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जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय

भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga

Rejuvenation

Government of India

Report on

AQUIFER MAPPING AND MANAGEMENT PLAN

Hukkeri Taluk, Belgaum District, Karnataka

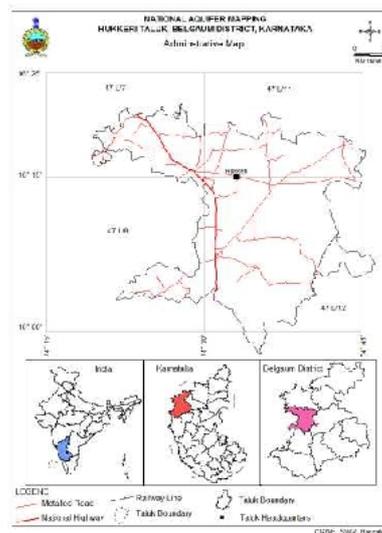
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South Western Region, Bengaluru



Government of India
Ministry of Water Resources, River Development
& Ganga Rejuvenation
Central Ground Water Board

HUKKERI TALUK AQUIFER MAPS AND MANAGEMENT PLAN
BELGAUM DISTRICT, KARNATAKA STATE



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CONTENTS

Sl. No.	Chapter Title	Page No.
1	SALIENT INFORMATION	1
2	AQUIFER DISPOSITION	7
3	GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES	9
4	GROUND WATER RESOURCE ENHANCEMENT	12
5	DEMAND SIDE INTERVENTIONS	13
6	SUMMARY	14

HUKKERI TALUK AQUIFER MAPS AND MANAGEMENT PLAN BELGAUM DISTRICT, KARNATAKA STATE

1. SALIENT INFORMATION

Name of the taluk : HUKKERI
District : Belgaum;
State : Karnataka
Area : 987 sq.km.
Population : 3,99,270
Annual Normal Rainfall : 622 mm

1.1 Aquifer management study area

Aquifer mapping studies have been carried out in Hukkeri taluk, Belgaum district of Karnataka, covering an area of 987 sq.kms under National Aquifer Mapping Project. Hukkeri taluk of Belgaum district is located between North Latitudes 15°57'58.2" and 16°21'21.6" and East Longitudes between 74° 19' 19.2" to 74°46'12" and is falling in Survey of India Toposheets No forms parts of 47L/7, L/8, L/11 &L/12. The study area is bounded on the North by Chickodi Taluk, on the East by Gokak taluk, on the West by Maharashtra state and on the South by the Belgaum taluk of Belgaum district. Location map of Hukkeri taluk of Belgaum district is presented in Fig-1.

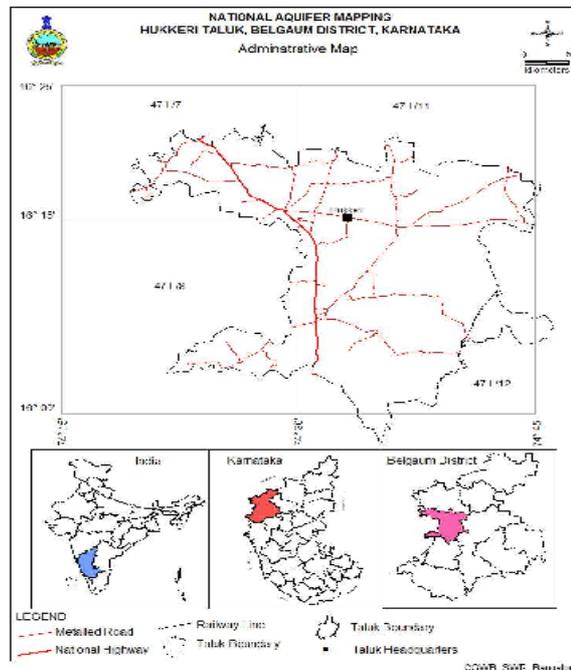


Fig 1: Location map of Hukkeri taluk of Belgaum district

Administratively, Hukkeri town is taluk head quarters and there is no other town in this taluk. There are 53 inhabited and 3 uninhabited villages in the taluk.

1.2 Population

According to 2011 census, the population in Hukkeri taluk is 3,99,270, in which all constitute the rural population. The study area has an overall population density of 405 persons per sq.km. The decadal variation in population from 2001-2011 is 11.78% in Hukkeri taluk.

1.3 Rainfall

Hukkeri taluk enjoys semi-arid climate. The area falls under Northern transitional agro-climatic zone of Karnataka state and is categorized as drought prone. The normal annual rainfall in Hukkeri taluk for the period 1981 to 2010 is 622 mm. Seasonal rainfall pattern indicates that, major amount of (406 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 65% of the annual normal rainfall, followed by North-East Monsoon season (136 mm) constituting 22% and remaining (81 mm) 13% in Pre-Monsoon season (Table-1).

