# केन्द्रीय भूमिजल बोर्ड

जल शक्ति मंत्रालय, जल संसाधन, नदी विकास और गंगा संरक्षण विभाग

भारत सरकार

# Central Ground Water Board

Ministry of Jal Shakti,
Department of Water Resources, River Development
and Ganga Rejuvenation
Government of India

Report on

# AQUIFER MAPPING AND MANAGEMENT PLAN

## Holenarasipura Taluk, Hassan District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु

South Western Region, Bengaluru

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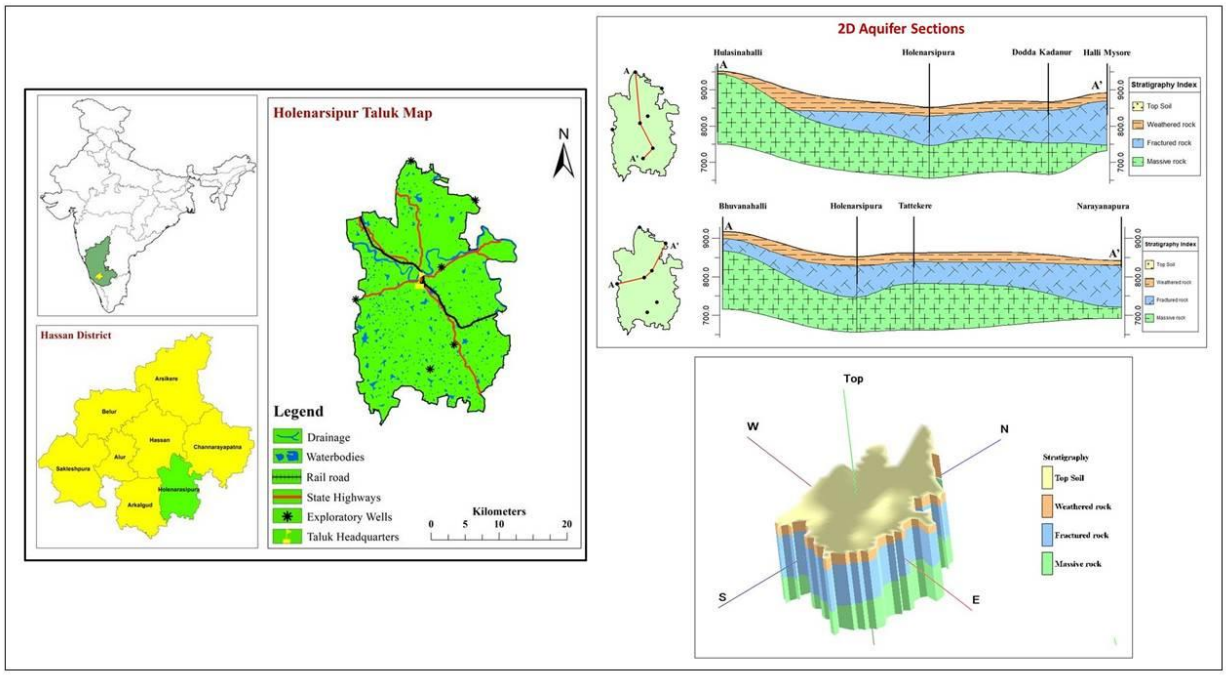
# Aquifer Maps and Management Plan, Holenarasipura Taluk, Hassan District, Karnataka State

**(AAP: – 2021-2022)**




*By*

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SEPTEMBER 2022

# Aquifer Maps and Management Plan, Holenarasipura Taluk, Hassan District, Karnataka State

*(AAP: – 2021-2022)*

## Contents

# AQUIFER MANAGEMENT PLAN FOR HOLENARASIPURA TALUK, HASSAN DISTRICT, KARNATAKA STATE

## 1. SALIENT FEATURES

| | |
|---|---|
| Name of the Taluk | : Holenarasipura |
| District | : Hassan |
| State | : Karnataka |
| Area | : 599 sq.km |
| Population (Census 2011) | : 182187 |
| Normal annual rainfall | : 1142 mm |

### 1.1 Study area

Aquifer mapping studies have been carried out in Holenarasipura taluk, Hassan district, Karnataka State under National Aquifer Mapping Project. Holenarasipura covering an area of 599sq.km is situated between latitudes 12°36'34.92″N - 12°56'26.88″N and longitudes 76°9'33.12 ″E - 76°22'26.76″E. The area is bounded on the north by Hassan and Channarayapatna taluks of Hassan district, on the south by Krishnarajanagara taluk of Mysore district, on the east by the Mandya taluk of Mandya district, and on the west by Arkalgud taluk of Hassan district. The taluk has 03 hoblies, 26 Gram Panchayaths and 249 villages. Holenarasipura is the taluk headquarters. The location map of the Holenarasipura taluk is presented in

**Fig-1**.

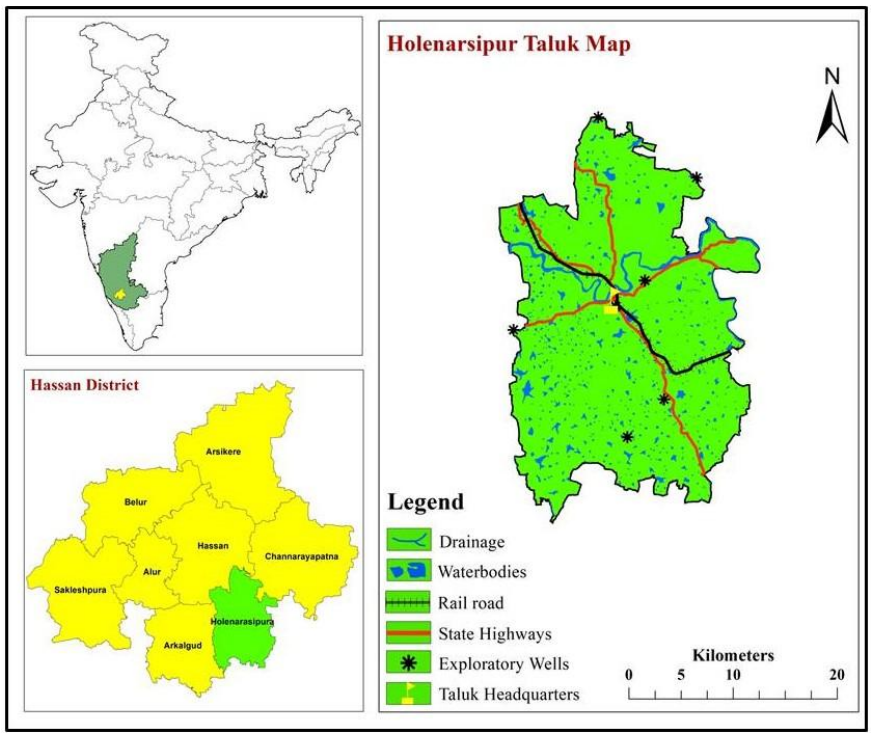



**Fig 1: Location Map**

## 1.2 Population

According to 2011 census, the human population in Holenarasipura taluk is 182187 out of which 17% constitutes the urban population and 83% constitutes the rural population. The taluk has an overall population density of 306 persons per sq.km. In Holenarasipura taluk, the decadal variation in population from 2001-2011 is 3.96 %. The population details are given in **Table-1.**

**Table-1: Population details**

| Total | Male | Female | Share of the district population | Rural population | Urban population | Decadal change in population | Decadal change in rural population | Decadal change in urban population |
|---|---|---|---|---|---|---|---|---|
| 182187 | 91565 | 90622 | 10.25 | 152213 | 29974 | 3.96 | 2.62 | 9.84 |

**Source:** District at a glance 2019-20, Govt. of Karnataka

## 1.3 Rainfall and Climate

Holenarasipura taluk enjoys semi-arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Southern Dry agro-climatic zone of Karnataka state and is categorized as drought prone.

The climate of the study area is quite agreeable and free from extremes. The year is usually divided into four seasons: summer from March to May; rainy season or south-west monsoon season from June to September; post-monsoon season covering the months of October and November and dry or winter Season from December to February.

