



केंद्रीय भूमि जल बोर्ड

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भारत सरकार

Central Ground Water Board

Department of Water Resources, River
Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

HALIYAL TALUK

UTTARAKANNADA DISTRICT, KARNATAKA

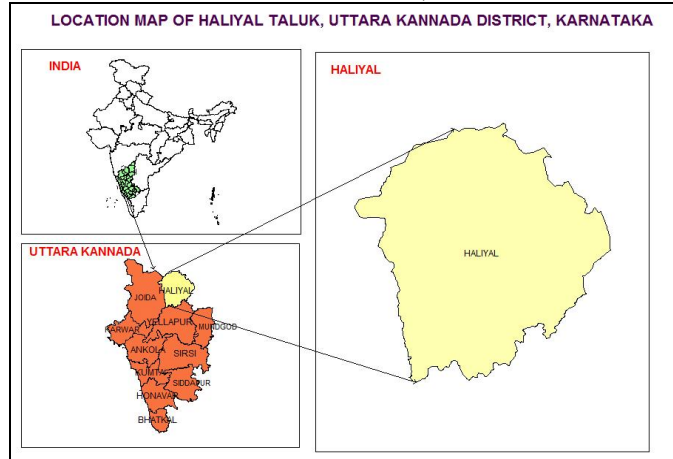
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GOVERNMENT OF INDIA
MINISTRY OF JAL SHAKTI
DEPT. OF WATER RESOURCES, RD & GR
CENTRAL GROUND WATER BOARD

AQUIFER MANAGEMENT PLAN OF HALIYAL TALUK UTTARAKANNADA DISTRICT, KARNATAKA STATE

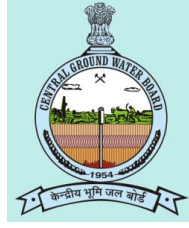


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AQUIFER MANAGEMENT PLAN OF HALIYAL TALUK UTTARAKANNADA DISTRICT, KARNATAKA STATE

CONTENTS

Sl. No.	Title	Page No.
1	Salient information	1
2	Aquifer disposition	6
3	Ground water resource, extraction, Contamination and other issues	8
4	Summary	11

AQUIFER MANAGEMENT PLAN OF HALIYAL TALUK, UTTARAKANNADA DISTRICT, KARNATAKA STATE

1.0 SALIENT INFORMATION

Name of the taluk: **Haliyal**

District: Uttarakannada;

State: Karnataka

Area: 847.45 sq.km.

Population: 171426

Annual Normal Rainfall: 1328 mm

1.1 Aquifer management study area

Aquifer mapping studies have been carried out in Haliyal taluk, Uttarakannada district of Karnataka, covering an area of 847.45 sq.kms under National Aquifer Mapping Project. Haliyal taluk of Uttarakannada district is located between North Latitudes 15°25'31" and 15°04'36.99" and East Longitudes between 74° 34' 0.84" to 74° 54'38.88" and is falling in Survey of India Toposheets No forms parts of 48I/11, 48I/12, 48I/15 & 48I/16. The study area is bounded on the North by Khanapur taluk of Belagavi district, on the East by Dharwad district, on the South by Yellapur taluk and on west by Joida taluk of Uttarakannada district. Location map of Haliyal taluk of Uttarakannada district is presented in **Fig-1**. Haliyal is taluk headquarter and there are two towns, 24 grama panchayats, 4 hoblis and there are 110 villages in the taluk.

