9	6.8	**-2.2**	11.2	NWSDB
Inlet	31-Aug-00	28	28	22	23	0.1	1.9	0.9	1.4	9	6.9	**-2.1**	11.1	NWSDB
109/7 Gothami Rd Co 8	31-Aug-00	26	28	22	23	0.1	1.9	0.9	1.4	9	6.9	**-2.1**	11.1	NWSDB
Inlet	06-Sep-00	48	28	22	32	0.1	1.9	0.9	1.5	8.9	6.9	**-2.0**	10.9	NWSDB
109/7 Gothami Rd Co 8	06-Sep-00	44	28	22	32	0.1	1.9	0.9	1.5	8.9	6.9	**-2.0**	10.9	NWSDB
109/7 Gothami Rd Co 8	14-Sep-00	48	28	32	29	0.1	1.9	1.1	1.5	8.7	6.6	**-2.1**	10.8	NWSDB
Inlet	20-Sep-00	41	28	16	9	0.1	1.9	0.8	1	9.5	6.4	**-3.1**	12.6	NWSDB
109/7 Gothami Rd Co 8	20-Sep-00	38	28	16	10	0.1	1.9	0.8	1	9.5	6.4	**-3.1**	12.6	NWSDB
Inlet	27-Sep-00	21	28	23	24	0.1	1.9	1	1.4	8.9	6.4	**-2.5**	11.4	NWSDB
109/7 Gothami Rd Co 8	27-Sep-00	28	28	22	24	0.1	1.9	0.9	1.4	9	6.4	**-2.6**	11.6	NWSDB
Inlet	04-Oct-00	54	29	16	20	0.1	1.9	0.8	1.3	9.2	6.9	**-2.3**	11.5	NWSDB
109/7 Gothami Rd Co 8	04-Oct-00	42	29	16	20	0.1	1.9	0.8	1.3	9.2	6.9	**-2.3**	11.5	NWSDB
Inlet	18-Oct-00	58	29	18	22	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
109/7 Gothami Rd Co 8	18-Oct-00	48	29	16	22	0.1	1.9	0.8	1.3	9.2	6.6	**-2.6**	11.8	NWSDB
Inlet	25-Oct-00	55	29	20	26	0.1	1.9	0.9	1.4	9	6.9	**-2.1**	11.1	NWSDB
109/7 Gothami Rd Co 8	25-Oct-00	44	29	20	26	0.1	1.9	0.9	1.4	9	6.6	**-2.4**	11.4	NWSDB
Inlet	01-Nov-00	25	29	30	32	0.1	1.9	1.1	1.5	8.7	7.2	**-1.5**	10.2	NWSDB
109/7 Gothami Rd Co 8	01-Nov-00	21	29	29	31	0.1	1.9	1.1	1.5	8.7	7.2	**-1.5**	10.2	NWSDB

Appendix 2A - Langelier Saturation Index

Source of NWSDB data: Treatment Plant Laboratory at Mulleriyawa

Location	Date	Total Dissolved Solids mg/l	Temperature °C	Calcium Hardness as $CaCO_3$ mg/l *	Total Alkalinity as $CaCO_3$ mg/l	A	B	C	D	pH_S	pH	LI	RI	Test Carried out by
Inlet	08-Nov-00	36	29	16	22	0.1	1.9	0.8	1.3	9.2	7	**-2.2**	11.4	NWSDB
109/7 Gothami Rd Co 8	08-Nov-00	42	29	16	22	0.1	1.9	0.8	1.3	9.2	7	**-2.2**	11.4	NWSDB
Inlet	15-Nov-00	54	29	24	26	0.1	1.9	1	1.4	8.9	7	**-1.9**	10.8	NWSDB
109/7 Gothami Rd Co 8	15-Nov-00	51	29	28	28	0.1	1.9	1.1	1.5	8.7	6.9	**-1.8**	10.5	NWSDB
Inlet	22-Nov-00	29	29	16	24	0.1	1.9	0.8	1.4	9.1	7	**-2.1**	11.2	NWSDB
Inlet	29-Nov-00	29	29	20	29	0.1	1.9	0.9	1.5	8.9	6.8	**-2.1**	11	NWSDB
109/7 Gothami Rd Co 8	29-Nov-00	29	29	20	28	0.1	1.9	0.9	1.5	8.9	6.8	**-2.1**	11	NWSDB
Average		39.3	28.8	19.7	22.2	0.1	1.9	0.9	1.3	9.1	6.8	**-2.2**	11.3	
Maligakanda														
Inlet	13-Nov-00	42	27	18	16	0.1	1.9	0.9	1.2	9.2	9.1	**-0.1**	9.3	ITI
Inside Reservoir	13-Nov-00	39	29	17	12	0.1	1.9	0.8	1.1	9.4	8.5	**-0.9**	10.3	ITI
Ellie House														
Inlet	13-Jan-00	32	28	18	19	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
104 College St Kotahena	13-Jan-00	30	28	18	19	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	21-Jan-00	22	28	16	20	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
104 College St Kotahena	21-Jan-00	24	28	16	20	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
Inlet	10-Feb-00	54	29	20	20	0.1	1.9	0.9	1.3	9.1	6.6	**-2.5**	11.6	NWSDB
104 College St Kotahena	10-Feb-00	48	29	20	20	0.1	1.9	0.9	1.3	9.1	6.6	**-2.5**	11.6	NWSDB
Inlet	17-Feb-00	51	29	20	20	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
104 College St Kotahena	17-Feb-00	44	29	20	20	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	25-Feb-00	34	29	18	20	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
104 College St Kotahena	25-Feb-00	32	29	18	20	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
Inlet	02-Mar-00	57	29	18	20	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
104 College St Kotahena	02-Mar-00	52	29	18	20	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	09-Mar-00	21	29	20	28	0.1	1.9	0.9	1.5	8.9	6.8	**-2.1**	11	NWSDB
104 College St Kotahena	09-Mar-00	18	29	20	28	0.1	1.9	0.9	1.5	8.9	6.6	**-2.3**	11.2	NWSDB
Inlet	16-Mar-00	32	29	30	14	0.1	1.9	1.1	1.2	9	6.8	**-2.2**	11.2	NWSDB
104 College St Kotahena	16-Mar-00	28	29	30	14	0.1	1.9	1.1	1.2	9	6.8	**-2.2**	11.2	NWSDB
Inlet	23-Mar-00	24	29	22	18	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
104 College St Kotahena	23-Mar-00	28	29	20	18	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	06-Apr-00	18	30	20	20	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
104 College St Kotahena	06-Apr-00	21	30	20	20	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	27-Apr-00	32	30	20	24	0.1	1.9	0.9	1.4	9	6.6	**-2.4**	11.4	NWSDB
104 College St Kotahena	27-Apr-00	30	30	20	24	0.1	1.9	0.9	1.4	9	6.6	**-2.4**	11.4	NWSDB
Inlet	04-May-00	49	30	20	20	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
104 College St Kotahena	04-May-00	48	30	20	20	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	11-May-00	52	30	20	20	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	19-May-00	28	30	14	24	0.1	1.9	0.8	1.4	9.1	6.6	**-2.5**	11.6	NWSDB
104 College St Kotahena	19-May-00	22	30	14	22	0.1	1.9	0.8	1.3	9.2	6.6	**-2.6**	11.8	NWSDB
Inlet	25-May-00	28	30	20	24	0.1	1.9	0.9	1.4	9	6.9	**-2.1**	11.1	NWSDB
104 College St Kotahena	25-May-00	27	30	20	24	0.1	1.9	0.9	1.4	9	6.9	**-2.1**	11.1	NWSDB
Inlet	01-Jun-00	53	28	26	24	0.1	1.9	1	1.4	8.9	6.8	**-2.1**	11	NWSDB
104 College St Kotahena	01-Jun-00	48	28	26	24	0.1	1.9	1	1.4	8.9	6.8	**-2.1**	11	NWSDB
Inlet	29-Jun-00	46	28	16	20	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
104 College St Kotahena	29-Jun-00	39	28	16	20	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
Inlet	13-Jul-00	44	28	16	18	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
104 College St Kotahena	13-Jul-00	41	28	16	18	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
Inlet	20-Jul-00	41	28	22	33	0.1	1.9	0.9	1.5	8.9	6.8	**-2.1**	11	NWSDB
104 College St Kotahena	20-Jul-00	46	28	22	33	0.1	1.9	0.9	1.5	8.9	6.8	**-2.1**	11	NWSDB
Inlet	27-Jul-00	32	28	16	20	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
104 College St Kotahena	27-Jul-00	28	28	16	20	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
Inlet	03-Aug-00	52	28	22	22	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
104 College St Kotahena	03-Aug-00	32	28	22	22	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
Inlet	09-Aug-00	48	28	16	19	0.1	1.9	0.8	1.3	9.2	6.9	**-2.3**	11.5	NWSDB
104 College St Kotahena	09-Aug-00	46	28	16	19	0.1	1.9	0.8	1.3	9.2	6.9	**-2.3**	11.5	NWSDB
Inlet	16-Aug-00	46	28	14	22	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
104 College St Kotahena	16-Aug-00	48	28	14	22	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
Inlet	23-Aug-00	32	28	20	22	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
104 College St Kotahena	23-Aug-00	28	28	20	22	0.1	1.9	0.9	1.3	9.1	6.8	**-2.3**	11.4	NWSDB
Inlet	31-Aug-00	48	28	16	24	0.1	1.9	0.8	1.4	9.1	6.9	**-2.2**	11.3	NWSDB
104 College St Kotahena	31-Aug-00	32	28	16	24	0.1	1.9	0.8	1.4	9.1	6.9	**-2.2**	11.3	NWSDB
Inlet	06-Sep-00	26	28	20	32	0.1	1.9	0.9	1.5	8.9	6.9	**-2.0**	10.9	NWSDB
104 College St Kotahena	06-Sep-00	22	28	20	32	0.1	1.9	0.9	1.5	8.9	6.9	**-2.0**	10.9	NWSDB
Inlet	04-Oct-00	40	29	14	18	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
104 College St Kotahena	04-Oct-00	50	29	14	18	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
Inlet	18-Oct-00	21	29	18	22	0.1	1.9	0.9	1.3	9.1	6.6	**-2.5**	11.6	NWSDB
104 College St Kotahena	18-Oct-00	21	29	18	22	0.1	1.9	0.9	1.3	9.1	6.6	**-2.5**	11.6	NWSDB
Inlet	25-Oct-00	49	29	18	24	0.1	1.9	0.9	1.4	9	7	**-2.0**	11	NWSDB
104 College St Kotahena	25-Oct-00	52	29	18	24	0.1	1.9	0.9	1.4	9	7	**-2.0**	11	NWSDB
Inlet	01-Nov-00	48	29	24	40	0.1	1.9	1	1.6	8.7	7.2	**-1.5**	10.2	NWSDB
108 Blumendal Rd Kotahe	01-Nov-00	52	29	24	40	0.1	1.9	1	1.6	8.7	7.2	**-1.5**	10.2	NWSDB

Appendix 2A - Langelier Saturation Index

Source of NWSDB data: Treatment Plant Laboratory at Mullieriyawa

Location	Date	Total Dissolved Solids mg/l	Temperature °C	Calcium Hardness as $CaCO_3$ mg/l *	Total Alkalinity as $CaCO_3$ mg/l	A	B	C	D	pH_s	pH	LI	RI	Test Carried out by
Inlet	08-Nov-00	48	29	16	18	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
108 Blumendal Rd Kotahe	08-Nov-00	35	29	16	20	0.1	1.9	0.8	1.3	9.2	6.8	**-2.4**	11.6	NWSDB
Inlet	15-Nov-00	53	29	22	27	0.1	1.9	0.9	1.4	9	6.9	**-2.1**	11.1	NWSDB
108 Blumendal Rd Kotahe	15-Nov-00	48	29	22	27	0.1	1.9	0.9	1.4	9	6.9	**-2.1**	11.1	NWSDB
Inlet	22-Nov-00	30	29	18	20	0.1	1.9	0.9	1.3	9.1	6.9	**-2.2**	11.3	NWSDB
Inlet	29-Nov-00	35	29	22	26	0.1	1.9	0.9	1.4	9	6.9	**-2.1**	11.1	NWSDB
108 Blumendal Rd Kotahe	29-Nov-00	35	29	24	29	0.1	1.9	1	1.5	8.8	6.9	**-1.9**	10.7	NWSDB
Average		37.6	28.8	19.2	22.5	0.1	1.9	0.9	1.3	9.07	6.82	**-2.3**	11.3	
Ellie House														
Inlet	13-Nov-00	54	27	20	15	0.1	1.9	0.9	1.2	9.2	9	**-0.2**	9.4	ITI
Inside Reservoir	13-Nov-00	52	28	17	12	0.1	1.9	0.8	1.1	9.4	8.1	**-1.3**	10.7	ITI
Ambathale WTP	20-Oct-00	32	29	16	24	0.1	1.9	0.8	1.4	9.1	7.2	**-1.9**	11	NWSDB

Notes LI = pH - pH_s and $pH_s = (9.3+A+B)-(C+D)$

* NWSDB Test Total Hardness (for this calculation purpose it assumed to be equal to Calcium Hardness)

INDUSTRIAL TECHNOLOGY INSTITUTE (ITI)

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successor to the Ceylon Institute of Scientific & Industrial Research (CISIR)

TEST REPORT No: SS 29455

Issue Date: 20th November, 2000

Ceywater Consultants (Pvt) Ltd.
397, Nawala Road
RAJAGIRIYA

Laboratory Services Group
Chemical and Environmental Technology Division

... Continuation Sheet

TEST REPORT No. SS 29455

CLIENT	:	Ceywater Consultants (Pvt) Ltd. 397, Nawala Road RAJAGIRIYA.
SAMPLES	:	**WATER**

Collection Points : Sp.01. Inlet of the Maligakanda Reservoir at Colombo 10.
Sp.02. Inside the Maligakanda Reservoir at Colombo 10.
Sp.03. Inlet (south) of the Ellie House Reservoir at Colombo 15.
Sp.04. Inside the Ellie House Reservior at Colombo 15

Sampling Method: Grab sampling

Description : Clear water

Sampling carried out by	:	Mr. M.N.A. Mubarak of ITI
Witness	:	Mr. Kugaprasatham, Engineer of Ceywater Consultants Pvt) Ltd.
Date & Time of sampling	:	13th November, 2000 from 10.30 a.m. - 12.20 p.m.
Temperature of samples at collection	:	Sample 01 and 03 - 27°C Sample 02 - 29°C Sample 04 - 28°C
Date & time of reception of samples at ITI	:	13th November, 2000 at 1.20 p.m
Temperature samples at reception	:	28°C
Condition of samples at reception	:	Satisfactory
TESTED FOR	:	Parameters given in SLS 614 : 1983 Specifcation for Potable water Part 1 Tables 1&2. - reference client's letter of 10th November, 2000 Date of analysis- 13th - 17th November, 2000
TEST METHODS & PRINCIPLES	:	See Table 1

... Continuation Sheet

SS 29455

RESULTS :

TEST		TEST VALUE			
		Sample 01	**Sample 02**	**Sample 03**	**Sample 04**
Langelier Index		- 0.2 at 27°C	- 0.91 at 29°C	- 0.35 at 27°C	- 1.34 at 28°C
* Temperature		27°C	29°C	27°C	28°C
* Total residual chlorine (as Cl_2),	mg/l	0.6	0.4	0.6	0.3
* Free residual chlorine (as Cl_2),	mg/l	0.4	0.3	0.4	0.2
*# pH		9.1 at 27°C	8.5 at 29°C	9.0 at 29°C	8.1 at 28°C
# Total Alkalinity (as $CaCO_3$),	mg/l	16	12	15	12
Phenolphthalin Alkalinity (as $CaCO_3$),	mg/l	Nil	Nil	Nil	Nil
Manganese (as Mn),	mg/l	0.1	Less than 0.05	0.07	0.0
Calcium (as Ca),	mg/l	6.8	6	6.8	5.8
# Total Dissolved Solids at 180°C,	mg/l	42	39	54	52
# Total Hardness (as $CaCO_3$),	mg/l	18	17	20	17
Total Iron (as Fe),	mg/l	Less than 0.1	Less than 0.1	Less than 0.1	Less than 0.1
Ferrous (as Fe^{2+}),	mg/l	Less than 0.1	Less than 0.1	Less than 0.1	Less than 0.1

* Measured on site.

Accredited test.

