जल वर्ष 2007 Water Year 2007

स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE

GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES

CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION BOOKLET

HAVERI DISTRICT, KARNATAKA

SOUTH WESTERN REGION
BANGALORE

September 2012

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अध्यक्ष
भारत सरकार
केन्द्रीय भूमि जल बोर्ड
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Foreword

Groundwater is an essential component of the environment and economy. It sustains the flow in our rivers and plays an important role in maintaining the fragile ecosystems. The groundwater dependence of agrarian states like Karnataka is high. Recent studies indicate that 26 percent of the area of Karnataka State is under over exploited category and number of blocks is under critical category. In view of the growing concerns of sustainability of ground water sources, immediate attention is required to augment groundwater resources in stressed areas. Irrigated agriculture in the state is putting additional stress on the groundwater system and needs proper management of the resources.

Central Ground Water Board is providing all technical input for effective management of ground water resources in the state. The groundwater scenario compiled on administrative divisions gives a better perspective for planning various ground water management measures by local administrative bodies. With this objective, Central Ground Water Board is publishing the revised groundwater information booklet for all the districts of the state.

I do appreciate the efforts of Dr. K.Md.Najeeb, Regional Director and his fleet of dedicated Scientists of South Western Region, Bangalore for bringing out this booklet. I am sure these brochures will provide a portrait of the groundwater resources in each district for planning effective management measures by the administrators, planners and the stake holders.

Dr. S. C. Dhiman

PREFACE

Ground water contributes to about eighty percent of the drinking water requirements in the rural areas, fifty percent of the urban water requirements and more than fifty percent of the irrigation requirements of the nation. Central Ground Water Board has decided to bring out district level ground water information booklets highlighting the ground water scenario, its resource potential, quality aspects, recharge – discharge relationship, vulnerability area etc., for all the districts of the country. As part of this, Central Ground Water Board, South Western Region, Bangalore, is preparing such booklets for all the 30 districts of Karnataka state, incorporating the data up to the period 2011-12.

The Haveri District Ground Water Information Booklet has been prepared based on the information available and data collected from various state and central government organisations by several hydro-scientists of Central Ground Water Board with utmost care and dedication. This booklet has been prepared by Shri. B.P.Singh, Scientist-B. The figures were prepared by Sri. J. Sivaramakrishnan, Assistant Hydrogeologist and the rainfall data provided by Shri. H.P.Jayaprakash Scientist-C. The efforts of Report processing section in finalising and bringing out the report in this format are commendable

I take this opportunity to congratulate them for the diligent and careful compilation and observation in the form of this booklet, which will certainly serve as a guiding document for further work and help the planners, administrators, academicians, hydrogeologists and engineers to plan the water resources management in a better way in the district.

(Dr. K.Md.Najeeb)

Regional Director

HAVERI DISTRICT AT A GLANCE

Sl No	ITEMS	STATISTICS	
1	GENERAL INFORMATION		
	i) Geographical area (Sq Km)	4848	
	ii) Administrative Divisions	2	
	Number of tahasils	7	
	No. of Panchayat /Villages	208/698	
	iii) Population (As per 2011 Census)	15.99 lakhs	
	iv) Average annual rain fall	592 -903 mm	
2	GEOMORPHOLOGY		
	Major Physiographic Units	Major part of the district is a gently undulating plain with hilly terrain on western most parts adjoining Uttar Kannada district, and moderately rugged terrain with series of ridges in southern part in Hirekerur taluk.	
	Major Drainages	Tungabhadra, Varada, Kumudavati and Dharma.	
3	LAND USE (Sq Km)		
	Forest area	474.54	
	Net area sown	3639.39	
	Cultivable area	4474.0	
4	MAJOR SOIL TYPES: Red sandy soil, Medium black soil, Deep black soil, Red loamy soil and Lateritic soil.		
5	AREA UNDER PRINCIPAL CROPS (2010-2011 in ha)	**Crop** Paddy Ragi Jowar Maize Wheat Pulses Oil seeds Spices Total:	Area 50927 483 35982 135931 1086 1942 33889 1942 2,62,182
6	IRRIGATION BY DIFFERENT SOURCES Dug wells Borewells Tanks/ Ponds Canals Other Sources Net irrigated area	**Area in ha** 205 23995 10536 5975 2141 42852	**Number** 81 25331 1904 47Km -

7	PREDOMINANT GEOLOGICAL FORMATIONS		
	Quaternary	Alluvium	
	Dharwar super group	Metasedimentary & Metavolcanics.	
8	HYDROGEOLOGY		
	Major Water Bearing Formations -		
	Shallow aquifers of alluvium along the stream courses and weathered zones of schists, metasedimentaries and meta-volcanic occurring between the depths of 3 to 20 mbgl		
	Deeper aquifers of fractured and jointed schists, metasedimentaries and meta-volcanic, up to 200 mbgl.		
	Premonsoon Water levels during 2011	4.30 to 13.34 mbgl.	
	Postmonsoon Water levels during 2011	1.35 to11.14 mbgl.	
	Long term water level trends (2002-2011) m/year		
	Premonsoon	Rising trend in the range of 0.088 to 3.427 m/year at eleven hydrograph network stations. Declining trend in the range of 0.010 to 1.087 m/year at two hydrograph network stations.	
	Post monsoon	Rising trend in the range of 0.015 to 2.882 m/year at seventeen hydrograph network stations.	
9	GROUND WATER EXPLORATION BY C.G.W.B (as on 31/03/2012)		
		Phase I	Phase II
	No. of wells drilled	14	28
	Depth range (m)	90 - 200	96 - 200
	Discharge (liter/second)	0.1 – 6.5	0 – 14.30
	Storativity (S)	N.A	N.A
	Transmissivity (m2/day)	0.95 -211	26 - 70
10	GROUND WATER QUALITY		
	Presence of chemical constituents more than the permissible limit	Nitrate, Chloride, Fluoride and Electrical Conductivity.	
	Type of water	**Alkaline type**	
11	DYNAMIC GROUND WATER RESOURCES (2009, in mcm):		
	Net Annual Ground WaterAvailability	547.50	
	Net Annual Ground Water Draft	347.33	
	Projected Demand For Domestic And Industrial Uses up to 2025	34.85	
	Stage of Development as on March 2009 (%)	63.44	

12	AWARENESS AND TRAINING ACTIVITY	
	Mass awareness programmes arranged	
	Date Place No of participants	27/09/2005 Haveri town 200 persons from different section of society participated in the programme.
13	GROUND WATER CONTROL AND REGULATION:	
	Number of OE Blocks Number of critical blocks Number of blocks notified	3 Nil Nil

HAVERI DISTRICT

1.0 Introduction

1.1 Location

The Haveri district was formed in the year 2001 by dividing the earlier Dharwad district into Dharwad, Haveri and Gadag districts. The Haveri district is located between north latitudes 14^0 17' 02" to 15^0 15' 01" and east longitudes $75^0$0'35" to $75^0$49'23" falling in the survey of India Toposheet Nos-48M/4, 48 M/8, 48M/12, 48N/1, 48N/2, 48N/5, 48N/6, 48N/7, 48N/9, 48N/10, 48N/11, 48N/13, 48N/14, and 48N/15.

1.2 Administrative Setup

The district is divided into seven taluks having a total geographical area of 4848 sq. kms. The district is also divided into two sub divisions with taluks Shiggaon, Hangal, Savanur coming under Savanur subdivision and taluks Haveri, Hirekerur, Byadagi and Ranibennur coming under Haveri subdivision. A map showing administrative setup of the district is given as Fig-1.

1.3 Population

The total population in the district is around 15.99 lakhs (as per 2011 census), out of which male population constitutes 8.19 lakhs and female population is 7.79lakhs. The percentage decadal growth is 11.08% and population density is 331/sq.km.

Land use pattern

The district has 474.54 sq.km of forest, which constitutes 9.79% of the total geographical area of the district. The fallow land in the district is around 33779 ha. Net area sown during the year 2010-11 was around 262182 ha.

1.5 Crops

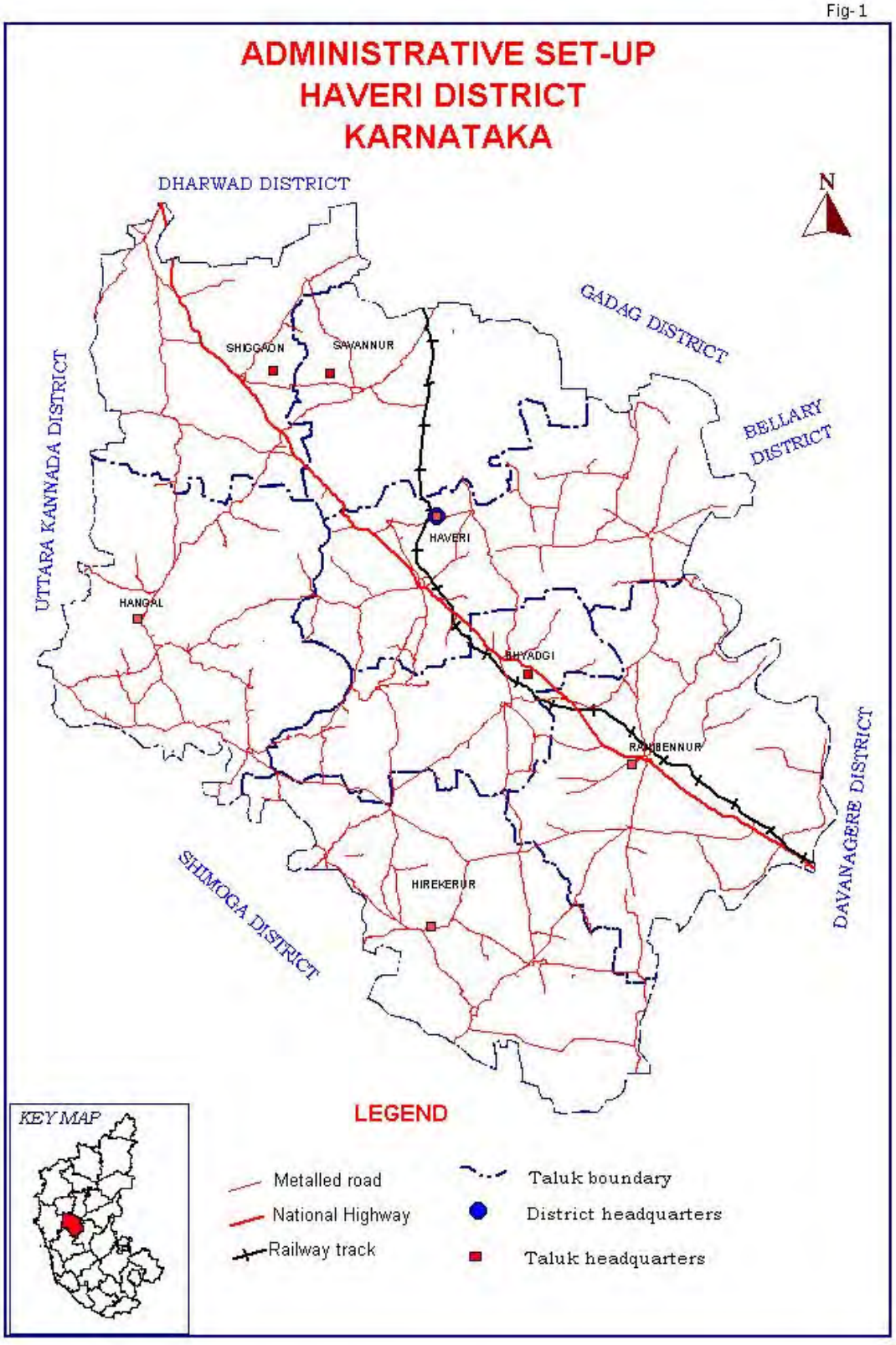
The main crops grown in the district are jowar, maize,cotton, chilly, paddy, ragi, pulses, groundnut, horse gram, sugarcane and sunflower.