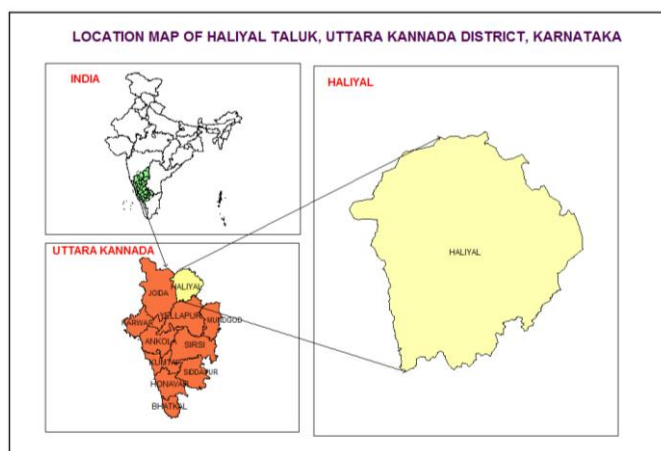


Fig-1: Location map of Haliyal taluk of Uttarakannada district

1.2 Population

According to 2011 census, the population in Haliyal taluk is 171426. Out of which 86601 are male while 84625 are females. The average sex ratio of Haliyal taluk is 975. The Haliyal taluk

has an overall population density of 202 persons per sq.km. The decadal growth rate in population from 2001-2011 is 7.72% in Haliyal taluk.

1.3 Rainfall

The normal annual rainfall in Haliyal taluk for the period 1951 to 2000 is 1328 mm. The rainfall received show wide variation seasonally and major share of the annual precipitation is received from southwest monsoon, which is active during June-September months. The Southwest monsoon accounts for 85% of annual rainfall, whereas the winter rainfall contributes about 8 to 10%. The balance is received during pre monsoon period. The actual rainfall for the period from 2007 to 2017 is given in **Table -1**.

Table –1: Actual rainfall (mm) for the period from 2007 to 2017

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Rainfall	1403	1190	1472	1260	1492	924	1162	1326	863	871	1115

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Haliyal taluk. Major Kharif crops are Maize, Paddy and Vegetables. Main crops of Rabi season are paddy, vegetable and sugarcane (**Table-2**). Water intensive crops like sugarcane and paddy are grown in 70% of total crop area. Maize is grown in 18% and pulses in 3 % of total crop area of taluk. Cotton account for 4% and fruits & vegetables also account for 4% of total crop area.

Table-2: Cropping pattern in Haliyal taluk 2017-18 (Ha)

Year	Maize	Paddy	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
	Area under cultivation (in ha)								
2017-2018	3948	8935	2	758	774	32	9	6409	899

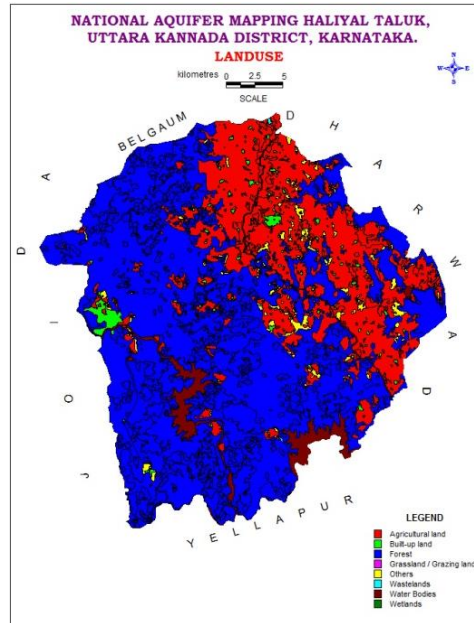
Source: District at a glance 2017-18, Govt. of Karnataka

It is observed that net sown area accounts 25% and area sown more than once is 1.5 % of total geographical area in Haliyal taluk (**Table-3**) and shown in **Fig.2**. Area not available for cultivation and Fallow land cover 6 % & 1 % of total geographical area respectively. Forest area comprises about 68% total geographic area. Irrigation from bore well accounts for about 65.6% of the total area irrigated whereas irrigation from tanks accounts for 32.6% of the total area of irrigation. (**Table-4**).

