REFERENCES

[1]Annual corporative plan-NWSDB, 2013

[2]Ebara Pump system Engineering hand book,Second Edition: September, 2001, Published By EBARA Corporation, pp139-166

[3]Internet www.engineeringtoolbox.com

[4]Mohanty, A.K (1994).Fluid Mechanics, SecondEdition, Prentice Hall, pp415-430, pp494-500

[5]National Water Supply & Drainage Board Energy Data

[6]Report fromM&E section, Eastern province, 2013

[7]TERI (2004), Training and audit for NWSDB, Sri Lanka, pp7-19

APPENDICES

[Appendix-A:Pump operation data- Batticaloa Region]

Table 10 : Pump operation data - Batticaloa Region

No.	Pump	Pump ID	Pump Type	Make	Model
1	Raw Water Pump	RWP1	Submersible Pump	KSB	AmarexKRTK 300-500/1006 UNG1
2	Raw Water Pump	RWP2	Submersible Pump	KSB	AmarexKRTK 300-500/1006 UNG1
3	Raw Water Pump	RWP3	Submersible Pump	KSB	AmarexKRTK 300-500/1006 UNG1
4	Recycle Pump	RP1	Vertical Multistage	KSB	Multitec V 125/3-9.1
5	Recycle Pump	RP2	Vertical Multistage	KSB	Multitec V 125/3-9.1
6	Recycle Pump	RP3	Vertical Multistage	KSB	Multitec V 125/3-9.1
7	Sand Filter Backwash Pump	SF BW1	Horizontal split case	KSB	OMEGA 300-300B
8	Sand Filter Backwash Pump	SF BW2	Horizontal split case	KSB	OMEGA 300-300B
9	Sand Filter Backwash Pump	SF BW3	Horizontal split case	KSB	OMEGA 300-300B
10	GAC Filter Backwash Pump	GF BW1	Vertical split case	KSB	OMEGA V350-360A
11	GAC Filter Backwash Pump	GF BW2	Vertical split case	KSB	OMEGA V350-360A
12	GAC Feed Pump	GAC FF1	Vertical split case	KSB	OMEGA 300-300A
13	GAC Feed Pump	GAC FF2	Vertical split case	KSB	OMEGA V300-300A
14	GAC Feed Pump	GAC FF3	Vertical split case	KSB	OMEGA V300-300A
15	Treated Water Pump	TW1	Horizontal split case	KSB	OMEGA 300-300B
16	Treated Water Pump	TW2	Horizontal split case	KSB	OMEGA 300-300B
17	Treated Water Pump	TW3	Horizontal split case	KSB	OMEGA 300-300B
18	Sludge Lagoon feed Pump	SLFP1	Submersible Pump	KSB	KRTK 150-315/114 UG-S
19	Sludge Lagoon feed Pump	SLFP2	Submersible Pump	KSB	KRTK 150-315/114 UG-S
20	Supernatant pump	SP1	Submersible Pump	KSB	KRTF 80-250/54 UG-S
21	Supernatant pump	SP2	Submersible Pump	KSB	KRTF 80-250/54 UG-S
22	Waste Sludge Transfer Pump	WSTP1	Submersible Pump	KSB	KRTF 80-250/54 UG-S
23	Waste Sludge Transfer Pump	WSTP2	Submersible Pump	KSB	KRTF 80-250/54 UG-S
24	Service water pump	SWP1	Vertical split case	Grundfos	MMG 160M-2-42FF30-G1
25	Service water pump	SWP2	Vertical split case	Grundfos	MMG 160M-2-42FF30-G1
26	Service water pump	SWP3	Vertical split case	Grundfos	MMG 160M-2-42FF30-G1

27	Airfield/Town Pump	P1	Vertical split case	KSB	OMEGA V100-310A
28	Airfield/Town Pump	P2	Vertical split case	KSB	OMEGA V100-310A
29	Chenkalady/Eravur Pump	P1	Vertical split case	KSB	OMEGA V150-460A
30	Chenkalady/Eravur Pump	P2	Vertical split case	KSB	OMEGA V150-460A
31	Iruthayapuram/Kallady Pump	P1	Vertical split case	KSB	OMEGA V200-420B
32	Iruthayapuram/Kallady Pump	P2	Vertical split case	KSB	OMEGA V200-420B
33	Kattankudy/Arayampathy	P1	Vertical split case	KSB	OMEGA V200-420B
34	Kattankudy/Arayampathy	P2	Vertical split case	KSB	OMEGA V200-420B

[Appendix-B:Pump operation data- Akkaraipattu Region]

Table 11 : Pump operation data - Akkaraipaththu Region

Model	Capacity (m^3/hr)	Poles	Head (m)	MRP(KW)	RPM
8*6*4	388.8	4	37	75	1475
8*6*4	388.8	4	37	75	1475
8*6*4	388.8	4	37	75	1475
8*6*4	342	4	70	132	1480
8*6*4	342	4	70	132	1480
8*6*4	234	4	58	75	1475
8*6*4	234	4	58	75	1475
8*6*4	223.2	4	56.38	75	1475
8*6*4	223.2	4	56.38	75	1475
8*6*4	223.2	4	56.38	75	1475
8*6*4	223.2	2	54.56	75	2950
8*6*4	223.2	2	54.56	75	2950
8*6*4	223.2	2	54.56	75	2950
TO80280-01	237.6	4	19	18.5	1455
TO80280-01	237.6	4	19	18.5	1455
TO80280-01	237.6	4	61.5	75	1475
TO80280-01	237.6	4	61.5	75	1475
100	216	4	36.27	37	1465
100	216	4	36.27	37	1465
100	216	4	36.27	37	1465
100	300	4	9	11.8	1465
100	95	4	10	5.5	1430
100	95	4	10	5.5	1430
100	42	4	11	5.5	1430
100	388.8	4	27	90	1480
100	388.8	4	27	90	1475

100	388.8	4	27	90	1475
100	281.22	4	28	30	1480
100	281.22	4	28	30	1480
100	208	4	36	37	1475
100	208	4	36	37	1475
8*6*4	155	4	19	13.5	1480
8*6*5	155	4	19	13.5	1480
8*6*6	155	4	19	13.5	1480
150*125*30	250	4	20	22	1500
150*125*31	250	4	20	22	1500
150*125*32	80	4	19	7.5	1450
150*125*33	80	4	19	7.5	1450
150*125*34	210	4	35	37	1460
150*125*35	210	4	35	37	1460
150*125*36	210	4	35	37	1460
CR3	45	2	41.4	5.5	2930
CR3	45	2	41.4	5.5	2930
CR3	45	2	41.4	5.5	2930
CR3	30	2	90.2	11	2924
CR3	30	2	90.2	11	2924

[Appendix-C: Pump operation data -- Trincomalee Region]

