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

Yelandur Taluk, Chamarajanagara District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु

South Western Region, Bengaluru

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भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
एवं गंगा संरक्षण विभाग
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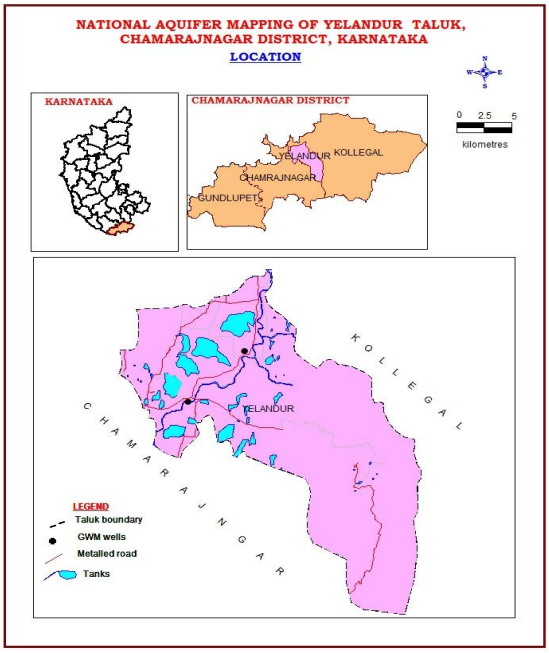
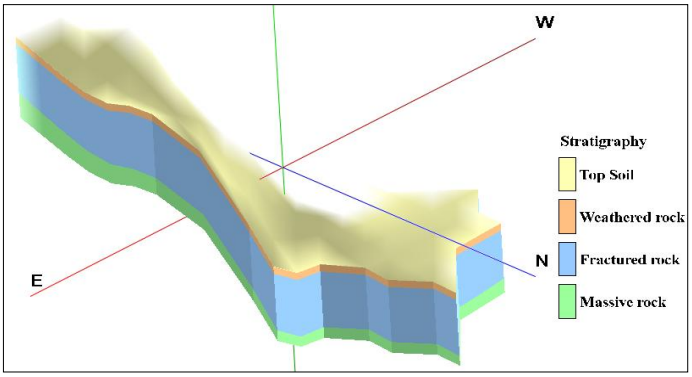
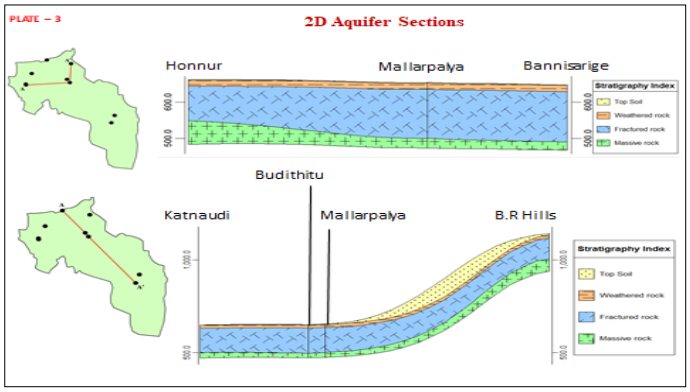
South Western Region,
Bengaluru

AQUIFER MAPS AND MANAGEMENT PLAN, YELANDUR TALUK, CHAMARAJANAGARA DISTRICT, KARNATAKA STATE

(AAP: – 2020-2021)







By

V.Hemalatha, Assistant Hydrogeologist, CGWB, SWR, Bengaluru

AUGUST 2022

AQUIFER MAPS AND MANAGEMENT PLAN, YELANDUR TALUK, CHAMARAJANAGARA DISTRICT, KARNATAKA STATE

(AAP: – 2020-2021)

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AQUIFER MAPS AND MANAGEMENT PLAN, YELANDUR TALUK, CHAMARAJANAGARA DISTRICT, KARNATAKA STATE

1 SALIENT INFORMATION

Name of the Taluk: **YELANDUR**

District: **CHAMARAJANAGARA**

State: Karnataka

Area: 264.73 sq.km

Population: 82,069

1.1 Aquifer Management Study Area

Aquifer Mapping Studies have been carried out in Yelandur taluk, Chamarajanagara district of Karnataka, covering an area of 264.73 sq.kms under National Aquifer Mapping Project. The Yelandur taluk is located between North Latitudes 11° 53' 15" and 12° 08' 12"and East Longitudes between 76° 59' 13" and 77° 11' 02". The study area is bounded on the East by Kollegala taluk of Chamarajanagara District, on the North by T.Narasipura Taluk of Mysore District, on the South by Tamil Nadu State, on the West by Chamarajanagara Taluk of Chamarajanagara Dsitrict. Location map of Yelandur taluk of Chamarajanagara district is presented in **Fig-1.** Yelandur is taluk headquarters. There are 28 villages and 12 Gram panchayats in this taluk.

