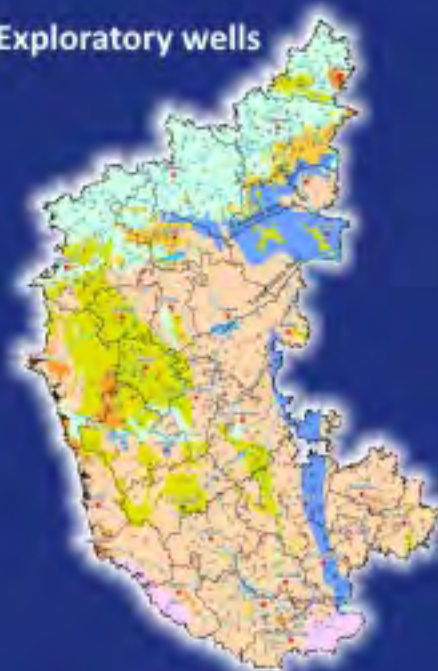


AQUIFER SYSTEMS OF KARNATAKA

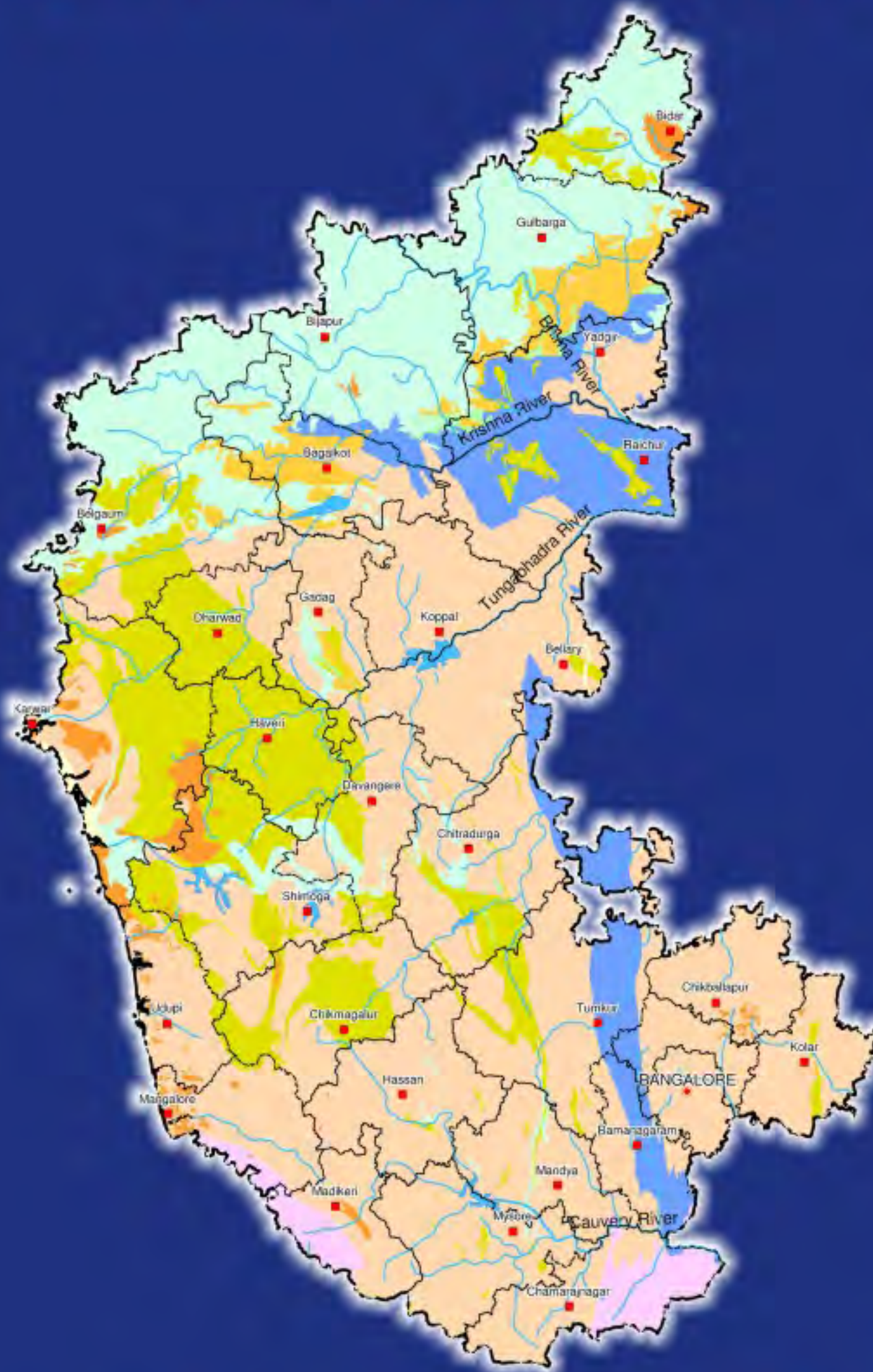
Exploratory wells



Observation wells



Management Plan



CENTRAL GROUND WATER BOARD

Ministry of Water Resources, Government of India

South Western Region, Bangalore

September 2012

AQUIFER SYSTEMS OF KARNATAKA

CENTRAL GROUND WATER BOARD

South Western Region, Bangalore

Ministry of Water Resources, Government of India

September 2012

ध्रुव विजय सिंह
DHRUV VIJAI SINGH



सचिव
भारत सरकार
जल संसाधन मंत्रालय
श्रम शक्ति भवन
रफी मार्ग, नई दिल्ली-110 001
SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
SHRAM SHAKTI BHAWAN
RAFI MARG, NEW DELHI-110 001

13TH September 2012

MESSAGE

Ground water utilization has increased significantly during the last two decades. The unplanned and indiscriminate use of this vital resource has resulted in declining water levels and water quality deterioration in certain areas. The apparent stress on ground water resources is more often a management issue, and this needs to be addressed in a holistic manner, for its long term sustainability, through an integrated approach. Aquifer mapping is an essential step towards the effective management of ground water resources.

The atlas entitled “**Aquifer Systems of Karnataka**” is a step towards achieving the ultimate goal of aquifer wise management of ground water resources in Karnataka State.

I congratulate Central Ground Water Board, Ministry of Water Resources for its efforts to bring out this document containing data and information pertaining to various aspects of ground water including aquifer disposition in the State. I am sure this atlas will be of immense use to planners, policy makers, researchers and users involved in ground water sector.


(Dhruv Vijai Singh)

स्वच्छ सुरक्षित जल - सुन्दर खुशहाल कल

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Foreword

Availability of fresh water has always been a prime consideration in fostering the socio economic growth of the people. Rapid urbanization coupled with industrialization has resulted in increased demand of ground water at an alarming rate. Dependence on ground water is increasing continuously in order to supplement the domestic, agricultural and industrial requirements. In the last two decades there is a paradigm from development to management of Ground Water. The management of ground water is to be focussed on aquifers, which act as the repository of ground water.

To meet these challenges, it has become imperative to formulate aquifer management plan to establish the priorities for ground water use with community involvement at various levels of implementation. Central Ground Water Board over the years has generated enormous data on various aspects of ground water and has been utilised to prepare aquifer maps depicting their extent and characteristics and are compiled in the form of Atlas on "Aquifer Systems of Karnataka".

This will provide a framework for prioritizing the aquifer level management strategies and build inventory of the aquifers for better understanding of the groundwater resources. An attempt has been made to present various aquifer systems in the form of maps by integrating all thematic information to formulate the aquifer wise ground water management plans.

The sincere efforts of the dedicated team of officers of Central Ground Water Board, South Western Region, Bangalore is highly appreciated. I am sure this atlas would be of immense use in formulating scientifically viable implementable strategies for efficient management of ground water resources ensuring sustainability.

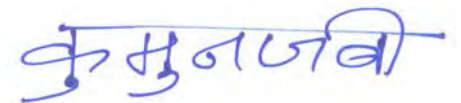
(Dr. S.C. Dhiman)

PREFACE

Management of ground water resource is a challenging task in comparison with its development. Any strategy for management of ground water resource on sustainable basis depends on proper understanding of the characteristics of the aquifer system. Since the development of ground water is in the unorganized sector, huge investment in this sector is not getting due recognition. Further, the private entrepreneurs have little access to scientific data base on aquifers resulting in financial loss due to unsustainable approach on its development. Hence, it is appropriate to bridge the data gap and to create scientific understanding on sustainability aspects of aquifer systems in national and state level.

Central Ground Water Board (CGWB) for the last five decades has carried out detailed hydrogeological investigations and ground water exploration generating voluminous data. This data is finding place as technical reports for each of the investigations. In an effort to make this valuable information user friendly and in a layman's language, now the CGWB has oriented its efforts to bring out popular publication series on ground water. Hitherto, the thrust was on bringing out technical reports of individual studies and investigations. During the present compilation, the thrust is bestowed in bringing out an aquifer oriented publication highlighting the aquifer parameters, vulnerable areas, development and management plans, quality issues and all related aspects of aquifer wise development planning.

This publication will go a long way in helping the planners and managers as well as the academia, as a guide and reference volume. The untiring efforts put forth by a team of Scientists namely Dr.K.R.Sooryanarayana, H.P.Jayaprakash, Dr.K.Rajarajan, J.Sivaramakrishnan, A.Sakthivel, Dr.S.Srinivasa Vittala, G.R.C.Reddy and Bijimol Jose in bringing this atlas is placed on record.



Dr.K.Md. Najeeb
Regional Director

INTRODUCTION

Karnataka state is located in southwestern part of India and covers an area of 191761 sq km. It is divided into 30 districts and 176 taluks. The state is drained by five river basins namely Godavari, Krishna, Cauvery, Pennar and West Flow rivers. Though the state is blessed with the bounties of nature, 63% of the land falls under dry tracts ranking second only to Rajasthan in having arid tracts. Even though the normal annual rainfall of the state is about 1100 mm, major parts of the state (106 out of the total of 176 taluks of the state) receive a normal annual rainfall of less than 800 mm of which 33 taluks receive less than 600 mm of annual rainfall, while 27 taluks of falling to the west of Western Ghats receive a normal annual rainfall of 2000-4740 mm.

Major part (99%) of the Karnataka is occupied by hard rock aquifers leaving a small part of the coastal terrain, which is occupied by alluvium. The state is dependent on ground water for its all round development. There is a spurt in groundwater development since the 1990 and the same is more pronounced in some of the districts like Bangalore, Belgaum, Chickballapura, Chitradurga, Kolar, Ramanagaram and Tumkur. Consequently, there was a steady decline in the water levels resulting in drying up of dug wells and shallow bore wells. The progressive farmers were trying their luck with deeper bore wells. Now it is common to have irrigation bore wells of the depth range of 250-300 m in parts of Kolar and Bangalore districts. The groundwater scarcity, decline in water levels, over-exploitation, deterioration in quality and related problems are encountered in the areas to the east of the Western Ghats covering the plateau region.

Scientific management of the aquifers is undoubtedly a tough task. Sustainable management of the ground water resource depends on proper understanding of the aquifers. For this, all the available data collected from various sources under different activities to be compiled and presented so as to make it handy for the administrators and user agencies to prepare ground water development and management plan.

In Karnataka, the aquifer systems are classified into nine major groups depending upon their characteristics and distribution namely Banded Gneissic Complex (BGC), Basalt, Schists, Granites, Charnockites, Limestones, laterites, Sandstones and alluvium. These major aquifers are then superimposed over the state map with administrative district boundaries to arrive the district wise aquifer characteristics. Both thematic layers and corresponding data tables are presented for easy reference. Maps showing important aquifer characteristics like depth to water level-their seasonal fluctuation, decadal mean of premonsoon, postmonsoon and all season water level, over burden thickness, fracture depth, yield range, transmissivity, storativity are presented. Similarly, maps showing distribution of ground water quality such as electrical conductivity, nitrate and fluoride are compiled. Details like population density, river basins are also included. Map showing the 28 parliamentary constituencies in the state is also depicted.

Ground water in the state is vulnerable to various developmental activities and is prone for deterioration in quality and quantity in the state. The vulnerability is high in certain areas while in other areas it is comparatively stable. Based on its susceptibility to various stress factors, the vulnerability map is also prepared and appended.

About 66379 sq. km (35%) of the area of the state is over-exploited. In about 12930 sq.km (7%) of the area, the stage of development has touched critical level. Keeping in view of the status, maps showing the present stage of ground water development, areas prioritized for artificial recharge, area delineated for water conservation and harvesting, area suitable for ground water development, aquifer wise ground water management plan and aquifer wise unit recharge are presented during the present exercise.

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ADMINISTRATIVE DIVISIONS

Karnataka is located within 11°30' North to 18°30' North latitudes and 74° East to 78°30' East longitude on a table land in Peninsular India. The state covers an area of 191,976 sq. km or 5.83% of the total geographical area of India. It is covered by Survey of India topo sheets 47L,O,P,48I,J,K,L,M,N,O, P 49M,, 56C,D,F,G,H, 57A,B,C,D,E,F,G,H,K,L and 58A,E. The State is bounded by Maharashtra and Goa States in the north and northwest; the Arabian Sea in the west; Kerala and Tamil Nadu States in the south and the State of Andhra Pradesh in the east.

The state is well connected by air, railway and road network to all metros in the country. The national highway numbers 4,4A,7,13,17,48,63,206,207,209,212 and 218 passes through the state.

Karnataka is now divided into 30 districts and 4 administrative Divisions and 176 taluks. Districts are administered by Deputy Commissioners and divisions are administered by a Divisional Commissioners. Bangalore is the capital of the state. Total number of villages in Karnataka is 29340 including un- inhabited villages as per 2011 census figures. There are 241 towns in the state. The district wise details of the administrative set-up are shown in Table.1 and the administrative map is shown in Plate-I.

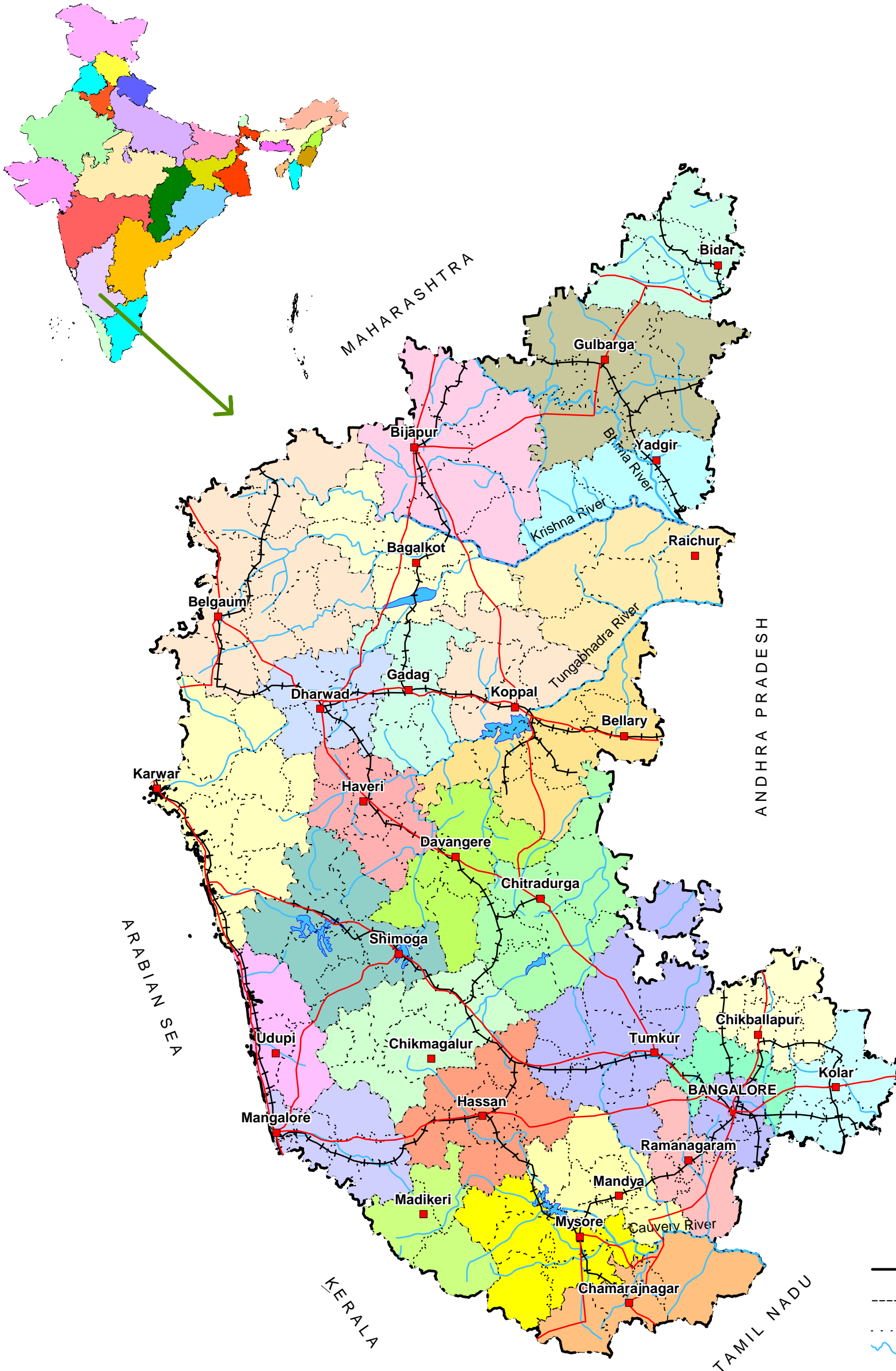
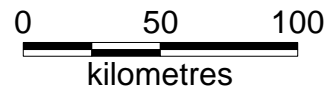
Table 1 : Administrative Divisions

S.N.	District Name	Geographical area	No of Taluks	No. of Towns
1	Bagalkot	6575	6	12
2	Bangalore Rural	2259	4	3
3	Bangalore Urban	2208	4	6
4	Belgaum	13415	10	20
5	Bellary	8450	7	10
6	Bidar	5448	5	7
7	Bijapur	10494	5	6
8	Chamarajnagar	5101	4	5
9	Chikballapur	4254	6	6
10	Chikmagalur	7201	7	9
11	Chitradurga	8440	6	7
12	Dakshina Kannada	4560	5	9
13	Davangere	5924	6	7
14	Dharwad	4260	5	6
15	Gadag	4656	5	9
16	Gulbarga	10951	7	13
17	Hassan	6814	8	11
18	Haveri	4823	7	8
19	Kodagu	4102	3	4
20	Kolar	3969	5	7
21	Koppal	7189	4	5
22	Mandya	4961	7	7
23	Mysore	6854	7	10
24	Raichur	6827	5	7
25	Ramanagaram	3538	4	4
26	Shimoga	8477	7	9
27	Tumkur	10597	10	10
28	Udupi	3880	3	5
29	Uttara Kannada	10291	11	14
30	Yadgir	5273	3	5
Total		191761	176	241

Source: censusindia.gov.in-census-2011. (All area in Sq.km)



ADMINISTRATIVE DIVISIONS



LEGEND

- State Capital
- District Headquarters
- State Boundary
- - - District Boundary
- Drainage
- Surface waterbody
- Road
- ++++ Railway

RIVER BASIN

Major rivers that flow in Karnataka state are Krishna, Godavari, Cauvery, West flowing rivers & Pennar. These river systems drain with their tributaries in the state. River Krishna is an interstate river flows with tributaries like Tungabhadra, Malaprabha, Ghataprabha, Bhima in Karnataka. River Cauvery is also an inter-state river, drains with tributaries Hemavathi, Kabini, Harangi, the Lakshmanathirtha, Shimsha, Arkavathi and the Suvarnavathy. Manjera river which is tributary to Godavari river having a partial catchment in Karnataka State. West Flowing Rivers are originating in the western ghats and generally flowing towards west and joins to Arabian sea. This river system consists of rivers like Mahadayi, Kalinadi, Gangavalli, Aghnashini, Sharavathi Chakranadi, Varahi & Netravathi. The Pennar river system in Karnataka state is having relatively less catchment area and flows with tributaries like North pennar, South pennar & Jayamangali.

The morphological characteristics of a basin represent its attributes, which may be employed in synthesizing its hydrological response. Basin characteristics when measured and expressed in quantified morphometric parameters helps to study the runoff in the basin. Interpretation and quantitative analysis of various drainage parameters enable qualitative evaluation of surface run-off, infiltration and susceptibility to erosion within the basin

The location of catchments of major basins is shown in Plate II and the drainage characteristics of all the major catchments are given in the Table 2.

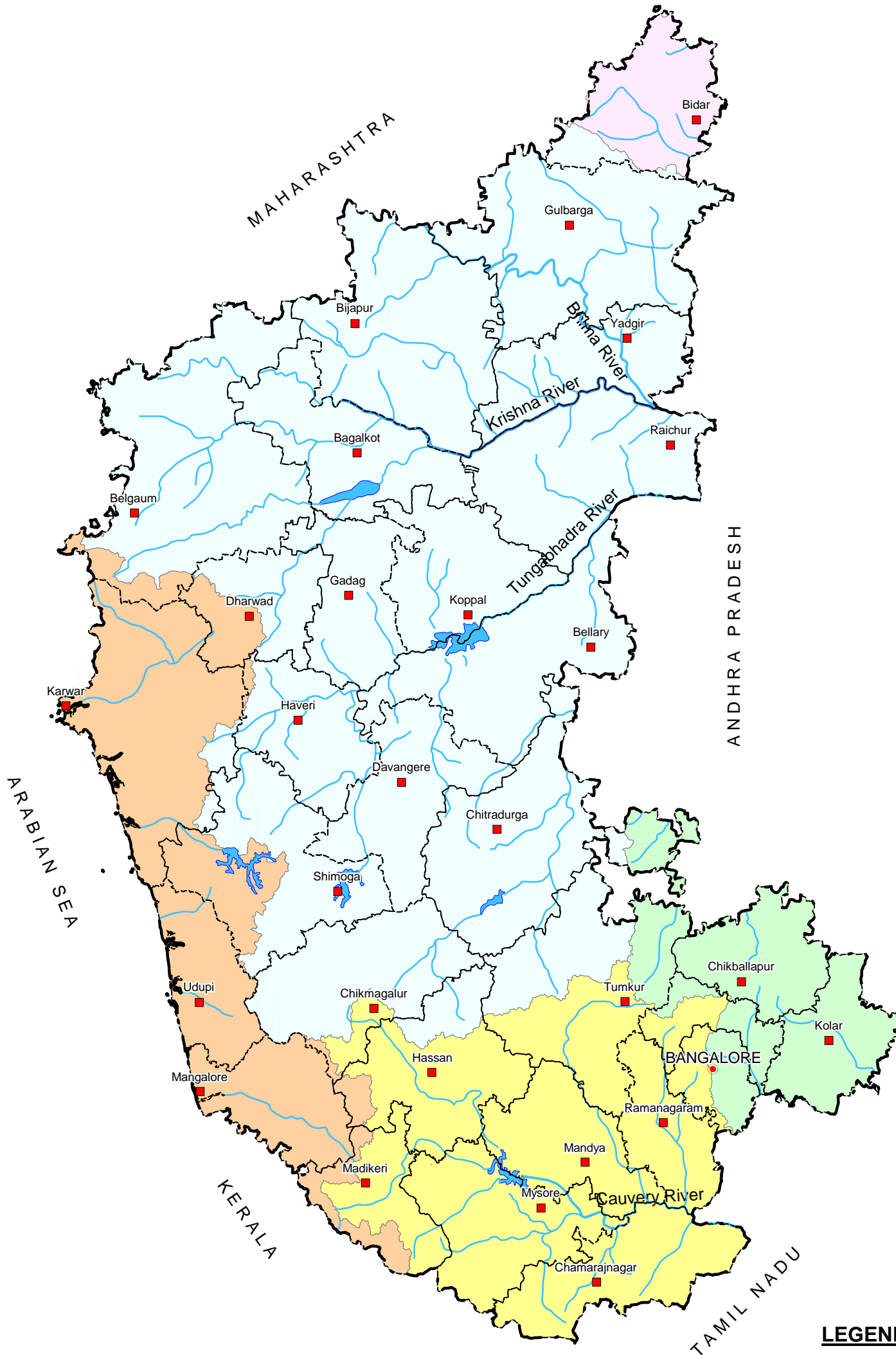
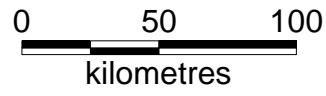
Table 2: River Basins

S.NO	Basin Name	Place of origin of main river	Catchment area		Major tributaries
			Total	In Karnataka	
1	Godavari	Timbak, Maharashtra	313200	4600	Manjera
2	Krishna	Mahabaleshwar, Maharashtra	258948	113580	Tungabhadra, Malaprabha, Ghataprabha, Bhima
3	Cauvery	Talacauvery, Karnataka	87590	34880	Simsha, Hemavathi, Kabini & Arkavathi
4	West Flowing	Western Ghats, Karnataka	56200	25301	Kali,Sharavathi & Netravathi
5	Pennar	Nandihills, Karnataka	55210	13400	North pennar, South pennar, Jayamangali
Total				191761	

Source: Watershed Atlas of India, all areas are in Sq.km.



