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
BIDAR DISTRICT, KARNATAKA

SOUTH WESTERN REGION
BANGALORE
AUGUST 2012

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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 Bidar 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 Mr. A. Suresha, Scientist-B, Central Ground Water Board, South Western Region, Bangalore. The figures were prepared by Sri. J. Sivaramakrishnan, Assistant Hydrogeologist. 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 and manage the water resources in a better way in the district.

(K.Md.Najeeb)
Regional Director

BIDAR DISTRICT AT A GLANCE

Sl. No	ITEMS	Statistics	
1.	GENERAL INFORMATION		
	i) Geographical area (Sq.km)	5417.65	
	ii) Administrative Divisions (As on 2009-10)		
	a) Number of Tahsil / Blocks	05	
	b) Number of panchayat/village	175/621	
	iii) Population (As on 2001Census)	17,00,018	
	iv) Normal Rainfall (mm, 1941-1990)	886	
2.	GEOMORPHOLOGY		
	Major physiographic units	Northern low land and southern high land (Bidar platue)	
	Major Drainage	The Manjara and The Karanja river	
3.	LAND USE (Sq.km)		
	a) Forest area	277.07	
	b) Net area sown	3407.86	
	c) Cultivable area	3850.47	
4.	MAJOR SOIL TYPES	Black soil and Lateritic soil	
5.	IRRIGATION BY DIFFERENT SOURCES (Areas in sq km)		
	Dug well	236.50	
	Tube wells /Bore well	184.13	
	Tanks/Pond	10.36	
	Canals and lift irrigation	43.06 and 3.05 respectively	
	Other sources	10.45	
	Net Irrigated area	490.95	
6.	NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.03.2012)		
	No of Dug wells	45	
	No of Piezometers	19	
7.	PREDOMINANT GEOLOGICAL FORMATIONS	Deccan trap	
8.	HYDROGEOLOGY	Fractured basalt and weathered vesicular basalt	
	Major water bearing formation	Basalt	
	Pre-monsoon Depth to water level during-2011	1.45 to 17.73m bgl	
	Post-monsoon Depth to water level during-2011	0.69 to 16.46 mbgl	
	Long term water level trend in 10 years (2002-2011) in m/year	Pre-monsoon	0.088 to 2.70 Falling 0.043 to 0.91 Rising
		Post - monsoon	0.00 to 0.148 Falling 0.017 to 0.99 Rising

9.	GROUND WATER EXPLORATION BY CGWB (As on 31.3.2012)	
	No of wells drilled (EW, OW, PZ, SH, Total)	EW-45 OW-20
	Depth range (m)	47.75 to 308.4
	Discharge (litres per second)	Negligible to 16.5
	Transmissivity (m^2/day)	1.71 to 228
10.	GROUND WATER QUALITY	
	Presence of chemical constituents more than the permissible limit Electrical Conductivity (micro mohs/cm at 25° c) Fluoride (F in ppm) Nitrate (No_3 in ppm) Chloride (Cl in ppm)	Range 165-1140 0.02-1.6 02-120 14-187
	Type of water	Alkaline
11.	DYNAMIC GROUND WATER RESOURCES (2009) IN HAM	
	Annual Replenishable Ground water Resources	31332
	Net Annual Ground Water Draft	29353
	Projected demand for domestic and industrial uses up to 2025	3306
	Stage of Ground Water Development (%)	77.6
12.	AWARENESS AND TRANING ACTIVITY	
	Mass Awareness Programmes organised Date Place No of participants Ground Water Management Training programme Date Place No of participants	 01-12-2010 Bhalki 250 29-11-2010 & 30-11-2010 Bidar 50
13.	EFFORTS OF ARITIFICIAL RECHARGE & RAINWATER HARVESTING	
	Projects completed by CGWB (No & amount spent)	Nil
	Projects under technical guidance of CGWB (Numbers)	Nil
14.	GROUND WATER CONTROL AND REGULATRION	
	Area of OE Taluk	40% of Bidar taluk, 70% of Basvakalyan taluk and 55% of Humnabad taluk
	Area of Semi -critical Taluk	5% of Bhalki taluk
	No of Blocks notified	Nil
15.	MAJOR GROUND WATER PROBLEMS AND ISSUES	Water scarcity in some areas, vulnerability to the various kinds of ground water contamination such as Nitrate, Fluoride etc.

BIDAR DISTRICT

1.0 INTRODUCTION

The Bidar district is located in the northern most part of the Karnataka state with a geographical area of 5417.65 sq.km. It lies between 17°35' and 18°29' North latitude and 76°41' to 77°39' East longitude. It is bounded by Nizamabad and Medak districts of Andhra Pradesh state on the eastern side, Latur and Osmanabad districts of Maharastra state on the western side, Nanded district of Maharastra state on the northern side and Gulbarga district on southern side.

1.1 ACCESSIBILITY

The Hyderabad-Parli Vaijanath, broad gauge railway section of the South Central Railway passes through Bidar and Bhalki taluks of the district. The National Highway No-9 connecting Hyderabad with Puna and Bombay passes through Humanabad and Bidar taluks of the district. The district is served by a good network of roads, which connects Bidar district with other important towns of the district of state and neighbouring state. Metal roads have connected all the important villages and all parts of area are easily approachable.

1.2 ADMINISTRATIVE DIVISIONS

The Bidar district is constituted by five talukas i.e. Aurad, Basavakalyan, Bhalki, Bidar and Humnabad with Bidar being the head quarters of the district. The Taluk wise statistics are given in table-1 and the administrative map is presented in Fig-1. The district has a population of 17,00,018 persons with a density of 312 persons per square kilometer.

Table-1. Taluk wise Area, Villages and Population

S. No.	Taluk	Area (sq. km)	No. of villages	
			Inhabited	Uninhabited
1	Aurad	1216.22	151	01
2	Basavakalyan	1194.38	112	03
3	Bhalki	1092.59	130	03
4	Bidar	922.03	124	10
5	Humnabad	992.43	82	05
	Total	5417.65	599	22

1.3 DRAINAGE

The major part of the district comes under Godavari basin, drained by its two major tributaries the Manjara and the Karanja River. The Manjara River is perennial and flows over a distance of 155 km in the central parts of the district and flows towards eastern direction with a meandering course. The Karanja River flows in northwestern direction for 74km. Karanja reservoir is built on this river. The river Mullamari takes its origin near Matala village of Basavakalyan taluk and flows from west to east direction for a length of 38 sq.km and then flows into Gulbarga district before joining the river Kagna. The Kagna River is one of the major tributary of Bhima River. Besides these, there are several streams, which are of ephemeral in nature. The drainage pattern in the district varies from sub-dendritic to dendritic and some streams have a sub parallel drainage to the main river. The drainage map of the district is presented in Fig-2.

Fig: 1

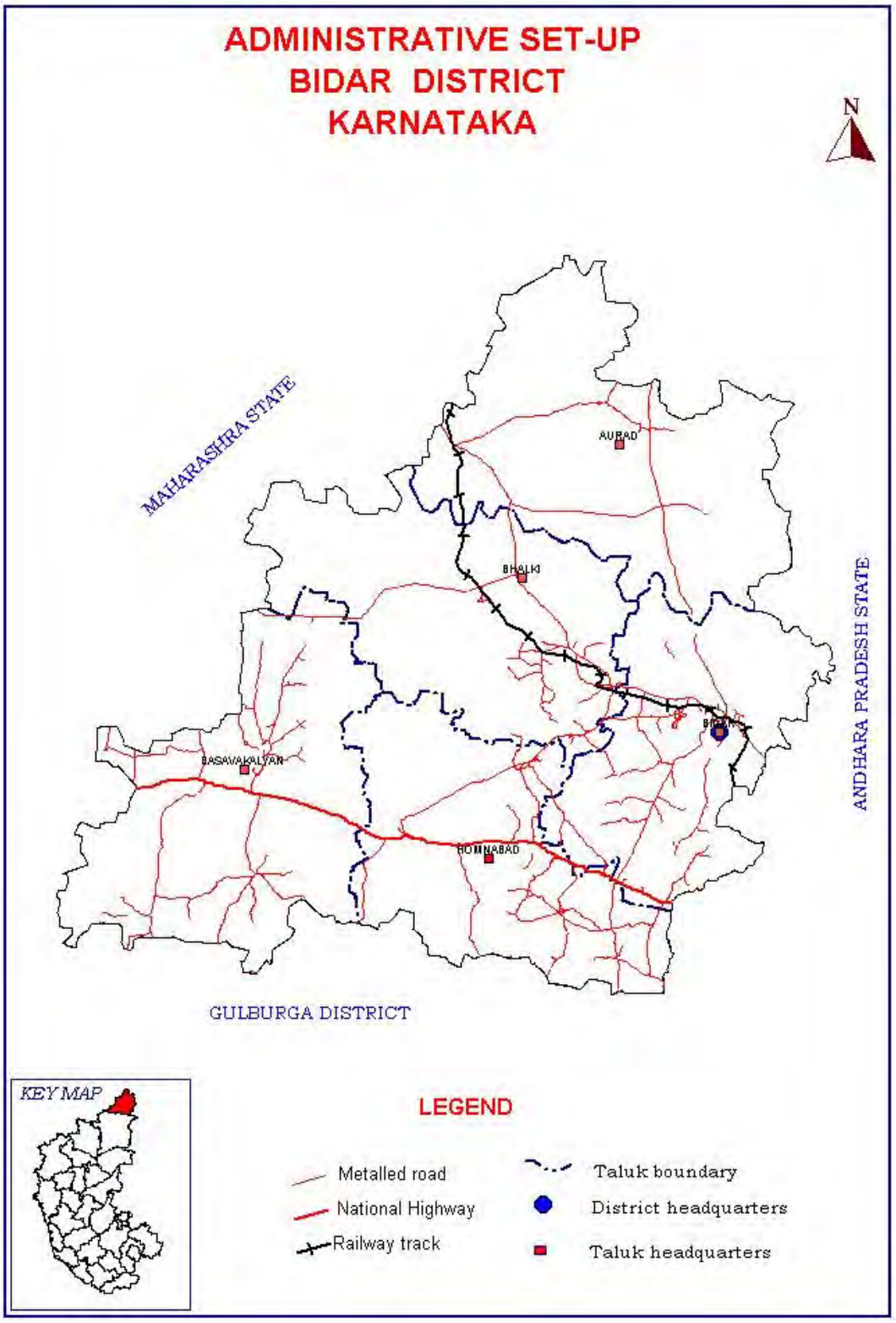
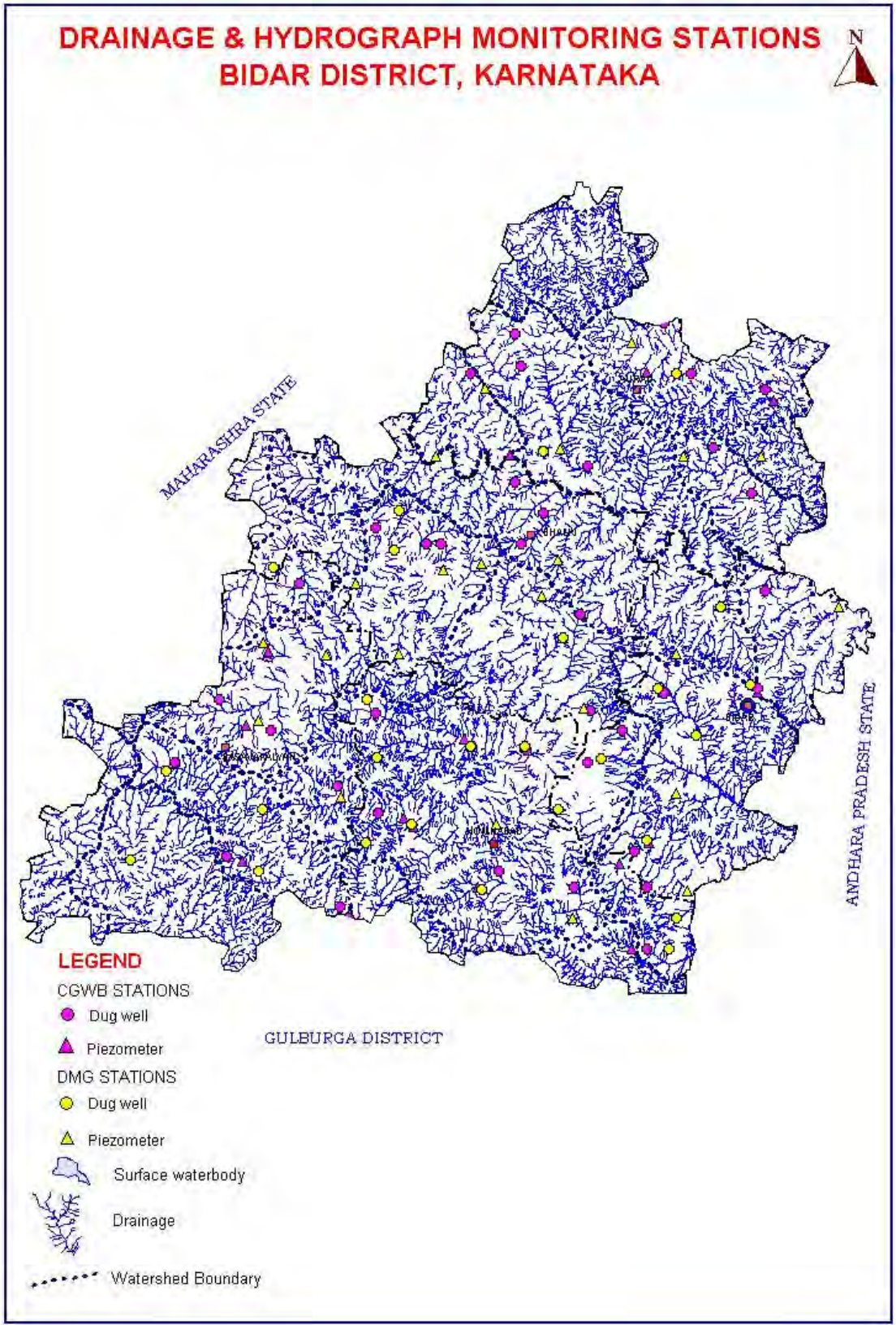