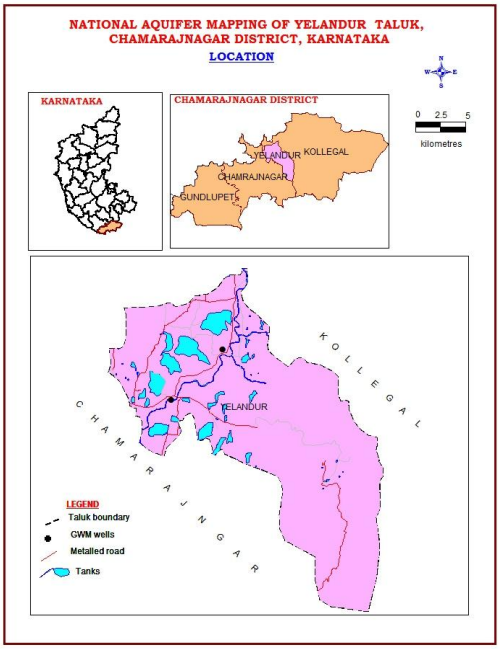


Fig-1: Location map

1.2 Population

According to 2011 census, the population in Yelandur taluk is 82,069. The taluk has an overall population density of 310 persons per sq.km. The decadal variation in population from 2001-2011 is 5.3% in Yelandur taluk.

1.3 Rainfall

Yelandur taluk enjoys semi-arid climate. The normal annual rainfall in Yelandur taluk for the period 1951 to 2000 is 890 mm. 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 annual rainfall data from 2006 to 2016 of the Yelandur taluk is collected from the District at Glance, Chamarajnagara report and is given in **Table.1.**

Table-1 Actual Annual Rainfall of Yelandur taluk from 2006 to 2016

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Rainfall (mm)	756	1155	954	938	830	791	438	502.5	930	1883	456.2

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Yelandur taluk. Major crops are Jowar, Maize, Ragi Tur, Pulses, Oil seeds, Fruits and Vegetables. Water intensive crops like Paddy and Tobacco are grown in Yelandur Taluk **(Table.2).**

Table-2: Cropping pattern in Yelandur taluk 2016-2017 (Ha)

Principle crops grown in Yelandur Taluk

Crops	Cereals (Area in Ha)			Pulses (Area in Ha)					Fruits (Area in Ha)	Veg (Area in Ha)	Sugarcane
	Paddy	Ragi	Maize	Cow pea	Horse gram	Black gram	Green gram	Bengal gram			
	2497	385	944	133	163	1373	720	3	676	244	1835
Total	3826			2392					676	244	
	Total Food grains = 6218								676	244	1835

Source: District at a glance 2016-2017

It is observed that net sown area accounts 75.54(Ha) and area sown more than once is 23.30(Ha) of total geographical area in Yelandur taluk **(Table-3).** Area under Forest is 105.89(Ha) Area not available for cultivation and Fallow land cover 56.39(Ha) and 19.94(Ha) of total geographical area respectively. 31.10(Ha) of net area irrigated from Groundwater **(Table.4).**

Table-3: Details of land use in Yelandur taluk 2018-2019 (Ha)

Area	Forest	Area not Available for cultivation	Other uncultivable land	Fallow land	Net area sown		
					Net area sown	Area sown > once	Total
264.73	105.89	56.39	4.97	19.94	75.54	23.30	98.84

Table-4: Details of Irrigation

Source of Irrigation	Length in Km/No of structures	Gross area Irrigated (Ha)	Net area Irrigated (Ha.)	% of area
Canals	18.5	2617	2617	45.5
Tanks	11	24	24	0.5
Wells	338	0	0	0
Bore/Tube wells	1221	4764	3110	54
Lift Irrigation	0	0	0	0
Other Sources		0	0	0
Total		7405	5751	

1.5 Geomorphology, Physiography & Drainage

The geomorphology of the Yelandur is formed by Southern maidan region plain to undulating mountainous. The southern and eastern ghat ranges converging into group of hills, the elevation in the taluk varies from 661m to 1750m in the taluk. The differential altitude is significant because, it is likely to cause irregular ground water flow patterns on the micro scale **(Fig.-2).** Topography is dominantly controlled by geological structures. The entire Yelandur taluk falls in Cauvery river basin. The Drainage pattern is dendritic to subdendritic **(Fig.-3).**