Table 12 : Pump operation data -- Trincomalee Region

NO	**Pump**	**Pump ID**	**Pump Type**	**Capacity (m^3/hr)**	**Poles**	**Head (m)**	**MRP(KW)**	**RPM**	**Specific speed**
1	Mahaweli Intake	MRWP1	Vertical Turbine	612	4	139	400	1480	50.4025
2	Mahaweli Intake	MRWP2	Vertical Turbine	612	4	139	400	1480	50.4025
3	Mahaweli Intake	MRWP3	Vertical Turbine	612	4	139	400	1480	50.4025
4	Mahaweli Intake	MRWP4	Vertical Turbine	612	4	139	400	1480	50.4025
5	Kantale Intake	KRWP1	Vertical Turbine	759.6	4	46.1	160	1480	64.6248
6	Kantale Intake	KRWP2	Vertical Turbine	759.6	4	46.1	160	1480	64.6248
7	Kantale Intake	KRWP3	Vertical Turbine	759.6	4	46.1	160	1480	64.6248
8	KantaleHLPS	KHLPS 1	Horizontal Multistage	1260	4	108	630	1480	43.9542
9	KantaleHLPS	KHLPS2	Horizontal Multistage	1260	4	108	630	1480	43.9542
10	KantaleHLPS	KHLPS3	Horizontal Multistage	1560	4	108	630	1480	48.9077

[Appendix-D: Pump operation data- AmparaRegion]

Table 13 : Pump operation data – Ampara Region

No	Location	Pump ID	Pump Type	Make	Model	Capacity (m^3/hr)	Poles	Head (m)	MRP (KW)
1	KTPECTAD	KTP P-1	High lift, Double suction, centrifugal	ITT FLYGT	AC-9100	828	4	55	185
2	KTP ECTAD	KTPP-2	High lift, Double suction, centrifugal	ITT FLYGT	AC-9100	828	4	55	185
3	KTP ECTAD	KTP P-3	High lift, Double suction, centrifugal	ITT FLYGT	AC-9100	828	4	55	185
4	KTP ECTAD	KTP P-4	High lift, Double suction, centrifugal	ITT FLYGT	AC-8100	385.2	4	63	90
5	KTP ECTAD	KTP P-5	High lift, Double suction, centrifugal	ITT FLYGT	AC-8100	313.2	2	42	55
6	KTP ECTAD	KTP P-6	High lift, Double suction, centrifugal	ITT FLYGT	AC-8100	313.2	2	42	55
7	KTP ECTAD	KTP P-7	High lift, Double suction, centrifugal	Water board	6UP4 200X150	400	4	45	75
8	KTP ECTAD	KTP P-8	High lift, Double suction, centrifugal	Water board	6UP4 200X150	400	4	45	75
9	KTPKFW	KTP P-9	High lift, Double suction, centrifugal	KSB	OMEGA 125-500B	175	4	57	55
10	KTPKFW	KTP P-10	High lift, Double suction, centrifugal	KSB	OMEGA 125-500B	175	4	57	55
11	KTPKFW	KTP P-11	High lift, Double suction, centrifugal	KSB	OMEGA 125-500B	175	4	57	55
12	KTPECTAD	KTP P-12	End suction vertical delivery centrifugal	AHLSTRON	APP43-300	1200	4	13	55
13	KTPECTAD	KTP P-13	End suction vertical delivery centrifugal	AHLSTRON	APP43-300	1200	4	13	55
14	KTPECTAD	KTP P-16	End suction vertical delivery centrifugal	AHLSTRON	APP43-300	1200	4	13	55
15	KTPKFW	KTP P-15	End suction vertical delivery centrifugal	KSB	APP43-300	375	4	30	22
16	KTPKFW	KTP P-16	End suction vertical delivery centrifugal	KSB	app43-300	375	4	30	22
17	KTPECTAD	KTP P-17	vertical turbine(8 stages)	TYCO	450M	1080	4	20	90

18	KTPECTAD	KTP P-18	vertical turbine	TYCO	450M	1080	4	20	90
19	KTPECTAD	KTP P-19	vertical turbine	TYCO	450M	1080	4	20	90
20	KTPECTAD	KTP P-20	vertical turbine	TYCO	450M	1080	4	20	90
21	KTPKFW	KTP P-21	vertical turbine	KSB	1LG4 207	368	4	16	30
22	KTPKFW	KTP P-22	vertical turbine	KSB	1LG4 208	368	4	16	30
23	KTPECTAD	KTP P-23	High lift, Double Suction, Vertical Centrifugal	Grundfos	NP33153	45	2	75	5.5
24	KTP ECTAD	KTP P-24	High lift, Double Suction, Vertical Centrifugal	Grundfos	NP33154	45	2	75	5.5
25	KTP ECTAD	KTP P-25	High lift, Vertical, Centrifugal	CRN	CRN90-4X-F-G	97.2	4	80	30
26	KTP ECTAD	KTP P-26	High lift, Vertical, Centrifugal	CRN	CRN90-4X-F-G	97.2	4	80	30
27	KTP ECTAD	KTP P-27	High lift, Vertical, Centrifugal	CRN	CRN90-4X-F-G	97.2	4	80	30
28	KTPECTAD	KTP P-28	High lift, Vertical, Centrifugal	CRN	CRN90-4X-F-G	97.2	4	80	30
29	KTPECTAD	KTP P-29	High lift, Vertical, Centrifugal	CRN	CRN90-4X-F-G	97.2	4	80	30
30	KTPECTAD	KTP P-30	High lift, Vertical, Centrifugal	CRN	CRN90-4X-F-G	97.2	4	80	30
31	Bangalawadiya T/P	HL (KAL)	High lift, Double suction, centrifugal	NIJHUISPOMPEN	HGT1-125	330	2	86	112
32	Bangalawadiya T/P	HL (SAM)	High lift, Double suction, centrifugal	NIJHUISPOMPEN	HGT1-126	240	4	42	45
33	Bangalawadiya T/P	LL-1	vertical turbine	HOXTON	XP10MFHG	205	4	64	75
34	Bangalawadiya T/P	LL-2	vertical turbine	LIANCHENG	SLO100-320	420	4	64	160

35	Inginiyagala	HL&.LL	B/H Submersible	KSB	B/H	30	2	52.5	9.3
36	Dehiattakandiya T/P	.LL	vertical turbine	REGENT	150VTC120-12X7	120	4	85	45
37	Dehiattakandiya T/P	HL	High lift, Double suction, centrifugal	REGENT	150VTC120-12X8	137	4	25	15
38	Padiyathalawa T/P	HL	High lift, Double suction, centrifugal	REGENT	150VTC120-12X9	30	4	26	5
39	Padiyathalawa T/P	LL	B/H Submersible	CFG	137	33	4	50	11
40	MahaOya	HL&LL P-1	High lift, Double suction, centrifugal	Jinasena	137	13.5	2	38	3.7
41	MahaOya	HL&.L P-2	High lift, Double suction, centrifugal	Jinasena	137	21.6	2	55	5.5

[Appendix-E:Pump operation details with calculations -Batticaloa Region]

