केन्द्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण

विभाग, जल शक्ति मंत्रालय

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

KOLHAPUR DISTRICT MAHARASHTRA

मध्यक्षेत्र, नागपुर

Central Region, Nagpur

AQUIFER MAPS AND GROUND WATER MANAGEMENTPLAN, KOLHAPUR DISTRICT, MAHARASHTRA

(AAP 2020-21)
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KOLHAPUR DISTRICT AT A GLANCE

1. GENERAL INFORMATION			
	Geographical Area	:	7697 sq.km
	Administrative Divisions (2011)	:	Taluka- 12, Karveer, Panhala, Shanuwadi, Kagal, Hatkanangle, Shirol, Gadhinglaj, Chandgad, Ajra, Bhudergad, Radhanagari, GaganBavda
	Villages (Census 2011)	:	1216
	Population (Census 2011)	:	3876001
	Rainfall		637 – 5507 mm
	Normal rainfall (1998-2019)		2057.1 mm
	Long term rainfall Trend (1998-2019)		-15.89 m/year
2. GEOMORPHOLOGY			
	Major Physiographic unit	:	Hills and plateau, Foothill Zone, Plains,
	Major Drainage	:	Varna, Panchganga, Dudhaganga, Vedganga, Ghataprabha Hirenyasheri
3. LAND USE *(sources: mahasdb.maharashtra.gov.in/district Report)*			
	Forest Area	:	1933.8 sq.km
	Cultivable Area	:	3632.36 sq.km
	Net Area Sown	:	3600.7 sq.km
4.	**SOIL TYPE**	:	Medium Black and Deep Black soil
5. PRINCIPAL CROPS			
	Rice	:	1014.88 sq.km.
	Sugarcane	:	1577.52 sq.km.
	Pulses	:	109.03 sq. km.
	Vegetables	:	127.47 sq. km.
	Jowar	:	124.15 sq. km.
	Fruits	:	205.63 sq.km.
6. IRRIGATION BY DIFFERENT SOURCES (2020-21) **-** Nos. / Potential Created (ha)			
	Dugwells	:	28878/79566
	Tubewells/Borewells	:	148/-
	Surface Flow Schemes	:	-/5276
	Surface Lift Schemes	:	5/-
7. GROUND WATER MONITORING WELLS (March 2020)			
	Dugwells	:	41
	Piezometers	:	Nil
8. GEOLOGY			
	Age		Formation
	Pleistocene-Recent	:	Alluvium
	Upper Cretaceous to Lower Eocene	:	Basalt (Deccan Traps)

9. HYDROGEOLOGY			
	Water Bearing Formation	:	Basalt- Weathered/fractured/ jointed vesicular/ massive, under phreatic condition and semi-confined to Confined conditions.
	Depth to water level in Shallow Aquifer		
	Pre monsoon Depth to Water Level (May-2020)	:	0.90 to 15.0 mbgl
	Post monsoon Depth to Water Level (Nov.-2020)	:	0.10 to 11.10 mbgl
	Depth to water level in Deeper Aquifer		
	Pre-monsoon Depth to Water Level (May-2020)		9.0 to 100 mbgl
	Post-monsoon Depth to Water Level (Nov.-2020)		-
	Water level Trend (2010-19)		
	Pre-monsoon Water Level Trend (2010-2020)	:	Rise: 0.0009 to 0.7585 m/year
			Fall: 0.0004 to 1.2 m/year
	Post-monsoon Water Level Trend (2010-2020)	:	Rise: 0.0006 to 0.56 m/year
			Fall: 0.0003 to 0.87 m/year
10. GROUND WATER EXPLORATION (As on March, 2021)			
	Wells Drilled	:	23 (EW:18, OW:05)
	Depth Range	:	32.1-200
	Discharge	:	0.14-4.43 lps
	Storativity	:	-
	Transmissivity	:	-
11. GROUND WATER QUALITY			
	Water Quality Data	:	Aquifer-I : In major part of the district ground water is potable and its quality is well within permissible limit Auifer-II : In major part of the district groundwater is potable and its quality is well within permissible limit except Fluoride contamination
	Type of Water	:	Ca-HCO_3
12. DYNAMIC GROUND WATER RESOURCES - (2017)			
	Net Annual Ground Water Recharge (ham)	:	122084.13ham
	Annual Ground Water Extraction (Irrigation + Domestic+ Industrial)	:	51308.87 ham
	Projected Demand for (Domestic use up to 2025)	:	1997.00ham

	Stage of Ground Water Development	:	42.03 %
	Category		**All the blocks are Safe**
13. MAJOR GROUND WATER PROBLEMS AND ISSUES			
	The basaltic rocks form prominent hill ranges, isolated hillocks, undulation etc. in the district. These basalts have poor primary as well as secondary porosity. As a result, these rocks have poor storage as well as transmissivity characteristics, which give rise to higher runoff, rather than natural recharge. The formations due to poor storage and transmission characteristics get fully saturated during the monsoon and a situation of rejected recharge is resulted. These aquifers then are drained naturally due to slopping and undulation topography. As a result, the dug wells become dry by the month of February onwards. In addition to this, the laterites occurring as capping on basalt are highly porous and permeable which do not retain ground water into interstices as a result, the groundwater is not available during the time it is required.		
14.	**Aquifer Management Plan**		
	Supply side Management		Proposed AR structures: 25 Percolation Tanks and 74 Check dams. The expected recharge every year from these structures is 5.46 MCM.
	Demand side Management		A total of 176.69 sq km area of Sugarcane crop is proposed to cover under drip and sprinkler irrigation. 100.71 MCM of ground water can be saved.
	Development plan		Proposed 19124 Dug wells and 3189 Borewells in phased manner for 6 years.

AQUIFER MAPS AND GROUND WATER MANAGEMENTPLAN, KOLHAPUR DISTRICT, MAHARASHTRA

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ANNEXURES

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, KOLHAPUR DISTRICT, MAHARASHTRA

1. INTRODUCTION

National Aquifer Mapping (NAQUIM) has been taken up in XII five-year plans by CGWB to carry out detailed hydrogeological investigation on toposheet scale of 1:50,000. The NAQUIM has been prioritized to study Over-exploited, Critical and Semi-Critical Blocks as well as the other stress areas recommended by the State Govt. Aquifer mapping is a process wherein a combination of geological, geophysical, hydrological and chemical analyses is applied to characterize the quantity, quality and sustainability of ground water in aquifers.

The vagaries of rainfall, inherent heterogeneity & unsustainable nature of basalt aquifers, over exploitation of once copious alluvial aquifers, lack of regulation mechanism has a detrimental effect on ground water scenario of the Country in last decade or so. Thus, prompting the 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 the robust and implementable ground water management plans. The proposed management plans will provide the “Road Map” for ensuring sustainable management and equitable distribution of ground water resources, thereby primarily improving drinking water security and irrigation coverage. Thus, the crux of NAQUIM is not merely mapping, but reaching the goal-that of ground water management through community participation. The aquifer maps and management plans will be shared with the Administration of Kolhapur district, Maharashtra for its effective implementation.

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

1.1 About the Area

The Kolhapur district is located at southern end of Maharashtra State. This district was ruled by pioneer social reformer “Chhatarapati Sahu Maharaj”. It is among the few districts of India, having the distinction of first wired village in India. The famous Goddess of Kolhapur “Godess Ambabai Mahalaxmi” is worshiped in almost every Maharashtrian house. The Place like Panhala, Jyotibha, Vishalgad, Nurshinwadi and Bahubali are the famous tourist places.

The district has total area of 7697 sq. km which is about 2.5% by the area by State. The district is bounded by North latitudes 15o40’, 17o15’, and East longitudes 73o30’, and 74o45’,. The district is sub divided into four sub divisions i.e., Karveer, Ichalkaranj,

Gandhinglaj, Radhanagri which are further divided into 12 talukas viz Karveer, Panhala, Shanuwadi, Kagal, Hatkanangle, Shirol, Gadhinglaj, Chandgad, Ajra, Bhudergad, Radhanagari, Gaganbavda. The district has 18 towns and 1216 villages. It has a total population by 3876001 as per 2011 census.

Kolhapur district has been taken up under NAQUIM study during the year 2020-21. The total area of the district is 7697 sq km. All the 12 Blocks are categorized as safe as per Ground Water Resources Estimation as on March 2017. The Index and Administrative map of the study area is presented in **Figure.1.1 (a&b)**.

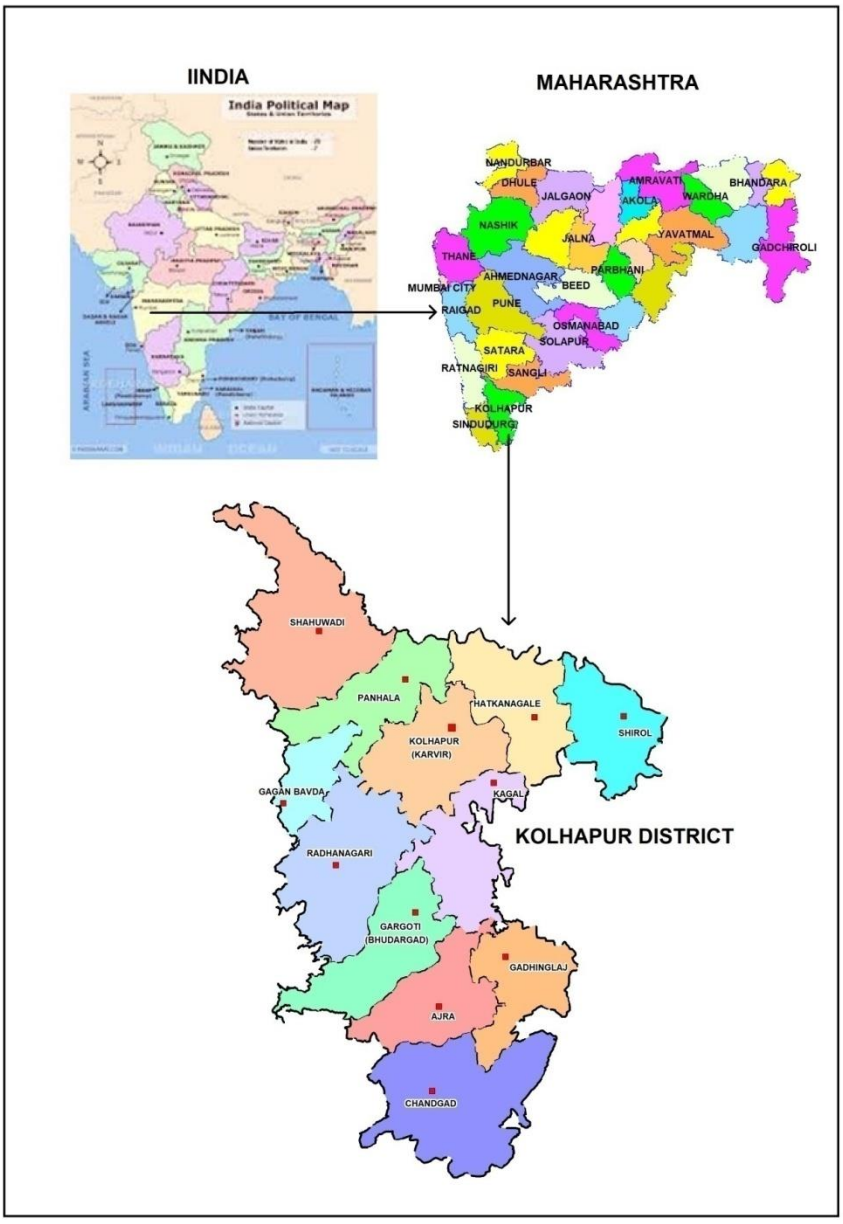


Figure.1.1 (a) Index map, Kolhapur District

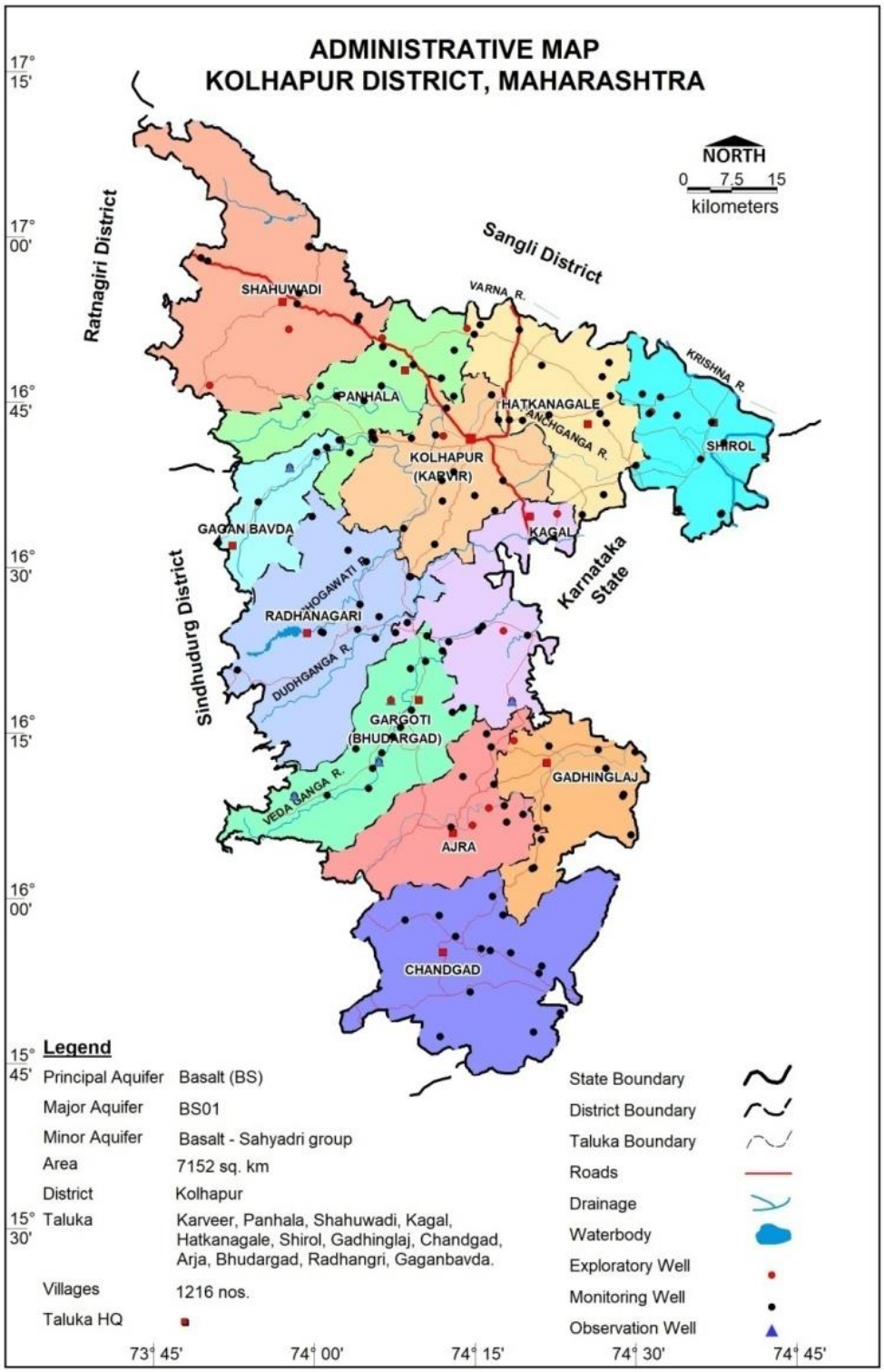


Figure 1.1 (b): Administrative map, Kolhapur District

Ground Water Exploration was taken up in the district and so far, 23 wells (18 EW+ 5 OW) have been drilled as on 31st March 2021. The taluka wise salient features of ground water exploration are given in Annexure-I.

A total of 41 existing ground water monitoring stations were being monitored 4 times in a year to assess the ground water scenario of the district Based on data gap analysis additional 93 KOWs data of state Government is considered to acquire micro

level hydrogeological data to decipher the water level scenario, sub-surface lithological disposition and hydrogeological setup of shallow aquifer (Aquifer-I). The details of KOWs, GWRM and PMP wells are given in Annexure-II and IV. Locations of existing Exploratory wells, Key wells, and Ground Water Monitoring Wells is presented in Fig-1.2

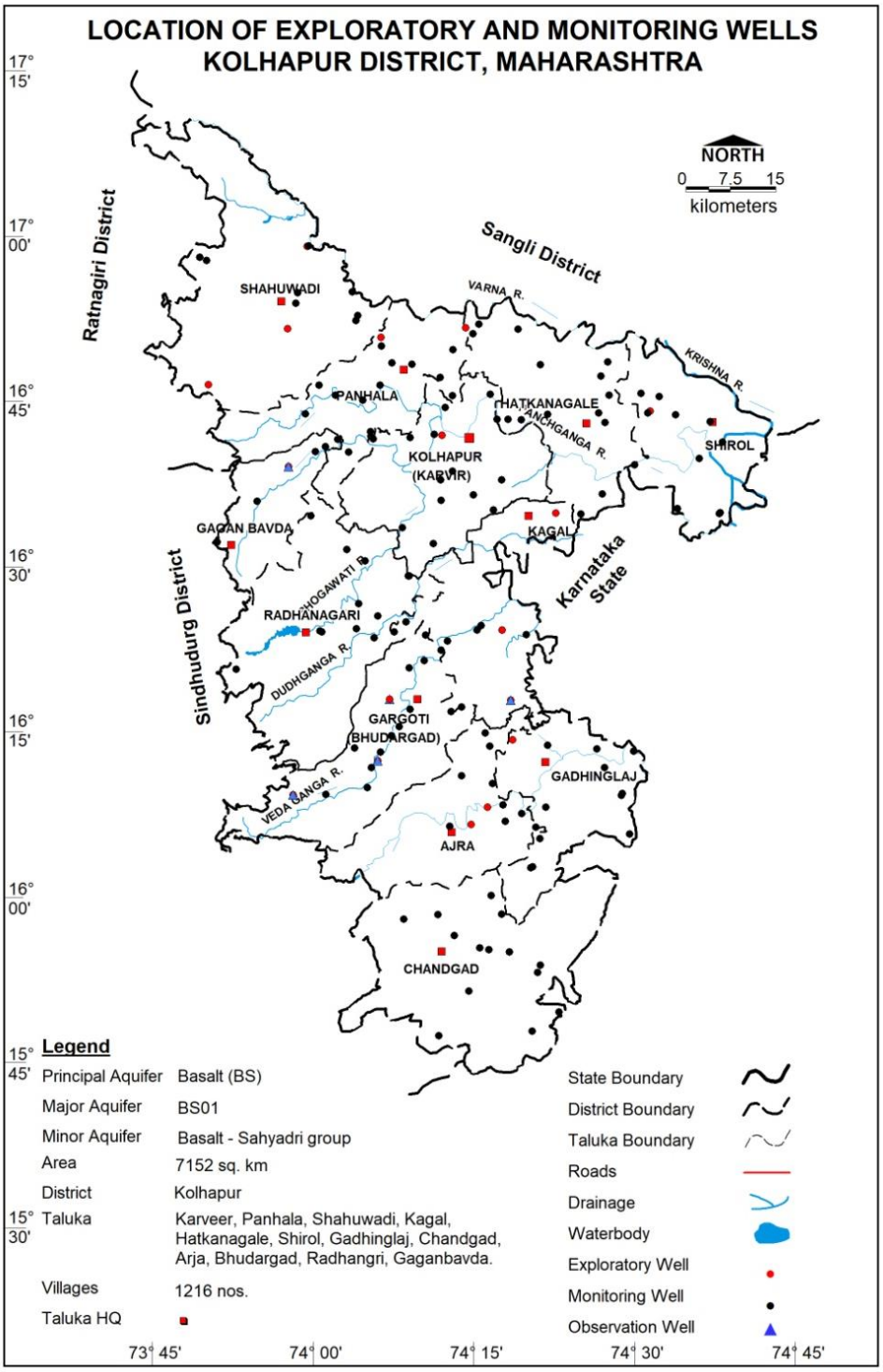


Figure 1.2: Location of Existing Exploratory wells, Ground Water Monitoring Wells and Observation Wells

1.2 Geomorphology, Drainage, Land Use and Soil Types

The district is a part by the Deccan table land with an average height by 550 m. amsl with the Sahyadri forming the most prominent feature along its western administrative boundary. The Central portion by the district, the hill range exhibit a similar form and possess the same height but they have a south west- north east trend and they extend to a length of about 24 kms. The southern hill range viz the Kagal range and Bhudargad range maintain the same trend SW-NF.

Broadly, the district has three major characteristic land forms (1) the hill, ghats and plateau (2) the foot hill zones (3) the plains.

The geomorphological map of Kolhapur district is shown in **Figure. 1.3**

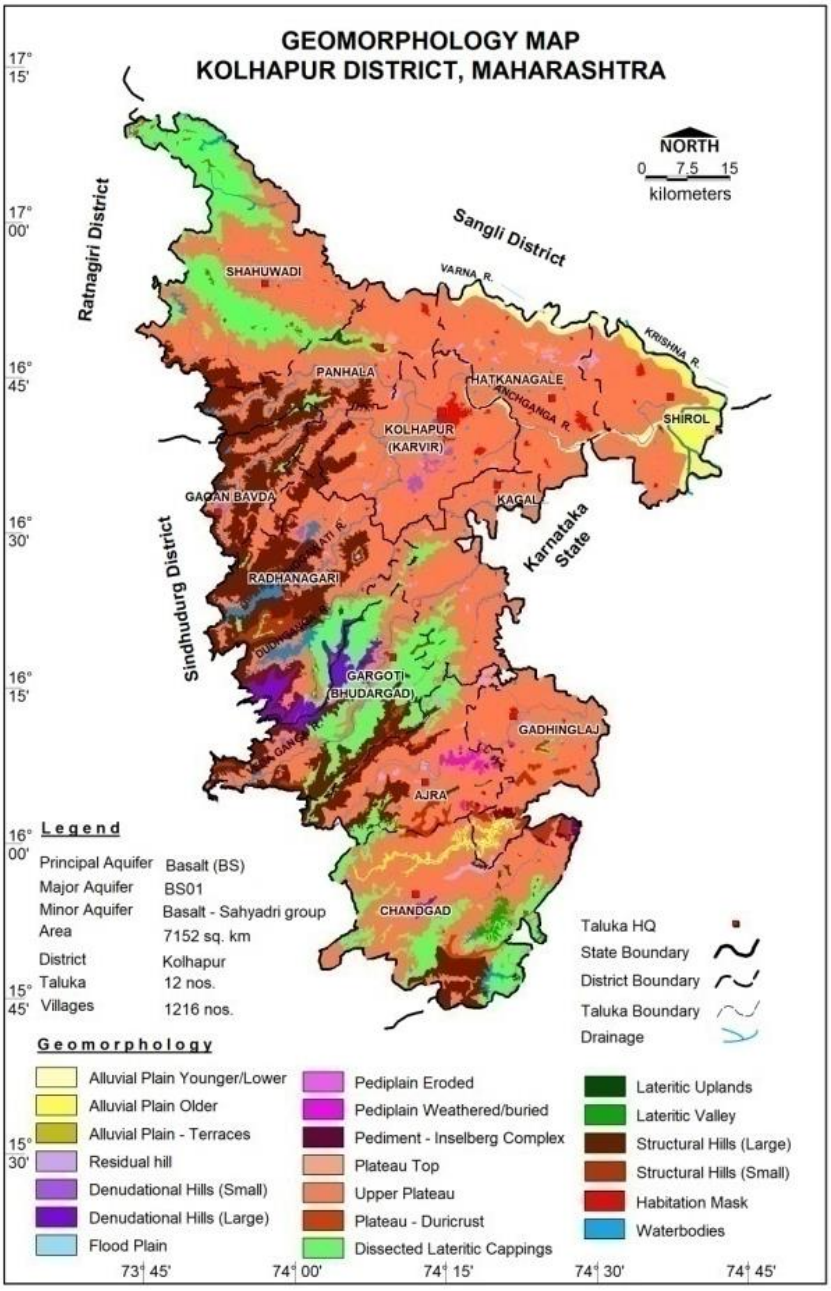


Figure 1.3: Geomorphology of Kolhapur district

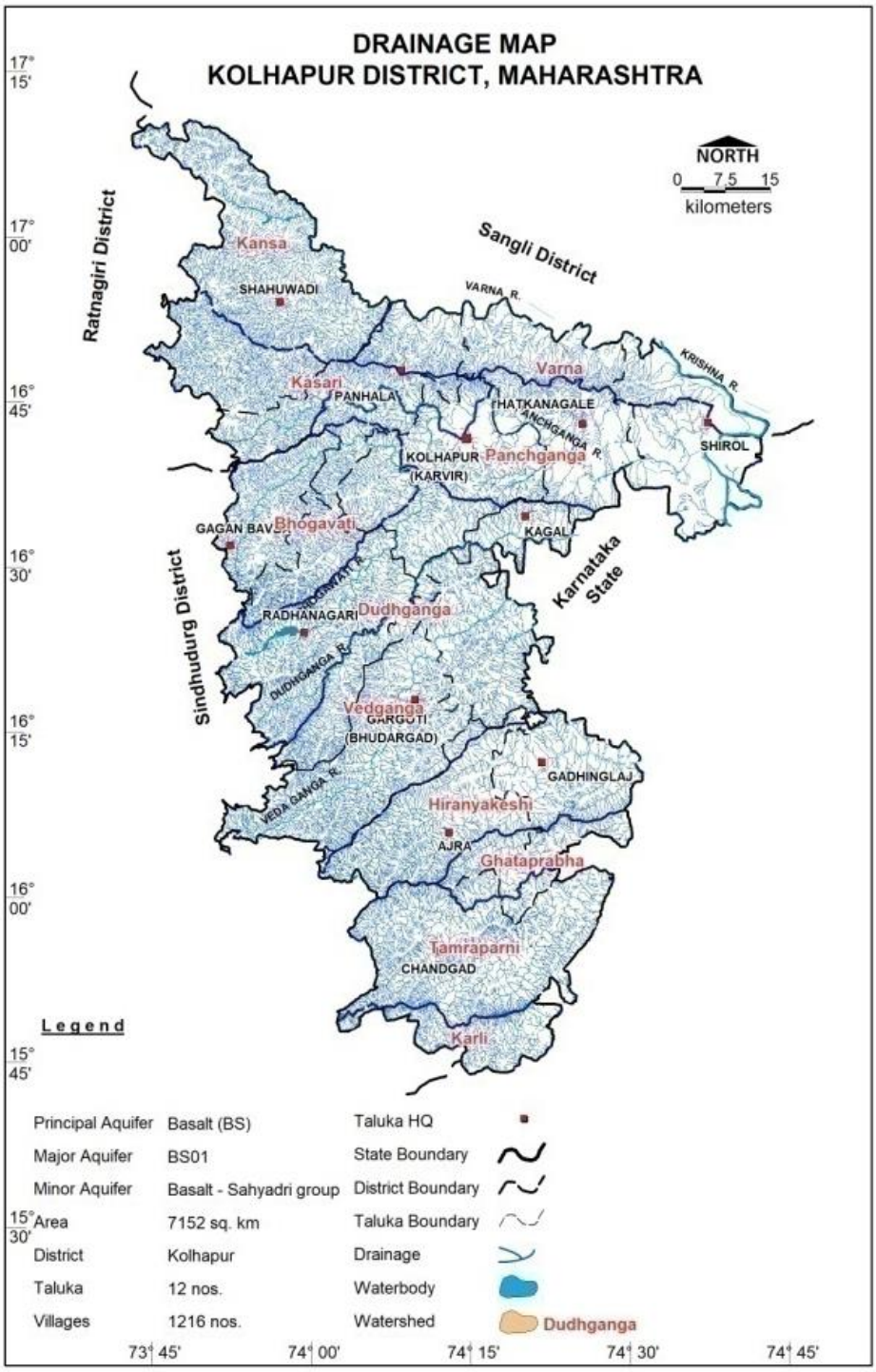


Figure 1.4: Drainage, Kolhapur district

The entire district is mainly drained by Krishna River and its tributaries viz., Varna, Panchganga, Dudhaganga, Vedganga, Ghataprabha Hirenyakeshi. Based on geomorphological setting and drainage pattern, the district is divided into watersheds.

