ASSESSMENT OF SEASONAL VARIATIONS IN WATER QUALITY OF MUDHOL TALUKA IN BAGALKOT DISTRICT, KARNATAKA INDIA .

P.D.Pol[*], M. C. Sangannavar, R. R. Chavan and M. S. Yadawe[#]
Commerce,B.H.S.Arts and T.G.P.Science College Jamakhandi, Karnataka India[*]
S.B.Arts and K.C.P.Science College Vijayapur-586103[#]
mallikarjunyadawe82@gmail.com

Abstract: Assessment of seasonal changes in surface water quality is an important aspect for evaluating temporal variations of water pollution due to natural or anthropogenic inputs of point and non-point sources. In this study, surface water quality data for 7 physical and chemical parameters collected from 50 monitoring stations in a water of Mudhol taluka of Bagalkot district, Karnataka were analyzed. The principal component analysis technique was employed to evaluate the seasonal variations of water quality parameters, while the principal factor analysis technique was used to extract the parameters that are most important in assessing seasonal variations of water quality. Analysis shows that a parameter that is most important in contributing to water quality variation for one season may not be important for another season except for DOC and electrical conductance, which were always the most important parameters in contributing to water quality variations for all four seasons

Introduction

Water is the most vital resources for all kinds of life on this planet. Water is one of the nature's most important gifts to mankind. It is essential and most precious commodity for life. Rivers are vital and vulnerable freshwater systems and are essential for the sustenance of all life. Pollution of surface water with toxic chemicals and eutro-phication of rivers and lakes with excess nutrients are of great environmental concern worldwide. Agricultural, Indus-trial, and urban activities are considered as being major sources of chemicals and nutrients to aquatic ecosystems, while atmospheric deposition could be an important source to certain constituents such as mercury and nitrogen. The concentrations of toxic chemicals and biologically available nutrients in excess can lead to diverse problems such as toxic algal blooms, loss of oxygen, fish kills, loss of biodiversity, and loss of aquatic plant beds and coal reefs [1]. Nutrient enrichment seriously degrades aquatic ecosystems and impairs the use of water for drinking, industry, agriculture, and recreation and for other purposes. The modern civilization, urbanization and prolonged discharge of industrial effluents, domestic sewage and solid waste dump cause the water to became polluted. Wild and domestic animals using same drinking water can also contaminate the water through direct defection and urination [2]. The modern civilization, urbanization and prolonged discharge of industrial effluents, domestic sewage and solid waste dump cause the water to became polluted. Wild and domestic animals using same drinking water can also contaminate the water through direct defection and urination [3]. Rivers are considered as vital and vulnerable freshwater ecosystems that are important for the sustenance of all life. Untreated discharge of pollutants to a water resource system from domestic sources, storm water discharges, industrial wastewaters, agricultural runoff and the other sources, all can have short term and long term significant effects on the quality of a river system[4]. The physico-chemical parameters useful for water quality assessment are determined by the presence of both organic and inorganic compounds that are either suspended or dissolved in water. At the same time, water quality characteristics of aquatic environment arise from a multitude of physical, chemical and biological interactions [5]. While some of these compounds are toxic to the ecosystem, some are providing nutrients to aquatic organisms and others are responsible for the aesthetics of the water body[6]. Human activities are a major factor determining the quality of the surface and ground water through atmospheric pollution, effluent discharges, use of agricultural chemicals, eroded soils and land use [7]. These land use changes increase the amount of impervious surface resulting in storm runoff events that negatively affect stream ecosystems and water quality [8]. Natural and synthetic estrogens, other pharmaceuticals and disease-causing bacteria are entering streams through the release of wastewater from sewage treatment plants and effluent from septic systems [9,10].

The present study is an attempt to characterize the trends in physico-chemical properties of water quality in Mudhol taluka, Karnataka, India and compare the results with WHO standards.

MATERIALS AND METHODS

Study area: Mudhol is a town previously known as "'Muduoolalu"' in the Bagalkot District in the Northern part of the South Indian state of Karnataka. It is about 60 km from the district headquarters of Bagalkot town on the left bank of the Ghataprabha River. It is famous for a breed of dog known as the Mudhol Hound. Mudhol State was ruled by the Ghorpade-Maratha royal family. The Principality of Mudhol ruled by the Ghorpade dynasty of the Marathas, was one of the 9-gun princely states of British India, under the summit of Niranjan. The state measured 368 square miles (508 km^2) in area. According to the 1901 census, the population was 63,001, with the population of the town itself at 8,359 in that year. In 1901, the state enjoyed revenue estimated at £20,000. The state flag, called 'Bavuta', has a triangular tricolor of horizontal bands, in order from the top: white, black and green. All color bands came to the point in the fly. Birthplace of Vinay Koppad, founder of Youth For Unity and former co-founder of NaMo-Brigade. Youth For Unity is non government organization contribute towards Girl child

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education, Rural Empowerment, Environment causes etc. Mudhol is located at 16.35°N 75.28°E.[1] It has an average elevation of 549 metres (1801 feet).

