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ASSESSMENT OF GROUNDWATER QUALITY FOR DRINKING PURPOSE IN HYDERABAD AND NACHARAM INDUSTRIAL DEVELOPMENT AREAS

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Abstract

Drinking water is the one of the most important parameters in the daily life. The ground water resources are decrease in day to day because of population and industrial development. In the Hyderabad city flood are frequently happening Because of the developments, hence the drainage water mixed along with flood water then infiltrate in to the ground so that ground water will be polluted. In this paper study is focussed on Assessment of Groundwater Quality in the Hyderabad City and Nachram industrial area. In this study GIS and WQI method had been applied to visualize the spatial pattern of the groundwater quality status in the study area. A total of 62 bore well samples are collected in study area and physicochemical analysis was performed for 14 parameters such as Colour, pH, Conductivity, Turbidity, Total dissolved solids, Total hardness, Alkalinity, Dissolved oxygen, Chlorides, Phosphates, Nitrates, Sulphates, Fluorides and Lead. The analysed physicochemical parameters were compared with the BIS limits, From the results it is concluded that selected parameters are not within the permissible limits of drinking water

I. Introduction

Groundwater is a vital natural resource that serves as the primary source of drinking water for millions of people worldwide. However, groundwater pollution has become a growing concern due to the increasing use of chemicals and contaminants in industrial, agricultural, and domestic activities. Groundwater pollution occurs when contaminants and pollutants, such as chemicals, pesticides, heavy metals, and sewage, enter the groundwater system and contaminate the water supply. This pollution can have severe consequences for public health, ecosystem health, and economic activity. The effects of groundwater pollution can be long-lasting and difficult to reverse, making it essential to understand the causes, effects, and prevention of groundwater pollution. In this context, it is important to raise awareness of the issue and take measures to prevent and mitigate groundwater pollution.

Groundwater is an essential and vital component of our life support system, and it can be optimally used and sustained only when the quantity and quality is properly analyzed. Groundwater used for various purposes like for Drinking, (SwarnaLatha, et al, 2010) Agriculture, industrial and geothermal generation many more. And Changes in local topography and drainage system directly affect both quality and quantity of the ground water. Pollutants are being added to the groundwater system through human activities and natural processes, such as Solid waste from industrial units is being dumped near the factories, and is subjected to reaction with percolating rainwater and reaches the groundwater level. Due to which water gets contaminated. Contamination of ground water by human activities and natural processes. Groundwater pollution most often results from improper disposal of wastes on land. Major sources include industrial and household chemicals and garbage landfills, excessive fertilizers and pesticides used in agriculture, industrial waste lagoons, tailings and process wastewater from mines, industrial fracking, oil field brine pits, leaking underground oil storage tanks and pipelines, sewage sludge and septic systems. The water used for drinking purpose should be free from any toxic elements, living and nonliving organism and excessive amount of minerals that may be hazardous to health. Therefore, preventing the ground water from contamination is essential to the management of ground water resources.

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Geographical Information System (GIS) has the ability to store, arrange, retrieve, classify, manipulate, analyze and present huge spatial data and information in a simple manner.
GIS is used as a tool to assess the groundwater quality by means of water quality parameters overlay analysis. The objective of the research is to explore the groundwater quality through Water quality analysis, Water Quality Index (WQI) and spatial data analysis. The study will also evaluate the geostatistical methods to interpolate the groundwater Quality Index. In this study the geostatistical analyst of GIS is used for data investigation. And groundwater Quality Index map is used to visualize and understand the relationship among the measured points and areal extent of Ground water contamination in the study area. Study Area Description
The present study area considered as overall Hyderabad city Especially Nacharam and Mallapur Industrial Areas located in Medchal Malkajgiri district of the state Telangana in India. Study area is situated at 17°25′24.34"N latitude and 78°32‘47.18" E longitude and at the mean sea level of 494 meters. It covers an area of 921 acres. Average annual rainfall is about 763.2cm and Annual average temperature of 26.7 °C (degrees Celsius) . The study area is identified as a multi Industrial cluster.

