

GROUND WATER QUALITY MONITORING IN SELECTED CITIES OF RAJASTHAN WITH REFERENCE TO HEAVY METALS [2009-10]

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1.0 INTRODUCTION

According to present statistical analysis about 75 – 80% human requirements are fulfilled by groundwater which accounts for more than 95% of all fresh water available on the earth. Due to the indiscriminate use of surface water, most of these are direct recipient of sewage, industrial effluent, etc. and surface water becomes unfit for drinking purpose even in some cases the surface water is not fit for uses like irrigation, fish propagation, industrial purposes, and recreational activities. In urban areas, water is tapped for domestic and industrial use from rivers, streams, wells and lakes. Almost 80% of the water supplied for domestic use comes out as wastewater. In most of the cases wastewater is let out untreated and it either sinks into the ground as potential pollutant of groundwater or is discharged into the natural drainage system causing pollution in downstream areas.



At the time of independence on 15th August 1947, Rajasthan was known as Rajputana (region of Rajputs) and comprised of 18 princely States. It took seven stages to form Rajasthan as it is defined today. In today's Rajasthan, there are 24 class I cities and 21 class II towns having urban population 1,12,10,750 in 2008. The total water supply in these 45 cities is approximately 1912 MLD leading to generation of 1530 MLD sewage.

The present study was aimed to assess the effect of rapid Urbanization, Industrialization and Unscientific dumping of Solid and liquid municipal waste on groundwater quality. Seven cities of Rajasthan, identified for the present study, are in a state of rapid urbanization and industrialization. In almost all towns/cities, the drinking water is being supplied through bore wells, hand pumps and in some cities river/lake water is being supplied. The total wastewater generated in the state is either discharged in the River or on land. About 313 MLD sewage generated in 04 class I cities and 37.5 MLD generated from 06 class II towns is discharged in to tributaries of River Ganga. There are 03 operational sewage treatment plants in Rajasthan state (Jaipur-02, Jodhpur-01) having total treatment capacity of 109.5 MLD and 04 STPs are proposed (Ajmer-02, Bikaner-01, Jodhpur-01) for enhancing treatment capacity by 68 MLD.

This monitoring was conducted by the Zonal office during the year 2009-10. The seven cities identified from Rajasthan were Jaipur, Udaipur, Jodhpur, Ajmer, Pali and Bhiwadi. In each city samples were collected from pollution sensitive areas like sites having common facilities, Industrial areas and residential areas. The samples were collected from tube wells, hand pumps or open wells from these locations depending upon available source. The field parameters like temperature & pH were recorded at site and Physio-chemical parameters and heavy metals were analyzed in Zonal Office Laboratory. The observed values of all parameters are as presented in Table- 2&3.

2.0 METHODOLOGY

2.1 Sampling: Ground Water samples in the identified cities were collected form minimum five locations in each city. Samples were collected in fresh containers of high density polyethylene material for physico-chemical parameters and heavy metals with proper preservation as per the standard procedure for analysis in Zonal Office Laboratory. The grab samples were collected preferably from hand pump having depth of approximately 70 ft. The detail of sampling locations is presented in Table 01.

2.2 Analysis: Analysis of ground water samples was performed in the laboratory as early as possible. However, the analysis of pH and temperature were performed on site. The analysis for other parameters was performed as per the standard methods for the examination of water and waste water, APHA. Analysis of parameters like pH, conductance, turbidity anions and cations was performed using instrumental method whereas volumetric methods were adopted for the analysis of alkalinity, chemical oxygen demand, chloride and hardness. Heavy Metals were analysed by Atomic Absorption Spectrophotometer (GBS Awanta Sigma).

