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Ministry of Jal Shakti
Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

SHAHPUR TALUK,

YADGIR DISTRICT, KARNATAKA

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region, Bengaluru

AQUIFER MAPS & MANAGEMENT PLAN OF SHAHPUR TALUK,YADGIR DISTRICT, KARNATAKA STATE

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AQUIFER MANAGEMENT PLAN OF SHAHPUR TALUK,YADGIR DISTRICT, KARNATAKA ATATE

1. SALIENT INFORMATION

Name of the Taluk: Shahpur

District: Yadgir

State: Karnataka

Area: 1706 sq.km.

Population: 1, 80,163

Annual Normal Rainfall: 870 mm

1.1 Aquifer management study area

Aquifer mapping studies was carried out in Shahpur taluk, Yadgir district of Karnataka, covering an area of 1706 sq.kms under National Aquifer Mapping Project. Shahapur taluk of Yadgir district is located between north latitude 16°24'07" & 16°53'48", and East longitudes 76°36'57" & 77°17'19" and is covered in parts of Survey of India Toposheet Nos. 56D/10, 56D/13, 56D/14, 56D/15 and 56 H/7.

Shahpur taluk is bounded by the Shorapur taluk, Yadgir district in the west, Jewargi taluk, Gulburga district in the north, Yadgir taluk, Yadgir taluk in east and Devadurga taluk in south. Location map of Shahpur taluk of Yadgir district is presented in **Fig.1**.

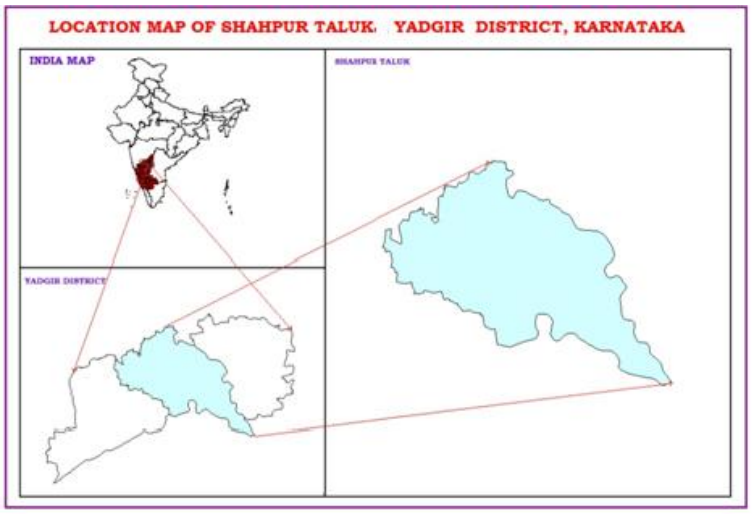

Fig.1: Location map of Shahpur Taluk, Yadgir District

Administratively Shahpur taluk is divided 3 Towns, 5 Hoblies, 36 Gram Panchayats and 154 villages which includes 145 inhabited and 9 un-inhabited villages.

1.2 Population

According to 2011 census, the population in Shahpur taluk is 363621 in which 294682 constitute the rural population and 68939 is the urban population., which is 81 % (rural) and 19 % (urban) of the total population of taluk. Percent Decadal change in total population from 2001 - 2011 is 24 % in Shapur taluk. Similarly, Percent Decadal change in rural & urban population is 18 % and 8 % respectively.

1.3 Rainfall

Shahpur taluk enjoys semi-arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Northern Dry agro-climatic zone of Karnataka state and is categorized as drought prone. The climate of the study area is quite agreeable and free from extremes. The year is usually divided into four seasons: summer from March to May; rainy season or south-west monsoon season from June to September; post-monsoon season covering the months of October and November and dry or winter Season from December to February. There is one rain gauge station located in Shahpur taluk **(Table 1).**

Table 1: Rain gauge and its location in Shahpur taluk

Station	Latitude	Longitude	Altitude
Shahpur	16.67	76.93	932.6

The data in respect of this station from the year 1981 to 2010 is analyzed and presented in **Table 2.** The data pertaining to these gauges is of long term nature and are well maintained. It is presumed that they are representative of the taluk and the same is used for analysis. Normal annual rainfall in Shahpur taluk for the period 1981 to 2010 is 870 mm.

Computations were carried out for the 30 year blocks of 1981- 2010 on Mean, Standard deviation and coefficient of variation of each month pre-monsoon, monsoon, post monsoon and annual and are shown in Table 2.The mean monthly rainfall at Shahpur taluk is ranging between 2 mm during February to 190 mm during September. The CV percent for pre monsoon, monsoon and post monsoon season is 73, 45 & 57 percent respectively. Annual CV at this station works out to be 32 percent.

Table 2: Statistical Analysis of Rainfall Data of Shahpur Taluk 1981 to 2010

Normal Rainfall (mm)	JAN	FEB	MAR	APR	MAY	PRE MONSOON	JUN	JUL	AUG	SEP	SOUTH WEST MONSOON	OCT	NOV	DEC	NORTH EAST MONSOON	ANNUAL RAINFALL
	6	2	9	22	44	83	132	135	157	190	614	135	33	5	173	870
STDEV	16	8	32	41	47	61	120	91	99	111	274	90	53	11	98	283
CV%	257	440	366	184	106	73	91	67	63	59	45	67	162	243	57	32

Rainfall data of Shahpur taluk has been analyzed for 46 years using IMD method to assess the drought condition in Shahpur taluk. The results of the classification are listed in the **Table 3**. It is observed that the Shahpur taluk has experienced alternating no drought to severe drought conditions over the years.