Mr. M.N.A. Mubarak
TECHNICAL OFFICER

Ms. M.S.L. de Costa
SENIOR RESEARCH OFFICER
CHEMICAL & ENVIRONMENTAL
TECHNOLOGY DIVISION

SS 29455

Table 1- Test Methods and Principles

Parameter	Test Method	Principle
Langlier index	IS 8188	Calculated
Temperature	APHA 2550 B	Mercury Thermometer
Total Residual chlorine	APHA 4500 Cl G	Colorimetry
Free Residual chlorine	APHA 4500 Cl G	Colorimetry
pH	APHA 4500 – H^+B	Glass electrode
Total Alkalinity	APHA 2320 B	Titrimetry
Phenoptheline Alkalinity	APHA 2320 B	Calculated
Manganese	CETD 9	Colorimetry
Calcium	APHA 3500 Ca D	Titrimetry
Total Dissolved Solids at 180°C	APHA 2540 C	Gravimetry
Total Iron	APHA 3500-Fe D	Colorimetry
Ferrous	APHA 3500 Fe D	Colorimetry
Total Hardness	APHA 2340 C	Titrimetry

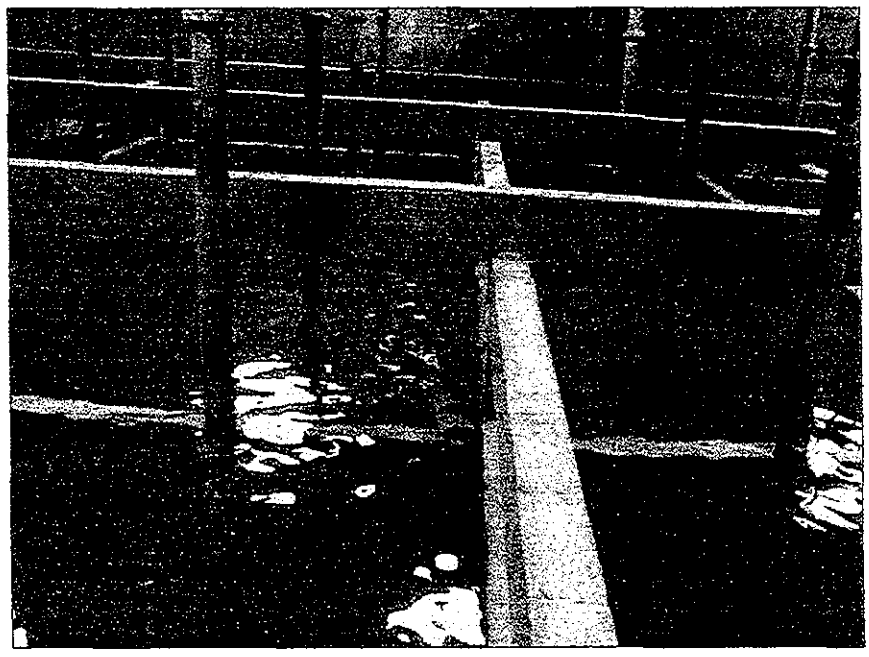
APHA – Standard Methods for the examination of water and waste water APHA, AWWA, WEF 1992, 18th edition

IS - Indian Standard

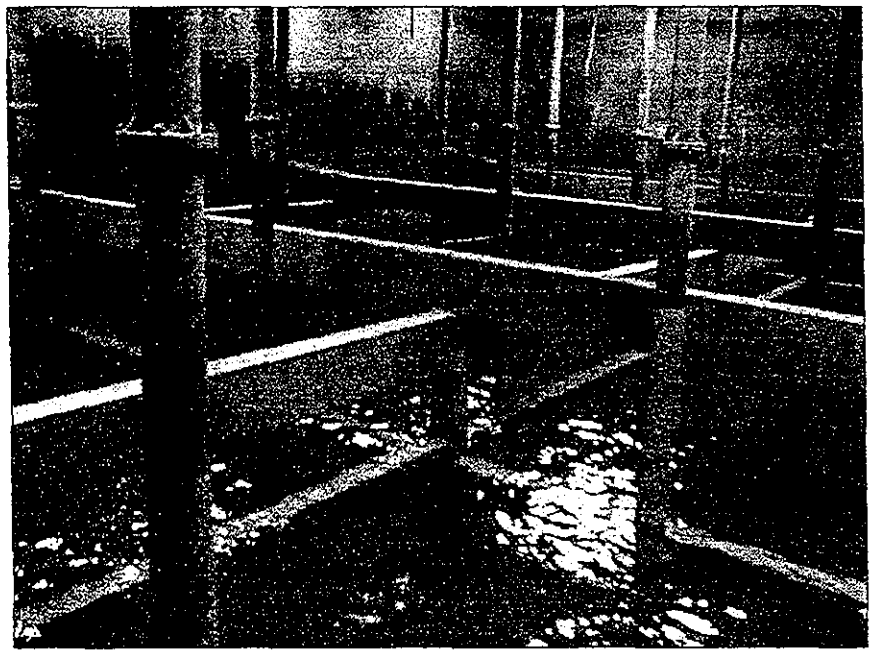
CETD – Chemical & Environmental Technology Division

APPENDIX 2B

INSPECTION OF MALIGAKANDA ROOF STRUCTURE JAN.29, 2000

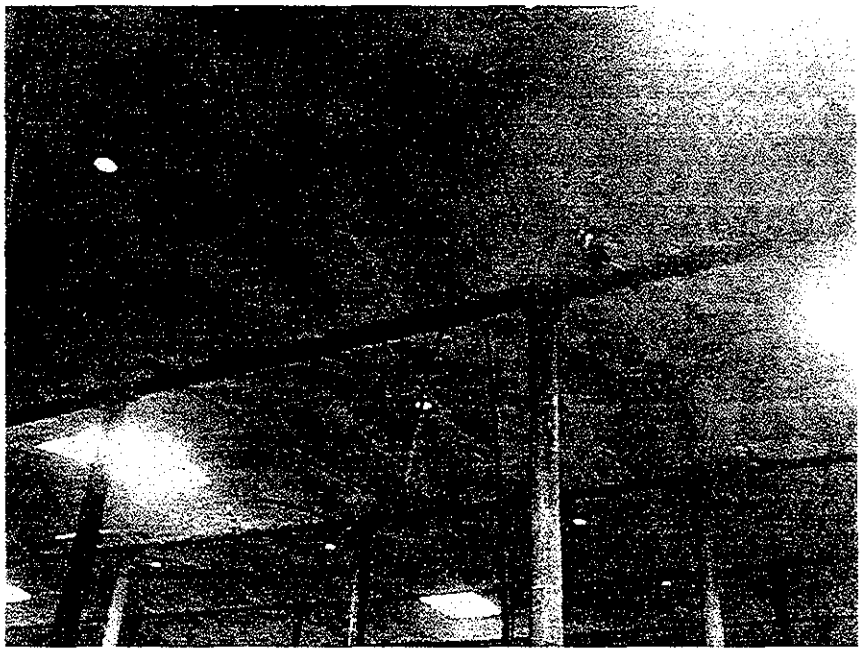


Photograph M1 – Wall Tie Beam Grid and Roof Columns



Photograph M2 – Wall Tie Beams and Roof Columns

Photograph M3 – Roof Beams, Cracked Concrete Roof Arches and Corroded Ties

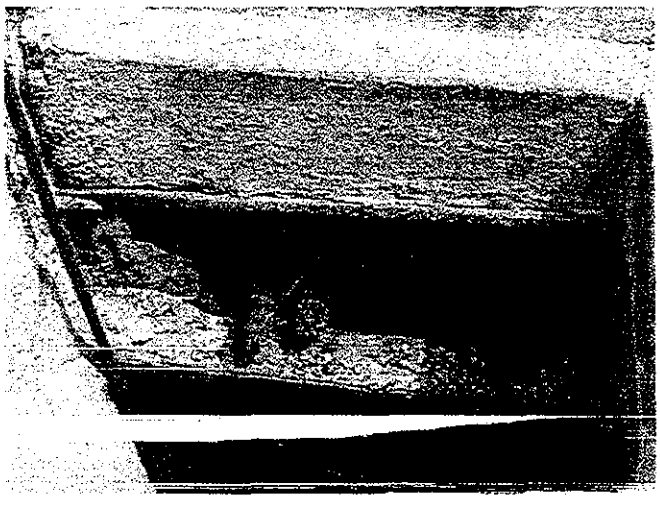


Photograph M4 – Cracked Concrete Roof Arches and Missing Ties

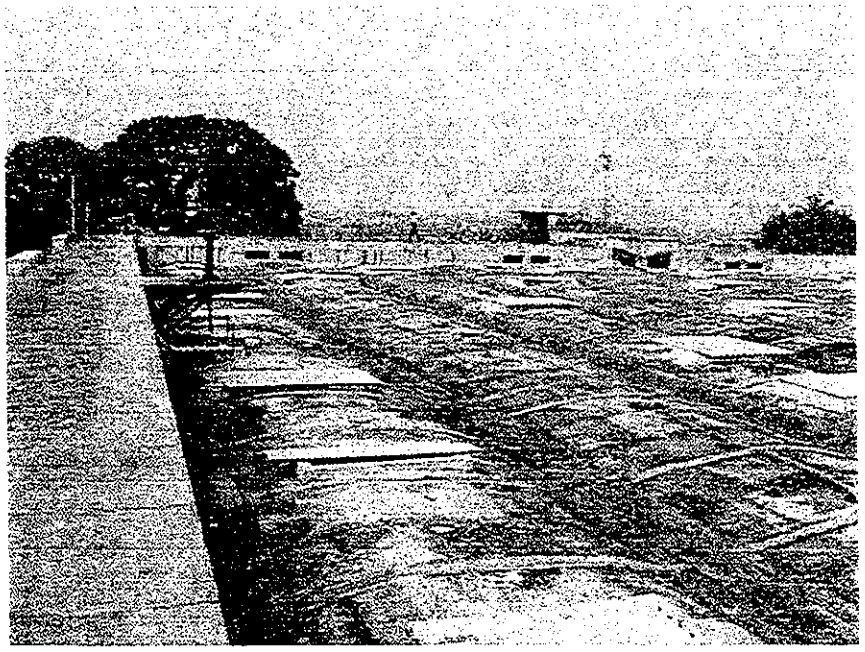
Photographs M5 – New 30" Inlet, Tie Beam Connection at Wall, and Missing Roof Ties

Photograph M6 – New 30" Inlet and Roof Connection at Wall

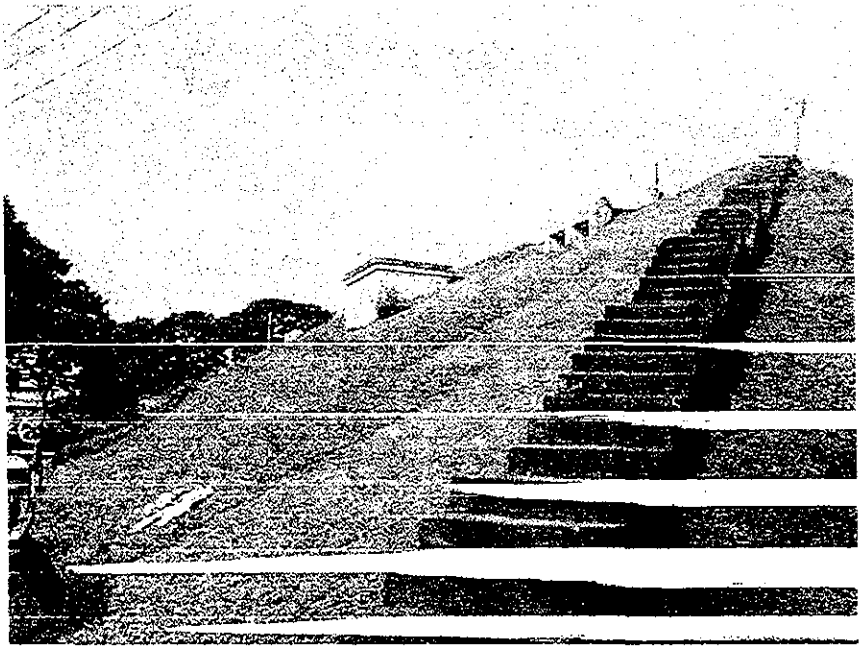
Photograph M7 – Reinforcement of Wall at North East Corner



Photograph M8 –Connection of Main Roof Beam at Wall and Corroded Tie Rod Connections



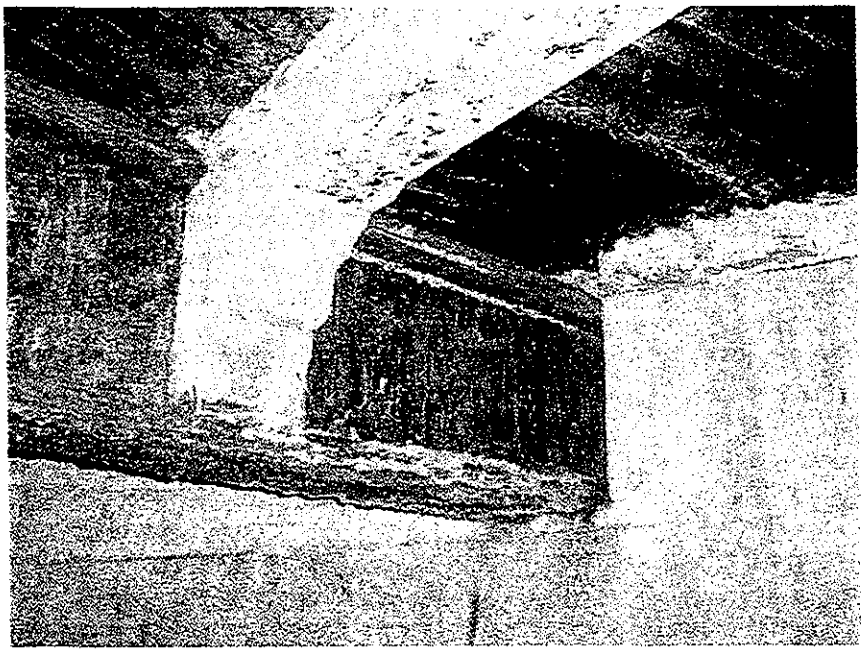
Photograph M9 – Cracked Concrete Arches on Roof Top



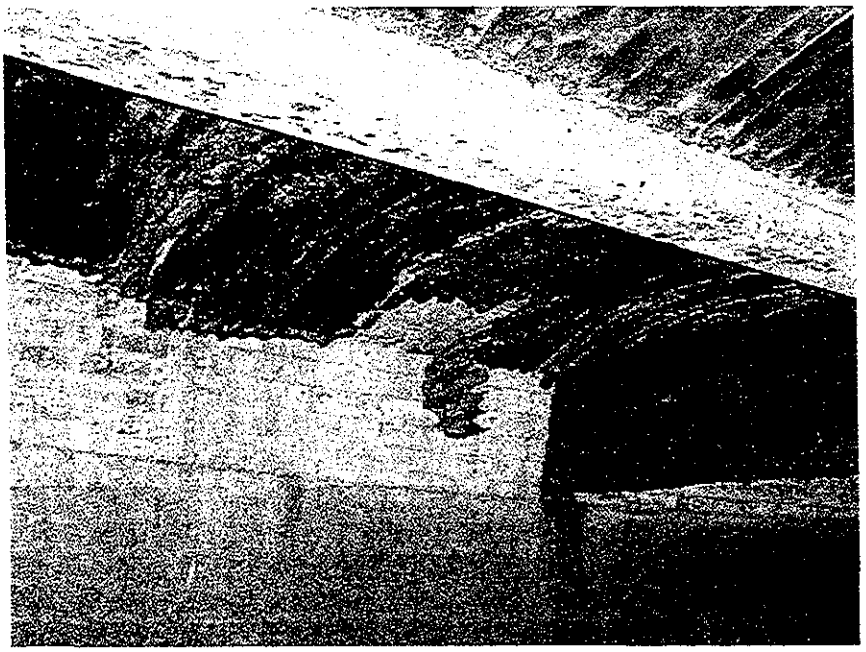
Photograph M10 – Earth Embankment

APPENDIX 2C

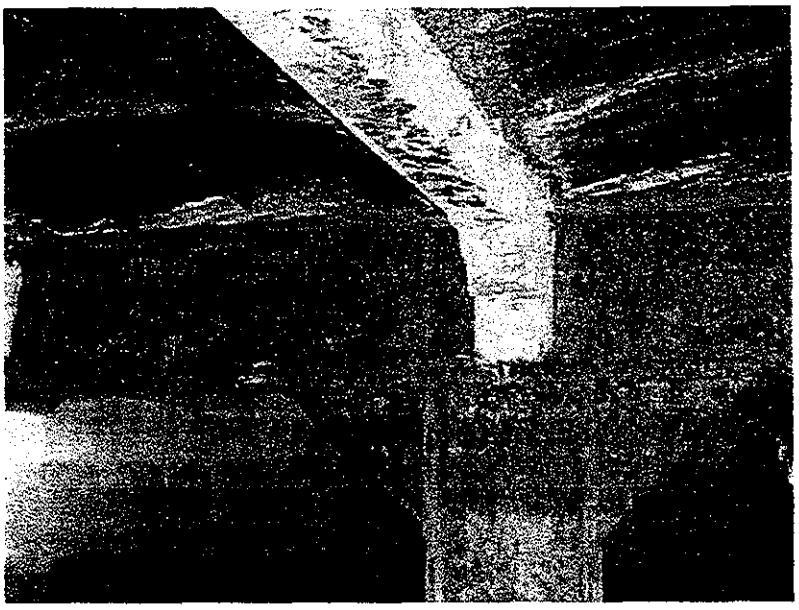
INSPECTION OF ELLIE HOUSE ROOF STRUCTURE JAN.27, 2000



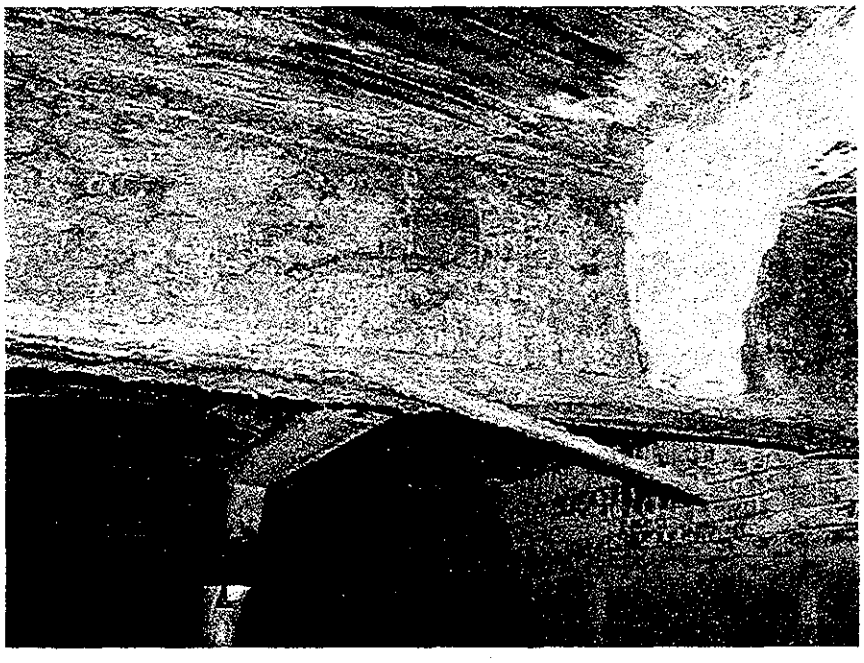
Photograph E1 – Main Beam and Wall Connection



