

## **APPENDIX A**

Table A1 Monthly municipal water consumption (Mm<sup>3</sup>) from April 1980-March 2012

Municipal demand (Mm <sup>3</sup> )	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1980	0.02	0.16	0.14	0.17	0.12	0.18	0.17	0.16	0.18	0.22	0.10	0.10
1981	0.15	0.18	0.15	0.17	0.18	0.16	0.43	0.20	0.19	0.25	0.10	0.25
1982	0.25	0.21	0.19	0.16	0.23	0.23	0.17	0.17	0.17	0.75	0.71	0.74
1983	0.74	0.72	0.65	0.85	0.60	0.60	0.64	0.61	0.61	0.60	0.66	0.68
1984	0.73	0.71	0.68	0.73	0.71	0.66	0.66	0.63	0.62	0.66	0.56	0.67
1985	0.69	0.70	0.72	0.83	0.73	0.70	0.78	0.71	0.65	0.68	0.63	0.72
1986	0.77	0.66	0.80	0.76	0.69	0.70	0.76	0.55	0.70	0.76	0.60	0.81
1987	0.64	0.65	0.49	0.80	0.64	0.55	0.62	0.56	0.57	0.63	0.60	0.65
1988	0.64	0.63	0.62	0.65	0.66	0.65	0.66	0.64	0.67	0.62	0.47	0.50
1989	0.67	0.68	0.67	0.76	0.79	0.79	0.80	0.79	0.80	0.81	0.81	0.94
1990	0.85	0.90	0.95	0.95	0.94	0.88	0.82	0.56	0.25	0.29	0.27	0.34
1991	0.33	0.34	0.25	0.27	0.23	0.24	0.20	0.28	0.29	0.25	0.27	0.39
1992	0.37	0.34	0.28	0.28	0.28	0.27	0.27	0.28	0.29	0.28	0.30	0.31
1993	0.28	0.27	0.26	0.27	0.27	0.27	0.34	0.26	0.35	0.16	0.31	0.34
1994	0.27	0.27	0.28	0.28	0.28	0.29	0.32	0.30	0.32	0.33	0.30	0.32
1995	0.26	0.24	0.28	0.28	0.28	0.27	0.28	0.30	0.30	0.31	0.29	0.31
1996	0.30	0.30	0.26	0.30	0.34	0.30	0.31	0.29	0.32	0.37	0.30	0.36
1997	0.33	0.29	0.28	0.27	0.30	0.25	0.28	0.28	0.30	0.30	0.28	0.30
1998	0.29	0.30	0.30	0.35	0.46	0.38	0.36	0.45	0.49	0.36	0.23	0.22
1999	0.17	0.17	0.29	0.33	0.35	0.33	0.33	0.32	0.36	0.37	0.35	0.33
2000	0.29	0.10	0.29	0.31	0.29	0.29	0.35	0.34	0.39	0.40	0.36	0.40
2001	0.39	0.40	0.39	0.40	0.40	0.39	0.40	0.39	0.40	0.40	0.36	0.40
2002	0.39	0.40	0.39	0.40	0.40	0.39	0.40	0.39	0.40	0.40	0.36	0.40
2003	0.39	0.40	0.39	0.40	0.40	0.39	0.40	0.39	0.40	0.40	0.36	0.40
2004	0.39	0.40	0.39	0.40	0.40	0.39	0.40	0.39	0.40	0.40	0.36	0.40
2005	0.39	0.40	0.39	0.40	0.40	0.39	0.40	0.39	0.57	0.57	0.52	0.57
2006	0.56	0.57	0.78	0.80	0.80	0.78	0.80	0.78	0.80	0.80	0.73	0.80
2007	0.78	0.80	0.78	0.80	0.80	0.78	0.80	0.78	0.99	0.99	0.90	0.99
2008	0.96	0.99	0.96	0.99	0.99	0.96	0.99	0.96	0.99	0.99	0.90	0.99
2009	0.96	0.99	0.96	0.99	0.99	0.96	0.99	0.96	0.99	0.99	0.90	0.99
2010	0.96	0.99	0.96	0.99	0.54	0.53	0.54	0.53	0.54	0.54	0.49	0.54
2011	0.53	0.54	0.53	0.54	0.54	0.53	0.54	0.53	0.54	0.54	0.49	0.54
Mean	0.49	0.49	0.49	0.53	0.50	0.48	0.51	0.47	0.50	0.51	0.46	0.52