The data from the year 1981 to 2010 is analysed and presented in **Table2.** The data pertaining to these rain gauges is of long term nature and are well maintained. It is presumed that they are representative of the taluks and the same is used for analysis. Normal annual rainfall in Holenarasipura taluk for the period 1981 to 2010 is **791 mm**. The 10 years average monthly, seasonal and annual rainfall data of Holenarasipura taluk is given in **Table 3**. The Holenarasipura taluk has received less than normal annual rainfall during the last 10 years (2010 to 2019) except 2010.

**Table 2 : STATISTICAL ANALYSIS OF NORMAL ANNUAL RAINFALL OF HOLENARASIPURA TALUK, HASSAN DISTRICT (1981-2010)**

| | Jan | Feb | Mar | Apr | May | PRE MONSOON | Jun | Jul | Aug | Sep | SOUTH WEST MONSOON | Oct. | Nov | Dec | NORTH EAST MONSOON | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NRM | 2 | 3 | 15 | 46 | 96 | 162 | 86 | 106 | 84 | 122 | 397 | 158 | 63 | 11 | 233 | 791 |
| STDEV | 6 | 11 | 29 | 34 | 59 | 81 | 62 | 87 | 52 | 84 | 153 | 127 | 65 | 17 | 156 | 242 |
| CV% | 371 | 353 | 187 | 75 | 62 | 50 | 72 | 82 | 62 | 69 | 39 | 80 | 102 | 154 | 67 | 31 |

| Table 3: ANNUAL RAINFALL OF HOLENARASIPURA, HASSAN DISTRICT (2010 to 2019) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Jan. | Feb. | Mar. | Apr. | May. | PRE | Jun. | Jul. | Aug. | Sep. | MON | Oct. | Nov. | Dec. | POST | Annual |
| 2010 | 0 | 0 | 1 | 45 | 111 | 157 | 68 | 88 | 138 | 161 | 455 | 180 | 221 | 2.0 | 403 | 1015 |
| 2011 | 0 | 0 | 27 | 58 | 100 | 185 | 55 | 43 | 50 | 35 | 183 | 184 | 111 | 0 | 295 | 663 |
| 2012 | 0 | 0 | 0 | 130 | 91 | 221 | 91 | 38 | 58 | 32 | 219 | 32 | 28 | 2 | 62 | 502 |
| 2013 | 0 | 36 | 22 | 52 | 0 | 110 | 91 | 38 | 58 | 32 | 219 | 32 | 28 | 2 | 62 | 391 |
| 2014 | 0 | 0 | 3 | 23 | 73 | 99 | 53 | 121 | 75 | 156 | 405 | 116 | 1 | 28 | 145 | 649 |
| 2015 | 0 | 0 | 15 | 134 | 103 | 252 | 97 | 1 | 67 | 54 | 219 | 65 | 101 | 8 | 174 | 645 |
| 2016 | 0 | 0 | 0 | 17 | 93 | 110 | 123 | 89 | 28 | 30 | 270 | 8 | 24 | 30 | 62 | 442 |
| 2017 | 0 | 0 | 12 | 45 | 110 | 167 | 14 | 35 | 63 | 229 | 341 | 89 | 9 | 28 | 126 | 634 |
| 2018 | 0 | 0 | 25 | 5 | 112 | 142 | 169 | 91 | 81 | 48 | 389 | 145 | 0 | 0 | 145 | 676 |
| 2019 | 0 | 0 | 0 | 51 | 69 | 120 | 65 | 27 | 209 | 99 | 400 | 140 | 30 | 11 | 181 | 701 |

## 1.4 Agriculture & Irrigation

Agriculture is the main occupation in Holenarasipura taluk. Major Kharif crops are, Ragi, Paddy, Maize, Jowar, Pulses and vegetables. Important crops of Rabi season are Maize, vegetables and oilseeds **(Table-4)**. Water intensive crops like sugarcane grown in 3.97 % of the total crop area. Coconuts and Arecanut grown in 12.44 % and oil seeds in 2.6% of total crop area in the taluk. Pulses are grown in 9.40% of the total area. Paddy is grown in 9880 Ha (23.57 %) and short duration crop vegetables are grown in 2870 Ha (6.85 %) of the crop area which requires groundwater during post monsoon season especially during summer.

**Table-4: Cropping pattern 2018-2019 (Ha)**

| Crop | Paddy | Maize | Jowar | Ragi | Pulses | Fruits | Vege tables | Oil seeds | Sugar cane | Flower crops | Coconuts/ Arecanut | Total crop |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area(ha) | 9880 | 4855 | 1142 | 10275 | 3940 | 1221 | 2870 | 551 | 1663 | 301 | 5216 | 41914 |
| Area % | 23.57 | 11.58 | 2.72 | 24.51 | 9.40 | 2.91 | 6.85 | 1.31 | 3.97 | 0.72 | 12.44 | 100 |

**Source:** District at a glance 2019-20, Govt. of Karnataka

About 6.05% of the geographical area is covered by forest. It is observed that net sown area accounts for 54.58% and area sown more than once is 16.88 % of total geographical area in Holenarsipura taluk. Area not available for cultivation, the other uncultivable land and fallow land cover are 27.63%, 1.44% and 10.29 % respectively of total geographical area. About 60.77 % of net area irrigated is from bore/ tube wells, 28.99 % are from canals and 10.24 % from tanks constituting 39.23 % of irrigation is from surface water and 60.77 % from groundwater. Thus major source of irrigation is groundwater **(Fig.-2)**. The details of land use and the details of Irrigation are given in **Table 5 and 6** respectively. The land use pattern is given in **Fig.-3**.

**Table-5: Details of land use 2018-2019 (Ha)**

| Total Geographical Area | Area under Forest | Area not available for cultivation | Other uncultivable land | Fallow land | Net sown area | Area sown more than once | Gross sown area |
|---|---|---|---|---|---|---|---|
| 59524 | 3604 | 16447 | 860 | 6123 | 32490 | 10045 | 42535 |
| % of the area | 6.05 | 27.63 | 1.44 | 10.29 | 54.58 | 16.88 | 71.46 |

**Source:** District at a glance 2019-20, Govt. of Karnataka

**Table-6: Details of Irrigation**

| Source of Irrigation | Length in Km/No of structures | Gross area Irrigated (Ha) | Net area Irrigated (Ha.) | % of area |
|---|---|---|---|---|
| Canals | 205 | 5891 | 5750 | 28.99 |
| Tanks | 333 | 2081 | 1610 | 10.24 |
| Wells | 5 | 0 | 0 | 0.00 |
| Tube wells | 2482 | 12349 | 9622 | **60.77** |
| Lift Irrigation | 10 | 0 | 0 | 0.00 |
| Other Sources | 0 | 0 | 0 | 0.00 |
| Total | 205/2830 | 20321 | 16982 | 100 |

