APPENDICES

CHAPTER 3

REVIEW OF PHASE 1 PROJECT

Report on phytoplankton composition in 4 reservoirs in Anuradhapura District

1. Mahakandarwa
2. Nuwarawewa
3. Thuruwila Tank
4. Kekirawa Tank

Investigator: Prof. S.A. Kulasooriya
Technical Assistant: Ms. Iranganie Thumpela

Introduction

This is the report on the observations made on the waters of Nuwarawewa, Thuruwila, Kekirawa and Mahakandarawa reservoirs sampled for phytoplankton analyses on behalf of Ceywater PLC.

Method

Net samples as well as direct samples were collected for taxonomical and counting examinations. A 20 micron net was used to collect the net sample for taxonomic observations. A 50 ml sample was taken directly to a graduated tube for counting purposes. 2-3 drops of Lugol's iodine solution was added to each sample for preservation. These samples were kept overnight to settle down and the supernatant water was decanted until only 5 ml remained. This was shaken and 1.0 ml was taken for counting. Samples were observed in a Sedgewick Rafter counting cell and observed under an Olympus microscope (model). 50 squares per sample was counted and the mean value taken for tabulation.

Results

The results of the algae indentified and their counts (units per ml) are presented in Tables 1, 2, 3 and 4 for Nuwarawewa, Kekirawa, Thuruwila and Mahakandarawa reservoirs respectively.

Parameter : Phytoplankton Composition
Date : 19.08.2014

Table 1: Nuwarawewa

Species Name	Taxa	Counts
CYANOPHYCEAE		
Anabeana solitaire	c	24
Chroococococus disperse	c	22
Cylindrospermopsis raciborskii	**d**	**32,000**
Merismopaedia punctata	c	32
Mycrocystis aergunosa	r	4
Microcyatis sp.	r	10
Microcystis wesenbergii	r	4
Oscillatoria sp.	c	24
Pseudanabeana sp.	c	22
DIATOMOPHYCEAE		
Melosira granulata	c	20
Navicula sp.	m	60
Surella sp	r	4
Synedra sp	c	22
CHLOROPHYCEAE		
Ankistrodesmus sp.	r	4

Pediastrum simplex	r	4
DINOPHYCEAE		
Peridiniopsis sp	r	8
ZYGNEMAPHYCEAE		
Cosmarium sp	r	12
EUGLENOPHYCEAE		
Euglena sp.	c	20
No. of taxa		**18**
Total Counts per ml		**32,296**

Table 2: Kekirawa Tank

Species Name	**Taxa**	**Counts**
CYANOPHYCEAE		
Anabeana solitaire	r	12
Chroococcocus disperse	c	34
Cylindrospermopsis raciborskii	d	4200
Merismopaedia punctata	c	24
Mycrocystis aergunosa	r	2
Microcyatis sp.	r	4
Microcystis wesenbergii	r	8
Oscillatoria sp.	r	12
DIATOMOPHYCEAE	r	12
Melosira granulata	m	190
Navicula sp.	c	22
Pinularia sp	c	26
Pinularia sp. (long strains)	C	22
Synedra sp	m	640
CHLOROPHYCEAE		
Pediastrum simplex	c	22
Scenedesmus sp.	r	12
ZYGNEMAPHYCEAE		
Strautrum sp	r	12
EUGLENOPHYCEAE		
Euglena sp.	r	12
No. of taxa		18
Total Counts per ml		**5266**

Table 3: Thuruwila Tank

Species Name	Taxa	Counts
CYANOPHYCEAE		
Anabeana solitaire	m	32
Chroococococus disperse	m	32
Cylindrospermopsis raciborskii	d	1200
Merismopaedia punctata	c	130
Mycrocystis aergunosa	r	2
Microcyatis sp.	m	26
Pseudanabeana sp.	m	36
DIATOMOPHYCEAE		
Navicula sp.	c	28
Surella sp	r	4
Synedra sp	m	32
CHLOROPHYCEAE		
Ankistrodesmus sp.	r	4
Pediastrum simplex	m	32
Scenedesmus sp.	r	8
DINOPHYCEAE		
Peridiniopsis sp	c	22
ZYGNEMAPHYCEAE		
Strautrum sp	r	8
EUGLENOPHYCEAE		
Euglena sp.	r	8
No. of taxa		16
Total Counts per ml		**1604**

Table 4; Mahakandarawa Tank

Species Name	Taxa	Counts
CYANOPHYCEAE		
Anabeana solitaire	r	12
Chroococococus disperse	c	24
Cylindrospermopsis raciborskii	**d**	**26900**
Merismopaedia punctata	c	22
Mycrocystis aergunosa	r	8
Microcyatis sp.	r	10
Microcystis wesenbergii	r	8
Oscillatoria sp.	R	8
Planktolyngbia sp.	m	326
Spirulina sp.	m	164
DIATOMOPHYCEAE		
Melosira granulata	m	40
Navicula sp.	c	28
Synedra sp	m	72
CHLOROPHYCEAE		
Ankistrodesmus sp.	R	6
Pediastrum simplex	r	8
Scenedesmus sp.	R	6
No. of taxa		16
Total Counts per ml		**27642**

d=dominant : m=moderately: c=common: r=rare

Table 5: Relative Abundance of *Cylindrospermopsis raciborskii*

Reservoir Name	Relative Abundance %
Nuwarawewa	99.08
Kwkirawa Tank	79.75
Thurwila Tank	74.8
Mahakandarawa Tank	97.3

Discussion

The results presented in the four Tables show that the total algae in the Nuwarawewa and Mahaknadarawa tanks are much higher than in Thuruwila and Kekirawa. Perhaps they are more eutrophied than the other two. Nonetheless, in all the four tanks the predominant alga is *Cylindrospermopsis raciborskii* (Table 5) which has the potential to produce the algal toxin cylindrospermopsin. The abundance of *Cylindrospermopsis raciborskii* and other algae in North Central Province is influenced by water pollution that determines the trophic levels of the reservoir and this could also vary with the rainfall. Relative abundance and species spectrum shows the dominant, sub-dominant, common and occasional species which reflects the eutrophication of the water body.

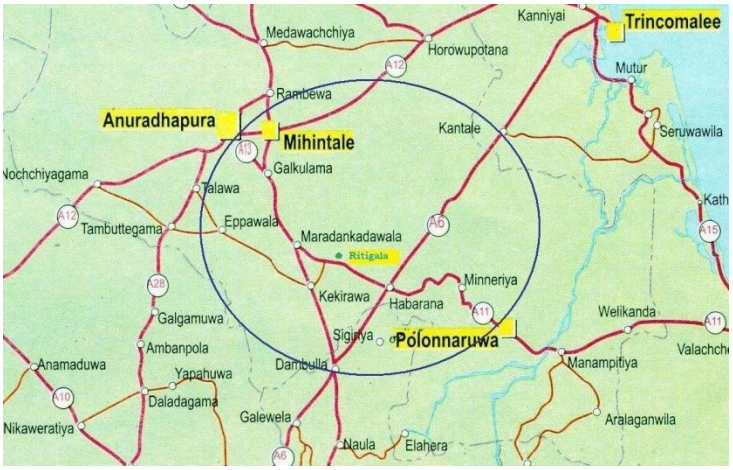
Accordingly the phytoplankton composition of the four water bodies could be identified as follows.

1. Mahakandarawa: the dominant species is *Cylindrospermopsis raciborskii* among the Cyanophyceae along with the other species belonging to other algal families. Comparing the results obtained earlier there's no significant changes in the phytoplankton composition.
2. Thurwila Reservoir: the dominant species is *Cylindrospermopsis raciborskii* but less in counts than Mahakandarawa.
3. Kekirawa Reservoir: This records the lowest population of algal species but even here the dominant alga was *Cylindrospermopsis raciborskii* with a relatively high abundance of diatoms.
4. Nuwarawewa Reservoir: Highest algal counts with a predominance of *Cylindrospermopsis raciborskii* indicating eutrophic conditions. While diatoms were common an increase in the Euglena population indicates plenty of exposure to sunlight and richness in organic matter. Water body in under eutrophic conditions.

Recommendations

In all the four reservoirs examined the dominant alga is *Cylindrospermopsis raciborskii,* a toxigenic species. The counts for Nuwarawewa and Mahakandarawa tanks are certainly beyond the danger levels. However, the mere presence of a cyanobacterium does not mean it produces toxins. The IFS is currently

in a position to measure and quantify the toxin cylindrospermopsin produced by this organism. If the NWSDB can purchase the ELISA kits needed for this work, we will be able to estimate the quantity of the toxins presnt (if any) in these waters. It is recommended that such analysis are done at least for Nuwarawewa and Mhakandarawa water samples before and after water treatment. It is then possible to see to what extent the water treatment is effective in reducing the toxin levels.



Prof. S.A. Kulasooriya

Visiting Professor/IFS

Jar Test Carried out on the 04th of September 2014 at the Anuradhapura Regional Laboratory.

Those present : Mr. Buw Perera (Ceywater Consultants (pvt) Ltd)
Mr. Lakruwan Alwis (NWSDB – Chemist, Anuradhapura)

1.0 Jar testing Procedure

a) Measure the turbidity of the raw water so as to estimate the dosing of Alum.
b) Measure the pH value of the raw water so as to estimate the dosing of Hydrated Lime required to enable the flocculation and coagulation of the alum taken place within the pH rage of 6.4 – 6.8.
c) Measure 1000 ml raw water into each jar.
d) Adjust the Flocculator speed at 100 PRM.
e) Add in the estimated Hydrated Lime dosing .
(1 ml 0.1% solution to 1 Litre = 1 ppm)
f) Add in the estimated Alum dosing .
(1 ml 0.1% solution to 1 Litre = 1 ppm)
g) The above mentioned chemicals should be added quickly and then stir at 100 RPM for 1 minutes after chemicals addition.
h) Reduce the speed to 20 RPM and stir for 15 minutes.
i) Then allow the floc to settle for 15 minutes and observe its speed of settlement. Grade the floc size and speed of settlement. Decant supernatant from each jar and measure the turbidity and pH value.

Additional Tests

a) Filter the decantered supernatant through a 0.45µ watman filter paper using a Buchner Funnel under Vacuum.
b) Send samples of the raw water and filtered water to NWSDB laboratory in Ratmalana for heavy metal analysis. 1ml of dilute nitric acid was added as a preservative.

2.0 Results of the Jar Test

Stock Solution = 1% Alum
Therefore 1 ml of stock solution = 10mg of Alum

Best dose rate

	Dose Rate mg/l	30	34	36	38	***40***	42
Raw Water	pH	8.37	8.37	8.37	8.37	***8.37***	8.37
	Turbidity (NTU)	5.27	5.27	5.27	5.27	***5.27***	5.27
	Conductivity (µ/sem)	760	760	760	760	***760***	760

						Best settling flocc	
Dosed Water	PH	7.36	7.26	7.21	7.14	***7.12***	7.1
	Supernatant Turbidity (NTU)	1.33	1.21	0.94	1.54	***0.77***	0.79
	Conductivity (µ/sem)	-	-	-	-	-	-

Tests were repeated for reproducibility.

Equipment Used for Jar Testing

Jar Testing in Progress

3.0 Results of Heavy Metal Analysis

(To be provided by NWSDB - Ratmalana, Samples handed over 5th September 2014)

MAHAKANDARAWA WEWA RAW WATER DATA FROM JICA REPORT VOL 1 & 2 (2011 to 2012)

Sri Lanka Standards SLS -	Units	2011			2012																														
Sampling station		Inlet	Outlet	Deepes t	Inlet	Outlet	Deepes t	Inlet	Outlet	Deepes t	Inlet	Outlet	Deepes t	Inlet	Outlet	Deepes t	C Conn. S	C Conn. B	Deepes t	IC Conn. S	IC Conn. B	Deepes t	IC Conn. S	IC Conn. B.	Deepes t	IC Conn. S.	IC Conn. B.	Deepes t	IC Conn. S.	IC Conn. B.	Deepes t	STATISTICS			
Date		20/12/11	20/12/11	20/12/11	11/1/2012	21/01/12	21/01/12	14/02/12	14/02/12	14/02/12	19/03/12	19/03/12	19/03/12	2/5/2012	2/5/2012	2/5/2012	22/05/12	22/05/12	22/05/12	28/06/12	28/06/12	28/06/12	26/07/12	26/07/12	26/07/12	26/09/12	26/09/12	26/09/12	16/10/12	16/10/12	16/10/12	Average	Maximum	Parameter	Units
Odor		Object.	Object.	Object.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	unob	obj	Odor	
Colour	Hazen Unit	5	5	5	7.5	10	7.5	5	5	5	ND	ND	ND	5	5	5	5	5	5	7.5	10	10	10	10	10	10	10	10	10	10	10	7.5	10	Colour	Hazen Unit
Turbidity	NTU	4	4	3.8	3.7	3.5	2.9	2.7	3.7	6.8	3.9	3	3	5.1	4.3	3.4	6.8	7.5	8.8	15	15	16	12	11	13	18	18	20	15	27	20	9.36	27	Turbidity	NTU
Taste		Object.	Object.	Object.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Unobject.	Object.	Object.	Object.	Object.	Object.	Object.	Object.	Object.	Object.	Object.	Object.	Object.	Object.	Object.	obj	obj	Taste	
pH		6.7	6.5	6.7	7.8	7.9	7.7	7.6	7.7	7.7	7.6	7.9	7.8	8.2	7.4	7.7	8.2	8	7.4	8.6	8.5	8.4	8.5	8.2	8.4	8.4	8.3	8.7	7.9	7.3	7.6	7.8	8.7	pH	
EC	µS/cm	344	343	343	348	355	370	411	415	417	471	462	470	464	223	251	512	512	509	576	580	585	620	624	625	736	746	738	711	719	685	506	746	EC	µS/cm
Chloride	m g/L	51	51	51	52	53	52	61	54	60	76	79	79	74	80	79	86	85	86	95	77	92	105	103	104	142	140	144	131	133	123	87	144	Chloride	m g/L
Free residual C	m g/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.14	<0.04	0.1	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04																n/a	n/a	Free residual C	m g/L
Free ammonia	m g/L	<0.04	<0.04	<0.04	<0.04	0.22	0.2	0.04	0.22	0.15	0.05	0.07	0.05	0.33	0.3	0.38	<0.04	0.16	<0.04	<0.04	0.02	<0.04	<0.01	0.02	0.02	0.53	0.45	0.35	0.12	0.13	0.14	0.19	0.53	Free ammonia	m g/L
Alkalinity	m g/L	86	88	87	93	94	97	107	107	96	112	120	55	138	139	134	130	125	134	100	110	143	152	70	94	162	162	164	155	152	184	120	184	Alkalinity	m g/L
Albminoid ammonia	m g/L	<0.04	<0.04	<0.04	0.05	0.35	0.28	0.36	0.33	0.22	0.27	0.28	0.23	0.91	0.82	0.84	0.49	0.66	0.57	0.14	0.12	0.15	0.26	0.22	0.33	2.7	2.3	2.5	1.6	1.6	1.8	0.75	2.7	Albminoid ammonia	m g/L
Nitrite	m g/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.05	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.05	Nitrite	m g/L
Nitrate	m g/L	0.26	0.11	0.07	0.09	0.07	0.07	<0.05	<0.05	<0.05	0.41	0.38	0.23	0.12	0.21	0.18	0.16	0.15	0.3	0.19	0.45	0.21	0.54	0.13	0.56	0.3	0.57	0.27	0.27	0.24	0.21	0.25	0.57	Nitrate	m g/L
Fluoride	m g/L	0.09	0.08	0.11	0.1	0.12	0.14	0.17	0.33	0.3	0.18	0.17	0.17	0.43	0.38	0.37	0.34	0.38	0.37	0.43	0.36	0.45	0.52	0.51	0.51	0.45	0.46	0.47	0.47	0.46	0.44	0.33	0.52	Fluoride	m g/L
Phosphate	m g/L	<0.05	0.05	<0.05	0.2	0.16	0.23	0.06	0.09	0.06	<0.05	<0.05	<0.05	0.1	0.06	<0.05	0.14	0.12	0.1	0.54	0.8	0.92	0.21	<0.21	<0.21	0.32	0.3	0.31	0.21	0.25	0.22	0.25	0.92	Phosphate	m g/L
Total res idue	m g/L	166	164	176	132	172	170	226	235	234	279	250	263	277	208	264	339	332	361	375	289	359	400	404	399	456	457	480	420	436	369	303.07	480	Total res idue	m g/L
Hardnes s	m g/L	96	92	96	95	96	96	104	105	109	94	100	96	148	144	144	142	144	146	151	119	158	161	163	159	173	179	173	196	186	182	134.90	196	Hardnes s	m g/L
Ion	m g/L	0.1	0.1	0.1	0.2	0.1	0.3	0.2	0.2	0.3	0.48	<0.1	<0.1	0.2	<0.1	0.1	0.2	0.3	0.1	0.6	0.4	0.5	0.6	<0.1	0.8	0.6	0.6	0.6	0.4	1	0.5	0.37	1	Ion	m g/L
Sulphate	m g/L	2	2	2	1.4	1	1.4	1.4	3.4	1.5	4	4.2	5.4	2.1	1.5	1.8	3.8	2	1.6	12	10	9.9	1.6	1.9	2.4	23	21	22	8.9	12	11	5.94	23	Sulphate	m g/L
Anionic detergent	m g/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1																<0.1	<0.1	Anionic detergent	m g/L
Phenol conpound	m g/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002																<0.002	<0.002	Phenol conpound	m g/L
COD	m g/L	14	17	20	<5	<5	<5	21	16	20	42	14	10	14	20	22																19.17	42	COD	m g/L
O&G	m g/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1																<1	<1	O&G	m g/L
Ca	m g/L	16	16	16	18	18	17	18	30	22	21	22	22	24	24	24																20.53	30	Ca	m g/L
M g	m g/L	14	13	14	12	13	13	9	9.7	9.2	10	11	10	22	21	21																13.46	22	M g	m g/L
Bacteriological																																STATISTICS			
																																Average	Maximum	Parameter	Units
Total plate count	CFU/m L	3.2x102	2.0x102	1.7x102	34	64	40	4.9x102	2.0x102	9.5x102	3.0x103	5.8x103	2.3x103	2.8x103	2.8x103	1.6x103																46	64	Total plate count	CFU/m L
E. coli	MPN./100mL	13	5	ND	ND	ND	ND	13	13	2	ND	ND	ND	ND	8	ND	23	13	2	ND	2	2	8	2	7	8	14	2	80	45	35	15	80	E. coli	MPN./100mL
Total coliform	MPN/100mL	79	8	23	8	9	8	130	79	79	2	240	5	33	49	13	23	23	33	25	25	25	1600	80	70	23	35	8	1600	1600	250	206	1600	Total coliform	MPN/100mL
Algae																																STATISTICS			
																																Average	Maximum	Parameter	Units
Chlorophyl a	mg/L																0.0022	0.074	0.091	0.2	0.2	0.18	0.21	0.28	0.23	0.54	0.59	0.5	0.34	0.38	0.55	0.29	0.59	Chlorophyl a	mg/L
Heavy Metals																																STATISTICS			
																																Average	Maximum	Parameter	Units
Cu	ppb	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 350	< 20																<20	<20	Cu	ppb
Mn	ppb	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	110	160	120																130.00	160	Mn	ppb
Zn	ppb	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	40	90	20																50.00	90	Zn	ppb
As	ppb	< 10	< 10	< 10	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 20	< 20	< 20	< 10	< 10	< 10	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	<10	<20	As	ppb
Cd	ppb	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	<5	<5	Cd	ppb
Cr	ppb	< 20	< 20	< 20	< 20	< 20	< 20	< 30	< 30	< 30	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	<10	<30	Cr	ppb
Al	ppb	< 80	< 80	< 80	< 80	< 80	< 80	< 80	< 80	< 80	< 80	< 80	< 80	100	< 80	< 80																<80	100	Al	ppb
Pb	ppb	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 10	< 10	< 10	< 30	< 30	< 30	< 40	< 40	< 40	< 40	< 40	< 40	<30	<40	Pb	ppb
CN	ppb	< 30	< 30	< 30	< 30	< 30	< 30	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	<30	<60	Cn	ppb
Hg	ppb	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 0.5	< 0.5	< 0.5	< 1	< 1	< 1	< 0.5	< 0.5	< 0.5	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<1	<1	Hg	ppb
Se	ppb	< 10	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	<10	<10	Se	ppb

