



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

**NAVALGUND TALUK,
DHARWAD DISTRICT, KARNATAKA**

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region, Bengaluru



AQUIFER MANAGEMENT PLAN OF NAVALGUND TALUK, DHARWAD DISTRICT, KARNATAKA STATE

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AQUIFER MANAGEMENT PLAN OF NAVALGUND TALUK, DHARWAD DISTRICT, KARNATAKA STATE

1.0 SALIENT INFORMATION

Name of the taluk: **Navalgund**

District: Dharwad; State: Karnataka

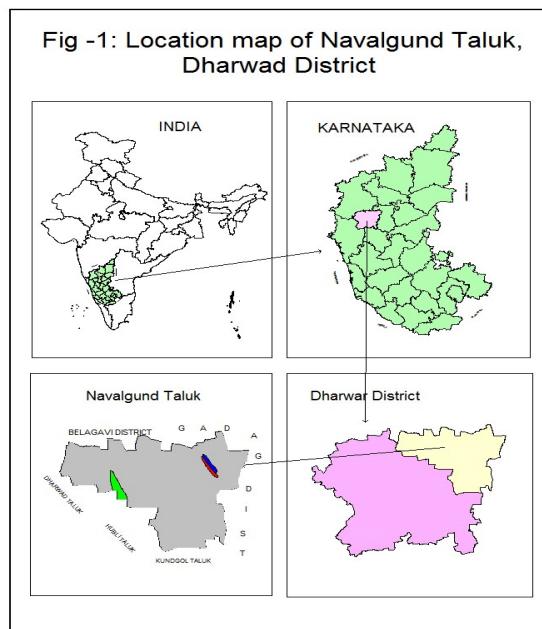
Area: 1080 sq.km.

Population: 1,90,208

Annual Normal Rainfall: 605 mm

1.1 Aquifer management study area

Aquifer mapping studies have been carried out in Navalgund taluk, Dharwad district of Karnataka, covering an area of 1087 sq.kms under National Aquifer Mapping Project. Navalgund taluk of Dharwad district is located between North Latitudes 15°20'01" and 15°41'00" and East Longitudes between 75° 05' 00" to 75°33'00" and is falling in Survey of India Toposheets No forms parts of 48M/2, M/6, M/7 & M/10. The study area is bounded on the North by Saundatti taluk & Nargund taluk, on the East by Ron and Gadag taluks, on the South by Kundgol taluk and on West by Dharwad and Hubli taluks of Dharwad district. Location map of Navalgund taluk of Dharwad district is presented in **Fig-1**. Navalgund is taluk head quarter and 58 villages in this taluk.



1.2 Population

According to 2011 census, the population in Navalgund taluk is 1,90,208. Out of which 96,942 are males while 93,266 are females. The average sex ratio of Navalgund taluk is 962. The Navalgund taluk has an overall population density of 498 persons per sq.km. The decadal variation in population from 2001-2011 is 7.1% in Navalgund taluk.

1.3 Rainfall

Navalgund taluk enjoys semi-arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Northern 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 in respect of Navalgund station from the year 1981 to 2010 is analysed and presented in **Table-1**.

The data pertaining to these gauges is of longterm 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 Navalgund taluk for the period 1981 to 2010 is 585 mm. Seasonal rainfall pattern indicates that, major amount of (354 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 60% of the annual normal rainfall, followed by North-East Monsoon season (130 mm) constituting 22% and remaining (102 mm) 18% in Pre-Monsoon season.

On Computations were carried out for the 30 year blocks of 1981-2010, the mean monthly rainfall at Navalgund taluk is ranging between 2 mm during February to 125 mm during September. The coefficient of variation percent for pre-monsoon, monsoon and post-monsoon season is 61, 38 & 60 percent respectively. Annual CV at this station works out to be 27 percent (**Table-1**).

Table1: Statistical Analysis of Rainfall Data of Navalgund taluk, Dharwad district (1981 to 2010)

STATION		JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
NAVALGUND	NRM	0	2	11	27	62	102	92	64	72	125	354	93	32	5	130	586
	STDEV	1	9	35	27	39	62	62	38	33	80	135	67	47	13	78	161
	CV%	334	548	320	98	64	61	67	59	46	64	38	73	145	272	60	27

Assessment of Drought

Rainfall data of has been analysed for 100 years using IMD method to assess the drought condition in Navalgund taluk. The results of the classification are listed in the **Table 2**. It is observed that the Navalgund taluk has experienced alternating no drought to severe drought conditions over the years.