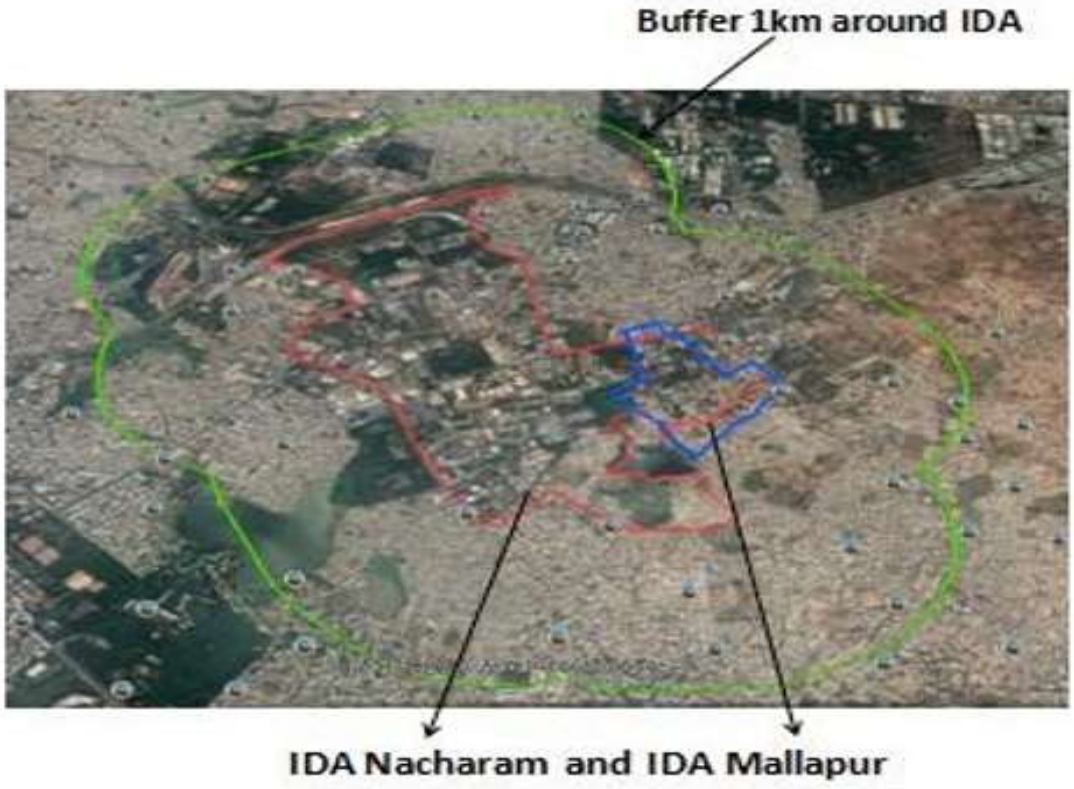

Fig 1.3 Shows Study Area Map.

II. Statement of the problem

The study area overall Hyderabad city especially Nacharam and Mallapur Industrial Area is surrounded by small scale industries working on fabrication; clothing exports, tyres, rubber material, and furniture. It is famous for its shoe factories. The industrial area comprises of various types of industries like pharmaceutical industries, food industries, electronic workshops, chemical and plastic industries etc. Over 10,000 people live within a 2-3 km radius of the IDAs (Jena Vinod, et al, 2013). The most affected are residents of Vasavi nagar coloney, Mallaiah Colony, Jyothi Nagar Colony, Gayathri Hills and Tirmala Meadows Colony. Residents of Nacharam, Mallapur industrial development areas have raised an alarm over foul smell and ground water pollution emanating from adjoining industries, which they claim has exacerbated during monsoon. Residents complained of health issues such as asthma and bronchitis.