Computations were carried out for the 30 year blocks of 1981-2010, the mean monthly rainfall at Hukkeri taluk is ranging between 0 mm during February to 116 mm during June. The coefficient of variation percent for pre-monsoon, monsoon and post-monsoon season is 64, 39 & 65 percent respectively. Annual CV at this station works out to be 26 percent (Table-1).

Table 1: Statistical Analysis of Rainfall Data of Hukkeri taluk, (1981 to 2010)

STATION		JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
HUKKERI	NRM	1	0	4	18	56	81	116	96	84	110	406	109	22	4	136	622
	ST.DEV	5	1	8	22	50	52	70	56	40	86	160	76	32	11	88	164
	CV%	324	381	203	119	89	64	60	58	47	78	39	69	146	269	65	26

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Hukkeri taluk. Major Kharif crops are maize, bajra, jowar, tur and vegetables. Main crops of Rabi season are maize, Bajra, Jowar and sunflower (Table-2). Water intensive crops like sugarcane and paddy are grown in 18% of total crop area. Maize is grown in 11% and oil seeds in 23% of total crop area of taluk. Bajra & jowar account 12% of total crop area.

Table 2: Cropping pattern in Hukkeri taluk 2014-2015 (Ha)

Year	Paddy	Maize	Bajra	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
Area under cultivation (Ha)										
2014-2015	1853	10775	53	11410	29238	170	2292	22982	16259	3797

It is observed that net sown area accounts 63% and area sown more than once is 14% of total geographical area in Hukkeri taluk (Table-3). Area not available for cultivation and Fallow land cover 14% & 6% of total geographical area respectively. 8% of net area irrigated is only from bore wells and 1% from lift irrigation (Table-4).

Table 3: Details of land use in Hukkeri taluk 2014-2015 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Hukkeri	99140	13987	14273	5964	62027	14338

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

Table 4: Irrigation details in Hukkeri taluk

Source of Irrigation	Net area irrigated (Ha.)	% of area
Canals	3015	12%
Tanks	0	0
Wells	9815	39%
Bore wells	8042	32%
Lift Irrigation	270	1%
Other Sources	3889	16%
Total	25031	

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

1.5 Geomorphology, Physiography & Drainage

Northern portion of the Hukkeri taluk is a plateau region formed by basaltic lava flows, which represents “Deccan penplain”. The central and southern parts exhibit moderate to gently “undulating terrain” having sparsely distributed knolls and tors. The remaining part of the taluk is in general a “plateau area”. The elevation in the plains varies from 620 m in the Southeastern part to 780m amsl in the North western part of the taluk. This has its bearing on the regional slope which is towards northeast. The differential altitude is significant because, it is likely to cause irregular ground water flow patterns on the micro scale (Fig.-2).

The entire Hukkeri taluk falls in Krishna basin. The Ghataprabha river, along with its tributaries are perennial and effluent in nature and flow in North-Easterly direction. The drainage density varies from 0.80 to 3.4 km/sq.km (Fig-2). Hiranyakshi, Doddahalla and Hattargi Halla are tributaries of Ghataprabha river, which are flowing in the taluk. A Major irrigation project across this Ghataprabha river exists at Hidkal in Hukkeri taluk. Number of minor streams which rises locally and ultimately drains into Ghataprabha river. The drainage in the taluk is dendritic to sub-Dendritic in nature (Fig.-3).

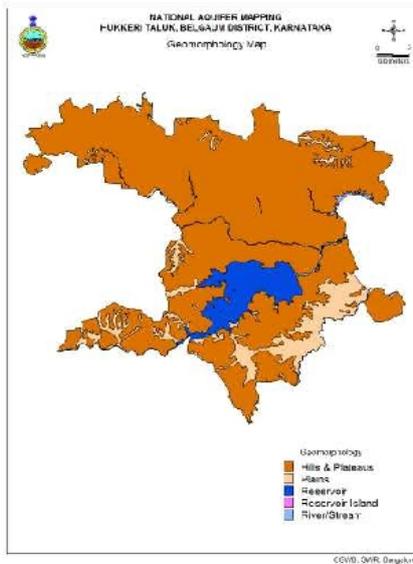


Fig 2: Geomorphology Map

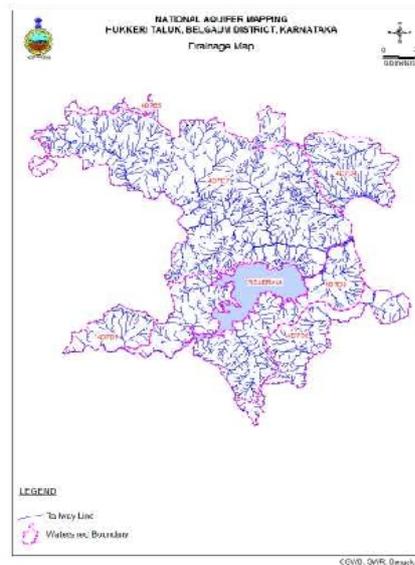


Fig 3: Drainage Map

1.6 Soil

The soils of Hukkeri taluk can broadly be classified into red soils and black soils. These soils vary in depth and texture, depending on the parent rock type, physiographic settings and climatic conditions. By and large, black soils predominates the Deccan Trap terrain and the red soils are found in the southwestern and southeastern part of the district in gneissic terrain. These soils in turn can be grouped into seven categories viz. Shallow black soil, medium black soil, Deep to very black soil, mixed red & black soil, red loamy soil, which cover large tracks of land and the other two lateritic and alluvium soils are local in nature.

