



## 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**

**Arsikere Taluk, Hassan District, Karnataka**

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

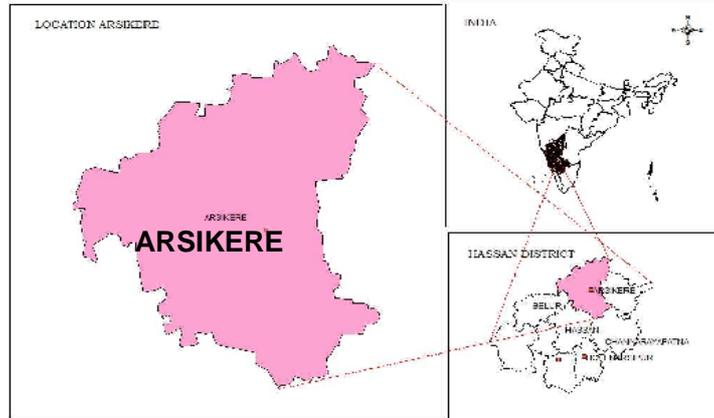
South Western Region, Bengaluru

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

**ARSIKERE TALUK AQUIFER MAPS AND MANAGEMENT  
PLANS, HASSAN DISTRICT, KARNATAKA STATE**



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**ARSIKERE TALUK AQUIFER MAPS AND MANAGEMENT PLANS,  
HASSAN DISTRICT, KARNATAKA STATE**

**1. SALIENT INFORMATION**

**Name of the taluk** : ARSIKERE  
**District** : Hassan  
**State** : Karnataka  
**Area** : 1,275 sq.km.  
**Population** : 3,15,339  
**Annual Normal Rainfall** : 764 mm

**1.1 Aquifer management study area**

Aquifer mapping studies was carried out in Arsikere taluk, Hassan district of Karnataka, covering an area of 1,275 sq.kms under National Aquifer Mapping Project. Arsikere taluk of Hassan district is located between north latitude 13° 04' 30.4" and 13° 32' 50.6" & east longitude 76° 01' 40.4" and 76° 25' 53.7", and is covered in parts of Survey of India Topo sheet Nos. 57C/3, 57C/4, 57C/6, 57C/7 and 57C/8. Arsikere taluk is bounded by Kadur taluk of Chikmagalur district on north, Belur & Chikmagalur taluks on south, Hassan & Channarayapatna taluks on east and Tiptur & Chikanayakanahalli taluks of Tumkur district on western side. Location map of Arsikere taluk of Hassan district is presented in Figure-1.

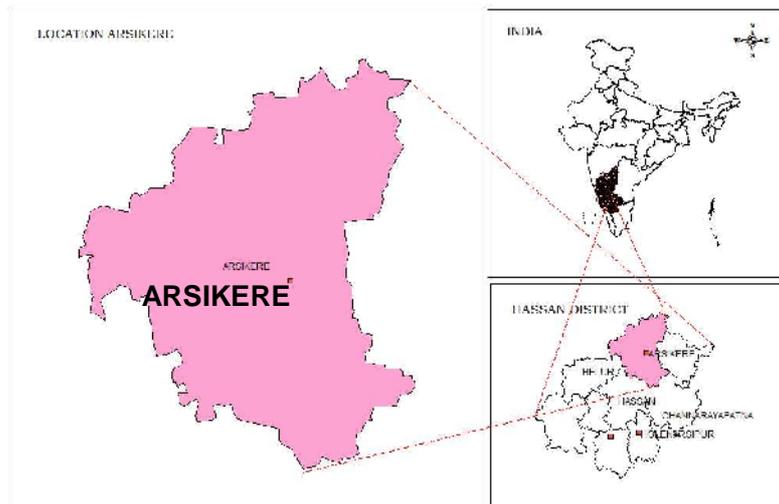


Fig 1: Location Map of Arsikere taluk, Hassan district

Taluk administration of Arsikere taluk is divided into 5 Hoblies namely Kasba, Kanakatte, Javagallu, Banavar and Gandasi. Arsikere is only one town, which is also the taluk head quarter. There are 369 inhabited and 25 uninhabited villages in Arsikere taluk.