Table A2 Monthly industrial water consumption (Mm<sup>3</sup>) from April 1980-March 2012

Industrial demand (Mm <sup>3</sup> )	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1980	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1981	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.01
1982	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.02	0.01	0.00	0.01	0.01
1983	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.00	0.00	0.02	0.02
1984	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
1985	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1986	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.02
1987	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.02
1988	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
1989	0.02	0.01	0.00	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.02
1990	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
1991	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.02	0.01	0.01	0.02	0.01
1992	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
1993	0.01	0.00	0.01	0.02	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02
1994	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02
1995	0.01	0.00	0.00	0.00	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01
1996	0.00	0.00	0.00	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.02
1997	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1998	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
1999	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
2000	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	1.52	1.37	1.52
2001	1.47	1.52	1.47	1.52	1.52	1.47	1.52	1.47	1.52	1.52	1.37	1.52
2002	1.47	1.52	1.47	1.52	1.52	1.47	1.52	1.47	1.52	1.52	1.37	1.52
2003	1.47	1.52	1.47	1.52	1.52	1.47	1.52	1.47	1.52	1.52	1.37	1.52
2004	1.47	1.52	1.47	1.52	1.52	1.47	1.52	1.47	1.52	1.52	1.37	1.52
2005	1.47	1.52	1.47	1.52	1.52	1.47	1.52	1.47	1.00	1.00	0.90	1.00
2006	0.97	1.00	0.97	1.00	1.00	0.97	1.00	0.97	1.00	1.00	0.90	1.00
2007	0.97	1.00	0.97	1.00	1.00	0.97	1.00	0.97	1.00	1.00	0.90	1.00
2008	0.97	1.00	0.97	1.00	1.00	0.97	1.00	0.97	1.00	1.00	0.90	1.00
2009	0.97	1.00	0.97	1.00	1.00	0.97	1.00	0.97	1.00	1.00	0.90	1.00
2010	0.97	1.00	1.05	1.09	1.09	1.05	1.09	1.05	1.09	1.09	0.98	1.09
2011	1.05	1.09	1.05	1.09	1.09	1.05	1.09	1.05	1.09	1.09	0.98	1.09
Mean	0.42	0.43	0.42	0.43	0.44	0.42	0.44	0.42	0.42	0.47	0.42	0.47

Table A3 Monthly irrigation water consumption (Mm<sup>3</sup>) from April 1980-March 2012