Table-3: Details of land use in Haliyal taluk 2016-2017 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Uncultivable waste land	Fallow land	Net sown area	Area sown more than once
Haliyal	84745	57819	3964	883	574	21505	1259

Source: District at a glance 2017-18, Govt. of Karnataka

**Fig-2: Land use Map****Table 4: Irrigation details in Haliyal taluk (in ha)**

Source of Irrigation	Numbers	Net area irrigated (Ha.)	% of area
Canals		nil	
Tanks	352	2529	32.65
Wells	6	nil	
Bore wells	1763	5082	65.6
Lift Irrigation		nil	
Other Sources		134	1.7
Total		7745	

Source: District at a glance 2017-18, Govt. of Karnataka

1.5 Geomorphology, Physiography & Drainage

Haliyal taluk is a plain region formed by schistose formation. The central and southern parts exhibit moderate to gently “undulating terrain” having sparsely distributed knolls and tors. The remaining part of the taluk is in general a “plateau area”. This has its bearing on the regional slope which is towards northeast. The differential altitude is significant because, it is

likely to cause irregular ground water flow patterns on the micro scale (**Fig. 3**). Topography is dominantly controlled by geological structures.

The entire area of Haliyal taluka is being drained by Kali river and its tributaries. Generally, the drainage pattern of the river is dendritic to sub dendritic (**Fig. 4**).

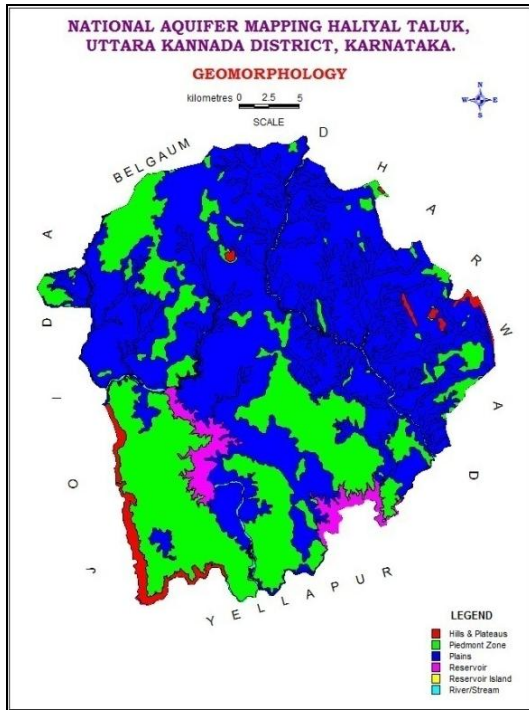


Fig-3: Geomorphology Map

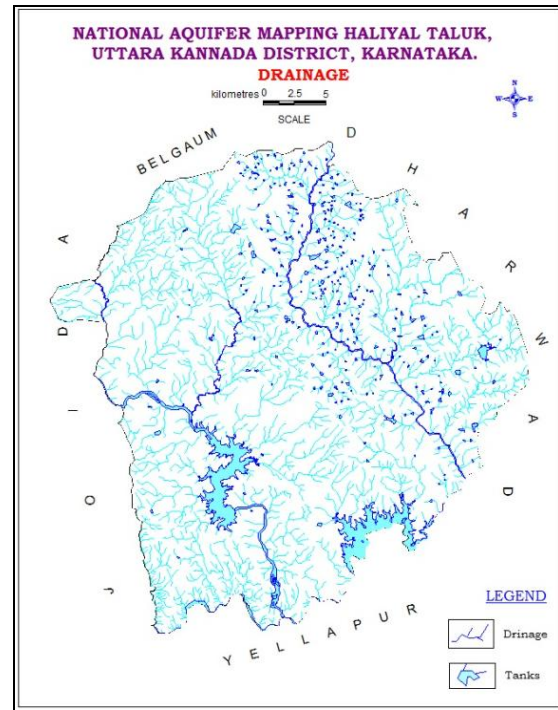


Fig-4: Drainage Map

1.6 Soil

The soils of Haliyal taluk can broadly be classified into clayey and clayey skeletal soils. The clayey soils are produced in high rainfall area because of the leaching process. These soils vary in depth and texture, depending on the parent rock type, physiographic settings and climatic conditions (**Fig. 5**).

