



## **केंद्रीय भूमि जल बोर्ड**

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**

**Hagaribommanahalli Taluk, Bellary District,  
Karnataka**

दक्षिण पश्चिमी क्षेत्र, बेंगलोर

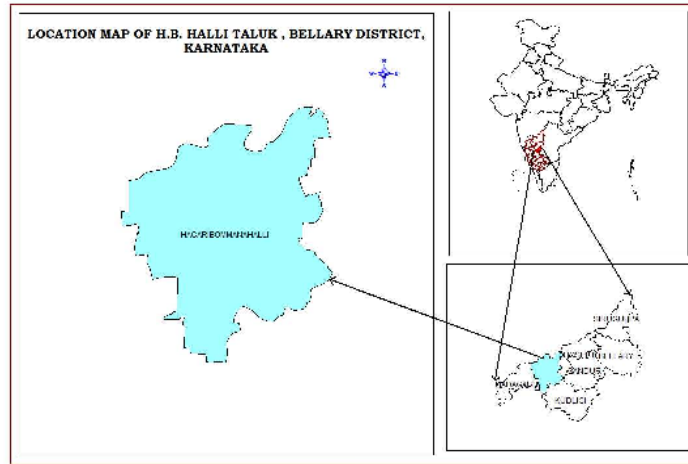
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**Government of India  
Ministry of Water Resources, River Development  
& Ganga Rejuvenation  
Central Ground Water Board**

**HAGARIBOMMANAHALLI TALUK AQUIFER MAPS AND MANAGEMENT  
PLANS, BELLARY DISTRICT, KARNATAKA STATE**



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## **HAGARIBOMMANAHALLI TALUK AQUIFER MAPS AND MANAGEMENT PLANS, BELLARY DISTRICT, KARNATAKA STATE**

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# HAGARIBOMMANAHALLI TALUK AQUIFER MAPS AND MANAGEMENT PLANS, BELLARY DISTRICT, KARNATAKA STATE

## 1. SALIENT INFORMATION

<b>Name of the taluk</b>	: HAGARIBOMMANAHALLI (H.B.Halli)
<b>District</b>	: Bellary
<b>State</b>	: Karnataka
<b>Area</b>	: 1,017 sq.km.
<b>Population</b>	: 1,88,238 (2011)
<b>Annual Normal Rainfall</b>	: 556 mm

### 1.1 Aquifer management study area

Aquifer mapping studies have been carried out in Hagaribommanahalli (H.B.Halli) taluk, Bellary district of Karnataka, covering an area of 1,017 sq.kms, under National Aquifer Mapping Project. H.B.Halli taluk of Bellary district is located between north latitude  $14^{\circ}50'44.4''$  and  $15^{\circ}14'11.1''$  & east longitude  $76^{\circ}00'52.5''$  and  $76^{\circ}22'00.3''$ , and is covered in parts of Survey of India Toposheet Nos. 57A/2, 57A/8, 57B/1 and 57B/5. The taluk is bounded by Koppal taluk of Koppal district on north, Harapanahalli & Kudligi taluks on south, Hospet taluk on east and Hadagali taluk on western side. Location map of Hagaribommanahalli taluk is presented in Fig-1.

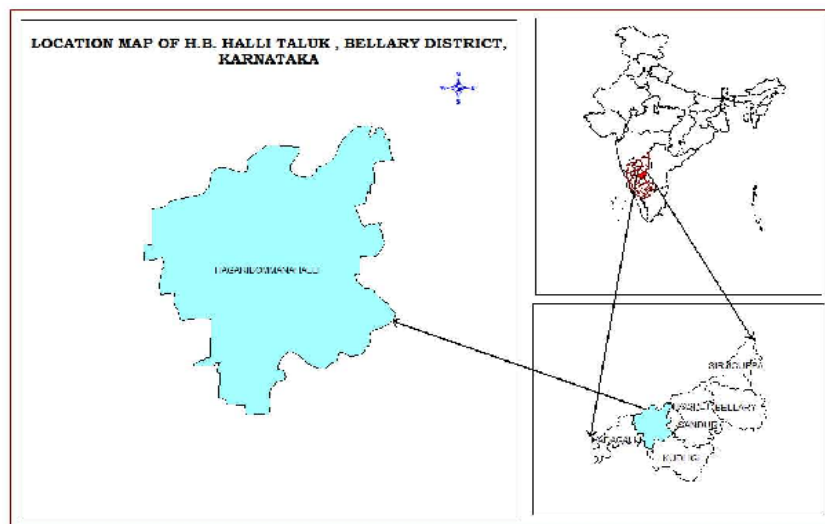


Fig 1. Location Map of Haqaribommanahalli taluk

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

## 1.2 Population

According to 2011 census, the population in H.B.Halli taluk is 1,88,238, in which all constitute the rural population. The study area has an overall population density of 185 persons per sq.km. The decadal variation in population from 2001-2011 is 17.73% in H.B.Halli taluk.