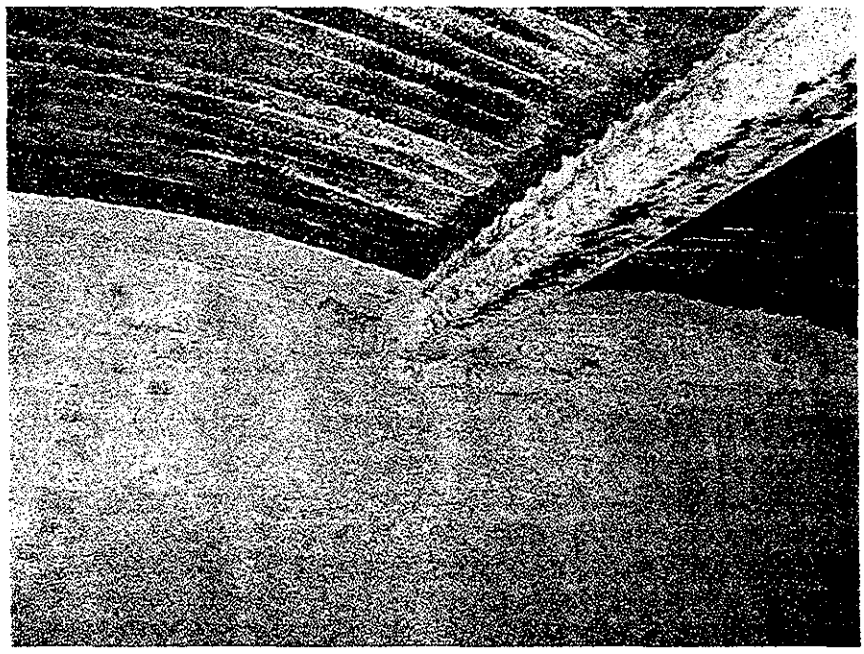
Photograph E2 - Main Beam and Wall Connection



Photograph E3 – Main Beam Column Connection



Photograph E4 – Badly Corroded Main Beam



Photographs E5 – Wall, Roof and Secondary Beam Connection

Photograph E6 – Secondary Beam Corroded Reinforcing Steel and Roof Leakage

Photograph E7 – Secondary Beams and Corrugated Sheeting Detached from Roof Arch

Photograph E8 – Secondary Beams Connection to Main Beam

CHAPTER 3

APPENDIX 3A

WATER DEMAND

APPENDIX 3A-1

SAPROF WATER DEMAND ESTIMATE FOR KOTIKAWATTE-MULLERIYAWA AREA

Appendix 3A-1 SAPROF Water Demand Estimate for Kotikawatte and Mulleriyawa Area

District: Colombo

Division: Kottikawatte-Mulleriyawa PS

		Year					
		1995	2000	2005	2010	2015	2020
A	Projected Population	92,400	98,500	101,500	104,500	107,400	110,300
	Total Land Use, ha	1,483	1,515	1,531	1,546	1,552	1,557
	Net Population density, person/ha	62	65	66	68	69	71
B	Percentage of Population Served, %	67	100	100	100	100	100
C	Total Service Population	61,908	98,500	101,500	104,500	107,400	110,300
D	Direct Connection	49 3	55 5	61 6	67 7	73 9	80
	Connected Population	30,521	54,668	62,524	70,747	79,369	88,240
	Per Capita Water Consumption, lpcd	155	168	174	178	179	180
	Water Consumption(Direct), m3/d	4,731	9,184	10,879	12,593	14,207	15,883
E	Community Tap (Stand Posts & Garden Taps)						
	Percentage of Served Population	47 3	39.84	32 38	24.92	17 46	10
	Population	29,282	39,242	32,866	26,041	18,752	11,030
	Per Capita Water Consumption, lpcd	53	53	53	53	53	53
	Water Consumption(Community Tap), m3/d	1,552	2,080	1,742	1,380	994	585
F	Direct Connection (without in-house plumbing)						
	Percentage of Served Population	3 3	4 64	5 98	7 32	8 66	10
	Population	2,043	4,570	6,070	7,649	9,301	11,030
	Per Capita Water Consumption, lpcd	75	75	75	75	75	75
	Water Consumption(Direct/low cons), m3/d	153	343	455	574	698	827
G	Total of Percentage	100	100	100	100	100	100
H	Total Served Population	61,846	98,480	101,459	104,437	107,421	110,300
	Total Domestic Water Consumption, m3/d	6,436	11,607	13,076	14,547	15,898	17,295
I	Industrial Water Use						
	Industrial Area, ha	133	136	138	140	132	124
	Unit Industrial Water Use, L/(ha d)	13,078	13,078	13,078	13,078	13,078	13,078
	Industrial Water Consumption, m3/d	1,739	1,779	1,805	1,831	1,726	1,622
J	Commercial Water Use						
	Commercial Area, ha	108	112	114	116	118	120
	Unit commercial Water Use, L/(ha d)	686	686	686	686	686	686
	Commercial Water Consumption, m3/d	74	77	78	80	81	82
K	Institutional Water Use						
	Institutional Area, ha	94	96	98	100	102	104
	Unit Institutional Water Use, L/(ha d)	49,968	49,968	49,968	49,968	49,968	49,968
	Institutional Water Consumption, m3/d	4,697	4,797	4,897	4,997	5,097	5,197
L	Total Net Water Consumption, m3/d	12,946	18,259	19,856	21,454	22,802	24,196
M	Water Loss						
	Water Loss Ratio, %	25	23	21	20	19	18
	Water Loss, m3/d	4,315	5,454	5,278	5,364	5,349	5,311
N	Total Water Supply Required, m3/d	17,262	23,713	25,134	26,818	28,151	29,507
	domestic	8,581	15,074	16,552	18,183	19,628	21,092
	non-domestic	8,681	8,639	8,582	8,634	8,523	8,415

APPENDIX 3A-2

REVISED SAPROF WATER DEMAND ESTIMATE FOR KOTIKAWATTE-MULLERIYAWA AREA

Appendix 3A-2 Revised SAPROF Water Demand Estimate for Kotikawatte and Mulleriyawa Area

District: Colombo
Division: Kottikawatte-Mulleriyawa PS

		Year					
		1995	2000	2005	2010	2015	2020
A	*Projected Population*	92,400	*110,500*	*113,900*	*117,300*	*120,600*	*123,900*
	Total Land Use, ha	1,483	1,515	1,531	1,546	1,552	1,557
	Net Population density, person/ha	62	65	66	68	69	71
B	Percentage of Population Served, %	67	*72*	*81*	*91*	*100*	100
C	Total Service Population	61,908	*79,600*	*92,666*	*106,366*	*120,600*	*123,900*
D	Direct Connection	49.3	*59.2*	*69.1*	*72.7*	*76.4*	80
	Connected Population	30,521	*47,107*	*63,994*	*77,334*	*92,081*	*99,120*
	Per Capita Water Consumption, lpcd	155	155	174	178	179	180
	Water Consumption(Direct), m3/d	4,731	*7,302*	*11,135*	*13,765*	*16,483*	*17,842*
E	Community Tap (Stand Posts & Garden Taps)						
	Percentage of Served Population	47.3	*36.2*	*29.6*	*23.1*	*16.6*	10
	Population	29,282	*28,800*	*27,429*	*24,571*	*20,020*	*12,390*
	Per Capita Water Consumption, lpcd	53	53	53	53	53	53
	Water Consumption(Community Tap), m3/d	1,552	*1,526*	*1,454*	*1,302*	*1,061*	*657*
F	Direct Connection (without in-house plumbing)						
	Percentage of Served Population	3.3	4.64	5.98	7.32	8.66	10
	Population	2,043	*3,693*	*5,541*	*7,786*	*10,444*	*12,390*
	Per Capita Water Consumption, lpcd	75	75	75	75	75	75
	Water Consumption(Direct/low cons.), m3/d	153	*277*	*416*	*584*	*783*	*929*
G	Total of Percentage	100	100	100	100	100	100
H	Total Served Population	61,846	*79,600*	*96,964*	*109,691*	*122,545*	*123,900*
	Total Domestic Water Consumption, m3/d	6,436	*9,105*	*13,004*	*15,652*	*18,327*	*19,428*
I	Industrial Water Use						
	Industrial Area, ha	133	136	138	140	132	124
	Unit Industrial Water Use, L/(ha.d)	13,078	13,078	13,078	13,078	13,078	13,078
	Industrial Water Consumption, m3/d	1,739	1,779	1,805	1,831	1,726	1,622
J	Commercial Water Use						
	Commercial Area, ha	108	112	114	116	118	120
	Unit commercial Water Use, L/(ha.d)	686	686	686	686	686	686
	Commercial Water Consumption, m3/d	74	77	78	80	81	82
K	Institutional Water Use						
	Institutional Area, ha	94	96	98	100	102	104
	Unit Institutional Water Use, L/(ha.d)	49,968	49,968	49,968	49,968	49,968	49,968
	Institutional Water Consumption, m3/d	4,697	4,797	4,897	4,997	5,097	5,197
L	Total Net Water Consumption, m3/d	12,946	15,757	19,784	22,559	25,231	26,328
M	Water Loss						
	Water Loss Ratio, %	25	23	21	20	19	18
	Water Loss, m3/d	4,315	4,707	5,278	5,364	5,349	5,311
N	Total Water Supply Required, m3/d	17,262	20,464	25,043	28,199	31,149	32,108

Note: 1. Revised values are shown in underlined italic letters.

2. Population of year 2000 is revised.

3. Served population in year 2000 is revised based on data of number of connections.

4. Full coverage of population is assumed in the year 2015.

APPENDIX 3A-3

NWSDB ESTIMATE FOR KOTIKAWATTE-MULLERIYAWA WATER SUPPLY IMPROVEMENT

Appendix 3A-3 NWSDB Estimate for Kotikawatte-Mulleriyawa Water Supply Improvement

(Distribution system information is included by JICA Study Team)