The drainage pattern of the Kolhapur district has three important aspects. The Sahyadris form the main water-divide separating the eastern drainage from that flowing in the west to the Arabian Sea. Secondly, the western flowing streams are ungraded and run down the Sahyadrian scarp face with a tremendous velocity, with the result that the

scarp face presents a highly eroded appearance when seen from the Konkan side.

The rivers occupy wider valleys; there is a good tributary development, though in some cases the head-waters have been ' captured' by the fast-flowing streams of the main range draining the region to the Konkan lowlands. Thus, from north to south, the district is drained by the Varna, Panchaganga, Dudhganga, Vedaganga and Hiranyakeshi. The southernmost river, Hiranyakeshi, empties its waters in the Ghataprabha which in its turn is a tributary of the Krishna, near Ingli outside the limits of this district. The main rivers flowing through the district are Krishna, Panchganga, Dudhganga, Warna, Heranyakeshi and Dudhganga. The drainage map of Kolhapur district is shown in **Figure. 1.4**

The Land Use details of the district are depicted in Figure 1.5. In the district it is observed that net sown area of 3600.7 Sq.km (47%). Forest covers an area of 1933.8 Sq.km (25 %) and cultivable area covers 3632.36 Sq.km (47%) is available. The built-up area is reflected wherever settlements have come up.

The soil of the district is basically derived from Deccan Trap Basalt, which is predominating rock formation comprising of clay and loam mixture. The hill tops are covered with lateritic soil while in the valleys, the soil is of mixed character varying in colour from brownish to reddish. The soils of the district can be grouped as., Gravely Sandy Loam, Gravely Sandy Clay Loam. Gravely clay, Gravely clay Loam, Silt cay loam, Silt clay, Sandy Loam, Sandy Clay Loam. Loamy clayey and Clayey soil covers major part of the district. The thematic map of soil distribution in the district is shown **in Figure. 1.6**

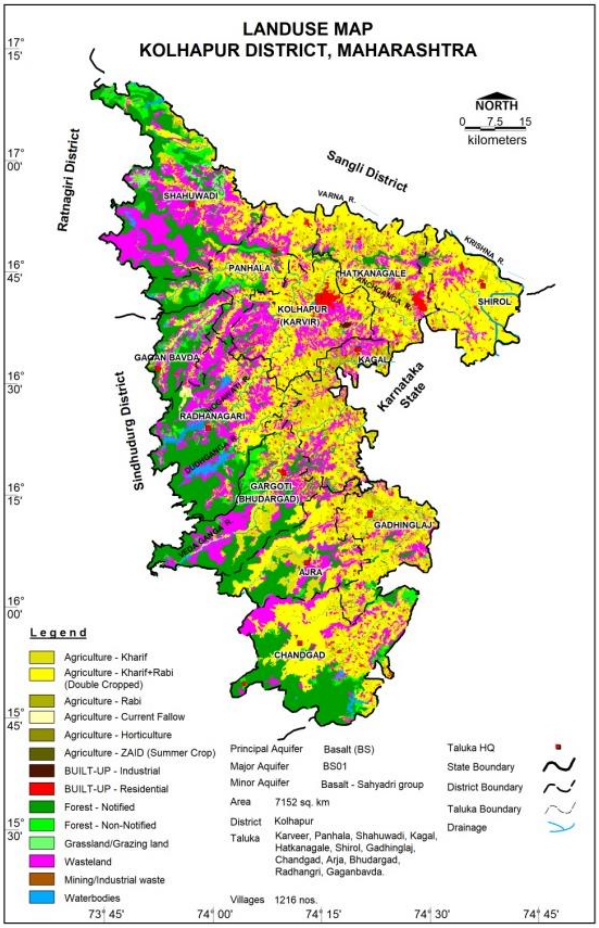


Figure 1.5: Land Use of Kolhapur District

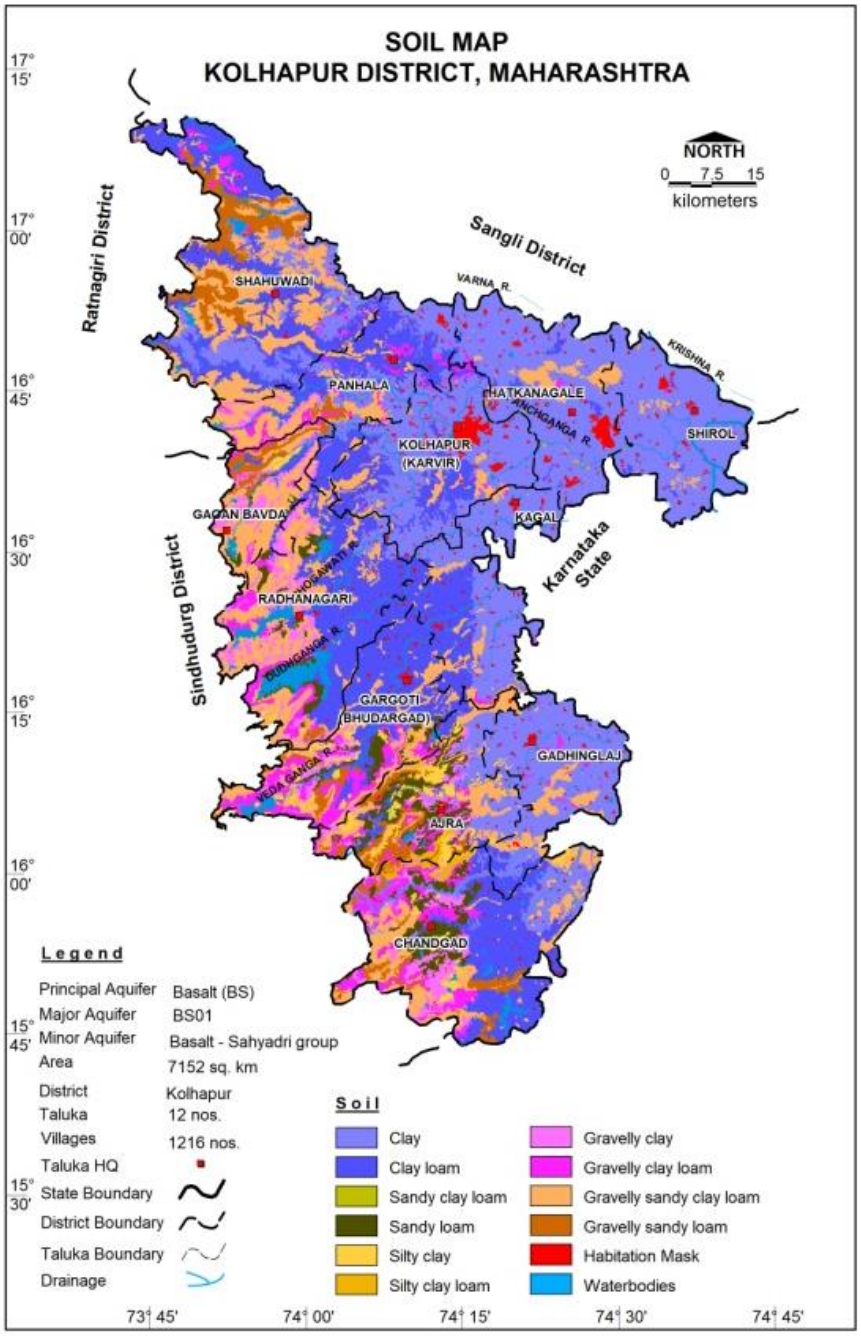


Figure 1.6: Soil, Kolhapur District

1.3 Climate and Rainfall

The climate of the district is characterized by general dryness except during south west monsoon season. The cold season is from December to February followed by summer from March to May. June to September is the south west monsoon season while October and November constitute the post monsoon season.

The normal rainfall of the district is 2057.1 mm spread over 79 to 126 rainy days in normal condition. Long term rainfall analysis (1998-2019) and annual rainfall data of last ten years is given in **Table 1.1** and **1.2** and **Figure. 1.7**. The spatial distribution of the rainfall is given in **Figure. 1.8**.

Table 1.1: Long-term rainfall analysis

District	Period	No of years	Normal Rainfall (mm)	Std. Deviation (mm)	Coefficient of Variation (%)	Rainfall Trend (mm/year)
KOLHAPUR	1998-2019	22	2057.1	518.24	28.5	-15.89
CATEGORY	**NUMBER OF YEARS**			**% OF TOTAL YEARS**		
DEPARTURES						
POSITIVE	5			23		
NEGATIVE	17			77		
DROUGHTS						
MODERATE	8			36		
SEVERE	1			5		
ACUTE	0			0		
NORMAL & EXCESS R/F						
NORMAL	11			50		
EXCESS	2			9		

Table 1.2: Annual rainfall data (2011-2019) (in mm)

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average Rainfall (mm)
Kolhapur	2004.3	2142.9	1729.4	1353.9	1355.9	798.2	1363	1250.9	1421.5	2304.9	1572.49

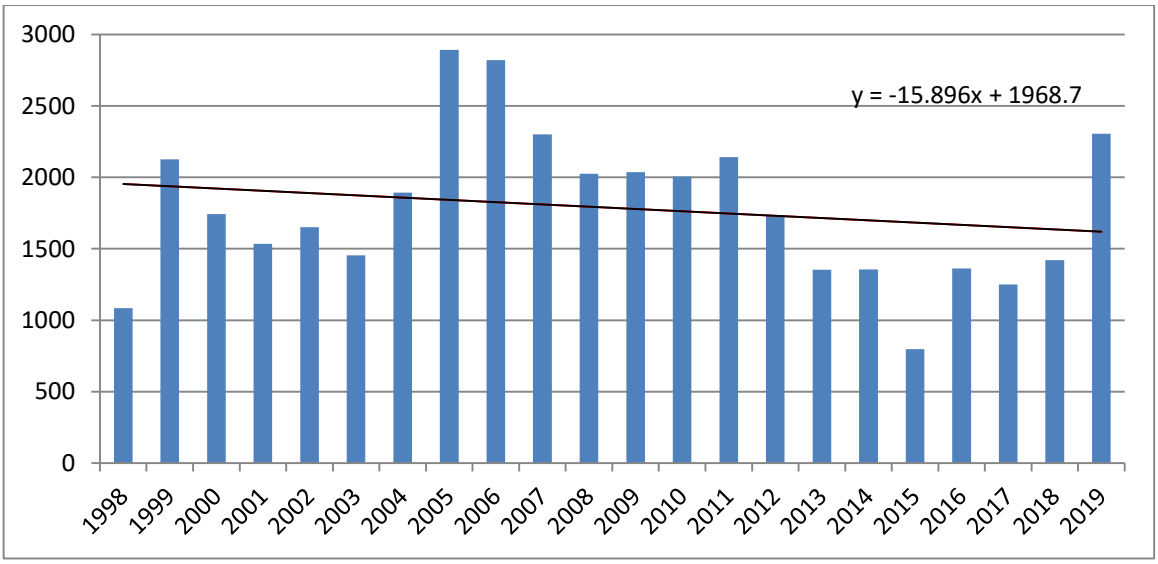


Figure 1.7: Rainfall Analysis (1998-2019), Kolhapur district

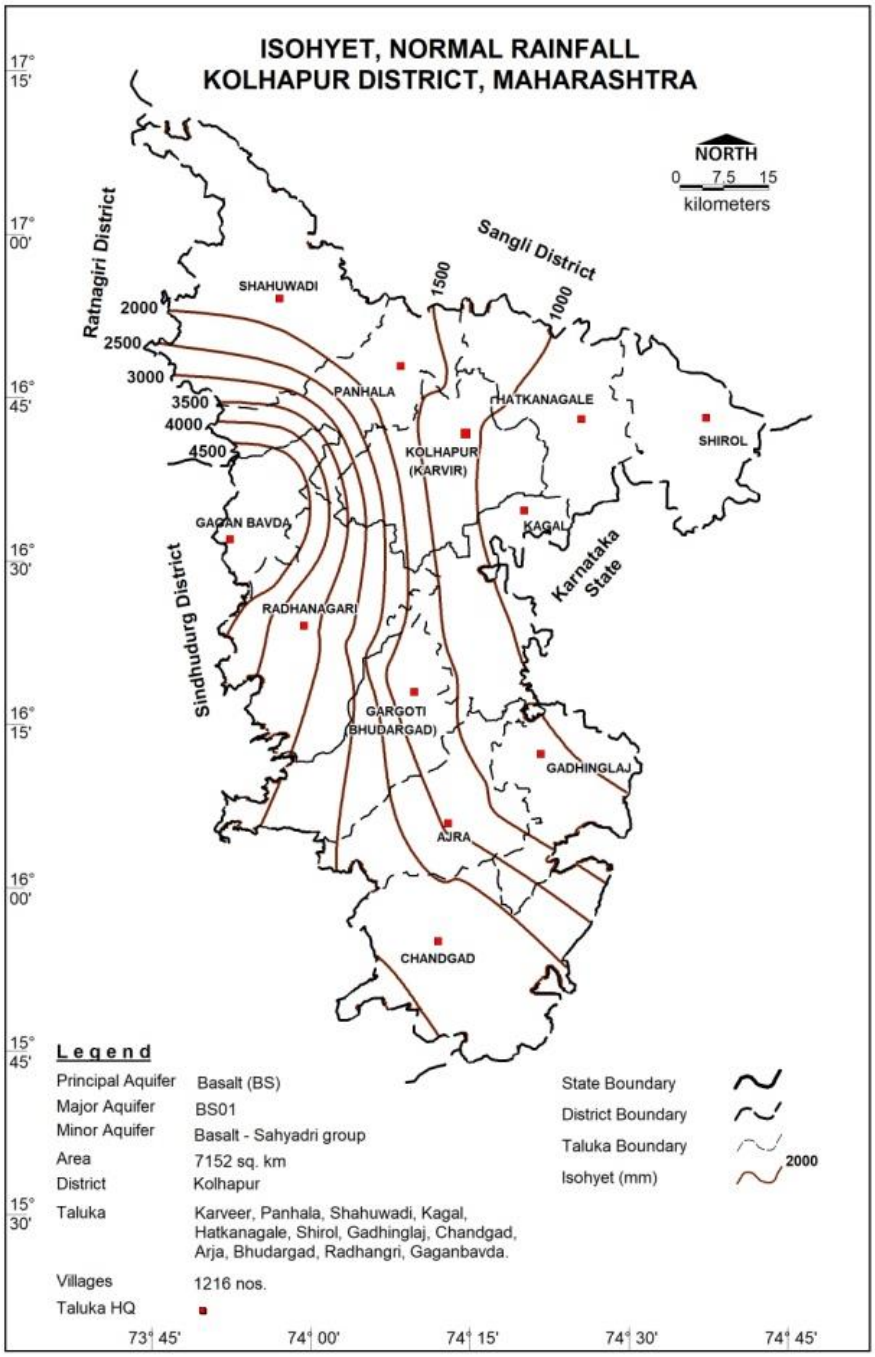


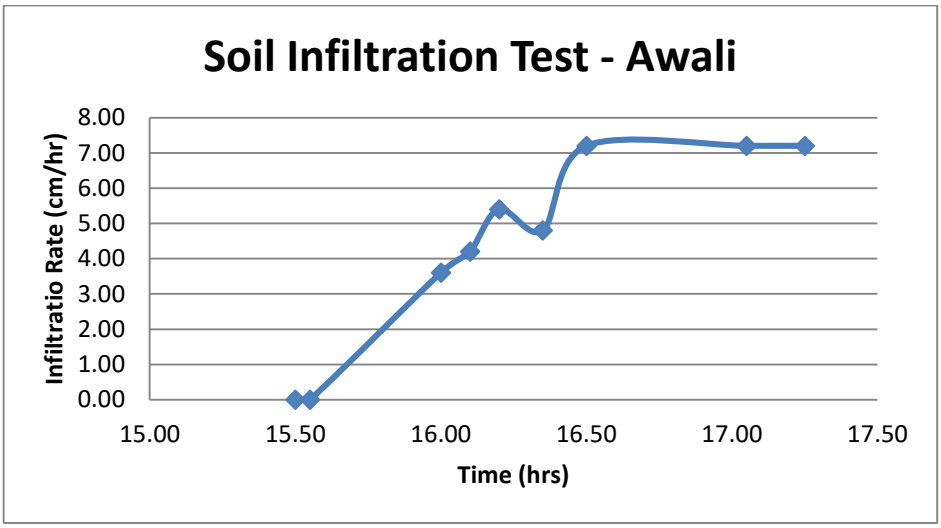
Figure 1.8: Isohyet map of Kolhapur district

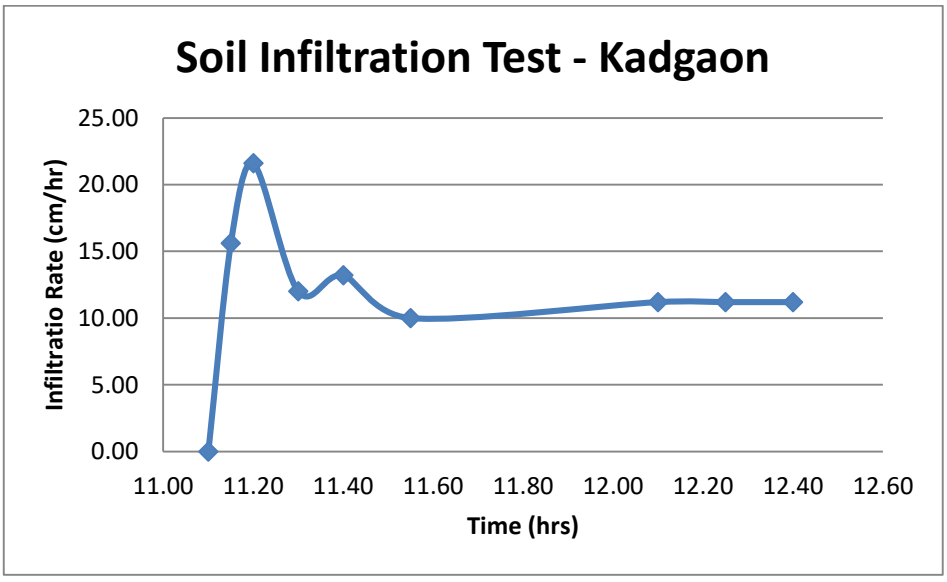
1.4 Soil Infiltration Tests

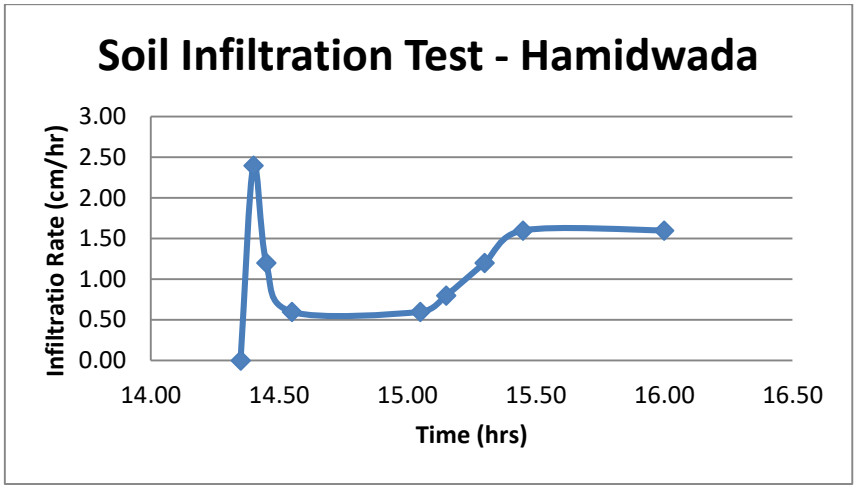
To estimate the actual rate of infiltration of various soil cover and their impact on recharge to ground water, 4 infiltration tests have been conducted at Asandoli, Awali, Hamidwada and Kadgaon in various soil types. The data has been analysed and the salient features of the infiltration tests are presented in **Table 1.3**, whereas the data is presented in **Annexure-V** and the plots of soil infiltration tests are presented in **Fig. 1.9**. The duration of the test ranges from 75 to 185 minutes, the depth of water infiltrated varied from 0.40 cm to 2.80 cm and the final infiltration rate in the area are 1.60 cm/hr at Hamidwada and 13.20 cm/hr at Asandoli.

Table 1.3: Salient Features of Infiltration Tests

Sr. No.	Village	Taluka	Date of Test	Duration (min)	Water Level (cm agl)	Final infiltrated Water Depth(cm)	Final Infiltration rate (cm/hr)
1	Awali	Panhala	09/03/2021	75	14.5	1.80	7.20
2	Kadgaon	Gadhinglaj	10/03/2021	75	17.5	2.80	11.20
3	Hamidwada	Kagal	10/03/2021	75	17.8	0.40	1.60
4	Asandoli	Gagan bawda	11/03/2021	185	14.00	1.10	13.20







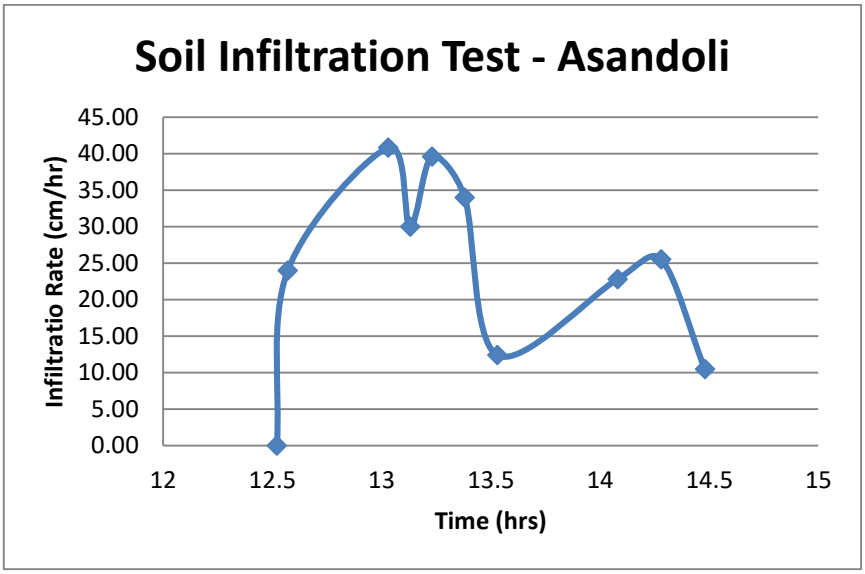


Figure 1.9: Soil Infiltration Tests of Kolhapur district

2. HYDROGEOLOGY

2.1 Major Aquifer Systems

There are 2 types of aquifer systems in the area namely Basalt as a major formation and Kaladgi Sandstone covering small area. Due to hilly terrain, conspicuous spreads of Alluvium are rarely noticed, except in some lower reaches of rivers.

Basalts

The major portion of district is covered by Basaltic lava flows of upper Cretaceous to lower Eocene age. These flows are part of the plateau Basalt of the Peninsular India, and believed to have been extruded by fissure type of Volcanoes.

The Basaltic flows of the area are of 'aa' type. These show a basal section having chilled basalt of greyish clincker with fragments of highly vesicular trap cemented by

zeolites, secondary silica and powdered rock. The main middle section of the flow comprises dark or dark grey dense basalt.

In the Basaltic Terrain, in parts of Kolhapur district, the ground water occurs under un-confined conditions in the phreatic zone up to the depth of 8 to 30 m in the weathered zone, joints and fractures in them and weathered vesicular units. The water bearing strata below massive units exhibits mild confined conditions as observed in the borewells tapping deeper aquifers.

Kaladgi Sandstone: The Pre-Cambrians comprising of Kaladgi Sandstone covering small area of the district, which constitutes compact shale, bedded sandstone/ quartzites. The shales are generally having some porosity but are impermeable and do not permit the movement of water while in sandstone strata the intervening shales form aquicluds and give rise to confined conditions in the underlying sandstone.

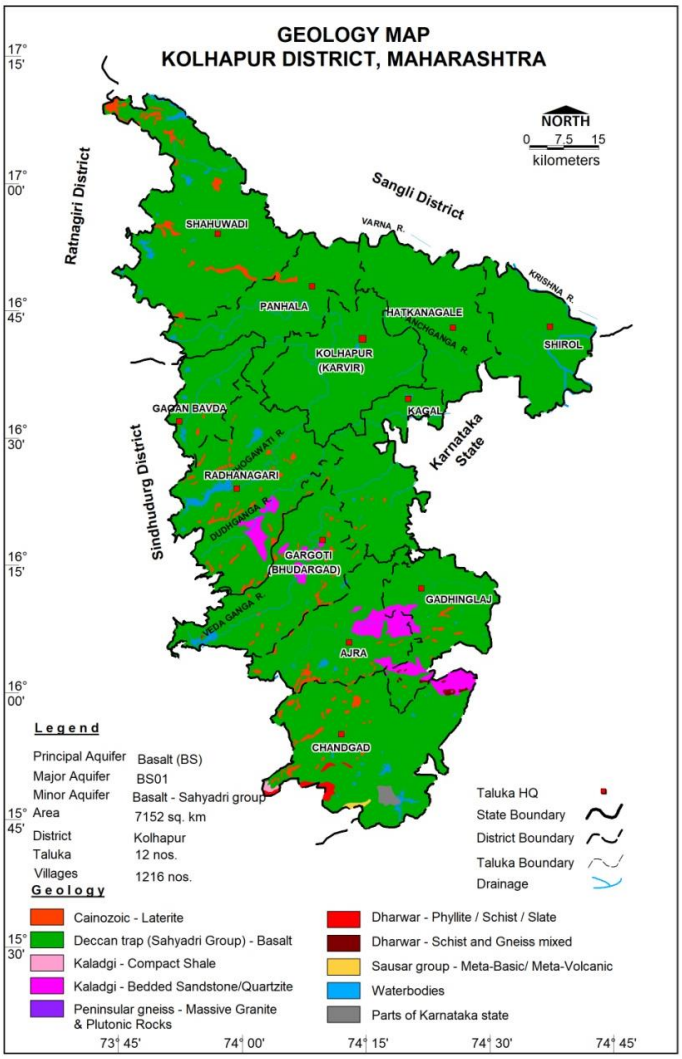


Figure 2.1: Geology showing major Aquifers

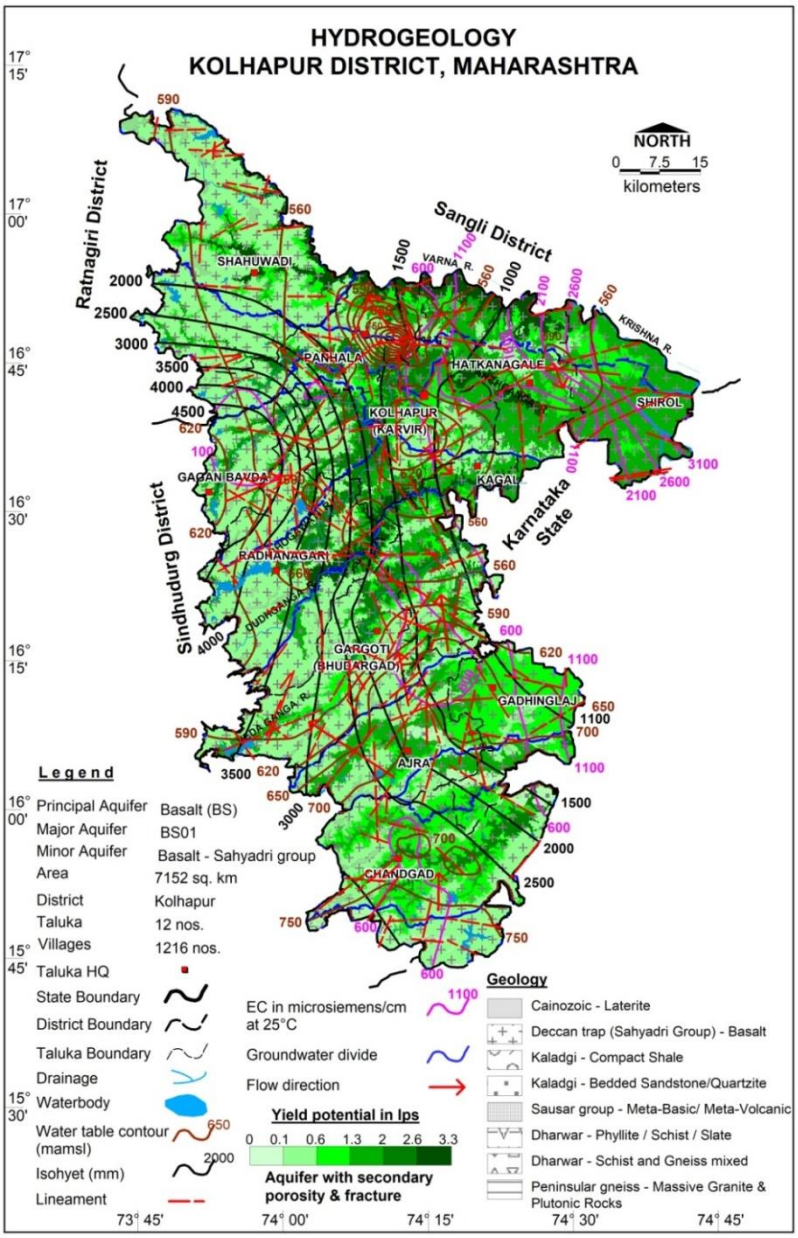


Figure 2.2: Hydrogeology

Water Table Elevation range 500 m amsl to 750 m amsl. The entire district is mainly drained by Panchganga River which is the tributary of Krishna River, the general slope is eastwards. Groundwater movement is from NE to E with elevation from 590 m to 560 m amsl. Groundwater movement along Bhogwati river is from W to E with elevation from 690 m to 520 m amsl. Along Dudhganga river in Western part of the district, the Groundwater movement is from W to E with elevation from 590 m to 560 m amsl. Along Veda Ganga River Groundwater movement is from SW to N with elevation from 590m to 560mamsl. It has been observed that the groundwater flow direction follows the drainage and topography of the area. This indicates the topographic control for the groundwater movement.