## 1.2 Population

According to 2011 census, the population in Arsikere taluk is 3,15,339, in which 2,62,123 constitute the rural population and 53,216 is the urban population, which works out to 83% (rural) and 17% (urban) of the total population of taluk. The study area has an overall population density of 247 persons per sq.km. The decadal variation in population from 2001-2011 is 4.06% in Arsikere taluk.

## 1.3 Rainfall

Arsikere taluk enjoys semi-arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Central Dry agro-climatic zone of Karnataka state and is categorized as drought prone. The normal annual rainfall in Arsikere taluk for the period 1981 to 2010 is 764 mm. Seasonal rainfall pattern indicates that, major amount of (407 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 53% of the annual normal rainfall, followed by North-East Monsoon season (211 mm) constituting 28% and remaining (145 mm) 19% in Pre-Monsoon season (Table-1).

Computations were carried out for the 30 year blocks of 1981-2010, the mean monthly rainfall at Arsikere taluk is ranging between 4 mm during February to 159 mm during October. The coefficient of variation percent for pre-monsoon, monsoon and post monsoon season is 167, 260 & 169 percent respectively. Annual CV at this station works out to be 316 percent (Table-1).

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

STATION		JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
ARSIKERE	NRM	5	4	16	34	87	145	80	95	102	130	407	159	46	6	211	764
	ST.DEV	14	14	32	33	59	87	66	88	67	66	156	122	57	10	125	242
	CV%	35	29	48	101	147	167	120	109	153	197	260	131	81	65	169	316

## 1.4 Agriculture & Irrigation

Agriculture is the main occupation in Arsikere taluk. Major Kharif crops are maize, ragi, jowar, tur and vegetables. Main crops of Rabi season are maize, ragi, horse gram, groundnut, and sunflower (Table-2). Maize is grown in 20%, ragi in 36%, pulses in 31% and oil seeds in 5% of total crop area of taluk. Water intensive crops like sugarcane and paddy are grown in the taluk.

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

Year	Paddy	Maize	Ragi	Jowar	Pulses	Fruits	Vege- tables	Oil seeds	Sugar- cane	Cotton
	Area under cultivation (Ha)									
2014-2015	0	14519	26259	1045	22544	3017	2464	3776	7	32

It is observed that net sown area accounts 64% and area sown more than once is 20% of total geographical area in Arsikere taluk (Table-3). Area not available for cultivation and Forest cover each

12% of total geographical area. 79% of net area irrigated is only from bore wells and 21% from tank irrigation (Table-4).

Table 3: Details of land use in Arsikere 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
Arsikere	123452	15049	14923	9973	79442	24413

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

Table 4: Irrigation details in Arsikere taluk (Ha)

Source of Irrigation	Net area irrigated (Ha)	% of Net area irrigated
Canals	0	
Tanks	3704	21%
Wells	0	
Bore wells	13952	79%
Lift Irrigation	0	
Other Sources	0	
<b>Total</b>	<b>17656</b>	<b>100</b>

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

### 1.5 Geomorphology, Physiography & Drainage

The general land elevation on the southern side of the Arsikere taluk is about 980 m and it reduces to about 760 m amsl in the north. The general slope is mostly towards north. The other prominent hillocks are Karekal Gudda (1272m), Doddagudda (1202m), Tirupati Gudda (1171m). The taluk headquarter has an average elevation of 807 m amsl (Fig.-2).

The taluk is mostly drained by 1<sup>st</sup> to 4<sup>th</sup> order streams and mostly flow towards north. The southern boundary of the taluk is mostly coinciding with the basin boundary between Krishna and Cauvery basins. The tank system is well developed in the taluk and there are 249 tanks. The general drainage patterns in gneissic and granite formation is dendritic to sub dendritic in nature (Fig.-3).