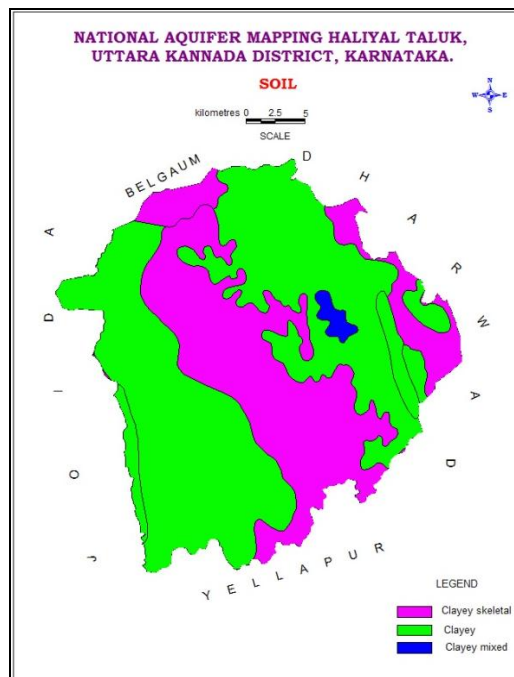


Fig-5: Soil Map

1.7 Ground water resource availability and extraction

Aquifer wise total groundwater resources up to 200 m depth is given in **Table-5** below.

Table-5: Total Ground Water Resources (2013) (Ham)

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (Down to 200m)	
HALIYAL	4215			Dynamic + phreatic in-storage + fractured
		11970	3672	19857

1.8 Existing and future water demands (as per GEC-2017)

- Net ground water availability for future irrigation development : 45.12 MCM
- Domestic (Industrial sector) demand for next 25 years : 8.2 MCM

1.9 Water level behavior

(a) Depth to water level

Aquifer - I

- Pre-monsoon: 1.59 – 12.65 mbgl (**Fig.6**)
- Post-monsoon: 0.80 – 1.50 mbgl (**Fig.7**)

(b) Water level fluctuation

Aquifer-I (Fig.8)

- Seasonal Fluctuation: Rise ranges 0.74 – 11.85 m

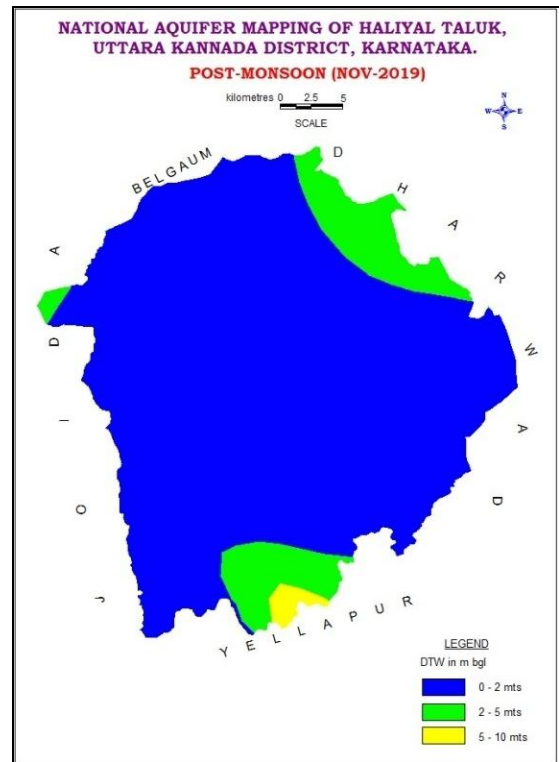
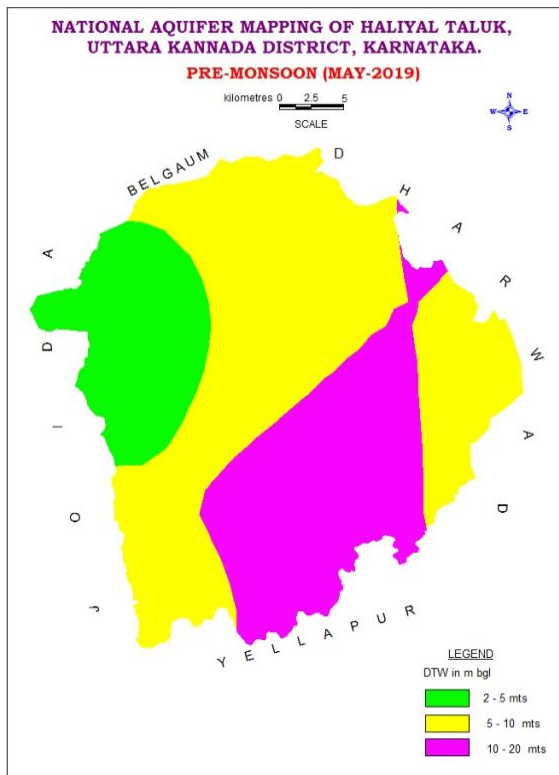