Table 3: Classification of drought and its periodicity (IMD, 1971)

% Deviation (Di)		>0	0 to -25	-25 to -50	50 to 75	<-75	Probability of drought occurrences
Category		No drought	Mild (Normal)	Moderate	Severe	Acute	
		Years					
Taluk	Shahpur	10	20	16	0	0	Once in **3** years

The details of the drought assessment are discussed as herein under. Out of 46 years of analysis in Shahpur taluk, "No Drought" condition is experienced in 10 years, "Mild Drought" condition is experienced in 20 years and "Moderate Drought" condition experienced in 16 years. Based on occurrence and frequency of past drought events, the probability of occurrence of various intensities of drought at each station has been studied. It has been observed that the frequency of occurrence of drought is **once in 3 years** at Shahpur taluk.

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Shahpur taluk, since 81% of the total population constitutes the rural population. The amount of rainfall and its distribution throughout the season contributes to the cropping pattern in the area. There are two agricultural seasons namely Kharif (June – October) and Rabi season (Mid October – Mid February). Major Kharif crops are paddy, jowar, and vegetables. Main crops of Rabi season are pulses, and oilseeds, which together constitute 34593 ha of cropped area. Among pulses, Tur and Green Gram constitute the cropped area of 13653 ha and 3168 ha respectively, which indicate dominance in pulse production in the taluk. Sugarcane, fruits and cotton are other crops grown in the area **(Table 4).**

Table 4: Area wise crops grown in Shahpur Taluk

Sl. No	Name of Crop	Area in Ha (2014-15)
1	Paddy	27856
2	Jowar	10832
3	Bajra	2523
4	Maize	704
5	Wheat	451
6	Pulses	21110
7	Sugarcane	743
8	Oilseeds	13483
9	Cotton	59186
10	Total Fruits &Vegetables	360

Source: District at a glance 2014 - 15, Govt. of Karnataka

During the year 2014 – 15, percentage of gross cropped area of total geographical area was 87% and net cropped area was 70% in Shahpur taluk. (**Table 5)**. Land use map of Shahpur Taluk is shown in **Fig.2.**

Table 5: Land use pattern in Shahpur Taluk, Yadgir district

Total Geographical Area (ha)	Area under Forest (ha)	Area not available for cultivation (ha)	Fallow land (ha)	Net sown area (ha)	Area sown more than once (ha)
159492	4995	15773	22272	111616	26613

Source: District at a glance 2014 - 15, Govt. of Karnataka

The upper Krishna project is the main Irrigation project in Yadgir district which covers maximum area in Shahpur taluk. Surface water irrigation through Narayanapura Dam is the only major source for irrigation. The Irrigation from other sources is very low and is limited to only where ever there is no canal water supply. Presently groundwater is added source for domestic, industrial as well as irrigation requirements. The entire irrigated area of 61639 hectares in the taluk is catered through different sources is tabulated below (**Table 6**).

Table 6: Irrigation sources in Shahpur Taluk, Yadgir district

Sl.No.	Irrigation source	Area (Ha)
1	Canal	573006
2	Tanks	185
3	Dug wells	667
4	Bore Well	2598
5	Lift Irrigation	823
6	Other Sources	60
	Total	**61639**

Source: District at a glance 2014 - 15, Govt. of Karnataka

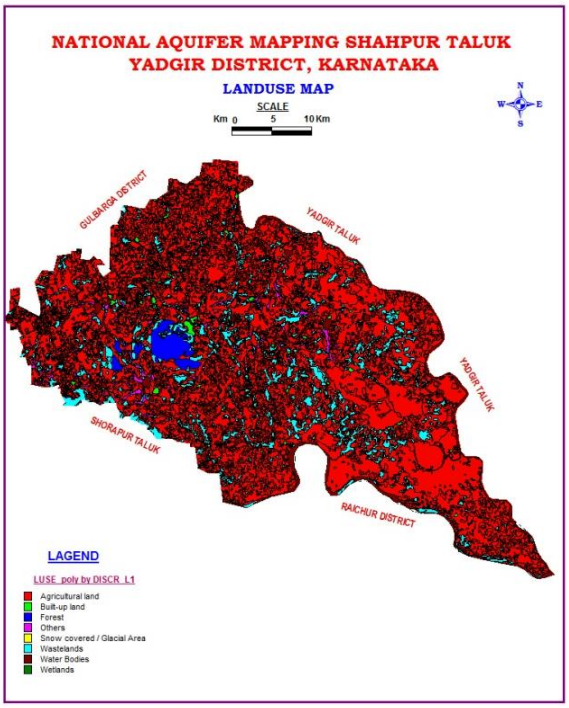

Fig.2: Land use map

1.5 Geomorphology, Physiography & Drainage

The geomorphology of the district is characterized by vast stretches of undulated plains interspersed with sporadic ranges or isolated clusters of low ranges of rocky hills **(Fig.3).**