3.0 OBSERVATIONS

All the computed data have been presented in the Table -1&2. City wise observations of ground water quality are discussed here-

3.1 Ajmer

Ajmer is a popular pilgrimage centre for the Muslims as well as Hindus and is famous for the Dargah Sharif-tomb of the Sufi saint Khwaja Moinuddin Chisti and Pushkar. The city experiences huge floating population in addition to its stationary population (5,96,790 in year 2008). Mean annual rainfall (1987-2006) of the district is 453.2 mm whereas normal rainfall (1901-70) is lower than average rainfall and placed at 433.8. January is the coldest month with mean maximum and minimum temperatures being lowest at 22.7°C & 7.6°C . Temperature in summer month, June, reaches up to 39.5°C . Atmosphere is generally dry except during the monsoon period. The humidity is highest in August with mean daily relative humidity 80%. Pushkar & Bud Pushkar are two natural lakes near the Ajmer city.

In Ajmer ground water samples were collected from five locations 03 in residential area, 01 each from MSW dump site and CBWTF site. The results of the physico-chemical and biological parameters of ground water in Ajmer are

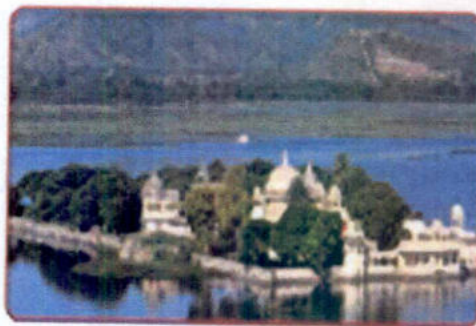
presented in Table -02. The TDS in the water samples in the study area varied from 1390 to 2276 mg/L indicating the ionic contamination of ground water. Although there is no specific limit for conductivity, but the values observed indicate the high concentration of soluble ion in the water. The electrical conductivity of water samples varied from 580 to 1940 $\mu\text{S}/\text{cm}$.

The pH of ground water samples of the area was 7.0 to 8.0, which is neutral but the chloride content of the water samples varied from 156 to 270 mg/L, more than the desirable limits prescribed in IS 10500.

MSW leachate may contain heavy metals and may find its way into the underground water, rendering it unfit for drinking. In view of this the heavy Metals like copper (Cu), cadmium(Cd), lead(Pb), zinc(Zn), iron(Fe) and chromium(Cr) were analyzed in all the ground water samples. No metals were detected during the study.

3.2 Udaipur

Surrounded by Aravali Ranges, forests and lakes this is also known as the 'city of lakes'. Udaipur comes under class I cities of Rajasthan and having a population of 4,78,860 as in year 2008. The total water supply in the city is around 95 MLD covering 100 % populations leading to generation of



76, MLD sewage. The Udaipur is located in the Arid Zone of India at altitude of 577m. It has characterized by high temperature and low rainfall. In winter temperature varies between 11.6 degree C to 28.3 degree C and in summer 28.8 – 38.3 degree C. The normal rainfall of Ajmer is 610 mm.

In Udaipur ground water samples were collected from six locations including Bichidi village. The pH value of the ground water was in the range of 7.1 to 7.8. Water samples had wide range of conductivity, from 712 μS to 4130 $\mu\text{S}/\text{cm}$, which may be due to high concentration of chloride and dissolved solids.

The hardness of water in Sisrama, Sukher and Bichdi areas was found above the desirable limit and varied from minimum 154 to maximum 430 mg/L. Ground water quality was not found fit for drinking in terms of TDS concentration, which had exceeded the desirable limit in three areas and permissible limit in three areas. The TDS concentration was found varying between 950 to 3829 mg/L. The Chlorides in water samples varied from 108 to 1056 mg/L exceeding permissible limit for drinking water.

The heavy metals like copper (Cu), cadmium(Cd), lead(Pb), zinc(Zn), iron(Fe) and chromium(Cr) were analyzed in all the ground water samples. The iron concentration in Sisrama and Sukher area was found exceeding the permissible limit of 1.0 mg/L. Other metals were not detected in ground water of Udaipur city except Fe and Zn.