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The minimum bore depth in the study area is 100ft and the maximum bore depth is about 500 ft. The scary reality that turbidity of water ranges from reddish brown to yellowish. In addition to these industrial effluents from IDA Nacharam and Mallapur contain appreciable amounts of inorganic and organic chemicals as their by-products also contaminating groundwater in study Area. Drinking water is a major problem in study area. It is supplied on alternate days or once in three days. Even the quantity of water supplied is meagre. As a result, people living in nearby colonies in the area are worst-hit with the problem of unsafe ground water. Many of the residents near industrial development areas have raised issues related to water quality. Majority of people in Study Area are dependent and using groundwater for drinking and domestic purpose. The problem of ground water pollution in several parts of study area has become so acute that unless urgent steps for water quality assessment are taken, ground water resources may be damaged and human health get affected. Hence regular water quality assessment is Necessary.

Table 1 : About Parameters and its sources

S.No	Parameters	Sources	Potential health affects
1.	Colour	Dissolved salts	Consumer acceptance decreases
2.	pH	Due to different dissolve gases and solid	Bitter taste, corrosion, affect mucus membrane
3.	EC	Due to different dissolved salts	Increases corrosive nature of water
4.	Turbidity	Soil runoff	High level causing bacteria
5.	TDS	From the presence of all dissolved salts	Undesirable taste, corrosion
6.	Hardness	Ca/Mg salts	Throat infections
7.	Alkalinity	Rocks	Agitate the body normal ph
8.	DO	Water plants	Harmful to aquatic life
9.	Chlorides	Dry cleaners	Nose and throat infections
10.	Phosphate	Waste water from detergent effluents	Stimulate microbial growth
11.	Nitrate	Runoff	Blue baby syndrome
12.	Fluoride	Presence of mineral salts	Dental and skeletal flourish
13.	Sulphate	Due to dissolved Ca/ Mg sulphate	Taste affect
14.	Lead	Metal pipes	Breathing problems

III. Data And Methodology

The following Methodology steps are adopted to achieve the objectives of the study.

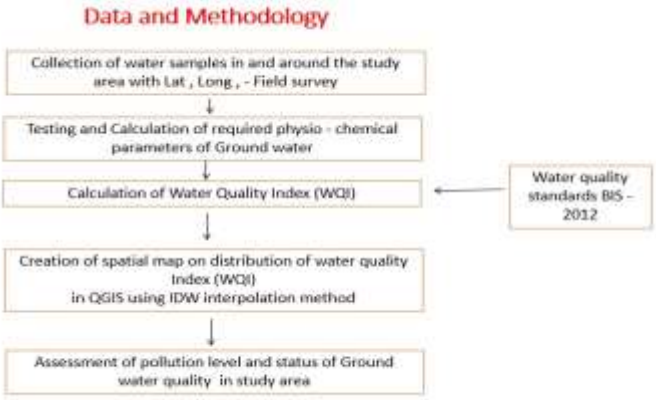

Fig.4.1: Methodology flow chart

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IV. Calculation of Water Quality Index (WQI)

WQI provides information about water quality in a single value. WQI is commonly used for the detection and evaluation of water pollution and may be defined as a reflection of composite influence of different quality parameters on the overall quality of water. The Water Quality Index was calculated for parameters namely: Colour, pH, Conductivity, Turbidity, Total dissolved solids, Total hardness, Alkalinity, Dissolved oxygen, Chlorides, Phosphates, Nitrates, Sulfates, Fluorides and Lead

WQI Calculation:

Calculation of WQI was carried out in this work by Horton's method. The WQI is calculated by using the following expression

WQI = Σ qn Wn / Σ Wn

Where qn = Quality rating of nth water quality parameter

Wn= Unit weight of nth water quality parameter

Quality rating (qn)

The quality rating is calculated using the expression given by

qn = (Vn-Vio)/ (Sn-Vio)

Where Vn= estimated chemical value of sample

Vio= ideal value (for pH it is zero and for DO it is 14.6) Sn = desirable limit as given in standards

Unit Weight (Wi)

- In the first step weights should be assigned from 1-5 to the selected water parameters (pH, turbidity, hardness, conductivity, DO, nitrates etc…), according to their relative significance in the overall quality of water for the drinking purposes.
- In the next step calculate the relative weight (Wi) for each chemical parameter using the below equation