## 1.3 Rainfall

Hagaribommanahalli 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 normal annual rainfall in the taluk for the period 1981 to 2010 is 556 mm. Seasonal rainfall pattern indicates that, major amount of (334 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 60% of the annual normal rainfall, followed by North-East Monsoon season (128 mm) constituting 23% and remaining (94 mm) 17% in Pre-Monsoon season (Table-1).

Computations were carried out for the 30 year blocks of 1981-2010, the mean monthly rainfall at H.B.Halli is ranging between 0 mm during January to 125 mm during September. The coefficient of variation percent for pre-monsoon, monsoon and post-monsoon season are 68, 35 and 51 percent respectively. Annual CV at this station works out to be 29 percent (Table-1).

Table 1: Statistical Analysis of Rainfall Data of H.B.Halli Station, (1981 to 2010)

	JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
NRM	0	1	8	18	67	94	72	59	78	125	334	90	28	10	128	556
ST. DEV.	1	4	19	18	59	64	71	39	44	88	117	49	39	22	65	162
CV%	275	353	246	100	88	68	99	65	57	70	35	55	141	223	51	29

## 1.4 Agriculture & Irrigation

Agriculture is the main occupation in H.B.Halli taluk. Major Kharif crops are maize, bajra, jowar, tur and vegetables. Main crops of Rabi season are maize, horse gram, groundnut, and sunflower (Table-2). Water intensive crops like sugarcane and paddy are grown in 6% of total crop area. Maize is grown in 37% and oil seeds in 25% of total crop area of taluk. Bajra & jowar account 16% of the total cropped area.

It is observed that net sown area accounts 42% and area sown more than once is 20% of total geographical area in H. B. Halli taluk (Table-3). Area not available for cultivation and Fallow land cover 27% & 23% of total geographical area respectively. Irrigation by groundwater accounts for 96% of net area irrigated and only 4% are is irrigated by lift irrigation (Table-4).

Table 2: Cropping pattern in H.B.Halli taluk 2014-2015 (Ha)

Year	Paddy	Maize	Bajra	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
Area under cultivation (Ha)										
2014-2015	3247	22282	5719	4029	3453	1292	2166	14977	752	2209

Table 3: Details of land use in H.B.Halli 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
H.B.Halli	97599	4482	26306	22253	41268	19862

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

Table 4: Irrigation details in H.B.Halli taluk (Ha)

Source of Irrigation	Net area irrigated (Ha.)	% of area
Canals	0	0
Tanks	0	0
Wells	0	0
Bore wells	14328	96%
Lift Irrigation	607	4%
Other Sources	0	0
<b>Total</b>	<b>14935</b>	

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

### 1.5 Geomorphology, Physiography & Drainage

H.B.Halli taluk may be classified as Northern Maidan region with monotonous, treeless, and expansive plateau landscape. The step like landscape, hills and ridges are the general features of the northern maidan region. The central part is occupied by hills and plains to east and west. The Sandur hills run North West of the Bellary district dividing the district in to two distinct parts. Hagaribommanahalli taluk falls in western part. The average elevation of the taluk is 493.71m amsl (Fig.-2).

H.B.Halli taluk falls in Krishna basin. The Tungabhadra perennial river forms major drainage system. Tungabhadra drains from south western part, than flows north east to east west and drains out of the Bellarydistrict. Chikka Hagari and Hagari/Vedavathi are the tributaries of Tungabhadra runs south to north from the southern tip of the Bellary district. These are seasonal rivers flows during monsoon season. A Medium irrigation project across this Chikkahagari river exists at Malavi in H.B.Halli taluk. Number of minor streams which rises locally and ultimately drains into Tungabhadra. The drainage in the district is dendritic to sub-dendritic in nature (Fig 3).