Sampling: Polythene bottle which were thoroughly washed thrice with the water to be analyzed. Samples of drinking water were collected in clean polyethylene bottles from different sources viz. tube well, bore well and hand pump in the monsoon ,pre and post monsoon from Mudhol taluka. The samples for physiochemical analysis were placed an ice box and transported to the laboratory for immediate analysis lie pH and EC were measured on-site by (using HACH sensION156 portable), respectively (APHA, 1998). TDS is calculated by the evaporation method, TH is determined by EDTA titration [11]. Chloride has been determined using spectrophotometer. The data have been compared with standard values which are given by Indian [12] and WHO [13] standards. Table 1 shows the seasonal variation of water quality of Mudhol taluka.

Material and Methods

Water samples from different sites were collected in polystyrene bottles. At each sampling location, composite surface water was collected and stored in clean polyethylene bottles that have been pre-washed with HNO3 and thoroughly rinsed with demonized water. Some physico-chemical parameters like water pH, conductivity, Electrical conductivity ,total dissolved solid, Total hardness, were analyzed and recorded immediately after collection of the water samples. Analysis for the remaining physico-chemical parameters like calcium, magnesium and sulphate were carried out in the laboratory. The methods used for the estimation of the variables were standard methods of APHA [14] and Trivedy and Goel [15] .

Results and discussions

pH: The pH value of drinking water is an important index of acidity or alkalinity. Most of the waters are slightly alkaline due to presence of carbonates and bicarbonates. A number of minerals and organic matter interact with one another to give the resultant pH value of the sample. Among the ground water analyzed, maximum average pH values varied from 8.32 at S 31 and minimum average pH value 6.60 was observed at sample S 20 during pre monsoon. The pH value of different water samples show a mark fluctuation for the different sites. The range of pH value shows a variation from 7.16 at S4 to 8.21 at S 31 during monsoon season and 8.05 during postmonsoon,7.12 to 8.20 during monsoon and 7.02 S 20 to 8.01 at S 31 during post monsoon respectively. According to Fakayode [16], the pH of a water body is very important in determination of water quality since it affects other chemical reactions such as solubility and metal toxicity. The pHs of the water under study in all three seasons are within the WHO standard of 6.50-8.50.

Conductivity: Electrical conductivity is an important parameter for determining the water quality of domestic and agricultural purpose. The WHO permissible limit for EC in water is 600 mhos cm^{-1}, the germination of almost all the crops is affected and it may result in reduced yield [17]. Electrical conductivity is a measure of water capacity to conduct electrical current. It signifies the amount of total dissolved salts. In the present study EC values in the range of 2019 mhos cm^{-1} at S 11 to 2852 mhos cm^{-1} at S19 in pre monsoon,2126 mhos cm^{-1} at S10 to 2688 mhos cm^{-1} at S1, and 2175 mhos cm^{-1} at S44 to 2814 mhos cm^{-1} at S1 in post monsoon season respectively.

TDS: TDS is an important parameter which imparts a peculiar taste to water and reduce its potability. Desirable limit of TDS is 500mg/l (IS: 10500 standards) and maximum allowable limit is 1500 mg/l. The TDS of studied ground water samples varied between348.3 ppm atS1 to 1747ppm at S11 in premonsoon,108.6 ppm at S21 to 1877ppm at S1 in monsoon season and 869.5ppm at S44 to 1797.2ppm at S1 in post monsoon respectively. All the values obtained are much higher than the limits. High TDS increase density of water, decrease solubility of gases like oxygen and ultimately make the water unsuitable for drinking [18]. High TDS level(>500mg/L) result in excessive scaling in water pipes, water heater, boilers, and household appliances [19].