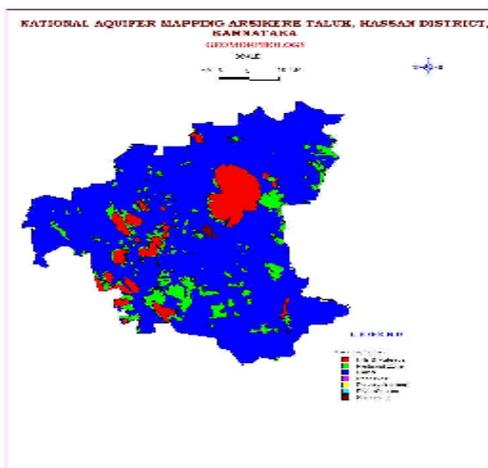


Fig 2: Geomorphology Map

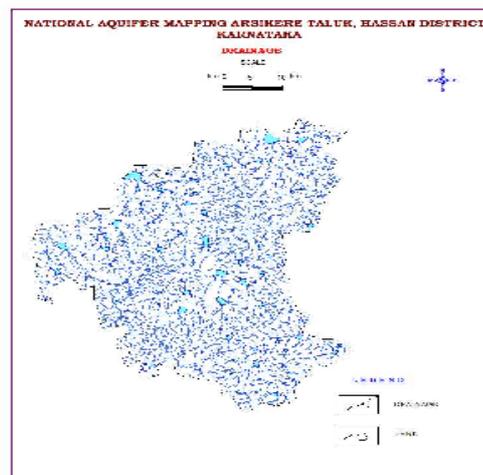


Fig 3: Drainage Map

## 1.6 Soil

In general the taluk is covered by red soil. Patches of black cotton soil are also found at places. The red soils in general derive from granite gneisses. Black cotton soil is derived from schist and alluvial soil found in limited extent and confined to river/nala courses.

## 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)	
Arsikere	10122	0	2762	12883

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

- Net ground water availability for future irrigation development : 9.34 MCM
- Domestic (Industrial sector) demand for next 25 years : 4.24 MCM

## 1.9 Water level behavior

### (a) Depth to water level

#### Aquifer - I

- Pre-monsoon: 2.16 – 15.96 mbgl (Fig.-4)
- Post-monsoon: 0.11 – 11.16 mbgl (Fig.-5)

#### Aquifer - II

- Pre-monsoon: 5.07 – 83.13 mbgl (Fig.-6)
- Post-monsoon: 4.02 - 78.00 mbgl (Fig.-7)

### (b) Water level fluctuation

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

- Seasonal Fluctuation: Rise ranges 0.0 – 2.53 m;  
Fall ranges 3.55 (0.0 – 4.0) m

#### Aquifer-II (Fig.-9)

- Seasonal Fluctuation: Rise shows 4.2 m;

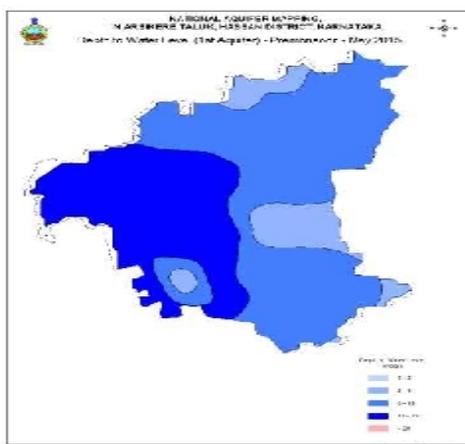


Fig 4: Pre-monsoon Depth to Water Level (Aq-I)