**Source:** District at a glance 2019-20, Govt. of Karnataka

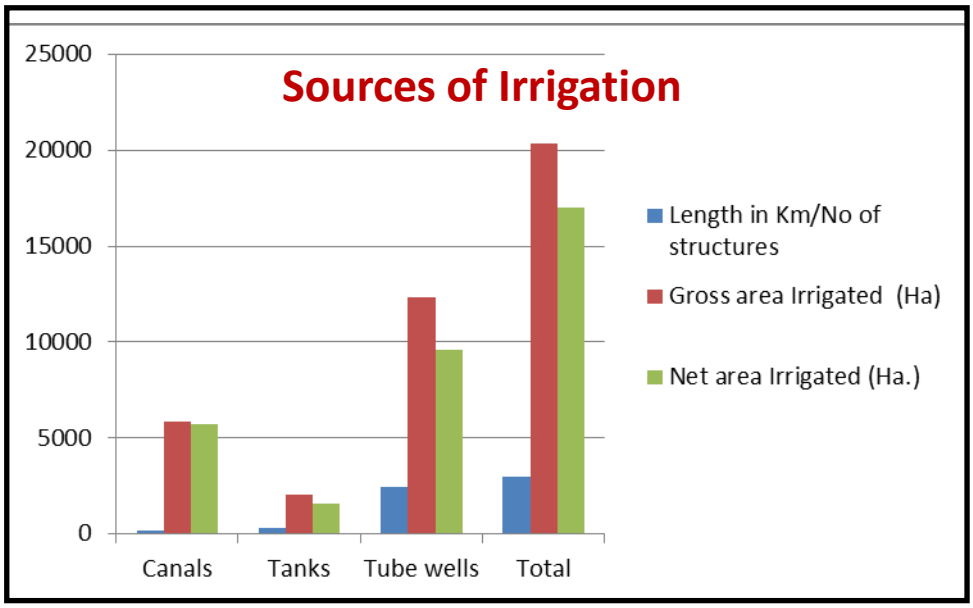



**Fig 2-Sources of Irrigation**

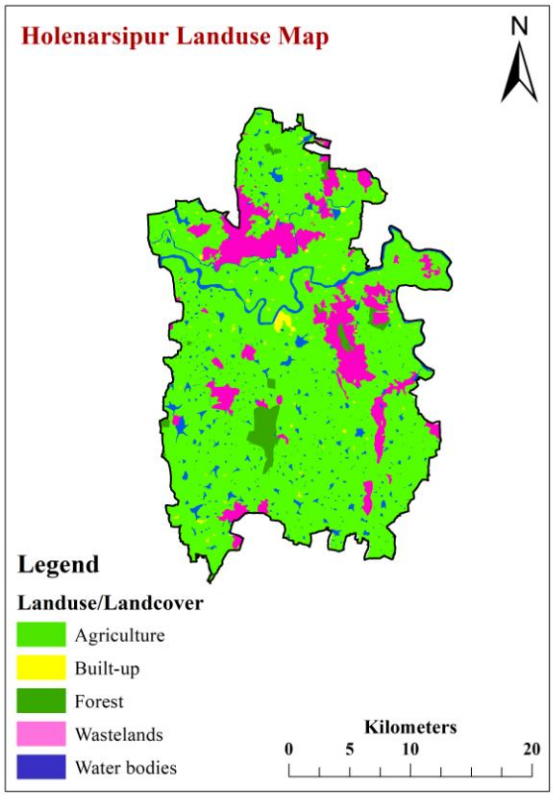



**Fig. 3: Land use/land cover map**

## 1.5 Geomorphology, Physiography & Drainage

The geomorphology of an area is the external appearance of landforms that gives a reliable picture of the underground strata and its physio-chemical condition. The different formations and the layer confirms and cogent to its geomorphology. The major part of the taluk area is occupied by plains followed by hills and pediments. The general slope of the area is towards south direction (**Fig.4**).

Hemavathi River is the major river draining the taluk which flows from west to east with the tributary streams. The taluk falls in the Cauvery basin. The tank system is well developed in the Taluk. The general drainage pattern is dendritic to sub-dendritic in nature (**Fig.5**).

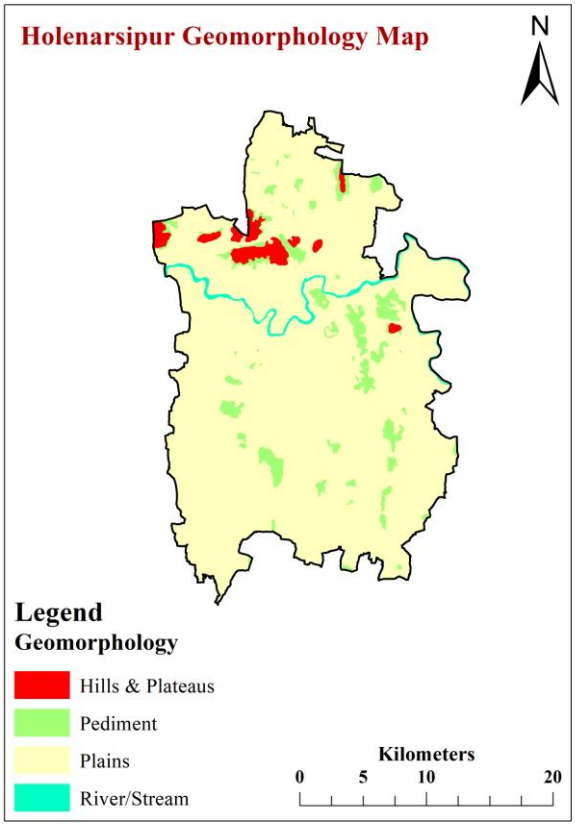



**Fig. 4: Geomorphology map**

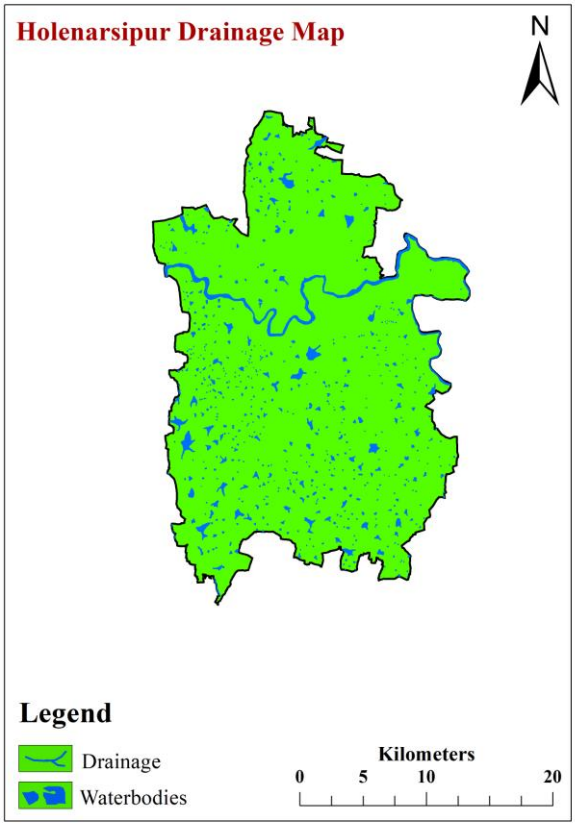



**Fig. 5: Drainage map**

## 1.6 Soil

Soils play a major role in hydrologic control of the infiltrating water. Soils are generally classified by taking their color, texture, fertilities and chemical combinations includes salts, minerals and the solution effect over them. Most of the area consists of clayey and clayey skeletal soils. Clayey mixed soil is noticed in eastern part of the taluk **(Fig.6).**

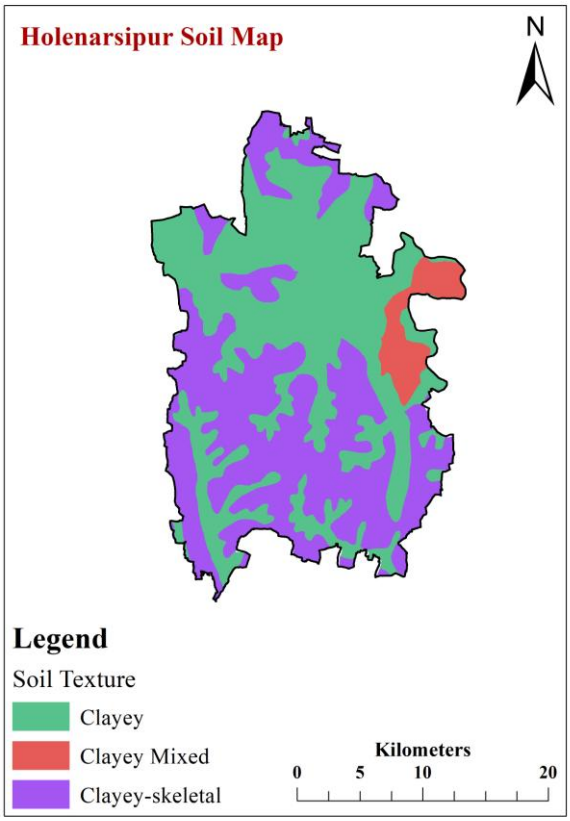



**Fig. 6: Soil map**

## 1.7 Groundwater resource availability and extraction

As per the groundwater resource estimation 2020 (**Table 7a**), the data on groundwater resources shows that the Net annual extractable groundwater resource **10539** ham. The existing gross groundwater extraction for irrigation is **5544** ham. The stage of groundwater development is **57**% and falling under '**Safe'** category.