Hardness: Hardness reflects the composite measure of polyvalent cations whereas calcium and magnesium is the primary constituent of hardness [20]. Public acceptability of the degree of hardness may vary considerably from one community to another. Hardness value above 200mg/L is generally unacceptable. There is no recent reliable data on possible adverse effects associated with hardness 200mg/L may cause scale deposition in distribution system as well as increase soap consumption. Hardness of studied ground water samples varied from 186.5 mg/L at S7 to 718.4 mg/L at S26 in pre-monsoon season,242.9 mg/L at S 21 to 799.9 mg/L in monsoon season and 261.9 mg/L at S 20 to 769.9 mg/L in post-monsoon respectively and most of the values are above the permissible limits of WHO.

Calcium: There is a significant variation in calcium content during the three seasons of investigation in all the sites which varied from 51.0 mg/L at S11 to 96.0 mg/L at S 19 mg/L in Pre-monsoon, 59.0 mg/L at S 21 to 88.0 mg/L at S24 in monsoon season and 51 mg/L at S11 to 80.0 mg/L at 19 in Post monsoon respectively. According to Bureau of Indian Standards [21], standard value for calcium is 75 mg/L and can be relaxed up to 200 mg/L. The higher value of calcium registered during the study period may be due to the influx of industrial waste and sewage to the river water . In estuarine water, the variation of concentration of calcium is quite significant due to land drainage, high rates of biological uptake, and precipitation and dissolution process characteristics of shallow system [22]. More than 50% of present water samples exceed the permissible limits.

Magnesium: As per BIS [21], prescribed standard limit for magnesium is 30-70 mg/L and hence the observed values were beyond the permissible limit. Calcium content of Mudhol taluka ranged from 48.0 mg/L at S13 to 86.o at S 9 in pre-monsoon, 55.0 mg/L at S 21 to 92.0 mg/L at S9 mg/L in monsoon season and 50.0 mg/L at S 17 to 98.0 mg/L at S 5 in post monsoon season respectively. As estuaries receive inputs from multiple sources of organic and inorganic matter such as materials exported from agricultural, urban development through drainage basin in to the river and intrusion of marine water from ocean during high tidal periods which contain multiple ionic sources such as Ca^{+2}, Mg^{+2}, Cl^{-} etc may increase the magnesium content in the study sites [23].

Sulphate: The sources of sulphate in underground waters may be rocks, geological formation, and so on. Excess sulphate has a laxative effect, especially in combination with magnesium and/or sodium. Sulphates exist in nearly all natural waters, the concentrations varying according to the nature of the terrain through which they flow. They are often derived from the sulphides of heavy metals (iron, nickel, copper and lead). Iron sulphides are present in sedimentary rocks from which they can be oxidised to sulphate in humid climates; the latter may then leach into watercourses so that ground waters are often excessively high in sulphates[24]. As magnesium and sodium are present in many waters, their combination with sulphate will have an enhanced laxative effect of greater or lesser magnitude depending on concentration. The utility of water for domestic purposes will therefore be severely limited by high sulphate concentrations, hence the limit of 200 mg/dm^3 SO_4^{2-} [24]. The sulphate contents of all the water samples ranged from 140mg/L at S21 to 178mg/L in Pre-monsoon,141mg/L at S49 to 187mg/L at S9 in monsoon season season and 139mg/L to 166mg/L in post-monsoon season respectively. The sulphate contents of all the water samples fall below the MPL (200 mg/dm^3).

Conclusion

In this case study, different physico-chemical parameters were successfully applied and compared with the respective standards to monitor the water quality of Mudhol taluaka of Bagalkot district ,Karnataka India . Water analysis of pH, conductivity, TDS, hardness, calcium, magnesium and sulphate , are the most important parameters represent the pollution. status of the water. The pollutants are due to the release of effluents from several sources into the estuary, which causes significant changes in the quality of water and pose some deleterious effect to the mangrove ecosystem in a long run. The immediate need is to maintain existing sewage treatment plants so that effluent discharge has a minimum of suspended solids. As a result, it is essential that Mudhol taluka environment monitoring is urgently required.