% Deviation (Di)	>0	0 to -25	25 to -50	50 to -75	<-75	Probability of drought occurrences
Category	No drought	Mild (Normal)	Moderate	Severe	Acute	
Years						
Navalgund	20	60	17	3	0	Once in 5 years

The details of the drought assessment are discussed as herein under. Out of 100 years of analysis in Navalgund taluk, “No Drought” condition is experienced in 20 years, “Mild Drought” condition is experienced in 60 years and “Moderate Drought” condition experienced in 17 years. Further it is observed that “Severe Drought” condition is experienced in 3 years i.e., during 1904, 1945 and 2003 in Navalgund taluk. Based on occurrence and frequency of past drought events, the probability of occurrence of various intensities of drought at each station has been studied. It has been observed that the frequency of occurrence of drought is **once in 5 years** at Navalgund taluk.

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Navalgund taluk. Major Kharif crops are Maize, Bajra, Jowar, Tur and Vegetables. Main crops of Rabi season are Maize, Bajra and Jowar (**Table 3**). Water intensive crops like sugarcane and paddy are grown in less than 1% of total crop area. Maize is grown in 10% and wheat in 14% of total crop area of taluk. jowar & pulses account 17% and 51 % of total crop area respectively.

Table 3: Cropping pattern in Navalgund taluk 2016-2017 (Ha)

Year	Wheat	Maize	Paddy	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
Area under cultivation (in ha)										
2016-17	14,947	11,064	-	17954	54843	79	22978	6954	61	26532

It is observed that net sown area accounts 95% and area sown more than once is 57% of total geographical area in Navalgund taluk (**Table-4**). Area not available for cultivation and Fallow land cover 4% & 2% of total geographical area respectively. 94% of net area irrigated is only from canal and 6% from bore wells (**Table-5 & Fig.2**).

Table 4: Details of land use in Navalgund taluk 2016-2017 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
NAVALGUND	1,08,218	000	3,941	1,700	1,02,508	62,164

Source: District at a glance 2016-17, Govt. of Karnataka

Table 5: Irrigation details in Navalgund taluk (in ha)

Source of Irrigation	Net area irrigated (Ha.)	% of area
Canals	11938	94
Tanks	-	
Wells	-	
Bore wells	230	6
Lift Irrigation	-	
Other Sources	-	
Total	12,168	