Fig-6: Pre-monsoon Depth to Water Level (Aq-I) Fig-7: Post-monsoon Depth to Water Level (Aq-I)

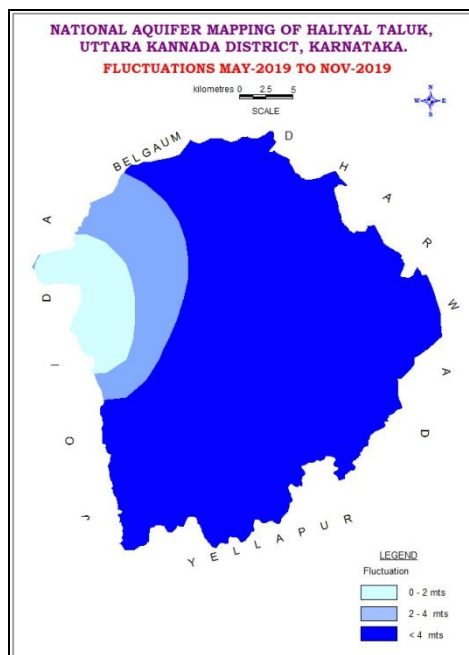


Fig-8: Water Level Fluctuation (Aq-I)

2.0 AQUIFER DISPOSITION

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

- i. **Aquifer-I (Phreatic aquifer)** Weathered schist
- ii. **Aquifer-II (Fractured aquifer)** Fractured schist

In Haliyal taluk, schistose rocks of Dharwar group are the main water bearing formations (**Fig-9**). Ground water occurs within the weathered and fractured schist under water table condition and semi-confined condition. In Haliyal taluk bore wells were drilled from a minimum depth of 181 mbgl to a maximum of 200 mbgl. Depth of weathered zone ranges from 7 to 10 mbgl. Ground water exploration reveals that aquifer-II fractured formation was encountered between the depth of 20 to 105 mbgl. Yield ranges from 0.20 to 5.5 lps. Ground water exploration done in this taluk is given in **Table 5**, and the basic characteristics of each aquifer are summarized in **Table 6**.