Table 14 : Pump operation details with calculations -Batticaloa Region

No.	Pump	Pump ID	Pump Type	Make	Model	Capacity (m^3/hr)	Poles	Head (m)	MRP(KW)	RPM	Rated Current (A)	Specific speed	Pump efficiency	Load factor	Motor efficiency	Electrical Power Requirement	SEC Rated	AuditedCapacity (m^3/hr)	Power Consumption	SEC Audited	SEC Variation
1	Raw Water Pump	RWP1	Submersible Pump	KSB	AmarexKRTK 300-500/1006 UNG1	921.6	6	20.67	100	977	191	50.9928	0.858	0.6049	0.92	65.7569	0.0713	840	52	0.0619	-0.0091
2	Raw Water Pump	RWP2	Submersible Pump	KSB	AmarexKRTK 300-500/1006 UNG1	921.6	6	20.67	100	977	191	50.9928	0.858	0.6049	0.92	65.7569	0.0713	860	57	0.0662	-0.0050
3	Raw Water Pump	RWP3	Submersible Pump	KSB	AmarexKRTK 300-500/1006 UNG1	921.6	6	20.67	100	977	191	50.9928	0.858	0.6049	0.92	65.7569	0.0713	867	65	0.0749	0.0036
4	Recycle Pump	RP1	Vertical Multistage	KSB	Multitec V 125/3-9.1	104.4	4	87	45	1470	78.7	20.0317	0.74	0.7432	0.925	36.1559	0.3463	98.3	27.9	0.2838	-0.0624
5	Recycle Pump	RP2	Vertical Multistage	KSB	Multitec V 125/3-9.1	104.4	4	87	45	1470	78.7	20.0317	0.74	0.7432	0.925	36.1559	0.3463	97.8	28.35	0.2898	-0.0564
6	Recycle Pump	RP3	Vertical Multistage	KSB	Multitec V 125/3-9.1	104.4	4	87	45	1470	78.7	20.0317	0.74	0.7432	0.925	36.1559	0.3465	99	28.35	0.2863	-0.0599
7	Sand Filter Backwash Pump	SF BW1	Horizontal split case	KSB	OMEGA 300-300B	568.8	6	6.7	15	970	28.1	92.5857	0.845	0.8192	0.91	13.5042	0.0237	570	14.2	0.0249	0.0011
8	Sand Filter Backwash Pump	SF BW2	Horizontal split case	KSB	OMEGA 300-300B	568.8	6	6.7	15	970	28.1	92.5857	0.845	0.8192	0.91	13.5042	0.0237	575	14.5	0.0252	0.0014
9	Sand Filter Backwash Pump	SF BW3	Horizontal split case	KSB	OMEGA 300-300B	568.8	6	6.7	15	970	28.1	92.5857	0.845	0.8192	0.91	13.5042	0.0237	580	14.2	0.0244	0.0007
10	GAC Filter Backwash Pump	GF BW1	Vertical split case	KSB	OMEGA V350-360A	1423.08	6	5.5	37	980	65.6	171.5605	0.87	0.6625	0.92	26.6451	0.0187	1418	34.35	0.0242	0.0055
11	GAC Filter Backwash Pump	GF BW2	Vertical split case	KSB	OMEGA V350-360A	1423.08	6	5.5	37	980	65.6	171.5605	0.87	0.6625	0.92	26.6451	0.0187	1412	33.76	0.0239	0.0051
12	GAC Feed Pump	GAC FF1	Vertical split case	KSB	OMEGA 300-300A	875.2	6	4.5	18.5	970	35.4	154.7977	0.856	0.6776	0.92	13.6267	0.0155	877	16.8	0.0191	0.0035
13	GAC Feed Pump	GAC FF2	Vertical split case	KSB	OMEGA V300-300A	875.2	6	4.5	18.5	970	35.4	154.7977	0.856	0.6776	0.92	13.6267	0.0155	880	17.2	0.0195	0.0039

14	GAC Feed Pump	GAC FF3	Vertical split case	KSB	OMEGA V300-300A	875.2	6	4.5	18.5	970	35.4	154.7977	0.856	0.6776	0.92	13.6267	0.0155	875	17	0.0194	0.0038
15	Treated Water Pump	TW1	Horizontal split case	KSB	OMEGA 300-300B	828	4	19.42	75	1480	128.65	76.7253	0.858	0.6808	0.94	54.3248	0.0656	808	29	0.0358	-0.0297
16	Treated Water Pump	TW2	Horizontal split case	KSB	OMEGA 300-300B	828	4	19.42	75	1480	128.65	76.7251	0.858	0.6808	0.94	54.3248	0.0656	810	28.5	0.0351	-0.0304
17	Treated Water Pump	TW3	Horizontal split case	KSB	OMEGA 300-300B	828	4	19.42	75	1480	128.65	76.7251	0.858	0.6808	0.94	54.3248	0.0656	800	30	0.0375	-0.0281
18	Sludge Lagoon feed Pump	SLFP1	Submersible Pump	KSB	KRTK 150-315/114 UG-S	300	4	9	11.8	1465	23.5	81.3888	0.833	0.7484	0.88	10.0362	0.0334	297	10.25	0.0345	0.0010
19	Sludge Lagoon feed Pump	SLFP2	Submersible Pump	KSB	KRTK 150-315/114 UG-S	300	4	9	11.8	1465	23.5	81.3888	0.833	0.7484	0.88	10.0362	0.0335	296	9.95	0.0336	0.0001
20	Supernatant pump	SP1	Submersible Pump	KSB	KRTF 80-250/54 UG-S	95	4	10	5.5	1430	12.1	41.3091	0.787	0.5980	0.82	4.0111	0.0422	94	4.58	0.0487	0.0065
21	Supernatant pump	SP2	Submersible Pump	KSB	KRTF 80-250/54 UG-S	95	4	10	5.5	1430	12.1	41.3091	0.787	0.5980	0.82	4.0111	0.0422	93	4.51	0.0484	0.0062
22	Waste Sludge Transfer Pump	WSTP1	Submersible Pump	KSB	KRTF 80-250/54 UG-S	42	4	11	5.5	1430	12.1	25.5720	0.697	0.3283	0.82	2.2025	0.0524	41.5	5.16	0.1243	0.0718
23	Waste Sludge Transfer Pump	WSTP2	Submersible Pump	KSB	KRTF 80-250/54 UG-S	42	4	11	5.5	1430	12.1	25.5720	0.697	0.3283	0.82	2.20256	0.0524	41.3	5.61	0.135835351	0.0833
24	Service water pump	SWP1	Vertical split case	Grundfos	MMG 160M-2-42FF30-G1	45	4	67.2	11	2920	19.2	31.7067	0.75	0.9987	0.909	12.0862	0.2685	30	4.6	0.1533	-0.1152
25	Service water pump	SWP2	Vertical split case	Grundfos	MMG 160M-2-42FF30-G1	45	4	67.2	11	2920	19.2	31.7067	0.75	0.9987	0.909	12.0862	0.2685	31	4.8	0.1548	-0.1137
26	Service water pump	SWP3	Vertical split case	Grundfos	MMG 160M-2-42FF30-G1	45	4	67.2	11	2920	19.2	31.7067	0.75	0.9987	0.909	12.0862	0.2685	30	5.05	0.1683	-0.1002
27	Airfield/Town Pump	P1	Vertical split case	KSB	OMEGA V100-310A	133.2	4	26.91	18.5	1450	34.4	23.6066	0.783	0.6742	0.913	13.6621	0.1025	133.8	12.83	0.0958	-0.0066
28	Airfield/Town Pump	P2	Vertical split case	KSB	OMEGA V100-310A	133.2	4	26.91	18.5	1450	34.4	23.6066	0.783	0.6742	0.913	13.6621	0.1025	136	12.6	0.0926	-0.0099
29	Chenkalady/Eravur Pump	P1	Vertical split case	KSB	OMEGA V150-460A	471.6	4	68.34	132	1480	227	22.5362	0.816	0.8153	0.932	115.472	0.2448	322	61	0.1894	-0.05546
30	Chenkalady/Eravur Pump	P2	Vertical split case	KSB	OMEGA V150-460A	471.6	4	68.34	132	1480	227	22.5367	0.816	0.8153	0.932	115.472	0.2448	325	62	0.1907	-0.0540
31	Iruthayapuram/Kallady Pump	P1	Vertical split case	KSB	OMEGA V200-420B	543.6	4	30.16	75	1480	124	44.6865	0.854	0.697	0.938	55.7678	0.1025	529	51	0.0964	-0.0061
32	Iruthayapuram/Kallady Pump	P2	Vertical split case	KSB	OMEGA V200-420B	543.6	4	30.16	75	1480	124	44.6865	0.854	0.6974	0.938	55.7678	0.1025	520	52	0.1000	-0.0025
33	Kattankudy/Arayampathy	P1	Vertical split case	KSB	OMEGA V200-420B	511.2	4	45.05	90	1480	163	32.0726	0.838	0.8320	0.928	80.691	0.1578	502	65	0.1294	-0.0283
34	Kattankudy/Arayampathy	P2	Vertical split case	KSB	OMEGA V200-420B	511.2	4	45.05	90	1480	163	32.0726	0.838	0.8320	0.928	80.6916	0.1578	500	66	0.1320	-0.0258