MAHAKANDARAWA WEWA RAW WATER DATA 2013 to 2014

No	Sri Lanka Standards SLS - 614 - Part 1	Units	Aug-13		Sep-13		Oct-13		Nov-13		Jan-14		Feb-14		Mar-14		Apr-14		May-14		Jun-14		STATISTICS			
			Canal	Intake	Canal	Intake	Canal	Intake	Canal	Intake	Canal	Intake	Canal	Intake	Canal	Intake	Canal	Intake	Canal	Intake	Canal	Intake	Average	Max	parameter	Units
1	Appearance																								Apearence	
2	Colour	Pt.Co.	28	18	63	29	42	13	63	24	42	27	68		28	30	22	20	18	15	16	15	31	68	Colour	Pt.Co.
3	Turbidity	NTU	8.07	5.47	6.97	6.57	1.91	0.75	4.39	2.85	8.75	5.13	15.49		4.44	4.9	5.27	4.48	3.11	2.91	4.6	4.46	5	15.49	Turbidity	NTU
4	pH value		7.87	7.89	7.78	7.85	8.13	8.1	7.82	7.67	7.43	7.24	8.07		8.17	8.1	8.05	8.01	8.09	8.11	8.23	8.32	8	8.32	pH value	
5	Electrical Conductivity	µs/cm	530	530	580	570	610	610	610	590	550	500	590		640	630	640	630	600	580	620	630	592	640	Electrical Conductivity	µs/cm
6	Chloride	mg/ 1 as Cl	88	94	80	84	164	168	104	112	96	92	112		120	112	112	100	112	104	124	120	110	168	Chloride	mg/ 1 as Cl
7	Total Alkalinity	mg / l as $Caco_3$	108	196	140	132	132	148	140	140	106	108	104		110	120	104	104	120	110	110	110	123	196	Total Alkalinity	mg / l as $Caco_3$
8	Total Hardness	mg / l as $Caco_3$	132	136	148	132	142	150	140	152	160	160	136		180	170	148	144	152	156	132	140	148	180	Total Hardness	mg / l as $Caco_3$
9	Nitrate	mg / l as N	0.2	0.3	0.2	0.2	0.3	0.5	0.2	0.5	0.1	0.3	0.3		0.1	0.1	<0.10	<0.10	<0.1	<0.1	0.4	0.3	0.267	0.500	Nitrate	mg / l as N
10	Nitrite	mg / l as N	0.001	0.007	0.005	0.008	0.003	0.004	0	0.004	0.001	0.005	0.001		0.001	0.006	<0.001	<0.001	0.002	0.003	<0.001	0.001	0.003	0.008	Nitrite	mg / l as N
11	Sulphate	mg / l as SO_4	3	3	3	4	5	5	5	5	14	5	4		5	5	5	5	4	4	4	5	4.895	14.000	Sulphate	mg / l as SO_4
12	Fluoride	mg / l as F	0.28	0.31	0.29	0.21	0.2	0.26	0.32	0.23	0.34	0.32	0.4		0.45	0.42	0.39	0.41	0.55	0.58	0.58	0.6	0.376	0.600	Fluoride	mg / l as F
13	Total Phosphate	mg / l as PO_4	0.17	0.16	0.15	0.08	0.05	0.06	0.28	0.3	0.17	0.28	0.23		0.31	0.22	0.12	0.09	0.1	0.05	0.4	0.38	0.189	0.400	Total Phosphate	mg / l as PO_4
14	Total Iron	mg / l as Fe	0.12	0.05	0.07	0.08	0.01	0.01	0.08	0.03	0.05	0.04	0.21		0.07	0.06	0.15	0.11	0.03	0.03	0.07	0.1	0.072	0.210	Total Iron	mg / l as Fe
15	Free Ammonia	mg / l	0.09	0.18	0.15	0.11	0.12	0.1	0.02	0.03	0.12	0.06	0.13		0.06	0.12	0.04	0.06	0.17	0.16	0.35	0.28	0.124	0.350	Free Ammonia	mg / l
16	Residual Chlorine	mg / l as OCl/HOCl	-	-	-	-	-	-	-	-	-	-	-		-	-		-	-	-	-	-	n/a	n/a	Residual Chlorine	mg/l

Bacteriological

																							STATISTICS			
																							Ave	Max	Parameter	unit
1	Total Coliform Bacteria	Colonies / 100ml	66	82	42	68	28	28	40	380	125	600	102		66	304	92	368	44	124	70	144	146	600	Total Coliform Bacteria	Colonies / 100ml
2	E-Coli Bacteria	Colonies / 100ml	24	36	Nil	20	Nil	Nil	Nil	140	56	432	22		28	42	44	120	12	28	32	36	71	432	E-Coli Bacteria	Colonies / 100ml

Algae

																							STATISTICS			
																							Ave	Max	Parameter	unit
1	Cylindrospermopsis	Count per ml							15600		6200	4400											8733	15600	Cylindrospermopsis	Count per ml
2	Total algal count	Count per ml							15392		6692	4914											8999	15392	Total Algae	Count per ml

Heavy Metals

	Parameters	Unit							01.11.2013		16.01.2014						23.04.2014						STATISTICS			
									Bottle 1	Bottle 3	Bottle 1	Bottle 2	Bottle 3				Bottle 1	Bottle 2	Bottle 3				Ave	Max	Parameter	unit
1	As	ppb							1.623	1.95	1.6	1.501	1.941				1.8	1.701	1.942				1.757	1.95	As	ppb
2	Cd	ppb							0.832	1.456	0.87	0.73	1.51				0.91	0.83	1.51				1.081	1.51	Cd	ppb
3	Zn	ppb							23	42	72	72	71				70	690	71				138.88	690	Zn	ppb
4	Mn	ppb							156	84	28	ND	ND				21	ND	ND				72.25	156	Mn	ppb
5	Cu	ppb							4	3	ND	ND	ND				ND	ND	ND				3.5	4	Cu	ppb
6	Cr	ppb							ND	ND	201	312	244				ND	ND	ND				252	312	Cr	ppb
7	Pb	ppb							ND	ND	ND	ND	ND				ND	ND	ND				ND	ND	Pb	ppb

TESTS BY IFS		Kakirawa lake	Thiruwila lake	Nuwara W. lake	Kakirawa WTP	Thiruwila WTP	Nuwara W WTP	Mahakandarawa lake	Madawachiya CBO 1	Madawachiya CBO 2	Anuradhapura town tap	Rembewa CBO 1	Rembewa CBO 2	Kandy town Tap Water Control 1	Getambe Mahaweli River Control 2	Limits on SLS 614: 1983 part 1 & 2
Parameter	**Unit**															
Total Manganese	**mg/l**	0.21	0.41	0.38	0.03	0.12	0.15	0.24	0.12	0.16	0.33	0.10	0.15	0.15	0.08	**0.05mg/l**
Free Amonia	**mg/l**	0.09	0.17	0.13	0.09	0.14	0.10	0.12	0.10	0.12	0.07	0.14	0.12	0.28	0.03	**0.06mg/l**
Soluble Iron	**mg/l**															
Soluble Manganese	**mg/l**	0.10	0.22	0.37	0.02	0.10	0.12	0.17	0.04	0.12	0.11	0.01	0.12	0.07	0.04	
Temporary Hardness	**mg/l**	21.92	44.76	26.92	0.09	63.62	6.52	27.68	321.84	372.04	34.44	320.44	300.04	5.12	0.96	**250 -600 (As CaCo3)**
Albimanoid ammonia	**mg/l**	0.31	0.92	2.03	ND	0.68			0.06	ND	0.70	ND	ND	0.07	ND	**0.15 mg/l**
Anionic detergent	**mg/l**															
Phenolic compounds	**mg/l**															
Pesticide residue																
Grease and Oil	**mg/l**															
Copper	**mg/l**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.05mg/l**
Zinc	**mg/l**	0.02	0.02	0.01	0.04	0.03	0.08	0.03	0.04	0.02	0.03	0.02	0.02	0.02	0.03	**5mg/l**
Aliminium	**mg/l**															
Arsenic	**ug/l**															
Cadmium	**ug/l**	0.16	0.14	0.13	0.25	0.16	0.11	0.33	0.04	0.04	0.01	0.01	0.13	0.27	0.18	**5ug/l**
Cyanide	**ug/l**															
Total Mercury	**ug/l**															
Lead	**ug/l**	0.48	3.56	3.03	3.39	1.51	3.72	ND	0.45	ND	ND	0.64	0.79	5.21	2.55	**50ug/l**
Selenium	**ug/l**															
Chromium	**ug/l**	0.09	ND	0.26	ND	ND	0.28	ND	0.71	2.63	ND	0.08	0.81	0.12	ND	**50ug/l**
Algae- Taxonomy																
Algae- Counting																
Total																

Sampling locations

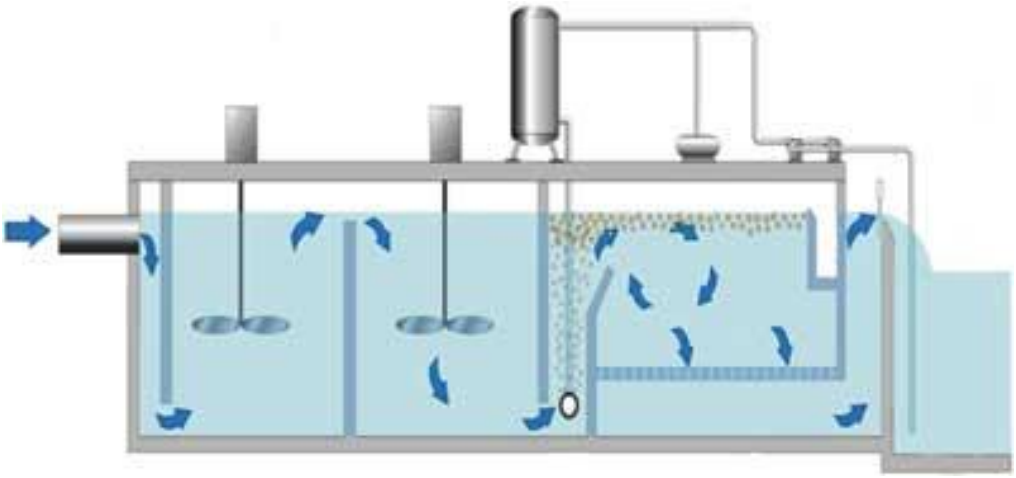
1	**Kakirawa lake**	(algae required)
2	**Thiruwila lake**	(algae required)
3	**Nuwara wewa lake**	(algae required)
4	**Kakirawa WTP treated water**	
5	**Thiruwila WTP treated water**	
6	**Nuwara wewa WTP trewated water**	
7	**Mahakanarawa lake near intake**	
8	**Madawachiya area CBO location 1**	
9	**Madawachiya area CBO location 2**	
10	**Anuradhapura town tap water**	
11	**Rembewa area CBO location 1**	
12	**Rembewa area CBO location 2**	
13	**Control 1 raw water from Kandy**	
14	**Control 2 raw water from kandy**	

Albimanoid ammonia ND - LOD -0.05mg/l

Copper- ND - LOD -0.01mg/l

Chromium ND - LOD - 0.05 ug/l

Dissolved Air Flotation



Flotation is described as a gravity separation process in which gas bubbles attach to solid particles to cause the apparent density of the bubbled solid agglomerates to be less than that of water, thereby allowing the agglomerate to float to the surface. DAF is employed mainly for the treatment of nutrient rich reservoir waters that may have heavy algal blooms and for low turbidity low alkalinity coloured water

Advantages

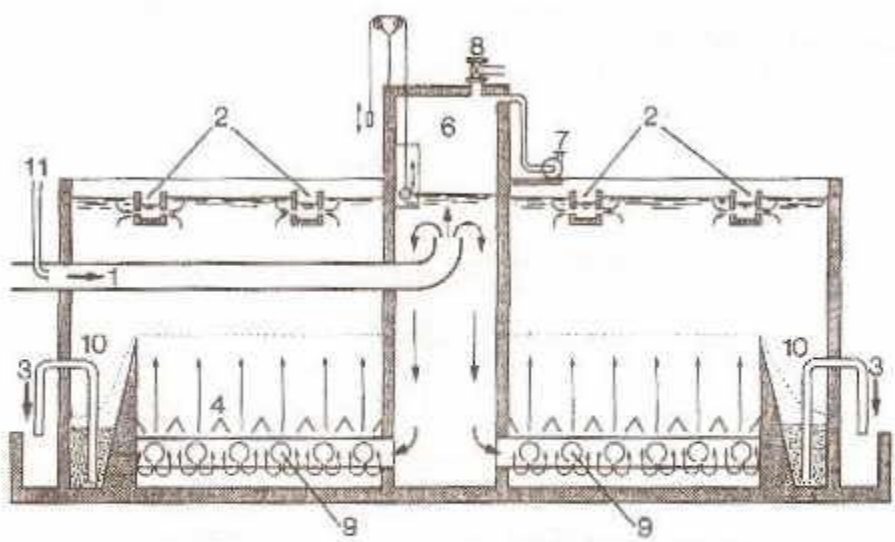
1. High loading rates can be used , typically 8 to 12 m/h for potable water treatment plant.
2. A thick float of typically 1 to 3 % total solids can be used using hydraulic or mechanical skimming.
3. Large dense flocc is not required and hence less flocculation time when compared to sedimentation.
4. coagulation dose rate can be reduced in some circumstances as a smaller flocc particle size is required.
5. No polymer is required.
6. Rapid start up time, typically 30 to 60 mins.
7. Excellent algae removal efficiency.
8. 2 to 2.5 log removal of crypto and giardia possible.
9. Smaller footprint required compared to conventional flocculation and sedimentation.

10. Many Contractors have the experience and technology to install these and hence a competitive price can be expected for these clarifiers.

Disadvantages

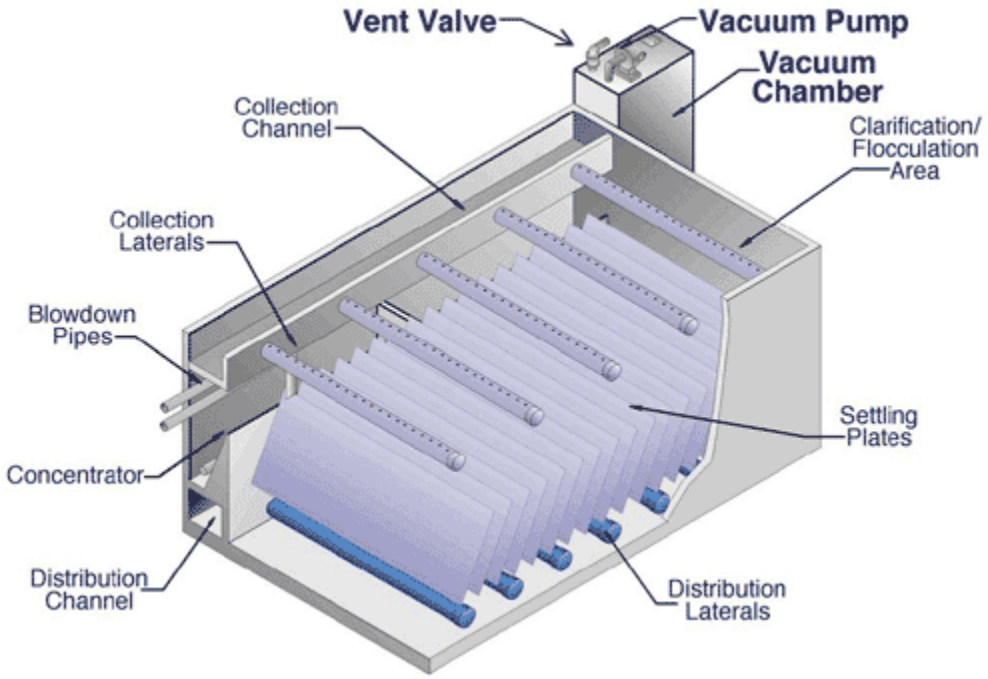
1. Requires a cover or roof to protect the float layer from rain.
2. Mechanically more complex than conventional gravity clarifiers.
3. More power consumption that conventional sedimentation plant as recycle pumps, compressor/saturators, scrapers are required.
4. Not suitable for high turbidity waters.
5. Requires a higher degree of maintenance and operator skill.
6. With some waters it may be more difficult to dewater the sludge.

Pulsator



1. *Raw water inlet.*
2. *Clarified water outlet.*
3. *Sludge discharge.*
4. *Stilling plates.*
6. *Vacuum chamber.*
7. *Vacuum pump.*
8. *Automatic vacuum-breaker.*
9. *Raw water perforated distribution piping.*
10. *Sludge concentrators.*
11. *Reagent inlet.*

Superpulsator



The pulsator clarifier combines basic chemical principles and proven clarification technology in a high rate solids contact clarifier. It is a pulsed sludge blanket type clarifier which simultaneously carries out flocculation and clarification without the need for separate stages. The sludge formed during flocculation is made up of an expansion mass called the sludge bed or the sludge blanket. Water that has been coagulated beforehand arrives from the bottom of the device and flows through the this sludge bed to emerge clarified at the top of the settling tank. The forces resulting from the pulsation of the flow and the collisions and entrapments within the flocc blanket ensures complete flocculation and efficient separation of the flocc from the clarified water.

