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

Hosanagara Taluk, Shimoga District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु

South Western Region, Bengaluru

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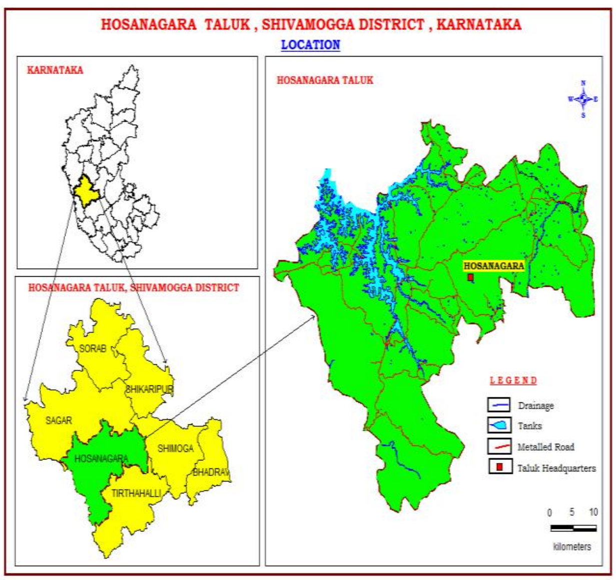
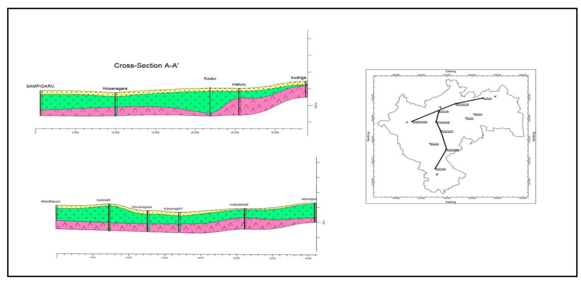
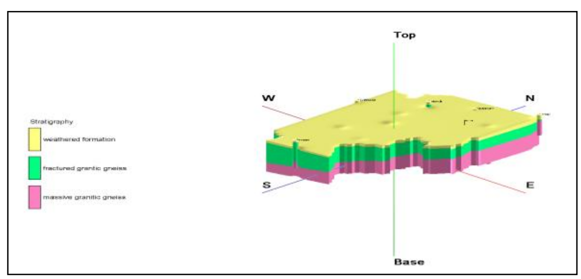
Bengaluru

Aquifer Maps and Management Plan, Hosanagara Taluk, Shimoga District, Karnataka State

(AAP: – 2022-2023)







By

Anu V, Sc-C, CGWB, KR, Trivendrum

APRIL 2023

Aquifer Maps and Management Plan, Hosanagara Taluk, Shimoga District, Karnataka State

(AAP: 2022-23)

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1. INTRODUCTION

In XII five-year plan, National Aquifer Mapping (NAQUIM) has been taken up by CGWB to carry out detailed hydrogeological investigation on topographic sheet scale (1:50,000). Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical analyses is applied to characterize the quantity, quality and sustainability of ground water in aquifers.

The vagaries of rainfall, inherent heterogeneity of hard rock aquifers, over exploitation and lack of regulation mechanisms had a detrimental effect on ground water scenario of the country in last decade or so, demanding a paradigm shift from “traditional groundwater development concept” to “modern groundwater management concept”.

Varied and diverse hydrogeological settings demand precise and comprehensive mapping of aquifers down to the optimum possible depth at appropriate scale to arrive at robust and implementable ground water management plans. The proposed management plans will provide the “Road Map” ensuring sustainable development of ground water resources, thereby primarily improving drinking water security and irrigation requirement. Thus, the crux of NAQUIM is not merely mapping, but reaching the goal of community participation in ground water management.

By understanding the goals of NAQUIM, during the Annual Action Plan of 2022-23, Hosanagara taluka of Shimoga district of Kerala state covering a geographical area of 1428 sq.km. has been taken up. The aquifer maps and management plans formulated subsequently by this study will be shared with the Shimoga district administration for its effective implementation.

1.1 Objective and Scope

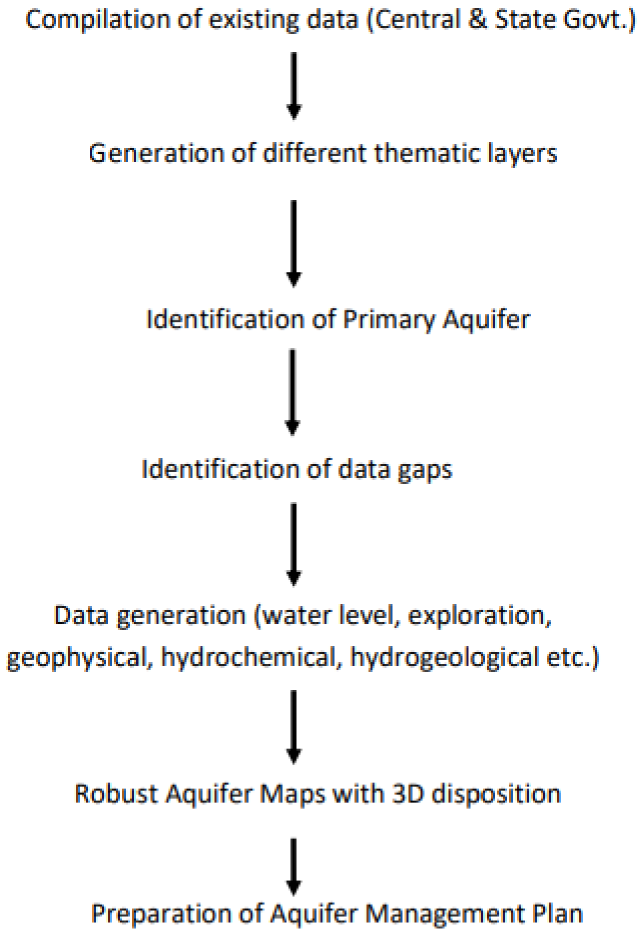
Aquifer mapping itself is an improved form of groundwater management – recharge, conservation, harvesting and protocols of managing groundwater. These protocols will be the real derivatives of the aquifer mapping exercise and will find a place in the output i.e, the aquifer map and management plan. The activities under NAQUIM are aimed at:

- Identifying the aquifer geometry,
- Aquifer characteristics and their yield potential
- Quality of water occurring at various depths
- Aquifer-wise assessment of ground water resources
- Preparation of aquifer maps and
- Formulate ground water management plan.

This clear demarcation of aquifers and their potential will help the agencies involved in water sector to ascertain the volume of water available for various uses as well as the need of management measures implemented to achieve a sustainable development goal.

1.2. Approach and Methodology

The ongoing activities of NAQUIM include topographic sheet wise micro-level hydrogeological data acquisition, geophysical and hydro-chemical investigations, supplemented by ground water exploration down to the depth of 200/300 meters. The data on various components thus collected were brought on GIS platform by geo-referencing for its utilisation in the preparation of various thematic maps. The approach and methodology followed for Aquifer mapping is as given below:



1.3 Study area

Hosanagara taluka falls in Sagar subdivision of Shimoga district which is nested in the Western Ghats covering an area of 1428 sq.km covering parts of Survey of India toposheets 49R13,48J16,48O1,48N8,48O5 and 48N4. The taluka is covered with dense tropical forests, plantations, scrublands and agricultural lands with a mappable area of 1158 sq.km. The district is bounded by North latitudes 13^{0}36’ and 14^{0}05’ and East longitudes 75^{0}06’ and 75^{0}04’. It is bounded by Sagar district in the north, Tirthahalli district in the south, Shimoga in the east and Udupi district in the west.

Administratively, the taluka has 01 Town Panchayath and 30 Gram panchayats consisting of 204 villages of which 202 villages are inhabited. The Census data for the year 2011 reveals that the taluka has total population of 1,12,381 persons with 55670 males and 56711 females, literacy rate of 71.4% and Population density of 83 person per square kilometre. The projected population as on 2021 is 60837 males, 60692 females and a total of 121530 which is 6.48% of total population of the district. The number of rural households in the taluka is 25917, urban households is 1396 and the total households is 27313 as per 2011 census. The taluka falls in south transition zone of agro-climatic zone.

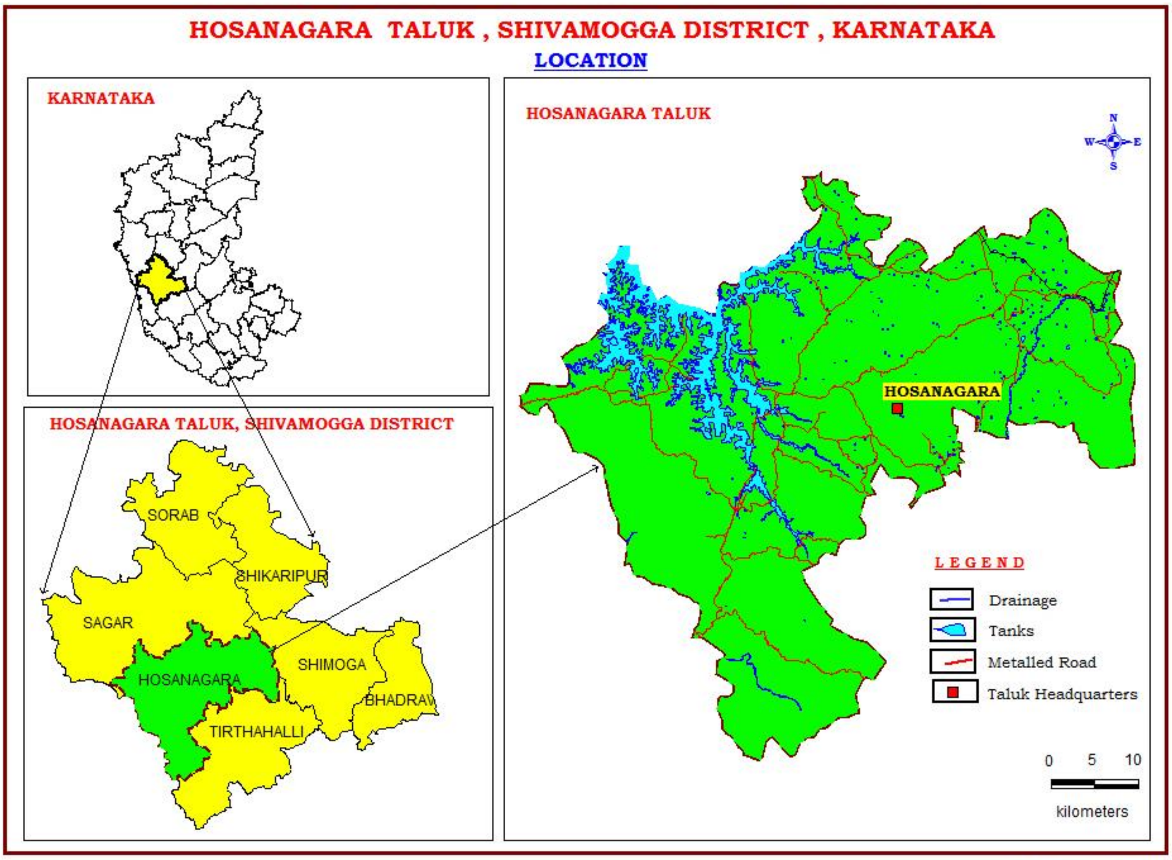


Figure 1.1 Administrative set-up, Hosanagara Taluka, Shimoga District

1.4 Data Adequacy and Data Gap Analysis and Data Generation:

The available data on Exploration activities, Geophysical Surveys, Ground water monitoring and ground water quality of Central Ground Water Board were compiled and analysed for aquifer mapping studies. In addition to these, data on ground water monitoring and ground water quality from State Ground Water Department, Govt. of Karnataka were also utilised. The data adequacy and data gap analysis were carried out for each quadrant of topographic sheet as per the criteria suggested in the manual of Aquifer Mapping in respect of the following primary and essential data requirements and the same is shown in table 1.1 viz.

- Exploratory Wells
- Geophysical Surveys

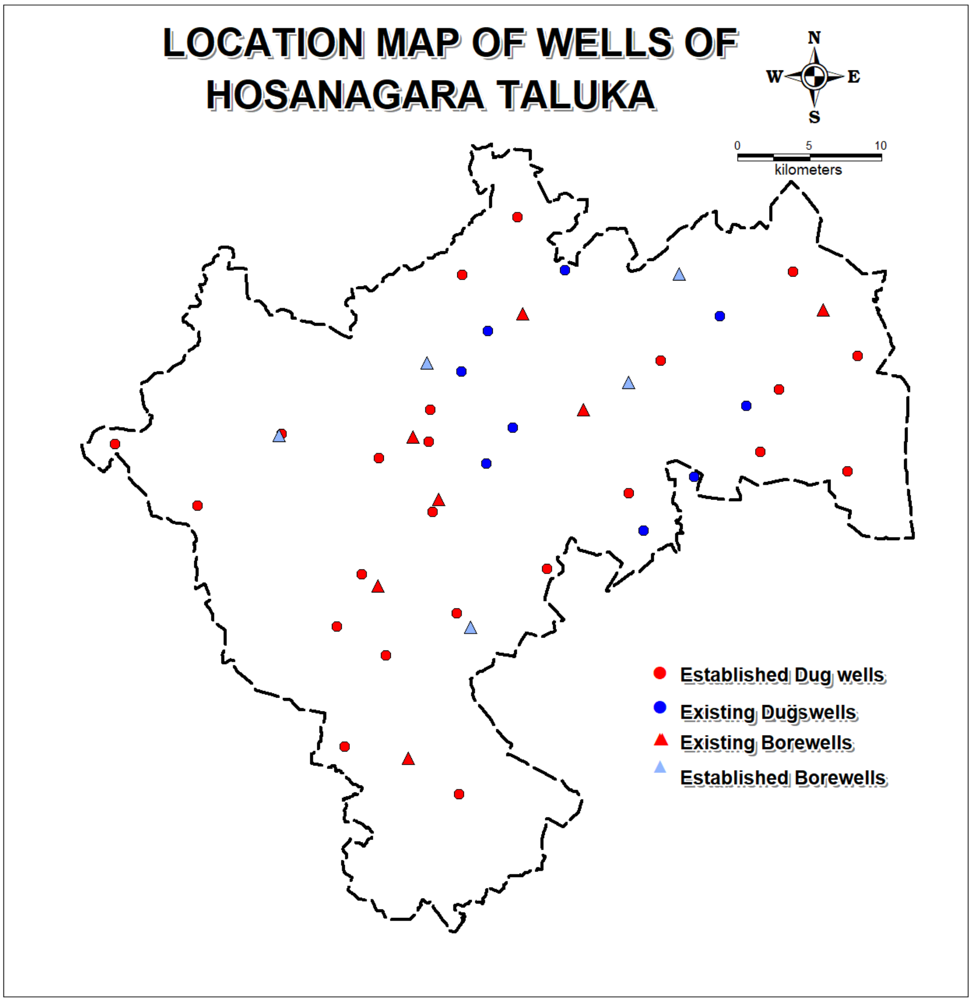
- Ground Water Monitoring and
- Ground Water Quality

Table 1.1 Data Gap Analysis

Sl.No.	Items	Data available with State govt. Agency	Data available with CGWB	Data Requirement/ Data gap identified	Data generated	Total
1	Ground water level data	02 DW+03 PZ	11 DW+0 PZ	25 DW	25 DW	41
2	Ground water quality Data	-	DW 11 + BW 0	25 DW + 8 BW	25 DW + 8 BW	33
3	Borehole Lithology Data	--	6 EW	8 BW	8 BW	14
4	Geophysical Survey	-	-	-	-	-

The location map of existing borewells, dug wells and the locations of established key wells as per data gap is shown in fig 1.2.

Fig 1.2 Location Map of wells of Hosanagara Taluka



1.5 Rainfall and Climate

Hosanagara taluka has tropical climate throughout the year. Generally, the weather is very pleasant in the area. The relative humidity ranges from 27 to 88%, the wind speed recorded is between 4 and 7km/hr. The evapotranspiration is normally high being ghat section. Summer prevails between March to early June, the wet months start from early June to September, October and November months experience scanty rain by N-E monsoon.

The normal annual rainfall (1961 - 2010) of the taluka is 3071mm which is the highest in Shimoga district. The average annual rainfall of the district is 3619 mm (2010 to 2019 period). The taluka gets heavy rainfall as the taluka is located in the windward side of the Western Ghats. Table 1.2 shows the monthly rainfall in the taluka for the period 2010-2019 and graphical representation of variation of average annual rainfall over the period 2010-19 is given in figure 1.3. The graph shows an increasing trend of average annual received in the taluka @ 20 mm/year. However the year 2019 received an exceptional high rainfall of 6177 mm.

Table 1.2. Monthly rainfall (2010-19)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2010	14	0	0	93	66	677	1173	621	494	230	193	0	3560
2011	0	0	13	44	60	834	1065	758	826	106	45	0	3751
2012	0	0	0	218	0	461	465	897	291	46	104	0	2482
2013	0	35	0	67	0	461	465	897	291	46	104	0	2366
2014	0	71	0	81	291	423	1738	965	536	146	5	158	4414
2015	0	0	2	100	334	1813	398	257	246	142	38	0	3330
2016	0	0	0	0	95	832	1069	876	314	67	9	1	3263
2017	0	0	22	0	387	910	889	568	302	111	4	0	3193
2018	0	0	24	98	251	661	1177	1095	167	142	35	5	3655
2019	0	0	0	6	0	402	1546	2942	681	563	38	0	6177
											Annual Average		3619

Source: Karnataka District at a glance

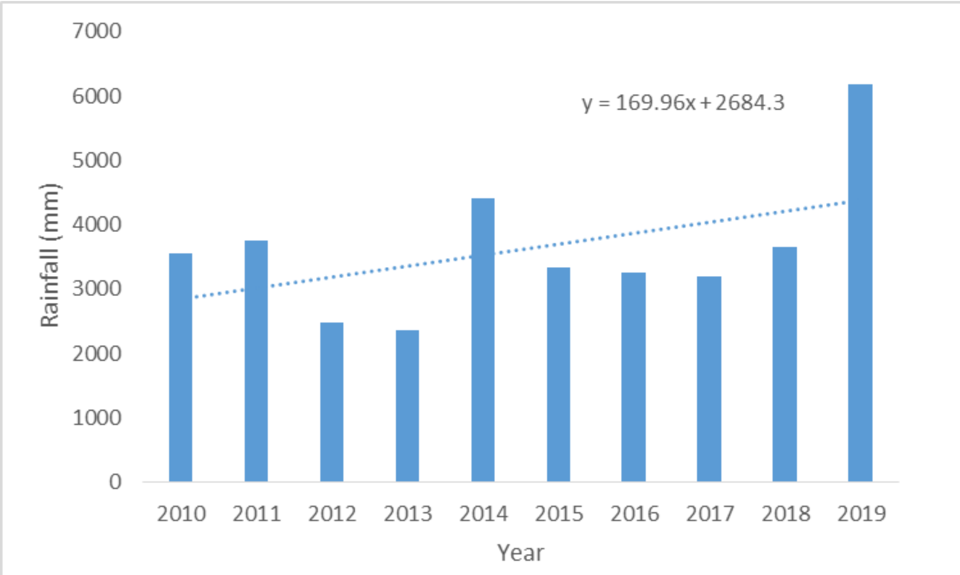


Figure 1.3. Average Annual Rainfall Plot (2010-18)

1.6 Physiography, Geomorphology, Drainage and Slope

Hosanagara taluka is classified as Malnad region, characterized by mountains with heavy downpour. The mountains are part of Western Ghats (Sahayadrihill ranges), which can be demarcated into densely forested, high and hilly located in the western part of Shimoga district. There are 34 named mountains in Hosanagara taluka. A part of Kodachadri, with an altitude of 1074 mamsl within the taluka. A digital elevation model (SRTM-USGS) depicting the major physiographic features in the district given in figure 1.4.