Source: District at a glance 2016-17, Govt. of Karnataka

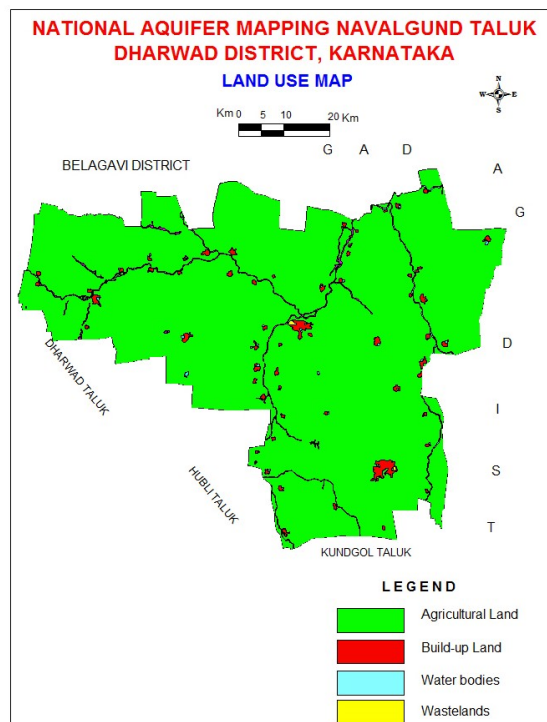


Fig. 2: Land Use and Land cover

1.5 Geomorphology, Physiography & Drainage

Navalgund taluk falls in the eastern maidan region with gentle undulating terrain. Navalgund taluk forms more or less vast plain at an average elevation of 564 m above MSL. The entire taluk comes between contours 564 and 625 m above MSL. A small hill stands out as a ridge behind Navalgund town to a height of 650.57 m above MSL. The entire taluk is either flat or gently sloping towards Bennihalla and its tributaries. Except around Navalgund where Kaladgi Quartzites are exposed as an outlier forming Navalgund fort hill, the rest of the area is soil covered. 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 Navalgund taluk falls in Malaprabha river, which is tributary of Krishna river basin. The taluk is drained by major nallas like Bennihalla, Hirehalla, Tuprihalla, Handignhalla, Gundiganhalla and Yarnahalls. These are fed by numerous streamlets joining from both sides. All the water drains into Maprabha river flowing north of the taluk. Bennihalla forms the major basin and it flows through central parts of the taluk over a distance of 50 km. it enters the taluk near Bllerwad village and takes northly course upto Yamanur. There onwards changes its course to ENE direction upto Belvatigi villages. Then again takes northly course upto Tadnal and there onwards it flows along the northern border of the taluk in ENE direction. This slightly meandering course of the nalla shows that it flows in gently sloping area. Tuperihalla and Handigenhalla are major tributaries of Bennihalla. The Drainage pattern is dendritic to sub-dendritic (**Fig. 4**).

1.6 Soil

Navalgund taluk is covered by black cotton soil (BCS) varying in thickness between 1.0 and 5.0 metres. The soil covers thicker in nala sections and lowlying areas and less in elevated places. The soil is medium to deep black in colour. Kankary nodules of different sizes from 0.2 to 5 cm are common, especially where soil profile is low and in nala courses. The black cotton soil contains high humus and low phosphate content, with normal pH- value and very low infiltration characteristic. The Loamy to kankary soil are seen along the banks of river/stream courses. The red soil is characteristically seen on hilly region around Navalgund hill and slopes (**Fig. 5**).

