APPENDIX I

WATER QUALITY DATA

Tables

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Table I-1 - Surface Water Samples

	SW1 3M River 00 03 01 14:30	SW1 3M River @Bridge 00 04 01	SW2 Anandr. River 00 03 01 12:15	SW2 Anandra-no River 00 04 01	SW3 Ambavar. Lake 00 03 02 10:15	SW3 Ambavar-no Lake 00 04 01	SW4 Lanirano Lake 00 02 29 11:00	SW4 Lanirano Lake 00 04 01	SW4 Lanirano Lake QA 00 04 01	SW5 3M River @ Mouth 00 03 02 12:45	SW5 3M River @Mouth 00 04 01	WHO Drinking Water Guideline 1998	Canadian[1] Drinking Water Guideline 1999
Physical Tests													
Colour (CU)	18	20	23	17	82	18	32	31	33	38	13		15 [AO]
Conductivity (umhos/cm)	53	53	49	60	2940	17200	79	134	115	1060	20300		
Total Dissolved Solids	34	41	36	28	1550	10100	52	62	72	530	12400		500 [AO]
Hardness CaCO3	4.25	4.86	4.39	5.42	262	1690	8.34	13	11	90.8	207		
pH (pH units)	6.43	6.61	6.26	7.24	6.75	7.84	6.77	6.85	7.07	6.61	7.68		6.5 - 8.5 [AO]
Total Suspended Solids	4	<3	<3	<3	3	15	<3	3	5	<3	4		
Turbidity (NTU)	4.8	2.5	4.3	5	0.8	0.2	2.5	2.8	3.6	2.5	0.6		1
Dissolved Anions													
Alkalinity-Total CaCO3	2	6	3	4	15	37	5	6	10	6	100		
Chloride Cl	11.1	10.6	10.6	11.8	877	5550	18.1	31.7	27.2	296	6820		250 [AO]
Fluoride F	<0.02	<0.02	<0.02	0.15	<0.02	0.46	<0.02	<0.02	0.07	<0.02	0.45	1.5	1.5
Sulphate SO4	2	1	1	1	115	958	2	7	3	41	760		500 [AO]
Nutrients													
Nitrate Nitrogen N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11.3	10
Nitrite Nitrogen N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.06	1
Total Metals													
Aluminum T-Al	0.102	0.053	0.116	0.098	0.12	0.11	0.117	0.09	0.102	0.13	0.007		
Arsenic T-As	0.0002	<0.0001	0.0002	<0.0001	0.006	0.029	0.0003	0.0002	0.0002	0.0026	0.0036	0.01	0.025 [IO]
Barium T-Ba	0.009	0.01	0.01	0.013	<0.01	0.01	0.009	0.009	0.009	0.007	<0.001	0.7	1
Boron T-B	<0.05	<0.05	<0.05	<0.05	<0.5	1.4	<0.05	<0.05	<0.05	<0.3	0.18	0.5	5 [IO]
Cadmium T-Cd	<0.0002	<0.0002	<0.0002	<0.0002	<0.002	<0.002	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	0.003	0.005
Calcium T-Ca	0.48	0.54	0.52	0.62	19.8	121	1.41	2.05	1.71	6.4	14.6		
Chromium T-Cr	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.001	<0.005	0.001	0.05	0.05
Copper T-Cu	<0.001	<0.001	<0.001	<0.001	<0.01	0.07	<0.001	<0.001	<0.001	<0.005	<0.001	2	1 [AO]
Iron T-Fe	0.98	1.35	1.42	1.59	0.28	<0.03	0.81	0.99	1.15	0.65	0.08		0.3 [AO]
Lead T-Pb	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.001	<0.005	<0.001	0.01	0.01
Magnesium T-Mg	0.74	0.85	0.75	0.94	51.6	337	1.17	1.92	1.64	18.2	41.4		
Manganese T-Mn	0.013	0.017	0.016	0.039	0.01	<0.01	0.01	0.013	0.013	0.009	<0.001	0.5	0.05 [AO]
Mercury T-Hg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.001	0.001
Potassium T-K	0.78	0.58	0.8	0.7	19.9	121	0.94	1.14	0.98	6.8	14.7		
Selenium T-Se	<0.001	<0.001	<0.001	<0.001	<0.0005	<0.0005	<0.001	<0.001	<0.001	<0.005	<0.0005	0.01	0.01
Sodium T-Na	6.45	6.6	6	6.86	476	3350	9.8	17.2	14.7	158			200 [AO]
Uranium T-U	0.00002	0.00002	0.00002	0.00002	0.0003	0.0008	0.00003	0.00003	0.00002	0.0001	0.0001	0.002	0.1
Zinc T-Zn	<0.005	<0.005	<0.005	<0.005	<0.05	<0.05	<0.005	<0.005	<0.005	<0.03	<0.005		5 [AO]