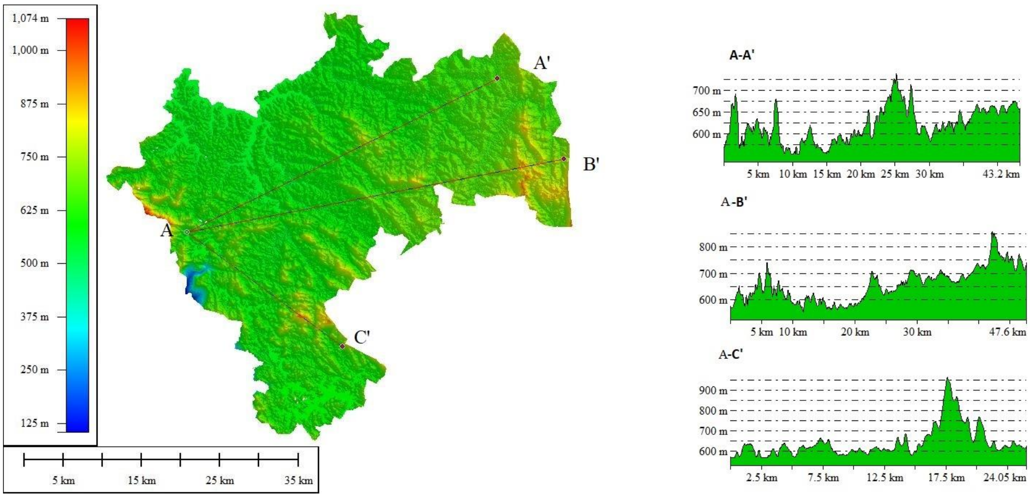


Figure 1.4. Digital Elevation Model of Hosanagara Taluka

Geomorphologically, the area can be divided into dissected hills and valleys along the west and in some parts of the east, plains along the north, pediment pediplain complex along the north-eastern part of the taluka. Valleys deposits are widely distributed in the central and eastern part of the taluka. The geomorphological map of the district is given in figure 1.5.

The Drainage in Hosangara taluk is contributed by river Sharavati and its tributaries such as Nandihole, Haridravathi, Mavinahole, Hilkunji, Yennehole, Hurlihole, and Nagodihole. The river Sharavati originates at Ambutheertha in the Thirthahalli taluk and flows northwards and ultimately joins with Arabian Sea at Honnavar in Uttara Kannada district. The river is dammed at Linganamakki which is located at Kargal village of Sagara taluk. The dam has a length of 2.74 kilometres constructed across the river. Major part of the taluka falls under west flowing river basin and some of the eastern part in Cauvery basin. Mani dam is a major hydrological project and Chakra Dam, Savehakalu Dam, Kyragunda Saddle, Varahi H E Pikup, Hulikal forebay are the minor hydrological projects in the taluka The drainage ap is given in fig 1.6

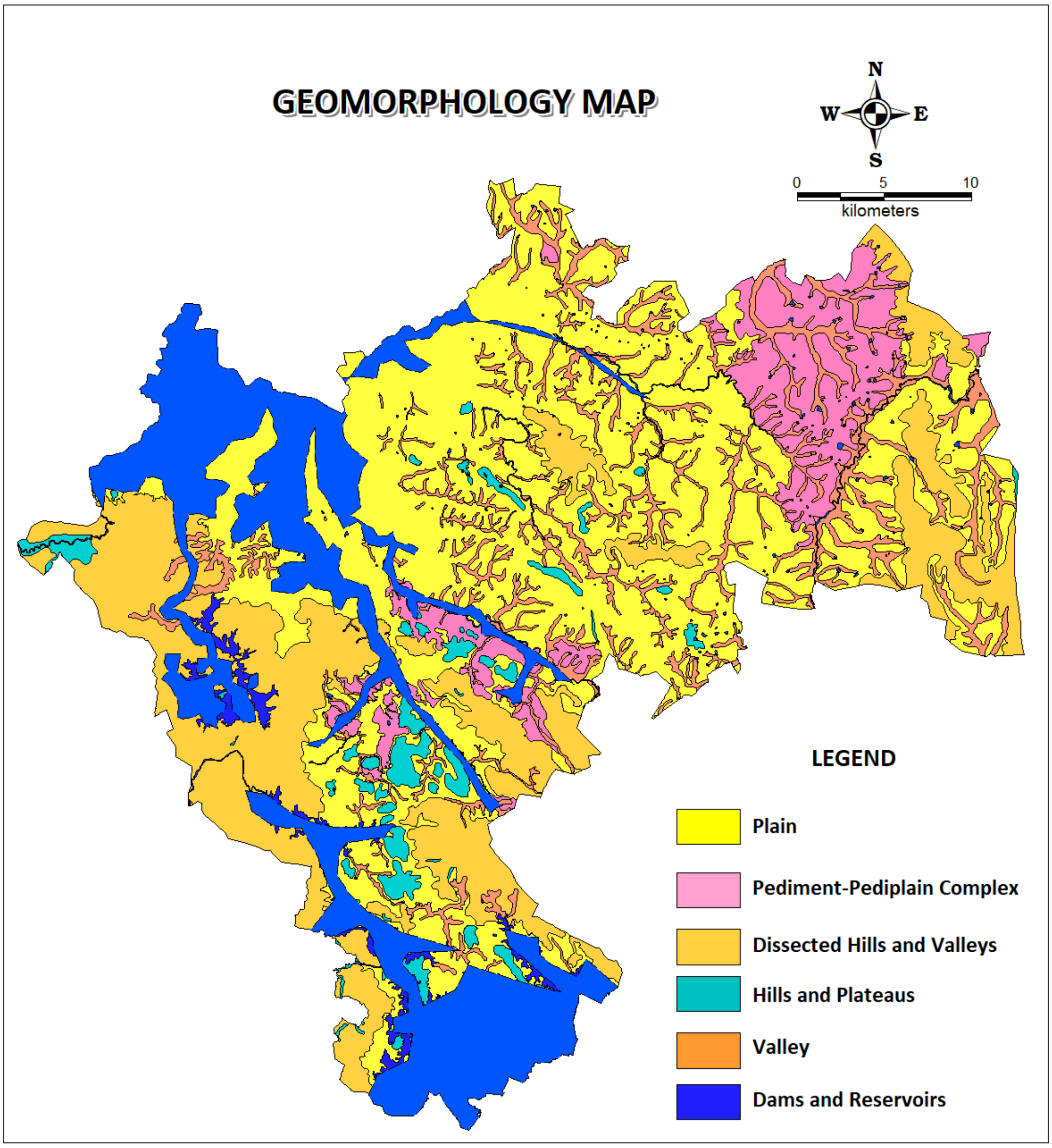
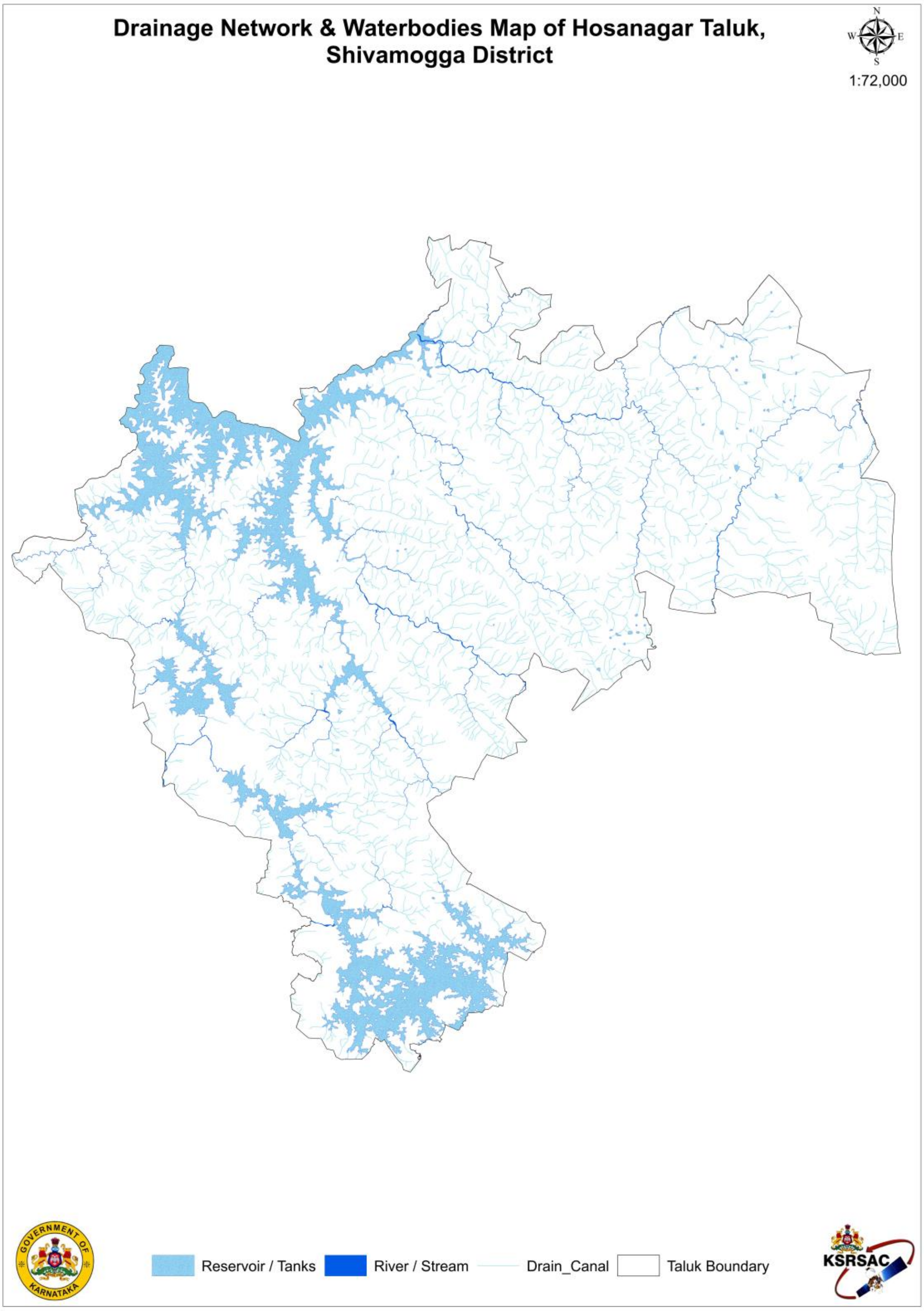


Figure 1.5. Geomorphology of Hosanagara Taluka



Source: Karnataka State Remote Sensing Application Centre (KSRAC)

Figure 1.6. Drainage Map of Hosanagara Taluka

1.7 Land Use, Soil, Slope, Agriculture, Irrigation and Cropping Pattern

An understanding of land use/ land cover is important as it has a direct relation with ground water resource availability and utilisation. As per Annual Season and crop report 2018-19, 25

% of Hosanagara taluka comes under forest area (350.3 Km^2). Summarised land use pattern in figure 1.7. The major crops raised in the district are Paddy arecanut, banana, plantational crops, coconut, maize etc. The area under different crops is given in table 1.4.

Table 1.3. Land use pattern

Item	Area (Sq Km)	Percentage to total district area
Forest	350.27	24.53
Land put to non-agricultural use	211.12	14.78
Barren and uncultivable land	41.7	2.92
Land under miscellaneous tree crops	14.98	1.05
Cultivable waste land	25.5	1.7
Fallow other than current fallow	35.1	2.46
Current fallow	31.6	2.21
Social forestry	73	5.11
Net area sown	184.71	12.93
Area sown more than once	22.26	1.56
Total Area Cropped	206.97	14.49

(*Source: Karnataka District at a glance 2019-20)*

Table 1.4. Area under different crops

Crop	Area (Ha)	Percentage of total cropped area
Paddy	5964	41.77348
Maize	742	5.19717
Pulses	8	0.056034
Banana	648	4.538769
Condiments & Spices	1498	10.4924
Coconut	502	3.516145
Plantational crops	561	3.929397
Arecanut	7827	54.82244

(*Source: Karnataka District at a glance 2019-20)*

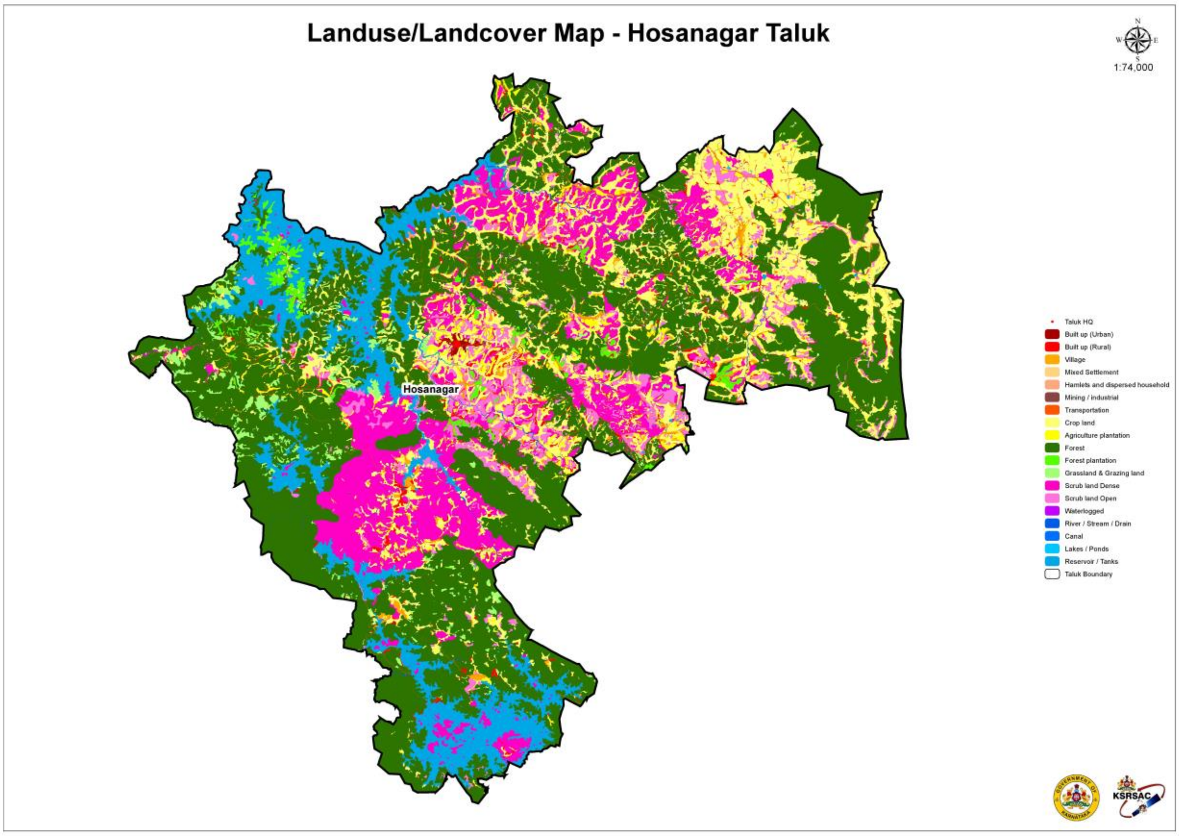


Figure 1.7. Land use/ Land cover – Hosanagara Taluka

Source: Karnataka State Remote Sensing Application Centre (KSRAC)

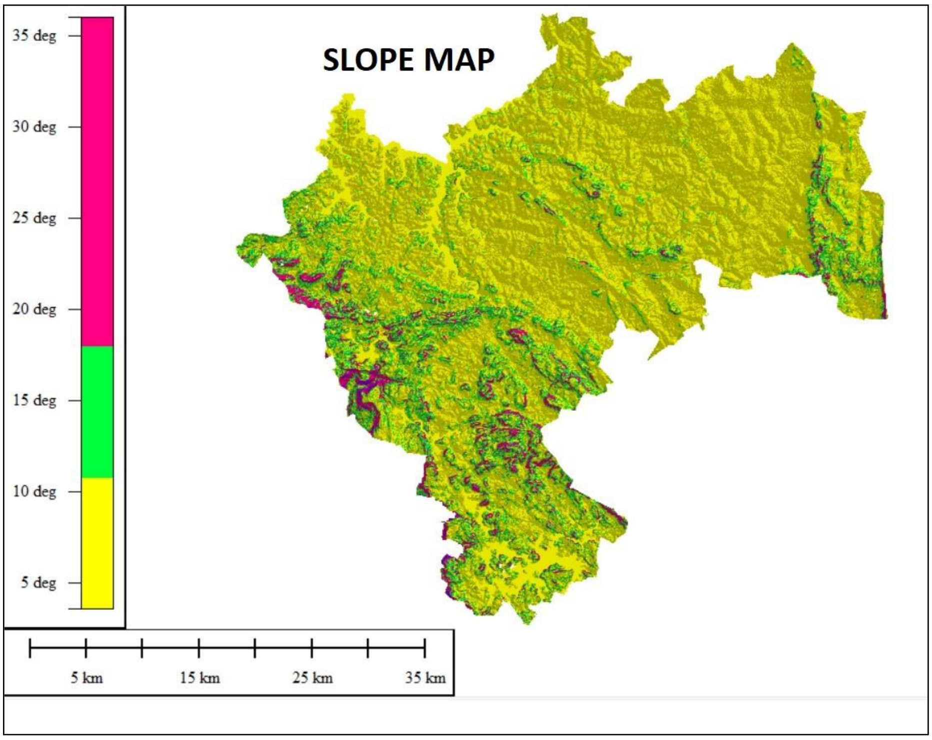


Figure 1.8 Slope Map – Hosanagara Taluka

The source wise area irrigated as per Agricultural Statistics 2019-20 is given in table 1.5.

Table 1.5. Sources of Irrigation

Source	Area irrigated (Ha)	Percentage of net irrigated area
Small Stream (Thodu/Canal)	-	-
Tanks	6207	53.84749
Well	2050	17.78433
Bore well	670	5.81244
Lift & Minor Irrigation	690	5.985946
Other sources	1910	16.56979
Grand Total	**11527**	

(*Source: Karnataka District at a glance 2019-20)*

The main types of soil observed in the taluka are Clayey loamy clayey loamy river alluvium and Forest Loam. The soils that occur in the study area are reddish to brownish clayey to lateritic. These cover major parts of the area. Thin strips of yellowish loamy soil are seen along the banks of major river and nallah courses. In general, these soils are acidic in nature. The Soil map of the taluka is given in figure 1.9

The Slope of the taluka varies from 0 to 50% with 0 to 1% in 301.4 Sq Km area, 1 to 3% in 109.98%, 3 to 5% in 333.7 Sq km, 5 to 10% slope in 163.99 Sq Km, 10 to 15% in 219.11 sq. km, 15-35% slope in 110 Sq Km, 35 to 50% in 184.67 sq. km. This indicates that the major portion covering of the district has slope in the range 0 to 5% and 3 to 5%. The slope map is given in fig 1.8

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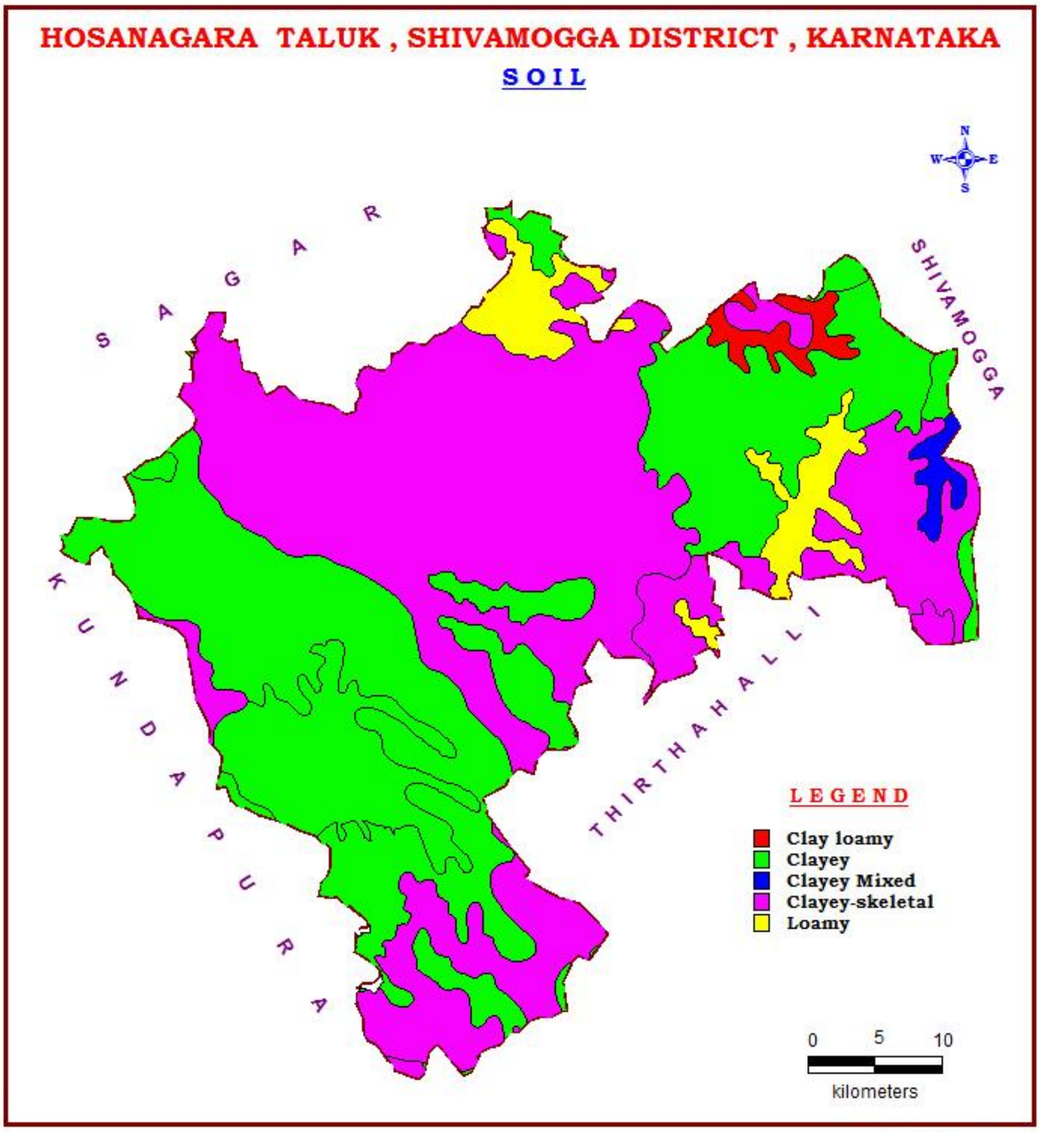

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Figure 1.9. Textural classification of soils

2.0 Data Interpretation, Integration and Aquifer Mapping

Various data pertaining to hydrogeology, geophysics and exploratory drilling were collected and validated. Using this data maps of ground water level scenario, quality aspects, 2-D and 3-D sub-surface aquifers disposition, yield potential etc. were prepared. Finally, aquifer maps were generated and their characteristics are discussed in detail below.