1.7 Ground water resource availability and extraction

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

Table 5: Total Ground Water Resources (2013) (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 + fractured
Hukkeri	12208	685	1503	14396

1.8 Existing and future water demands (as per GEC-2013)

- Net ground water availability for future irrigation development : 38.99 MCM
- Domestic (Industrial sector) demand for next 25 years : 20.31 MCM

1.9 Water level behavior

(a) Depth to water level

Aquifer - I

- Pre-monsoon: 1.85 – 19.75 mbgl (Fig.-4)

- Post-monsoon: 0.66 – 17.73 mbgl (Fig.-5)

Aquifer - II

- Pre-monsoon: 2.29 -84.88 mbgl (Fig.-6)
- Post-monsoon: 1.80 – 29.87 mbgl (Fig.-7)

(b) Water level fluctuation

Aquifer-I (Fig.-8)

- Seasonal Fluctuation: Rise ranges 1.22 – 1.18 m;
Fall ranges 0.2 (0.0 – 4.0) m

Aquifer-II (Fig.-9)

- Seasonal Fluctuation: Rise shows 4.2 m;
Fall ranges 0.0 – 2.0 m

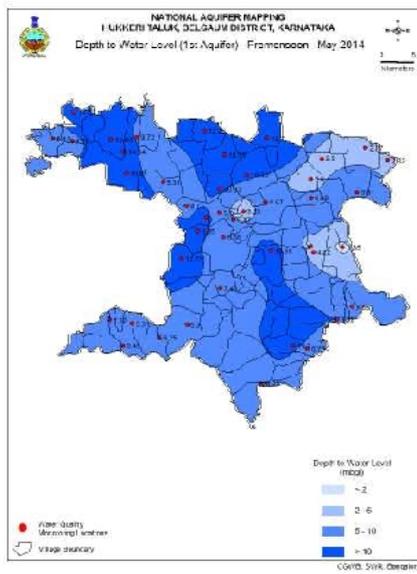


Fig 4: Pre-monsoon Depth to Water Level (Aq-I)

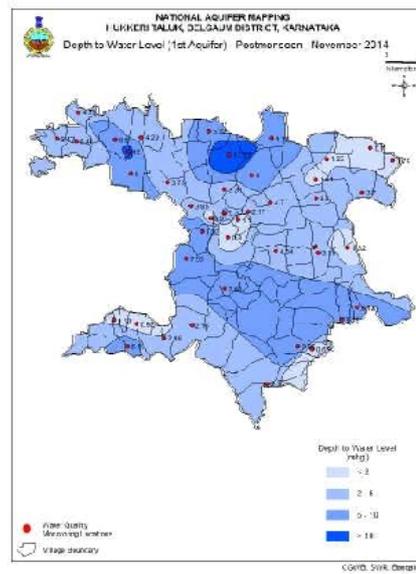


Fig 5: Post-monsoon Depth to Water Level (Aq-I)

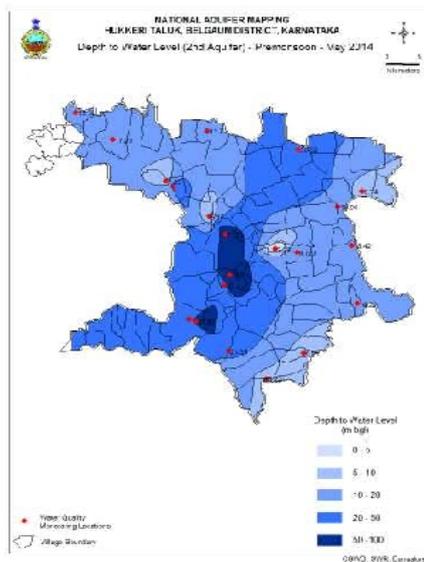


Fig 6: Pre-Monsoon Depth to Water Level (Aq-II)

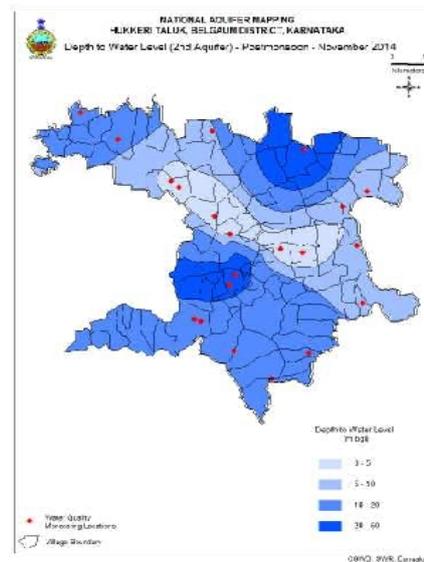


Fig 7: Post-Monsoon Depth to Water Level (Aq-II)