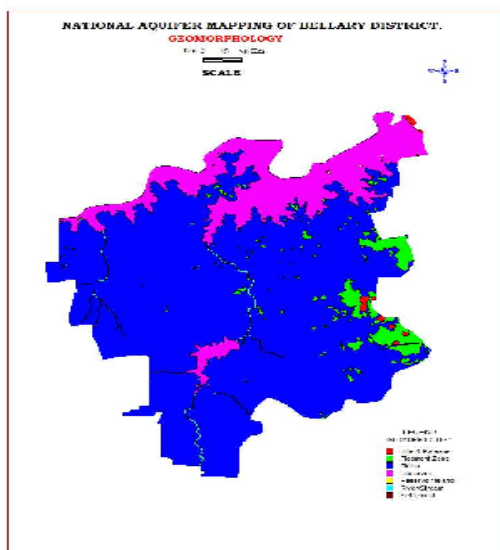


Fig 2: Geomorphology Map

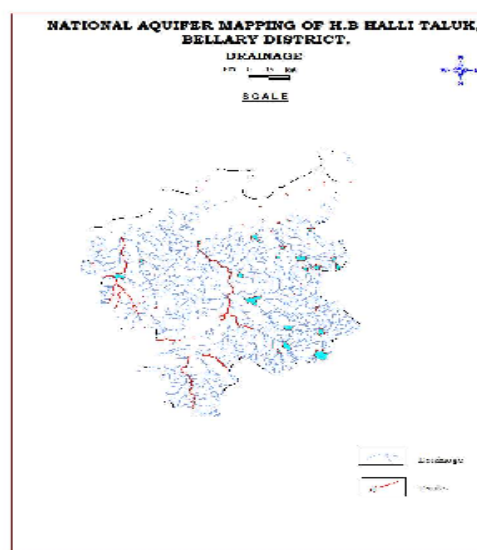


Fig 3: Drainage Map

## 1.6 Soil

The soils of the H.B.Halli taluk are derived from gneiss and granite rocks. The sandy loam soil mixed with black and grey soil occurs along the stream beds. The red soil are the major type of soil, found mainly at elevated places especially at fringes of hills. The black soil is found in the prolonged submerged areas and canal command areas.

## 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 Dynamic + phreatic in-storage + fractured
		Phreatic	Fractured (Down to 200m)	
H.B.Halli	5339	18681	3264	27283

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

- Net ground water availability for future irrigation development : 4.39 MCM
- Domestic (Industrial sector) demand for next 25 years : 6.53 MCM

## 1.9 Water level behavior

### (a) Depth to water level

#### Aquifer - I

- Pre-monsoon: 1.30 – 3.87 mbgl (Fig.-4)
- Post-monsoon: 1.18 – 1.85 mbgl (Fig.-5)

#### Aquifer - II

- Pre-monsoon: 13.58 (5.0 - 40.0) mbgl (Fig.-6)

- Post-monsoon: 18.30 (2.0 - 40.0) mbgl (Fig.-7)

**(b) Water level fluctuation**

**Aquifer-I (Fig.-8)**

- Seasonal Fluctuation: Rise ranges 0.92 – 2.02 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

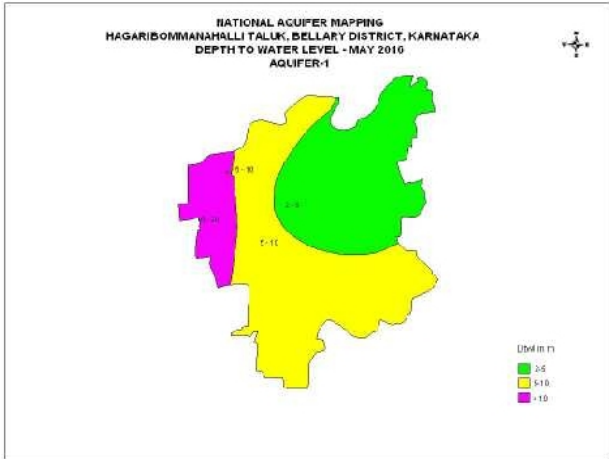


Fig 4: Pre-monsoon Depth to Water Level (Aq-I)

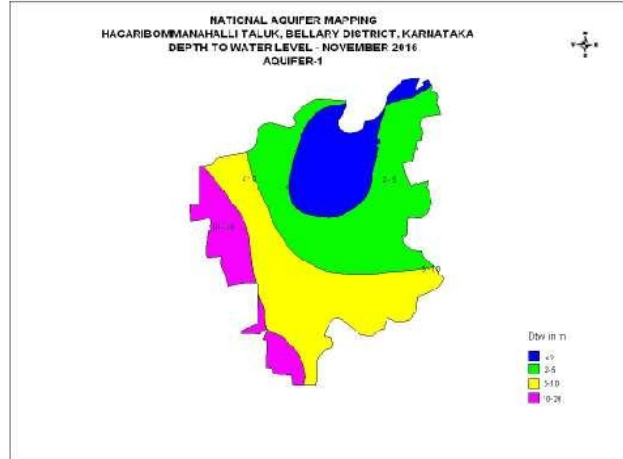


Fig 5: Post-monsoon Depth to Water Level (Aq-II)