Values in mg/L unless otherwise specified

[1] Maximum acceptable concentration where available, then interim maximum acceptable concentration, finally aesthetic objective

[IO] interim maximum acceptable concentration

[AO] aesthhetic objective

Table I-2 - Groundwater Samples

	GW7H Mandena Shallow 00 03 15	GW8M Mandena Medium 00 03 15	GW10P Mandena Deep 00 03 15	GW15 Airport 00 03 04	GW12QA Airport 00 04 06	WHO Drinking Water Guideline 1998	Canadian[1] Drinking Water Guideline 1999
Physical Tests							
Colour (CU)	162	52	20	52	49		15 [AO]
Conductivity (umhos/cm)	52	85	80	138	134		
Total Dissolved Solids	60	80	58	86	82		500 [AO]
Hardness CaCO3	4	10.2	5.09	16.1	7.78		
pH (pH units)	5.3	6.4	6.31	6.42	6.8		6.5 - 8.5 [AO]
Total Suspended Solids	<3	4	<3	<3	14		
Turbidity (NTU)	7.1	3.8	2.2	3.7	7.1		1
Dissolved Anions							
Alkalinity-Total CaCO3	3	15	9	14	16		
Chloride Cl	9	15.4	16.7	28.7	27		250 [AO]
Fluoride F	<0.02	<0.02	<0.02	<0.02	0.07	1.5	1.5
Sulphate SO4	4	<1	<1	2	<1		500 [AO]
Nutrients							
Nitrate Nitrogen N	<0.1	<0.1	<0.1	<0.1	<0.1	11.3	10
Nitrite Nitrogen N	<0.1	<0.1	<0.1	<0.1	<0.1	0.06	1
Dissolved Metals							
Aluminum D-Al	0.034	0.162	0.045	0.409	0.48		
Arsenic D-As	<0.0001	0.0003	0.0006	0.0007	<0.001	0.01	0.025 [IO]
Barium D-Ba	0.226	0.157	0.155	0.24	0.11	0.7	1
Boron D-B	0.05	<0.05	<0.05	0.06	<0.5	0.5	5 [IO]
Cadmium D-Cd	<0.0002	<0.0002	<0.0002	<0.0002	<0.002	0.003	0.005
Calcium D-Ca	0.45	2.35	0.36	3.4	1.53		
Chromium D-Cr	<0.001	<0.001	<0.001	0.004	<0.01	0.05	0.05
Copper D-Cu	0.001	<0.001	<0.001	<0.001	<0.01	2	1 [AO]
Iron D-Fe	0.25	1.48	4.54	0.36	0.4		0.3 [AO]
Lead D-Pb	<0.001	<0.001	<0.001	<0.001	<0.01	0.01	0.01
Magnesium D-Mg	0.7	1.05	1.02	1.84	1		
Manganese D-Mn	0.002	0.011	0.006	0.005	<0.01	0.5	0.05 [AO]
Mercury D-Hg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.001	0.001
Potassium D-K	0.98	2.06	1.06	1.62	1		
Selenium D-Se	<0.001	<0.001	<0.001	<0.004	<0.01	0.01	0.01
Sodium D-Na	7.4	11.9	10.3	19	8.45		200 [AO]
Uranium D-U	0.00007	0.00005	0.00006	0.00032	0.0003	0.002	0.1
Zinc D-Zn	0.087	0.043	0.044	0.012	0.09		5 [AO]

Values in mg/L unless otherwise specified

[1] Maximum acceptable concentration where available, then interim maximum acceptable concentration, finally aesthetic objective