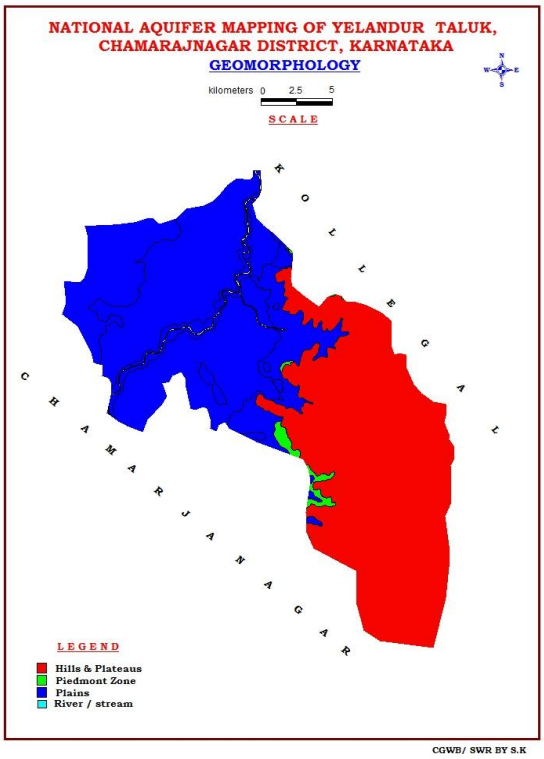


Fig-2: Geomorphology Map

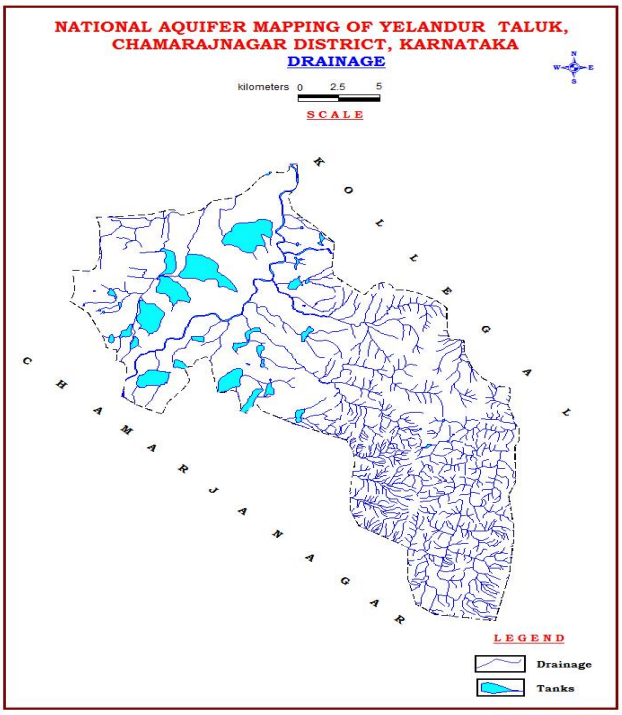


Fig-3: Drainage Map

1.6 Soil and Landuse

The soils of Yelandur taluk can broadly be classified into Clayey to clayey mixed and Clayey skeletal soils. These soils vary in depth and texture, depending on the parent rock type, physiographic settings and climatic conditions **(Fig-4).** Landuse map shown in **Fig.5**

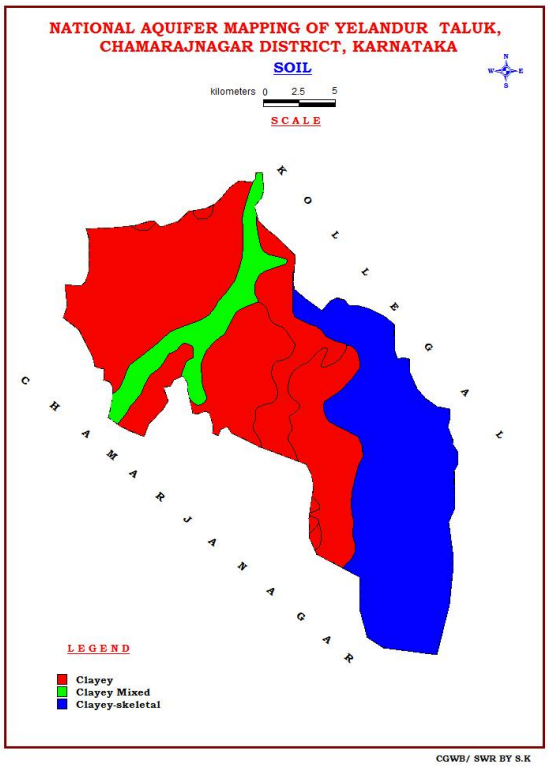


Fig-4: Soil Map

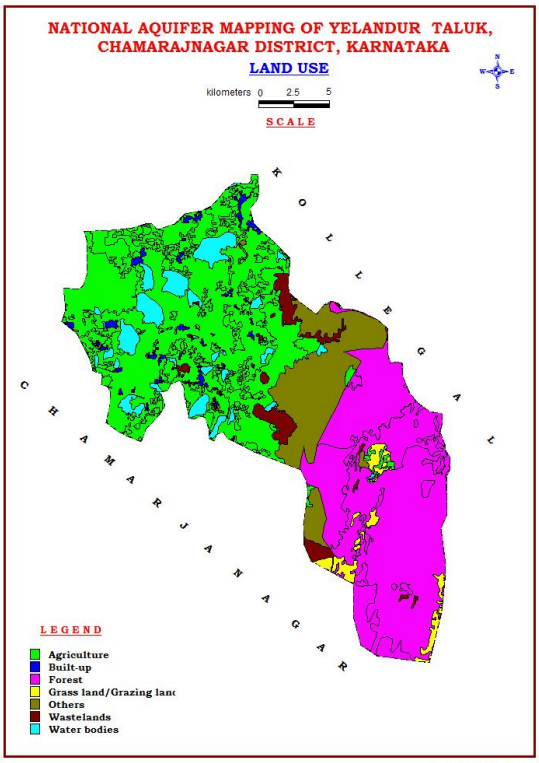


Fig-5: Land use Map

1.7 Ground water resource availability and extraction

As per the ground water resource estimation 2017 **(Table 5a),** the data on ground water resources shows that the net annual ground water availability is 4148 ham. The existing gross groundwater for irrigation is 3220 ham. The stage of groundwater development is 81% and falling under 'Semi-Critical' category.