Inclined settling plates inside the clarifier in the Superpulsator keeps the sludge blanket homogeneous across the entire settling area aiding in the flocculation and helps guide the sludge into the concentrator during the pulsing.The vacuum generated flow pulsing creates a homogeneous sludge blanket that results in excellent effluent quality at minimal operating costs.

Advantages

1. Relatively high loading rates of 3 to 4.5 m/h rise rates are possible with Pulsators. 10 m/h may be possible with the Superpulsator models.
2. Flexible operation. Capable of removing colour , turbidity and organics
3. Controlled hydraulics.
4. Reduced operating costs. Most other solids contact clarifiers require mechanical or flow impeding devices such as mixers, pumps, or baffles to keep the sludge homogeneous
5. Easy operation. The vacuum pump, vent valve arrangement, and sludge waste valves are the only mechanical parts which are automated and require minimal operator attention.

Disadvantages

1. Not good if the inlet raw water has more than 100,000 u/ml of algae(This is according to Infilco Degremont's own brochure)
2. Flocc carryover is fine particles and hence not ideal for filtration downstream.
3. Algal growth and slime in the plates in a Superpulsator, if allowed to accumulate, will partially clog them and hence affect performance.
4. Requires the installation of a distribution lateral system at the base , and in the case of the superpulsator, inclined plates have to be installed inside the tanks.
5. Relatively large footprint of the Pulsator compared to the DAF.
6. For waters that need aeration, an upstream aerator is needed for the solids contact clarifiers whereas the DAF does not need this.
7. Pulsator and Superpulsator designs are patented technologies from Degremont. Although there are other similar solids contact clarifier technologies available from other Contractors, NWSDB appear to prefer the Pulsator. This would narrow down the Contractor to one (unless this technology is made available to other Contractors under some license agreement by Degremont)

General note on process selection.

With respect to use of Superpulsators for the project, we have major concern as this directs us to use only one vendor – which is Degremont and then we are at the mercy of getting economical solution – capex and opex. The client will eventually loose on this. If they say any sludge blanket clarifier would do in stead of saying Superpulsator then it is not true. Other sludge blanket clarifiers would not be as effective as a Superpulsators, resulting in large algal masses floating and chocking on the filters as is normally happening. With DAF there are number of vendors, including Degremontt that can participate in the project and client would get a better competitive bids resulting in cost savings for the client in Capex and Opex.

National Water Supply and Drainage Board

Anuradhapura North Water Supply Project

Optimal WTP Process

30 August 2007

Optimal WTP Process that may help mitigate probable contaminants causing CKD

Water Treatment Plant

Production Capacity = 17, 900 m3/day
(ultimate)

Raw Water Source = Mahakandarawa Lake

Existing WTPs

Nuwara Wewa

Kakirawa

Thuruwila

Algae – floating

Raw Water Quality

Raw Water Quality Analysis (2013-14 data)

STATISTICS			
Average	Max	parameter	Units
		Apearence	
31	68	Colour	
5	15.49	Turbidity	Pt.Co.
8	8.32	pH value	NTU
592	640	Electrical Conductivity	
110	168	Chloride	µs/cm
123	196	Total Alkalinity	mg/ 1 as Cl
148	180	Total Hardness	mg / l as $Caco_3$
0.267	0.500	Nitrate	mg / l as $Caco_3$
0.003	0.008	Nitrite	mg / l as N
4.895	14.000	Sulphate	mg / l as N
0.376	0.600	Fluoride	mg / l as SO_4
0.189	0.400	Total Phosphate	mg / l as F
0.072	0.210	Total Iron	mg / l as PO_4
0.124	0.350	Free Ammonia	mg / l as Fe
n/a	n/a	Residual Chlorine	mg / l

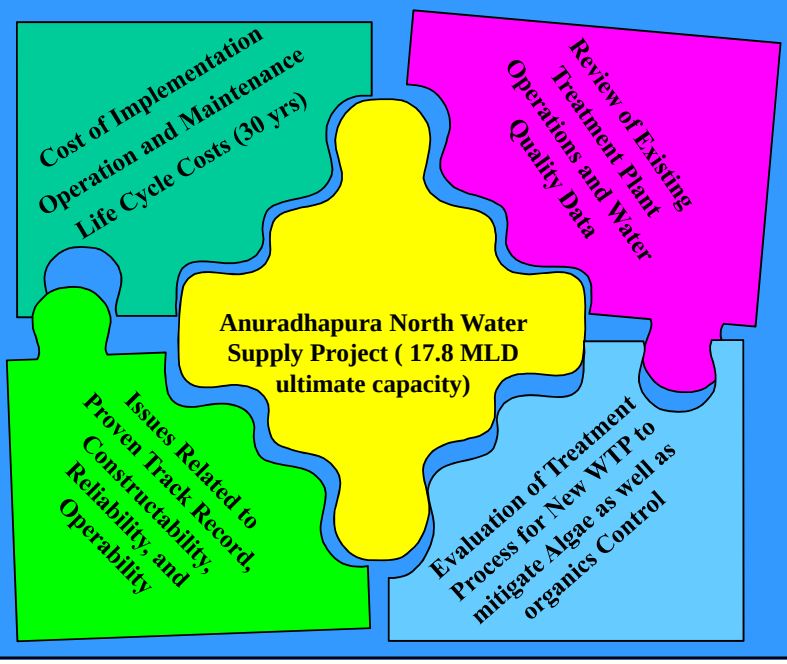
STATISTICS			
Ave	Max	Parameter	unit
8733	15600	Cylindrospermopsis	Count per ml
8999	15392	Total Algae	Count per ml

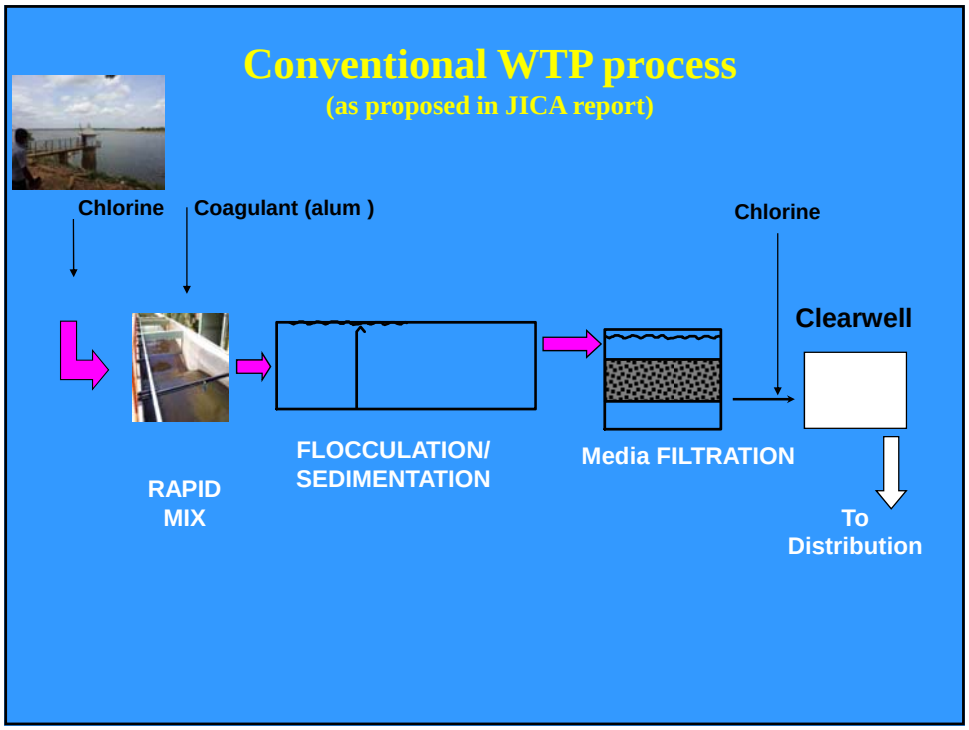
STATISTICS			
Ave	Max	Parameter	unit
1.757	1.95	As	ppb
1.081	1.51	Cd	ppb
138.88	690	Zn	ppb
72.25	156	Mn	ppb
3.5	4	Cu	ppb
252	312	Cr	ppb
ND	ND	Pb	ppb

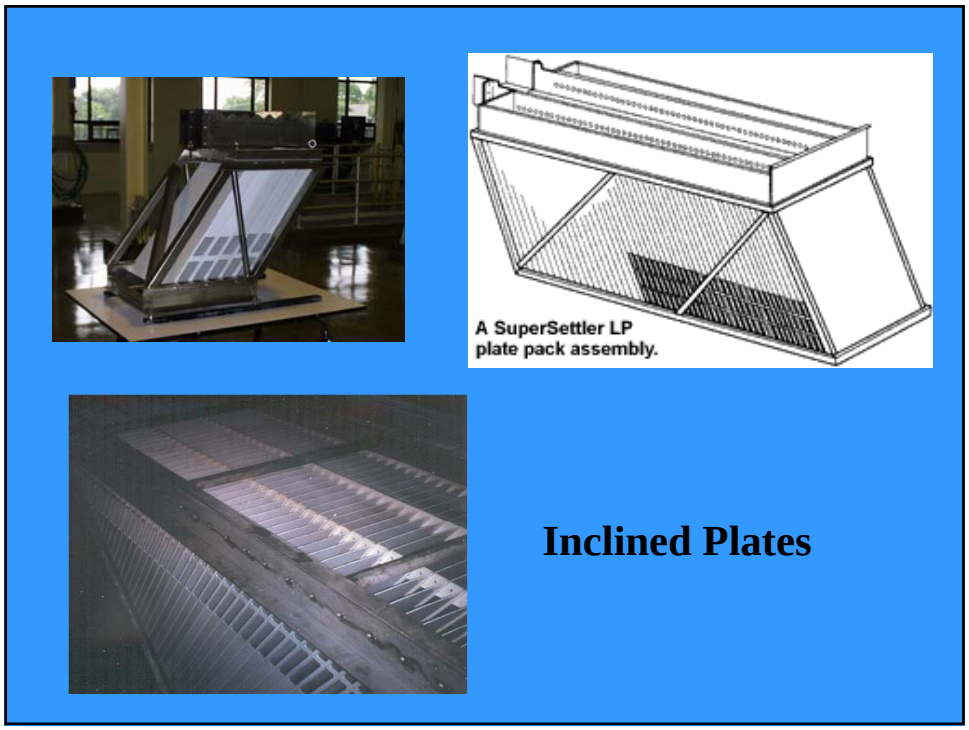
Probable Causes of CKD

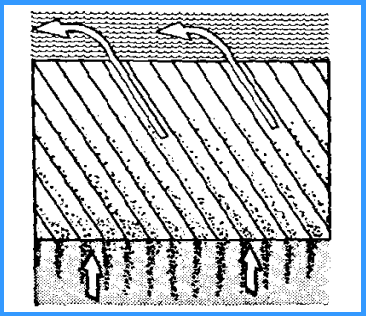
- hardness and/or high content of fluorides in drinking water;
- use of cheap aluminium cookware which is easily solubilised by the fluoride in water;
- excessive use of agrochemicals containingnephrotoxic chemicals, such as compounds of heavy metals like cadmium and arsenic, and even plant nutrients like phosphate itself (*hyperphosphatemia);* and Glyphosate.
- consumption of food items such as lotus roots and smoking tobacco, which have high Cadmium (Cd) levels;
- algal and herbal toxins in the drinking water supply;
- high ionic concentration in groundwater aquifers supplying the wells from which people draw their drinking water;
- nephrotoxic ingredients (e.g.*Sapsanda*) in widely used ayurvedic herbal medicines;
- excessive dehydration in the work environment of farmers; and even genetic predisposition of the affected population to kidney damage from normally harmless levels of nephrotoxins

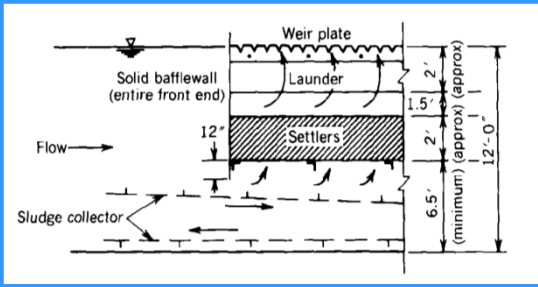
Selection of WTP Process




Conventional WTP process
(as proposed in JICA report)
Chlorine
Coagulant (alum)
Chlorine
Clearwell
RAPID MIX
FLOCCULATION/ SEDIMENTATION
Media FILTRATION
To Distribution


A SuperSettler LP plate pack assembly.
Inclined Plates



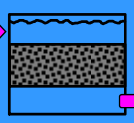


Dissolved Air Flotation (DAF)

Coagulant (alum)

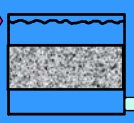
RAPID MIX

Dissolved Air Flotation



Dual Media Filtration

Granular Activated Carbon Filtration

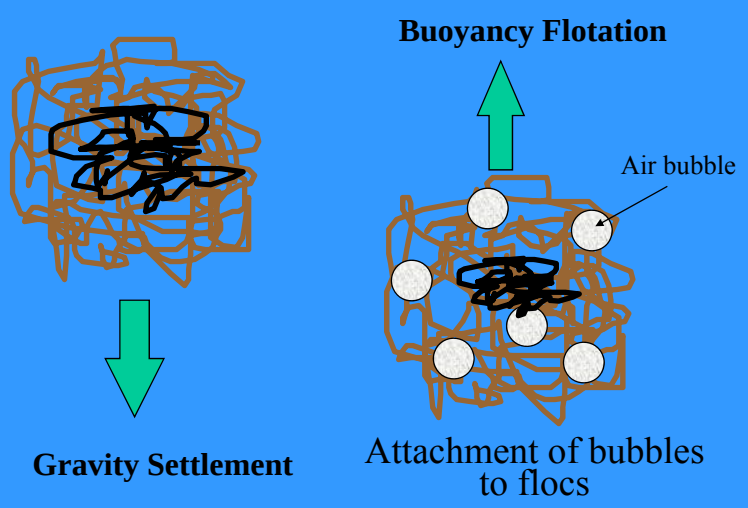


Chlorine

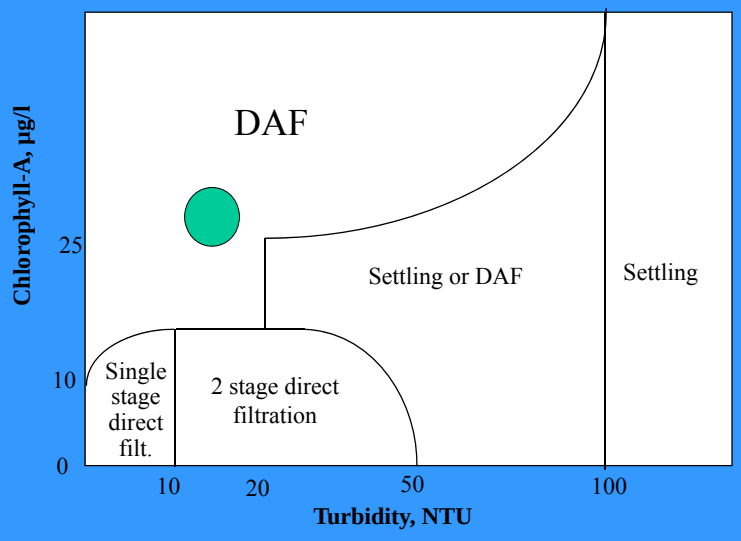
Clear well

To Distribution

Primary difference between conventional and dissolved air flotation



Clarification/ Process Selection Range



Source: Jansenns, J., and A.Buekens (1993). Assessment of Process Selection for Particle Removal in Surface Water Treatment. Aqua.

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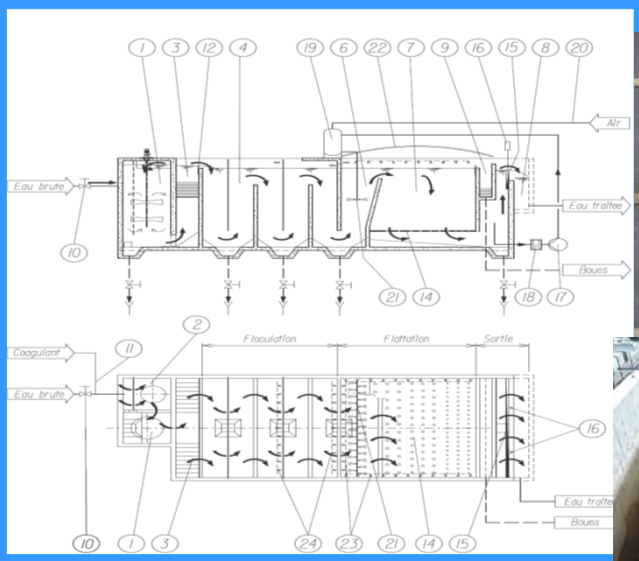
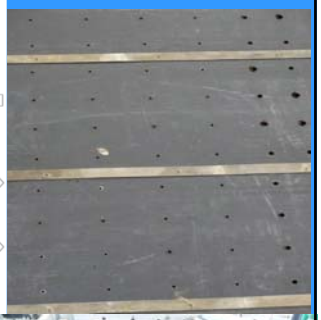
Typical DAF Arrangement





Way Forward

- Initiate the design of First phase of WTP with DAF, Media Filtration followed by GAC as primary barriers for Algae and other organic & pesticide control.
- Continue to monitor data on specific water quality parameters from existing WTPs (inlet and outlet) as well as from proposed water source.
- Develop detailed mapping of existing as well as future CKD patients within the existing water Distribution system area
- Allocate specific budget and continue to provide public education program on use of treated surface water from WTPs

THANK YOU

ANURADHAPURA NORTH WATER SUPPLY PROJECT PHASE 1

Minutes of Discussion on Working Paper No.4 Mahakandarawa Water Treatment Plant at RSC (North-Central) Office

Date: 01.10.2014

The power point presentation of and discussion on Working Paper No.4 were organized by the Project Director. There was a discussion between the NWSDB staff (Project & RSC) following the power point presentation, which was made by the Consultant's staff. The following staff members of the NWSDB and Consultant participated and the key points discussed are given below:

NWSDB Staff

Mr. M.A.G.Susantha	AGM (NWSDB)
Mr. D.B.Gunadasa	PD (ANWSP)
Mr. N.Chandrasena	Manager (O&M)
Mr. C.S.Lokubarana	CE (C)
Ms. D.P.K.Jayasena	CE (P&D)
Mr. W.A.T.P Senevirathne	ME (NWSDB)
Mr. S.C.Rathnayake	CE (SP)
Mr. M.M.R.U.Kumara	Eng. (ANWSP)
Mr. K.M.K.G.Karunarathna	Eng. (ANWSP)
Mr. S.H.N.S.Senanayake	OIC (NWSDB)

Consultant's Staff

Mr.Kevin Holroyd	Team Leader (ANWSP)	NJS
Mr.P.Kulatunga	Co-Team Leader	Ceywater
Mr. Uday Kelkar	Water Treatment Expert	NJS
Mr. Yasuaki Konda	Mechanical Engineer	NJS
Mr. K.G.Dayarathne	Mechanical Engineer	Ceywater
Mr.V.B.Perera	Microbiologist	Ceywater
Mr.B.A.Gunarathne	Electrical Engineer	Ceywater
Mr.Lal Elamaldeniya	Instrumentation Engineer	Ceywater

1) Application of Dissolved Air Flotation (DAF) followed by Rapid Sand Filters (RSF) and Granular Activated Carbon (GAC) is an appropriate process selected for this treatment plant, would it be applicable to add Powder Activated Carbon (PAC) upfront in the treatment process? (Question by CE (SP))

   Addition of PAC would certainly be helpful in removing additional colour as well as Taste and Odour (T&O) compounds. However, the dose of PAC needs to be pre-determined based on laboratory study to evaluate optimal PAC dose for maximum adsorption of colour and T&O compounds. Consultant can provide space for implementing PAC, if it is required in the future. As the plant is designed with GAC, which would provide as a barrier to Geosmin/MIB/and other organic compounds.