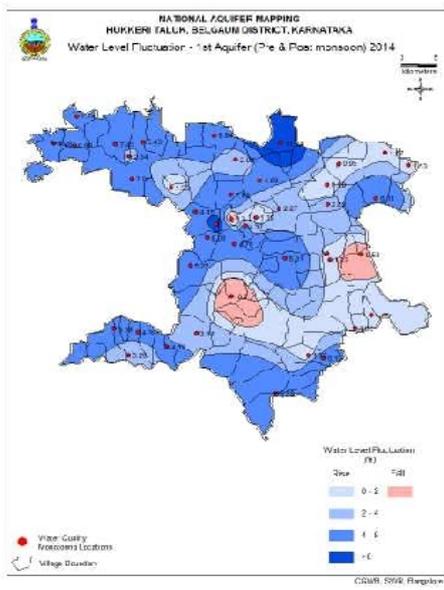


Fig 8: Water Level Fluctuation (Aq-I)

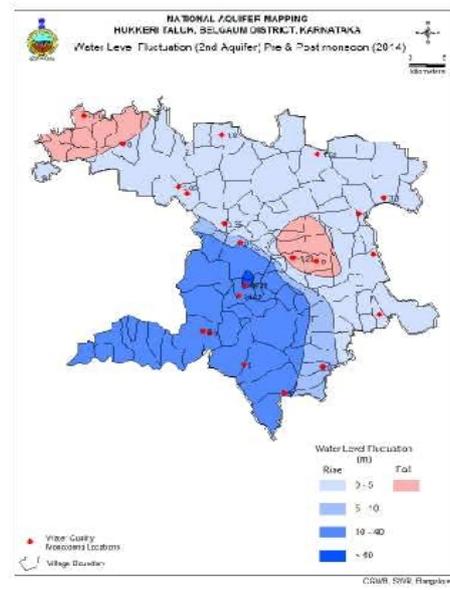


Fig 9: Water Level Fluctuation (Aq-II)

2. AQUIFER DISPOSITION

2.1 Number of aquifers: In Hukkeri taluk, there are mainly two types of aquifer systems;

- i. Aquifer-I (Phreatic aquifer) comprising Weathered Basalt Sandstone and Quartzites
- ii. Aquifer-II (Fractured aquifer) comprising Fractured Basalt Sandstone and Quartzites

In Hukkeri taluk, Basalt Sandstone and Quartzites are the main water bearing formations (Fig-10). Ground water occurs within the weathered and fractured Basalt Sandstone and Quartzites under water table condition and semi-confined condition. In Hukkeri taluk bore wells were drilled from a minimum depth of 175.5 mbgl to a maximum of 300 mbgl (Table-6). Depth of weathered zone (Aquifer-I) ranges from 3.77 mbgl to 36.0 mbgl (Fig-11). Ground water exploration reveals that aquifer-II (fractured formation) has been encountered between the depth of 20 and 200 mbgl. Yield ranges from 0.20 to 6.91 lps.

The basic characteristics of each aquifer are summarized in Table-7.