No	Section	Distribution System	Length (m)	No of Houses			No. of Shops	E.P. (Se.)	OFF. (Pe.)	REL. (Pe.)	FAC. (Pe.)	SCH. (No)	Domestic Demand (l/d)	Shop Demand (l/d)	E.P. Demand (l/d)	Office Demand (l/d)	Rel. Demand (l/d)	Factory Demand (l/d)	School Demand (l/d)	Other Demand	(l/d)	Total Demand (m3/d)	A.A.W. Demand (m3/d)	Projected Demand 2003 (m3/d)	2008 (m3/d)	2013 (m3/d)	2018 (m3/d)	Demand (l/s)
				90% of Tota	Total	Adju.																						
				Adjustment																								
1	15-110	Gothatuwa	500	39	39	43							37,068	0	0	0	0	0	0	Garage(5)	300	37	40.71	49.58	52.62	55.86	59.29	0.69
2	17-111	Gothatuwa	550	43	43	47	1						40,881	75	0	0	0	0	0			43	51.18	54.32	57.66	61.21	64.97	0.76
3	13-111	Gothatuwa	600	65	58	62							53,222	0	0	0	0	0	0			53	66.53	70.62	74.96	79.56	84.45	0.98
4	17-112	Gothatuwa	900	111	112	123							106,445	0	0	0	0	0	0			106	133.06	141.23	149.91	159.13	168.91	1.95
5	105-108	Gothatuwa	900	102	103	113			4				97,891	0	0	100	0	0	0	Garage(4),T.Mill(6)	420	98	123.01	130.57	138.60	147.12	156.16	1.81
6	105-113	Gothatuwa	650	118	119	131	20						113,058	1500	0	0	0	0	0	Garage(6)	360	116	143.70	152.63	161.90	171.85	182.41	2.11
7	113-114	Gothatuwa	900	161	163	179	2	10		6	10		154,915	150	600	0	960	300	0			157	196.16	208.21	221.01	234.59	249.01	2.88
8	113-115	Gothatuwa	450	118	119	131	3	10					113,098	225	600	0	0	0	0	Timber Mill(3)	240	114	142.70	151.47	160.78	170.68	181.15	2.10
9	115-116	Gothatuwa	900	143	144	158				10			138,858	0	0	0	1600	0	0			138	173.07	183.71	195.00	206.98	219.70	2.54
10	115-117	Gothatuwa	200	51	52	57	9		5			1000	49,421	675	0	125	0	0	10000	Timber Mill(6)	180	80	78.50	80.14	85.07	90.29	95.84	1.11
11	117-118	Gothatuwa	1100	348	352	387	3						334,641	225	0	0	0	0	0			335	418.46	444.17	471.47	500.45	531.20	6.15
12	120-131	Gothatuwa	400	53	54	59	77	30	72				51,322	6775	1800	1800	0	0	0			63	76.87	80.63	85.48	90.74	96.31	1.11
13	121-122	Gothatuwa	350	5	5	6	6		260				4,152	450	0	6500	0	0	0			12	14.63	15.63	16.48	17.49	18.57	0.21
14	121-118	Gothatuwa	1000	144	145	160	18		640				137,808	1350	0	13500	0	0	0			153	190.82	202.55	215.00	228.21	242.24	2.80
15	31-133	Gothatuwa	300	30	30	33							28,512	0	0	0	0	0	0			29	35.64	37.83	40.16	42.62	45.24	0.52
16	31-134	Gothatuwa	850	115	116	128	5						110,246	375	0	0	0	0	0			111	138.28	146.77	155.80	165.37	175.53	2.03
17	27-138	Gothatuwa	700	74	76	83				7			71,280	0	0	0	1120	0	0			72	90.50	96.06	101.97	108.23	114.88	1.33
18	66-170	Gothatuwa	150	30	30	33	29						28,512	2175	0	0	0	0	0	Bus St	5000	36	44.01	47.35	50.26	53.35	56.63	0.66
19	170-171	Gothatuwa	700	25	25	28	2		50				23,760	150	0	1250	0	0	0	Qtus. Hospital (200)	46700	72	89.83	95.35	101.21	107.42	114.03	1.32
20	171-172	Gothatuwa	400	71	72	79							68,429	0	0	0	0	0	0			68	85.54	90.79	96.37	102.30	108.58	1.26
21	172-173	Gothatuwa	500	60	61	67							57,974	0	0	0	0	0	0			58	72.47	76.92	81.65	86.67	91.99	1.06
22	172-174	Gothatuwa	300	37	37	41	1						35,185	75	0	0	0	0	0			35	44.05	46.76	49.63	52.68	55.92	0.65
23	174-170	Gothatuwa	100	12	12	13		20					11,405	0	1200	0	0	0	0			13	15.76	16.72	17.75	18.84	20.00	0.23
24	171-175	Gothatuwa	900	78	79	87				7			75,082	0	0	0	1120	0	0			76	95.25	101.11	107.32	113.92	120.92	1.40
25	176-84	Gothatuwa	250	49	49	54	7						46,570	525	0	0	0	0	0			47	58.87	62.49	66.33	70.40	74.73	0.86
26	174-178	Gothatuwa	250	77	78	86							74,131	0	0	0	0	0	0			74	92.66	98.36	104.40	110.82	117.63	1.36
27	176-177	Gothatuwa	150	34	34	37	2						32,314	150	0	0	0	0	0			32	40.68	43.07	45.72	48.53	51.51	0.60
28	176-178	Gothatuwa	350	87	88	97							83,635	0	0	0	0	0	0			84	104.54	110.97	117.79	126.03	132.71	1.54
29	176-178	Gothatuwa	50	5	5	6							4,752	0	0	0	0	0	0			5	5.94	6.31	6.69	7.10	7.54	0.09
30	58-179	Gothatuwa	1000	201	203	223	38		45				192,931	2850	0	1125	0	0	0			197	248.13	263.28	277.32	294.38	312.45	3.62
31	179-134	Gothatuwa	300	36	36	40	3						34,214	225	0	0	0	0	0	T.Mill(4),Garage(1)	540	35	43.72	46.41	49.28	52.29	55.51	0.64
32	66-180	Gothatuwa	200	16	16	17	24						14,268	1800	0	0	0	0	0			16	20.07	21.30	22.61	24.00	25.48	0.29
33	180-181	Gothatuwa	1200	234	236	260	11					1000	224,294	825	0	0	0	0	10000			235	293.90	311.96	331.13	351.48	373.09	4.32
34	180-182	Gothatuwa	750	109	110	121	23		25		300		104,544	1725	0	625	0	9000	0	Dis(4),Servic St (6)	600	117	145.97	154.83	164.35	174.45	185.17	2.14
35	182-183	Gothatuwa	1450	254	257	283	19			10	50		244,253	1425	0	0	1600	1500	0	Bakery(15)	3000	252	314.72	334.06	354.59	376.39	399.52	4.62
36	183-184	Gothatuwa	400	63	64	70							60,826	0	0	0	0	0	0			61	76.03	80.70	85.66	90.93	96.52	1.12
37	182-185	Gothatuwa	350	50	51	56	14			5			48,470	1050	0	0	800	0	0	garage(6)	360	51	63.36	67.24	71.38	75.76	80.42	0.93
38	185-186	Gothatuwa	400	35	35	40							34,214	0	0	0	0	0	0			34	42.77	45.40	48.19	51.15	54.29	0.63
39	186-177	Gothatuwa	200	35	35	39							33,264	0	0	0	0	0	0			33	41.58	44.14	46.85	49.73	52.78	0.61
40	186-177	Gothatuwa	450	48	48	53							45,619	0	0	0	0	0	0			46	57.02	60.53	64.25	68.20	72.39	0.84
41	185-187	Gothatuwa	150	36	36	40	31						34,214	2325	0	0	0	0	0			37	45.67	48.48	51.46	54.62	57.98	0.67
42	187-188	Gothatuwa / Mulleriyawa	300	53	54	59	18						51,322	1350	0	0	0	0	0			53	65.84	69.89	74.18	78.74	83.58	0.97
43	188-189	Gothatuwa / Mulleriyawa	400	45	45	50	1						42,768	75	0	0	0	0	0	Garage (1)	420	43	54.03	57.40	60.93	64.67	68.65	0.79
44	176-190	Gothatuwa / Mulleriyawa	800	149	150	165	14			8			142,560	1050	0	0	1280	0	0			145	181.91	192.24	204.06	216.60	229.91	2.66
45	190-373	Kolonnawa	800	139	140	154	16				20		133,056	1200	0	0	0	600	0			135	168.57	178.93	189.93	201.60	213.99	2.48
46	190-191	Kolonnawa	500	44	44	48	21					500	41,818	1575	0	0	0	0	5000			48	60.49	64.21	68.15	72.34	76.79	0.89
47	192-173	Kolonnawa	60	12	12	13							11,405	0	0	0	0	0	0			11	14.26	15.13	16.06	17.05	18.10	0.21
48	192-193	Kolonnawa	400	35	35	39						1500	33,264	0	0	0	0	0	15000			48	60.33	64.04	67.97	72.15	76.58	0.89
49	192-188	Kolonnawa	650	103	104	114	3				20		98,842	225	0	0	0	600	0	Garage (12),T. Mill(6)	900	101	125.71	133.43	141.63	150.34	159.58	1.85
50	118-200	Kolonnawa	400	27	27	30	8		310	4	200		25,651	600	0	7750	640	6000	0			41	50.81	53.94	57.25	60.77	64.50	0.76
51	200-201	Kolonnawa	550	48	48	53			50				45,619	0	0	1250	0	0	0			47	58.69	62.19	66.01	70.07	74.37	0.86
52	200-202	Kolonnawa	200	20	20	22			30		60		19,008	0	0	750	0	1800	0	Service St (10)	1800	23	29.20	30.99	32.90	34.92	37.06	0.43
53	202-203	Kolonnawa	550	111	112	123							106,445	0	0	0	0	0	0			106	133.06	141.23	149.91	159.13	168.91	1.95
54	203-204	Kolonnawa	300	39	39	43							37,068	0	0	0	0	0	0			37	46.33	49.18	52.20	55.41	58.82	0.68
55	203-205	Kolonnawa	450	37	37	41							35,185	0	0	0	0	0	0			35	43.96	46.66	49.52	52.57	55.80	0.65
56	202-206	Kolonnawa	100	3	3	3							2,851	0	0	0	0	0	0	Garage(10)	600	3	4.31	4.58	4.86	5.16	5.48	0.06
57	206-207	Kolonnawa	300	23	23	25			15				21,869	0	0	375	0	0	0			22	27.19	29.60	31.31	33.24	35.28	0.41
58	201-208	Kolonnawa	700	34	34	37					600		32,314	0	0	0	0	18000	0			50	62.89	68.76	70.88	76.21	79.84	0.92
59	208-209	Kolonnawa	400	125	126	139							119,750	0	0	0	0	0	0			120	149.69	158.89	168.85	179.02	190.02	2.20
60	208-210	Kolonnawa	400	94	95	105							90,288	0	0	0	0	0	0			90	112.86	119.80	127.16	134.97	143.27	1.66
61	207-211	Kolonnawa	500	239	241	265			20			300	229,046	0	0	500	0	0	3000	Bus Depo	42000	275	343.18	364.27	386.65	410.42	435.65	5.04
62	210-211	Kolonnawa	250	117	118	130	21						112,147	1575	0	0	0	0	0			114	142.15	150.89	160.16	170.01	180.45	2.09
63	210-212	Kolonnawa	400	28	28	31	2		10				26,611	150	0	250	0	0	0			27	33.76	35.84	38.04	40.38	42.86	0.50
64	211-213	Kolonnawa	1000	360	364	400			20	10		100	345,946	0	0	500	1600	0	1000			349	436.31	463.12	491.58	521.79	553.86	6.41
65	214-206	Kolonnawa	300	73	74	81	2		20				70,330	150	0	500	0	0	0			71	88.72	94.18	99.97	106.11	112.63	1.30
66	214-215	Kolonnawa	200	36	36	40	2						34,214	150	0	0	0	0	0			34	42.96	45.60	48.40	51.37	54.53	0.63
67	215-216	Kolonnawa	50	4	4	4	3			4			3,802	225	0	0	640	0	0			5	5.83	6.19	6.57	6.98	7.40	0.09
68	214-216	Kolonnawa	250	54	55	61							52,272	0	0	0	0	0	0			52	65.34	69.36	73.62	78.14	82.94	0.96
69	216-41	Kolonnawa	450	99	100	110	5						95,040	375	0	0	0	0	0			95	119.27	126.60	134.38	142.64	151.40	1.75

Appendix 3A-3 NWSDB Estimate for Kotikawatte-Mulleriyawa Water Supply Improvement

(Distribution system information is included by JICA Study Team)

No	Section	Distribution System	Length (m)	No of Houses 90% of Total	No of Houses Adjustment	Total	Adju.	No. of Shops	E.P. (Se.)	OFF. (Pe.)	REL. (Pe.)	FAC. (Pe.)	SCH. (No)	Domestic Demand (l/d)	Shop Demand (l/d)	E. P. Demand (l/d)	Office Demand (l/d)	Rel. Demand (l/d)	Factory Demand (l/d)	School Demand (l/d)	Other Demand	(l/d)	Total Demand (m3/d)	A.A.W. Demand (m3/d)	Projected Demand 2003 (m3/d)	2008 (m3/d)	2013 (m3/d)	2018 (m3/d)	Demand (l/s)
70	215-41	Kolonnawa	300	66	67	74		36		30				63,677	2700	0	750	0	0	0	Shed (5)	300	67	84.28	89.46	94.96	100.80	106.99	1.24
71	272-218	Kolonnawa	150	22	22	24		48		10	4		1500	20,909	3600	0	250	640	0	15000			40	50.50	53.60	56.90	60.39	64.10	0.74
72	218-213	Kolonnawa	200	66	67	74		3						63,677	225	0	0	0	0	0			64	79.88	84.79	90.00	95.53	101.40	1.17
73	213-169	Kolonnawa	200	35	35	39		26		30				33,264	1950	0	750	0	0	0	Fair	1000	37	46.21	49.04	52.06	55.26	58.65	0.68
74	218-211	Kolonnawa	800	176	176	196				35		50		169,171	0	0	875	0	1500	0			172	214.43	227.61	241.60	256.45	272.21	3.15
75	169-221	Kolonnawa	200	24	24	26	16			11			1500	22,810	1200	0	275	0	0	15000			39	49.11	52.12	55.33	58.73	62.34	0.72
76	221-271	Kolonnawa	200	32	32	35								30,413	0	0	0	0	0	0			30	38.02	40.35	42.83	45.46	48.26	0.56
77	221-222	Kolonnawa	200	50	51	56	18	12	300					48,470	1350	720	7500	0	0	0			58	72.55	77.01	81.74	86.77	92.10	1.07
78	222-223	Kolonnawa	400	99	100	110	1		150					95,040	75	0	3750	0	0	0			99	123.58	131.18	139.24	147.80	156.88	1.82
79	223-271	Kolonnawa	200	81	82	90								77,933	0	0	0	0	0	0			78	97.42	103.40	109.76	116.50	123.66	1.43
80	41-272	Kolonnawa	150	21	21	23								19,958	0	0	0	0	0	0			20	24.93	26.48	28.11	29.84	31.67	0.37
81	223-224	Kolonnawa	1200	155	158	174	3							150,163	225	0	0	0	0	0			150	187.99	199.54	211.80	224.82	238.63	2.76
82	212-222	Kolonnawa	800	93	94	103	36		200			1500		89,338	2700	0	5000	0	45000	0			142	177.55	188.46	200.04	212.33	225.38	2.61
83	225-212	Kolonnawa	100	0		0	6		15					0	450	0	375	0	0	0			1	1.03	1.09	1.16	1.23	1.31	0.02
84	225-226	Kolonnawa	600	246	248	273	2				15			235,699	150	0	0	2400	0	0			238	297.81	316.11	335.54	356.16	378.05	4.38
85	226-300	Kolonnawa	100	45	45	50								42,768	0	0	0	0	0	0			43	53.46	56.75	60.23	63.93	67.86	0.79
86	227-225	Kolonnawa	200	6	6	7	50							5,702	3750	0	0	0	0	0			9	11.82	12.54	13.31	14.13	15.00	0.17
87	227-228	Kolonnawa	100	16	16	18								15,206	0	0	0	0	0	0			15	19.01	20.18	21.42	22.73	24.13	0.28
88	229-227	Kolonnawa	300	35	35	39	66							33,264	4650	0	0	0	0	0			38	47.77	50.70	53.82	57.13	60.64	0.70
89	225-230	Kolonnawa / Mulleriyawa	400	87	88	97	49	18				23		83,635	3675	1050	0	0	690	0	fair(25), garage(10)	1500	91	113.35	120.32	127.71	135.56	143.89	1.67
90	1-3	Kolonnawa / Mulleriyawa	400	16	16	18	11	10	58					15,206	825	600	1450	0	0	0	Petrol Shed (6),Dis(4)	440	19	23.15	24.57	26.08	27.69	29.39	0.34
91	3-4	Kolonnawa / Mulleriyawa	100	15	15	17	18							14,256	1350	0	0	0	0	0	Garage(6(,Servic St(6)	1440	17	21.31	22.62	24.01	25.48	27.05	0.31
92	4-7	Kolonnawa / Mulleriyawa	400	68	69	76	16	12				100	2000	65,578	1200	720	0	0	3000	20000	Garage(4)	240	91	113.42	120.39	127.79	135.65	143.98	1.67
93	7-9	Kolonnawa / Mulleriyawa	75	7	7	8								6,653	0	0	0	0	0	0			7	8.32	8.83	9.37	9.95	10.56	0.12
94	9-12	Kolonnawa / Mulleriyawa	375	52	53	58	43	25						50,371	3225	1500	0	0	0	0	Garage (4),Mill(15)	720	56	69.77	74.06	78.61	83.44	88.57	1.03
95	12-13	Kolonnawa / Mulleriyawa	400	49	49	54	3				4			46,570	225	0	0	640	0	0	Concrete Site(8)	1440	49	61.09	64.85	68.83	73.06	77.55	0.90
96	13-15	Kolonnawa / Mulleriyawa	200	37	37	41	10	40						35,165	750	2400	0	0	0	0			38	47.89	50.84	53.96	57.28	60.80	0.70
97	15-17	Mulleriyawa	200	15	15	17	8	20						14,256	600	1200	0	0	0	0	Shed(6),Mill(5)	510	17	20.71	21.98	23.33	24.76	26.29	0.30
98	17-20	Mulleriyawa	650	88	89	98	31		2					84,586	2325	0	50	0	0	0	Dis(4),T.Mill(5),shed(4),Garge(	1190	88	110.19	116.98	124.15	131.78	139.88	1.62
99	20-21	Mulleriyawa	600	50	50	55	16	10				30	700	47,520	1200	600	0	0	900	7000	Garge (20),Ser.St(12) Mill(10)	3660	61	76.10	80.78	85.74	91.01	96.60	1.12
100	21-22	Mulleriyawa	100	4	4	4	13	8						3,802	975	480	0	0	0	0			5	6.57	6.97	7.40	7.86	8.34	0.10
101	22-23	Mulleriyawa	750	25	25	28	4		60			650		23,760	300	0	1500	0	19500	0	Timber Mill(20)	600	45	57.08	60.56	64.31	68.26	72.45	0.84
102	1-24	Mulleriyawa	50	0		0	13						1000	0	975	0	0	0	0	10000	Hotel(20)	4000	15	18.72	19.87	21.09	22.39	23.76	0.28
103	24-27	Mulleriyawa	500	50	50	55	11	10		6			1500	47,520	825	600	0	960	0	15000			65	81.13	86.12	91.41	97.03	102.99	1.19
104	27-31	Mulleriyawa	450	75	76	84	13	10				70		72,230	975	600	0	0	2100	0	garage (6)	360	76	95.33	101.19	107.41	114.01	121.02	1.40
105	31-32	Mulleriyawa	350	27	27	30	11	10						25,661	825	600	0	0	0	0	Cycle Repair(3)	180	27	34.08	36.18	38.40	40.76	43.27	0.50
106	32-39	Mulleriyawa	650	91	92	101	24	10						87,437	1800	600	0	0	0	0	T.Mill(12),Garage(4)	600	90	113.05	119.99	127.37	135.20	143.50	1.66
107	39-40	Mulleriyawa	200	11	11	12	5							10,454	375	0	0	0	0	0			11	13.54	14.37	15.25	16.19	17.18	0.20
108	40-41	Mulleriyawa	200	10	10	11	16	36						9,504	1200	2160	0	0	0	0	Bus St	1000	14	17.33	18.40	19.53	20.73	22.00	0.25
109	1-42	Mulleriyawa	150	37	37	41	49	8						35,165	3675	480	0	0	0	0	Bakery(6),Markeet	2080	41	51.75	54.93	58.31	61.89	65.69	0.76
110	42-43	Mulleriyawa	100	27	27	30								25,661	0	0	0	0	0	0			26	32.08	34.05	36.14	38.36	40.72	0.47
111	43-44	Mulleriyawa	50	3	3	3								2,851	0	0	0	0	0	0	T.Mill(8)	160	3	3.79	4.02	4.27	4.53	4.81	0.06
112	43-147	Mulleriyawa	400	45	45	50								42,768	0	0	0	0	0	0			43	53.46	56.75	60.23	63.93	67.86	0.79
113	44-148	Mulleriyawa	400	52	53	58								50,371	0	0	0	0	0	0			50	62.96	66.83	70.94	75.30	79.93	0.93
114	44-45	Mulleriyawa	100	3	3	3								2,851	0	0	0	0	0	0			3	3.56	3.78	4.02	4.26	4.52	0.05
115	45-149	Mulleriyawa	500	64	65	72	2							61,376	150	0	0	0	0	0			62	77.41	82.16	87.21	92.57	98.26	1.14
116	45-48	Mulleriyawa	400	34	34	37	6				4			32,314	450	0	0	640	0	0	garage(6)	360	34	42.20	44.80	47.55	50.47	53.58	0.62
117	48-49	Mulleriyawa	250	17	17	19	1	10						16,157	75	600	0	0	0	0			17	21.04	22.33	23.71	25.16	26.71	0.31
118	49-51	Mulleriyawa	250	81	82	90	1							77,933	75	0	0	0	0	0			78	97.51	103.50	109.86	116.62	123.78	1.43
119	49-150	Mulleriyawa	625	82	83	91								78,883	0	0	0	0	0	0			79	98.60	104.66	111.10	117.92	125.17	1.45
120	51-53	Mulleriyawa	200	12	12	13								11,405	0	0	0	0	0	0			11	14.26	15.13	16.06	17.05	18.10	0.21
121	53-150	Mulleriyawa	200	29	29	32								27,562	0	0	0	0	0	0			28	34.45	36.57	38.82	41.20	43.73	0.51
122	51-151	Mulleriyawa	300	35	35	39								33,264	0	0	0	0	0	0			33	41.58	44.14	46.85	49.73	52.78	0.61
123	150-152	Mulleriyawa	200	35	35	39								33,264	0	0	0	0	0	0			33	41.58	44.14	46.85	49.73	52.78	0.61
124	53-54	Mulleriyawa	100	9	9	10								8,554	0	0	0	0	0	0			9	10.69	11.35	12.05	12.79	13.57	0.16
125	54-153	Mulleriyawa	100	9	9	10								8,554	0	0	0	0	0	0			9	10.69	11.35	12.05	12.79	13.57	0.16
126	153-154	Mulleriyawa	150	27	27	30								25,661	0	0	0	0	0	0			26	32.08	34.05	36.14	38.36	40.72	0.47
127	153-155	Mulleriyawa	300	36	36	40								34,214	0	0	0	0	0	0			34	42.77	45.40	48.19	51.15	54.29	0.63
128	54-56	Mulleriyawa	450	18	18	20	29		100					17,107	2175	0	2500	0	0	0	Dis(40	80	22	27.33	29.01	30.79	32.68	34.69	0.40
129	3-60	Mulleriyawa	700	149	150	165	8							142,560	600	0	0	0	0	0			143	178.95	189.95	201.62	214.01	227.17	2.63
130	60-61	Mulleriyawa	400	47	47	52								44,669	0	0	0	0	0	0			45	55.84	59.27	62.91	66.78	70.88	0.82
131	60-62	Mulleriyawa	400	51	52	57	1							49,421	75	0	0	0	0	0			49	61.87	65.67	69.71	73.99	78.54	0.91
132	4-63	Mulleriyawa	50	5	5	6								4,752	0	0	0	0	0	0			5	5.94	6.31	6.69	7.10	7.54	0.09
133	63-64	Mulleriyawa	20	1	1	1								950	0	0	0	0	0	0			1	1.19	1.26	1.34	1.42	1.51	0.02
134	64-65	Mulleriyawa	50	10	10	11					8			9,504	0	0	0	1260	0	0			11	13.48	14.31	15.19	16.12	17.11	0.20
135	64-42	Mulleriyawa	250	20	20	22					10			19,008	0	0	0	1600	0	0	Bakery(8)	1440	22	27.56	29.25	31.05	32.95	34.99	0.40
136	63-67	Mulleriyawa	200	27	27	30								25,661	0	0	0	0	0	0			26	32.08	34.05	36.14	38.36	40.72	0.47
137	67-68	Mulleriyawa	500	83	84	92								79,834	0	0	0	0	0	0			80	99.79	105.92	112.43	119.34	126.68	1.47
138	68-69	Mulleriyawa	75	18	18	20	1							17,107	75	0	0	0	0	0			17	21.48	22.80	24.20	25.69	27.26	0.32
139	69-70	Mulleriyawa	100	13	13	14	1							12,355	75	0	0	0	0	0			12	15.54	16.49	17.51	18.58	19.72	0.23
140	69-71	Mulleriyawa	200	20	20	22	2							19,008	150	0	0	0	0	0			19	23.93	25.42	26.98	28.64	30.40	0.35
141	68-72	Mulleriyawa	750	156	158	174		30						150,163	0	1800	0	0	0	0			152	189.95	201.63	214.02	227.17	241.13	2.79