The ground water quality of Bichidi village was found contaminated in terms of Hardness, TDS, Chloride, Sulphate and Zinc. The concentrations of all parameters were exceeding the permissible norms for drinking water.

3.3 Pali

Today's Pali is well known for severe water pollution created by cluster of small scale dyeing and printing textile industries. There are four common effluent treatment plants of total 34.68 MLD capacity provided for treatment of effluent generated in this area. Pali is one of the class I cities of Rajasthan and the population of Pali as in 2008 is 2,30,710. Total water supply in Pali area is 45.56 MLD and sewage generation 36.45 MLD. The treated and untreated effluents of these industries as well as sewage are discharged into River Bandi, deteriorating quality of River up to 40 kms downstream. Percolation of waste water has also contaminated the ground water of the area.

In Pali city the ground water samples were collected from seven locations covering residential and industrial area. The pH value of the ground water was in the range of 7.3 to 7.9. Water samples had wide range of conductivity, from

1,360 to 12,400 $\mu\text{S}/\text{cm}$, which may be due to high concentration of ionic content. The hardness of water varied from minimum 200 to 2250 mg/L and was above the permissible limit in Lohriya, Rajendra Nagar, Mandia Road and Umaid Mill area. The TDS concentration in ground water could not be analyzed but values of total solids indicate that TDS concentration will be above the desirable limit. The Chlorides in water samples varied from 182 to 2,600 mg/L and sulphates 86 to 980 mg/L, exceeding the permissible limits for drinking water in four areas i.e. Mandia road, Bhageshwar road, CETP area and Umaid mill road.

The heavy Metals like copper (Cu), cadmium (Cd), lead (Pb), zinc (Zn), iron (Fe) and chromium (Cr) were analyzed in all the ground water samples. The concentration of the metals was found either in limit or below detection limit.

3.4 Jaipur

Jaipur is a bustling capital city and a business centre with all the trappings of a modern metropolis. The population of Jaipur is 28,58,910 in 2008 excluding floating population visiting the city as tourists. The total water supply is around 565 MLD leading to generation of sewage 452 MLD. The treated and untreated sewage is discharged on land. There are two municipal solid waste disposal sites and one water sample was also collected near the disposal site.

The Jaipur is located in the semi-Arid Zone of India. It has characterized by high temperature, low rainfall and mild winter. The mean temperature of Jaipur is 36 °C varying from 18 °C in winter (January) to 40 °C in summer (June). Thus the January and June are the coldest and hottest months. The normal rainfall of Jaipur is 600 mm; nearly 90 percent of which takes place in the summer monsoon period i.e. from June to September, the rest comes from the winter cyclones.

In Jaipur city, ground water samples were collected from six locations covering residential, industrial and MSW dump site areas. The pH value of the ground water was in the range of 7.9 to 8.6. and conductivity varied from 825

to 2390 $\mu\text{S}/\text{cm}$. The hardness of water varied from minimum 240 to 388 mg/L and was above the permissible limit in all areas except Durgapur. The TDS concentration in ground water from 464 to 1162 mg/L is also above the desirable limit, may be due to high concentration of chlorides varying from 57 to 495 mg/L. The high concentration of hardness, TDS and chloride in ground water of both municipal dump sites i.e. Chanpura and Mathuradaspura indicates the percolation of inorganic lechate in ground water.

The heavy metals like copper (Cu), cadmium (Cd), lead (Pb), zinc (Zn), iron (Fe) and chromium (Cr) were analyzed in all the ground water samples. The concentrations of all metals were found below the detection limit.

3.5 Bhiwadi

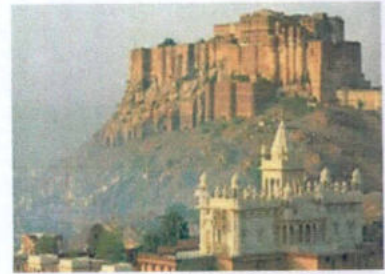
The Bhiwadi town is located at border of Rajasthan and Haryana and growing very fast due to large industrialization. RILCO has developed 06 industrial areas in Bhiwadi and getting maximum entrepreneurship from Delhi. The town has one CETP and a MSW dump site.