Aquifer wise total ground water resources up to 165 m depth is given in **Table-5b** below.

Table.5.a Dynamic Ground Water Resource, (March 2017 Figures in Ham)

Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross GW 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 Develop-ment	Existing Stage of Ground Water Development	Category
4148	3220	131	3351	260	668	81	Semi-Critical

Table-5b: Total Ground Water Resources (2017) (Ham)

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
Yelandur	38831	Phreatic	Fractured (Down to 150m)	Dynamic + phreatic in-storage + fractured
		48641	8359	95831

1.8 Existing and future water demands (as per GWRA-2017 and 2020)

The details of dynamic (Phreatic) ground water resources for Yelandur taluk as on March 2020 is shown in **Table.6.** It is observed that the stage of ground water extraction is increased in the taluk from 81 % to 96 % from 2017 to 2020.

Table.6 Detail of Dynamic Ground Water resource, (as on March 2020)

Annual Extractable GW Resource (Ham)	GW Extraction for Irrigation Use (Ham)	GW Extraction for Industrial Use (Ham)	GW Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net GW Availability for future use (Ham)	Stage of GW Extraction (%)	Categorization (Over-Exploited/ Critical/ Semi-critical/ Safe/Saline)
3022.81	2712.03	0.00	188.65	2900.68	235.98	74.81	95.96	Critical

1.9 Water level behavior

Depth to Water level in Yelandur Taluk

	Pre monsoon		Post monsoon	
	Aquifer-I	Aquifer-II	Aquifer-I	Aquifer-II
Range	3.31-19	4.89-35.8	1.48-18.2	6.02-33.29
Average	8.18	23.11	5.93	19.91

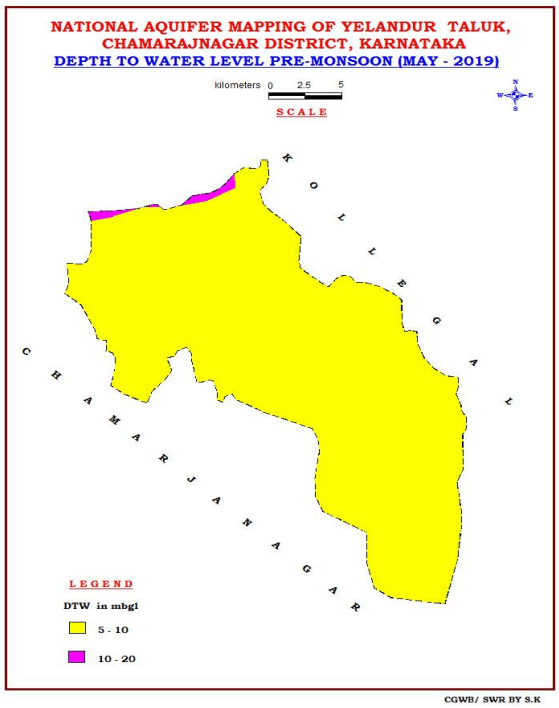


Fig-6: Pre-monsoon Depth to Water Level

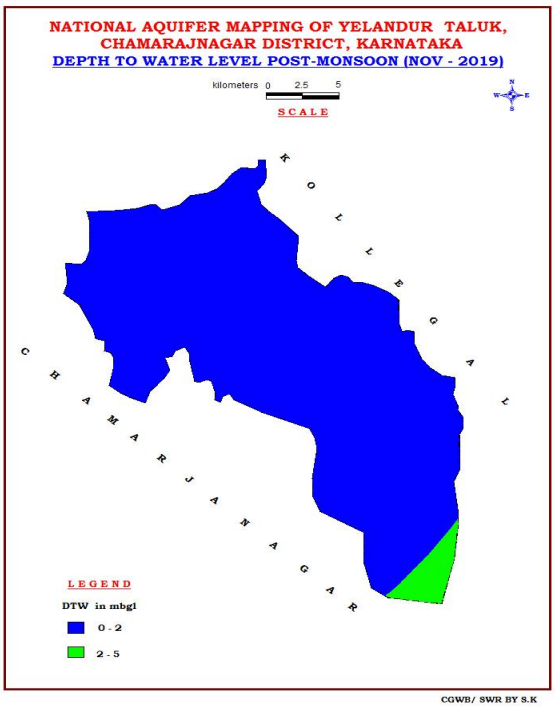


Fig-7: Post-monsoon Depth to Water Level

2 AQUIFER DISPOSITION

2.1 Aquifer Types

In Yelandur taluk, there are mainly two types of aquifer systems

i. Aquifer-I (Phreatic aquifer) Weathered Granitic gneiss

ii. Aquifer-II (Fractured aquifer) Fractured Granitic gneiss

In Yelandur taluk, Schist and Granitic gneiss are the main water bearing formations (Fig-8). Ground water occurs within the weathered and fractured Schist, Granite and Granitic gneiss under water table condition and semi-confined condition. In Yelandur taluk bore wells were drilled from a minimum depth of 60mbgl to a maximum of 200mbgl. Depth of weathered zone ranges from 10mbgl to 17mbgl. Ground water exploration reveals that aquifer-II fractured formation was encountered between the depths of 45 to 165mbgl. Yield ranges from Negligible to 5.94lps. The basic characteristics of each aquifer are summarised in **Table-7.**