2) Can the existing treatment process reduce Total Dissolved Solids (TDS) below 300 mg/L level, which is being put in as a desirable level for CKDu area? (Question by CE (SP))

The treatment scheme that is provided here in really does not provide any reduction for more than 10% to the influent raw water TDS. It is interesting to know whether there has been kept a desirable limit for TDS by the NWDSB. Overall the influent TDS levels are in the 500 to 650 mg/L levels and to achieve lower than 300 mg/L TDS, the plant has to use reverse osmosis (RO) process and that is not practical as it will require higher volume, almost twice the amount of raw water source to meet the total production capacity, as RO processes, do not provide more than 75% product recovery and the rejects will to be discharged appropriately as it will contain much higher levels of TDS. What has seen from the literature that Total hardness (TH) should be less than 300 mg/L and fluoride less than 0.6 mg/L in the treated water. The raw water from the lake does not have more than 200 mg/L TH and fluoride is less than 0.5 mg/L, which is essentially get reduced to more than 50% as a result of treatment process through coagulation/filtration.

3) Will the plant be designed for use of poly aluminium chloride as a coagulant instead of alum that has been proposed? (Question by CE (SP))

Yes, the coagulant could be either Alum or poly aluminium chloride, which will provide better coagulation regime in the pH range of the raw water, have less degree of sludge production as the dosages required for coagulation are lower than that of Alum for this type of water. We can make provision to use either of the coagulant.

4) Will you be using polymer in the DAF process? (Question by CE (SP))

No. Polymers have not been used in the process, it is only suggested that if you use high rate DAF process, you need to use polymer, however, high rate DAF has not been suggested here. The sludge thickener will also not have polymer addition as the supernatant will be discharged in to natural drains/channels.

5) The groundwater level in the area where the plant is located is very high. We hope that you have taken into account this for lagoon as well as sludge drying bed. (Question by CE (P&D))

Yes, we have. The concrete bed underneath the sand drying beds will be designed to reduce any effect of uplift, as well as to have proper collection of dewatered fluid. The lagoons will also be constructed with a concrete bed and will be designed to reduce any effect of uplift.

6) Have you considered other advanced oxidation processes like ozone, chlorine dioxide instead of chlorine? (Question by CE (SP))

We have not specifically considered these chemicals as we think they are not required since, DAF and GAC have been adopted for the treatment and pre-chlorination dose would be reduced to get better treatment and reduce any T&O associated with higher dosages of pre-chlorination. Plus both ozone and chlorine dioxide needs to be produced on-site and cannot

be stored as these are very reactive chemicals and get exhausted within no time. The cost of producing and maintaining the unit operation for these chemicals is also very energy intensive and costlier. Hence are not recommended.

The above minutes are certified as correct.

.....	.....
Assistant General Manager (NC)	Manager (O&M)
.....	.....
Project Director (ANWSP)	Team Leader (Consultant)

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

CONSTRUCTION OF INTAKE FACILITY, WATER TREATMENT PLANT, WATER STORAGE STRUCTURES, MECHANICAL, ELECTRICAL AND BUILDING WORKS

CONTRACT NO. AN/JICA/STRCT/LOT A

BILL OF QUANTITIES

GRAND SUMMARY

BILL NO.	DESCRIPTION	TOTAL AMOUNT			
		Supplied from outside the Employer's Country Price		Supplied from within the Employer's Country Price	Installation & all Other Civil Works
		CIF	Port charges & taxes (except custom duties & VAT), handling, double handling, clearance, CIP Anuradhapura site, etc.	Supply & delivery to Anuradhapura site	
		US$	SLRs.	SLRs.	SLRs.
1	GENERAL REQUIREMENTS				97,539,940.00
2	PROVISIONAL SUMS				335,121,818.00
3 - 1	CONSTRUCTION OF INTAKE STRUCTURE				86,057,481.07
3 - 2	CONSTRUCTION OF FLOW CONTROL STRUCTURE				5,785,098.72
3 - 3	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT INTAKE	9,064.10	315,086.37	0.00	121,865.39
3 - 4	SUPPLY AND INSTALLATION OF MECHANICAL EQUIPMENT AT INTAKE AND FLOW CONTROL STRUCTURE	323,131.41	11,233,017.12	76,000.00	3,864,184.22
3 - 5	SUPPLY AND INSTALLATION OF ELECTRICAL EQUIPMENT AT INTAKE	95,803.71	3,330,328.71	2,861,000.00	1,306,682.81
3 - 6	SUPPLY AND INSTALLATION OF INSTRUMENTATION EQUIPMENT AT INTAKE	53,841.16	1,871,626.37	390,000.00	554,115.44
4 - 1	SITE WORK - INTAKE AND WTP				191,001,722.50
4 - 2	CONSTRUCTION OF STRUCTURE - RECEIVING AND DISTRIBUTION CHAMBER				11,277,254.28
4 - 3	CONSTRUCTION OF STRUCTURE - FLOCCULATION TANKS AND DAF UNIT				44,970,534.27
4 - 4	CONSTRUCTION OF STRUCTURE - RAPID SAND FILTER				57,312,853.00
4 - 5	CONSTRUCTION OF STRUCTURE - GAC FILTER				81,463,467.18
4 - 6	CONSTRUCTION OF STRUCTURE - CLEAR WATER TANK AND PUMP HOUSE				105,101,776.65
4 - 7	CONSTRUCTION OF STRUCTURE - BACKWASH WATER RECYCLING TANK AND SLUDGE BALANCING TANK				31,164,029.07
4 - 8	CONSTRUCTION OF STRUCTURE - SLUDGE THICKENER AND PUMP HOUSE				15,631,356.61
4 - 9	CONSTRUCTION OF STRUCTURE - SLUDGE DRYING BED				35,337,197.33
	TOTAL CARRIED FORWARD TO PAGE BOQ - 1334	**481,840.39**	**16,750,058.57**	**3,327,000.00**	**1,103,611,376.55**

3.2-1 -1

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

CONSTRUCTION OF INTAKE FACILITY, WATER TREATMENT PLANT, WATER STORAGE STRUCTURES, MECHANICAL, ELECTRICAL AND BUILDING WORKS

CONTRACT NO. AN/JICA/STRCT/LOT A

BILL OF QUANTITIES

GRAND SUMMARY

BILL NO.	DESCRIPTION	TOTAL AMOUNT			
		Supplied from outside the Employer's Country Price		Supplied from within the Employer's Country Price	Installation & all Other Civil Works
		CIF	Port charges & taxes (except custom duties & VAT), handling, double handling, clearance, CIP Anuradhapura site, etc.	Supply & delivery to Anuradhapura site	
		US$	SLRs.	SLRs.	SLRs.
	TOTAL BROUGHT FORWARD FROM PAGE BOQ - 1333	**481,840.39**	**16,750,058.57**	**3,327,000.00**	**1,103,611,376.55**
4 - 10	CONSTRUCTION OF STRUCTURE - SLUDGE LAGOON				10,320,548.58
4 - 11	CONSTRUCTION OF CHEMICAL BUILDING AT WATER TREATMENT PLANT				22,609,328.47
4 - 12	CONSTRUCTION OF CHLORINATION BUILDING AT WATER TREATMENT PLANT				8,332,526.77
4 - 13	CONSTRUCTION OF ADMINISTRATION BUILDING AT WATER TREATMENT PLANT				41,068,082.76
4 - 14	CONSTRUCTION OF STORE BUILDING AT WATER TREATMENT PLANT				10,827,829.88
4 - 15	CONSTRUCTION OF WORK SHOP AT WATER TREATMENT PLANT				11,458,403.47
4 - 16	CONSTRUCTION OF GENERATOR BUILDING AT WATER TREATMENT PLANT				7,318,735.69
4 - 17	CONSTRUCTION OF GUARD HOUSE AT WATER TREATMENT PLANT				2,500,380.51
4 - 18	CONSTRUCTION OF CARETAKER QUARTERS AT WATER TREATMENT PLANT				6,310,822.56
4 - 19	CONSTRUCTION OF OIC QUARTERS AT WATER TREATMENT PLANT				8,605,496.59
4 - 20	CONSTRUCTION OF PARKING SHED AT WATER TREATMENT PLANT				4,523,290.71
4 - 21	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT RECEIVING AND DISTRIBUTION CHAMBER	6,188.51	215,125.04	0.00	104,809.29
4 - 22	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT FLOCCULATION TANKS AND DAF UNIT	7,468.00	259,602.56	0.00	103,386.74
4 - 23	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT RAPID SAND FILTER	102,413.77	3,560,107.35	0.00	334,320.78
4 - 24	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT GAC FILTER	101,366.40	3,523,698.83	0.00	661,619.74
	TOTAL CARRIED FORWARD TO PAGE BOQ - 1335	**699,277.07**	**24,308,592.34**	**3,327,000.00**	**1,238,690,959.09**

3.2-1 -2

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

CONSTRUCTION OF INTAKE FACILITY, WATER TREATMENT PLANT, WATER STORAGE STRUCTURES, MECHANICAL, ELECTRICAL AND BUILDING WORKS

CONTRACT NO. AN/JICA/STRCT/LOT A

BILL OF QUANTITIES

GRAND SUMMARY

BILL NO.	DESCRIPTION	TOTAL AMOUNT			
		Supplied from outside the Employer's Country Price		Supplied from within the Employer's Country Price	Installation & all Other Civil Works
		CIF	Port charges & taxes (except custom duties & VAT), handling, double handling, clearance, CIP Anuradhapura site, etc.	Supply & delivery to Anuradhapura site	
		US$	SLRs.	SLRs.	SLRs.
	TOTAL BROUGHT FORWARD FROM PAGE BOQ - 1334	**699,277.07**	**24,308,592.34**	**3,327,000.00**	**1,238,690,959.09**
4 - 25	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT CLEAR WATER TANK AND PUMP HOUSE	37,057.86	1,288,205.26	0.00	2,501,708.27
4 - 26	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT BACKWASH WATER RECYCLING TANK AND SLUDGE BALANCING TANK	12,549.68	436,252.04	0.00	429,262.70
4 - 27	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT SLUDGE THICKENER AND SLUDGE PUMP HOUSE	3,388.08	117,776.55	0.00	58,934.54
4 - 28	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT SLUDGE DRYING BED	9,817.48	341,275.22	0.00	158,686.27
4 - 29	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT SLUDGE LAGOON	656.06	22,805.90	17,892.00	13,195.30
4 - 30	SUPPLY AND INSTALLATION OF YARD PIPES AT INTAKE AND WTP	77,449.32	2,692,272.71	1,760,465.00	9,370,376.56
4 - 31	SUPPLY AND INSTALLATION OF MECHANICAL EQUIPMENT AT WTP	3,047,017.09	101,720,884.77	2,902,130.53	29,381,234.50
4 - 32	SUPPLY AND INSTALLATION OF ELECTRICAL EQUIPMENT AT WTP	993,002.24	34,518,743.72	34,264,500.00	13,390,284.89
4 - 33	SUPPLY AND INSTALLATION OF INSTRUMENTATION EQUIPMENT AT WTP	428,822.99	14,906,744.82	16,310,939.50	5,681,529.33
4 - 34	RE-CONSTRUCTION OF LB CANAL (UP STREAM OF INTAKE)				27,334,628.70
5 - 1	SITE WORK - RAMBEWA				19,344,493.00
5 - 2	CONSTRUCTION OF 1500M^3 GROUND RESERVOIR AND PUMP HOUSE AT RAMBEWA				76,996,838.66
5 - 3	CONSTRUCTION OF ELEVATED WATER TOWER CAPACITY 1000 M^3 AT RAMBEWA				92,661,192.89
5 - 4	CONSTRUCTION OF RE - CHLORINATION BUILDING AT RAMBEWA				2,142,328.71
	TOTAL CARRIED FORWARD TO PAGE BOQ - 1336	**5,309,037.86**	**180,353,553.33**	**58,582,927.03**	**1,518,155,653.40**

3.2-1 -3

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

CONSTRUCTION OF INTAKE FACILITY, WATER TREATMENT PLANT, WATER STORAGE STRUCTURES, MECHANICAL, ELECTRICAL AND BUILDING WORKS

CONTRACT NO. AN/JICA/STRCT/LOT A

BILL OF QUANTITIES

GRAND SUMMARY

BILL NO.	DESCRIPTION	TOTAL AMOUNT			
		Supplied from outside the Employer's Country Price		Supplied from within the Employer's Country Price	Installation & all Other Civil Works
		CIF	Port charges & taxes (except custom duties & VAT), handling, double handling, clearance, CIP Anuradhapura site, etc.	Supply & delivery to Anuradhapura site	
		US$	SLRs.	SLRs.	SLRs.
	TOTAL BROUGHT FORWARD FROM PAGE BOQ - 1335	**5,309,037.86**	**180,353,553.33**	**58,582,927.03**	**1,518,155,653.40**
5 - 5	CONSTRUCTION OF GENERATOR BUILDING AT RAMBEWA				7,318,735.69
5 - 6	CONSTRUCTION OF OIC OFFICE AT RAMBEWA				12,012,517.20
5 - 7	CONSTRUCTION OF AREA ENGINEER QUARTERS AT RAMBEWA				9,673,288.32
5 - 8	CONSTRUCTION OF CARETAKER QUARTERS AT RAMBEWA				6,295,822.56
5 - 9	CONSTRUCTION OF GUARD HOUSE AT RAMBEWA				2,040,186.51
5 - 10	CONSTRUCTION OF PARKING SHED AT RAMBEWA				2,260,505.34
5 - 11	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT 1500M^3 GROUND RESERVOIR AND PUMP HOUSE AT RAMBEWA	27,258.34	947,554.27	0.00	2,271,920.58
5 - 12	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT 1000M^3 ELEVATED WATER TOWER AT RAMBEWA	25,227.12	876,945.29	2,000.00	225,328.94
5 - 13	SUPPLY AND INSTALLATION OF YARD PIPES AT RAMBEWA	36,929.18	1,283,732.30	100,800.00	1,527,208.48
5 - 14	SUPPLY AND INSTALLATION OF MECHANICAL EQUIPMENT AT RAMBEWA	280,281.61	9,744,445.93	1,765,625.02	3,680,040.07
5 - 15	SUPPLY AND INSTALLATION OF ELECTRICAL EQUIPMENT AT RAMBEWA	197,249.21	6,856,777.21	3,288,000.00	2,186,370.81
5 - 16	SUPPLY AND INSTALLATION OF INSTRUMENTATION EQUIPMENT AT RAMBEWA	79,712.97	2,770,982.24	525,000.00	795,787.48
6 - 1	SITE WORK - EAST RAMBEWA				11,297,621.00
6 - 2	CONSTRUCTION OF 500M^3 GROUND RESERVOIR AND PUMP HOUSE AT EAST RAMBEWA				42,879,552.64
	TOTAL CARRIED FORWARD TO PAGE BOQ - 1337	**5,955,696.30**	**202,833,990.56**	**64,264,352.05**	**1,622,620,539.01**

3.2-1 -4

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

CONSTRUCTION OF INTAKE FACILITY, WATER TREATMENT PLANT, WATER STORAGE STRUCTURES, MECHANICAL, ELECTRICAL AND BUILDING WORKS

CONTRACT NO. AN/JICA/STRCT/LOT A

BILL OF QUANTITIES

GRAND SUMMARY

BILL NO.	DESCRIPTION	TOTAL AMOUNT			
		Supplied from outside the Employer's Country Price		Supplied from within the Employer's Country Price	Installation & all Other Civil Works
		CIF	Port charges & taxes (except custom duties & VAT), handling, double handling, clearance, CIP Anuradhapura site, etc.	Supply & delivery to Anuradhapura site	
		US$	SLRs.	SLRs.	SLRs.
	TOTAL BROUGHT FORWARD FROM PAGE BOQ - 1336	**5,955,696.30**	**202,833,990.56**	**64,264,352.05**	**1,622,620,539.01**
6 - 3	CONSTRUCTION OF ELEVATED WATER TOWER CAPACITY 250 M^3 AT EAST RAMBEWA				50,534,972.05
6 - 4	CONSTRUCTION OF RE - CHLORINATION BUILDING AT EAST RAMBEWA				2,142,328.71
6 - 5	CONSTRUCTION OF GENERATOR BUILDING AT EAST RAMBEWA				7,318,735.69
6 - 6	CONSTRUCTION OF CARETAKER QUARTERS AT EAST RAMBEWA				6,295,822.56
6 - 7	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT 500M^3 GROUND RESERVOIR AND PUMP HOUSE AT EAST RAMBEWA	9,301.39	323,335.05	0.00	1,746,288.87
6 - 8	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT 250M^3 ELEVATED WATER TOWER AT EAST RAMBEWA	11,519.42	400,438.00	900.00	131,945.41
6 - 9	SUPPLY AND INSTALLATION OF YARD PIPES AT EAST RAMBEWA	10,003.81	347,752.39	0.00	504,971.95
6 - 10	SUPPLY AND INSTALLATION OF MECHANICAL EQUIPMENT AT EAST RAMBEWA	181,685.84	6,317,128.49	1,512,866.14	3,337,461.39
6 - 11	SUPPLY AND INSTALLATION OF ELECTRICAL EQUIPMENT AT EAST RAMBEWA	134,403.95	4,672,150.27	2,541,400.00	1,525,120.11
6 - 12	SUPPLY AND INSTALLATION OF INSTRUMENTATION EQUIPMENT AT EAST RAMBEWA	55,902.65	1,943,287.84	365,000.00	619,517.32
7 - 1	SITE WORK - MEDAWACHCHIYA				41,302,172.00
7 - 2	CONSTRUCTION OF 1000M^3 GROUND RESERVOIR AND PUMP HOUSE AT MEDAWACHCHIYA				65,184,312.14
7 - 3	CONSTRUCTION OF RE - CHLORINATION BUILDING AT MEDAWACHCHIYA				2,142,328.71
	TOTAL CARRIED FORWARD TO PAGE BOQ - 1338	**6,358,513.36**	**216,838,082.60**	**68,684,518.20**	**1,805,406,515.92**

