

Summary

Regarding the arsenic mitigation in Bangladesh, safe water supply must be advanced first of all. Bangladesh government gave the first priority to Dugwell among the alternative safe drinking options.

JICA/AAN is advancing the three year project on arsenic research and mitigation in Sharsha Upazila, Jessore District since January 2002. AAN has installed 51 Dugwells in Sharsha Upazila based on the request of Users Committee which was formed by the villagers. After installation the arsenic concentration of the raw water of these Dugwells was analyzed. Early June, water was once pumped out of Dugwell, and on the next day fresh water was collected which accumulated in the dugwell. AAN has detected arsenic which exceeded Bangladesh standard (0.05 mg/L) from 23 out of 51 Dugwells. This was an unexpected thing. It is because specialist said, "Dugwell water does not contain arsenic".

It was expected that arsenic concentration would go down, if we stored the water inside Dugwell. Three monitoring was performed about stored water of 23 Dugwells till the end of July. Consequently, arsenic concentration of six dugwells fell below the standard. But in case of 17 Dugwells, arsenic concentration sometimes went up and sometimes went down. The effect which we expected was not obtained.

These results are shown in the report "Follow-up Survey of Arsenic-contaminated Dugwells in Sharsha Upazila".

The other parameters of 51 Dugwells were also investigated from October to November, 2003. Thus it came out that the contamination of Iron, Manganese, Ammonium, Total Hardness, Turbidity, etc. were over the standard of drinking water in Bangladesh. Now in Bangladesh, many Dugwells are constructed and people are drinking water from those dugwells. Based on the report "Water Quality of Dugwells in Sharsha Upazila" the study suggests that:

The water of many Dugwells cannot be accepted for drinking without treatment.
It is necessary to check the water quality of all dugwells in Bangladesh.

AAN has a plan to attach sand filter to 46 of 51 excavated Dugwells for purifying water. We abandoned 5 Dugwells in which arsenic concentration was detected over 0.25 mg/L. and it is on planning to install Pond Sand Filter or Deep Tubewell instead.

Follow-up Survey on Arsenic Contaminated Dugwells in Sharsha Upazila

Md. Shamim Uddin

Abu Shamim Khan

Environmental Chemist, Asia Arsenic Network

Objective

To observe the changes of arsenic concentration in dugwells installed in Sharsha Upazila, Jessore District.

Background

During the screening of tubewells in Sharsha, the Asia Arsenic Network (AAN) identified many highly arsenic-contaminated areas where safe water options were required. To provide safe drinking water, AAN has installed 51 dugwells in response to the request of villagers during the period between 24 January and 14 June 2003. AAN wished to know the water quality of these dug wells. First, the stored water was pumped and on the following day the top water was collected from the dugwells. Arsenic was detected higher than the permissible level of 0.05mg/L in the water of 23 dugwells out of 51. Before the survey, it was assumed that dugwell water was not contaminated with arsenic. However, some dugwell fresh water was arsenic-contaminated. Therefore it became necessary to know the changes of arsenic concentration of stored water in dugwells through oxidization and sedimentation.

Method of Water Sampling and Instrument

For the first phase survey, water samples were collected from each dugwell during the period of 3 to 9 June 2003 and identified that 23 dugwells were contaminated with arsenic exceeding 0.05mg/L.

It was necessary to monitor the arsenic concentrations of those dugwells. The second and third phase surveys were carried out during 17-21 June and 8-9 July respectively. For the fourth phase survey, AAN selected 19 arsenic-contaminated dug wells out of 23, and checked the water quality on 20 and 21 July 2003.