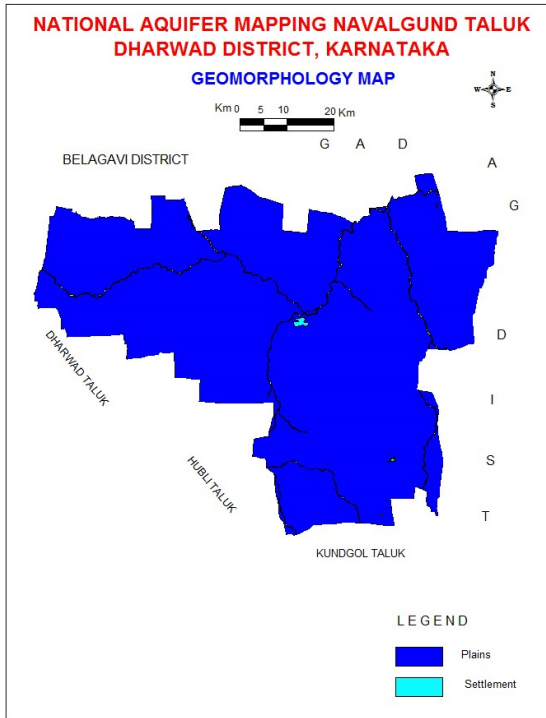


Fig-3: Geomorphology Map

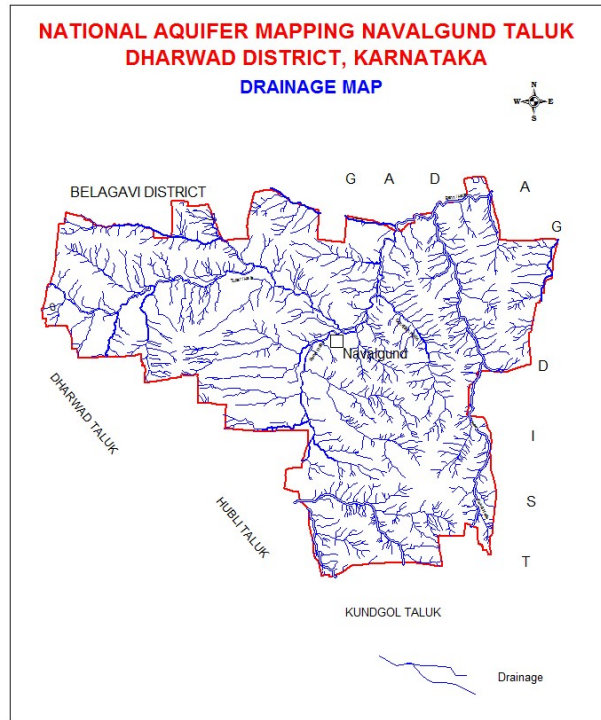


Fig-4: Drainage Map

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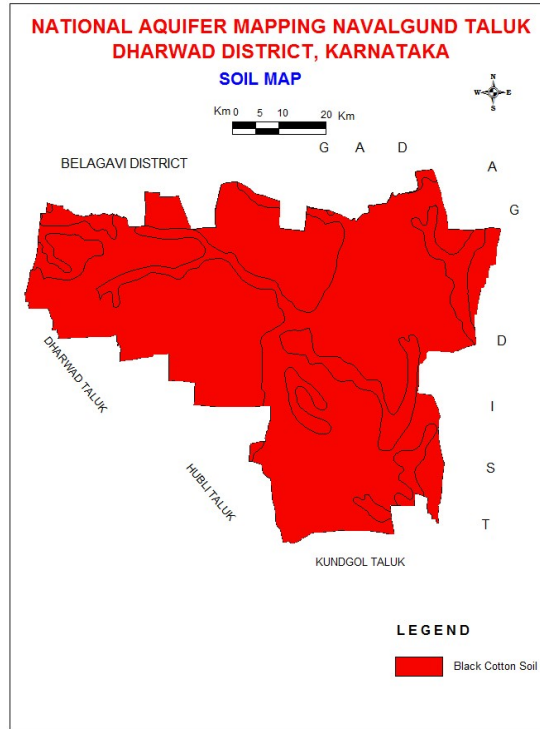


Fig. 5: Soil map

1.7 Ground water resource availability and extraction

Aquifer wise total groundwater resources up to 200 m depth is given in **Table-6** below.

Table-6: Total Ground Water Resources (2017) (Ham)

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (Down to 200m)	
NAVALGUND	5754			Dynamic + phreatic in-storage + fractured
		6805	2100	14659

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

- Net ground water availability for future irrigation development : 18.64 MCM
- Domestic (Industrial sector) demand for next 25 years : 7.81 MCM

1.9 Water level behavior

(a) Depth to water level

Aquifer - I

- Pre-monsoon: 7.68 – 18.30 mbgl (Fig.-6)
- Post-monsoon: 6.90 – 16.01 mbgl (Fig.-7)

(b) Water level fluctuation

Aquifer-I (Fig.-10)

- Seasonal Fluctuation: Rise ranges 0.70 – 2.29 m;
Fall ranges 0.0 – 1.50 m

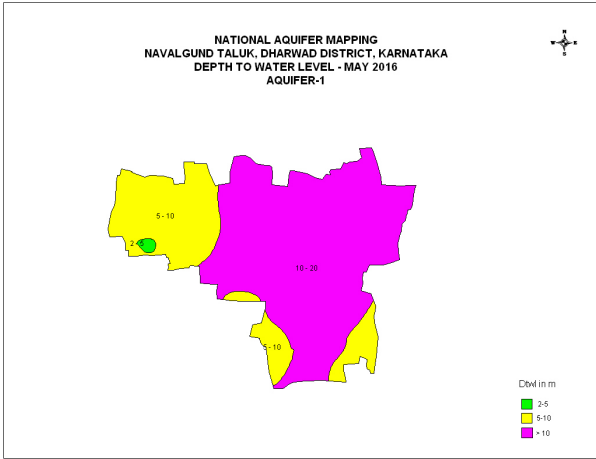


Fig-6: Pre-monsoon Depth to Water Level (Aq-I)