Table-6: Details of Ground Water Exploration

Sl. No	Location	Lat/Long	Depth Drilled/ casing m bgl	Aquifer Zones m.bgl	Discharge (lpm)	DTW m bgl	DD (m)	T m ² /day
1.	Janaga-EW	15°14' 14" 74°49' 53"	180.95/ 7.0	11.15 12.15	0.01	7.36	-	-
2.	Kelagina-Koppa-EW	15°15' 15" 74°48' 53"	200.00/ 12.20	10.12 12.5-16.2 52.8-54.8	6.0	7.64		2.57 Slug test
3.	Havagi-EW	15°21' 10" 74°45' 08"	200.00/1 0.50	10.5 11.1-13.2 29.4-30.4 49-49.8 69-72 83 102.6-103	305.4	3.22	23.70	11.115 (APT)

Table-7: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aquifer I)	Fractured Zone (Aquifer II)
Prominent Lithology	Weathered schist	Fractured / Jointed schist
Thickness range (mbgl)	20	Fractures upto 105 mbgl
Depth range of occurrence of fractures (mbgl)	10-15	20-103
Range of yield potential (lps)	Poor yield	1 - 5
T (m ² /day)	-	2.5 – 11.0
Quality Suitability for Domestic & Irrigation	Suitable	Suitable

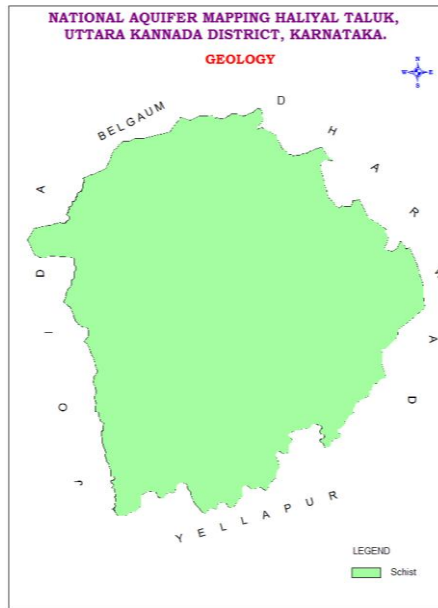


Fig-9: Geology Map

3.0 GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

3.1 Aquifer wise resource availability and extraction

Table 8 (a): Present Dynamic Ground Water Resource (2017)

Taluk	Net Annual Ground Water Availability	Existing Gross Ground Water Draft For Irrigation	Existing Gross Ground Water Draft For Domestic And Industrial Water Supply	Existing Gross Ground Water Draft For All Uses	Allocation For Domestic And Industrial Use For Next 25 Years	Net Ground Water Availability For Future Irrigation Development	Existing Stage Of Ground Water Development	Category
Haliyal	4215	3037	76	3114	82	1096	74	Semicritical

Table 8 (b): Present total Ground Water Resource (in ham)

Taluk	Annual replenishable GW resources (in ham)	Fresh In-storage GW resources (in ham)		Total availability of GW resource (in ham)
		Phreatic	Fractured	Dynamic + phreatic in-storage + fractured in-storage
Haliyal	4215	11970	3672	19857

Table 8 (c): Comparison of ground water availability and draft scenario (in ham)

Taluk	GW availability	GW draft	Stage of GW development	GW availability	GW draft	Stage of GW development	GW availability	GW draft	Stage of GW development	GW availability	GW draft	Stage of GW development
	2009			2011			2013			2017		
Haliyal	6425	1849	29 %	4501	2986	66%	4533	3293	73%	4215	3114	74%

3.1 Chemical quality of ground water and contamination

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

Electrical Conductivity: In general, EC values range from 310 to 890 μ /mhos/cm in the Aquifer-I at 25°C

EC values range from 350 to 1250 μ /mhos/cm in the Aquifer-II at 25°C

Fluoride: Fluoride concentration in ground water ranges between 0.5 – 1.4 mg/l in the Aquifer-I
Fluoride concentration in ground water ranges between 0.12 – 0.54 mg/l in the Aquifer-II

Nitrate: Nitrate value ranges from 1.0 and 19 mg/l in the Aquifer –I
Nitrate value ranges from 4.0 and 55 mg/l in the Aquifer –II