[IO] interim maximum acceptable concentration

[AO] aesthhetic objective

Table I-3 - Drinking Water Samples

	DW1 Villa Daly 00 03 20 8:30	DW2 Tap Wat. Tamambad 00 03 10	DW3 Evatra Barrage 00 03 11	DW4 Ampasy Lamand. 00 03 11 14:30	DW3 Evatra, Barrage 00 04 01	WHO Drinking Water Guideline	Canadian[1] Drinking Water Guideline
Physical Tests							
Colour (CU)	5	6	17	14	27		15 AO
Conductivity (umhos/cm)	84	82	185	76	207		
Total Dissolved Solids	56	57	76	54	121		500 AO
Hardness CaCO3	11.9	12	15	6.6	16.7		
pH (pH units)	6.93	6.83	6.46	6.49	6.85		6.5 - 8.5 AO
Total Suspended Solids	<3	7	<3	6	<3		
Turbidity (NTU)	0.6	10	1.3	3.3	2.3		1
Dissolved Anions							
Alkalinity-Total CaCO3	6	5	4	4	9		
Chloride Cl	19.2	19.4	49.7	17.5	54.1		250 AO
Fluoride F	<0.02	0.02	<0.02	<0.02	<0.02	1.5	1.5
Sulphate SO4	2	2	3	2	7		500 AO
Nutrients							
Nitrate Nitrogen N	0.2	0.2	<0.1	0.1	<0.1	11.3	10
Nitrite Nitrogen N	<0.1	<0.1	<0.1	<0.1	<0.1	0.06	1
Total Metals							
Aluminum T-Al	0.046	0.149	0.035	0.09	0.06		
Arsenic T-As	<0.0001	<0.0001	0.0005	<0.0001	<0.001	0.01	0.025 IO
Barium T-Ba	0.006	0.01	0.007	0.01	<0.01	0.7	1
Boron T-B	<0.05	<0.05	<0.05	<0.05	<0.5	0.5	5 IO
Cadmium T-Cd	<0.0002	<0.0002	<0.0002	<0.0002	<0.002	0.003	0.005
Calcium T-Ca	3.07	3.24	1.42	0.83	1.6		
Chromium T-Cr	<0.001	<0.001	<0.001	<0.001	<0.01	0.05	0.05
Copper T-Cu	<0.001	0.002	<0.001	<0.001	<0.01	2	1 AO
Iron T-Fe	0.34	1.84	0.78	1.07	1.74		0.3 AO
Lead T-Pb	<0.001	<0.001	<0.001	<0.001	<0.01	0.01	0.01
Magnesium T-Mg	1.02	0.94	2.79	1.1	3.1		
Manganese T-Mn	0.009	0.04	0.009	0.011	0.01	0.5	0.05 AO
Mercury T-Hg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.001	0.001
Potassium T-K	0.99	1	0.82	0.92	0.7		
Selenium T-Se	<0.001	<0.001	<0.001	<0.001	<0.01	0.01	0.01
Sodium T-Na	9.9	9.7	26.2	10.1	28.7		200 AO
Uranium T-U	<0.00001	0.00002	<0.00001	0.00002	<0.0001	0.002	0.1
Zinc T-Zn	0.072	0.007	<0.005	<0.005	<0.05		5 AO

Values in mg/L unless otherwise specified

[1] Maximum acceptable concentration where available, then interim maximum acceptable concentration, finally aesthetic objective