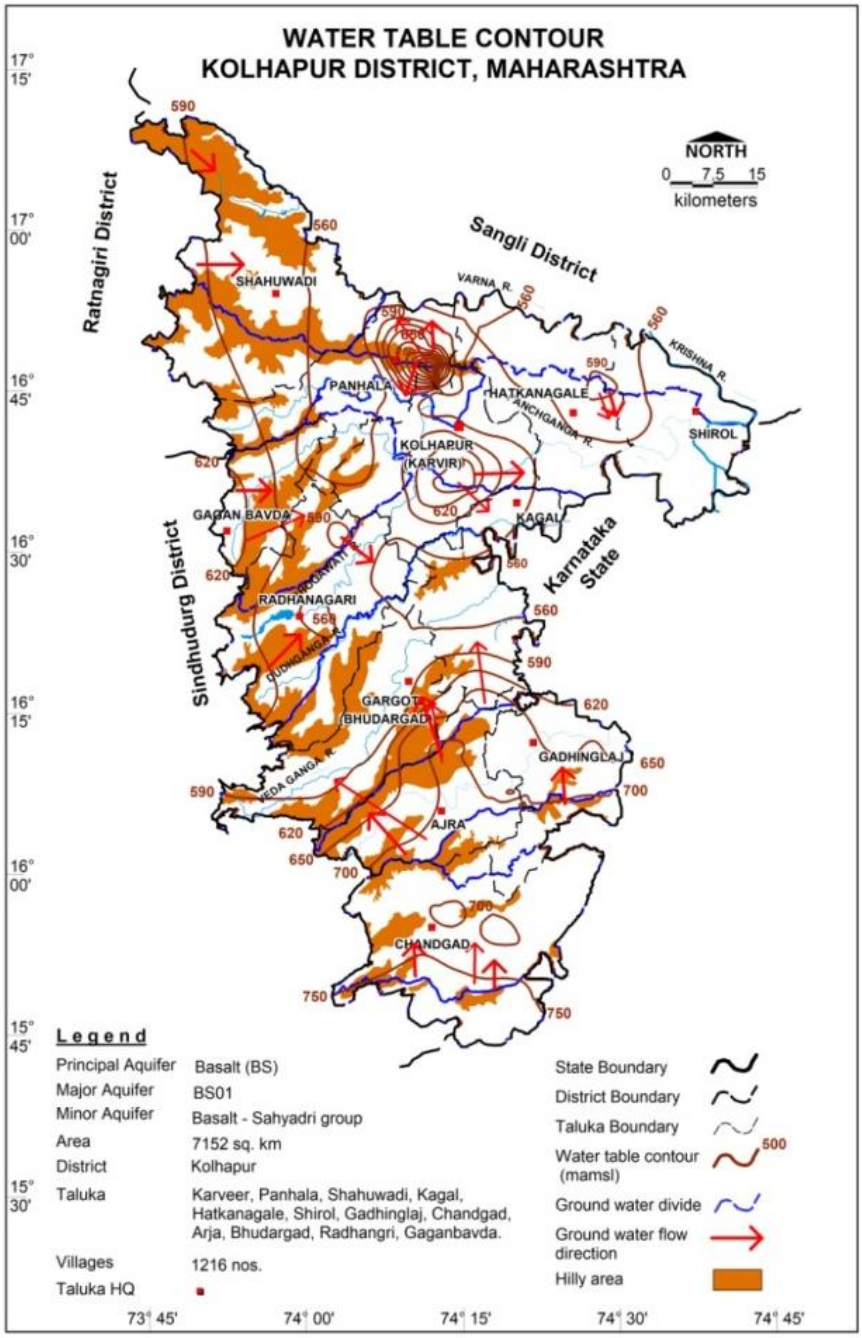


Figure 2.3: Water Table contour

Table 2.1: Aquifer Characteristic of Kolhapur district

Major Aquifers	**Basalt (Deccan Traps)**	
Type of Aquifer	**Aquifer-I**	**Aquifer-II**
Formation	Weathered/Fractured Basalt	Jointed / Fractured Basalt
Depth of Occurrence (m bgl)	8 to 30	25 to 180
SWL (m bgl)	1 to 15	9 to 85
Weathered, Jointed / Fractured rocks thickness (m)	5 to 20	0.5 to 3

Fractured zones encountered (mbgl)	4 to 30	25 to 180
Yield	5 –160 m3/day	0.1 –3.3 lps
Sustainability	1 to 4 hrs	0.5 to 3 hrs
Transmissivity(m2/day)	-	-
Specific Yield/ Storativity (Sy/S)	-	-
Suitability for drinking/ irrigation	Suitable for both	In major part of the district ground water is potable and its quality is well within permissible limit except Fluoride contamination

Aquifer Characteristic of Kolhapur district is shown in **Table 2.1.** Deccan Trap Basaltic Formation is the major aquifer in the district. Weathered/Fractured Basalt and Jointed / Fractured Basalt are the water bearing formations in Basalt of Kolhapur District. Yield of Aquifer –I is 5-160 m^3/day, Aquifer-II is 0.1-3.3 lps.

Depth of occurrence and fractured/granular rock thickness of Aquifer-I and Aquifer-II is shown in **Figure 2.4 and 2.5,** respectively. Depth of occurrence of Aquifer –I Basalt (Weathered /Fractured Basalt) are 8 to 30 m while depth of occurrence of Aquifer-II Basalt (Jointed & Fractured Basalt) is 25 to 180 m.

Yield Potential of Aquifer-I (Weathered /Fractured Basalt) and Aquifer-II (Basalt) is shown in **Figure 2.6 and2.7**. Yield potential of Aquifer-I is 5 to 160 m^3/day and Yield Potential of Aquifer-II (Jointed & Fractured Basalt) is 0.1 to 3.3 lps.

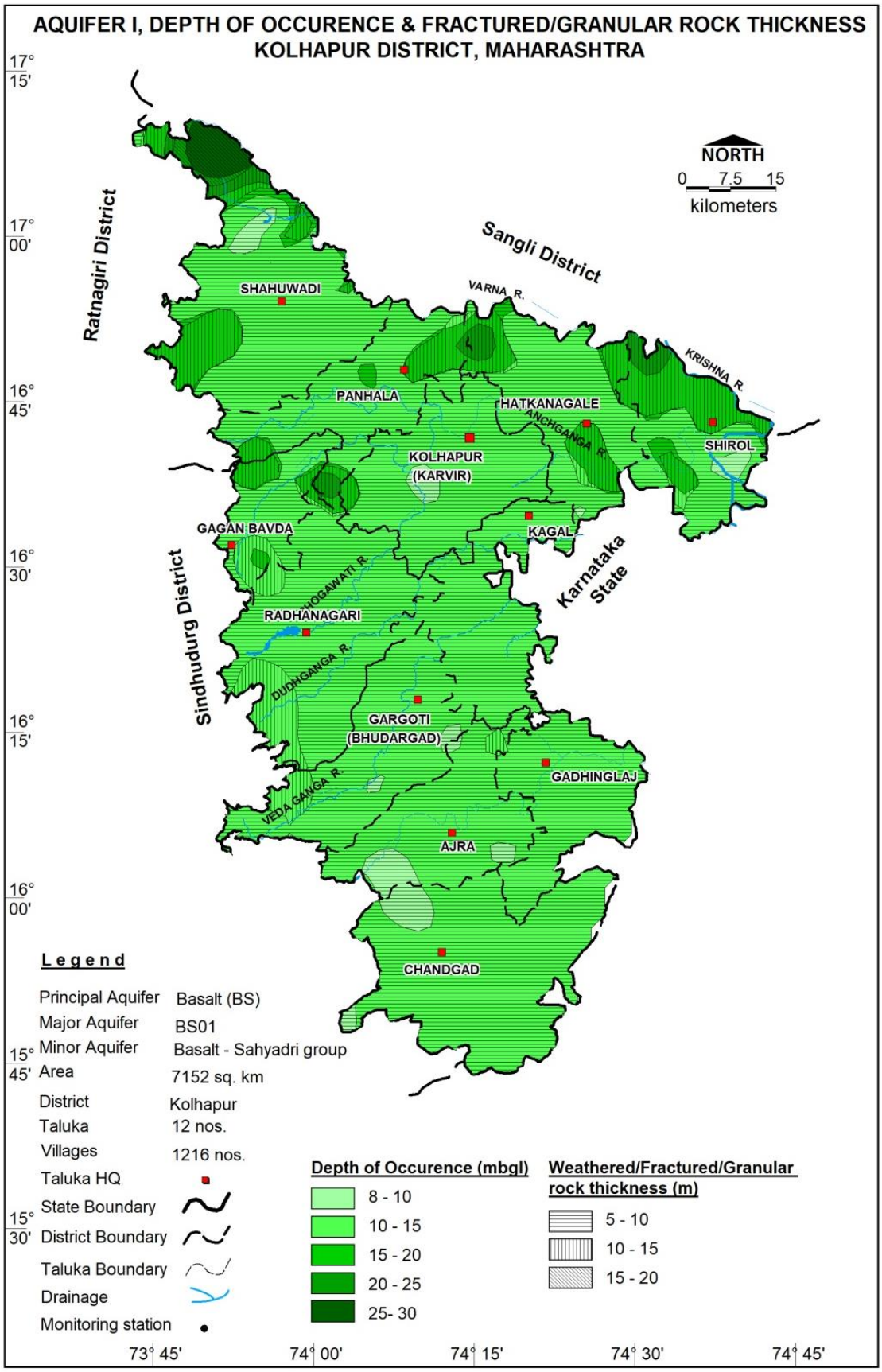


Figure 2.4: Depth of occurrence and fractured/granular rock thickness of Aquifer-I

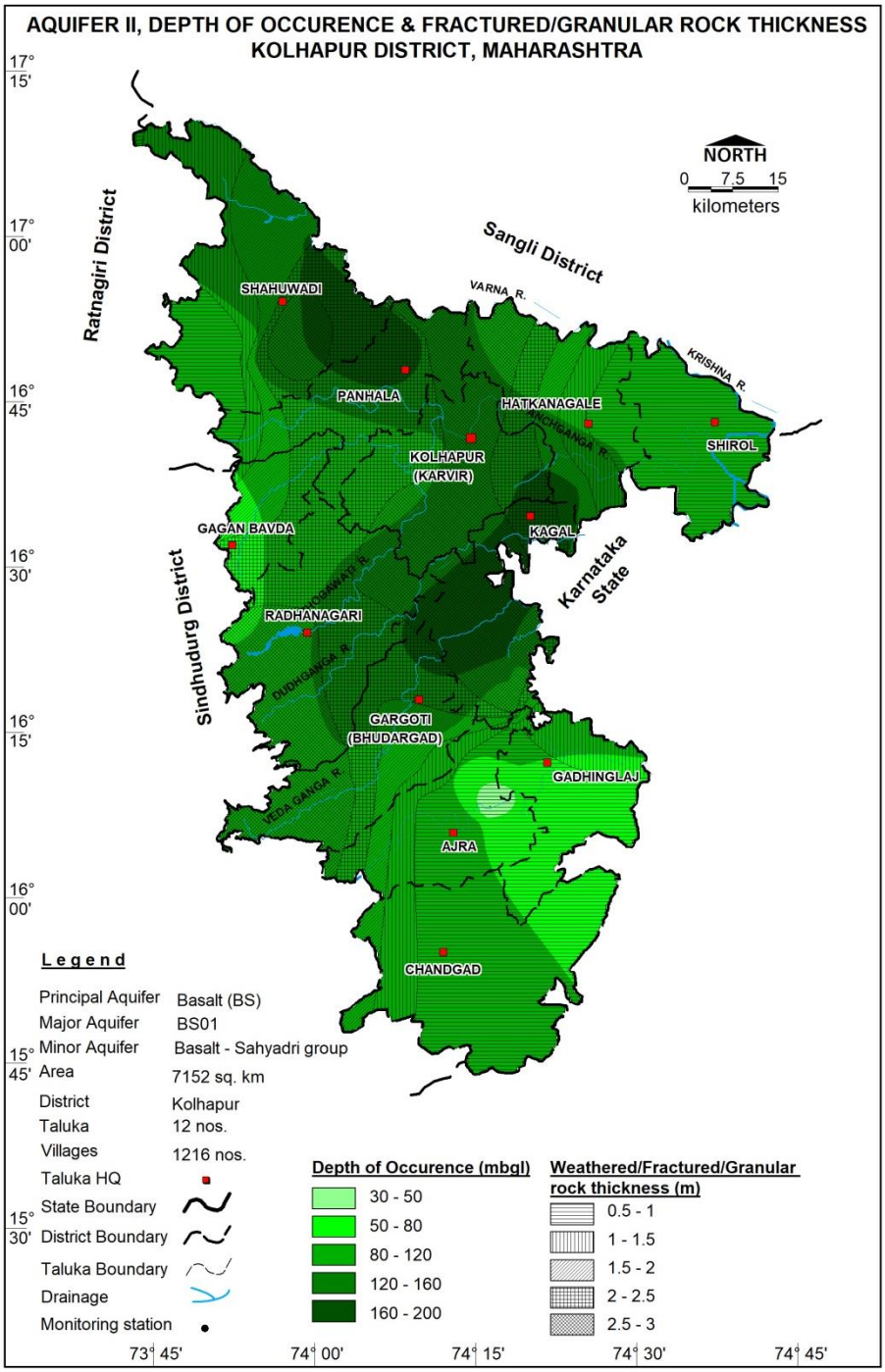


Figure 2.5: Depth of occurrence and fractured/granular rock thickness of Aquifer-II

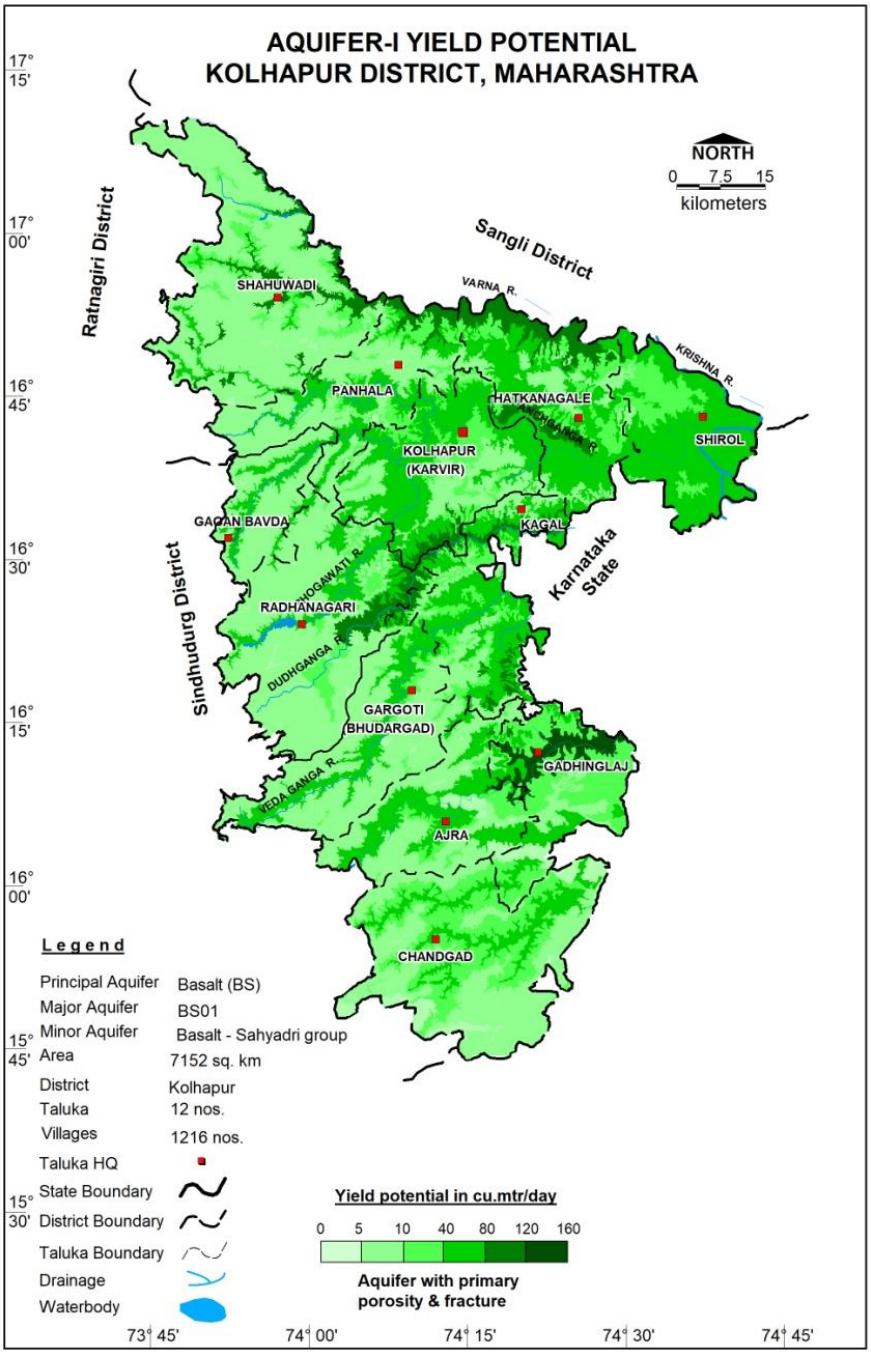


Figure 2.6: Aquifer-I Yield Potential (Basalt)

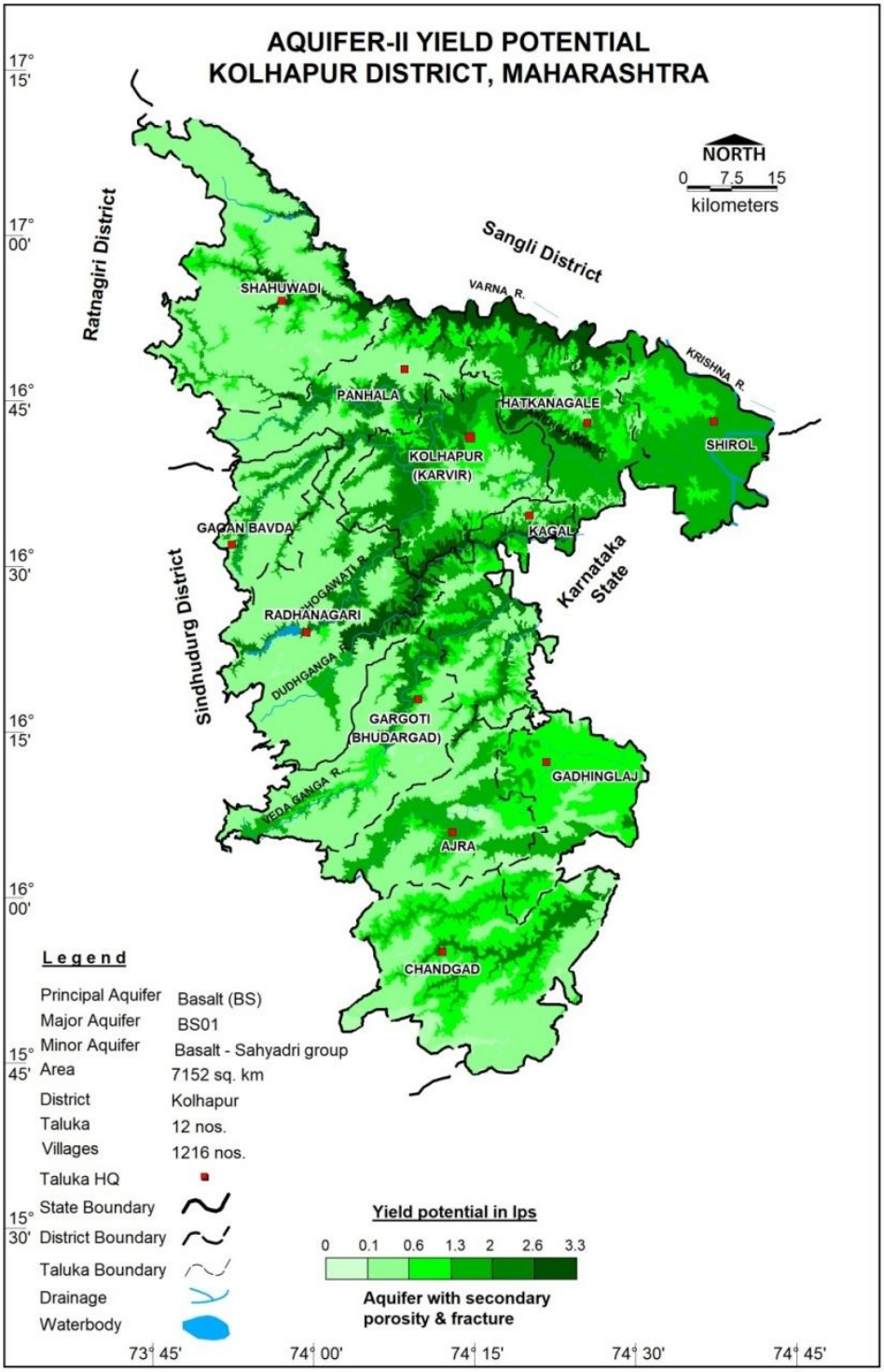


Figure 2.7: Aquifer-II Yield Potential (Basalt)

Yield potential	Aquifer I	Aquifer II
Basalt	5 to 160 m^3/day	0.1 to 3.3 lps

2.2 Aquifer Parameters

Aquifer parameters will be incorporated after conducting Pumping Tests.

2.3 3-D and 2-D Aquifer Disposition

Based on the existing data, 3D aquifer disposition, Fence diagram, Bar diagram and hydrogeological sections along different directions have been prepared and shown in **Figure ,2.8 ,2.9, 3.1, and 3.1a to 3.1d** to understand the subsurface disposition of aquifer system.