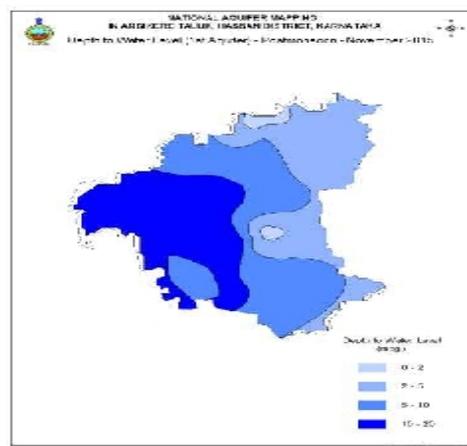


Fig 5: Post-monsoon Depth to Water Level (Aq-I)

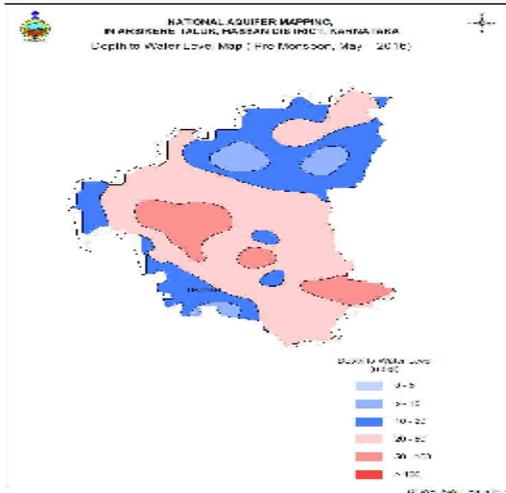


Fig 6: Pre-monsoon Depth to Water Level (Aq-II)

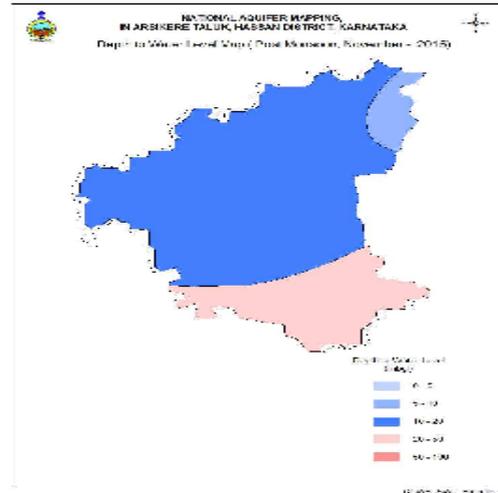


Fig 7: Post-monsoon Depth to Water Level (Aq-II)

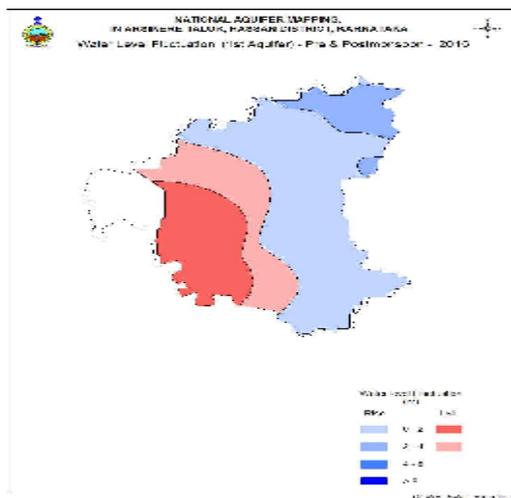


Fig 8: Water Level Fluctuation (Aq-I)