[Appendix-F:Pump operation details with calculations –Akkaraipaththu]

Table 15 : Pump operation details with calculations –Akkaraipaththu

No	Pump	Pump ID	Pump Type	Make	Model	Capacity (m^3/hr)	Poles	Head (m)	MRP(KW)	RPM	Rated Current (A)	Specific speed	Pump efficiency	Load factor	Motor efficiency	Electrical Power (kW)	SEC Rated
1	Booster Pump AKP	AKP-P-1	high lift 8100	morton grove	8*6*4	388.8	4	37	75	1475	133	32.3111	0.834	0.6266	0.93	50.5374	0.1299
2	Booster Pump AKP	AKP -p-2	high lift 8100	morton grove	8*6*4	388.8	4	37	75	1475	133	32.3111	0.834	0.6266	0.93	50.5374	0.1299
3	Booster Pump AKP	AKP-P-3	high ligt 8100	morton grove	8*6*4	388.8	4	37	75	1475	133	32.3111	0.834	0.6266	0.93	50.5374	0.1299
4	Booster Pump AKP	ADD-P-1	high lift 9100	morton grove	8*6*4	342	4	70	132	1480	227	18.8495	0.74	0.6678	0.925	95.2982	0.2786
5	Booster Pump AKP	ADD-P-2	high lift 9100	morton grove	8*6*4	342	4	70	132	1480	227	18.8495	0.74	0.6678	0.925	95.2982	0.2786
6	Booster Pump AKP	OLUVIL-P-1	higt lift 8100	morton grove	8*6*4	234	4	58	75	1475	133	17.8927	0.74	0.6663	0.925	54.0262	0.2308
7	Booster Pump AKP	OLUVIL-P-2	high lift 8100	morton grove	8*6*4	234	4	58	75	1475	133	17.8927	0.845	0.5835	0.91	48.0928	0.2055
8	Booster Pump NTR	NTR-P-1	Booster	flygt china	8*6*4	223.2	4	56.38	75	1475	133	17.8502	0.845	0.5410	0.91	44.5918	0.1997
9	Booster Pump NTR	NTR-P-2	Booster	flygt china	8*6*4	223.2	4	56.38	75	1475	133	17.8502	0.845	0.5410	0.91	44.5918	0.1997
10	Booster Pump NTR	NTR-P-3	Booster	morton grave	8*6*4	223.2	4	56.38	75	1475	133	17.8502	0.87	0.5255	0.92	42.8397	0.1919
11	Booster Pump NTR	KRTV-P-1	Centrifugal	morton grave	8*6*4	223.2	2	54.56	75	2950	109.3	36.5899	0.87	0.5085	0.92	41.4568	0.1857
12	Booster Pump NTR	KRTV-P-2	Centrifugal	morton grave	8*6*4	223.2	2	54.56	75	2950	109.3	36.5899	0.856	0.5168	0.92	42.1348	0.1887

13	Booster Pump NTR	KRTV-P-3	Centrifugal	morton grave	8*6*4	223.2	2	54.56	75	2950	109.3	36.5899	0.856	0.5168	0.92	42.1348	0.1887
14	Intake Pump PVL	Pump 1	Centrifugal	EBARA CORP	TO80280 -01	237.6	4	19	18.5	1455	33.2	41.0742	0.856	0.7767	0.92	15.6197	0.0657
15	Intake Pump PVL	Pump 2	Centrifugal	EBARA CORP	TO80280 -01	237.6	4	19	18.5	1455	33.2	41.0742	0.858	0.7749	0.94	15.2517	0.0641
16	Booster Pump PVL	Pump 1	Centrifugal	EBARA CORP	TO80280 -01	237.6	4	61.5	75	1475	133	17.2547	0.858	0.6187	0.94	49.3674	0.2077
17	Booster Pump PVL	Pump 2	Centrifugal	EBARA CORP	TO80280 -01	237.6	4	61.5	75	1475	133	17.2547	0.858	0.6187	0.94	49.3674	0.2077
18	Booster Pump KAL	Maru P1	Centrifugal	morton grove	100	216	4	36.27	37	1465	68.5	24.2802	0.858	0.6724	0.94	26.4679	0.1225
19	Booster Pump KAL	Maru P2	Centrifugal	morton grave	100	216	4	36.27	37	1465	68.5	24.2802	0.858	0.6724	0.94	26.4679	0.1225
20	Booster Pump KAL	Maru P3	Centrifugal	morton grave	100	216	4	36.27	37	1465	68.5	24.2802	0.833	0.6926	0.88	29.1211	0.1348
21	Booster Pump Nav	BP1	Centrifugal	KSB	100	300	4	9	11.8	1465	23.5	81.3888	0.833	0.7484	0.88	10.0362	0.0334
22	Booster Pump Nav	BP2	Centrifugal	KSB	100	95	4	10	5.5	1430	12.1	41.3091	0.787	0.5980	0.82	4.01115	0.0422
23	Booster Pump Nav	HLP1	Centrifugal	KSB	100	95	4	10	5.5	1430	12.1	41.3091	0.787	0.5980	0.82	4.01115	0.0422
24	Booster Pump Nav	HLP2	Centrifugal	KSB	100	42	4	11	5.5	1430	12.1	25.5720	0.697	0.3283	0.82	2.20257	0.0524
25	Booster Pump Irakamam	AKP-P-1	Centrifugal	morton grove USA	100	388.8	4	27	90	1480	158	41.0630	0.697	0.4559	0.82	50.0469	0.1287
26	Booster Pump Irakamam	AKP -p-2	Centrifugal	morton grove USA	100	388.8	4	27	90	1475	158	40.9242	0.75	0.4237	0.909	41.9565	0.1079
27	Booster Pump Irakamam	AKP-P-3	Centrifugal	morton grove USA	100	388.8	4	27	90	1475	158	40.9242	0.75	0.4237	0.909	41.9565	0.1079
28	Booster Pump Irakamam	IRK-P-1	Vertical split case	morton grove USA	100	281.2	4	28	30	1480	53.8	33.9832	0.75	0.9535	0.909	31.4712	0.1119
29	Booster Pump Irakamam	IRK-P-2	Vertical split case	morton grove USA	100	281.2	4	28	30	1480	53.8	33.9832	0.783	0.9133	0.913	30.0127	0.1067