Wi = wi / Σwi

Where Wi is relative weight of parameter

V. Results & Discussion

Physicochemical Analysis of Groundwater Samples

The collected 45 water samples of the study area Nacharam and Mallapur Industrial Development Areas were analyzed in laboratory for 14 water quality parameters such as: Colour, pH, Conductivity, Turbidity, Total dissolved solids, Total hardness, Alkalinity, Dissolved oxygen, Chlorides, Phosphates, Nitrates, Sulfates, Fluorides and Lead using various specific analytical instruments and standard procedures. The results are shown in Table 2&3(Suresh Konkey et al, 2014). According to BIS 10500 (2012), the desirable limit for drinking water has been explained as acceptable limit and permissible limit as a limit in the absence of alternate source the mean values and standard deviations were studied and shown in Table 4 provides the results of 45 samples using the above-mentioned parameters.

Table: 2: Physicochemical analysis results of selected ground water samples in Hyderabad city Areas

S NO	Colour	PH	EC	Turbidity	TDS	Total Hardness	Alkalinity	DO	Chlorides	Phosphates	Nitrates	Fluorides	Sulfates	Lead
1	56	7.7	809	1.3	485.4	890	200	5.8	225	0.8	3	0.28	50	1.10
2	83	7.5	658	3.9	412.8	860	220	6	250.23	6.6	13	1.1	116	0.50
3	150	8.3	870	3.8	407	820	230	6.5	300.08	0.52	30	1.2	80	0.30
4	290	7.57	845	3.5	507	920	250	6.5	255	4.1	10	0.93	52	1.10
5	71	8.25	892	3.7	535.2	1100	260	5.7	275.19	12	150	0.88	97	0.30
6	89	8.12	841	3.6	504	980	180	6	230.7	0.6	40	1.03	86	0.10

7	66	8.45	946	3.4	567.5	1060	320	6.5	300	4.1	260	0.86	150	0.00
8	215	8.92	506	4.3	303.6	1326	130	9.4	175.19	2.2	9	1.30	113	0.4
9	55	7.95	852	3.7	511.2	1200	310	8	250.25	8.4	30	0.86	170	0.3
10	81	8.46	680	3.8	408	1000	340	6.5	225.24	0.6	60	1.17	20	0.1
11	34	7.90	194	3.9	411	700	200	5	300	0.4	9	1.3	69	0.2
12	133	8.35	985	3.8	404.4	860	290	4.7	200	9.9	190	0.66	150	0.3
13	43	8.10	522	3.8	411	680	330	8	257.65	8.6	6	1.09	92	0.7
14	14	7.62	494	3.7	404.4	900	400	5	250.15	2.7	12	0.3	54	0.00
15	64	8.25	935	3.6	513	832	200	4.6	200.15	2.6	40	1.48	80	0.6
16	53	8.25	935	3.6	296.4	410	280	6.5	275.30	12	27	0.95	42	0.5
17	67	8.10	950	3.8	591	632	270	6.7	249.92	2.4	11	0.86	87	0.00

Table: 3: Physicochemical analysis results of selected ground water samples in Nacharam and Mallapur Industrial Development Areas