RIVER BASINS



LEGEND

- | | |
|--------------------------|-----------------------|
| Godavari basin | State Capital |
| Krishna basin | District Headquarters |
| West Flowing River basin | State Boundary |
| Pennar basin | District Boundary |
| Cauvery basin | Drainage |
| | Surface waterbody |

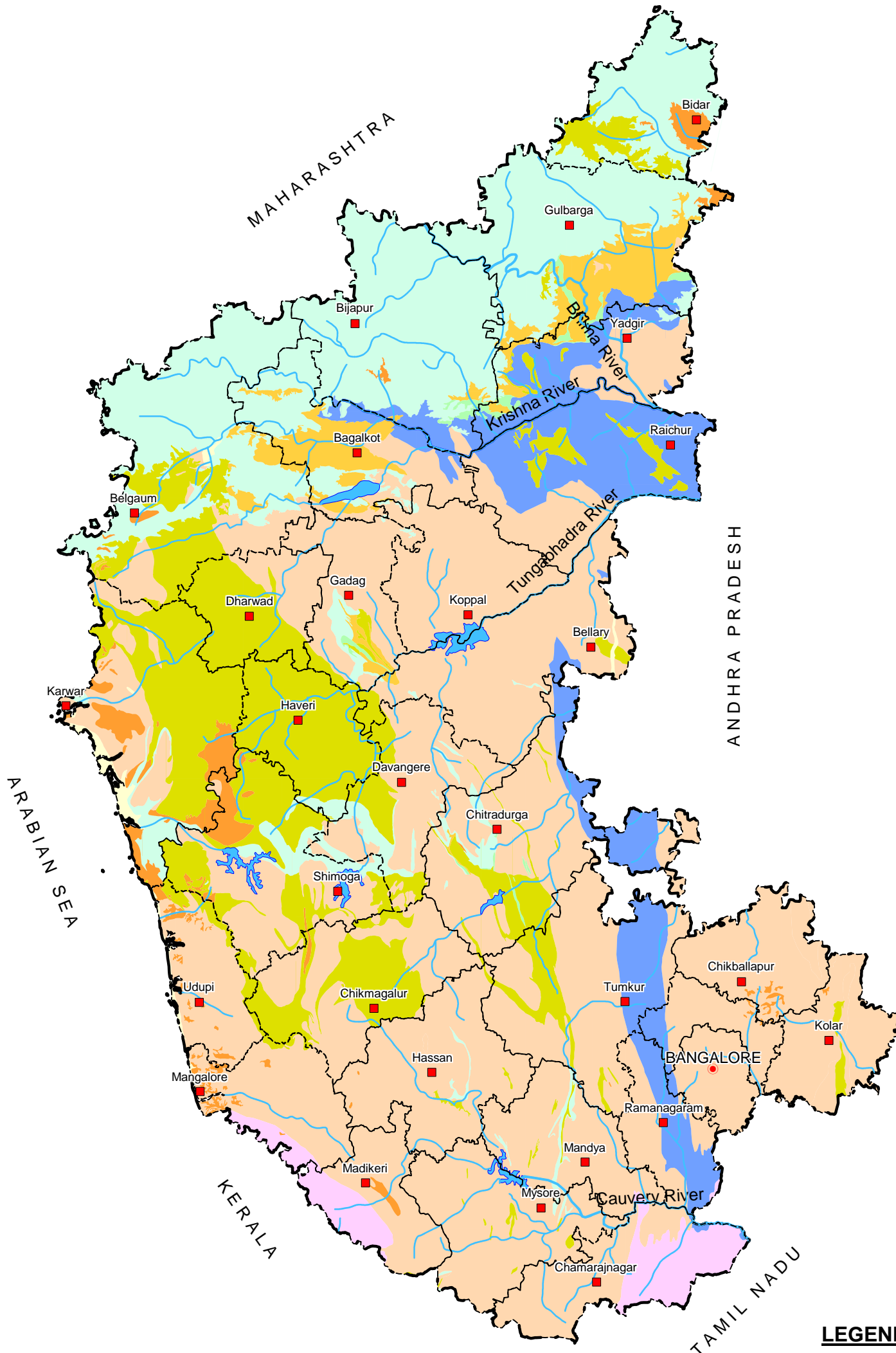
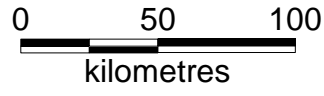
Table 3 : Distribution of Principal Aquifer Systems

S.N.	District Name	Alluvium		Laterite		Basalt		Sandstone		Limestone		Granite		Schist		Charnockite		BGC		Total area (sq.km)
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	
1	Bagalkot					2466.00	37.59			1933.00	29.46	578.00	8.81	8.81	0.13			1584.00	24.14	6561
2	Bangalore Rural			48.00	2.06							341.00	14.64					1941.00	83.30	2330
3	Bangalore Urban											67.00	3.07					2114.00	96.93	2181
4	Belgaum	65.00	0.50	102.00	0.79	7889.00	61.01			538.00	4.16			2701.00	20.89			1636.00	12.65	12931
5	Bellary	83.00	0.98			43.00	0.51			48.00	0.57	217.00	2.57	408.00	4.84			7637.00	90.53	8436
6	Bidar			665.00	11.68	4026.00	70.71							1003.00	17.62				0.00	5694
7	Bijapur			99.00	0.94	9395.00	89.09	133.00	1.26	135.00	1.28	665.00	6.31					118.00	1.12	10545
8	Chamarajnar											58.00	1.32			1479.00	33.71	2851.00	64.97	4388
9	Chikballapur			125.00	2.94													4127.00	97.06	4252
10	Chikmagalur			50.00	1.17							748.00	17.46					3485.00	81.37	4283
11	Chitradurga			7.00	0.09	409.00	5.37			28.00	0.37			1251.00	16.44			5915.00	77.73	7610
12	Dakshina Kannada	27.00	0.80	270.00	8.01									23.00	0.68	529.00	15.69	2523.00	74.82	3372
13	Davangere					745.00	12.54							1125.00	18.94			4070.00	68.52	5940
14	Dharwad													2796.00	65.46			1475.00	34.54	4271
15	Gadag					433.00	8.49	74.00	1.45	270.00	5.29	462.00	9.06	365.00	7.16			3497.00	68.56	5101
16	Gulbarga			232.00	2.18	7465.00	70.19	224.00	2.11	2570.00	24.17			73.00	0.69			71.00	0.67	10635
17	Hassan			11.00	0.17	83.00	1.26							103.00	1.56			6385.00	97.01	6582
18	Haveri			2.00	0.04	210.00	4.37							4594.00	95.59				0.00	4806
19	Kodagu			104.00	3.04									8.00	0.23	870.00	25.43	2439.00	71.29	3421
20	Kolar			23.00	0.58									208.00	5.23			3748.00	94.19	3979
21	Koppal					43.00	0.77			7.00	0.13							5513.00	99.10	5563
22	Mandya					258.00	5.23							78.00	1.58	36.00	0.73	4563.00	92.46	4935
23	Mysore					48.00	0.76							120.00	1.91			6120.00	97.33	6288
24	Raichur											5143.00	60.94	787.00	9.32			2510.00	29.74	8440
25	Ramanagaram											1602.00	45.64			32.00	0.91	1876.00	53.45	3510
26	Shimoga			1527.00	17.24	902.00	10.18							3028.00	34.18			3401.00	38.39	8858
27	Tumkur			6.00	0.06	10.00	0.09					2529.00	23.83	1095.00	10.32			6972.00	65.70	10612
28	Udupi	122.00	4.24	403.00	14.00									88.00	3.06			2265.00	78.70	2878
29	Uttara Kannada	414.00	7.15			311.00	5.37							3882.00	67.01			1186.00	20.47	5793
30	Yadgir					196.00	3.74	192.00	3.66	457.00	8.71	2200.00	41.95	144.00	2.75			2055.00	39.19	5244
Total		711		3674		34930		5986		5966		14609		26551		2946		92077		187450

Hilly areas not included, all areas are in Sq.km, % - in respect of total area of district



PRINCIPAL AQUIFER SYSTEMS



LEGEND

Aquifer

- | | |
|-----------|-------------------------|
| Alluvium | Granite |
| Laterite | Schist |
| Basalt | Charnockite |
| Sandstone | Banded Gneissic Complex |
| Limestone | |

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

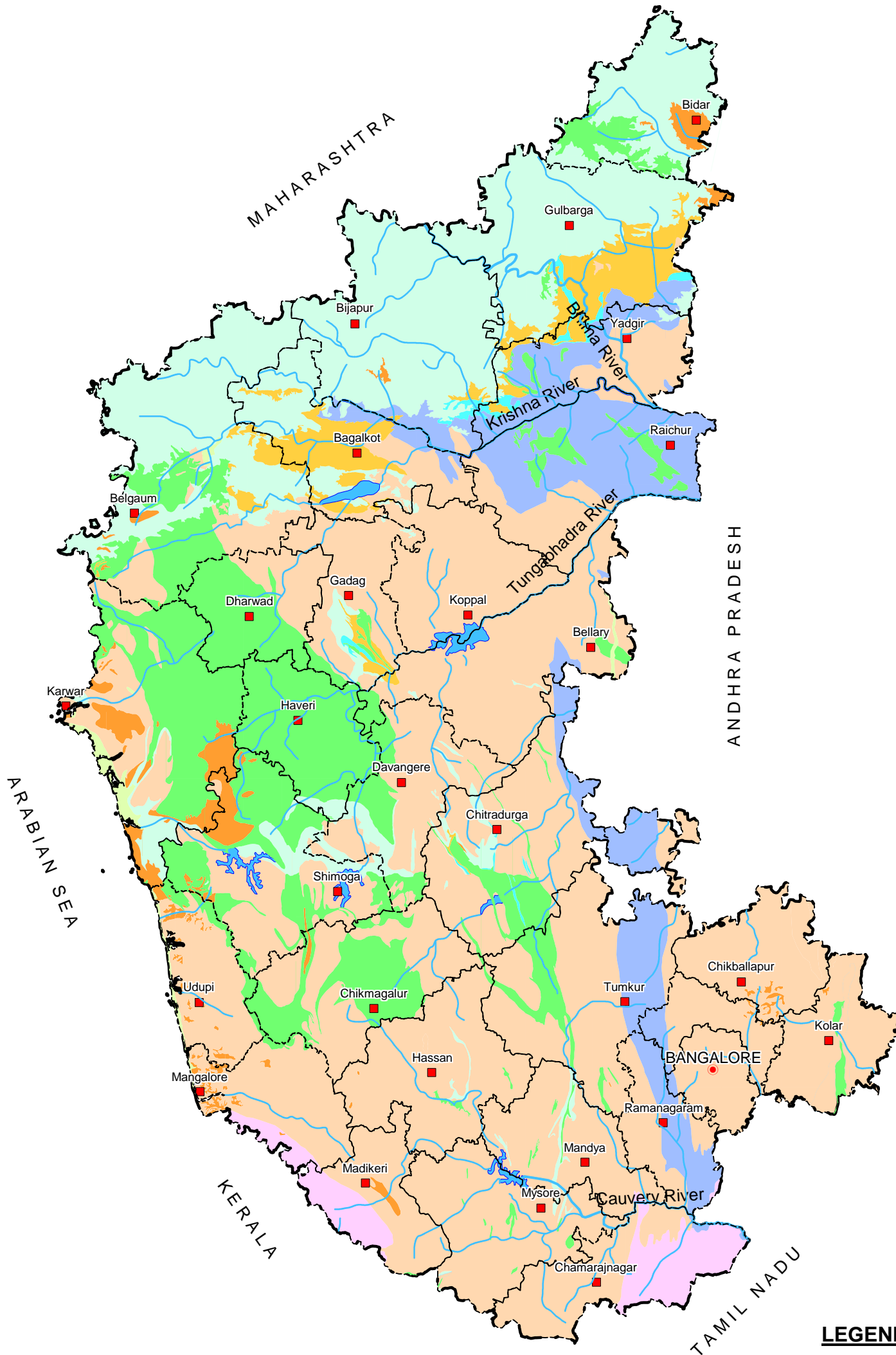
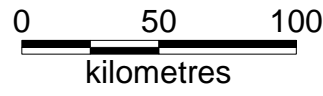
Table 4: Major Aquifer Systems of Karnataka

S.N.	Aquifer code	Principal aquifer Name	Major aquifer code	Major aquifer	Area Covered	%
1	AL	Alluvium	AL01	Younger Alluvium (Clay/Silt/Sand/ Gravel)	711	0.37
2	LT	Laterite	LT01	Laterite / Ferruginous concretions	3674	1.92
3	BS	Basalt	BS01	Basic Rocks (Basalt)	34930	18.22
4	ST	Sandstone	ST05	Sandstone/Conglomerate	623	0.32
5	LS	Limestone	LS03	Limestone/Dolomite	5986	3.12
6	GR	Granite	GR02	Acidic Rocks (Pegmatite, Granite, Syenite, etc.)	14609	7.62
7	SC	Schist	SC02	Phyllite	26551	13.85
8	CK	Charnockite	CK01	Charnockite	2946	1.54
9	BG	Banded Gneissic Complex (BGC)	BG01	BGC	92077	48.02

Hilly areas not included, all areas are in sq.km



MAJOR AQUIFER SYSTEMS



LEGEND

- | | | |
|---------------------------------|----------------------------------|-------------------------|
| Aquifer | | ● State Capital |
| ■ Younger Alluvium (AL01) | ■ Intrusive Acidic Rocks (GR02) | ■ District Headquarters |
| ■ Laterite (LT01) | ■ Phyllite (SC02) | — State Boundary |
| ■ Basalt (BS01) | ■ Charnockite (CK01) | - - - District Boundary |
| ■ Sandstone Conglomerate (ST05) | ■ Banded Gneissic Complex (BG01) | ~ Drainage |
| ■ Limestone / Dolomite (LS03) | | ■ Surface waterbody |

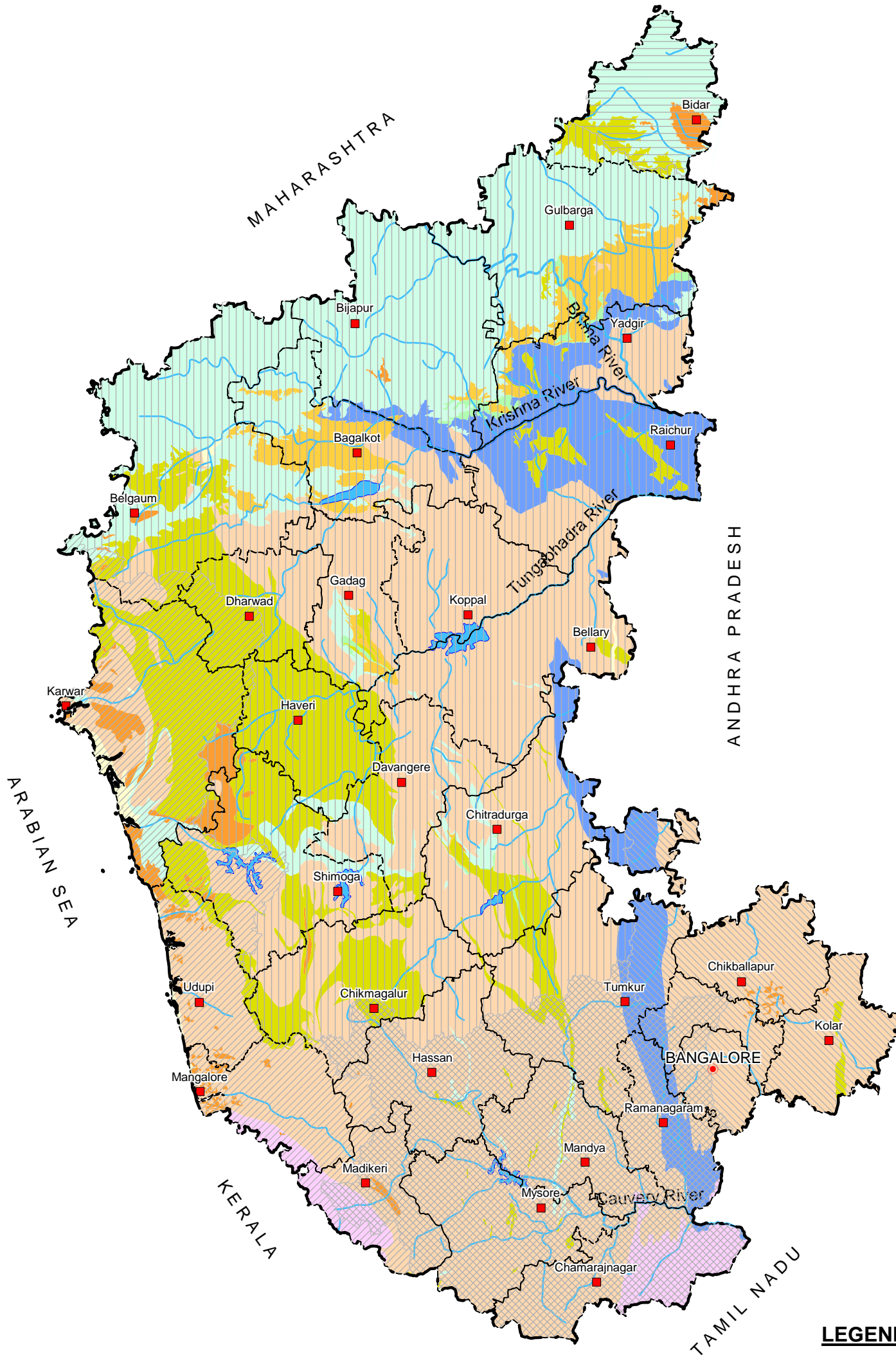
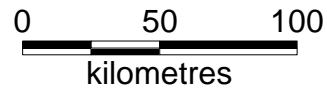
Table 5 : River Basin wise Aquifer distribution

S.N.	Basin Name	Alluvium	Laterite	Basalt	Sandstone	Limestone	Granite	Schist	Charnockite	BGC
1	Godavari	-	404	3526	-	-	-	634	-	-
2	Krishna	201	1473	30624	623	5981	10440	18874	-	45583
3	Cauvery	-	107	1146	-	-	2392	916	2885	28351
4	West flowing	510	1560	402	-	19	-	8287	-	12413
5	Pennar	-	138	-	-	-	1777	-	1225	11270
Total		711	3682	35698	623	6000	14609	28711	4110	97617

Area are in Sq. Km. (Hilly areas included)



RIVER BASIN WISE AQUIFER DISTRIBUTION



Basins

- Godavari basin
- Krishna basin
- West Flowing River basin
- Pennar basin
- Cauvery basin

Aquifer

- Alluvium
- Laterite
- Basalt
- Sandstone
- Limestone
- Granite
- Schist
- Charnockite
- Banded Gneissic Complex

LEGEND

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

Table 6a: Aquifer wise River Gauge and Discharge sites

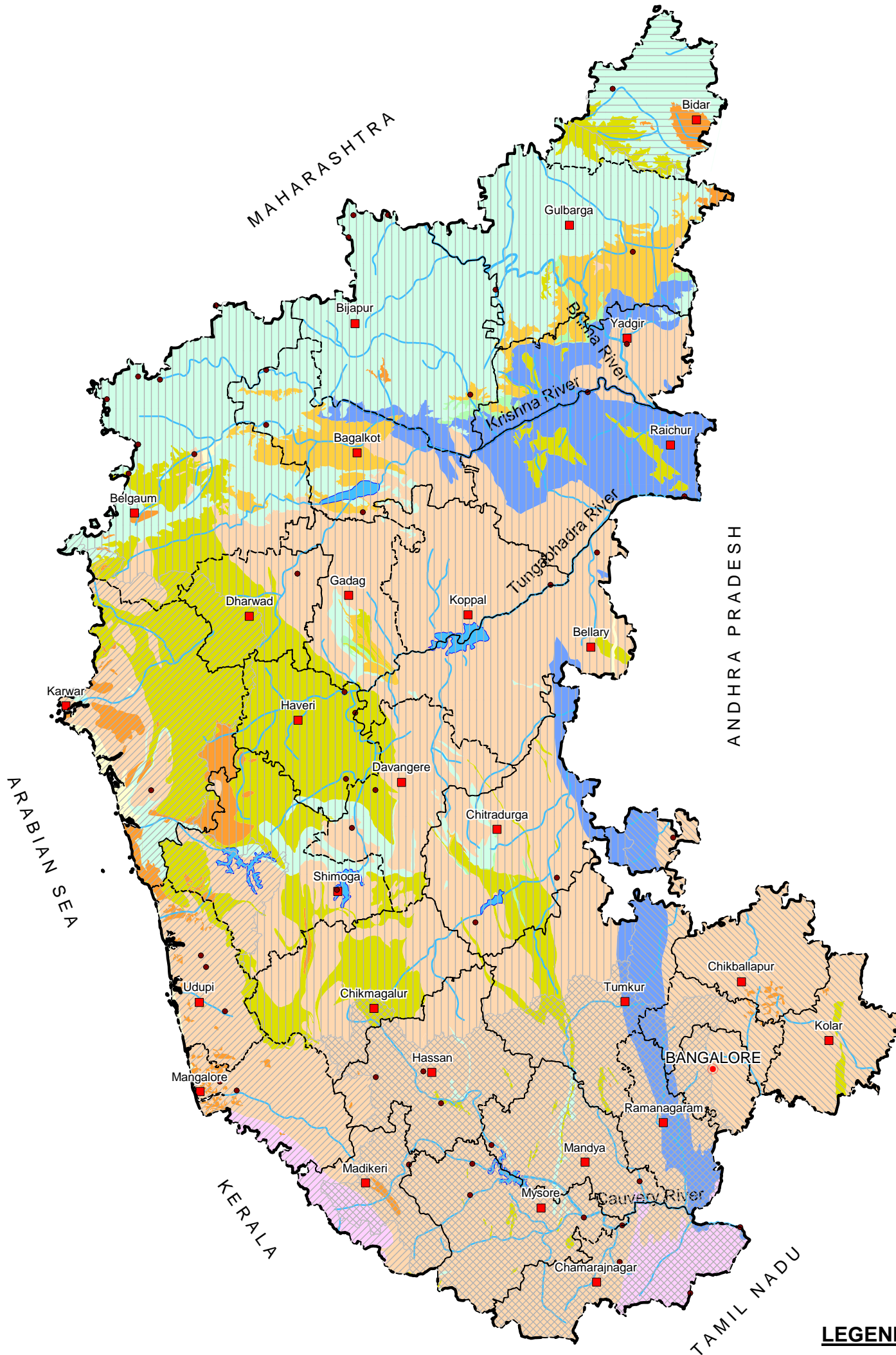
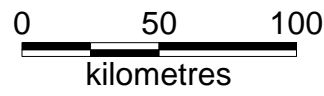
S.N.	Principal Aquifer Name	No. of Gauges and Discharge point
1	Alluvium	
2	Laterite	
3	Basalt	12
4	Sandstone	
5	Limestone	2
6	Granite	2
7	Schist	6
8	Charnockite	2
9	Banded Gneissic Complex (BGC)	28
Total		52

Table 6b : Basins wise River Gauge and Discharge sites

S.N.	Basins	No. of Gauges and Discharge point
1	Godavari	1
2	Krishna	31
3	Cauvery	13
4	West flowing	6
5	Pennar	1
Total		52



RIVER GAUGE AND DISCHARGE SITES



Basins		Aquifer			LEGEND	
• River Gauges and Discharge Sites	Godavari basin	Alluvium	Granite	State Capital	District Headquarters	
	Krishna basin	Laterite	Schist	State Boundary	District Boundary	
	West Flowing River basin	Basalt	Charnockite	Drainage	Surface waterbody	
	Pennar basin	Sandstone	Banded Gneissic Complex			
	Cauvery basin	Limestone				

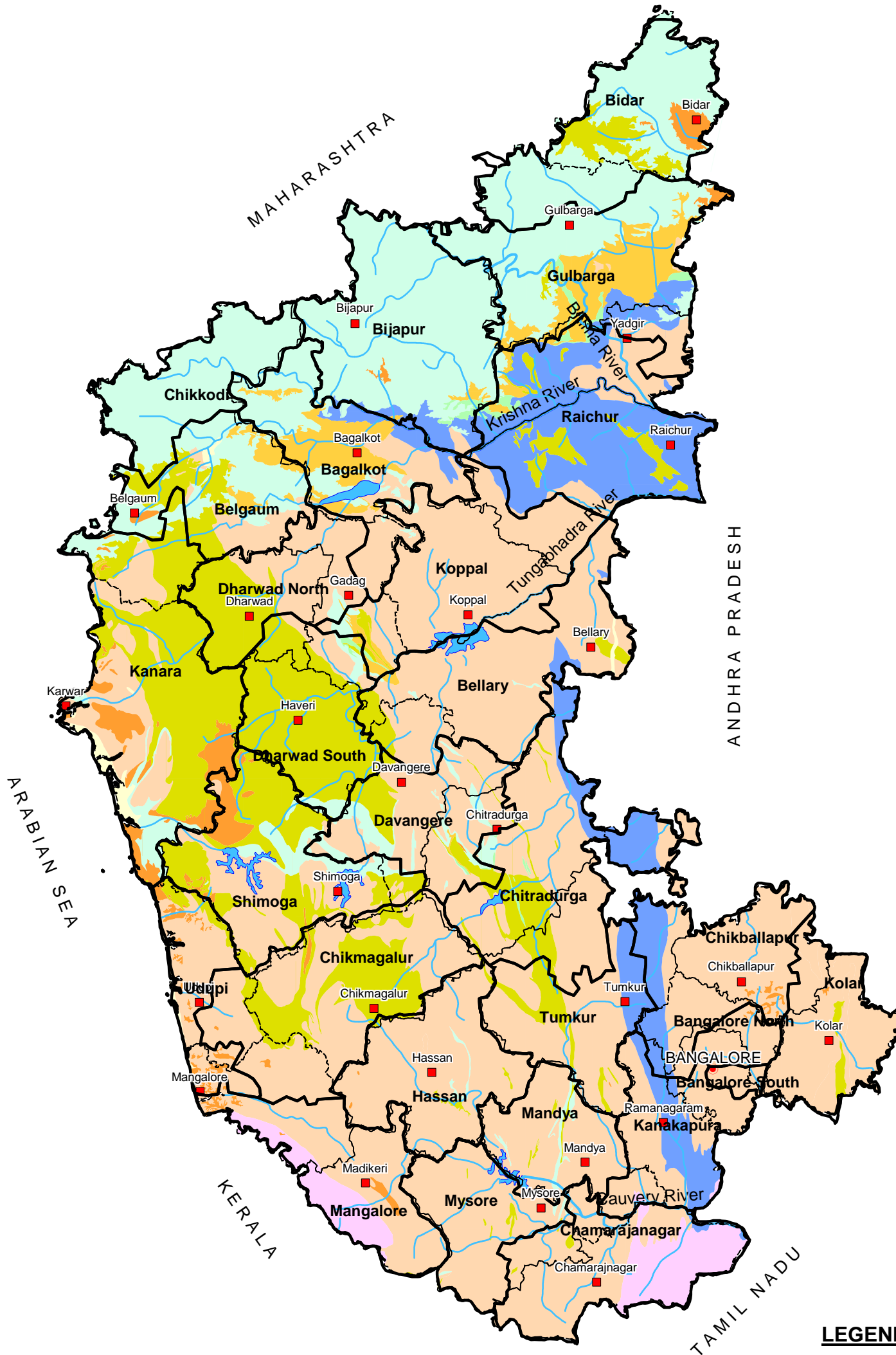
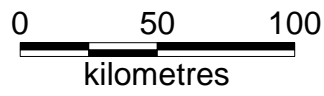
Table 7: Aquifer wise Parliamentary Constituencies in Karnataka State

S.N.	District Name	Alluvium	Laterite	Basalt	Sandstone	Limestone	Granite	Schist	Charnockite	BGC	Total
1	Bagalkot			2424.26		1911.87	621.77			2492.1	7450
2	Bangalore North		28							1267	1295
3	Bangalore South									481	481
4	Belgaum	65	81.25	2782.12		554.57		1398		1076.06	5957
5	Bellary	88		50.1		52.28	214.19	643.99		8231.44	9280
6	Bidar		403.07	6817.13				994.8			8215
7	Bijapur		50.24	9557	123	138.57				202.19	10071
8	Chamarajanagar			6.42			64.62	41.03	2405.05	4844.88	7362
9	Chikballapur		106.88				1409.81			5212.31	6729
10	Chikkodi			4990.7				198.3			5189
11	Chikmagalur		72.47					3285.57		6738.96	10097
12	Chitradurga			147.52	62		1492.67	1345.13		6831.68	9879
13	Davangere		6.05	925.38	10	27.79		914.61		4356.17	6240
14	Dharwad North			122.8		5.08		2177.96		2899.16	5205
15	Dharwad South			332.07	31	38.05		5322.13		693.75	6417
16	Gulbarga		112.62	4520.08	210	2681.91	872.46	62.15		1209.78	9669
17	Hassan		6.88	83.72				167.87		6767.53	7026
18	Kanakapura						1493.26		73.26	3572.48	5139
19	Kanara	450	1554.22	1278.57		19.12		6156.24		2987.85	12446
20	Kolar		10.77					208.77		4835.46	5055
21	Koppal			181.84	24	227.8	1057.28	134.34		7669.74	9295
22	Mandya			246.67				77.62		4000.71	4325
23	Mangalore		190.59					8.38	1631.69	4563.34	6394
24	Mysore			53.12				78.67		4568.21	4700
25	Raichur			113.14	163	342.96	6599.02	935.45		2015.43	10169
26	Shimoga		654.15	1046.24				3526.06		3479.55	8706
27	Tumkur		1.97	16.59			783.92	729.14		4134.38	5666
28	Udupi	108	402.84	2.53				304.79		2485.84	3304
Total		711	3682	35698	623	6000	14609	28711	4110	97617	191761

(All areas are in sq.km)



PARLIAMENTARY CONSTITUENCIES



LEGEND

- | | | | |
|------------------------------|-------------|-------------------------|-----------------------|
| Parliamentary constituencies | Alluvium | Granite | State Capital |
| Laterite | Basalt | Schist | District Headquarters |
| Sandstone | Charnockite | Banded Gneissic Complex | State Boundary |
| Limestone | | | District Boundary |
| | | | Drainage |
| | | | Surface waterbody |

POPULATION

Population of Karnataka is 6,11,30,704 (Census, 2011). The percentage of male and female population is 50.8% and 49.2% respectively. The rural population constitutes 61.43% of the total population and 38.57% reside in urban areas out of which 1,20,46,744 are males and 1,15,31,431 persons are females. The density of population is 319 persons per sq. km. The weaker sections constitute about 22.8% of the total population out of which 16.2% are Scheduled Tribes (ST) and 6.6% are Scheduled Castes (SC).

The decadal growth rate of population for the state has come down to 15.67 % (1991-2001) from the previous decade's rate of 17.51%. The sex ratio for Karnataka has improved to 968 from the previous decade's ratio of 985. The literacy rate stands at 82.85 % for males and 68.13 % for the female population whereas the state average is 75.6%. The district wise demographical status is shown in Table 8.