30	Booster Pump Irakamam	DAMANA	Vertical split case	morton grove USA	100	208	4	36	37	1475	68.5	24.1237	0.783	0.7042	0.913	28.5409	0.1372
31	Booster Pump Irakamam	DAMANA	Vertical split case	morton grove USA	100	208	4	36	37	1475	68.5	24.1237	0.816	0.6757	0.932	26.8283	0.1289
32	Thirukovil Intake Pump	RW P1	Submersible	Flygt	8*6*4	155	4	19	13.5	1480	17	33.7451	0.816	0.7284	0.932	10.5515	0.0680
33	Thirukovil Intake Pump	RW P2	Submersible	Flygt	8*6*5	155	4	19	13.5	1480	17	33.7451	0.816	0.7284	0.932	10.5515	0.0680
34	Thirukovil Intake Pump	RW P3	Submersible	Flygt	8*6*6	155	4	19	13.5	1480	17	33.7451	0.816	0.7284	0.932	10.5515	0.0680
35	T/P to Tkulam	HLP TK1	Horizontal Split casing	Grundfos	150*125*30	250	4	20	22	1500	40	41.7962	0.816	0.7589	0.932	17.9142	0.0716
36	T/P to Tkulam	HLP TK2	Horizontal Split casing	Grundfos	150*125*31	250	4	20	22	1500	40	41.7962	0.816	0.7589	0.932	17.9142	0.0716
37	T/P to Mandanai	HLP M 1	Horizontal Split casing	Grundfos	150*125*32	80	4	19	7.5	1450	12	23.7518	0.816	0.6767	0.932	5.44592	0.0680
38	T/P to Mandanai	HLP M2	Horizontal Split casing	Grundfos	150*125*33	80	4	19	7.5	1450	12	23.7518	0.816	0.6767	0.932	5.44592	0.0680
39	Mandanai to Distribution	DP 1	Horizontal Split casing	Grundfos	150*125*34	210	4	35	37	1460	67.5	24.5053	0.816	0.6633	0.932	26.3339	0.1254
40	Mandanai to Distribution	DP2	Horizontal Split casing	Grundfos	150*125*35	210	4	35	37	1460	67.5	24.5053	0.816	0.6633	0.932	26.3339	0.1254
41	Mandanai to Distribution	DP3	Horizontal Split casing	Grundfos	150*125*36	210	4	35	37	1460	67.5	24.5053	0.816	0.6633	0.932	26.3339	0.1254
42	Tkulam to Nerupuram	DP 1	Multi Stage	Grundfos	CR3	45	2	41.4	5.5	2930	12.4	45.7523	0.76	1.2144	0.925	7.2209	0.1604
43	Tkulam to Nerupuram	DP2	Multi Stage	Grundfos	CR3	45	2	41.4	5.5	2930	12.4	45.7523	0.76	1.2144	0.925	7.2209	0.1604
44	Tkulam to Nerupuram	DP3	Multi Stage	Grundfos	CR3	45	2	41.4	5.5	2930	12.4	45.7523	0.76	1.2144	0.925	7.2209	0.1604
45	Sangamankanda Pump	HLP 1	Multi Stage	Grundfos	CR3	30	2	90.2	11	2924	20.5	20.7884	0.68	0.9857	0.925	11.7223	0.39074
46	Sangamankanda Pump	HLP2	Multi Stage	Grundfos	CR3	30	2	90.2	11	2924	20.5	20.7884	0.68	0.9857	0.925	11.7223	0.3907

[Appendix-G:Pump operation details with calculations -- Trincomalee Region]

Table 16 : Pump operation details with calculations -- Trincomalee Region

No	Pump	Pump ID	Pump Type	Capacity (m^3/hr)	Poles	Head (m)	MRP(KW)	RPM	Specific speed	Pump efficiency	Load factor	Motor efficiency	Electrical Power Requirement	SEC Rated
1	Mahaweli Intake	MRWP1	Vertical Turbine	612	4	139	400	1480	50.4025	0.857	0.6761	0.967	279.7002	0.4570
2	Mahaweli Intake	MRWP2	Vertical Turbine	612	4	139	400	1480	50.4025	0.857	0.6761	0.967	279.7002	0.4570
3	Mahaweli Intake	MRWP3	Vertical Turbine	612	4	139	400	1480	50.4025	0.857	0.6761	0.967	279.7002	0.4570
4	Mahaweli Intake	MRWP4	Vertical Turbine	612	4	139	400	1480	50.4025	0.857	0.67617	0.967	279.7002	0.4570
5	Kantale Intake	KRWP1	Vertical Turbine	759.6	4	46.1	160	1480	64.6248	0.862	0.6918	0.914	121.1061	0.1594
6	Kantale Intake	KRWP2	Vertical Turbine	759.6	4	46.1	160	1480	64.6248	0.862	0.6918	0.914	121.1061	0.1594
7	Kantale Intake	KRWP3	Vertical Turbine	759.6	4	46.1	160	1480	64.6248	0.862	0.6918	0.914	121.1061	0.1594
8	KantaleHLPS	KHLPS 1	Horizontal Multistage	1260	4	108	630	1480	43.9542	0.874	0.6734	0.97	437.3660	0.3471
9	KantaleHLPS	KHLPS2	Horizontal Multistage	1260	4	108	630	1480	43.9542	0.874	0.6734	0.97	437.3660	0.3471
10	KantaleHLPS	KHLPS3	Horizontal Multistage	1560	4	108	630	1480	48.9077	0.874	0.8337	0.97	541.5008	0.3471

[Appendix-H:Pump operation details with calculations -- Ampara Region]