ADMINISTRATIVE SET-UP
BIDAR DISTRICT
KARNATAKA
N
MAHARASHRA STATE
AURAD
BHALKI
BIDAR
BASAVAKALYAN
HUMNABAD
ANDHARA PRADESH STATE
GULBURGA DISTRICT
KEY MAP
LEGEND
Metalled road
National Highway
Railway track
Taluk boundary
District headquarters
Taluk headquarters

Fig: 2


DRAINAGE & HYDROGRAPH MONITORING STATIONS
BIDAR DISTRICT, KARNATAKA
N
MAHARASHRA STATE
ANDHARA PRADESH STATE
GULBURGA DISTRICT
LEGEND
CGWB STATIONS
Dug well
Piezometer
DMG STATIONS
Dug well
Piezometer
Surface waterbody
Drainage
Watershed Boundary

1.4 IRRIGATION PRACTICES

In the district the irrigation takes place from surface water and ground water. The surface water irrigation is through canals, tanks and from medium and minor irrigation projects. A major irrigation dam was constructed across the Karanja River and medium irrigation dams were constructed across Chukkenala and Mullamari rivers. The irrigation from ground water is through dug wells, dug cum bore wells and bore wells. Taluk wise irrigated area from different sources is shown in table - 2.

Table-2. Area Irrigated by different sources in each taluk of Bidar district.

S. No.	Taluk	Canals	Tanks	Dug wells	Bore wells	Lift irrigation	Other source	Total
1	Aurad	Nil	325	991	1145	25	461	2947
2	Basavakalyan	103	38	6556	2869	Nil	Nil	9566
3	Bhalki	4159	380	3838	2995	240	769	12381
4	Bidar	Nil	272	4790	6060	40	155	11317
5	Humnabad	44	21	7475	5344	Nil	Nil	12884
	Total	4306	1036	23450	18413	305	1385	49095

1.5 LAND USE

The district has 5418 sq km of total geographical area. Out of the total district area, 277.07sq km is forest, which is 5.11% of the total area. The land not available for cultivation in the district is 411.33 sq km and uncultivable land is 442.61sq.km. Net sown area is 3407.86 sq km and out of that 603.39 sq km area is sown more than once. The taluk wise details of land utilization are given in table-3.

Table- 3. Taluk wise land utilisation in Bidar district (in sq.km)

Taluk	Area (sq.km)	Forest	Land not available for cultivation	Un-cultivable land	Fallow Land	Net area sown		
						Net Sown	Sown > once	Total
Aurad	1216.22	23.11	58.74	78.50	253.34	802.53	117.58	920.11
Basavakalyan	1194.38	71.43	109.41	95.73	196.92	720.89	141.24	862.13
Bhalki	1092.59	25.84	56.55	139.46	101.54	769.20	184.36	953.56
Bidar	922.03	46.55	68.24	34.77	235.57	536.90	76.55	613.45
Humnabad	992.43	110.14	118.39	94.15	91.41	578.34	83.66	662.00
Total	5417.65	277.07	411.33	442.61	878.78	3407.86	603.39	4011.25

1.6 CROPPING PATTERN

The main occupation of the people in the district is agriculture and agriculture related activties. There are two major seasons in which agricultural practices are carried out. The two seasons are Khariff and Rabi. Khariff season commences from June and the crops are harvested in the month of September. Rabi season commences from September and crops harvested in the month of February. The main food crops are Jowar, Paddy, Wheat, Bajra, Maize and Pulses. Groundnut, sugarcane and cotton are the major cash crops. The Taluk wise details of cropping pattern are given in table-4.

Table- 4. Taluk wise cropping pattern in Bidar district (in Ha)

Taluk	Food grains	Oil seeds	Fruits	Vegetable	Sugar cane	Other non food crops	Total area under all crops
Aurad	66980	21376	62	348	1700	1545	92011
Basavakalyan	62253	16428	384	548	5068	1532	86213
Bhalki	76790	12465	302	287	5046	66	95356
Bidar	43922	7465	318	496	8016	1128	61345
Humnabad	48091	7286	488	320	9196	819	66200
Total	298036	65020	1554	1999	29026	6490	401125

1.7 STUDIES CARRIED OUT BY CGWB

The Central Ground Water Board has drilled 65 bore wells under ground water exploration programme. The statistics of these bore wells comprising number of bore wells, depth range and discharge range etc are summarized in district at a glance. The periodic water level monitoring of 45 observation dug wells and 19 piezometer bore wells in the district are also carried out by CGWB during January, May, August and November of every year. CGWB has carried out Hydrogeological Surveys in the district.

2.0 RAINFALL AND CLIMATE

The district experiences semi-arid climate with extreme summer. The dust storms and severe heat waves are common in the district between April and May. The temperature begins to rise towards the end of February till the end of May, which is the hottest month of the year. Coldest months are December and January. The temperature varies in the district between 20 ºC and 42 ºC

The year in the district may be divided into summer season from March to May, southwest monsoon season from June to September, post-monsoon season from October to November and winter season from December to February.

Generally, the monsoon sets in the month of June and reaches its peak in the month of September. The rainfall generally is spread over 45 to 55 days. Nearly 75% to 80% of the annual rainfall is during the period of southwest monsoon. A few showers are also received during the Northeast monsoon period, generally in the month of December. Bidar district receives an average normal rainfall of 886 mm. The normal rainfall over the district ranges from 821 mm to 998 mm and taluk wise normal and actual rainfall of the district is presented in Table-5. Seasonal and Annual Normal rainfall for the period 2001-2010 is given in table-6. Annual Normal rainfall for the period 2001-2010, Bidar district is given in table-7. District and Taluk wise rainfall for the year 2011in Bidar district is given in table-8.

Table- 5. Taluk wise normal rainfall in Bidar district (Statistical Dept, GOK)

Taluk	No.of Rain gauge stations	Rainfall in mm		Rainy days	
		Normal 1941-90	Actuall 2009	Normal 1941-90	Actual 2009
Aurad	6	888	644	45	41
Basavakalyan	6	821	619	49	41
Bhalki	9	894	678	50	44
Bidar	8	998	916	55	42
Humnabad	8	828	901	47	39
Average	37(Total)	886	752	49	41

Table- 6. Seasonal and Annual normal rainfall for the period 2001-2010, Bidar district

Station	Pre-Monsoon	SW Monsoon	NE Monsoon	Annual
Aurad	70	719	81	869
Basavakalyan	86	599	79	763
Bhalki	79	706	88	873
Bidar	93	751	124	968
Humnabad	99	634	101	835

Table: 7. Annual normal rainfall for the period 2001-2010, Bidar district

Station	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Aurad	730	760	1042	690	1221	1024	741	899	639	948
Basavakalyan	681	685	740	833	771	643	598	737	618	1326
Bhalki	884	669	786	711	918	969	887	1023	671	1210
Bidar	1120	838	1046	721	1073	866	794	1172	912	1135
Humnabad	581	820	605	873	911	899	688	928	901	1144

Table- 8. District and taluk wise rainfall for the year 2011, Bidar District

Station	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Pre**	**Jun**	**Jul**	**Aug**	**Sept**	**SWM**	**Oct**	**Nov**	**Dec**	**NEW**	**Annual**
Bidar	0	2	0	40	26	68	66	334	265	50	715	25	0	0	25	809
Aurad	0	3	0	43	27	64	66	440	262	91	859	9	0	0	9	932
Basava kalyan	0	5	0	6	31	42	48	252	266	16	582	39	0	0	39	663
Bhalki	0	0	0	20	16	36	46	330	203	51	720	32	0	0	32	788
Bidar	0	2	0	72	24	98	57	325	223	58	663	12	0	0	12	773
Humna bad	0	1	0	68	32	101	111	323	283	35	752	34	0	0	34	887

The Indian Meteorological Department (IMD) has divided rainfall pattern into five categories i.e. excess, normal, moderate, severe and acute to arrive at the agricultural drought conditions. When the rainfall is more than 25% of Normal Annual rainfall it is excess. When the rainfall departs from the Normal Annual rainfall between +25% and -25% it is normal. When the rainfall departs more than -25% from Normal Annual rainfall it causes drought. The drought is classified as moderate, severe and acute according to the departure of rainfall from Normal Annual rainfall. Thus, if the departure is between -25 and -50%, then it is termed as moderate drought, if the departure is between -50 and -75%, then it is severe drought, and if the departure is more than -75%, then it is termed as acute drought. The details of the Agricultural Drought based on rainfall departure from the Normal rainfall are given in table - 9.

Table- 9. Agricultural Drought based on Rainfall Departure from the Normal rainfall

Taluk	Rainfall (mm)		Departure in % from Normal Annual Rainfall	Category
	Normal 1941-90	Actual (2009)		
Aurad	888	644	-27	Moderate drought
Basavakalyan	821	619	-25	Normal
Bhalki	894	678	-24	Normal
Bidar	998	916	-08	Normal
Humnabad	828	901	+09	Normal

The percentage probability of occurrence of normal rainfall over the district has shown in table-10.

Table-10. Probability analysis of occurrence of Annual rainfall (2001-2010)

Probability (%)	Rain gauge station				
	Aurad	Basavakayan	Bhalki	Bidar	Humanabad
10	1110	1000	1100	1195	1050
20	1080	940	1050	1150	1000
30	1000	900	1000	1100	950
40	950	840	950	1040	900
50	890	790	900	990	850
60	830	740	850	940	800
70	780	690	800	890	750
80	730	640	740	840	700
90	680	590	690	790	650
100	600	540	650	740	600

The dependable rainfall for the above stations may be used for the construction of any recharge structure in the district.

3.0 GEOMORPHOLOGY AND SOIL TYPES

Physiographically, the district can be divided into two regions. They are northern low land and southern high land. The southern high land is popularly known as Bidar plateau, which is made up of laterite. The ground altitude of Bidar district is varying from 420 to 684 m above MSL. Bidar plateau has an elevation range from 640 to 684 m above MSL. The ground surface is flat, gently sloping forming broad valleys and flat topped hills. The flat topped hills with step like sides exhibit the terraced landscape.

Soils

Two important types of soil are noticed in the district and they are black soil and lateritic soil.