3.2-1 -5

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

CONSTRUCTION OF INTAKE FACILITY, WATER TREATMENT PLANT, WATER STORAGE STRUCTURES, MECHANICAL, ELECTRICAL AND BUILDING WORKS

CONTRACT NO. AN/JICA/STRCT/LOT A

BILL OF QUANTITIES

GRAND SUMMARY

BILL NO.	DESCRIPTION	TOTAL AMOUNT			
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		US$	SLRs.	SLRs.	SLRs.
	TOTAL BROUGHT FORWARD FROM PAGE BOQ - 1337	**6,358,513.36**	**216,838,082.60**	**68,684,518.20**	**1,805,406,515.92**
7 - 4	CONSTRUCTION OF GENERATOR BUILDING AT MEDAWACHCHIYA				7,318,735.69
7 - 5	CONSTRUCTION OF WORK SHOP AT MEDAWACHCHIYA				11,453,403.47
7 - 6	CONSTRUCTION OF AREA ENGINEER'S OFFICE AT MADAWACHCHIYA				13,451,734.11
7 - 7	CONSTRUCTION OF AREA ENGINEER'S QUARTERS AT MEDAWACHCHIYA				9,635,583.12
7 - 8	CONSTRUCTION OF CARETAKER QUARTERS AT MEDAWACHCHIYA				6,295,822.56
7 - 9	CONSTRUCTION OF GUARD HOUSE AT MEDAWACHCHIYA				2,040,186.51
7 - 10	CONSTRUCTION OF PARKING SHED AT MEDAWACHCHIYA				2,260,505.34
7 - 11	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT 1000M^3 GROUND RESERVOIR AND PUMP HOUSE AT MEDAWACHCHIYA	20,734.55	720,774.32	0.00	2,176,866.06
7 - 12	SUPPLY AND INSTALLATION OF YARD PIPES AT MEDAWACHCHIYA	26,063.65	906,024.54	181,440.00	1,440,768.41
7 - 13	SUPPLY AND INSTALLATION OF MECHANICAL EQUIPMENT AT MEDAWACHCHIYA	241,322.08	8,390,083.35	1,512,866.14	2,995,128.69
7 - 14	SUPPLY AND INSTALLATION OF ELECTRICAL EQUIPMENT AT MEDAWACHCHIYA	179,195.14	6,229,181.41	3,414,900.00	1,988,773.23
7 - 15	SUPPLY AND INSTALLATION OF INSTRUMENTATION EQUIPMENT AT MEDAWACHCHIYA	76,080.78	2,644,720.00	410,000.00	708,128.37
8 - 1	SITE WORK - ISSINBASSAGALA				29,945,492.00
8 - 2	CONSTRUCTION OF ELEVATED WATER TOWER CAPACITY 2000 M^3 AT ISSINBASSAGALA				123,700,697.21
	TOTAL CARRIED FORWARD TO PAGE BOQ - 1339	**6,901,909.55**	**235,728,866.21**	**74,203,724.34**	**2,020,818,340.68**

3.2-1 -6

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

CONSTRUCTION OF INTAKE FACILITY, WATER TREATMENT PLANT, WATER STORAGE STRUCTURES, MECHANICAL, ELECTRICAL AND BUILDING WORKS

CONTRACT NO. AN/JICA/STRCT/LOT A

BILL OF QUANTITIES

GRAND SUMMARY

BILL NO.	DESCRIPTION	TOTAL AMOUNT			
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		CIF	Port charges & taxes (except custom duties & VAT), handling, double handling, clearance, CIP Anuradhapura site, etc.	Supply & delivery to Anuradhapura site	
		US$	SLRs.	SLRs.	SLRs.
	TOTAL BROUGHT FORWARD FROM PAGE BOQ - 1338	**6,901,909.55**	**235,728,866.21**	**74,203,724.34**	**2,020,818,340.68**
8 - 3	CONSTRUCTION OF CARETAKER QUARTERS AT ISSINBASSAGALA				6,295,822.56
8 - 4	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT 2000M^3 ELEVATED WATER TOWER AT ISSINBASSAGALA	31,427.69	1,092,489.41	0.00	263,742.17
8 - 5	SUPPLY AND INSTALLATION OF YARD PIPES AT ISSINBASSAGALA	13,328.15	463,313.15	0.00	713,664.82
8 - 6	SUPPLY AND INSTALLATION OF MECHANICAL EQUIPMENT AT ISSINBESSAGALA	19,987.14	694,792.80	0.00	139,540.87
8 - 7	SUPPLY AND INSTALLATION OF ELECTRICAL EQUIPMENT AT ISSINBESSAGALA	2,858.64	99,372.00	256,000.00	54,425.31
8 - 8	SUPPLY AND INSTALLATION OF INSTRUMENTATION EQUIPMENT AT ISSINBESSAGALA	18,937.92	658,320.00	120,000.00	143,398.28
9 - 1	SITE WORK - ETHAKADA				16,025,874.00
9 - 2	CONSTRUCTION OF ELEVATED WATER TOWER CAPACITY 750 M^3 AT ETHAKADA				93,050,393.03
9 - 3	CONSTRUCTION OF RE - CHLORINATION BUILDING AT ETHAKADA				2,142,328.71
9 - 4	CONSTRUCTION OF CARETAKER QUARTERS AT ETHAKADA				6,295,822.56
9 - 5	SUPPLY AND INSTALLATION OF INTERNAL PIPES AT 750M^3 ELEVATED WATER TOWER AT ETHAKADA	20,248.60	703,881.71	2,000.00	190,762.90
9 - 6	SUPPLY AND INSTALLATION OF YARD PIPES AT ETHAKADA	20,486.45	712,150.08	228,000.00	2,285,068.86
9 - 7	SUPPLY AND INSTALLATION OF MECHANICAL EQUIPMENT AT ETHAKADA	59,536.96	2,070,907.52	1,474,866.14	836,345.14
	TOTAL CARRIED FORWARD TO PAGE BOQ - 1340	**7,088,721.10**	**242,224,092.87**	**76,284,590.48**	**2,149,255,529.89**

3.2-1 -7

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

CONSTRUCTION OF INTAKE FACILITY, WATER TREATMENT PLANT, WATER STORAGE STRUCTURES, MECHANICAL, ELECTRICAL AND BUILDING WORKS

CONTRACT NO. AN/JICA/STRCT/LOT A

BILL OF QUANTITIES

GRAND SUMMARY

BILL NO.	DESCRIPTION	TOTAL AMOUNT			
		Supplied from outside the Employer's Country Price		Supplied from within the Employer's Country Price	Installation & all Other Civil Works
		CIF	Port charges & taxes (except custom duties & VAT), handling, double handling, clearance, CIP Anuradhapura site, etc.	Supply & delivery to Anuradhapura site	
		US$	SLRs.	SLRs.	SLRs.
	TOTAL BROUGHT FORWARD FROM PAGE BOQ - 1339	**7,088,721.10**	**242,224,092.87**	**76,284,590.48**	**2,149,255,529.89**
9 - 8	SUPPLY AND INSTALLATION OF ELECTRICAL EQUIPMENT AT ETHAKADA	47,412.73	1,648,161.34	584,100.00	506,597.59
9 - 9	SUPPLY AND INSTALLATION OF INSTRUMENTATION EQUIPMENT AT ETHAKADA	25,919.22	901,004.00	80,000.00	248,163.09
A	**Total of (1 to 9-9)**	**7,162,053.05**	**244,773,258.21**	**76,948,690.48**	**2,150,010,290.56**
B	Day Works				5,247,282.61
C	Total Provisional Sum				335,121,818.00
D	**Total of (A - C)**	**7,162,053.05**	**244,773,258.21**	**76,948,690.48**	**1,814,888,472.56**
E	Contingencies (10% of D)	716,205.31	24,477,325.82	7,694,869.05	181,488,847.26
F	**Grand Total (B + C + D + E) excluding VAT Carried to Letter of Bid**	**7,878,258.36**	**269,250,584.04**	**84,643,559.53**	**2,336,746,420.44**

Foreign Currency Component	US$	7,878,258.36
Converted based on rates 28 days prior to the bid closure (1 US$ = 133.70 SLRs.)	SLRs.	1,053,323,142.44
Local Currency Component	SLRs.	2,690,640,564.00
TOTAL ESTIMATED COST IN LOCAL CURRENCY	**SLRs.**	**3,743,963,706.45**
TOTAL ESTIMATED COST IN FOREIGN CURRENCY	**US$**	**28,002,720.32**
VAT Amount	SLRs.	**411,836,007.71**

3.2-1 -8

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

CONSTRUCTION OF INTAKE FACILITY, WATER TREATMENT PLANT, WATER STORAGE STRUCTURES, MECHANICAL, ELECTRICAL AND BUILDING WORKS

CONTRACT NO. AN/JICA/STRCT/LOT A

BILL OF QUANTITIES

BILL NO. 2 : PROVISIONAL SUMS **ANURADHAPURA NWSP**

ITEM No.	CESMM3 Code No.	DESCRIPTION	UNIT	QTY	RATE SLRs.	TOTAL PRICE SLRs.
		CLASS A : GENERAL ITEMS				
		General obligations, site services and facilities, temporary works, testing of materials and work, provisional items and prime cost items				
		Provisional Sums may be used in whole or in part or not at all as directed by the Engineer.				
		Other Provisional Sums				
1	A 420.1	Allow for inspection, testing of materials and other required laboratory tests as directed by the Engineer.	P.Sum		500,000.00	500,000.00
2	A 420.2	Percentage adjustment to above Provisional Sum item (.....%).	%			
3	A 420.3	Allow for soil testing, geotechnical investigation where necessary as directed by the Engineer.	P.Sum		200,000.00	200,000.00
4	A 420.4	Percentage adjustment to above Provisional Sum item (.....%).	%			
5	A 420.5	Allow for making trial pits at suitable intervals for identifying utility services in path of pipe trace and to facilitate arrangements for any deviations necessary as directed by the Engineer	P.Sum		200,000.00	200,000.00
6	A 420.6	Percentage adjustment to above Provisional Sum item (.....%).	%			
7	A 420.7	Allow for diversion, support, protection or relocation of existing services or utilities as directed by the Engineer	P.Sum		500,000.00	500,000.00
8	A 420.8	Percentage adjustment to above Provisional Sum item (.....%).	%			
9	A 420.9	Allow for demolition and reinstatement of private properties as directed by the Engineer	P.Sum		500,000.00	500,000.00
10	A 420.10	Percentage adjustment to above Provisional Sum item (.....%).	%			
11	A 420.11	Allow for payment to RDA/PRDA/PS/LA for supervision and others.	P.Sum		500,000.00	500,000.00
12	A 420.12	Percentage adjustment to above Provisional Sum item (.....%).	%			
13	A 420.13	Allow for payment to other authorities for supervision and others.	P.Sum		500,000.00	500,000.00
14	A 420.14	Percentage adjustment to above Provisional Sum item (.....%).	%			
		Total of Page BOQ - 6 to Page BOQ - 9 Summary				**2,900,000.00**

3.2-1 -9

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

CONSTRUCTION OF INTAKE FACILITY, WATER TREATMENT PLANT, WATER STORAGE STRUCTURES, MECHANICAL, ELECTRICAL AND BUILDING WORKS

CONTRACT NO. AN/JICA/STRCT/LOT A

BILL OF QUANTITIES

BILL NO. 2 : PROVISIONAL SUMS **ANURADHAPURA NWSP**

ITEM No.	CESMM3 Code No.	DESCRIPTION	UNIT	QTY	RATE SLRs.	TOTAL PRICE SLRs.
		Other Provisional Sums (Contd.)				
15	A 420.15	Allow sum for Technical staff/Engineer's Representative for working during holidays and after working hours as assigned by the Engineer	P.Sum		3,500,000.00	3,500,000.00
16	A 420.16	Percentage adjustment to above Provisional Sum item (.....%).	%			
17	A 420.17	Allow sum for construction of canal close to access bridge location B (up stream and down stream) with the erosion protection as directed by Engineer.	P.Sum		10,000,000.00	10,000,000.00
18	A 420.18	Percentage adjustment to above Provisional Sum item (.....%).	%			
19	A 420.19	Provision of permanent power supply to the Works from Ceylon Electricity Board including transformers, meter cubicals, etc; at WTP and all other sites.	P.Sum		40,000,000.00	40,000,000.00
20	A 420.20	Percentage adjustment to above Provisional Sum item (.....%).	%			
21	A 420.21	Provision of permanent telephone line from Sri Lanka Telecom for the Administration building, OIC Office, Area Engineer's Office and other locations as identified by NWSDB.	P.Sum		200,000.00	200,000.00
22	A 420.22	Percentage adjustment to above Provisional Sum item (.....%).	%			
23	A 420.23	Furniture and equipment for Administration Building, Area Engineer's Office, OIC Office, Stores, Workshop and Laboratory.	P.Sum		6,000,000.00	6,000,000.00
24	A 420.24	Percentage adjustment to above Provisional Sum item (.....%).	%			
25	A 420.25	Supply and installation of Automatic power factor correction system	P.Sum		3,000,000.00	3,000,000.00
26	A 420.26	Percentage adjustment to above Provisional Sum item (.....%).	%			
27	A 420.27	Allow for manufacturer's recommended spare parts for Electrical, Mechanical, Instrumentation and SCADA equipment.	P.Sum		15,000,000.00	15,000,000.00
28	A 420.28	Percentage adjustment to above Provisional Sum item (.....%).	%			
29	A 420.29	Topographic Survey, design and construction of 1km long earthen trapezoidal canal for effluent discharge. Proposed canal demension are 450mm bed with 1:1 side slopes and depth of 750mm	P.Sum		3,000,000.00	3,000,000.00
30	A 420.30	Percentage adjustment to above Provisional Sum item (.....%).	%			
		Total of Page BOQ - 7 to Page BOQ - 9 Summary				**80,700,000.00**

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

CONSTRUCTION OF INTAKE FACILITY, WATER TREATMENT PLANT, WATER STORAGE STRUCTURES, MECHANICAL, ELECTRICAL AND BUILDING WORKS

CONTRACT NO. AN/JICA/STRCT/LOT A

BILL OF QUANTITIES

BILL NO. 2 : PROVISIONAL SUMS **ANURADHAPURA NWSP**

ITEM No.	CESMM3 Code No.	DESCRIPTION	UNIT	QTY	RATE SLRs.	TOTAL PRICE SLRs.
		Other Provisional Sums (Contd.)				
31	A 420.31	Supply of 400mm wide, 4m long Aluminium ladders (2 nos.) for Water Teatment Plant	P.Sum		100,000.00	100,000.00
32	A 420.32	Percentage adjustment to above Provisional Sum item (.....%).	%			
33	A 420.33	Allow for Overseas Training of NWSDB Staff	P.Sum		4,000,000.00	4,000,000.00
34	A 420.34	Percentage adjustment to above Provisional Sum item (.....%).	%			
35	A 420.35	Allow for design, supply and installation of automated LB canal sluice gate including control panel by Department of Irrigation.	P.Sum		2,000,000.00	2,000,000.00
36	A 420.36	Percentage adjustment to above Provisional Sum item (.....%).	%			
37	A 420.37	Allow for Re-construction of existing irrigation turn out structure, chinage at 0+087	P.Sum		1,000,000.00	1,000,000.00
38	A 420.38	Percentage adjustment to above Provisional Sum item (.....%).	%			
39	A 420.39	Allow for Internal communication system	P.Sum		1,200,000.00	1,200,000.00
40	A 420.40	Percentage adjustment to above Provisional Sum item (.....%).	%			
41	A 420.41	Allow provisional sum for payment to Dispute Board(Employer's portion)	P.Sum		500,000.00	500,000.00
42	A 420.42	Allow for Price Escalation	P.Sum		145,000,000.00	145,000,000.00
43	A 420.43	Supply,Installation and vender arranged training of the respective staff of NWSDB for the following softwares(each software with 5 user license). Small Word Water Network Information System,ArcGIS,WaterCAD,Surge Analysis Software,Structural Design Software & Project Management Software.	P.Sum		82,358,901.00	82,358,901.00
44	A 420.44	Percentage adjustment to above Provisional Sum item (.....%).	%			
45	A 420.45	Capacity Building Training (Oversees)	P.Sum		15,362,917.00	15,362,917.00
46	A 420.46	Percentage adjustment to above Provisional Sum item (.....%).	%			
		Total of Page BOQ - 8 to Page BOQ - 9 Summary				**251,521,818.00**

3.2-1 -11

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

SUPPLY AND LAYING OF HDPE, DI TRANSMISSION MAIN, SUBMAIN AND DISTRIBUTION MAINS

CONTRACT NO. AN/JICA/PL(M&SM)/LOTB

BILL OF QUANTITIES

GRAND SUMMARY

BILL NO.	DESCRIPTION	TOTAL AMOUNT		
		FOREIGN COMPONENT	LOCAL COMPONENT	
		CIF	Port charges & taxes (other than stated in preamble to BOQ), handling, double handling, clearance, CIP Anuradhapura site, etc.	Installation & all Other Civil Works
		Yen	SLRs.	SLRs.
1	GENERAL REQUIREMENTS			81,157,490.00
2	PROVISIONAL SUMS			147,325,000.00
3	SUPPLY AND LAYING OF TRANSMISSION MAINS & SUB MAINS	819,819,598.44	240,479,369.58	788,105,885.45
4	SUPPLY AND LAYING OF DISTRIBUTION MAINS EAST RAMBEWA ZONE	3,653,857.29	1,082,253.01	16,989,938.43
5	SUPPLY AND LAYING OF DISTRIBUTION MAINS ETHAKADA ZONE	54,974,793.39	16,178,078.39	154,670,553.44
6	SUPPLY AND LAYING OF DISTRIBUTION MAINS RAMBEWA ZONE	42,284,748.95	12,384,236.24	73,887,494.87
7	SUPPLY AND LAYING OF DISTRIBUTION MAINS ISSINBESSAGALA ZONE	203,066,392.80	59,995,909.09	431,132,397.26
A	**Total of (1 to 7)**	**1,123,799,390.87**	**330,119,846.31**	**1,693,268,759.44**
B	Total Provisional Sum (Except Percentage Adjustment)			147,325,000.00
C	**Total of (A - B)**	**1,123,799,390.87**	**330,119,846.31**	**1,545,943,759.44**
D	Contingencies (10% of C)	112,379,939.09	33,011,984.63	154,594,375.94
E	**Grand Total (B + C + D) excluding VAT Carried to Letter of Price Bid**	**1,236,179,329.96**	**363,131,830.94**	**1,847,863,135.39**