IO interim maximum acceptable concentration

AO aesthhetic objective

Table I-4 - Sediment and Soil Samples

	Sediment samples					Soil samples			
	SW4 Lanirano Lake 00 02 29 11:30	SW2 Anandr. River 00 03 01 12:30	SW1 3M River 00 03 01	SW3 Ambavar. Lake 00 03 02 10:30	SW5 3M River @ Mouth 00 03 02 13:00	SS1-1 Forest Horiz. A 00 03 17 15:30	SS1-2 Forest Horiz. B 00 03 17 15:40	SS2-1 Swamp 00 03 17 16:10	SS3-1 Praire 00 03 17 15:55
Moisture %	19.3	21.9	18.7	21.3	30.9	3.4	0.5	30	3.6
Total Metals									
Aluminum T-Al	348	65200	81600	1100	13000	139	<50	120	95
Antimony T-Sb	<20	<20	<20	<20	<20	<20	<20	<20	<20
Arsenic T-As	<100	<100	<100	<100	<100	<100	<100	<100	<100
Barium T-Ba	2	45	15	5	6	1	<1	<1	<1
Beryllium T-Be	<0.5	0.7	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bismuth T-Bi	<10	<10	<10	<10	<10	<10	<10	<10	<10
Boron T-B	-	-	-	-	-	-	-	-	-
Cadmium T-Cd	<2	<2	<2	<2	<2	<2	<2	<2	<2
Calcium T-Ca	<50	149	92	153	615	1690	123	91	337
Chromium T-Cr	<2	29	64	9	14	<2	<2	<2	<2
Cobalt T-Co	<2	3	<2	<2	<2	<2	<2	<2	<2
Copper T-Cu	<1	5	2	<1	2	1	<1	<1	<1
Iron T-Fe	608	36200	12200	2180	9130	334	285	786	687
Lead T-Pb	<50	<50	<50	<50	<50	<50	<50	<50	<50
Lithium T-Li	<2	9	3	<2	8	<2	<2	<2	<2
Magnesium T-Mg	<50	770	200	205	768	162	<50	103	229
Manganese T-Mn	6	49	17	17	28	7	4	11	10
Mercury T-Hg	<0.005	0.075	0.11	<0.005	0.014	0.018	<0.005	0.226	0.007
Molybdenum T-Mo	<4	<4	<4	<4	<4	<4	<4	<4	<4
Nickel T-Ni	<5	10	6	<5	<5	<5	<5	<5	<5
Phosphorus T-P	<50	574	224	64	320	<50	<50	<50	<50
Potassium T-K	<200	503	<200	<200	<200	<200	<200	<200	<200
Selenium T-Se	<50	<50	<50	<50	<50	<50	<50	<50	<50
Silver T-Ag	<2	<2	<2	<2	<2	<2	<2	<2	<2
Sodium T-Na	-	-	-	-	-	-	-	-	-
Strontium T-Sr	2.7	6.8	2.5	5.6	10.3	18.5	1.9	2.7	3.4
Thallium T-Tl	<50	<50	<50	<50	<50	<50	<50	<50	<50
Tin T-Sn	<10	<10	<10	<10	<10	<10	<10	<10	<10
Titanium T-Ti	451	909	308	926	1100	212	263	740	348
Uranium T-U	-	-	-	-	-	-	-	-	-
Vanadium T-V	<2	27	22	5	10	<2	<2	3	2
Zinc T-Zn	2	36	24	5	19	1	<1	1	2
Leachable Anions & Cations									
Alkalinity-Total CaCO3	58	143	48	95	154	44	34	34	27
Chloride Cl	14	59	9	1160	149	16	18	18	13
Fluoride F	0.6	0.4	0.4	0.8	1.6	<0.2	<0.2	<0.2	<0.2
Nitrate Nitrogen N	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nitrite Nitrogen N	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sulphate SO4	<10	<10	<10	191	67	<10	<10	<10	<10
Leachable Nutrients									
Total Phosphate P	0.26	0.06	0.34	0.31	0.63	0.47	0.23	0.38	0.46

Values in mg/dry kgm unless otherwise specified

Table I-5 - PAH, Pesticide, and TOC Samples

	Surface water		WHO	Canadian[1]	Sediment	
	SW4 Lanirano Lake 00 02 29 11:00	SW5 3M River @ Mouth 00 03 02 12:45	Drinking Water Guideline	Drinking Water Guideline	SW4 Lanirano Lake 00 02 29 11:30	SW2 Anandr. River 00 03 01 12:30
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	<0.00005	<0.00005			<0.01	<0.01
Acenaphthylene	<0.00005	<0.00005			<0.01	<0.01
Acridine	<0.00005	<0.00005			-	-
Anthracene	<0.00005	<0.00005			<0.01	<0.01
Benz(a)anthracene	<0.00005	<0.00005			<0.01	<0.01
Benzo(a)pyrene	0.00002	<0.00001	0.0007	0.00001	<0.01	<0.01
Benzo(b)fluoranthene	<0.00005	<0.00005			<0.01	<0.01
Benzo(g,h,i)perylene	<0.00005	<0.00005			<0.01	<0.01
Benzo(k)fluoranthene	<0.00005	<0.00005			<0.01	<0.01
Chrysene	<0.00005	<0.00005			<0.01	<0.01
Dibenz(a,h)anthracene	<0.00005	<0.00005			<0.01	<0.01
Fluoranthene	<0.00005	<0.00005			<0.01	<0.01
Fluorene	<0.00005	<0.00005			<0.01	<0.01
Indeno(1,2,3-c,d)pyrene	<0.00005	<0.00005			<0.01	<0.01
Naphthalene	<0.00005	<0.00005			<0.01	<0.01
Phenanthrene	<0.00005	<0.00005			<0.01	<0.01
Pyrene	<0.00005	<0.00005			<0.01	<0.01
Organochlorine Pesticides						
Aldrin	<0.00005	<0.00005	0.00003*	0.0007*	<0.001	<0.001
alpha-BHC	<0.00005	<0.00005			<0.001	<0.001
beta-BHC	<0.0001	<0.0001			<0.002	<0.002
delta-BHC	<0.00005	<0.00005			<0.001	<0.001
cis-Chlordane (alpha)	<0.00005	<0.00005			<0.001	<0.001
trans-Chlordane (gamma)	<0.00005	<0.00005			<0.001	<0.001
2,4'-DDD	<0.0001	<0.0001			<0.001	<0.001
4,4'-DDD	<0.00005	<0.00005			<0.001	<0.001
2,4'-DDE	<0.0001	<0.0001			<0.002	<0.002
4,4'-DDE	<0.00005	<0.00005			<0.001	<0.001
2,4'-DDT	<0.0001	<0.0001			<0.001	<0.001
4,4'-DDT	<0.0001	<0.0001			<0.002	<0.002
Dieldrin	<0.00005	<0.00005	0.00003*	0.0007*	<0.001	<0.001
Endosulfan I	<0.00005	<0.00005			<0.001	<0.001
Endosulfan II	<0.00005	<0.00005			<0.001	<0.001
Endosulfan Sulfate	<0.00005	<0.00005			<0.001	<0.001
Endrin	<0.0002	<0.0002			<0.005	<0.005
Endrin Aldehyde	<0.00005	<0.00005			<0.001	<0.001
Heptachlor	<0.0001	<0.0001	0.00003**		<0.002	<0.002
Heptachlor Epoxide	<0.00005	<0.00005	0.00003**		<0.001	<0.001
Lindane (gamma - BHC)	<0.00005	<0.00005	0.002		<0.001	<0.001
Methoxychlor	<0.0002	<0.0002	0.02	0.9	<0.005	<0.005
Mirex	<0.00005	<0.00005			<0.001	<0.001
cis-Nonachlor	<0.00005	<0.00005			<0.001	<0.001
trans-Nonachlor	<0.00005	<0.00005			<0.001	<0.001
Organophosphate Pesticides						
Azinphos methyl	<0.001	<0.001			<0.05	<0.05
Carbophenothion	<0.001	<0.001			<0.01	<0.01
Diazinon	<0.001	<0.001		0.02	<0.02	<0.02
Dimethoate	<0.001	<0.001		0.02 [IO]	<0.02	<0.02
Fenitrothion	<0.001	<0.001			<0.02	<0.02
Fensulfothion	<0.001	<0.001			<0.01	<0.01
Fenthion	<0.001	<0.001			<0.02	<0.02
Fonofos	<0.001	<0.001			<0.02	<0.02
Malathion	<0.001	<0.001		0.19	<0.01	<0.01
Mevinphos	<0.001	<0.001			<0.05	<0.05
Parathion	<0.001	<0.001		0.05	<0.01	<0.01
Parathion-methyl	<0.001	<0.001			<0.02	<0.02
Phosmet	<0.001	<0.001			<0.03	<0.03
Organic Parameters						
Total Organic Carbon C	5.6	5			<0.05	0.13