Black Soil

Major parts of the district are comprised of black soils and are derived from Deccan traps. These are deep black in colour and their texture varies from loam to clay. Lime concentration in this soil is high resulting in poor infiltration capacities. Their infiltration characteristics are poor to moderate. This type of soil is found mainly in areas lying below 610 m contour and along the valley portions.

Lateritic Soil

Lateritic soil is confined to the central portion of the district. Lateritic soils are pale to bright red in colour and clay to clayey loam in nature. This soil has moderate to good infiltration characteristics. This type of soil is found mainly in areas lying above 610 m contour.

4.0 GROUND WATER SCENARIO

4.1 HYDROGEOLOGY

The entire district is underlain by lava flows of the Deccan trap except small area covered with the lateritic capping and is shown in Fig-3. Deccan trap consists of successive lava flows, almost horizontal in disposition. Individual flows show considerable variation in physical character, thickness, nature and extent of weathering etc. The basaltic lava flows are generally dark, grey, hard and compact in nature. Each lava flow normally consists of two units such as lower massive basalt and upper vesicular basalt. The secondary minerals like zeolite, quartz, calcite or some earthy or ferruginous material fill the vesicles. Well developed columnar joints and spherical weathering are characteristic features of the massive basalt. The massive basalt and vesicular basalt are similar in terms of composition and texture.

Water bearing properties of formation

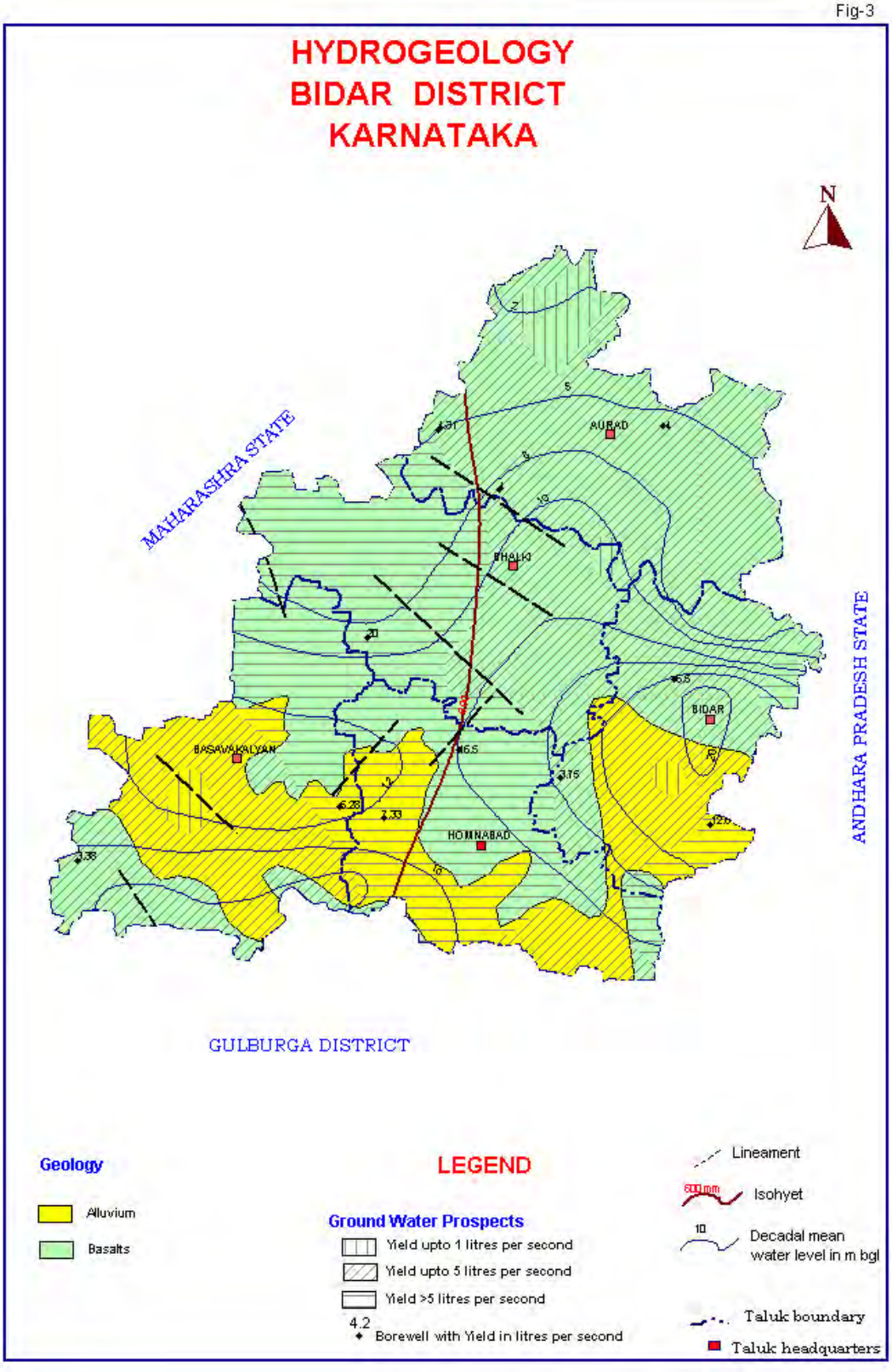
Deccan trap basalts are a thick pile of nearly horizontal layered formation. The porosity and the permeability change within an individual flow and also from flow to flow and place to place. The weathered portion, joints and fractures in the massive and vesicular units of basalt form the water bearing horizons. Abundance of vesicles with interconnecting nature together with joints and horizontal partings in the vesicular basalt make it a good aquifer. The red bole bed, occurring as top undulating layer of flow, inhibit movement of ground water as it is composed of mixture of fragmentary material and clay particles. Therefore, it acts like an aquiclude and its position in the lava sequence indicate the presence of permeable water bearing zone underneath.

Occurrence of Groundwater

Basalt: In general ground water occurs under water table conditions in shallow aquifer and semi-confined to confined conditions in deeper aquifer. The fractured, jointed vesicular basalt and massive basalt when overlain by red bole bed of considerable thickness develops semi-confined to confined conditions. Hence, the red bole bed acts as a confining layer. The red bole bed being clayey in nature also acts as a ground barrier for the downward movement of water. The weathered and jointed zone of massive basalt unit and vesicular basalt unit constitute the unconfined aquifer, which are generally tapped by dug well. The semi-confined to confined aquifers are tapped by dug cum bore well and bore well. The presence of columnar joints in massive basalt also helps in the occurrence and movement of ground water.

Depth to Water Level: The Central Ground Water Board has established 45 hydrograph stations. These hydrograph stations are monitored four times in a year, i.e. in the month of January, May, August and November. The Depth to water level varies within the area depending on the hydrogeological setup, incidence of rainfall, topographic setting and stage of groundwater development.

Fig-3


HYDROGEOLOGY
BIDAR DISTRICT
KARNATAKA
N
MAHARASHRA STATE
ANDHARA PRADESH STATE
GULBURGA DISTRICT
AURAD
BHALKI
BIDAR
BASAVAKALYAN
HOMNABAD
LEGEND
Geology
Alluvium
Basalts
Ground Water Prospects
Yield upto 1 litres per second
Yield upto 5 litres per second
Yield >5 litres per second
4.2
Borewell with Yield in litres per second
Lineament
600 mm
Isohyet
10
Decadal mean water level in m bgl
Taluk boundary
Taluk headquarters

Pre-monsoon Depth to Water Level: In order to study the premonsoon ground water regime of the district, depth to water level map has been prepared based on pre-monsoon (May 2011) water level data and presented in Fig-4. The depth to water level in the district varies from 1.45 to 17.73 m bgl. The depth to water level map shows that the shallow water level less than 5 m bgl occur in the northern part of the district around Kamalnaga, Donegaon and Ekamba of Aurad taluk and Saigaon of Bhalki taluk comprising about 20% of the area. The shallow water level in these areas may be due to low topography and proximity to Karanja and Manjra rivers. These are the areas where ground water development can be accelerated. The depth to water level in the range of 5 to 10 mbgl is found in central and southern part of the district comprising about 40% of the area. The depth to water level from 10 to 20 mbgl occurs in south central part of the district comprising about 40% of the area. The deeper water level in pre monsoon is generally found in lateritic area.
The distribution of pre-monsoon depth to water level is shown in Fig-4.

Post-monsoon Depth to Water Level: Depth to water level map has been prepared based on post-monsoon (November 2011) water level data and presented in Fig-5. The post-monsoon water level in the district varies from 0.69 to 16.46 m bgl. The depth to water level map shows that depth to water level less than 2 m bgl occur at two isolated pockets in the northern and north western part of the district comprising about 05 % of the district. The depth to water level in the range between 2 and 5 m bgl is found in northern, western and extreme southern part of the district comprising about 45% of the district. The depth to water level in the range of 5 to 10 mbgl is found in the south central part of the district comprising about 40% of the district. The depth to water level in the range between 10 and 20 mbgl occur in the south eastern part of the district comprising about 10% of the district.
The distribution of post-monsoon depth to water level is shown in Fig-5.

Ground Water Level Fluctuation

Seasonal water fluctuation (Year 2011) ranges from 0.27 to 10.54 m. About 95% of the area shows rise in water level as compared May 2011 water level with November 2011 water level. Only 05% of the area shows fall in water level.

Ground water level fluctuation (The decadal mean pre-monsoon (May2001-2010 with reference to May-2011) shows that about 95%of the area show rise in water level whereas 05% of the area show fall in water level.
The ground water level fluctuation (The decadal mean pre-monsoon (May2001-2010 with reference to May-2011) is shown in Fig-6.

Ground water level fluctuation (The decadal mean post-monsoon (November 2001-2010 with reference to November-2011) shows that about 55%of the area show rise in water level whereas 45%of the area show fall in water level.
The ground water level fluctuation (The decadal mean post-monsoon (November 2001-2010 with reference to November-2011) is shown in Fig-7.