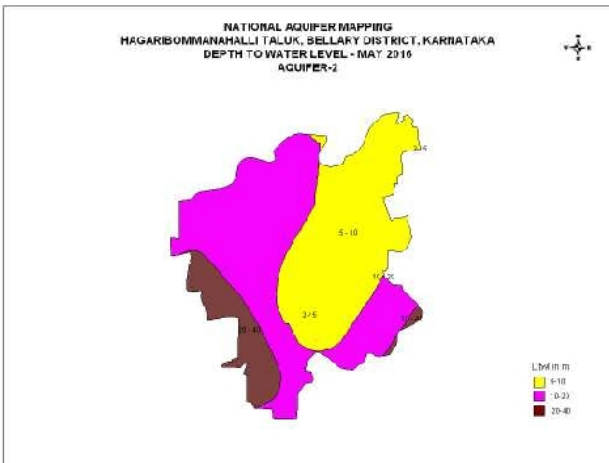


Fig 6: Pre-monsoon Depth to Water Level (Aq-II)

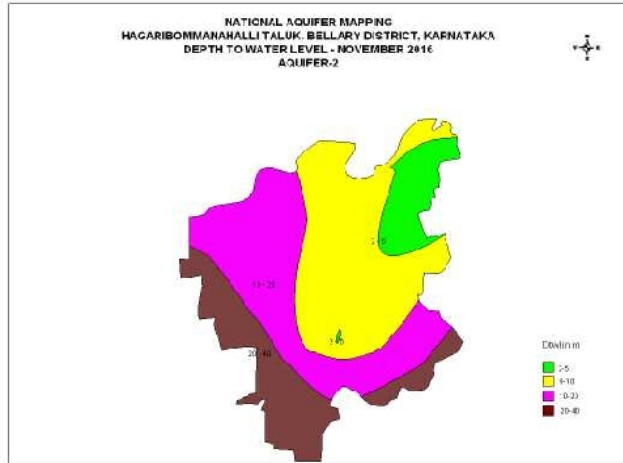


Fig 7: Post-monsoon Depth to Water Level (Aq-II)



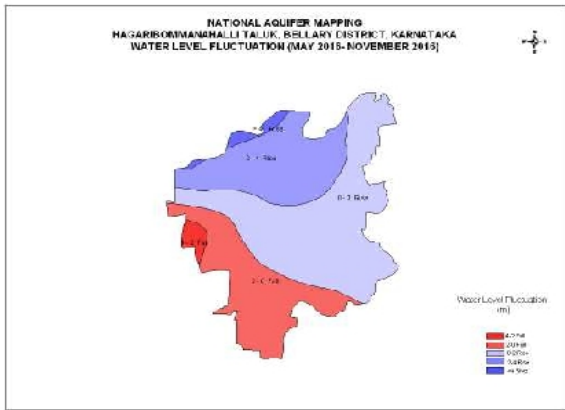


Fig 8: Water Level Fluctuation (Aq-I)

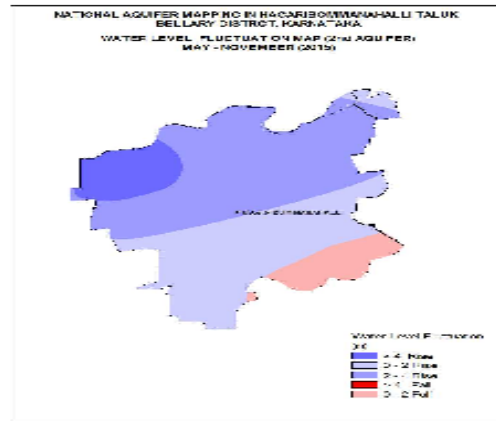


Fig 9: Water Level Fluctuation (Aq-II)

## 2. AQUIFER DISPOSITION

**2.1 Number of aquifers:** In H.B.Halli taluk, there are mainly two types of aquifer systems;

- i. **Aquifer-I (Phreatic aquifer)** comprising Weathered Granite Gneiss
- ii. **Aquifer-II (Fractured aquifer)** comprising Fractured Granite Gneiss