Table 8: Population Census

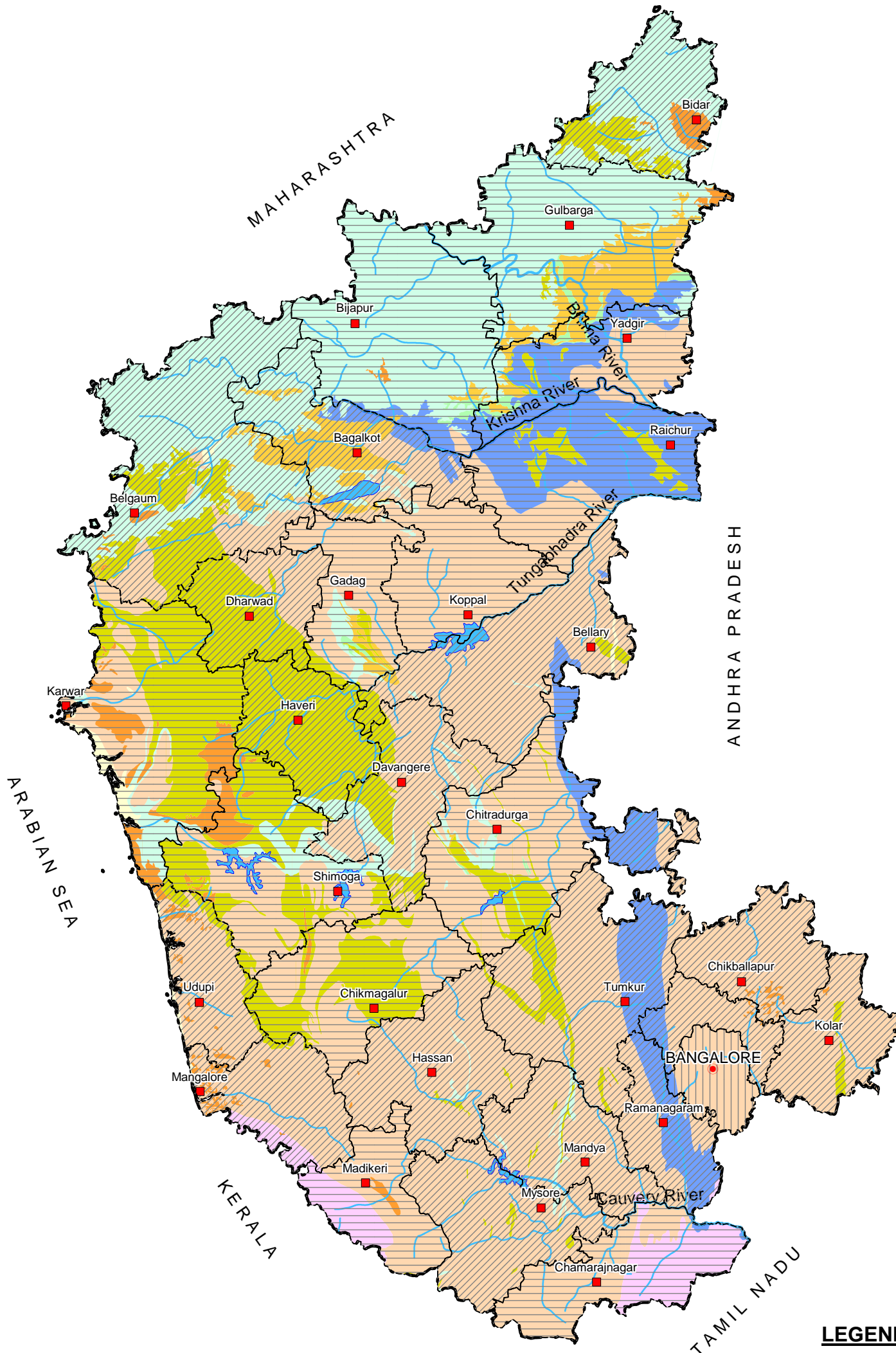
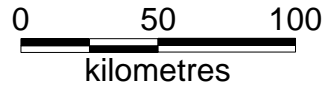
S.N.	District Name	Males	Females	Total	Density	Decennial growth rate	Sex ratio
1	Bagalkot	24,27,104	23,51,335	18,90,826	319	15.67	968
2	Bangalore Rural	5,07,514	4,79,743	9,87,257	441	16.02	945
3	Bangalore Urban	50,25,498	45,63,412	95,89,910	4,378	46.68	908
4	Belgaum	24,47,104	23,51,335	47,78,439	356	13.38	969
5	Bellary	8,43,411	8,16,967	25,32,383	197	9.39	969
6	Bidar	8,70,850	8,29,168	17,00,018	312	13.16	952
7	Bijapur	11,12,953	1,0621,49	21,75,102	207	20.38	954
8	Chamarajnagar	5,13,359	5,07,603	10,20,962	200	5.75	989
9	Chikballapur	6,37,504	6,16,873	12,54,377	298	9.17	968
10	Chikmagalur	5,67,483	5,70,270	11,37,753	158	-0.28	1,005
11	Chitradurga	8,43,411	8,16,967	16,60,378	197	9.39	969
12	Dakshina Kannada	10,32,577	10,51,048	20,83,625	457	9.8	1,018
13	Davangere	9,89,602	9,57,303	19,46,905	329	8.71	967
14	Dharwad	9,39,127	9,07,866	18,46,993	434	15.13	967
15	Gadag	5,38,477	5,26,758	10,65,235	229	9.61	978
16	Gulbarga	13,07,061	12,57,831	25,64,892	233	17.94	962
17	Hassan	8,85,807	8,90,414	17,76,221	261	3.17	1,005
18	Haveri	8,19,295	7,79,211	15,98,506	331	11.08	951
19	Kodagu	2,74,725	2,80,037	5,54,762	135	1.13	1,019
20	Kolar	7,79,401	7,60,830	15,40,231	384	11.04	976
21	Koppal	7,01,479	6,88,813	13,91,292	250	16.32	983
22	Mandya	9,09,441	8,99,239	18,08,680	365	2.55	989
23	Mysore	15,11,206	14,83,538	29,94,744	437	13.39	982
24	Raichur	9,66,493	9,58,280	19,24,773	228	15.27	992
25	Ramanagaram	5,48,060	5,34,679	10,82,739	303	5.06	976
26	Shimoga	8,79,817	8,75,695	17,55,512	207	6.88	995
27	Tumkur	13,54,770	13,26,679	26,81,449	253	3.74	979
28	Udupi	5,62,896	6,15,012	11,77,908	304	5.90	1,093
29	Uttara Kannada	7,27,424	7,09,423	17,36,847	140	6.15	975
30	Yadgir	5,91,104	5,81,881	11,72,985	224	22.67	984
Total		3,10,57,742	3,00,72,962	6,11,30,704	319	15.67	968
		(50.8%)	(49.2%)				

Source: censusindia.gov.in-census-2011

Density is in Persons/sq. Km



POPULATION DENSITY



**Population Density
(Persons/sq.km)**

- Less than 250
- 250 - 500
- 1000 - 5000

Aquifer

- Alluvium
- Laterite
- Basalt
- Sandstone
- Limestone
- Granite
- Schist
- Charnockite
- Banded Gneissic Complex

LEGEND

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

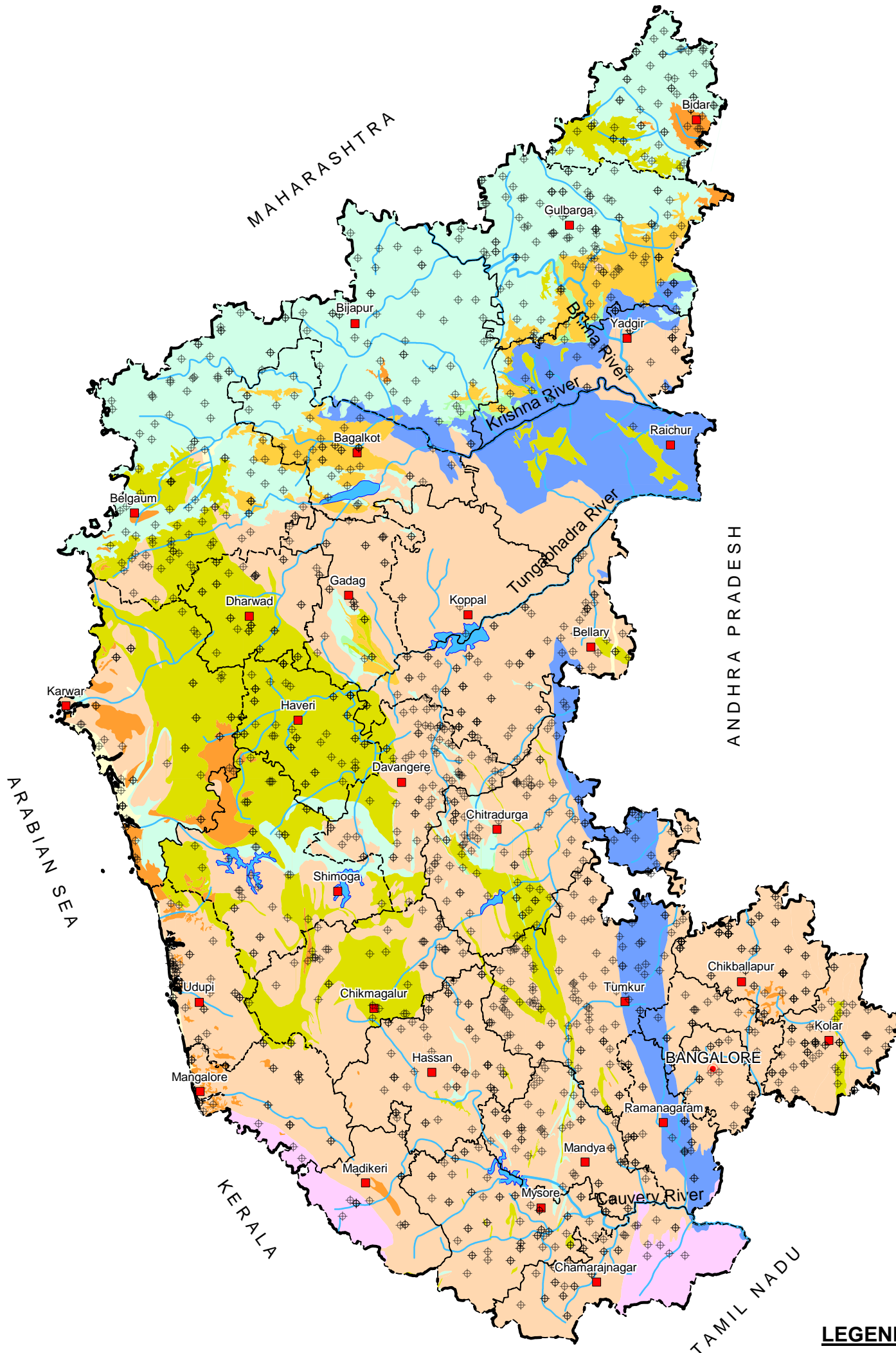
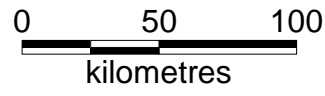
Table 9: Districts and Aquifer wise Number of Groundwater Exploratory Wells

S.N.	District Name	Geographical Area	Depth Range (m bgl)	Discharge Range (lps)	As on March -2011			Alluvium	Laterite	Basalt	Sandstone	Limestone	Granite	Schist	Charnockite	BGC	Total
					EW	OW	PZ										
1	Bagalkot	6575	11-120	<1-7.5	40	7	0	NA	NA	5	8	24	0	3	NA	7	47
2	Bangalore Rural	2259	25-264	0.1-11.09	12	13	3	NA	0	NA	NA	NA	5	1	NA	22	28
3	Bangalore Urban	2208	17-241	1-9	12	9	2	NA	NA	NA	NA	NA	0	NA	NA	23	23
4	Belgaum	13415	23-204	<1-7.5	102	16	22	NA	0	103	7	10	NA	4	NA	16	140
5	Bellary	8450	16-200	<1-11	68	24		0	NA	0	1	0	36	20	NA	35	92
6	Bidar	5448	45-300.2	<1-20	48	23		NA	0	71	NA	NA	0	NA	NA	NA	71
7	Bijapur	10494	30-120	<1-7.6	29	6		NA	0	29	0	1	1	4	NA	0	35
8	Chamarajnar	5101	34-201	2-7	40	17		NA	NA	NA	2	NA	0	1	0	54	57
9	Chikballapur	4254	13.62-500.7	0.21-10.7	21	21	2	NA	0	NA	NA	NA	NA	NA	NA	44	44
10	Chikmagalur	7201	41.4-265	<1-11.6	28	11		NA	0	NA	NA	NA	0	4	NA	35	39
11	Chitradurga	8440	27-200	1-11	85	12		NA	0	0	NA	0	8	30	NA	59	97
12	Dakshina Kannada	4560	16-256	0.2 – 4.5	18	12	4	5	0	NA	NA	NA	NA	0	0	29	34
13	Davangere	5924	9-200.06	Dry-18.56	69	10		NA	NA	0	NA	NA	NA	26	NA	53	79
14	Dharwad	4260	43-196	0.07-6.6	42	14		NA	NA	0	NA	NA	NA	27	NA	29	56
15	Gadag	4656	53.65-92	<1-3.1	9	8		NA	NA	NA	0	0	0	0	NA	17	17
16	Gulbarga	10951	18-308	0.2-9.50	93	21		NA	0	40	3	35	32	2	NA	2	114
17	Hassan	6814	25.05-256	<1-9.92	58	28		NA	0	0	NA	NA	NA	28	NA	58	86
18	Haveri	4823	50.85-200	<1-6	47	20	1	NA	0	0	NA	NA	NA	68	NA	NA	68
19	Kodagu	4102	59.05-	<1-8.2	10	14		NA	0	0	NA	NA	NA	6	1	17	24
20	Kolar	3969	20-501	<1-7.3	56	9	2	NA	0	7	NA	NA	NA	12	0	48	67
21	Koppal	7189	60 - 185	-	1	1		NA	NA	0	NA	0	NA	NA	NA	2	2
22	Mandya	4961	15.9-200	0.2-7	51	13		NA	NA	0	NA	NA	NA	5	0	59	64
23	Mysore	6854	26-90	1-8	34	19		NA	NA	0	NA	NA	NA	8	NA	45	53
24	Raichur	6827	11-90	<1-7.14	66	54		NA	NA	NA	15	NA	88	10	NA	7	120
25	Ramanagaram	3538	30-225	<1-11.29	20	12		NA	NA	NA	NA	NA	3	1	0	28	32
26	Shimoga	8477	77-200	2-6.5	31	12		NA	0	3	NA	NA	NA	21	NA	19	43
27	Tumkur	10597	34-230	<1-8.9	108	15	2	NA	0	0	NA	NA	15	8	NA	102	125
28	Udupi	3880	7-308	<1-6.5	31	15	1	17	0	NA	NA	NA	NA	0	NA	30	47
29	Uttara Kannada	10291	16-200	1-11.6	36	12		11	NA	0	NA	NA	NA	16	NA	21	48
30	Yadgir	5273	17.40-90	0.01-6.7	25	13		NA	NA	0	NA	8	0	2	NA	28	38
Total		191761			1290	461	39	33		258	36	78	188	307	1	889	1790

Are in sq.km, mbgl- meter below ground level, EW- Exploratory well, OW- Observation well , PZ- Piezometer NA- Aquifer not available 0- No well



GROUND WATER EXPLORATORY WELL



LEGEND

- | | | | |
|--------------------|-----------|-------------------------|-------------------------|
| ⊕ Exploratory well | Alluvium | Granite | ● State Capital |
| | Laterite | Schist | ■ District Headquarters |
| | Basalt | Charnockite | — State Boundary |
| | Sandstone | Banded Gneissic Complex | - - - District Boundary |
| | Limestone | | ~ Drainage |
| | | | ■ Surface waterbody |

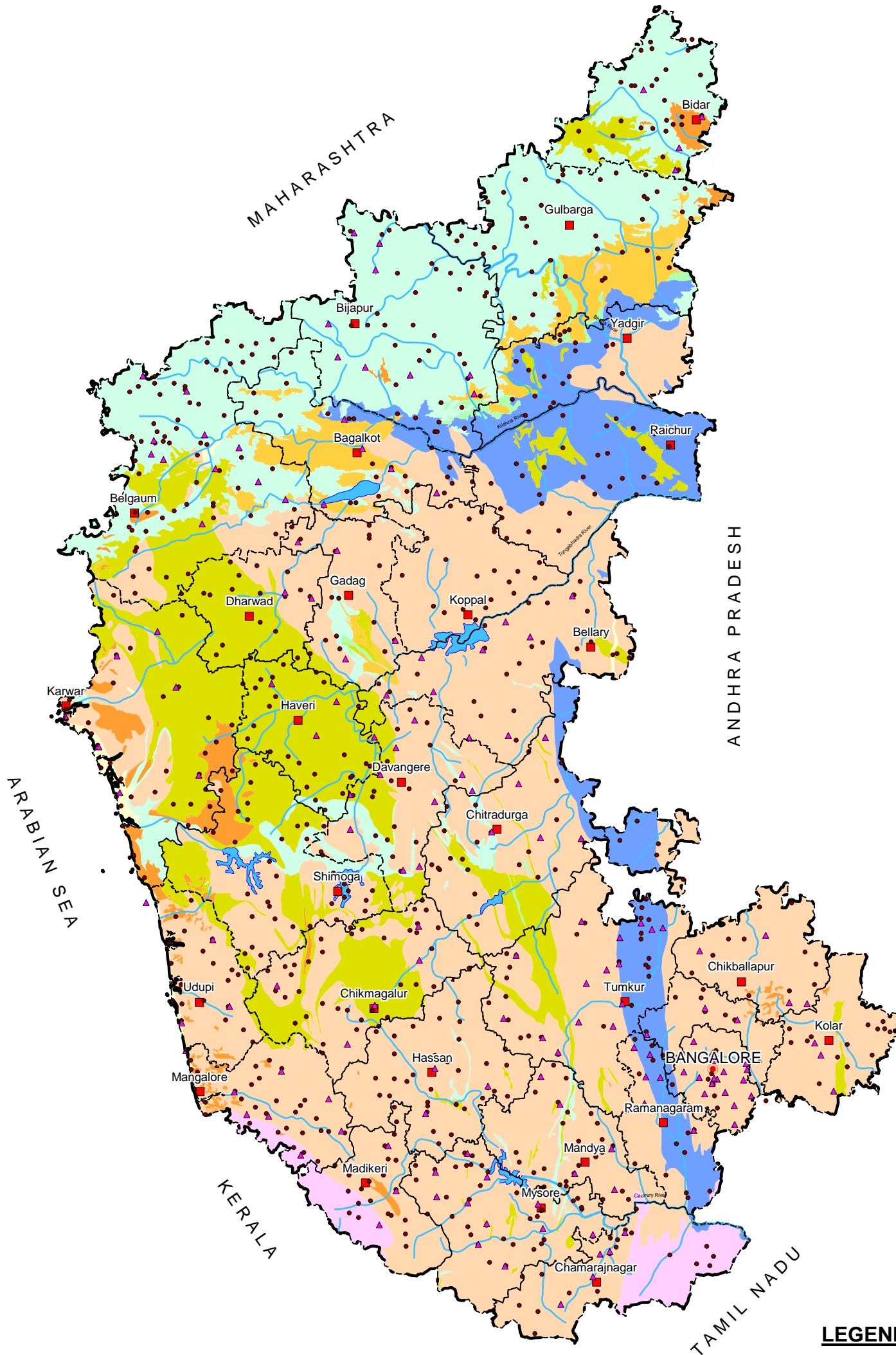
Table 10: Districts and Aquifer wise number of GW Observation Wells (Dugwells /Piezometers)

S.N.	District Name	Alluvium		Laterite		Basalt		Sandstone		Limestone		Granite		Schist		Charnockite		BGC		Total	
		DW	Pz	DW	Pz	DW	Pz	DW	Pz	DW	Pz	DW	Pz	DW	Pz	DW	Pz	DW	Pz	DW	Pz
1	Bagalkot	NA	NA	NA	NA	7	1	0	0	2	5	8	1	0	0	NA	NA	7	1	24	8
2	Bangalore Rural	NA	NA	0	0	NA	NA	NA	NA	NA	NA	2	2	0	0	NA	NA	7	4	9	6
3	Bangalore Urban	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	0	NA	NA	NA	NA	6	18	7	18
4	Belgaum	NA	NA	1	1	46	13	0	0	0	0	NA	NA	6	5	NA	NA	7	2	60	21
5	Bellary	1	0	NA	NA	0	0	0	0	0	0	0	0	2	-	NA	NA	23	12	26	12
6	Bidar	NA	NA	3	1	11	5	NA	NA	NA	NA	0	0	4	1	NA	NA	0	0	18	7
7	Bijapur	NA	NA	0		39	13	1	1	0	1	4	1	0	0	NA	NA	NA	NA	44	16
8	Chamarajnar	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	0	0	4	0	13	5	17	5
9	Chikballapur	NA	NA	1	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13	9	14	9
10	Chikmagalur	NA	NA	1	0	NA	NA	NA	NA	NA	NA	0	0	7	1	NA	NA	25	5	33	6
11	Chitradurga	NA	NA	0	0	2	1	NA	NA	1	0	1	1	4	2	NA	NA	22	8	30	12
12	Dakshina Kannada	1	0	2	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	4	1	20	6	27	7
13	Davangere	NA	NA	NA	NA	4	2	NA	NA	NA	NA	NA	NA	2	2	NA	NA	10	7	16	11
14	Dharwad	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NA	NA	11	1	NA	NA	5	3	16	4
15	Gadag	NA	NA	NA	NA	2	1	0	0	NA	0	0	0	1	0	NA	NA	12	5	15	6
16	Gulbarga	NA	NA	0	0	33	7	0	0	12	2	0	0	0	0	NA	NA	NA	NA	45	9
17	Hassan	NA	NA	0	0	0	0	NA	NA	NA	NA	NA	NA	2	0	NA	NA	29	4	31	4
18	Haveri	NA	NA	0	0	2		NA	NA	NA	NA	NA	NA	21	4	NA	NA	NA	NA	23	4
19	Kodagu	NA	NA	0	0	0	0	NA	NA	NA	NA	NA	NA	0	0	6	2	18	4	24	6
20	Kolar	NA	NA	0	0	0	0	NA	NA	NA	NA	NA	NA	0	1	NA	NA	13	12	13	13
21	Koppal	NA	NA	NA	NA	0	0	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	20	5	20	5
22	Mandya	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NA	NA	2	0	0	0	21	7	23	7
23	Mysore	NA	NA	NA	NA	0	0	NA	NA	NA	NA	NA	NA	0	0	NA	NA	32	12	32	12
24	Raichur	NA	NA	NA	NA	NA	NA	15	15	NA	0	16	6	3	0	NA	NA	11	2	30	8
25	Ramanagaram	NA	NA	0	0	NA	NA	NA	NA	NA	NA	6	4	0	0	0	0	7	4	13	8
26	Shimoga	NA	NA	2	1	4	-	NA	NA	NA	NA	NA	NA	12	1	NA	NA	21	3	39	5
27	Tumkur	NA	NA	0	0	0	0	NA	NA	NA	NA	18	8	0	1	NA	NA	24	17	42	26
28	Udupi	3	0	2	-	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	16	4	21	4
29	Uttara Kannada	6	2	8	2	2	-	NA	NA	NA	NA	NA	NA	9	5	NA	NA	10	2	35	11
30	Yadgir	NA	NA	NA	NA	0	1	1	1	3	0	14	4	0	0	NA	NA	2	2	20	8
Total		11	2	20	5	152	44	2	2	18	8	70	27	86	24	14	3	394	163	767	278

Dw- Dug well Pz- Piezometer, NA- Aquifer not available 0- No well



GROUND WATER OBSERVATION WELL



LEGEND

- | | |
|------------------|-------------------------|
| • Dug well | • State Capital |
| ▲ Piezometer | ■ District Headquarters |
| — State Boundary | - - - District Boundary |
| — Drainage | — Surface waterbody |
-
- | Aquifer | |
|-------------|---------------------------|
| □ Alluvium | □ Granite |
| □ Laterite | □ Schist |
| □ Basalt | □ Charnockite |
| □ Sandstone | □ Banded Gneissic Complex |
| □ Limestone | |

Table 11 : Districts and Aquifer wise Depth to Water Level, Pre-monsoon, 2011

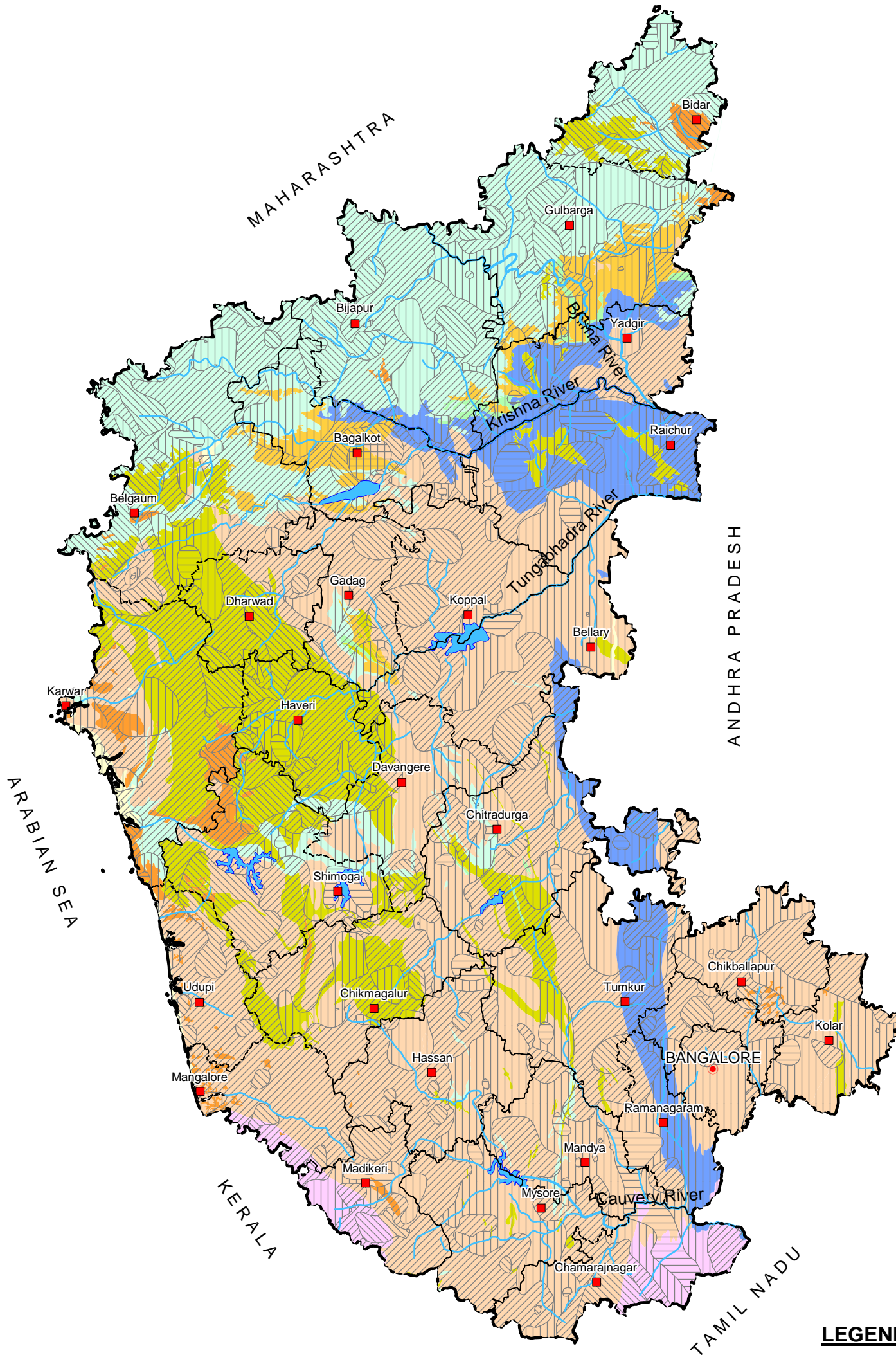
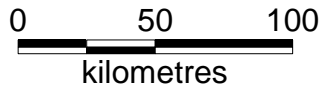
Sl. no	District Name	Alluvium		Laterite		Basalt		Sandstone		Limestone		Granite		Schist		Charnockite		BGC	
		Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min	Max	Min	Max	Min.	Max	Min.	Max
1	Bagalkot					2.01	7.98			5.77	30.68	2.01	7.03					0.71	7.64
2	Bangalore Rural											2.93	11.05					2.0	10.98
3	Bangalore Urban											2.13	7.23					2.0	5.87
4	Belgaum			5.03	5.49	1.89	17.29							3.33	9.41			1.02	12.35
5	Bellary	3.46	4.81											2.96	6.09			1.61	12.05
6	Bidar			11.15	17.73	2.00	16.8							9.7	14.22				
7	Bijapur					2.35	12.54	4.12	5.62			1.88	6.93					5.02	6.12
8	Chamarajnar															1.2	7.82	1.59	10.45
9	Chikballapur			11.5	13.22													1.8	8.85
10	Chikmagalur			9.68	11.12									2.69	16.02			0.79	17.83
11	Chitradurga					2.00	6.3			0.4	4.14	1.15	3.46	3.7	6.63			1.25	10.4
12	Dakshina Kannada	6.74	9.04	4.12	5.02											4.9	10.03	4.69	12.8
13	Davangere					2.00	14.84							4.47	5.51			1.84	6.78
14	Dharwad													2.18	17.4			2.8	14.12
15	Gadag					3.78	4.99							13.47	16.82			1.54	24.6
16	Gulbarga					1.87	16.75			2.1	10.5								
17	Hassan													2.08	2.95			1.2	12.00
18	Haveri					11.1	13.34							0.81	13.24				
19	Kodagu															4.5	12.35	0.9	14.65
20	Kolar																	1.47	8.5
21	Koppal																	1.82	12.26
22	Mandya													1.84	8.22			0.38	8.07
23	Mysore																	1.1	13.28
24	Raichur											0.41	8.06	2.91	5.15			1.84	8.08
25	Ramanagaram											2.09	9.15					1.67	9.37
26	Shimoga			2.14	9.55	1.31	3.9							2.05	17.37			1.05	12.3
27	Tumkur											1.29	8.77					1.17	9.00
28	Udupi	4.63	6.62	5.24	6.00													2.8	14.44
29	Uttara Kannada	2.94	8.08	1.76	15.19	6.54	9.31							5.05	9.99			2.25	10.74
30	Yadgir							1.15	2.75	2.2	10.42	1.98	8.75					3.99	7.56