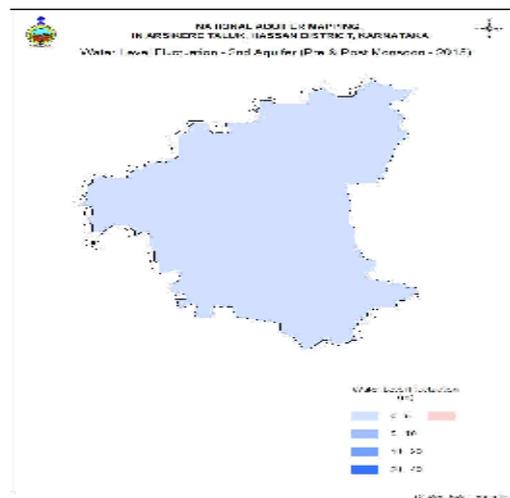


Fig 9: Water Level Fluctuation (Aq-II)

## 2. AQUIFER DISPOSITION

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

- i. **Aquifer-I (Phreatic aquifer)** comprising Weathered Banded Gneissic Complex / Schist
- ii. **Aquifer-II (Fractured aquifer)** comprising Fractured Banded Gneissic Complex / Schist

In Arsikere taluk, granitic-gneisses & schist are the main water bearing formations (Figure-10). Ground water occurs within the weathered and fractured granitic-gneisses & schist under water table condition and semi-confined condition. In Arsikere taluk bore wells were drilled from a minimum depth of 162 mbgl to a maximum of 200 mbgl (Table-6). Depths of weathered zone (Aquifer-I) ranges from 6.0 mbgl to 33.0 mbgl (Figure-11). Ground water exploration reveals that aquifer-II fractured formation was

encountered between the depths of 30 to 200 mbgl. Yield ranges from 0.01 to 12.14 lps. Transmissivity ranges from 18.48 to 354.96 m<sup>2</sup>/day.

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

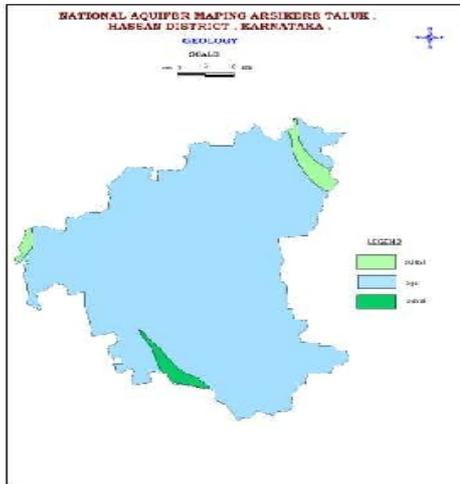


Fig 10: Geology Map

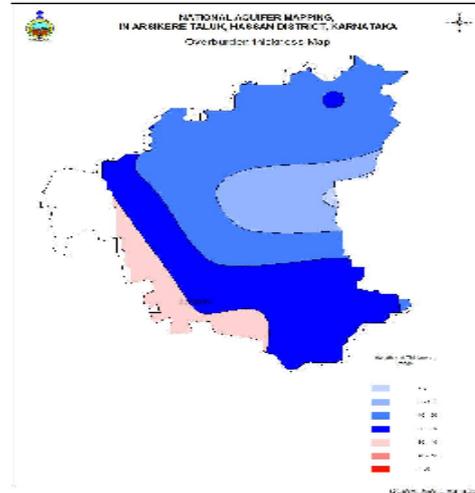


Fig 11: Weathered thickness map (Aq-I disposition)