Appendix 3A-3 NWSDB Estimate for Kotikawatte-Mulleriyawa Water Supply Improvement

(Distribution system information is included by JICA Study Team)

No	Section	Distribution System	Length (m)	No of Houses 90% of Total	No of Houses Total	No of Houses Adjustment	No. of Shops	E.P. (Se.)	OFF. (Pe.)	REL. (Pe.)	FAC. (Pe.)	SCH. (No)	Domestic Demand (l/d)	Shop Demand (l/d)	E.P. Demand (l/d)	Office Demand (l/d)	Rel. Demand (l/d)	Factory Demand (l/d)	School Demand (l/d)	Other Demand	(l/d)	Total Demand (m3/d)	A.A.W. Demand (m3/d)	Projected Demand 2003 (m3/d)	2008 (m3/d)	2013 (m3/d)	2018 (m3/d)	Demand (l/s)
142	68-70	Mulleriyawa	50	6	6	7							5,702	0	0	0	0	0	0			6	7.13	7.51	8.03	8.52	9.05	0.10
143	70-73	Mulleriyawa	450	51	52	58	2						58,925	150	0	0	0	0	0			59	73.84	78.38	83.20	88.31	93.74	1.08
144	7-67	Mulleriyawa	250	32	32	35							30,413	0	0	0	0	0	0			30	38.02	40.35	42.83	45.46	48.26	0.56
145	9-74	Mulleriyawa	450	51	52	58	1						58,925	75	0	0	0	0	0			59	73.75	78.28	83.09	88.20	93.62	1.08
146	12-74	Mulleriyawa	300	39	39	43	4						37,066	300	0	0	0	0	0			37	46.71	49.58	52.62	55.86	59.29	0.69
147	74-75	Mulleriyawa	550	42	42	46				6			39,917	0	0	0	960	0	0			41	51.10	54.24	57.57	61.11	64.86	0.75
148	12-76	Mulleriyawa	830	121	122	134	20		4				115,949	1500	0	300	0	0	0	Garage(15)	900	118	148.06	157.16	166.82	177.07	187.95	2.18
149	76-77	Mulleriyawa	150	15	15	17			10	5			14,256	0	0	250	800	0	0			15	19.13	20.31	21.56	22.88	24.29	0.28
150	76-78	Mulleriyawa	500	23	23	25	20		25			1000	21,859	1500	0	625	0	0	10000			34	42.48	45.09	47.86	50.80	53.93	0.62
151	78-79	Mulleriyawa	200	13	13	14	1		100				12,355	75	0	2500	0	0	0			15	18.66	19.81	21.03	22.32	23.69	0.27
152	79-80	Mulleriyawa	200	27	27	30							25,661	0	0	0	0	0	0			26	32.03	34.05	36.14	38.36	40.72	0.47
153	80-81	Mulleriyawa	300	29	29	32							27,562	0	0	0	0	0	0			28	34.45	36.57	38.82	41.20	43.73	0.51
154	80-82	Mulleriyawa	325	45	45	50							42,758	0	0	0	0	0	0			43	53.46	56.75	60.23	63.93	67.86	0.79
155	79-82	Mulleriyawa	200	23	23	25	2						21,859	150	0	0	0	0	0			22	27.51	29.20	31.00	32.90	34.92	0.40
156	82-111	Mulleriyawa	950	57	58	64	1						55,123	75	0	0	0	0	0			55	69.00	73.24	77.74	82.52	87.59	1.01
157	78-72	Mulleriyawa	500	34	34	37	35						32,314	2625	0	0	0	0	0			35	43.67	46.36	49.21	52.23	55.44	0.64
158	72-48	Mulleriyawa	200	163	165	182	6						156,816	450	0	0	0	0	0			157	196.58	208.66	221.49	235.10	249.55	2.89
159	78-84	Mulleriyawa	400	0		0			50			500	0	0	0	1250	0	0	5000	Hosp Pa1400,Staff500	295000	301	376.56	399.71	424.27	450.34	478.02	5.53
160	84-81	Mulleriyawa	500	42	42	46	19	12					39,917	1425	720	0	0	0	0			42	52.58	55.81	59.24	62.88	66.74	0.77
161	81-85	Mulleriyawa	150	13	13	14							12,355	0	0	0	0	0	0	T Mill(4)	120	12	15.59	16.55	17.57	18.65	19.80	0.23
162	85-86	Mulleriyawa	300	34	34	37	2						32,314	150	0	0	0	0	0			32	40.58	43.07	45.72	48.53	51.51	0.60
163	85-87	Mulleriyawa	350	38	38	42							36,116	0	0	0	0	0	0			36	45.14	47.92	50.86	53.99	57.31	0.66
164	87-89	Mulleriyawa	450	64	65	72	5						61,776	375	0	0	0	0	0			62	77.69	82.46	87.53	92.91	98.62	1.14
165	87-89	Mulleriyawa	200	24	24	26	6						22,810	450	0	0	0	0	0			23	29.07	30.85	32.76	34.77	36.91	0.43
166	89-90	Mulleriyawa	375	52	53	58				6			50,371	0	0	0	960	0	0			51	64.18	68.11	72.29	76.74	81.45	0.94
167	89-91	Mulleriyawa	500	46	46	51							43,718	0	0	0	0	0	0	Garage(12)	720	44	55.65	58.96	62.59	66.43	70.51	0.82
168	89-92	Mulleriyawa	600	98	99	109	8						94,099	600	0	0	0	0	0			95	118.38	125.64	133.38	141.65	150.25	1.74
169	92-93	Mulleriyawa	900	90	91	100	25						86,486	1875	0	0	0	0	0	Hosp(pa700,staff300),gar(6),C	149440	238	297.25	315.62	334.91	355.49	377.34	4.37
170	93-94	Mulleriyawa	200	25	25	28	1						23,760	75	0	0	0	0	0			24	29.79	31.62	33.57	35.63	37.82	0.44
171	93-95	Mulleriyawa	200	27	27	30	6		4				25,661	450	0	100	0	0	0			26	32.76	34.78	36.91	39.18	41.59	0.48
172	95-96	Mulleriyawa	200	26	26	29							24,710	0	0	0	0	0	0	Garage(4)	240	25	31.19	33.10	35.14	37.30	39.59	0.46
173	96-97	Mulleriyawa	400	74	75	83	15						71,280	1125	0	0	0	0	0			72	90.61	96.07	101.97	108.24	114.89	1.33
174	97-98	Mulleriyawa	1400	180	182	200	10						172,973	750	0	0	0	0	0			174	217.15	230.50	244.67	259.70	275.66	3.19
175	97-99	Mulleriyawa	1200	123	124	136	6				16	1500	117,850	375	0	0	0	480	15000			134	167.13	177.40	188.30	199.88	212.16	2.46
176	92-20	Mulleriyawa	1500	184	186	205	19				100		176,774	1425	0	0	0	3000	0	Garage(12)	720	182	227.40	241.37	256.21	271.95	288.67	3.34
177	21-112	Mulleriyawa	1500	127	128	141							121,651	0	0	0	0	0	0			122	152.06	161.41	171.33	181.85	193.04	2.23
178	112-75	Mulleriyawa	1000	81	82	90	4						77,933	300	0	0	0	0	0	Timber mill(20)	600	79	98.84	104.90	111.33	118.15	125.39	1.45
179	75-61	Mulleriyawa	600	88	89	98	8		2		100		84,586	375	0	50	0	3000	0			88	110.01	116.77	123.95	131.57	139.65	1.62
180	75-101	Mulleriyawa	600	22	22	24	4						20,909	300	0	0	0	0	0			21	26.51	28.14	29.87	31.71	33.65	0.39
181	61-100	Mulleriyawa	600	57	58	64	6			6			55,123	450	0	0	960	0	0	Timber(10)	300	57	71.04	75.41	80.04	84.96	90.18	1.04
182	100-102	Mulleriyawa	900	61	62	68	4	10				1000	58,923	300	600	0	0	0	10000	Timber(5)	180	70	87.61	92.68	98.09	104.05	111.08	1.29
183	102-107	Mulleriyawa	900	94	95	105	1			5			90,286	75	0	0	960	0	0			91	114.15	121.17	128.62	136.52	144.91	1.68
184	40-103	Mulleriyawa	600	95	96	106				8		2000	91,238	0	0	0	1280	0	20000	Garage(15)	900	113	141.77	150.49	159.73	169.55	179.97	2.08
185	103-104	Mulleriyawa	400	105	106	117							100,742	0	0	0	0	0	0			101	125.93	133.67	141.88	150.60	159.86	1.85
186	103-105	Mulleriyawa	100	9	9	10							8,554	0	0	0	0	0	0			9	10.69	11.35	12.05	12.79	13.57	0.16
187	102-106	Mulleriyawa	400	55	56	62	2						53,222	150	0	0	0	0	0			53	66.72	70.82	75.17	79.79	84.69	0.98
188	106-107	Mulleriyawa	1200	90	91	100							86,486	0	0	0	0	0	0			88	108.11	114.76	121.80	129.29	137.24	1.59
189	107-32	Mulleriyawa	300	36	36	40	4						34,214	300	0	0	0	0	0			35	43.14	45.79	48.61	51.60	54.77	0.63
190	39-109	Mulleriyawa	1200	289	292	321							277,517	0	0	0	0	0	0			278	348.90	368.22	390.84	414.87	440.36	5.10
191	24-140	Mulleriyawa	400	63	64	70	3						60,826	225	0	0	0	0	0			61	76.31	81.00	85.98	91.27	96.87	1.12
192	27-135	Mulleriyawa	100	12	12	13							11,405	0	0	0	0	0	0			11	14.26	15.13	16.06	17.05	18.10	0.21
193	135-137	Mulleriyawa	300	45	45	50	3						42,768	225	0	0	0	0	0			43	53.74	57.04	60.55	64.27	68.22	0.79
194	135-140	Mulleriyawa	500	103	104	114	3						98,842	225	0	0	0	0	0			99	123.83	131.44	139.52	148.10	157.20	1.82
195	140-141	Mulleriyawa	100	18	18	20	1						17,107	75	0	0	0	0	0			17	21.48	22.80	24.20	25.69	27.26	0.32
196	141-142	Mulleriyawa	250	42	42	46	2						39,917	150	0	0	0	0	0			40	50.05	53.18	56.43	59.90	63.58	0.74
197	141-62	Mulleriyawa	200	14	14	15	1			8			13,209	75	0	0	1280	0	0			15	18.33	19.45	20.65	21.92	23.26	0.27
198	62-143	Mulleriyawa	200	16	16	18	3						15,206	225	0	0	0	0	0			16	19.29	20.47	21.73	23.07	24.49	0.28
199	143-144	Mulleriyawa	100	22	22	24							20,909	0	0	0	0	0	0			21	26.14	27.74	29.45	31.26	33.18	0.38
200	144-145	Mulleriyawa	400	77	78	86							74,131	0	0	0	0	0	0			74	92.66	98.36	104.40	110.82	117.63	1.36
201	144-146	Mulleriyawa	400	46	46	51	2						43,718	150	0	0	0	0	0			44	54.84	58.21	61.78	65.58	69.61	0.81
202	143-100	Mulleriyawa	300	47	47	52	12						44,669	900	0	0	0	0	0			45	56.96	60.46	64.18	68.12	72.31	0.84
203	169-169	Mulleriyawa	300	77	78	86	14						74,131	1050	0	0	0	0	0			76	93.98	99.76	105.88	112.39	119.30	1.38
204	169-270	Mulleriyawa	250	36	38	42		12					36,116	0	720	0	0	0	0			37	46.04	48.87	51.88	55.07	58.45	0.68
205	169-270	Mulleriyawa	100	24	24	26	2						22,810	150	0	0	0	0	0	Bakery(8)	1280	24	30.30	32.16	34.14	36.24	38.48	0.45
206	270-271	Mulleriyawa	200	50	50	55			100	8			47,520	0	0	2500	1280	0	0			51	64.13	68.07	72.26	76.69	81.40	0.94
207	168-272	Mulleriyawa	250	260	263	289							249,965	0	0	0	0	0	0			250	312.44	331.65	352.03	373.65	396.63	4.59
208	167-273	Mulleriyawa	300	61	62	68							58,928	0	0	0	0	0	0			59	73.68	78.18	82.99	88.09	93.50	1.08
209	134-108	Mulleriyawa	300	67	68	75	1		6				64,627	75	0	150	0	0	0	Montissory(100)	2000	67	83.57	88.70	94.15	99.94	106.08	1.23
210	108-157	Mulleriyawa	850	78	77	85	7						73,181	525	0	0	0	0	0			74	92.13	97.79	103.80	110.18	116.96	1.35
211	167-168	Mulleriyawa	250	76	77	85	6						73,181	450	0	0	0	0	0			74	92.04	97.69	103.70	110.07	116.84	1.35
			88,950	13,201	13,334	14,667	1,494	383	2,778	178	3,893	18,500	12,672,624	112,050	22,980	69,450	28,000	116,970	186,000		679,440	13,788	17,234	18,294	19,419	20,611	21,878	253

APPENDIX 3B

DIAMETERS OF TRANSMISSION MAIN

APPENDIX 3B DIAMETERS FOR TRANSMISSION MAIN

3B.1 OUTLINE

To determine the economical transmission system to pump water from Ambatale Water Treatment Plant to Gothatuwa Ground Reservoir and Kolonnawa New Ground Reservoir, analysis was carried out comparing present worth of capital and operation costs for the following.

- Separate pump houses and separate transmission mains to Gothatuwa and Kolonnawa
- Common pump house, common transmission main with branches to Gothatuwa and Kolonnawa

Three cases were developed for analysis.