In Bhiwadi town ground water samples were collected from three locations covering residential, industrial and MSW dump area. The pH value of the ground water was in the range of 7.3 to 8.0, whereas conductivity varied from 3960 to 6870 $\mu\text{S}/\text{cm}$. The hardness of water varied from minimum 1064 to 1720 mg/L and was above the permissible limit in all areas. The TDS concentration in ground water ranged from 1859 to 3162 mg/L above the desirable limit for ground water, may be due to high concentration of chlorides varying form 544 to 672 mg/L. The sulphate concentrations in all samples were 316 to 562 mg/L, due to percolation of inorganic element in ground water.

The heavy metals like copper (Cu), cadmium (Cd), lead (Pb), zinc (Zn), iron (Fe) and chromium (Cr) were analyzed in all the ground water samples. The concentrations of all metals were found the below detection limits.

3.6 Jodhpur

This bustling desert city is the second largest in Rajasthan after Jaipur. The city has a population of 10,41,080 (2008) excluding approximately 10 percent floating population visiting the city as tourists. The district experiences arid to semi-arid type of climate. Mean annual rainfall (1971-2005) of the district is 326.8 mm whereas normal rainfall (1901-1970) is lower than average rainfall and placed at 296.1 mm. As the district lies in the desert area, extreme heat in summer and cold in winter is the characteristic of the desert. Atmosphere is generally dry except during the monsoon period. The humidity is highest in August with mean daily relative humidity is 81%.



The total water supply in city is 206 MLD excluding unorganized ground water extraction and sewage generation is 165 MLD. The city has one operational STP and another is under construction. The MSW and CBWTF sites of Jodhpur are at Village Kairu approximately 12 Km from city. Jodhpur has 15 industrial areas with Steel and textile as major categories of industries. One CETP, with treatment facility for both steel and textile units, has been established in July 2004 and discharges treated and untreated effluents to River Jojari.

The ground water samples were collected from five locations covering residential, industrial and MSW dump area. The pH value of the ground water was in the range of 7.0 to 7.8, and conductivity, from 780 to 2304 $\mu\text{S}/\text{cm}$. The hardness of water varied from minimum 54 to 462 mg/L and was above the permissible limit in Basni Industrial Area and Pall road industrial area. The TDS concentration in ground water was found from 794 to 3060 mg/L, above the desirable limit. The concentration of chloride was found varying form 90 to 380 mg/L.

The heavy metals like copper (Cu), cadmium (Cd), lead (Pb), zinc (Zn), iron (Fe) and chromium (Cr) were analyzed in all the ground water samples. The concentrations of all metals were either within limit or below detection limit.

3.7 Balotra – Jasol- Bithuja

Balotra town which comes under Barmer district is having population 70,370 as in 2008 and total water supply 5.8 MLD. The 4.64 MLD sewage generated is discharged in River Luni. Balotra is very dense industrial area having more than 1000 printing and dyeing industries using ground water in the process and generating around 90 MLD of wastewater against treatment capacity of only 50.5 MLD. The partially treated and untreated wastewater is discharged into River Luni. River Luni originates from district Ajmer and reaches Balotra via Pipar and Samdhadi. In Balotra area it receives final discharge of Bithuja CETP, untreated effluent of industries in Bithuja and passes under the bridge of Balotra- Jasol road. After receiving sewage of Balotra, River gets divided into two streams. The left stream receives waste of Jasol CETP and right stream receives waste of Balotra CETP mixed with untreated effluent of Balotra.