1.6 Irrigation

Out of 282182 ha. of cultivated land during 2010-11, 42852 ha. which was under irrigation. Out of the 42852 ha. which was under irrigation, 5975 ha.

was irrigated by canals, 10536 ha. was irrigated by tanks/ponds, 205 ha. was irrigated by dug wells, 23995 ha. was irrigated by tube/bore wells.

Fig-1



Industries

The sugar factory at Sangur in Haveri taluk and Grasim industry located at Kumara pattanam in Ranebennur taluk are the important industries in the district.

2.0 Climate and Rainfall.

The district enjoys sub tropical climate with temperatures ranging in between 18^0 and 40^0 C. The rainfall varies in the district from over 1110 mm in west (Hangal) to less than 671 mm in east (Ranebennur). October is the wettest month with normal monthly rainfall in all hydrometeriological stations is recorded in excess of 80mm. During the year 2011, the annual rain fall in all the taluks was normal except in shiggaon taluk where it received deficit rainfall and Hangal taluk received excess rain fall. The rainfall received in the district during 2011 is given in table1.

3.0 Geomorphology and Soil Types

3.1 Geomorphology

The district is generally a gently undulating plain except for the hilly area on the western most part of the district bordering Uttara Kannada district and ridges on southernmost parts of the district, which forms part of Hirekerur taluk. The landmass of the district is situated between the elevations of 515 to 732 m above msl. The general slope in the district is in northeast direction.

The Tunga-Bhadra river flowing on the eastern boarder of the district is the only perennial river in the district. The Varada and Kumudvati rivers are major tributaries of Tungabhadra and river Dharma a
major tributary of Varada drains the district. All the rivers in the district together with their tributaries exhibit dendretic drainage pattern and they form part of Krishna main basin. The drainage map of the district is presented as Fig-2.

Fig- 2

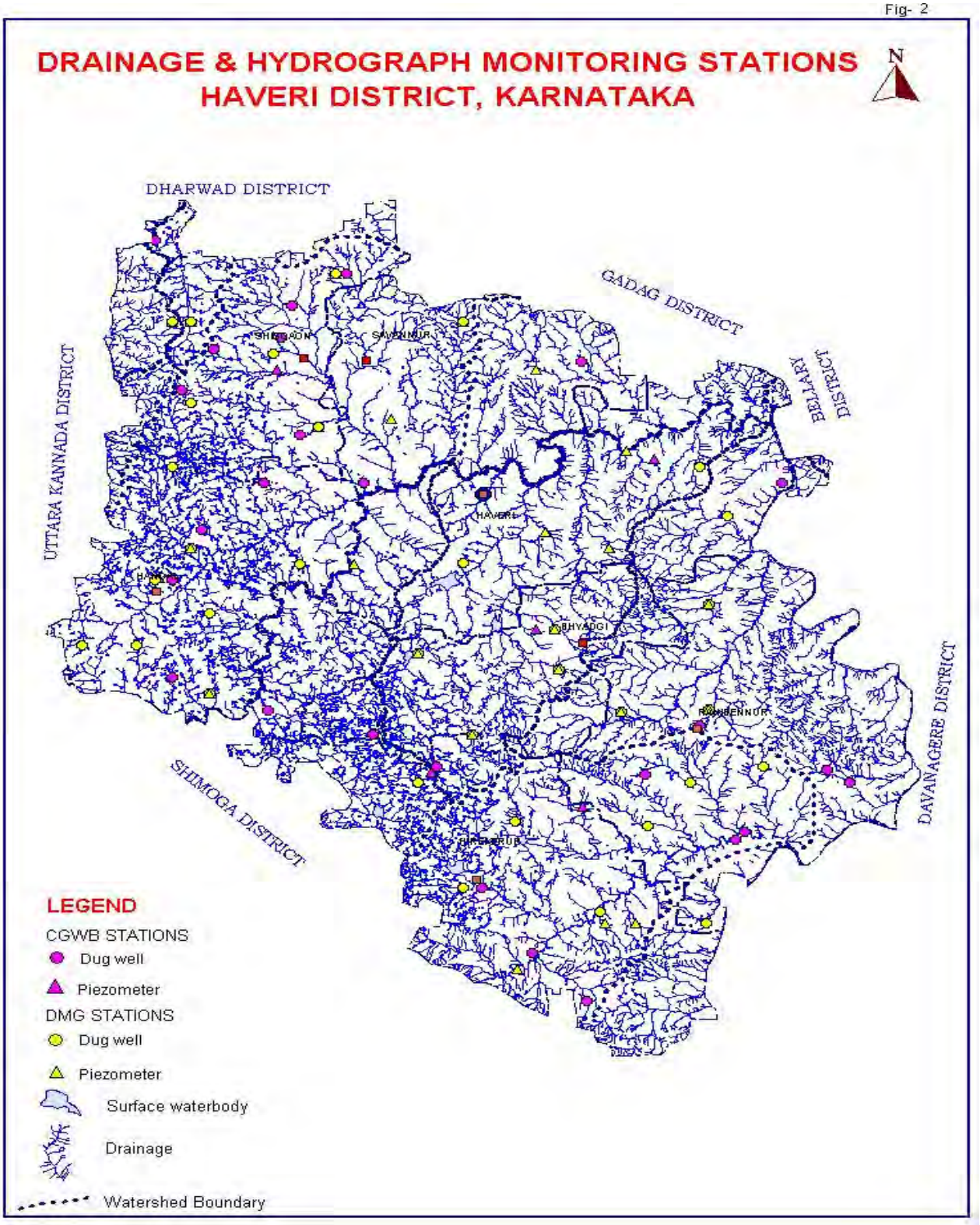

DRAINAGE & HYDROGRAPH MONITORING STATIONS
HAVERI DISTRICT, KARNATAKA
N
DHARWAD DISTRICT
GADAG DISTRICT
BELLARY DISTRICT
UTTARA KANNADA DISTRICT
DAVANAGERE DISTRICT
SHIMOGA DISTRICT
SHIGGAON
SAVANUR
HAVERI
BYADGI
RANNENNUR
HIREKERUR
LEGEND
CGWB STATIONS
Dug well
Piezometer
DMG STATIONS
Dug well
Piezometer
Surface waterbody
Drainage
Watershed Boundary

Table.1 Monthly rainfall received in the district during 2011

DISTRICTS/ TALUKS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	ANNUAL
HAVERI	0	1	0	105	58	137	136	120	83	134	18	0	792
BYADGI	0	0	0	90	43	123	112	117	93	121	1	0	700
HAVERI	0	0	0	161	41	115	123	118	59	79	3	0	699
HANAGAL	0	0	0	71	47	245	212	201	139	134	61	0	1110
HIREKERUR	0	0	0	138	55	160	163	137	99	126	48	0	926
RANEBENNUR	0	4	0	157	93	102	84	75	62	89	5	0	671
SAVANUR	0	0	0	52	69	111	104	80	53	168	0	0	637
HIGGAON	0	0	0	65	58	104	154	114	76	223	8	0	802

The Dharma anicut is the only medium project in operation with about 2136 hectares of command area in Hangal taluk. About 10579 hectares of land is under irrigation from minor irrigation tanks and about 11946 hectares of land is under lift irrigation in the district.

3.2 Soil types

In the major part of the district red sandy soil is occurring, followed by the medium black soil and deep black soil. The red loamy soil and lateritic soil are seen in very small parts on southern border of the district.

4.0 Ground Water Scenario

4.1.1 Occurrence of Ground Water

Haveri district except, for small part occupied by gneiss, exhibit the schistose formations comprised of greywacke, metasedementaries, meta -volcanics, green-stones, chlorite-serecite-schist, etc. These formations are later traversed by various intrusives. The Hydrogeological map of the district is presented as Fig-3. The ground water occurs under water table conditions in the weathered parts of above rocks at shallow depth up to 20 m and generally under semi-confined to confined conditions in the jointed and fractured portions of the above rocks up to about 200 m depth. The ground water also occurs in the inter-granular spaces in the alluvial patches along the stream courses under water table conditions at shallower depth.

4.1.2 Depth to water levels

Out of 23 national Hydrograph stations located in Haveri district, during May 2006, 4 national hydrograph stations were found to be dry and during November 2006,only 1 national hydrograph stations was found to be dry. The general depth to water levels in the national hydrograph stations (dug wells) recorded during May 2011 was in the range of 4.30 to13.34 mbgl. The pre-monsoon depth to water level map of the district for the year 2011 is presented as Fig-4. The general depth to water levels in the national hydrograph stations (dug wells) recorded during November 2011 was in the range of 1.35 to11.14 mbgl. The post-monsoon depth to water level map of the district for the year 2011 is presented as Fig-5. The water levels in the 4 piezometer stations ranges from 5.45 to 16.65 m.bgl during May 2011 and 2.55 to 12.35 mbgl during November 2011.