Fig-4

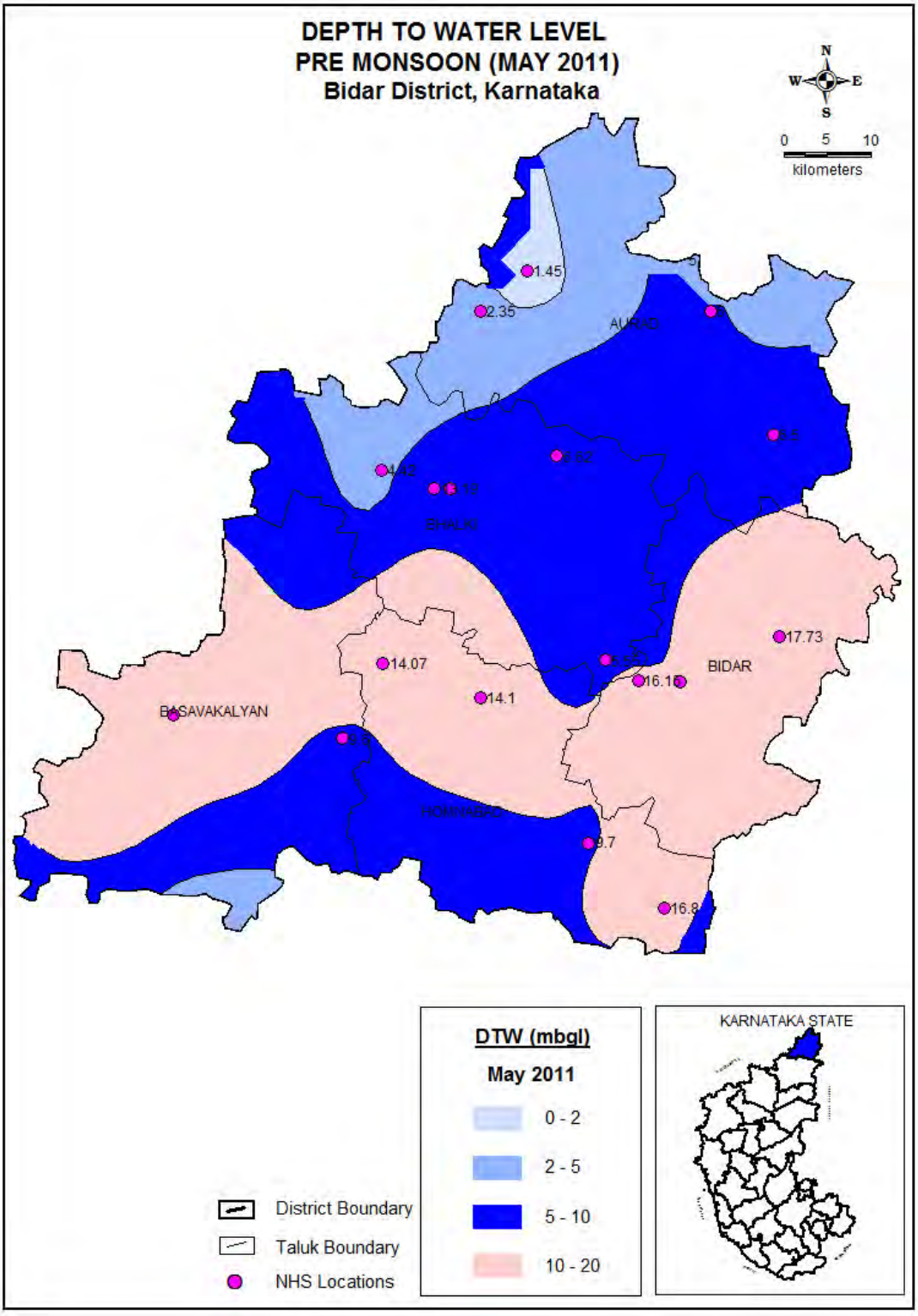

DEPTH TO WATER LEVEL
PRE MONSOON (MAY 2011)
Bidar District, Karnataka
N
W
E
S
0 5 10
kilometers
1.45
2.35
AURAD
6.5
6.62
4.42
BHALKI
17.73
14.07
16.1
BIDAR
14.1
BASAVAKALYAN
HOMNABAD
9.7
16.8
DTW (mbgl)
May 2011
0 - 2
2 - 5
5 - 10
10 - 20
District Boundary
Taluk Boundary
NHS Locations
KARNATAKA STATE

Fig-5

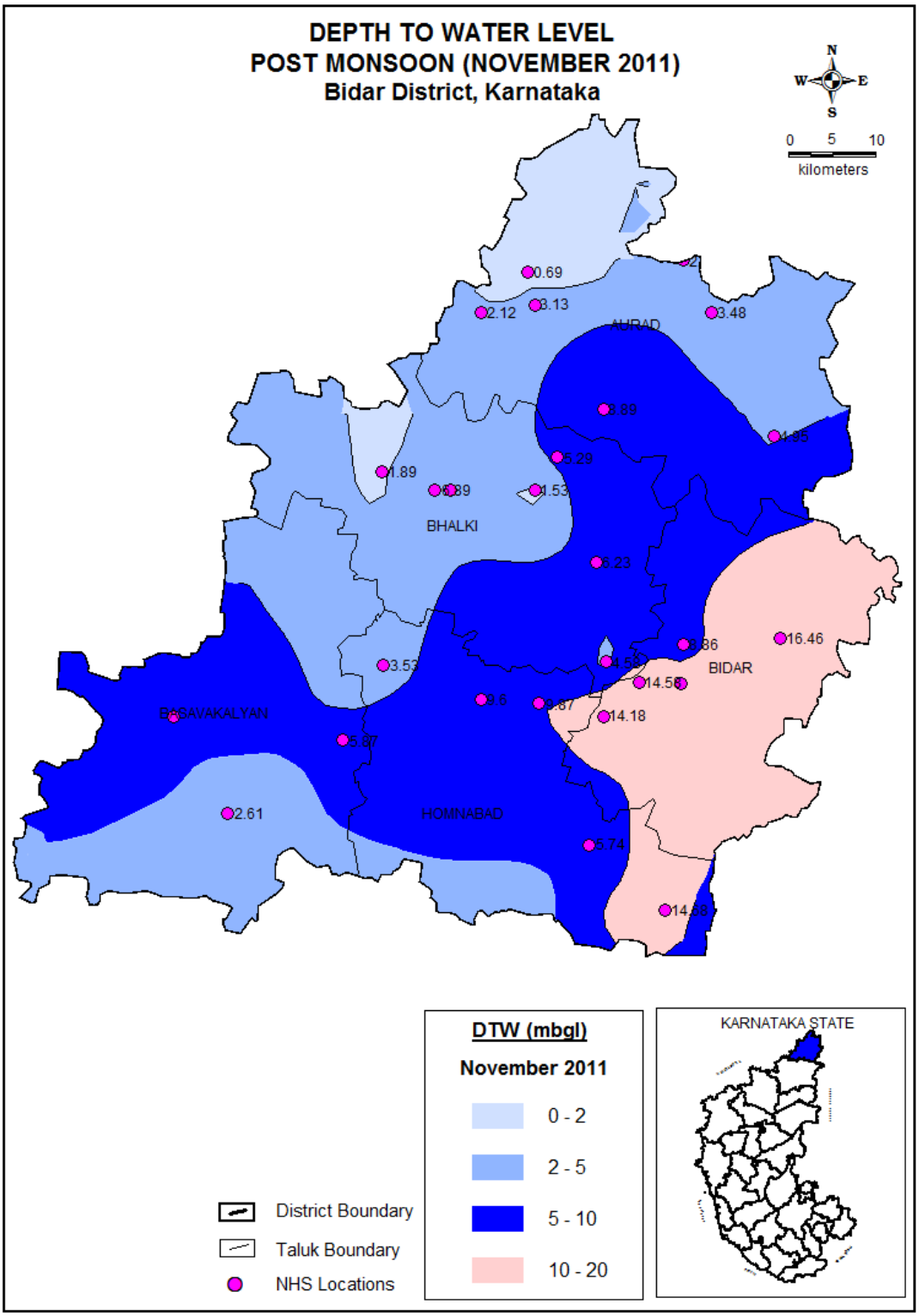

DEPTH TO WATER LEVEL
POST MONSOON (NOVEMBER 2011)
Bidar District, Karnataka
N
W
E
S
0 5 10
kilometers
0.69
2.12
3.13
3.48
AURAD
3.89
4.95
5.29
1.89
1.53
BHALKI
6.23
16.46
3.53
14.58
BIDAR
14.18
BASAVAKALYAN
5.87
2.61
HOMNABAD
5.74
DTW (mbgl)
November 2011
0 - 2
2 - 5
5 - 10
10 - 20
District Boundary
Taluk Boundary
NHS Locations
KARNATAKA STATE

Fig-6

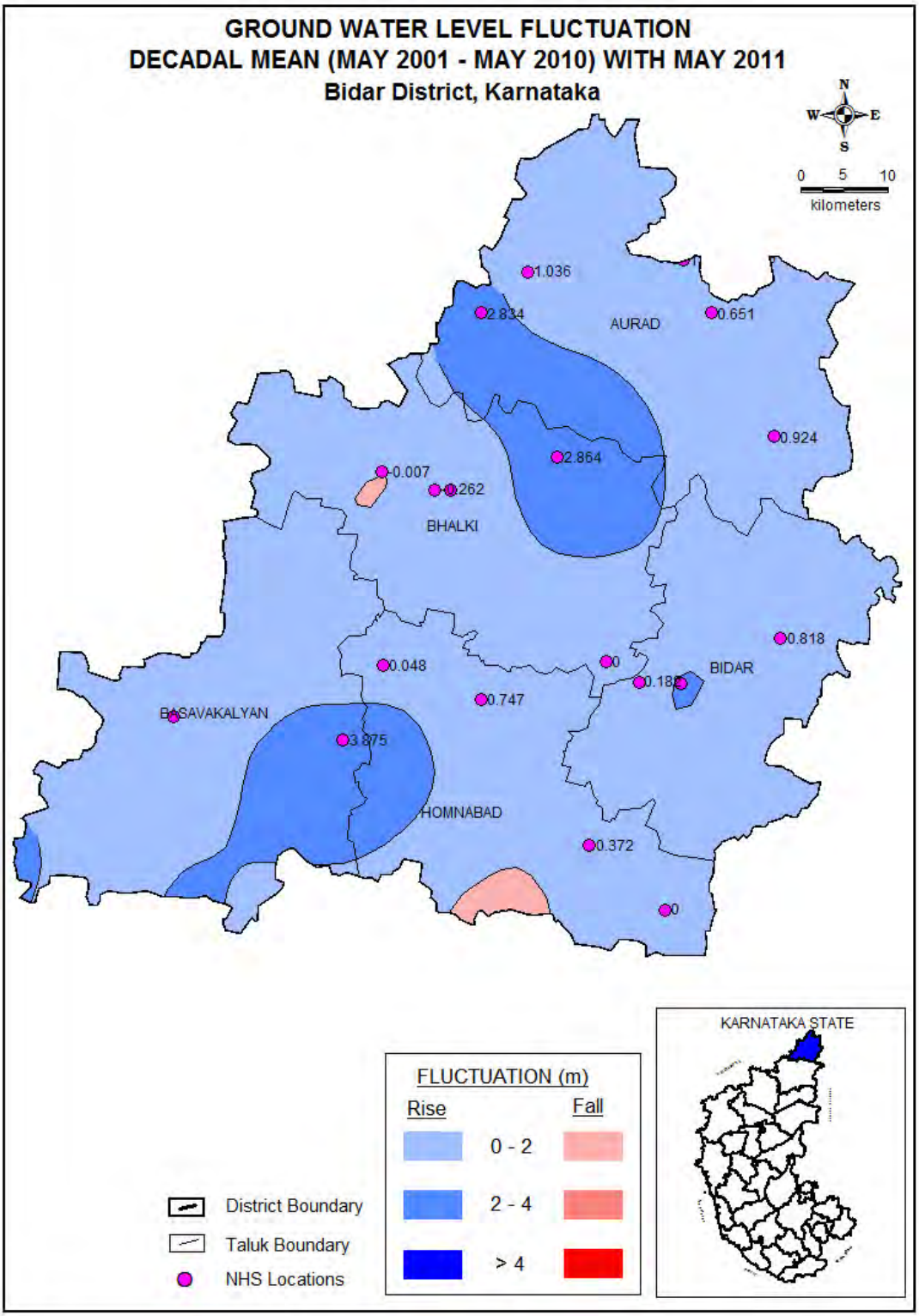
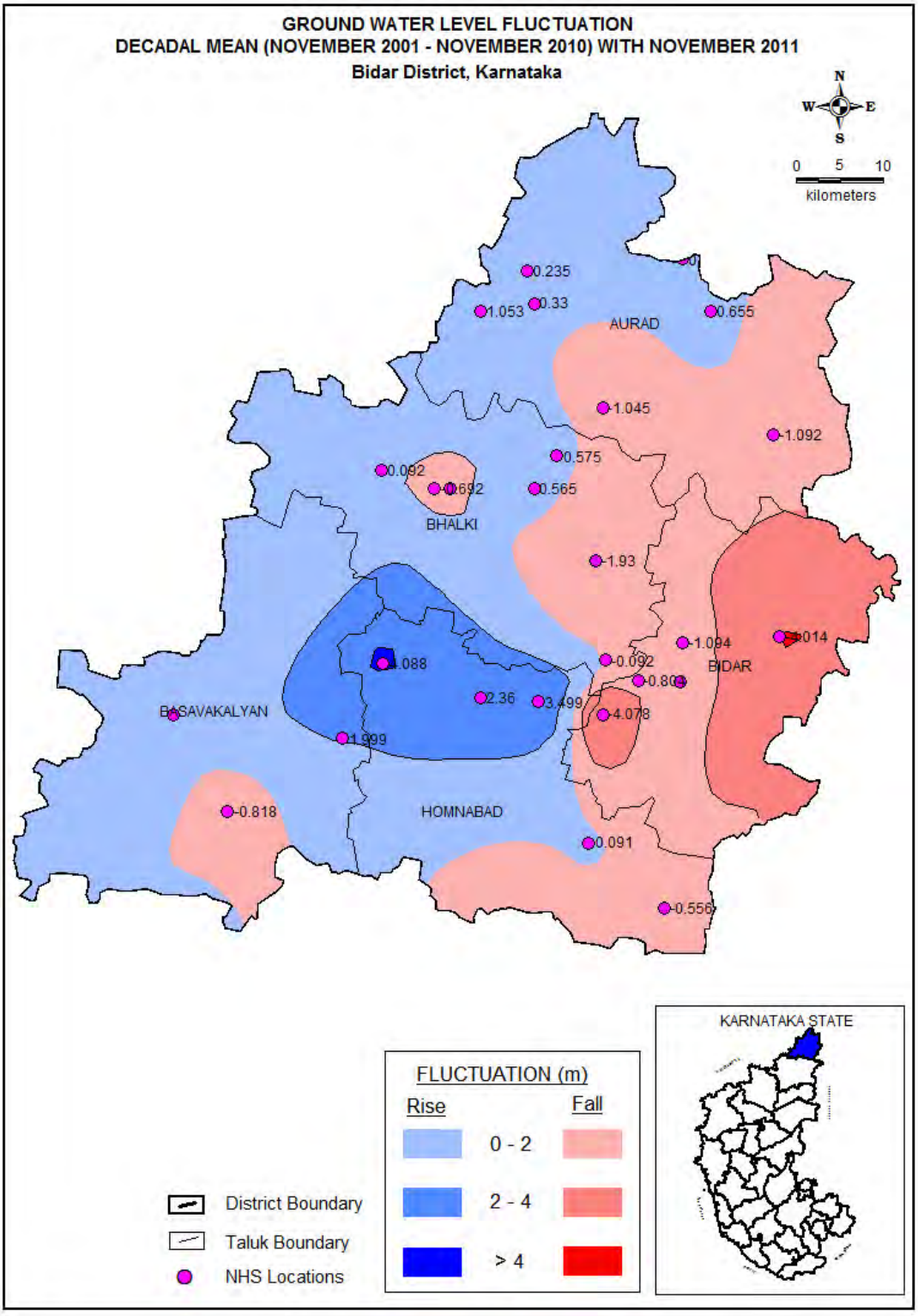