Values in mg/L for water and mg/dry kgm for soil unless otherwise specified

[1] Maximum acceptable concentration where available, then interim maximum acceptable concentration, finally aesthetic objective

[IO] interim maximum acceptable concentration

* Concentration of Aldrin plus dieldrin

** Concentration of Heptachlor plus Heptachlor Epoxide

Table I-6 - Portable Laboratory Summary of Test Results

TOTAL COLIFORMS, E-COLI, NITRATES AND TOTAL PHOSPHATES

Sample Group	Site Identidfication	Sample Code	Date of Analysis	E-Coli (P/A)	Total Coliforms (MPN/100ml)	Nitrates (mg/l)	Total Phosphates (mg/l)
Surface Water	Mandromondromotra River @ bridge	SW1	14 Mars	P	9,000	< 0.1	0,24
	Anandrano River @ bridge	SW2	03 Mars	P	30,000	< 0.1	
	Ambavarano Lake @ staff gauge	SW3	24 Mars	P	800	< 0.1	0,12
	Lanirano Lake at JIRAMA intake	SW4	07 Mars	P	3,000	< 0.1	0,22
	Lanirano Lake at JIRAMA intake	SW4	21 Mars	P	170	< 0.1	0,22
	Mandromondromotra River @ mouth	SW4 QA	09 Mars	A	230	< 0.1	
Drinking water	Villa Daly tap water	DW1	07 Mars	A	0	< 0.1	0,12
	Tanambao public tap water	DW2	10 Mars	A	0	< 0.1	0,1
	Evatra @ barrage	DW3	12 Mars	A	130	< 0.1	0,16
	Evatra @ barrage	DW3 QA	23 Mars	P	900	< 0.1	0,26
	Ampasy village, Lakandava River	DW4	11 Mars	P	17,000	< 0.1	0,08
Groundwater	Mandena	GW7H	16 Mars	A	0	< 0.1	0,48
	Mandena	GW8M	18 Mars	A	13	< 0.1	0,26
	Mandena	GW10P	15 Mars	A	0	< 0.1	0,18
	Airport	GW12	04 Mars	P	500	< 0.1	0,34
	Airport	GW12P	06 Avril	P		< 0.1	0,36

Notes:

P = Presence
A = Absence
MPN = Most Probable Number