S NO	Colour	PH	EC	Turbidity	TDS	Total Hardness	Alkalinity	DO	Chlorides	Phosphates
1	56	6.19	4040	3.8	2180	938	200	8.20	967.2	0.3
2	83	6.24	1419	5.3	734	916	220	8.10	277.41	9.9
3	150	6.41	3130	5.2	1690	1672	650	5.60	774.75	0.08
4	290	5.61	7990	91	5000	5164	130	2.30	1382.07	1.6
5	71	7.02	458	4.9	267	416	180	7.80	59.981	9.9
6	89	6.44	2140	5.3	1090	1508	250	2.50	322.4	0.4
7	66	6.48	2090	3.9	1140	1760	210	2.70	302.406	0.52
8	215	7.44	2040	49.9	1120	772	340	8.10	267.41	34.5
9	55	6.44	2660	3.2	1450	1936	380	7.50	422.37	10.1
10	81	6.86	2440	3.3	1360	1324	220	7.70	399.876	0.03
11	34	6.48	2510	3.2	1300	1420	300	8.00	349.892	0.52
12	133	6.57	890	5.8	505	500	160	6.90	124.96	0.7
13	43	6.44	2090	4	1110	1060	330	5.70	282.41	12
14	14	6.44	2490	3.2	1280	1408	420	7.50	474.85	6.4
15	64	6.52	2080	3.8	1110	1480	250	2.70	357.38	0.6
16	53	6.39	1932	3	1050	2412	260	4.50	487.34	12.2
17	67	6.49	1938	3.7	1021	904	200	6.50	249.92	8.4
18	165	6.41	2220	3.3	1140	1384	400	3.30	354.88	6.5
19	112	6.16	3000	3.4	1710	2296	310	7.30	299.9	4.1
20	95	6.24	4210	3.9	2340	3564	300	2.50	537.3	1.4
21	63	6.5	2600	3.5	1530	2016	280	2.70	504.84	1.8
22	64	6.55	1354	3.7	775	1056	200	3.90	172.446	2.2
23	62	6.4	1482	3.8	807	1076	450	7.70	149.95	7.3
24	76	7.71	2270	7.1	1230	552	330	3.10	649.79	4.2
25	95	6.35	1444	3.1	789	1084	6020	5.40	147.45	0.12
26	60	6.29	1484	5.3	804	1292	560	2.50	112.46	0.76
27	54	6.82	1329	2.6	741	728	370	2.50	150	0.4
28	65	6.76	1511	3.3	806	1248	320	6.40	172.44	0.08
29	45	6.31	1582	4.3	814	784	550	6.80	307.4	2.4

30	83	6.88	3060	3	1480	1236	340	4.90	524.83	6.9
31	58	7.04	557	3.6	311	468	480	3.30	117.46	4.6
32	53	6.67	1404	4.8	787	1244	470	5.80	114.96	2.9
33	127	6.79	1705	3.3	888	956	450	6.80	357.38	20.8
34	59	6.52	1790	4.6	925	1164	340	2.40	182.443	1.8
35	53	6.61	1173	5.9	682	932	290	5.60	149.95	7.1
36	79	6.47	1491	4.9	832	1224	440	2.40	154.95	9
37	89	6.77	1235	5.2	681	984	290	2.80	157.45	8.8
38	74	6.55	1498	3.7	825	720	420	7.10	184.94	4
39	61	6.54	1452	3.4	757	572	290	8.10	487.34	8.3
40	83	6.62	1385	4.5	737	652	330	7.50	202.43	0.8
41	68	6.73	880	3.4	673	632	340	3.30	109.96	4
42	77	6.73	1664	3.8	951	1288	590	3.00	212.34	0.4
43	106	6.37	1994	2.8	1003	1664	290	7.60	262.4	0.5
44	105	6.56	1317	4.5	761	892	250	3.10	147.45	0.9
45	52	6.23	1034	2.9	1150	672	200	3.10	122.16	2.7

Table: 4: Comparative statistical summary of the physicochemical parameters analyzed with BIS - 2012 standards:

S.No	Water Quality parameter	BIS Standards (IS 10500 : 2012) Desirable - Permissible	Study area ranges Min - Max
1	Colour (pt/co)	0 - 5	34 - 215
2	pH	6.5 - 8.5	6.19 - 7.71
3	Conductivity (µs/cm)	700 - 3000	557 - 4210
4	Turbidity (N T U)	ND - 5	2.9 - 49.9
5	TDS (ppm)	500 - 2000	267 - 5000
6	Total Hardness (ppm)	300 - 600	468 - 3564
7	Alkalinity (ppm)	200 - 600	130 - 6020
8	Dissolved Oxygen (ppm)	6 - ND	2.30 - 8.30
9	Chloride (ppm)	250 - 1000	112 - 1384
10	Phosphates (ppm)	0.08 - 0.1	0.3 - 34.5
11	Nitrate (ppm)	45 - No relaxation	3 - 408
12	Fluoride (ppm)	1 - 1.5	0.17 - 1.61
13	Sulphate (ppm)	250 - 400	7 - 384
14	Lead (ppm)	0.01 - ND	0 - 1.40