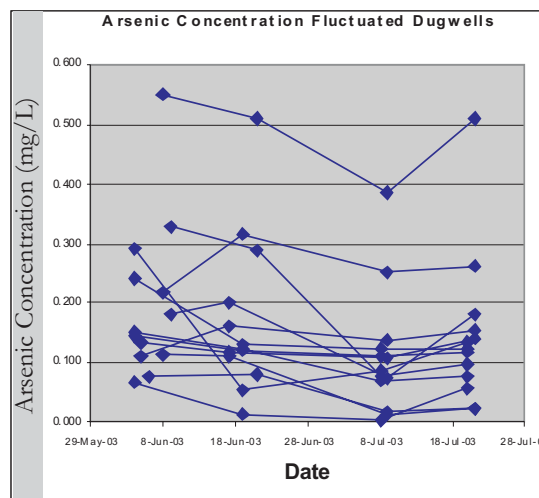
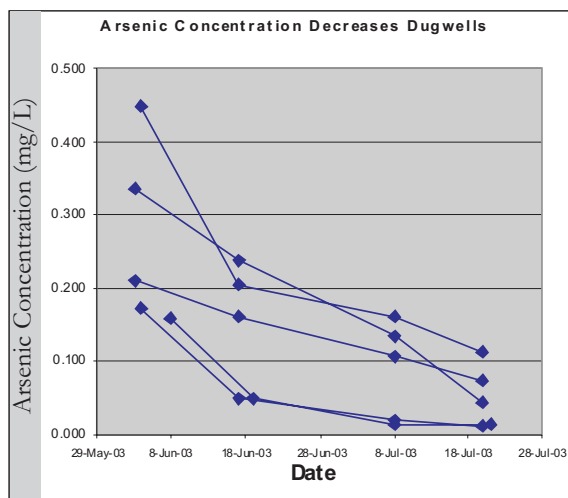
After collecting 100ml water sample from each dug well, 1% concentrated hydrochloric acid was added. The arsenic concentration was measured by Atomic Absorption Spectrophotometer (Shimadzu AA-660 Model) in AAN laboratory.

Results

The range of arsenic concentration of these samples varied from 0.053mg/L to 0.550mg/L and it was identified two types of concentration changes:

1. The arsenic concentration of five dugwells (Nos. 7, 8, 11, 12 and 34) spontaneously decreased. Among the five dug wells, Nos. 7, 8, 11 and 12 are located in Basotpur village of Bagachra union and No. 34 in Bagachra village of Bagachra union. The distance between Basotpur village and Bagachra village is around 1 km.
2. The arsenic concentration of other 14 dugwells sometimes increased and sometimes decreased.

The following graphs illustrate those two patterns of changes:



Comments

1. It is difficult to say that the arsenic concentration of stored water in dugwell goes down below the permissible level (0.05mg/L).
2. No reason was found why arsenic concentration of some dugwells decreased and that of other dugwells fluctuated.
3. It is needed to do the same survey in the dry season too.

Follow-Up Research of Arsenic Contaminated Dugwells in Sharsha Upazila
JICA/AAN Arsenic Mitigation Project