**Table.7(a) Dynamic Groundwater Resource, (March 2020 Figures in Ham)**

| Net Annual Annual Extractable Groundwater Resource | Existing Groundwater Extraction for Irrigation Use | Existing Groundwater Extraction for Industrial Use | GW Extraction for Domestic Use | Total Extraction | Annual GW Allocation for Domestic Use as on 2025 | Net Ground Net Groundwater Availability for future use | Stage of GW Extraction (%) | Category |
|---|---|---|---|---|---|---|---|---|
| 10539 | 5544 | 0 | 515 | 6059 | 566 | 5326 | 57 | **SAFE** |

## 1.8 Total Groundwater resource availability

Aquifer wise total ground water resources up to 200 m depth as on March 2017 are given in **Table.7 (b)** below.

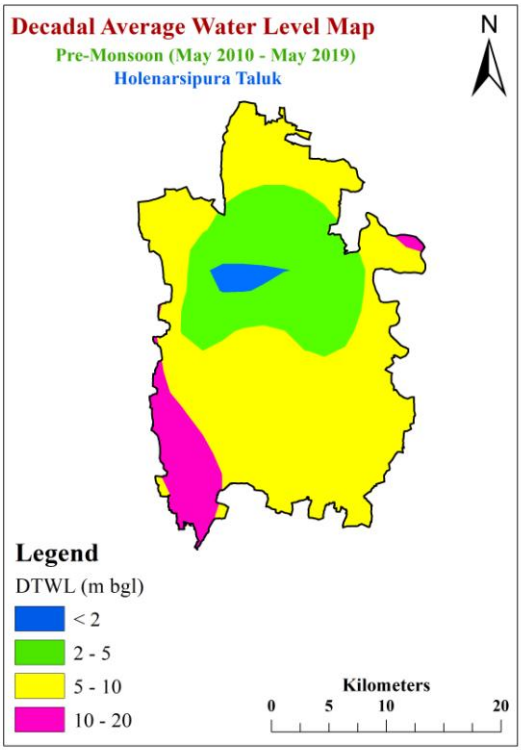
**Table.7 (b): Total GW Resources (2017) (Ham)**

| Taluk | Annual Replenishable GW resources | Fresh In-storage GW resources | | Total availability of fresh GW resources |
|---|---|---|---|---|
| | | Phreatic | Fractured (Down to 200m) | Dynamic +Fresh in-storage |
| Holenarasipura | 9449 | 6539 | 1083 | 17070 |

**(Source: Report of Groundwater Resources of Karnataka - March-2017)**

## 1.9 Water level behavior

The water level data have been monitored from the representative dug wells and borewells under ground water level monitoring programme for both pre and post monsoon seasons during 2019 in Aquifer I. During pre-monsoon, the decadal average water level ranges from 1.46 to 19.10 mbgl **(Fig.7)**, whereas in post-monsoon it varies from 1.39 to 16.04 mbgl **(Fig.8).** Whereas in Aquifer II, the water level ranges from 17.65 to 66.5 mbgl in premonsoon and 3.5 to 28.7 mbgl during post monsoon as per Groundwater Department, Govt of Karnataka data. However, the most frequent depth to water level range during the pre-monsoon period is 2 to 10 m.



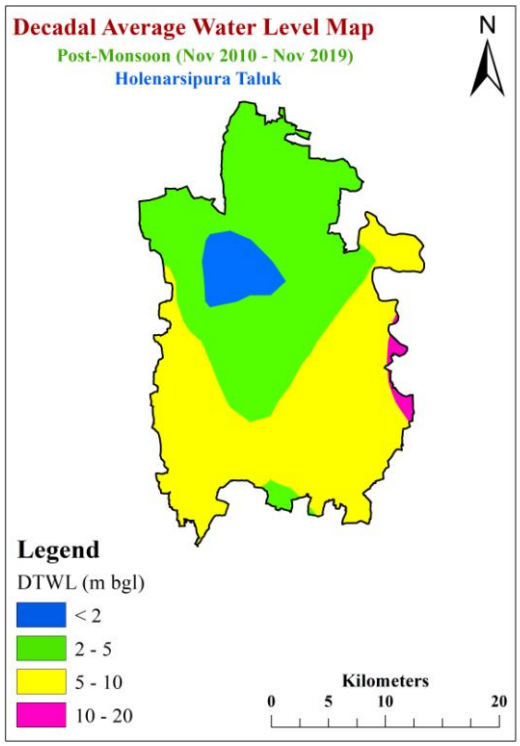




**Fig.7:Pre-monsoon decadal average water level**

**Fig.8:Post-monsoon decadal average water level**

## 2. AQUIFER DISPOSITION

The occurrence and movement of water in the subsurface is broadly governed by geological frameworks i.e., nature of rock formations including their porosity (primary and secondary) and permeability. The principal aquifers in the area are Banded Gneissic Complex, Schist and Ultramafic rocks and the occurrence and movement of groundwater in these rocks is controlled by various factors and it primarily depends on the degree of interconnection of secondary pores/voids developed by fracturing and weathering in the hard rock.

### 2.1 Aquifer Types

In Holenarasipura Taluk, there are mainly two types of aquifer systems

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

ii. **Aquifer-II (Fractured aquifer)** comprising Fractured Banded Gneissic Complex / Ultramafic/ Schist

In Holenarasipura Taluk, Banded gneissic complex occupies major part of the taluk area, Schist and Ultramafic formations are noticed as a isolated pocket. (**Fig.9**). Groundwater occurs within the weathered and fractured gneisses, schist and ultramafic under water table condition and semi-confined condition. In the Taluk, bore wells were drilled from a minimum depth of 115 mbgl to a maximum of 200 mbgl. Depth of weathered zone (Aquifer-I) ranges from 12 mbgl to 30 mbgl. Groundwater exploration reveals that aquifer-II, fractured formation was encountered between the depths of 12 to 181 mbgl. The yield of this aquifer unit II ranges from 0.5 to 2.4 lps and dry at some places. Tranmissivity ranges from 10 to 46 $m^{2/}$day. During monsoon period the wells tapping this aquifer zone sustains for 2 to 4 hrs /day of pumping, while during non-monsoon period (May to July) sustains for 1 to 3 hour/day of pumping**.** In general groundwater in fractured aquifer is potable. 2D and 3D aquifer disposition maps are shown in **Figure.10 and 11.**

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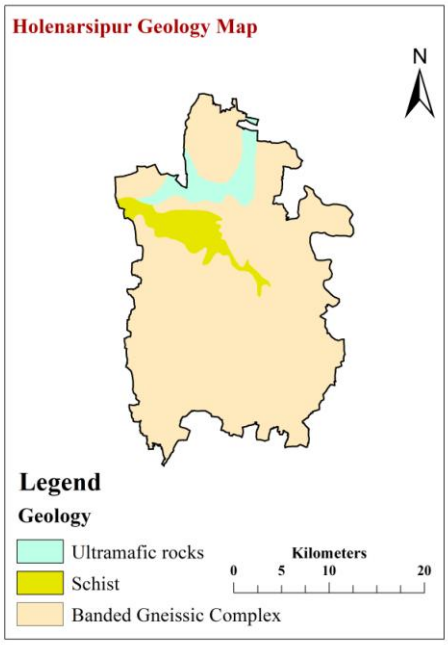