Table-7: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Granitic gneiss	Fractured Granitic gneiss, Charnokites
Thickness range (mbgl)	10-17	Fractures upto 165 mbgl
Depth range of occurrence of fractures (mbgl)	-	45-165
Range of yield potential (lps)	-	<1 – 5.94
T (m^2/day)	-	5-85

2.2 3D aquifer disposition and Cross-Sections

Aquifer disposition – Rockworks output (Fig.8,9,10)

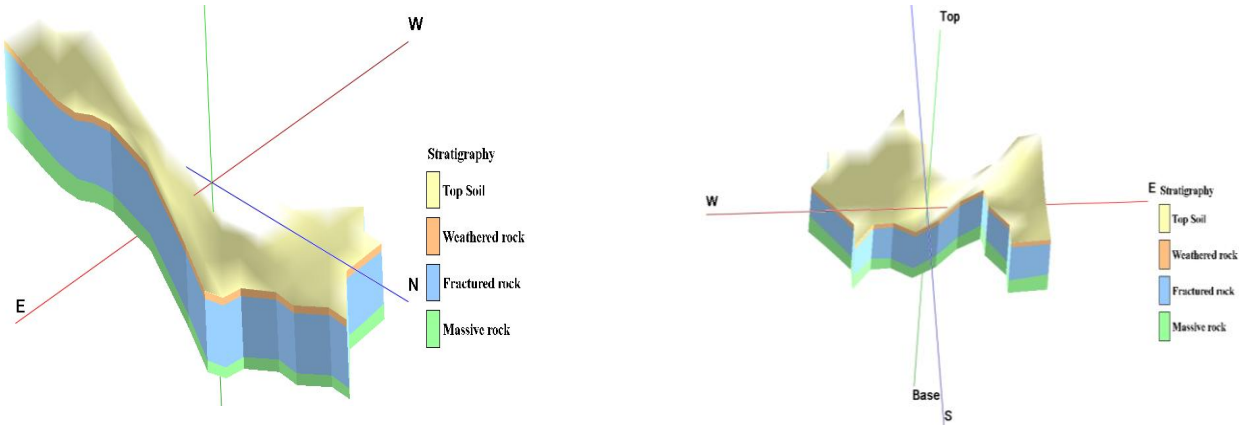


Fig-8: 3D Aquifer Dispositions

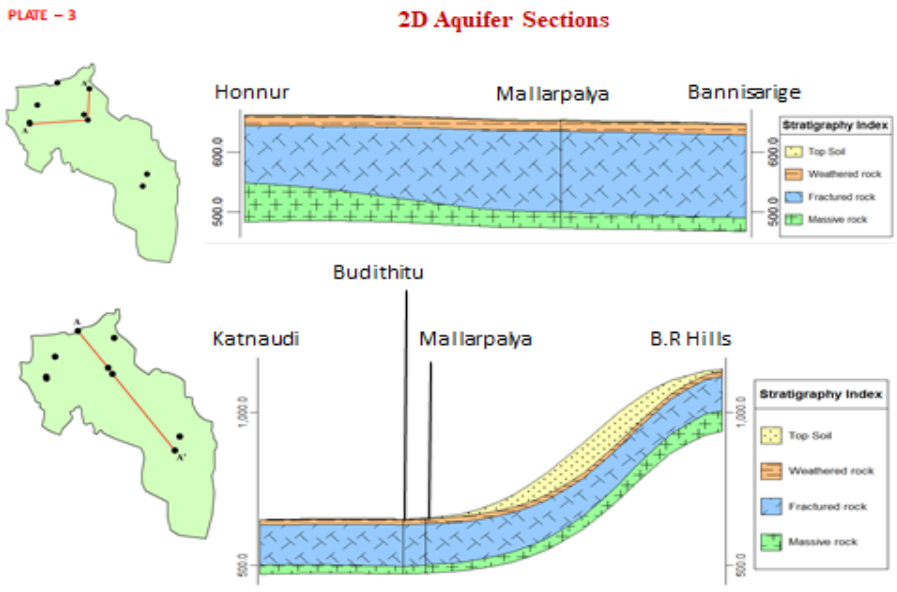


Fig-9: 2D Cross sections in different directions

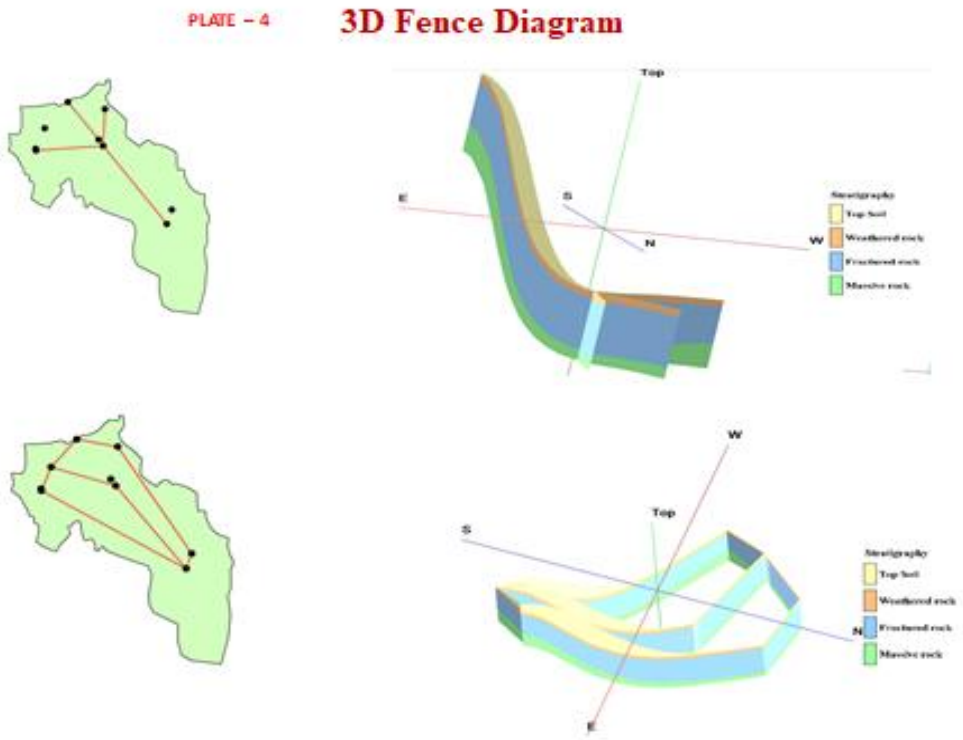


Fig-10: 3D Aquifer Fence Diagram

3 Ground water resource, extraction, contamination and other issues

The main ground water issues are over exploitation, Limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, deeper water levels especially in Aquifer II, declining water level trend which are all inter-related or inter dependent.