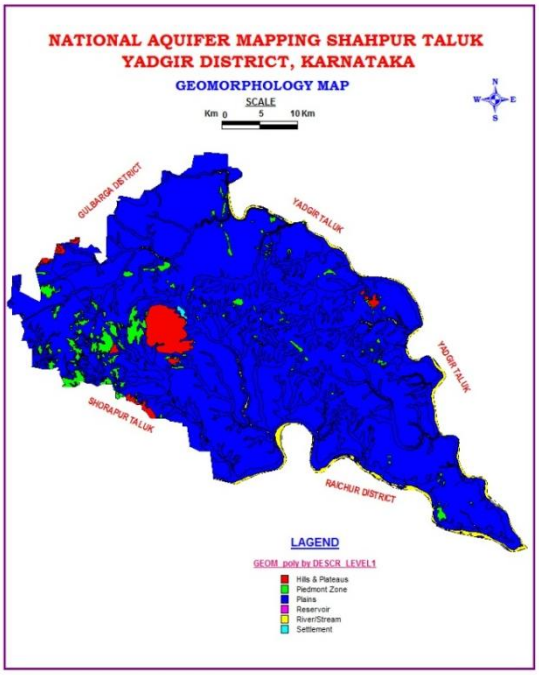

Fig 3: Geomorphology Map

The Shahpur taluk of Yadgir district falls under Krishna River basin. Two main rivers namely Krishna and Bhima and a few tributaries flow in this region. Major drainage pattern is dendritic in nature. Drainage map of the study area is presented in **Fig.4**.

Fig 4: Drainage Map

1.6 Soil

The clayey soil covers major part in the taluk. Clayey skeletal soil observed in Central and South western parts of taluk. Loamy Soil observed in North West part of taluk. Loamy skeletal soil and Clayey mixed soils observed only in few packets in the taluk. Water Infiltration capacity and Hydraulic conductivity of these soils are very low.

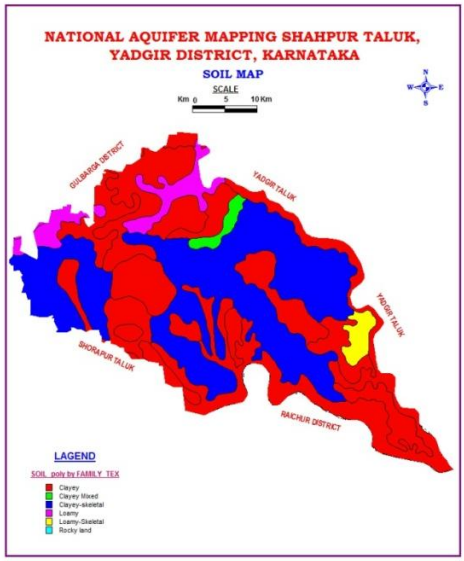

Fig 5: Soil Map

1.7 Groundwater resource availability and extraction

Aquifer wise total ground water resources up to 200 m depth are given in **Table-5** below.

Table 5: Total GW Resources (2017) (Ham)

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (Down to 200m)	Dynamic +phreatic in-storage
Shahpur	19318	4493	3677	27488

1.8 Existing and future water demands (as per GEC- 2017)

- Net groundwater availability for future irrigation development : 16831 Ham
- Domestic (Industrial sector) demand for next 25 years : 522 Ham

1.9 Water level behavior

(a) Depth to water level

Aquifer - I

- Pre-monsoon: 2.86 to 13.97 mbgl **(Fig. 6)**
- Post-monsoon: 0.80 to 8.36mbgl **(Fig.7)**

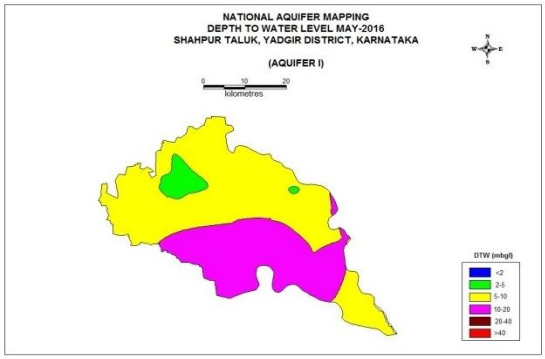

Fig. 6: Pre-monsoon DTW (May 2016)

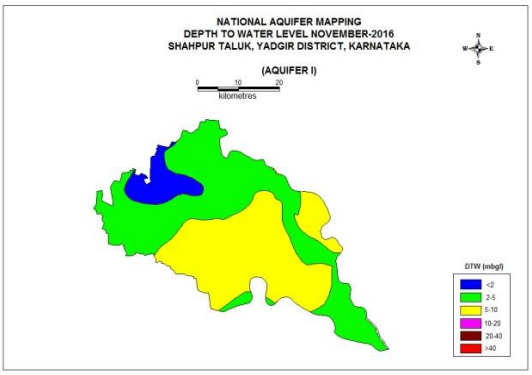

Fig.7: Post-monsoon DTW (Nov 2016)