**Fig.9: Geology map**

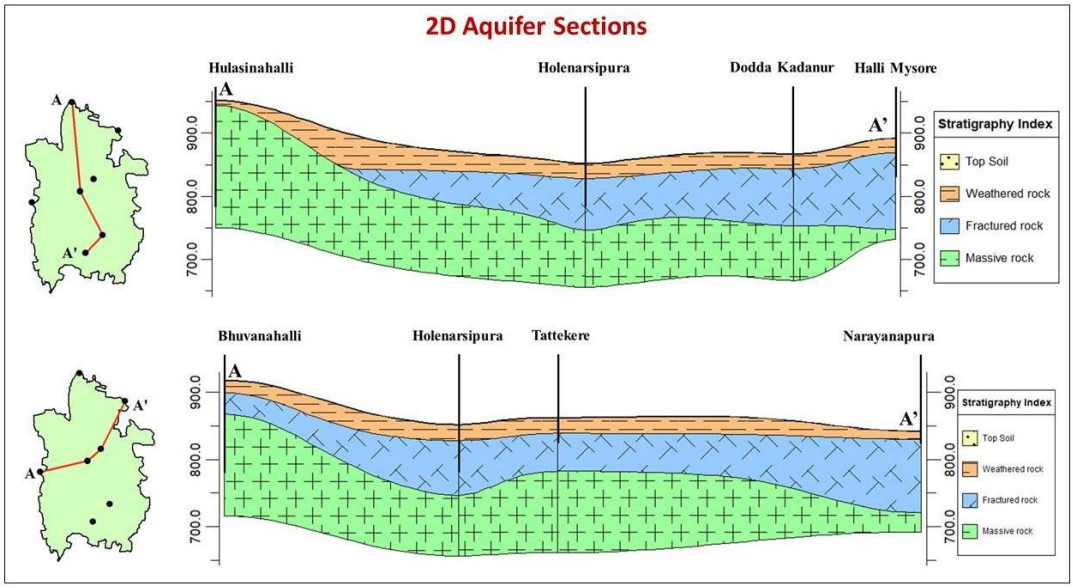


**Fig. 10: 2D Aquifer section**

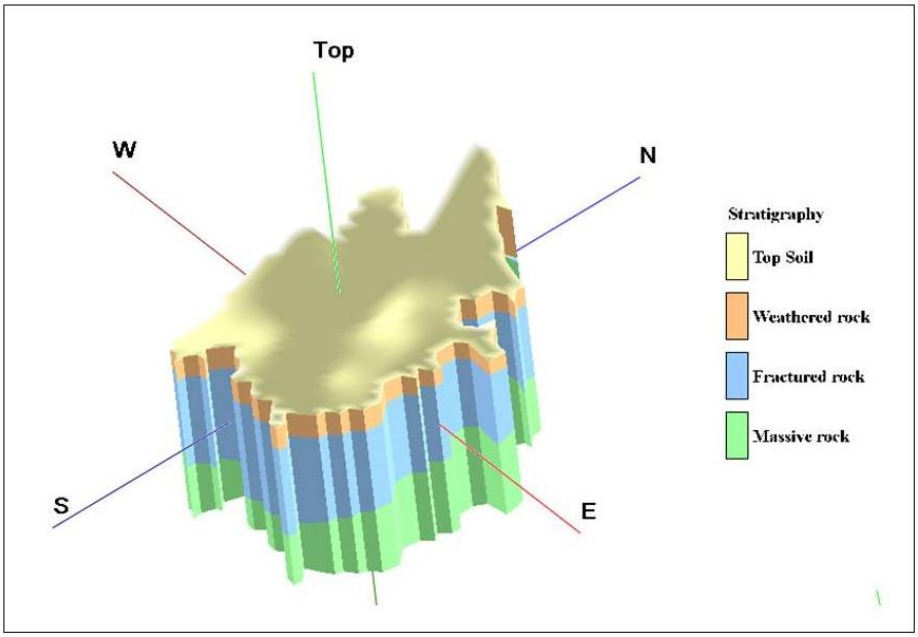


**Fig.11: 3D Aquifer model**

## 3. GROUNDWATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

The main groundwater issues are limited Aquifer Thickness/ Sustainability, deeper water levels especially in Aquifer II, declining water level trend which are all inter-related or inter dependent. Hence, ground water dependedant areas and pockets get affected due to shortage in supply, particularly during the summer.

## 3.1 Comparison of Groundwater Resource and Extraction

The Dynamic Groundwater Resource 2017 and as on 2020 have been summarized and are shown in **Table.8**. It is observed that the groundwater availability in 2020 is more compared to 2017 due to water conservation measures and also groundwater extraction has for irrigation has increased in 2020. Groundwater resource availability and extraction over the years given in **Fig.12**.

**Table 8: Comparison of groundwater availability and draft scenario (in ham)**

| Holenarasipura taluk | GW Availability | GW Extraction for Irrigation | GW Extraction for all uses | Stage of GW Extraction % |
|---|---|---|---|---|
| March 2017 | 9449 | 5245 | 5611 | **59** |
| March 2020 | 10539 | 5544 | 6059 | **57** |

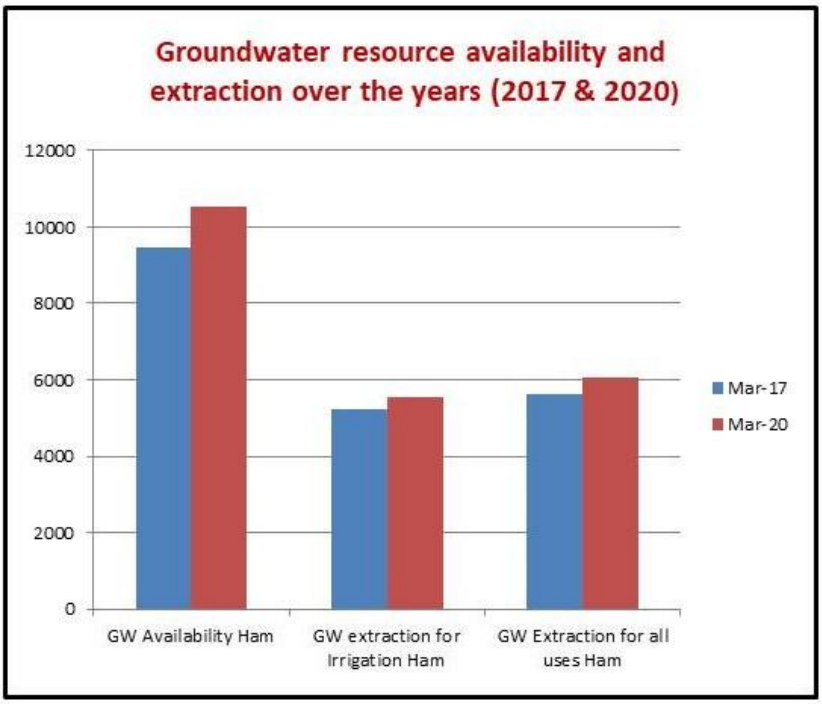


**Fig.12: GW resource over the years**

## 3.2 Chemical quality of groundwater and contamination

The quality of phreatic and of fractured aquifer in Holenarsipura taluk has been evaluated from wells inventoried during the field survey as monitoring wells of CGWB and State representing fractured aquifer is inadequate. Total 20 samples were collected, 10 each from phreatic aquifer and fractured aquifer. The well wise chemical analysis data of the samples representing the phreatic and fractured aquifer are given in the **Table.9**.

Electrical conductivity is the indicator of the total mineral content of water and hence it indicates the total dissolved solids (TDS) present in water. TDS of water determines its usefulness to various purposes. Generally, water having TDS <500 mg/L is good for drinking and other domestic uses. However,

in the absence of alternative sources TDS up to 2000 mg/L may be used for drinking purposes. In phreatic aquifer groundwater quality is fresh and ranging from 507 to 1860 (µS/cm at 25°C). Map showing the EC distribution in ground water is shown in **Fig.13**.

Nitrate ranges from 4 to 141 mg/l. In phreatic aquifer 80 % of wells analyzed have recorded nitrate greater than the permissible limit of 45 mg/l. In general, the groundwater quality of phreatic aquifer is potable. All the groundwater samples of phreatic aquifer generally have recorded the chemical parameters within the desirable limit. Map showing the nitrate distiribution in ground water is presented in **Fig.14.** In fractured aquifer 20 % of wells analysed have recorded nitrate greater than the permissible limit of 45 mg/l.