GROUND WATER LEVEL FLUCTUATION
DECADAL MEAN (MAY 2001 - MAY 2010) WITH MAY 2011
Bidar District, Karnataka
N
W
E
S
0 5 10
kilometers
1.036
2.834
AURAD
0.651
0.924
2.864
0.007
0.262
BHALKI
0.818
0.048
0
0.18
BIDAR
0.747
BASAVAKALYAN
3.875
HOMNABAD
0.372
0
KARNATAKA STATE
FLUCTUATION (m)
Rise
Fall
0 - 2
2 - 4
> 4
District Boundary
Taluk Boundary
NHS Locations

Fig-7


GROUND WATER LEVEL FLUCTUATION
DECADAL MEAN (NOVEMBER 2001 - NOVEMBER 2010) WITH NOVEMBER 2011
Bidar District, Karnataka
N
W
E
S
0 5 10
kilometers
0.235
1.053
0.33
0.655
AURAD
1.045
1.092
0.575
0.092
0.692
0.565
BHALKI
1.93
1.094
BIDAR
0.092
0.80
2.36
3.499
4.078
BASAVAKALYAN
1.999
0.818
HOMNABAD
0.091
0.556
KARNATAKA STATE
FLUCTUATION (m)
Rise
Fall
0 - 2
2 - 4
> 4
District Boundary
Taluk Boundary
NHS Locations

Long Term Water Level Trend: Ground water is a renewable resource. It gets depleted when the aquifer is over drafted. The aquifer gets recharged during monsoon period. Rainfall is the main source for ground water recharge. In order to study the long-term trend of ground water level in the district, water level data has been analyzed for 45 NHS observation wells for the period pre-monsoon and post-monsoon, established by Central Ground Water Board, for the periods from January 2002 to November-2011. The long-term water level trend data of Bidar district is presented in Table-11.

Table-11. Long term water level trend of Bidar district

Ranges of long-term water level trend m/year			
Pre monsoon		Post monsoon	
Fall	Rise	Fall	Rise
0.088 to 2.699	0.043 to 0.913	0.000 to 0.148	0.017 to 0.992

Pre-Monsoon Water Level Trend

The pre monsoon water level trend shows that 72% of the observation wells show rise in water level in the range from 0.043 to 0.913 m/year. Only 28% of the observation wells show fall in water level in the range from 0.088 to 2.699 m/year. The rise in the water level is may be because of the good rain fall in the recent years.

Post-Monsoon Water Level Trend

The post monsoon water level trend indicates whether the ground water body has been fully recharged or not. If water level trend is declining, it suggests that the aquifer is getting desaturated year after year. The post monsoon water level trend shows that 80% of the observation wells show rise in water level in the range from 0.017 to 0.992m/year. Only 20% of the observation wells show fall in water level in the range from 0.000 to 0.148 m/year. The rise in the water level is may be because of the good rain fall in the recent years.

Yield

In Bidar district, there are three types of ground water abstraction structures i.e. the dug well, bore well and dug cum bore well. The yield of the well depends upon the geological formation, their location with respect to topography, diameter and depth of the well etc.

Yield of Dug well

Majority of the dug wells are used for domestic purposes. The rope and bucket is usually used for the withdrawal of water. The dug wells and dug cum bore wells tap phreatic aquifer of basalt and laterite. In basaltic area, the yield of wells depends upon the saturated thickness and jointed & fractured thickness of vesicular/massive basalt. The dug wells located in topographic low yield relatively better. Yield of dug wells and dug cum bore wells range from 20 to 200 m^3 / day with pumping duration of one to four hour per day during summer and 5 to 10 hour during winter.

Yield of Bore well

To provide drinking water facilities to villages, the state government has drilled large number of bore wells. The yield of these bore wells range from less than 1 lps to 12.64 lps. Most of the high yielding bore wells are generally in the close vicinity of lineament. Most of the high yielding bore wells are fitted with power pump and poor yielding bore wells are fitted with hand pump.

Ground Water Exploration

45 exploratory and 20 observation wells were drilled in the district under Ground water exploration programme carried out in two phases, to ascertain the aquifer geometry, quality of ground water and aquifer parameter. The depth of the exploratory wells ranged from 47.75 (Junawad) to 308.4mbgl (Chikpet). The discharge of the wells ranged from negligible to 16.5 lps (DubalgundI). The Transmissivity ranged from 1.71 (Chikpet) to 222 m^2 /day (Rajolkheni). The distribution of exploratory well is shown in Fig-8.

4.2 GROUND WATER RESOURCES

The resource estimation and categorization is carried out as per the recommendations of 'Ground Water Resources Estimation Methodology - 97 '(GEM - 97) considering the water shed as a unit. Water shed and hydrological boundaries do not match with the administrative boundaries. As a result different parts of taluk fall in different watersheds having different stages of ground water development and categorization. Pro-rata approach to consolidate the watershed data into Talukwise data gives only details on ground water resource, draft, and additional irrigation potential. Pro-rata approach cannot be applied for taluk, as a unit, as far as stage of development and categorization is concerned. However, average stage of development is considered to have an overall idea about the taluk.

The percentage of safe, critical and over exploited area in each taluk is given table-12. It is observed from the table-12 that Aurad taluk is completely under safe category. 60% of Bhalki and 30% of Basavakalyan, 60% of Bidar and 45% of Humnabad taluk are under safe category. 70% of Basavakalyan, 35% of Bhalki, 40% of Bidar and 55% of Humnabad taluk are under over exploited category. Only 5% of Bhalki taluk area comes under the category of semi-critical. The overall stage of ground water development in the district has reached 77.6%. Even though, some parts of the district has reached to the overexploited stage there are of areas of safe category which can be brought under developmental activity. In the over exploited areas water conservation measures may be taken up so that the situation in the district as a whole can be kept under control.

The status of ground water utilisation map of Bidar district has been prepared based on ground water resource estimation and is shown in Fig-9.

Fig:8

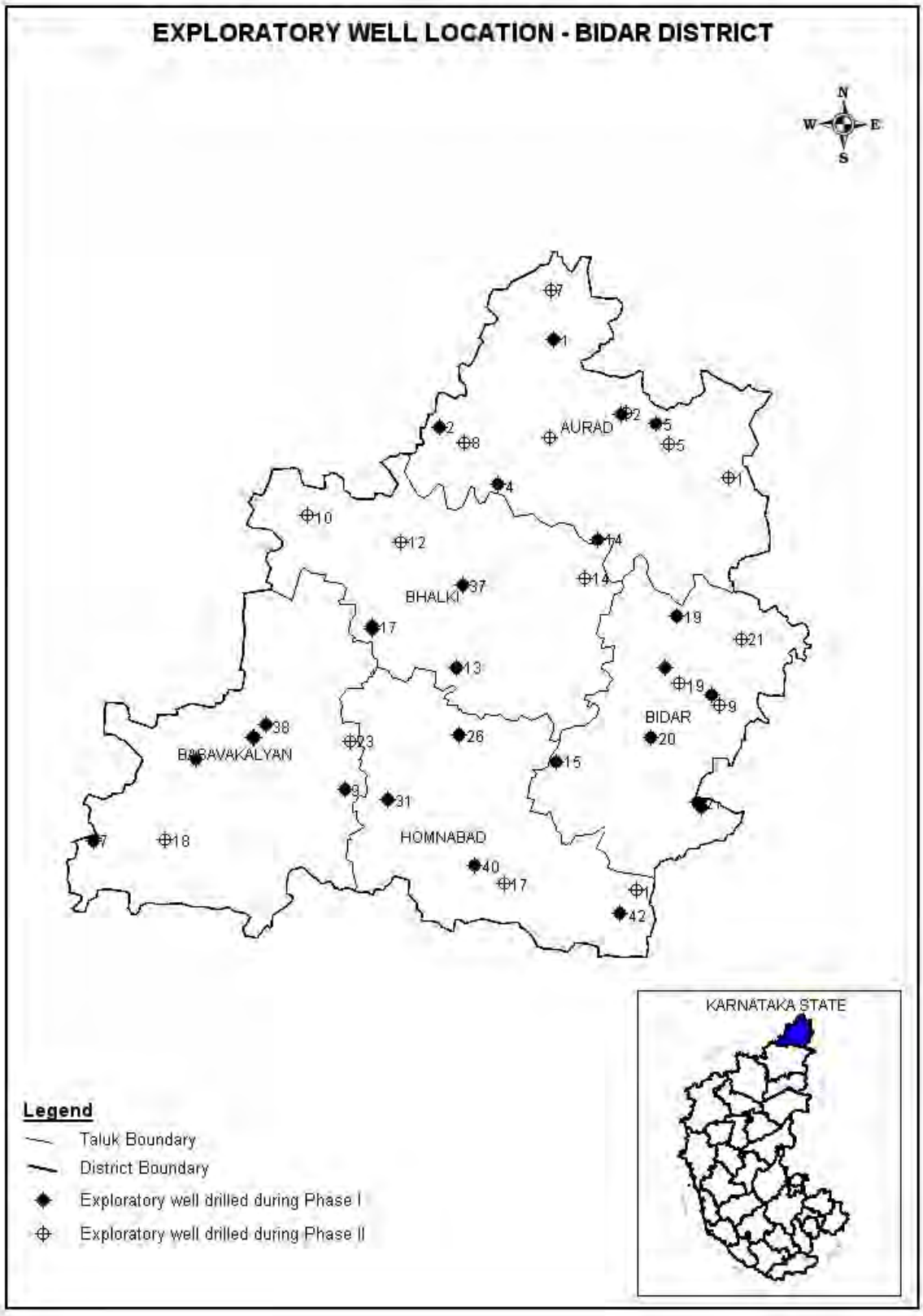

EXPLORATORY WELL LOCATION - BIDAR DISTRICT
N
W
E
S
AURAD
BHALKI
BIDAR
BASAVAKALYAN
HOMNABAD
KARNATAKA STATE
Legend
Taluk Boundary
District Boundary
Exploratory well drilled during Phase I
Exploratory well drilled during Phase II

Table- 12.TALUKWISE GROUND WATER RESOURCES OF BIDAR DISTRICT AS ON 31ST MARCH 2009													
Taluk	Command/ Non command area	TOTAL ANNUAL GROUND WATER RECHARGE	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 REQUIREMWNT SUPPLY TO 2025	NET GROUND WATER AVAILABILITY FOR FUTURE IRRIGATION DEVELOPMENT	EXISTING STAGE OF GROUND WATER DEVELOPMENT	CATEGORISATION OF TALUKS AS ON MARCH 2009 (%)			
										SAFE AREA	SEMI-CRITICAL AREA	CRITICAL AREA	OE AREA
		HAM	HAM	HAM	HAM	HAM	HAM	HAM	%				
Aurad	**Non command**	**5723**	**5354**	**2012**	**547**	**2559**	**652**	**2690**	**48**	**100**			
Basvakalyan	Command	270	263	107	15	123	36	119	47	100			
	Non command	6169	5693	3164	626	3790	737	1895	67	30			70
	Total	**6439**	**5956**	**3271**	**641**	**3912**	**774**	**2014**	**66**	**30**			**70**
Bhalki	Command	1948	1840	907	111	1018	264	669	55	100			
	Non command	8254	7768	7922	1064	8984	1114	1300	116	40	20		40
	Total	**10204**	**9609**	**8830**	**1172**	**1002**	**1378**	**1969**	**104**	**60**	**5**		**35**
Bidar	**Non command**	**6396**	**6049**	**4212**	**283**	**4495**	**316**	**2021**	**74**	**60**			**40**
Humnabad	Command	63	60	13	1	14	2	45	23	100			
	Non command	2508	2327	999	152	1151	184	1143	49	40			60
	Total	**2570**	**2386**	**1012**	**152**	**1165**	**186**	**1188**	**49**	**45**			**55**
Total		**31332**	**29353**	**19337**	**2795**	**13133**	**3306**	**9882**	**77.6**				

4.3 GROUND WATER QUALITY

Water quality observations are essential to know the changes in quality of ground water, which plays a prominent role in promoting both the standards of agricultural production and human health. To evaluate the quality of ground water, ground water samples have been collected from observation wells of National Hydrograph Stations and Exploratory bore wells. The ground water quality of the district has been analysed from the point of view of drinking and irrigation purposes.