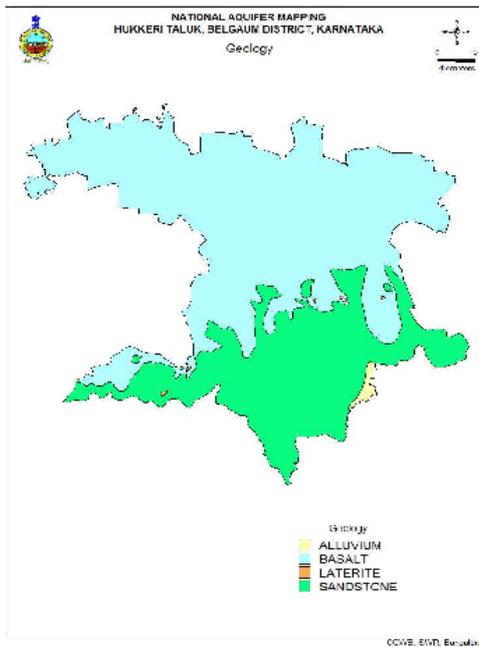


Fig 10: Geology

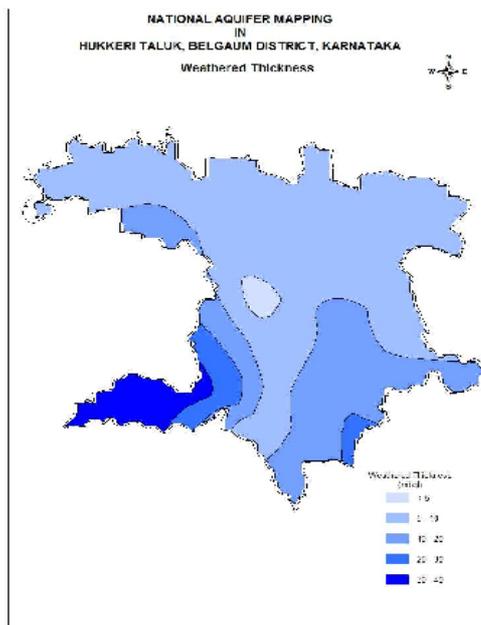


Fig 11: Weathered Thickness Map

Table 6: Details of Ground Water Exploration

S. No.	Location	Lat.	Long.	Depth (mbgl)	Casing Depth (m)	SWL (mbgl)	Q (lps)	DD (m)	Sp.Cap. (lpm/mdd)
1	Sankeshwar	74.493	16.253	202.2	10	26.0	0.20	-	-
2	Kurni	74.551	16.196	300	3.77	75.21	0.44	-	-
3	Jinral	74.556	16.152	267.3	5.67	76.30	1.21	32.05	6.43
4	Islampur	74.556	16.053	238.5	7.1	21.35	0.38	-	-
5	Ghodageri	74.696	16.179	300	5.6	18.42	1.79	12.95	9.38
6	Basapur EW	74.642	16.050	226.5	11.7	9.89	2.90	10.12	20.48

7	Basapur OW	74.642	16.050	275.5	29.5	8.50	4.36	12.50	18.01
8	Hosur EW	74.635	16.174	202.1	14.1	9.72	4.92	16.13	16.13
9	Hosur OW	74.635	16.174	247.1	9.2	24.32	0.52	-	-
10	Narsingapur EW	74.518	16.089	175.5	30	84.88	3.81	1.47	155
11	Narsingapur OW	74.518	16.089	167	25.7	79.98	3.62	1.71	127
12	Mahagaon	74.421	16.084	300	36	32.15	0.22	-	-

Table 7: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Basalt Sandstone and Quartzites	Fractured / Jointed Basalt Sandstone and Quartzites
Thickness range (mbgl)	20	Fractures upto 200 mbgl
Depth range of occurrence of fractures (mbgl)	-	30 - 200 80% between 30 - 200
Range of yield potential (lps)	Poor yield	1 - 5
Specific Yield	2%	0.2%
T (m ² /day)	-	0.4 - 243
Quality Suitability for Irrigation	Suitable	Suitable
Suitability for Domestic purposes	Suitable	Suitable
Remarks	Safe	GW potential fractures, 1 to 3 sets likely up to the depth of 200 m bgl.