2.1 Geology

Geologically, Shimoga district is characterised by various lithounits spanning from Archaean to Present day deposits. The predominant geological formation of Shimoga is as described below:

Quarternary	Alluvium
Dharwar Super group	Ultra mafic complex, Grewacke, Argellite, Quartz Chlorite schist with orthoquartzite
Lower Precambrian	Metabasalt with thin Ironstone.
Archaean formation	Granite Migmatites and Granodioritic to Tonolitic gneisses, Amphibolites and Pelitischists.

The taluka is underlain mostly by Archean formation with the most pre-dominant formation is banded gneissic complex with the occurrence of schist along the north-eastern and western parts of the taluka, ultramafic along the western part of the taluka. The geology map of the district is given in figure 2.1.

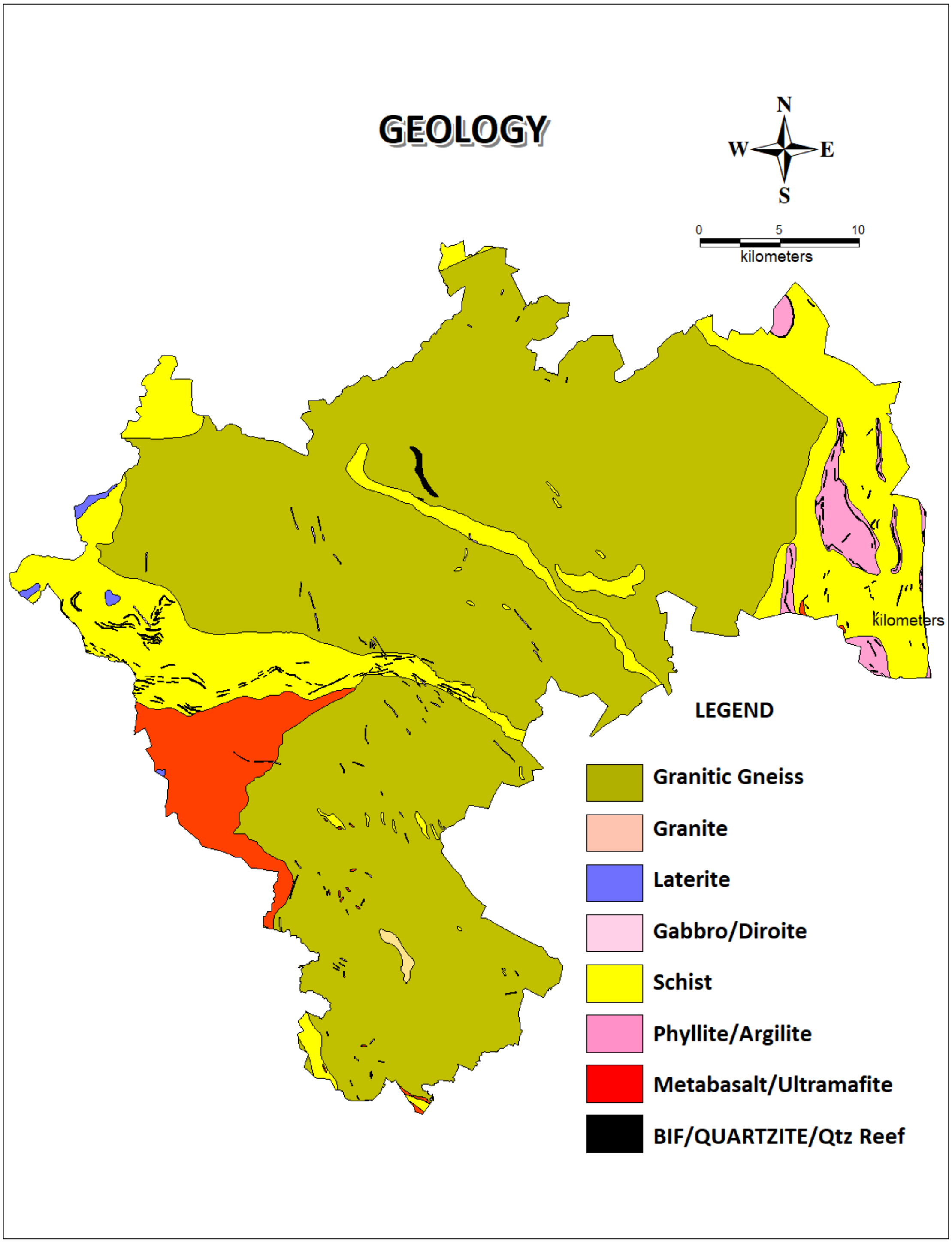


Figure 2.1. Geology-Hosanagara Taluka.

2.2 Hydrogeology

Main aquifers in the study area are the weaker weathered and fractured zones of gneissic-granites and schists. The gneissic-granitic complex does not possess the primary porosity. Secondary structures like joints, fissures and faults present in these formations act as a porous media. The ground water occurs under atmospheric influence in the phreatic zone, which generally occurs within the depth range of 8 to 32.0 mbgl. The sustained yield of dugwells ranges from negligible to 60 m3 /day. The fracture zones that occur at various depth zones within the depth of 185.00 mbgl are expected to be saturated with ground water. It is found that the water bearing characteristics of schists are more or less similar to that of gneisses and granites. But the weathered zones of schists may not yield as granites, because of their compact and fine-grained nature. Laterites occur over the schists and granitic-gneisses with an approximate thickness of few centimetres to 10.00 m, which cover isolated patches north-western parts of Hosanagara Taluka. Ground water in these aquifer materials generally occurs under unconfined to semi-confined conditions. The depth to weathering map of the district is given in figure 2.2.

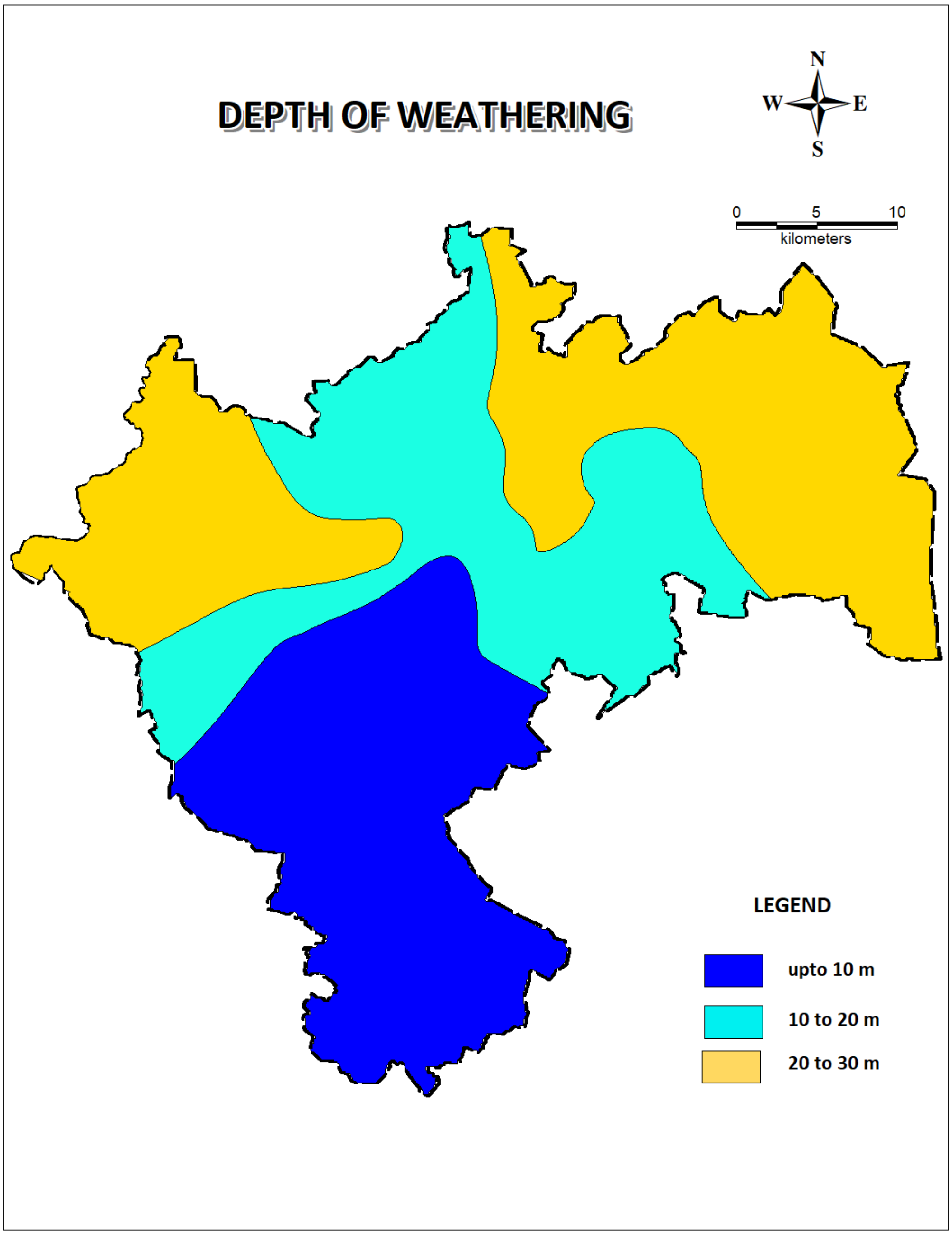


Figure 2.2. Depth to weathering map-Hosanagara Taluka.

In the deeper aquifers, the occurrence and movement of ground water is controlled by the incidence and inter-connection of fractures or joints. The ground water in deeper aquifer occurs under *semi-confined to confined* conditions. Based on the available data with CGWB, state government agencies and people's participatory approach, it is observed that the depth of bore wells in the taluka ranges from 10 – 200 m depth. The yield of bore wells generally ranges from 0.13 to 7.65 lps.

The phreatic aquifers in the district are controlled mostly by local geomorphology rather than geologic structures. Hence, dug wells tapping the weathered crystallines/ laterites located in valley portion and flats are perennial, whereas those along hill slopes dry up during summer, especially where the thickness of overburden is limited

2.3 Ground Water Dynamics

2.3.1 Occurrence of Ground Water and Water Level Behaviour in Aquifer-I

Ground water occurs under atmospheric pressure conditions in aquifer-I. The shallow phreatic aquifers of weathered crystalline are generally developed through dug wells. The depth of dug wells ranges from 8.12 to 32 mbgl.

To understand the depth to water level scenario, water level measurement from all the observation wells were carried out in the month of April (pre-monsoon) and November (post-monsoon). The depth to water levels in the taluka during April 2022 ranges between 0.6 (Karagadi) to 15.27 (Hosangare). About 179 Sq Km area has depth to water level raging between 0 to 5 mbgl observed in eastern part of the taluka, 742 Sq Km area covering the major parts of the taluka has depth to water level between 5 to 10 and 505 sq km covering southern, parts of central and north-western parts of the taluka have depth to water level >10 mbgl. The Pre-monsoon depth to water level map of the district is given in fig 2.3.

The depth to water levels in the taluka during November 2022 ranges between 4.64 mbgl (Bilehalli) to 9.57 mbgl (Brahmeeshwara). Only 97 Sq Km area I the eastern part of the block has depth to water level less than 5 mbgl. The remaining parts of the taluka had water levels in the range 5 to 10 mbgl. The Post-monsoon depth to water level map of the district is given in fig 2.4.

2.3.2 Occurrence of Ground Water and Water Level Behaviour Deeper Aquifer-II

The deeper fractured aquifers are under confined to semi-confined conditions. CGWB has an available data of 6 exploratory wells drilled upto a total depth of 200m of which 3 are high yielding. The discharge ranges from negligible to 7.65. The yield cum recouperation tests indicate that the specific capacity ranges from 11.31 to 28.1lpm/m/dd. The data of these wells has deciphered that most potential fractures are encountered up to 132 mbgl. However the fractures extend upto 185 mbgl. The Ground Water Department, Karnataka has only 3 deeper wells having a maximum depth of 110 m. Besides, participatory involvement of local people of the taluka on the details of drilling in their private lands has indicated the presence of occasional fractured aquifers down to the depth of 175 mbgl. However, the productivity of fractures beyond the depth of 135 m is questionable. The depth to water level of the drilled piezometer has depth to water level ranging between 3.29 to 16 mbgl.

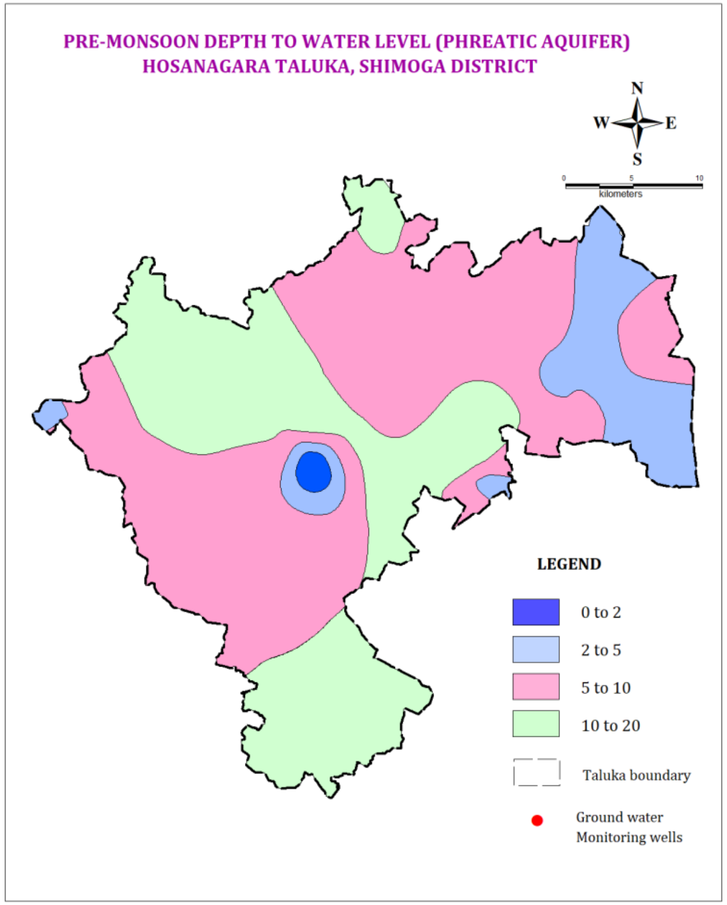


Figure 2.3. Pre-monsoon depth to water level map, Hosanagara Taluka

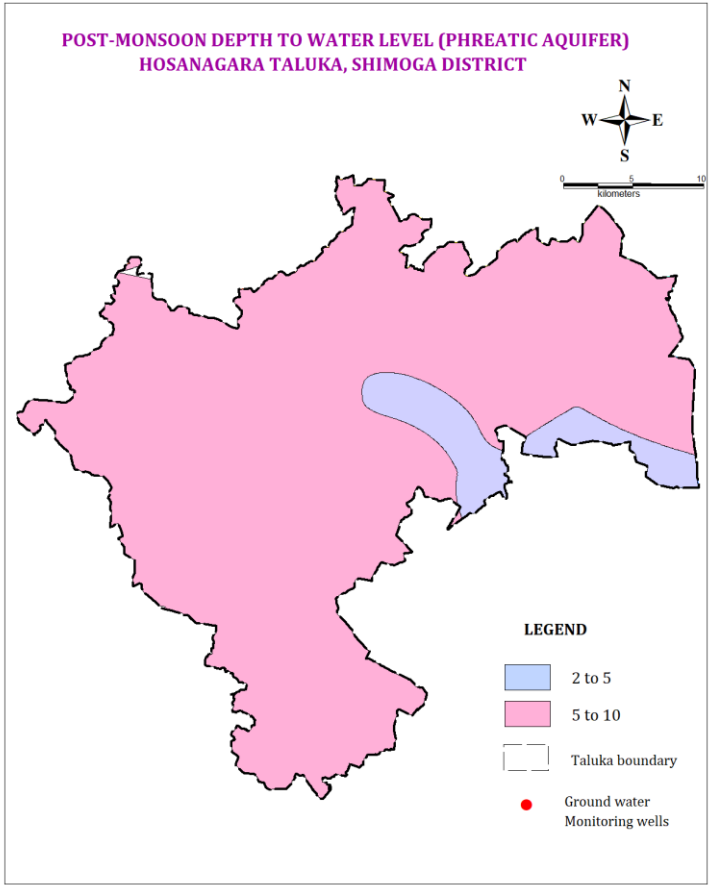


Figure 2.4. Post-monsoon depth to water level map, , Hosanagara Taluka

2.3.3 Long Term Water Level Trend (2010-2019)- Hydrograph analysis

The variation in water level with reference to time and space is the net result of groundwater extraction and recharge. The long-term change in water level is apparent from the trend of water levels over a period of time and is best reflected in a hydrograph. The decadal trend (2010-2019) of groundwater levels, for pre-monsoon and post-monsoon periods has been analysed for the present study. The hydrographs of 3 observation wells of CGWB namely Hosangara 1, Humacha and Riponpet has been presented below in fig 2.5 (a), 2.5 b) and 2.5 (c) respectively. Analysis of hydrographs shows that there is a very slight decline of premonsoon water level trend and a slight increase of post monsoon water level trend in Hoasanagara and Riponpet which are negligible wherein Humache shows declining water level trend @0.06m/yr post monsoon trend and declining post monsoon water level trend @0.1068. Hence, all the 3 hydrographs depicts that the decal water level trend during both the seasons are in a pace that is manageable with sustainable use of ground water.