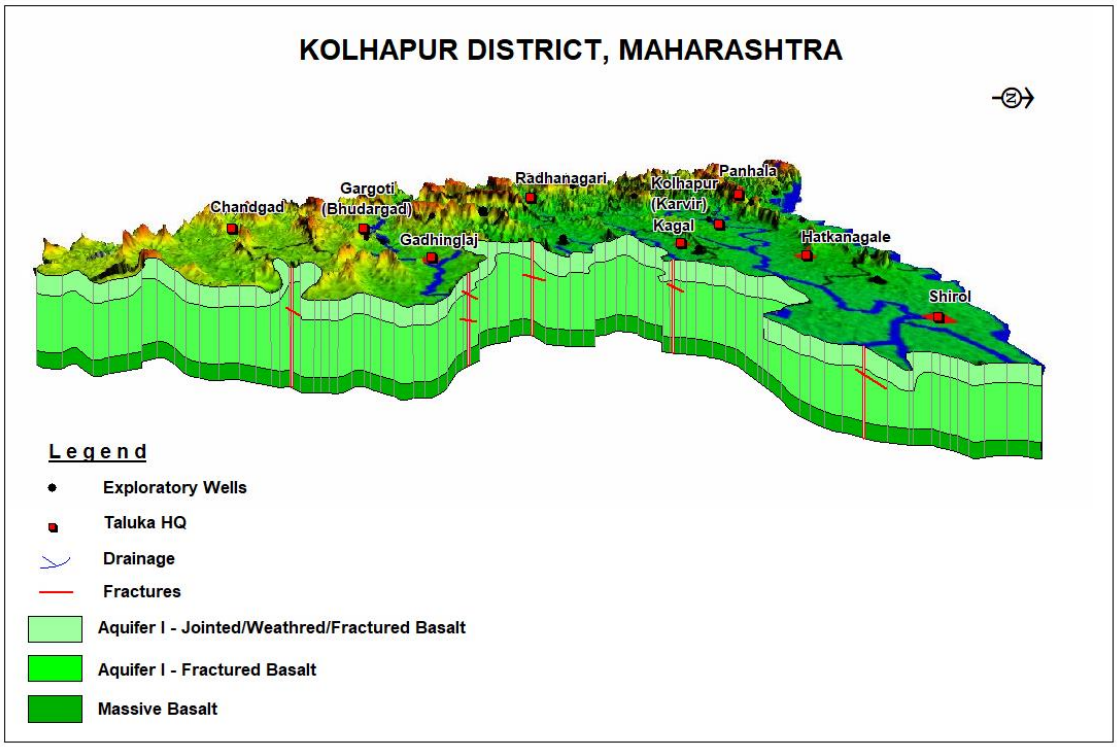


Figure 2.8- 3D Aquifer Disposition

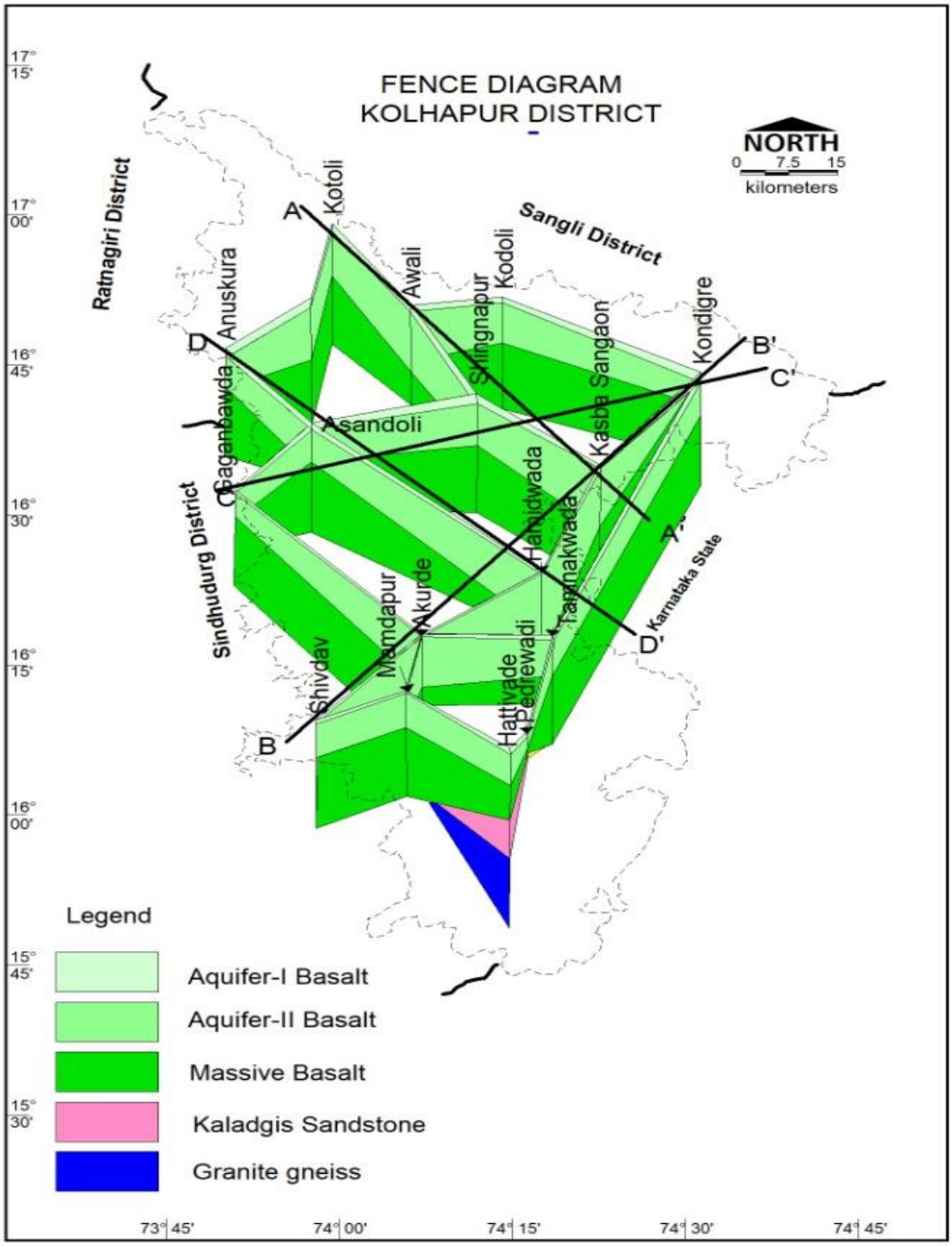


Figure2.9: Fence Diagram

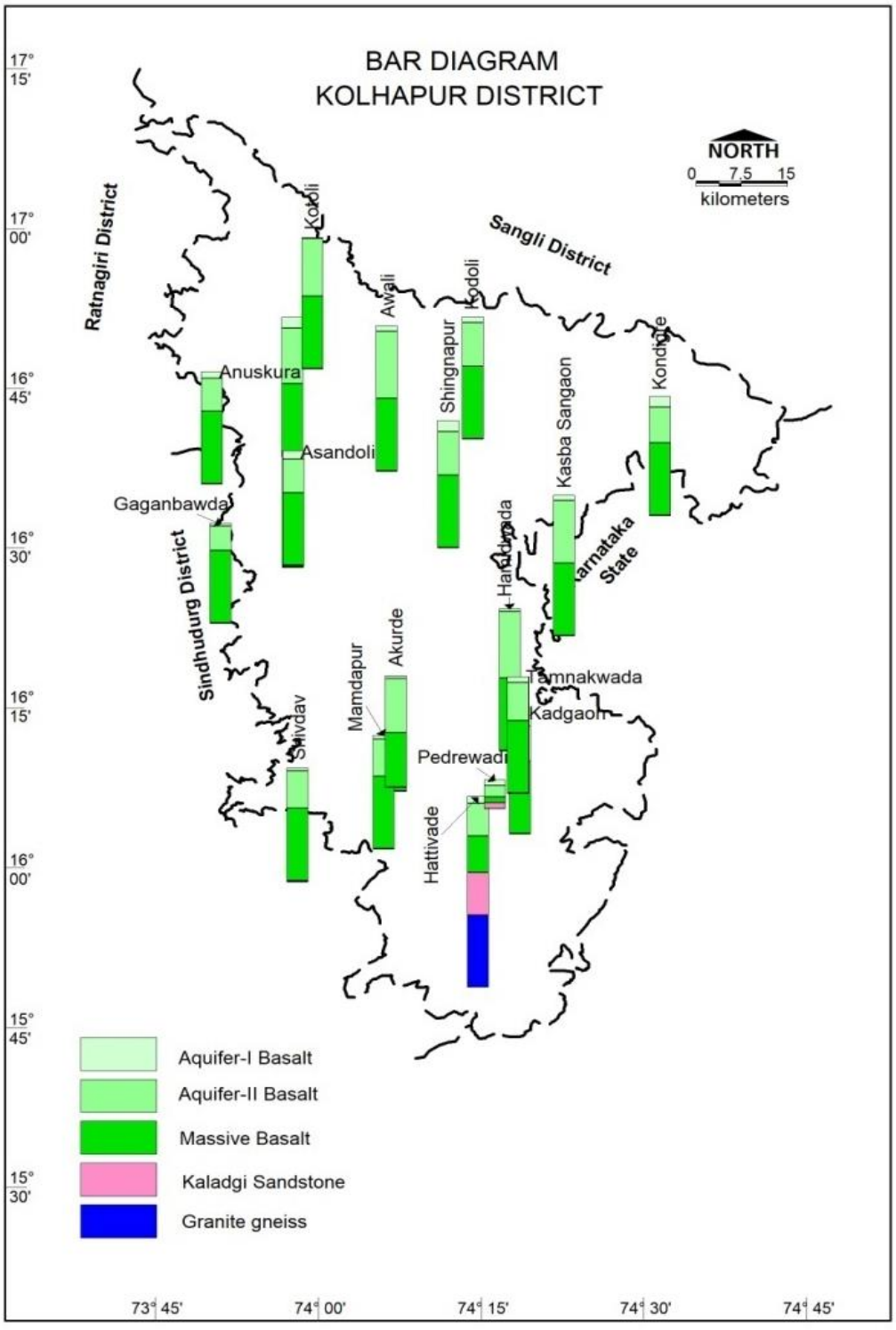


Figure 3.1: Bar Diagram

Figure 3.1 (a): Lithological section

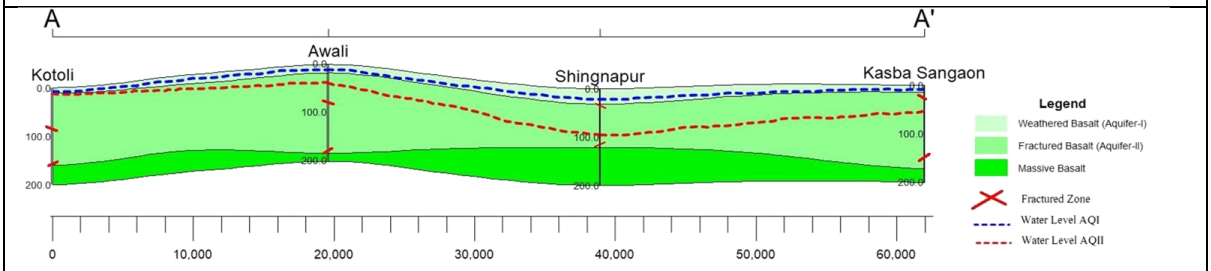


Figure 3.1 (b): Lithological section

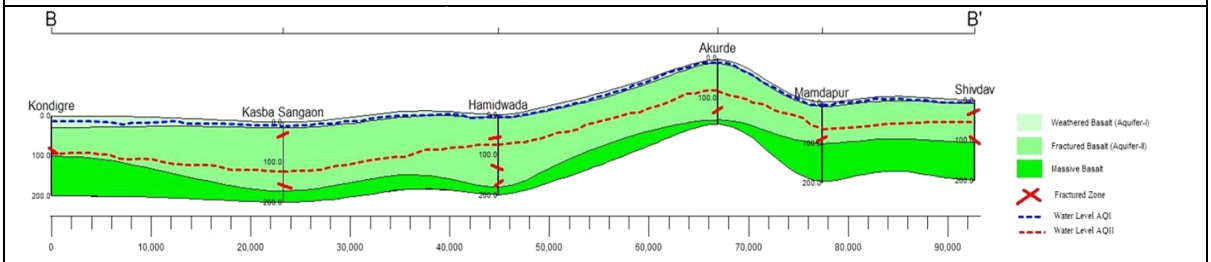


Figure 3.1 (c): Lithological section

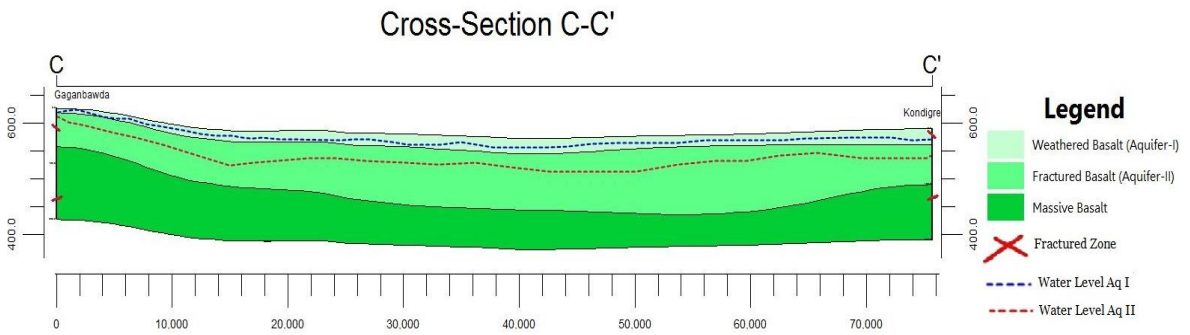
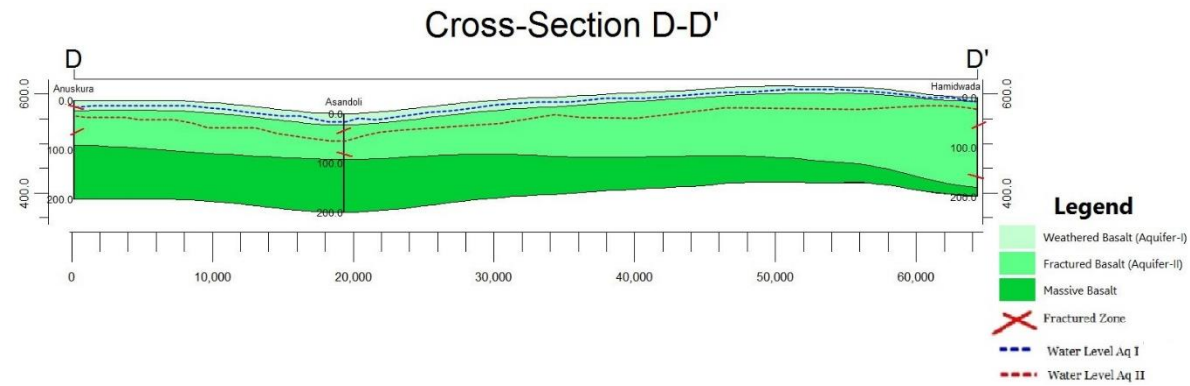


Figure 3.1 (d): Lithological section



3.WATER LEVEL SCENARIO

3.1 Depth to Water level of (Aquifer-I/Shallow Aquifer)

Central Ground Water Board periodically monitors 41 (GWMW-41, PZ-0) Ground Water monitoring wells in the Kolhapur district, four times a year i. e. in January, May (Pre-monsoon), August and November (Post-monsoon). These data have been used for preparation of depth to water level maps of the district. Pre-monsoon and post monsoon water levels along with fluctuation during 2020 and long-term water level trends (2010-2020) are given in Annexure-VI.

3.1.1 Pre-monsoon DTW (May-2020)

The depth to water levels in Kolhapur district during May 2020 ranges between 0.9 (Boravade and Murgud, Kagal block) and 15.00 mbgl (Surute, Chandgad block). The depth to water levels less than 15 mbgl and more than 10 mbgl are observed in isolated patches. The depth to Water level between 5-10 mbgl covers almost the entire area of the district. Water level range between 2-5 m bgl is observed in north to south of all blocks. Water level ranges between 0-2 m bgl is observed in Shahuwadi, Panhala, Karvir in large area while occurs in isolated patches in Hatkannagle, Chandgad and Gadhingaj blocks of the Kolhapur district. The Pre-monsoon depth to water level map is depicted in **Figure. 3.2.**

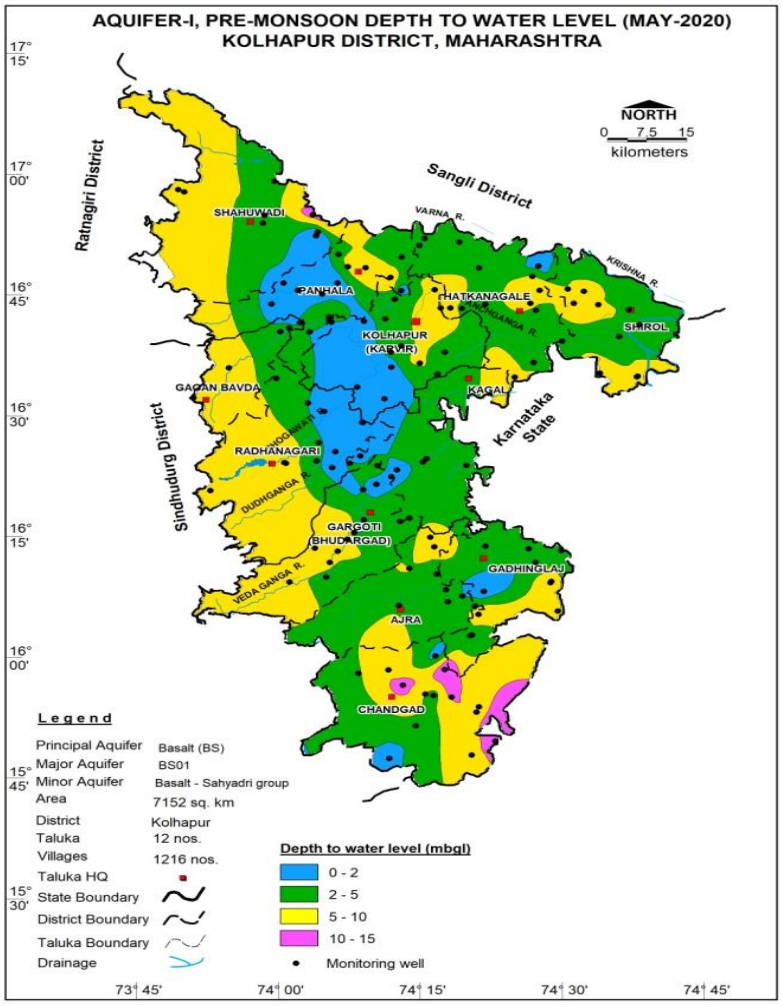


Figure 3.2: DTWL shallow aquifer (May 2020)

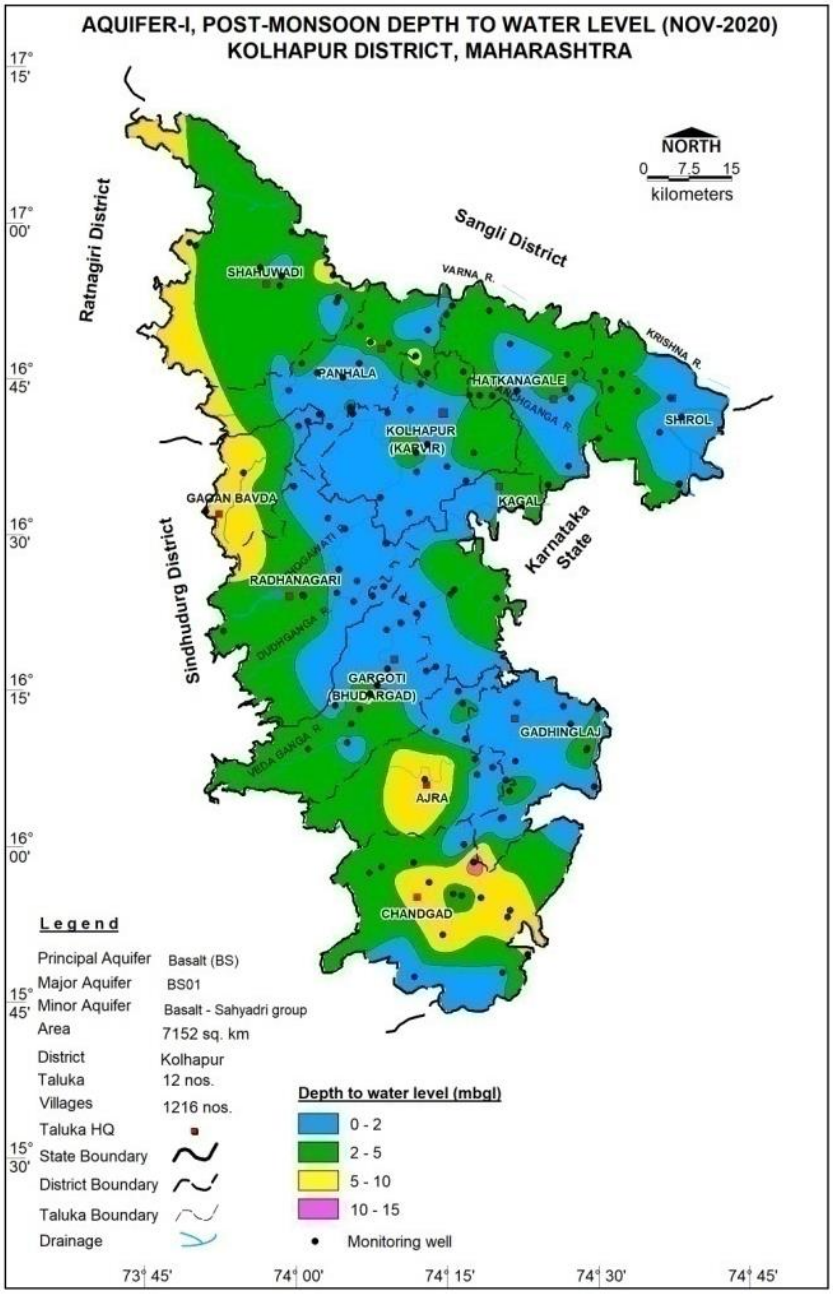


Figure 3.3: DTWL shallow aquifer (Nov. 2020)

3.1.2 Post-monsoon Depth to Water Level (Nov-2020)

The depth to water levels in Kolhapur district during Nov2020 ranges between 0.10 (Uttur, Kolhapur block) and 11.10 mbgl (Porewadi, Chandgad block). The depth to water levels less than 15 mbgl and more than 10 mbgl are observed in only Chandgad block. The depth to water levels less than 10 mbgl and more than 5 mbgl are observed in isolated patches. The depth to Water level between 2-5 mbgl covers almost the entire area of the district. Water level range between 0-2 m bgl is observed in small patches of all blocks. The Post monsoon depth to water level map is depicted in **Figure. 3.3.**

3.2 Depth to water level of (Aquifer-II /Deeper Aquifer)

3.2.1 Pre-monsoon Depth to Water Level (May-2020)

The pre-monsoon depth to water level in deeper aquifer of Kolhapur district, during May 2020 range from 9.00 mbgl (Asandoli, Gaganbavdablock) to more than 100 mbgl (Kodingre, Shirol block). The depth to water level between 10 and 20 mbgl is observed in the parts of Shahuwadi, Gaganbawda, Kagal, Ajra and Gadhinglaj blocks. The depth to water level between 20 and 30 mbgl is observed in the parts of Shahuwadi, Panhala, Karvir, Radhanagri, gaganbawda, Ajra and Gadhinglaj blocks. The depth to water level between 30 and 40 mbgl is observed in the parts of Shahuwadi, Gaganbawda, Kagal, Ajra and Gadhinglaj blocks. The pre-monsoon depth to water level map of Aquifer-II is given in **Figure 3.4.**

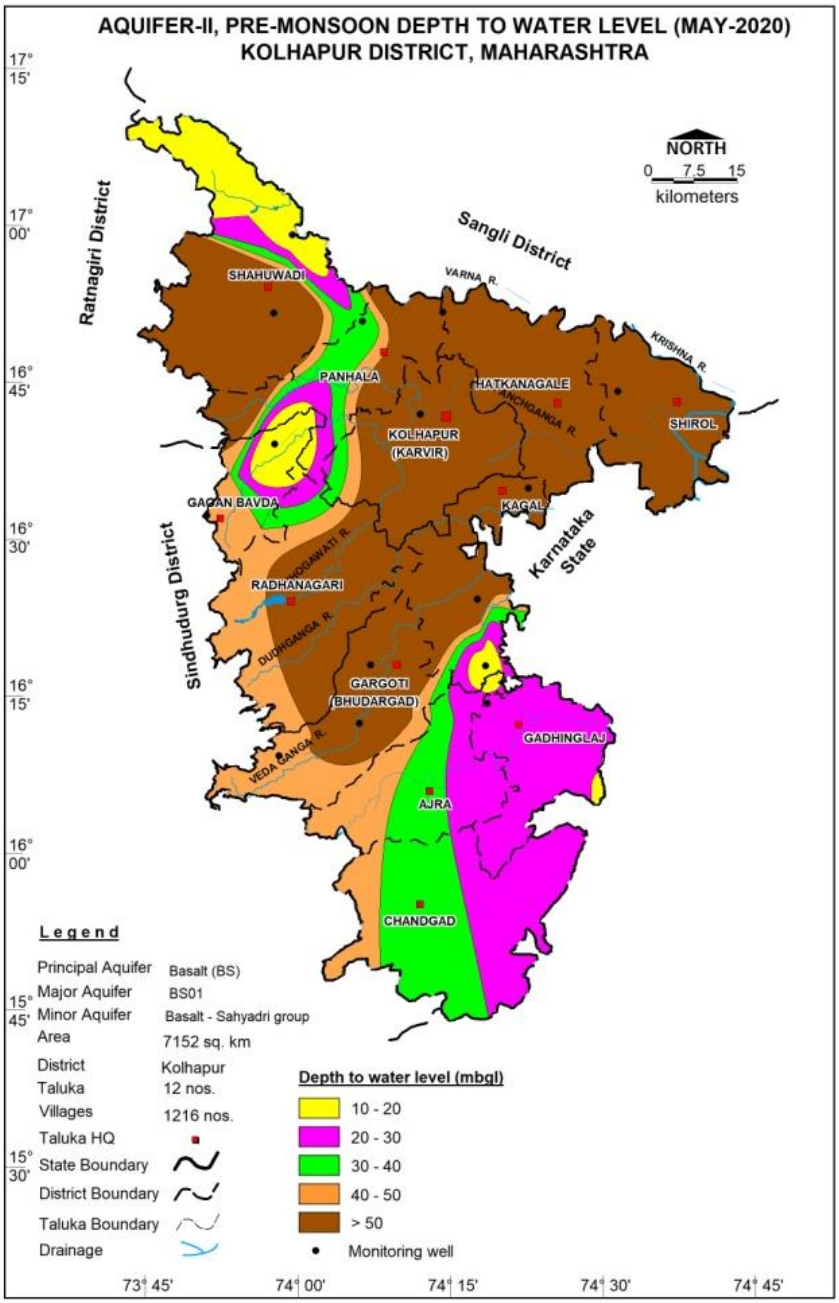


Figure3.4: DTWL deeper aquifer (May 2020)

3.3 Water Level Trend (2011-2020)

During pre-monsoon, rise in water level trend has been recorded at 55 stations and ranges from 0.0009m/year Hindgaon, Chandgad block) to 0.7585 m/year Surute. Chandgad block) while falling trend was observed in 79 stations varying from 0.0004 (Pimpalthane, Panhala block) to 1.21 m/year (Adkur, Chandgad block). Major Area showing rising trend upto 0.20 m/yr (53%) (**Figure 3.5**).

During post monsoon, rise in water level trend has been recorded at 43 stations and it ranges between 0.0006 m/year (Harur, Ajra block) to 0.56m/year (Panhala, Panhala block) while falling trend was observed in 91 stations varying from 0.0003 (Chipari, Shirol Block) to 0.87 m/year (Adkur, Chandgad block). Major Area showing rising trend upto 0.20 m/yr(58%) (**Figure3.6**).