3.1 Comparison of Ground Water Resource and Extraction

The Dynamic Ground Water Resource 2017 and as on 2020 have already been summarised above and are shown in **Table 8**. It is observed that the ground water availability in 2020 is less compare to 2017 due to decrease in rainfall and in water table. It is attributable to the improvement in the irrigation practice, influence of command area and also due to the water conservation / recharge activities carried out in the taluk by various state govt. and other agencies.

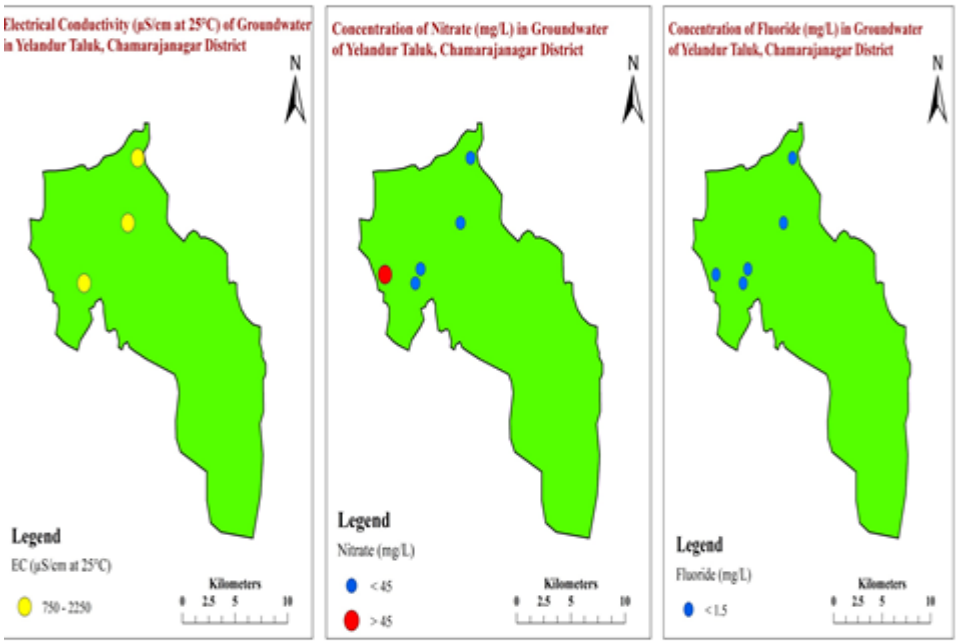
Table 8: Comparison of groundwater availability and draft scenario (in ham)

Taluk	March 2017			March 2020		
	GW availability	GW Extraction	Stage of GW development	GW availability	GW Extraction	Stage of GW development
Yelandur	4148	3351	81	3022.81	2900.68	95.96