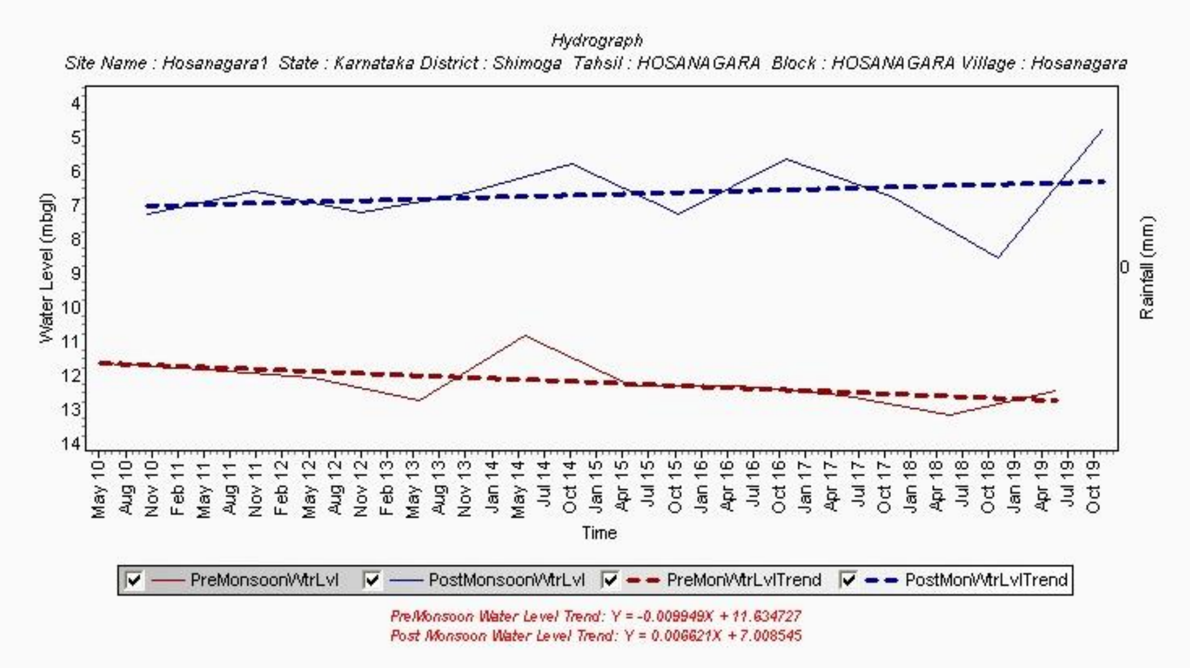


Fig 2.5(a): Hydrograph of Hosangara-1, Hosanagara Taluka

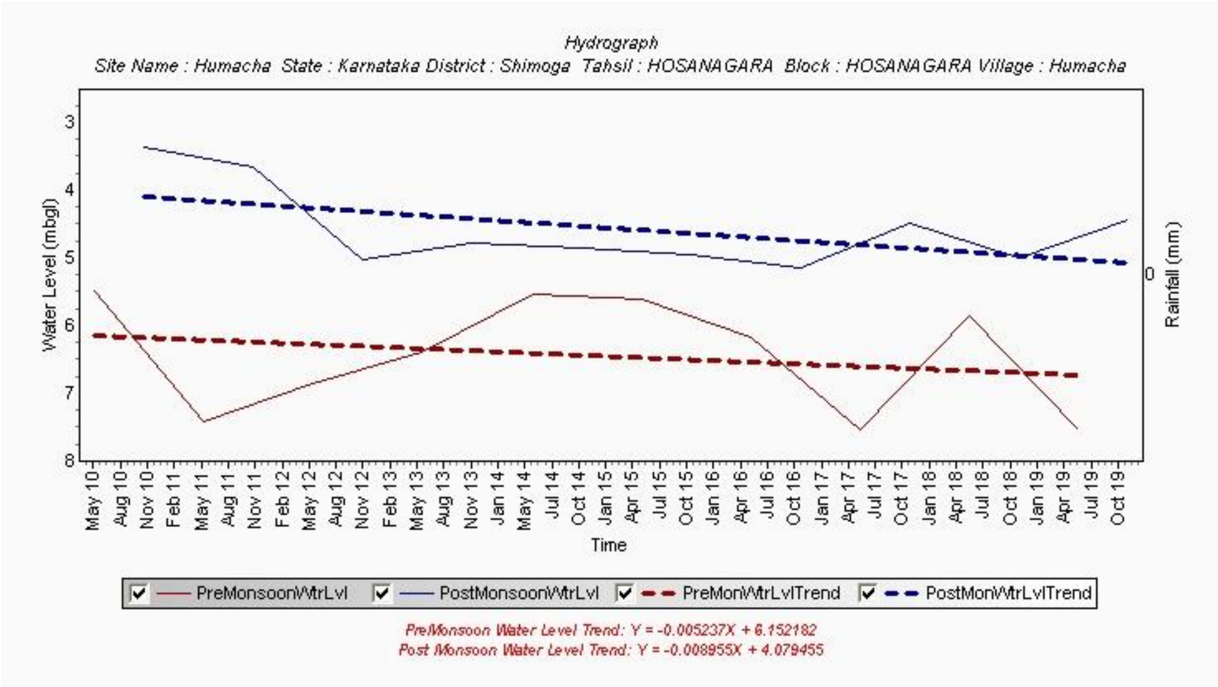


Fig 2.5(b): Hydrograph of Humache, Hosanagara Taluka

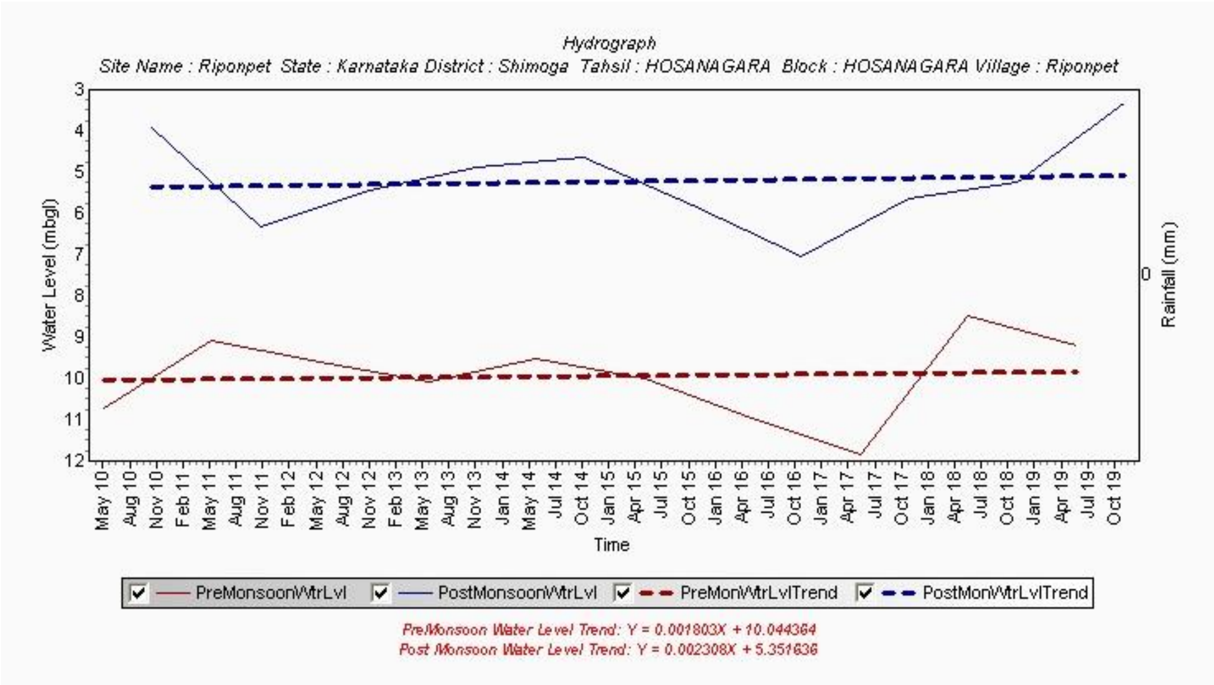


Fig 2.5(c): Hydrograph of Riponpet, Hosanagara Taluka

2.3.4 Ground Water Flow

Equipotential lines, the lines joining points of equal head on the potentiometric surface, were drawn for pre-monsoon period, based on the variation of the head in the aquifer. Based on the Water table elevation, ground water flow directions can be identified (Figure 2.6). It has been observed that the topography of the area is the main controlling factor in determining ground water flow direction. Also, the effluent nature of streams (gaining streams) is evident from the contour pattern. The general flow direction is towards west following the terrain slope

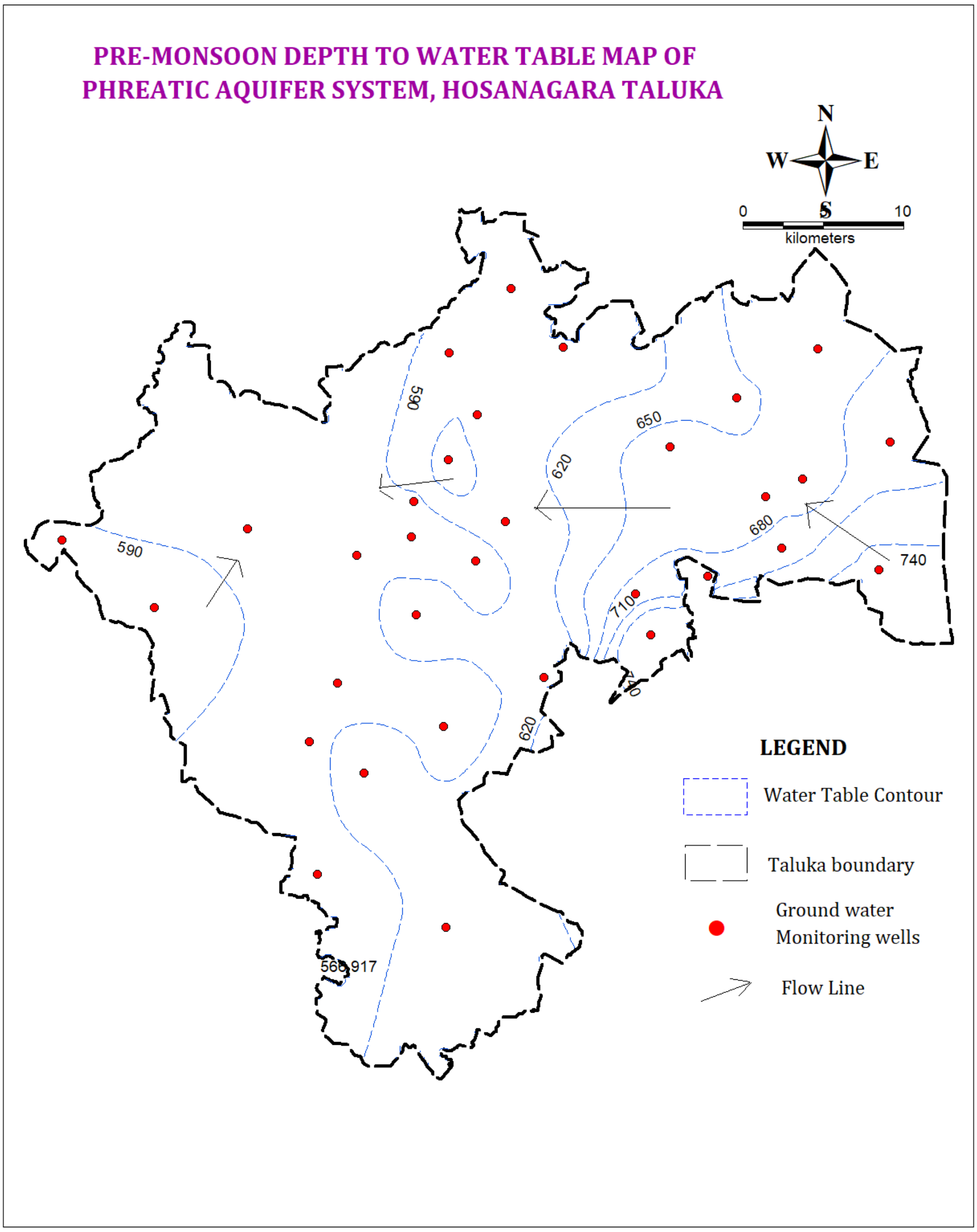
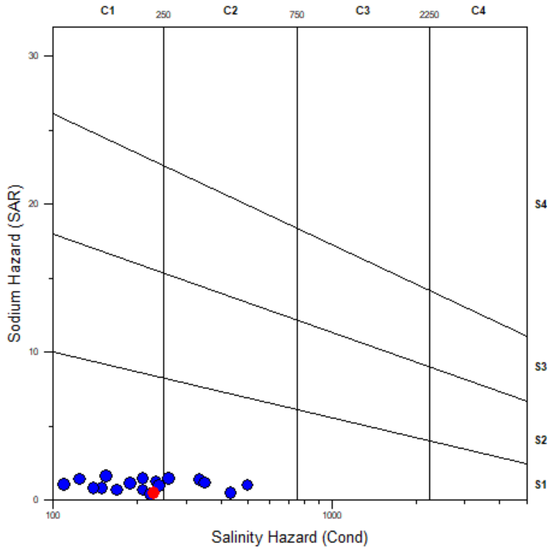


Figure 2.6. Pre-monsoon DTWT map (mamsl)-Phreatic aquifer system

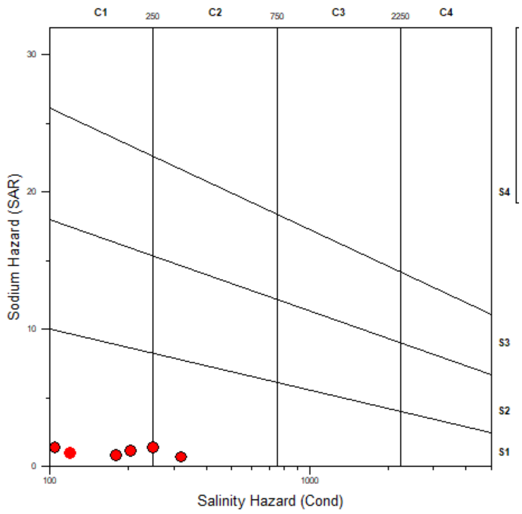
2.4 Ground Water Quality

The suitability of ground water for drinking/irrigation and industrial purposes is determined by the abundance of various chemical constituents in water. Though many ions are very essential for the growth of plants and human body, when present in excess, have an adverse effect on health. For estimation of the quality of ground water, ground water samples from 21 samples from dug wells dug wells representing phreatic aquifer have been collected during pre-monsoon. Similarly, for Aquifer – II, the ground water samples (7 Nos.) were collected from bore wells. The aquifer wise ranges of different chemical constituents present in ground water are given in Table 3.5. All the major ions are within permissible limits, except for Fluoride (> 1.5mg/l) in 2 samples from Sampigaru and Hosanagara.

Generally, the Irrigation suitability is good for Aquifer-I and for aquifer-II (EC <500 µS/cm).. USSL plot depicting the classification of irrigation water quality with respect to salinity hazard and sodium hazard for both the aquifers are given in figure 2.7.



Aquifer-1



Aquifer-II

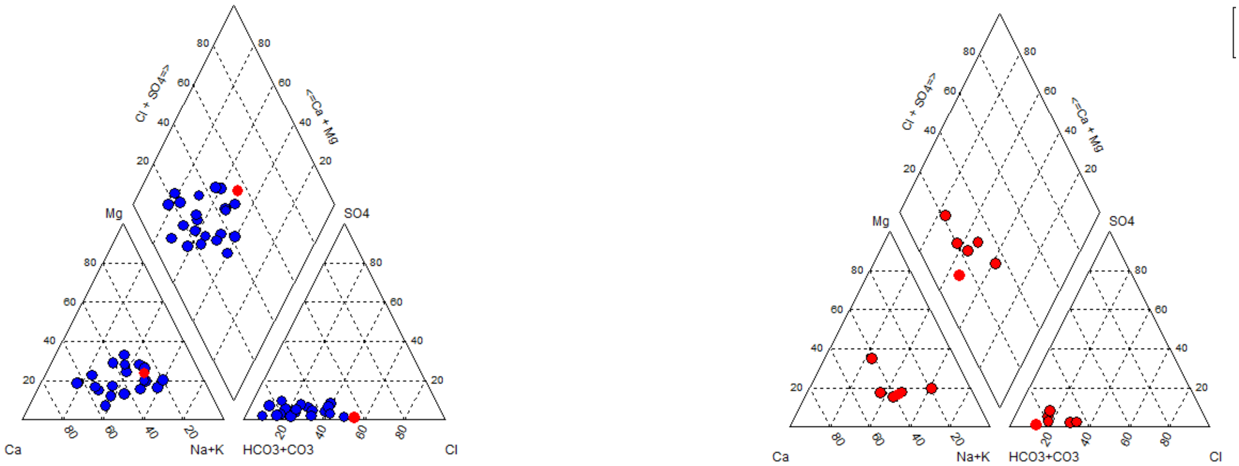
Figure 2.7. Classification of irrigation based on USSL diagram

To understand the hydrochemical facies, Hill piper diagrams were prepared separately for both the aquifers. In the current study it has been observed that the water samples from aquifer-I and aquifer II shows no-dominant cation predominance, whereas the anions are mostly dominated by HCO_3+CO_3>Cl>SO_4. The order of predominance of anions can be attributed to the high rainfall recharge followed by natural flushing out process existing in the phreatic aquifer system. Hill piper diagrams for both the aquifers are given in figure 2.8.

Table 2.1 Aquifer wise ranges of chemical constituents in Kannur district

Constituents	Aquifer-I		Aquifer-II	
	Min	Max	Min	Max
pH	6.5	7.86	6.48	7.53
EC (µS/cm)	80	500	105	350
TH (mg/l)	20	175	20	120
Calcium (mg/l)	2.1	4	4	26
Magnesium (mg/l)	1.2	9.7	2.4	13.3
Potassium (mg/l)	0.4	17.6	0.5	3.1

Sodium (mg/l)	7	30	12	25
Carbonate (mg/l)	0	0	0	
Bi carbonate (mg/l)	24.4	256	36.6	140.3
Chloride (mg/l)	7.09	38.8	10.63	17.72
Sulphate (mg/l)	1	19	1	7
Nitrate (mg/l)	1	27	2	8
Fluoride (mg/l)	0.21	2.27	0.23	0.9



Aquifer-1 **Aquifer-II**

Figure 2.8. Hill piper Diagram

2.5 3-D and 2-D Aquifer Disposition

Based on the analysis of existing and generated data through hydrogeological surveys and ground water exploration, following two types of aquifer systems were identified in Hosangara taluka. The details of ground water exploration are given in Annexure-I. The litholog data from ground water exploration data has been used to generate the 2D and 3D disposition aquifers. The aquifer disposition models clearly depict the vertical and horizontal extension of various litho-units and the zones tapped, forming aquifers. Based on the ground water exploration and micro-level hydrogeological survey, lithological fence diagrams and cross sections were prepared and are given in figure 2.10 and 2.11 respectively. The 3D lithological view of Hosanagara Taluka is shown in figure 2.9.

The aquifer units in each of the formation are listed below:

• Aquifer I – Aquifer I consists of weathered crystallines and associated shallow fractures. The thickness of the first aquifer ranges up to 24 m and the thickness is highly variable. Along hill slopes it is virtually absent; thickness is maximum along valleys and plateau regions.

- Aquifer-II – Aquifer II consists of massive crystallines and associated fractures. As per drilling data by CGWB, potential fractures are limited down up to 132 mbgl. However, the fractures extend upto 185 mbgl. The Ground Water Department, Karnataka has only 3 deeper wells having a maximum depth of 110 m. Besides, participatory involvement of local people of the taluka on the details of drilling in their private lands has indicated the presence of occasional fractured aquifers down to the depth of 175 mbgl. However, the productivity of fractures beyond the depth of 135 m is questionable