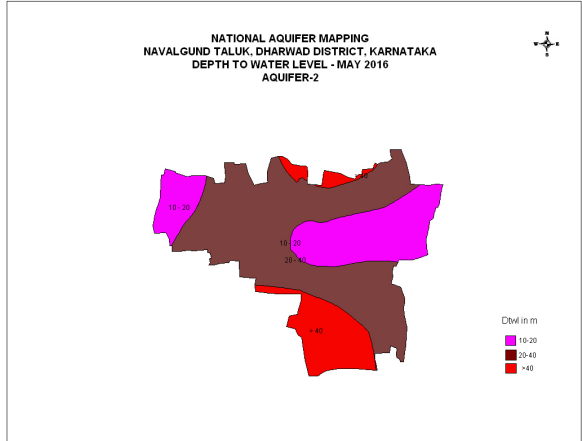


Fig-8: Pre-monsoon Depth to Water Level (Aq-II)

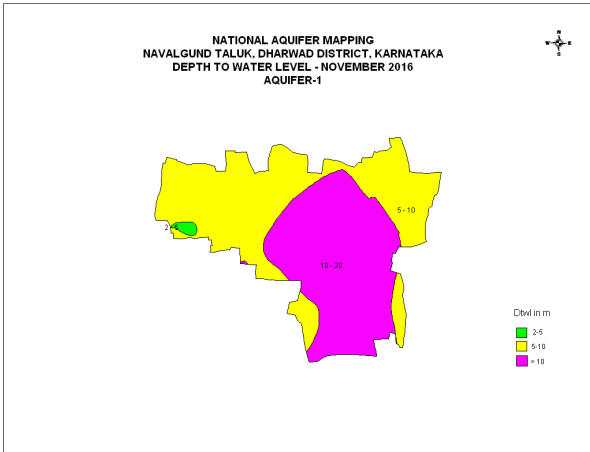


Fig- 7: Post-Monsoon Depth to Water Level (Aq-I)

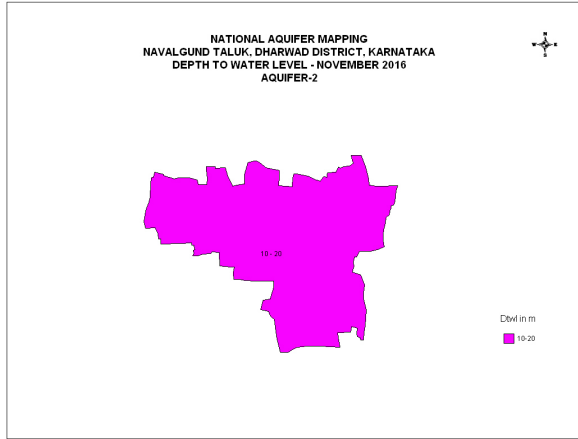


Fig-9 Post-Monsoon Depth to Water Level (Aq-II)

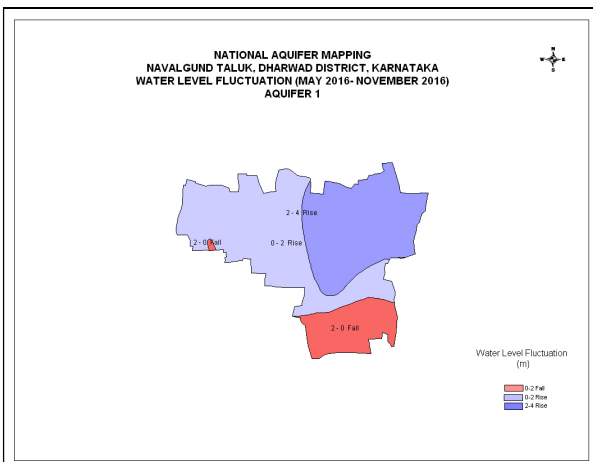


Fig-10: Water Level Fluctuation (Aq-I)

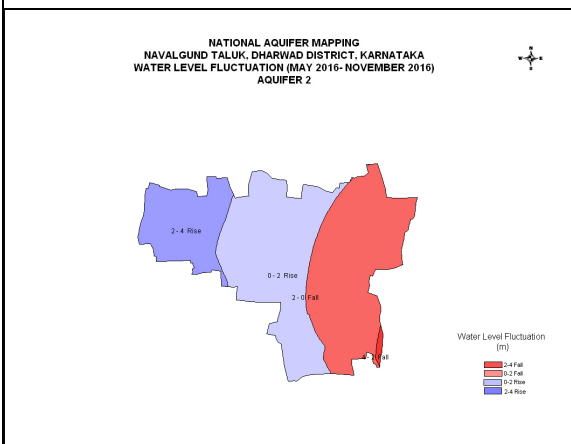


Fig-11: Water Level Fluctuation (Aq-II)