Fig-3

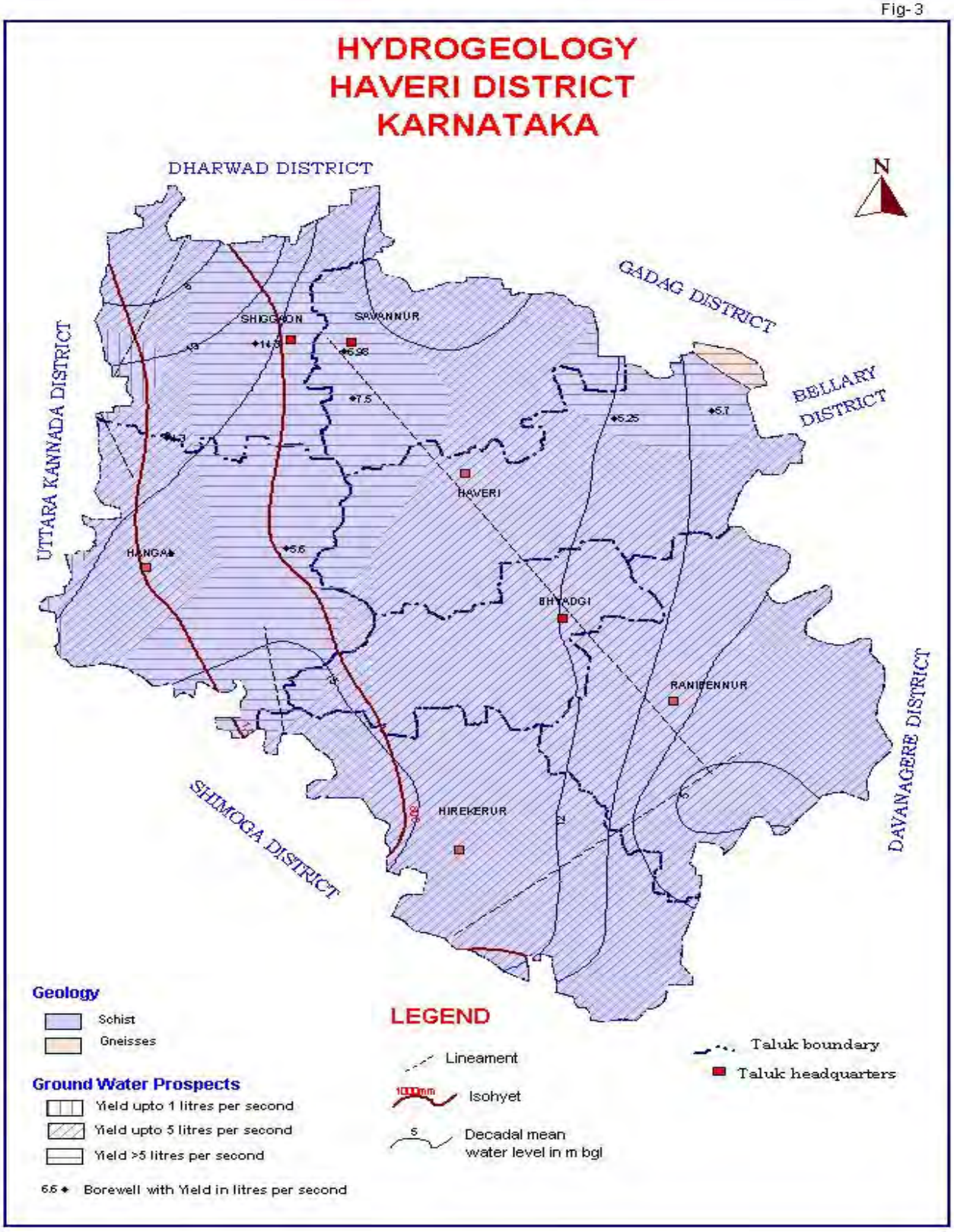

HYDROGEOLOGY
HAVERI DISTRICT
KARNATAKA
DHARWAD DISTRICT
N
GADAG DISTRICT
BELLARY DISTRICT
UTTARA KANNADA DISTRICT
SHIGGAON
SAVANNUR
HAVERI
HANGAL
BYADGI
RANIBENNUR
HIREKERUR
SHIMOGA DISTRICT
DAVANAGERE DISTRICT
Geology
Schist
Gneisses
Ground Water Prospects
Yield upto 1 litres per second
Yield upto 5 litres per second
Yield >5 litres per second
6.6 Borewell with Yield in litres per second
LEGEND
Lineament
1000mm Isohyet
5 Decadal mean water level in m bgl
Taluk boundary
Taluk headquarters

Fig-4

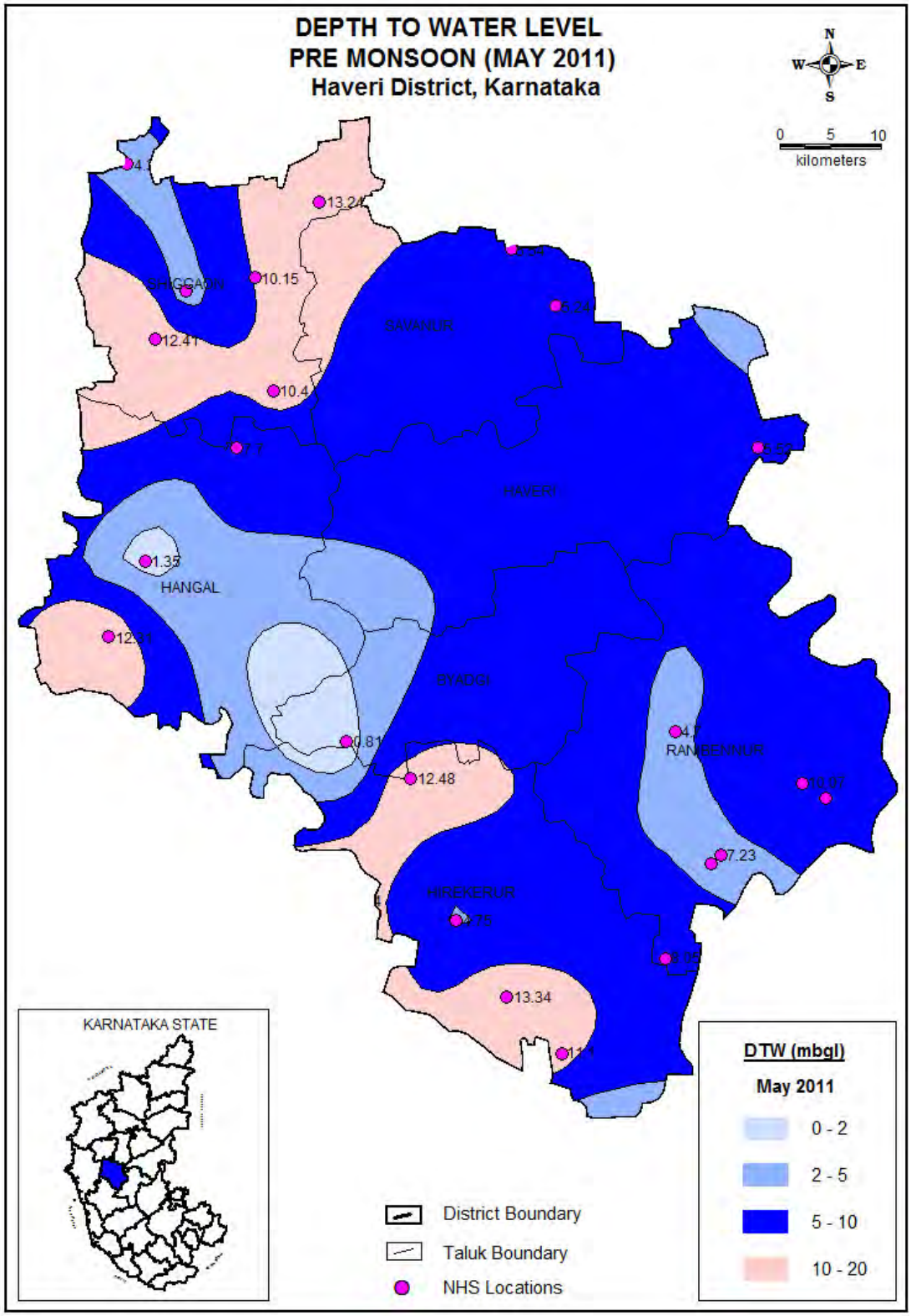
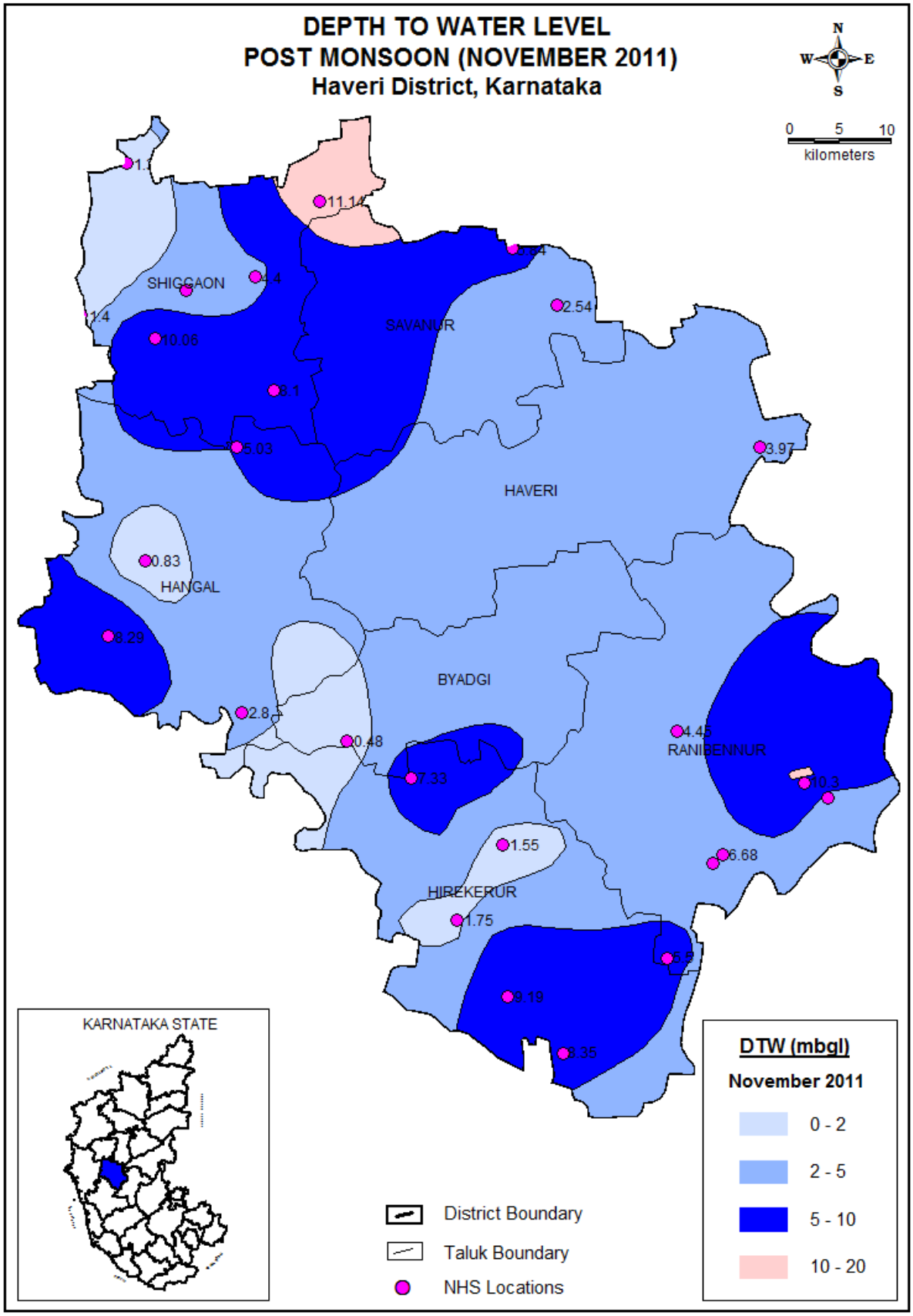