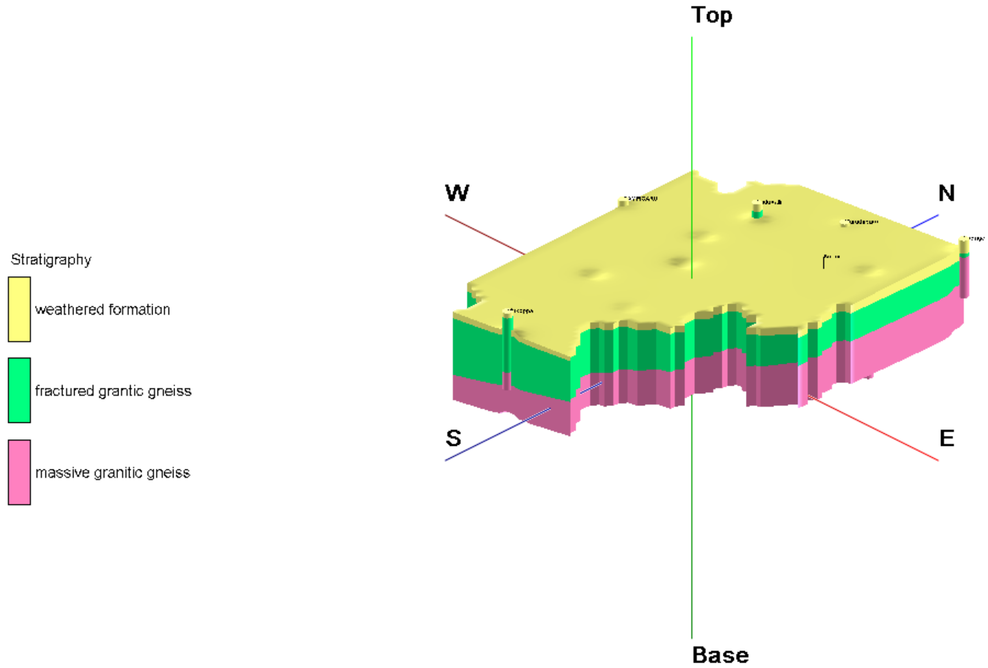


Figure 2.9. 3D Diagram of Hosanagara Taluka

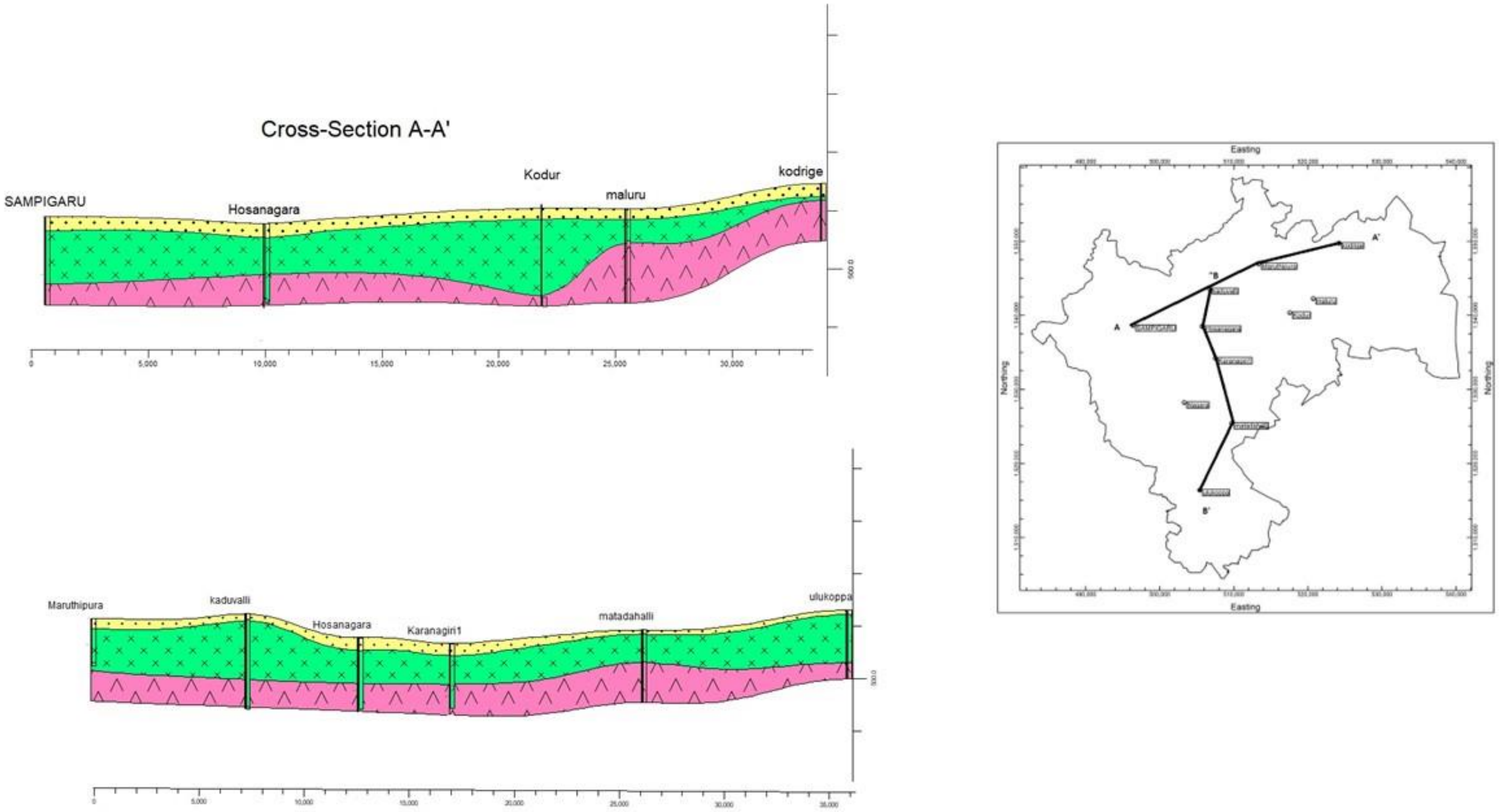


Figure 2.10 2D Sections of Hosanagara Taluka

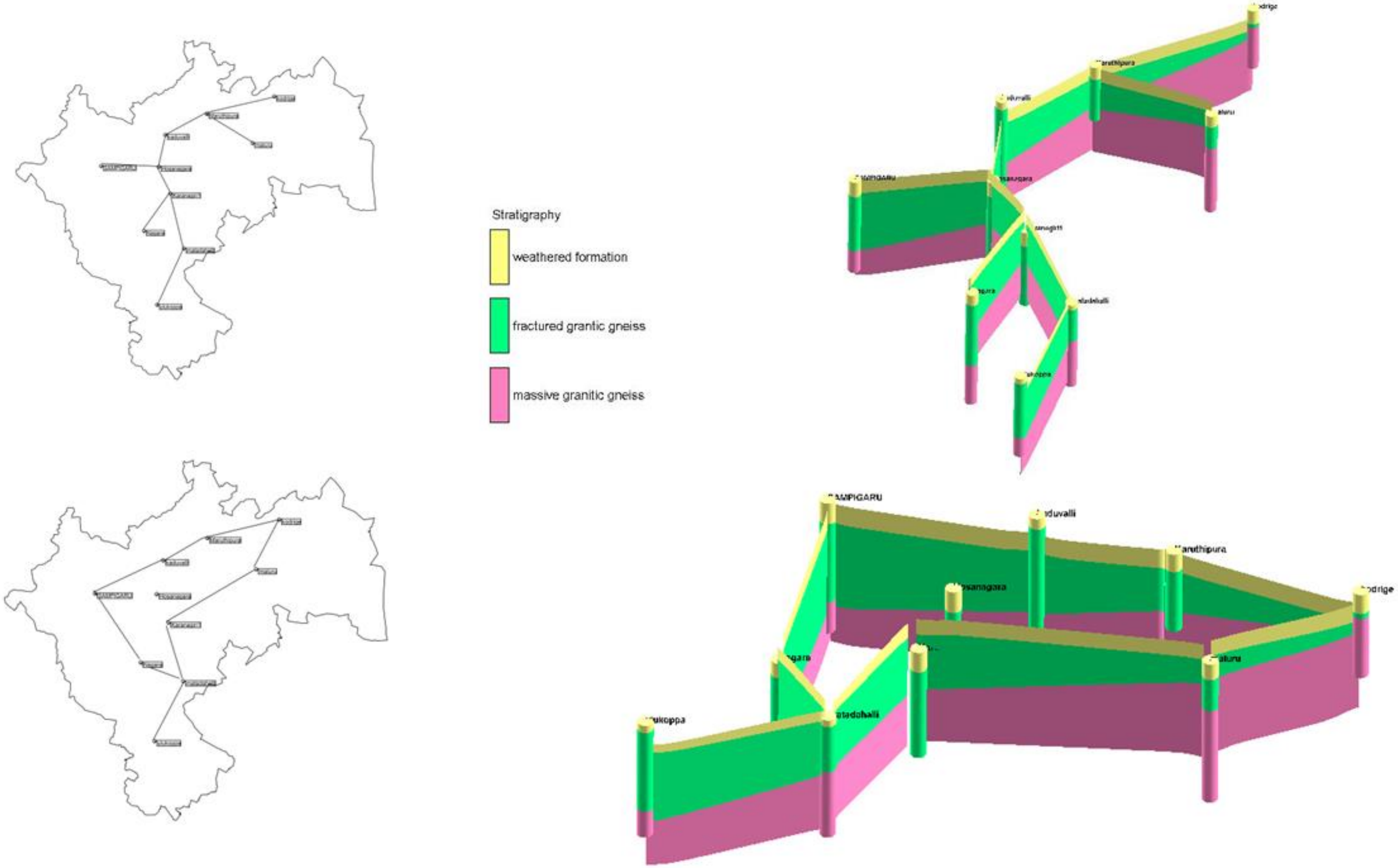


Figure 2.11 Fence Diagram of Hosanagara Taluka

The salient features of the two aquifer systems in the district is summarized in table 2.2 and is given below:

Table 2.2. Salient features of the aquifer systems in Hosanagara Taluka

Type of aquifer	Aquifer-I	Aquifer-II
Formation	Weathered Crystallines/Laterite	Fractured Crystallines.
Depth to bottom (mbgl)	Up to 24 m (including in storage part of unconfined aquifer)	upto 185 m.
SWL	Range between 1.00 to 15.27 mbgl	Range between 3.2 - 16 mbgl.
Thickness (Weathered zone/fractured)	8.12 to 32 m	1 to 16 m
Weathered/Fractured zones encountered	Mostly weathered formations up to 32 mbgl	Up to 185 mbgl
Yield	Negligible to 30 m^3/day	Negligible to 7.65 lps
Aquifer Parameter (Transmissivity-m^2/day)	-	2.56 to 56 m^2/day
Sy/S	0.02 to 0.09	0.000032 to 0.0195
Suitability for drinking & irrigation	Yes	Yes

2.6 Aquifer maps

An aquifer map of the area is evolved out finally, based on aquifer geometry, aquifer characteristics, ground water resources, yield characteristics and water quality. The aquifer map of the phreatic (Aquifer-I) and fracture aquifer systems (Aquifer-II) are shown in figures 2.12 and 2.13 respectively. In phreatic aquifer system, along the western hilly tracts the yield up to 10 m^3/ day, in valley portions yield upto 30 m^3/ day is noticed. In the deeper aquifers discharge is generally found to be within 3 lps. More than 3 lps is noticed near reservoir area. The aquifer map of phreatic and deeper aquifers are given in fig 2.12 & 2.13

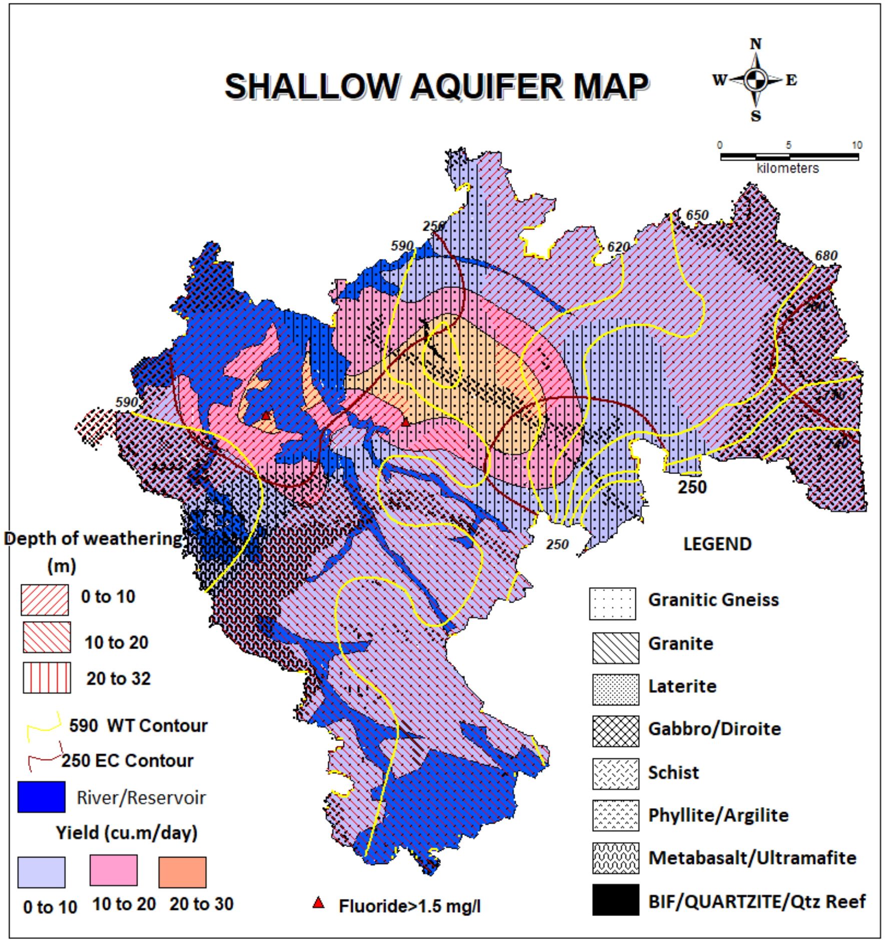


Figure 2.12. Aquifer map-Phreatic aquifer system

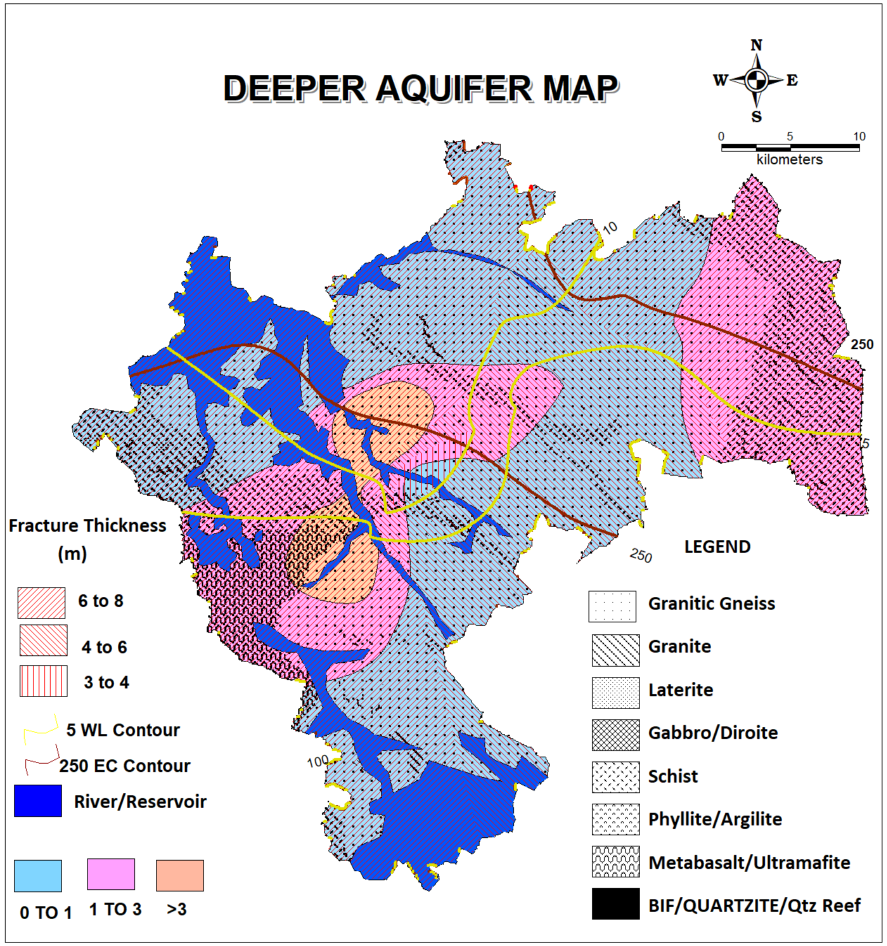


Figure 2.13. Aquifer map-Deeper aquifer system

3.0 Ground Water Resources

Aquifer wise and block-wise estimation of ground water resources have been carried out for the 2 aquifers existing in the area i.e., Aquifer-I (the phreatic aquifer) and Aquifer-II (the fractured aquifer system) using GEC-2015 methodology. The details of the assessment are discussed below.

3.1 Ground water resources in the Phreatic aquifer (Aquifer-I)

The annual extractable ground water recharge of aquifer-I was estimated to be 134.12 mcm. As per estimation the annual gross extraction for all uses is 30.81 mcm with extraction for irrigation requirement being the major consumer having a draft of 28.3 mcm. The annual draft for irrigation, domestic and industrial uses together account for about 30.8 mcm. The allocation for domestic use up to 2025 is about 2.54 mcm. The categorisation of Hosanagara is Safe with Stage of Extraction of 22.9%. The Pie chart depicting the same is shown in fig 3.1.

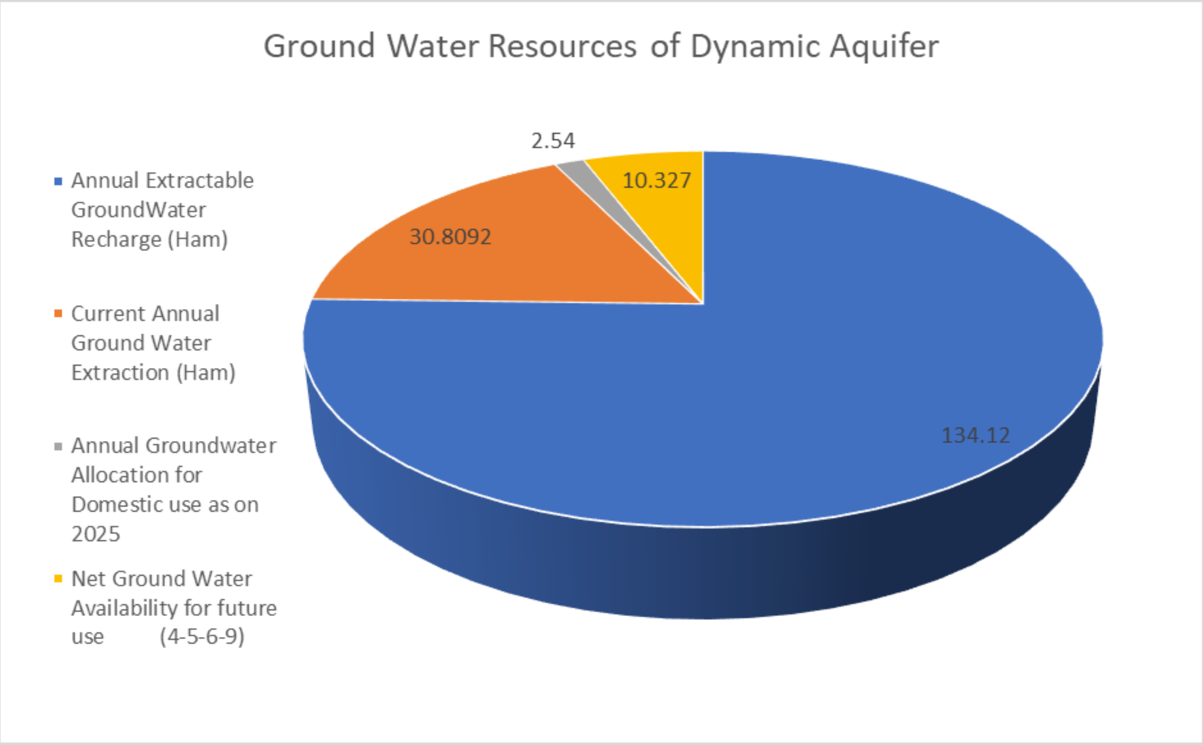


Figure 3.1: Ground Water Resources of Aquifer I

3.2 Ground Water Resources in the fracture aquifer system – Aquifer-II

The total resources of Aquifer-II have been computed to be 1122.64 mcm and is shown in table 3.2.

The total ground water resources of the entire aquifer system (Aquifer-I and II) was estimated to about 1256.76, out of which 134.12 mcm is from Aquifer-I and the remaining 1122.64 mcm is accounted in aquifer-II.

Table 3.1. Ground water resources in the phreatic zone of Hosanagara Taluka (Aquifer-I; Dynamic and in-storage)

Sl. No.	Assessment Unit/ Block	Command / Non-Command	Annual Extractable GroundWater Recharge (Ham)	Current Annual Ground Water Extraction (Ham)				Annual Groundwater Allocation for Domestic use as on 2025	Net Ground Water Availability for future use (4-5-6-9)	Stage of Ground Water Extraction (%) (8/4)*100
				Irrigation Use	Industrial Use	Domestic Use	Total Extraction (5+6+7)			
1	Hosangara	Non-command	13412	2830.2	0.00	250.72	3080.92	254.21	10327.6	22.97
	TOTAL (ha.m)		**13412**	**2830.2**	**0.00**	**250.72**	**3080.92**	**254.21**	**10327.6**	**22.97**
	TOTAL (MCM)		**134.12**	**28.302**	**0.00**	**2.50**	**30.8092**	**2.54**	**103.27**	**22.97**

Table 3.2. Ground water resources in the phreatic zone of Hosanagara Taluka (Aquifer-I; Dynamic and in-storage)

Sl. No.	Assessment Unit/ Block	Command / Non-Command	Geographical Area (Sq Km)	Storativity	Fractured Thickness	Gw resources
1	Hosangara	Non-command	142800	0.009766	80.5	112264
	TOTAL (ha.m)		142800	0.009766	80.5	112264
	TOTAL (MCM)		**1428**	**0.009766**	**80.5**	**1122.64**

4.0 GROUND WATER RELATED ISSUES

The extraction of ground water resources in Hosanagara is increasing over a period of time. It is evident from the comparison of ground water resources carried out as on 2022 by CGWB and GWD, Karnataka. In 2020, the SOE was 19.9 % and in 2022 it come up to 22.9%, In 2022 'the annual ground water recharge" was 134.12 and the existing gross draft for all uses was estimated to be 30.80 mcm, wherein in 2020 the "annual ground water recharge" was 146.02 and the existing gross draft for all uses was estimated to be 29.06 mcm. This shows an a slightly increased dependency in ground water. The major ground water related problems observed in the district are detailed below:

4.1 Deeper water Level during summer

Many parts of the district experiences deeper ground water levels in dug wells due to limited weathering thickness and lower sustainability. Major part of the taluka has yield range 0 to 70 m^3/day.