2.2 3 D aquifer disposition and Cross-Sections

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

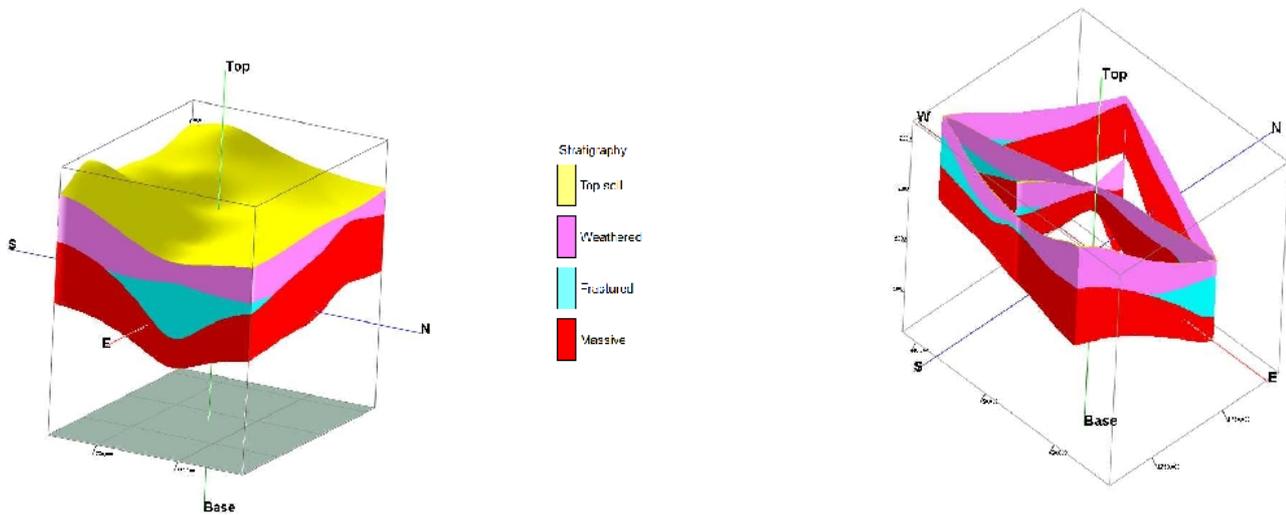


Fig 12: 3D aquifer Disposition and Fence Diagram

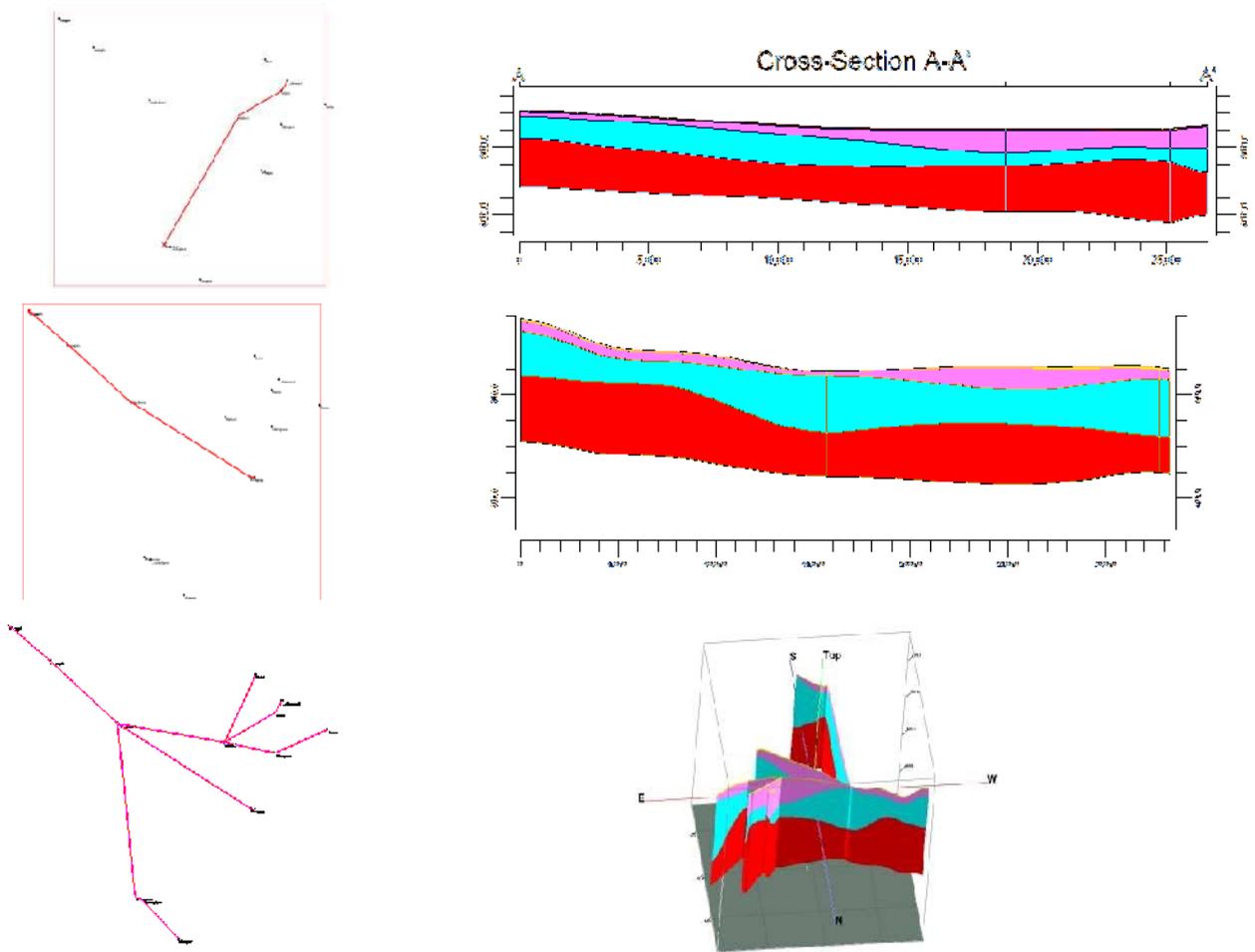


Fig 13: Cross sections in different directions & Fence diagram

3. GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

a. Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2013) (Ham)

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
Hukkeri	12208	7107	1392	8499	2031	3899	70%	SAFE

(b) Present total Ground Water Resource (Ham)

Taluk	Annual replenishable GW resources (in ham)	Fresh In-storage GW resources (in ham)		Total availability of GW resource (in ham)
		Phreatic	Fractured	Dynamic + phreatic in-storage + fractured in-storage
Hukkeri	12208	685	1503	14396

(c) Comparison of ground water availability and draft scenario

Taluk	GW availability (in ham)	GW draft (in ham)	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Stage of GW development
	2009			2011			2013		
Hukkeri	12838	11467	89	12201	8590	70	12208	8499	70

b. Chemical quality of ground water and contamination

Interpretation from Chemical Analysis results in Hukkeri taluk is mentioned as under:

Electrical Conductivity: In general, EC values range from 280 to 1390 μ /mhos/cm at 25°C which are within the permissible limit in both the aquifers (Fig-14 & Fig-15).