Irrigation demand (Mm <sup>3</sup> )	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1980	9.07	9.07	29.42	29.42	29.42	29.42	29.42	25.34	25.34	25.34	25.34	25.34
1981	25.34	25.34	59.40	59.40	59.40	59.40	59.40	28.57	28.57	28.57	28.57	28.57
1982	28.57	28.57	47.58	47.58	47.58	47.58	47.58	26.38	26.38	26.38	26.38	26.38
1983	26.38	26.38	60.76	60.76	60.76	60.76	60.76	9.99	9.99	9.99	9.99	9.99
1984	9.99	9.99	20.71	20.71	20.71	20.71	20.71	20.71	20.71	20.71	32.30	32.30
1985	32.30	32.30	68.90	68.90	68.90	68.90	68.90	32.24	32.24	32.24	32.24	32.24
1986	32.24	32.24	91.82	91.82	91.82	91.82	91.82	16.05	16.05	16.05	16.05	16.05
1987	16.05	16.05	76.88	76.88	76.88	76.88	76.88	34.49	34.49	34.49	34.49	34.49
1988	34.49	34.49	105.55	105.55	105.55	105.55	105.55	26.90	26.90	26.90	26.90	26.90
1989	26.90	26.90	102.89	102.89	102.89	102.89	102.89	62.99	62.99	62.99	62.99	62.99
1990	62.99	62.99	96.35	96.35	96.35	96.35	96.35	71.40	71.40	71.40	71.40	71.40
1991	71.40	71.40	91.57	91.57	91.57	91.57	91.57	74.48	74.48	74.48	74.48	74.48
1992	74.48	74.48	104.37	104.37	104.37	104.37	104.37	70.81	70.81	70.81	70.81	70.81
1993	70.81	69.23	69.23	69.23	69.23	69.23	69.23	68.38	68.38	68.38	68.38	68.38
1994	68.38	68.38	50.66	50.66	50.66	50.66	50.66	53.89	53.89	53.89	53.89	53.89
1995	53.89	53.89	64.10	64.10	64.10	64.10	64.10	5.00	5.00	5.00	5.00	5.00
1996	5.00	5.00	86.58	86.58	86.58	86.58	86.58	16.82	16.82	16.82	16.82	16.82
1997	16.82	16.82	97.20	97.20	97.20	97.20	97.20	36.72	36.72	36.72	36.72	36.72
1998	36.72	36.72	67.64	67.64	67.64	67.64	67.64	54.47	54.47	54.47	54.47	54.47
1999	54.47	54.47	91.83	91.83	91.83	91.83	91.83	31.21	31.21	31.21	31.21	31.21
2000	31.21	31.21	61.38	61.38	61.38	61.38	61.38	11.85	25.65	178.68	85.50	97.82
2001	47.65	4.69	0.85	81.71	81.71	81.71	81.71	69.49	69.49	69.49	69.49	69.49
2002	69.49	69.49	21.11	121.87	59.71	50.83	76.58	3.22	0.00	177.34	92.24	91.33
2003	45.62	21.51	66.01	89.89	60.42	64.82	51.77	0.00	0.00	177.34	92.24	91.33
2004	45.62	21.51	6.58	78.71	85.36	101.64	140.71	35.56	0.00	119.22	88.82	95.14
2005	53.22	28.11	4.59	105.11	76.17	48.05	116.91	0.00	101.13	96.50	88.24	66.26
2006	37.29	0.00	10.68	84.21	73.04	38.40	47.83	1.93	0.00	95.86	103.98	137.53
2007	129.51	34.95	0.00	111.34	58.15	86.84	67.50	23.32	35.69	106.50	118.95	138.88
2008	116.65	6.84	13.19	98.14	110.95	72.47	78.71	4.58	26.87	112.64	116.29	140.16
2009	117.29	5.75	34.85	122.91	126.77	125.45	125.18	4.05	43.22	104.38	118.79	141.95
2010	122.61	10.57	0.00	0.00	11.22	89.25	92.84	4.08	50.00	121.01	117.48	138.59
2011	135.60	26.07	46.15	96.93	90.83	28.23	14.65	0.00	47.27	111.08	119.43	139.37
Mean	53.38	31.73	54.65	79.24	74.35	72.89	76.23	28.90	36.44	69.90	62.18	66.45

Table A4 Monthly in-stream requirement (Mm<sup>3</sup>) from April 1980-March 2012

In-stream requirement (Mm <sup>3</sup> )	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1980	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1981	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1982	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1983	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1984	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1985	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1986	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1987	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1988	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1989	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1990	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1991	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1992	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1993	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1994	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1995	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1996	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1997	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1998	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
1999	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
2000	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
2001	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
2002	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
2003	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
2004	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
2005	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
2006	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
2007	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
2008	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
2009	12.00	12.40	12.00	12.40	12.40	12.00	12.40	12.00	12.40	12.40	11.20	12.40
2010	12.00	12.40	21.00	21.70	21.70	21.00	21.70	21.00	21.70	21.70	19.60	21.70
2011	21.00	21.70	21.00	21.70	21.70	21.00	21.70	21.00	21.70	21.70	19.60	21.70
Mean	12.28	12.69	12.56	12.98	12.98	12.56	12.98	12.56	12.98	12.98	11.73	12.98

Table A5 Monthly other water consumption (Mm<sup>3</sup>) from April 1980-March 2012