4.2 Low Yielding Deeper Aquifers

The borewells drilled by CGWB has shown a maximum yield of upto 4.5 lps. The deeper water levels of dugwells during summer does increase the dependency in borewells for domestic and irrigation purpose, However, the borewells does not sustain for longer periods of pumping.

4.3 Quality Problems

Generally, the ground water quality in the district is good. However, Fluoride contamination has been observed in two sites namely Hosanagara (1.59mg/l) and Sampigaru (2.27mg/l). which may be due to underlying granitic gneisses.

4.4 Low Stage of Development

The majority of agriculture is surface water/rainfed type of agriculture. Increasing the area of cultivation by bringing additional area likw cultivable waste land and barren lands into cultivation by use of ground water resources in water efficient method can develop resources in sustainable manner

5.0 MANAGEMENT STRATEGIES & AQUIFER MANGEMENT PLAN

The groundwater management strategies are inevitable either when there is much demand to the resource than the available quantity or when the quality of resource deteriorates due to contamination in each geographical unit. Hence, it is the need to formulate sustainable management of the groundwater resource in a more rational and scientific way. In the present study, in Hosanagara Taluka, the sustainable management plan for aquifer is being proposed after a detailed understanding of the aquifer disposition down to a depth of 200 m bgl.

The study area falls under non-command area and out of gross irrigated area of 206.97, 104 Sq Km area is under rainfed irrigation, 53 Sq Km is irrigated by tanks/ponds/reservoirs, 16.41 sq km area is irrigated by ground water, 4.2 sq km area is under lift irrigation, 8.84 sq km is irrigated by other sources. Thus in the district, rainfed irrigation is more than surface water or ground water irrigation. Hence, more area can be bought under cultivation by development of ground water resources.

5.1. Supply Side Management Plan

Augmentation of groundwater can be achieved through construction of additional recharge structures like check dams, vented cross bars, percolation ponds etc. Normally it can be attained through capturing surface runoff. The details of supply side intervention proposed in the area is discussed below and the tentative location of the structures is depicted in fig 5.1.

Geographical Area (Sq Km)	1423
Area unsuitable for artificial recharge ie hilly/rocky area (sq Km)	270
Area Unsuitable for AR DTW < 3 mbgl	0.000
Command area (sq km)	-
Area Suitable for Artificial Recharge (Sq Km)	1153
Mean DTW (mbgl)	6.1
Thickness of usaturated Zone (m)	3.1
Volume of unsturated Zone (MCM)	3574.98502
Total Storage Potential (MCM)	71.4997004
Surface Water Requirement (MCM)	95.0946015
Talukwise surplus water Resource Available (MCM)	196.73428
Surface water for planning artificial recharge (MCM)	95.0946015
No. of percolations suitable as per field condition	64
No. of check dam as per field condition	492
No. of filter beds as per field condition	14

The implementation of maintenance and desilting of the existing structures is a necessary check to ensure proper recharge. Periodic de-siltation as well as cleaning of existing Panchayath ponds and irrigation tanks, check dams, individual and community ponds has to be carried out in the study area to increase the storage capacity as well as infiltration rate.

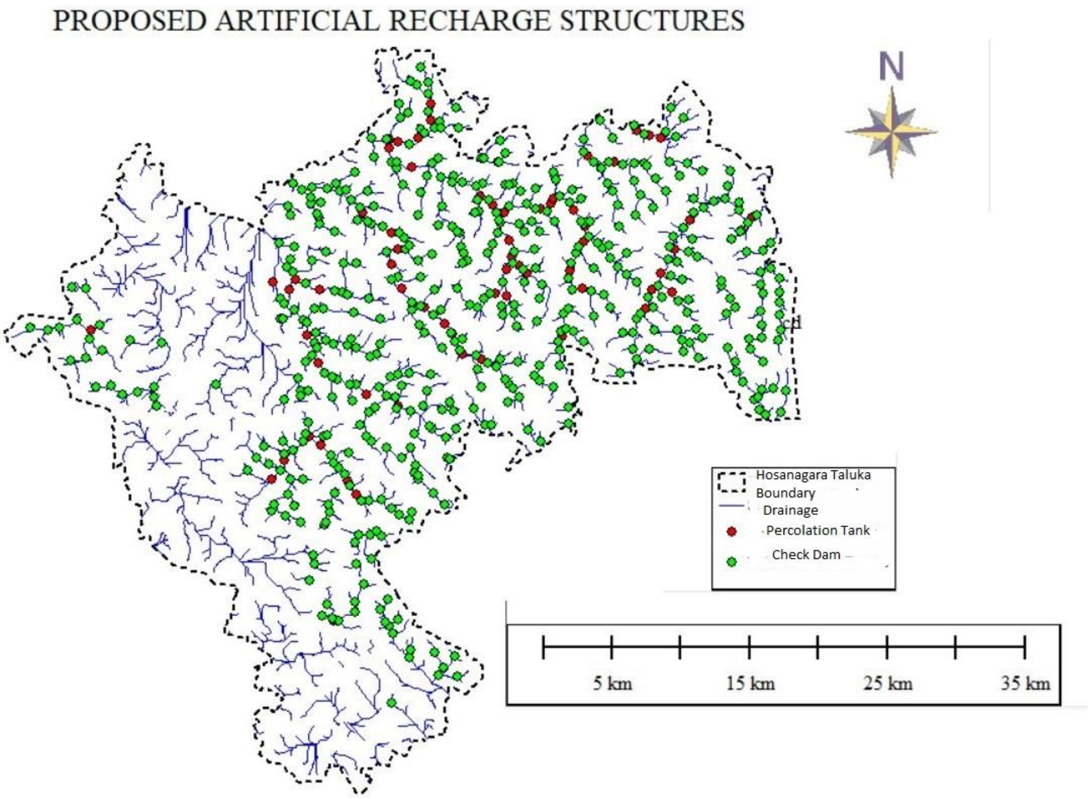


Figure 5.1: Proposed location of AR Structures

5.2. Creation of irrigation potential through ground water

Additional irrigation potential can be created in the district considering the relatively low stage of ground water development in the blocks. This will promote the financial stability and economic growth of the farmers in the district. Details are given in table 5.1 and 5.2 respectively.

5.3.1.(a). General suggestions for the creation of irrigation potential through ground water

Creation of irrigation potential through groundwater depends upon yield potential of underlying aquifers. Hence, any new construction of groundwater well should be based on the data/ knowledge available for the area with the Central/ State Agencies involved in groundwater development and management. Some of the important points to be considered while planning any groundwater development are as below:

- The groundwater management schemes should not be planned in areas classified as over-exploited, critical and semi critical areas. Further eligibility criteria has been laid down in subsequent paras.
- Groundwater development will be carried out preferably through Dug wells and or BWs in hard rock areas whereas shallow/deep tube wells are recommended alluvial areas. Bore wells are to be taken up in areas where hydro-geological setup and groundwater aquifers justifies their suitability.

- Promotion and adoption of water use efficiency & conservation practices viz. drip/sprinkler, diversification to low water demand crops, promoting on-farm rainwater harvesting etc shall be encouraged by the State Govt/ Project Authorities.
- The State agencies involved in planning and execution of ground water schemes shall formulate the proposals in consultation with State Ground Water Department & CGWB duly considering nature of aquifer system in the area, spatio-temporal behaviour of water level, ground water resource availability, artificial recharge structures suitable for that area, sites for their construction etc.
- To minimize the failure of wells geophysical and hydro-geological investigations may be carried out for proper site selection.

5.3.1.(b). Eligibility criteria

Ground Water irrigation facility through Dug wells, Dug cum Bore wells, Tube wells and Bore wells etc. can be funded for schemes in areas other than Over Exploited (OE), Critical or Semi-Critical meeting the following criteria:

- Less than 60 per cent of the annual replenishable groundwater resources have been developed.
- Average annual rainfall of 750 mm or more should be received to enable enough water for recharge.
- Shallow groundwater levels within range of 15m below ground level or less during pre-monsoon period. Ground water development for irrigation can be planned in such a way that after implementation of the project, stage of Ground Water Development (SOD) in an area should not exceed 70% at any time. However, as already mentioned Scheme in unclassified areas shall be considered on case to case basis depending upon various criterions laid down in the guidelines.

1. The beneficiary under this scheme shall be small and marginal farmers only with priority to be given to SC/ST and Women farmers
2. The scheme is applicable for individual farmer, group of farmers/ cooperatives, Govt. Scheme utilising Govt. Land etc

Considering the above guidelines, creation of additional irrigation potential through ground water is admissible in the taluka. The details of the tentative number of new abstraction structures feasible in these blocks are given in table 5.1

Table 5.1. Additional abstraction structures possible in the block

Annual Extractable GroundWater Recharge (Ham)	13412
Total Extraction (Ham)	3080.92
Net Ground Water Availability for future use (Ham)	10327.6
Stage of Ground Water Extraction (%)	22.97

60% of the Annual extractable GWR (Ham)	8047.2
GW Resource available for Development (Ham)	4966.28
GW Resource to be developed through DW (Ham)	2979.768
GW Resource to be developed through BW (Ham)	1986.512
No. of DW to be feasible	2980
No. of BW to be feasible	1324

As the additional number of borewells/dugwells proposed in the study area is large as compared to the available area of the taluka, it is recommended to develop the available cultivable waste land. The additional potential required and additional structures required for development of the waste land is mentioned below in table 5.1 As per the table, 2550 Ha of cultivable waste land can be brought under irrigation by use of 1530 dug wells and 680 borewells

Table 5.2. Additional abstraction structures recalculated as per the availability of cultivable waste land.

Area of cultivable waste to develop (Ha)	2550
No. of DW to be feasible(@ 1 ham for 60% of GWR Available)	1530
No. of BW to be feasible (@ 1.5 ham for 40% of GWR Available)	680

ANNEXURES

Annexure-I: Details of ground water exploration

Sl NO	PROJECT	**DISTRICT**	**TALUKA**	**LOCATION**	**LONGITUDE**	**LATITUDE**	**DEPTH OF WELL**	**DEPTH OF CASING**	**BOTTOM OF PHREATIC AQUIFER**	**lithology**	**Fracture Zones**	**DRILLING DISCHARGE) LPS)**	**SWL**	**DISCHARGE**	**DD**	**T**	**S**
1	GWE	Shimoga	Hosanagara	Nagara EW	13.82361	75.03056	126.9		22	Gneiss	22.0-23.0 43-44 57-58 118-119 33-35	2.9	3.29	_	5.79	25.35	0.0195
1	GWE	Shimoga	Hosanagara	Nagara OW	13.82361	75.03056	184.85		17	Gneiss	18-23 33-35 181-182	4.36	3.61	360	17.94	23.54	
2	GWE	Shimoga	Hosanagara	Karanagiri1	13.87778	75.06944	200.1		22	Gneiss	23-24 84.20-85.20 121-123	0.731	16	_		1.8 (slug test)	
3	GWE	Shimoga	Hosanagara	Araslu EW	13.99583	75.31667	168.55	32.5	37	Gneiss	32.35-33.35 36.40-37.40 46.55-47.60 86.20-88.25	2.11	7.36	_	24.7	8.58	3.22E-05
4	GWE	Shimoga	Hosanagara	Araslu OW	13.99583	75.31667	100.48	24.4	43	Gneiss	26 35-43 57-66	3.34	7.48	328	14.33	8.83	

Sl NO	PROJECT	**DISTRICT**	**TALUKA**	**LOCATION**	**LONGITUDE**	**LATITUDE**	**DEPTH OF WELL**	**DEPTH OF CASING**	**BOTTOM OF PHREATIC AQUIFER**	**lithology**	**Fracture Zones**	**DRILLING DISCHARGE) LPS)**	**SWL**	**DISCHARGE**	**DD**	**T**	**S**
5	GWE	Shimoga	Hosanagara	Kodur EW	13.93333	75.1625	200.1	21.2	29	Gneiss	25.20-26.25 61.80-62.85 81.15-82.15 153.5-154.5 184-185	1.21	3.59	150		1.43 (pyt)	
6	GWE	Shimoga	Hosanagara	Hosanagara EW	13.91667	75.05278	336.05	22.6	33	Gneiss	23-25 92-93 126-127 135-136	7.65	15.63	475	29	12	
7	GWE	Shimoga	Hosanagara	Hosanagara oW	13.91667	75.05278	129.95	23.95	25	Gneiss	24-25 106-109 120-123 126-130	5.54	14.14	_	20.52	12.08	0.000196
8	GWE	Shimoga	Hosanagara	Maruthipura	13.99306	75.12361	90.3	20.4	24	Gneiss	20-21 24-24 81-85	0.136	10.9			0.38 (slug test)	
9	ESTABLISHED WELLS	Shimoga	Hosanagara	ulukoppa	13.7167	75.0499	131.15	8.5	8.5		100.65						
10	ESTABLIS	Shimoga	Hosanaga	matadahalli	13.7982	75.0898	137.25	7.63	7.63		61						

Sl NO	PROJECT	DISTRICT	TALUKA	LOCATION	LONGITUDE	LATITUDE	DEPTH OF WELL	DEPTH OF CASING	BOTTOM OF PHREATIC AQUIFER	lithology	Fracture Zones	DRILLING DISCHARGE) LPS)	SWL	DISCHARGE	DD	T	S
	HED WELLS		ra														
11	ESTABLISHED WELLS	Shimoga	Hosanagara	maluru	13.95064	75.19177	161.65	18.3	18.3		54.9						
12	ESTABLISHED WELLS	Shimoga	Hosanagara	kodrige	14.01819	75.22405	97.6	22.22	22.22		28.3						
13	ESTABLISHED WELLS	Shimoga	Hosanagara	kaduvalli	13.9627	75.0621	183	12.2	12.2		178.4						
14	ESTABLISHED WELLS	Shimoga	Hosanagara	SAMPIGARU	13.9176	74.9668	152.5	24.4	24.4		115.9						

Annexure-II: Details of Ground Water Monitoring Wells and Key Wells Established

TALUK	Type	LOCATION	LON	LAT	DEPTH	MP	Aquifer	May 2022 (mbgl)	Nov 2022 (mbgl)	Altitude	RL
Hosanagara	GWM	Battemallappa	75.1503	14.0203	14.35	1	Unconfined	9.43	7.1	601.4	591.97
Hosanagara	GWM	Bilehalli	75.1169	13.9222	14	0.63	Unconfined	6.35	4.64	609.7	603.35
Hosanagara	GWM	Brahmeeshwara	75.0839	13.9572	11.13	1	Unconfined	6.87	9.57	651.3	644.43
Hosanagara	GWM	Chennakoppa	75.4011	14.0344	24	0.7	Unconfined	1.7	3.2	661	659.3
Hosanagara	GWM	Gartikere	75.2333	13.8917	11	0.6	Unconfined	7.8	5.1	690.2	682.4
Hosanagara	GWM	Heddaripura	75.2669	13.9361	11.5	0.7	Unconfined	3.8	5	666.7	662.9
Hosanagara	GWM	Hosanagara1	75.1	13.9	14	0.74	Unconfined	11.51	7.86	596	584.49
Hosanagara	GWM	Humacha	75.2008	13.8583	10.4	0.76	Unconfined	4.8	4.89	781.7	776.9
Hosanagara	GWM	Kaijegebulu	75.1008	13.9825	14.55	0.8	Unconfined	8.52	8	610.6	602.08
Hosanagara	GWM	Kote Kargya	75.2011	13.7989	13.43	0.55	Unconfined	8.85		644.4	635.55
Hosanagara	GWM	Riponpet	75.2503	13.9917	13	1.16	Unconfined	6.26	6.34	651.3	645.04
Hosanagara	KOW	mallapura	75.3188	13.7958	9.25	0.85	Unconfined	5.49		680.9	675.41
Hosanagara	KOW	maskani	75.3322	13.8952	55.458	0.86	Unconfined	2.13		748.4	746.27
Hosanagara	KOW	talale	75.288	13.9461	9.16	0.85	Unconfined	3.56		671.7	668.14
Hosanagara	KOW	Mandli	75.276	13.9073	11.9	0.7	Unconfined	7.36		701.5	694.14
Hosanagara	KOW	Gunavanthe	75.3604	13.5719	13.17	0.75	Unconfined	11.43		775	763.57
Hosanagara	KOW	Yadur	75.0824	13.6941	13.76	0.8	Unconfined	11.79		611	599.21

Hosanagara	KOW	Hullikal	75.0087	13.7239	12.68	0.7	Unconfined	9.78		576.7	566.92
Hosanagara	KOW	Attihalli	75.0356	13.7808	8.12	0.73	Unconfined	5.22		620.5	615.28
Hosanagara	KOW	Chakranagar colony	75.0038	13.7984	9.19	0.93	Unconfined	5.49		581.5	576.01
Hosanagara	KOW	Belur	75.0812	13.8069	8.8	0.95	Unconfined	6.99		587.2	580.21
Hosanagara	KOW	Karagadi	75.0657	13.8701	11.33	0.67	Unconfined	0.6		597.9	597.3
Hosanagara	KOW	Billodi	75.1389	13.8344	17.89	1.03	Unconfined	12.86		608.6	595.74
Hosanagara	KOW	Hosanagare	75.0629	13.9138	17.64	0.6	Unconfined	15.27		592.4	577.13
Hosanagara	KOW	Nagarahalli	75.1917	13.8816	15.28	0.67	Unconfined	14.24		705.1	690.86
Hosanagara	KOW	Thariga	75.212	13.9641	14.3	0.65	Unconfined	8.77		666	657.23
Hosanagara	KOW	Harohattilu	75.3387	13.9668	10.59	0.65	Unconfined	6.61		700.5	693.89
Hosanagara	KOW	Masaruru	75.2969	14.0195	10.08	0.99	Unconfined	4.14		676.4	672.26
Hosanagara	KOW	Hunasavalli	75.12	14.0534	14.55	0.53	Unconfined	10.26		604.1	593.84
Hosanagara	KOW	Vijapura	75.0845	14.0175	12.45	0.76	Unconfined	9.14		599.8	590.66
Hosanagara	KOW	Kaluru	75.0642	13.9336	14.83	0.68	Unconfined	11.96		598.4	586.44
Hosanagara	KOW	Guddekoppa	75.0311	13.9032	14.44	0.65	Unconfined	10.8		594.9	584.1
Hosanagara	KOW	Kattinahole	74.9147	13.8739	11.85	0.79	Unconfined	7.95		609.7	601.75
Hosanagara	KOW	Sampigaru	74.9685	13.9183	15.81	0.91	Unconfined	12.63		590.6	577.97
Hosanagara	KOW	Edumane	74.8613	13.912	9.16	0.96	Unconfined	4.93		595.8	590.87
Hosanagara	KOW	Nagara	75.02	13.8313	9.84	0.69	Unconfined	7.05		584.2	577.15

Annexure-III: Details of Quality monitoring Stations in Hosanagara Taluka

Location	District	Longitude	Latitude	Type of well	pH (6.5-8.5)	EC in m S/cm	TH (600)	Ca (200)	Mg (100)	Na	K	CO3	HCO3	Cl (1000)	SO4 (400)	NO3 (45)	SiO2	PO4	F (1.5)	TDS (2000)
Talale	Shimoga	75.288	13.9461	DW	6.59	230	85	24	6.08	10	3.3	0	85.4	14.18	2	11	18	BDL	0.38	130.94
Mandli	Shimoga	75.2769	13.9072	DW	6.75	170	60	14	6.08	12	0.4	0	54.9	14.18	4	13	9	BDL	0.55	100.21
Yadur	Shimoga	75.08247	13.69408	DW	7.34	90	25	6	2.432	7	1.1	0	24.4	10.635	3	2	6	BDL	0.27	50.437
Hullickal	Shimoga	75.0087	13.7239	DW	7.2	80	20	4	2.432	8	0.4	0	24.4	10.635	1	1	8	BDL	0.23	47.697
Attihali	Shimoga	75.03557	13.78084	DW	6.67	235	65	20	3.648	23	1.3	0	103.7	14.18	6	1	32	BDL	0.32	152.448
Chakranagar colony	Shimoga	75.00385	13.79844	DW	6.75	110	25	6	2.432	12	0.5	0	36.6	10.635	2	2	14	BDL	0.21	67.777
Belur	Shimoga	75.08121	13.80685	DW	6.59	125	25	6	2.432	16	1.1	0	36.6	14.18	2	5	15	BDL	0.27	79.982
Kargadi	Shimoga	75.06568	13.87013	DW	6.5	260	65	14	7.296	27	2.8	0	54.9	38.995	1	27	15	BDL	0.48	160.571
Billodi	Shimoga	75.13895	13.83441	DW	7.02	240	75	22	4.864	19	1.3	0	91.5	17.725	4	13	10	BDL	0.52	137.409
Hosanagara	Shimoga	75.06293	13.91375	DW	6.57	210	50	12	4.864	23	1.4	0	48.8	28.36	1	19	4	BDL	1.59	119.214
Nagarahalli	Shimoga	75.1917	13.88158	DW	7.33	435	175	54	9.728	14	7.1	0	195.2	21.27	19	5	23	0.44	0.41	249.508
Thariga	Shimoga	75.21202	13.96411	DW	7.13	190	50	10	6.08	18	0.5	0	73.2	14.18	3	4	13	BDL	0.84	105.6
Vijapura	Shimoga	75.08459	14.01756	DW	7.57	335	80	22	6.08	28	17.	0	115	24.	10	18	13	BDL	0.35	196.