All Figures are in meter below ground level. Water level refers to phreatic aquifer (dug well zone) only

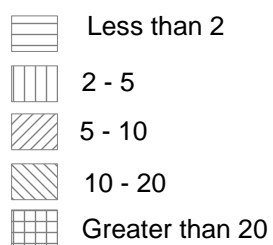


GROUND WATER DEPTH TO WATER LEVEL

(May - 2011)



Depth to water level in mbgl



Aquifer



LEGEND

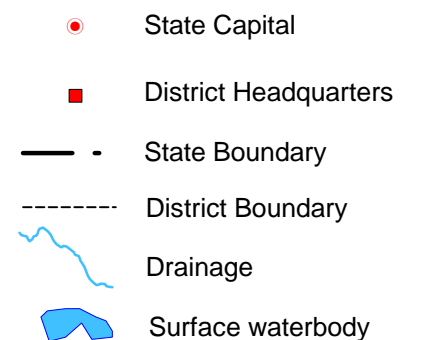


Table 12: Districts and Aquifer Wise Depth to Water Level, Post-monsoon, 2011

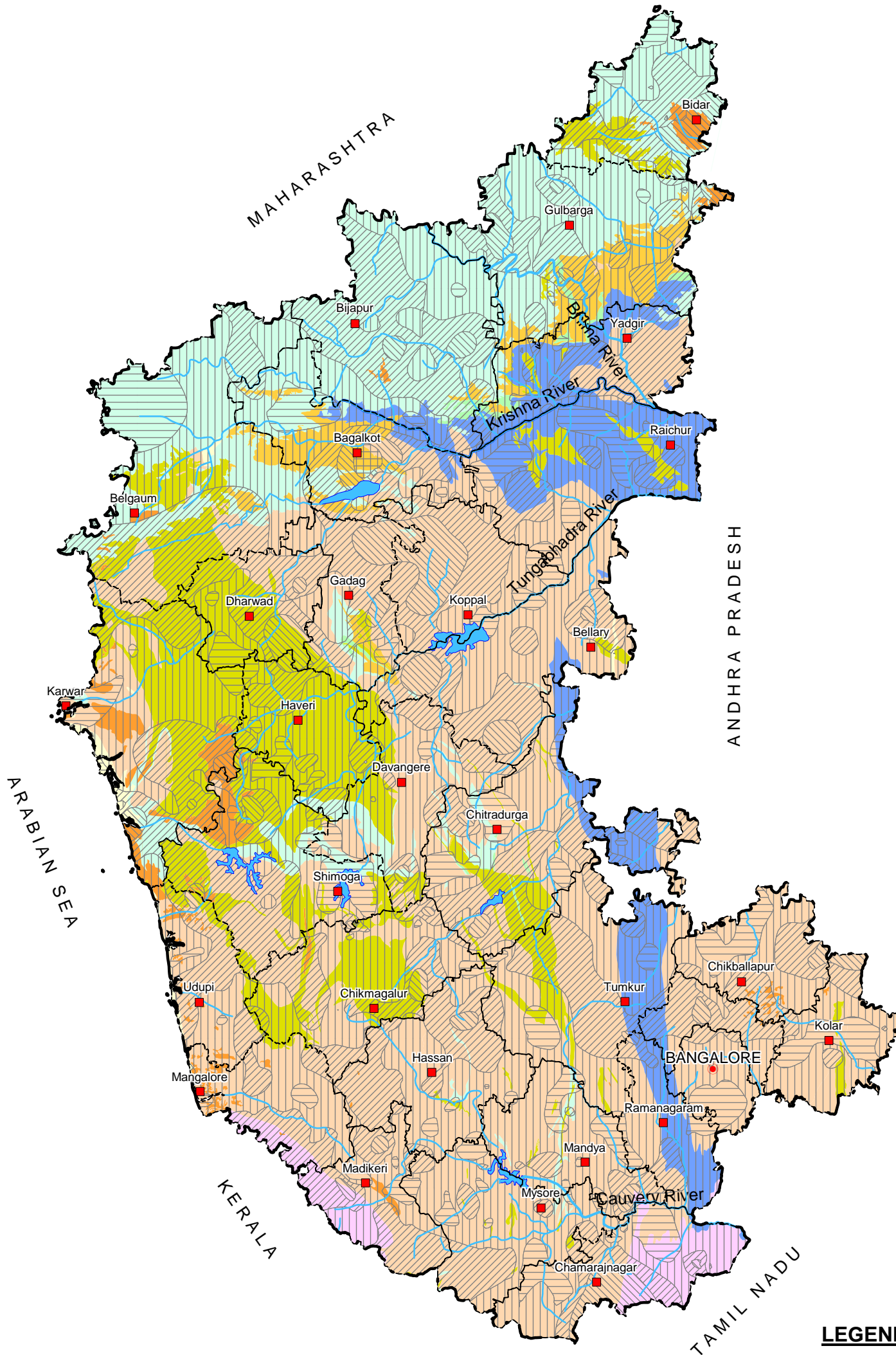
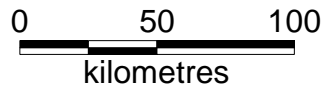
S.N.	District Name	Alluvium		Laterite		Basalt		Sandstone		Limestone		Granite		Schist		Charnockite		BGC	
		Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max
1	Bagalkot									5.78	26.75	1.64	5.79	1.41	5.28			0.5	7.62
2	Bangalore Rural											3.08	9.02					2.4	11.51
3	Bangalore Urban											2.01	5.08					0.39	3.58
4	Belgaum			0.75	4.74	0.33	10.76							0.75	5.6			0.77	8.42
5	Bellary	3.30	4.7											2.87	5.3			1.26	13.2
6	Bidar			8.86	16.4	0.69	14.68							2.61	6.82				
7	Bijapur					1.75	12.27	4.03	4.86			1.48	6.36					4.23	4.83
8	Chamarajnagar															1.03	7.32	0.28	9.84
9	Chikballapur			9.34	10.8													1.04	8.12
10	Chikmagalur			8.15	9.36									9.54	15.93			0.71	13.85
11	Chitradurga					0.82	4.64			0.40	3.84			3.65	6.57			0.6	10.19
12	Dakshina Kannada	5.80	8.24	1.63	2.87											4.2	7.57	0.75	9.8
13	Davangere					1.56	11.59					1.2	4.6	3.7	5.08			1.72	6.21
14	Dharwad													1.28	17.1			2.8	12.91
15	Gadag					3.24	3.7							12.83	16.47			1.24	24.3
16	Gulbarga					0.68	12.4			1.9	10.48								
17	Hassan													1.74	2.86			1.19	18.82
18	Haveri					8.35	9.19							0.48	11.14				
19	Kodagu															2.13	11.7	0.71	12.55
20	Kolar																	0.93	7.86
21	Koppal																	1.18	11.74
22	Mandya													1.65	5.87			0.2	7.2
23	Mysore																	0.1	9.83
24	Raichur											0.35	7.92	1.01	4.62			0.58	7.06
25	Ramanagaram											1.8	8.65					1.32	9.3
26	Shimoga			0.51	5.64	0.93	3.88							1.26	13.56			0.45	8.58
27	Tumkur											0.98	8.38					0.26	8.98
28	Udupi	2.83	3.5	3.75	5.9													1.6	10.45
29	Uttara Kannada	0.66	6.84	1.5	13.9	5.92	6.44							3.4	9.78			0.56	6.55
30	Yadgir							0.77	1.94	1.16	3.54	1.64	8.63					3.04	7.32

All Figures are in meters below ground level. Water level refers to phreatic aquifer (dug well zone) only

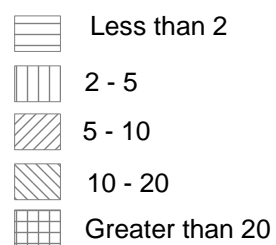


GROUND WATER DEPTH TO WATER LEVEL

(November - 2011)



Depth to water level in mbgl



Aquifer



LEGEND

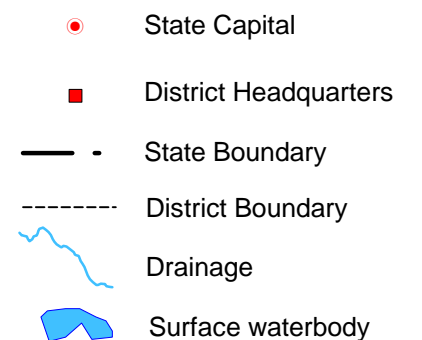


Table 13 : Districts and Aquifer wise Seasonal Ground Water Level Fluctuation, November 2011 vs May 2011

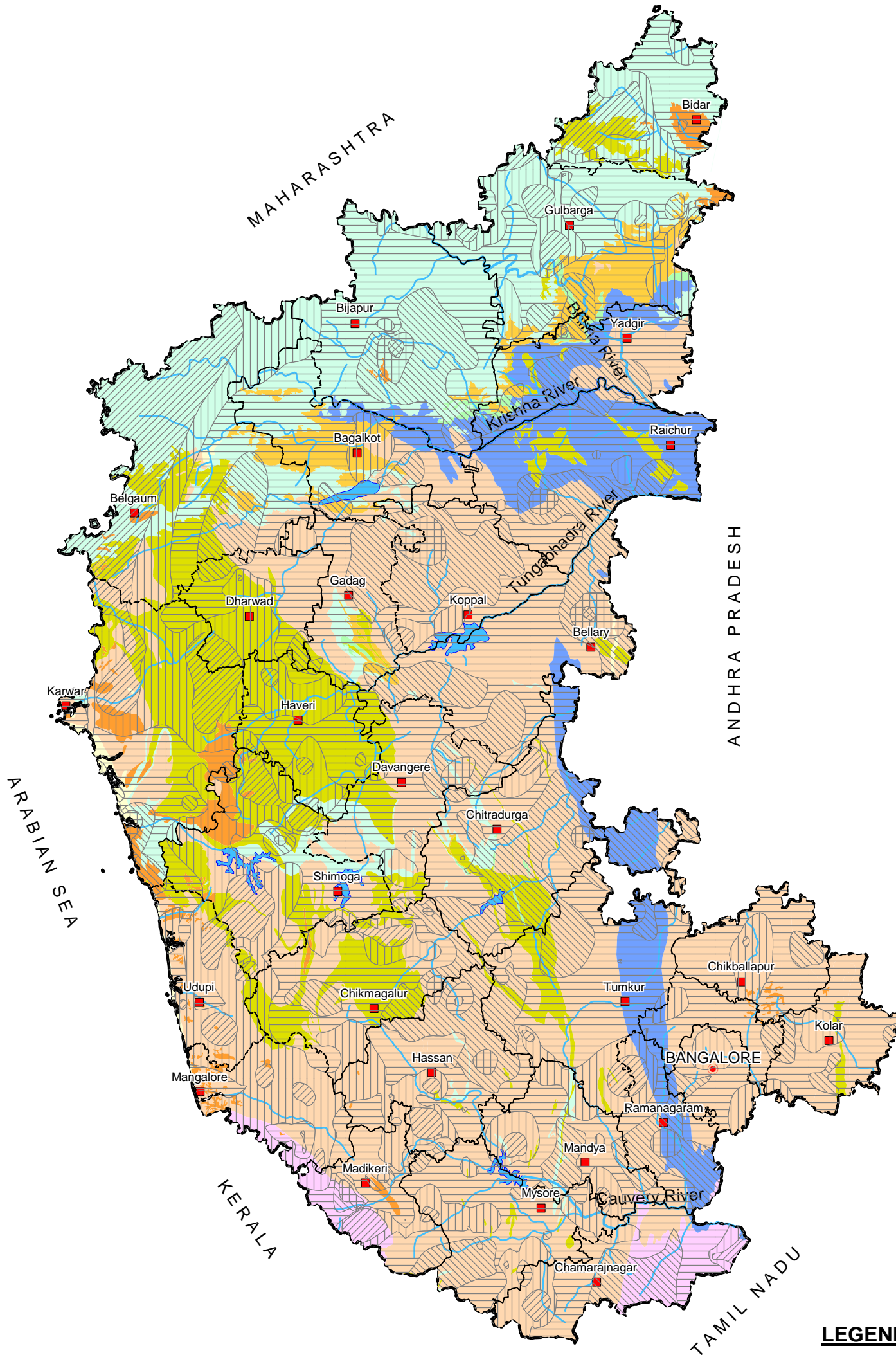
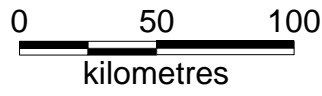
S.N.	District Name	Alluvium		Laterite		Basalt		Sandstone		Limestone		Granite		Schist		Charnockite		BGC	
		Min	Max	Min	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min	Max	Min.	Max	Min.	Max
1	Bagalkot					-0.05	3.45			-0.16	3.93	0.08	2.35					-1.58	1.53
2	Bangalore Rural											0.15	2.03					0.2	2.62
3	Bangalore Urban											-0.19	0.19					-0.05	3.94
4	Belgaum			4.74	4.74	1.00	14.22							0.94	5.56			-0.05	3.94
5	Bellary	-0.24	-0.24											-0.39	0.79			-4.27	6.52
6	Bidar			-0.40	1.57	0.23	4.5							3.73	10.94				
7	Bijapur					-4.72	3.97	0.09	0.09			-0.43	1.14						
8	Chamarajnar															-0.12	5.14	-0.09	6.75
9	Chikballapur			2.16	2.16													-0.58	4.08
10	Chikmagalur			1.53	1.53									-0.01	1.44			-3.22	5.78
11	Chitradurga					-1.18	-1.16			-0.08	-0.08			-1.16	2.25			-1.94	2.15
12	Dakshina Kannada			2.15	3.94											-0.3	2.84	-0.1	5.3
13	Davangere					0.03	3.25					0.3	0.3	0.29	1.06			0.17	3.06
14	Dharwad													-1.7	4.25			0.17	1.21
15	Gadag					0.08	1.75							0.35	0.35			-1.05	6.10
16	Gulbarga					-1.65	5.45			-1.58	5.65								
17	Hassan													-0.11	0.34			-3.26	7.65
18	Haveri					2.75	4.15							-0.3	5.75				
19	Kodagu															-4.1	10.22	-3.9	3.87
20	Kolar																	0.67	3.88
21	Koppal																	-3.54	2.71
22	Mandya													-0.16	2.15			-0.88	4.68
23	Mysore																	-2.2	4.51
24	Raichur											-0.81	3.55	0.14	1.9			-2.87	2.41
25	Ramanagaram											-3.22	2.85					-0.65	4.88
26	Shimoga			1.63	3.91	-2.57	1.45							0.34	7.78			0.15	5.20
27	Tumkur											-0.61	2.13					-1.73	6.97
28	Udupi	1.8	3.06	0.86	2.25													1.2	5.12
29	Uttara Kannada	-1.38	2.54	-2.44	3.16	0.62	2.87							-0.94	5.4			0.77	5.64
30	Yadgir							0.38	0.38	-1.29	6.88	-1.28	0.93					-0.31	0.95

All Figures are in meter. Water level fluctuation refers to phreatic aquifer (dug well zone) only



GROUND WATER LEVEL FLUCTUATION

(November - 2011 vs May - 2011)



water level fluctuation in m

Rise		fall	
	>4		>4
	2 - 4		2 - 4
	0 - 2		0 - 2

Aquifer

	Alluvium		Granite
	Laterite		Schist
	Basalt		Charnockite
	Sandstone		Banded Gneissic Complex
	Limestone		

LEGEND

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

Table 14 : Districts and Aquifer wise Depth to Water Level (Decadal Mean, Pre-monsoon, 2002-2011)

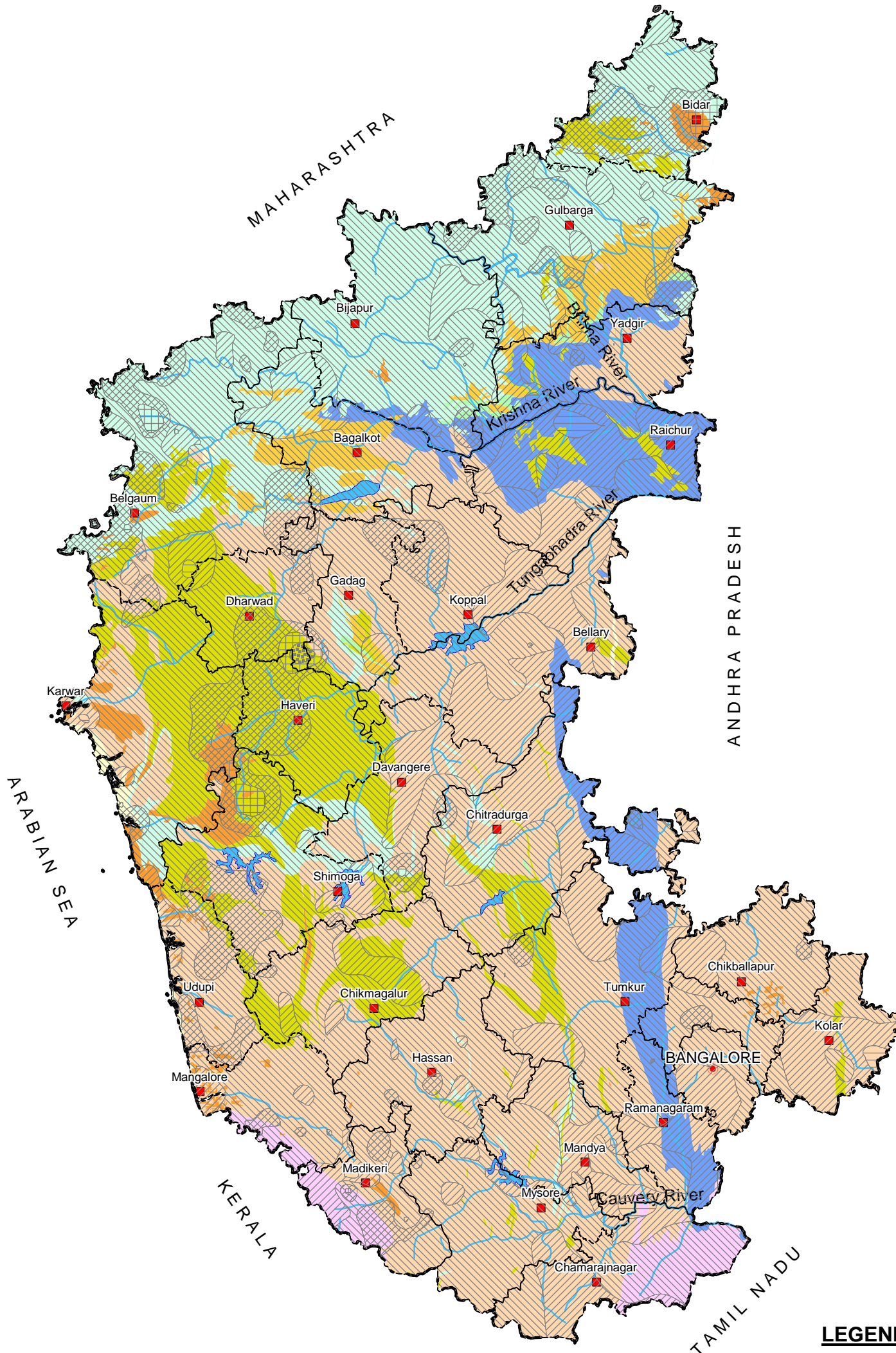
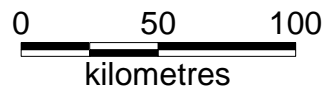
S.N.	District Name	Alluvium		Laterite		Basalt		Sandstone		Limestone		Granite		Schist		Charnockite		BGC	
		Min	Max	Min	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min	Max	Min.	Max	Min.	Max
1	Bagalkot					2.54	8.99			5.25	25.4	4.85	8.30					4.72	8.82
2	Bangalore Rural											5.70	8.73					3.52	11.3
3	Bangalore Urban																	2.46	5.92
4	Belgaum			6.02	6.34	1.79	15.38							1.63	14.42			2.04	16.1
5	Bellary													5.70	5.90			3.52	10.2
6	Bidar			12.71	17.9	2.28	14.43							10.0	14.56				
7	Bijapur					3.38	11.77	5.99	6.21			2.16	11.22						
8	Chamarajnagar															5.62	7.85	0.68	7.20
9	Chikballapur																	2.47	10.3
10	Chikmagalur													3.12	9.65			2.36	12.2
11	Chitradurga					4.81	4.94			2.05	2.17	2.51	2.64	9.57	10.16			2.41	11.1
12	Dakshina Kannada	6.87	8.40	7.01	12.0											5.62	10.25	3.84	12.7
13	Davangere					8.42	15.43							2.88	7.08			2.88	8.36
14	Dharwad													6.61	22.46			4.92	15.2
15	Gadag					7.09	10.16							21.1	21.14			2.49	11.6
16	Gulbarga					2.98	13.73			4.24	13.4								
17	Hassan					4.80	5.86							2.45	4.41			2.39	11.9
18	Haveri													2.91	15.05				
19	Kodagu															2.74	16.36	1.19	13.4
20	Kolar																	1.44	5.65
21	Koppal																	3.01	10.9
22	Mandya													4.88	6.88			1.17	9.64
23	Mysore																	3.39	11.0
24	Raichur											1.18	6.35	2.79	5.55			3.61	8.18
25	Ramanagaram											4.20	10.54					2.66	9.61
26	Shimoga			7.47	9.45	4.02	7.46							2.94	18.52			2.18	12.6
27	Tumkur											2.24	11.39					4.22	11.1
28	Udupi	4.05	11.91	4.37	11.0														
29	Uttara Kannada	4.25	8.36	2.90	17.1	7.31	9.16							5.01	11.79			1.73	9.67
30	Yadgir							2.11	3.31	3.68	7.76	1.68	10.78					4.97	8.61

All Figures are in meter below ground level. Water level refers to phreatic aquifer (dug well zone) only



GROUND WATER DEPTH TO WATER LEVEL

(Decadal Mean, May - 2002-11)



Depth to water level in mbgl

- Less than 2
- 2 - 5
- 5 - 10
- 10 - 20
- Greater than 20

Aquifer

- Alluvium
- Laterite
- Basalt
- Sandstone
- Limestone
- Granite
- Schist
- Charnockite
- Banded Gneissic Complex

LEGEND

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

Table 15: Districts and Aquifer wise Depth to Water Level (Decadal Mean, Post-monsoon,2002-2011)

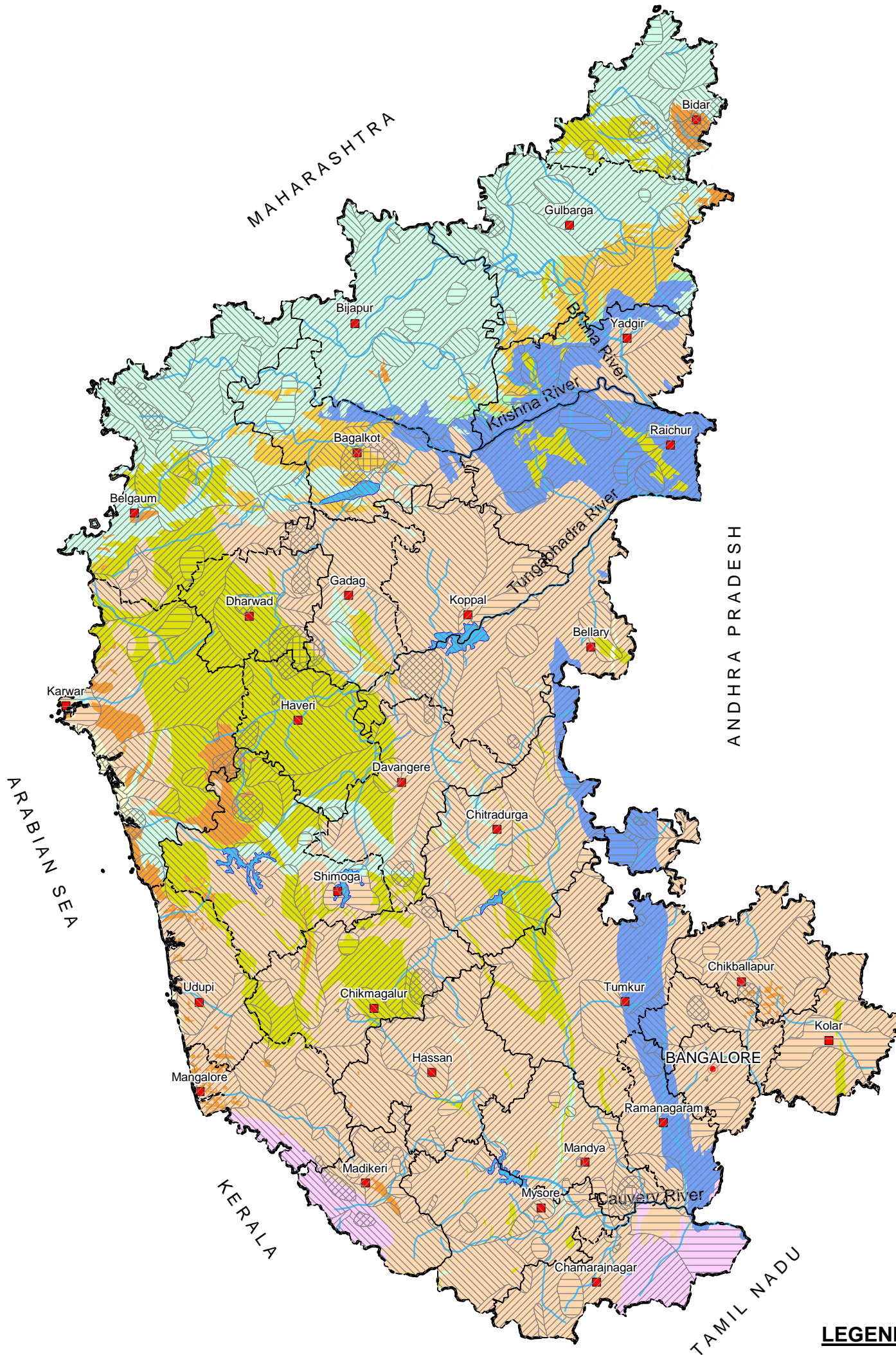
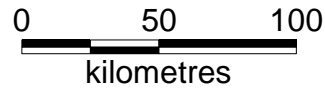
S.N.	District Name	Alluvium		Laterite		Basalt		Sandstone		Limestone		Granite		Schist		Charnockite		BGC	
		Min	Max	Min	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min	Max	Min.	Max	Min.	Max
1	Bagalkot					1.55	4.00			4.77	17.2	3.25	6.41					1.14	7.72
2	Bangalore Rural											4.21	7.32					2.51	10.3
3	Bangalore Urban											3.93	3.93					1.09	3.31
4	Belgaum			3.56	3.92	0.70	12.57							1.30	7.09			1.04	8.84
5	Bellary													3.43	6.57			2.18	12.5
6	Bidar			7.76	13.7	0.92	14.12							1.79	7.86				
7	Bijapur					1.52	8.35	3.70	4.02			1.42	6.98					4.56	4.56
8	Chamarajnagar															1.65	1.93	0.49	5.61
9	Chikballapur			11.10	11.1													1.19	9.17
10	Chikmagalur			6.96	7.78									2.08	15.02			1.54	12.4
11	Chitradurga					2.47	2.50					1.38	1.43	7.15	7.94			2.05	9.15
12	Dakshina Kannada	5.40	8.01	4.74	5.16													2.17	10.7
13	Davangere					2.58	13.31							1.95	4.72			2.29	10.1
14	Dharwad													3.83	18.35			3.96	14.3
15	Gadag					5.77	5.83							20.0	20.05			1.34	13.1
16	Gulbarga					1.30	11.91			1.38	8.43								
17	Hassan					2.16	2.56							1.24	1.47			1.26	8.43
18	Haveri													1.17	11.92				
19	Kodagu															4.20	13.89	0.87	11.7
20	Kolar																	0.55	4.42
21	Koppal																	1.27	9.53
22	Mandya													2.58	5.93			0.65	19.7
23	Mysore																	0.76	9.97
24	Raichur											1.22	7.85	1.38	3.49			2.38	6.62
25	Ramanagaram											2.00	9.27					1.80	9.33
26	Shimoga			5.01	5.69	1.24	3.89							2.03	14.00			0.91	8.21
27	Tumkur											0.83	10.51					2.23	7.08
28	Udupi	2.80	3.56	2.76	6.89													1.17	9.95
29	Uttara Kannada	0.75	6.26	2.91	16.4	7.52	7.84							1.57	6.76			0.74	6.14
30	Yadgir							1.08	1.62	1.92	4.17	1.38	7.83					3.25	7.04