2. AQUIFER DISPOSITION

2.1 Number of aquifers: In Navalgund 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 Navalgund taluk, Granitic Gneiss is the main water bearing formations (**Fig-12**). Ground water occurs within the weathered and fractured Granitic Gneiss under water table condition and semi-confined condition. In Navalgund taluk bore wells were drilled from a minimum depth of 53 mbgl to a maximum of 200 mbgl. Depth of weathered zone ranges from 5 mbgl to 20 mbgl. Ground water exploration reveals that aquifer-II fractured formation was encountered between the depth of 28 to 200 mbgl. Yield ranges from 0.07 to 3.10 lps. The basic characteristics of each aquifer are summarized in **Table-7**.

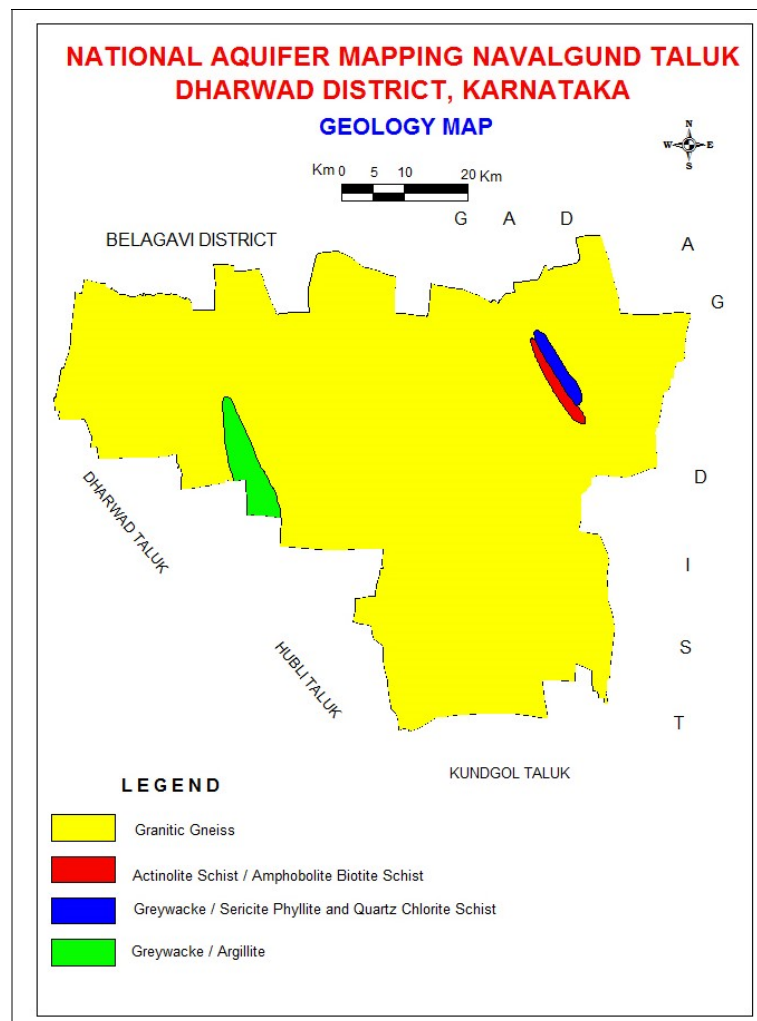


Fig-12: Geology Map

Table-7: Details of Ground Water Exploration

S.No	Location	Lat & Long	Depth m bgl	Casing (m)	Lithology	SWL (mbgl)	Q (lps)	DD (m)	T (m ² /day)
1	Alagawadi EW	15 ⁰ 37 ¹ 15" :75 ⁰ 17 ¹ 30"	92.50	35.30	Granitic Gneiss	13.28	2.50	6.42	49.44
2	Alagawadi OW	15 ⁰ 37 ¹ 15" :75 ⁰ 17 ¹ 30"	71.15	40.00	Granitic Gneiss	13.57	3.0	6.25	37.97
3	Bhadrapur EW	15 ⁰ 23 ¹ 15" :75 ⁰ 23 ¹ 15"	92.50	18.10	Granitic Gneiss	9.54	3.10	9.41	28.46
4	Bhadrapur OW	15 ⁰ 23 ¹ 15" :75 ⁰ 23 ¹ 15"	75.40	15.70	Granitic Gneiss	9.30	3.00	13.98	-
5	Shalwadi EW	15 ⁰ 34 ¹ 40" :75 ⁰ 28 ¹ 10"	92.50	35.75	Granitic Gneiss	6.83	0.07	-	6.835
6	Talimorab EW	15 ⁰ 32 ¹ 20" :75 ⁰ 08 ¹ 40"	65.40	23.75	Granitic Gneiss	6.29	1.75	17.53	39.40
7	Talimorab OW	15 ⁰ 32 ¹ 20" :75 ⁰ 08 ¹ 40"	53.65	24.40	Granitic Gneiss	6.29	1.75	17.53	-
8	Tuppadak urahatti EW	15 ⁰ 32 ¹ 30" :75 ⁰ 29 ¹ 00"	92.50	29.12	Granitic Gneiss	4.84	2.55	19.46	4.84
9	Tuppadak urahatti OW	15 ⁰ 32 ¹ 30" :75 ⁰ 29 ¹ 00"	92.50	31.70	Granitic Gneiss	-	0.01	-	-

Table-8: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Granitic Gneiss	Fractured / Jointed Granitic Gneiss