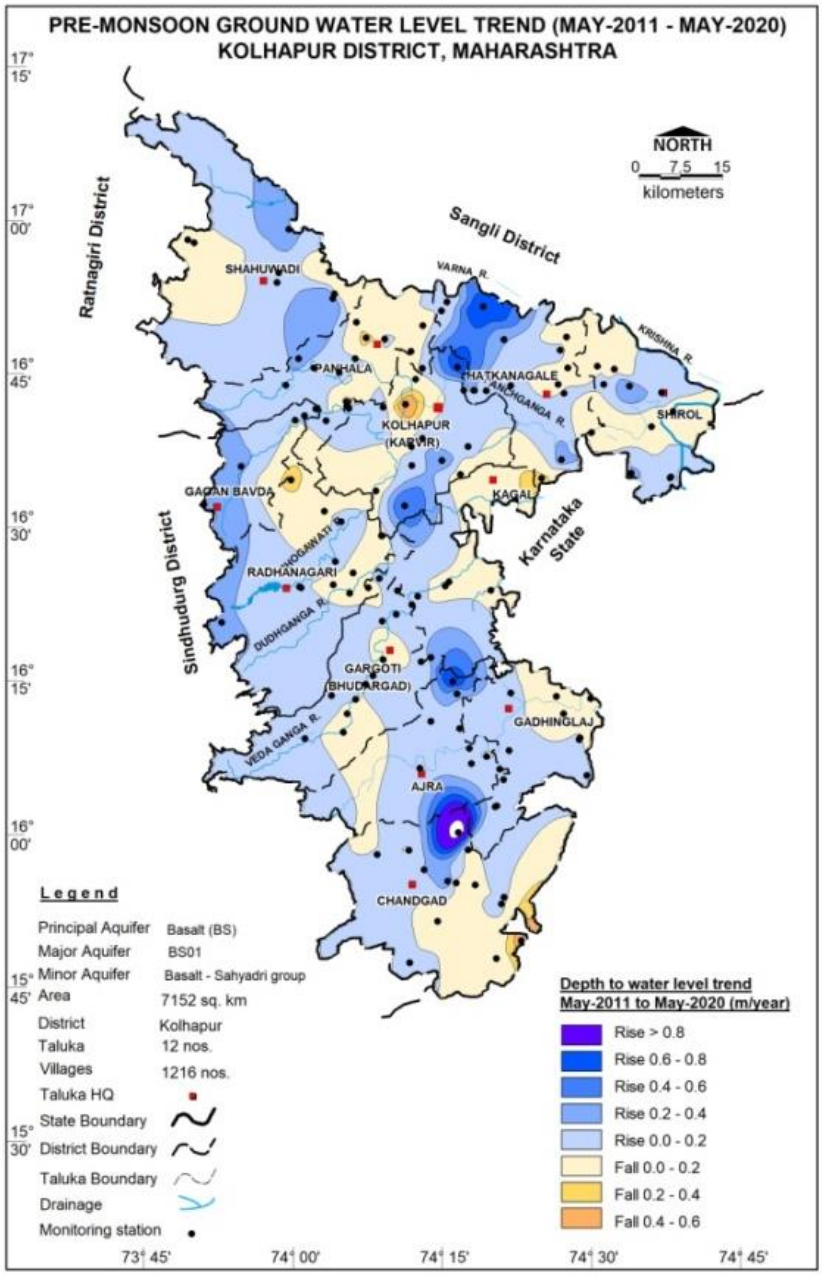


Figure 3.5: Pre-monsoon decadal trend (May 2011-May 2020)

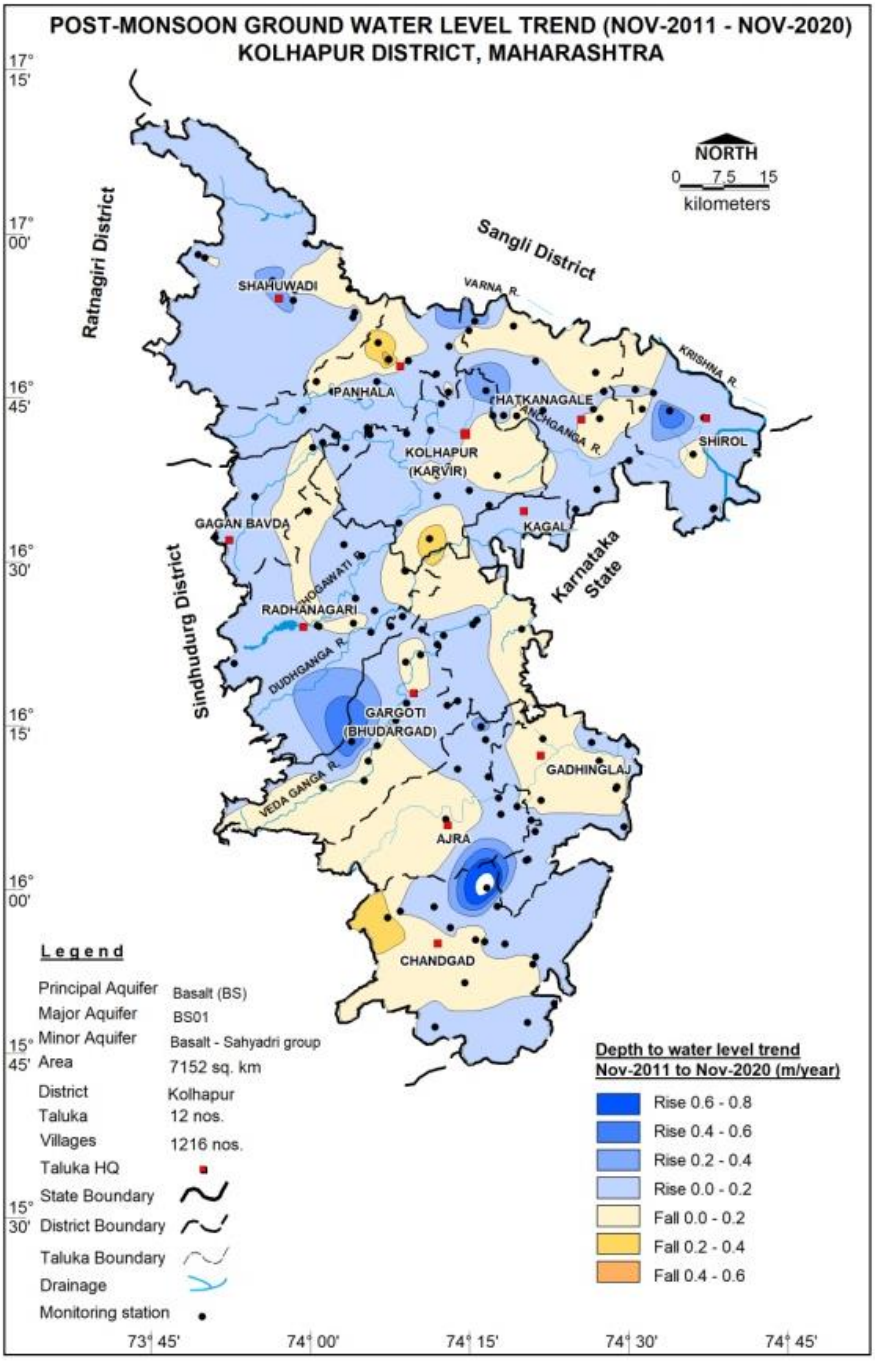


Figure 3.6: Post-monsoon decadal trend (Nov 2011-Nov20)

3.4 Hydrograph Analysis

The variation in short term and long-term water level trends may be due to variation in natural recharge due to rainfall and withdrawal of groundwater for various agricultural activities, domestic requirements, and industrial needs. The analysis of hydrographs shows that the annual rising limbs in hydrographs indicate the natural recharge of groundwater regime due to monsoon rainfall, as the monsoon rainfall is the sole source of natural recharge to the ground water regime (**Figure. 3.7 a to k**). However, continuous increase in the groundwater draft is indicated by the recessionary limb.