All Figures are in meter below ground level. Water level refers to phreatic aquifer (dug well zone) only

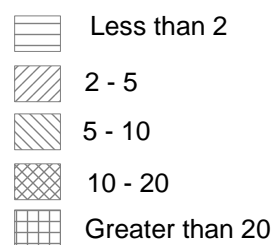


GROUND WATER DEPTH TO WATER LEVEL

(Decadal Mean November, 2002 - 2011)



Depth to water level in mbgl



Aquifer



LEGEND

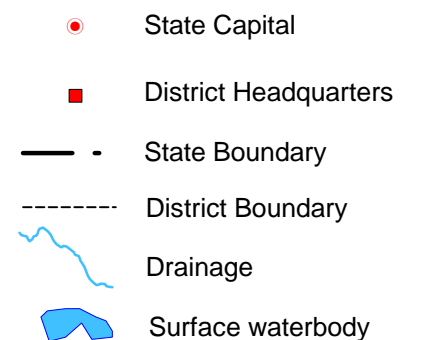


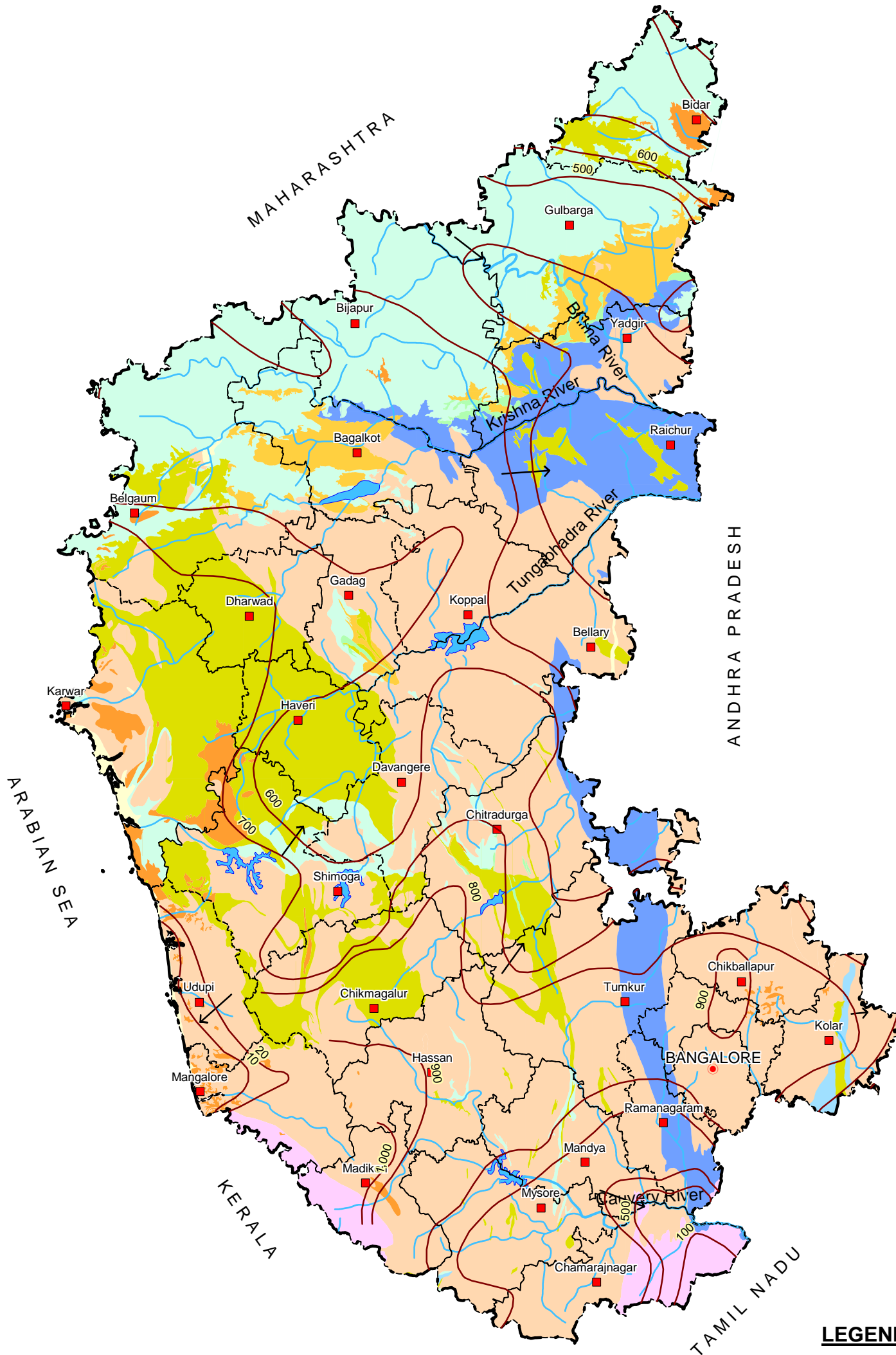
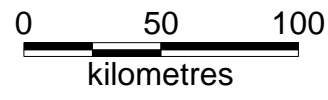
Table 16: Districts and Aquifer wise Water table Elevation

S.N.	District Name	Alluvium		Laterite		Basalt		Sandstone		Limestone		Granite		Schist		Charnockite		BGC	
		Min	Max	Min	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min	Max	Min.	Max	Min.	Max
1	Bagalkot					523	575			515	567	517	541					512	567
2	Bangalore Rural											759	926					813	940
3	Bangalore Urban											815	815					876	918
4	Belgaum			544	752	530	732							619	789			544	695
5	Bellary	406	486											405	611			396	651
6	Bidar			515	651	542	600							628	695				
7	Bijapur					402	615					512	555						
8	Chamarajnar															621	674	641	771
9	Chikballapur			832	906													678	939
10	Chikmagalur			657	743									657	1030			617	1131
11	Chitradurga					608	722			479	506	595	649	479	665			520	721
12	Dakshina Kannada	2	4	77	93											60	171	8	120
13	Davangere					594	635							537	605			509	797
14	Dharwad													541	694			567	661
15	Gadag					615	678											513	664
16	Gulbarga					388	551			388	471								
17	Hassan													794	846			780	1021
18	Haveri					516	563							509	746				
19	Kodagu															833	915	119	1116
20	Kolar																	725	864
21	Koppal																	399	752
22	Mandya													736	746			626	870
23	Mysore																	639	877
24	Raichur											336	485	380	514			385	540
25	Ramanagaram											638	903					564	850
26	Shimoga			557	591	613	634							524	787			565	693
27	Tumkur											677	853					647	826
28	Udupi	3	6	33	44													5	126
29	Uttara Kannada	8	10	4	591									476	742			6	575
30	Yadgir							396	426	409	603	381	598					361	398

All Figures are in meters above mean sea level



WATER TABLE ELEVATION



LEGEND

- 700 Water table elevation contour (mamsl)
- Groundwater flow direction

Aquifer

- | | |
|-----------|-------------------------|
| Alluvium | Granite |
| Laterite | Schist |
| Basalt | Charnockite |
| Sandstone | Banded Gneissic Complex |
| Limestone | |

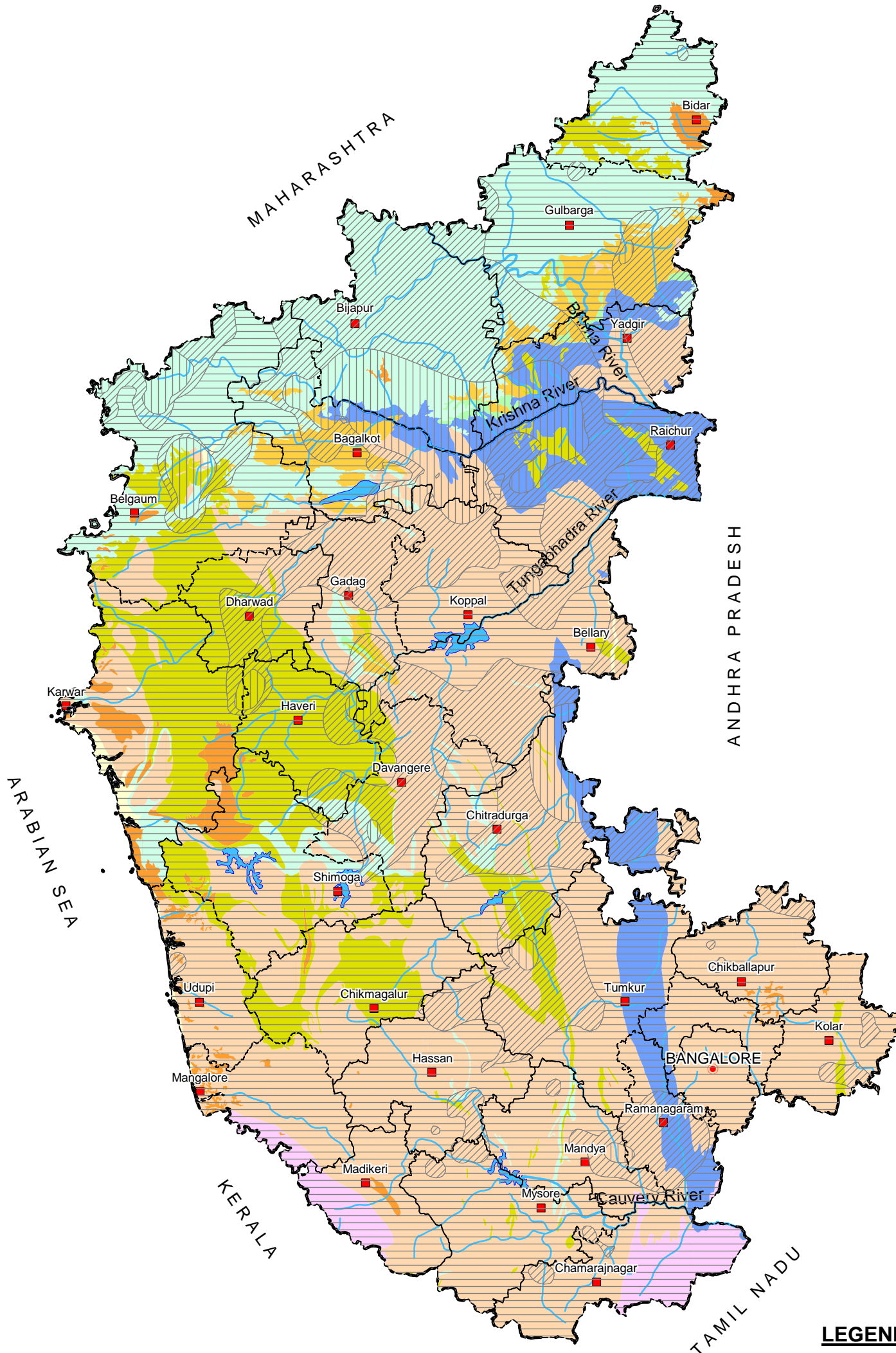
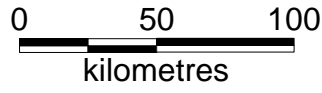
- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

Table 17: Districts showing Salinity in Groundwater

S. No.	Name of Districts (in parts) with Ec > 3000 $\mu\text{S}/\text{cm}$ in Shallow aquifer
1	Bagalkot
2	Belgaum
3	Chitradurga
4	Davangere
5	Gadag
6	Gulbarga
7	Haveri
8	Koppal
9	Mandya
10	Mysore
11	Raichur
12	Tumkur
13	Udupi



ELECTRICAL CONDUCTIVITY



Electrical Conductivity (microsiemens/cm)

- Less than 1500
- 1500 - 3000
- More than 3000

Aquifer

- Alluvium
- Laterite
- Basalt
- Sandstone
- Limestone
- Granite
- Schist
- Charnockite
- Banded Gneissic Complex

LEGEND

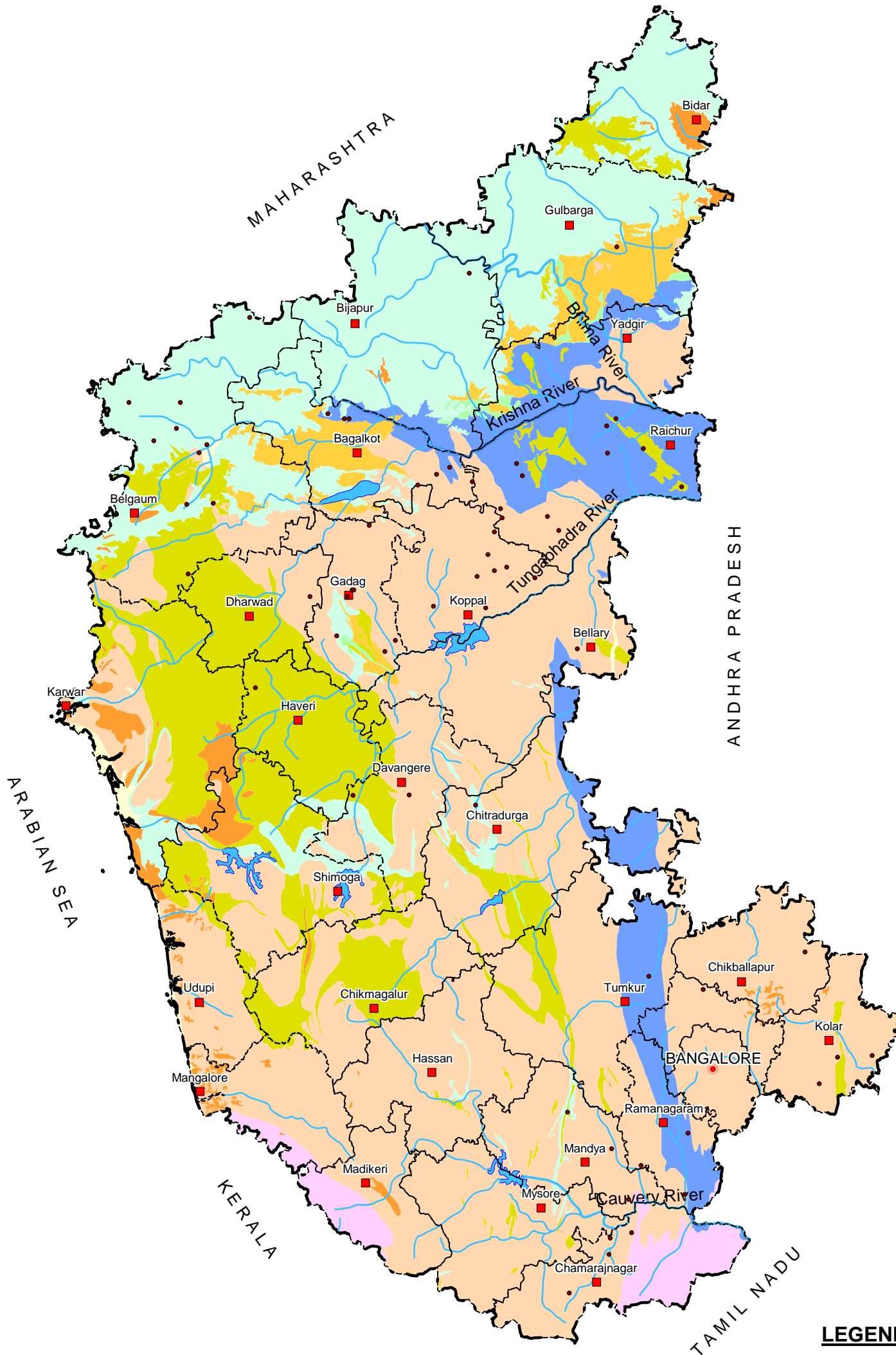
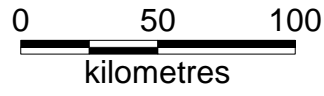
- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

Table 18: Districts showing Fluoride in Groundwater (>1.5mg/litre)

Sl. No.	Name of Districts (in parts) with F > 1.5mg/litre in shallow aquifer
1	Bagalkot
2	Bangalore Rural
3	Belgaum
4	Bellary
5	Chamarajnagar
6	Davangere
7	Dharwad
8	Gadag
9	Gulbarga
10	Haveri
11	Kolar
12	Koppal
13	Mandya
14	Raichur
15	Tumkur



FLUORIDE



Fluoride Concentration

- Fluoride > 1.5 mg/l

Aquifer

- | | |
|-----------|-------------------------|
| Alluvium | Granite |
| Laterite | Schist |
| Basalt | Charnockite |
| Sandstone | Banded Gneissic Complex |
| Limestone | |

LEGEND

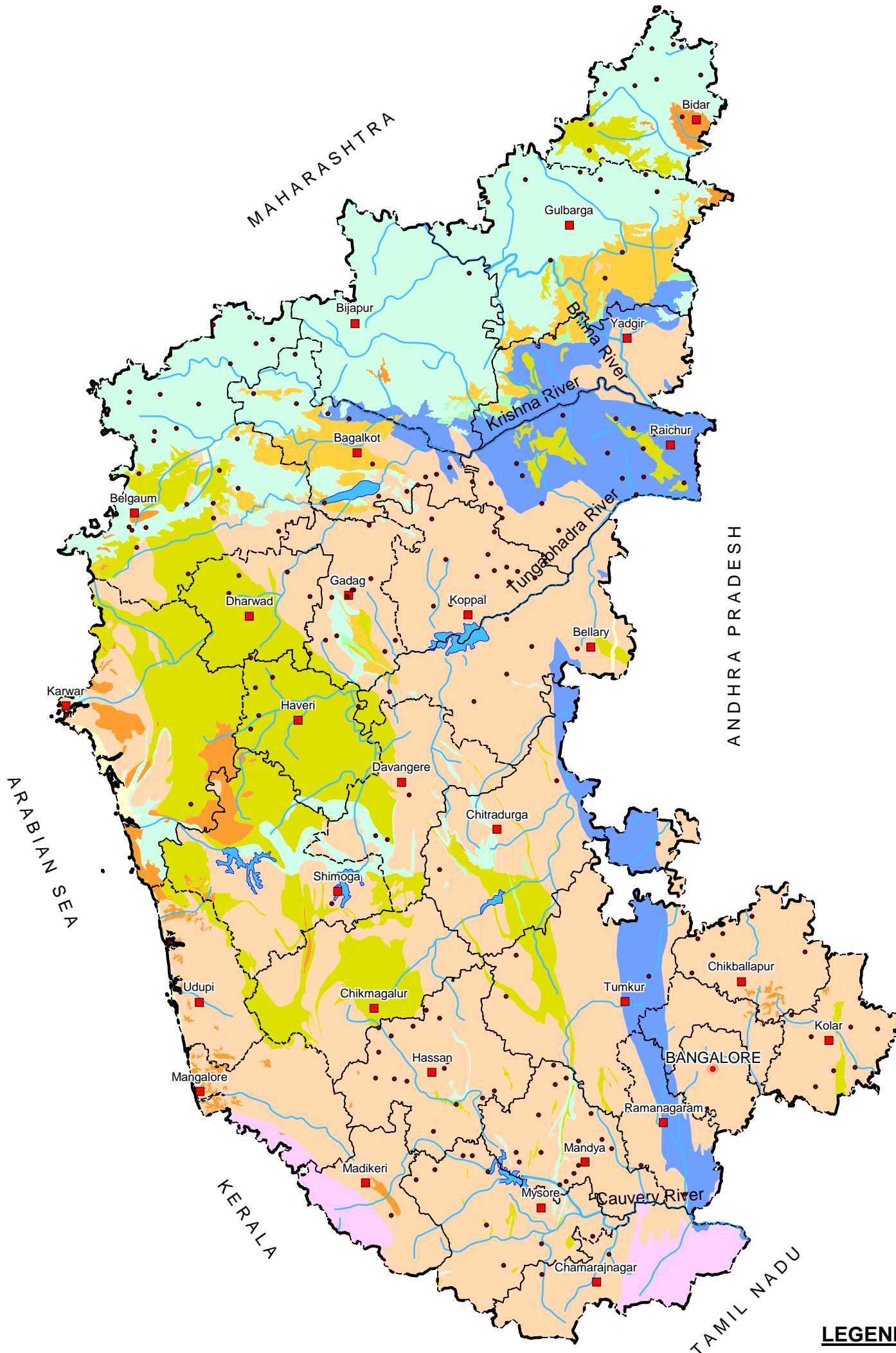
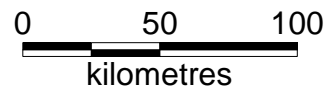
- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

Table 19: Districts showing Nitrate in Groundwater (>45mg/litre)

S. No.	Name of Districts (in parts) with NO ₃ > 45mg/litre in Shallow aquifer
1	Bagalkot
2	Bangalore Rural
3	Belgaum
4	Bellary
5	Bidar
6	Chamarajnagar
7	Chikballapur
8	Chitradurga
9	Davangere
10	Dharwad
11	Gadag
12	Gulbarga
13	Hassan
14	Haveri
15	Kodagu
16	Kolar
17	Koppal
18	Mandya
19	Mysore
20	Raichur
21	Shimoga
22	Tumkur
23	Udupi
24	Uttara Kannada



NITRATE



Nitrate Contamination

- Nitrate > 45 mg/l

Aquifer

- | | |
|-----------|-------------------------|
| Alluvium | Granite |
| Laterite | Schist |
| Basalt | Charnockite |
| Sandstone | Banded Gneissic Complex |
| Limestone | |

LEGEND

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

Table 20a: District wise Distribution and Characteristics of Alluvium Aquifer System

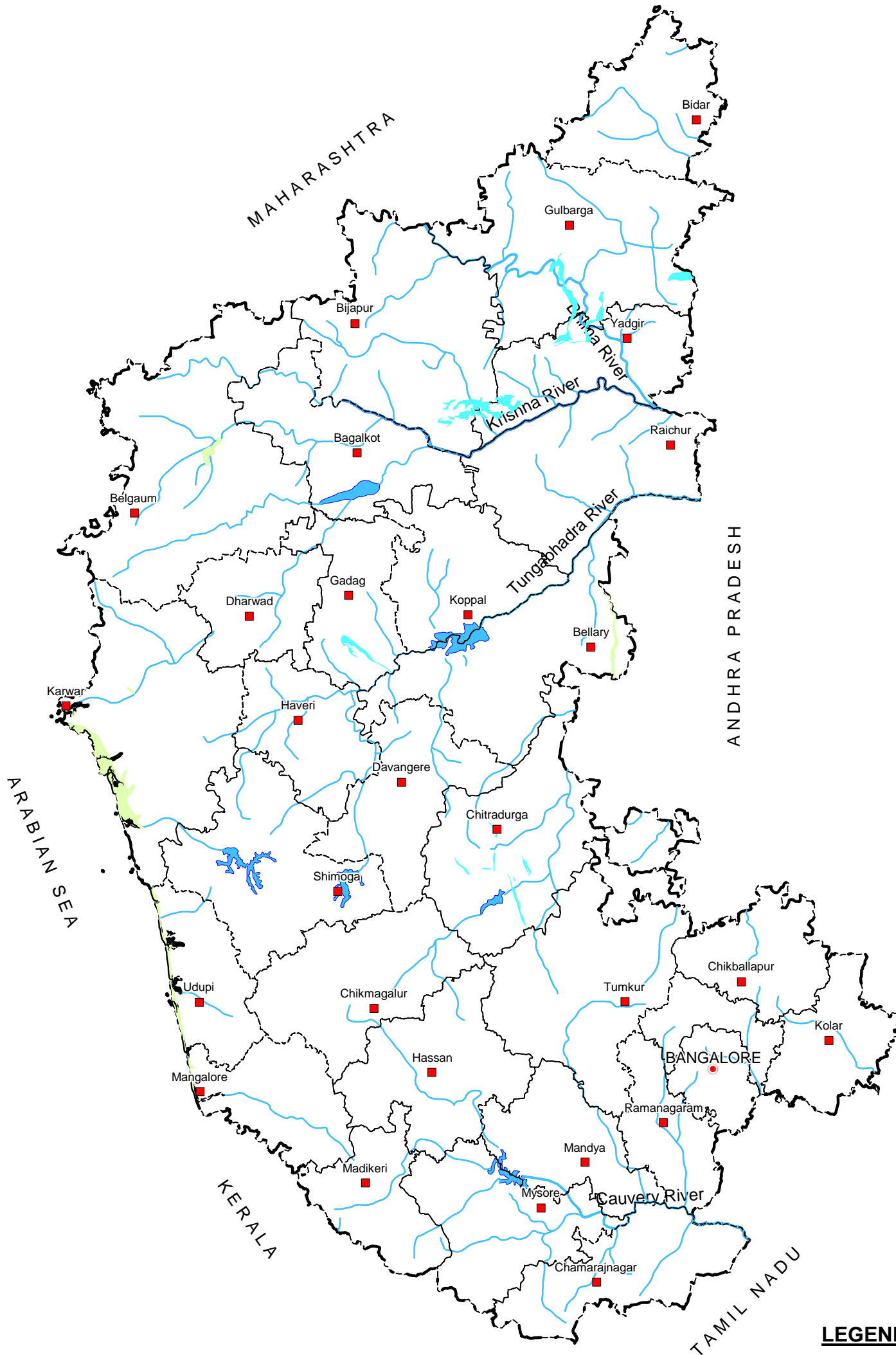
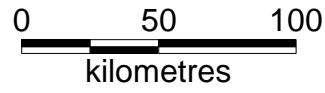
District Name	Major Aquifers (Area in Sq.km.)	Aquifer Properties							
	Younger Alluvium	Aquifer System	Type of Aquifer	Aquifer Thickness	DTWL (Dec.Avg)	Transmissivity	Yield	Specific Yield	Quality (EC in $\mu\text{S}/\text{cm}$)
	AL01			m	m bgl	m^2/day	m^3/day	%	
Belgaum	65	Single	Unconfined	10-20		1-200	10-80	1-2	500-1000
Bellary	83	Single	Unconfined	10-20		1-200	20-80	1-2	500-1000
Dakshina Kannada	27	Single	Unconfined	10-40		1-220	80-160	1-2	500-750
Udupi	122	Single	Unconfined	5-30	4.05-11.91	1-120	100-200	1-2	250-500
Uttara Kannada	414	Single	Unconfined	10-30	4.25-8.37	1-228	10-50	1-2	250-500
Total	711	Single	Unconfined	5-40	4.05-11.91	1-228	100-200	1-2	250-1000

Table 20b: District wise Distribution and Characteristics of Sandstone Aquifer Systems

District Name	Major Aquifers (Area in Sq.km.)	Aquifer Properties								
	Sandstone/ Conglomerate	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	DTWL (Dec.Avg)	Fractures encountered	Transmissivity	Yield	S	Quality (EC in $\mu\text{S}/\text{cm}$)
	ST05			m	mbgl	m bgl	m^2/day	m^3/day		
Bijapur	133	single	semi confined-confined	24-38	6.00-6.00	16-95	2.6-260	43-600	$1 \times 10^{-3} - 10^{-5}$	1280-1150
Gadag	74	single	semi confined-confined	20-80	4.8-14.32	20-100	1-60	40-80	$1 \times 10^{-3} - 10^{-5}$	1000-2000
Gulbarga	224	single	semi confined-confined	13-80	4.3-14.32	28-87	1-114	40-200	$1 \times 10^{-3} - 10^{-5}$	500-1000
Yadgiri	192	single	semi confined-confined	50-100	2.11-2.11	10-60	10-40	40-120	$1 \times 10^{-3} - 10^{-5}$	1000-3000
Total	626	single	semi confined-confined	13-100	2.11-14.32	10-100	1-114	40-600	$1 \times 10^{-3} - 10^{-5}$	500-3000



ALLUVIUM AND SANDSTONE AQUIFER SYSTEMS



LEGEND

- | | |
|--|-----------------------|
| | State Capital |
| | District Headquarters |
| | State Boundary |
| | District Boundary |
| | Drainage |
| | Surface waterbody |

Aquifer

- Younger Alluvium (AL01)
- Sandstone / Conglomerate (ST05)