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Table.1 Physico-Chemical Parameters in the different locations of Mudhol taluka in Bagalkot District.(Pre Mansoon)

S No	Area of Samples collected	pH	EC	TDS in ppm	Hardness in ppm	Ca	Mg	SO_4
1	Kesargoppa public bore well	7.02	2543	1547.1	559.5	70	65	141
2	Sameerwadi public bore well	7.89	2335	1125.2	413.3	60	65	150
3	Belagali public bore well	6.92	2254	1061.0	399.2	55	64	142
4	Mugalkod public tap	7.16	2289	1008.2	372.9	62	65	150
5	Budni PM 1 public bore well	7.21	2312	1002.0	368.2	61	67	156
6	Budni PM 2 public bore well	7.12	2485	1053.0	385.9	60	67	145
7	Nagaral public bore well	7.33	2588	1014.6	389.8	61	65	141
8	Dhavaleshwar public bore well	7.05	2443	1108.2	405.4	63	61	136
9	Sanganatti public bore well	7.55	2537	1408.6	758.3	71	80	164
10	Vajjarmatti public bore well	7.25	2004	869.3	369.2	56	58	141
11	Lokapur public bore well	8.02	1919	638.3	276.5	51	55	148
12	Nandaganv public bore well	7.33	2413	1184.6	437.6	62	60	150
13	Akkimaradi public bore well	7.45	2165	878.8	303.8	52	48	145
14	Sayadapur Public bore well	7.11	2198	965.4	332.6	60	55	143
15	Mugalkod public bore well	7.31	2445	1024.6	423.8	65	69	161
16	Kullalli public tap	7.18	2389	1085.8	399.3	62	54	151
17	Mudhol public bore well budni road	7.33	2025	1007.8	277.8	60	51	144
18	Mudhol public bore well bilagi road	7.22	2115	920.1	362.2	58	52	150
19	Mudhol public bore well near buss stand	7.47	2652	1381.5	769.9	86	70	171
20	Alagundi BK public bore well	6.48	2134	401.9	261.9	58	51	142
21	Malapur public tap	8.02	2174	1009.5	390.5	52	46	140

22	Shirol public Bore well	8.01	2256	1004.5	385.9	57	58	154
23	Shirol public tap water	7.80	2301	1016.4	395.9	52	54	152
24	Konnur public Bore well	7.43	2585	1087.4	418.4	72	69	170
25	Mantur public Bore well	7.59	2557	1006.4	389.4	56	60	141
26	Machaknur public Bore well	7.16	2684	1107.4	413.5	69	70	162
27	Timmapur public Bore well	7.29	2548	1005.3	387.2	66	61	145
28	Jeergal public Bore well	8.04	2454	989.3	385.6	66	61	152
29	Chichakandi public Bore well	7.66	2401	1008.8	375.4	61	52	141
30	Kasabajambagi public Bore well	7.15	2421	987.5	370.5	63	56	150
31	Malali public Bore well	7.75	2568	1105.4	389.7	65	54	153
32	Halagali public Bore well	7.39	2424	1007.3	385.3	60	51	145
33	Kataraki public Bore well	7.14	2489	1022.3	395.5	57	52	145
34	Muddapur public Bore well	7.72	2398	996.4	386.4	61	55	150
35	Bisanal public Bore well	8.02	2454	1007.2	384.7	64	66	161
36	Mahalingapur public Bore well	7.69	2415	1015.5	390.4	70	67	160
37	Madhabanvi public Bore well	7.59	2511	1084.3	416.6	63	62	152
38	Marapur public Bore well	7.82	2465	992.9	381.7	58	62	153
39	Hebbal public Bore well	7.37	2145	901.4	378.4	62	54	145
40	Soraganvi Bore well	7.07	2289	985.9	422.3	68	63	158
41	Alagur public Bore well	8.05	2101	988.5	418.7	60	54	141
42	Chikkalgundi public Bore well	7.77	2135	1037.4	459.7	62	67	161
43	Chikkur public Bore well	7.69	2391	1086.3	416.3	71	73	164
44	Bantanur public Bore well	8.01	2123	903.8	389.6	61	63	165
45	Bannurpublic Bore well	7.72	2566	1104.5	479.2	67	70	167

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46	Rugi public Bore well	8.01	2167	1017.5	470.3	70	67	160
47	Jaliber public Bore well	7.78	2685	1102.3	479.5	75	72	161
48	Metagudda public Bore well	7.57	2402	1104.5	423.6	70	65	160
49	Dadanatti public Bore well	7.82	2275	1026.4	403.4	63	60	150
50	Baragi public Bore well	7.77	2362	1109.6	475.5	65	63	156

Table.2 Physico-Chemical Parameters in the different locations of Mudhol taluka in Bagalkot District.(Mansoon)