Table 6: Details of Ground Water Exploration

S. No.	Location	Lat.	Long.	Depth Drilled (mbgl)	Casing Depth (m)	Fracture Zones	SWL (mbgl)	Q (lps)	DD (m)	T (m <sup>2</sup> /day)
1	Madalu EW	13.4806	76.3500	192	24.4	54.48-56.48: 76.4-77.4: 107.96-109.96: 113.96-115.60	16.45	6.58	12.36	41
2	Madalu EW-II	13.4806	76.3500	200	18	130.88-132.88: 136.8-138.52	13.92	5	3.88	77
3	Mallikallu Tirupathi EW	13.3300	76.2800	174.08	6	33.56-35.56	18.58	8.2	3.9	354.96
4	Mallikallu Tirupathi OW	13.3300	76.2800	200	6	22.28-22.35,46.84-48.84	20.32	0.01		
5	Manakattur EW-I	13.3861	76.1722	168.52	12	28-30;36-37;39-40;51-52;54-55;80-81;152-154;162.44	4.035	7.2	4.65	88
6	Manakattur EW-II	13.3861	76.1722	162.44	13.5	50.84-51.15,129.24-130.5.161.44-162.5	3.6	12.14	12.12	60
7	S.Diggenahalli EW	13.3600	76.0700	200	32.5	62.12-64.12, 109.96-111.96, 140.52-142.52, 148.16-150.16, 182.72-184.36, 186.36-188.36	11.51	6.41	10.58	22.26
8	S.Diggenahalli OW	13.3600	76.0700	200	33	31.56-32.05, 69.76-70.0, 93.68-94.25, 138.52-139, 165.04-166.	4.81	4.42	14.91	18.48

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)	30	Fractures up to 200 mbgl
Depth range of occurrence of fractures (mbgl)	-	28 - 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.

### 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
	ham	ham	ham	ham	ham	ham	%	
Arsikere	10122	9965	412	10377	424	934	103	OE

##### (b) Present total Ground Water Resource (in 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
Arsikere	10122	0	2762	12883

##### (c) Comparison of ground water availability and draft scenario in Arsikere taluk

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		
Arsikere	10123	10340	102	10060	10167	101	10122	10377	103

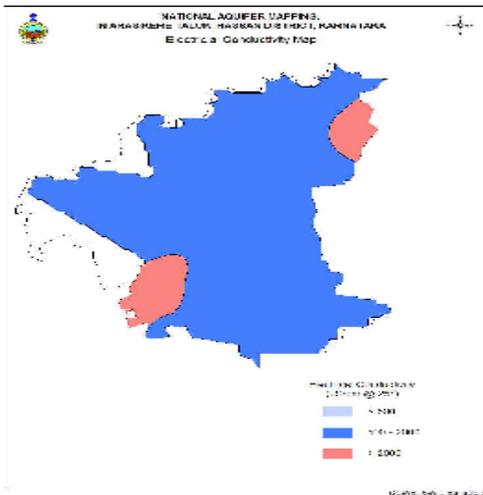
#### b. Chemical quality of ground water and contamination

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

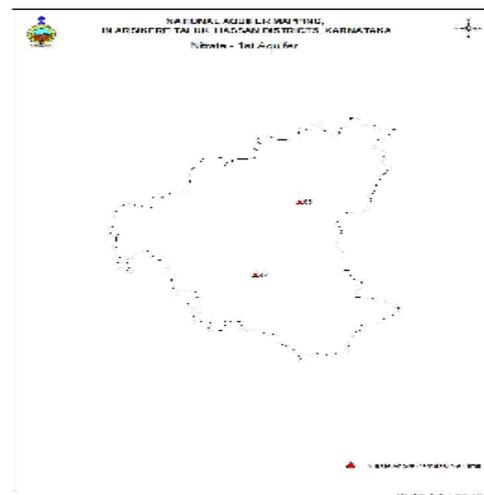
**Electrical Conductivity:** In general, EC values in Aq-I range from 510 to 2410  $\mu$ /mhos/cm at 25°C which are within the permissible limit in both the aquifers (Figure-14). In Aquifer-II, EC value ranges from 980 to 1930  $\mu$ /mhos/cm at 25°C.

**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 0.54 – 0.91mg/l which are within the permissible limit of 1.5 mg/l.