The ground water samples were collected in Balotra, Bithuja and Jasol as ground water quality in the area is reported contaminated. The pH value of the ground water was in the range of 7.3 to 8.0. The hardness, TDS and chloride concentration of ground water were found exceeding permissible limit by several times. The concentration of fluoride in ground water of Jasol area was 1.6 mg/L which is exceeded the prescribed of 1.0 mg/L. It is revealed from data that concentration of TDS, and Chloride are exceeding the permissible limit for drinking water. In true terms ground water of the area is not fit for drinking. Residents of area are bothered to purchase drinking water supplied by tankers. Continuous percolation of high TDS water through river bed may be increasing TDS of ground water to many folds.

The heavy metals like copper (Cu), cadmium (Cd), lead (Pb), zinc (Zn), iron (Fe) and chromium (Cr) were analyzed in all the ground water samples. The concentrations of all metals were either within limit or below detection limit.

4.0 CONCLUSION

The objective of this study was to evaluate the ground water quality status around the pollution sensitive sites in the selected cities of Rajasthan. The physico-chemical parameters and heavy metals in ground water samples of Ajmer, Udaipur, Pali, Jaipur, Bhiwadi, Jodhpur and Barmer area of Rajasthan have been studied during 2009-10. The TDS concentrations in all samples were found exceeding the permissible limit of drinking water. In case of hardness 43% samples were within limit, 34% exceeding the desired limit but below permissible limit and 23% were exceeding the permissible limit. The chloride concentration was found within limits in 40% of samples, exceeding desirable norms in 40% and exceeding permissible limits in 20% of samples. Likewise sulphate concentration was found well within limit in 75% of samples, exceeding desirable limit in 11% and exceeding permissible limit in 14% of samples. In all 35 samples collected from different cities of Rajasthan only 02 samples of Jawadiya village, district Pali and Durgapur, district Jaipur are meeting, all norms of IS:10500 for drinking water. In total ground water of 33 areas is not fit for drinking as per IS:10500.

The most contaminated water is in village Bichdi of Udaipur, Balotra, Bithuja and Jasol of district Barmer. These areas require attention to review the ongoing problem of drinking water and to provide an alternate source for it.

5.0 RECOMMENDATIONS

1. Heavy Ground water withdrawal from areas of Balotra, Jasol and Bithuja for industrial use has to be controlled by preventing further industrialization. Awareness program to educate about conservation of precious ground water resources and training on rainwater harvesting will be beneficial to check decline in water level and justified use. Modern agricultural

management techniques have to be adopted for effective and optimum utilization of the water resources.

2. High water requirement crops to be discouraged. Proper agriculture extension services should be provided to the farmers so that they can adopt low water requirement economical crops.
3. Traditional rainwater harvesting structures like Tankas, roof top rain water storage should be encouraged for day to day requirements which will reduce ground water draft.
4. Industrial effluent should be treated to comply river water quality standard before being discharged in to Luni River through an effluent treatment plant and to be recycled for industrial use.
5. Small check dams or earthen dams, at suitable sites, may be constructed to store rainwater. This will increase recharge to ground water which ultimately result in increase of yield of wells.
6. Central Ground Water Board may be advised to restrict giving permission for with drawl of ground water.
7. Measures are required to be adopted to tackle the rising water level problem observed in the Jodhpur city during last few years.