DEPTH TO WATER LEVEL
PRE MONSOON (MAY 2011)
Haveri District, Karnataka
N
W
E
S
0 5 10
kilometers
SHIGGAON
SAVANUR
HAVERI
HANGAL
BYADGI
RANNENNUR
HIREKERUR
10.15
12.41
10.4
1.35
12.48
7.23
13.34
KARNATAKA STATE
District Boundary
Taluk Boundary
NHS Locations
DTW (mbgl)
May 2011
0 - 2
2 - 5
5 - 10
10 - 20

Fig-5


DEPTH TO WATER LEVEL
POST MONSOON (NOVEMBER 2011)
Haveri District, Karnataka
N
W
E
S
0 5 10
kilometers
SHIGGAON
SAVANUR
HAVERI
HANGAL
BYADGI
RANIBENNUR
HIREKERUR
11.14
10.06
5.03
3.1
2.54
3.97
0.83
8.29
2.8
0.48
7.33
4.45
10.3
1.55
6.68
1.75
5.5
9.19
9.35
KARNATAKA STATE
DTW (mbgl)
November 2011
0 - 2
2 - 5
5 - 10
10 - 20
District Boundary
Taluk Boundary
NHS Locations

4.1.3 Seasonal water level fluctuation

The seasonal water level fluctuation for the year 2011 is available for eighteen national hydrograph network stations and is in the range of 0.25 to 5.75 m. The seasonal water level fluctuation for the year 2011 is available for four piezometers(hydrograph network stations) and is in the range between 1.15 to 6.30 m. The decadal water level fluctuation in May and November 2011 with respect to decadal mean (2001-2010) for the corresponding months are given in figure 6 and 7 respectively.

4.1.4 Long term water level trends

The premonsoon water level trends calculated for the period between 2002 to 2011 shows a rising trend in the range between 0.088 and 3.427 m/year at eleven hydrograph network stations and declining trend in the range of 0.010 to 1.087 m/year at two hydrograph network stations. The post monsoon water level trends calculated for the period from 2002 to 2011 are rising in the range of 0.015 to 2.882 m/year in all seventeen hydrograph network stations and no declining trend in any hydrograph network stations was recorded.

4.1.5 Results of ground water exploration

On the basis of the hydrogeological surveys followed by resistivity surveys total of 42 sites were recommended for the deep drilling up to a depth of 200m. The drilling results available indicate fractures at 112m, 149 m, 162m and 191 m depth. The aquifer tests on these wells reveal that the schistose complexes have an effective porosity of about 1 to 3%. The Aquifer Performence tests conducted on the wells show the discharge of the wells in the range of 0.081 to 14.3 lps. and transmissivity in thel range of 26 to 70 m^2/day. The details of Exploratory wells drilled in phase-1 & Phase-2 are given in table 2a -b and the exploration locations are shown in figure 8.

Fig-6

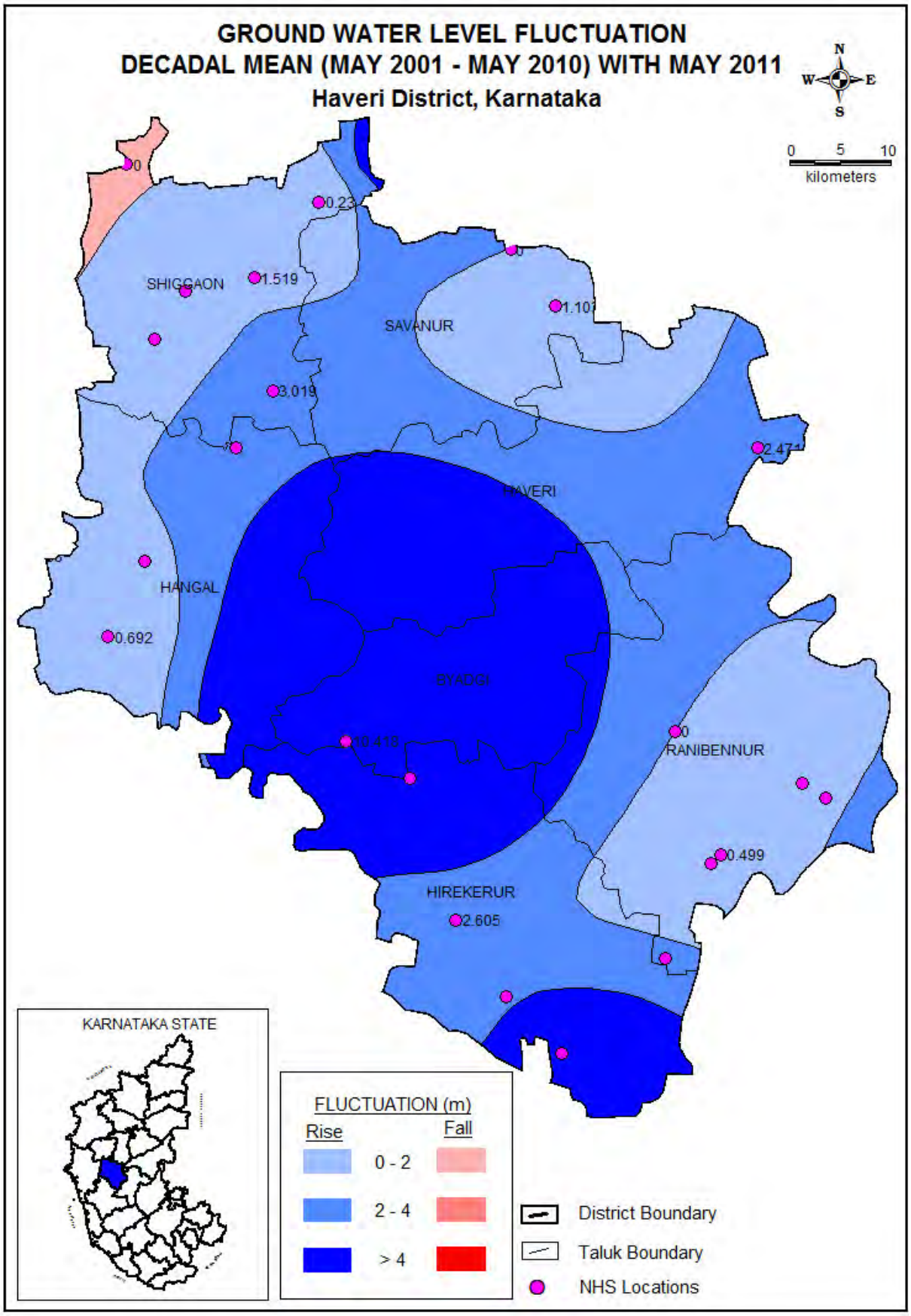

GROUND WATER LEVEL FLUCTUATION
DECADAL MEAN (MAY 2001 - MAY 2010) WITH MAY 2011
Haveri District, Karnataka
N
W
E
S
0 5 10
kilometers
0
0.23
SHIGGAON
1.519
SAVANUR
1.107
3.019
2.474
HAVERI
HANGAL
0.692
SYADGI
0.419
0
RANIBENNUR
0.499
HIREKERUR
2.605
KARNATAKA STATE
FLUCTUATION (m)
Rise
Fall
0 - 2
2 - 4
> 4
District Boundary
Taluk Boundary
NHS Locations