Foreign Currency Component	Yen	1,236,179,329.96	1,123,799,390.87
Converted based on rates 28 days prior to the bid closure (1 Yen = 1.139 SLRs.)	SLRs.	1,408,008,256.82	
Local Currency Component	SLRs.	2,210,994,966.33	2,023,388,605.76
TOTAL ESTIMATED COST IN LOCAL CURRENCY	**SLRs.**	**3,619,003,223.15**	
TOTAL ESTIMATED COST IN FOREIGN CURRENCY	**Yen**	**3,177,351,381.17**	
VAT Amount	SLRs.	**398,090,354.55**	

3.2-1 -12

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

SUPPLY AND LAYING OF HDPE, DI TRANSMISSION MAIN, SUBMAIN AND DISTRIBUTION MAINS

CONTRACT NO. AN/JICA/PL(M&SM)/LOTB

BILL OF QUANTITIES

BILL NO. 2 : PROVISIONAL SUMS **ANURADHAPURA NWSP**

ITEM No.	CESMM3 Code No.	DESCRIPTION	UNIT	QTY	RATE SLRs.	TOTAL PRICE SLRs.
		CLASS A : GENERAL ITEMS				
		General obligations, site services and facilities, temporary works, testing of materials and work, provisional items and prime cost items				
		Provisional Sums may be used in whole or in part or not at all as directed by the Engineer.				
		Contractual Requirements				
2.1	A 190.1	For payment of actual charges incurred for all insurance policies taken under the contract as per clause 18 of GCC and PCC	P.Sum		24,000,000.00	24,000,000.00
2.2	A 190.2	Percentage adjustment to above Provisional Sum item (.....%).	%			
		Daywork				
2.3	A 411	Daywork labour	P.Sum		1,000,000.00	1,000,000.00
2.4	A 412	Percentage adjustment to provisional sum for daywork labour (.....%).	%			
2.5	A 413	Daywork Materials	P.Sum		1,000,000.00	1,000,000.00
2.6	A 414	Percentage adjustment to provisional sum for daywork Materials (.....%).	%			
2.7	A 415	Daywork Plants	P.Sum		1,000,000.00	1,000,000.00
2.8	A 416	Percentage adjustment to provisional sum for daywork Plants (.....%).	%			
		Other Provisional Sums				
2.9	A 420.1	Allow for inspection, testing of materials and other required laboratory tests as directed by the Engineer.	P.Sum		500,000.00	500,000.00
2.10	A 420.2	Allow for soil testing, geotechnical investigation where necessary as directed by the Engineer.	P.Sum		200,000.00	200,000.00
2.11	A 420.3	Allow for making trial pits at suitable intervals for identifying utility services in path of pipe trace and to facilitate arrangements for any deviations necessary as directed by the Engineer	P.Sum		500,000.00	500,000.00
2.12	A 420.4	Allow for diversion, support, protection or relocation of existing services or utilities as directed by the Engineer	P.Sum		4,000,000.00	4,000,000.00
		Total of Page BOQ - 5 to Page BOQ - 7 Summary				**32,200,000.00**

3.2-1 -13

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

SUPPLY AND LAYING OF HDPE, DI TRANSMISSION MAIN, SUBMAIN AND DISTRIBUTION MAINS

CONTRACT NO. AN/JICA/PL(M&SM)/LOTB

BILL OF QUANTITIES

BILL NO. 2 : PROVISIONAL SUMS **ANURADHAPURA NWSP**

ITEM No.	CESMM3 Code No.	DESCRIPTION	UNIT	QTY	RATE SLRs.	TOTAL PRICE SLRs.
		Other Provisional Sums (Contd.)				
2.13	A 420.5	Allow for demolition and reinstatement of private properties as directed by the Engineer	P.Sum		2,000,000.00	2,000,000.00
2.14	A 420.6	Allow for payment to RDA/PRDA/PS/LA for supervision and others.	P.Sum		2,400,000.00	2,400,000.00
2.15	A 420.7	Allow for payment to Sri Lanka Railway for work related to the crossings of the railway tracks	P.Sum		500,000.00	500,000.00
2.16	A 420.8	Allow for payment to other authorities for supervision and others.	P.Sum		500,000.00	500,000.00
2.17	A 420.9	Allow for conducting the HIV/AIDS, prevention programme as per the Clause 6.7 of General Conditions of Contract and maintain the health and hygienic condition at site through out the Contract period.	P.Sum		1,000,000.00	1,000,000.00
2.18	A 420.10	Allow sum for Technical staff/Engineer's Representative for working during holidays and after working hours as assigned by the Engineer	P.Sum		1,500,000.00	1,500,000.00
2.19	A 420.11	Allow sum for supply and installation of all necessary pipes, fittings, specials and ancillaries in railway crossings (8 nos.) using trenchless technology as specified and as approved by the Sri lanka Railway & Engineer through a Nominated Sub-Contractor.	P.Sum		18,000,000.00	18,000,000.00
2.20	A 420.12	Allow for removing and relocating of existing electrical posts as per the specifications given by relevant government authority.	P.Sum		2,800,000.00	2,800,000.00
2.21	A 420.13	Allow for removing and relocating of existing telephone posts as per the specifications given by relevant government authority.	P.Sum		2,800,000.00	2,800,000.00
2.22	A 420.14	Allow for pipeline flushing arrangement at 01 location of East Rambewa zone & 4 locations of Issinbessagala zone.(Reffer drawings no ANP1/LB/STD/031,ANP1/LB/DM/510/G/003a & ANP1/LB/DM/530/G/002a	P.Sum		3,125,000.00	3,125,000.00
2.23	A 420.16	Percentage adjustment to above Provisional Sum items 2.9, 2.10, 2.11, 2.12, 2.13, 2.14, 2.15, 2.16, 2.17, 2.18, 2.19, 2.20, 2.21 ,& 2.22 (.....%)	%			
2.24	A 420.17	Allow provisional sum for payment to Dispute Board(50% only)	PS		500,000.00	500,000.00
2.25	A 420.18	Allow for Price Escalation	PS		80,000,000.00	80,000,000.00
		Total of Page BOQ - 6 to Page BOQ - 7 Summary				**115,125,000.00**

3.2-1 -14

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

TENDER FOR LAYING OF uPVC PIPES, FITTINGS AND SPECIALS AND SUPPLY AND LAYING OF DI AND GI PIPES, FITTINGS AND SPECIALS IN ISSINBESSAGALA ZONE.

CONTRACT NO. AN/JICA/PL(DSS)/LOT C1

BILL OF QUANTITIES

GRAND SUMMARY

BILL NO.	DESCRIPTION	TOTAL AMOUNT		
		FOREIGN COMPONENT	LOCAL COMPONENT	
		CIF	Port charges & taxes (other than stated in preamble to BOQ), handling, double handling, clearance, CIP Anuradhapura site, etc.	Installation & all Other Civil Works
		Yen	SLRs.	SLRs.
1	GENERAL REQUIREMENTS			35,396,000.00
2	PROVISIONAL SUMS			85,600,000.00
3	SUPPLY AND LAYING OF DISTRIBUTION MAINS ISSINBESSAGALA ZONE	14,280,724.00	3,520,686.00	248,016,167.00
4	SUPPLY AND DELIVERY OF GI PIPES AND FITTINGS (EAST RAMBEWA,RAMBEWA,ETHAKADA & ISSINBESSAGALA ZONES FOR LOT C2)	3,222,752.60	170,644.75	
5	SUPPLY AND DELIVERY OF DI VALVES AND MAN HOLE COVERS (EAST RAMBEWA,RAMBEWA,ETHAKADA & ISSINBESSAGALA ZONES FOR LOT C2)	4,441,581.68	235,181.75	
A	**Total of (1 to 5)**	**21,945,058.28**	**3,926,512.50**	**369,012,167.00**
B	Total Provisional Sum			85,600,000.00
C	**Total of (A - B)**	**21,945,058.28**	**3,926,512.50**	**283,412,167.00**
D	Contingencies (10% of C)	2,194,505.83	392,651.25	28,341,216.70
E	**Grand Total (B + C + D) excluding VAT Carried to Letter of Price Bid**	**24,139,564.11**	**4,319,163.75**	**397,353,383.70**

Foreign Currency Component	Yen	24,139,564.11	21,945,058.28
Converted based on rates 28 days prior to the bid closure (1 Yen = 1.059 SLRs.)	SLRs.	25,563,798.39	
Local Currency Component	SLRs.	401,672,547.45	372,938,679.50
TOTAL ESTIMATED COST IN LOCAL CURRENCY	**SLRs.**	**427,236,345.84**	
TOTAL ESTIMATED COST IN FOREIGN CURRENCY	**Yen**	**403,433,754.33**	
VAT Amount	SLRs.	**46,995,998.04**	

3.2-1 -15

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

TENDER FOR LAYING OF uPVC PIPES, FITTINGS AND SPECIALS AND SUPPLY AND LAYING OF DI AND GI PIPES, FITTINGS AND SPECIALS IN ISSINBESSAGALA ZONE.

CONTRACT NO. AN/JICA/PL(DSS)/LOT C1

BILL OF QUANTITIES

BILL NO. 2 : PROVISIONAL SUMS **ANURADHAPURA NWSP**

ITEM No.	CESMM3 Code No.	DESCRIPTION	UNIT	QTY	RATE SLRs.	TOTAL PRICE SLRs.
		CLASS A : GENERAL ITEMS				
		General obligations, site services and facilities, temporary works, testing of materials and work, provisional items and prime cost items				
		Provisional Sums may be used in whole or in part or not at all as directed by the Engineer.				
		Contractual Requirements				
2.1	A 190.1	For payment of actual charges incurred for all insurance policies taken under the contract as per clause 18 of GCC and PCC	P.Sum		5,000,000.00	5,000,000.00
2.2	A 190.2	Percentage adjustment to above Provisional Sum item (.....%).	%			
		Daywork				
2.3	A 411	Daywork labour	P.Sum		700,000.00	700,000.00
2.4	A 412	Percentage adjustment to provisional sum for daywork labour (.....%).	%			
2.5	A 413	Daywork Materials	P.Sum		700,000.00	700,000.00
2.6	A 414	Percentage adjustment to provisional sum for daywork Materials (.....%).	%			
2.7	A 415	Daywork Plants	P.Sum		700,000.00	700,000.00
2.8	A 416	Percentage adjustment to provisional sum for daywork Plants (.....%).	%			
		Other Provisional Sums				
2.9	A 420.1	Allow for inspection, testing of materials and other required laboratory tests as directed by the Engineer.	P.Sum		500,000.00	500,000.00
2.10	A 420.2	Percentage adjustment (.....%).				
2.11	A 420.3	Allow for soil testing, geotechnical investigation where necessary as directed by the Engineer.	P.Sum		700,000.00	700,000.00
2.12	A 420.4	Percentage adjustment (.....%).				
2.13	A 420.5	Allow for making trial pits at suitable intervals for identifying utility services in path of pipe trace and to facilitate arrangements for any deviations necessary as directed by the Engineer	P.Sum		450,000.00	450,000.00
2.14	A 420.6	Percentage adjustment (.....%).				
		Total of Page BOQ - 4 to Page BOQ - 7 Summary				**8,750,000.00**

3.2-1 -16

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

TENDER FOR LAYING OF uPVC PIPES, FITTINGS AND SPECIALS AND SUPPLY AND LAYING OF DI AND GI PIPES, FITTINGS AND SPECIALS IN ISSINBESSAGALA ZONE.

CONTRACT NO. AN/JICA/PL(DSS)/LOT C1

BILL OF QUANTITIES

BILL NO. 2 : PROVISIONAL SUMS **ANURADHAPURA NWSP**

ITEM No.	CESMM3 Code No.	DESCRIPTION	UNIT	QTY	RATE SLRs.	TOTAL PRICE SLRs.
		Other Provisional Sums (Contd.)				
2.15	A 420.7	Allow for diversion, support, protection or relocation of existing services or utilities as directed by the Engineer	P.Sum		200,000.00	200,000.00
2.16	A 420.8	Percentage adjustment (.....%).				
2.17	A 420.9	Allow for demolition and reinstatement of private properties as directed by the Engineer	P.Sum		900,000.00	900,000.00
2.18	A 420.10	Percentage adjustment (.....%).	%			
2.19	A 420.11	Allow for payment to RDA/PRDA/PS/LA for supervision and others.	P.Sum		900,000.00	900,000.00
2.20	A 420.12	Percentage adjustment (.....%).	%			
2.21	A 420.13	Allow for payment to other authorities for supervision and others.	P.Sum		200,000.00	200,000.00
2.22	A 420.14	Percentage adjustment (.....%).	%			
2.23	A 420.15	Allow for conducting the HIV/AIDS, prevention programme as per the Clause 6.6 of Contract Data and maintain the health and hygienic condition at site through out the Contract period.	P.Sum		500,000.00	500,000.00
2.24	A 420.16	Percentage adjustment (.....%).	%			
2.25	A 420.17	Allow sum for the Staff of Engineer's Representative for working during holidays and after working hours as assigned by the Engineer	P.Sum		900,000.00	900,000.00
2.26	A 420.18	Percentage adjustment (.....%).	%			
2.27	A 420.19	Allow for removing and relocating of existing electrical posts as per the specifications given by relevant government authority.	P.Sum		900,000.00	900,000.00
2.28	A 420.20	Percentage adjustment (.....%).	%			
2.29	A 420.21	Allow for removing and relocating of existing telephone posts as per the specifications given by relevant government authority.	P.Sum		900,000.00	900,000.00
2.30	A 420.22	Percentage adjustment (.....%).	%			
2.31	A 420.23	Allow for pipeline flushing arrangement at 12 locations.(Reffer drawings no ANP1/LC/DM/510/GA/001 & ANP1/LC/STD/018)	P.Sum		7,200,000.00	7,200,000.00
		Total of Page BOQ - 5 to Page BOQ - 7 Summary				**12,600,000.00**

3.2-1 -17

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

TENDER FOR LAYING OF uPVC PIPES, FITTINGS AND SPECIALS AND SUPPLY AND LAYING OF DI AND GI PIPES, FITTINGS AND SPECIALS IN ISSINBESSAGALA ZONE.

CONTRACT NO. AN/JICA/PL(DSS)/LOT C1

BILL OF QUANTITIES

BILL NO. 2 : PROVISIONAL SUMS **ANURADHAPURA NWSP**

ITEM No.	CESMM3 Code No.	DESCRIPTION	UNIT	QTY	RATE SLRs.	TOTAL PRICE SLRs.
2.32	A 420.24	Percentage adjustment (.....%).	%			
2.33	A 420.25	Allow sum for Dewatering	P.Sum		2,000,000.00	2,000,000.00
2.34	A 420.26	Percentage adjustment (.....%).	%			
2.35	A 420.27	Allow sum for Shoring	p.sum		36,000,000.00	36,000,000.00
2.36	A 420.28	Percentage adjustment (.....%).	%			
2.37	A 420.29	Allow provisional sum for payment to Dispute Board	PS		500,000.00	500,000.00
2.38	A 420.31	Allow for Price Escalation	PS		25,000,000.00	25,000,000.00
2.39	A 420.32	Supply and delivery of a portable engine driven pump with minimum duty point of 10m3/hr at 40m head.(This pump will be used for flushing of dead ends of the distribution pipe net work of Issenbessagala,Ethakada,Rambewa & East Rambewa zones)	p.sum		750,000.00	750,000.00
2.40	A 420.33	Percentage adjustment (.....%).	%			
		Total of Page BOQ - 6 to Page BOQ - 7 Summary				**64,250,000.00**

3.2-1 -18

TENDER FOR SUPPLY AND DELIVERY OF uPVC PIPES, FITTINGS AND SPECIALS FOR
ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1
CONTRACT NO. AN/JICA/SUP(PIPES)/LOT C2
GRAND SUMMARY

BOQ BILL NO.	DESCRIPTION	TOTAL AMOUNT(Rs)
01	SUPPLY AND DELIVERY OF uPVC PIPES,FITTINGS AND SPECIALS FOR EAST RAMBEWA,RAMBEWA,ETHAKADA & ISSINBASSAGALA ZONES OF LOT C2	23,991,318.00
02	SUPPLY AND DELIVERY OF uPVC PIPES,FITTINGS AND SPECIALS FOR EAST RAMBEWA ZONE OF LOT C3	6,574,225.00
03	SUPPLY AND DELIVERY OF uPVC PIPES,FITTINGS AND SPECIALS FOR ETHAKADA ZONE OF LOT C3	26,813,481.00
04	SUPPLY AND DELIVERY OF uPVC PIPES,FITTINGS AND SPECIALS FOR RAMBEWA ZONE OF LOT C3	20,524,451.00
05	SUPPLY AND DELIVERY OF uPVC PIPES,FITTINGS AND SPECIALS FOR ISSINBASSAGALA ZONE OF LOT C1	47,308,067.00
A	**SubTotal of (1 to 5)**	**125,211,542.00**
B	Less Discount (if any)	
C	**Grand Total (A -B) excluding VAT Carried to Letter of Price Bid**	**125,211,542.00**

TOTAL ESTIMATED COST IN LOCAL CURRENCY (SLRs.)	**125,211,542**
VAT Amount (11%) IN LOCAL CURRENCY (SLRs.)	**13,773,270**

3.2-1 -19

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

TENDER FOR LAYING OF uPVC PIPES, FITTINGS AND SPECIALS AND SUPPLY AND LAYING OF DI AND GI PIPES, FITTINGS AND SPECIALS IN RAMBEWA, EAST RAMBEWA & ETHAKADA ZONES.