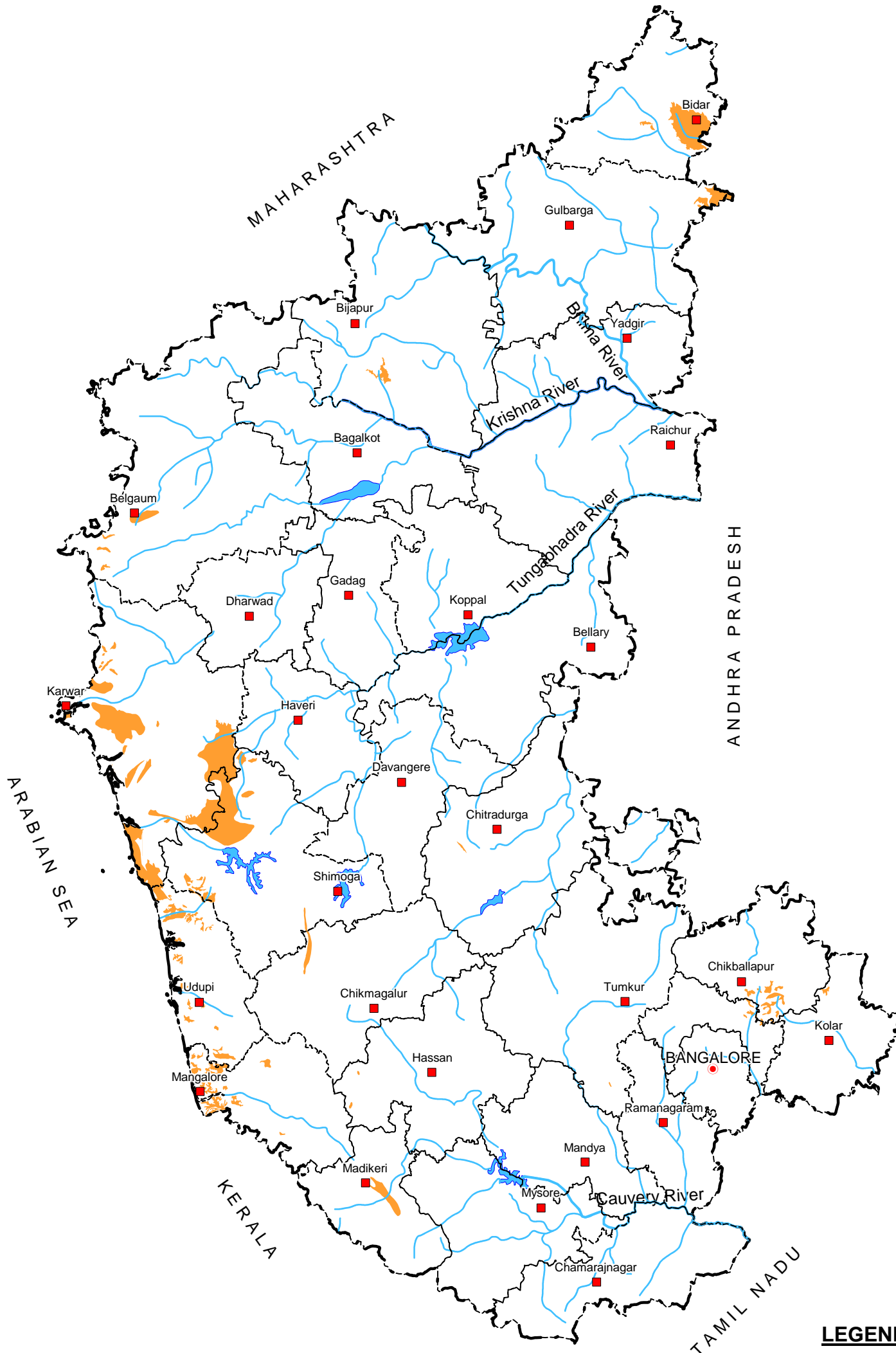
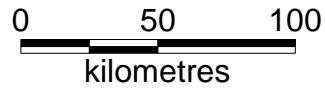
Table 21 : District wise Distribution and Characteristics of Laterite Aquifer Systems

District Name	Major Aquifers (Area in Sq.km.)	Aquifer Properties								
	Laterite	Aquifer System	Type of Aquifer	Aquifer Thickness	DTWL (Dec.Avg)	Zones encountered	Transmissivity	Yield	Specific Yield	Quality (EC in $\mu\text{S/cm}$)
	LT01			m	mbgl	mbgl	m^2/day	m^3/day	%	
Bagalokot										
Bangalore Rural	23	single	unconfined	10-40		20-35	10-18	30-40	1-2	500-1000
Bangalore Urban										
Belgaum	99	single	unconfined	8-18	6.34-6.34	10-15	10-60	20-80	1-2	500-1000
Bellary										
Bidar	403	single	unconfined	8-20	12.78-14.57	10-18	5-80	20-100	1-2	500-750
Bijapur	50	single	unconfined	10-20		10-18	5-70	10-80	1-2	
Chamarajnagar										
Chikballapur	104	single	unconfined	5-28		10-25	20-70	20-70	1-2	750-1000
Chikmagalur		single	unconfined	5-18	9.66-9.66	10-15	10-40	20-40	1-2	750-1000
Chitradurga	6	single	unconfined	5-25		10-20	10-60	10-45	1-2	500-1000
Dakshina Kannada	232	single	unconfined	5-20	7.02-7.02	5-15	10-110	20-100	1-2	500-750
Davangere										
Dharwad										
Gadag										
Gulbarga	125	single	unconfined	10-20		10-18	1-45	10-45	1-2	250-500
Hassan	7	single	unconfined			NA				
Haveri	1	single	unconfined			NA				
Kodagu	102	single	unconfined	8-20		10-20	10-70	10-70	1-2	500-750
Kolar	11					NA				
Koppal										
Mandya										
Mysore										
Raichur										
Ramanagaram										
Shimoga	685	single	unconfined	10-20	7.48-9.46	10-18	10-90	10-85	1-2	500-750
Tumkur	2	single	unconfined	5-18		8-15	1-45	20-40	1-2	500-1000
Udupi	270	single	unconfined	10-30	4.38-11.16	10-20	10-120	20-150	1-2	250-500
Uttara Kannada	1527	single	unconfined	10-35	2.90-17.18	10-25	10-25	20-180	1-2	250-500
Yadgiri										
Total	3674	single	unconfined	5-40	2.90-17.18	5-35	1-110	10-180	1-2	250-1000

NA – Data unavailable



LATERITE AQUIFER SYSTEMS



LEGEND

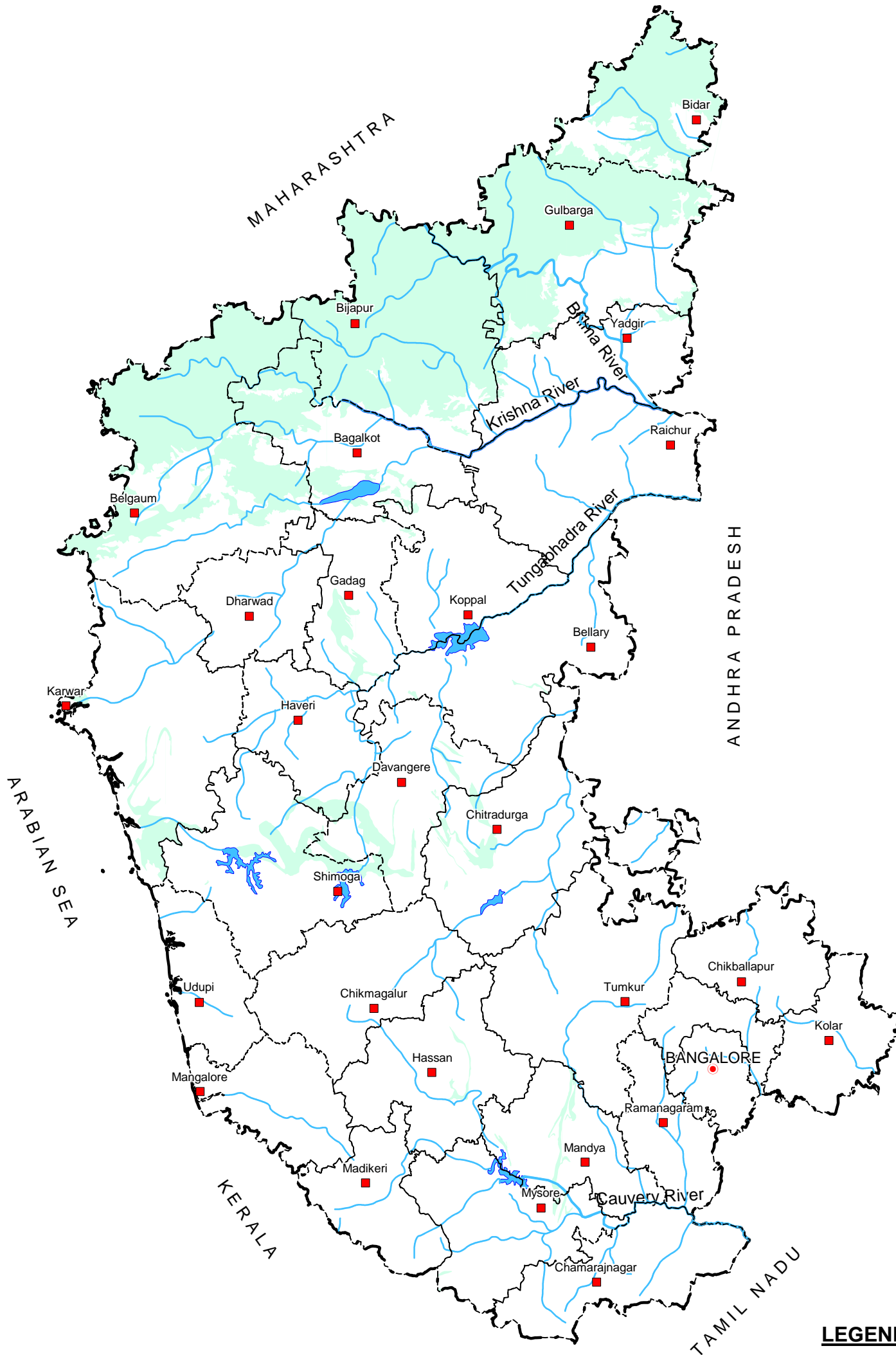
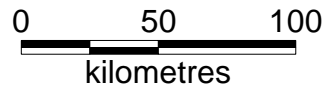
- State Capital
 - District Headquarters
 - State Boundary
 - - - District Boundary
 - Drainage
 - Surface waterbody
- Aquifer**
- Laterite (LT01)

Table 22 : District wise Distribution and Characteristics of Basalt Aquifer Systems

District Name	Major Aquifers (Area in Sq.km.)	Aquifer Properties								
	Basic -Basalt	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	DTWL (Dec.Avg)	Fractures encountered	Transmissivity	Yield	S	Quality (EC in $\mu\text{S/cm}$)
	BS01			m	mbgl	m bgl	m^2/day	m^3/day		
Bagalokot	2466	Single	Semi-confined / Confined	10-20	2.55-8.99	20.120	1-90	40-120	$1 \times 10^{-3 \text{ to } -5}$	500-3000
Bangalore Rural										
Bangalore Urban										
Belgaum	7889	Single	Semi-confined / Confined	10-45	1.79-18.88	40-80	1-80	40-80	$1 \times 10^{-3 \text{ to } -5}$	500-750
Bellary	43	Single	Semi-confined / Confined	10-20		40.90	1-40	10-60	$1 \times 10^{-3 \text{ to } -5}$	1000-2000
Bidar	4026	Single	Semi-confined / Confined	10-30	2.28-14.04	20.-80	1-95	10-95	$1 \times 10^{-3 \text{ to } -5}$	500-1000
Bijapur	9395	Single	Semi-confined / Confined		3.68-11.78	20-90	1-110	10-60	$1 \times 10^{-3 \text{ to } -6}$	500-2500
Chamarajnaragar										
Chikballapur										
Chikmagalur										
Chitradurga	409	Single	Semi-confined / Confined	20-40	4.95-4.95	20-80	1-85	10-80	$1 \times 10^{-3 \text{ to } -5}$	750-3000
Dakshina										
Davangere	745	Single	Semi-confined / Confined	20-40	8.42-15.44	20-75	1-90	20-75	$1 \times 10^{-3 \text{ to } -5}$	750-2000
Dharwad										
Gadag	433	Single	Semi-confined / Confined	20-30	7.09-7.09	15-85	1-70	20-85	$1 \times 10^{-3 \text{ to } -5}$	500-3500
Gulbarga	7465	Single	Semi-confined / Confined	10-50	4.81-4.81	25-80	2-80	10-90	$1 \times 10^{-3 \text{ to } -5}$	1000-4000
Hassan	83	Single	Semi-confined / Confined	10-40		20-65	2-90	20-80		500-1000
Haveri	210	Single	Semi-confined / Confined	20-30		20-80	1-85	10-50		500-1500
Kodagu										
Kolar										
Koppal	43	Single	Semi-confined / Confined	20-30	2.24-4.86		2-40	20-40	$1 \times 10^{-3 \text{ to } -5}$	1000-2000
Mandya	258	Single	Semi-confined / Confined	20-40	3.28-6.87		2-35	20-60	$1 \times 10^{-3 \text{ to } -5}$	500-1500
Mysore	48	Single	Semi-confined / Confined	20-40	8.86-10.21		2-80	20-50	$1 \times 10^{-3 \text{ to } -5}$	500-1500
Raichur										
Ramanagaram										
Shimoga	902	Single	Semi-confined / Confined	20-30	4.02-7.46		4-85	20-80	$1 \times 10^{-3 \text{ to } -5}$	500-1000
Tumkur	10	Single	Semi-confined / Confined	20-30						1500-2000
Udupi										
Uttara Kannada	311	Single	Semi-confined / Confined	10-30	7.31-9.17	10-45	1-80	10-55	$1 \times 10^{-3 \text{ to } -5}$	500-750
Yadgiri	196	Single	Semi-confined / Confined	20-30	7.87-12.45	20-50	2-60	10-65	$1 \times 10^{-3 \text{ to } -5}$	1000-1500
Total	34932	Single	Semi-confined / Confined	10-40	1.79-18.88	10-120	1-95	10-120	$1 \times 10^{-3 \text{ to } -5}$	500-4000



BASALT AQUIFER SYSTEMS



LEGEND

- Aquifer**
- Basalt (BS01)
- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

Table 23a : District wise Distribution and Characteristics of Limestone Aquifer System

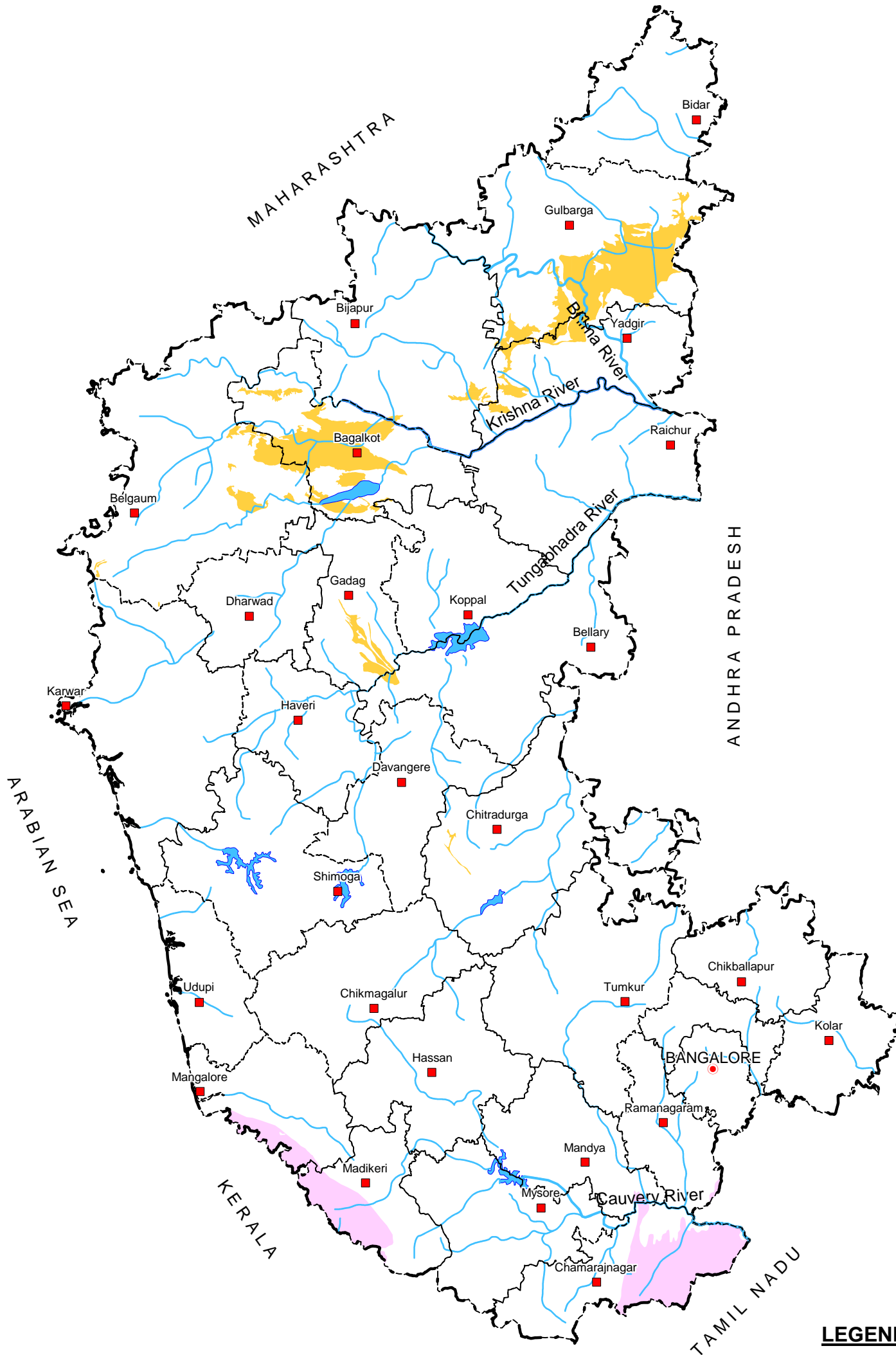
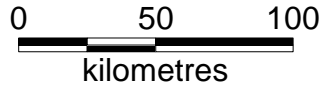
District Name	Major Aquifers (Area in Sq.km.)	Aquifer Properties								
	Limestone/ Dolomite	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	DTWL (Dec.Avg)	Fractures encountered	Transmissivity	Yield	S	Quality (EC in $\mu\text{S/cm}$)
	LS03			m	m bgl	m bgl	m^2/day	m^3/day		
Bagalokot	1933	single	Semi-confined / Confined	40-150		10-120	250	40-180	$1 \times 10^{-3}-10^{-5}$	500-2000
Belgaum	538	single	Semi-confined / Confined	20-150		20-100	1-90	30-100	$1 \times 10^{-3}-10^{-5}$	500-1000
Bellary	48	single	Semi-confined / Confined	20-120		30-80	1-60	20-80	$1 \times 10^{-3}-10^{-5}$	1000-2000
Bijapur	135	single	Semi-confined / Confined	60-80		10- 60	1-20	40-65	$1 \times 10^{-3}-10^{-5}$	1000-2000
Chitradurga	28	single	Semi-confined / Confined	20-150	2.17-2.17	80-100	1-90	30-80	$1 \times 10^{-3}-10^{-5}$	500-1500
Gadag	270									
Gulbarga	2570	single	Semi-confined / Confined	2-18.4	4.25-13.44	5-82	0.12-330		$1 \times 10^{-3}-10^{-5}$	380-8200
Koppal	7									
Yadgiri	457	single	Semi-confined / Confined		3.68-7.76	10-30	5 to 20	30-300	$1 \times 10^{-3}-10^{-5}$	1000-2000
Total	5986	single	Semi-confined / Confined	2-150	2.17 – 13.44	5 - 120	0.12 to 330	20-300	$1 \times 10^{-3}-10^{-5}$	380-8200

Table 23b: District wise Distribution and Characteristics of Charnockite Aquifer Systems

District Name	Major Aquifers (Area in Sq.km.)	Aquifer Properties								
	Charnockite	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	DTWL (Dec.Avg)	Fractures encountered	Transmissivity	Yield	S	Quality (EC in $\mu\text{S/cm}$)
	CK01			m	mbgl	m bgl	m^2/day	m^3/day		
Chamarajnaragar	1479	Single	Semi-confined/confined	20-40	5.62-7.86	30-100	1-200	20-100	$1 \times 10^{-3}-10^{-5}$	1000-2000
Dakshina	529	Single	Semi-confined/confined	20-30	5.63-10.26	40-120	1-460	20-200	$1 \times 10^{-3}-10^{-5}$	300-1000
Kodagu	870	Single	Semi-confined/confined	10-30	2.75-16.36	30-80	1-100	20-120	$1 \times 10^{-3}-10^{-5}$	500-750
Mandya	36	Single	Semi-confined/confined							
Ramanagaram	32	Single	Semi-confined/confined							
Total	2946	Single	Semi-confined/confined	10-40	2.75-16.36	30-120	1-460	20-200	$1 \times 10^{-3}-10^{-5}$	300-2000



LIMESTONE AND CHARNOCKITE AQUIFER SYSTEMS



LEGEND









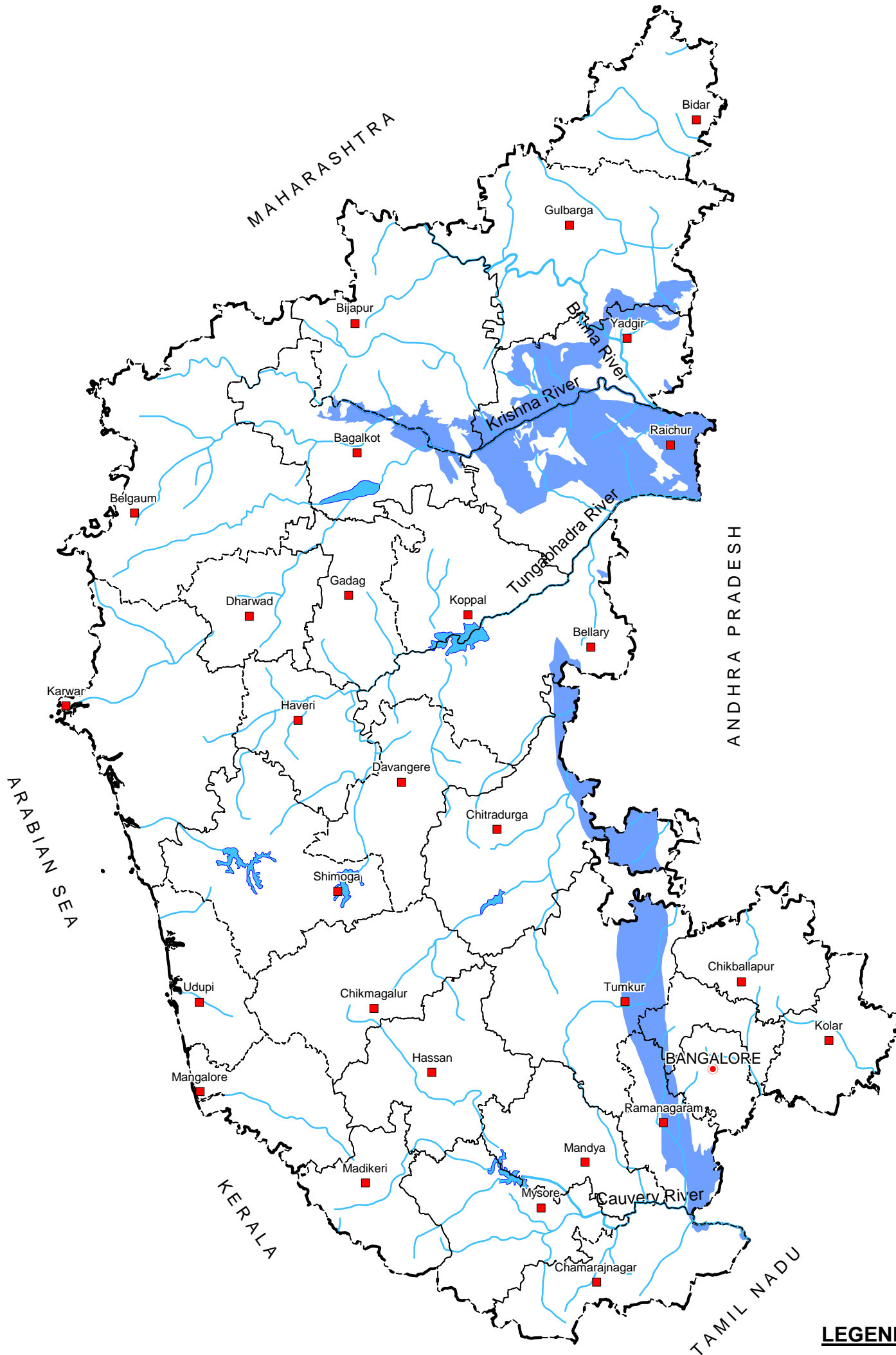
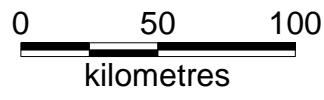
- | | | | |
|---|-----------------------------|---|-----------------------|
|  | Limestone / Dolomite (LS03) |  | State Capital |
|  | Charnockite (CK01) |  | District Headquarters |
| | |  | State Boundary |
| | |  | District Boundary |
| | |  | Drainage |
| | |  | Surface waterbody |

Table 24: District wise Distribution and Characteristics of Granite Aquifer Systems

District Name	Major Aquifers (Area in Sq.km.)	Aquifer Properties								
	Intrusive Acidic Rocks	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	DTWL (Dec.Avg)	Fractures encountered	Transmissivity	Yield	S	Quality (EC in $\mu\text{S}/\text{cm}$)
	GR02			m	mbgl	m bgl	m^2/day	m^3/day		
Bagalokot	578	single	semi confined-confined	5-30	5.5-14.8	20-80	1-160	4-140	$1 \times 10^{-3}-10^{-5}$	500-3000
Bangalore Rural	341	single	semi confined-confined	20-50	10.3-19.5	30-150	1-120	40-400	$1 \times 10^{-3}-10^{-5}$	500-2000
Bangalore Urban	67	single	semi confined-confined	12-40	10.2-20.1	10-140	1-160	40-300	$1 \times 10^{-3}-10^{-5}$	500-2500
Belgaum										
Bellary	217	single	semi confined-confined	10-30	10-20	30-80	1-100	30-150	$1 \times 10^{-3}-10^{-5}$	500-3000
Bidar										
Bijapur	665	single	semi confined-confined	60-80	2.17-11.23	10-60	1-100	20-200	$1 \times 10^{-3}-10^{-5}$	500-2000
Chamarajnagar	58	single	semi confined-confined	10-30		20-40	1-200			500-2500
Chikballapur										
Chikmagalur										
Chitradurga	751.8	single	semi confined-confined	5-20	2.52	10-90	1-90	20-340	$1 \times 10^{-3}-10^{-5}$	1500-2000
Dakshina Kannada										
Davangere										
Dharwad										
Gadag										
Gulbarga	462	single	semi confined-confined	5-20		10-80	1-350	20-400	$1 \times 10^{-3}-10^{-5}$	1500-3000
Hassan										
Haveri										
Kodagu										
Kolar										
Koppal										
Mandya										
Mysore										
Raichur	5143	single	semi confined-confined	5-15	1.18-9.54		5-200	20-200	$1 \times 10^{-3}-10^{-5}$	1500-2000
Ramanagaram	1602	single	semi confined-confined	5-20	4.20-10.54		5-500	20-400	$1 \times 10^{-3}-10^{-5}$	500-2500
Shimoga										
Tumkur	2529	single	semi confined-confined	5-40	2.24-11.40		5-250	20-4500	$1 \times 10^{-3}-10^{-5}$	500-3000
Udupi										
Uttara Kannada										
Yadgiri	2200	single	semi confined-confined	10-20	1.68-10.78		10-250	20-300	$1 \times 10^{-3}-10^{-5}$	1500-3000
Total	14609	single	semi confined-confined	5-80	1.18-20.1	10-150	1-500	4-4500	$1 \times 10^{-3}-10^{-5}$	500-3000