Ground Water Suitability for drinking purpose

Based on analytical data of 56 samples of hydrograph stations and exploratory bore wells ground water was classified for drinking purpose as per the IS standards given below in table-13.

The ground water sample analysis of the district shows that the ground water quality is potable in general as compared with standards prescribed by BIS (IS-10500-1991) and it is also suitable for irrigation purposes in the major parts of the district. The distribution of fluoride concentration map has been presented in Fig- 10. The figure-10 shows that the entire district is having fluoride concentration in the range of less than 1.5 ppm except area around Bidar.

Fig-9

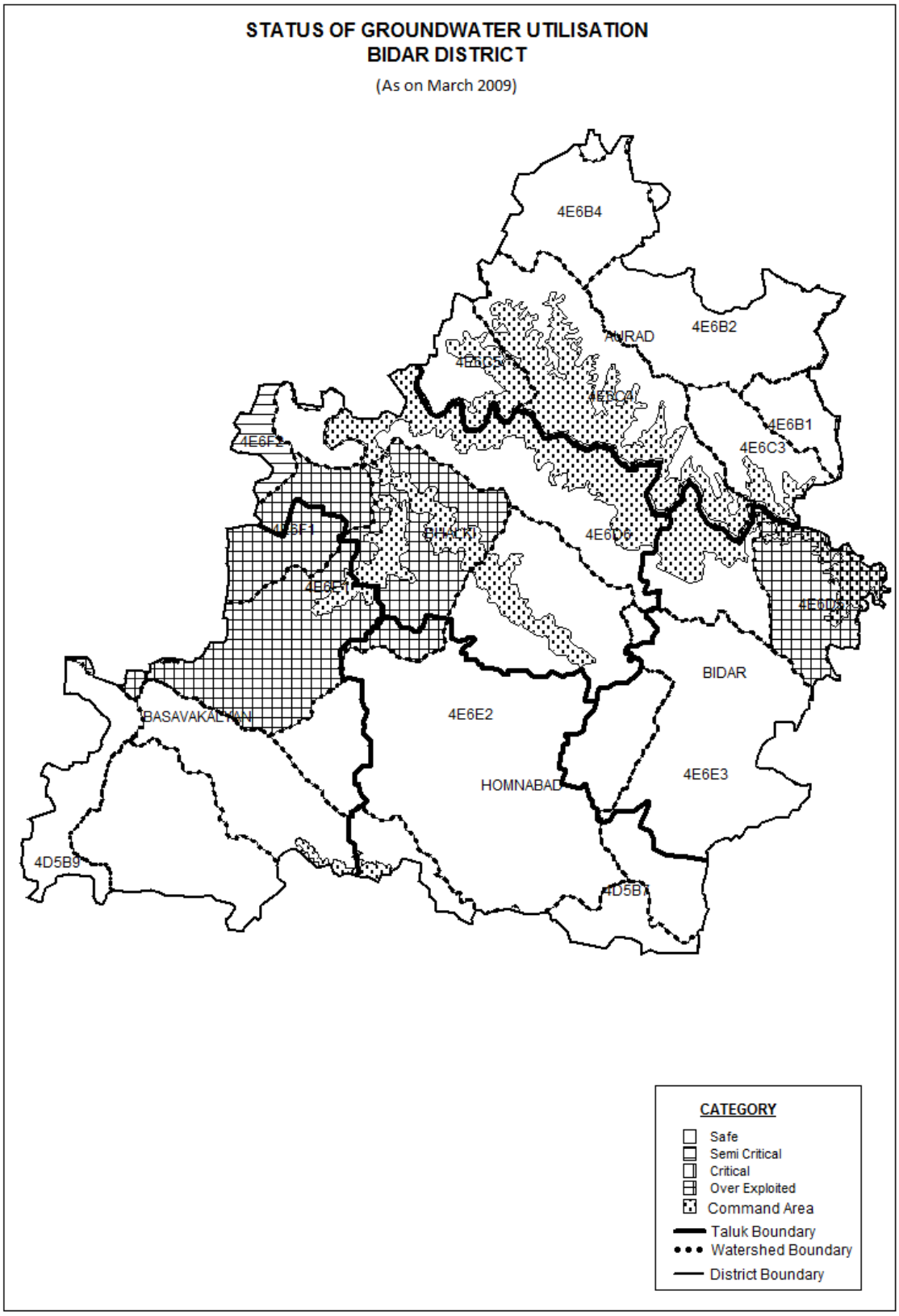

STATUS OF GROUNDWATER UTILISATION
BIDAR DISTRICT
(As on March 2009)
4E6B4
4E6B2
AURAD
4E6B1
4E6C3
4E6F2
4E6D6
4E6F1
BIDAR
BASAVAKALYAN
4E6E2
HOMNABAD
4E6E3
4D5B9
4D5B7
CATEGORY
Safe
Semi Critical
Critical
Over Exploited
Command Area
Taluk Boundary
Watershed Boundary
District Boundary

Table -13. Drinking water standards and concentration ranges (IS: 1991)

Parameters	Desirable Limit (ppm)	Permissible Limit (ppm)	Undesirable effect outside limit	Concentration ranges in the district (ppm)
Total dissolved solids	500	2000	Palatability decrease and may cause gastro intestinal problems	105-690
Nitrate	45	No Relaxation	May cause Methamoglobineimia	02-120
P^H	6.5-8.5	No Relaxation	The water will affect the mucous membrane and water supply system.	7.0-8.5
Fluoride	<1.5	>1.5	Excessive fluoride causes mottling of tooth enamel and skeletal deformation	0.02-1.6
Calcium	75	200	Encrustation in water supply structure and adverse effects on domestic use.	03-110
Magnesium	30	100	-do-	04-54
Chloride	250	1000	Taste, Corrosion palatability are affected	14-187
Sulphate	200	400	May cause gastro intestinal	01-101
Hardness	300	600	Encrustation in water supply structure and adverse effects on domestic use.	68-492

Ground Water Suitability for irrigation purpose

Apart from domestic consumption, irrigation requires a major share of ground water for agricultural activities. The quality of water used for irrigation is an important factor in productivity and quality of irrigated crops.

Electrical conductivity

The ability of water to conduct an electrical current is called its electrical conductance or conductivity. Electrical conductivity is a very important factor in determining quality of water because it is an indicator of salinity in water, which affects the taste and has an impact on the user acceptance of water as potable. The ground water classified based on EC values, for irrigation purpose is given in table-14.

Table-14. Suitability of ground water based on Electrical conductivity for irrigation purpose

Conductivity (μMhos/cm)	Suitability for irrigation	% of samples
Below 250	Entirely safe	10
250 - 750 (Moderately Saline)	Safe under practically all conditions	57
750-2250 (Medium to high salinity)	Safe only with permeable soil and moderate leaching	33
Above 2250	Unfair for irrigation	Nil

According to the above classification, 67% of ground water samples have EC value less than 750 μmhos/cm and falls in safe category. 33% of ground water samples have EC value between 750- 2250 μmhos/cm and falls in medium salinity to high salinity category. Isocone map has been prepared based on EC value of ground water samples and shown in Fig-10. Iso cone map depicts that area around Mudubi of Basvakalyan taluk, Changler of Humanabad taluk and Bhalki having EC value more than 1000 μmhos/cm and falls under medium to high salinity.

Chloride

The suitability of ground water based on chloride concentration has been classified and shown in table-15.

Table-15. Classification of based on Chloride (Scofield 1933)

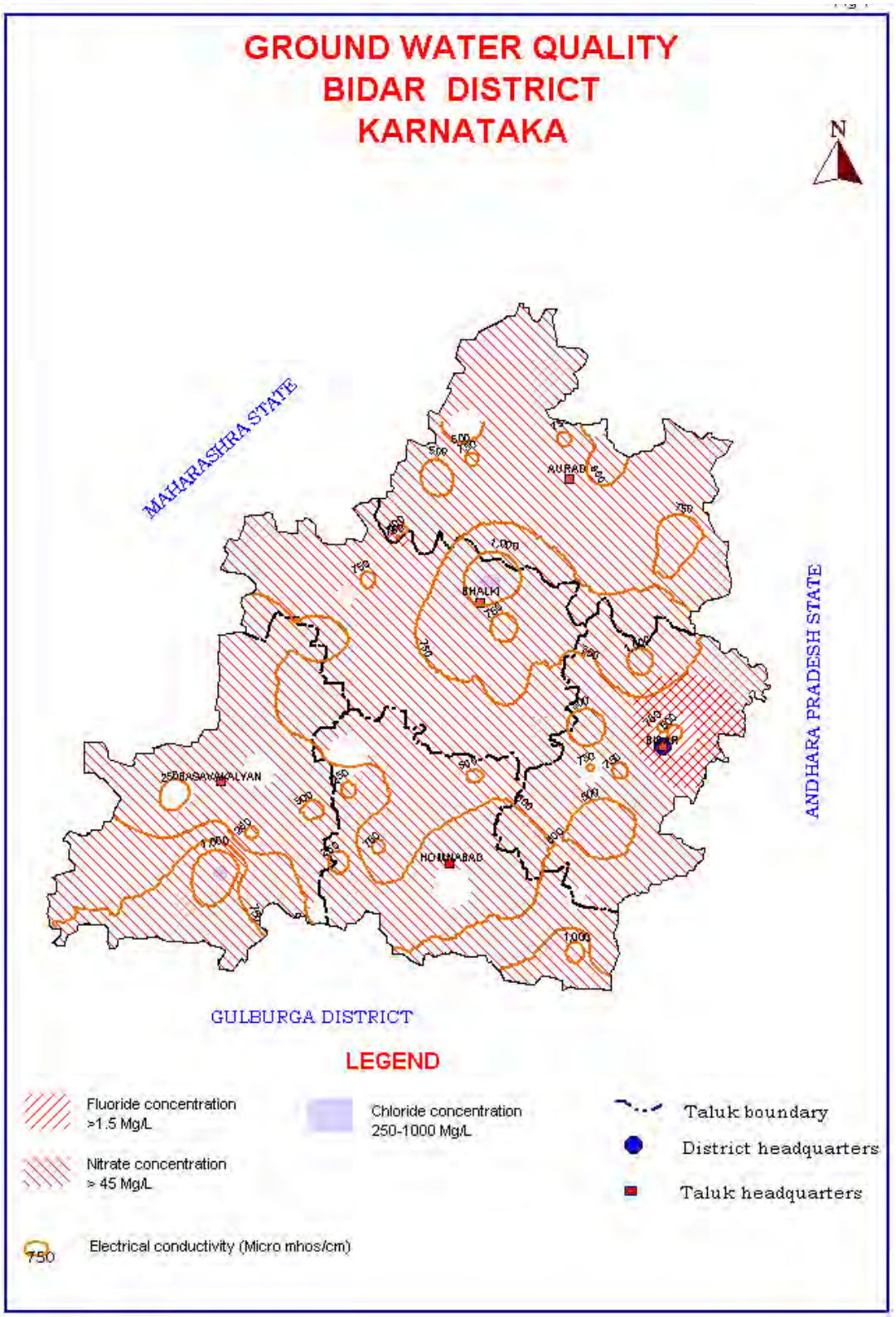
Class	Chloride Concentration (ppm)	% of Samples
Class I	<150	92
Class II	150-500	08
Class III	>500	Nil

According to above classification, 92% of ground water samples fall in class I and 8 % of ground water samples fall in class II. Thus, it is indicating that the ground water of the district is suitable for irrigation activities under ordinary condition of soil and climate. None of the samples indicated that the water is unsuitable for irrigation purposes.