Fluoride: Fluoride concentration in ground water ranges between 0.02 – 1.4 mg/l in both aquifers, which are also within the permissible limit of 1.5 mg/l(Fig-16 & Fig-17).

Nitrate: Nitrate value ranges from 8 and 60 mg/l in Aquifer –I (Fig-18) and from 5 to 50 mg/l in Aquifer-II (Fig-19).

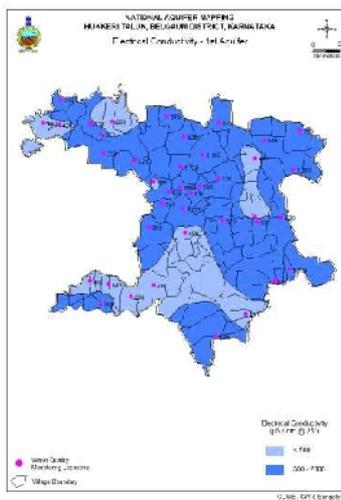


Fig 14: Electrical Conductivity Map Aq-I

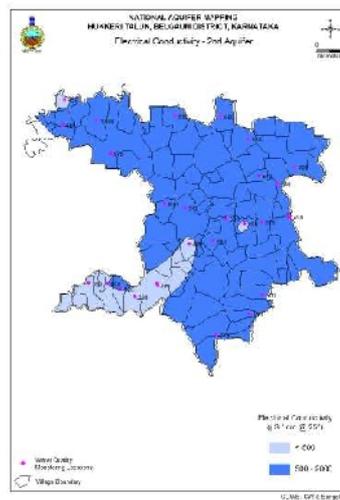


Fig 15: Electrical Conductivity Map Aq-II

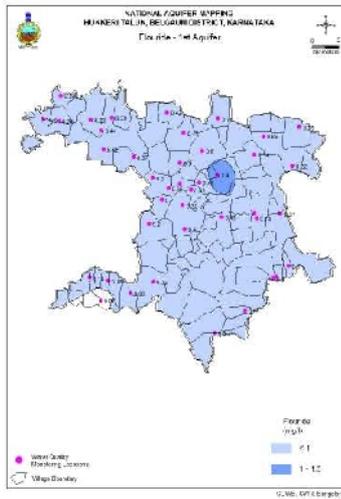


Fig 16: Fluoride Map Aq-I

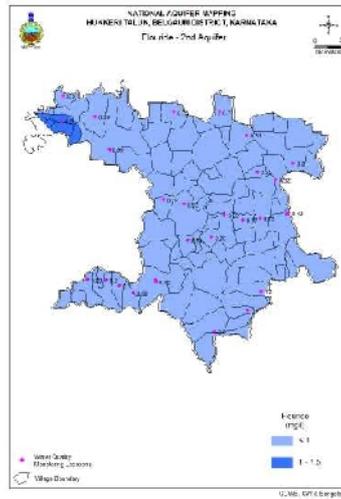


Fig 17: Fluoride Map Aq-II

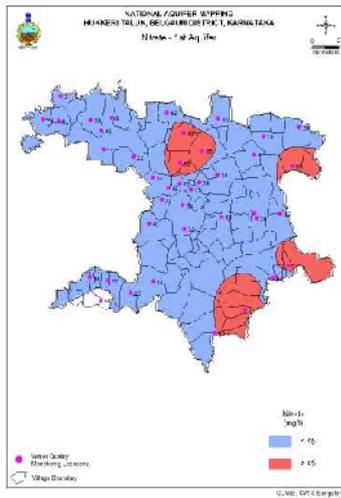


Fig 18: Nitrate Map Aq-I

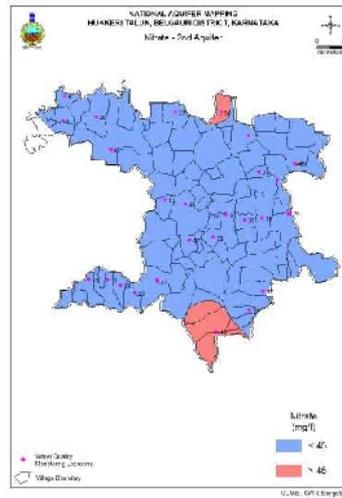


Fig 19: Nitrate Map Aq-II

In general, ground water quality in Hukkeri taluk is good for drinking purpose except in some areas as depicted in above illustrated maps, where nitrate is found to be greater than the permissible limit as per “Indian Standard Drinking Water Specification 2009”. Ground water samples have also been tested and found suitable for agriculture & irrigation purposes.