Chloride and Fluoride are within desirable limit (Figure 12). In general, groundwater quality in Holenarsipura taluk is good for drinking purpose except in some areas, where nitrate is found to be greater than the permissible limit as per Indian Standard IS 10500: 2012 for Drinking Water specification. Map showing the fluoride distribution in ground water is presented in **Fig.15.**

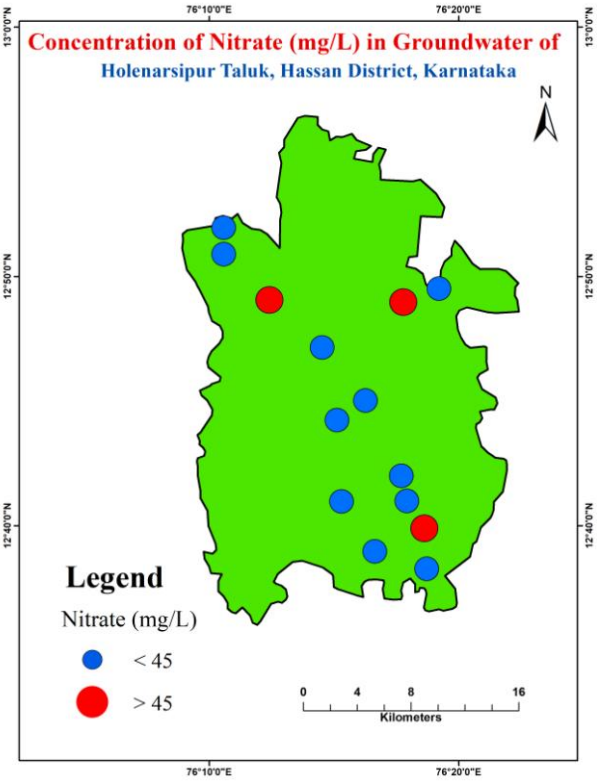


**Fig.13: EC distribution map**

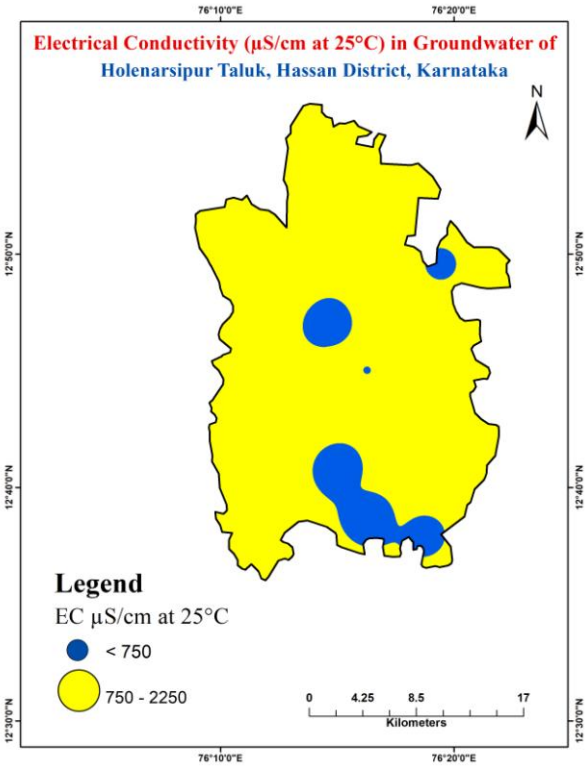


**Fig.14: Nitrate distribution map**

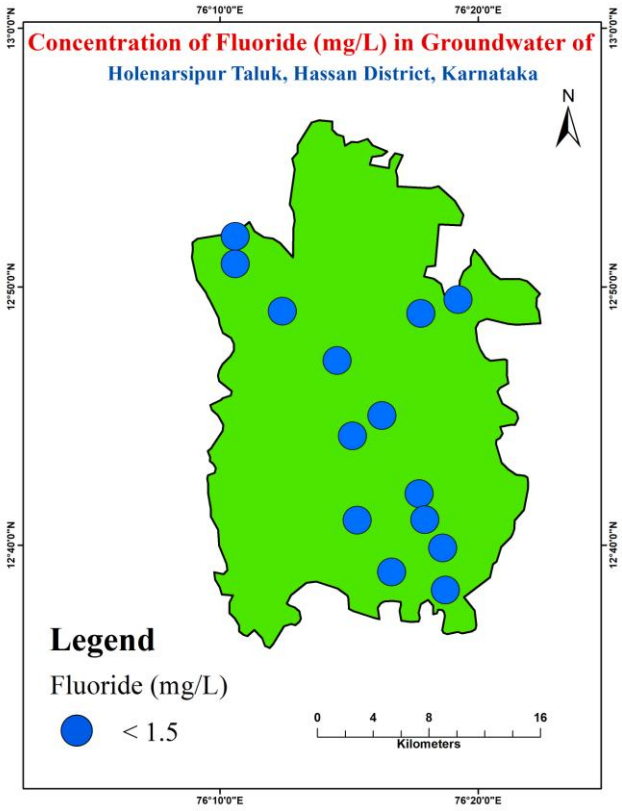


**Fig.15. Map showing the nitrate distribution**

Uranium is found in fractured aquifer of three groundwater samples exceeding the WHO Guideline values of 30 ppb. The Indian Standard IS 10500: 2012 for Drinking Water specification has specified the maximum acceptable limits for radioactive residues as alpha and beta emitters, values in excess of which render the water not suitable. These requirements take into account all radioactive elements including Uranium. No individual radioactive elements have been specifically identified. Uranium exceeds 30 ppb in Hirenahallikoppalu, Tejur and Hanekannambadi villages. It is the localized occurrence of Uranium concentration and detailed specific studies have to be carried out regarding Uranium behavior during rock water interaction. Further, repeat sample collection for Uranium studies will give the accurate and precise results to further ascertain the pre ence of Uranium in ground water which is very much needed in view of the above results.Map showing the Uranium distribution in the three presently reported pockets are shown in **Fig.16**.