4.4 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 its susceptibility to various stress factors the district wise vulnerability map is prepared on a regional scale considering the following factors viz.

Fig-10


GROUND WATER QUALITY
BIDAR DISTRICT
KARNATAKA
N
MAHARASHRA STATE
ANDHARA PRADESH STATE
AURAD
BHALKI
BIDAR
BASAVAKALYAN
HUMNABAD
GULBURGA DISTRICT
LEGEND
Fluoride concentration
>1.5 Mg/L
Nitrate concentration
> 45 Mg/L
Chloride concentration
250-1000 Mg/L
Electrical conductivity (Micro mhos/cm)
750
Taluk boundary
District headquarters
Taluk headquarters

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 district 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 Bidar district whole of the Bidar district is vulnerable to one or the other factor. The northern part of the district, ie. whole of Aurad taluk is vulnerable to Nitrate contamination and also south of Aurad taluk, north & central part of Bhalki taluk and northern part of Bidar taluk is vulnerable to intensive irrigation and fertiliser/pesticide contamination. The eastern part of Bidar taluk, north western part of Homnabad taluk, north eastern part of Basavakalyan taluk and south cental part of Bhalki taluk is prone to over exploitation. Rest of the district, ie. about 95% of Basavakalyan taluk, 70% of Bhalki taluk, 70% of Homnabad taluk and 55% of Bidar taluk is prone to Nitrate contamination as well as over exploitation.

4.5 STATUS OF GROUND WATER DEVELOPMENT

At present ground water is being utilised in the district through dug wells and bore wells for irrigation and domestic proposes. Dug wells are usually circular, square or rectangular in shape and the depth varies from 7 to 20 m in lateritic area and 6 to 12 m in basaltic area. Depth of well depends upon the topography of the terrain as well as the depth of water level and seasonal fluctuation. The talukwise ground water structures have been presented in table-16.

In 60% of the district area the yield of shallow zones down to the depth of 20m was less than 1 lps. In rest of the 40% area of the district the yield recorded was between 1 and 2 lps, especially in Aurad, Humnabad and Bidar taluk. Within the weathered and fractured basalt, phreatic aquifers are encountered at a shallow depth range of 0 to 20 mbgl and are tapped mainly by dug wells. The average thickness of these aquifers range from 5 to 15m. For the deeper depth range (40-200m) bore wells are the most common abstraction structures with a yield ranging from 1 to 12 lps.

Fig-11

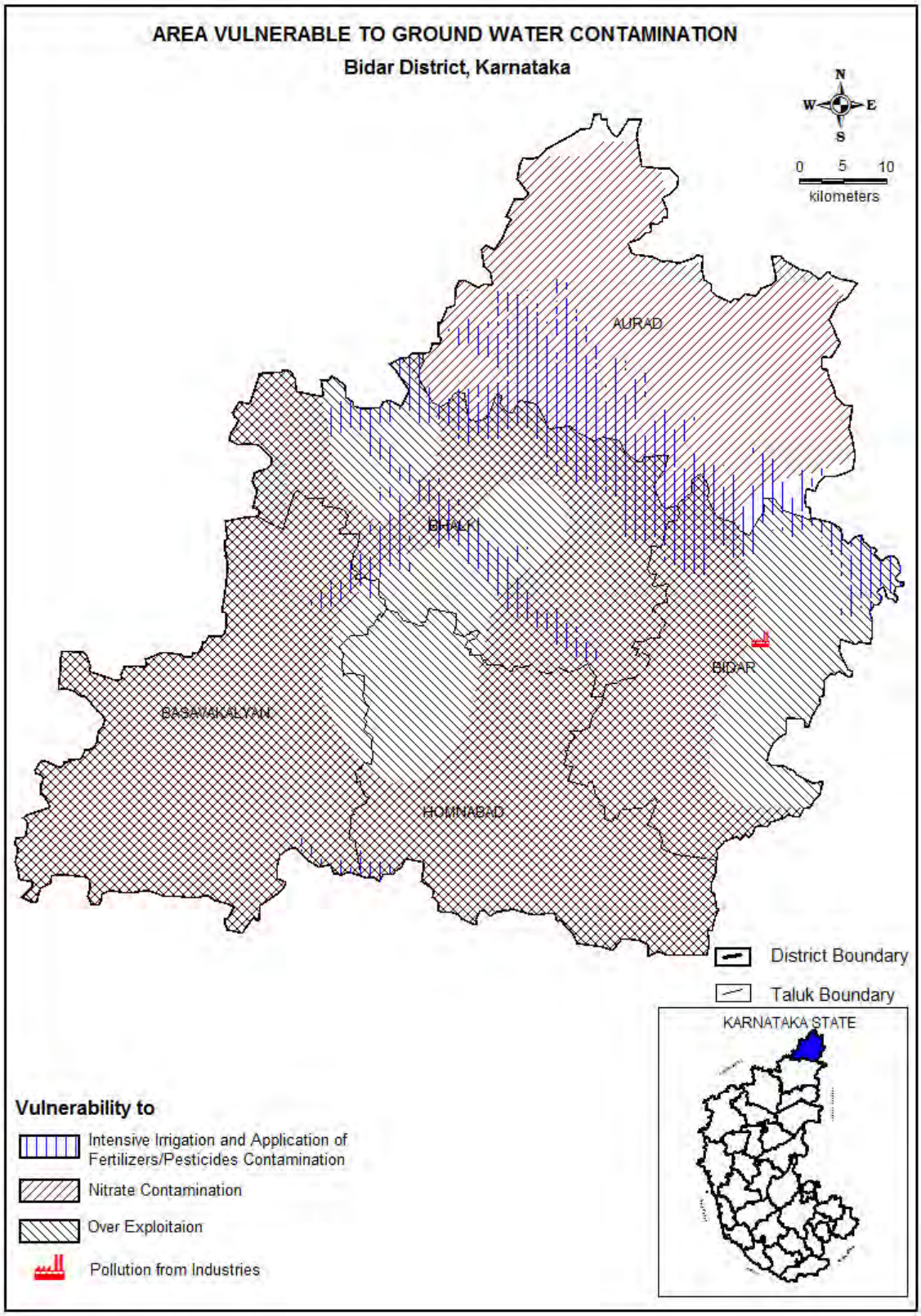

AREA VULNERABLE TO GROUND WATER CONTAMINATION
Bidar District, Karnataka
N
W
E
S
0 5 10
kilometers
AURAD
BHALKI
BIDAR
BASAVAKALYAN
HUMNABAD
District Boundary
Taluk Boundary
KARNATAKA STATE
Vulnerability to
Intensive Irrigation and Application of Fertilizers/Pesticides Contamination
Nitrate Contamination
Over Exploitaion
Pollution from Industries

Table-16. Taluk wise ground water structures in Bidar district

Sl. No	Taluk	Irrigation structure	Domestic water supply		
			Bore well	Piped WS scheme	MW scheme
1	Aurad	4742	1453	89	142
2	Basavakalyan	11249	1522	78	162
3	Bhalki	5796	1373	80	139
4	Bidar	12419	1447	79	137
5	Humnabad	12860	1274	76	72
	Total	47066	7069	402	652

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 GROUND WATER DEVELOPMENT

The ground water is a renewable natural resource. Therefore, only certain quantity of water may be withdrawn annually so that no detrimental effects such as water level deflection take place. In the district, ground water is developed through dug wells dug cum bore wells and bore wells. The dug wells tap the shallow aquifer whereas dug-cum bore wells and bore well tap both shallow and deeper aquifer. It is observed from the table-12 that Aurad taluk is completely under safe category. 60% of Bhalki and 30% of Basavakalyan, 60% of Bidar and 45% of Humnabad taluk are under safe category. 70% of Basavakalyan, 35% of Bhalki, 40% of Bidar and 55% of Humnabad taluk are under over exploited category. Only 5% of Bhalki taluk area comes under the category of semi-critical. The overall stage of ground water development in the district has reached 77.6%. Even though, some parts of the district has reached to the overexploited stage there are of areas of safe category which can be brought under developmental activity. In the areas of ground water over exploitation, ground water augmentation technique should be taken up to arrest the declining trend of water level. There should not be any additional development of ground water in the over exploited area. In these areas priority should be given for ground water augmentation by constructing suitable structures such as nala bunds, cheek dams, percolation tanks etc.

5.2 WATER CONSERVATION AND ARTIFICIAL RECHARGE

Artificial recharge to the aquifer is a remedy to the declining trend of ground water level in some parts of the district due to over- exploitation of the ground water resources and poor saturation of the aquifer due to erratic rainfall pattern. There is an increase in the utilization of ground water for irrigation and domestic purposes by means of dug wells and bore wells. To enhance the augmentation to ground water the following strategy may be adopted to enhance / save the ground water resources for future development.

a) Artificial recharge practices should be adopted by rainwater harvesting method. There are two basic types of water harvesting methods. The first one is the direct method where runoff water is collected and stored in the soil profile during the precipitation. The second one is where water is collected and stored in some container or in some reservoir and applied later to the crop with some form of irrigation practice.

b) Minor irrigation tanks, check dams and ponds are state owned and was in use as a source of irrigation in the past. Many of these structures are in disuse on account of poor maintenance or no maintenance. The farmers in the vicinity of such tanks, check dams and ponds are to be organized and user groups formed to own and maintain the structure. A proper legislation is required in this regard.

c) Formation of cooperative societies must be encouraged for the construction, operation and maintenance of both existing and new structures and for the distribution of water among the small scale farmers.

d) The design of water harvesting structure is basically same for all locations. At the same time there is no standard design for a water harvesting structure. Each site unique and each structure must be suitable with the local condition and needs. There are many parameters which are to be considered such as precipitation pattern, water requirement pattern, soil type, land topography, equipment, labour and acceptability of water harvesting concepts by the water user group.

e) The farmer should be encouraged to make arrangement for the preservation of rainwater running out of their filed by digging numerous narrow channels of 15 m long, 15 cm broad and 15 cm deep in their field.

f) Construction of small ponds in the field of farmers is to be encouraged at individual small farm level.