Aquifer - II

- Pre-monsoon: 8.06 to 15.04 mbgl **(Fig.-8)**
- Post-monsoon: 0.56 to 9.34 mbgl **(Fig.-9)**

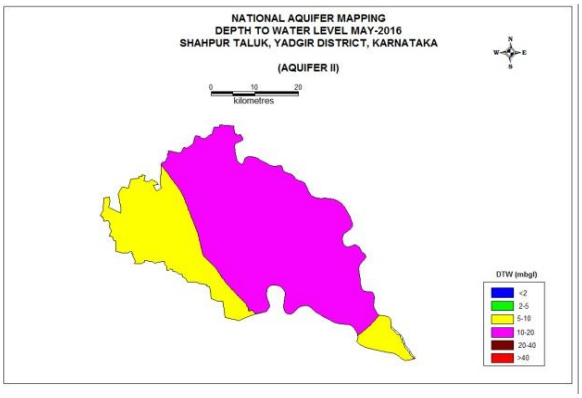

Fig. 8: Pre-monsoon DTW (May 2016)

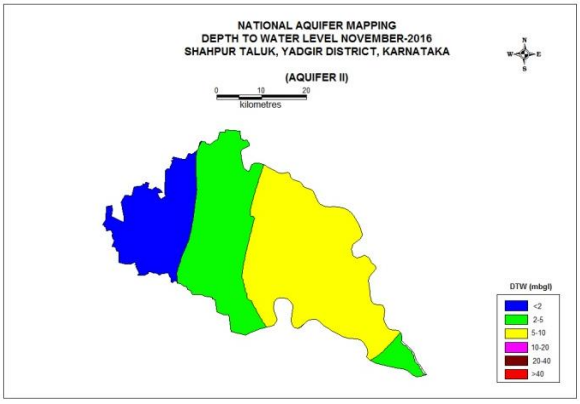

Fig. 9: Post-monsoon DTW (Nov 2016)

(b) Seasonal Water level fluctuation (May 2016 to Nov 2016)

Aquifer-I

- Seasonal Fluctuation: Rise ranges upto 4.0 m; No Fall in depth to water level **(Fig.-10)**

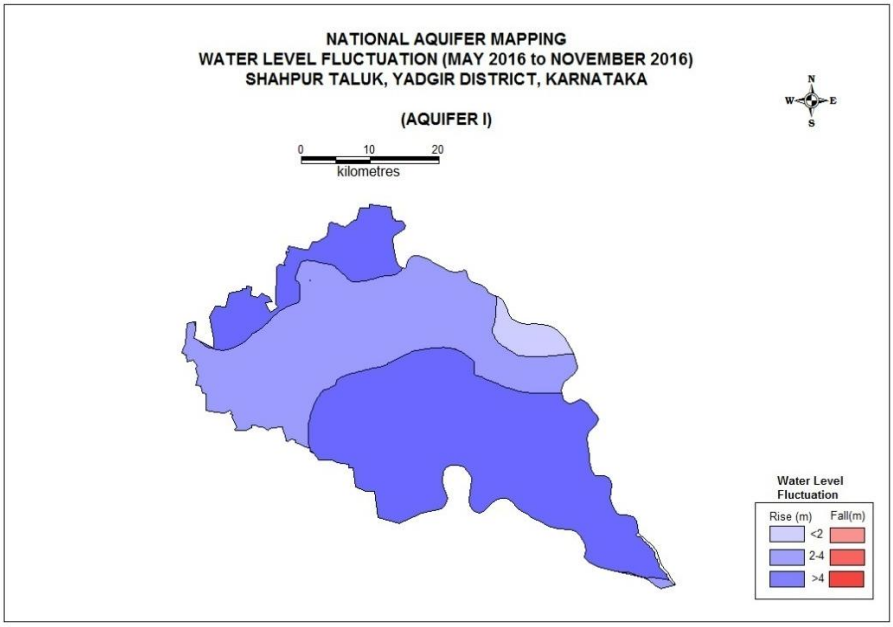

Fig. 10: Seasonal Water level fluctuation (Aquifer 1)

Aquifer-II

- Seasonal Fluctuation: Rise shows upto 2.0 m; No Fall in depth to water level **(Fig.-11)**

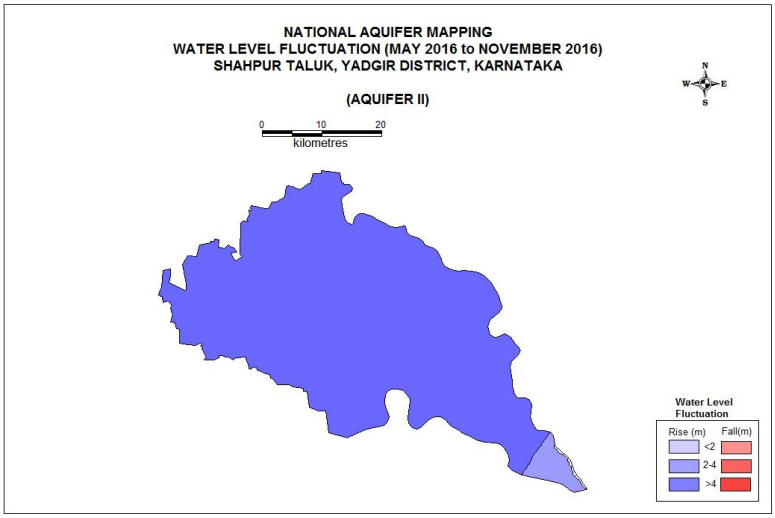

Fig. 11: Seasonal Water level fluctuation (Aquifer II)