Table: 01 Location and detail of Ground Water sampling points

S No	Location	Use of water	Depth of source	Category of area
AJMER				
01	MSW Site	Drinking & irrigation	Open Well – 60ft	Well of Nangar Singh at Makhapura
02	CBWTF Site	Industrial	Bore well – 150 ft	Ajmer Jaipur by pass road near RIICO Industrial area
03	JananaHospital	Domestic	HP-120 ft	Hospital area
04	Vishramsthal	Drinking	HP-80 ft	Near Anna sagar Lake
05	Rambagh Police Station	Drinking	HP- 100 ft	Residential Area
UDAIPUR				
06	MSW Site	Irrigation & Drinking	Bore well – 600 ft	Hiruthalai area village Balidna
07	Nagar Nigam	Domestic and drinking	HP-90 ft	Municipal commercial area
08	Govt School, Sisrama	Domestic and drinking	HP- 60 ft	Govt. primary School residential area
09	Govt School, Sukher	Domestic and drinking	HP-60 ft	Govt. Secondary School in industrial area
10	Sukha Naka	Domestic and drinking	HP-60 ft	U/s of Udai Sagar Lake
11	Bichidi Village	Domestic and drinking	HP- 70 ft	Near boundary of Jarofix pond (HZL)
PALI				
12	Jawadiya Village	Drinking	HP- 200 ft	Village near CETP
13	CETP – IV	Drinking and Industrial	HP- 70 ft	Inside the new CETP
14	LIC Office, Mandia Road	Drinking	HP- 200 ft	Commercial area
15	Lohriya Tank	Drinking	Tube well – 100 ft	Residential
16	Rajendra Nagar, Bhageshwar Road	Drinking		Residential
17	Lodha Fabric, Mandia Road	Industrial	HP- 150 ft	Dying and printing industry
18	Umaid Mill	Industrial	Bore well – 105 ft	The biggest industry of the area
JAIPUR				
19	Kunda Basti	Drinking	HP-200ft	Residential area
20	Durgapura	Drinking	HP- 300 ft	Residential
21	Sanganer	Industrial	HP- 250 ft	Industrial area
22	RIICO Jaipur	Industrial	HP- 300 ft	Industrial area
23	Chanpura	Residential	Bore well -180 ft	MSW dump site
24	Mothura Daspur	Residential	Bore well – 200ft	MSW dump site

BHIWADI				
25	Sheetal Village, Bhiwadi	Not fit for use	HP-100 ft	Local residential area named as Sheetal
26	RIICO Bhiwadi		Bore well - 150 ft	Industrial
27	MSW site	Drinking	Bore well - 300 ft	MSW dump site
JODHPUR				
28	Basni industrial area	Industrial use	Bore well - 350 ft	Industrial area
29	Pall road	Domestic and drinking	Bore well- 200 ft	Residential area
30	MSW site	Irrigation	HP- 90 ft	MSW site and CBWTF site
31	Arun hotel	Domestic and drinking	HP- 70 ft	Near Railway Station PWD hand pump
32	Salawas Village	Domestic and drinking	HP- 80 ft	PWD hand pump in village area
33	Near CETP Jasol	Industrial	Bore well -150 fi	In side the CETP
34	Near CETP Bithuja	Industrial	Bore well-90 ft	From industry near CETP
35	Near CETP Balotra	Industrial	Bore well - 250 ft	In side the CETP