Case 1 Separate Transmission system to Gothtuwa Ground Reservoir and Kolonnawa New Ground Reservoir
  Case 1-1 Pumping to Gothatuwa Ground Reservoir Only
  Case 1-2 Pumping to Kolonnawa New Ground Reservoir Only
Case 2 Pumping to Gothatuwa and Kolonnawa – 800/500/600
Case 3 Pumping to Gothatuwa and Kolonnawa – 700/500/600

Table 3B-1 shows the hydraulic calculations for transmission main alternatives. Figures 3B-1 show the schematic of transmission system for each of the above case. Head loss around pump is accounted for by adding 2 m head and approximating to the nearest whole number.

Hazen-William coefficient C is assumed at 110 accounting for the losses in fittings, curves etc. along the pipeline.

3B.2 Basic Assumptions

Main components of transmission system for comparison are as follows.

- Capital cost of transmission mains
- Energy cost (power) for pumping

Construction cost of pump house at Ambatale is excluded as the difference between that for a common pump house and that for separate pump houses are negligible for the purpose of this analysis. Capital cost of umps are also excluded as their costs are similar for Case 2 and Case 3. For Case 1, including the cost of pumps will increase the cost.

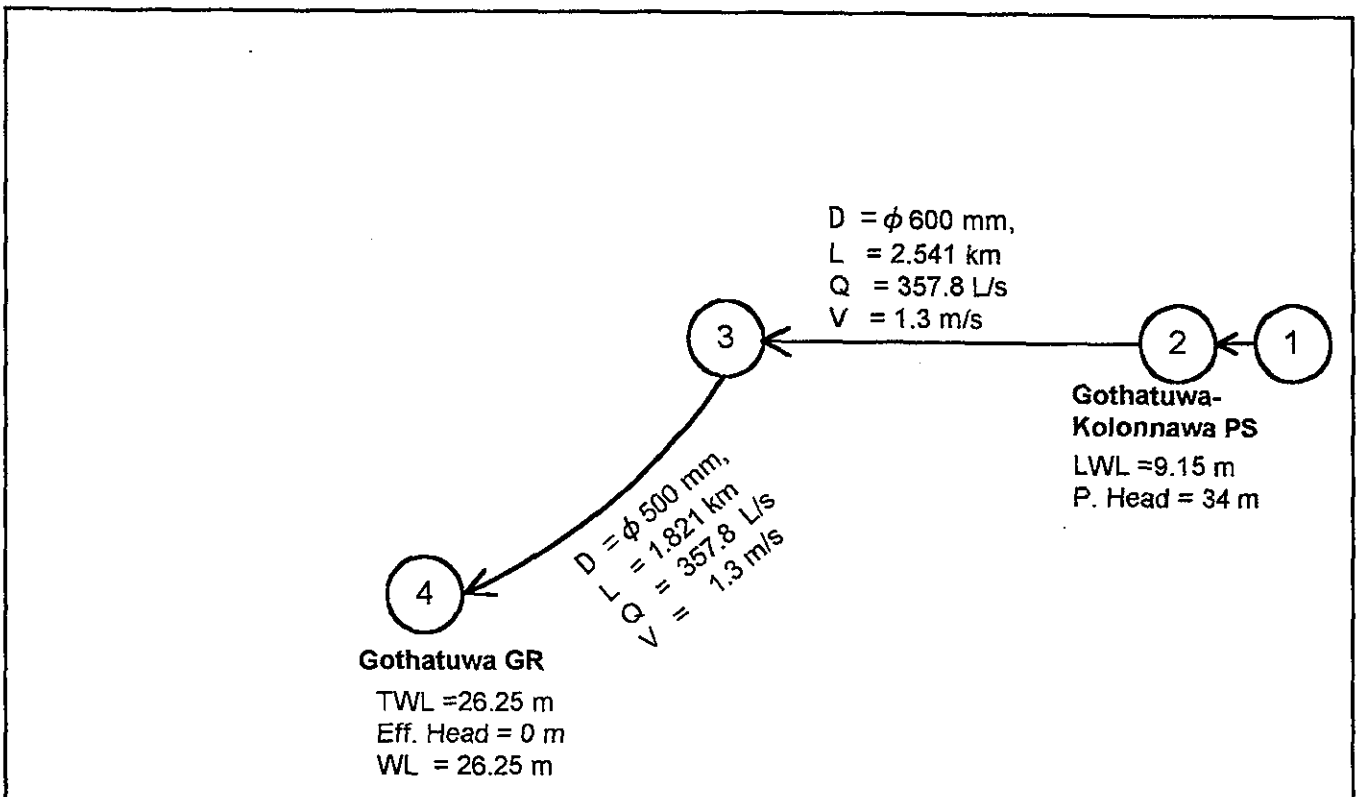
3B.3 Results

Table 3B-2 shows the comparison for discount rate at 10%, 5% and 15%. Table B-3 shows the summary of comparison for discount rate of 10%.

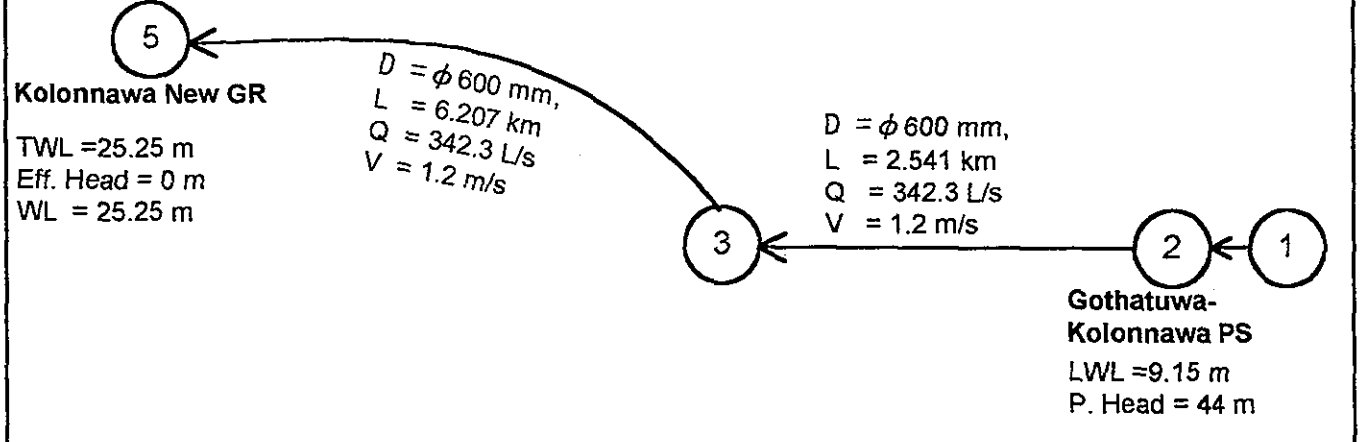
Table 3B-3 Summary of Transmission Alternatives

Item	Case 1-1	Case 1-2	Case 1	Case 2	Case 3
Cost of Transmission mains, SLRs.	104,160,198	208,893,492	313,053,690	269,009,331	265,167,339
Energy Cost, SLRs.	27,638,047	26,043,488	53,681,535	61,801,319	71,643,141
Net Present Value, SLRs. (nearest thousand)	131,798,000	234,937,000	366,735,000	330,811,000	336,810,000

Based on the above results, Case 2 is the most economical transmission system. As evident from Figure 3B-1, pumping through a common will result in excess energy that need to be dissipated in Case 2 and in Case 3. However, combining the transmission main for Gothatuwa and for Kolonnawa far outweigh individual pumping in Case 1 and therefore excess energy dissipation in Case 2 or Case 3 is inevitable.



CASE 1-1



CASE 1-2

FIG. 3B-1	**Schematic of Transmission System Alternatives**
SCALE	Not to scale

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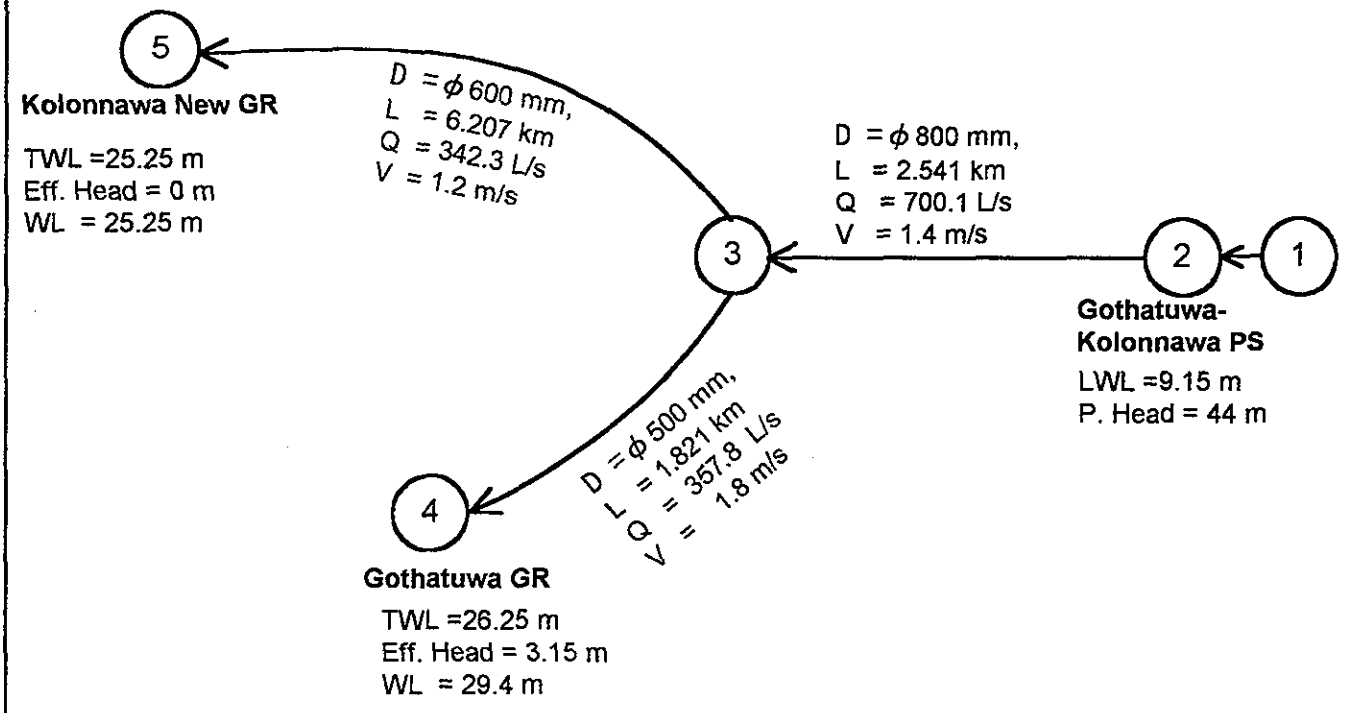
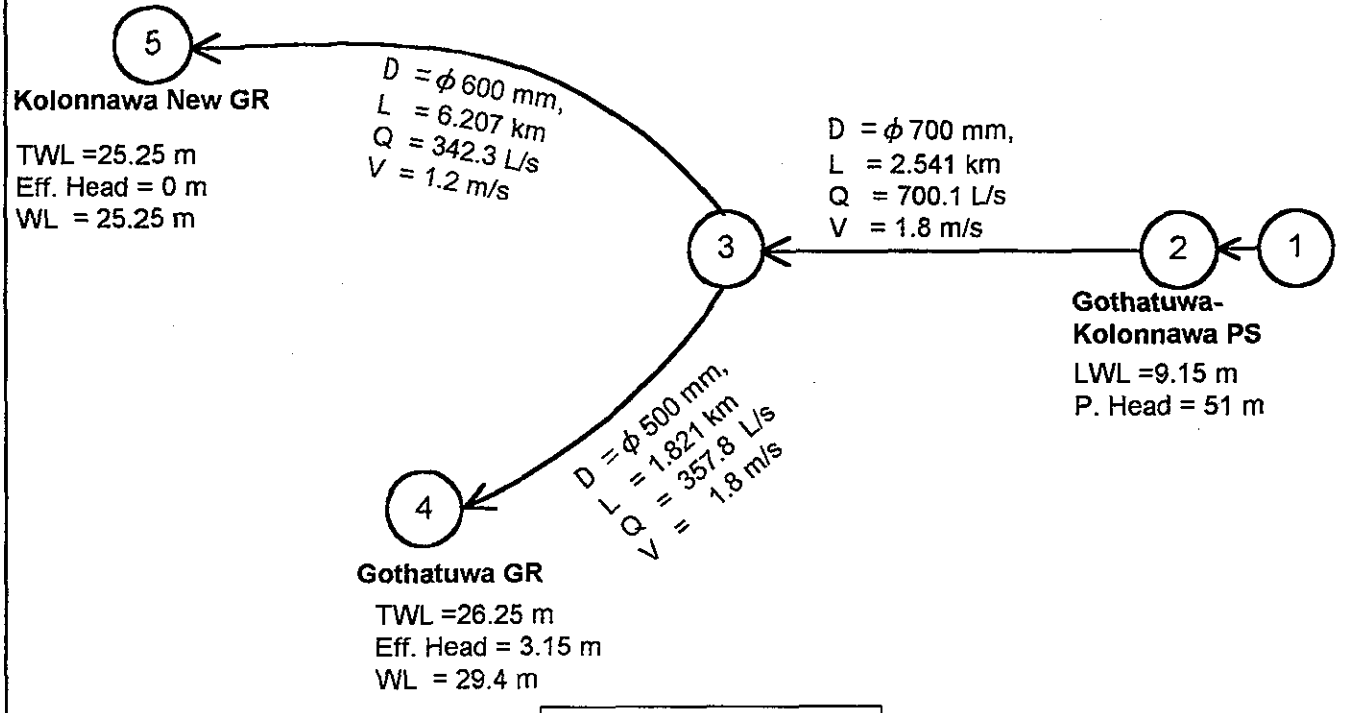
THE DETAILED DESIGN STUDY ON THE PROJECT FOR REDUCTION OF NON-REVENUE WATER IN THE GREATER COLOMBO AREA IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA



CASE 2



CASE 3

FIG. 3B-2	Schematic of Transmission System Alternatives
SCALE	Not to scale

JICA STUDY TEAM

THE DETAILED DESIGN STUDY ON THE PROJECT FOR REDUCTION OF NON-REVENUE WATER IN THE GREATER COLOMBO AREA IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

Table 3B- 1 Hydraulic Calculation of Transmission Alternatives

CASE 1-1 Pumping to Gothatuwa Ground Reservoir Only

NODE

NO	Type	Q l/sec	WL m	GL m	EH m
1	1	-357.800	9.15	7.00	2.15
2	0	0.000	40.24	11.00	29.24
3	0	0.000	32.09	18.00	14.09
4	0	357.800	26.25	26.25	0.00
		1.000			

PIPE

NO(u)	NO(d)	Dia mm	Length m	C	dH m	Q l/sec	V m/sec	I o/oo
1	2	600	50	110	31.25	357.80	1.27	3.21
2	3	600	2541	110		357.80	1.27	3.21
3	4	600	1821	110		357.80	1.27	3.21

End

CASE 1-2 Pumping to Kolonnawa New Ground Reservoir Only

NODE

NO	Type	Q l/sec	WL m	GL m	EH m
1	1	-342.300	9.15	7.00	2.15
2	0	0.000	51.09	11.00	40.09
3	0	0.000	43.58	18.00	25.58
5	0	342.300	25.25	25.25	0.00
		1.000			

PIPE

NO(u)	NO(d)	Dia mm	Length m	C	dH m	Q l/sec	V m/sec	I o/oo
1	2	600	50	110	42.09	342.30	1.21	2.95
2	3	600	2541	110		342.30	1.21	2.95
3	5	600	6207	110		342.30	1.21	2.95

End

CASE 2 Pumping to Gothatuwa and Kolonnawa 800/500/600

NODE

NO	Type	Q l/sec	WL m	GL m	EH m
1	1	-700.100	9.15	7.00	2.15
2	0	0.000	50.53	11.00	39.53
3	0	0.000	43.59	18.00	25.59
4	0	357.800	29.40	26.25	3.15
5	0	342.300	25.25	25.25	0.00
		1.000			

PIPE

NO(u)	NO(d)	Dia mm	Length m	C	dH m	Q l/sec	V m/sec	I o/oo
1	2	600	50	110	41.94	700.10	2.48	11.10
2	3	800	2541	110		700.10	1.39	2.73
3	4	500	1821	110		357.80	1.82	7.79
3	5	600	6207	110		342.30	1.21	2.95

End

CASE 3 Pumping to Gothatuwa and Kolonnawa 700/500/600

NODE

NO	Type	Q l/sec	WL m	GL m	EH m
1	1	-700.100	9.15	7.00	2.15
2	0	0.000	56.90	11.00	45.90
3	0	0.000	43.59	18.00	25.59
4	0	357.800	29.40	26.25	3.15
5	0	342.300	25.25	25.25	0.00
		1.000			

PIPE

NO(u)	NO(d)	Dia mm	Length m	C	dH m	Q l/sec	V m/sec	I o/oo
1	2	600	50	110	48.31	700.10	2.48	11.10
2	3	700	2541	110		700.10	1.82	5.24
3	4	500	1821	110		357.80	1.82	7.79
3	5	600	6207	110		342.30	1.21	2.95