Fig-7

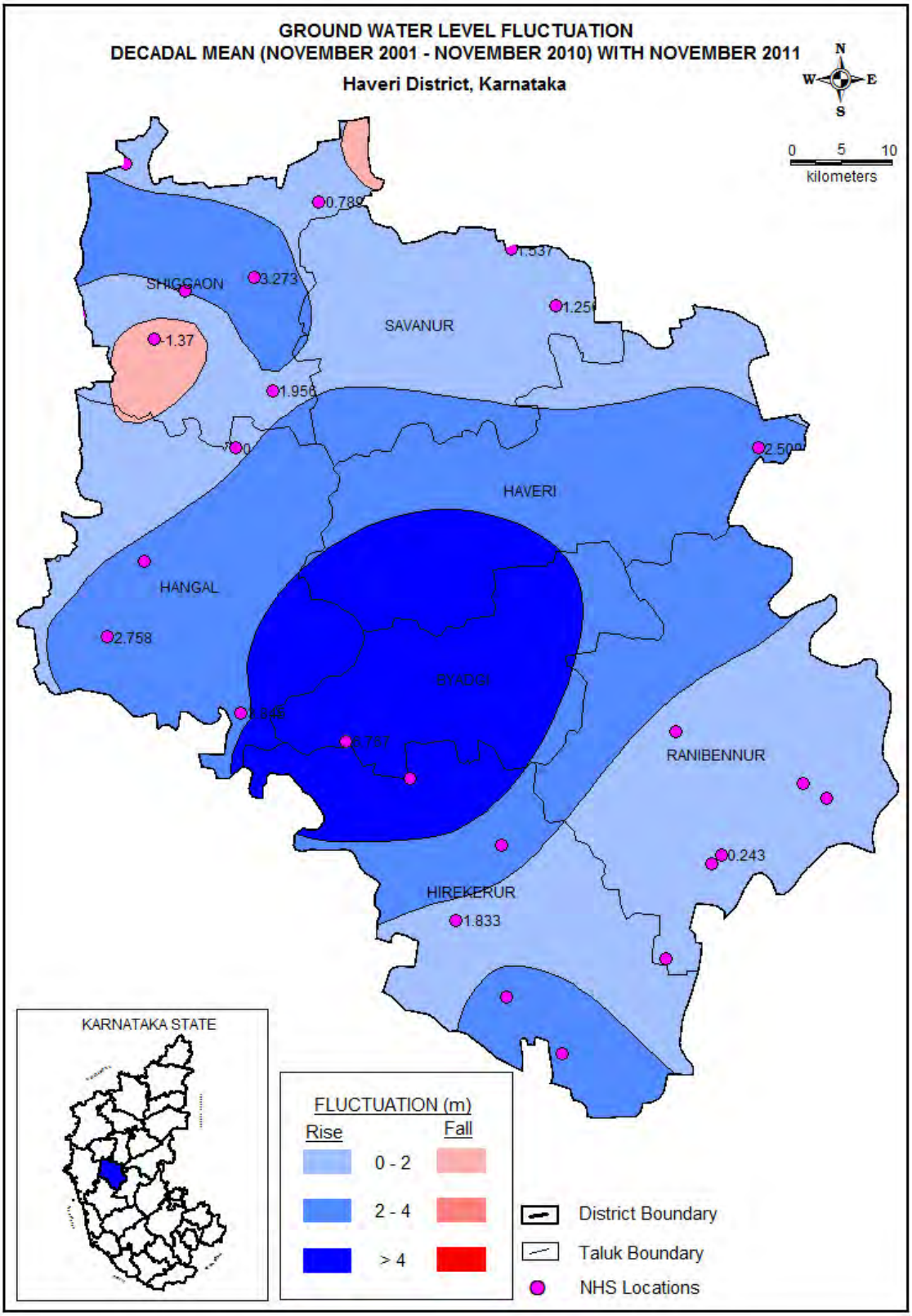

GROUND WATER LEVEL FLUCTUATION
DECADAL MEAN (NOVEMBER 2001 - NOVEMBER 2010) WITH NOVEMBER 2011
Haveri District, Karnataka
N
W
E
S
0 5 10
kilometers
0.789
1.537
SHIGGAON
3.273
SAVANUR
1.25
1.37
1.956
2.50
HAVERI
HANGAL
2.758
BYADGI
RANIBENNUR
0.243
HIREKERUR
1.833
KARNATAKA STATE
FLUCTUATION (m)
Rise
Fall
0 - 2
2 - 4
> 4
District Boundary
Taluk Boundary
NHS Locations

Fig. 8

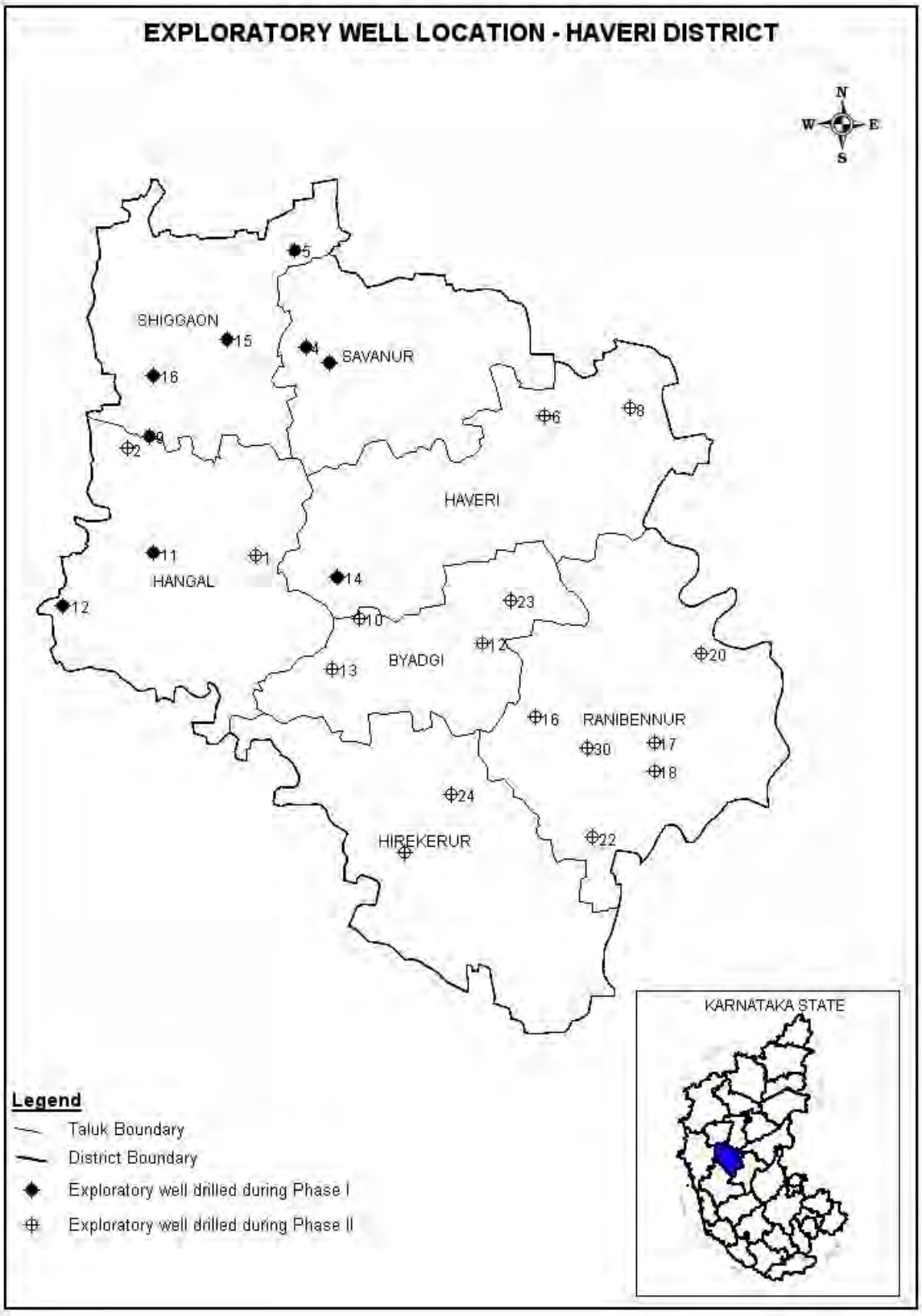

EXPLORATORY WELL LOCATION - HAVERI DISTRICT
N
W
E
S
SHIGGAON
SAVANUR
HAVERI
HANGAL
BYADGI
RANIBENNUR
HIREKERUR
KARNATAKA STATE
Legend
Taluk Boundary
District Boundary
Exploratory well drilled during Phase I
Exploratory well drilled during Phase II

Table.2a. Details of groundwater exploration in Phase 1

S.No	Location	year of drilling	Depth Drilled	Lithology	Fracture Zone	SWL	Q	DD	T
1	ALLIPUR	1996-97	132.15 / 5.1	GRCK	39.5-39.6	18.34	2.84		
4	OLD GUNDUR	do	127.6 / 11.5	do	34.55-35.60, 36.6-37.6, 45.75-46.75, 47 - 48.8, 100.65-101.65	6.505	6.98	5.185	51.37
5	OLD GUNDUR	1997-98	130.15 / 5.45	SCST, META, GRCK	19.30-20.35, 31.5-32.55, 34.55-36.60, 37.60-38.60, 61.62-97.6-98.6	6.84	6.66	5.085	55.5
6	HULGUR	do	179/ 13.7	do	39,50.5, 72.73, 84.86, 102-104	27.67	1.2	4.995	6.33
7	HULGUR	do	154 /19.7	do	78, 123, 143	27.04	2.18	10.095	8.5
8	HULGUR	do	175.9 / 14	do		27.67	1.2	4.995	-
9	BOMMANAHALLI	1997-98	178.95 / 18.65	do	28.4-49.8, 53.9	11.8	4.3	10.39	11.8

10	BOMMANAHALLI OW	do	178.95 / 19.65	do	27.45-33.55, 54.95-61.15	12.63	3.5	8.065	11.01
11	HANAGAL	do	175.65 / 17	do	24.15-35.35, 40.4	14.4	4	9.598	32
12	HANAGAL OW	do	180.4 21.3	do	33.45-34.0	14.5	0.13	6.715	26
13	SAMSAGI	1997-98	182.45 / 30.5	GRCK	25-25.96, 50.9-51.30, 72.8-73.65	6.244	0.31		8
14	KABBUR	do	200.05 / 7.1	do		46.25		-	-
15	SHIGGAON	1997-98	102.7 / 11	GRWK	18, 23-25, 34-38, 56-57, 87-88	10.56	3.44	7.99	37.2
16	SHIGGAON	Do	102.7 / 11.5	do		11.52	14.3	3.626	70
17	KONANKERI EW	Do	151.5 / 28	GRWK	21, 23-25, 40-42,68-70	11.26	4.49	6.303	64.3
18	KONANKERI	do	179 / 31.65	do		12.2	Negl	2.488	56