Table 02: Analysis results of ground water for Heavy Metal

S No	Location	Zn	Pb	Cr	Cd	Cu	Fe
AJMER							
01	MSW Site	BDL	ND	ND	ND	ND	BDL
02	CBWTF Site	BDL	ND	ND	ND	ND	BDL
03	JananaHospital	BDL	ND	ND	ND	ND	BDL
04	Vishramsthal	BDL	ND	ND	ND	ND	BDL
05	Rambagh Police Station	BDL	ND	ND	ND	ND	BDL
UDAIPUR							
06	MSW Site	BDL	ND	ND	ND	ND	BDL
07	Nagar Nigam	0.546	ND	ND	ND	ND	BDL
08	Govt School, Sisrama	1.648	ND	ND	ND	ND	6.03
09	Govt School, Sukher	0.664	BDL	ND	ND	BDL	20.32
10	Sukha Naka	0.965	BDL	BDL	ND	ND	BDL
11	Bichidi Village	15.25	BDL	ND	ND	ND	BDL
PALI							
12	Jawadiya Village	0.064	BDL	BDL	BDL	BDL	BDL
13	CETP – IV	0.067	BDL	BDL	BDL	BDL	BDL
14	LIC Office, Mandia Road	0.318	BDL	BDL	BDL	BDL	1.14
15	Lohriya Tank	0.029	BDL	BDL	BDL	BDL	BDL
16	Rajendra Nagar,	0.382	BDL	BDL	BDL	BDL	2.516
17	Lodha Fabric, Mandia Road	0.029	BDL	BDL	BDL	BDL	BDL
18	Umed Mill	0.035	BDL	BDL	BDL	BDL	BDL
JAIPUR							
19	Kunda Basti	0.027	0.027	BDL	BDL	BDL	BDL
20	Durgapura	0.031	0.031	BDL	BDL	BDL	BDL
21	Sanganer	0.081	0.081	BDL	BDL	BDL	BDL
22	RIICO Jaipur	0.072	0.072	BDL	BDL	BDL	BDL
23	Chanpura	0.023	0.023	BDL	BDL	BDL	BDL
24	Mothura Daspur	0.015	0.015	BDL	BDL	BDL	BDL
BHIWADI							
25	Sheetal Village, Bhiwadi	0.15	BDL	BDL	BDL	BDL	BDL
26	RIICO Bhiwadi	0.37	BDL	BDL	BDL	BDL	BDL
27	MSW site	0.69	BDL	BDL	BDL	BDL	BDL
JODHPUR							
28	Basni industrial area	0.076	BDL	BDL	BDL	BDL	BDL
29	Pall road	0.097	BDL	BDL	BDL	BDL	BDL
30	MSW site	0.148	BDL	BDL	BDL	BDL	BDL
31	Arun hotel	0.334	BDL	BDL	BDL	BDL	BDL
32	Salawas Village	0.133	BDL	BDL	BDL	BDL	BDL
33	Near CETP Jasol	0.098	BDL	BDL	BDL	BDL	BDL
34	Near CETP Bithuja	0.062	BDL	BDL	BDL	BDL	BDL
35	Near CETP Balotra	0.057	BDL	BDL	BDL	BDL	BDL
BDL value		0.010	0.324	1.5	0.009	0.161	0.962
Drinking Water Standard as per IS:10500							
Desirable Limits		5.0	0.01	0.01	0.01	0.05	0.30
Remarks: May be extended up to		10.0	NR	NR	NR	1.5	1.0

Table 03: Analysis results of ground water for general parameters

S No	Location	pH	Cond	Hard	TS	TDS	Cl	SO ₄	PO ₄	NO ₃	F	Na	K	COD
AJMER														
01	MSW Site	7.33	991	160	1422	1390	156	08.33	0.81	2.07	0.11	80.4	7.6	06
02	CBWTF Site	7.01	1380	211	1652	1589	270	25.20	1.32	0.61	BDL	215.0	11.9	08
03	JananaHospital	8.03	1820	248	2332	2276	223	67.20	2.11	6.62	0.18	384.0	22.0	12
04	Vishramsthal	7.73	1940	236	2174	2123	255	71.50	2.15	2.81	0.17	372.0	19.1	12
05	Rambagh Police Station	7.51	580	110	1110	1083	52	03.00	BDL	0.42	BDL	33.0	4.4	04
UDAIPUR														
06	MSW Site	7.20	712	154	964	950	108	7.11	0.04	0.54	BDL	86	5.9	04
07	Nagar Nigam	7.62	1120	274	1292	1261	270	27.00	0.90	1.95	0.10	51	4.6	06
08	Govt School, Sisrama	7.11	2140	372	2454	2369	374	120.00	2.49	5.20	0.21	116	9.6	10
09	Govt School, Sukher	7.39	2270	356	2504	2476	472	147.00	2.87	5.72	0.23	151	12.1	12
10	Sukha Naka	7.19	1910	230	1874	1823	429	136.00	1.96	4.37	0.13	234	18.9	10
11	Bichidi Village	7.86	4130	430	3876	3829	1056	311.00	4.23	14.55	0.32	701	26.2	16
PALI														
12	Jawadiya Village	7.56	1360	300	308	NA	190	86.78	0.10	0.35	NA	NA	05	20
13	CETP - IV	7.66	8840	200	5560	NA	1590	980.80	BDL	0.48	NA	NA	17	24
14	LIC Office, Mandia Road	7.98	4060	275	1952	NA	665	277.90	0.04	2.67	NA	NA	08	28
15	Lohriya Tank	7.87	1390	360	740	NA	182	124.70	0.12	0.26	NA	NA	05	08
16	Rajendra Nagar, Bhageshwar Road	7.47	5930	400	3232	NA	910	784.80	BDL	2.94	NA	NA	23	32
17	Lodha Fabric, Mandia Road	7.37	12400	825	7176	NA	2250	603.80	BDL	0.59	NA	NA	27	96
18	Umed Mill	7.88	9650	2250	6272	NA	2600	569.90	BDL	2.76	NA	NA	20	36