Table 17 : Pump operation details with calculations -- Ampara Region

No	Location	Pump ID	Pump Type	Make	Model	Capacity (m^3/hr)	Poles	Head (m)	MRP (KW)	RPM	Rated Current (A)	Specific speed	Pump Efficiency	Load factor	Motor Efficiency	Electrical Power Requirement	SEC Rated
1	KTPECTAD	KTP P-1	High lift, Double suction, centrifugal	ITT FLYGT	AC-9100	828	4	55	185	1500	320	25.1865	0.852	0.7872	0.93	156.6045	0.1891
2	KTPECTAD	KTP P-2	High lift, Double suction, centrifugal	ITT FLYGT	AC-9100	828	4	55	185	1500	320	25.1865	0.852	0.7872	0.93	156.6045	0.1891
3	KTPECTAD	KTP P-3	High lift, Double suction, centrifugal	ITT FLYGT	AC-9100	828	4	55	185	1500	320	25.1865	0.852	0.7872	0.93	156.6045	0.1891
4	KTPECTAD	KTP P-4	High lift, Double suction, centrifugal	ITT FLYGT	AC-8100	385.2	4	63	90	1500	168	15.5153	0.754	0.9744	0.947	92.6060	0.2404
5	KTPECTAD	KTP P-5	High lift, Double suction, centrifugal	ITT FLYGT	AC-8100	313.2	2	42	55	3000	93	37.9252	0.844	0.7721	0.92	46.1609	0.1473
6	KTPECTAD	KTP P-6	High lift, Double suction, centrifugal	ITT FLYGT	AC-8100	313.2	2	42	55	3000	93	37.9252	0.844	0.7721	0.92	46.1609	0.1473
7	KTPECTAD	KTP P-7	High lift, Double suction, centrifugal	Water toard	6UP4 200X150	400	4	45	75	1500	132	20.3491	0.795	0.8225	0.943	65.4225	0.1635
8	KTPECTAD	KTP P-8	High lift, Double suction, centrifugal	Water toard	6UP4 200X150	400	4	45	75	1500	140	20.3491	0.795	0.8225	0.943	65.4225	0.1635
9	KTPKFW	KTP P-9	High lift, Double suction, centrifugal	KSB	OMEGA 125-500B	175	4	57	55	1500	100	11.2729	0.672	0.7353	0.928	43.5842	0.2490
10	KTPKFW	KTP P-10	High lift, Double suction, centrifugal	KSB	OMEGA 125-500B	175	4	57	55	1500	100	11.2729	0.672	0.7353	0.928	43.5842	0.2490
11	KTPKFW	KTP P-11	High lift, Double suction, centrifugal	KSB	OMEGA 125-500B	175	4	57	55	1500	100	11.2729	0.672	0.7353	0.928	43.5842	0.2490
12	KTPECTAD	KTP P-12	End suction vertical delivery centrifugal	AHLSTRON	APP43-300	1200	4	13	55	970	99	81.8001	0.873	0.8852	0.937	51.9642	0.0433

13	KTPECTAD	KTP P-13	End suction vertical delivery centrifugal	AHLSTRON	APP43-300	1200	4	13	55	970	99	81.8001	0.873	0.8852	0.937	51.9642	0.0433
14	KTPECTAD	KTP P-16	End suction vertical delivery centrifugal	AHLSTRON	APP43-300	1200	4	13	55	970	99	81.8001	0.873	0.8852	0.937	51.9642	0.0433
15	KTPKFW	KTP P-15	End suction vertical delivery centrifugal	KSB	APP43-300	375	4	30	22	1500	41.5	37.7671	0.84	1.6587	0.93	39.2395	0.1046
16	KTPKFW	KTP P-16	End suctionupright delivery centrifugal	KSB	app43-300	375	4	30	22	1500	41.5	37.7671	0.84	1.6587	0.93	39.2395	0.1046
17	KTPECTAD	KTP P-17	vertical turbine(8 stages)	TYCO	450M	1080	4	20	90	1500	160	413.234	0.87	0.7516	0.917	73.7732	0.0683
18	KTPECTAD	KTP P-18	vertical turbine	TYCO	450M	1080	4	20	90	1500	160	413.2347	0.87	0.7516	0.917	73.7732	0.0683
19	KTPECTAD	KTP P-19	vertical turbine	TYCO	450M	1080	4	20	90	1500	160	413.23479	0.87	0.7516	0.917	73.7732	0.0683
20	KTPECTAD	KTP P-20	vertical turbine	TYCO	450M	1080	4	20	90	1500	160	413.2347	0.87	0.7516	0.917	73.7732	0.0683
21	KTPKFW	KTP P-21	vertical turbine	KSB	1LG4 207	368	4	16	30	1500	56	285.1618	0.846	0.6321	0.922	20.5683	0.0558
22	KTPKFW	KTP P-22	vertical turbine	KSB	1LG4 208	368	4	16	30	1500	56	285.1618	0.846	0.6321	0.922	20.5683	0.0558
23	KTPECTAD	KTP P-23	High lift, Double Suction, Vertical Centrifugal	Grundfos	NP33153	45	2	75	5.5	3000	11	9.3060	0.58	2.8828	0.897	17.6761	0.3928
24	KTPECTAD	KTP P-24	High lift, Double Suction, Vertical Centrifugal	Grundfos	NP33154	45	2	75	5.5	3000	11	9.3060	0.58	2.8828	0.897	17.6761	0.3928
25	KTPECTAD	KTP P-25	High lift, Vertical, Centrifugal	CRN	CRN90-4X-F-G	97.2	4	80	30	1500	55	9.2141	0.633	1.1157	0.932	35.9145	0.3694
26	KTPECTAD	KTP P-26	High lift, Vertical, Centrifugal	CRN	CRN90-4X-F-G	97.2	4	80	30	1500	55	9.2141	0.633	1.1157	0.932	35.9145	0.3694
27	KTPECTAD	KTP P-27	High lift, Vertical, Centrifugal	CRN	CRN90-4X-F-G	97.2	4	80	30	1500	55	9.2141	0.633	1.1157	0.932	35.9145	0.3694