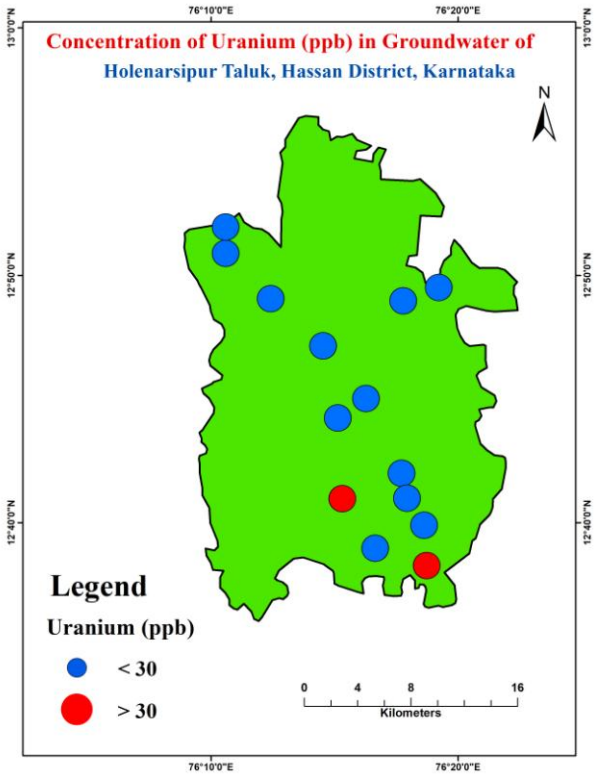


**Fig.16. Map showing the concentration of Uranium in ground water**

**Table 9: Groundwater quality of Holenarasipura taluk (2022)**

| S.no | Location | Source of GW | PH | EC | TH | Ca | Mg | Na | K | CO3 | HCO3 | Cl | SO4 | NO3 | F | U |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | µS/cm | | mg/L | | | | | | | | | | ppb |
| 1 | Jakavalli Koppal | BW | 7.72 | 636 | 305 | 46 | 46 | 10 | 2.5 | 0 | 290 | 32 | 15 | 13 | 0.70 | 1.25 |
| 2 | Mudalahippe | DW | 7.96 | 1423 | 275 | 52 | 35 | 71 | 199.6 | 0 | 439 | 171 | 57 | 76 | 1.30 | 1.58 |
| 3 | Holenarsipur | DW | 7.93 | 507 | 125 | 28 | 13 | 29 | 59.6 | 0 | 244 | 21 | ND | 4 | 0.70 | 1.08 |
| 4 | Bedanahalli | BW | 7.67 | 745 | 225 | 52 | 23 | 58 | 7.5 | 0 | 293 | 36 | 37 | 45 | 0.50 | 18.23 |
| 5 | Doddakadanuru | BW | 7.9 | 1074 | 305 | 48 | 45 | 109 | 2.6 | 0 | 494 | 36 | 87 | 8 | 0.80 | 14.32 |
| 6 | Kabburu Basaveswara | BW | 7.57 | 1012 | 275 | 40 | 42 | 99 | 2.5 | 0 | 403 | 43 | 45 | 43 | 0.70 | 15.34 |
| 7 | Yedagowdanahalli | BW | 8.25 | 1053 | 575 | 26 | 123 | 29 | 3.2 | 0 | 580 | 57 | 21 | 54 | 0.60 | 2.79 |
| 8 | Hanekannambadi | BW | 8 | 664 | 310 | 32 | 56 | 32 | 2.9 | 0 | 397 | 21 | 19 | 12 | 0.50 | 39.47 |
| 9 | Jogikoppalu | HP | 7.68 | 635 | 205 | 38 | 27 | 59 | 4.8 | 0 | 258 | 36 | 46 | 16 | 0.60 | 0.81 |
| 10 | Tejur | BW | 7.95 | 624 | 150 | 20 | 24 | 77 | 4.5 | 0 | 268 | 36 | 38 | 12 | 0.70 | 48.80 |
| 11 | Lakkur | BW | 7.97 | 990 | 285 | 54 | 36 | 95 | 6.4 | 0 | 415 | 64 | 52 | 39 | 1.00 | 24.80 |
| 12 | Yalleshpura | DW | 8.17 | 1554 | 355 | 76 | 40 | 64 | 107.5 | 0 | 287 | 188 | 85 | 141 | 0.70 | 1.06 |
| 13 | Halekote | DW | 7.96 | 1398 | 330 | 70 | 38 | 105 | 129.2 | 0 | 409 | 146 | 78 | 45 | 0.70 | 3.02 |
| 14 | Nyamanahalli | BW | 7.85 | 894 | 350 | 50 | 54 | 52 | 4.0 | 0 | 311 | 75 | 49 | 33 | 0.80 | 0.98 |
| 15 | Kuppe | DW | 7.32 | 1860 | 505 | 104 | 60 | 185 | 8.3 | 0 | 354 | 280 | 115 | 50 | 0.89 | 4.21 |
| 16 | Hirenahallikoppalu | BW | 7.71 | 1270 | 375 | 80 | 43 | 115 | 12.8 | 0 | 317 | 177 | 122 | 13 | 0.63 | 175 |
| 17 | Odanahalli | HP | 8.03 | 1690 | 565 | 120 | 64 | 118 | 10.4 | 0 | 482 | 188 | 117 | 49 | 0.46 | 0.35 |
| 18 | Haragowdanahalli | HP | 8.04 | 1620 | 155 | 32 | 18 | 125 | 287.2 | 0 | 525 | 149 | 87 | 48 | 1.07 | 11 |
| 19 | Ichanahalli | HP | 7.7 | 1500 | 185 | 42 | 19 | 155 | 169 | 0 | 488 | 167 | 87 | 48 | 1.14 | 3.11 |
| 20 | Hariharapura | HP | 7.99 | 1180 | 370 | 88 | 36 | 92 | 7.1 | 0 | 464 | 71 | 55 | 51 | 0.65 | BDL |

# 4. GROUNDWATER RESOURCE ENHANCEMENT AND PROPOSED MANAGEMENT STRATEGY

## 4.1 Resource Enhancement by Supply Side Interventions

The Master Plan for Artificial recharge to ground water prepared by CGWB (2020) recommended to recharge the de-saturated and dried-up phreatic aquifer r(Aq-I) in the taluk, through construction of artificial recharge structures such as Check dams and Percolation tanks **(Table.10).** As of now, recharging dried-up phreatic aquifer in the taluk, through construction of artificial recharge and watershed treatment structures has already been taken up by state Government agencies and are being implemented under MGNREGA. The choice of recharge structures should be site specific and such structures need to be constructed in areas already identified as feasible for artificial recharge. The structures proposed in the taluk through utilizing the uncommitted surface runoff of 2.484MCM (CGWB 2020) is also presented in Table 11. By constructing 9 check dams and 2 percolation tanks, 0.002 lakhs hectares of additional irrigation potential is likely to be created. Area feasible for artificial recharge and the tentative location of the recharge structures in Holenarasipur taluk is shown in **Fig.17.** The tentative list of the proposed Percolation tanks and Check dams are listed **in Table 11a & 11b.**

**Table-10: Details of Proposed AR structures**

| | |
|---|---|
| Geographical area | 602 |
| Area feasible for AR | 389 |
| Non committed monsoon runoff available (MCM) | 2.484 |
| Number of Check Dams | 9 |
| Number of Percolation Tanks | 2 |
| Tentative total cost of the project (Rs. in lakhs) | 138.541 |
| Expected likely recharge (MCM) | 1.863 |
| Additional likely irrigation Potential (Lakh hectares) | 0.002 |

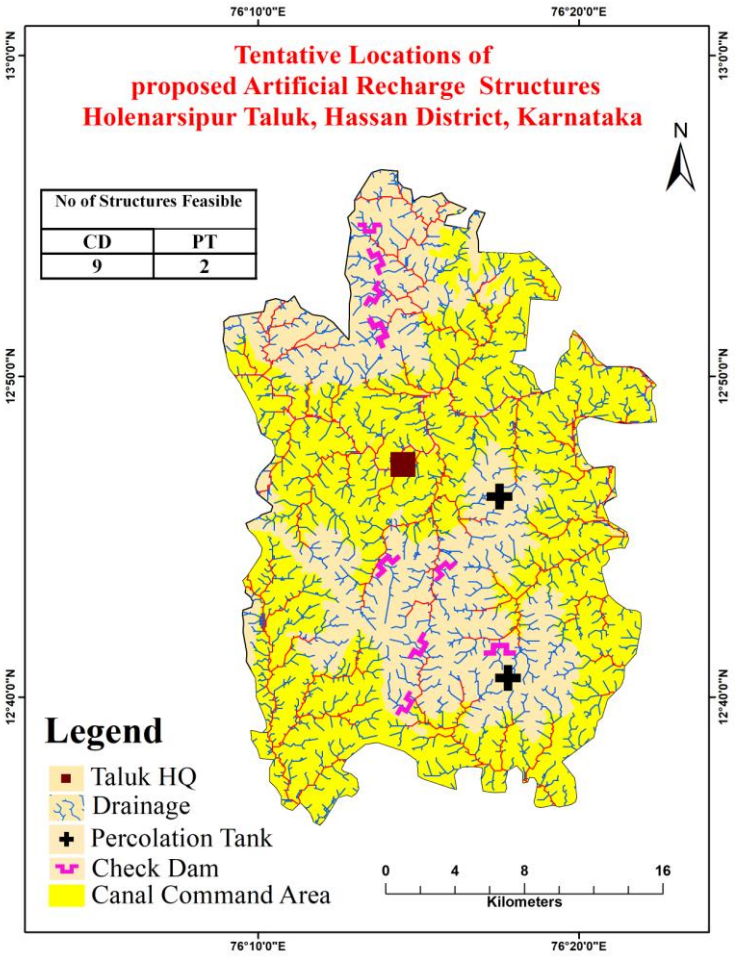


**Fig.17 Tentative Locations of AR Structures**

**Table.11 (a) Tentative Locations of Proposed Check Dams, Holenarasipur Taluk, Hassan District.**

| SL. No | Longitude | Latitude | Village | Grama Panchayat | Taluk |
|---|---|---|---|---|---|
| 1 | 76.24375000 | 12.66000000 | H.Hindalahalli | Kytanahalli | Holenarasipur |
| 2 | 76.25137655 | 12.68949379 | T.Mayagondanahalli | Tatanahalli | Holenarasipur |
| 3 | 76.29177833 | 12.69189000 | Bachanahalli | Doddakadanur | Holenarasipur |
| 4 | 76.26083333 | 12.73333333 | Menaganahalli | Doddakadanur | Holenarasipur |
| 5 | 76.23250000 | 12.73500000 | Haralahalli | Ichanahalli | Holenarasipur |
| 6 | 76.22984538 | 12.85787801 | J.I.Shigaranahalli | Hariharapura | Holenarasipur |
| 7 | 76.22846910 | 12.87583333 | J.I.Thavanandhi | Hariharapura | Holenarasipur |
| 8 | 76.22958333 | 12.89500000 | Theranya | Malali | Holenarasipur |
| 9 | 76.22449566 | 12.90885938 | Karaganahalli | Malali | Holenarasipur |

*(Source: Master Plan, CGWB, 2020. It is likely that the number of structures proposed may vary depending upon the ground truth verification and feasibility criteria)*