GRANITE AQUIFER SYSTEMS



LEGEND

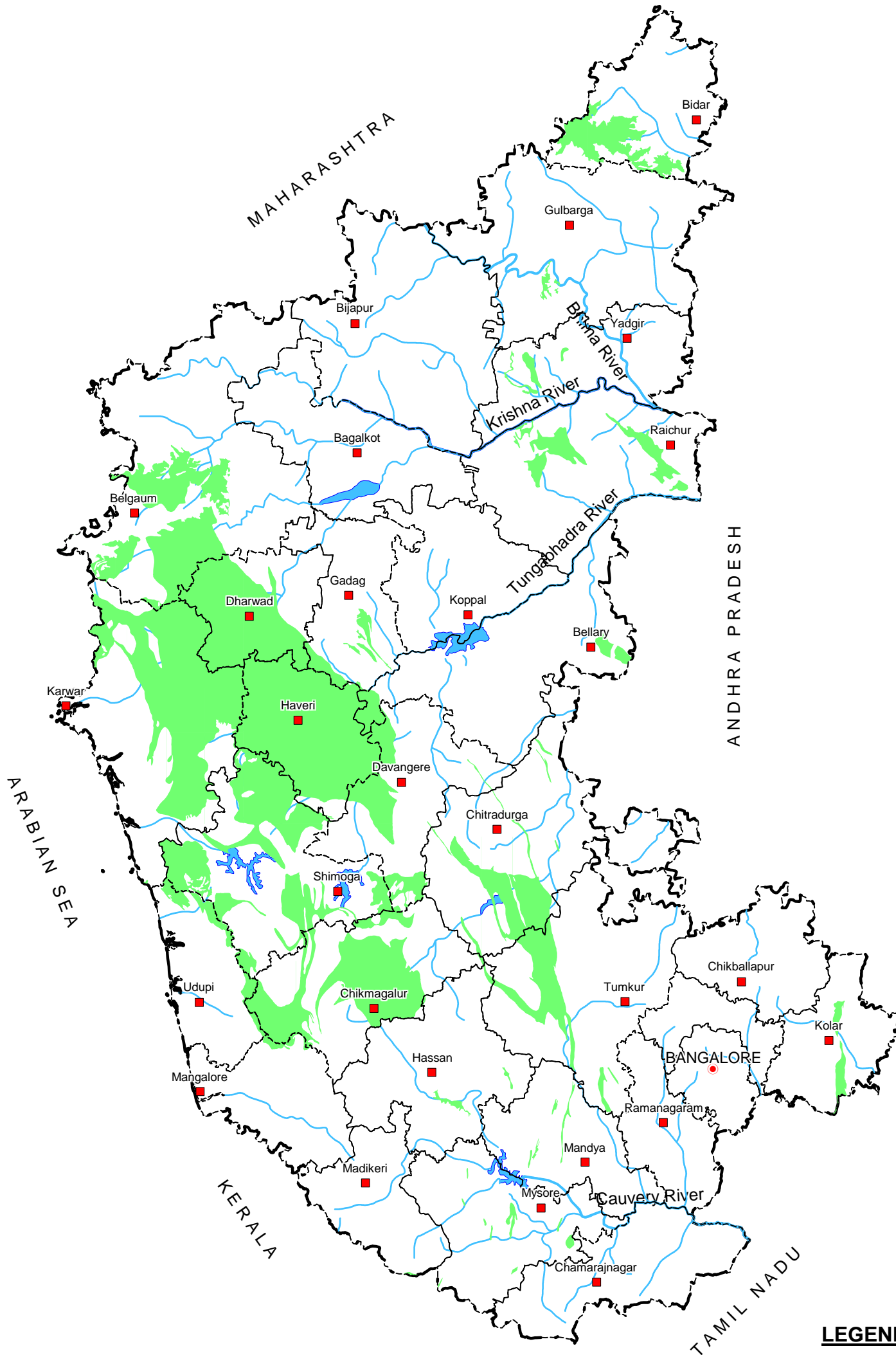
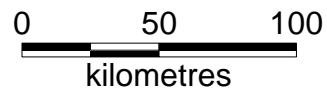
- Aquifer
- Intrusive acidic rocks (GR02)
- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

Table 25 : District wise Distribution and Characteristics of Schist Aquifer Systems

District Name	Major Aquifers (Area in Sq.km.)	Aquifer Properties								
	Phyllite	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	DTWL (Dec.Avg)	Fractures encountered	Transmissivity	Yield	S	Quality (EC in $\mu\text{S}/\text{cm}$)
	SC02			m	mbgl	m bgl	m^2/day	m^3/day		
Bagalokot										
Bangalore Rural										
Bangalore Urban										
Belgaum	2701	Single	semi confined-confined	5-25	1.64-14.43	20-120	10-20	20-110	$1 \times 10^{-3}-10^{-5}$	500-1500
Bellary	408	Single	semi confined-confined	5-40	5.91-5.91	10-140	1-340	40-450	$1 \times 10^{-3}-10^{-5}$	1000-1500
Bidar	1003	Single	semi confined-confined	10-40	10.06-14.57	20-100	1-250	20-240	$1 \times 10^{-3}-10^{-5}$	1000-1500
Bijapur										
Chamarajnagar										
Chikballapur										
Chikmagalur	2669	Single	semi confined-confined	4-20	3.12-9.42	10-80	2-100	10-400	$1 \times 10^{-3}-10^{-5}$	500-4000
Chitradurga	1251	Single	semi confined-confined	3-15	9.57-9.57	10-90	1-85	10-300	$1 \times 10^{-3}-10^{-5}$	750-2000
Dakshina	23	Single	semi confined-confined	5-15		10-100	1-140	10-150	$1 \times 10^{-3}-10^{-5}$	250-750
Davangere	1125	Single	semi confined-confined	5-20	2.88-7.08	10-80	5-100	20-400	$1 \times 10^{-3}-10^{-5}$	500-2000
Dharwad	2796	Single	semi confined-confined	5-60	6.61-22.46	10-190	1-400	20-600	$1 \times 10^{-3}-10^{-5}$	500-6000
Gadag	365	Single	semi confined-confined	5-20	21.15-21.15	15-80	1-350	10-200	$1 \times 10^{-3}-10^{-5}$	500-2500
Gulbarga	73	Single	semi confined-confined	10-30		20-100	1-250	20-40	$1 \times 10^{-3}-10^{-5}$	500-2000
Hassan	103	Single	semi confined-confined	10-20	2.46-2.46	15-180	1-360	20-600	$1 \times 10^{-3}-10^{-5}$	500-2000
Haveri	4594	Single	semi confined-confined	5-50	2.91-15.05	10-120	2-160	20-400	$1 \times 10^{-3}-10^{-5}$	500-3000
Kodagu	8	Single	semi confined-confined							
Kolar	208	Single	semi confined-confined	5-60	12.0-16.8	25-160	1-300	20-400	$1 \times 10^{-3}-10^{-5}$	500-1500
Koppal										
Mandya	78	Single	semi confined-confined	5-20	4.88-4.88	10-180	2-290	20-200	$1 \times 10^{-3}-10^{-5}$	500-2000
Mysore	120	Single	semi confined-confined	5-20	5.62-8.89	50-150	1-250	20-250	$1 \times 10^{-3}-10^{-5}$	500-2000
Raichur	787	Single	semi confined-confined	7-25	2.79-2.79	25-90	1-300	20-180	$1 \times 10^{-3}-10^{-5}$	1500-2000
Ramanagaram										
Shimoga	3028	Single	semi confined-confined	5-35	5.58-7.92	20-130	1-200	40-500	$1 \times 10^{-3}-10^{-5}$	750-1000
Tumkur	1095	Single	semi confined-confined	5-40	12.21-18.93	25-100	2-340	20-500	$1 \times 10^{-3}-10^{-5}$	500-3000
Udupi	88	Single	semi confined-confined	5-40	5.58-7.26	20-80	1-450	10-250	$1 \times 10^{-3}-10^{-5}$	500-1000
Uttara Kannada	3882	Single	semi confined-confined	5-30	4.4-8.29	15-100	2-90	10-450	$1 \times 10^{-3}-10^{-5}$	500-1000
Yadgiri	144	Single	semi confined-confined	5-25	7.78-10.83	10-90	5-70	10-350	$1 \times 10^{-3}-10^{-5}$	2000-5000
Total	26551	Single	semi confined-confined	3-40	1.64-22.46	10-180	1-400	10-350	$1 \times 10^{-3}-10^{-5}$	500-6000



SCHIST AQUIFER SYSTEMS



LEGEND

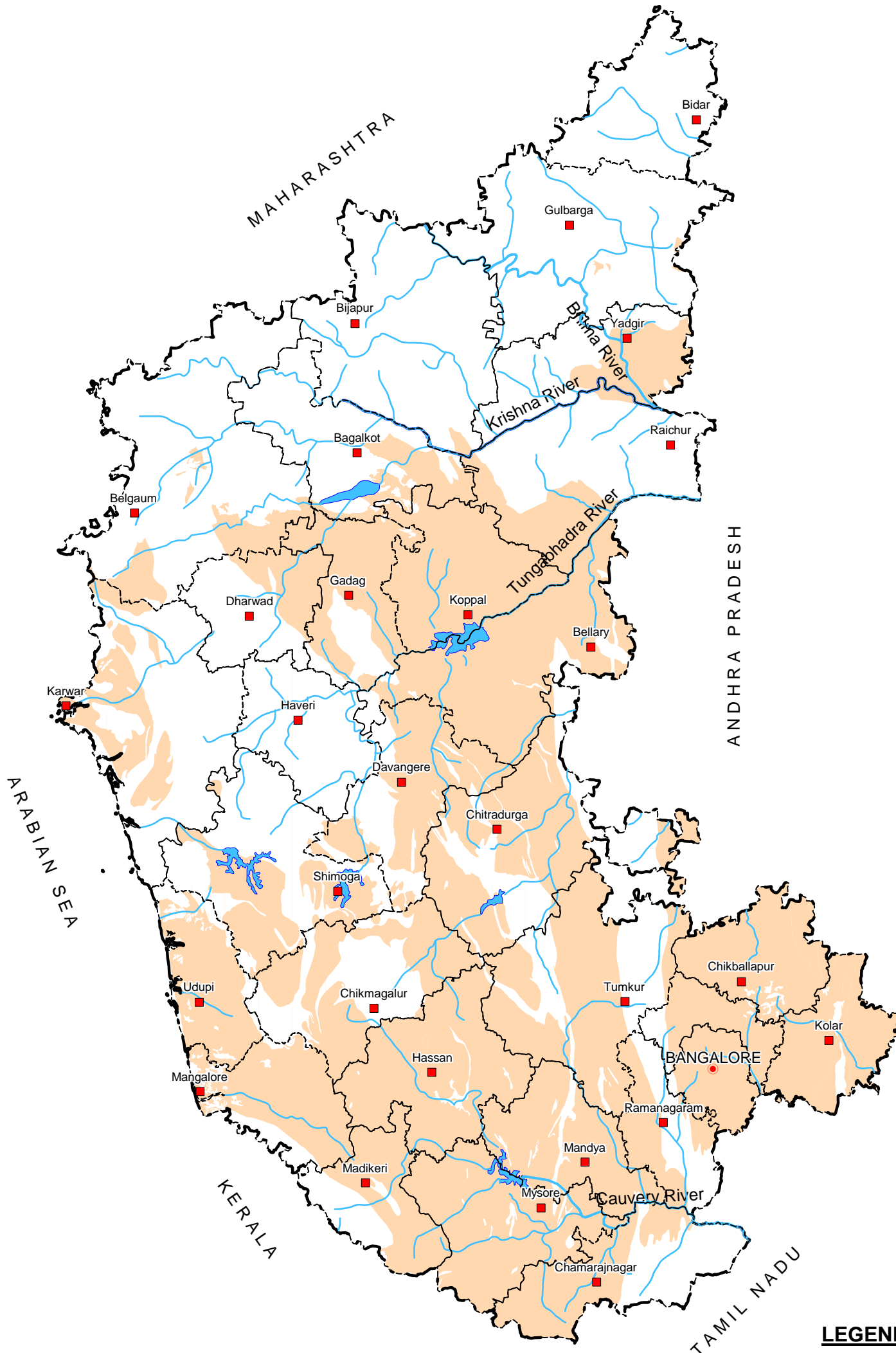
- State Capital
 - District Headquarters
 - State Boundary
 - - - District Boundary
 - Drainage
 - Surface waterbody
- Aquifer**
- Phyllite (SC02)

Table 26: District wise Distribution and Characteristics of Banded Gneissic Complex Aquifer Systems

District Name	Major Aquifers (Area in Sq.km.)	Aquifer Properties								
	Banded Gneissic complex	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	DTWL (Dec.Avg)	Fractures encountered	Transmissivity	Yield	S	Quality (EC in $\mu\text{S/cm}$)
	BG01			m	mbgl	m bgl	m^2/day	m^3/day		
Bagalokot	1584	Single	Semi-confined/confined	5-35	4.72-8.82	16-120	1-660	10-330	$1 \times 10^{-3}-10^{-5}$	250-6000
Bangalore Rural	1941	Single	Semi-confined/confined	3-80	3.52-11.36	10-260	1-160	10-450	$1 \times 10^{-3}-10^{-6}$	250-2500
Bangalore Urban	2114	Single	Semi-confined/confined	12-40	2.46-5.98	13-210	1-165	10-350	$1 \times 10^{-3}-10^{-7}$	500-3000
Belgaum	1636	Single	Semi-confined/confined	5-60	2.03-18.82	20-180	1-400	5-320	$1 \times 10^{-3}-10^{-8}$	250-1500
Bellary	7637	Single	Semi-confined/confined	2-40	3.53-10.21	6-180	1-340	10-450	$1 \times 10^{-3}-10^{-9}$	1500-3000
Bidar										
Bijapur	118	Single	Semi-confined/confined	5-80		20-160	1-200	10-200	$1 \times 10^{-3}-10^{-11}$	500-1000
Chamarajnaragar	2851	Single	Semi-confined/confined	6-20	0.68-7.20	20-80	3-122	10-250	$1 \times 10^{-3}-10^{-12}$	500-2000
Chikballapur	4127	Single	Semi-confined/confined	5-35	2.47-10.34	30-300	2-72	10-300	$1 \times 10^{-3}-10^{-13}$	500-3000
Chikmagalur	3485	Single	Semi-confined/confined	3-20	2.36-12.25	9-80	2-110	10-450	$1 \times 10^{-3}-10^{-14}$	500-4300
Chitradurga	5915	Single	Semi-confined/confined	2-20	2.41-11.20	10-90	1-85	10-350	$1 \times 10^{-3}-10^{-15}$	250-2000
Dakshina	2523	Single	Semi-confined/confined	5-40	3.85-12.78	10-100	1-220	10-200	$1 \times 10^{-3}-10^{-16}$	500-750
Davangere	4070	Single	Semi-confined/confined	5-40	2.89-8.37	10-120	5-100	10-400	$1 \times 10^{-3}-10^{-17}$	500-2000
Dharwad	1475	Single	Semi-confined/confined	5-65	4.92-15.21	20-180	1-480	10-600	$1 \times 10^{-3}-10^{-18}$	500-3000
Gadag	3497	Single	Semi-confined/confined	5-35	2.49-11.67	15-90	6-118	10-120	$1 \times 10^{-3}-10^{-19}$	750-7000
Gulbarga	71	Single	Semi-confined/confined	2-20		5-80	1-330	10-400	$1 \times 10^{-3}-10^{-20}$	300-8000
Hassan	6385	Single	Semi-confined/confined	9		16-180	1-350	10-600	$1 \times 10^{-3}-10^{-21}$	250-2000
Haveri										
Kodagu	2439	Single	Semi-confined/confined	5-40	1.20-13.68	10-95	1-260	10-350	$1 \times 10^{-3}-10^{-23}$	250-750
Kolar	3748	Single	Semi-confined/confined	11-90	1.44-5.67	11-309	2-420	10-550	$1 \times 10^{-3}-10^{-24}$	500-1500
Koppal	5513	Single	Semi-confined/confined	10-35	3.01-10.95	10-120	2-220	10-200	$1 \times 10^{-3}-10^{-25}$	500-2000
Mandya	4563	Single	Semi-confined/confined	6-20	1.65-9.66	10-180-	2-300	10-250	$1 \times 10^{-3}-10^{-26}$	500-2000
Mysore	6120	Single	Semi-confined/confined	4-25	1.17-11.04	10-90	1-810	10-320	$1 \times 10^{-3}-10^{-27}$	500-3500
Raichur	2510	Single	Semi-confined/confined	5-35	3.62-8.18	10-110	1-400	10-400	$1 \times 10^{-3}-10^{-28}$	500-1000
Ramanagaram	1876	Single	Semi-confined/confined	2-25	2.66-9.61	10-145	1-530	10-450	$1 \times 10^{-3}-10^{-29}$	500-1000
Shimoga	3401	Single	Semi-confined/confined	6-50	2.18-12.63	20-130	1-200	10-500	$1 \times 10^{-3}-10^{-30}$	500-1500
Tumkur	6972	Single	Semi-confined/confined	2-40	4.22-11.15	9-100	5-240	10-500	$1 \times 10^{-3}-10^{-31}$	500-3500
Udupi	2265	Single	Semi-confined/confined	5-20	2.36-12.66	5-80	5-230	10-400	$1 \times 10^{-3}-10^{-32}$	250-500
Uttara Kannada	1186	Single	Semi-confined/confined	7-30	1.76-9.68	15-100	5-80	10-450	$1 \times 10^{-3}-10^{-33}$	250-500
Yadgiri	2055	Single	Semi-confined/confined	5-60.	4.97-8.68	9-140	5-220	10-350	$1 \times 10^{-3}-10^{-34}$	1500-6000
Total	92077	Single	Semi-confined/confined	2-90	0.68 – 18.82	5 - 309	1 - 810	5 - 550	$1 \times 10^{-3}-10^{-34}$	250 - 8000



BANDED GNEISSIC COMPLEX AQUIFER SYSTEMS



LEGEND









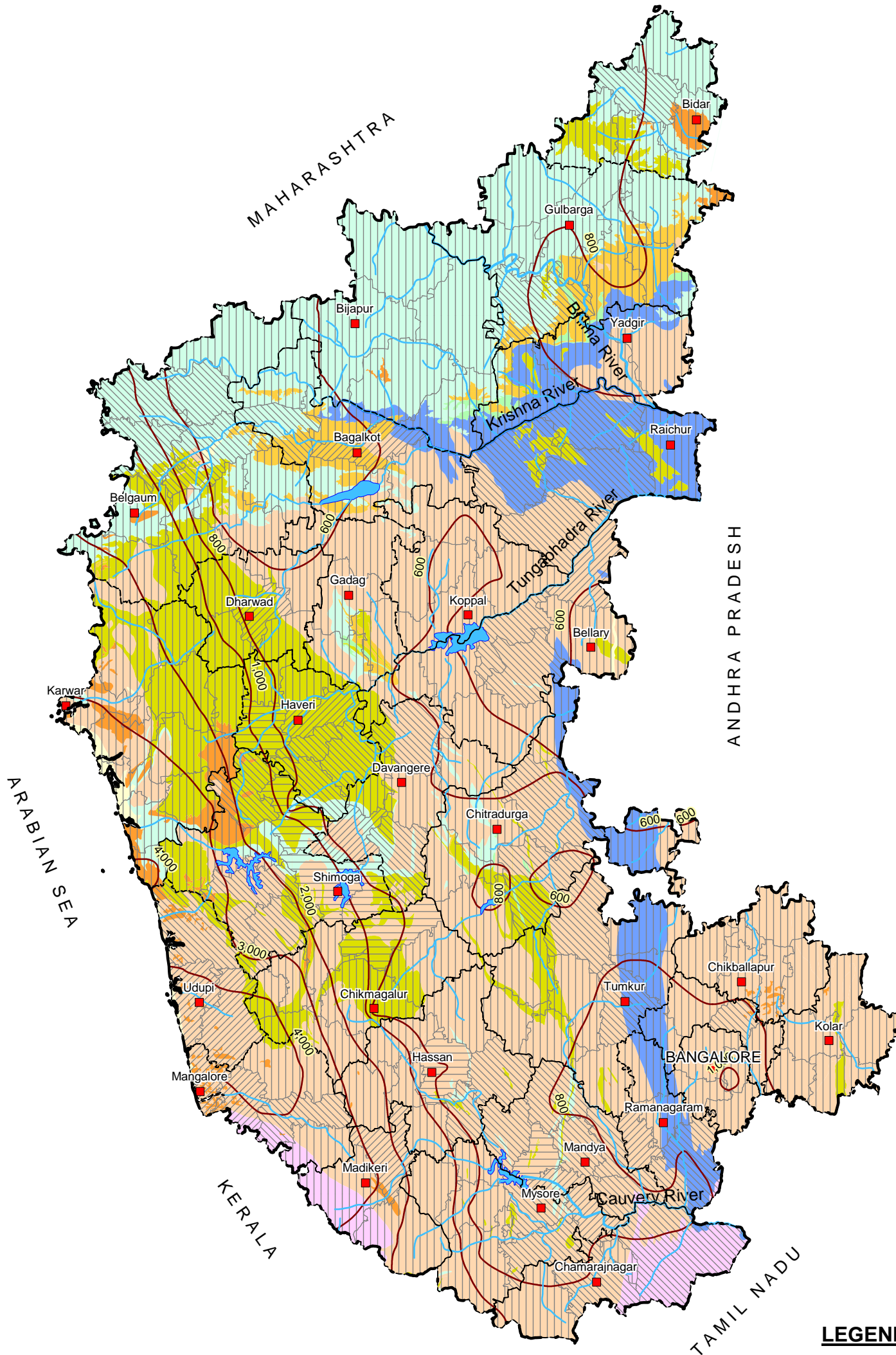
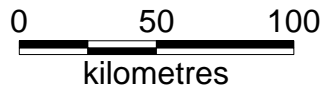
-  Aquifer
-  Banded Gneissic Complex (BG01)
-  State Capital
-  District Headquarters
-  State Boundary
-  District Boundary
-  Drainage
-  Surface waterbody

Table 27: District and Aquifer wise Annual Replenishable Recharge (m/yr)

S.N.	District Name	Alluvium		Laterite		Basalt		Sandstone		Limestone		Granite		Schist		Charnockite		BGC	
		Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max
1	Bagalkot					0.057	0.131			0.063	0.075	0.063	0.075					0.057	0.075
2	Bangalore Rural			0.095	0.106							0.075	0.078					0.075	0.106
3	Bangalore Urban											0.081	0.081					0.081	0.097
4	Belgaum	0.12	0.12	0.078	0.096	0.069	0.16			0.069	0.12			0.069	0.16			0.069	0.12
5	Bellary	0.1	0.191			0.06	0.0638			0.06	0.06	0.56	0.191	0.06	0.1			0.03	0.191
6	Bidar			0.068	0.097	0.05	0.97							0.05	0.097				
7	Bijapur			0.042	0.042	0.042	0.077	0.052	0.052	0.042	0.05	0.042	0.052					0.052	0.052
8	Chamarajnagar													0.114	0.114	0.105	0.115	0.72	0.114
9	Chikballapur			0.077	0.096	0.05	0.05											0.076	0.096
10	Chikmagalur			0.104	0.116									0.067	0.168			0.067	1.68
11	Chitradurga			0.06	0.099	0.053	0.099	0.06	0.099	0.06	0.099	0.052	0.053	0.052	0.059			0.052	0.99
12	Dakshina Kannada	0.175	0.175	0.141	0.183									0.141	0.141	0.1256	0.183	0.126	0.183
13	Davangere					0.054	0.174							0.054	0.174			0.054	0.174
14	Dharwad													0.054	0.114			0.054	0.079
15	Gadag					0.045	0.085	0.045	0.07	0.045	0.07			0.045	0.7			0.045	0.121
16	Gulbarga			0.056	0.056	0.032	0.156	0.032	0.156	0.036	0.156	0.032	0.1565	0.051	0.156			0.032	0.56
17	Hassan			0.093	0.093	0.09	0.282							0.09	0.282			0.09	0.282
18	Haveri			0.25	0.25	0.107	0.125							0.085	0.25				
19	Kodagu			0.069	0.079	0.079	0.079									0.069	0.079	0.069	0.079
20	Kolar			0.069	0.069							0.098	0.098	0.069	0.109			0.069	0.109
21	Koppal					0.05	0.05			0.05	0.05							0.05	0.306
22	Mandya					0.14	0.451							0.15	0.451	0.201	0.201	0.14	0.451
23	Mysore													0.062	0.13			0.062	0.245
24	Raichur											0.054	0.247	0.054	0.247	0.054	0.054	0.054	0.247
25	Ramanagaram					0.064	0.064					0.064	0.083			0.064	0.064	0.064	0.083
26	Shimoga			0.104	0.349	0.104	0.349											0.104	0.349
27	Tumkur			0.097	0.097	0.075	0.09	0.088	0.088			0.07	0.121	0.075	0.097			0.07	0.121
28	Udupi	0.138	0.208	0.138	0.208	0.138	0.138							0.138	0.199			0.138	0.208
29	Uttara Kannada	0.069	0.125	0.069	0.125	0.069	0.125					0.069	0.069	0.072	0.125			0.069	0.118
30	Yadgir					0.054	0.107	0.054	0.107	0.054	0.107	0.054	0.107	0.054	0.107			0.054	0.107



ISOHYETS AND ANNUAL REPLENISHABLE RECHARGE



3000mm Rainfall

Annual Replenishable recharge (m/year)

- 0.25 - 0.50
- 0.15 - 0.25
- 0.10 - 0.15
- 0.025 - 0.10

Aquifer

- Alluvium
- Laterite
- Basalt
- Sandstone
- Limestone
- Granite
- Schist
- Charnockite
- Banded Gneissic Complex

LEGEND

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

Table 28a: District and aquifer wise Area under Over Exploited (OE) Taluks

S.N.	District Name	Alluvium	Laterite	Basalt	Sandstone	Limestone	Granite	Schist	Charnockite	BGC
1	Bagalkot			554.8		1051.3	145.98			572.2
2	Bangalore Rural		22.9				654.02			2264.74
3	Bangalore Urban						67.15			2123.9
4	Belgaum			3388.44		396.02		1119.03		1000.91
5	Bellary			19.85				264.08		1639.05
6	Chitradurga		6.06	410.63		27.79		241.36		1774.43
7	Dakshina			87.99						
8	Davangere							12.33		877.95
9	Kolar		115.19					209.02		7911.07
10	Koppal									1514.05
11	Tumkur						1220.94	496.02		1175.49
Total			144.15	4461.71		1523.71	2088.09	2341.84		20853.79

Area in sq.km

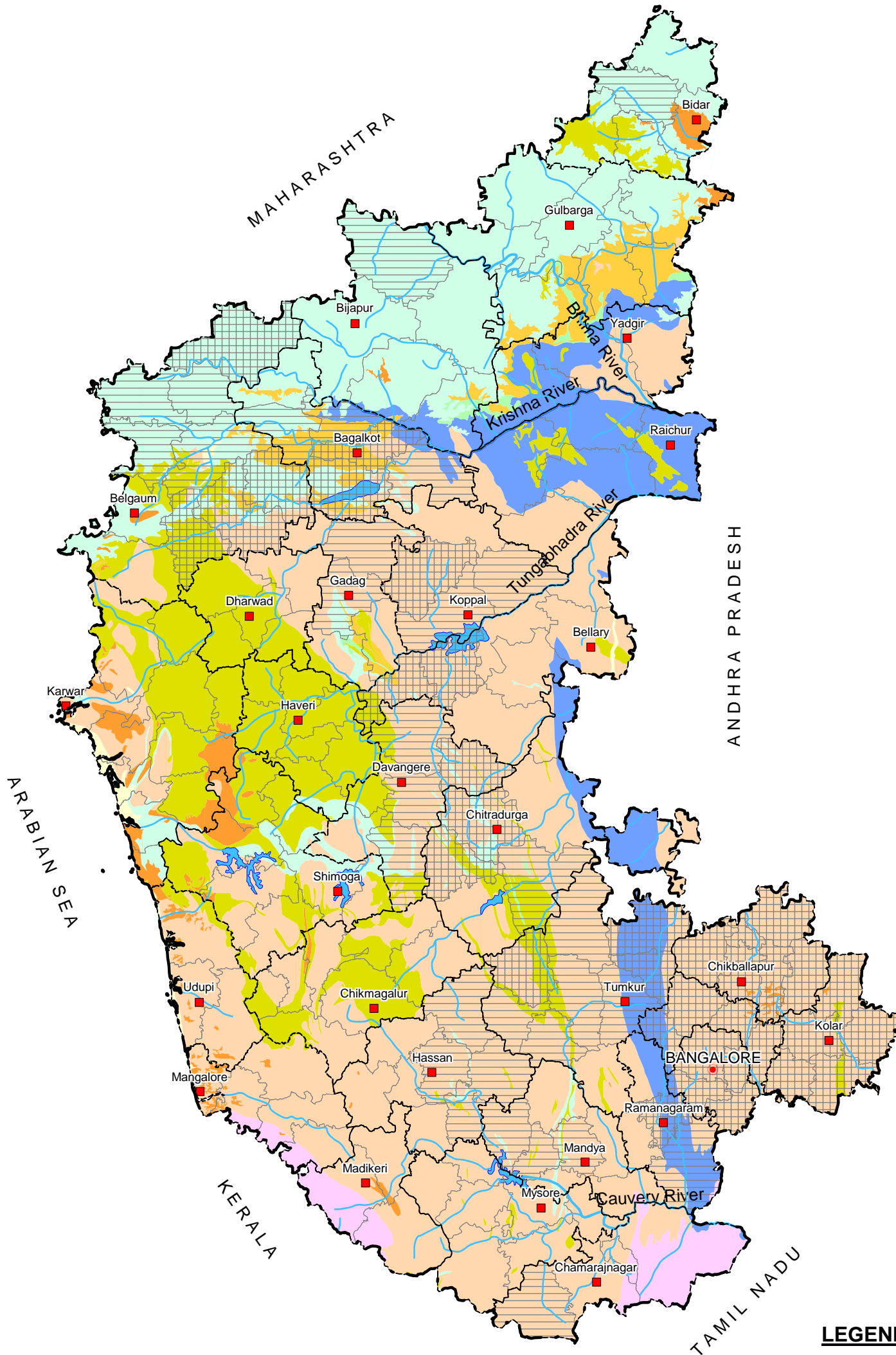
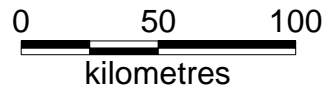
Table 28b : District and aquifer wise Area under Critical Taluks