28	KTPECTAD	KTP P-28	High lift, Vertical, Centrifugal	CRN	CRN90-4X-F-G	97.2	4	80	30	1500	55	9.2141	0.633	1.1157	0.932	35.9145	0.3694
29	KTPECTAD	KTP P-29	High lift, Vertical, Centrifugal	CRN	CRN90-4X-F-G	97.2	4	80	30	1500	55	9.2141	0.633	1.1157	0.932	35.9145	0.3694
30	KTPECTAD	KTP P-30	High lift, Vertical, Centrifugal	CRN	CRN90-4X-F-G	97.2	4	80	30	1500	55	9.2141	0.633	1.1157	0.932	35.9145	0.3694
31	Bangalawadiya T/P	HL (KAL)	High lift, Double suction, centrifugal	NIJHUISPOMPEN	HGT1-125	330	2	86	112	2950	219	22.3634	0.799	0.8641	0.925	104.6303	0.3170
32	Bangalawadiya T/P	HL (SAM)	High lift, Double suction, centrifugal	NIJHUISPOMPEN	HGT1-126	240	4	42	45	1470	79	16.2674	0.761	0.8020	0.925	39.0182	0.1625
33	Bangalawadiya T/P	LL-1	vertical turbine	HOXTON	XP10MFHG	205	4	64	75	1500	127.5	75.2487	0.752	0.6338	0.94	50.5733	0.2466
34	Bangalawadiya T/P	LL-2	vertical turbine	LIANCHENG	SLO100-320	420	4	64	160	1500	272	107.7078	0.813	0.5630	0.924	97.4991	0.2321
35	Inginiyagala	HL&LL	B/H Submersible	KSB	B/H	30	2	52.5	9.3	3000	18	14.0414	0.616	0.7491	0.91	7.6558	0.2551
36	Dehiattakandiya T/P	LL	vertical turbine	REGENT	150VTC120-12X7	120	4	85	45	1500	76	46.5354	0.641	0.9635	0.923	46.9758	0.3914
37	Dehiattakandiya T/P	HL	High lift, Double suction, centrifugal	REGENT	150VTC120-12X8	137	4	25	15	1450	26	17.8898	0.748	0.8317	0.9	13.8627	0.1011
38	Padiyathalawa T/P	HL	High lift, Double suction, centrifugal	REGENT	150VTC120-12X9	30	4	26	5	1450	8.6	8.1289	0.51	0.8334	0.82	5.0821	0.1694
39	Padiyathalawa T/P	LL	B/H Submersible	CFG	137	33	4	50	11	1450	19	7.3832	0.487	0.8392	0.88	10.4907	0.3179
40	MahaOya	HL&LL P-1	High lift, Double suction, centrifugal	Jinasena	137	13.5	2	38	3.7	3000	9	8.4875	0.417	0.9059	0.82	4.0879	0.3020
41	MahaOya	HL&LL P-2	High lift, Double suction, centrifugal	Jinasena	137	21.6	2	55	5.5	3000	11.4	8.1359	0.462	1.2739	0.894	7.8373	0.3628

[Appendix-J:Pump operation details with calculations -- Ampara Region]

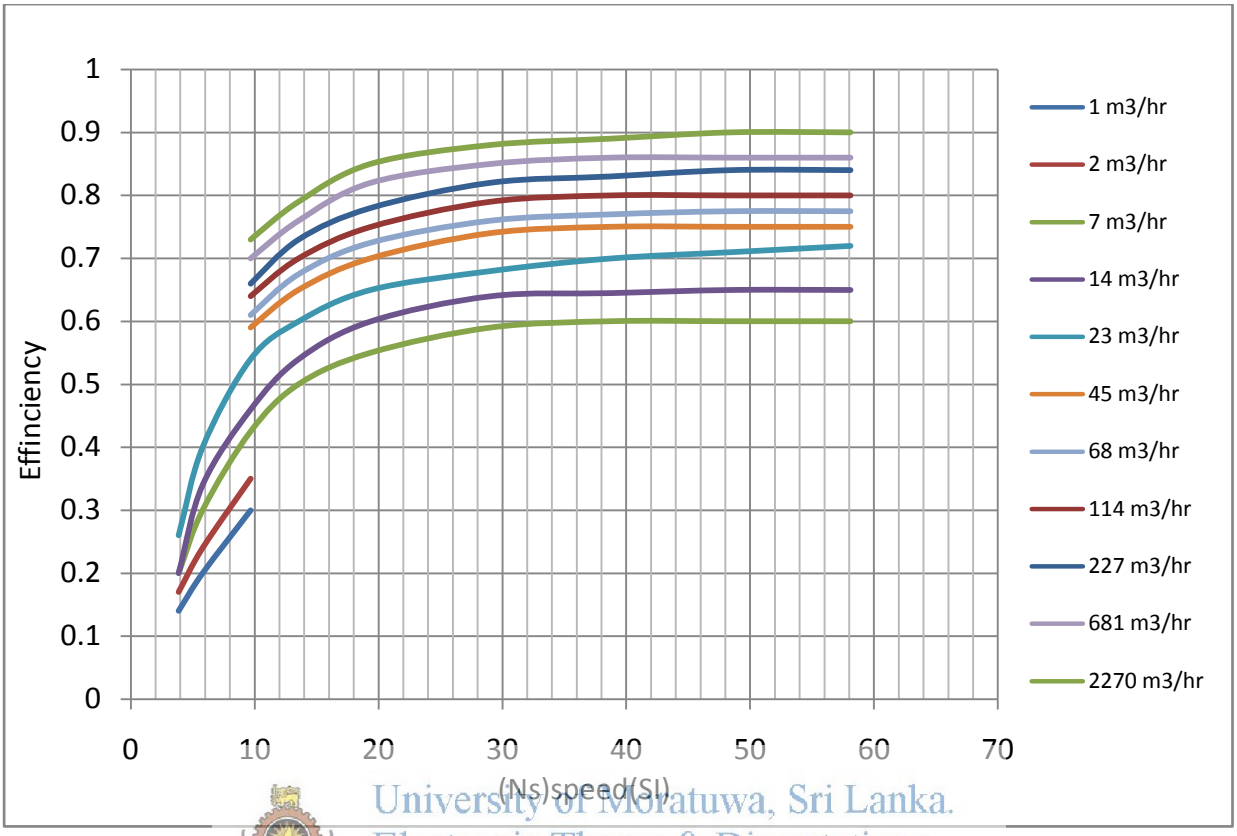

Figure5: Efficiency Vsmotor Speed

Table 18: Pump data for efficiency calculations

Ns(SI)	1 m^3/hr	2 m^3/hr	7 m^3/hr	14 m^3/hr	23 m^3/hr	45 m^3/hr	68 m^3/hr	114 m^3/hr	227 m^3/hr	681 m^3/hr	2270 m^3/hr
4	0.14	0.17	0.2	0.2	0.26						
6	0.2	0.24	0.3	0.34	0.4						
10	0.3	0.35	0.425	0.46	0.54	0.59	0.61	0.64	0.66	0.7	0.73
14			0.5	0.54	0.6	0.65	0.675	0.7	0.73	0.76	0.79
19			0.55	0.6	0.65	0.7	0.725	0.75	0.78	0.82	0.85
29			0.59	0.64	0.68	0.74	0.76	0.79	0.82	0.85	0.88
39			0.6	0.645	0.7	0.75	0.77	0.8	0.83	0.86	0.89
48			0.6	0.65	0.71	0.75	0.775	0.8	0.84	0.86	0.9
58			0.6	0.65	0.72	0.75	0.775	0.8	0.84	0.86	0.9