Thickness range (mbgl)	20	Fractures upto 200 mbgl
Depth range of occurrence of fractures (mbgl)	6-12	28-180
Range of yield potential (lps)	Poor yield	1 - 3
Specific Yield	2%	0.2%
T (m ² /day)	-	1 – 49.44
Quality Suitability for Domestic & Irrigation	Suitable	Suitable

3.0 GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

3.1 Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2017) ham

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
NAVALGUND	5754	3261	431	3692	781	1864	64	SAFE

(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
NAVALGUND	5754	6805	2100	14659

3.2 Chemical quality of ground water and contamination

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

Electrical Conductivity: In general, EC values range from 1123 to 7188 μ /mhos/cm in the aquifer-I at 25°C.

Fluoride: Fluoride concentration in groundwater ranges between 0.44 – 1.50 mg/l in the aquifer-I.

Nitrate: Nitrate value ranges from 43 and 740 mg/l in the Aquifer –I.

Table-9: Quality of ground water (Aquifer-I) in Navalgund taluk of Dharwad district

S_No	Location	PH	EC	TH	Ca	Mg	Na	K	CO ₃	HCO ₃	CL	SO ₄	NO ₃	F
1	Morab-Dw	8.17	6670	1380	200	214	586	121	0	140	1497	532	119	1.03
2	Basapur-Dw	7.92	1123	150	52	5	189	1	0	372	78	149	85.14	1.50
3	Alagawadi-Bw	7.84	2868	648	98	96	428	2.6	0	146	652	192	350	0.55
4	T.Kurhatti-Bw	7.54	7188	2020	384	258	760	4.8	0	98	1461	900	740	0.44
5	Shelwadi-Bw	7.76	3830	948	196	109	488	2.1	0	195	668	808	43	0.98
6	Bhadrapur-Bw	8.38	4128	1160	220	140	458	4.3	0	378	745	624	115	0.85

4.0 GROUND WATER RESOURCE ENHANCEMENT

4.1 Aquifer wise space available for recharge and proposed interventions

Recharge dry phreatic aquifer (Aq-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 structures needs to be constructed in areas already identified as feasible for artificial recharge (**Fig.13**).