3.2 Chemical quality of ground water and contamination

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

- **ELECTRICAL CONDUCTIVITY:** In general, EC values range from 1468 to 1800 µ/mhos/cm in the aquifer-I at 25°C (Fig.11)
- **NITRATE:** Nitrate concentration in ground water ranges from 6 to 59 mg/l in the Aquifer –I (Fig.11)
- **FLUORIDE:** Fluoride concentration in ground water ranges between 0.36and 0.65mg/l in the aquifer-I (Fig.11)



(Fig.11) Chemical quality maps

4 GROUND WATER RESOURCE ENHANCEMENT

4.1 Resource Enhancement by Supply Side Interventions

Recharge dry **phreatic aquifer (Aq-I)** in the taluk, through construction of artificial recharge structures, viz; check dams, percolation tanks & Sub surface dyke **(Table-9).** 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. **(Fig.12)**

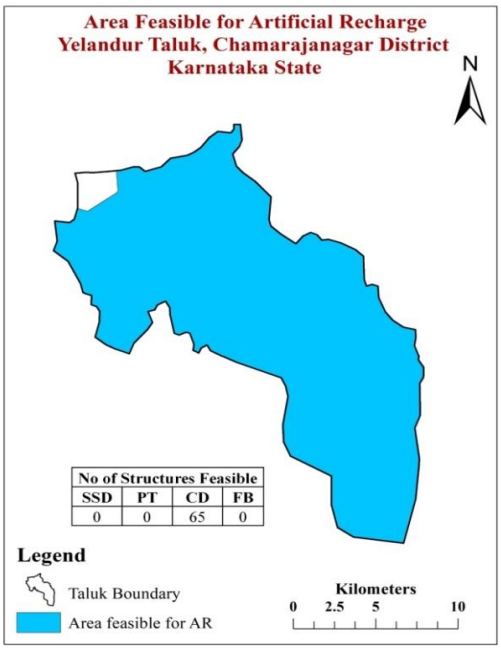


Fig.12. Area feasible for Artificial recharge structures

Table-9: Quantity of non-committed surface runoff & expected recharge through AR structures

Details of Artificial Recharge structures in Yelandur Taluk		
S.No	**Artificial recharge structures available/proposed**	
1	Non committed monsoon runoff available in (MCM)	14.931
2	No of Point Recharge structures	0
3	No of Check Dams	65
4	No of percolation tanks	0
6	Tentative total cost of the project (Rs in lakhs)	654.28
7	Expected Recharge in (MCM)	1.95
8	Expected Rise in water level in (m)	0.01
9	Cost benefit ratio (Rupees/Cubic.m of water harvested)	8.89

After implementation of Artificial Recharge structures for GW recharge, the annual ground water availability will increase from 3022.81 to 3217.81 ham and the expected improvement in stage of development is 6% from 96% to 90%.

Table 10: Improvement in GW availability due to Recharge as per GWRA 2020

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	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of groundwater development
	HAM	HAM	%	HAM	HAM	%	%
Yelandur	3022.81	2900.68	95.96	195	3217.81	6	90.14

4.1.1 Strategic Action Plan:

The provision for minimum protective irrigation can only improve the agricultural growth in the taluk which is dependent on rain. This objective can be achieved by utilizing the rain water more efficiently by harvesting structures like farm ponds, check-dams, barrages and other surface structures. The Strategic Action Plan, prepared for the taluk has included the irrigation infrastructure for major irrigation, minor irrigation, ground water recharge, harvesting of rain water, improvement of irrigation efficiency and strengthening the adoption of micro-irrigation. Considering the existing infrastructure in the taluk and considering the irrigation potential required to be created to meet the gap between demand and supply of all the sectors of water use, the Strategic Action Plans are developed under PMKSY project and the same is given below.

4.1.2 Benefit of Artificial recharge scheme

Artificial recharge structures namely check dams and Nala bunds can be taken up on large scale in the over-exploited areas as a management plan to tackle falling ground water levels.

- These structures have proved in building-up of ground water levels and sustainability of ground water abstraction structures, mainly in bore wells.
- An increase in the area irrigated by ground water source is also observed in the area of influence.
- Such activities help in providing sustainable drinking water to the rural population. The qualitative result from farmer's perception indicate that, there is rising trend in ground water levels in the area of influence, productivity of crops enhanced and improvement in yield is observed in bore wells.
- The cropping pattern has shown that farm households have resumed growing crops such as grapes which were not previously grown in the area.

4.2 Resource Savings by Demand Side Interventions

4.2.1 Water Use Efficiency by Micro Irrigation Practices

It is observed that presently, in the command areas, canals are the source of irrigation and in non-command areas, ground water through bore/tube wells is used for irrigation purpose in the taluk. Water use efficiency measures have to be adopted for saving the ground water resources.