4. GROUND WATER RESOURCE ENHANCEMENT

a. Water Logging and additional area of irrigation

Water logging area falls in <2 m pre-monsoon water level contour and area prone for water logging falls between 2-5 m water level contour are estimated (Table-9). In these areas, quantum of withdrawal of ground water is calculated considering specific yield of 2% and water column to be reduced to 10 mbgl (Fig-20). The volume of ground water withdrawn in Hukkeri taluk is 9840 ham (3.475 TMC). Additional area of crop can be irrigated using 75% of irrigation efficiency is calculated on the basis of recommendation of Agriculture University, Bangalore. Accordingly, since maize is grown in 15% and Jowar is grown 25% and sugar cane is grown 4 % of total crop area of taluk, it is suggested that an additional area of 14762 ha of Maize or 24603 ha of Jowar or 3690 ha of sugarcane can be irrigated (Table-8). Thus, additional area can be irrigated or double crop may be planned in the Hukkeri taluk.

Table 8: Withdrawal of Ground Water and Increase in area of Irrigation in Hukkeri taluk

WL Range (mbgl)	WL to be reduced to (mbgl)	Water Column (m)	Area (Ha)	Specific Yield	Volume of Ground Water to be withdrawn		Area of crop can be irrigated using 75% of Irrigation Efficiency (Ha)		
					(Ham)	(TMC)	Maize	Jowar	Sugarcane
0 - 2	10	10	9600	0.02	1920	0.678	2880	4801	720
2 - 5	10	8	49500	0.02	7920	2.797	11881	19802	2970
Total					9840	3.475	14762	24603	3680

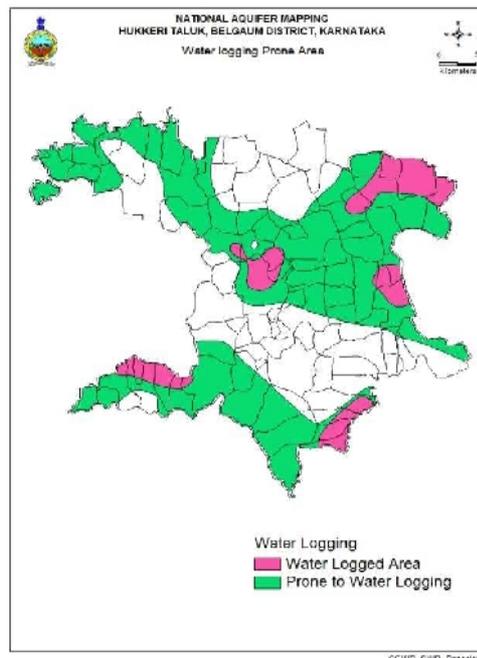


Fig 20: Water Logged area

5. DEMAND SIDE INTERVENTIONS

a. Advanced irrigation practices

It is observed that wells & bore wells are the source for 3015 ha of net irrigation in the taluk. Thus, by adopting the below mentioned techniques will contribute in ground water resource enhancement in the long run.

- Efficient irrigation practices like Drip irrigation & sprinkler needs to be adopted by the farmers in the existing 17,857 ha of net irrigated area by wells & borewells.
- Irrigation draft is 7107 ham.
- Efficient irrigation techniques will contribute in saving ground water by 2132 ham and thus will improve stage of development by 11% from 70% to 59% (Table-9).

b. Change in cropping pattern

- Water intensive crops like paddy & sugarcane are grown in 18% of total cropped area by surface water from canal source in the Hukkeri taluk. Hence, change in cropping pattern has not been suggested.

Table 9: Improvement in GW availability due to saving by adopting water use efficiency

Taluk	Net annual ground water availability	Existing gross ground water draft for all uses	Existing stage of ground water development	Saving due to adopting WUE measures	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 ground water development
	HAM	HAM	%	HAM	HAM		%
Hukkeri	12208	8499	70	2132	14340	59	11

c. Other interventions proposed

- Excess nitrate concentration is found in ground water samples requires remedial measures viz.
 - Dilution of nitrate rich ground water through artificial recharge & water conservation.
 - Roof top rain water harvesting.
 - Limited usage of Nitrogenous fertilizers.

6. SUMMARY

The summary of Management plan of Hukkeri taluk is given in Table-10.

Table 10: Summary of Management plan of Hukkeri taluk

Hukkeri taluk is safe & present stage of GW Development (2013)	70%
Net Annual Ground Water Availability (MCM)	122.08
Existing Gross Ground Water Draft for all uses	84.99
Groundwater development feasibility	38.99
Total GW Resources (Dynamic & Static upto the depth of 200 mbgl) (MCM)	143.96
Expected Saving due to adopting WUE measures (MCM)	21.32
Change in Stage of GW development, %	70 to 59
Prone for Water Logging area	<ul style="list-style-type: none"> • Area prone for water logging is 59100 ha • Volume of ground water withdrawn in Hukkeri taluk is 9840 ham • Additional area of 14762 ha can be irrigated for Maize or 24603 ha for Jowar crops or 3690 ha for sugar cane
Nitrate contamination	<ul style="list-style-type: none"> • Improving quality by proper drainage and • Limited usage of Nitrogenous fertilizers