Location	**District**	**Longitude**	**Latitude**	**Type of well**	**pH (6.5-8.5)**	**EC in m S/cm**	**TH (600)**	**Ca (200)**	**Mg (100)**	**Na**	**K**	**CO3**	**HCO3**	**Cl (1000)**	**SO4 (400)**	**NO3 (45)**	**SiO2**	**PO4**	**F (1.5)**	**TDS (2000)**
											6		.9	815						845
Kaluru	Shimoga	75.06423	13.93361	DW	7.32	210	70	22	3.648	13	2.1	0	85.4	10.635	2	12	11	BDL	0.33	118.713
Guddekoppa (Nandikoppa)	Shimoga	75.03108	13.90323	DW	7.41	155	30	6	3.648	20	0.9	0	48.8	14.18	1	11	6	BDL	0.42	87.148
Kattanihole	Shimoga	74.91467	13.87385	DW	7.16	150	45	16	1.216	12	1.2	0	61	10.635	1	7	17	BDL	0.52	96.571
Sampigaru	Shimoga	74.96857	13.91834	DW	7.47	500	175	54	9.728	30	2.3	0	256.2	14.18	4	2	58	BDL	2.27	302.478
Edumane	Shimoga	74.86125	13.91201	DW	6.55	95	30	6	3.648	7	0.4	0	36.6	7.09	2	1	8	BDL	0.53	53.668
Nagara	Shimoga	75.02007	13.83136	DW	7.11	225	90	28	4.864	8	2	0	97.6	10.635	2	3	18	BDL	0.47	124.969
Harohittalu	Shimoga	75.33874	13.96684	DW	7.86	350	105	34	4.864	27	4.9	0	164.7	10.635	11	2	45	BDL	0.63	221.029
Marasaruru	Shimoga	75.2969	14.01951	DW	6.51	140	45	10	4.864	12	0.4	0	42.7	17.725	4	2	8	BDL	0.46	80.449
Hunasavalli	Shimoga	75.12005	14.05346	DW	6.52	80	20	4	2.432	8	0.8	0	24.4	10.635	1	1	5	BDL	0.43	45.297

Annexure-IV: Annexure-III: Proposed location of AR Structures in Hosanagara Taluka

Sl No	LATITUDE	LONGITUDE	TYPE
1	14° 2.29408' N	75° 16.88537' E	Percolation Tank
2	13° 59.05610' N	75° 18.05882' E	Percolation Tank
3	14° 1.34284' N	75° 14.99481' E	Percolation Tank
4	14° 1.61725' N	75° 13.90735' E	Percolation Tank
5	13° 59.73193' N	75° 12.44200' E	Percolation Tank
6	13° 59.89853' N	75° 12.52530' E	Percolation Tank
7	13° 59.66042' N	75° 10.09044' E	Percolation Tank
8	14° 0.00075' N	75° 9.59842' E	Percolation Tank
9	13° 58.27994' N	75° 10.77453' E	Percolation Tank
10	13° 57.15339' N	75° 10.62734' E	Percolation Tank
11	13° 57.25634' N	75° 11.13621' E	Percolation Tank
12	13° 56.19371' N	75° 10.17105' E	Percolation Tank
13	13° 53.61410' N	75° 9.60399' E	Percolation Tank
14	13° 53.78790' N	75° 8.86937' E	Percolation Tank
15	13° 54.97165' N	75° 8.14862' E	Percolation Tank
16	13° 55.61873' N	75° 7.36095' E	Percolation Tank
17	13° 56.36918' N	75° 6.40035' E	Percolation Tank
18	13° 57.34602' N	75° 5.99177' E	Percolation Tank
19	13° 54.56702' N	75° 2.60590' E	Percolation Tank
20	13° 56.35046' N	75° 1.88798' E	Percolation Tank
21	13° 56.63720' N	75° 1.19968' E	Percolation Tank
22	13° 54.57827' N	75° 8.43753' E	Percolation Tank
23	13° 51.78256' N	75° 6.28523' E	Percolation Tank
24	13° 52.19305' N	75° 4.99560' E	Percolation Tank
25	13° 53.44026' N	75° 3.03124' E	Percolation Tank
26	13° 56.96087' N	75° 16.84563' E	Percolation Tank
27	13° 57.94349' N	75° 17.44543' E	Percolation Tank
28	13° 59.44777' N	75° 13.37634' E	Percolation Tank
29	13° 56.35359' N	75° 3.10835' E	Percolation Tank
30	13° 56.73710' N	75° 2.12746' E	Percolation Tank
31	14° 2.16921' N	75° 6.27329' E	Percolation Tank
32	14° 2.32438' N	75° 7.07840' E	Percolation Tank
33	14° 2.40129' N	75° 16.41312' E	Percolation Tank
34	13° 56.22038' N	75° 17.30866' E	Percolation Tank
35	13° 56.37751' N	75° 13.68929' E	Percolation Tank
36	13° 57.05460' N	75° 13.21775' E	Percolation Tank
37	13° 58.22730' N	75° 13.73965' E	Percolation Tank
38	13° 58.79739' N	75° 13.79144' E	Percolation Tank
39	13° 59.50229' N	75° 12.01939' E	Percolation Tank
40	13° 59.38344' N	75° 10.52926' E	Percolation Tank
41	14° 3.67524' N	75° 7.59146' E	Percolation Tank
42	13° 57.91590' N	75° 6.27469' E	Percolation Tank
43	13° 58.59936' N	75° 5.98898' E	Percolation Tank

Sl No	LATITUDE	LONGITUDE	TYPE
44	13° 59.35645' N	75° 4.83520' E	Percolation Tank
45	13° 48.26649' N	75° 4.57214' E	Percolation Tank
46	13° 48.83327' N	75° 4.22004' E	Percolation Tank
47	13° 50.19688' N	75° 3.17346' E	Percolation Tank
48	13° 50.57031' N	75° 2.67829' E	Percolation Tank
49	13° 49.62045' N	75° 1.69763' E	Percolation Tank
50	13° 48.88716' N	75° 1.14916' E	Percolation Tank
51	13° 54.73265' N	74° 53.90809' E	Percolation Tank
52	13° 43.30334' N	75° 3.67355' E	Percolation Tank
53	13° 56.11011' N	75° 10.65955' E	Percolation Tank
54	14° 3.02524' N	75° 7.60109' E	Percolation Tank
55	14° 2.25269' N	75° 5.92403' E	Percolation Tank
56	14° 1.90271' N	75° 5.89061' E	Percolation Tank
57	14° 1.16564' N	75° 6.83499' E	Percolation Tank
58	14° 2.59183' N	75° 15.92099' E	Percolation Tank
59	13° 59.13613' N	75° 20.52003' E	Percolation Tank
60	13° 55.55870' N	75° 16.26695' E	Percolation Tank
61	13° 56.35124' N	75° 16.52235' E	Percolation Tank
62	13° 54.48156' N	75° 12.90611' E	Percolation Tank
63	13° 56.96608' N	75° 11.47517' E	Percolation Tank
64	13° 57.61987' N	75° 10.87046' E	Percolation Tank
65	13° 54.30798' N	75° 21.60010' E	Check Dam
66	13° 55.83787' N	75° 21.66564' E	Check Dam
67	13° 56.77121' N	75° 21.65047' E	Check Dam
68	13° 53.47715' N	75° 19.84015' E	Check Dam
69	13° 54.38633' N	75° 20.42992' E	Check Dam
70	13° 55.46234' N	75° 20.88369' E	Check Dam
71	13° 56.50566' N	75° 20.88525' E	Check Dam
72	13° 57.00562' N	75° 20.90263' E	Check Dam
73	13° 55.39423' N	75° 19.51703' E	Check Dam
74	13° 55.64375' N	75° 19.86983' E	Check Dam
75	13° 57.83972' N	75° 20.35517' E	Check Dam
76	13° 54.25947' N	75° 18.03927' E	Check Dam
77	13° 58.67336' N	75° 20.12358' E	Check Dam
78	13° 59.27913' N	75° 20.75638' E	Check Dam
79	13° 54.72342' N	75° 17.52785' E	Check Dam
80	13° 54.01214' N	75° 15.72831' E	Check Dam
81	13° 54.62213' N	75° 15.72900' E	Check Dam
82	13° 54.64591' N	75° 15.31343' E	Check Dam
83	13° 55.16197' N	75° 15.87923' E	Check Dam
84	13° 54.72114' N	75° 16.63014' E	Check Dam
85	13° 55.40956' N	75° 17.95763' E	Check Dam
86	13° 55.86000' N	75° 17.59245' E	Check Dam
87	13° 57.62572' N	75° 18.34292' E	Check Dam
88	13° 59.45684' N	75° 20.00831' E	Check Dam

Sl No	LATITUDE	LONGITUDE	TYPE
89	13° 53.02935' N	75° 15.21525' E	Check Dam
90	13° 53.34832' N	75° 12.80200' E	Check Dam
91	13° 53.93168' N	75° 12.76929' E	Check Dam
92	13° 54.29171' N	75° 12.73304' E	Check Dam
93	13° 54.67830' N	75° 12.82649' E	Check Dam
94	13° 54.69116' N	75° 13.35183' E	Check Dam
95	13° 55.39818' N	75° 12.95350' E	Check Dam
96	13° 55.58135' N	75° 13.13655' E	Check Dam
97	13° 54.79478' N	75° 13.03606' E	Check Dam
98	13° 55.28038' N	75° 14.18363' E	Check Dam
99	13° 55.61306' N	75° 14.83235' E	Check Dam
100	13° 56.14666' N	75° 14.56358' E	Check Dam
101	13° 56.34785' N	75° 13.31351' E	Check Dam
102	13° 56.64527' N	75° 15.89755' E	Check Dam
103	13° 56.92903' N	75° 15.49883' E	Check Dam
104	13° 57.21274' N	75° 15.13335' E	Check Dam
105	13° 56.79800' N	75° 13.15432' E	Check Dam
106	13° 57.38123' N	75° 13.25464' E	Check Dam
107	13° 57.79772' N	75° 13.45457' E	Check Dam
108	13° 57.56305' N	75° 14.83443' E	Check Dam
109	13° 57.99671' N	75° 14.50233' E	Check Dam
110	13° 58.19690' N	75° 14.30300' E	Check Dam
111	13° 58.39726' N	75° 13.93738' E	Check Dam
112	13° 58.91408' N	75° 13.77160' E	Check Dam
113	13° 58.99752' N	75° 13.65528' E	Check Dam
114	13° 59.78124' N	75° 13.22367' E	Check Dam
115	13° 59.99829' N	75° 12.79148' E	Check Dam
116	14° 0.79844' N	75° 12.61260' E	Check Dam
117	13° 59.90755' N	75° 19.47679' E	Check Dam
118	13° 59.89252' N	75° 18.21287' E	Check Dam
119	13° 59.54202' N	75° 18.61153' E	Check Dam
120	13° 59.37588' N	75° 18.19556' E	Check Dam
121	13° 58.75976' N	75° 17.76240' E	Check Dam
122	13° 58.42687' N	75° 17.39615' E	Check Dam
123	13° 59.75681' N	75° 20.02537' E	Check Dam
124	13° 54.86639' N	75° 11.07445' E	Check Dam
125	13° 55.39316' N	75° 10.94520' E	Check Dam
126	13° 55.33350' N	75° 10.47632' E	Check Dam
127	13° 55.71648' N	75° 10.95875' E	Check Dam
128	13° 55.68351' N	75° 10.45996' E	Check Dam
129	13° 56.51561' N	75° 12.05672' E	Check Dam
130	13° 56.64950' N	75° 11.36184' E	Check Dam
131	13° 57.16913' N	75° 11.82450' E	Check Dam
132	13° 57.11619' N	75° 11.32565' E	Check Dam
133	13° 59.01591' N	75° 11.67641' E	Check Dam

Sl No	LATITUDE	LONGITUDE	TYPE
134	13° 58.89963' N	75° 11.17744' E	Check Dam
135	13° 58.01427' N	75° 13.57118' E	Check Dam
136	13° 57.15374' N	75° 14.13898' E	Check Dam
137	13° 58.63900' N	75° 11.97209' E	Check Dam
138	13° 59.43540' N	75° 12.28541' E	Check Dam
139	13° 59.72565' N	75° 11.45373' E	Check Dam
140	13° 59.63330' N	75° 10.72901' E	Check Dam
141	14° 1.30951' N	75° 17.93199' E	Check Dam
142	14° 3.09297' N	75° 17.80123' E	Check Dam
143	14° 3.47692' N	75° 17.28605' E	Check Dam
144	14° 2.55053' N	75° 17.07198' E	Check Dam
145	14° 2.42487' N	75° 16.19359' E	Check Dam
146	14° 2.24827' N	75° 13.75685' E	Check Dam
147	14° 1.36307' N	75° 14.77196' E	Check Dam
148	14° 1.27913' N	75° 15.35399' E	Check Dam
149	14° 0.06173' N	75° 16.05113' E	Check Dam
150	14° 0.72771' N	75° 16.65063' E	Check Dam
151	14° 0.22722' N	75° 17.08242' E	Check Dam
152	13° 59.64607' N	75° 15.11936' E	Check Dam
153	14° 0.52980' N	75° 14.72118' E	Check Dam
154	14° 1.09671' N	75° 14.47231' E	Check Dam
155	14° 0.45005' N	75° 10.59660' E	Check Dam
156	14° 1.33693' N	75° 10.29124' E	Check Dam
157	14° 1.49404' N	75° 9.64602' E	Check Dam
158	13° 59.41415' N	75° 9.50489' E	Check Dam
159	13° 59.88416' N	75° 9.48193' E	Check Dam
160	14° 0.50070' N	75° 9.66529' E	Check Dam
161	14° 0.55121' N	75° 8.86703' E	Check Dam
162	14° 0.81808' N	75° 8.51794' E	Check Dam
163	14° 0.56812' N	75° 8.45126' E	Check Dam
164	13° 59.61837' N	75° 8.03493' E	Check Dam
165	14° 2.70183' N	75° 7.75394' E	Check Dam
166	14° 4.40218' N	75° 7.02291' E	Check Dam
167	14° 4.49860' N	75° 7.50873' E	Check Dam
168	14° 5.11875' N	75° 7.19963' E	Check Dam
169	14° 3.36196' N	75° 7.49814' E	Check Dam
170	14° 3.11915' N	75° 6.39016' E	Check Dam
171	14° 2.28631' N	75° 5.17554' E	Check Dam
172	14° 2.64211' N	75° 7.20832' E	Check Dam
173	14° 2.25275' N	75° 5.79096' E	Check Dam
174	13° 50.79939' N	75° 11.50334' E	Check Dam
175	13° 50.36565' N	75° 12.01818' E	Check Dam
176	13° 52.08301' N	75° 11.13873' E	Check Dam
177	13° 52.59663' N	75° 10.75684' E	Check Dam
178	13° 53.31699' N	75° 10.25872' E	Check Dam

Sl No	LATITUDE	LONGITUDE	TYPE
179	13° 53.44725' N	75° 9.88314' E	Check Dam
180	13° 52.52409' N	75° 9.61322' E	Check Dam
181	13° 51.00729' N	75° 9.80165' E	Check Dam
182	13° 50.53495' N	75° 8.17927' E	Check Dam
183	13° 51.63170' N	75° 8.03365' E	Check Dam
184	13° 51.75210' N	75° 7.26584' E	Check Dam
185	13° 52.12260' N	75° 6.18566' E	Check Dam
186	13° 52.98590' N	75° 6.28577' E	Check Dam
187	13° 49.43555' N	75° 6.99875' E	Check Dam
188	13° 49.69823' N	75° 8.27185' E	Check Dam
189	13° 50.36964' N	75° 5.20435' E	Check Dam
190	13° 52.50287' N	75° 5.50434' E	Check Dam
191	13° 53.79625' N	75° 5.40178' E	Check Dam
192	13° 54.05319' N	75° 4.60728' E	Check Dam
193	13° 54.35353' N	75° 3.37721' E	Check Dam
194	13° 55.18287' N	75° 5.53532' E	Check Dam
195	13° 56.81923' N	75° 6.28750' E	Check Dam
196	13° 57.91911' N	75° 6.57067' E	Check Dam
197	13° 58.38579' N	75° 6.52101' E	Check Dam
198	13° 58.92358' N	75° 3.11890' E	Check Dam
199	13° 58.90299' N	75° 5.20754' E	Check Dam
200	13° 59.55981' N	75° 4.73216' E	Check Dam
201	13° 59.88659' N	75° 4.37638' E	Check Dam
202	13° 50.65367' N	75° 2.52873' E	Check Dam
203	13° 58.11710' N	75° 10.07934' E	Check Dam
204	13° 57.76390' N	75° 9.89618' E	Check Dam
205	13° 58.57794' N	75° 8.78262' E	Check Dam
206	13° 57.48778' N	75° 9.05130' E	Check Dam
207	13° 56.38468' N	75° 8.66485' E	Check Dam
208	13° 55.71436' N	75° 9.19313' E	Check Dam
209	13° 55.61750' N	75° 9.49564' E	Check Dam
210	13° 53.19751' N	75° 9.47738' E	Check Dam
211	13° 53.76756' N	75° 9.41127' E	Check Dam
212	13° 53.93463' N	75° 8.76307' E	Check Dam
213	13° 54.31809' N	75° 8.54721' E	Check Dam
214	13° 56.20718' N	75° 9.97820' E	Check Dam
215	13° 57.46887' N	75° 7.08591' E	Check Dam
216	13° 54.65208' N	75° 7.33384' E	Check Dam
217	13° 54.93552' N	75° 7.11787' E	Check Dam
218	13° 55.51900' N	75° 6.81892' E	Check Dam
219	13° 55.36523' N	75° 7.69332' E	Check Dam
220	13° 55.67548' N	75° 7.20470' E	Check Dam
221	13° 53.47304' N	75° 11.09995' E	Check Dam
222	13° 51.66760' N	75° 9.34005' E	Check Dam
223	13° 54.20287' N	75° 5.53825' E	Check Dam

Sl No	LATITUDE	LONGITUDE	TYPE
224	13° 56.00303' N	75° 5.09007' E	Check Dam
225	13° 56.23669' N	75° 4.04271' E	Check Dam
226	13° 57.36986' N	75° 4.60837' E	Check Dam
227	13° 57.47032' N	75° 2.79600' E	Check Dam
228	13° 56.58370' N	75° 2.56305' E	Check Dam
229	13° 54.16330' N	75° 4.23162' E	Check Dam
230	13° 54.41993' N	75° 4.35804' E	Check Dam
231	13° 54.18679' N	75° 3.65977' E	Check Dam
232	13° 51.55234' N	75° 6.76712' E	Check Dam
233	13° 51.64258' N	75° 6.22533' E	Check Dam
234	13° 52.61986' N	75° 4.57356' E	Check Dam
235	13° 52.80674' N	75° 3.82563' E	Check Dam
236	13° 52.88679' N	75° 3.62619' E	Check Dam
237	13° 52.37039' N	75° 2.32958' E	Check Dam
238	13° 41.15166' N	75° 7.87489' E	Check Dam
239	13° 41.88798' N	75° 8.52638' E	Check Dam
240	13° 41.85224' N	75° 6.72925' E	Check Dam
241	13° 42.81920' N	75° 6.08191' E	Check Dam
242	13° 43.08595' N	75° 5.88270' E	Check Dam
243	13° 43.76608' N	75° 5.57069' E	Check Dam
244	13° 44.05311' N	75° 4.52427' E	Check Dam
245	13° 40.06917' N	75° 6.01431' E	Check Dam
246	13° 43.33540' N	75° 6.26881' E	Check Dam
247	13° 44.12802' N	75° 5.85591' E	Check Dam
248	13° 43.22600' N	75° 5.77645' E	Check Dam
249	13° 43.62765' N	75° 4.54528' E	Check Dam
250	13° 44.74968' N	75° 4.88000' E	Check Dam
251	13° 43.30329' N	75° 3.83966' E	Check Dam
252	13° 43.29052' N	75° 3.88949' E	Check Dam
253	13° 43.38669' N	75° 3.59052' E	Check Dam
254	13° 43.97214' N	75° 3.39133' E	Check Dam
255	13° 43.52170' N	75° 3.22353' E	Check Dam
256	13° 47.28232' N	75° 6.72187' E	Check Dam
257	13° 47.74931' N	75° 6.00428' E	Check Dam
258	13° 48.06946' N	75° 5.61891' E	Check Dam
259	13° 48.04966' N	75° 5.07057' E	Check Dam
260	13° 48.00309' N	75° 4.78807' E	Check Dam
261	13° 48.60323' N	75° 4.33962' E	Check Dam
262	13° 47.08682' N	75° 3.28574' E	Check Dam
263	13° 47.57011' N	75° 3.50851' E	Check Dam
264	13° 47.88679' N	75° 3.45874' E	Check Dam
265	13° 48.32006' N	75° 3.72471' E	Check Dam
266	13° 49.33670' N	75° 3.87454' E	Check Dam
267	13° 49.52008' N	75° 3.69179' E	Check Dam
268	13° 49.80346' N	75° 3.54230' E	Check Dam