S.N.	District Name	Alluvium	Laterite	Basalt	Sandstone	Limestone	Granite	Schist	Charnockite	BGC
1	Bagalkot			858.49		789.08	434.29			1021.09
2	Bangalore Rural						879.87			647.23
4	Belgaum			3836.66		125.4		639.35		82.63
6	Bidar		28.87	1079.78				0.11		
7	Bijapur			2239.69						
8	Chamarajnaragar									1375.85
10	Chikmagalur									1003.08
11	Chitradurga							662.43		
12	Dakshina Kannada									2648.78
13	Davangere			319.92				664.15		
15	Gadag			266.53		21.4		3.47		2088.97
17	Hassan			83.72				101.36		3669.5
21	Koppal									2715.33
22	Mandya			92.55				41.98		1995.74
27	Tumkur			0.99			470.23	516.72		4404.86
Total			28.87	8778.33		935.88	1784.39	2629.57		21653.06

Area in sq.km



CATEGORISATION OF GROUNDWATER ASSESSMENT UNITS (As on March-2009)



Category

	OE taluks
	Critical taluks

Aquifer

	Alluvium		Granite
	Laterite		Schist
	Basalt		Charnockite
	Sandstone		Banded Gneissic Complex
	Limestone		

LEGEND

	State Capital
	District Headquarters
	State Boundary
	District Boundary
	Drainage
	Surface waterbody

Table 29: District and aquifer wise Area Prioritized for Artificial Recharge

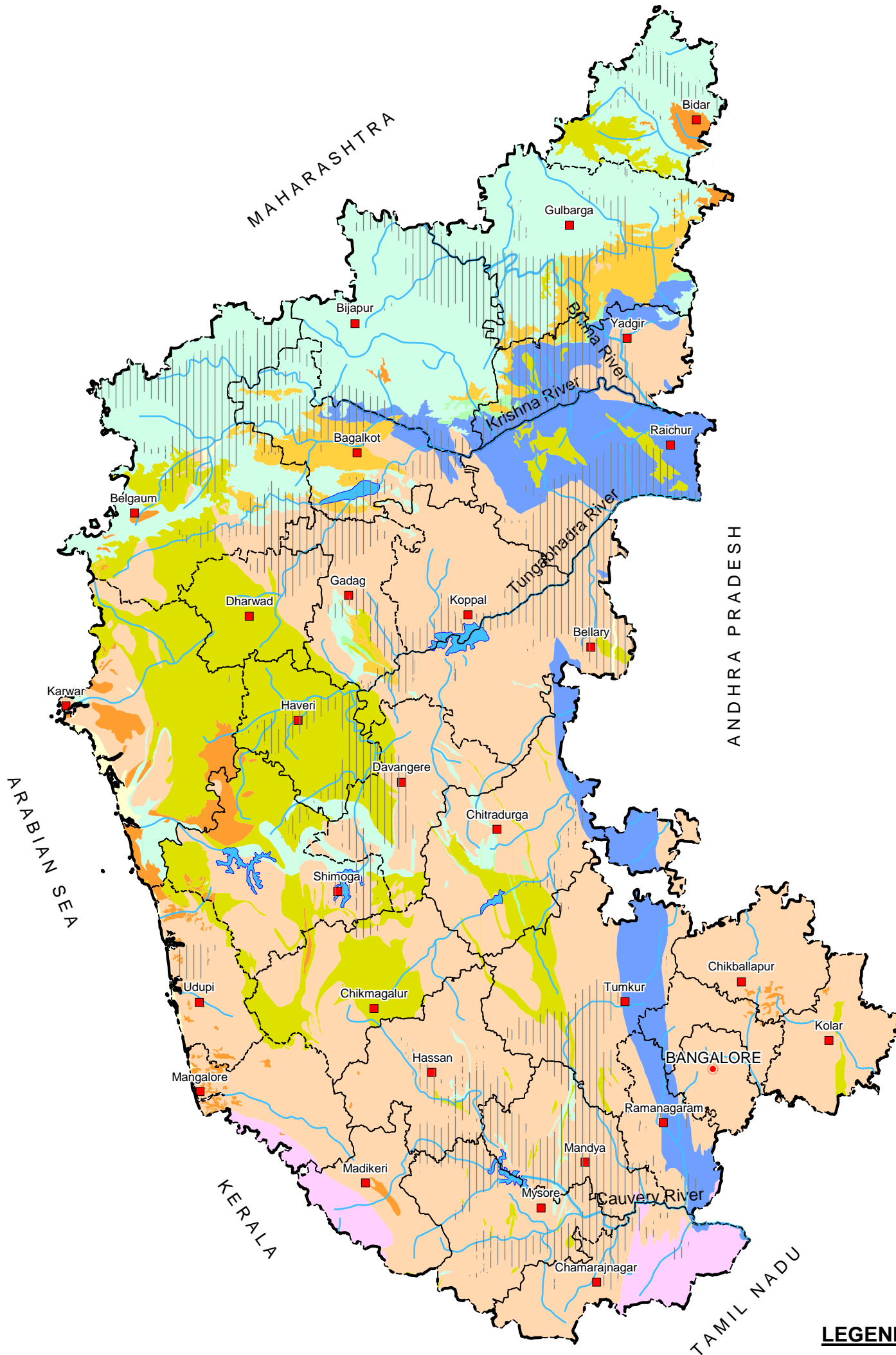
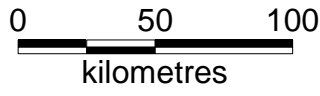
S.N.	District Name	Alluvium	Laterite	Basalt	Sandstone	Limestone	Granite	Schist	Charnockite	BGC
1	Bagalkot			1347		662	310			536
2	Bangalore Rural									
3	Bangalore Urban						2			
4	Belgaum	81		4015		262		599		710
5	Bellary	66		2		48	20	151		2570
6	Bidar			764						
7	Bijapur			2341		9	339			69
8	Chamarajnaragar								68	722
9	Chikballapur							48		
10	Chikmagalur									73
11	Chitradurga						40	35		214
12	Dakshina Kannada									
13	Davangere			84				548		736
14	Dharwad							6		742
15	Gadag			88		52		22		1601
16	Gulbarga			2338		1192	4	62		4
17	Hassan			32				50		1339
18	Haveri			41				1615		
19	Kodagu									21
20	Kolar									1
21	Koppal									1200
22	Mandya			191				62		3199
23	Mysore							42		2254
24	Raichur						1404	166		1621
25	Ramanagaram						132			155
26	Shimoga			94				182		475
27	Tumkur			7				229		1993
28	Udupi						8			346
29	Uttara Kannada							15		
30	Yadgir			5		368		141		774
Total		147		11349		2593	2259	3973	68	21355

Area in Sq. Km



AQUIFER MANAGEMENT PLAN

(ARTIFICIAL RECHARGE- PRIORITY AREAS)



LEGEND

- | | | | |
|--------------------------------------|-------------|-------------------------|-----------------------|
| Artificial Recharge - Priority Areas | Alluvium | Granite | State Capital |
| Laterite | Basalt | Schist | District Headquarters |
| Sandstone | Charnockite | Banded Gneissic Complex | State Boundary |
| Limestone | | | District Boundary |
| | | | Drainage |
| | | | Surface waterbody |

Table 30: District and aquifer wise area Prioritized for Water Conservation and Harvesting

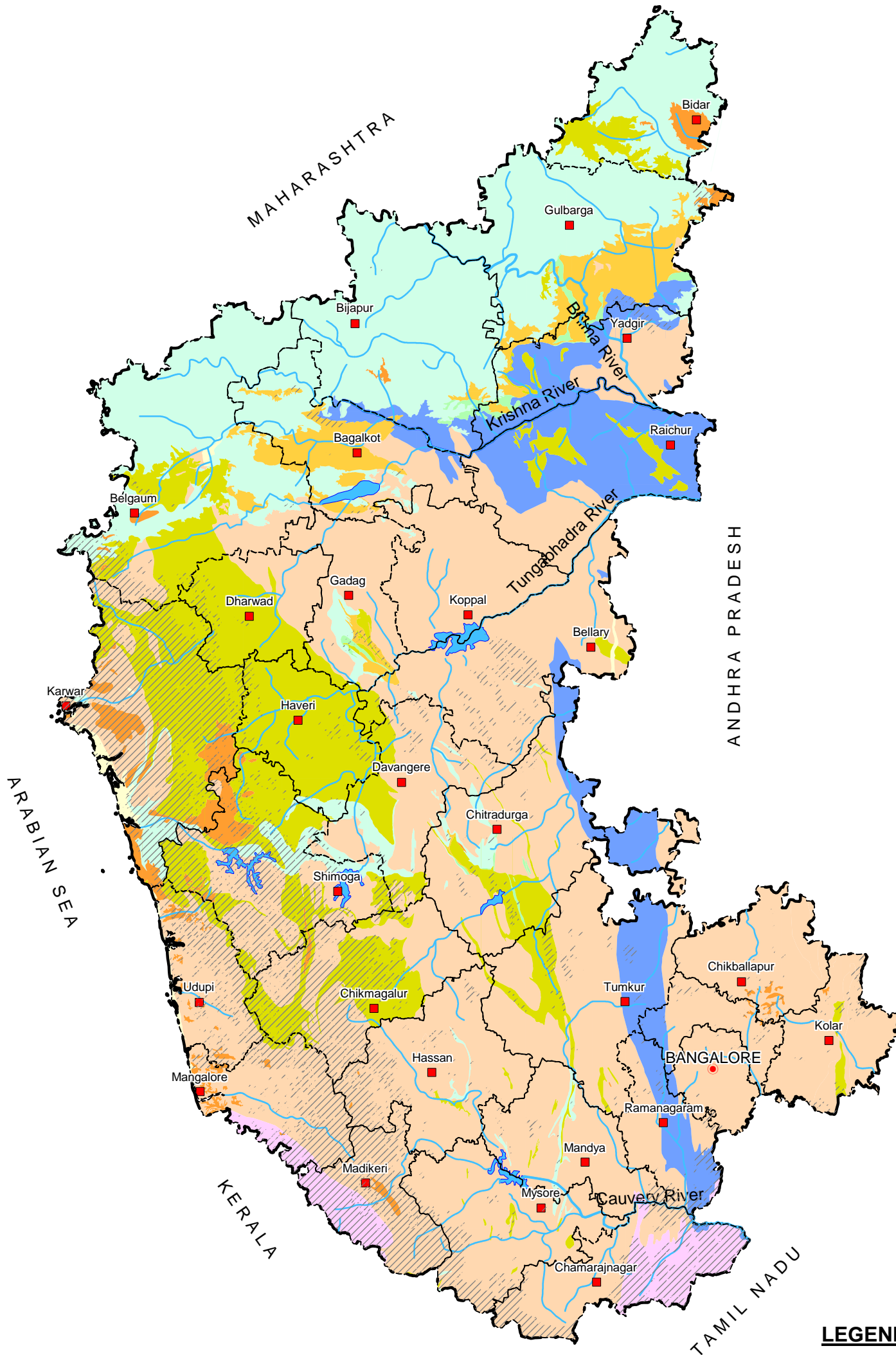
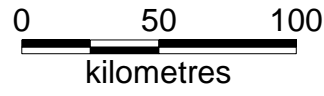
S.N.	District Name	Alluvium	Laterite	Basalt	Sandstone	Limestone	Granite	Schist	Charnockite	BGC
1	Bagalkot			16		128	4			13
2	Bangalore Rural		23				7			102
3	Bangalore Urban									31
4	Belgaum		100	262		19		375		305
5	Bellary			8				23		740
6	Bidar		404	7				4		
7	Bijapur			6						
8	Chamarajnagar						54		1807	586
9	Chikballapur		104							487
10	Chikmagalur		48					1895		1840
11	Chitradurga		6	22		1	13	118		163
12	Dakshina Kannada	2	233					89	547	3890
13	Davangere			79				127		295
14	Dharwad							333		
15	Gadag			8		53		22		2
16	Gulbarga		125	87		1	40			
17	Hassan		7					5		1068
18	Haveri		1					313		
19	Kodagu		103					4	1209	2361
20	Kolar		11					62		
21	Koppal					1				
22	Mandya			15						154
23	Mysore			15				18		930
24	Raichur									
25	Ramanagaram						288		32	167
26	Shimoga		2	588				1949		1863
27	Tumkur						56	217		120
28	Udupi	16	271	1				415		1290
29	Uttara Kannada	144	1533	765				3945		2384
30	Yadgir			2			17			31
Total		162	2971	1881	0	203	479	9914	3595	18646

(Area in Sq. Km.)



AQUIFER MANAGEMENT PLAN

(WATER CONSERVATION AND HARVESTING - PRIORITY AREA)



LEGEND

Water Conservation and Harvesting - Priority Area

Aquifer

- | | |
|-----------|-------------------------|
| Alluvium | Granite |
| Laterite | Schist |
| Basalt | Charnockite |
| Sandstone | Banded Gneissic Complex |
| Limestone | |

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

Table 31 : District and aquifer wise area Suitable for Ground Water Development

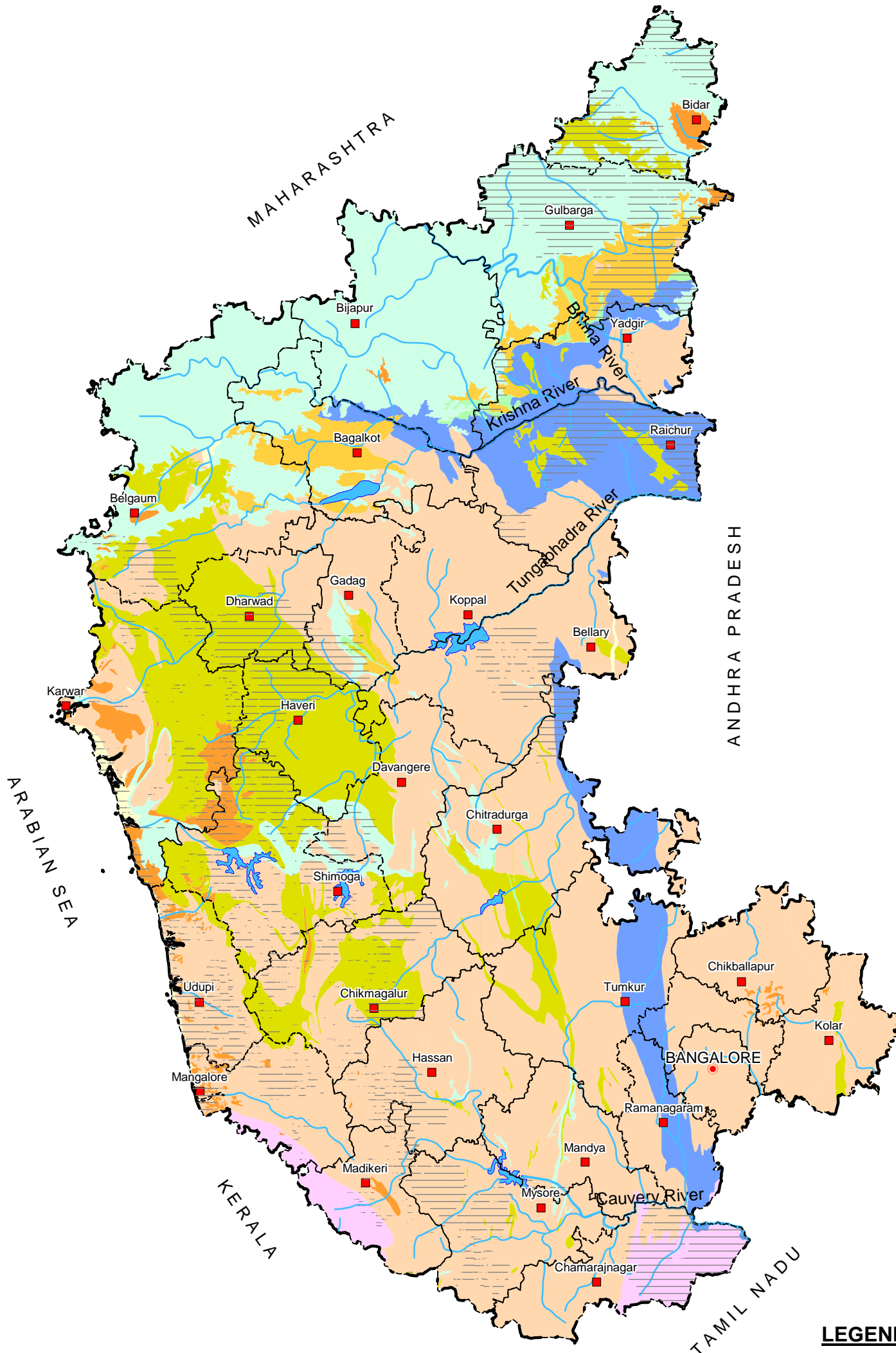
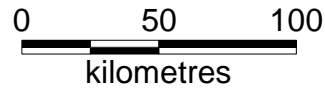
S.N.	District Name	Alluvium	Laterite	Basalt	Sandstone	Limestone	Granite	Schist	Charnockite	BGC
1	Bagalkot									
2	Bangalore Rural									
3	Bangalore Urban									
4	Belgaum		5	101				413		342
5	Bellary			20			101			1106
6	Bidar		13	2089				1004		
7	Bijapur									
8	Chamarajnar						59		482	
9	Chikballapur									
10	Chikmagalur		6					773		
11	Chitradurga						363			302
12	Dakshina Kannada	25	75						18	879
13	Davangere			215				12		261
14	Dharwad							1603		260
15	Gadag				35	46		230		434
16	Gulbarga		92	4302	107	1389	420	12		67
17	Hassan		1							998
18	Haveri		1					1477		
19	Kodagu							5	20	424
20	Kolar									
21	Koppal									
22	Mandya			26						93
23	Mysore			1				26		1875
24	Raichur						2581	341		437
25	Ramanagaram									
26	Shimoga		210	229				1332		1110
27	Tumkur									
28	Udupi	106	201					2		1512
29	Uttara Kannada	271	150	47				963		150
30	Yadgir			126	59	88	88	4		38
Total		402	754	7156	201	1523	3612	8197	520	10288

(Area in Sq. Km.)



AQUIFER MANAGEMENT PLAN

(AREAS SUITABLE FOR GROUND WATER DEVELOPMENT)



LEGEND

- | | | | |
|--|-------------|-------------------------|-----------------------|
| Areas suitable for groundwater development | Alluvium | Granite | State Capital |
| Laterite | Basalt | Schist | District Headquarters |
| Sandstone | Charnockite | Banded Gneissic Complex | State Boundary |
| Limestone | | | District Boundary |
| | | | Drainage |
| | | | Surface waterbody |

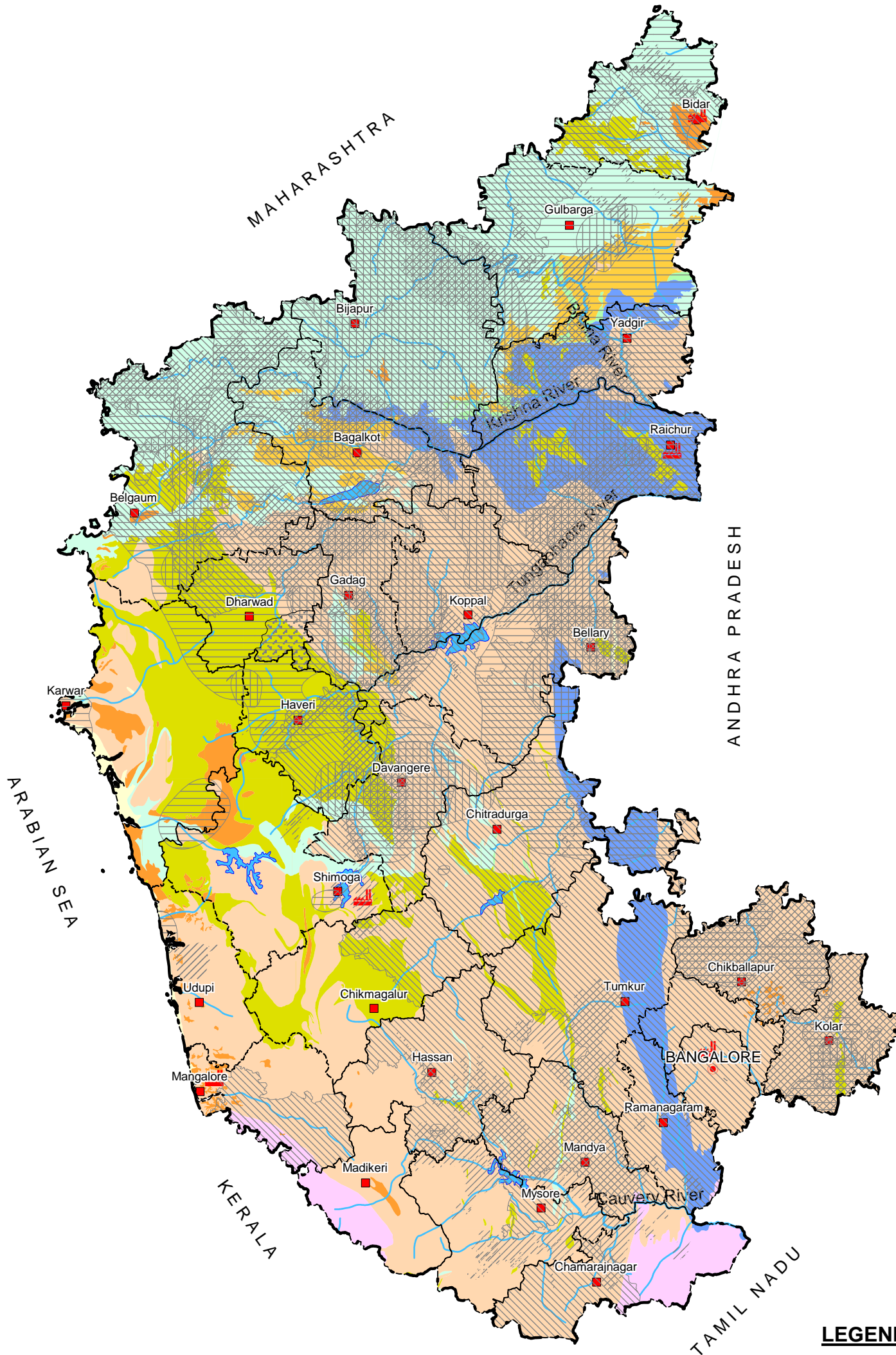
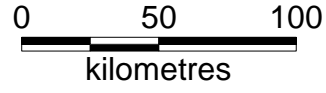
Table 32 : Aquifer wise Ground Water Management Plan

S.N	Aquifer	Area covered (Sq. Km.)	Area Suitable for Artificial Recharge		Area Suitable for Development		Area Suitable for Conservation	
			Sq. Km.	%	Sq. Km.	%	Sq. Km.	%
1	Alluvium	711	147	20	402	56	162	22
2	Laterite	3682			754	20	2971	80
3	Basalt	35698	11349	31	7156	20	1881	5
4	Sandstone	623			201	32		
5	Limestone	6000	2593	43	1523	25	203	3
6	Granite	14609	2259	15	3612	24	479	3
7	Schist	28711	3973	13	8197	28	9914	34
8	Charnockite	4110	68	1	520	12	3595	87
9	BGC	97617	21355	21	10288	10	18646	19
Total		191761	41744	21	32653	18	37851	20

% - percentage with respect to aquifer



GROUND WATER VULNERABLE AREAS



Area vulnerable to ground water contamination

- Fluoride contamination
- Nitrate contamination
- Groundwater over exploited areas
- Intensive irrigation and application of Fertilizers / pesticides contamination
- Inland salinity
- Pollution from Industry

Aquifer

- Alluvium
- Laterite
- Basalt
- Sandstone
- Limestone
- Granite
- Schist
- Charnockite
- Banded Gneissic Complex

LEGEND

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

WAY FORWARD

Increase in population density and improvement in quality of life has resulted in an increase in demand of natural resources like water. Groundwater being the major source of water supply catering to about 85% of rural water supply, the stress on groundwater is ever increasing. It has resulted in over-exploitation of the resources at places. The situation demands for a reorientation of the strategy for its development and management. Scientific understating of the hydro geological conditions and the aquifer systems are the important inputs for sustainable management of ground water resource so that the requirement of present generation is met without compromising the ability of future generations to meet their own needs. The ground water development over the years has changed the hydro geological regime and the recharge and draft components to a great extent. Large areas of Karnataka have been experiencing declining ground water levels due to over-exploitation. Over- development of the ground water resources results in declining ground water levels, shortage in water supply, intrusion of saline water in coastal areas and increased pumping lifts necessitating deepening of ground water structures and increase in power costs.

Karnataka state is mostly occupied by hard rock aquifers systems. Laterites and alluvium occupy the coastal tracts of the state. The state is covered by nine aquifers systems viz. Banded Gneissic Complex (BGC), Basalt, Schist, Granite, Charnockite, Limestone, Laterite, Sandstone and Alluvium. The complexity of the aquifer geometry in the hard rock terrain poses challenge for an exact and overall understanding of the type of aquifer parameters and nature of its behaviour. The productivity of an aquifer depends on its ability to store and transmit water and these qualities vary from place to place. The experience gained so far will definitely help in scientific management of the aquifers while reminding us of the limitation of evolving a precise development plan. Some of the activities to be carried forward further are summarised below:

- There is an urgent need for sustainable management of ground water resource through scientific management.
- The highly diversified hydro geologic settings in hard rock aquifers and variations in the availability of ground water resources call for a holistic approach in evolving suitable management strategies.
- Aquifers cannot be dealt in isolation for management as different group of formations. When multi-aquifer systems are encountered in a terrain, the characteristics and influence of each of the individual aquifer types are to be considered for the management of the system.
- Improving the monitoring network of ground water levels and quality is essential for arriving village-wise ground water budget and management plan.
- To avoid mutual interference and dwindling of yield resulting in drying up of bore wells, there is a need to regulate indiscriminate drilling of bore wells.
- Constructions of artificial recharge structures are to be taken up in areas covered by over-exploited aquifers to maintain the sustainability.
- To arrest the declining trend in water levels, drying-up of wells and deterioration of ground water quality, the following measures are needed.
 - Change in Irrigation Pattern
 - Change in Cropping Pattern
 - Restricting free power supply to farmers
 - Water intensive crops like paddy, banana and sugarcane should be avoided as far as possible in ground water stressed areas.
- Understanding the aquifer behavior in hard rock terrain is always difficult. A paradigm shift from “ground water management” to “aquifer management” by involving the farming community and other beneficiaries is expected to yield the desired impact, particularly the sustainability of the resource.
- Co-ordinated efforts amongst various Central and State Government agencies, non-Governmental and social service organizations, academic institutions and the stakeholders are required for evolving and implementing suitable ground water management strategies in hard rock aquifers.
- Rainwater harvesting and artificial recharge schemes are being implemented by various agencies, NGOs/ VOs, industries, commercial establishments etc. under their corporate social responsibility or other schemes. Many of the implementing agencies are not having the scientific background and knowledge base for being it effective and at times there is a duplication of work by different department. To avoid this there should be an umbrella agency to monitor/ coordinate various schemes and to provide capacity building.

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Water is the elixir of life

Prevent water from pollution

Water security is food security

Care for ground water before it becomes rare

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