Table 2b. Details of groundwater exploration in Phase II

S.No.	Location	Type of Well	year of drilling	Depth Drilled	Lithology	DTW	Q	DD	T
1	Adur	EW	1998-99	130.92 / 30	GRWK	14.41	5.6	2.629	
2	Adur	OW	1998-99	131 / 29	GRWK	14.48	5.6	2.583	
3	Agadi	EW	1998-99	200 / 16.5	GRWK	20.56	2.3	11.96	6
4	Agadi	OW	1998-99	200.10 / 18	GRWK	18.33	2.2	6.685	19
6	Hosritti	EW	1998-99	123.80 / 13.60	GRWK	15.84	5	3.417	36
7	Hosritti	OW	1998-99	123.80 / 16.80	GRWK	13.06	5.25	1.725	319
8	Belvigi	EW	1998-99	132.95 / 25.2	GRWK	13.125	4	1.726	42
9	Belvigi	OW	1998-99	117.70 / 29.25	GRWK	12.7	5.7	1.7	150
10	Mallur	EW	1998-99	185.85 / 24.55	GRWK	19.12	3.5	8.315	23
11	Mallur	OW	1998-99	160.45 / 24.55	GRWK	20.25	3.17	7.64	23
12	Byadagi	EW	1998-99	175.70 / 19.36	GRWK	31.537	0.96	6.863	6
13	Hirehalli		1998-99	161.50 / 44	GRWK	14.14	4.8	9.86	28.02
14	Hirehalli	OW1	1998-99	178.7 / 49.35	GRWK	14.94	4	10.11	12
15	Hirehalli	OW2	1998-99	95.35 / 44.30	GRWK	16.1	4.1	5.885	
16	Asundi	EW	1998-99	200.10 / 16.50	GRWK	50.79	0.01		34

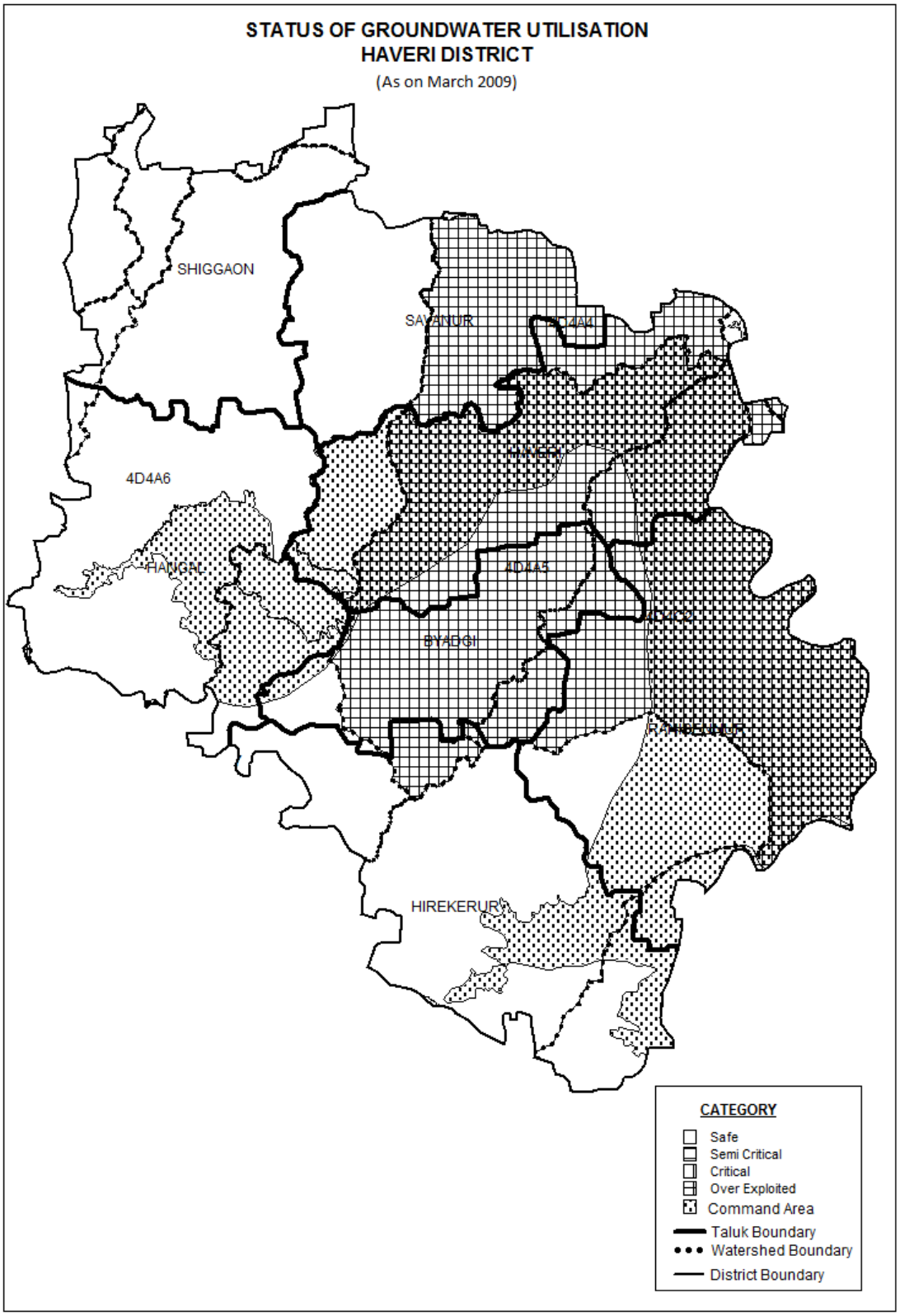
17	Makanur	EW	1999-00	200.1 / 24.8	GRWK	14.4	3	13.7	8.5
18	Itagi	EW	1999-00	200 / 20.5	GRWK	19.63	1.7	3.6	28
19	Itagi	OW	1999-00	151.3 / 21.7	GRWK	16.77	0.1	2.26	4.3
20	Madleri	EW	1999-00	175.7 / 18.6	GRWK	40.53	2.6	1.75	211
21	Madleri	OW	1999-00	120 / 18.53	GRWK	39.69	1.69	1.86	56
22	Kuppellur	EW	1999-00	102.5 / 20	GRWK	10.02	6.5	13	26
23	Aldageri	EW	1999-00	159.4/20.50		17.78	3.55	7.62	30
24	Koda		1999-00	151.3 / 22.25	GRWK	13.73	2.93	10.46	24
25	Koda	EW	1999-00	90.3 / 23.20	GRWK	12.14	1.93	15.09	2.55
26	Hirekerur	EW	1999-00	155.35 / 10.60	GRWK	14.616	5.08	2.045	100
27	Hirekerur	OW	1999-00	90 / 13.85	GRWK	16.21	2.03	0.58	107
28	Sannagubbi	EW	1999-00	108.6 / 12.75	GRWK	11.11	4.93	4.53	111
29	Sanngubbi	OW	1999-00	107.55 / 13.50	GRWK	10.64	6.28	4.46	113
30	Bannihalli	EW	1999-00	164.50 / 34.60	GRWK	Neg	-	-	
31	Tannikallu	EW	2000-01	185.75 / 17	GR GN	Neg	-	2.28	
32	Hadigalu	EW	2000-01	200 / 17.5	GR GN	2.5	28.63	-	
33	M.K.Byle	EW	2000-01	200 / 33.9	GR GN				
34	M.K.Byle	OW	2000-01	84.20 / 42.38	GR GN	Neg	-	-	
35	Suntikatte	EW	2000-01	181.3 / 30.75	GR GN			0.95	

4.2 Ground water resources

The ground water resource estimation indicates that total annual ground water recharge as 596.32 mcm and net annual ground water availability as 547.50 mcm for Haveri district for year 2009. Annual ground water draft for domestic and industrial uses was 26.65 mcm and for irrigation purposes the draft computed was 320.67 mcm. Total draft during the year 2009 was 347.33 mcm. The net ground water availability for future irrigation development was computed as 197.52 mcm, after allocating 34.85 mcm of ground water for domestic and industrial uses for the next 25 years. The stage of ground water development for the whole district was computed as63.44%. But the taluk wise ground water estimation data indicates the stage of ground water development varies between 32 and 50 % for Hangal, Savanur and Shiggaon taluks where 100% area belongs to safe category. The taluk wise groundwater estimation data also indicates the stage of ground water development varies between 64 to 92 % for Byadagi, Haveri and Ranibennur where 60 to 80 % of area of these taluks belongs to over exploited category. The stage of ground water development in Hirekerur taluk is 77% and 10 % of this taluk is categorised as over-exploited. The taluk wise ground water estimation studies is summerised in **table-3** and a map showing status of ground water utilisation of Haveri district is presented as Fig-9

The perusal of table-3 shows that the considerable part of the area (in parts of Haveri, Ranebennur and Byadagi) is over developed from the stage of ground water development point i.e. the stage of ground water development in parts of Haveri, Ranebennur and Byadagi taluks is computed between 60 to 80 % with water levels in that area showing appreciable declining trends. The net ground water availability for future irrigation for the district is 19752 ha. The stage of ground water development for the district as a whole is63.44%.