Table-10: Quantity of non-committed surface runoff & expected recharge through AR structures (As per Master Plan on Artificial Recharge in Karnataka and Goa,2020)

Artificial Recharge Structures Proposed	Navalgund taluk
Non committed monsoon runoff available (MCM)	171.219
Number of Check Dams	899
Number of Percolation Tanks	152
Number of Filter beds	30
Number of Subsurface dykes	05
Tentative total cost of the project (Rs. in lakhs)	12170.069
Expected recharge (MCM)	128.414
Additional irrigation potential (Lakh Hectares)	0.155
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	9.5

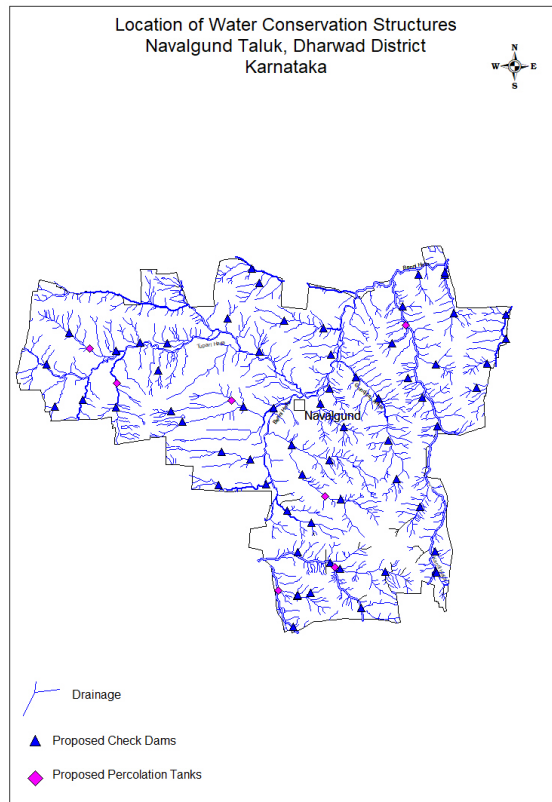


Fig-13: Feasible area for AR Structures

Table-11: Improvement in GW availability due to Recharge, Navalgund 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	Cumulative annual groundwater availability after implementation of 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	HAM	%	%
Navalgund	5754	3692	64	12841.4	18595.4	19.85	44.15

After implementation of Artificial Recharge structures for GW recharge, the annual ground water availability will increase from 5754 to 18595.4 ham and the expected improvement in stage of development is 44.15% from 64% to 19.85%.

5.0 DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

It is observed that groundwater through wells & borewells contribute only 2% of the source for irrigation in Navalgund taluk. Balance 98% irrigation is from surface water from canals. Also, water intensive crops sugarcane is grown in less than 2% of total crop area from surface water source. Present stage of ground water development is 64% (GEC 2017). Thus, Water use efficiency measures are suggested in the taluk. Adopting these measures will contribute in ground water resource enhancement in the long run. Efficient irrigation practices like Drip irrigation and sprinkler need to be adopted by the farmers in the existing 19,025 ha of gross irrigated area. Presently, draft through irrigation is 3261 ham. Efficient irrigation techniques will contribute in saving ground water by 978 ham and thus, will improve stage of development by 01% from 19.85% to 18.86% (**Table-12**).

Table-12: Improvement in GW availability due to saving by adopting water use efficiency

Taluk	Cumulative annual ground water availability after implementing AR structures & irrigation development schemes	Existing gross ground water draft for all uses	Stage of ground water development after implementing AR structures & Yettinahole project	Saving due to adopting WUE measures	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 ground water development
	Ham	Ham	%	Ham	Ham		%
Navalgund	18595.4	3692	19.85	978	19573.4	18.86	1

5.2 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 rain water harvesting.

6.0 SUMMARY

The summary of Management plan of Navalgund taluk is given in **Table-13**.

Table 13: Summary of Management plan of Navalgund taluk

Navalgund taluk is safe & present stage of GW Development (2017)	64%
Net Annual Ground Water Availability (MCM)	57.54
Existing Gross Ground Water Draft for all uses	36.92
Total GW Resources (Dynamic & Static up to the depth of 200 mbgl (MCM)	146.59
Expected additional recharge from monsoon surplus runoff (MCM)	128.414
Change in Stage of GW development, %	64 to 19.85
Expected Saving due to adopting WUE measures (MCM)	9.78
Change in Stage of GW development, %	19.85 to

		18.86
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.	