Figure 3.7 a: Hydrograph (2011-20), Ajra, Ajra Taluka

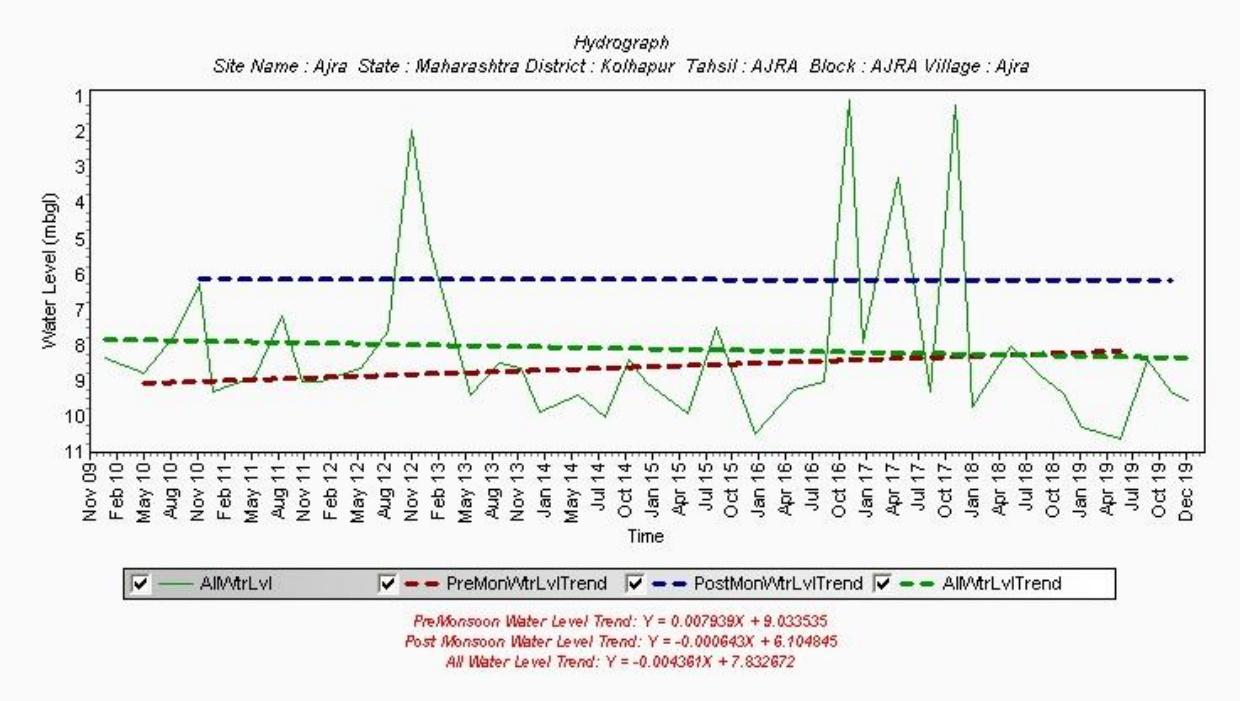


Figure3.7 b: Hydrograph (2011-20), Nitavade, Bhudargad Taluka

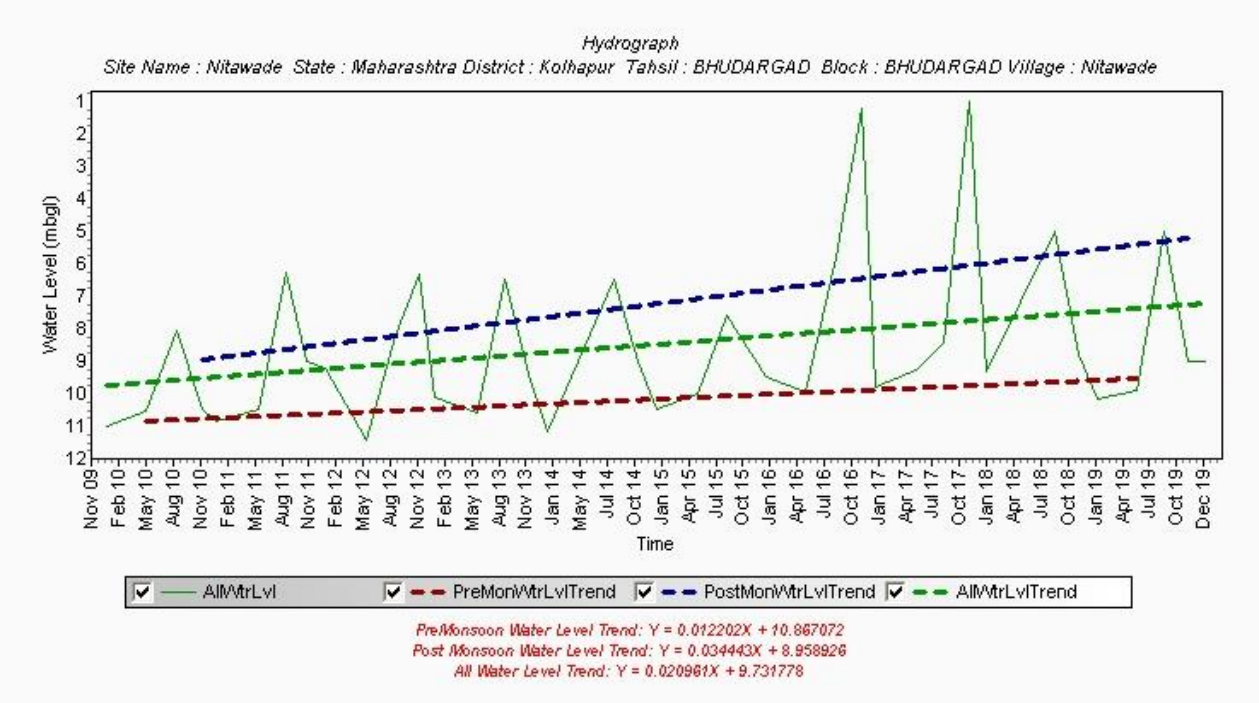


Figure3.7 c: Hydrograph (2011-20), Patne, Chandgad Taluka

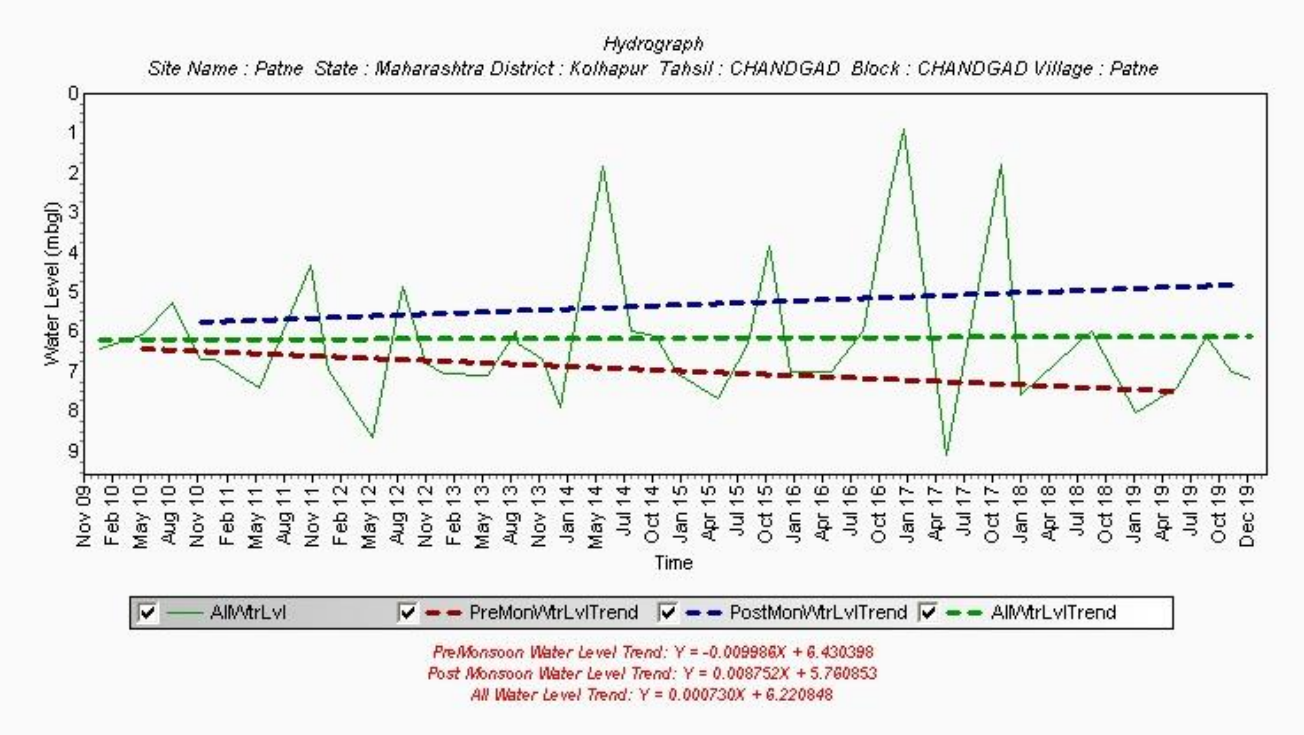


Figure3.7 d: Hydrograph (2011-20), Aslaj, Gaganbavada Taluka

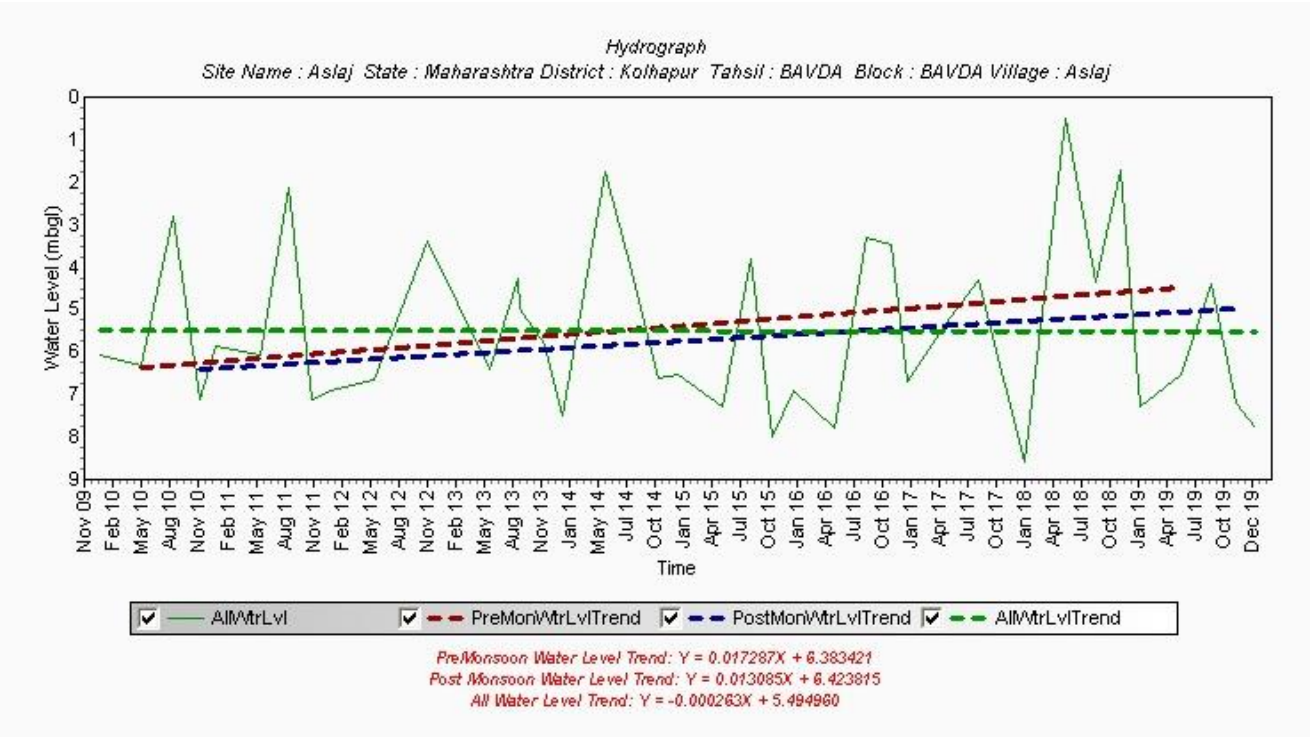


Figure3.7 e: Hydrograph (2011-20), Halkarne, Gadhinglaj Taluka

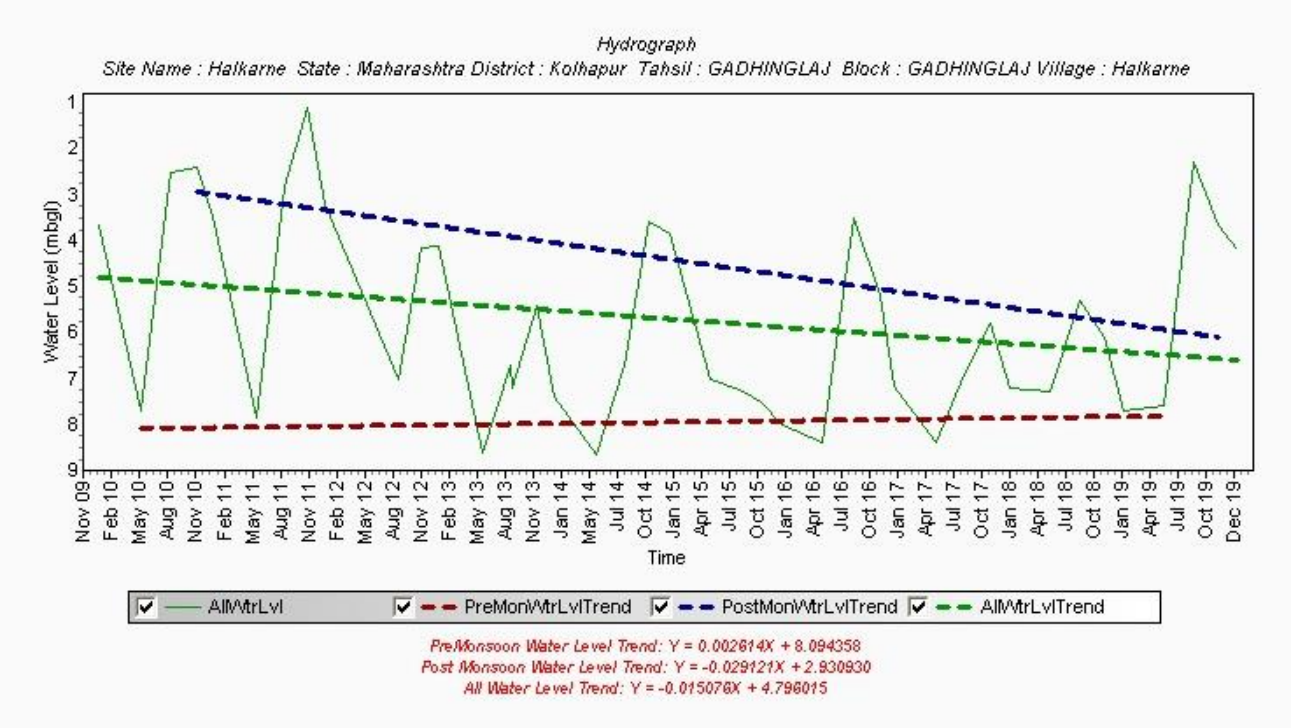


Figure3.7 f: Hydrograph (2011-20), Shirol, Hatkanangale Taluka

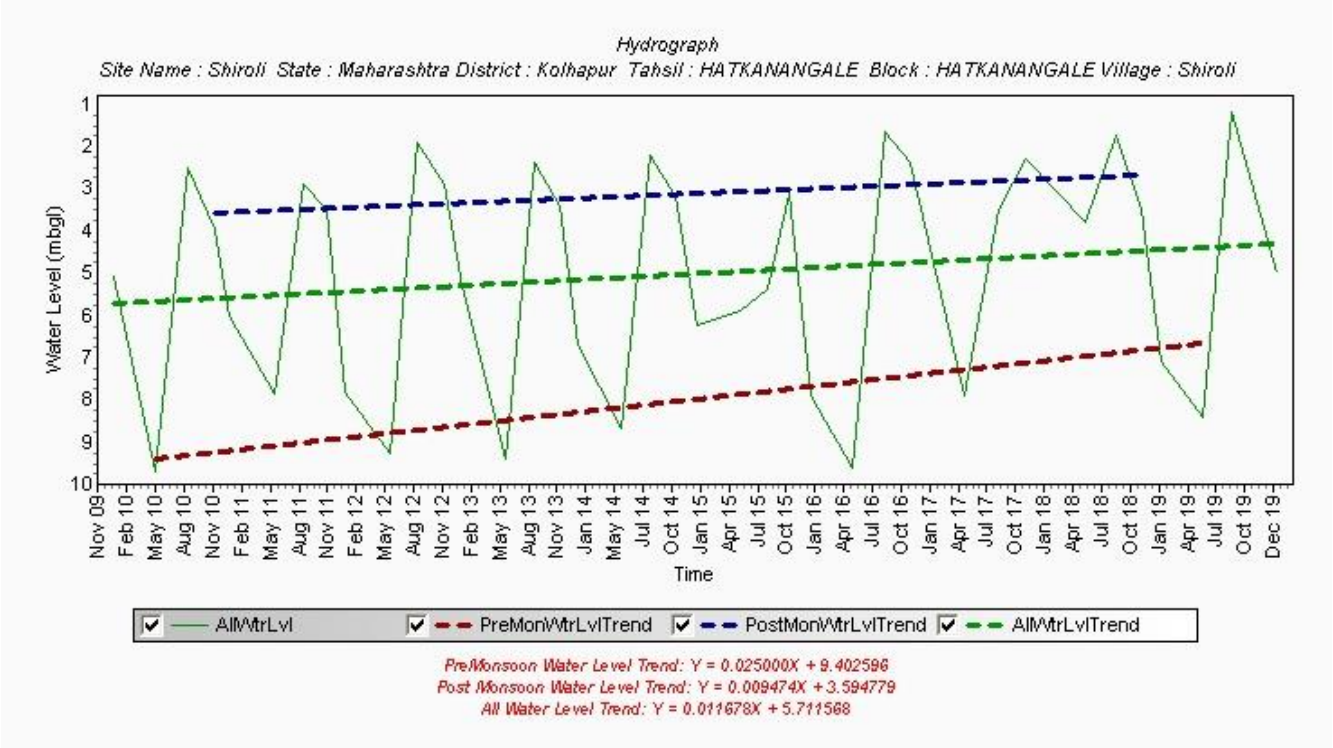


Figure3.6 g: Hydrograph (2011-20), Surupali, Kagal Taluka

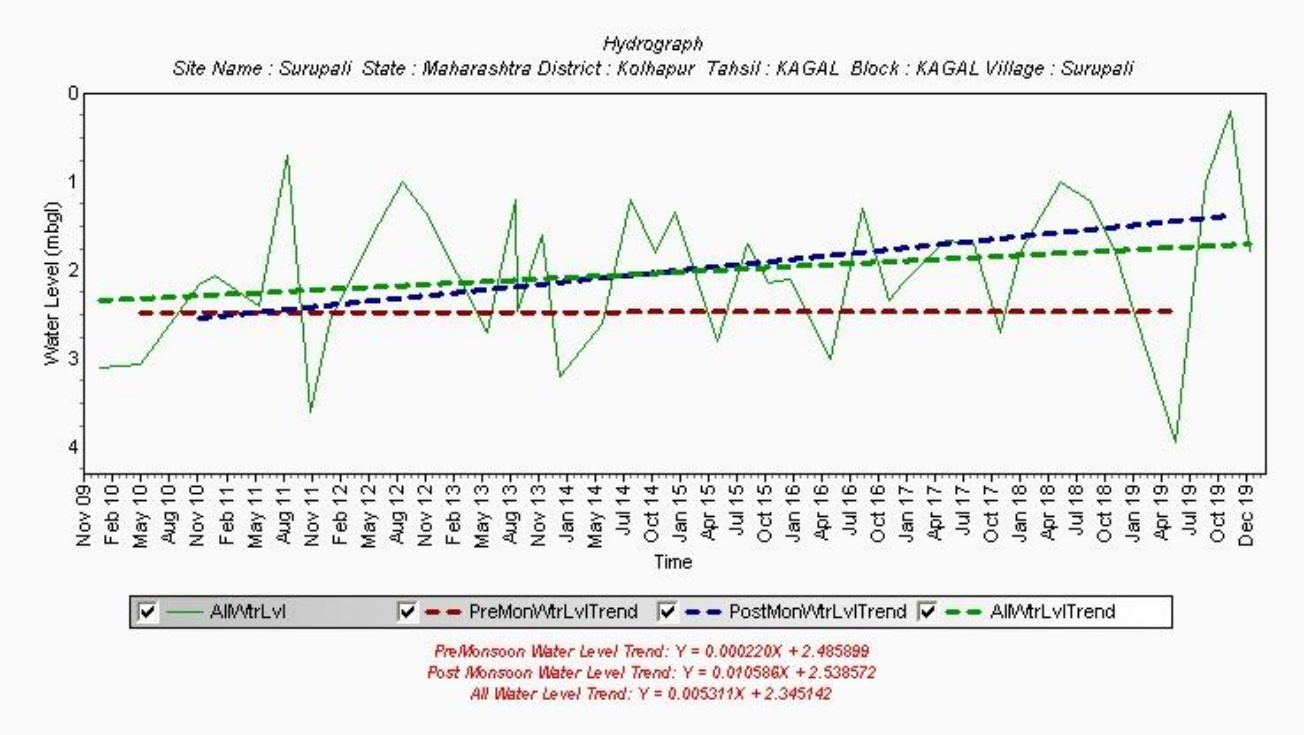


Figure3.7 h: Hydrograph (2011-20), Washi, Karvir Taluka

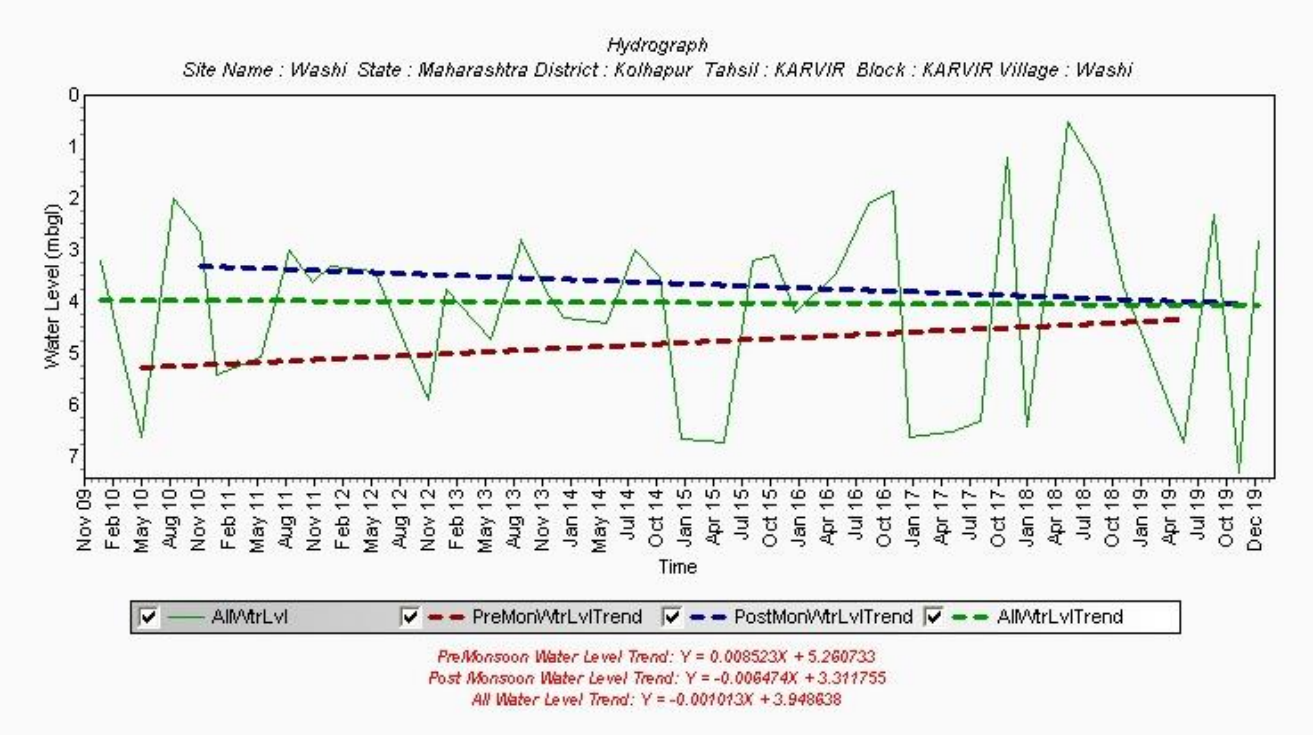


Figure3.7 i: Hydrograph (2011-20), Undri, Panhala Taluka

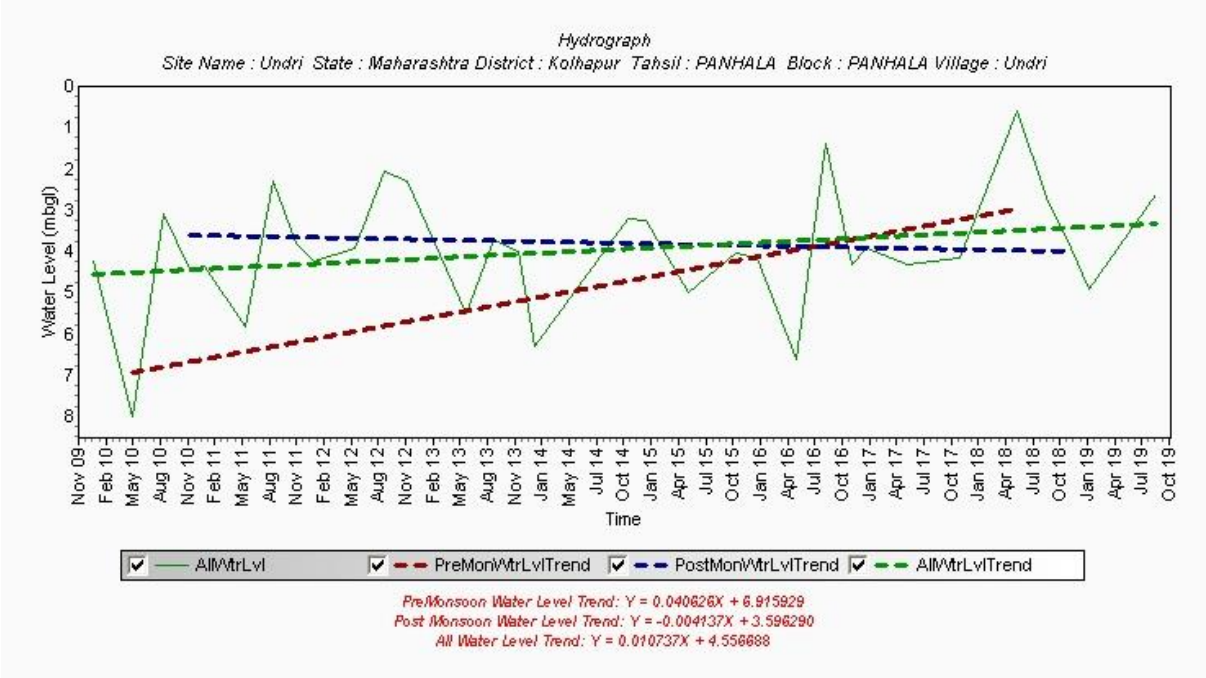


Figure3.7 j: Hydrograph (2011-20), Radhanagari, Radhanagri Taluka

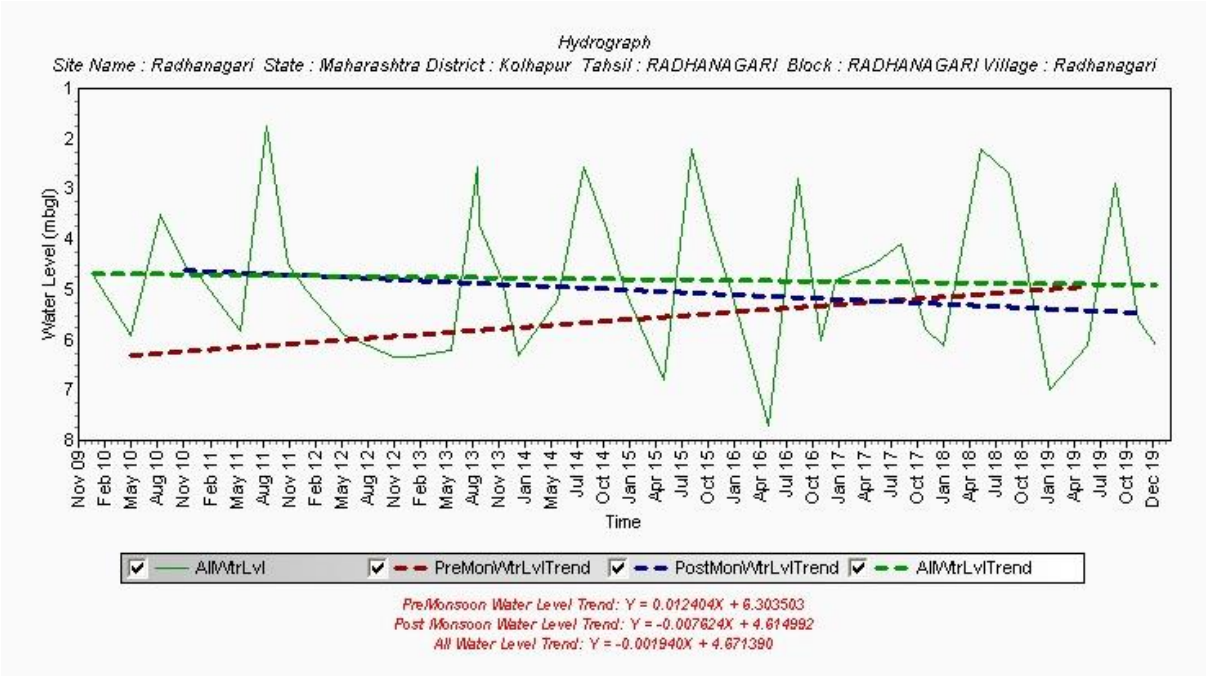
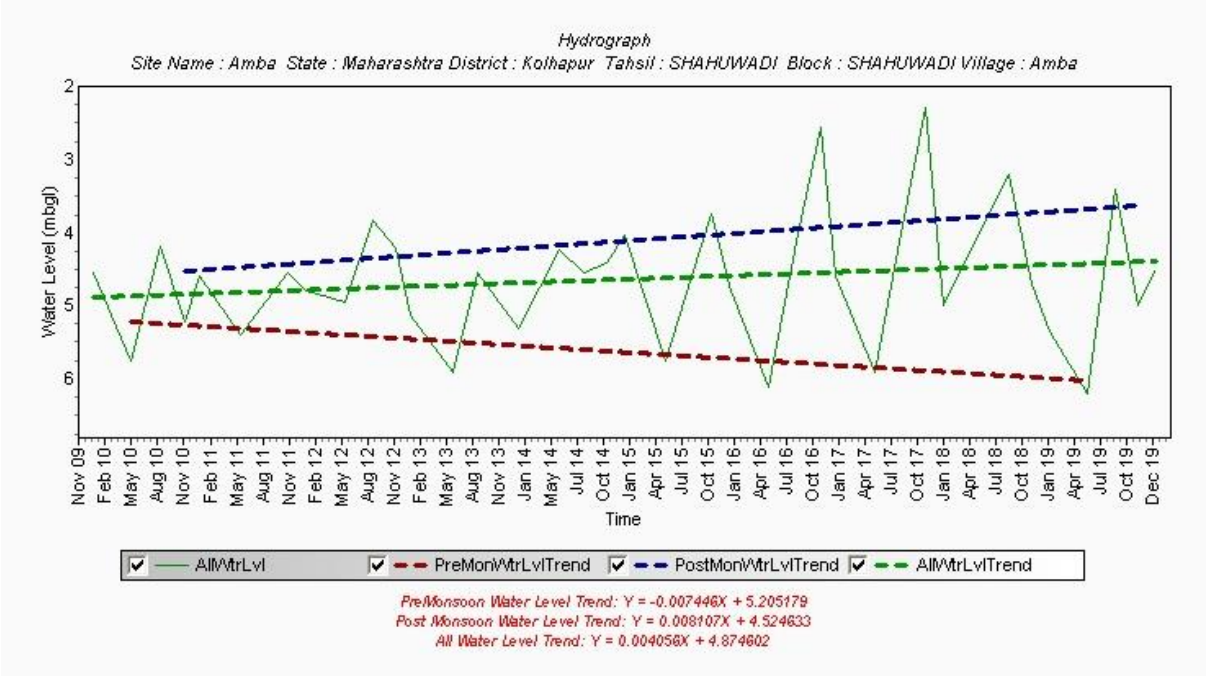


Figure3.7 k: Hydrograph (2011-20), Amba, Shahuwadi Taluka



4.0 GROUND WATER QUALITY

Water sampling is being done every year from GWM wells during pre-monsoon period (May). The data gap analysis has been carried out to find out the adequacy of information on water quality. To decipher the ground water quality scenario, 40 samples from aquifer-I / shallow aquifer and 22 from aquifer – II / deeper aquifers have been utilized including monitoring wells/exploratory wells, bore wells of CGWB data from earlier studies. The aquifer wise ranges of different chemical constituents present in ground water are given in **Table 4.1**. The details of chemical analysis are given in **Annexure VIII and IX**.

Table 4.1: Aquifer wise ranges of chemical constituents in Kolhapur district

Constituents	Shallow aquifer		Deeper aquifer	
	Min	Max	Min	Max
Ph	7	8.1	6.4	11.6
EC (µS/cm)	48	3699	146	3105
TDS (mg/l)	31.2	2404.35	78	1645
TH (mg/l)	9.18	1116.39	45	1100
Calcium (mg/l)	2.0440	271.86	6.01	396.79
Magnesium (mg/l)	0.9721	104.38	3.64	26.73
Potassium (mg/l)	0.11	3.15	0.04	10.86
Sodium (mg/l)	1	112	0.29	105
Bicarbonate (mg/l)	5.94	749.38	42.71	695.63
Carbonate (mg/l)	0	0	0	0
Chloride (mg/l)	0	496.54	7.09	120.53
Sulphate (mg/l)	2	146	1.6	300

Constituents	Shallow aquifer		Deeper aquifer	
	Min	Max	Min	Max
Nitrate (mg/l)	2	62	2.8	41
Fluoride (mg/l)	0.01	1.2	0.29	2.8

***BDL- below detection limit**

4.1 Electrical Conductivity (EC)

4.1.1 Distribution of Electrical Conductivity in Shallow Aquifer

The concentration of EC in shallow aquifer varies between 48 (Aslaj, Gaganbavda) and 3699µS/cm (Shirol). Out of 40 samples collected from dug wells, 12 samples are having EC <250 µS/cm and 21 samples have shown EC ranges from 250 to 750 µS/cm. 06 samples have shown EC ranges from 750 to 2250 µS/cm and Concentration of EC >3000 µS/cm has been observed in one sample. The distribution of electrical conductivity in shallow aquifers is shown in **Figure 3.8** and analytical data is presented in **Table 4.2.**

4.1.2 Distribution of Electrical Conductivity in Deeper Aquifer

The concentration of EC in deeper aquifer varies between 146 (Asandoli, Gaganbavda block) and 3105 µS/cm (Kasba Sangaon, Kagal block). Out of 22 samples collected from bore wells, 10 samples are having EC <250 µS/cm and 09 samples have shown EC ranges from 250 to 750 µS/cm. 01 samples have shown EC ranges from 750 to 2250 µS/cm, EC ranges from 2250 to 3000 µS/cm is observed in 1 sample and only one sample having EC >3000 µS/cm (Kasba Sangaon, Kagal block) is observed. The distribution of electrical conductivity in deeper aquifers is shown in **Figure 3.9** and analytical data is presented in **Table 4.2.**

Table 4.2: Aquifer wise Electrical conductivity analytical data

S.No.	EC (µS/cm)	Shallow aquifer		Deeper Aquifer	
		No. of samples	% of samples	No. of samples	% of samples
1	< 250	12	30	10	45.45
2	>250-750	21	52.5	9	40.90
3	>750-2250	06	15	1	4.54
4	>2250-3000	0	0	1	4.54
5	>3000	1	2.5	1	4.54
Total samples		40	100	22	100

4.2 Nitrate

Nitrogen in the form of dissolved nitrate nutrient for vegetation, and the element is essential to all life. The major contribution in ground water is from sewage, waste disposal, nitrate fertilizer and decaying of organic matter. In Kolhapur district nitrate concentration varies between 2 to 62 mg/l. As per BIS (2012) the desirable limit is 45 mg/l. In shallow aquifer, 40 samples were analysed; out of this, 01 water sample show the nitrate concentrations exceeding the desirable limit of 45 mg/l. The high concentration of Nitrate may be due to domestic waste and sewage in the urban and rural parts of district. In deeper aquifer, 22 wells were analysed, out of this no water sample show nitrate concentration exceeding the desirable limit of 45 mg/l. Aquifer wise nitrate concentration is given in **Table 4.3.**

4.3 Fluoride

In shallow aquifer, concentration of fluoride ranges from 0.01 to 1.2 mg/l. out of 40 samples was analysed, 02samples show fluoride concentration more than 1 mg/l. In Deeper Aquifer, concentration of fluoride ranges from 0.29 to 2.8 mg/l. Out of 22 samples analysed, 10 samples show fluoride concentration more than 1 mg/l. Aquifer wise fluoride concentration is given in **Table 4.3.**

Table 4.3: Aquifer wise Nitrate and Fluoride concentration

Aquifer	No_3> 45 mg/l		Fluoride >1 mg/l	
	Total Samples	No of samples	Total Samples	No of samples
Shallow Aquifer	40	01	40	02
	Total Samples	No of samples	Total Samples	No of samples
Deeper Aquifer	22	00	22	10

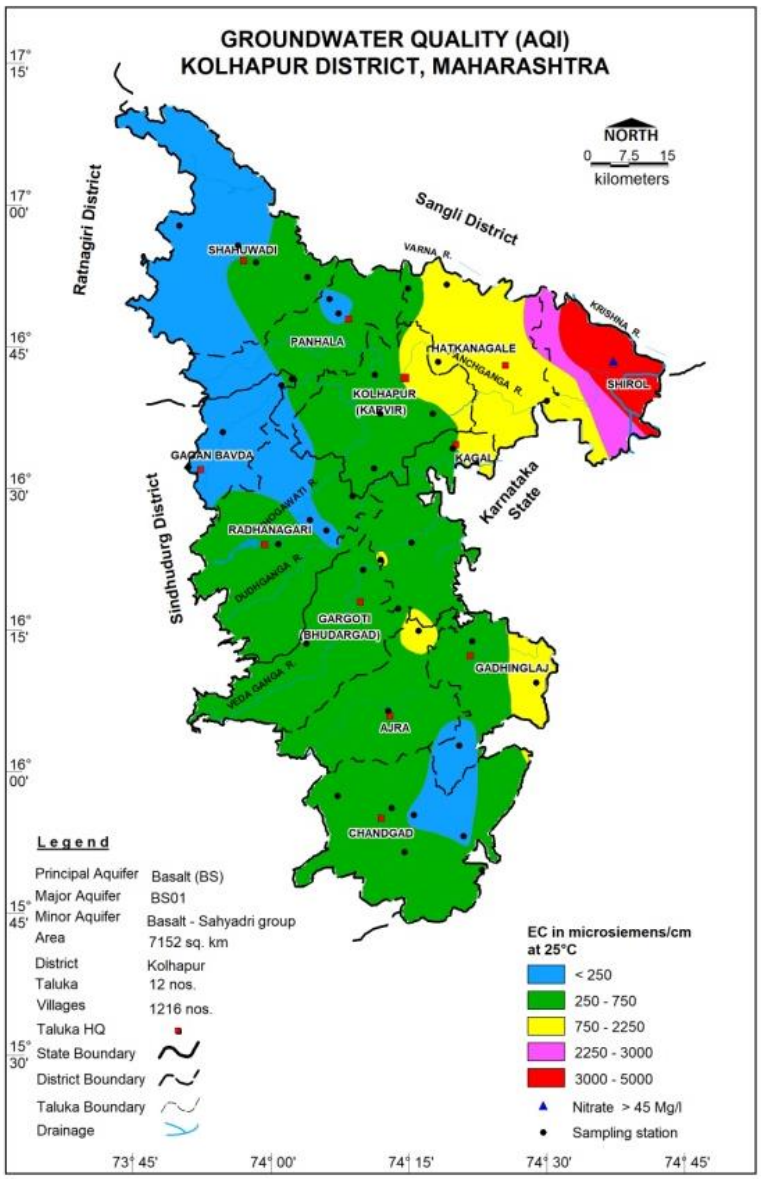


Figure.4.1: Ground Water Quality, Aquifer-I

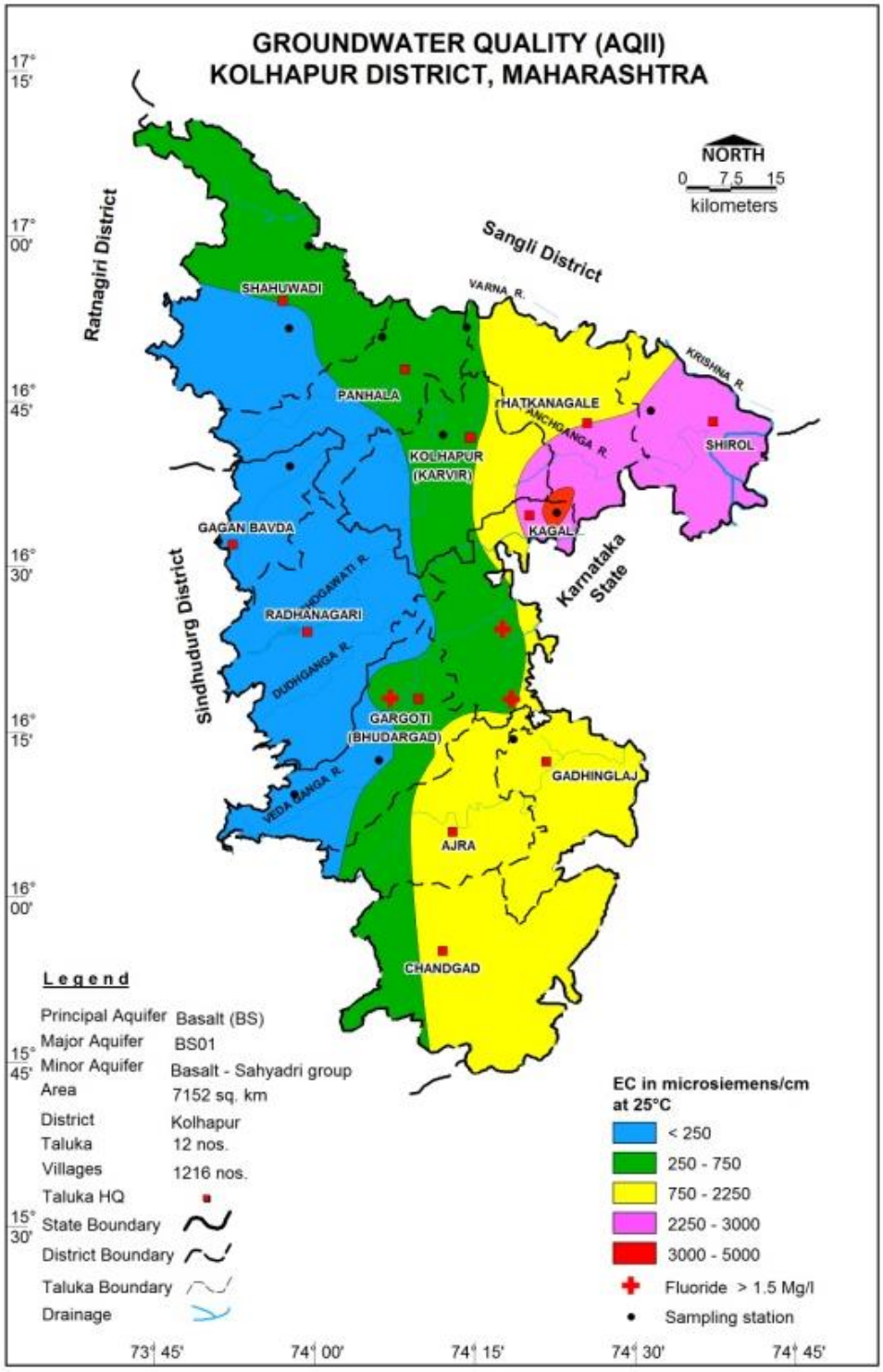


Figure 4.2: Ground Water Quality, Aquifer-II

4.5 Suitability of Ground Water for Drinking Purpose

In shallow aquifer, 15 % of samples have TDS concentration above the Desirable limit (DL) but below the MPL. The water from such area is not fit for drinking purpose if directly consumed without treatment. It is also seen that about 0 to 2.5 % samples are beyond the

maximum permissible limit for the parameters like TH, Ca, Mg, F and NO_3 indicating that the water is not suitable for drinking purpose.

In major part of the district ground water is potable and its quality is well within permissible limit. Concentration of Chemical constituents in shallow Aquifer is given in **Table 4.4.**

In Deeper aquifer, none of the samples having TDS more than maximum permissible limit (MPL) and 13.6 % of samples have TDS concentration above the Desirable limit (DL) but below the MPL. The water from such area is not fit for drinking purpose if directly consumed without treatment. It is also seen that about 0 to 13.6 % samples are beyond the maximum permissible limit for the parameters like pH and Ca and F indicating that the water is not suitable for drinking purpose.

In major part of the district groundwater is potable and its quality is well within permissible limit except Fluoride contamination

Concentration of Chemical constituents in Deeper Aquifer is given in **Table 4.5.**

Table 4.4: Concentration of Chemical constituents in Shallow Aquifer

Parameter	Drinking water Standards (IS-10500-2012)		Total no of ground water samples	Shallow aquifer					
				Samples (<DL)		Samples (DL-MPL)		Samples (>MPL)	
	DL	MPL		No	%	No	%	No	%
pH	6.5	8.5	40	0	0.0	40	100.0	0	0.0
TDS(mg/L)	500	2000	40	33	82.5	06	15.0	01	2.5
TH(mg/L)	300	600	40	36	90.0	03	7.5	01	2.5
Ca (mg/L)	75	200	40	36	90.0	03	7.5	01	2.5
Mg (mg/L)	30	100	40	34	85.0	05	12.5	01	2.5
Cl (mg/L)	250	1000	40	39	97.5	01	2.5	00	0.0
SO_4 (mg/L)	200	400	40	40	100.0	0	0.0	0	0.0
NO_3 (mg/L)	45	No relaxation	40	39	97.5	0	0.0	01	2.5
F (mg/L)	1	1.5	40	38	95.0	02	5.0	0	0.0

(Here, DL- Desirable Limit, MPL- Maximum Permissible Limit)

Table 4.5: Concentration of chemical constituents in Deeper Aquifer

Parameter	Drinking water Standards (IS-10500-2012)		Total no of ground water samples	Deeper aquifer					
				Samples (<DL)		Samples (DL-MPL)		Samples (>MPL)	
	DL	MPL		No	%	No	%	No	%
pH	6.5	8.5	22	01	4.5	18	81.82	3	13.64
TDS(mg/L)	500	2000	22	18	81.8	3	13.64	0	0.00
TH(mg/L)	300	600	22	19	86.4	1	4.55	2	9.09
Ca (mg/L)	75	200	22	16	72.7	3	13.64	3	13.64
Mg (mg/L)	30	100	22	22	100.0	0	0.00	0	0.00
Cl (mg/L)	250	1000	22	22	100.0	0	0.00	0	0.00
SO_4 (mg/L)	200	400	22	20	90.9	2	9.09	0	0.00
NO_3 (mg/L)	45	No relaxation	22	22	100.0	0	0.00	0	0.00
F (mg/L)	1	1.5	22	12	54.5	7	31.82	3	13.64

(Here, DL- Desirable Limit, MPL- Maximum Permissible Limit)

4.5 Suitability of Ground Water for Irrigation

The quality of Irrigation water affects the productivity, yield and quality of the crops. The quality of irrigation water depends primarily on the presence of dissolved salts and their concentrations. The Electrical Conductivity (EC), Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the most important quality criteria, which asses the water quality and its suitability for irrigation.

Electrical Conductivity (EC)

The amount of dissolved ions in the water is represented by the electrical conductivity. The classification of water for irrigation based on the EC values is given in **Table 4.6** and discussed as follows: -

Low Salinity Water (EC: 100-250 µS/cm): This water can be used for irrigation with most crops on most soils with little likelihood that salinity will develop.

Medium Salinity Water (EC: 250 – 750 µS/cm): This water can be used if moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown in most cases without special practices for salinity control.

High Salinity Water (EC: 750 – 2250 µS/cm): This water cannot be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required and plants with good salt tolerance should be selected.

Very High Salinity Water (EC: >2250 µS/cm): This water is not suitable for irrigation under ordinary condition. The soils must be permeable, drainage must be adequate, irrigation water must be applied in excess to provide considerable leaching and very salt tolerant crops should be selected.

Table 4.6: Classification of Ground water for Irrigation based on EC values

S. No	Water Quality Type	EC in µS/cm	Shallow aquifer		Deeper Aquifer	
			No. of Samples	% of samples	No. of samples	% of samples
1	Low Salinity Water	< 250	12	30	10	45.45
2	Medium Salinity Water	>250-750	21	52.5	9	40.90
3	High Salinity Water	>750-2250	06	15	1	4.54
4	Very High Salinity Water	> 2250	1	2.5	2	9.09
Total			40	100	22	100

In shallow aquifer, maximum numbers of samples fall under the category of medium salinity type of water. In deeper Aquifer, maximum numbers of samples fall under the category of low salinity type of water. The areas where very high salinity prevails (>2250 µS/cm), ground water can be used for irrigation for very high salt tolerant crops and with proper soil and crop management practices

5.0 GROUND WATER RESOURCES

5.1 Ground Water Resources – Aquifer-I

Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Kolhapur district based on GEC-2015 methodology. Block wise ground water resources are given in **Table 5.1**, and graphical representations of the resources on the map are shown in **Figure 4.1**.

Ground Water Resources estimation was carried out for 5621.76 sq. km. area out of which 185.29 sq. km. is under command and 5436.46 sq. km. is under non-command.

As per the estimation, the net annual ground water availability comes to be 1220.84.14 MCM. The gross draft for all uses is estimated at 513.08 MCM with irrigation sector being the major consumer having a draft of 495.57 MCM. The domestic and industrial water requirements are worked out at 17.52 MCM. The net ground water availability for future irrigation is estimated at 705.30 MCM.