Other demand (Mm3)	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1980	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1981	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1982	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1983	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1984	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1985	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1986	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1987	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1988	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1989	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1990	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1991	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1992	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1993	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1994	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1995	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1996	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1997	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1998	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
1999	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	4.09	10.64	8.05
2000	6.84	0.10	0.16	7.03	3.00	0.53	5.19	7.21	1.81	18.85	17.02	18.85
2001	18.24	18.85	15.00	15.50	15.50	15.00	15.50	15.00	18.85	18.85	17.02	18.85
2002	18.24	18.85	15.00	15.50	15.50	15.00	15.50	18.24	18.85	18.85	17.02	18.85
2003	18.24	18.85	15.00	15.50	15.50	15.00	15.50	18.24	18.85	15.50	14.00	15.50
2004	15.00	15.50	15.00	15.50	15.50	15.00	15.50	15.00	15.50	15.50	14.00	15.50
2005	15.00	15.50	15.00	15.50	15.50	15.00	15.50	15.00	3.10	3.10	2.80	3.10
2006	3.00	3.10	7.78	8.04	8.04	7.78	8.04	7.78	8.04	1.87	1.69	1.87
2007	1.81	1.87	1.81	8.04	8.04	7.78	8.04	7.78	1.87	1.87	1.69	1.87
2008	1.81	1.87	1.81	1.87	1.87	1.81	1.87	1.81	1.87	1.87	1.69	1.87
2009	1.81	1.87	1.81	1.87	1.87	1.81	1.87	1.81	1.87	1.87	1.69	1.87
2010	1.81	1.87	1.81	1.87	1.87	1.81	1.87	1.81	1.87	1.87	1.69	1.87
2011	1.81	1.87	1.81	1.87	1.87	1.81	1.87	1.81	1.87	1.87	1.69	1.87
Mean	7.52	3.19	2.98	7.77	5.13	3.41	6.56	7.99	4.08	5.74	9.53	8.22

Table A6 Monthly rainfall data (mm.) at Nong wai from April 1981-March 2012

Year (mm)	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1981	93.70	200.70	242.20	242.40	142.30	121.30	127.20	68.20	0.00	0.00	25.60	31.20
1982	46.70	120.60	182.80	277.50	143.90	398.30	105.90	0.20	5.20	16.10	0.00	1.40
1983	19.30	145.40	321.40	158.20	218.50	140.20	47.90	15.10	2.60	0.00	11.90	5.20
1984	108.90	92.70	201.30	238.80	157.50	150.00	158.80	12.60	0.00	4.50	1.40	4.20
1985	29.50	172.30	235.00	124.10	264.80	146.30	129.70	0.00	0.00	0.00	0.00	32.30
1986	53.60	146.70	287.10	124.50	253.60	133.50	38.50	19.50	5.60	0.00	48.50	52.50
1987	159.70	146.50	222.70	124.00	321.20	154.00	77.90	10.00	0.00	0.00	1.90	13.60
1988	64.10	128.70	182.10	137.90	179.10	106.50	243.80	0.00	0.00	0.00	0.00	54.10
1989	27.30	215.90	238.80	70.90	157.30	180.70	152.80	0.00	0.00	0.00	55.90	43.50
1990	19.60	168.20	137.80	77.30	170.40	352.30	116.30	91.90	0.00	7.30	0.00	39.60
1991	30.80	122.30	90.10	213.20	288.20	244.90	20.20	0.00	60.70	8.30	10.60	16.00
1992	12.00	132.60	187.60	244.80	196.70	287.20	61.10	0.00	13.40	0.00	41.10	39.00
1993	33.00	111.10	118.30	118.60	196.00	255.60	32.50	0.00	1.30	0.00	94.20	128.00
1994	57.00	207.00	163.80	72.20	115.50	399.60	65.10	4.00	9.60	0.00	21.60	37.80
1995	38.10	147.00	188.90	185.40	246.60	80.20	87.50	6.50	0.00	2.00	12.70	79.80
1996	122.10	128.30	198.20	97.90	120.00	399.20	134.70	78.00	0.00	0.50	0.00	79.20
1997	146.30	97.10	231.10	283.60	147.80	208.60	172.30	11.30	0.00	0.00	92.50	4.70
1998	72.00	186.30	201.40	119.10	315.50	195.20	95.30	24.90	0.00	3.30	0.00	54.80
1999	196.00	245.90	93.80	193.90	47.10	254.50	105.70	9.00	0.20	0.00	3.10	5.10
2000	234.10	118.20	240.40	199.80	171.60	102.40	56.00	0.00	0.00	0.00	2.10	51.30
2001	56.50	234.20	207.40	150.10	355.30	198.80	141.50	19.30	0.00	0.40	1.20	30.20
2002	69.60	291.80	117.80	81.30	208.80	450.20	154.80	28.80	14.60	0.00	19.00	145.30
2003	39.10	78.50	144.70	110.50	310.70	226.50	35.50	0.00	0.00	11.70	44.00	6.20
2004	123.50	123.40	266.90	418.50	158.80	116.40	2.30	0.00	0.00	0.00	0.00	1.00
2005	64.60	108.70	122.50	143.80	98.60	220.40	57.40	29.90	2.80	0.00	12.00	27.80
2006	163.90	167.50	118.80	170.20	225.80	127.30	149.30	1.40	0.00	0.00	5.10	32.70
2007	36.70	140.40	87.00	201.40	331.30	110.00	133.50	0.90	0.00	15.50	11.80	69.00
2008	149.60	117.30	149.10	227.20	361.40	206.50	76.00	83.70	0.00	0.00	22.50	48.80
2009	138.90	108.50	66.60	164.30	200.70	217.30	48.30	1.20	0.00	44.40	15.50	38.00
2010	36.50	75.00	154.70	201.50	392.00	186.40	180.40	0.00	7.40	0.00	5.40	15.60
2011	14.90	128.90	85.10	201.60	275.30	458.20	149.70	29.10	0.00	11.50	0.00	24.60
Mean	79.28	148.64	176.95	173.37	218.46	220.27	101.87	17.60	3.98	4.05	18.05	39.11
STD	59.12	50.65	64.53	75.20	85.95	108.17	55.96	26.64	11.27	8.92	25.45	34.26