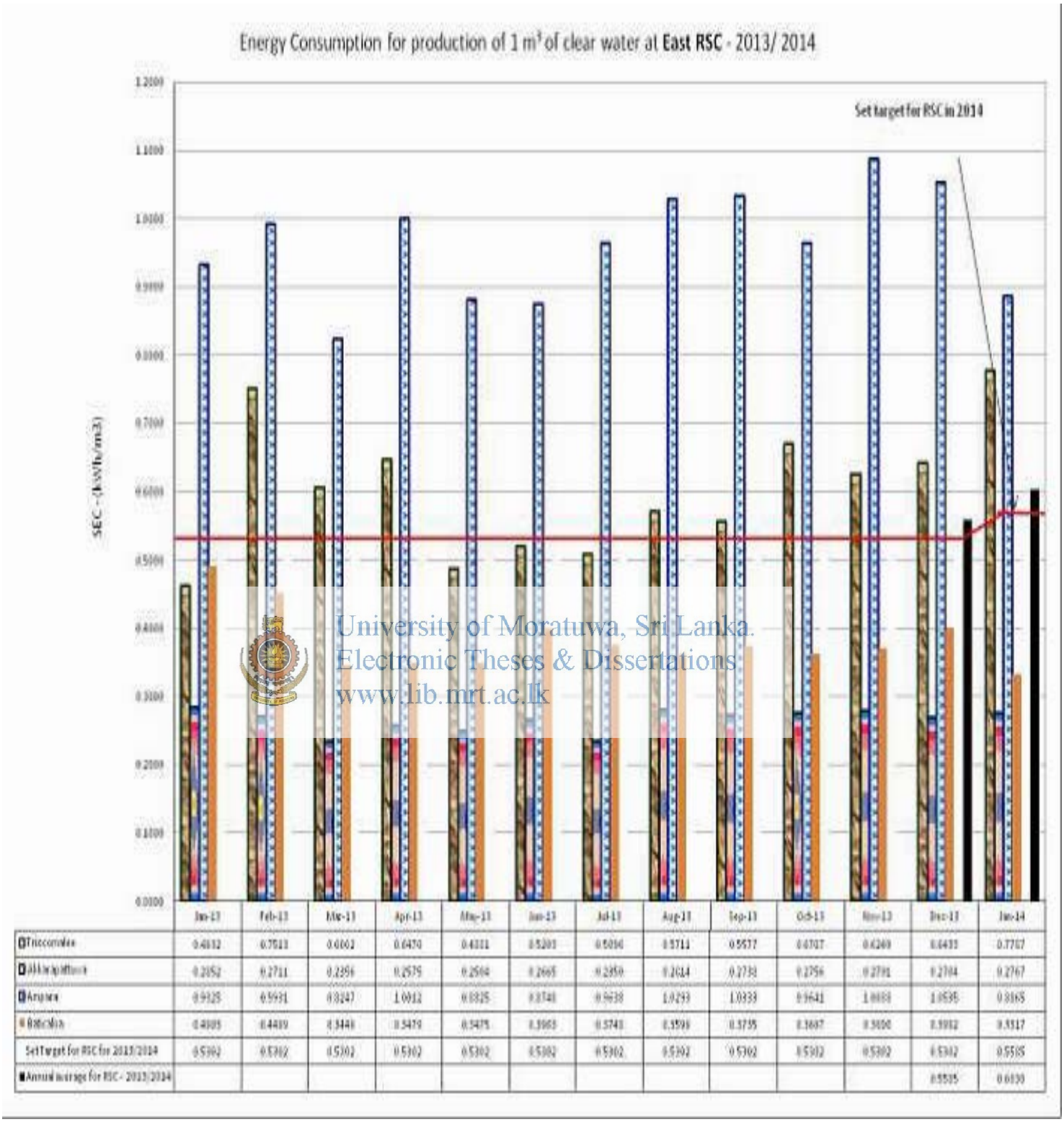

Figure6:Specific EnergyVs Month for Eastern RSC

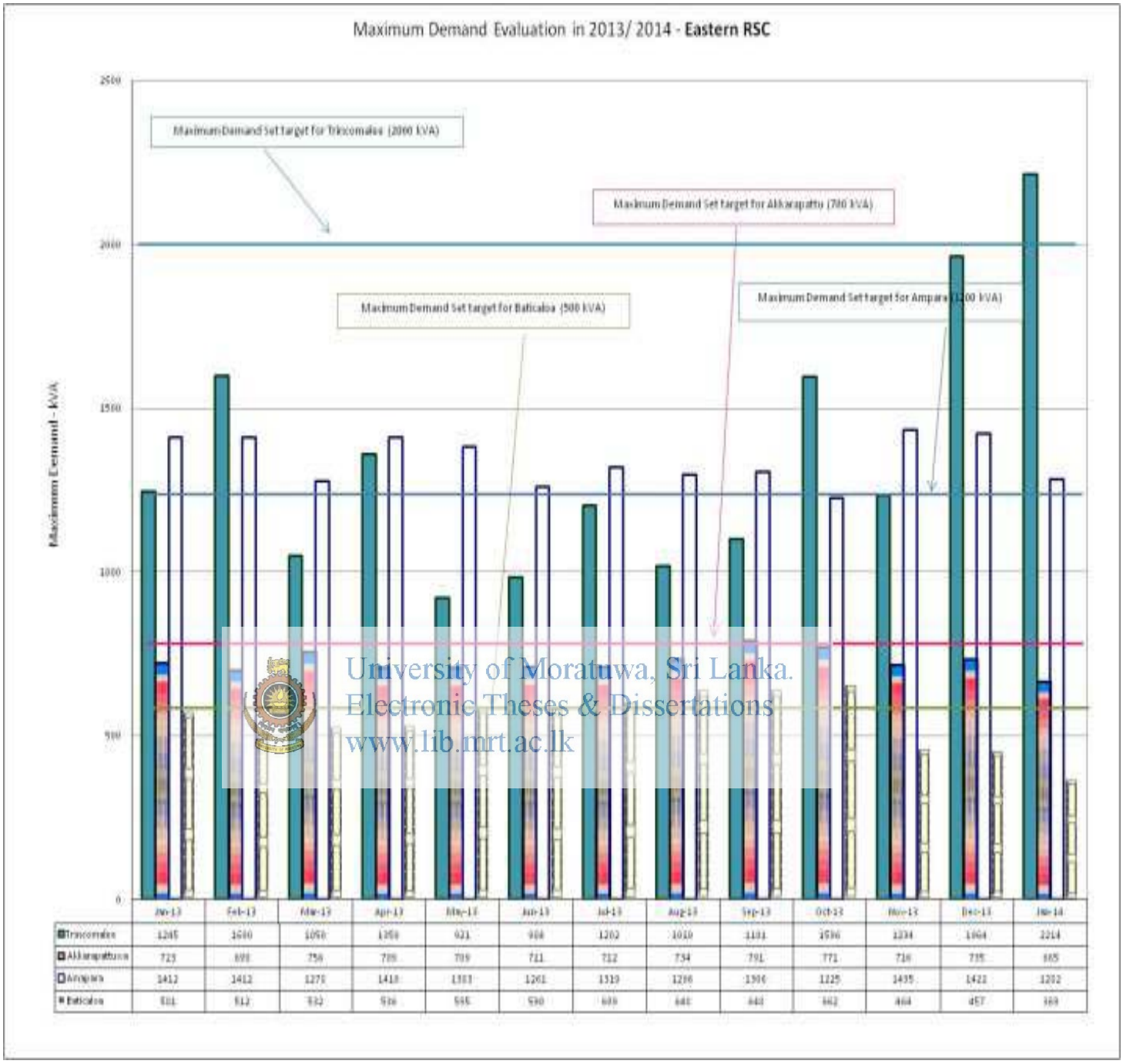

Figure7:Maximum Demand (kVA) Vs Month for Eastern RSC