End

Note:

Q	*Flowrate*	EH	Effective Head
C	Hazen-William Coefficient	dH	Pumping Head
WL	Water Level	V	Velocity
GL	*Ground Level*	I	Friction Gradient

Table B-2 Comparison of Transmission Alternatives

Item		Case 1-1	Case 1-2	Case 1	Case 2	Case-3
		Q=30,910 m^3/d	Q=29,575 m^3/d	Q=30,910+29,575 m^3/d	Q=60,485 m^3/d	Q=60,485 m^3/d
		ϕ 600 mm	ϕ 600 mm		ϕ 800/500/600 mm	ϕ 700/500/600 mm
		Pumping to Gothatuwa GR only	Pumping to Kolonnawa New GR Only		Pumping to Gothatuwa GR and New Kolonnawa GR	Pumping to Gothatuwa GR and New Kolonnawa GR
Cost of pipe (Ambatale-Hospital Junction), m	2,541	60,676,539	60,676,539	121,353,078	88,912,131	85,070,139
Cost of Pipe (Hospital Junction - Gothatuwa), m	1,821	43,483,659		43,483,659	31,880,247	31,880,247
Cost of Pipe (Hospital Junction - Kolonnawa), m	6,207		148,216,953	148,216,953	148,216,953	148,216,953
Total Cost of Pipe		**104,160,198**	**208,893,492**	**313,053,690**	**269,009,331**	**265,167,339**
Pump Head, m		34	44		44	51
Overall power efficiency		0.7	0.7		0.7	0.7
kVA rating required		155	192		392	455
Unit demand charge (SLRs./kVA)		240	240		240	240
Total Fixed Power Demand Charge (present value)		3,980,218	4,930,335	8,910,553	10,066,101	11,683,867
Unit power cost, (SLRs./kWh)		4.25	4.25		4.25	4.25
Total Power Consumption Cost (present value)		43,046,252	40,986,497	84,032,748	96,693,411	112,076,453
Total Cost of Energy , SLRs. (present value)		47,026,470	45,916,832	92,943,302	106,759,511	123,760,320
Total Present Value, SLRs. (year 2000)		**151,187,000**	**254,810,000**	**405,997,000**	**375,769,000**	**388,928,000**
				30,228,000	0	13,159,000

Annual power consumption cost (present value)						
year 2005		3,222,136	2,086,547	5,308,683	6,256,371	7,251,702
year 2006		3,151,175	2,210,097	5,361,273	6,288,089	7,288,467
year 2007		3,079,666	2,317,150	5,396,815	6,302,599	7,305,286
year 2008		3,007,821	2,408,995	5,416,816	6,301,469	7,303,976
year 2009		2,935,836	2,486,839	5,422,674	6,286,155	7,286,225
year 2010		2,863,885	2,551,806	5,415,691	6,258,011	7,253,603
year 2011		2,792,130	2,604,947	5,397,077	6,218,292	7,207,566
year 2012		2,720,715	2,647,241	5,367,956	6,168,166	7,149,465
year 2013		2,649,770	2,679,599	5,329,369	6,108,713	7,080,554
year 2014		2,579,412	2,702,873	5,282,285	6,040,936	7,001,994
year 2015		2,509,746	2,717,855	5,227,601	5,965,761	6,914,860
year 2016		2,440,866	2,725,280	5,166,146	5,884,048	6,820,147
year 2017		2,372,855	2,725,836	5,098,691	5,796,589	6,718,774
year 2018		2,305,787	2,720,159	5,025,945	5,704,118	6,611,591
year 2019		2,239,725	2,708,841	4,948,566	5,607,308	6,499,380
year 2020		2,174,726	2,692,433	4,867,159	5,506,785	6,382,864
Present value		43,046,252	40,986,497	84,032,748	96,693,411	112,076,453
Annual fixed power cost (present value)						
year 2005		349,766	433,259	783,025	884,570	1,026,733
year 2006		333,111	412,627	745,738	842,447	977,841
year 2007		317,248	392,978	710,226	802,331	931,277
year 2008		302,141	374,265	676,406	764,125	886,930
year 2009		287,753	356,443	644,196	727,738	844,696
year 2010		274,051	339,469	613,520	693,084	804,472
year 2011		261,001	323,304	584,305	660,080	766,164
year 2012		248,572	307,909	556,481	628,647	729,680
year 2013		236,735	293,246	529,982	598,712	694,933
year 2014		225,462	279,282	504,745	570,202	661,841
year 2015		214,726	265,983	480,709	543,049	630,325
year 2016		204,501	253,317	457,818	517,190	600,309
year 2017		194,763	241,255	436,017	492,562	571,723
year 2018		185,488	229,766	415,255	469,106	544,498
year 2019		176,656	218,825	395,481	446,768	518,570
year 2020		168,243	208,405	376,648	425,493	493,876
Present value		3,980,218	4,930,335	8,910,553	10,066,101	11,683,867
Discount rate	5%	1.05	1.05		1.05	1.05

Cost of pipe

400 DI	15,684
500 DI	17,507
600 DI	23,879
700 DI	33,479
800 DI	34,991

Table B-2 Comparison of Transmission Alternatives

Item		Case 1-1	Case 1-2	Case 1	Case 2	Case-3
		Q=30,910 m^3/d	Q=29,575 m^3/d	Q=30,910+29,575 m^3/d	Q=60,485 m^3/d	Q=60,485 m^3/d
		ϕ600 mm	ϕ600 mm		ϕ800/500/600 mm	ϕ700/500/600 mm
		Pumping to Gothatuwa GR only	Pumping to Kolonnawa New GR Only		Pumping to Gothatuwa GR and New Kolonnawa GR	Pumping to Gothatuwa GR and New Kolonnawa GR
Cost of pipe (Ambatale-Hospital Junction), m	2,541	60,676,539	60,676,539	121,353,078	88,912,131	85,070,139
Cost of Pipe (Hospital Junction - Gothatuwa), m	1,821	43,483,659		43,483,659	31,880,247	31,880,247
Cost of Pipe (Hospital Junction - Kolonnawa), m	6,207		148,216,953	148,216,953	148,216,953	148,216,953
Total Cost of Pipe		104,160,198	208,893,492	313,053,690	269,009,331	265,167,339
Pump Head, m		34	44		44	51
Overall power efficiency		0.7	0.7		0.7	0.7
kVA rating required		155	192		392	455
Unit demand charge (SLRs./kVA)		240	240		240	240
Total Fixed Power Demand Charge (present value)		1,519,703	1,882,471	3,402,174	3,843,378	4,461,064
Unit power cost, (SLRs./kWh)		4.25	4.25		4.25	4.25
Total Power Consumption Cost (present value)		15,787,977	13,898,660	29,686,637	34,330,160	39,791,776
Total Cost of Energy , SLRs. (present value)		17,307,680	15,781,131	33,088,811	38,173,538	44,252,840
Total Present Value, SLRs. (year 2000)		121,468,000	224,675,000	346,143,000	307,183,000	309,420,000
				38,960,000	0	2,237,000

Annual power consumption cost (present value)						
year 2005		2,044,566	1,323,992	3,368,559	3,969,902	4,601,477
year 2006		1,825,666	1,280,443	3,106,109	3,643,069	4,222,648
year 2007		1,629,085	1,225,728	2,854,814	3,333,956	3,864,359
year 2008		1,452,726	1,163,503	2,616,229	3,043,501	3,527,695
year 2009		1,294,657	1,096,657	2,391,314	2,772,096	3,213,111
year 2010		1,153,109	1,027,454	2,180,562	2,519,712	2,920,575
year 2011		1,026,459	957,646	1,984,105	2,286,005	2,649,688
year 2012		913,231	888,569	1,801,799	2,070,397	2,399,778
year 2013		812,077	821,219	1,633,295	1,872,142	2,169,982
year 2014		721,774	756,321	1,478,095	1,690,381	1,959,305
year 2015		641,212	694,381	1,335,593	1,524,185	1,766,669
year 2016		569,387	635,733	1,205,119	1,372,586	1,590,952
year 2017		505,389	580,570	1,085,959	1,234,603	1,431,017
year 2018		448,400	528,981	977,381	1,109,264	1,285,737
year 2019		397,679	480,974	878,652	995,617	1,154,010
year 2020		352,561	436,490	789,050	892,745	1,034,772
Present value		15,787,977	13,898,660	29,686,637	34,330,160	39,791,776
Annual fixed power cost (present value)						
year 2005		221,940	274,919	496,859	561,293	651,500
year 2006		192,991	239,060	432,051	488,081	566,522
year 2007		167,818	207,878	375,696	424,418	492,628
year 2008		145,929	180,764	326,693	369,059	428,372
year 2009		126,895	157,186	284,080	320,921	372,497
year 2010		110,343	136,683	247,027	279,062	323,911
year 2011		95,951	118,855	214,806	242,662	281,662
year 2012		83,435	103,352	186,788	211,011	244,923
year 2013		72,552	89,871	162,424	183,488	212,977
year 2014		63,089	78,149	141,238	159,554	185,197
year 2015		54,860	67,956	122,816	138,743	161,041
year 2016		47,704	59,092	106,796	120,646	140,036
year 2017		41,482	51,384	92,866	104,910	121,770
year 2018		36,071	44,682	80,753	91,226	105,887
year 2019		31,366	38,854	70,220	79,327	92,076
year 2020		27,275	33,786	61,061	68,980	80,066
Present value		1,519,703	1,882,471	3,402,174	3,843,378	4,461,064
Discount rate	15%	1.15	1.15		1.15	1.15

Cost of pipe	
400 DI	15,684
500 DI	17,507
600 DI	23,879
700 DI	33,479
800 DI	34,991

Table B-2 Comparison of Transmission Alternatives

Item		Case 1-1	Case 1-2	Case 1	Case 2	Case-3
		Q=30,910 m^3/d	Q=29,575 m^3/d	Q=30,910+29,575 m^3/d	Q=60,485 m^3/d	Q=60,485 m^3/d
		ϕ600 mm	ϕ600 mm		ϕ800/500/600 mm	ϕ700/500/600 mm
		Pumping to Gothatuwa GR only	Pumping to Kolonnawa New GR Only		Pumping to Gothatuwa GR and New Kolonnawa GR	Pumping to Gothatuwa GR and New Kolonnawa GR
Cost of pipe (Ambatale-Hospital Junction), m	2,541	60,676,539	60,676,539	121,353,078	88,912,131	85,070,139
Cost of Pipe (Hospital Junction - Gothatuwa), m	1,821	43,483,659		43,483,659	31,880,247	31,880,247
Cost of Pipe (Hospital Junction - Kolonnawa), m	6,207		148,216,953	148,216,953	148,216,953	148,216,953
Total Cost of Pipe		**104,160,198**	**208,893,492**	**313,053,690**	**269,009,331**	**265,167,339**
Pump Head, m		34	44		44	51
Overall power efficiency		0.7	0.7		0.7	0.7
kVA rating required		155	192		392	455
Unit demand charge (SLRs./kVA)		240	240		240	240
Total Fixed Power Demand Charge (present value)		**2,385,427**	**2,954,851**	**5,340,278**	**6,032,822**	**7,002,382**
Unit power cost, (SLRs./kWh)		4.25	4.25		4.25	4.25
Total Power Consumption Cost (present value)		**25,252,620**	**23,088,637**	**48,341,257**	**55,768,498**	**64,640,759**
Total Cost of Energy , SLRs. (present value)		**27,638,047**	**26,043,488**	**53,681,535**	**61,801,319**	**71,643,141**
Total Present Value, SLRs. (year 2000)		**131,798,000**	**234,937,000**	**366,735,000**	**330,811,000**	**336,810,000**
				35,924,000	0	5,999,000
Annual power consumption cost (present value)						
year 2005		2,563,448	1,653,527	4,206,975	4,957,989	5,746,760
year 2006		2,383,703	1,671,826	4,055,530	4,756,619	5,513,354
year 2007		2,223,719	1,673,133	3,896,851	4,550,886	5,274,891
year 2008		2,073,122	1,660,385	3,733,507	4,343,249	5,034,221
year 2009		1,931,529	1,636,127	3,567,657	4,135,753	4,793,714
year 2010		1,798,547	1,602,558	3,401,105	3,930,089	4,555,331
year 2011		1,673,780	1,561,571	3,235,351	3,727,639	4,320,673
year 2012		1,556,834	1,514,791	3,071,626	3,529,518	4,091,032
year 2013		1,447,319	1,463,612	2,910,930	3,336,612	3,867,437
year 2014		1,344,848	1,409,218	2,754,067	3,149,610	3,650,685
year 2015		1,249,048	1,352,619	2,601,666	2,969,033	3,441,380
year 2016		1,159,551	1,294,664	2,454,215	2,795,259	3,239,959
year 2017		1,076,003	1,236,067	2,312,071	2,628,542	3,046,720
year 2018		998,063	1,177,425	2,175,488	2,469,037	2,861,838
year 2019		925,402	1,119,230	2,044,631	2,316,808	2,685,391
year 2020		857,703	1,061,884	1,919,587	2,171,853	2,517,375
Present value		25,252,620	23,088,637	48,341,257	55,768,498	64,640,759
Annual fixed power cost (present value)						
year 2005		277,179	343,345	620,524	700,995	813,655
year 2006		251,981	312,132	564,113	637,268	739,687
year 2007		229,074	283,756	512,830	579,335	672,442
year 2008		208,249	257,960	466,209	526,668	611,311
year 2009		189,317	234,509	423,826	478,789	555,738
year 2010		172,107	213,190	385,297	435,263	505,216
year 2011		156,460	193,809	350,270	395,694	459,287
year 2012		142,237	176,190	318,427	359,721	417,534
year 2013		129,306	160,173	289,479	327,019	379,576
year 2014		117,551	145,612	263,163	297,290	345,069
year 2015		106,865	132,374	239,239	270,264	313,699
year 2016		97,150	120,340	217,490	245,695	285,181
year 2017		88,318	109,400	197,718	223,359	259,256
year 2018		80,289	99,455	179,744	203,053	235,687
year 2019		72,990	90,413	163,403	184,594	214,261
year 2020		66,355	82,194	148,548	167,813	194,783
Present value		2,385,427	2,954,851	5,340,278	6,032,822	7,002,382
Discount rate	10%	1.1	1.1		1.1	1.1
Cost of pipe						
		400 DI			15,684	
		500 DI			17,507	
		600 DI			23,879	
		700 DI			33,479	
		800 DI			34,991	

APPENDIX 3C

DISTRIBUTION PIPE NETWORK ANALYSIS

APPENDIX 3C DISTRIBUTION NETWORK ANALYSIS

3C.1 BASIS OF NETWORK ANALYSIS

Preliminary network analysis was carried out to determine the requirement of pipeline strengthening for the year 2020 demand. Approximately 40 km of priority pipeline was selected for strengthening under this project. Route and leveling surveys were carried out along the priority pipeline routes. Network analysis was refined with the information obtained from route and leveling survey and information from the NWSDB field staff. Following were used in the analysis.

- Preliminary analysis was based on length and ground elevation from 1:10000 scale map (blue print) provided by NWSDB. Length and ground elevation along priority pipeline routes are from the survey results. Difference in pipe lengths are negligible for this purpose.
- Hazen-Williams equation is used with C values as follows

For all PVC mains above 100 mm or 4"	- 130
DI pipes with cement mortar lining (250 mm and above)	- 120
All existing pipes less than 4" or 110 mm PVC	- 90

- Internal diameter used for the network calculations are as follows:

Table 3C-1 Internal Diameters Used for Network Calculations

Nominal Diameter	Internal Diameter used for computation, mm
1"	25
11/2"	38
2"	50
21/2"	63
3"	75
4"	100
6"	150
90 mm PVC	75
110 mm PVC	100
225 mm PVC	200
250 mm DI	250
300 mm DI	300
400 mm DI	400
500 mm DI	500

- All existing tappings from transmission mains are considered to be closed and the single distribution source will be the New Gothatuwa Water Tower whose minimum water level is 41.5 m above MSL. (Node number of the source is N1500.) Pipes for strengthening are added to the network starting from pipe number P2100 until P2307 connected at

interconnections to the existing network.

- Demand is allocated to the same nodes as NWSDB with a factor to account for the increased demand. Nodes where demand is allocated are shown in italics in the worksheet. Other dummy nodes are used with zero demand to account for the shape of the pipe route since pipe length is calculated automatically from the scanned map. Zero demand is assigned to these dummy nodes.
- Hourly maximum demand is 49,500 m^3/d (hourly peak factor of 1.6) and day maximum demand is 30,910 m^3/d in the year 2020.
- New pipelines along Avissawella Road was avoided as there are four large size transmission mains (two 30" and two 20") and a 4" distribution main existing on that road in addition to telephone cables. Laying another main will be extremely difficult unless road is widened. Larger main could be laid when road widening is carried out. Network analysis is made considering only the existing distribution main in that road.
- Minimum allowable residual pressure head is 10 m of water during maximum hourly flow condition. However, exceptions are allowed for interior nodes where residual pressure head is close to 10 m.
- Network analysis was carried out by VIPNES (Visual Pipeline Network Simulator) Program.
- Changes/modifications were made on the routes and diameters following the preliminary analysis and survey results.