Table A7 Relationship between Elevation - Area and Storage

Elevation (EL) m(MSL)	Surface Area (A) sq.km.	Storage (S) Mm <sup>3</sup>
154	0.0000	0.0000
155	0.0000	0.0000
156	0.0006	0.0002
157	0.0059	0.0026
158	0.0265	0.0171
159	0.0717	0.0632
160	0.1600	0.1750
161	0.2922	0.3972
162	0.4944	0.7837
163	0.8136	1.4244
164	1.4312	2.5059
165	2.6816	4.4827
166	5.9744	8.5295
167	11.5221	17.1634
168	21.2248	33.1071
169	34.2147	60.7010
170	49.9197	102.5488
171	65.6641	160.2937
172	82.3030	234.0380
173	103.4810	326.5873
174	127.4461	441.8723
175	152.5126	581.6707
176	181.5980	748.2605
177	213.8420	945.6515
178	247.2651	1,176.0170
179	282.2734	1,440.8334
180	315.3394	1,740.0543
181	346.3223	2,071.3307
182	373.3958	2,431.3199
183	432.2862	2,832.4893
184	499.4800	3,163.1000
185	551.5400	3,688.4300
186	605.5000	4,266.7400
187	663.0000	4,900.6800
188	724.0700	5,593.9300
189	788.0500	6,349.9500
190	850.1900	7,169.5000



Table A8 Monthly inflow record (Mm<sup>3</sup>) of the Ubonratana Reservoir from April 1970-March 2012

Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1970	27.01	61.91	462.05	180.43	500.84	1080.84	347.05	260.34	6.27	0.00	21.22	10.46
1971	6.31	27.56	59.73	271.40	367.88	786.95	616.68	11.24	0.37	0.00	0.42	18.43
1972	38.37	0.55	7.69	69.08	31.87	125.93	588.66	47.77	41.66	2.22	0.00	2.71
1973	12.60	56.09	162.51	216.89	121.94	805.08	462.10	0.00	0.00	13.11	27.00	25.92
1974	25.02	4.26	25.74	31.16	213.62	291.10	378.05	130.72	44.16	15.17	7.87	26.41
1975	29.60	78.07	223.80	425.63	150.04	770.07	804.61	39.32	21.28	35.80	56.71	49.90
1976	16.67	135.58	62.72	69.59	135.98	938.61	918.87	551.29	30.96	21.19	4.05	44.81
1977	40.29	45.61	55.19	19.70	155.56	1336.07	118.56	40.87	28.53	9.56	4.38	14.11
1978	20.11	57.14	31.62	1013.16	1066.53	2263.65	1347.23	28.17	28.73	11.20	9.22	13.53
1979	25.34	119.27	1030.33	158.97	295.09	259.04	330.91	11.43	15.54	8.63	10.42	19.07
1980	8.42	229.39	1580.19	416.43	331.94	2070.20	1004.60	70.23	5.40	9.46	45.69	3.41
1981	13.83	45.92	43.07	187.65	160.75	71.19	142.86	86.45	14.57	10.47	13.54	17.57
1982	25.18	37.44	62.25	27.46	18.88	594.53	937.54	147.68	27.28	32.48	20.29	16.19
1983	18.31	34.78	217.44	286.49	837.97	858.31	573.62	179.83	43.70	28.50	16.91	22.30
1984	41.91	28.58	132.78	99.97	159.27	277.64	838.81	47.39	32.79	17.99	23.46	12.22
1985	25.90	70.61	73.54	81.25	70.59	216.07	358.08	147.04	55.33	18.00	8.72	10.89
1986	48.18	195.23	187.22	77.27	124.71	314.47	58.03	77.39	26.28	13.30	20.08	39.43
1987	37.66	34.86	111.25	32.51	273.83	781.72	728.14	112.45	37.27	29.93	29.81	19.78
1988	33.91	97.63	195.80	250.19	190.20	325.63	1524.56	254.79	47.91	29.95	15.42	17.20
1989	20.90	56.41	113.71	182.90	130.76	462.22	831.51	97.62	26.40	19.20	33.99	33.62
1990	21.75	153.60	295.56	152.57	147.04	515.62	1740.89	258.76	35.94	21.83	17.78	24.34
1991	29.43	45.66	71.76	47.80	557.41	1254.61	834.50	51.95	46.76	59.73	27.74	20.27
1992	19.73	42.11	105.93	126.62	398.94	355.62	326.37	48.66	30.20	17.83	26.58	18.18
1993	29.73	43.04	40.18	46.78	25.53	222.41	68.81	12.33	15.29	16.52	17.04	19.70
1994	15.25	63.84	54.30	83.86	36.97	722.75	254.29	27.21	37.52	15.35	11.87	7.57
1995	24.29	50.54	60.58	194.59	674.17	982.22	368.95	51.71	20.61	19.50	25.55	61.61
1996	57.51	95.79	90.98	89.28	80.94	1013.91	760.45	546.08	42.24	31.59	26.20	55.04
1997	63.19	50.37	53.11	57.08	65.24	137.61	277.16	44.51	18.45	14.04	16.13	14.19
1998	27.90	25.58	33.89	115.30	332.78	312.86	165.41	40.01	17.16	15.02	9.87	16.80
1999	53.45	268.78	354.73	197.82	164.45	720.52	596.97	478.12	26.13	29.02	20.96	11.12
2000	198.91	1012.44	667.40	581.41	351.38	992.34	296.63	139.73	20.51	24.72	8.80	56.30
2001	22.57	144.50	206.32	107.05	1234.55	1124.30	1009.45	440.14	20.30	27.70	24.40	56.31
2002	29.20	100.85	151.55	51.94	94.18	3009.90	593.55	400.35	43.40	16.44	29.45	61.31
2003	30.94	24.43	95.58	178.14	325.23	1402.98	194.63	26.65	9.99	25.14	29.81	22.67
2004	58.71	43.14	273.67	400.64	813.73	571.59	41.22	15.44	12.20	19.84	14.00	16.40
2005	44.69	57.96	75.60	134.50	23.35	501.50	114.83	109.02	27.51	17.14	33.03	28.70
2006	53.66	124.94	76.65	61.51	93.98	515.58	1349.85	65.08	14.17	17.14	33.03	28.70
2007	31.31	86.22	49.94	45.61	355.78	689.29	1377.39	110.07	37.98	37.26	33.67	55.33
2008	89.36	236.72	238.00	188.94	221.46	1634.72	850.83	731.73	58.66	27.80	22.11	59.55
2009	57.75	178.07	153.66	150.20	83.53	391.34	712.50	81.70	28.45	27.40	14.33	21.17
2010	21.07	29.14	46.45	121.31	1083.99	1217.12	1641.29	269.61	71.28	27.86	25.66	29.90
2011	29.09	186.35	253.13	237.14	644.54	2432.99	1413.44	103.99	40.51	54.82	17.06	27.87
Mean	36.31	106.69	197.32	177.81	313.03	841.69	664.28	152.26	28.80	21.19	20.34	26.93

Table A9 Monthly rainfall data (mm.) from April 1988-March 2012 and average monthly evaporation (mm.) at the Ubonratana Reservoir