Fig. 9


STATUS OF GROUNDWATER UTILISATION
HAVERI DISTRICT
(As on March 2009)
SHIGGAON
SAVANUR
4D4A6
HANGAL
4D4A5
BYADGI
HIREKERUR
CATEGORY
Safe
Semi Critical
Critical
Over Exploited
Command Area
Taluk Boundary
Watershed Boundary
District Boundary

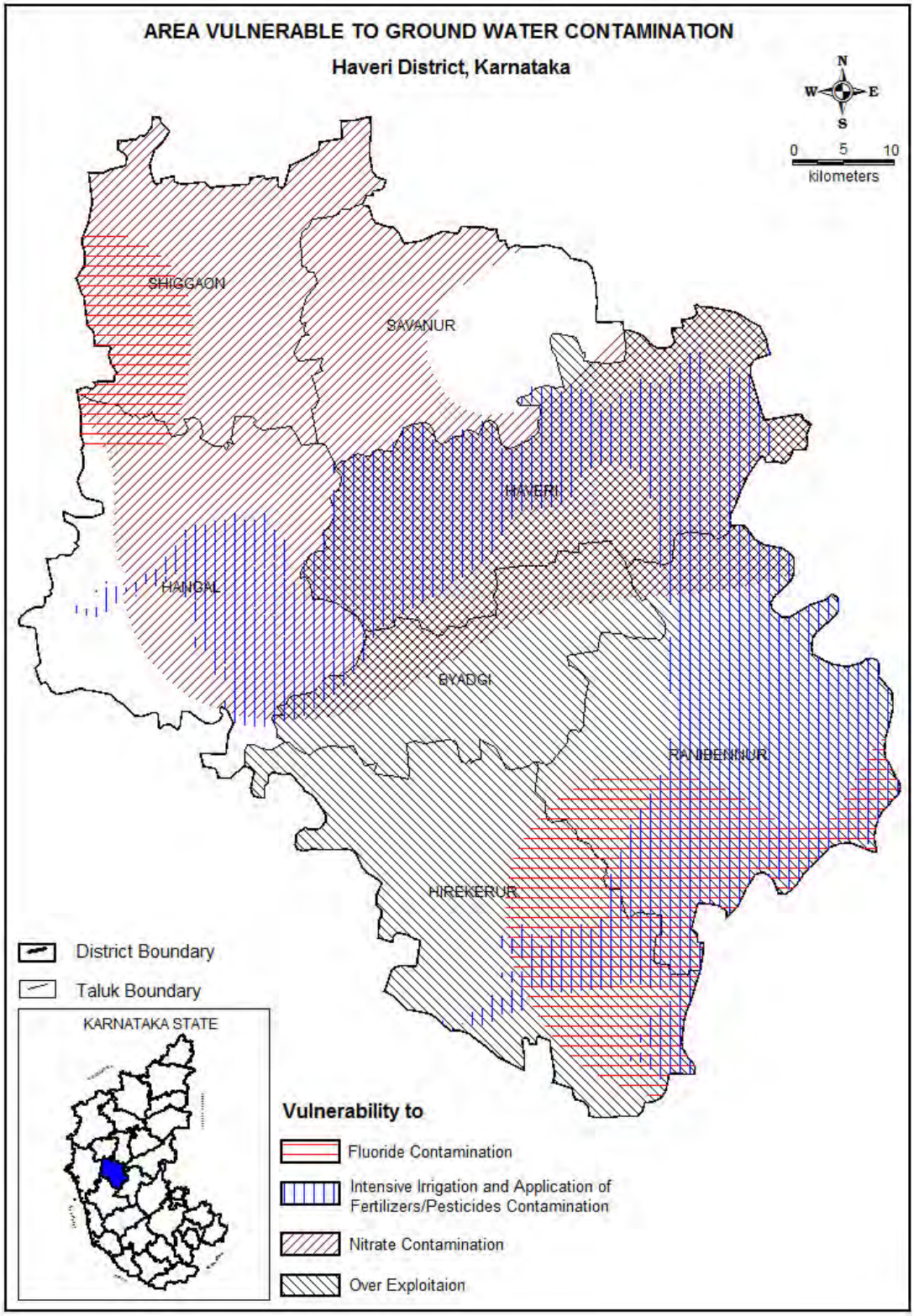
4.3. Groundwater Vulnerability area

Groundwater being a dynamic resource, getting recharged annually, primarily from the rainfall, is vulnerable to various developmental activities and is prone to deterioration in quality and quantity. The vulnerability is high in certain areas while in other areas it is comparatively stable. Based on it's susceptibility to various stress factors, the district wise vulnerability map is prepared on a regional scale considering the following factors viz.

1. Area under high stage of ground water development falling in over exploited (generally with stage of development more than100%) and critical (generally stage of development within 85-100%) category as on March 2009.
2. Area having intensive cultivation/ area falling under canal command, thus prone to pollution from fertilisers/ insecticides or water logging.
3. Area having fluoride above maximum permissible limit of 1.5ppm
4. Area having nitrate above maximum permissible limit of 45ppm. (Even though nitrate is point source pollution due to anthropogenic activity and as such area cannot be demarcated, for the convenience of the user group, area having high incidence of pollution is marked. Within the marked area there may be points devoid of high nitrate and vice-versa.)
5. Industrial cluster as identified by Central Pollution Control Board, prone for pollution from industries.

In some of the districts parts of the area groundwater is vulnerable due to more than one of the above parameters, while in some others the entire district is free from vulnerability. In Haveri district.,Area vulnerable to groundwater contamination is shown in fig.10.

Fig. 10


AREA VULNERABLE TO GROUND WATER CONTAMINATION
Haveri District, Karnataka
N
W
E
S
0 5 10
kilometers
SHIGGAON
SAVANUR
HAVERI
HANGAL
BYADGI
RANNEBENNUR
HIREKERUR
District Boundary
Taluk Boundary
KARNATAKA STATE
Vulnerability to
Fluoride Contamination
Intensive Irrigation and Application of Fertilizers/Pesticides Contamination
Nitrate Contamination
Over Exploitaion

4.4 Status of Ground Water Development

As per the data of 2004-05 the domestic water requirement is supplied through 635 numbers of Mini-water supply schemes, 597 numbers of piped water supply schemes through bore wells along with 6599 number of bore wells installed with hand pumps. The ground water is a major source for drinking purpose. Irrigation from ground water is mainly through bore wells with depth ranging between 60 to 200 m. The yield of the wells ranges between negligible to 14 lps.

5. Ground Water Management Strategy

5.1 Ground water development

Further ground water development should be encouraged only in the areas, which are categorized as safe. In those areas, which are categorized as over exploited, growing crops like paddy, sugarcane etc having high water requirement may be avoided. Advance irrigation methods like drip and sprinkler irrigation may be practiced.

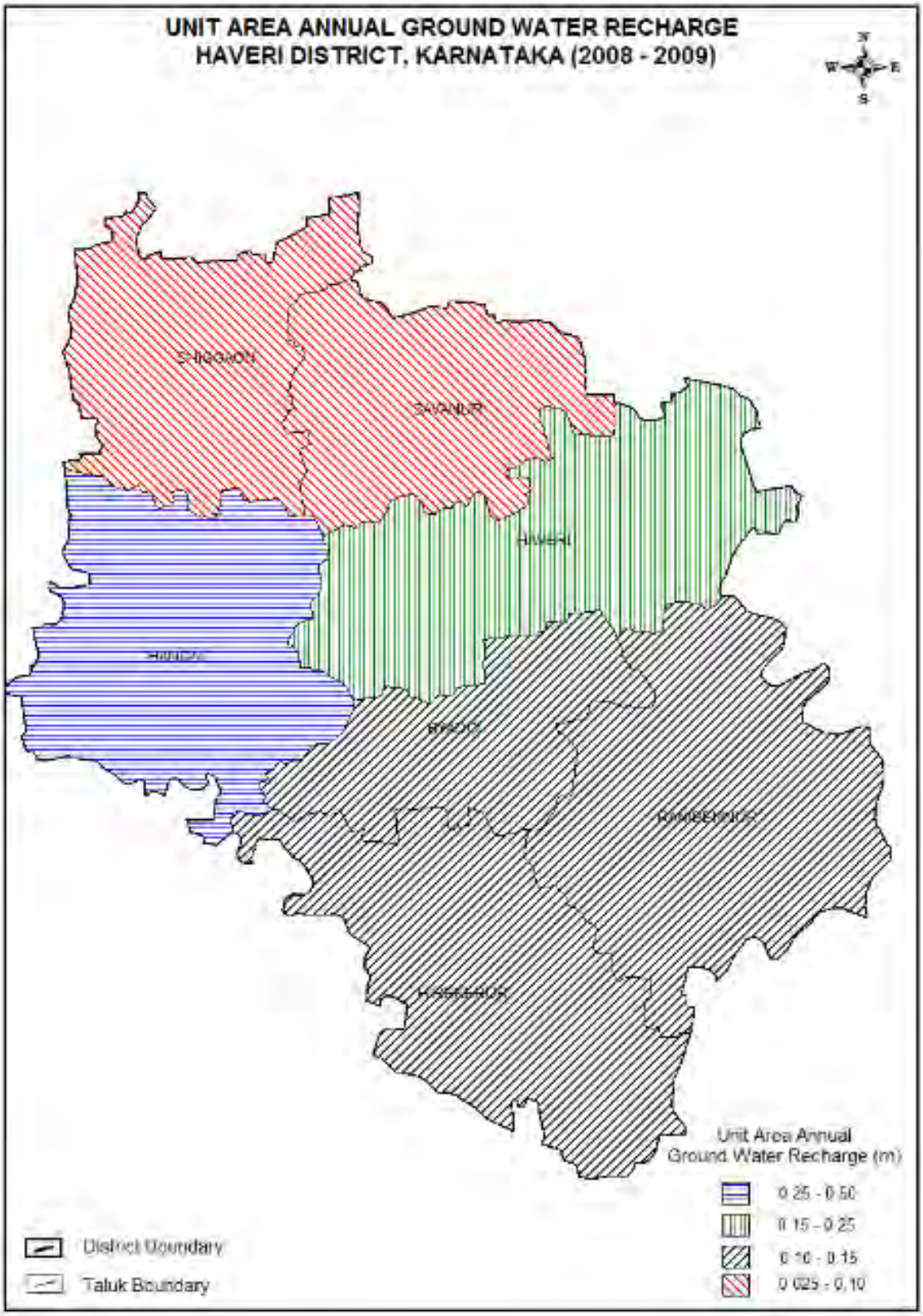
In the irrigation command areas conjunctive use of surface and ground water may be practiced to avoid long term hazards like water-logging, and soil salinity problems.

5.2 Unit area annual groundwater recharge

Sustainability of groundwater resource depends mainly on two factors viz. Annual groundwater recharge and annual groundwater draft. The annual groundwater recharge depends on the quantity and intensity of rain fall, the infiltration characteristics of the soil, the depth to groundwater level, the slope of the area and the geomorphology. The groundwater recharge is assessed separately for the monsoon and non monsoon period due to rainfall as well as due to other sources. The annual groundwater recharge includes all the above.