DW No	Caretaker	Para/Village	Union	1st Phase		2nd Phase		3rd Phase		4th Phase	
				Tested Date	As (mg/L)	Tested Date	As (mg/L)	Tested Date	As (mg/L)	Tested Date	As (mg/L)
5	Shaidul Islam	Gainpara/ Bagachra	Bagachra	3-Jun-03	0.062	19-Jun-03	0.059	8-Jul-03	0.017		
7	Faruq/Nur Islam	Madrashapara/ Basotpur	Bagachra	3-Jun-03	0.210	17-Jun-03	0.161	8-Jul-03	0.106	20-Jul-03	0.073
8	Abdus Sattar	Mathpara/ Basotpur	Bagachra	3-Jun-03	0.336	17-Jun-03	0.237	8-Jul-03	0.135	20-Jul-03	0.045
11	Lal Mia Bhuiya	South-west/ Basotpur	Bagachra	4-Jun-03	0.449	17-Jun-03	0.205	8-Jul-03	0.161	20-Jul-03	0.113
12	Abdul Sattar	Kacharipara/ Basotpur	Bagachra	4-Jun-03	0.173	17-Jun-03	0.048	8-Jul-03	0.019	20-Jul-03	0.011
15	Ansar Ali	North (Bazar)/ Basotpur	Bagachra	4-Jun-03	0.290	19-Jun-03	0.055	8-Jul-03	0.086	20-Jul-03	0.134
16	Jayed Ali	North/ Samta	Bagachra	4-Jun-03	0.152	19-Jun-03	0.123	8-Jul-03	0.072	20-Jul-03	0.076
17	Harunur Roshid	South (Palpara)/ Samta	Bagachra	4-Jun-03	0.144	19-Jun-03	0.122	8-Jul-03	0.112	20-Jul-03	0.118
18	Anawer House	South (Middle)/ Samta	Bagachra	4-Jun-03	0.240	19-Jun-03	0.132	8-Jul-03	0.123	20-Jul-03	0.125
19	Seer Ali	Samta (West)/ Samta	Bagachra	4-Jun-03	0.068	19-Jun-03	0.012	8-Jul-03	0.005	20-Jul-03	0.057
22	Moshiar Rahman	Bilpara/ Goga-5	Goga	5-Jun-03	0.133	17-Jun-03	0.116	9-Jul-03	0.106	21-Jul-03	0.140
23	Dr. Mottaleb	Middle/ Kaliani	Goga	5-Jun-03	0.111	17-Jun-03	0.161	9-Jul-03	0.138	21-Jul-03	0.153
24	Moniruzzaman	Bilpara/ Bhabanipur	Bayba	5-Jun-03	0.123	21-Jun-03	0.111	9-Jul-03	0.090		
28	Habibor Rahman	South/ Dhantara	Kayba	6-Jun-03	0.078	21-Jun-03	0.079	9-Jul-03	0.018	21-Jul-03	0.024
33	Rezaul Islam	Kolonipara/ Kathuria	Ulashi	8-Jun-03	0.053	21-Jun-03	0.056	8-Jul-03	0.048		
34	Nur Hossain	Amtala/ Bagachra-1	Bagachra	8-Jun-03	0.158	19-Jun-03	0.049	8-Jul-03	0.015	21-Jul-03	0.013
36	Motiar Rahman	Ahalahadispara/ Tengra	Bagachra	9-Jun-03	0.327	21-Jun-03	0.287	8-Jul-03	0.077	20-Jul-03	0.096
39	Md. Inshat Ali	West (Camppara)/ Goga-4	Goga	8-Jun-03	0.113	17-Jun-03	0.109	9-Jul-03	0.012	21-Jul-03	0.023
40	Md. Zeyad Ali	Eastpara/ Goga-5	Goga	8-Jun-03	0.217	19-Jun-03	0.315	9-Jul-03	0.253	21-Jul-03	0.261
44	Shamsur Rahman	South/ Kaliani	Goga	9-Jun-03	0.181	17-Jun-03	0.202	9-Jul-03	0.074	21-Jul-03	0.181
46	Shamsur Rahman	Morolpara/ Dhantara	Kayba	8-Jun-03	0.124	21-Jun-03	0.104	9-Jul-03	0.073	21-Jul-03	0.143
47	Md. Baki Billah	Sardarpara/ Dhantara	Kayba	8-Jun-03	0.550	21-Jun-03	0.510	9-Jul-03	0.384	21-Jul-03	0.508
49	Mohammad Ali	North/ Shibnathpur	Putkhali	9-Jun-03	0.200	17-Jun-03	0.029	9-Jul-03	0.021		

: Over the Bangladesh Standard (0.05 mg/L)

Water Quality of Dugwells in Sharsha Upazila

Md. Shamim Uddin

Abu Shamim Khan

Environmental Chemist, Asia Arsenic Network

Objective

To observe the water quality of dugwells installed by AAN in Sharsha Upazila.

Background

After screening all the tubwells in Sharsha upazila, Jessore district, Asia Arsenic Network (AAN) found out many highly arsenic contaminated areas, where the safe water options were needed. AAN dug 51 dugwells at the request of villagers in the areas from 24th January to 14th June, 2003. AAN wished to know the water quality of these dugwells.

Methods of water Sampling

First, the stored water pumped up from the dugwells. On the following day (2nd day) the middle water collected in the dugwells and measured pH, conductivity, Dissolve Oxygen (DO), Total Dissolve Solid (TDS), Oxidation Reduction Potential (ORP), temperature, turbidity, total hardness, nitrate, sulphate, phosphate, ammonium, arsenic, manganese, ferrous iron and total iron. The research was conducted from 22nd October to 5th November, 2003.

Instruments

The arsenic concentration was measured by Atomic Absorption Spectrophotometer (Shimadzu: AA-660 Model) in AAN laboratory.

The nitrate, sulphate, phosphate, ammonium, manganese, ferrous iron, total iron and turbidity were measured by Spectrophotometer (HACH, DR/2010 Model) at each dugwell site.



The pH, conductivity, Dissolves Oxygen (DO), Total Dissolve Solid (TDS) were measured by HACH sension 156 meter.

Oxidation reduction potential was measured by Toko TRX-90 meter and hardness was measured by titration with standard EDTA solution.

Results

Arsenic

22 dugwells out of 51 were contaminated by arsenic above 0.05 mg/L. The range of arsenic concentrations of these 22 water samples was from 0.056 mg/L to 0.935 mg/L.