Table-9a: Quality of ground water (Aquifer-I) in Haliyal taluk of Uttarakannada district

S.No.	VILLAGE	pH	EC	TDS	TH	Ca ⁺⁺	Mg ⁺⁺	Na ⁺	K ⁺	CO ₃ ⁻⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻⁻	NO3	F	SAR	%Na
1	Kulgi	8.2	710	461.5	220	16	44	58	1.0	0	183	114	30	10	1.2	1.70	36.7
2	Ambika Nagar	8.2	490	318.5	160	12	31	37	3.0	0	177	50	18	6	1.3	1.28	34.5
3	Bommanhalli	8.1	420	273	130	20	19	27	15.1	0	140	50	14	4	1.3	1.04	37.5
4	Bhagavati	8.2	490	318.5	120	20	17	52	8.3	0	122	85	12	9	1.2	2.06	50.8
5	Alur	8.2	350	227.5	120	20	17	23	1.2	0	110	43	16	6	1.3	0.91	30.04
6	Shirgur	8.2	350	227.5	80	20	7	43	1.2	0	134	36	10	1	1.3	2.11	54.28
7	Ajgaon	8.1	670	435.5	220	52	22	44	15.2	0	244	71	24	3	1.1	1.29	34.36
8	Kasaroli	8.2	790	513.5	240	24	43	69	1.8	0	128	192	10	5	1.2	1.95	38.82
9	Gardoli	8.0	390	253.5	120	28	12	33	1.4	0	128	43	9	19	1.3	1.31	38.00
10	Sambrani	8.2	430	279.5	120	32	10	40	4.9	0	134	57	11	9	1.1	1.58	43.73
11	Halyal	7.9	890	578.5	200	20	36	105	12.9	0	159	185	42	2	1.4	3.24	55.04
12	Pandarval Hosur	8.2	380	247	102	24	14	30	3.0	0	85	50	40	3	1.0	1.20	40.37
13	Tattageri	7.9	730	474.5	150	20	24	97	1.3	0	207	114	24	2	1.3	3.46	58.62
14	Madanalli	7.8	410	266.5	100	20	12	47	0.4	0	98	64	24	4	1.4	2.05	50.66
15	Nagesheeti Koppa	8.2	500	325	120	12	22	58	0.9	0	122	92	11	8	0.6	2.30	51.46
16	Belvategi	8.2	360	234	90	20	10	40	1.4	0	122	43	14	2	0.7	1.82	49.63
17	Telanger	7.5	310	201.5	110	24	12	20	0.8	0	116	28	10	5	0.5	0.83	28.77

Table-9b: Quality of ground water (Aquifer-II) in Haliyal taluk of Uttarakannada district

S.No.	VILLAGE	pH	EC	TDS	TH	Ca ⁺⁺	Mg ⁺⁺	Na ⁺	K ⁺	CO ₃ ⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻	NO ₃ ⁻	F	SAR	%Na
1	Nagasheeti koppa	7.7	1150	736	300	52	41	123	3.1	0	299	156	66	40	0.5	3.09	47.5
2	Tattegeri	8.1	1250	800	400	112	29	101	2.1	0	67	277	132	35	0.21	2.20	35.7
3	Belvatagi	8.5	700	448	180	8	39	76	1.4	9	159	114	20	22	0.38	2.46	48.1
4	Shirugur	8.3	910	582.4	310	52	43	53	22.6	9	91	177	80	29	0.97	1.32	31.8
5	Gardoli	8.3	920	588.8	290	48	41	75	3.8	12	98	149	98	55	0.42	1.92	36.7
6	Kesarolli	8.2	1160	742.4	360	76	41	99	1.3	0	116	270	80	14	0.12	2.27	37.6
7	Aiygaon	8.4	560	358.4	200	24	34	31	7.8	9	104	99	30	4	0.33	0.95	27.9
8	Kulgi	8.5	500	320	180	20	31	31	1.4	12	122	71	24	3	0.20	1.01	27.8
9	Bhagawati	8.4	1190	761.6	250	32	41	157	2.1	12	122	263	60	45	0.51	4.33	57.9
10	Bomanhalli	8.3	460	294.4	180	24	29	16	10.8	9	104	71	16	11	0.26	0.52	21.3
11	Ambikanagar	8.4	350	224	130	32	12	20	0.98	9	104	43	8	5	0.23	0.76	25.6
12	Madanahalli	8.3	380	243.2	100	24	10	39	3	6	110	50	10	5	0.54	1.69	46.99