2.0 AQUIFER DISPOSITION

2.1 Number of aquifers: In Shahpur taluk, there are two types of aquifer systems

i. Aquifer-I (Phreatic aquifer) comprising weathered Granite Gneiss / Schist, Basalt, Limestone, Sandstone.

ii. Aquifer-II (Fractured aquifer) comprising Fractured Granite Gneiss / Schist, Basalt.

Geologically, the entire taluk is covered by hard rocks, comprising of banded gneissic complex, granite, Lime stone, sandstone, Basalt and schistose rocks of Archaean age. The Banded Gneissic Complex (BGC) consists mainly of Quartz, Feldspars and mafic minerals like Hornblende and Biotite. The Central and South western parts are occupied by Granite and North western parts of the taluk are occupied by Lime stone and Sand stone. Schist and Basalts are also noticed as small patches in western part of the taluk. The BGC and Granite trend in NW-SE direction cutting across the entire area. A veneer of alluvium occurs along streams and river courses. Depth of weathered zone ranges between 2.0 to 25 m, with major part of the area having between 10 to 15m.

In this 'hard rock' taluk, main water bearing formations (aquifers) are granites, gneisses, Basalt, Limestone, Sandstone and schists. Granite, Gneisses and Basalt rocks are devoid of primary porosity, but secondary features like joints, fractures and fissures facilitate the occurrence and movement of water. Weathered parts on top of these rocks also act as rich repositories of ground water (phreatic aquifer). Thickness of this phreatic aquifer in the study area is found to vary with an average thickness of 12 meters.

Depth to water level is in phreatic aquifers is in the range of 0.80 to 13.97 m bgl and in deep aquifers ranges from 0.56 to 16.04mbgl. Since canal irrigation covered major part of the taluk, prone for water logging is noticed in 178 sq.km area where groundwater level is less than 5 mbgl.

To delineate aquifers and characterize them in terms of ground water potential and quality, data from as many as 14 Exploratory wells drilled during 1980-81 and 12 Exploratory wells drilled during 2018 were considered. Depth of these wells ranges between 45 to 238 m with casing depth of 2 m bgl to 25.60 m, (average casing depth found to be 15 m indicative of the weathered zone). Saturated weathered zone observed in some highly localised pockets, act as phreatic aquifer or Aquifer-I. This weathered zone is having connectivity with the fractured hard rock formation underneath, which extends down to 182.50 m depth is deep aquifer (Aquifer-II). The summarized data of exploratory wells are given in **Table 6** and details are given in **Table 7** and the geology map is shown in **Fig.12**.

Table 6: Summarized data of Exploratory Wells

Particulars	**Hard Rock**	**Sedimentary Rock**
No. of Wells	17	9
Total Depth(mbgl)	60-238	45-90
Casing Depth(m)	8.3 -25.6	2 -10
Discharge(lps)	0.01-8.52	0.01-6.67
Depth to water level(mbgl)	1.78-13.14	2 -13
Transmissivity (m2/day)	2.85-10.09	0.56-122