S No	Area of Samples collected	pH	EC	TDS in ppm	Hardness in ppm	Ca	Mg	SO_4
1	Kesargoppa public bore well	7.44	2968	1897.2	599.6	85	76	168
2	Sameerwadi public bore well	8.01	2755	1478.5	475.2	72	81	169
3	Belagali public bore well	7.52	2665	1309.2	419.6	75	79	169
4	Mugalkod public tap	7.36	2589	1206.6	482.5	79	79	169
5	Budni PM 1 public bore well	7.78	2654	1216.2	618.3	72	78	174
6	Budni PM 2 public bore well	7.61	2765	1332.1	495.2	79	78	171
7	Nagaral public bore well	7.81	2858	1252.3	398.6	79	79	169
8	Dhavaleshwar public bore well	7.46	2745	1208.6	455.9	77	79	156
9	Sanganatti public bore well	7.91	2869	1599.8	798.5	81	92	187
10	Vajjarmatti public bore well	7.71	2226	988.8	408.3	76	77	168
11	Lokapur public bore well	8.20	2229	995.6	420.4	66	65	166
12	Nandaganv public bore well	8.13	2868	1325.4	504.2	76	74	169
13	Akkimaradi public bore well	7.65	2525	1208.5	436.5	66	68	169
14	Sayadapur Public bore well	7.62	2435	1189.6	411.5	69	71	168
15	Mugalkod public bore well	7.62	2798	1318.5	469.5	79	77	177
16	Kullalli public tap	7.61	2745	1215.5	453.4	75	69	166
17	Mudhol public bore well budni road	7.79	2305	1122.5	438.6	66	62	161
18	Mudhol public bore well bilagi road	7.46	2758	1325.6	548.9	82	72	179
19	Mudhol public bore well near buss stand	7.57	2892	1481.7	809.9	89	76	188
20	Alagundi BK public bore well	7.12	2547	1152.6	461.7	69	68	162
21	Malapur public tap	8.02	2454	1118.6	428.9	63	62	168
22	Shirol public Bore well	8.12	2534	1107.8	409.2	68	72	170

23	Shirol public tap water	8.01	2589	11 26.5	417.5	69	71	168
24	Konnur public Bore well	7.72	2945	1408.6	802.6	87	88	184
25	Mantur public Bore well	7.99	2864	1325.3	732.8	70	71	168
26	Machaknur public Bore well	7.42	2894	1309.5	765.8	82	86	175
27	Timmapur public Bore well	7.51	2792	1238.4	705.3	77	79	170
28	Jeergal public Bore well	8.10	2698	1123.5	585.1	70	69	166
29	Chichakandi public Bore well	7.98	2698	1178.7	595.8	73	68	168
30	Kasabajambagi public Bore well	7.52	2723	1318.2	767.2	68	70	170
31	Malali public Bore well	8.31	2888	1472.5	785.9	72	73	172
32	Halagali public Bore well	7.68	2712	1377.5	702.5	68	69	163
33	Kataraki public Bore well	7.45	2898	1478.5	809.6	74	71	168
34	Muddapur public Bore well	8.12	2768	1266.5	715.9	71	70	168
35	Bisanal public Bore well	8.01	2712	1212.3	685.8	69	65	169
36	Mahalingapur public Bore well	7.57	2755	1243.2	695.8	71	75	171
37	Madhabanvi public Bore well	7.89	2889	1153.4	589.7	73	76	172
38	Marapur public Bore well	8.08	2724	1222.6	678.8	69	71	167
39	Hebbal public Bore well	7.77	2415	1185.5	525.6	62	63	168
40	Soraganvi Bore well	7.38	2536	1110.2	495.6	69	73	169
41	Alagur public Bore well	8.15	2401	1125.5	528.7	67	62	159
42	Chikkalgundi public Bore well	7.79	2335	1097.8	469.5	69	68	165
43	Chikkur public Bore well	7.78	2510	1136.7	543.8	73	74	169
44	Bantanur public Bore well	8.13	2340	1098.9	459.8	68	69	164
45	Bannurpublic Bore well	7.85	2661	1254.8	619.8	68	66	168
46	Rugi public Bore well	7.89	2445	1123.9	547.8	73	68	164

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47	Jaliber public Bore well	7.79	2765	1344.8	715.9	71	68	162
48	Metagudda public Bore well	7.79	2512	1228.4	614.7	73	68	160
49	Dadanatti public Bore well	8.11	2414	1120.8	512.5	68	66	161
50	Baragi public Bore well	7.87	2522	1138.8	548.7	69	72	169

Table.3 Physico-Chemical Parameters in the different locations of Mudhol taluka in Bagalkot District.(Post Mansoon)