  Shanthi Mawatha - revised route following survey

  Pethiagoda Road - revised route following survey

  Malpura Road - revised route following survey

  Salalihini Mawatha - eliminated (no connecting road between Siri Sumana Mawatha and Ranabiru Mawatha)

  Nagahawela Road / Abeysiri Perera Mawatha

  - small part eliminated and connection to Low level Road through Nagahawela Road is added

  Between Halgahasdeniya Road and Koswatta Road

  - additional route to reduce the diameter along Bandaranayakepura Road (400 mm to 300 mm) and increase network reliability

- Diameters were reduced to reduce residual pressures along low-lying areas, especially along Old Avissawella Road (Sedawatta Road)
- Diameter along Udumulla Road was increased to improve residual pressures along Udumulla Road

3C.2 RESULTS OF NETWORK ANALYSIS

Figure 3C-1 shows the pipeline network for the year 2020 showing priority pipelines to be strengthened as thick lines. Table 3C-2 shows the residual pressures at the nodes for the hourly maximum flow condition.

Network was checked for fire demand at average flow condition for not developing negative water pressures in the network.

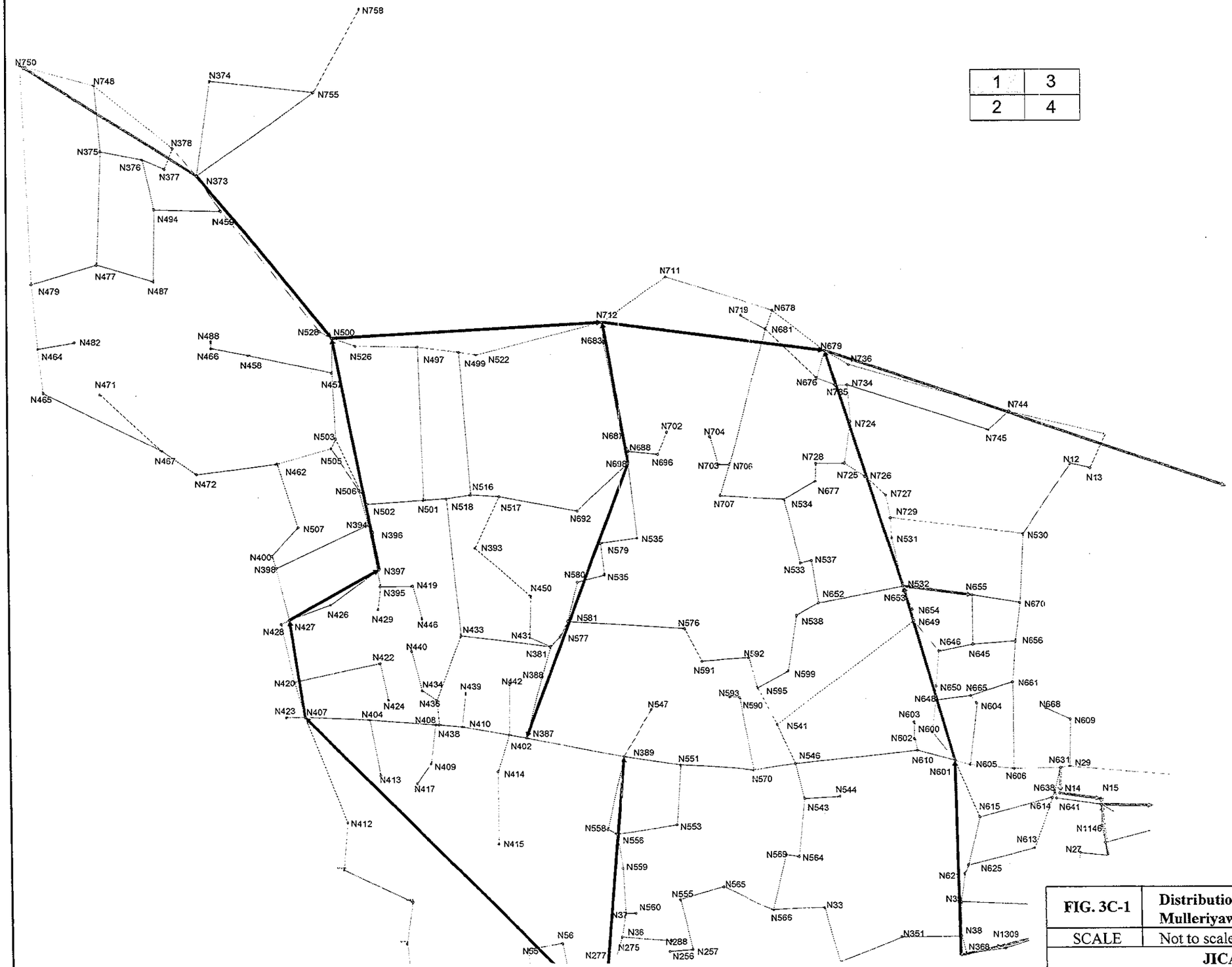


FIG. 3C-1	**Distribution Pipe Network for Kotikawatte-Mulleriyawa Area - Year 2020 (1/4)**
SCALE	Not to scale

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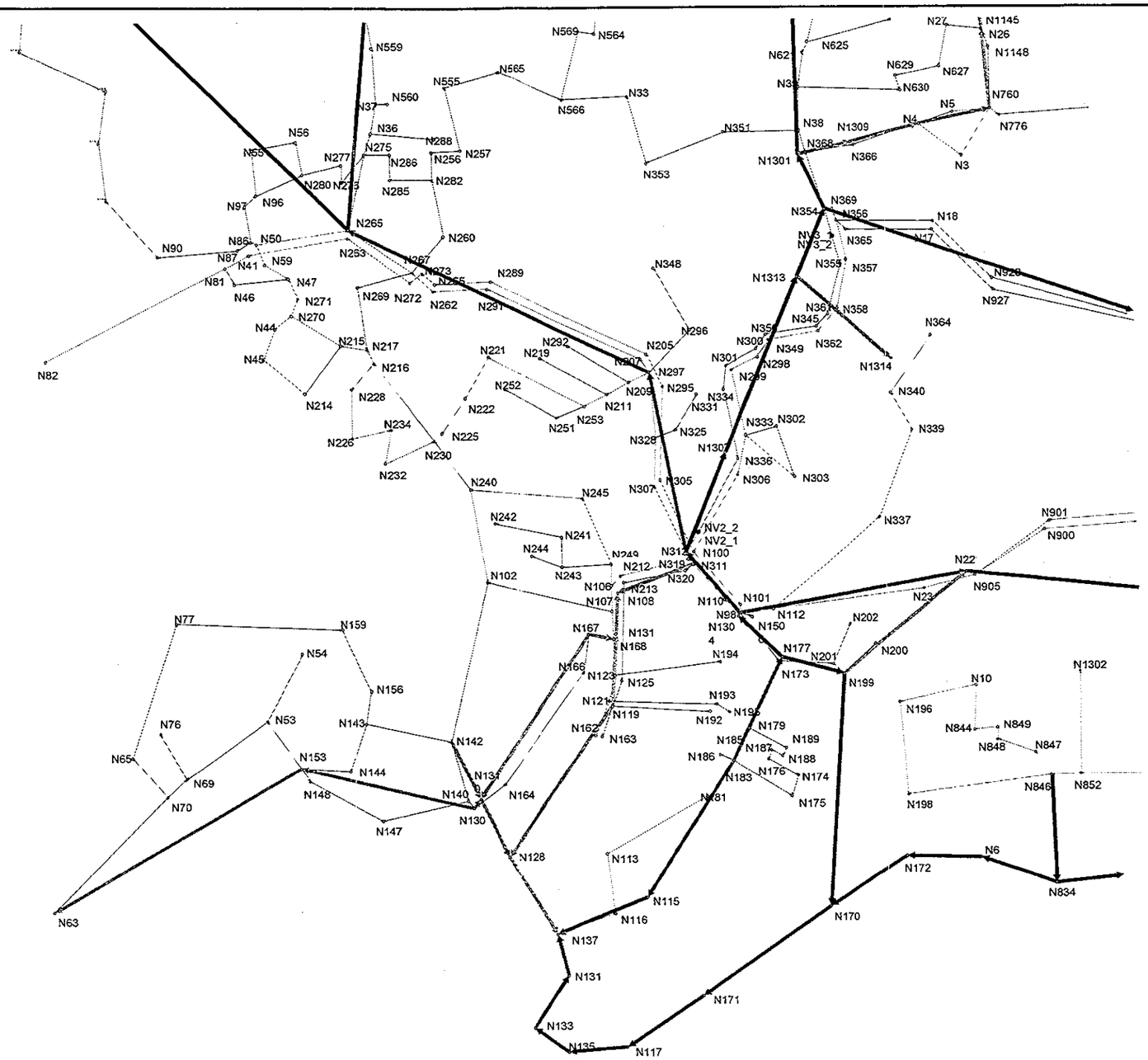
THE DETAILED DESIGN STUDY ON THE PROJECT FOR REDUCTION OF NON-REVENUE WATER IN THE GREATER COLOMBO AREA IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA



1	3
2	4

FIG. 3C-1	**Distribution Pipe Network for Kotikawatte-Mulleriyawa Area - Year 2020 (2/4)**
SCALE	Not to scale

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1	3
2	4

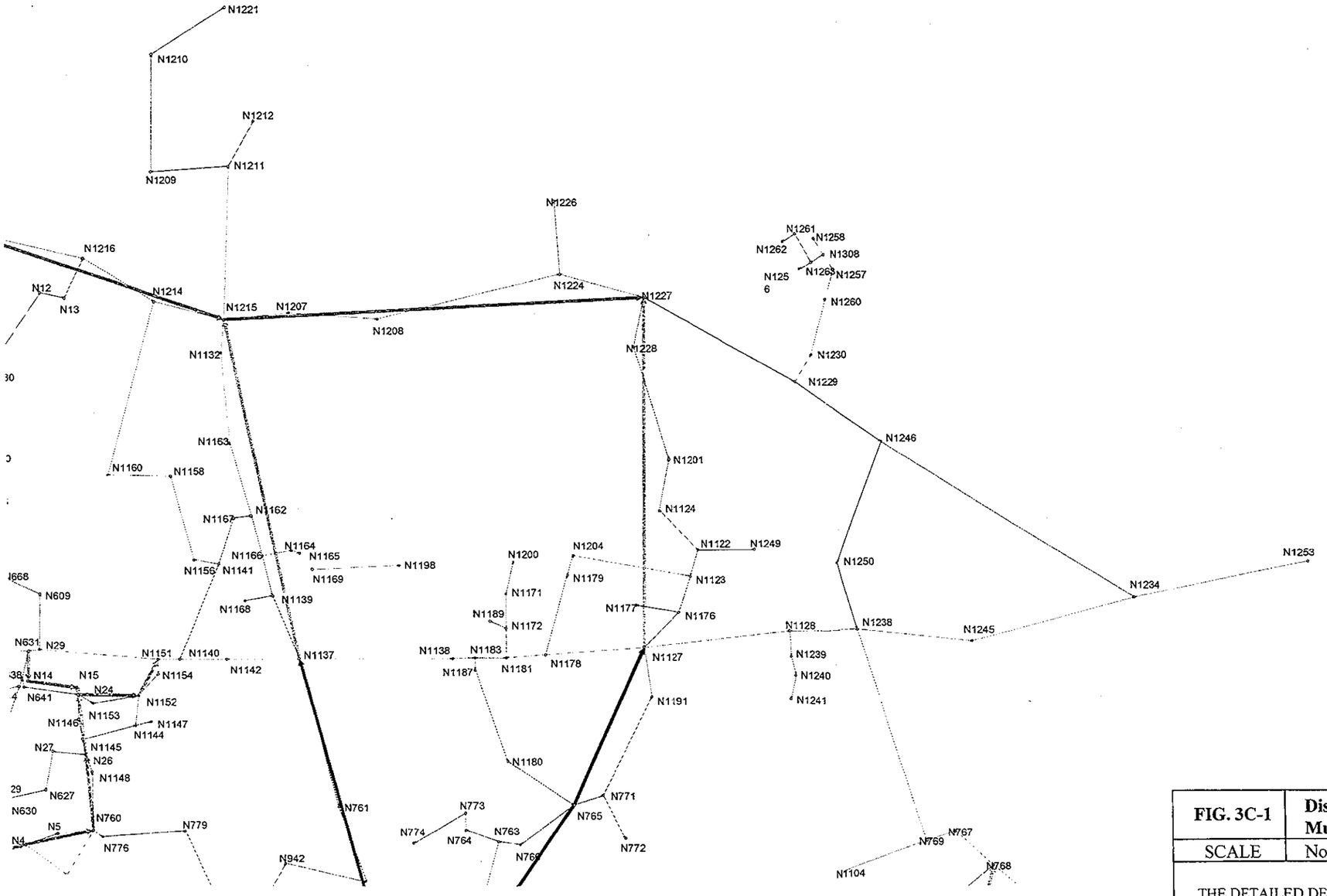

FIG. 3C-1	**Distribution Pipe Network for Kotikawatte-Mulleriyawa Area - Year 2020 (3/4)**
SCALE	Not to scale

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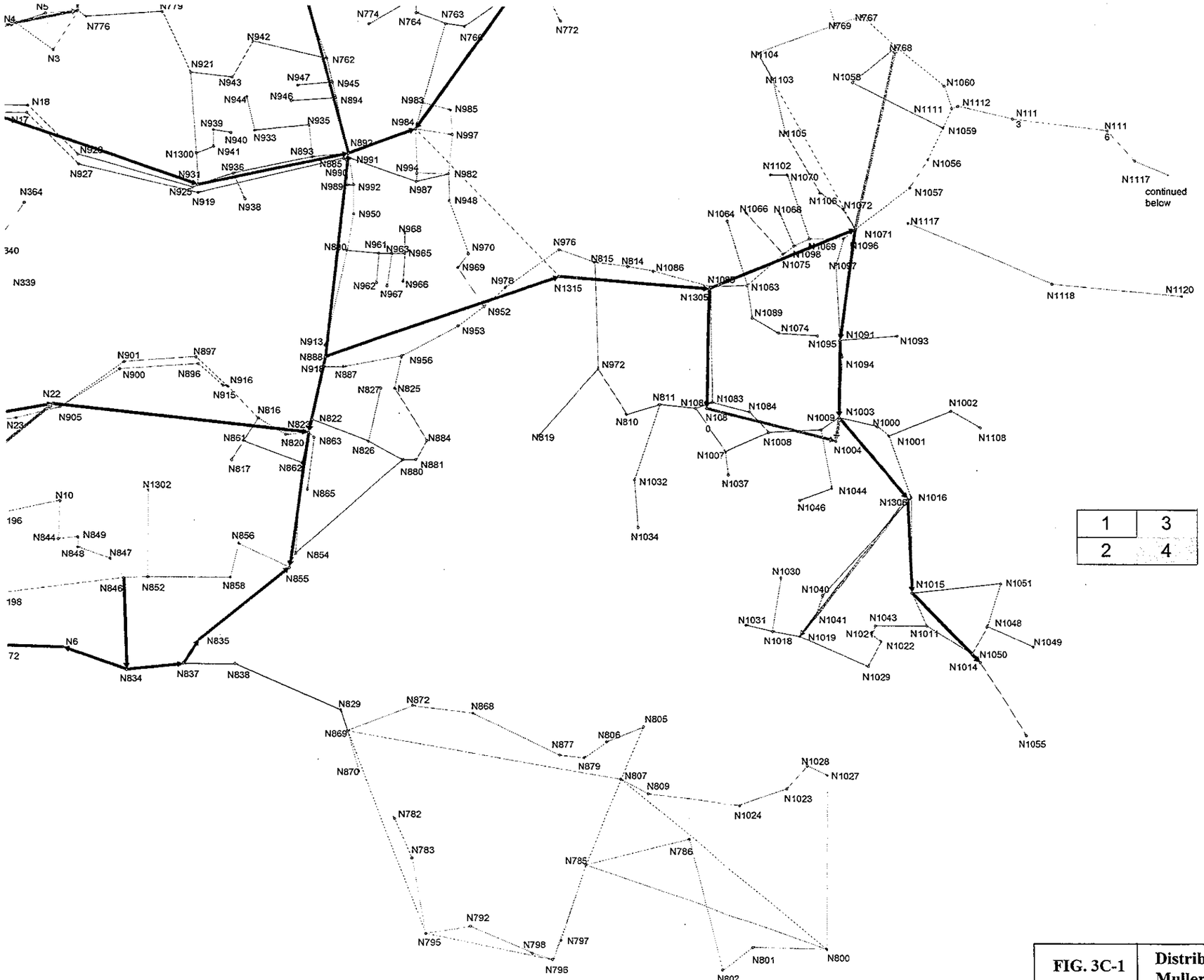

1	3
2	4

FIG. 3C-1	**Distribution Pipe Network for Kotikawatte-Mulleriyawa Area - Year 2020 (4/4)**
SCALE	Not to scale

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