In **Hagaribommanahalli taluk**, granitic-gneisses is the main water bearing formations (Fig-10). Ground water occurs within the weathered and fractured granitic-gneisses under water table condition and semi-confined condition. In the taluk bore wells were drilled from a minimum depth of 80 mbgl to a maximum of 200 mbgl (Table-6). Thickness of weathered zone (Aquifer-I) ranges from 11.7 mbgl to 16.9 mbgl (Fig-11). Ground water exploration reveals that aquifer-II (fractured formation) was encountered between the depth of 22 and 200 mbgl. Yield ranges from 0.01 to 6.5 lps. The basic characteristics of each aquifer are summarized in Table-7.

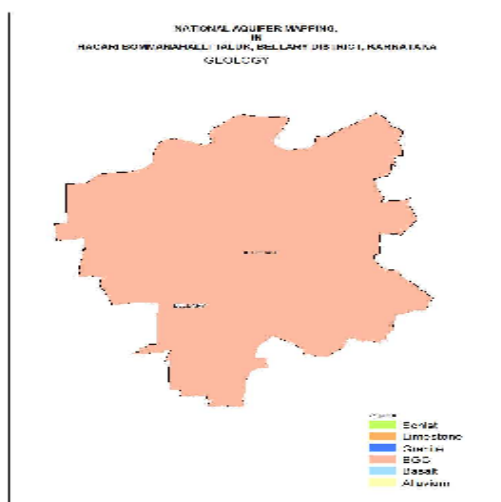


Fig 10: Geology Map

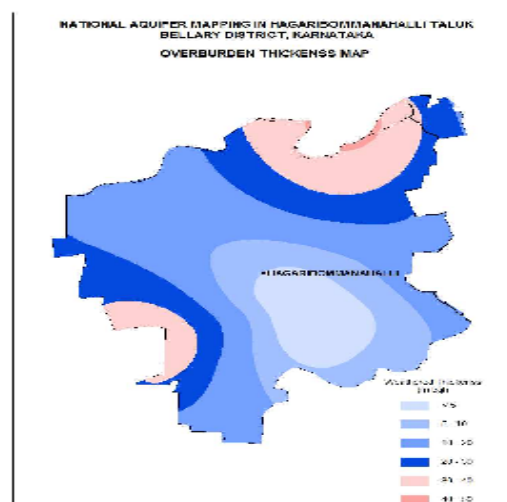


Fig 11: Weathered thickness map (Aq-I disposition)

Table 6: Details of Ground water Exploration

S. No.	Location	Latitude	Longitude	Depth Drilled (mbgl)	Casing Depth (m)	SWL (mbgl)	Q (lps)	DD (m)	T (m <sup>2</sup> /day)
1	Dhanapura	15.3772	76.2333	200	11.7	5.52	0.13	-	4
2	Magimavinahalli	15.0908	76.3289	200.75	16.9	3.71	0.61	30.05	0.4
3	Kogali EW	14.9417	76.1583	80		7.57	1.18	0.98	
4	Kogali OW	14.9417	76.1583	80		6.98	1.25	0.71	
5	Bannekallu OW	14.9667	76.2500	85		11.39	1.75	2.76	
6	Hampasagara	15.1194	76.0633	144.3	16.5	24.19	3.3	1.20	131
7	Hampasagara	15.1194	76.0633	200	14.3	23.02	3.5	4.40	157
8	H.B.Halli	12.5333	76.2089	200	15.6	14.47	5.5	1.35	243

Table 7: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Gneiss / Schist	Fractured / Jointed Gneiss / Schist
Thickness range (mbgl)	20	Fractures upto 200 mbgl
Depth range of occurrence of fractures (mbgl)	-	22 - 200 80% between 50 - 200
Range of yield potential (lps)	Poor yield	1 - 5
Specific Yield	2%	0.2%
T (m <sup>2</sup> /day)	-	0.4 – 243
Quality	Suitable	Suitable
Suitability for Irrigation	Suitable	Suitable
Suitability for Domestic purposes	Suitable	Suitable
Remarks	Over exploited	Ground water 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)