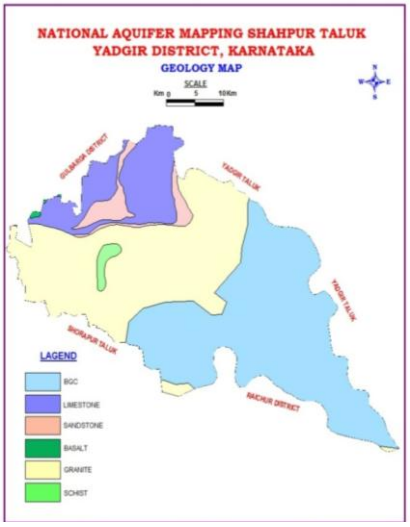

Fig. 12: Geology Map

Table 7: Details of Groundwater Exploration

S.No	Location	Latitude	Longitude	Depth Drilled (mbgl)	Casing Depth (m)	Fracture Zones (mbgl)	SWL (mbgl)	Q (lps)	DD (m)	T (m^3/ Day)
Sedimentary										
1	Dornahalli	16.727	76.938	90	2	14,21,38	4.105	0.05		16.65
2	Gogi	16.733	75.741	90			2.90	0.17		
3	Hulkal	16.752	76.791	73			7.525	0.01		
4	Hunsagi	16.476	76.502	70	2	Dry		0		
5	Mudbel	16.833	76.8	90	2.7	6,7	0.380	0.11	-	4.7
6	Ukinal	16.75	76.666	45	5.1	25,34	4.712	6.67	1.289	251
7	Ukinal	16.75	76.666	45		9.6		1.28		
8	Hadnur	16.744	76.551	90	4		5.36	0.25		
9	Kembhavi	16.64	76.49	90	10		13.26	1.8		
Hardrock										
1	Vibhutihalli	16.663	76.858	64			2.273	1.10	10.31	8.8
2	Wadgera	16.6	77.137	80	8.20	7.5,17, 20.4,38,43	5.173	2.70	1.922	9.5
3	Wadgera	16.6	77.137	60		8, 13, 20, 50	4.736	2.19	2.546	12.2
4	Hayyala.B	16.558	76.958	237.8	24.4	74.5-75.5, 235-236	8.84	1.7	30.55	2.97
5	Nalwadgi	16.762	77.041	210.8	9.8	94.9-95.9, 163-164	9.75	0.3		
6	Anbi	16.858	76.898	142.59	11.69	96-97	13.14	8.20	9.43	10.09
7	Bandebemli	16.48	77.167	200	20.69	dry				
8	Bevinahal	16.454	76.80	200	25.60	38.50-39	8.15	1.18	16.78	5.16
9	Gogi	16.777	76.74	200	11.58	dry				
10	Gundluru	16.421	77.257	200	13.82	dry				
11	Hayyal	16.608	76.94	200	17.88	99-100	4.20	0.43		
12	Ibrahimpur	16.798	76.956	200	17.61	131-131.5, 152-152.5	6.27	0.21		
13	Khanapur	16.705	76.994	200	17.60	108-108.5	1.78	0.01		
14	Madarki	16.80	76.779	200	11.59	Dry				
15	Sagar	16.624	76.803	140.20	20.21	24-24.5, 135-136	9.59	8.90	21.86	4.87
16	Shahpur Town	16.703	76.840	200	11.72	dry				
17	Thadibidi	16.684	76.979	200	8.32	97-97.8, 139.84-140.50	6.47	0.21		2.85