S No	Location	pH	Cond	Hard	TS	TDS	Cl	SO ₄	PO ₄	NO ₃	F	Na	K	COD
JAIPUR														
19	Kunda Basti	7.93	1580	415	913	905	136	46.4	0.02	4.25	BDL	62.0	3.2	2.4
20	Durgapura	8.62	825	240	471	464	57	7.9	0.02	3.19	BDL	116.8	3.1	2.4
21	Sanganer	8.04	1650	380	828	820	216	52.2	BDL	1.51	BDL	109.0	2.6	3.6
22	RILCO Jaipur	8.48	1220	350	604	598	120	13.5	0.20	2.45	BDL	104.0	2.5	4.1
23	Chanpura	7.94	2390	308	957	950	495	186.7	BDL	0.32	BDL	310.0	3.2	4.0
24	Mothura Daspur	7.95	2360	388	1168	1162	377	110.4	0.06	0.54	BDL	284.0	2.3	4.0
S No	Location	pH	Cond	Hard	TS	TDS	Cl	SO ₄	PO ₄	NO ₃	F	Na	K	COD
BHIWADI														
25	Bhiwadi Village	7.34	4440	1280	2188	2182	593	320.9	0.110	1.12	BDL	93.2	3.0	3.60
26	RILCO Bhiwadi	7.80	3960	1064	1864	1859	544	316.0	0.006	1.11	BDL	80.4	2.5	4.11
27	MSW site	8.04	6870	1720	3167	3162	672	562.8	0.040	2.42	BDL	100.4	2.5	3.98
JODHPUR														
28	Basni industrial area	7.72	2103	396	2993	2979	310	26.1	1.21	0.85	0.65	735	12.1	12
29	Pall road	7.09	2304	462	3072	3060	380	32.2	0.89	1.23	0.51	292	4.8	06
30	MSW site	7.61	1040	54	932	924	130	14.1	0.51	0.54	0.22	52	5.6	08
31	Arun hotel	7.53	780	104	804	794	90	9.5	0.31	0.22	0.15	34	4.5	08
32	Salawas Village	7.89	1203	118	1076	1062	135	12.6	0.91	1.26	0.86	71	5.8	10
BARMER														
33	Near CETP Jasol	7.36	--	3284	35814	35802	10800	--	2.51	18.5	1.26	9700	34.2	20
34	Near CETP Bithuja	7.61	--	768	13228	13218	4320	--	4.68	11.6	0.84	2720	12.1	12
35	Near CETP Balotra	8.06	--	2256	32532	32510	9300	--	5.62	19.6	0.75	9030	35.5	16
As	per	6.5-	--	300	--	500	250	200	--	45	1.0	--	--	--
IS:10500(Desirable)		8.5	--	600	--	2000	1000	400	--	100	1.5	--	--	--
Permissible limit		NR	--	600	--	2000	1000	400	--	100	1.5	--	--	--