Efficient irrigation practices like Drip irrigation and sprinkler has to be adopted by the farmers in the existing 7405 ha of gross irrigated area. Presently, groundwater extraction for irrigation is 2712 ham. It is proposed to adopt micro irrigation (drip) techniques in fruits and vegetables (920 ha) as well as water intensive sugarcane grown area (1835 ha). It is assumed that 50% of this area i.e., 460 and 917 ha is irrigated by ground water. Implementation of efficient irrigation techniques will contribute in saving ground water by 515 ham and thus enhancing the cumulative net availability of ground water from 3217.81 ham to 3732.81ham. Implementation of efficient irrigation techniques will contribute in saving ground water by 515 ham. Thus, will improve stage of extraction by 12.44% from 90.14% to 77.7% **(Table 11).**

4.2.2 Grey Water Utilization

As per data 95 ham of domestic grey water is available. It is suggested to put 50% of this grey water to secondary treatment and use the treated water either for irrigation or recharging the tanks and ponds. Thus 47 ham of treated sewage water can be utilized for gainful purposes thereby reducing the load on fresh groundwater. The resource enhancement by grey water use will bring the stage of extraction from 77.7% to 76.7%.

Table 11: Improvement in GW availability due to saving by adopting water use efficiency and Grey Water

Sl No.	Resource Details	As per 2020 Estimation
1	Cumulative Ground Water availability after implementation of artificial recharge schemes (ham)	3217.81
2	Existing Ground Water Extraction for all uses in ham	2900.68
3	Expected improvement in stage of Ground Water extraction after implementation of artificial recharge schemes	90.14%
4	Saving due to adopting Water Use Efficiency measures in ham a. **Fruits & Vegetables** irrigated by GW – 2467 ha, CWR by surface flooding – 0.50m, CWR by drip irrigation – 0.375 m, Savings – 0.125 b. **Sugarcane** irrigated by GW – 241 ha, CWR by surface flooding –	515 ham 57 ham

	2.00 m, CWR by drip irrigation – 1.50 m, Savings – 0.50	458 ham
5	Additional saving by adopting Grey Water (50% of Available grey water) in ham	47
6	Cumulative Ground Water Availability after adopting WUE and Grey water in ham	3779.81
7	Expected improved stage of Ground Water extraction after implementation of all interventions (%)	76.7
8	Total water likely to be saved after all interventions (ham)	757

4.2.3 Regulation and Control

Yelandur taluk has been categorized as **Critical**, since the Stage of ground water extraction has reached **95.96%** (GEC 2020). Hence, stringent action has to be taken up through Karnataka Ground Water Authority to control ground water exploitation in the taluk**.** Ground water recharge component needs to be made mandatory in the taluk to save the situation from deteriorating further.

5 SUMMARY

The main ground water issues are over exploitation, limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, deeper water levels particularly in Aquifer II in some parts, semi-urbanized areas which are all inter-related or inter dependent along with nitrate contamination in some parts. The summary of ground water management plan of Yelandur taluk is given in **Table-12.**

Table 12: Summary of Management plan

Stage of GW Extraction and Category (2020)	95.96%, Critical
Annual Extractable GW Resource (Ham)	3022.81
Total Extraction (Ham)	2900.68
Ground Water Draft for Irrigation (Ham)	2712
Ground Water Resource Enhancement by Supply side Interventions	
No of Proposed AR structures SSD PT	 0 0

CD FB	65 0
Expected Additional Recharge to GW due to AR (Ham)	195
Total Estimated Expenditure (Rs. in Lakhs.)	654.28
Additional Irrigation Potential that can be created (Lakh Ha)	0.013
Change in Stage of GW Extraction (%)	95.96 to 90.14
Ground Water Resource Enhancement by Demand side Interventions	
Expected Saving due to adopting WUE measures (ham)	515
Change in Stage of GW Extraction (%)	90.14 to 77.7
Expected Saving by adopting Grey water re-use (ham)	47
Change in Stage of GW Extraction (%)	77.7 to 76.7
Cumulative Ground Water availability by adopting all interventions (ham)	3779.81
Change in Stage of GW extraction after adopting all interventions, %	95.96 to 76.7
Total water likely to be saved after all interventions (ham)	757

As per the resource estimation – 2020, Yelandur taluk falls under Critical category with the stage of ground water extraction 95.96%. However, there is need to formulate management strategy to tackle the over exploitation, water scarcity related issues and nitrate contamination in the taluk. 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 14.931 MCM. This can be used to recharge the aquifer mainly through check dams (65). The volume of water expected to be recharged is 195 ham through these AR structures. The approximate cost estimate for construction of these AR structures is Rs. 654.28 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 54% of irrigation is by bore wells (ground water). It is proposed to adopt micro irrigation (drip) techniques in fruits and vegetables (920 ha) as well as water intensive sugarcane grown area (1835 ha). It is assumed that 50% of this area i.e., 460 and 917 ha is irrigated by ground water. Implementation of efficient irrigation techniques will contribute in saving ground water by 515 ham and thus enhancing the cumulative net availability of ground water from 3217.81 ham to 3732.81 ham. Implementation of efficient irrigation techniques will contribute in saving ground water by 515 ham.

Grey water utilization: As per data 95 ham of domestic grey water is available. It is suggested to put 50% of this grey water to secondary treatment and use the treated water either for irrigation or recharging the tanks and ponds. Thus 47 ham of treated sewage water can be utilized for gainful purposes thereby reducing the load on fresh groundwater.