Iron

27 dugwells were contaminated by iron above 1 mg/L and it ranged from 1.17 mg/L to 33.84 mg/L. It was found that 21 dugwells among 27 were contaminated by both iron and arsenic above the Bangladesh standard values for drinking water.

Manganese

It was found 48 dugwells where the concentration of manganese was above 0.1 mg/L, standard value for drinking water.

Ammonium

It was found 40 dugwells where ammonium concentration was above 0.64 mg/L, which is standard value of drinking water.

Total Hardness

The total hardness of 8 dugwells exceeded 500mg/L, the standard value of drinking water.

Turbidity

The turbidity of all dugwells was above the standard value of drinking water and some were ten times more than the standard value.

Others

The concentration of pH, sulphate, nitrate and phosphate were below the standard value of drinking water. It was found that the water of 8 dugwells had little color and the water of 16 dugwells smelled bad.

Comments

1. Arsenic, iron, manganese, ammonium and high turbidity was detected from many dugwells. The water of these dugwells cannot be accepted for drinking without treatment.
2. Many dugwells has already been dug to supply safe dirking water. It is recommended to check the water quality of dugwells in whole Bangladesh.
3. AAN will construct a sand filter to ensure the safe water in each dugwell site.

Water Quality of Dugwells in Sharsha Upazila JICA/AAN Arsenic Mitigation Project

Analyte	pH	Conductivity	DO	TDS	ORP	Temperature	Turbidity	Hardness	Nitrate	Sulphate	Phosphate	Ammonium	Arsenic	Ferrous	Iron Total	Manganese	Observation Date	Color	Smell
Method	pH meter	Conductivity meter	DO meter	ORP meter		SP	Titration by EDTA	SP	SP	SP	SP	AAS	SP	SP	SP				
WHO Guideline	-	-	-	1000	-	-	5	-	50	250	-	1.5	0.01		0.3	0.5			
Bangladesh Standard	6.5-8.5	-	6	1000	-	20-30	10	500	45	400	6	0.64	0.05		1	0.1			
Unit	-	µS/cm	mg/L	mg/L	(mV)	Deg C	FAU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Mg/L			
DW#1	6.97	952	1.71	444	-51	27.6	34	350	BDL	BDL	1.12	2.59	0.006	0.46	2.11	0.4	22-Oct-03	Clear	Clear
DW#2	6.76	1917	2.35	914	57	27.5	26	736	BDL	84	0.73	1.63	0.007	0.06	0.17	0.5	22-Oct-03	Clear	Clear
DW#3	6.66	743	0.88	346	-74	26.9	90	392	4.1	BDL	2.32	4.60	0.143	2.16	4.10	0.5	22-Oct-03	Clear	Little bad smell
DW#4	6.80	1068	1.16	495	-80	28.0	48	374	3.6	BDL	2.01	2.65	0.043	2.06	3.18	0.3	22-Oct-03	Clear	Clear
DW#5	6.66	1012	1.66	470	87	27.8	20	427	1.2	7	0.85	0.33	0.045	0.03	0.90	0.6	23-Oct-03	Clear	Clear