The recharge from other sources includes return seepage from irrigated area, seepage from canals, seepage from water bodies, seepage from influent rivers etc. The recharge can be expressed in meters. In the state of Karnataka, the unit area recharge is grouped into four categories viz. 0.025-0.10m, 0.10-0.15m, 0.15-0.25m and 0.25-0.50m. In Haveri district the unit area annual recharge is in the range of 0.10-0.15 in parts and in the range of 0.025-0.25 in other parts of the district. (fig.11)

Fig.11


UNIT AREA ANNUAL GROUND WATER RECHARGE
HAVERI DISTRICT, KARNATAKA (2008 - 2009)
N
W
E
S
SHIGGAON
SAVANUR
HAVERI
RANEBENNUR
HIREKERUR
Unit Area Annual
Ground Water Recharge (m)
0.25 - 0.50
0.15 - 0.25
0.10 - 0.15
0.025 - 0.10
District Boundary
Taluk Boundary

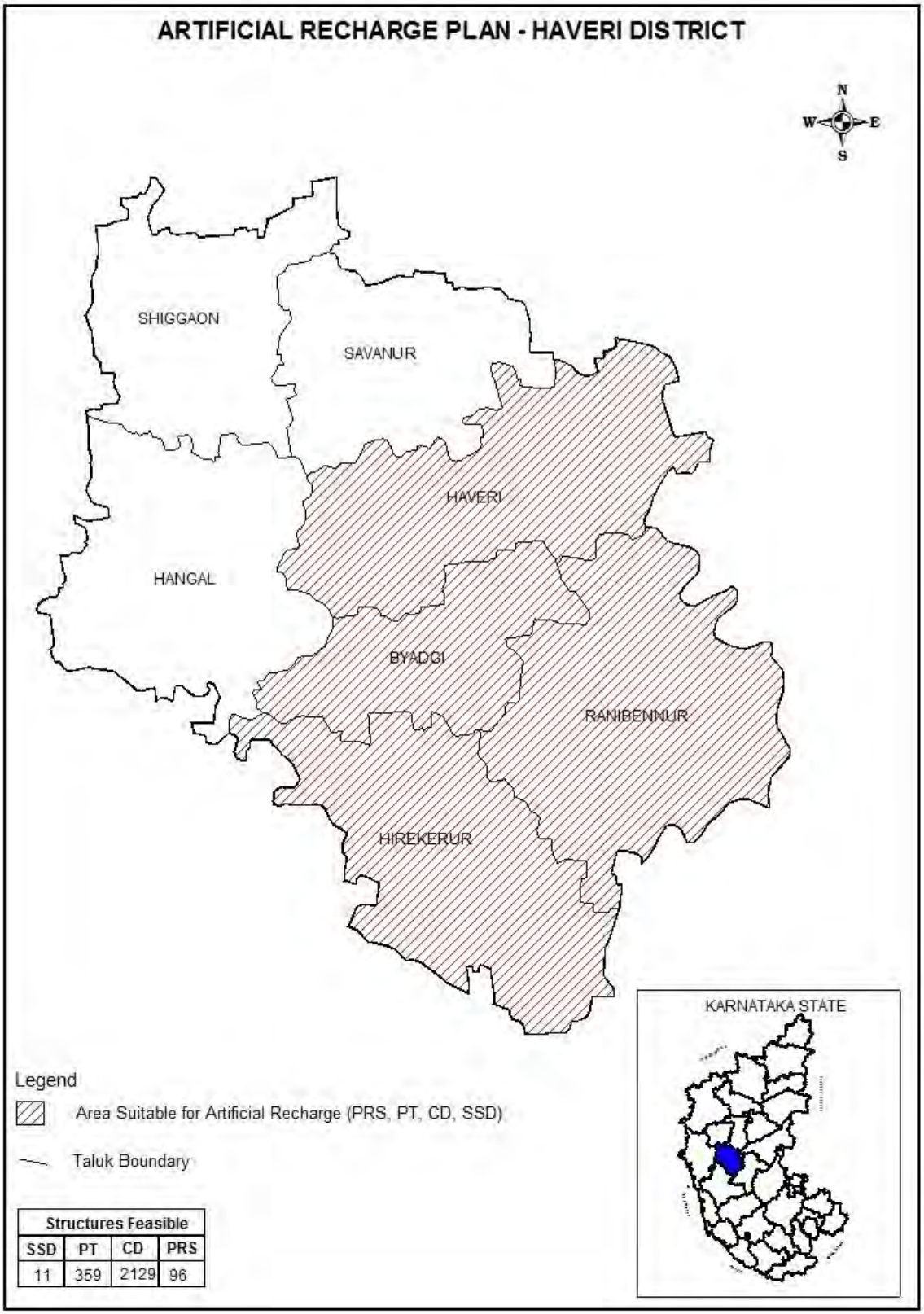
5.3 Water conservation and Artificial Recharge

In the district, where the topography is comparatively rugged, artificial recharge structures like nala bunds and gully plugs, contour bunds and contour trenches may be constructed. In plain areas percolation tanks and point recharge structures like recharge- shafts, recharge pits and recharging through existing dug/bore wells may be practiced. In semi-urban areas in the district (Haveri, Savanur, Shiggaon, Hangal, Herekerur, Byadagi, Ranebennur and Bankapur) lot of roof area is available for rooftop rainwater harvesting. So in these semi-urban areas, rooftop rainwater harvesting practices may be encouraged. This will help in reducing the load on urban water supply systems. The area suitable for artificial recharge and number of structures feasible are shown in Fig-12.

6. Awareness and Training Activity

On 27th of September 2005, a Mass Awareness Programme to create awareness about artificial recharge and rainwater harvesting was conducted by Central Ground Water Board, South Western Region, Bangalore. About 200 people belonging to different section of society had participated in the programme and benefited by film shows and lectures on the artificial recharge and rainwater harvesting subject. An interaction session was arranged where the participants and the officers of the Board exchanged their views on the subject.

Fig 12


ARTIFICIAL RECHARGE PLAN - HAVERI DISTRICT
N
W
E
S
SHIGGAON
SAVANUR
HAVERI
HANGAL
BYADGI
RANIBENNUR
HIREKERUR
KARNATAKA STATE
Legend
Area Suitable for Artificial Recharge (PRS, PT, CD, SSD)
Taluk Boundary
Structures Feasible
SSD
PT
CD
PRS
11
359
2129
96

7. Recommendations

Considering the prevailing scenario of the groundwater resources and development the following recommendations are made for the optimum drawl with sustainable development of resources in the area.

1. The dug wells, which penetrate partially the weathered, fractured zones of the aquifers, may be deepened further for the better productivity.
2. Construction of check dams and sub surface dykes at appropriate places across the nalas and streams in the water table depleting areas, over exploited, critical and Semi-critical areas of the district and the areas where water quality problem exists may be taken on priority basis.
3. It is recommended to sink additional 11853 bore wells in parts of the district, which are considered safe from ground water development point of view.
4. Sinking of the filter points and collector wells with the maximum depth of 4 to 6 m in the alluvial stretches of riverbanks would be ideal ground water abstraction structures.
5. In the hard rock terrain, in the areas with shallow water level, construction of suitable dug wells and dug-cum-bore wells with a maximum depth of 8 and 30 m recommended respectively for the structures. In the areas which are still under safe category, further development of ground water may be carried out with utmost care.
6. Considering the fresh water scarcity in some pockets of the district, a comprehensive programme should be formulated to harvest the rain water through roof top, check dams, surface tanks, bunds and subsurface dykes to use the resources directly from the structures, and in turn to arrest the sub surface flows and augment the groundwater resources.
7. The ground water worthy areas such as topographic lows, valley portions, low fluctuation zones should be developed with an adequate soil conservation measures to prevent the soil erosion during rainy seasons.
8. Constant monitoring of ground water quality should be carried out in the fluoride contaminated areas to prevent further deterioration and related problems. The determination of trace elements and organic compound is to be done to help in categorizing the quality of water.

9. A detailed geophysical study with the help of the state of the art technology should be conducted to demarcate the extent of potential aquifers and it's geometry, especially in central plain region.
10. As the shallow aquifer is free from fluoride as compared to deeper aquifer this has to be preserved by watershed treatment approach. Desilting and maintaining of the percolation/irrigation tanks are utmost importance, so that the natural recharge will take place without any hindrance and this will recharge the shallow aquifer mainly, which can be used for drinking use, which is free from fluoride.
11. The farming community in the valley and low lying regions should be encouraged with financial assistance and necessary technical guidance to sink appropriate abstraction structures, to install pump sets, to practice modern irrigation methods, thereby to strengthen their economy. It is also recommended to bring an estimated 22632 ha of land to irrigate through balance of ground water resources.
12. Conjunctive use of both Surface and Ground water should be practiced in the canal command area, which will improve the quality of ground water, prevent the water logging conditions and availability of canal water to the tail end areas.

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S.No	Taluk	Recharge from rainfall during monsoon season (mcm)	Recharge from other sources during monsoon season (mcm)	Recharge from rainfall during non-monsoon season (mcm)	*Recharge from other sources during non-monsoon season (mcm)*	*Net annual ground water availability (mcm)*	Ground water draft for drinking and industries (mcm)	Irrigation Bore well & Dug well draft (mcm)	Existing gross ground water draft for all uses (mcm)	Allocation for domestic and industrial use for next 25 years in (mcm)	Net ground water availability for future irrigation development (mcm)	Stage of development in %	Categorisation as on March 2009			
													Safe area (%)	Semi critical area (%)	Critical area (%)	O.E. area (%)
1	Byadagi	19.57	28.24	13.19	10.94	65.25	5.63	56.92	62.55	5.74	4.97	96	20			80
2	Hangal	38.39	136.62	16.08	23.87	196.48	4.81	94.08	98.89	9.80	92.66	50	100			
3	Haveri	26.90	41.63	14.89	11.86	88.62	5.32	51.41	56.74	6.14	33.00	64	40			60
4	Hirekerur	32.71	26.25	17.30	10.99	79.90	4.55	57.02	61.57	5.71	17.46	77	90			10
5	Ranebennur	20.02	13.81	12.3 7	5.47	46.50	3.72	39.16	42.88	4.24	3.98	92	40			60
6	Savanur	21.21	3.58	8.76	2.54	34.28	1.28	11.66	12.94	1.58	21.04	38	100			
7	Shiggaon	29.54	2.07	9.76	2.36	36.47	1.34	10.42	11.76	1.64	24.41	32	100			
8	Total	168.77	252.2	79.98	57.09	547.5	26.65	229.59	347.33	34.85	197.52	449				