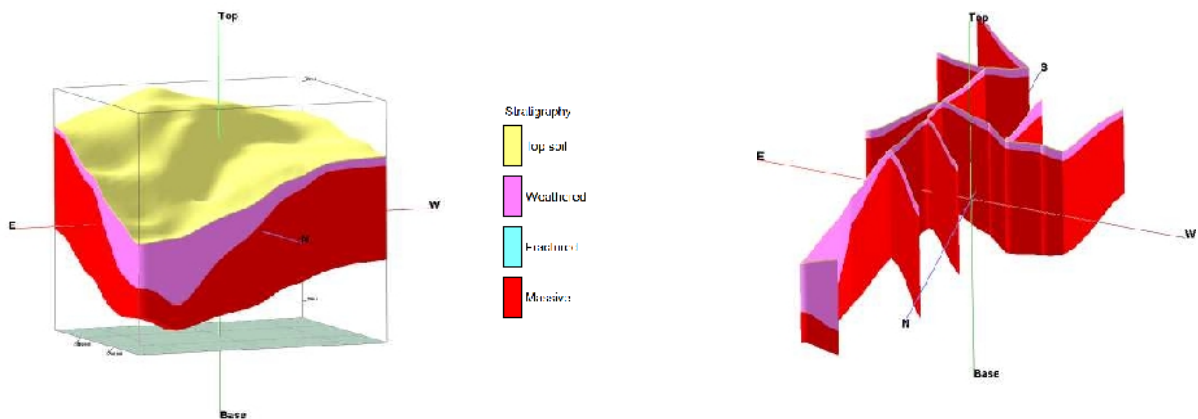


Fig 12: 3D aquifer Disposition and Fence Diagram

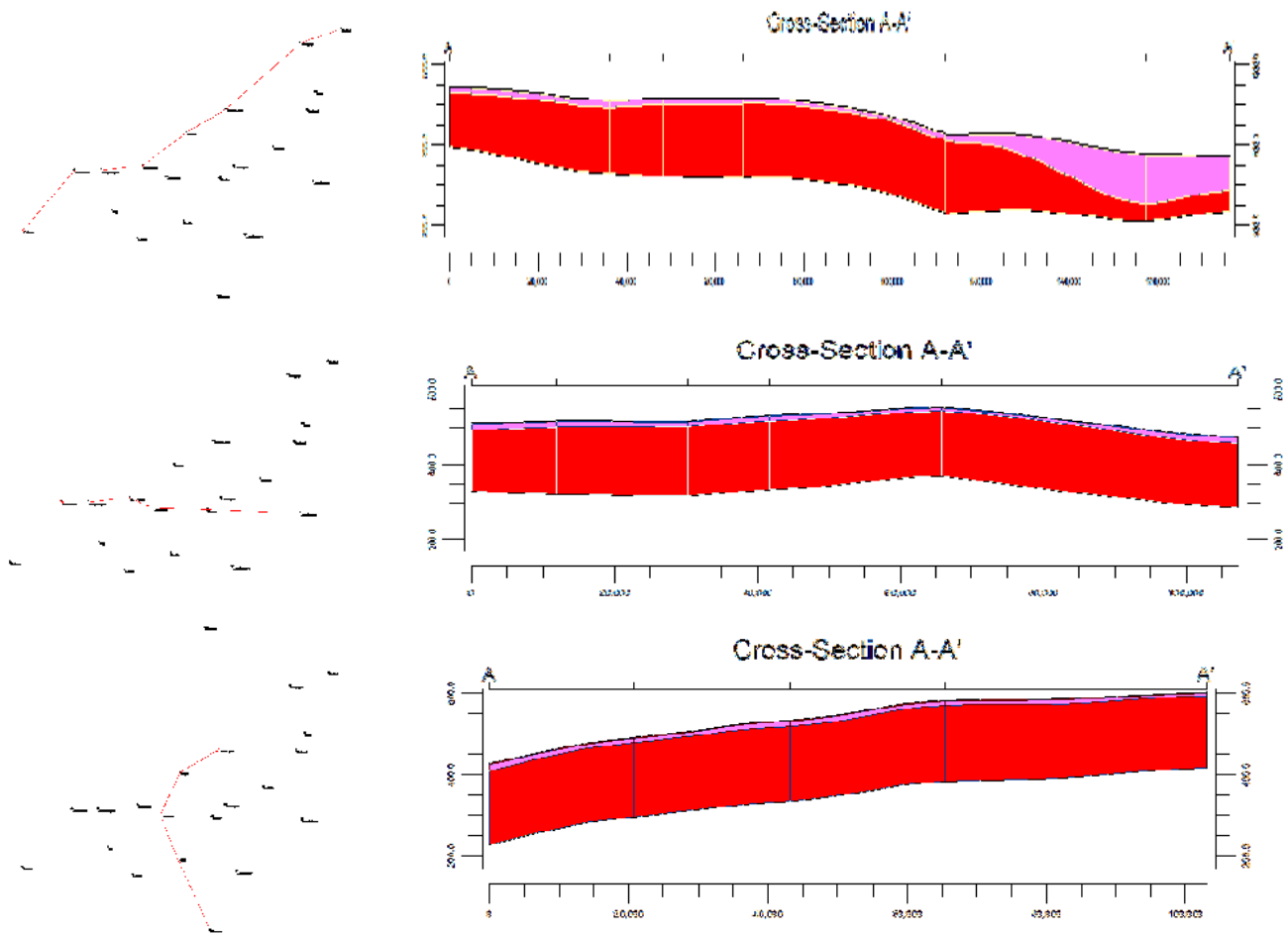


Fig 13: Cross sections of aquifers in different directions

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

#### a. Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2013)

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
H.B.Halli	5339	4953	533	5486	653	439	103	OE

(b) Present total Ground Water Resource (Ham)

Taluk	Annual Replenishble GW resources	Fresh In-storage GW resources		Total availability of GW resource
		Phreatic	Fractured	Dynamic + phreatic in-storage + fractured in-storage
H.B.Halli	5339	18681	3264	27283

(c) Comparison of ground water availability and draft scenario

Taluk	GW availability (Ham)	GW draft (Ham)	Stage of GW development %	GW availability (Ham)	GW draft (in ham)	Stage of GW development	GW availability (Ham)	GW draft (Ham)	Stage of GW development %
	2009			2011			2013		
	H.B.Halli	5223	5358	103	5261	5280	100	5339	5486

**b. Chemical quality of ground water and contamination**

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

**Electrical Conductivity:** In general, EC values range from 416 to 800  $\mu$ /mhos/cm at 25°C and are within the permissible limit in both the aquifers (Fig-14).

**Fluoride:** Fluoride concentration in ground water is of geogenic origin in areas underlain by younger granites/ gneisses containing minerals like Fluorspar & fluoroapatite. F value ranges between 0.2 – 0.4 mg/l which are also within the permissible limit of 1.5 mg/l(Fig-15).

**Nitrate:** Nitrate value ranges between 7.4 to 24 mg/l which are within the permissible limit of 45 mg/l.

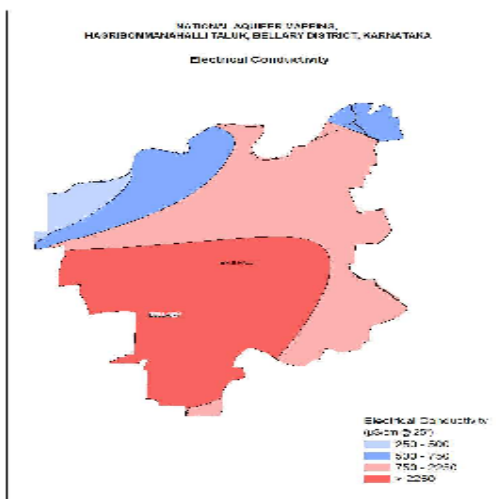


Fig 14: Electrical Conductivity Map