The analyzed physicochemical parameters were compared with the BIS 10500 limits (2012). The results indicating that all 14 parameters analyzed are not within the permissible limits of drinking water. The Water Quality assessment at all the sampling points in and around Nacharam and Mallapur Industrial Development Areas showed that Ground Water Quality is very poor. This clearly indicates that Ground Water samples for this region are highly polluted. The values of TDS, Total Hardness, Alkalinity, Chlorides, Phosphates, Nitrates, Fluorides, Sulphates, and Lead are very high. This may lead to potential health hazards in and around study area.

Water Quality Index (WQI) calculations:

The standards for drinking purposes as recommended by Bureau of Indian Standards - 2012 have been considered for the calculation of water quality index (Sharma, et. al, 2016). For computing water

quality index, Weight and Relative Weight of each of the Chemical Parameters are given below in table5.

Table: 5: Weight and Relative Weight of each of the Chemical Parameters

S.No	Chemical Parameter	BIS Standards (IS 10500 : 2012) Permissible limits	Weight (wi)	Relative Weight (Wi)
1	Colour(pt/co)	5	2	0.04
2	pH	8.5	5	0.1
3	Conductivity(µs/cm)	3000	3	0.06
4	Turbidity(N T U)	5	2	0.04
5	TDS(ppm)	2000	5	0.1
6	Hardness(ppm)	600	4	0.08
7	Alkalinity(ppm)	600	3	0.06
8	Dissolved Oxygen(ppm)	No Relaxation	5	0.1
9	Chloride(ppm)	1000	4	0.08
10	Phosphates(ppm)	0.1	2	0.04
11	Nitrate(ppm)	No Relaxation	4	0.08
12	Fluoride(ppm)	1.5	4	0.08
13	Sulphate(ppm)	400	3	0.06
14	Lead(ppm)	No Relaxation	4	0.08

The weightages are assigned and quality rating for parameters is calculated by using estimated values of parameters and their permissible limits using Vn and Sn values in table 6,7&8. The same procedure is adopted for all the parameters and WiQi values of all samples are calculated for all parameters. Then the Water Quality Index is calculated using formula mentioned in equation.

Table: 6: Water Quality Index (WQI) and status of water quality of nacharam area

S.No	WQI	Water Quality Status	Possible Usages
1	<50	Excellent	Drinking, Irrigation and Industrial
2	50-100	Good	Domestic, Irrigation and Industrial
3	100-200	Poor	Irrigation
4	200-300	Very poor	Restricted use for irrigation
5	>300	Unfit for drinking	Proper treatment required before use

Table: 7: WQI based classification of Groundwater quality status of Hyderabad Areas

S No	Lat	Long	Location	WQI	Ground Water Quality Status
1	17.37207	78.56876	Nagole	253.486	Very poor
2	17.38529	78.52749	Ramanthapur	481.50	Unfit for drinking
3	17.39992	78.50177	Nalakunta	336.33	Unfit for drinking
4	17.4831	78.44825	Balanagar	354.207	Unfit for drinking
5	17.34642	78.55348	LB Nagar	296.569	Very poor
6	17.3869	78.47938	Koti	203.321	Very poor
7	17.46791	78.48102	Bowenpally	465.121	Unfit for drinking

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8	17.43106	78.5611	Nacharam	390.654	Unfit for drinking
9	17.39112	78.51736	Amberpet	294.147	Very poor
10	17.37259	78.4911	Malakpet	154.149	Poor
11	17.52807	78.26612	Patancheruvu	214.258	Very poor
12	17.51737	78.42135	Chintal	305.159	Unfit for drinking
13	17.40211	78.4933	RTCxRoad	174.357	Poor
14	17.52546	78.6551	Kesara	310.288	Unfit for drinking
15	17.484854	78.39535	Kukatpally	260.133	Very poor
16	17.5013	78.39535	Damaiguda	297.456	Very poor
17	17.3984	78.5583	Uppal	424.852	Unfit for drinking