2.2 3 D aquifer disposition and Cross-Sections

Aquifer disposition – Rockworks output **(Fig.-12 & Fig.-13)**

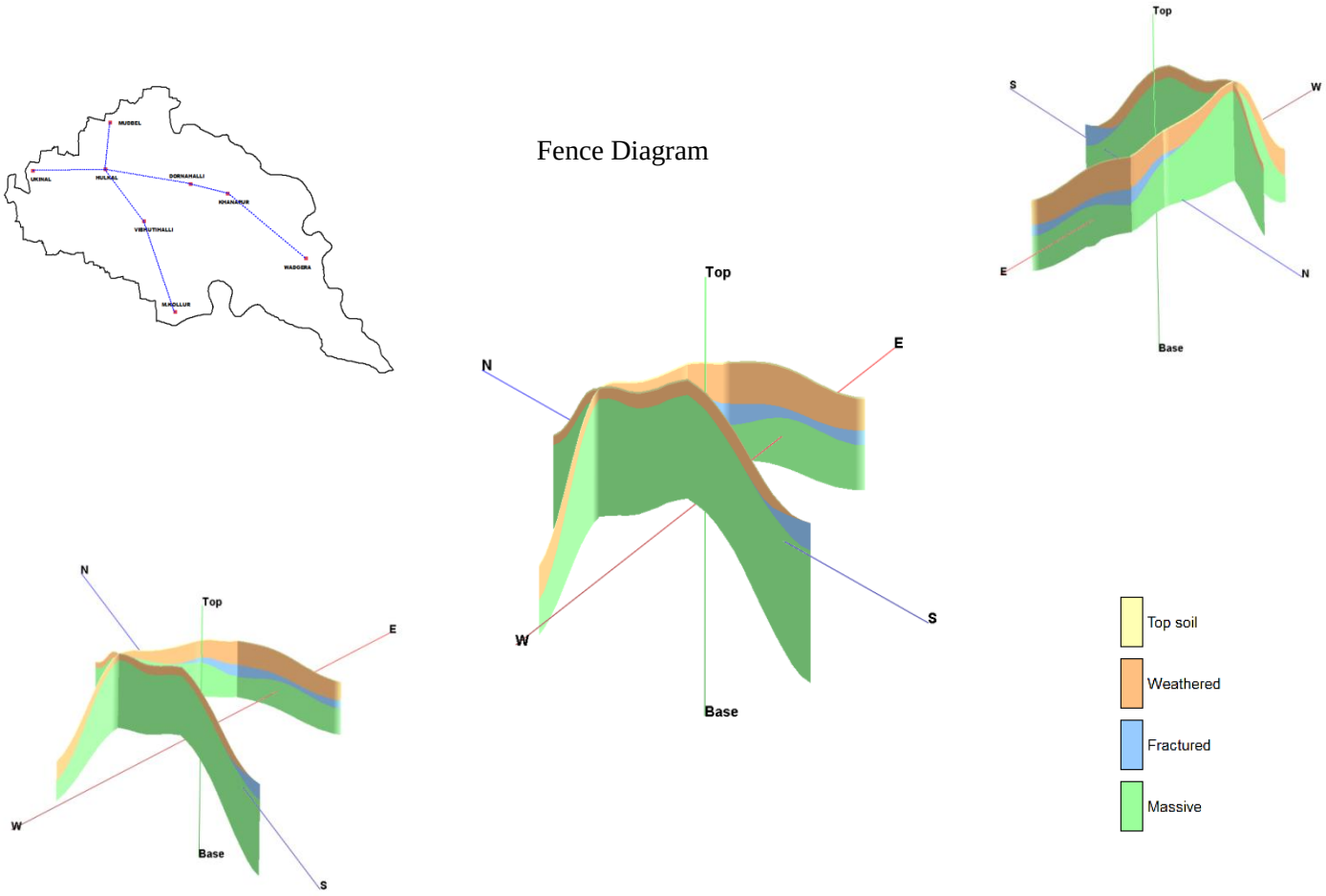

Fig 12: 3D Aquifer Disposition

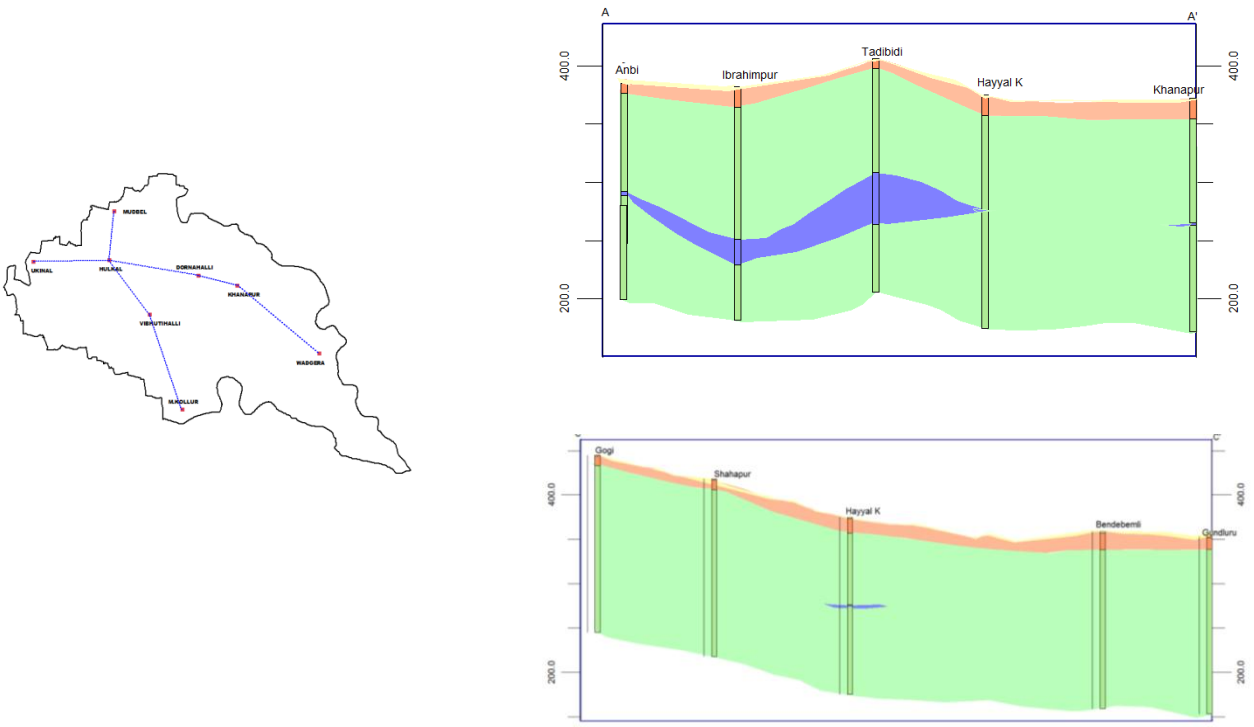

Fig 13: Cross sections of aquifers in different directions

3.0 GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

3.1 Aquifer wise resource availability and extraction

Table 10: Present Dynamic Ground Water Resource in ham (as on March 2017)

Taluk	Net annual ground water Availability	Existing gross ground Water draft for irrigation	Existing gross ground Water draft for domestic And industrial water supply	Existing gross ground Water draft for all uses	Allocation for domestic And industrial use for next 25 years	Net ground water Availability for future Irrigation development	Existing stage of ground Water development %	Category
Shahpur	19318	1965	241	2206	522	16831	11	Safe

Table 11: Present total Groundwater Resource (in ham)

Taluk	Annual replenishable GW resources (in ham)	Fresh In-storage GW resources (in ham)		Total availability of GW resource (in ham)
Shahpur	19318	Phreatic	Fractured	Dynamic +Phreatic in-storage + fractured in-storage
		4493	3677	27488

Table 12: Comparison of groundwater availability and draft scenario (in ham)

Taluk	2013			2017		
	GW availability	GW draft	Stage of GW development	GW availability	GW draft	Stage of GW development %
Shahpur	14037	752	5	19318	2206	11

3.2 Chemical quality of ground water and contamination

Quality of ground water in the taluk, in general is good and potable. It is suitable for domestic and irrigation purposes. Water samples collected from NHS (dug wells) during May2016were analysed **(Table 13)** to decipher the quality of shallow aquifer. All important parameters viz. EC, pH & TDS are within permissible limit, whereas fluoride concentration beyond permissible limit (1.1-1.5) has been found from the samples of Googi and Mudhal cross, Nitrate content beyond permissible limit (<45) has been found to occur in a few samples. Specific conductance ranges from 577 to 1506 micro mhos per cm at 25^{o}C and chloride is in the range of 43 to 369 ppm, thus rendering it suitable for irrigation.