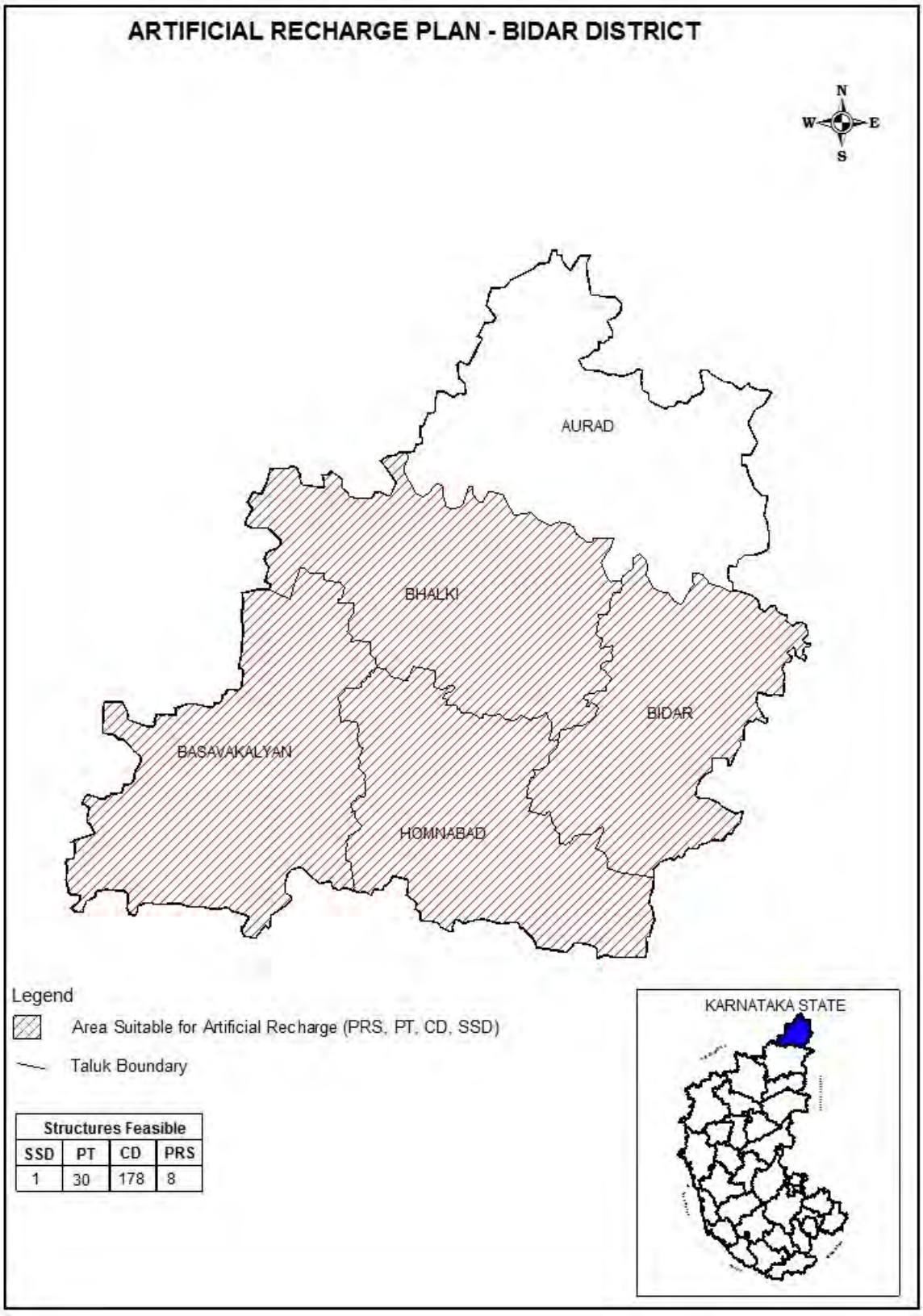
g) Many village ponds are silted and are in discarded state after the implementation of piped water supply scheme in the villages. Desilting and repairing of these ponds to be taken up.

In Bidar district, except Aurad taluk all the taluks require urgent need of artificial recharge measures. The artificial recharge to the ground water in the district can be implemented by constructing SSD-1, Percolation tank-30, Check Dam-178 and Point Recharge Structures- 8 numbers.

5.3 UNIT AREA ANNUAL GROUNDWATER RECHARGE

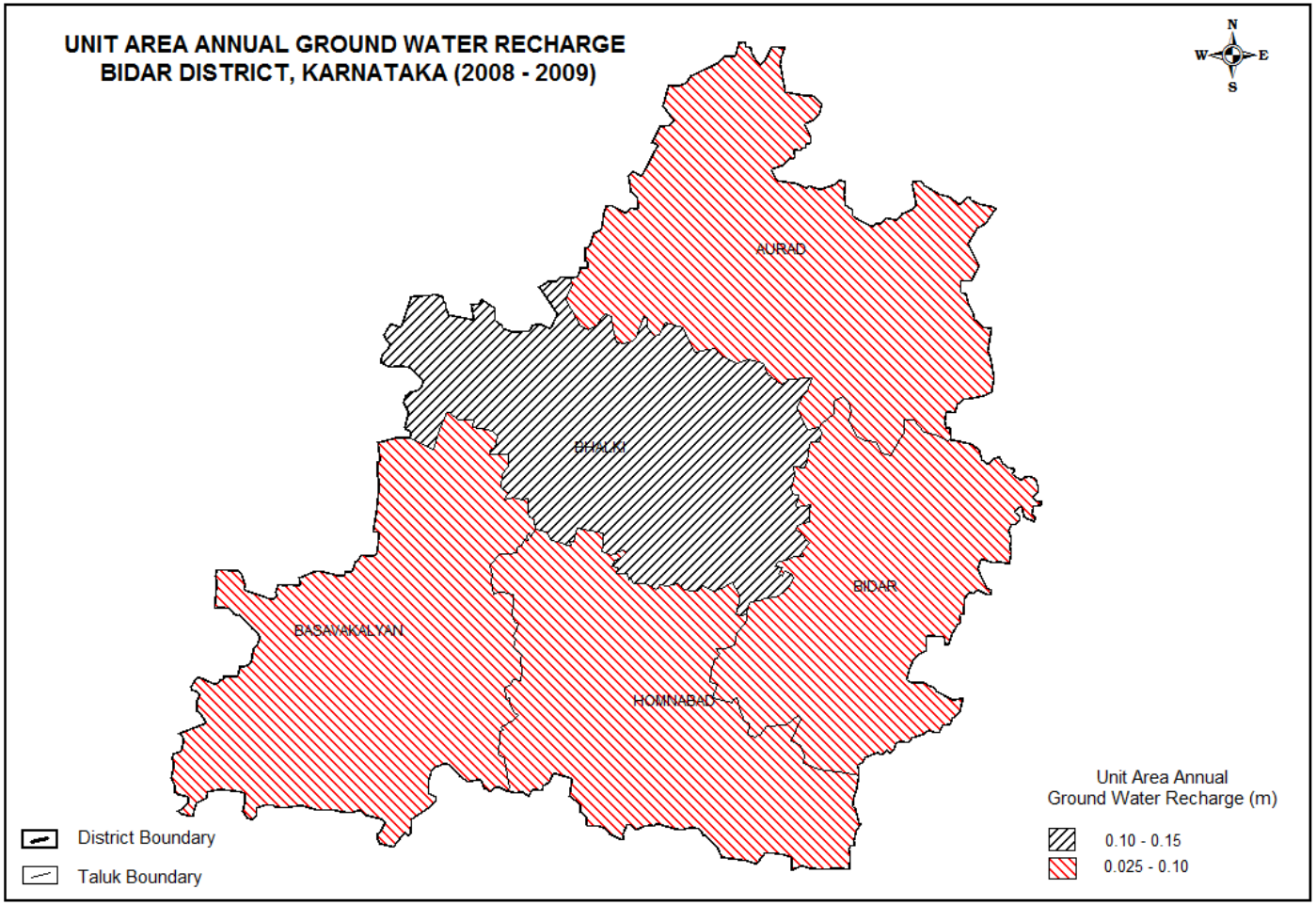
Sustainability of groundwater resource depends mainly on two factors viz. Annual groundwater recharge and annual groundwater draft. The annual groundwater recharge depends on the quantity and intensity of rain fall, the infiltration characteristics of the soil, the depth to groundwater level, the slope 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.

Fig: 12



Structures Feasible			
SSD	PT	CD	PRS
1	30	178	8

Fig-13


UNIT AREA ANNUAL GROUND WATER RECHARGE
BIDAR DISTRICT, KARNATAKA (2008 - 2009)
N
W
E
S
AURAD
BHALKI
BIDAR
BASAVAKALYAN
HUMNABAD
Unit Area Annual
Ground Water Recharge (m)
0.10 - 0.15
0.025 - 0.10
District Boundary
Taluk Boundary

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 metres. 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 Bidar district the unit area annual recharge is in the range of 0.025 to 0.10m in the whole of district except for Bhalki taluk where it is 0.1- 0.15m. The Fig-13 shows the unit area annual ground water in the district.

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

The availability and sustainability of ground water in Bidar district is controlled by physiography, geology and rainfall received etc. There are prominent hill ranges, many isolated hillocks etc. The entire district is occupied by hard rock formation of basaltic lava flow, which is generally very poor in ground water storage and transmissivity. Therefore, this formation gets maximum saturation during monsoon and when it is fully saturated resulting in a situation of rejected recharge. Later these aquifers are drained naturally due to slope and undulating topography. Similarly, wherever more groundwater development takes place, these aquifers become nearly dry or semi-dry resulting in water scarcity for drinking purpose during the summer months. In many areas adequate recharge to ground water does not take place due to one or the other reason. The presence of massive basalt at the ground surface also hinders the process of recharge to the underlying porous strata. The rainfall analysis indicates that the district is not free from drought condition. The late onset of monsoon or early withdrawal of monsoon affects the recharge from rainfall and ground water availability in the district. The years of low rainfall also adversely affect the ground water resources as. 1) Lesser amount of recharge to ground water reservoir and. 2) More withdrawal of water from the reservoir. This ultimately results in drying up and lowering of water levels in dug wells and bore wells in the summer.

7.0 RECOMMENDATIONS

The following recommendations are made for planned and scientific development of ground water resource based on hydrogeological studies.

The dependable rainfall accessed based on Probability Analysis of occurrence of Annual rainfall (2001-2010) for the rain gauge stations can be used for construction of any recharge structure in the district.

The study of average rainfall data reveals that district is not free from drought condition. Hence, it is suggested that the artificial recharge structures like percolation tanks, Nala bund etc may be constructed to augment the ground water resource. In the district except Aurad taluk all the taluks require urgent need of artificial recharge measures. The artificial recharge to ground water can be implemented by constructing SSD-1, Percolation tank-30, Check Dam-178 and Point Recharge Structures- 8 numbers.

Many village ponds are silted and are in discarded state after the implementation of piped water supply scheme in the villages. Desilting and maitanance of these ponds are to be taken up.

The recharge can be expressed in metres. 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 the district the unit area annual recharge is in the range of 0.025 to 0.10m in the whole of district except for Bhalki taluk where it is 0.1- 0.15m. The recharge structures are selected based on the rate of unit area annual recharge.

In Bidar district whole of the district is vulnerable to one or the other factor. The northern part of the district, ie. whole of Aurad taluk is vulnerable to Nitrate contamination and also south of Aurad taluk, north & central part of Bhalki taluk and northern part of Bidar taluk is vulnerable to intensive irrigation and fertiliser/pesticide contamination. The eastern part of Bidar taluk, north western part of Homnabad taluk, north eastern part of Basavakalyan taluk and south cental part of Bhalki taluk is prone to over exploitation. Rest of the district, ie. about 95% of Basavakalyan taluk, 70% of Bhalki taluk, 70% of Homnabad taluk and 55% of Biodar taluk is prone to Nitrate contamination as well as over exploitation. Therefore, both the artificial recharge to the ground water and ground water development activity should be preceded with proper investigation.

The depth of the dug wells developed in the district range between 8 to 15 m bgl depending upon topographic setup and thickness of the weathered zone. The depth of the well may be decided more precisely by referring to the depth to water level (Fig-4).

To augment the groundwater resource, percolation tanks and other artificial recharge structures may be constructed where the depth to water level is more than 15m bgl (Fig-4).

Red bole horizons in the basaltic areas invariably indicate that below them lie the weathered vesicular basalts and below the vesicular basalts lie the highly weathered and fractured massive basalts. Therefore, if a well ends in red bole, it should be deepened further to tap the entire thickness of the weathered/fractured zones until it encounters hard massive basalt below.

Many dug wells in the district are being used as waste dumping sites thus enhancing the nitrate concentrations and other harmful chemical substances. Care must be taken that these wells are cleaned once annually and used for domestic purposes.

In the urban areas, the roof top rainwater harvesting for artificial recharge should be made mandatory so that the available resources for drinking water supply may remain sustainable.

The ground water sample analysis of the district shows that the ground water quality is found to be potable in general when compared with the standards prescribed by BIS (IS-10500-1991) and it is also suitable for irrigation purposes in the major parts of the district. However, the concentration of fluoride and nitrate in the entire district is the matter of concern. Proper ground water quality monitoring should be made on the changes in concentration of fluoride and nitrate.