CONTRACT NO. AN/JICA/PL(DSS)/LOT C3

BILL OF QUANTITIES

GRAND SUMMARY

BILL NO.	DESCRIPTION	TOTAL AMOUNT		
		FOREIGN COMPONENT	LOCAL COMPONENT	
		CIF	Port charges & taxes (other than stated in preamble to BOQ), handling, double handling, clearance, CIP Anuradhapura site, etc.	Installation & all Other Civil Works
		Yen	SLRs.	SLRs.
1	GENERAL REQUIREMENTS			35,436,000.00
2	PROVISIONAL SUMS			92,200,000.00
3	SUPPLY AND LAYING OF DISTRIBUTION MAINS EAST RAMBEWA ZONE	2,695,601.54	632,913.07	41,605,005.89
4	SUPPLY AND LAYING OF DISTRIBUTION MAINS ETHAKADA ZONE	9,462,338.33	2,248,032.66	151,035,211.29
5	SUPPLY AND LAYING OF DISTRIBUTION MAINS RAMBEWA ZONE	6,681,239.78	1,553,774.28	107,362,053.39
A	**Total of (1 to 6)**	**18,839,179.65**	**4,434,720.01**	**427,638,270.57**
B	Total Provisional Sum			92,200,000.00
C	**Total of (A - B)**	**18,839,179.65**	**4,434,720.01**	**335,438,270.57**
D	Contingencies (10% of C)	1,883,917.96	443,472.00	33,543,827.06
E	**Grand Total (B + C + D) excluding VAT Carried to Letter of Price Bid**	**20,723,097.61**	**4,878,192.01**	**461,182,097.63**

Foreign Currency Component	Yen	20,723,097.61
Converted based on rates 28 days prior to the bid closure (1 Yen = 1.059 SLRs.)	SLRs.	21,945,760.37
Local Currency Component	SLRs.	466,060,289.64
TOTAL ESTIMATED COST IN LOCAL CURRENCY	**SLRs.**	**488,006,050.01**
TOTAL ESTIMATED COST IN FOREIGN CURRENCY	**Yen**	**460,817,799.82**
VAT Amount	SLRs.	**53,680,665.50**

3.2-1 -20

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

TENDER FOR LAYING OF uPVC PIPES, FITTINGS AND SPECIALS AND SUPPLY AND LAYING OF DI AND GI PIPES, FITTINGS AND SPECIALS IN RAMBEWA, EAST RAMBEWA & ETHAKADA ZONES.

CONTRACT NO. AN/JICA/PL(DSS)/LOT C3

BILL OF QUANTITIES

BILL NO. 2 : PROVISIONAL SUMS **ANURADHAPURA NWSP**

ITEM No.	CESMM3 Code No.	DESCRIPTION	UNIT	QTY	RATE SLRs.	TOTAL PRICE SLRs.
		CLASS A : GENERAL ITEMS				
		General obligations, site services and facilities, temporary works, testing of materials and work, provisional items and prime cost items				
		Provisional Sums may be used in whole or in part or not at all as directed by the Engineer.				
		Contractual Requirements				
2.1	A 190.1	For payment of actual charges incurred for all insurance policies taken under the contract as per clause 18 of GCC and PCC	P.Sum		6,000,000.00	6,000,000.00
2.2	A 190.2	Percentage adjustment to above Provisional Sum item (.....%).	%			
		Daywork				
2.3	A 411	Daywork labour	P.Sum		800,000.00	800,000.00
2.4	A 412	Percentage adjustment to provisional sum for daywork labour (.....%).	%			
2.5	A 413	Daywork Materials	P.Sum		800,000.00	800,000.00
2.6	A 414	Percentage adjustment to provisional sum for daywork Materials (.....%).	%			
2.7	A 415	Daywork Plants	P.Sum		800,000.00	800,000.00
2.8	A 416	Percentage adjustment to provisional sum for daywork Plants (.....%).	%			
		Other Provisional Sums				
2.9	A 420.1	Allow for inspection, testing of materials and other required laboratory tests as directed by the Engineer.	P.Sum		500,000.00	500,000.00
2.10	A 420.2	Percentage adjustment (.....%).				
2.11	A 420.3	Allow for soil testing, geotechnical investigation where necessary as directed by the Engineer.	P.Sum		800,000.00	800,000.00
2.12	A 420.4	Percentage adjustment (.....%).				
2.13	A 420.5	Allow for making trial pits at suitable intervals for identifying utility services in path of pipe trace and to facilitate arrangements for any deviations necessary as directed by the Engineer	P.Sum		500,000.00	500,000.00
2.14	A 420.6	Percentage adjustment (.....%).				
		Total of Page BOQ - 4 to Page BOQ - 7 Summary				**10,200,000.00**

3.2-1 -21

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

TENDER FOR LAYING OF uPVC PIPES, FITTINGS AND SPECIALS AND SUPPLY AND LAYING OF DI AND GI PIPES, FITTINGS AND SPECIALS IN RAMBEWA, EAST RAMBEWA & ETHAKADA ZONES.

CONTRACT NO. AN/JICA/PL(DSS)/LOT C3

BILL OF QUANTITIES

BILL NO. 2 : PROVISIONAL SUMS **ANURADHAPURA NWSP**

ITEM No.	CESMM3 Code No.	DESCRIPTION	UNIT	QTY	RATE SLRs.	TOTAL PRICE SLRs.
		Other Provisional Sums (Contd.)				
2.15	A 420.7	Allow for diversion, support, protection or relocation of existing services or utilities as directed by the Engineer	P.Sum		300,000.00	300,000.00
2.16	A 420.8	Percentage adjustment (.....%).				
2.17	A 420.9	Allow for demolition and reinstatement of private properties as directed by the Engineer	P.Sum		1,000,000.00	1,000,000.00
2.18	A 420.10	Percentage adjustment (.....%).	%			
2.19	A 420.11	Allow for payment to RDA/PRDA/PS/LA for supervision and others.	P.Sum		1,000,000.00	1,000,000.00
2.20	A 420.12	Percentage adjustment (.....%).	%			
2.21	A 420.13	Allow for payment to other authorities for supervision and others.	P.Sum		200,000.00	200,000.00
2.22	A 420.14	Percentage adjustment (.....%).	%			
2.23	A 420.15	Allow for conducting the HIV/AIDS, prevention programme as per the Clause 6.6 of Contract Data and maintain the health and hygienic condition at site through out the Contract period.	P.Sum		500,000.00	500,000.00
2.24	A 420.16	Percentage adjustment (.....%).	%			
2.25	A 420.17	Allow sum for the Staff of Engineer's Representative for working during holidays and after working hours as assigned by the Engineer	P.Sum		1,000,000.00	1,000,000.00
2.26	A 420.18	Percentage adjustment (.....%).	%			
2.27	A 420.19	Allow for removing and relocating of existing electrical posts as per the specifications given by relevant government authority.	P.Sum		1,000,000.00	1,000,000.00
2.28	A 420.20	Percentage adjustment (.....%).	%			
2.29	A 420.21	Allow for removing and relocating of existing telephone posts as per the specifications given by relevant government authority.	P.Sum		1,000,000.00	1,000,000.00
2.30	A 420.22	Percentage adjustment (.....%).	%			
2.31	A 420.23	Allow for pipeline flushing arrangement at 3 lacations of Rambewa zone,4 lacations of Ethakada zone & 3 loacations of East Rambewa zone.(Reffer drawings no ANP1/LC/DM/500/GA/001,ANP1/LC/DM/520/GA/001,ANP1/LC/DM/530/GA/001 & ANP1/LC/STD/018)	P.Sum		6,000,000.00	6,000,000.00
		Total of Page BOQ - 5 to Page BOQ - 7 Summary				**12,000,000.00**

3.2-1 -22

ANURADHAPURA NORTH WATER SUPPLY PROJECT - PHASE 1

TENDER FOR LAYING OF uPVC PIPES, FITTINGS AND SPECIALS AND SUPPLY AND LAYING OF DI AND GI PIPES, FITTINGS AND SPECIALS IN RAMBEWA, EAST RAMBEWA & ETHAKADA ZONES.

CONTRACT NO. AN/JICA/PL(DSS)/LOT C3

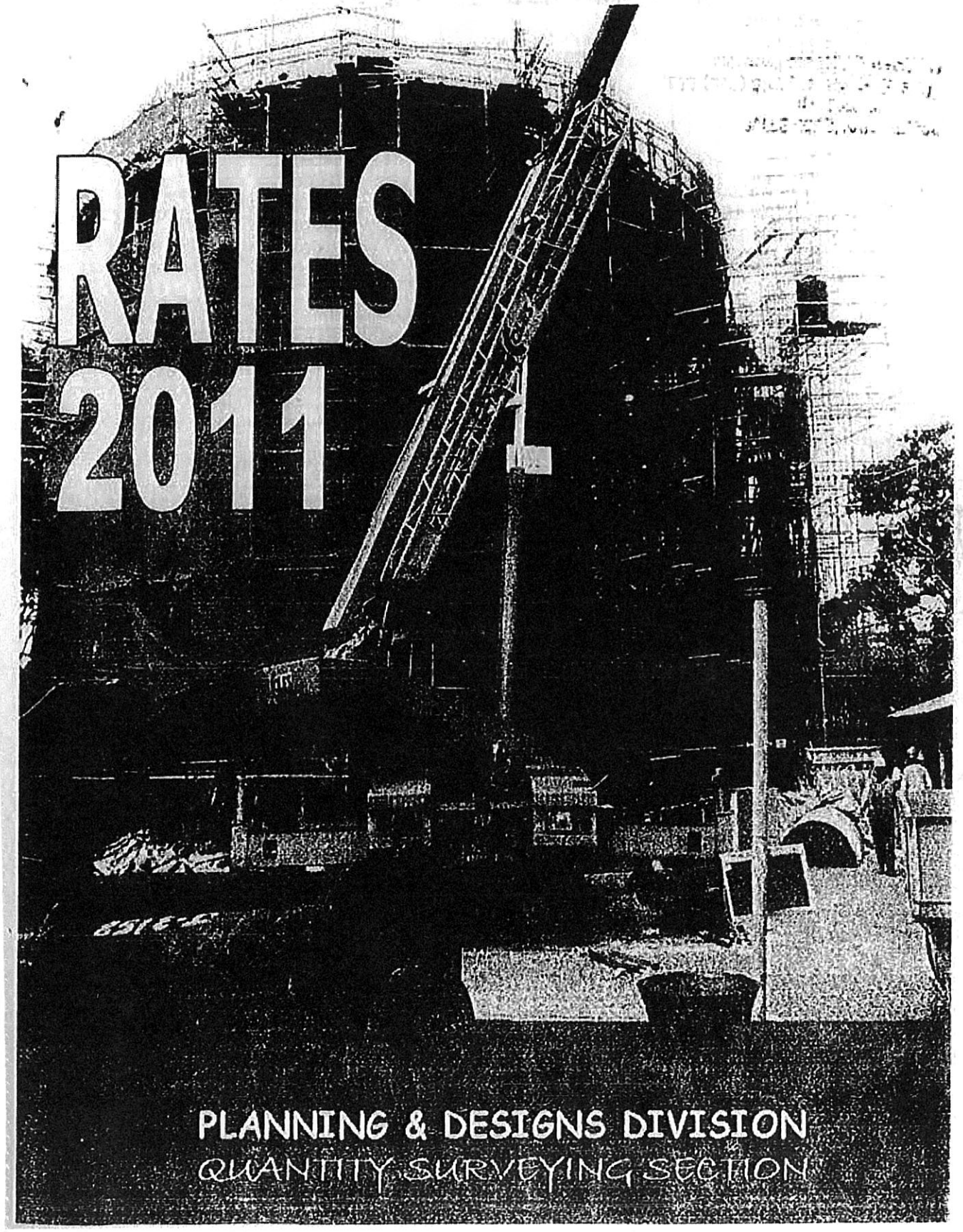
BILL OF QUANTITIES

BILL NO. 2 : PROVISIONAL SUMS **ANURADHAPURA NWSP**

ITEM No.	CESMM3 Code No.	DESCRIPTION	UNIT	QTY	RATE SLRs.	TOTAL PRICE SLRs.
2.32	A 420.24	Percentage adjustment (.....%).	%			
2.33	A 420.25	Allow sum for Dewatering	P.Sum		1,500,000.00	1,500,000.00
2.34	A 420.26	Percentage adjustment (.....%).	%			
2.35	A 420.27	Allow sum Shoring	p.sum		38,000,000.00	38,000,000.00
2.36	A 420.28	Percentage adjustment (.....%).	%			
2.37	A 420.29	Allow provisional sum for payment to Dispute Board	PS		500,000.00	500,000.00
2.38	A 420.31	Allow for Price Escalation	PS		30,000,000.00	30,000,000.00
		Total of Page BOQ - 6 to Page BOQ - 7 Summary				**70,000,000.00**

3.2-1 -23

National Water Supply & Drainage Board



RATES 2011

PLANNING & DESIGNS DIVISION

QUANTITY SURVEYING SECTION

SUPPLY OF PVC PIPES

Table A-PVC/1

SUPPLY OF TYPE 600 PVC PIPES

1	2	3	4
Diameter (mm)	Supply Rate (Rs:/m)	Supply Rate Transmission Main (Rs: /m)	Supply Rate Dristribution System (Rs: /m)
32	42.00	50.00	57.00
40	65.00	78.00	88.00
50	89.00	107.00	120.00
63	141.00	169.00	190.00
75	282.00	338.00	381.00
R.R.J. 90	380.00	456.00	513.00
S.C.J. 90	374.00	449.00	505.00
R.R.J. 110	556.00	667.00	751.00
160	998.00	1198.00	1347.00
225	1954.00	2345.00	2638.00
280	3080.00	3696.00	4158.00
315	3960.00	4752.00	5346.00

Table A-PVC/2

SUPPLY OF TYPE 1000 PVC PIPES

1	2	3	4
Diameter (mm)	Supply Rate (Rs:/m)	Supply Rate Transmission Main (Rs: /m)	Supply Rate Dristribution System (Rs: /m)
20	27.00	32.00	36.00
25	42.00	50.00	57.00
32	62.00	74.00	84.00
40	91.00	109.00	123.00
50	132.00	158.00	178.00
63	221.00	265.00	298.00
75	458.00	550.00	618.00
R.R.J. 90	581.00	697.00	784.00
S.C.J. 90	577.00	692.00	779.00
R.R.J. 110	873.00	1048.00	1179.00
160	1577.00	1892.00	2129.00
225	3074.00	3689.00	4150.00
280	4738.00	5686.00	6396.00
315	6200.00	7440.00	8370.00

Note :

1.0 Supply rate includes cost of rubber rings and lubricants.

2.0 Supplier's O/H&P included in the supply rate.

3.0 To obtain supply rate for transmission main, 20% was added to basic supply rate to accommodate cost of fittings, specials, valves, culvert crossings and valve chambers etc. that are incorporated in the Transmission System.

4.0 To obtain supply rate for distribution main, 35% was added to basic supply rate to accommodate cost of fittings, specials, valves, culvert crossings and valve chambers etc. and specials that are incorporated in the Distribution System.

5.0 Supply and laying contracts below 110mm dia. pipes 10% is to be added only for supply rate.

Source:

6.0 Tender Prices (NWS&DB)- 2010 3rd and 4th quarters.

7.0 Supplier's Price List.

PVC LAYING

Table A-PVC/3

Diameter	Basic Excavation Cost Max. depth n.e. 1.5m			Earth Work Support	Allow for Dewatering/ Disposal of Water	Laying & Plumbing
	Firm Sand	Soft or sandy soil	Gravel			
mm	Rs./m	Rs./m	Rs./m	Rs./m	Rs./m	Rs./m
63	84.00	106.00	108.00	757.00	13.00	51.00
90	154.00	193.00	197.00	832.00	24.00	51.00
110	168.00	208.00	215.00	908.00	26.00	55.00
160	222.00	276.00	286.00	908.00	35.00	61.00
225	240.00	299.00	310.00	983.00	38.00	72.00
280	240.00	299.00	310.00	983.00	38.00	107.00
315	311.00	388.00	402.00	1,021.00	49.00	139.00

Note :

1. Add for disposal of water and earth work support to basic laying cost if applicable.
2. Basic excavation cost includes excavation, preparation of bottom, backfilling, ramming (consider 95% compaction), disposal of excavated excess material and assuming earth available at site for backfilling.
3. Assuming earth available at site for backfilling. If imported soil is required an allowance should be made.(Calculated from basic price list)
4. Laying contractor's O/H & P not included.
5. Pressure testing, cleaning and disinfection included in laying cost. (Ref. Table B - PVC/2)
6. 30% is to be added to Laying rate for laying of specials, fittings, valves, culvert crossings and valve chambers etc.
7. To obtain laying rate in ordinary soil under high ways 40% is to be added to total cost of Excavation and laying (to remove asphalts coat and other base courses)
8. Traffic arrangements , dust controlling , maintenance of roads , temporary road reinstatement and other Preliminaries are not included

Source :

1. Based on work study and established data from published books.

Table A - PE2

Supply and Laying of HDPE Pipes (PE 100 - SDR 17 PN10)

Asian Countries (Without Japan and Malayasia)

1	2	3	4	5	6	7	8	9	10
Pipe Dia. mm	CIF Value Rs./m	Transmission main				Distribution main			
		CIF value for Specials Rs./m	(Col.2+3) Total CIFCost Rs./m	Transport & Clearing Rs./m	Custom Duty Rs./m	CIF value for Specials Rs./m	(Col.2+7) Total CIFCost Rs./m	Transport & Clearing Rs./m	Custom Duty Rs./m
90	274.00	69.00	343.00	35.00	158.00	96.00	370.00	37.00	171.00
110	333.00	84.00	417.00	42.00	192.00	117.00	450.00	45.00	207.00
160	637.00	160.00	797.00	80.00	367.00	223.00	860.00	86.00	396.00
180	1,053.00	264.00	1,317.00	132.00	606.00	369.00	1,422.00	143.00	655.00
225	1,274.00	319.00	1,593.00	160.00	733.00	446.00	1,720.00	172.00	792.00
250	1,717.00	430.00	2,147.00	215.00	988.00	601.00	2,318.00	232.00	1,067.00
280	1,824.00	456.00	2,280.00	228.00	1,049.00	639.00	2,463.00	247.00	1,133.00
315	2,928.00	732.00	3,660.00	366.00	1,684.00	1,025.00	3,953.00	396.00	1,819.00
355	3,519.00	880.00	4,399.00	440.00	2,024.00	1;232.00	4,751.00	476.00	2,186.00
400	4,944.00	1,236.00	6,180.00	618.00	2,843.00	1,731.00	6,675.00	668.00	3,071.00
450	6,000.00	1,500.00	7,500.00	750.00	3,450.00	2,100.00	8,100.00	810.00	3,726.00
500	8,640.00	2,160.00	10,800.00	1,080.00	4,968.00	3,024.00	11,664.00	1,167.00	5,366.00
560	11,520.00	2,880.00	14,400.00	1,440.00	6,624.00	4,032.00	15,552.00	1,556.00	7,154.00
630	14,400.00	3,600.00	18,000.00	1,800.00	8,280.00	5,040.00	19,440.00	1,944.00	8,943.00

Note :

1. Column (4) includes additional 25 % of CIF value for transmission mains and Column (8) includes additional 30% of CIF value for distribution mains to cover the costs of fittings,specials, valves, culvert crossings and valve chambers etc.
2. Column (5 and 9) 10% of total CIF cost is added for clearing & transporting (up to site stores)
3. Custom Duty is taken as 46.00% of CIF value.
4. Supplier's O/H & P are included in the CIF value.