Table 13: Hydrochemical data of water level monitoring stations, Karnataka, May 2016

Location	PH	ECµs/cm at 25^{o}	TH	Ca	Mg	Na	CO3	HCO3	Cl	SO4	NO3	F
			(mg/litre)									
Doranahalli	8.11	829	310	36	54	45	0	280	71	56	37	1.44
Googi	7.69	1476	170	48	12	259	0	246	349	177	16	1.73
Khanapur	7.88	1599	580	128	63	76	0	122	270	110	151	0.83
Mudbal	8	746	180	20	32	98	0	293	64	49	35	1.46
Mudbal cross	8.03	1483	350	48	56	156	0	256	234	160	17	1.61
Shahapur	7.63	1506	160	40	15	242	0	37	369	105	1	1.21
Ukinal	7.77	1181	190	44	19	168	0	189	234	51	37	0.83
Wadgera	8.07	577	240	28	41	44	0	287	43	26	22	1.31

4. 0 GROUND WATER RESOURCE ENHANCEMENT

4.1 Aquifer wise space available for recharge and proposed interventions

The choice of recharge structures should be site specific and such structures need to be constructed in areas already identified as feasible for artificial recharge. Structures like subsurface dykes, check dam, point recharge structures and percolation tank are recommended. This will pave for enhancement of groundwater resources in the taluk. As per Master plan of Artificial Recharge 103 sq km is the total area calculated out which is suitable for Artificial Recharge.

Table 13: Quantity of non-committed surface runoff & expected recharge through AR structures

Artificial Recharge Structures Proposed	**Shahpur Taluk**
Non committed monsoon runoff available (MCM)	41.35
Number of Check Dams	146
Number of Percolation Tanks	10
Number of Point Recharge structures	16
Tentative total cost of the project (Rs. in lakhs)	542
Excepted recharge (MCM)	13
Expected rise in water level (m)	6.4

4.2 Improvement in GW availability due to Recharge, Shahpur taluk

Taluk	**Net annual ground water availability**	**Existing gross ground water draft for all uses**	**Existing stage of ground water development**	**Expected recharge from proposed artificial recharge structures**	**Additional potential from proposed irrigation development scheme through inter basin transfer**	**Cumulative annual ground water availability**	**Expected improvement in stage of ground water development after the implementation of the project**	**Expected improvement in overall stage of GW development**
	Ham	Ham	%	Ham	Ham	Ham	%	%
Shahpur	19318	2206	11	1300	0	20618	10.69	0.31

5.0 DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

Canal irrigation covered major part of the taluk, hence limited groundwater extraction is through bore wells ranging in depth 140 to 200 m, depth to ground water level in these bore wells range between 8.06 to 15.04m.

Bore well is the prevalent source for irrigation in the non command area in the taluk. Thus, by adopting below mentioned techniques will contribute in groundwater resource enhancement in the long run.

Efficient irrigation techniques will contribute in saving groundwater and thus will reduce the irrigation draft. Existing stage of groundwater development in the taluk is only 11% and categorized as Safe. Hence, there is ample scope for irrigation from groundwater. Dependence on groundwater for irrigation is recommended, provided measures are taken for sustained recharge of groundwater through construction of groundwater recharge structures as recommended.

5.2 Change in cropping pattern

Not necessary since cultivation of water intensive crops is not widely prevalent in the taluk, although area under paddy cultivation is considerable. This practice may be replaced owing to consistent increase in stage of ground water development in the taluk.

5.2 Water Logging and additional area of irrigation

As per Groundwater Estimation 2017, only 11 % is the groundwater development. This is because of surplus of surface water from canal supply. Groundwater development is only in non-canal command area. Water logging issue has been observed in canal command area. Integrated approach has been proposed to use both surface and groundwater, so that where ever water level less than 5 meter in canal command area groundwater has to put into use and bring down the water level more than 5 mbgl.

5.3 Regulation and Control

- Shahpur taluk has been categorized as **Safe**, since the Stage of groundwater development is only 11% (GE March 2017). This is because of surplus of surface water from canal supply. But the groundwater recharge component needs to be made mandatory in the non command area of the taluk for further development of groundwater.

- Efficient irrigation techniques will contribute in saving ground water and thus will reduce the irrigation draft.
- Ground water recharge component needs to be made mandatory in State Govt. Project, concerned with further development of ground water, viz; Irrigation Projects or Public Water Supply Projects.

5.5 Other interventions proposed

- Remedial measures need to be adopted in the areas affected by Fluoride, Nitrate and EC like nitrate rich groundwater through artificial recharge and water conservation etc.
- The choice of recharge structures should be site specific and such structures need to be constructed in areas already identified as feasible for artificial recharge.
- Periodical maintenance of artificial recharge structures should be incorporated in the Recharge Plan.