Fig 15: Fluoride Map

In general, ground water quality in Hagaribommanahalli taluk is good for drinking purpose except in some areas as depicted in above illustrated maps, where nitrate & fluoride are found to be in higher concentrations 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. Aquifer wise space available for recharge and proposed interventions

Recharge dry **phreatic aquifer (Aq-I)** in the taluk, through construction of artificial recharge structures, viz; check dams, percolation tanks & point recharge structures (Table-8). 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.

Table 8: Quantity of non-committed surface runoff & expected recharge through AR structures

Artificial Recharge Structures Proposed	Hagaribommanahalli taluk
Non committed monsoon runoff available (MCM)	8.00
Number of Check Dams	49
Number of Percolation Tanks	3
Number of Point Recharge structures	5
Tentative total cost of the project (Rs. in lakhs)	191.74
Expected recharge (MCM)	4.51
Expected rise in water level (m)	0.23
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	4.26

##### b. Improvement in GW availability due to Recharge, Hagaribommanahalli 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 schemes through interbasin 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 ground water development
	HAM	HAM	%	HAM	HAM	HAM		%
H.B.Halli	5339	5486	103	620	5886	11845	47	56

##### c. Alternate water sources

- **Proposed GW Recharge and Assured Supply of Drinking Water Schemes (Inter basin Transfer):** Inter-basin transfer from Tunga Basin under Project-2 service canal

is proposed in the “Integrated Irrigation Development Schemes” by Shri.G.S.Paramashivaiah, Retd. CE, Irrigation Department and submitted to the Govt. of Karnataka.