Source :

Based on supplier's rates, tender prices of 2010 and forecast to 2011

Table A - PE4

Laying of HDPE Pipes (PE 100 - SDR 17 PN10)

1	2	3	4	5	6	7	8	9
Pipe Dia. mm	Basic Laying Cost	Transmission main		Distribution main		Excavation Cost (Ordinary Soil) Rs./m	EWS Cost Rs./m	Allow for Dewatering/Disposal of Water Rs./m
		Laying Cost for Specials Rs./m	Total Laying Cost	Laying Cost for Specials Rs./m	Total Laying Cost			
90	138.00	42.00	180.00	56.00	194.00	245.00	842.00	15.00
110	140.00	42.00	182.00	56.00	196.00	255.00	857.00	22.00
160	145.00	44.00	189.00	58.00	203.00	263.00	895.00	26.00
180	174.00	53.00	227.00	70.00	244.00	275.00	911.00	26.00
225	210.00	63.00	273.00	84.00	294.00	310.00	949.00	30.00
250	227.00	69.00	296.00	91.00	318.00	345.00	964.00	30.00
280	280.00	84.00	364.00	112.00	392.00	410.00	987.00	37.00
315	325.00	98.00	423.00	130.00	455.00	460.00	1,499.00	57.00
355	370.00	111.00	481.00	148.00	518.00	520.00	1,499.00	66.00
400	430.00	129.00	559.00	172.00	602.00	570.00	1,499.00	66.00
450	475.00	143.00	618.00	190.00	665.00	620.00	1,499.00	66.00
500	652.00	196.00	848.00	261.00	913.00	672.00	1,499.00	71.00
560	668.00	201.00	869.00	268.00	936.00	720.00	1,499.00	85.00
630	673.00	202.00	875.00	270.00	943.00	922.00	1,499.00	85.00

Note:

1 Column (2) Basic laying cost includes placing, jointing ,transporting from site stores,cleaning, disinfection,pressure testing and cost of polythene sleeving .

2 Column (4) includes additional 30% of basic laying cost for transmission mains and Column (6) includes additional 40% of basic laying cost for distribution mains to cover the cost of specials and other all costs,such as culvert crossings , bridge crossings,valve chambers,valves,thrrust blocks,pipe supports etc.

3 Column (7) Basic excavation cost includes excavation,preparation of bottom, backfilling ramming(consider 95% compaction)and assuming earth available at site for backfilling.

4 Contractor's OH and P not included.

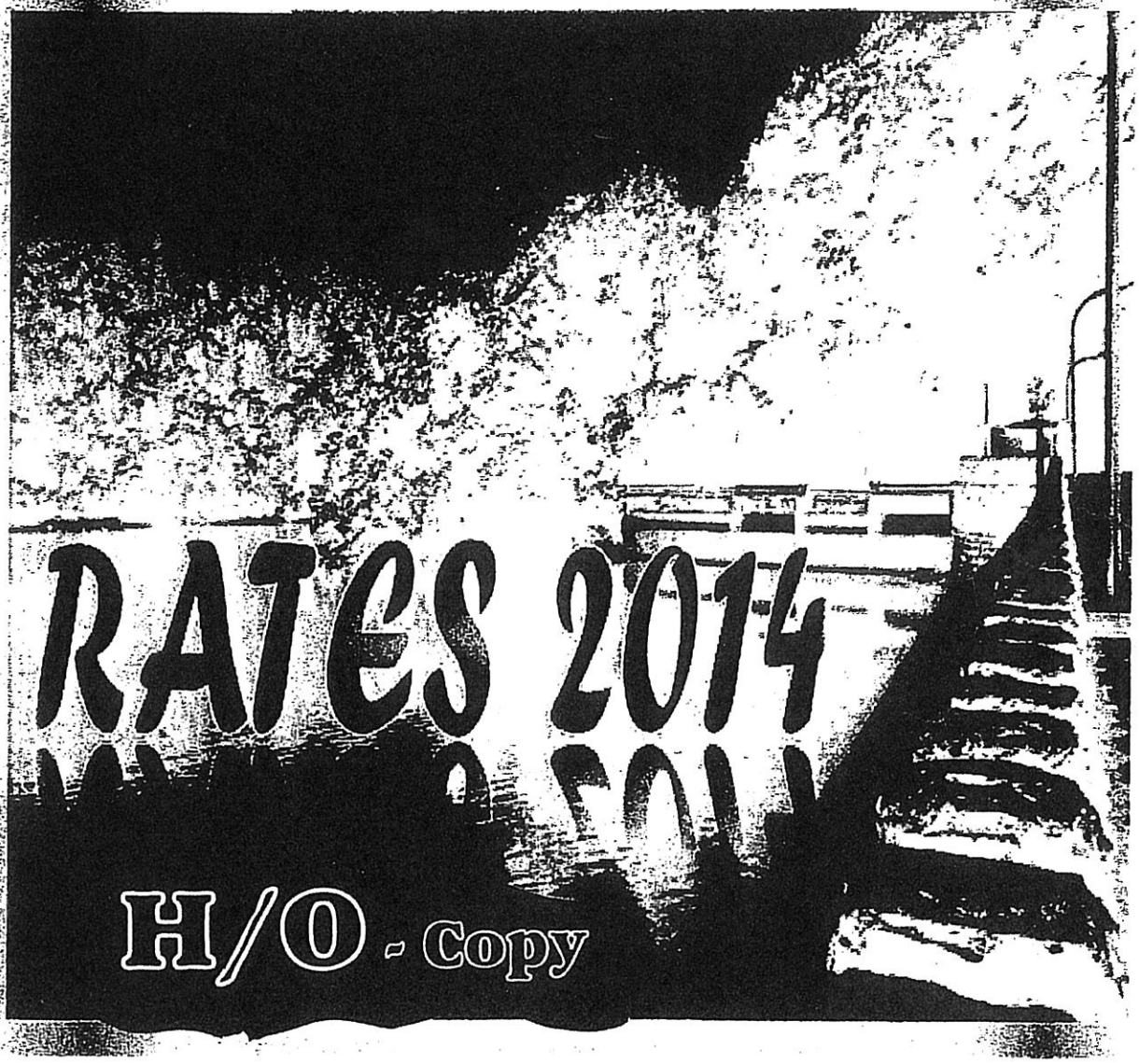
5 Rock excavation ,traffic management ,dust controlling and maintenanceof roads.Preliminaries are not to basic cost.

6 To obtain additional 40% to the total cost of laying and excavation under ordinary soil for highways.(To remove asphaltcoat with base courses and other relevant additional costs)

Source:

Based on work study and established data from published books.(Refer Annex 7)

National Water Supply & Drainage Board



RATES 2014

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PLANNING & DESIGNS DIVISION

QUANTITY SURVEYING SECTION

SUPPLY OF PVC PIPES

Table A – PVC/1

SUPPLY OF TYPE 600 PVC PIPES

1	2	3	4
Diameter (mm)	Supply Rate (Rs:/m)	Supply Rate Transmission Main (Rs:/m)	Supply Rate Distribution System (Rs: /m)
32	38.00	46.00	52.00
40	52.00	63.00	71.00
50	81.00	98.00	110.00
63	129.00	155.00	175.00
75	193.00	232.00	261.00
90 (RRJ)	257.00	309.00	347.00
110 (RRJ)	439.00	527.00	593.00
160	776.00	932.00	1,048.00
225	1,525.00	1,830.00	2,059.00
280	2,387.00	2,865.00	3,223.00
315	4,013.00	4,816.00	5,418.00

Table A – PVC/2

SUPPLY OF TYPE 1000 PVC PIPES

1	2	3	4
Diameter (mm)	Supply Rate (Rs:/m)	Supply Rate Transmission Main (Rs:/m)	Supply Rate Distribution System (Rs: /m)
20	26.00	32.00	36.00
25	39.00	47.00	53.00
32	52.00	63.00	71.00
40	82.00	99.00	111.00
50	128.00	154.00	173.00
63	217.00	261.00	293.00
75	309.00	371.00	418.00
90 (RRJ)	428.00	514.00	578.00
110 (RRJ)	568.00	682.00	767.00
160	1,338.00	1,606.00	1,807.00
225	2,568.00	3,082.00	3,467.00
280	4,136.00	4,964.00	5,584.00
315	8,066.00	9,680.00	10,890.00

Note:

1. Supply rate includes cost of rubber rings and lubricants.
2. Supplier's O/H & P included.
3. To obtain supply rate for transmission main, 20% added to basic supply rate to accommodate cost of fittings and specials, valves, culvert crossings, bridge crossings and valve chambers etc. that are incorporated in the Transmission System.
4. To obtain supply rate for distribution main, 35% added to basic supply rate to accommodate cost of fittings and specials, valves culvert crossings, bridge crossings and valve chambers etc. that are incorporated in the Distribution System.
5. Add 20% for supply rates for Contractor's O/H & P only for Supply and Laying Contracts.

Source:

Tender Prices (NWS&DB) – 2013 3rd and 4th quarters
Supplier's Price Lists

Table A – PVC/3

PVC LAYING

Diameter mm	Basic Excavation Cost Max. depth n.e. 1.5m			Earthwork Support Rs:/m	Allow for Disposal of Water Rs:/m	Laying & Plumbing Rs:/m
	Firm Sand Rs:/m	Soft or Sandy Soil Rs:/m	Gravel Rs:/m			
63	115.00	147.00	149.00	1,172.00	51.00	91.00
75	135.00	178.00	185.00	1,218.00	51.00	91.00
90	210.00	266.00	273.00	1,289.00	76.00	92.00
110	229.00	287.00	298.00	1,407.00	76.00	101.00
160	303.00	381.00	396.00	1,407.00	48.00	140.00
225	328.00	413.00	429.00	1,524.00	101.00	183.00
280	328.00	413.00	429.00	1,524.00	101.00	216.00
315	424.00	536.00	556.00	1,582.00	115.00	283.00

Note:

1. Add for dewatering and earthwork support to basic laying cost if applicable.
2. Basic excavation cost includes excavation, preparation of bottom, backfilling, ramming (consider 98% compaction), disposal of excess excavated material.
3. Generally use selected excavated material for backfilling. An allowance should be made for backfilling with imported material.
4. For pressure testing, cleaning and disinfection of pipes ; refer Table B – PVC/2.
5. For laying of specials, fittings, valves, valve chambers, culvert crossings etc. 30% to be added .
6. To obtain laying rate in ordinary soil under high ways 40% to be added to total cost of excavation and laying. (to remove asphalt coat and other base courses)
7. Traffic arrangement, dust controlling, maintenance of roads, permanent and temporary road reinstatement and other preliminaries are not included.
8. Pipe bedding and surroundings are not included.
9. Laying Contractor's O/H & P is not included.

Source:
Based on work study and established data from published books.

Table A - PE2

SUPPLY OF HDPE Pipes (PE 100 - SDR 17 PN10)

Asian Countries without Japan & Malaysia

1	2	3	4	5	6	7	8	9	10
Pipe	CIF	Transmission main				Distribution main			
Dia. mm	Value Rs./m	CIF value for Specials Rs./m	(Col.2+3) Total CIFCost Rs./m	Transport & Clearing Rs./m	Custom Duty Rs./m	CIF value for Specials Rs./m	(Col.2+7) Total CIFCost Rs./m	Transport & Clearing Rs./m	Custom Duty Rs./m
20	60.00	15.00	75.00	4.00	35.00	21.00	81.00	5.00	38.00
32	98.00	25.00	123.00	7.00	57.00	35.00	133.00	7.00	62.00
50	222.00	56.00	278.00	14.00	128.00	78.00	300.00	15.00	138.00
63	265.00	67.00	332.00	17.00	153.00	93.00	358.00	18.00	165.00
75	430.00	108.00	538.00	27.00	248.00	151.00	581.00	30.00	268.00
90	525.00	132.00	657.00	33.00	303.00	184.00	709.00	36.00	327.00
110	750.00	188.00	938.00	47.00	432.00	263.00	1,013.00	51.00	466.00
160	1,650.00	413.00	2,063.00	104.00	949.00	578.00	2,228.00	112.00	1,025.00
180	2,100.00	525.00	2,625.00	132.00	1,208.00	735.00	2,835.00	142.00	1,305.00
200	2,600.00	650.00	3,250.00	163.00	1,495.00	910.00	3,510.00	176.00	1,615.00
225	3,150.00	788.00	3,938.00	197.00	1,812.00	1,103.00	4,253.00	213.00	1,957.00
250	4,050.00	1,013.00	5,063.00	254.00	2,329.00	1,418.00	5,468.00	274.00	2,516.00
280	4,900.00	1,225.00	6,125.00	307.00	2,818.00	1,715.00	6,615.00	331.00	3,043.00
315	6,150.00	1,538.00	7,688.00	385.00	3,537.00	2,153.00	8,303.00	416.00	3,820.00
355	7,600.00	1,900.00	9,500.00	475.00	4,370.00	2,660.00	10,260.00	513.00	4,720.00
400	11,500.00	2,875.00	14,375.00	719.00	6,613.00	4,025.00	15,525.00	777.00	7,142.00
450	12,700.00	3,175.00	15,875.00	794.00	7,303.00	4,445.00	17,145.00	858.00	7,887.00
500	14,650.00	3,663.00	18,313.00	916.00	8,424.00	5,128.00	19,778.00	989.00	9,098.00
560	21,000.00	5,250.00	26,250.00	1,313.00	12,075.00	7,350.00	28,350.00	1,418.00	13,041.00
630	26,500.00	6,625.00	33,125.00	1,657.00	15,238.00	9,275.00	35,775.00	1,789.00	16,457.00
750	35,200.00	8,800.00	44,000.00	2,200.00	20,240.00	12,320.00	47,520.00	2,376.00	21,860.00
800	45,250.00	11,313.00	56,563.00	2,829.00	26,019.00	15,838.00	61,088.00	3,055.00	28,101.00
900	58,750.00	14,688.00	73,438.00	3,672.00	33,782.00	20,563.00	79,313.00	3,966.00	36,484.00

Note :

1. Column (4) includes additional 25 % of CIF value for transmission mains and Column (8) includes additional 35% of CIF value for distribution mains to cover the costs of fittings,specials, valves, culvert crossings, bridge crossing and valve chambers etc.
2. Column (5 and 9) 5% of total CIF cost is added for clearing & transporting (up to site stores)
3. Custom Duty is taken as 46.00% of CIF value.
4. Supplier's O/H & P are included in the CIF value.
5. For supply & laying contracts add an additional 20% for supply rate for transport, loading, unloading, investment cost, overhead and profit for supply parties.

Source :

Based on supplier's rates, tender prices of 2013 and forecast to 2014

Table A - PE3

LAYING OF HDPE PIPES (PE 100 - SDR 17 PN10)

1	2	3	4	5	6	7	8	9
Pipe Dia. mm	Basic Laying Cost	Transmission main		Distribution main		Excavation Cost (Ordinary Soil) Rs./m	EWS Cost Rs./m	Allow for Dewatering/Disposal of Water Rs./m
		Laying Cost for Specials Rs./m	Total Laying Cost	Laying Cost for Specials Rs./m	Total Laying Cost			
20	68.00	21.00	89.00	28.00	96.00	165.00	1,789.00	51.00
32	104.00	32.00	136.00	42.00	146.00	165.00	1,789.00	51.00
50	126.00	38.00	164.00	51.00	177.00	165.00	1,789.00	51.00
63	154.00	47.00	201.00	62.00	216.00	165.00	1,789.00	51.00
75	154.00	47.00	201.00	62.00	216.00	165.00	1,789.00	51.00
90	154.00	47.00	201.00	62.00	216.00	165.00	1,789.00	51.00
110	154.00	47.00	201.00	62.00	216.00	241.00	1,822.00	58.00
160	255.00	77.00	332.00	102.00	357.00	279.00	1,903.00	60.00
180	273.00	82.00	355.00	110.00	383.00	284.00	1,936.00	60.00
200	279.00	84.00	363.00	112.00	391.00	288.00	1,968.00	60.00
225	286.00	86.00	372.00	115.00	401.00	328.00	2,017.00	67.00
250	358.00	108.00	466.00	144.00	502.00	334.00	2,050.00	67.00
280	441.00	133.00	574.00	177.00	618.00	410.00	2,098.00	77.00
315	512.00	154.00	666.00	205.00	717.00	422.00	2,163.00	78.00
355	582.00	175.00	757.00	233.00	815.00	508.00	2,229.00	80.00
400	677.00	204.00	881.00	271.00	948.00	522.00	2,294.00	81.00
450	749.00	225.00	974.00	300.00	1,049.00	541.00	2,375.00	82.00
500	1,026.00	308.00	1,334.00	411.00	1,437.00	732.00	2,781.00	111.00
560	1,052.00	316.00	1,368.00	421.00	1,473.00	878.00	2,850.00	133.00
630	1,060.00	318.00	1,378.00	424.00	1,484.00	878.00	2,850.00	133.00
750	1,150.00	345.00	1,495.00	460.00	1,610.00	1,171.00	2,955.00	178.00
800	1,210.00	363.00	1,573.00	484.00	1,694.00	1,339.00	3,302.00	203.00
900	1,280.00	384.00	1,664.00	512.00	1,792.00	1,626.00	3,476.00	246.00

Note:

1 Column (2) Basic laying cost includes placing, jointing ,transporting from site stores,cleaning, disinfection,pressure testing and cost of polythene sleeving .

2 Column (4) includes additional 30% of basic laying cost for transmission mains and Column (6) includes additional 40% of basic laying cost for distribution mains to cover the cost of specials and other all costs,such as culvert crossings , bridge crossings,valve chambers,valves,thrrust blocks,pipe supports etc.

3 Column (7) Basic excavation cost includes excavation,preparation of bottom, backfilling ramming(consider 95% compaction)and assuming earth available at site for backfilling.

4 Contractor's OH and P not included.

5 Rock excavation ,traffic management ,dust controlling and maintenanceof roads.Preliminaries are not to basic cost.

6 To obtain additional 40% to the total cost of laying and excavation under ordinary soil for highways.(To remove asphaltcoat with base courses and other relevant additional costs)

Source:

Based on work study and established data from published books.(Refer Annex 7)