Table-9c: Quality of ground water (Aquifer-I, NHS) in Haliyal taluk of Uttarakannada district

Sl.No	Location	PH	EC	TH	Ca	Mg	Na	K	CO ₃	HCO ₃	Cl	SO ₄	NO ₃	F
1	Bhagavathi	7.39	531	210	60	15	25	2	0	134	43	8	85.220	0.45
2	Dandeli	7.67	327	130	24	17	23	1	0	134	28	29	137.228	0.41
3	Dandeli	7.87	608	170	28	24	58	2	0	146	113	14	35.221	0.41
4	Kulgi	8.01	770	300	52	41	46	1	0	189	99	96	264	0.65

3.3 Ground Water Resource Enhancement

3.3.1 Aquifer wise space available for recharge and proposed interventions

Recharge dry **phreatic aquifer (Aquifer-I)** in the taluk, through construction of artificial recharge structures, viz; check dams, percolation tanks & point recharge structures (**Table-10**). The choice of recharge structures should be site specific and such structure need to be constructed in areas already identified as feasible for artificial recharge.

Table-10: Quantity of non-committed surface runoff & expected recharge through AR structures

Artificial Recharge Structures Proposed	Haliyal taluk
Non committed monsoon runoff available (MCM)	102.9
Number of Check Dams	635
Number of Percolation Tanks	43
Number of Point Recharge structures	69
Tentative total cost of the project (Rs. in lakhs)	2480 Lakhs
Excepted recharge (MCM)	58
Expected rise in water level (m)	3.743
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	0.428

Table-11 Improvement in GW availability due to Recharge, Haliyal taluk

Taluk	Net annual ground water availability	Existing gross ground water draft for all uses	Existing stage of ground water development	Expected recharge from proposed artificial recharge structures	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of ground water development
	HAM	HAM	%	HAM	%	%
Haliyal	4215	3114	74	1029	59	15

3.4 Regulation and Control

- Haliyal taluk has been categorized as semi critical, since the Stage of ground water development is 74% (GE March 2017). Hence, stringent action has to be taken up through Karnataka Ground Water Authority to control further ground water exploitation in the taluk.
- Ground water recharge component needs to be made mandatory in the non-command area of the taluk for further development of ground water.

3.5 Other interventions proposed

- Periodical maintenance of artificial recharge structures should also be incorporated in the Recharge Plan.
- Excess nitrate & fluoride concentration is found in ground water samples require remedial measures viz.

- Dilution of nitrate rich ground water through artificial recharge & water conservation.
- Roof top rainwater harvesting.

4 Summary

The summary of Management plan of Haliyal taluk is given in **Table-12**.

Table 12: Summary of Management plan of Haliyal taluk

Haliyal taluk is semi critical & present stage of GW Development (2017)		74
Net Annual Ground Water Availability (MCM)		42.15
Existing Gross Ground Water Draft for all uses		31.14
Total GW Resources (Dynamic & Static upto the depth of 200 mbgl) (MCM)		156.42
Expected additional recharge from monsoon surplus runoff (MCM)		10.29
Change in Stage of GW development, %		74 to 59
Excess nitrate & fluoride concentration	<ul style="list-style-type: none"> • Dilution of nitrate rich ground water through artificial recharge & water conservation. • Roof top rainwater harvesting. 	