Table: 8: WQI based classification of Groundwater quality status of Nacharam and Mallapur Industrial Development Areas

S No	Lat	Long	Location	WQI	Ground Water Quality Status
1	17.444282	78.56149	Old meerpet	570.0627	Unfit for drinking
2	17.439428	78.564345	Narsimha nagar	430.23	Unfit for drinking
3	17.431718	78.569699	Nacharam	508.61	Unfit for drinking
4	17.433503	78.572554	Industrial area Mallapur	524.70	Unfit for drinking
5	17.431362	78.574482	Industrial area Mallapur	164.59	Poor
6	17.430434	78.576338	Ambedkar Nagar	260.56	Very poor
7	17.427935	78.574767	Ambedkar Nagar	354.60	Unfit for drinking
8	17.429648	78.572126	Industrial area Mallapur	545.81	Unfit for drinking
9	17.428506	78.568985	Tirumala colony	585.32	Unfit for drinking
10	17.425936	78.569342	Tirumala colony	204.82	Very poor
11	17.423581	78.569985	Hema Nagar	174.74	Poor
12	17.423295	78.573126	Boddupal	218.765	Very poor
13	17.42201	78.573982	Mallaiah Nagar	167.32	Poor
14	17.421439	78.571983	Ambedkar Nagar	386.31	Unfit for drinking
15	17.423795	78.567914	Tirumala Nagar	351.20	Unfit for drinking
16	17.423509	78.564916	Hema nagar	214.58	Very poor
17	17.435073	78.557849	Ravindra Nagar	671.57	Unfit for drinking
18	17.438143	78.560919	Nacharam Industrial Estate	349.99	Unfit for drinking
19	17.434788	78.563489	Industrial area Nacharam	234.62	Very poor
20	17.43079	78.565844	Industrial area Nacharam	415.62	Unfit for drinking
21	17.427578	78.56663	Hema Nagar	283.19	Very poor

22	17.452134	78.555993	Musi nagar	258.82	Very poor
23	17.45449	78.566201	HB Colony	518.88	Unfit for drinking
24	17.446424	78.566201	Shanthi nagar Colony	285.67	Very poor
25	17.449636	78.571555	Krishna Nagar	665	Unfit for drinking
26	17.442569	78.568557	Annapurna Colony	341.58	Unfit for drinking
27	17.444496	78.57284	Berappa hills	168	Poor
28	17.438643	78.570127	K.L Reddy Nagar	419.51	Unfit for drinking
29	17.440856	78.575338	Venkatramana colony	174.79	Poor
30	17.437857	78.580621	Industrial area	205.43	Very poor
31	17.42872	78.582334	RNS Colony	81.6	Good
32	17.422296	78.580621	Veera reddy Nagar	254.04	Very poor
33	17.42508	78.57748	Annapurna Colony	232.06	Very poor
34	17.417485	78.577746	Sai Bhavani Nagar	434.20	Unfit for drinking
35	17.413773	78.573177	East Balaji Hill Colony	175.57	Poor
36	17.41444	78.567752	Anand Nagar Colony	356.24	Unfit for drinking
37	17.414915	78.562136	Kalyanpuri	125.39	Poor
38	17.418913	78.558139	North Kalyanpuri	179.25	Poor
39	17.424719	78.554808	Raghavendra Nagar	169.34	Poor
40	17.429478	78.550049	Veera reddy Nagar	277.6	Very poor
41	17.419199	78.566229	Hema Nagar	255.53	Very poor
42	17.43595	78.551286	Baba Nagar	285.62	Very poor
43	17.439472	78.550715	Durganagar	296.25	Very poor
44	17.444802	78.544433	Siripuri Colony	204.29	Very poor
45	17.44985	78.54776	Sanjay Gandhi Nagar	243.45	Very poor

Water Quality Index values are very high in and surrounding areas of study area ranges from 81.6 to 671.57. According to the Groundwater quality status Classification of Nacharam and Mallapur Industrial Development Areas based on WQI no sample is there in Excellent category and only sample number 31 from RNS Colony falls under Good water quality status and it can be used for Domestic, Irrigation and Industrial purposes. The samples 5, 11, 13, 27, 29, 35, 37, 38 and 39 are in poor water quality status and these can be used for Irrigation but not other uses. The samples 6,10,12,16,19,21,22,24,30,32,33,40,41,42,43,44,and 45 are in very poor water quality status and these are restricted to use for irrigation also.