DW#6	7.02	1047	1.82	489	6	27.7	13	359	1.1	35	0.69	0.25	0.008	0.04	0.99	0.4	23-Oct-03	Clear	Clear
DW#7	6.91	628	1.05	291	-85	27.2	32	500	2.9	BDL	1.11	1.31	0.090	1.98	2.89	0.2	23-Oct-03	Clear	Little bad smell
DW#8	6.69	1016	2.90	477	-98	27.2	34	420	6.1	BDL	2.70	2.90	0.394	4.94	6.90	2.4	23-Oct-03	Clear	Little bad smell
DW#9	7.10	1153	1.58	543	78	27.4	17	384	0.4	21	0.57	3.45	0.008	0.03	0.60	0.7	26-Oct-03	Clear	Clear
DW#10	6.65	2520	1.41	1209	17	27.4	30	660	2.7	21	1.61	6.19	0.011	0.26	0.47	0.9	26-Oct-03	Little Brown	Clear
DW#11	6.87	964	1.28	454	-81	27.1	73	416	3.7	BDL	0.10	2.31	0.306	3.00	4.70	0.9	26-Oct-03	Little Brown	Clear
DW#12	6.90	1314	1.90	626	-12	27.1	43	424	1.5	1	0.15	1.12	0.042	0.38	0.41	0.7	27-Oct-03	Clear	Clear
DW#13	6.60	801	1.62	377	-30	26.8	46	256	1.0	8	1.13	2.67	0.022	0.25	0.87	1.2	28-Oct-03	Clear	Clear
DW#14	7.04	761	1.77	349	-30	28.0	35	260	1.9	BDL	1.11	0.72	0.025	0.31	0.73	0.3	20-Oct-03	Clear	Clear
DW#15	6.78	1149	1.50	530	-116	28.0	44	328	5.2	BDL	2.42	2.84	0.223	4.02	4.58	0.5	20-Oct-03	Clear	Little bad smell
DW#16	6.56	1528	1.50	733	-115	27.4	52	512	4.8	BDL	4.85	2.57	0.142	5.05	7.40	BDL	19-Oct-03	Clear	Little bad smell
DW#17	6.70	1044	1.61	485	-118	28.0	65	416	2.9	BDL	2.54	4.05	0.184	3.14	3.44	0.3	19-Oct-03	Clear	Little bad smell
DW#18	6.42	1512	1.12	717	-116	29.2	37	498	5.4	74	2.40	3.03	0.149	6.05	8.40	0.4	19-Oct-03	Clear	Little bad smell
DW#19	6.62	1073	1.44	500	28	28.2	93	722	2.2	40	0.54	4.30	0.118	1.21	4.35	0.6	19-Oct-03	Little Brown	Clear
DW#20	6.92	1219	1.45	579	-100	26.9	34	404	1.7	8	2.21	1.93	0.024	2.92	3.04	1.8	28-Oct-03	Clear	Little bad smell
DW#21	7.25	1359	3.18	637	28	27.8	43	332	1.3	13	1.72	0.36	0.005	0.04	0.17	0.2	28-Oct-03	Clear	Clear
DW#22	7.44	918	2.23	428	-105	28.0	19	276	2.5	6	2.30	2.73	0.184	4.12	4.72	1.2	29-Oct-03	Clear	Little bad smell
DW#23	6.54	2470	1.90	1224	-100	26.1	44	780	4.1	BDL	0.15	14.26	0.137	18.84	33.84	6.8	27-Oct-03	Brown	Clear
DW#24	7.74	1176	0.91	549	-77	27.3	42	376	3.4	BDL	3.40	4.96	0.093	6.70	10.05	3.2	3-Nov-03	Little Fe color	Little bad smell
DW#25	7.14	907	2.38	424	133	27.5	19	339	1.0	BDL	0.91	0.20	0.010	0.04	0.57	0.2	2-Nov-03	Clear	Clear
DW#26	6.99	1284	1.28	612	127	26.9	22	320	0.9	33	0.38	0.38	0.009	0.02	0.11	0.3	2-Nov-03	Clear	Clear
DW#27	6.77	1168	1.23	552	73	27.2	21	392	1.9	59	0.21	1.04	0.007	0.06	0.85	0.5	5-Nov-03	Clear	Clear
DW#28	6.87	1289	2.42	602	-37	27.4	61	332	2.6	35	0.72	2.33	0.076	0.60	3.28	0.4	5-Nov-03	Little Fe color	Clear