Sl No	LATITUDE	LONGITUDE	TYPE
269	13° 47.18700' N	75° 2.32872' E	Check Dam
270	13° 47.40709' N	75° 1.74721' E	Check Dam
271	13° 47.60715' N	75° 1.15238' E	Check Dam
272	13° 47.89714' N	75° 1.29531' E	Check Dam
273	13° 48.27042' N	75° 1.84701' E	Check Dam
274	13° 48.85375' N	75° 1.93018' E	Check Dam
275	13° 48.30185' N	75° 7.71271' E	Check Dam
276	13° 48.85218' N	75° 7.06493' E	Check Dam
277	13° 50.09941' N	75° 5.80918' E	Check Dam
278	13° 50.58353' N	75° 3.27659' E	Check Dam
279	13° 50.35380' N	75° 1.64786' E	Check Dam
280	13° 50.18720' N	75° 0.86343' E	Check Dam
281	13° 49.73721' N	75° 0.55097' E	Check Dam
282	13° 49.48718' N	75° 1.04951' E	Check Dam
283	13° 49.21721' N	75° 0.22857' E	Check Dam
284	13° 46.65278' N	75° 5.61835' E	Check Dam
285	13° 46.66963' N	75° 5.11991' E	Check Dam
286	13° 46.68643' N	75° 4.70455' E	Check Dam
287	13° 46.38647' N	75° 4.55492' E	Check Dam
288	13° 45.71959' N	75° 5.17938' E	Check Dam
289	13° 45.53792' N	75° 4.57272' E	Check Dam
290	13° 47.56562' N	75° 6.80176' E	Check Dam
291	13° 49.73583' N	75° 6.39509' E	Check Dam
292	13° 50.10233' N	75° 6.76642' E	Check Dam
293	13° 50.68558' N	75° 6.94952' E	Check Dam
294	13° 51.00048' N	75° 10.02435' E	Check Dam
295	13° 50.63683' N	75° 3.42617' E	Check Dam
296	13° 45.90356' N	75° 2.82692' E	Check Dam
297	13° 45.53688' N	75° 2.90992' E	Check Dam
298	13° 44.87357' N	75° 2.69714' E	Check Dam
299	13° 47.49585' N	75° 6.29993' E	Check Dam
300	13° 47.89162' N	75° 8.12456' E	Check Dam
301	13° 53.03021' N	75° 3.29378' E	Check Dam
302	13° 51.98324' N	75° 4.42044' E	Check Dam
303	13° 51.51969' N	75° 5.07182' E	Check Dam
304	13° 51.72626' N	75° 5.34115' E	Check Dam
305	13° 51.01979' N	75° 4.75553' E	Check Dam
306	13° 50.56971' N	75° 4.98838' E	Check Dam
307	13° 51.88820' N	75° 8.34295' E	Check Dam
308	13° 53.06903' N	75° 6.73461' E	Check Dam
309	13° 50.87139' N	75° 8.58167' E	Check Dam
310	13° 53.52036' N	75° 2.54587' E	Check Dam
311	13° 53.75698' N	75° 2.79526' E	Check Dam
312	13° 56.27011' N	75° 3.74345' E	Check Dam
313	13° 57.37002' N	75° 4.07629' E	Check Dam

Sl No	LATITUDE	LONGITUDE	TYPE
314	13° 57.81943' N	75° 5.80574' E	Check Dam
315	13° 58.55589' N	75° 6.29493' E	Check Dam
316	13° 56.35186' N	75° 7.75372' E	Check Dam
317	13° 57.74859' N	75° 7.62480' E	Check Dam
318	13° 56.83216' N	75° 7.17870' E	Check Dam
319	13° 52.61720' N	74° 58.93212' E	Check Dam
320	13° 54.24021' N	74° 56.71772' E	Check Dam
321	13° 55.60364' N	75° 2.87875' E	Check Dam
322	13° 55.16814' N	75° 2.46304' E	Check Dam
323	14° 0.45247' N	75° 6.47208' E	Check Dam
324	14° 1.11924' N	75° 6.23955' E	Check Dam
325	14° 1.29191' N	75° 7.62674' E	Check Dam
326	14° 1.38599' N	75° 6.02345' E	Check Dam
327	14° 4.52230' N	75° 6.77011' E	Check Dam
328	14° 2.21351' N	75° 10.40167' E	Check Dam
329	13° 59.00850' N	75° 12.56774' E	Check Dam
330	13° 58.86512' N	75° 7.88483' E	Check Dam
331	14° 0.23637' N	75° 5.04173' E	Check Dam
332	14° 0.22006' N	75° 3.91082' E	Check Dam
333	14° 0.33352' N	75° 3.40527' E	Check Dam
334	14° 0.28705' N	75° 2.38079' E	Check Dam
335	14° 2.34001' N	75° 17.50751' E	Check Dam
336	14° 1.32155' N	75° 16.19230' E	Check Dam
337	14° 0.61198' N	75° 15.81893' E	Check Dam
338	14° 0.39406' N	75° 19.58724' E	Check Dam
339	13° 58.97298' N	75° 20.39008' E	Check Dam
340	14° 2.93172' N	75° 7.94370' E	Check Dam
341	14° 1.69005' N	75° 10.59089' E	Check Dam
342	14° 2.29953' N	75° 14.95593' E	Check Dam
343	13° 59.25527' N	75° 15.87060' E	Check Dam
344	13° 59.54780' N	75° 16.58602' E	Check Dam
345	14° 1.01209' N	75° 18.54032' E	Check Dam
346	13° 51.40554' N	75° 21.10185' E	Check Dam
347	13° 51.58581' N	75° 20.81807' E	Check Dam
348	13° 52.01605' N	75° 20.64918' E	Check Dam
349	13° 52.37899' N	75° 20.92562' E	Check Dam
350	13° 52.67338' N	75° 20.16480' E	Check Dam
351	13° 53.07703' N	75° 19.93267' E	Check Dam
352	13° 54.01450' N	75° 19.55167' E	Check Dam
353	13° 51.47122' N	75° 21.69212' E	Check Dam
354	13° 52.44495' N	75° 21.41439' E	Check Dam
355	13° 53.99138' N	75° 16.41649' E	Check Dam
356	13° 55.90953' N	75° 17.97490' E	Check Dam
357	13° 56.88373' N	75° 17.24791' E	Check Dam
358	13° 56.46095' N	75° 16.77853' E	Check Dam

Sl No	LATITUDE	LONGITUDE	TYPE
359	13° 56.05304' N	75° 16.34577' E	Check Dam
360	13° 57.52048' N	75° 17.17554' E	Check Dam
361	13° 57.15835' N	75° 21.32186' E	Check Dam
362	13° 57.85380' N	75° 21.00067' E	Check Dam
363	14° 1.32098' N	75° 15.79864' E	Check Dam
364	13° 52.50523' N	75° 12.51866' E	Check Dam
365	13° 52.73237' N	75° 11.95372' E	Check Dam
366	13° 56.71646' N	75° 17.75315' E	Check Dam
367	13° 57.44672' N	75° 17.53792' E	Check Dam
368	13° 56.45781' N	75° 19.32233' E	Check Dam
369	13° 56.23790' N	75° 21.63634' E	Check Dam
370	13° 53.50556' N	75° 20.98050' E	Check Dam
371	13° 54.93892' N	75° 20.94940' E	Check Dam
372	13° 56.17221' N	75° 20.96788' E	Check Dam
373	13° 56.65781' N	75° 19.32260' E	Check Dam
374	13° 55.97034' N	75° 19.65047' E	Check Dam
375	13° 55.36512' N	75° 16.04571' E	Check Dam
376	13° 56.29716' N	75° 14.05166' E	Check Dam
377	14° 1.34701' N	75° 14.15656' E	Check Dam
378	14° 1.73072' N	75° 13.75777' E	Check Dam
379	13° 56.65014' N	75° 10.51057' E	Check Dam
380	13° 57.38650' N	75° 10.92681' E	Check Dam
381	13° 58.61615' N	75° 11.37010' E	Check Dam
382	13° 54.30080' N	75° 13.74045' E	Check Dam
383	13° 55.62124' N	75° 16.53479' E	Check Dam
384	14° 0.29243' N	75° 11.84047' E	Check Dam
385	13° 58.17051' N	75° 1.48582' E	Check Dam
386	13° 54.83476' N	74° 51.45761' E	Check Dam
387	13° 54.75181' N	74° 52.15588' E	Check Dam
388	13° 54.83540' N	74° 52.63794' E	Check Dam
389	13° 55.12573' N	74° 53.31940' E	Check Dam
390	13° 54.41929' N	74° 53.85171' E	Check Dam
391	13° 54.95279' N	74° 54.26709' E	Check Dam
392	13° 53.64921' N	74° 53.65922' E	Check Dam
393	13° 53.55228' N	74° 53.08744' E	Check Dam
394	13° 53.97283' N	74° 54.36390' E	Check Dam
395	13° 56.40255' N	74° 53.66794' E	Check Dam
396	13° 52.48604' N	74° 54.06864' E	Check Dam
397	13° 52.56961' N	74° 54.68361' E	Check Dam
398	13° 52.20644' N	74° 55.17241' E	Check Dam
399	13° 52.30663' N	74° 55.76410' E	Check Dam
400	13° 52.08681' N	74° 56.44563' E	Check Dam
401	13° 52.52013' N	74° 56.41228' E	Check Dam
402	13° 51.77016' N	74° 56.52882' E	Check Dam
403	13° 54.33654' N	74° 55.44763' E	Check Dam

Sl No	LATITUDE	LONGITUDE	TYPE
404	14° 0.18547' N	75° 7.19706' E	Check Dam
405	14° 3.48133' N	75° 8.61938' E	Check Dam
406	14° 1.54294' N	75° 5.28836' E	Check Dam
407	14° 3.63585' N	75° 6.30722' E	Check Dam
408	14° 3.30236' N	75° 6.66970' E	Check Dam
409	14° 0.83533' N	75° 7.46350' E	Check Dam
410	13° 53.33105' N	75° 11.95309' E	Check Dam
411	13° 53.57531' N	75° 15.88075' E	Check Dam
412	13° 53.89313' N	75° 17.77283' E	Check Dam
413	13° 53.63905' N	75° 18.38090' E	Check Dam
414	13° 55.99902' N	75° 11.97314' E	Check Dam
415	13° 55.07576' N	75° 11.87925' E	Check Dam
416	13° 57.81646' N	75° 10.97703' E	Check Dam
417	13° 53.68968' N	75° 5.12912' E	Check Dam
418	13° 57.84686' N	75° 3.36808' E	Check Dam
419	13° 58.03044' N	75° 2.07445' E	Check Dam
420	13° 59.72430' N	75° 2.72993' E	Check Dam
421	13° 59.60628' N	75° 5.30093' E	Check Dam
422	13° 58.03125' N	75° 8.81886' E	Check Dam
423	13° 58.95022' N	75° 10.37927' E	Check Dam
424	14° 2.04900' N	75° 6.74894' E	Check Dam
425	13° 57.78569' N	75° 15.49313' E	Check Dam
426	13° 57.05515' N	75° 2.04250' E	Check Dam
427	13° 57.24047' N	75° 1.76174' E	Check Dam
428	13° 55.45324' N	75° 4.45811' E	Check Dam
429	13° 54.63485' N	75° 8.38116' E	Check Dam
430	13° 58.59361' N	75° 10.30584' E	Check Dam
431	13° 56.01078' N	75° 16.92761' E	Check Dam
432	13° 50.85191' N	75° 7.63101' E	Check Dam
433	13° 50.95196' N	75° 7.53134' E	Check Dam
434	13° 50.35368' N	75° 2.46220' E	Check Dam
435	13° 49.86712' N	75° 1.70098' E	Check Dam
436	13° 50.02041' N	75° 2.03005' E	Check Dam
437	13° 49.23713' N	75° 1.54802' E	Check Dam
438	13° 52.81675' N	75° 10.59079' E	Check Dam
439	13° 54.04837' N	75° 8.04834' E	Check Dam
440	14° 0.95321' N	75° 4.52640' E	Check Dam
441	13° 55.56689' N	75° 3.26113' E	Check Dam
442	13° 55.19384' N	75° 1.52873' E	Check Dam
443	13° 54.23029' N	75° 2.92834' E	Check Dam
444	13° 54.05360' N	75° 3.01142' E	Check Dam
445	13° 55.97051' N	75° 1.50554' E	Check Dam
446	13° 55.77049' N	75° 1.66512' E	Check Dam
447	13° 51.06136' N	75° 13.13895' E	Check Dam
448	13° 51.68470' N	75° 13.12292' E	Check Dam

Sl No	LATITUDE	LONGITUDE	TYPE
449	14° 2.71835' N	75° 8.02009' E	Check Dam
450	14° 2.51870' N	75° 7.35463' E	Check Dam
451	14° 0.38697' N	75° 2.81322' E	Check Dam
452	14° 0.40086' N	75° 9.43239' E	Check Dam
453	13° 58.09309' N	75° 14.78511' E	Check Dam
454	13° 59.00050' N	75° 14.02778' E	Check Dam
455	13° 57.91249' N	75° 11.78523' E	Check Dam
456	13° 59.93417' N	75° 13.65620' E	Check Dam
457	13° 58.80265' N	75° 15.20492' E	Check Dam
458	14° 2.98338' N	75° 14.44101' E	Check Dam
459	14° 0.98183' N	75° 12.54291' E	Check Dam
460	13° 57.35581' N	75° 8.85465' E	Check Dam
461	13° 57.78786' N	75° 8.92512' E	Check Dam
462	13° 58.81481' N	75° 8.43689' E	Check Dam
463	14° 0.53648' N	75° 10.92596' E	Check Dam
464	14° 0.48329' N	75° 10.72967' E	Check Dam
465	13° 59.86719' N	75° 9.93094' E	Check Dam
466	13° 59.36697' N	75° 10.26317' E	Check Dam
467	14° 0.78503' N	75° 8.01897' E	Check Dam
468	14° 0.80989' N	75° 17.63198' E	Check Dam
469	14° 1.34371' N	75° 17.21686' E	Check Dam
470	14° 0.99394' N	75° 19.66459' E	Check Dam
471	13° 58.33600' N	75° 18.11771' E	Check Dam
472	13° 52.32760' N	75° 21.87960' E	Check Dam
473	13° 51.55477' N	75° 8.50231' E	Check Dam
474	13° 53.00194' N	75° 7.59893' E	Check Dam
475	13° 52.55916' N	75° 6.42853' E	Check Dam
476	13° 52.88270' N	75° 5.94996' E	Check Dam
477	13° 55.54839' N	75° 8.00930' E	Check Dam
478	13° 52.34033' N	75° 2.65868' E	Check Dam
479	13° 52.86435' N	75° 2.22388' E	Check Dam
480	13° 59.63714' N	75° 1.81526' E	Check Dam
481	13° 52.02047' N	75° 1.66468' E	Check Dam
482	13° 58.18505' N	75° 21.28352' E	Check Dam
483	13° 54.00295' N	75° 20.46593' E	Check Dam
484	13° 54.41553' N	75° 18.52156' E	Check Dam
485	13° 54.78247' N	75° 18.30593' E	Check Dam
486	13° 58.32722' N	75° 19.74063' E	Check Dam
487	13° 59.28554' N	75° 7.06356' E	Check Dam
488	13° 59.07319' N	75° 4.61892' E	Check Dam
489	13° 51.91666' N	75° 10.71975' E	Check Dam
490	13° 53.58689' N	75° 10.39190' E	Check Dam
491	13° 54.40456' N	75° 8.87974' E	Check Dam
492	13° 57.53713' N	75° 1.91807' E	Check Dam
493	13° 56.71602' N	75° 5.99815' E	Check Dam

Sl No	LATITUDE	LONGITUDE	TYPE
494	13° 52.93253' N	75° 11.75443' E	Check Dam
495	13° 59.82486' N	75° 18.99440' E	Check Dam
496	13° 54.71221' N	75° 21.72267' E	Check Dam
497	13° 55.30457' N	75° 21.64487' E	Check Dam
498	14° 0.21293' N	75° 11.20510' E	Check Dam
499	14° 1.35258' N	75° 6.22302' E	Check Dam
500	14° 2.79529' N	75° 15.80479' E	Check Dam
501	13° 52.12679' N	75° 3.62932' E	Check Dam
502	13° 56.41896' N	74° 53.10264' E	Check Dam
503	14° 4.05528' N	75° 7.50849' E	Check Dam
504	14° 2.71462' N	75° 8.70207' E	Check Dam
505	14° 0.51676' N	75° 3.77786' E	Check Dam
506	13° 59.38423' N	75° 9.37848' E	Check Dam
507	13° 52.43319' N	75° 10.90631' E	Check Dam
508	13° 55.85231' N	75° 6.85233' E	Check Dam
509	13° 56.16331' N	75° 4.22890' E	Check Dam
510	13° 52.36202' N	75° 7.43902' E	Check Dam
511	13° 49.11890' N	75° 6.94874' E	Check Dam
512	13° 49.03551' N	75° 7.06503' E	Check Dam
513	13° 49.93659' N	75° 4.29017' E	Check Dam
514	13° 51.11791' N	75° 2.66177' E	Check Dam
515	13° 52.15003' N	75° 2.32954' E	Check Dam
516	13° 47.19014' N	75° 3.33893' E	Check Dam
517	13° 46.83620' N	75° 5.38581' E	Check Dam
518	13° 49.66818' N	75° 8.34495' E	Check Dam
519	13° 41.10123' N	75° 8.63884' E	Check Dam
520	13° 41.46156' N	75° 8.07437' E	Check Dam
521	13° 42.04509' N	75° 7.72923' E	Check Dam
522	13° 42.16889' N	75° 6.76262' E	Check Dam
523	13° 47.82539' N	75° 2.08973' E	Check Dam
524	13° 48.87367' N	75° 2.46194' E	Check Dam
525	13° 49.08664' N	75° 4.10712' E	Check Dam
526	13° 52.16497' N	75° 5.80782' E	Check Dam
527	13° 52.58661' N	75° 4.30760' E	Check Dam
528	13° 54.65362' N	75° 2.96168' E	Check Dam
529	13° 55.03702' N	75° 2.59602' E	Check Dam
530	13° 55.17049' N	75° 1.63180' E	Check Dam
531	13° 55.53711' N	75° 2.06410' E	Check Dam
532	13° 55.96735' N	75° 9.72864' E	Check Dam
533	13° 59.95366' N	75° 2.72998' E	Check Dam
534	13° 59.76691' N	75° 3.14237' E	Check Dam
535	13° 59.22027' N	75° 3.04580' E	Check Dam
536	13° 59.32706' N	75° 2.99593' E	Check Dam
537	13° 59.29712' N	75° 1.91832' E	Check Dam
538	13° 58.64344' N	75° 3.74409' E	Check Dam

Sl No	LATITUDE	LONGITUDE	TYPE
539	14° 0.49717' N	75° 2.03816' E	Check Dam
540	14° 0.24756' N	75° 4.19236' E	Check Dam
541	13° 59.00184' N	75° 5.02586' E	Check Dam
542	13° 58.83616' N	75° 5.63987' E	Check Dam
543	13° 58.08571' N	75° 6.70378' E	Check Dam
544	13° 58.63467' N	75° 8.68288' E	Check Dam
545	13° 59.08358' N	75° 10.34611' E	Check Dam
546	14° 1.36630' N	75° 10.36445' E	Check Dam
547	14° 1.53397' N	75° 9.74917' E	Check Dam
548	14° 1.49842' N	75° 7.91626' E	Check Dam
549	14° 0.64808' N	75° 12.62577' E	Check Dam
550	14° 0.28118' N	75° 13.29067' E	Check Dam
551	14° 0.22627' N	75° 14.91378' E	Check Dam
552	13° 59.52911' N	75° 11.83649' E	Check Dam
553	13° 58.60679' N	75° 20.05697' E	Check Dam
554	13° 54.45560' N	75° 20.94868' E	Check Dam
555	13° 52.10586' N	75° 20.77895' E	Check Dam
556	13° 54.35984' N	75° 17.74017' E	Check Dam