The samples 1,2,3,4,,7,8,9,14,15,17,18,20,23,25,26,28,34 and 36 are Unfit for drinking and cannot be used for either for irrigation or industrial purpose. Proper treatment is required before use.

5.4 Spatial Distribution of Water quality Index

GIS and Geostatistical Techniques for Groundwater Science provide a detailed synthesis of the application of GIS and geostatistics in groundwater studies. Spatial interpolation methods are

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frequently used to estimate values of physical or chemical constituents and WQI of groundwater in locations where they are not measured. In this study a total of 45 samples were analyzed for 14 physicochemical parameters and the analyzed parameters were compared with BIS standards. Water quality Index of all ground water samples is calculated and used as input for spatial interpolation. The spatial distribution for Water quality Index of all the analyzed samples was mapped based on the Inverse Distance Weighed method (IDW) using the open-source software, Quantum GIS. WQI map was created showing the spatial variability of Ground water quality Status of the of Nacharam and Mallapur Industrial Development Areas as presented in Fig 4.1

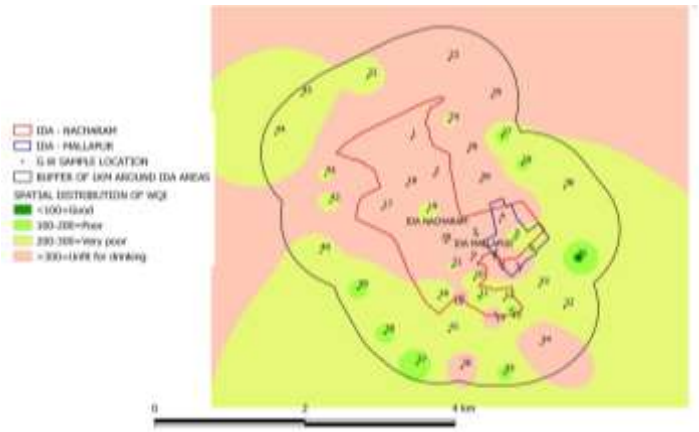

Fig .2: Spatial Distribution of Water Quality Index and Status of Groundwater Quality in and around Nacharam and Mallapur Industrial Development Areas

The Ground Water Quality Index spatial distribution assessment around 1km buffer area and in study area showed that Ground Water Quality is mostly very poor and unfit for drinking

VI. Conclusions

- A total of 62 bore well samples are collected in study area and physicochemical analysis was performed for 14 parameters such as; Colour, pH, Conductivity, Turbidity, Total dissolved solids, Total hardness, Alkalinity, Dissolved oxygen, Chlorides, Phosphates, Nitrates, Sulfates, Fluorides and Lead.
- The analyzed physicochemical parameters were compared with the BIS 10500 limits (2012). From the results it is concluded that all 14 parameters analyzed are not within the permissible limits of drinking water. The concentrations of TDS, Total Hardness, Alkalinity, Chlorides, Phosphates, Nitrates, Fluorides, Sulphates, and Lead are very high. This may lead to potential health hazards in and around study area.
- Water Quality Index values are very high in and surrounding areas of study area ranges from 81.6 to 671.57. According to the Groundwater quality status Classification of Hyderabad as well as Nacharam and Mallapur Industrial Development Areas based on WQI sample is there in good water quality status. The other categories include 11-poor, 24-very poor, and 26 - Unfit for drinking and no sample is there in Excellent category.
- The spatial distribution of the Water Quality Index allows interpolation of the water quality Index at unknown location from known values to create overall water quality index. The analysis indicated that most of the groundwater in and surrounding buffer of 1km of the study area is Unfit for drinking, domestic purposes and cannot be used for either for irrigation or industrial Application. Groundwater in the study area is highly polluted and Proper treatment is required before use.

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