S No	Area of Samples collected	pH	EC	TDS in ppm	Hardness in ppm	Ca	Mg	SO_4
1	Kesargoppa public bore well	7.12	2814	1797.2	576.8	78	73	166
2	Sameerwadi public bore well	7.41	2587	1289.6	447.1	60	71	153
3	Belagali public bore well	7.11	2489	1145.3	355.4	57	65	156
4	Mugalkod public tap	7.05	2404	1031.4	389.9	67	68	155
5	Budni PM 1 public bore well	7.11	2422	1049.3	565.4	63	98	160
6	Budni PM 2 public bore well	7.05	2581	1191.3	438.6	58	67	156
7	Nagaral public bore well	7.11	2689	1100.6	331.5	60	65	150
8	Dhavaleshwar public bore well	7.12	2509	1103.3	405.5	65	67	140
9	Sanganatti public bore well	7.32	2687	1401.5	706.6	70	78	160
10	Vajjarmatti public bore well	7.15	2009	1145.6	455.6	56	61	142
11	Lokapur public bore well	7.59	2045	938.4	459.8	52	53	141
12	Nandaganv public bore well	7.37	2671	1201.2	535.3	61	64	150
13	Akkimaradi public bore well	7.15	2315	1217.9	556.8	53	56	151
14	Sayadapur Public bore well	7.27	2249	1207.7	550.6	56	57	143
15	Mugalkod public bore well	7.32	2585	1088.4	426.7	68	65	156
16	Kullalli public tap	7.05	2520	1089.9	521.5	62	56	148
17	Mudhol public bore well budni road	7.32	2105	930.6	371.7	54	50	141
18	Mudhol public bore well bilagi road	7.02	2589	1146.8	603.7	70	56	151
19	Mudhol public bore well near buss stand	7.25	2788	1185.9	774.4	80	65	161
20	Alagundi BK public bore well	7.02	2358	1186.4	525.5	56	54	142
21	Malapur public tap	7.34	2287	1021.4	484.3	53	51	150
22	Shirol public Bore well	7.41	2335	1028.2	488.3	56	60	153

23	Shirol public tap water	7.57	2425	1051.8	471.8	54	61	153
24	Konnur public Bore well	7.33	2734	1326.2	673.8	70	72	170
25	Mantur public Bore well	7.55	2689	1035.5	588.5	58	61	145
26	Machaknur public Bore well	7.12	2735	1115.2	606.4	71	72	155
27	Timmapur public Bore well	7.28	2631	1038.8	544.8	65	68	152
28	Jeergal public Bore well	7.51	2504	1047.3	459.3	61	60	152
29	Chichakandi public Bore well	7.58	2507	1107.9	491.2	61	60	145
30	Kasabajambagi public Bore well	7.12	2536	1046.8	422.8	53	60	150
31	Malali public Bore well	8.01	2701	1178.8	548.4	56	60	153
32	Halagali public Bore well	7.26	2514	1083.4	441.8	55	61	152
33	Kataraki public Bore well	7.11	2716	1087.6	662.4	60	62	151
34	Muddapur public Bore well	7.72	2485	1015.3	395.3	59	61	151
35	Bisanal public Bore well	7.67	2511	1025.5	451.7	51	60	155
36	Mahalingapur public Bore well	7.19	2586	1025.3	531.6	62	65	160
37	Madhabanvi public Bore well	7.59	2604	1084.5	579.2	63	67	155
38	Marapur public Bore well	7.72	2510	1013.7	502.4	57	63	153
39	Hebbal public Bore well	7.32	2211	966.9	378.4	56	65	154
40	Soraganvi Bore well	7.10	2374	1022.8	364.2	55	61	151
41	Alagur public Bore well	7.78	2205	1015.8	361.8	54	51	140
42	Chikkalgundi public Bore well	7.55	2184	959.5	345.6	52	60	145
43	Chikkur public Bore well	7.54	2322	1001.8	509.7	60	62	150
44	Bantanur public Bore well	7.72	2175	869.5	311.4	52	53	145
45	Bannurpublic Bore well	7.57	2478	1087.1	468.4	52	54	151
46	Rugi public Bore well	7.61	2279	950.7	375.7	62	54	141

47	Jaliber public Bore well	7.51	2584	1021.7	472.7	68	60	146
48	Metagudda public Bore well	7.47	2304	1021.5	459.8	62	51	140
49	Dadanatti public Bore well	8.01	2292	1066.8	410.4	61	59	139
50	Baragi public Bore well	7.55	2389	1065.9	482.8	68	59	155