**Nitrate:** Nitrate value ranges between 10 to 47 mg/l. Mududi village sample indicate nitrate (100 mg/l) greater than the permissible limit of 45 mg/l



**Fig-14: Electrical Conductivity Map**



**Figure-15: Nitrate Map**

In general ground water quality in Arsikere taluk is good for drinking purpose except in some areas as depicted in above illustrated maps, where nitrate & fluoride 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. 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	Arsikere taluk
Non committed monsoon runoff available (MCM)	15.91
Number of Check Dams	98
Number of Percolation Tanks	7
Number of Point Recharge structures	11
Tentative total cost of the project (Rs. in lakhs)	383.64
Expected recharge (MCM)	9.02
Expected rise in water level (m)	0.41
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	4.26

**b. Improvement in GW availability due to Recharge, Arsikere 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 Yettinahole project 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 ground water development
	HAM	HAM	%	HAM	HAM	HAM		%
Arsikere	10122	10377	103	902	1133	12156	85	17

**c. Proposed Yettinahole Project**

- Yettinahole project is a drinking water supply scheme which neither proposes irrigation use nor development of any command areas.
- The project envisages Drinking Water Supply Scheme to Chikballapur district along with other six districts ie. Kolar, Bangalore Rural, Ramnagaram, Tumkur, Hassan and Chickmagalur by Karnataka Neeravri Nigam Ltd, Government of Karnataka.
- The project proposal comprises two components namely, drinking water and tank filling. In Arsikere taluk, implementation of the project helps to recharge 565 Ham to groundwater by which there will be increase in the groundwater availability and the stage of GW development will come down (Table-10).
- For Arsikere taluk, it is calculated that about 1133 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 10122 to 12156 ham and the expected improvement in stage of development is 17% from 103% to 85%

## 5. DEMAND SIDE INTERVENTIONS

### a. Advanced irrigation practices

It is observed that bore wells contribute 79% of the source for 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 13982 ha of gross irrigated area by bore wells.
- Irrigation draft is 9965 ham.
- Efficient irrigation techniques will contribute in saving ground water by 2990 ham and thus will improve stage of development by 16% from 85% to 69% (Table-9).

### b. Change in cropping pattern

Water intensive crops like paddy & sugarcane are not grown in the Arsikere 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 & Yettinahole project	Existing gross ground water draft for all uses	Stage of ground water development after implementing AR structures & Yettinahole project	Saving due to adopting water use efficiency (WUE) measures	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of the savings	Expected improvement in overall stage of ground water development
	HAM	HAM	%	HAM	HAM	%	%
Arsikere	12156	10377	85	2990	15146	69	16

### c. Regulation and Control

- Arsikere taluk has been categorized as **Overexploited**, 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.

**d. 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 Arsikere taluk is given in Table-11.

Table 11: Summary of Management plan of Arsikere taluk

Arsikere taluk is over-exploited & present stage of GW Development (2013)	103%
Net Annual Ground Water Availability (MCM)	101.22
Existing Gross Ground Water Draft for all uses	103.77
Ground Water development feasibility	9.34
Total GW Resources (Dynamic & Static up to the depth of 200 mbgl) (MCM)	128.83
Expected additional recharge from monsoon surplus runoff (MCM)	9.02
Change in Stage of GW development, %	103 to 94 %
Expected additional recharge from Proposed Yettinahole project through inter basin transfer (MCM)	11.33
Change in Stage of GW development, %	94 to 85 %
Expected Saving due to adopting WUE measures (MCM)	29.90
Change in Stage of GW development, %	85 to 69 %
Water Use efficiency measures	<ul style="list-style-type: none"> <li>• Water intensive crops (Paddy &amp; Sugarcane) are not being cultivated</li> <li>• Government to take initiative to encourage atleast 70% farmers to adopt water use efficiency irrigations practices like dip &amp; sprinkler irrigation</li> </ul>
Groundwater quality aspects - Fluoride & Nitrate	<ul style="list-style-type: none"> <li>• Alternate source</li> <li>• Removal technique</li> <li>• Artificial recharge</li> <li>• In-situ rainwater harvesting</li> <li>• Centralized drinking water supply from Yettinahole Project</li> </ul>