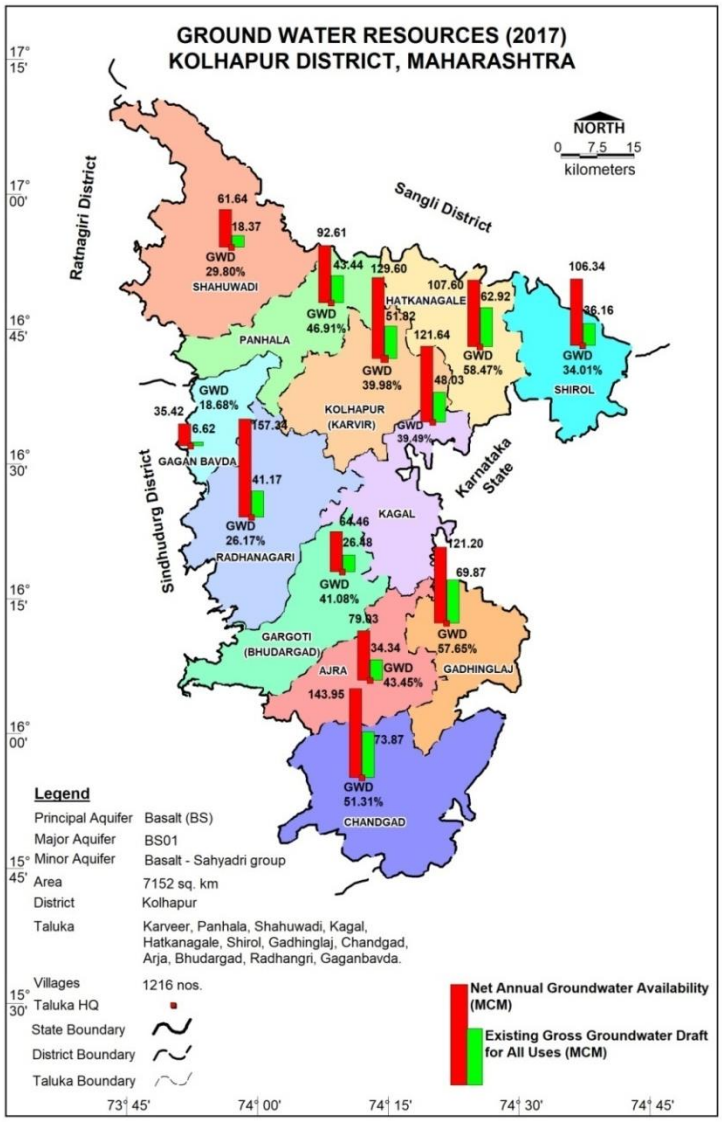


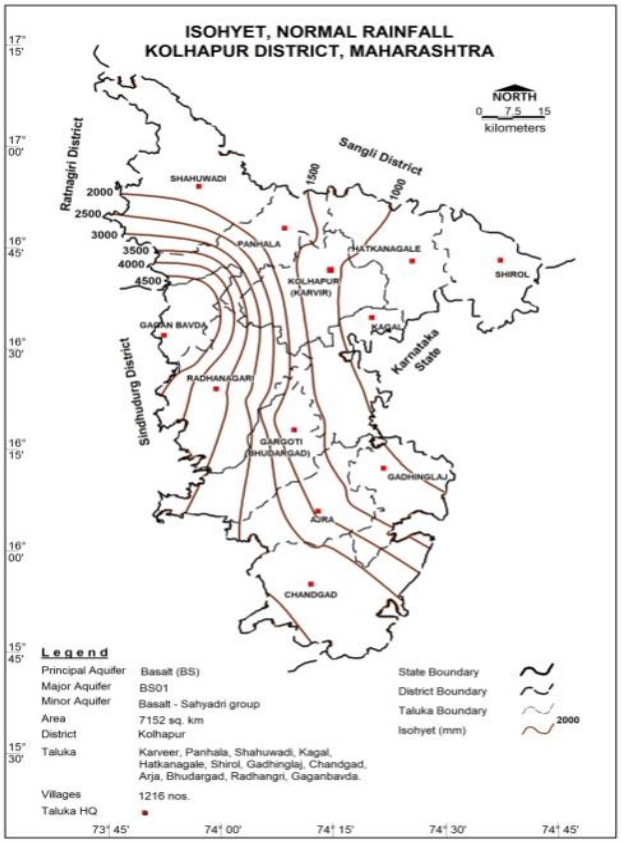
Figure 5.1: Ground Water Resources (2017), Kolhapur district

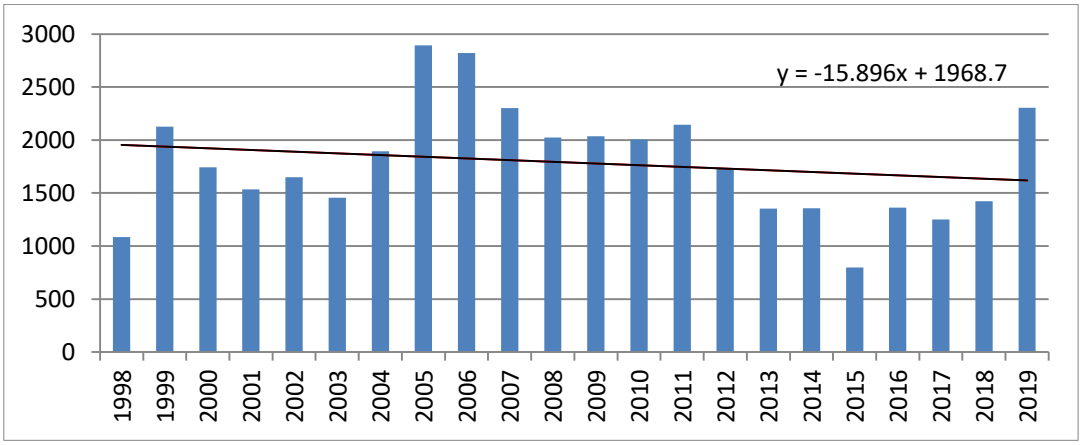
Table 5.1 Ground water resources, Aquifer-I (Shallow aquifer), Kolhapur district (2017)

Administrative Unit	Net Annual Ground Water Availability (MCM)	Existing Gross Ground Water Draft for irrigation (MCM)	Existing Gross Ground Water Draft for domestic and industrial water supply (MCM)	Existing Gross Ground Water Draft for All uses (MCM)	Provision for domestic and industrial requirement supply to 2025 (MCM)	Net Ground Water Availability for future irrigation development (MCM)	Stage of Ground Water Development	Category
Ajara	79.0321	33.3725	0.9675	34.34	1.1029	44.5567	43.45	Safe
Bhudargad	64.4643	25.329	1.1534	26.4824	1.3042	40.0687	41.08	Safe
Chandgad	143.9483	72.141	1.7259	73.867	1.9676	69.8397	51.31	Safe
Gadhinglaj	121.2009	68.602	1.2656	69.8675	1.4427	51.1562	57.65	Safe
Gaganbawada	35.424	5.9299	0.6883	6.6182	0.7847	28.7094	18.68	Safe
Hatkanangale	107.604	60.9514	1.9697	62.921	2.2462	44.8255	58.47	Safe
Kagal	121.6445	46.8654	1.1671	48.0325	1.33	65.0863	39.49	Safe
Karvir	129.5958	49.908	1.9084	51.8164	2.1749	77.1242	39.98	Safe
Panhala	92.6132	41.3954	2.0453	43.4407	2.3316	48.8861	46.91	Safe
Radhanagari	157.3353	39.8723	1.295	41.1673	1.4872	122.0704	26.17	Safe
Shahuwadi	61.6377	16.7203	1.6506	18.3709	1.8817	43.0358	29.8	Safe
Shirol	106.3414	34.4839	1.681	36.1649	1.9163	69.9412	34.01	Safe
Total	**1220.842**	**495.5711**	**17.5178**	**513.0888**	**19.97**	**705.3002**	**42.03**	**Safe**

6.0 GROUND WATER RELATED ISSUES

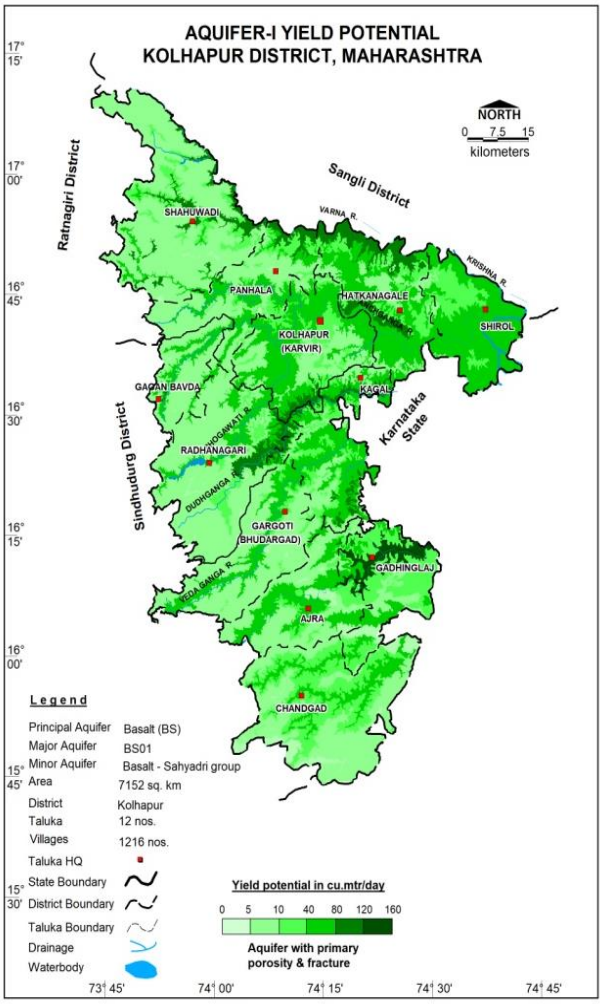
Declining rainfall with moderate droughts





The isohyets (line of equal rainfall) practically run from north to south. The city receives abundant rainfall from June to September due to its proximity to the Western Ghats, but from West to East, the rate of Rainfall decreases. In the western part of the district, there are lots of vegetation in the form of forests. The normal rainfall of the district is 2057.1 mm spread over 79 to 126 rainy days in normal condition. The west side in Gaganbavda, Radhanagari, Chandgad and Ajra talukas receives maximum rainfall while Hatkangale and Shirol talukas receives minimum rainfall. The district is showing decline in rainfall trend and the probability of moderated drought is 18.25%.

Limited ground water potential

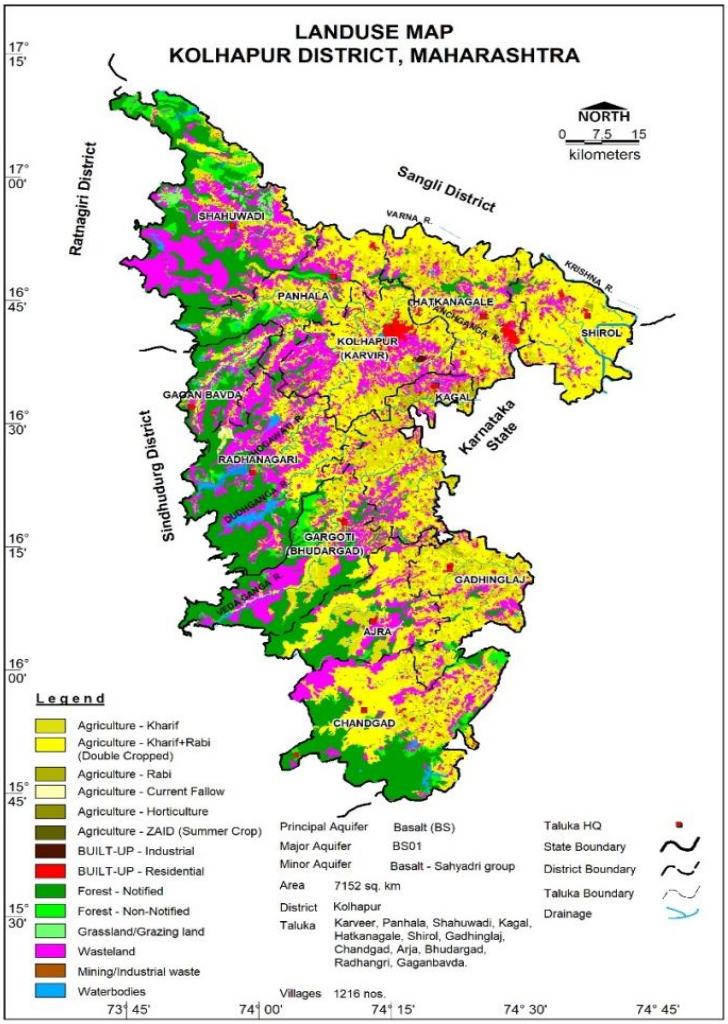


The basaltic rocks form prominent hill ranges, isolated hillocks, undulation etc., in the district. These basalts have poor primary as well as secondary porosity. The predominance of hard rock formation in the form of basaltic lava flows facilities the run off rather than natural recharge due to the poor ground water storage. The formation due to poor storage and transmission characteristics gets fully saturated during monsoon and a situation of rejected recharge is resulted. These aquifers then are drained naturally due to slopping and undulation topography.

Limited Agricultural Area

The district is having limited agricultural area, It is due to hilly region and undulating basaltic terrain which have poor primary as well as secondary porosity, these rocks have poor storage as well as transmissivity characteristics. As a result, the dugwells becomes dry by the month of February onwards. In addition to this, the laterites occurring as capping on basalt are highly porous and permeable which do not retain ground water into interstices as a result, the ground water is not available during the time it is required. The forest area in the district is in 1934 Sq Km which is 25% of the total area. Other than forest area larger part of the area

is comprising of land for grazing land and wasteland which leads to limited agricultural area of 48% (3666 Sq Km) in the district.



Less Groundwater Extraction:

The optimum development of Groundwater is not taken place in the district. The ground water development in almost entire district is on the lower side mainly due to the presence of hilly areas in major part of the district. The district also faces water scarcity during summer months in spite of heavy rainfall which leads to less extraction of Groundwater, the stage of Groundwater Development ranges from 40.92% in 2011 to 40.03% in 2017.

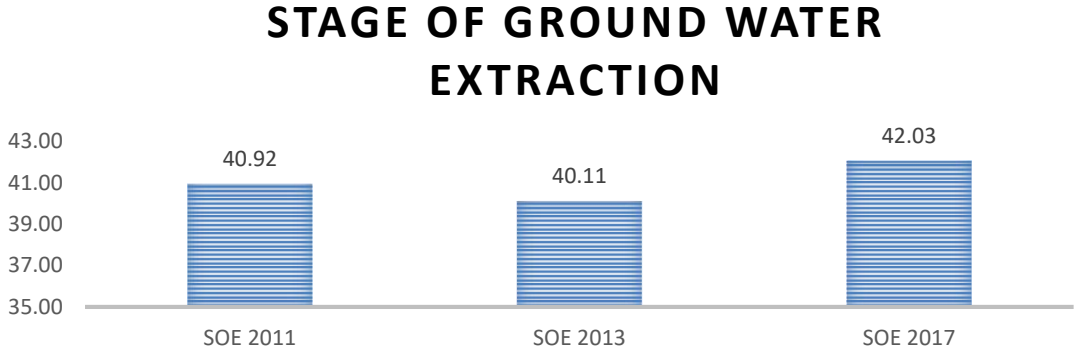


Fig. 6.1 Stage of Groundwater Extraction in Kolhapur district for 2011, 2013, 2017

7.0 GROUND WATER MANAGEMENT PLAN

The management plan has been proposed to manage the ground water resources and to arrest further decline in water levels. The management plan comprises two components namely supply-side management and demand side management. The supply side management is proposed based on surplus surface water availability and the unsaturated thickness of aquifer whereas the demand side management is proposed by use of micro irrigation techniques and change in cropping pattern.

7.1 Supply Side Management

The supply side management of ground water resources can be done through the artificial recharge of surplus runoff available within river sub basins and micro watersheds. Also, it is necessary to understand the unsaturated aquifer volume available for recharge. The unsaturated volume of aquifer was computed based on the area feasible for recharge, unsaturated depth below 3 mbgl and the specific yield of the aquifer. The **Table 7.1** gives the block wise volume available for the recharge.

Table 7.1: Area feasible and volume available for Artificial Recharge

Block	Area	Area feasible for recharge (Sq. km.)	Unsaturated Volume (MCM)
Ajara	581.27	402.65	0.00
Bhudargad	599.00	500.35	0.00
Chandgad	998.64	750.71	0.00
Gadhinglaj	482.72	477.55	0.00
Gaganbawada	312.96	122.19	0.00
Hatkanangale	573.09	573.09	23.10
Kagal	596.72	556.52	5.66
Karvir	618.96	492.21	14.23
Panhala	537.69	394.29	37.31
Radhanagari	833.72	471.62	98.80
Shahuwadi	1029.95	347.86	20.67
Shirol	532.73	532.73	256.10
Total	**7697.44**	5621.76	**455.87**

The total unsaturated volume available for artificial recharge is 455.87 MCM and it ranges from 5.66 MCM in Kagal block to 256.10 MCM in Shirol block. The available surplus runoff can be utilized for artificial recharge through construction of percolation tanks and Check dams.

The surplus water available for artificial recharge is 9.31 MCM. This surplus can be used to recharge facility through 25 Percolation Tanks and 74 Check dams. The expected recharge every year from these structures is 5.46 MCM. The taluka wise details are given

Table 7.2. Tentative locations of these structures are given in **Figure. 7.1** and details are given in **Annexure XI** and **X**II.

The rainwater harvesting in urban areas can be adopted in 50% of the household with 50 sq.m roof area. A total of 4.30 MCM potential can be generated by taking 80% runoff coefficient with a cost estimate of 436.08 corers. However, it is not economically viable and not recommended.

Table 7.2: Proposed Artificial Recharge Structures

Block	Geographical Area (sq. km.)	Area feasible for recharge (sq. km.)	Unsaturated Volume (MCM)	Surplus water available for AR (MCM)	Surplus water used for AR (MCM)	Proposed number of structures			Total Volume of Water expected to be recharged@ 75 % efficiency (MCM)			Total recharged @ 75 % efficiency (MCM)
						PT	CD	RS	PT	CD	RS	
Ajara	581.27	402.65	0.00	0.00	0.00	0	0	-	0.00	0.00	-	0.00
Bhudargad	599.00	500.35	0.00	0.00	0.00	0	0	-	0.00	0.00	-	0.00
Chandgad	998.64	750.71	0.00	0.00	0.00	0	0	-	0.00	0.00	-	0.00
Gadhinglaj	482.72	477.55	0.00	0.00	0.00	0	0	-	0.00	0.00	-	0.00
Gaganbawada	312.96	122.19	0.00	0.00	0.00	0	0	-	0.00	0.00	-	0.00
Hatkanangale	573.09	573.09	23.10	1.18	0.62	2	6	-	0.11	0.36	-	0.46
Kagal	596.72	556.52	5.66	0.28	0.15	1	2	-	0.03	0.08	-	0.11
Karvir	618.96	492.21	14.23	1.30	0.38	1	4	-	0.05	0.23	-	0.28
Panhala	537.69	394.29	37.31	1.26	0.99	3	10	-	0.17	0.58	-	0.75
Radhanagari	833.72	471.62	98.80	1.43	1.43	5	14	-	0.28	0.79	-	1.07
Shahuwadi	1029.95	347.86	20.67	0.70	0.55	2	6	-	0.10	0.31	-	0.41
Shirol	532.73	532.73	256.10	3.17	3.17	11	32	-	0.60	1.78	-	2.38
Total	**7697.44**	**5621.76**	**455.87**	**9.31**	**7.29**	**25**	**74**	**-**	**1.38**	**4.08**	**-**	**5.46**

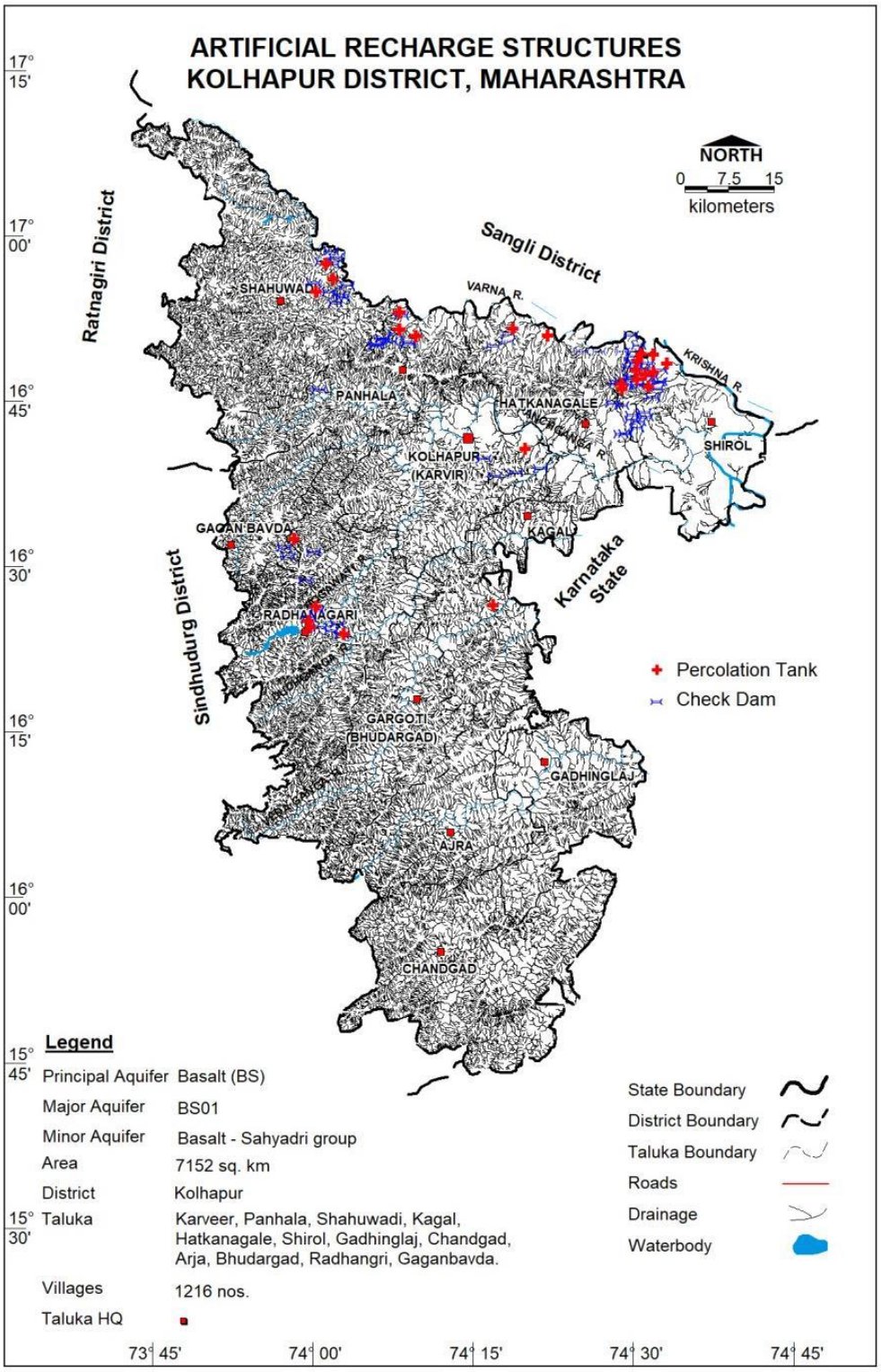


Figure. 7.1 Location of Proposed Artificial Recharge structures

7.2 Demand Side Management

The Demand Side Management is proposed in areas where the stage of ground water development is relatively high and adopting micro-irrigation techniques for water intensive crops or change in cropping pattern or both are required to save water. The details of Demand Side Intervention are given **Table 7.3** and depicted in **Figure. 7.2**.

Table 7.3 Demand side interventions proposed

Taluka	Sugarcane Area proposed to be covered under drip (sq.km)	Volume of Water expected to be saved with drip irrigation for Sugarcane (MCM)	Total GW Draft after Demand side intervention (MCM)	Stage of GWD after demand side interventions (%)	GWR available /required to bring the stage of GWD to 60% (MCM)	Additional Area proposed to be brought under assured GW irrigation (sq.km.)
Ajara	5.30	3.02	31.32	39.63	8.2	12.62
Bhudargad	7.78	4.44	22.05	34.20	10.19	15.68
Chandgad	12.93	7.37	66.50	46.19	5.48	8.43
Gadhinglaj	10.42	5.94	63.93	52.75	20.91	32.17
Gaganbawada	3.45	1.97	4.65	13.13	13.06	20.09
Hatkanangale	24.82	14.15	48.77	45.13	26.88	41.35
Kagal	26.42	15.06	32.97	27.08	52.26	80.4
Karvir	26.98	15.38	36.44	28.06	54.48	83.82
Panhala	13.72	7.82	35.62	38.15	11.06	17.02
Radhanagari	11.70	6.67	34.50	21.78	44.7	68.77
Shahuwadi	7.28	4.15	14.22	22.92	16.8	25.85
Shirol	25.89	14.76	21.41	19.69	54.69	84.14
Total	**176.69**	**100.71**	**412.37**	**32.39**	**318.71**	**490.34**

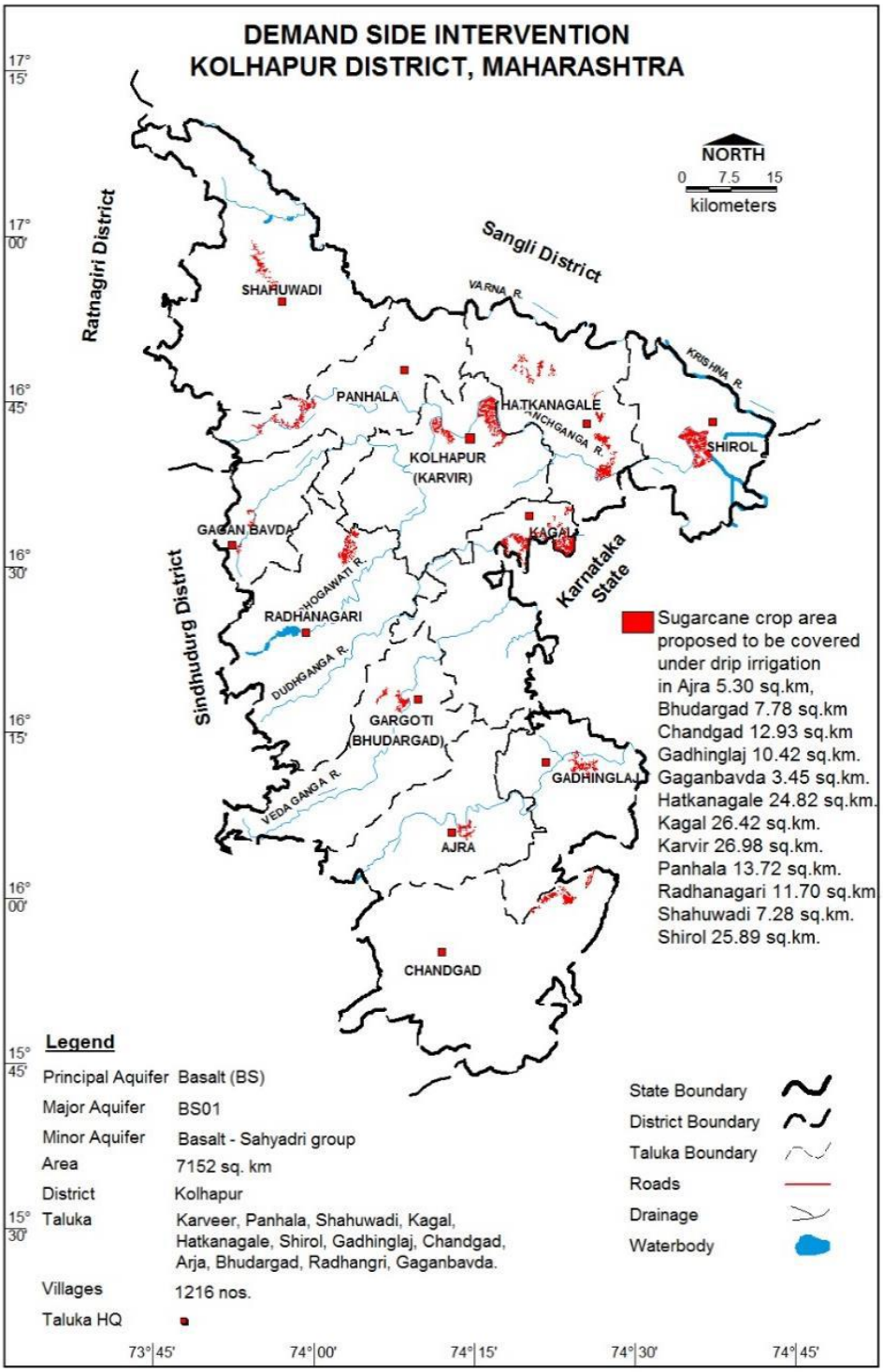


Figure. 7.2 Demand Side Intervention

7.3 Expected Benefits

The impact of groundwater management plans on the groundwater system in the district after its implementation is evaluated and the outcome shows significant improvement in groundwater scenario in all Blocks as given in the **Table 7.4.**

Table 7.4: Expected benefits after management options

Block	Total GW resource available after supply side intervention (MCM)	Total GW Draft after Demand side intervention (M CM)	Stage of GWD after supply side and demand side interventions (%)	GWR available/ required to bring the Stage of GWD to 60% (MCM)	Additional Area (sq.km.) proposed to be brought under assured GW irrigation (sq.km)
Ajara	3.02	31.32	39.63	8.2	12.62
Bhudargad	4.44	22.05	34.20	10.19	15.68
Chandgad	7.37	66.50	46.19	5.48	8.43
Gadhinglaj	5.94	63.93	52.75	20.91	32.17
Gaganbawada	1.97	4.65	13.13	13.06	20.09
Hatkanangale	14.15	48.77	45.13	26.88	41.35
Kagal	15.06	32.97	27.08	52.26	80.4
Karvir	15.38	36.44	28.06	54.48	83.82
Panhala	7.82	35.62	38.15	11.06	17.02
Radhanagari	6.67	34.50	21.78	44.7	68.77
Shahuwadi	4.15	14.22	22.92	16.8	25.85
Shirol	14.76	21.41	19.69	54.69	84.14
Total	**100.71**	**412.37**	**32.39**	**318.71**	**490.34**

The total ground water resource available after supply side intervention are 100.71 MCM whereas the total ground water draft after demand side intervention is 412.37 MCM. Thus about 318.71 MCM of ground water is available to bring stage of ground water development to 60%. With this, additional area of 490.34 sq.km can be irrigated.