**Table.11 (b) Tentative Locations of Proposed Percolation Tanks, Holenarsipura Taluk, Hassan District.**

| SL. NO | Longitude | Latitude | Village | Grama Panchayat | Taluk |
|---|---|---|---|---|---|
| 1 | 76.29648996130 | 12.67647877000 | Ragihalli Kaval | Nagaranahalli | Holenarsipura |
| 2 | 76.29201939820 | 12.77078226650 | Srimatadha Kaval | Mudalahippe | Holenarsipura |

*(Source: Master Plan, CGWB, 2020. It is likely that the number of structures proposed may vary depending upon the ground truth verification and feasibility criteria)*

## 4.2 Demand Side Interventions

### 4.2.1 Advanced irrigation practices

Principal crops in the area are Ragi, Paddy, Maize,Jowar, Pulses and vegetables. **About 60.77 % of net area irrigated is from bore through ground water source.** In view of this, **Water Use Efficiency** (**WUE**) practices like Drip irrigation needs to be strengthened to save irrigation water by way of precision farming mechanism. This ultimately enhances the area under irrigation potential. The details of the resource enhancement through water conservation and artificial recharge taluk and also through Water Efficiency practices in Irrigation are shown in **Table.12**

**Table 12: Details of Resource Enhancement**

| Sl. No. | **Resource Details** | **As per 2020 Estimation** |
|---|---|---|
| 1 | Net Ground Water Availability in Ham | 10539 |
| 2 | Existing ground water draft for all uses in Ham | 6059 |
| 3 | Existing Stage of Ground Water Development in percentage % | **57** |
| 4 | Expected Recharge from Artificial Recharge sources in Ham | 186 |
| 5 | Cumulative Ground water availability in Ham | 10725 |
| 6 | Expected improvement in stage of ground water development % | **56** |
| 8 | Saving due to adopting Water Use Efficiency in Ham | 1108 |
| 9 | Ground water availability after AR & WUE in Ham | 11833 |
| 10 | Expected improved stage of ground water development after implementation of AR & WUE % | **51** |
| 12 | Cumulative improved stage of ground water development after all implementation % | **6%** |

### 4.2.2 Change in cropping pattern

Farmers are facing inadequacy of groundwater for agriculture during summer and can opt for more rain-fed millets and water efficient Pulses for agricultural production.

## 4.3 Ground Water Development Plan

In Holenarasipura taluk, the present stage of ground water extraction (2020) is 57 % with net ground water availability for future use is 5326 ham and total extraction is 6059 ham(2020) The ground water draft for irrigation purpose is 5544 ham, thus indicating that ground water irrigation needs to be encouraged in the area after considering the "Safe" level of extraction of 70%. As per the statistical data of 2019-20, about 60.77 % of net area irrigated is from bore/ tube wells, 28.99 % are from canals and 10.24 % from tanks constituting 39.23 % of irrigation is from surface water and 60.77 % from groundwater.

For this, it is imperative to have a robust ground water resource development plan for the area, which can be implemented in scientific manner. The implementation of the plan needs to be based on site specific detailed hydrogeological, geophysical and scientific surveys for pinpointing the sites for construction of dug wells and bore wells.

As per the conservative estimate and after considering the average unit draft figure for the taluk, about 400 dug wells (10-15 m depth; 3 to 5 m diameter) are recommended to be constructed in feasible areas. Further. as per the estimate about, 1500 bore wells (100 to 200 m depth; 150 mm dia) are also recommended to be drilled in feasible areas so as to maintain the safe category of the taluk. The likely additional irrigation potential which can be created considering prevailing crop water requirement for the area is will be 2280 ha.

## 4.4 Conjunctive use plan in water logged area

About 352 sk.km (35200 hectares) of the taluk is covered by canal command area of Hemavathi/Harangi/Lift Irrigation Projects. As of now, the command area is free from water logged and associated issues (Source: CADA as on March 2021). In spite of this condition, conjunctive use plan is also recommended to benefit the water deficit and tail end area of the irrigation command.

## 4.5 Regulation and Control

As per the resource estimation – 2020, Holenarasipura taluk falls under **Safe** category with the stage of ground water extraction of 57**%**. However, the mandatory guidelines like rainwater harvesting and artificial recharge issued by Karnataka Ground Water Authority needs to be strictly implemented in the taluk, so that quality of ground water will improve in due course of time.

## 4.6 Other interventions proposed

- Remedial measures need to be adopted in the areas affected by Nitrate rich groundwater through artificial recharge and water conservation etc.
- The choice of recharge structures should be site specific and such structures need to be constructed in areas already identified as feasible for artificial recharge.
- Periodical maintenance of artificial recharge structures should be incorporated in the Recharge Plan.
- Augmenting surface water supply from feasible and dependable source..
- Intense monitoring of water level is recommended to keep an eye on water level trend in the Taluk.
- Awareness programmes and practice of participatory approach needs to be strengthened with the involvement of all the stake holders for sustainable management.

# 5. SUMMARY AND RECOMMENDATIONS

- **Holenarasipura taluk** enjoys semi-arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Southern Dry agro-climatic zone of Karnataka state and is categorized as drought prone.
- As per the resource estimation – 2020, Holenarasipur taluk falls under “safe” category with the stage of ground water extraction is 57 %. However, there is need to formulate management strategy to tackle the water scarcity related issues in ground water dependent pockets and ground water quality affected villages. It is suggested to adopt a scientific and multi-pronged ground water management strategy covering supply side and demand side interventions aspects as mentioned in the management plan suggested above.
- **Ground water resource enhancement by supply side interventions**: Quantity of surface water available through non-committed surface run-off is estimated to be 2.484 MCM. This can be used to recharge the aquifer mainly through check dams and percolation tanks. The volume of water expected to be recharged is 1.863 through these AR structures. The approximate cost estimate for construction of these AR structures is Rupees 138 lakhs. However, the figures given are tentative and pre-field studies / DPR are recommended prior to implementation of these recharge structures.

- **Ground water resource enhancement by demand side interventions**: At present about 60.77 % of the irrigated area is by dug wells and bore wells (ground water). It is proposed to adopt micro irrigation (drip) techniques in fruits and vegetables which is likely to save about 1108 ham of ground water and thus enhancing the cumulative net availability of ground water as discussed above.
- **Ground Water Development Plan:** As per the conservative estimate and after considering the average unit draft figure for the taluk, about 400 dug wells (10-15 m depth; 3 to 5 m diameter) are recommended to be constructed in feasible areas. Further. as per the estimate about, 1500 bore wells (100 to 200 m depth; 150 mm dia) are also recommended to be drilled in feasible areas so as to maintain the safe category of the taluk. The likely additional irrigation potential which can be created considering prevailing crop water requirement for the area is will be 2280 ha.
- **Conjunctive use plan in water logged area:** About 352 sk.km (35200 hectares) of the taluk is covered by canal command area of Hemavathi/Harangi/Lift Irrigation Projects. As of now, the command area is free from water logged and associated issues(Source: CADA as on March 2021). In spite of this condition, conjunctive use plan is also recommended to benefit the water deficit and tail end area of the irrigation command.
- **Drinking water Supply:** In view of ground water contamination with mainly higher Nitrate, drinking water supply from surface water needs to be explored/ ensured.
- **Uranium mitigation measures:** Uranium is found in fractured aquifer of three groundwater samples exceeding the WHO Guideline values of 30 ppb. Repeat sample collection for Uranium studies will give the accurate and precise results to further ascertain the pre ence of Uranium in ground water which is very much needed
- **Regulation and control:** Holenarasipura taluk is categorized as **"Safe"** (as per 2020 estimations). However, the mandatory guidelines like rainwater harvesting and artificial recharge issued by Karnataka Ground Water Authority needs to be strictly implemented in the taluk so that quality of ground water will improve in due course of time.
- **Participatory management:** Awareness programmes and practice of participatory approach needs to be strengthened with the involvement of all the stake holders for sustainable management.

- **Other Management Options proposed:**
    - Scientific disposal of sewage water by the concerned agency
    - Periodical maintenance of artificial recharge structures is recommended for better recharge and long life of the structure
    - RTRWH from each building and in-situ storage and use /mixing with surface water supply or groundwater in urban areas.
    - Priority to promote recycle and reuse of grey water effectively in urban pockets.
- **Water Linkages with other Activities:** Water sector has strong linkages with other developmental activities. Hence, the proposed management plans cannot be considered as static and needs to be reviewed and improved from time to time.