Water Quality of Dugwells in Sharsha Upazila JICA/AAN Arsenic Mitigation Project

Analyte	pH	Conductivity	DO	TDS	ORP	Temperature	Turbidity	Hardness	Nitrate	Sulphate	Phosphate	Ammonium	Arsenic	Ferrous	Iron Total	Manganese	Observation Date	Color	Smell
Method	pH meter	Conductivity meter	DO meter	ORP meter		SP	Titration by EDTA	SP	SP	SP	SP	AAS	SP	SP	SP				
WHO Guideline	-	-	-	1000	-	-	5	-	50	250	-	1.5	0.01		0.3	0.5			
Bangladesh Standard	6.5-8.5	-	6	1000	-	20-30	10	500	45	400	6	0.64	0.05		1	0.1			
Unit	-	µS/cm	mg/L	mg/L	(mV)	Deg C	FAU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Mg/L			
DW#29	6.83	1229	1.92	581	-20	27.1	31	416	1.0	7	0.46	0.56	0.009	0.65	0.70	1.4	30-Oct-03	Clear	Clear
DW#30	6.84	995	1.88	442	75	29.2	23	384	1.2	BDL	0.11	0.19	0.004	0.09	0.12	BDL	21-Oct-03	Clear	Clear
DW#31	6.99	1262	1.71	584	131	28.4	51	466	1.7	100	0.16	0.57	0.006	0.09	0.18	0.3	21-Oct-03	Clear	Clear
DW#32	6.80	1352	1.45	645	-123	27.3	31	454	6.0	BDL	2.69	2.63	0.056	6.46	6.75	0.4	21-Oct-03	Clear	Little bad smell
DW#33	6.77	1709	1.30	795	-62	28.0	33	468	2.1	73	0.74	1.06	0.064	0.97	1.17	0.6	21-Oct-03	Clear	Little bad smell
DW#34	7.11	1004	1.13	473	-47	27.6	60	210	1.2	BDL	0.66	0.85	0.180	0.45	0.45	0.5	5-Nov-03	Little Turbide	Clear
DW#35	6.65	1944	1.69	910	-25	28.1	46	660	2.0	8	0.15	2.20	0.032	0.40	2.29	1.1	20-Oct-03	Little Brown	Clear
DW#36	6.88	1038	1.58	458	90	28.2	18	398	0.8	BDL	0.42	0.70	0.101	BDL	0.13	0.4	20-Oct-03	Clear	Clear
DW#37	6.97	1920	2.86	881	-82	28.5	104	507	4.5	1	1.45	5.47	0.048	2.28	3.18	1.7	31-Oct-03	Turbide	Bad Smell
DW#38	6.88	1164	2.79	545	73	27.8	23	364	1.1	27	0.28	0.45	0.003	0.06	0.22	0.5	31-Oct-03	Clear	Clear
DW#39	7.67	1396	2.28	670	13	27.1	22	440	0.7	5	0.45	2.69	0.042	0.07	0.46	1.2	28-Oct-03	Clear	Clear
DW#40	6.08	714	1.59	327	-100	28.0	24	560	3.1	7	1.19	2.42	0.296	4.84	6.58	5.5	29-Oct-03	Clear	Clear
DW#41	7.47	2460	1.42	1175	27	27.0	27	446	1.6	101	6.23	3.18	0.020	0.03	0.21	1.1	29-Oct-03	Clear	Clear
DW#42	6.93	997	2.66	460	19	28.7	15	292	0.4	23	0.29	0.53	0.004	0.07	0.16	0.7	29-Oct-03	Clear	Clear
DW#43	6.75	1270	1.45	606	-68	26.8	97	376	0.7	BDL	1.44	5.85	0.047	1.09	3.40	0.5	27-Oct-03	Turbide	Clear
DW#44	6.78	1171	3.08	564	-110	26.7	107	346	5.9	BDL	3.15	8.56	0.211	3.29	7.48	BDL	27-Oct-03	Clear	Bad Smell
DW#45	6.75	879	2.35	418	5	26.4	17	292	3.4	BDL	0.33	0.40	0.022	0.09	0.23	0.5	27-Oct-03	Clear	Clear
DW#46	6.76	1294	1.38	617	-103	27.0	27	418	5.3	BDL	3.65	3.50	0.149	5.22	14.60	4.5	5-Nov-03	Little Fe color	Clear
DW#47	7.38	932	1.76	436	-88	27.7	35	322	3.4	BDL	2.72	1.55	0.935	3.80	6.04	1.5	5-Nov-03	Clear	Little bad smell
DW#48	6.85	1010	1.88	465	-83	28.1	33	324	1.6	7	3.63	2.75	0.122	0.91	1.52	1.6	30-Oct-03	Clear	Clear
DW#49	6.63	855	1.25	395	-102	27.8	42	396	3.1	8	1.56	1.95	0.019	3.74	5.40	1.4	30-Oct-03	Clear	Little bad smell
DW#50	6.47	1305	1.27	604	-54	28.3	17	332	1.1	49	0.42	0.87	0.032	0.91	0.96	0.9	30-Oct-03	Clear	Clear
DW#51	6.97	1459	2.87	671	52	28.9	42	388	2.1	52	1.03	0.83	0.021	0.06	0.35	0.8	31-Oct-03	Clear	Clear

: Excess values of both Bangladesh and WHO

: Excess value of Bangladesh standard

: Excess value of WHO guideline

ORP : Oxidation Reduction Potential

AAS : Atomic Absorption Spectrophotometer

DO : Dissolve Oxygen

SP : Spectrophotometer

EDTA : Ethylene Diamine Tetra Acetic Acid

WHO : World Health Organisation

DW : Dugwell

TDS : Total Dissolved Solid

FAU : Formazin Attenuation Units

BDL : Below Detection Limit