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1988	0	0	0	0	114.8	239.6	33.5	283.6	110.6	138.8	0	0
1989	0	0	22.4	10	56.4	85.5	45.8	82.3	264.3	168.1	0	0
1990	0	34.9	53.5	17.1	211	40.6	110	211.9	353.1	160.3	23.7	0
1991	0	0	18.4	19	143.3	103.7	57.3	285.9	159.7	37.8	0	43
1992	13.5	18.2	0	0	63.1	132.2	310	170	212.9	31.8	0	10.5
1993	0	1.3	3.3	58	186.3	103.4	126.1	111.3	240.5	11	0	0
1994	0	33.6	60.5	7.8	152.5	142.3	95.4	68.8	266.6	39	4.1	54.2
1995	0	20.5	15.9	59.9	112.3	178.3	114.9	260.9	90.5	19.2	4.5	0
1996	0	24.2	124.3	101.7	32.6	75.7	61.5	97.9	312.8	61.8	23.5	0
1997	0.5	0	65.6	97.6	134.7	57.1	70.6	77	118.2	61.8	11.6	0
1998	0	26.7	5.7	85	55.6	205.9	91.5	282.3	133.7	53	25.2	0
1999	6.2	0	16.9	200.1	277.2	15.1	130.9	84.2	213.5	36	11.6	0
2000	0	11	2.2	194.4	156.7	161.9	188.8	108	86.6	97.7	0	0
2001	0.7	0	17.9	196.5	196.5	159.3	140.1	361.7	189	157.9	10	0
2002	0	11.7	71.5	22.5	261	152	64.5	164.2	292.2	232	28	7
2003	0	8.1	50.6	0.8	24.3	111.7	154.8	222.5	288.4	35.5	0	0
2004	20.3	34.9	32.1	166.7	138.5	187.8	316.5	148.2	202	0	6.5	0
2005	0	0	0	86.3	61	145.9	107.5	180.7	110.8	40.3	23	2.2
2006	0	78.3	9.1	135.4	88.4	153.4	111.2	136	258.7	167.7	9.6	0
2007	0	0	0	55.2	118.7	68.1	168.5	356	184.2	165.2	19.6	0
2008	8.8	10.3	88.6	98.4	153.5	142.2	129.6	201.8	233.2	58.2	5.3	0
Average Rainfall (mm)	2.38	14.94	31.36	76.78	130.40	126.75	125.19	185.49	205.79	84.43	9.82	5.57
EVA (mm)	93.73	87.77	111.01	114.97	111.52	103.62	99.73	88.64	77.86	95.98	94.71	96.25
Net EVA (mm)	91.35	72.83	79.65	38.19	-18.88	-23.13	-25.46	-96.84	-127.92	11.54	84.89	90.68
ent (m)	0.091	0.073	0.080	0.038	-0.019	-0.023	-0.025	-0.097	-0.128	0.012	0.085	0.091

NB: EVA=Evaporation, ent= net evaporation

Appendix A

Table A10 Monthly inflow record (Mm<sup>3</sup>), annual mean, standard deviation and Cv of the Ubonratana Reservoir from April 1980-March 2012 (the lowest annual mean and highest C<sub>v</sub> values are circled)

Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Mean	SD	C <sub>v</sub>
1980	8.42	229.39	1580.18	416.43	331.94	2070.19	1004.59	70.23	5.40	9.46	45.69	3.41	481.28	697.77	1.45
1981	13.83	45.92	43.07	187.65	160.75	71.19	142.86	86.45	14.57	10.47	13.54	17.57	67.32	63.66	0.95
1982	25.18	37.44	62.25	27.46	18.88	594.53	937.54	147.68	27.28	32.48	20.29	16.19	162.27	293.53	1.81
1983	18.31	34.78	217.44	286.49	837.97	858.31	573.62	179.83	43.70	28.50	16.91	22.30	259.85	319.72	1.23
1984	41.91	28.58	132.78	99.97	159.27	277.64	838.81	47.39	32.79	17.99	23.46	12.22	142.73	232.79	1.63
1985	25.90	70.61	73.54	81.25	70.59	216.07	358.08	147.04	55.33	18.00	8.72	10.89	94.67	102.34	1.08
1986	48.18	195.23	187.22	77.27	124.71	314.47	58.03	77.39	26.28	13.30	20.08	39.43	98.47	91.32	0.93
1987	37.66	34.86	111.25	32.51	273.83	781.72	728.14	112.45	37.27	29.93	29.81	19.78	185.77	275.42	1.48
1988	33.91	97.63	195.80	250.19	190.20	325.63	1524.55	254.79	47.91	29.95	15.42	17.20	248.60	416.16	1.67
1989	20.90	56.41	113.71	182.90	130.76	462.22	831.51	97.62	26.40	19.20	33.99	33.62	167.44	242.83	1.45
1990	21.75	153.60	295.56	152.57	147.04	515.62	1740.89	258.76	35.94	21.83	17.78	24.34	282.14	483.10	1.71
1991	29.43	45.66	71.76	47.80	557.41	1254.60	834.50	51.95	46.76	59.73	27.74	20.27	253.97	407.56	1.60
1992	19.73	42.11	105.93	126.62	398.94	355.62	326.37	48.66	30.20	17.83	26.58	18.18	126.40	146.00	1.16
<b>1993</b>	<b>29.73</b>	<b>43.04</b>	<b>40.18</b>	<b>46.78</b>	<b>25.53</b>	<b>222.41</b>	<b>68.81</b>	<b>12.33</b>	<b>15.29</b>	<b>16.52</b>	<b>17.04</b>	<b>19.70</b>	<b>46.45</b>	<b>57.87</b>	<b>1.25</b>
1994	15.25	63.84	54.30	83.86	36.97	722.75	254.29	27.21	37.52	15.35	11.87	7.57	110.90	203.98	1.84
1995	24.29	50.54	60.58	194.59	674.17	982.22	368.95	51.71	20.61	19.50	25.55	61.61	211.19	312.29	1.48
1996	57.51	95.79	90.98	89.28	80.94	1013.91	760.45	546.08	42.24	31.59	26.20	55.04	240.83	337.14	1.40
1997	63.19	50.37	53.11	57.08	65.24	137.61	277.16	44.51	18.45	14.04	16.13	14.19	67.59	74.33	1.10
1998	27.90	25.58	33.89	115.30	332.78	312.86	165.41	40.01	17.16	15.02	9.87	16.80	92.71	117.24	1.26
1999	53.45	268.78	354.73	197.82	164.45	720.52	596.97	478.12	26.13	29.02	20.96	11.12	243.51	245.28	1.01
2000	198.91	1012.43	667.40	581.41	351.38	992.34	296.63	139.73	20.51	24.72	8.80	56.30	362.55	368.13	1.02
2001	22.57	144.50	206.32	107.05	1234.55	1124.29	1009.44	440.14	20.30	27.70	24.40	56.31	368.13	472.42	1.28
<b>2002</b>	<b>29.20</b>	<b>100.85</b>	<b>151.55</b>	<b>51.94</b>	<b>94.18</b>	<b>3009.90</b>	<b>593.55</b>	<b>400.35</b>	<b>43.40</b>	<b>16.44</b>	<b>29.45</b>	<b>61.31</b>	<b>381.84</b>	<b>846.10</b>	<b>2.22</b>
2003	30.94	24.43	95.58	178.14	325.23	1402.97	194.63	26.65	9.99	25.14	29.81	22.67	197.18	392.04	1.99
2004	58.71	43.14	273.67	400.64	813.73	571.59	41.22	15.44	12.20	19.84	14.00	16.40	190.05	269.53	1.42
2005	44.69	57.96	75.60	134.50	23.35	501.50	114.83	109.02	27.51	17.14	33.03	28.70	97.32	133.35	1.37
2006	53.66	124.94	76.65	61.51	93.98	515.58	1349.85	65.08	14.17	17.14	33.03	28.70	202.86	385.86	1.90
2007	31.31	86.22	49.94	45.61	355.78	689.29	1377.38	110.07	37.98	37.26	33.67	55.33	242.49	407.36	1.68
2008	89.36	236.72	238.00	188.94	221.46	1634.71	850.83	731.73	58.66	27.80	22.11	59.55	363.32	482.53	1.33
2009	57.75	178.07	153.66	150.20	83.53	391.34	712.50	81.70	28.45	27.40	14.33	21.17	158.34	203.83	1.29
2010	21.07	29.14	46.45	121.31	1083.99	1217.11	1641.28	269.61	71.28	27.86	25.66	29.90	382.06	579.72	1.52
2011	29.09	186.35	253.13	237.14	644.54	2432.98	1413.43	103.99	40.51	54.82	17.06	27.87	453.41	740.89	1.63