- Under this project, it is proposed to fill Minor Irrigation tanks with 79 TMC of water to 19 taluks of Bellary, Davanagere, Tumkur and Kolar districts. 50% recharge is considered from the surface water proposed to fill the tanks for irrigation, which includes recharge from tanks, canal seepage and return flow from irrigation.
- For Hagaribommanahalli taluk, it is calculated that about 5886 Ham can be considered as recharge from above project, if commenced.
- After implementation of Artificial Recharge structures and proposal of GW recharge scheme (inter-basin transfer), the annual ground water availability will increase from 5339 to 11676 ham and the expected improvement in stage of development is 56% from 103% to 47%

## **5. DEMAND SIDE INTERVENTIONS**

### **a. Advanced irrigation practices**

It is observed that bore wells are only the source for irrigation in H.B.Halli 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 21352 ha of gross irrigated area by bore wells.
- Irrigation draft is 4931 ham.
- Efficient irrigation techniques will contribute in saving ground water by 1490 ham and thus will improve stage of development by 5% from 47% to 42% (Table-9).

### **b. Change in cropping pattern**

Water intensive crops like paddy & sugarcane are grown in 6% of total cropped area by surface water from lift irrigation source in the H.B.Halli 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	Cumulative annual ground water availability after implementing AR structures & irrigation development schemes	Existing gross ground water draft for all uses	Stage of ground water development after implementing AR structures & proposed irrigation development schemes through interbasin transfer	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		%
H.B.Halli	11845	5486	47	1490	13335	42	5

### c. Water Logging and additional area of irrigation

Area prone for water logging falls between 2-5 m pre-monsoon water level contour is estimated (Table-10). In these areas, quantum of withdrawal of ground water is calculated considering specific yield of 2% and water column to be reduced to 5 mbgl. The volume of ground water withdrawn in H.B.Halli taluk is 1984 ham (0.0.701 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 37% of total crop area of taluk, it is suggested that additional area of 2977 ha can be irrigated for Maize or 4961 ha for Jowar crops (Table-10).

Table 10: Withdrawal of Ground Water and Increase in area of Irrigation in H.B.H taluk

Water Level Range (mbgl)	Water Level 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
0 - 2	5	4	0	0.02	0	0.000	0	0
2 - 5	5	3	33071	0.02	1984	0.701	2977	4961
<b>Total</b>					<b>1984</b>	<b>0.701</b>	<b>2977</b>	<b>4961</b>

### d. Regulation and Control

- Hagaribommanahalli taluk has been categorized as **Over-exploited**, since the Stage of ground water development has reached **103%** (GE March 2013). Hence, stringent action has to be taken up through Karnataka Ground Water Authority to control further ground water exploitation in the taluk.
- Ground water recharge component needs to be made mandatory in the non-command area of the taluk for further development of ground water.

**e. Other interventions proposed**

- Periodical maintenance of artificial recharge structures should also be incorporated in the Recharge Plan.
- Excess nitrate & fluoride concentration is found in ground water samples require remedial measures viz.
  - Dilution of nitrate rich ground water through artificial recharge & water conservation.
  - Roof top rain water harvesting.
  - Micro irrigation.

**6. SUMMARY**

The summary of Management plan of H.B.Halli taluk is given in Table-11.

Table 11: Summary of Management plan of H.B.Halli taluk

H.B.Halli taluk is over-exploited & present stage of GW Development (2013)	103%
Net Annual Ground Water Availability (MCM)	53.39
Existing Gross Ground Water Draft for all uses	54.86
Groundwater development feasibility	4.39
Total GW Resources (Dynamic & Static upto the depth of 200 mbgl) (MCM)	272.83
Expected additional recharge from monsoon surplus runoff (MCM)	6.20
Change in Stage of GW development, %	103 to 92
Expected additional recharge from proposed irrigation development schemes through interbasin transfer (MCM)	58.86
Change in Stage of GW development, %	92 to 47
Expected Saving due to adopting WUE measures (MCM)	14.90
Change in Stage of GW development, %	47 to 42
Prone for Water Logging area	<ul style="list-style-type: none"> <li>• Area prone for water logging is 33071 ham</li> <li>• volume of ground water withdrawn in H.B.Halli taluk is 1984 ham</li> <li>• additional area of 2977 ha can be irrigated for Maize or 4961 ha for Jowar crops</li> </ul>