7.4 Development Plan

Since additional ground water to the tune of 490.34 MCM is available for irrigating the additional area, a number of wells can be constructed. 90% of this water is proposed for constructing dug wells and remaining 10% for borewells. Thus about 19124 dug wells and 3189 borewells can be constructed. The block wise details are given in **Table 7.5.** The details of Additional area Proposed to be bought under Assured GW irrigation are given in **Figure. 7.4 .**

Table 7.5: Block wise additional area wells proposed

Block	GWR available/ required to bring the Stage of GWD to 60% (MCM)	Proposed No. of DW @1.5 ham for 90% of GWR Available	Proposed No. of BW @1 ham for 10% of GWR Available)	Additional Area (sq.km.) proposed to be brought under assured GW irrigation (sq.km)
Ajara	8.2	492	82	12.62
Bhudargad	10.19	611	102	15.68
Chandgad	5.48	329	55	8.43
Gadhinglaj	20.91	1255	209	32.17
Gaganbawada	13.06	784	131	20.09
Hatkanangale	26.88	1613	269	41.35
Kagal	52.26	3136	523	80.4
Karvir	54.48	3269	545	83.82
Panhala	11.06	664	111	17.02
Radhanagari	44.7	2682	447	68.77
Shahuwadi	16.8	1008	168	25.85
Shirol	54.69	3281	547	84.14
Total	**318.71**	**19124**	**3189**	**490.34**

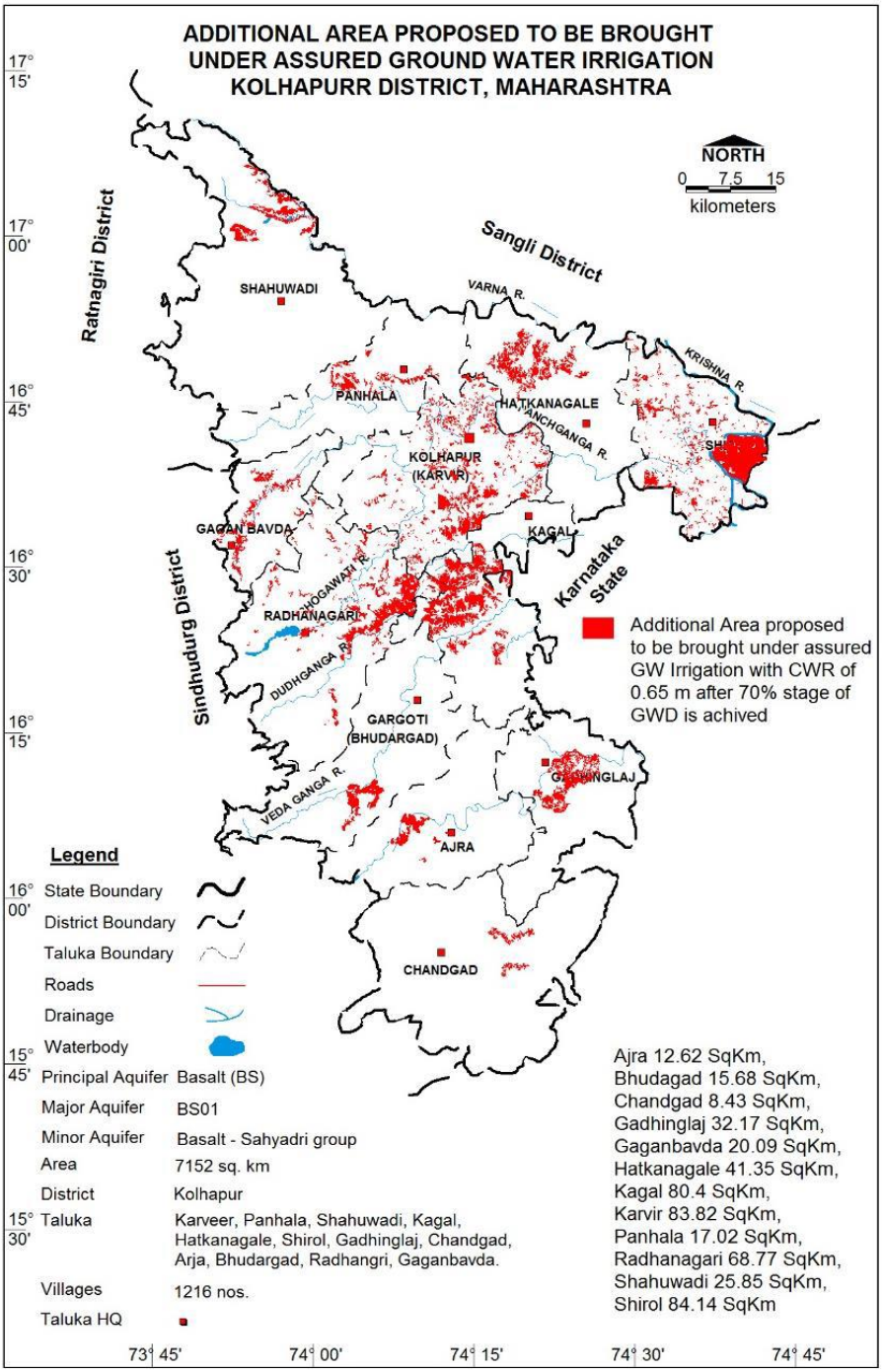


Figure. 7.3 Additional area Proposed to be bought under Assured GW irrigation

With supply side and demand side interventions, it is expected that about 318.71 MCM of ground water would be available to bring stage of ground water development to 60%. With this, additional area of 490.34 sq.km can be irrigated. The gist of Management plan is depicted in **Figure 7.4.**

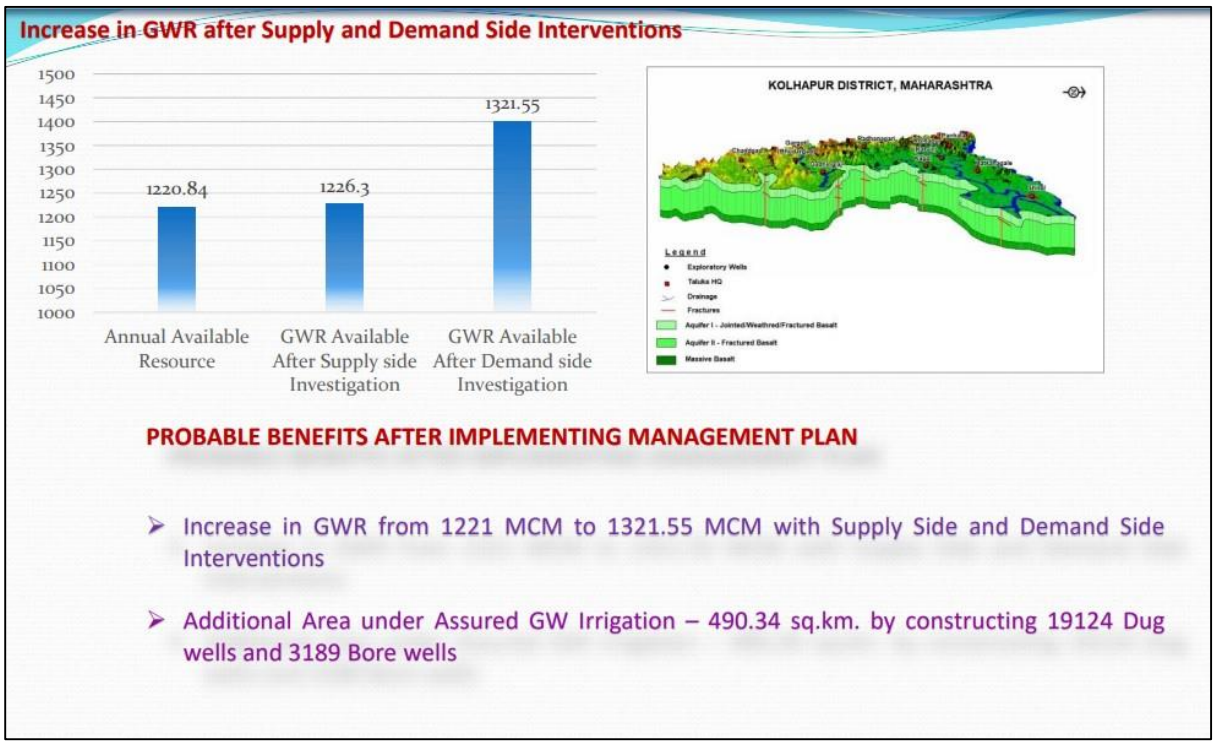


Figure. 7.4 Gist of Management plan

8.SUM UP

The highly diversified occurrence and considerable variations in the availability and utilization of groundwater makes its management a challenging task. Scientific development and management strategy for groundwater has become imperative to avert the looming water crisis. In this context, various issues such as, prioritization of areas for development of groundwater resources vis-a-vis its availability, augmentation of groundwater through rainwater harvesting and artificial recharge, pricing and sectoral allocation of resources and participation of the stakeholders must be considered. In view of the above, the present study area a systematic, economically sound and politically feasible framework for groundwater management is required.

A thorough study was carried out based on data gap analysis, data generated in-house; data acquired from State Govt. departments and GIS maps prepared for various themes. All the available data was brought on GIS platform and an integrated approach was adopted for preparation of block wise aquifer maps and aquifer management plans of Kolhapur district.

Geographically, Kolhapur district covers an area of 7685sq km, out of this 1742sq km areais occupied by forest. Geologically, the area is occupied by Basalt, laterites and Alluvial formations. The stage of ground water development is 42.03 % with the blocks are categorized as safe. The area has witnessed declining water level and low yield potential of aquifers are the major issues in the district. In Pre-monsoon declining water level trend was observed in 79 stations varying from 0.0004) to 1.21 m/year while in 91 stations varying

declining trend was observed from 0.0003 (Chipari, Shirol Block) to 0.87 m/year during post monsoon

The management plan has been proposed to manage the ground water resources and to arrest further decline in water levels. The management plan comprises two components namely supply-side management and demand side management.

The total unsaturated volume available for artificial recharge is 455.87 MCM and it ranges from 5.66 MCM in Kagal block to 256.10 MCM in Shirol block. The available surplus runoff can be utilized for artificial recharge through construction of percolation tanks and Check dams. The surplus water available for artificial recharge is 9.31 MCM. This surplus can be used to recharge facility through 25Percolation Tanks and 74 Check dams. The expected recharge every year from these structures is 5.46 MCM.

The demand side management can be implemented through the micro-irrigation techniques. It is proposed to be adopted drip irrigation in about 176.69 sq. km Sugarcane areas in the district. With this about area 100.71 MCM of ground water can be saved.

With supply side and demand side interventions, it is expected that about 318.71 MCM of ground water would be available to bring stage of ground water development to 60%. With this, additional area of 490.34 sq.km can be irrigated through additional 19124 dugwells and 3189 borewells.

Thus, the focus of proposed management plan was to use ground water very effectively with supply and demand side interventions. The perusal of above ground water management plan lays stress on adopting micro-irrigation techniques and artificial recharge measures. Considering the low stage of ground water, development in the district demand side interventions have not been proposed. However, this is the right time to further enhance the micro irrigation practices in the selected areas to manage the resources perceiving the future demand of resources.

These interventions also need to be supported by regulation for deeper aquifer and hence it is recommended to regulate/ban deeper tubewells/borewells of more than 60 m depth in these Blocks, so that the deeper ground water resources are protected for future generation and also serve as ground water sanctuary in times of distress/drought. IEC activities and capacity building activities needs to be aggressively propagated to establish the institutional framework for participatory ground water management.

Roof top Rainwater harvesting is not recommended as it is economically not viable.

ANNEXURES

Annexure-I: Salient Features of Ground Water Exploration

S/N	Village	Type of Well	Taluka	Lat_Dec	Long_Dec	Altitude (m a MSL)	Toposheet	Depth drilled (mbgl)	Depth of casing (mbgl)	Aquifer zones encountered (mbgl)	Aquifer	Discharge (lps)	EC	Date of commencement of driling	Rig Unit No.	Bottom of 1st Aquifer	Bottom of 2nd Aquifer	Massive Basalt	Kaladgis	BasementGranite Gneiss	Thickness of 2nd Aquifer	SWL-Pre	SWL-Post	SWL (mbgl)
1	Awali	EW	Panhala	16.85496	74.08234	619	47L/1	200	17.5	70.6-71.6 & 184-185	FAB & FMB	traces	407	11.02.2021	DTH/LMP-87/74	17.5	185	200			2		32	32
2	Anuskura	EW	Shahuwadi	16.779477	73.81259	587	47H/13	200	11.5	-	-	-	-	26.02.2021	DTH/LMP-87/74	20	90	200			0.5		-	dry
3	Kotoli	EW	Shahuwadi	16.991329	73.964803	569	47H/13	200	17.5	80.8-83.8 & 157-160.1	FAB & FMB	traces	555	14.03.2021	DTH/LMP-87/74	11	160.1	200			2		11.24	11.24
4	Shirale tarf Malkapur	EW	Shahuwadi	16.865898	73.935564	619	47H/13	200	29.5	56.4-62.5 & 144.8-154	FAB & FMB	0.78	295	22.03.2021	DTH/LMP-87/74	29.5	154	200			3		-	>100
5	Kodoli	EW	Panhala	16.87082	74.215252	576	47L/1	200	17.5	117.5-120.5	FMB	traces	837	25.01.2021	DTH/LMP-87/77	17.5	120.5	200			3		-	>100
6	Kondigre	EW	Shirol	16.748662	74.506761	590	47L/10	200	5.5	-	-	traces	2960	04.01.2021	DTH/LMP-87/77	29	100	200			0.5		-	100
7	Kasba Sangaon	EW	Kagal	16.59265	74.36027	574	47L/6	200	17.5	10.7-13.8 & 169.3-172.4	FAB	traces	3283	12.02.2021	DTH/LMP-87/77	13.8	172.4	200			2		-	100
8	Gaganbawda	EW	Gaganbawda	16.542275	73.829922	627	47H/14	200	5.5	43.3-44.3 & 67-68	FMB	0.38	272	28.02.2021	DTH/LMP-87/77	7.5	68	200			2		41.77	41.77
9	Asandoli	EW	Gaganbawda	16.657511	73.940265	560	47H/14	200	24.4	20-23 , 90-92	FAB	3.77	164	07.03.2021	DTH/LMP-87/77	23	92	200			2		9	9
10	Asandoli	OW	Gaganbawda	16.657524	73.940118	561	47H/14	200	30.5	32.5-35 & 96.1-99.2	FMB	0.38	170	19.03.2021	DTH/LMP-87/77	23	99.2	200			3.5		9	9
11	Shingnapur	EW	Karvir	16.707965	74.18	567	47L/2	200	5.5	32.1-35.1 & 117.5-120.5	FAB	0.14	342	28.03.2021	DTH/LMP-87/77	32	120.5	200			2.5		85	85
12	Hamidwada	EW	Kagal	16.41442	74.27863	592	47L/7	200	11.5	54-55, 115-116 & 182-183	FMB	0.38	362	22.02.2021	DTH/KLR-15/136	7.5	183	200			3		68	68
13	Akurde	EW	Bhudargad	16.307473	74.103915	734	47L/3	166	11.5	150-152	FMB	3.17	349	04.03.2021	DTH/KLR-15/136	9	152	160			2		82	82

S/N	Village	Type of Well	Taluka	Lat_Dec	Long_Dec	Altitude (m a MSL)	Toposheet	Depth drilled (mbgl)	Depth of casing (mbgl)	Aquifer zones encountered (mbgl)	Aquifer	Discharge (lps)	EC	Date of commencement of driling	Rig Unit No.	Bottom of 1st Aquifer	Bottom of 2nd Aquifer	Massive Basalt	Kaladgis	BasementGranite Gneiss	Thickness of 2nd Aquifer	SWL-Pre	SWL-Post	SWL (mbgl)
14	Akurde	OW	Bhudargad	16.307421	74.103995	734	47L/3	150.7	11.5	147.7-150.7	FMB	2.16	331	08.03.2021	DTH/KLR-15/136	9	150.7	147.7			3		80	80
15	Mamdapur	EW	Bhudargad	16.214081	74.086557	622	47L/4	200	11.5	101-103	FAB	3.17	255	15.03.2021	DTH/KLR-15/136	10.5	103	200			2		62	62
16	Mamdapur	OW	Bhudargad	16.214106	74.086475	622	47L/4	111	11.5	101-103	FAB	2.16	284	19.03.2021	DTH/KLR-15/136	10.5	103	200			2		68	68
17	Shivdav	EW	Bhudargad	16.160791	73.954534	629	47H/16	200	11.5	22.6-25.7 & 101.9-105	FAB	3.17	238	24.03.2021	DTH/KLR-15/136	8	105	200			3.1		42.7	42.7
18	Shivdav	OW	Bhudargad	16.16078	73.954237	629	47H/16	111.1	11.5	41-42 & 102-103	FAB	2.16	194	28.03.2021	DTH/KLR-15/136	8	103	200			2		45	45
19	Kadgaon	EW	Gadhinglaj	16.248858	74.296702	700	47L/8	200	5.5	19.8-22.8 & 28.9-32	FMB	traces	2475	04.03.2021	DTH/REL-06/119	32	97	200			0.5		21.4	21.4
20	Tamnakwada	EW	Kagal	16.308417	74.293095	615	47L/7	200	5.5	13.7-16.7 & 102.1-105.1	FMB & FAB	3.17	349	10.03.2021	DTH/REL-06/119	16.7	105.1	200			3		14.34	14.34
21	Tamnakwada	OW	Kagal	16.308514	74.293162	614	47L/7	200	5.5	13.7-16.7, 99.1-102.1 & 102.1-105.1	FMB & FAB	4.43	374	15.03.2021	DTH/REL-06/119	16.7	105.1	200			6		12.5	12.5
22	Pedrewadi	EW	Ajra	16.146124	74.259321	661	47L/4	32.1	5.5	13.7-16.7	FMB	traces	-	21.03.2021	DTH/REL-06/119	16.7	32.1	16.7	16.7 - 32.1	-	1		-	-
23	Hattivade	EW	Ajra	16.119692	74.23353	673	47L/4	200	5.5	-	-	-	-	24.03.2021	DTH/REL-06/119	20	90	102	117.4	200	0.5		-	dry

Annexure-II: Aquifer I depth to water level details in Kolhapur district

S/N	Dsitrict	Taluka	Village	latitude	longitude	altitude (m)	Static Water Level (mbgl) May_2020	RL
1.	Kolhapur	Ajra	Lakudwadi	16.11666667	74.33472222	762.7	3.2	759.5
2.	Kolhapur	Ajra	Maligre	16.12555556	74.28694444	704.2	3.4	700.8
3.	Kolhapur	Ajra	Harur	16.1375	74.3125	650	2	648
4.	Kolhapur	Ajra	Kowade	16.15	74.28333333	677	3.5	673.5
5.	Kolhapur	Ajra	Khoratwadi	16.18194444	74.26666667	667.3	4.2	663.1
6.	Kolhapur	Ajra	Vadakshiwale	16.19305556	74.21805556	713.4	5	708.4
7.	Kolhapur	Ajra	Uttur	16.23888889	74.26111111	691.2	5.5	685.7
8.	Kolhapur	Bavda	Gaganbavada	16.54166667	73.82916667	639	9.9	629.1
9.	Kolhapur	Bavda	Tisangi	16.68055556	73.98194444	557	2.1	554.9
10.	Kolhapur	Bhudargad	Anap Kh	16.1625	74.00611111	590	6.7	583.3
11.	Kolhapur	Bhudargad	Deulwadi	16.17361111	74.07083333	595.3	3	592.3
12.	Kolhapur	Bhudargad	Tiravade	16.20416667	74.07638889	576.3	7.5	568.8
13.	Kolhapur	Bhudargad	Vengrul	16.22777778	74.09027778	585.2	4.7	580.5
14.	Kolhapur	Bhudargad	Karadwadi	16.25277778	74.10694444	569.8	9.8	560
15.	Kolhapur	Bhudargad	Madur	16.26666667	74.11944444	579.7	1.3	578.4
16.	Kolhapur	Bhudargad	Helewadi	16.29027778	74.2	623.7	4.4	619.3
17.	Kolhapur	Bhudargad	Phanaswadi	16.29305556	74.13611111	582.6	3	579.6
18.	Kolhapur	Bhudargad	Nilpan	16.35555556	74.13333333	559.3	2	557.3
19.	Kolhapur	Bhudargad	Madilge Bk	16.36666667	74.15694444	565.3	1.4	563.9
20.	Kolhapur	Bhudargad	Admapur	16.40555556	74.15833333	561.7	2.9	558.8
21.	Kolhapur	Chandgad	Kodali	15.8	74.1875	776	1.7	774.3
22.	Kolhapur	Chandgad	Hajagoli	15.80833333	74.33333333	769	7	762
23.	Kolhapur	Chandgad	Surute	15.8375	74.375	749	15	734
24.	Kolhapur	Chandgad	Mauje Karve	15.90833333	74.34444444	712.3	8.5	703.8
25.	Kolhapur	Chandgad	Tambulwadi	15.92777778	74.29583333	695.3	10.5	684.8

S/N	Dsitrict	Taluka	Village	latitude	longitude	altitude (m)	Static Water Level (mbgl) May_2020	RL
26.	Kolhapur	Chandgad	Date	15.93055556	74.26388889	705.4	4.1	701.3
27.	Kolhapur	Chandgad	Shirgaon	15.95138889	74.20972222	705.2	11	694.2
28.	Kolhapur	Chandgad	Kanur Kh	15.975	74.13055556	722.3	4.8	717.5
29.	Kolhapur	Chandgad	Hindagaon	15.98305556	74.18333333	732.3	8	724.3
30.	Kolhapur	Chandgad	Porewadi	15.98472222	74.28333333	737.7	13	724.7
31.	Kolhapur	Chandgad	Adkur	16.0125	74.26666667	711	1.6	709.4
32.	Kolhapur	Gadhinglaj	Nesari	16.05527778	74.32777778	715.3	3.3	712
33.	Kolhapur	Gadhinglaj	Batkanangale	16.1	74.34166667	736	7.5	728.5
34.	Kolhapur	Gadhinglaj	Kalavi Katti	16.10833333	74.48194444	736.7	6	730.7
35.	Kolhapur	Gadhinglaj	Mahagaon	16.14722222	74.35	663	1.1	661.9
36.	Kolhapur	Gadhinglaj	Halkarni	16.16666667	74.46805556	667.3	7.1	660.2
37.	Kolhapur	Gadhinglaj	Kasaba Nool	16.20833333	74.44166667	659	2.1	656.9
38.	Kolhapur	Gadhinglaj	Nangnur	16.23333333	74.48666667	631	3.9	627.1
39.	Kolhapur	Gadhinglaj	Nilji	16.23611111	74.42916667	633.3	2.7	630.6
40.	Kolhapur	Hatkanangale	Yalgud	16.59166667	74.4	555	6.9	548.1
41.	Kolhapur	Hatkanangale	Rendal	16.62222222	74.43333333	547.7	2.2	545.5
42.	Kolhapur	Hatkanangale	Korochi	16.73055556	74.43611111	573.7	4.2	569.5
43.	Kolhapur	Hatkanangale	Shiroli	16.73333333	74.26666667	545	7.7	537.3
44.	Kolhapur	Hatkanangale	Halondi	16.73333333	74.30416667	547	4.82	542.18
45.	Kolhapur	Hatkanangale	Chokak	16.74166667	74.34583333	560	4.3	555.7
46.	Kolhapur	Hatkanangale	Hatkanangale	16.74444444	74.42583333	588.7	7.8	580.9
47.	Kolhapur	Hatkanangale	Majale	16.77166667	74.44222222	624	8.1	615.9
48.	Kolhapur	Hatkanangale	Nej	16.80083333	74.42861111	581.3	5.2	576.1
49.	Kolhapur	Hatkanangale	Minche	16.81666667	74.33333333	583	4.4	578.6
50.	Kolhapur	Hatkanangale	Kumbhoj	16.82222222	74.43888889	562.6	1.6	561
51.	Kolhapur	Hatkanangale	Pargaon	16.87666667	74.23583333	558		558

S/N	Dsitrict	Taluka	Village	latitude	longitude	altitude (m)	Static Water Level (mbgl) May_2020	RL
52.	Kolhapur	Kagal	Murgud	16.39722222	74.19305556	560.3	0.9	559.4
53.	Kolhapur	Kagal	Galgale	16.40833333	74.31666667	563	2.9	560.1
54.	Kolhapur	Kagal	Undarwadi	16.40972222	74.10972222	574.3	2.1	572.2
55.	Kolhapur	Kagal	Kurukali	16.42083333	74.24583333	557	3.4	553.6
56.	Kolhapur	Kagal	Boravade	16.425	74.12777778	556.3	0.9	555.4
57.	Kolhapur	Karvir	Kurukali	16.56777778	74.12027778	566.4	1.4	565
58.	Kolhapur	Karvir	Kogil Bk	16.59583333	74.2625	594	2.2	591.8
59.	Kolhapur	Karvir	Jaital	16.60972222	74.18055556	649.4	1.6	647.8
60.	Kolhapur	Karvir	Girgaon	16.61861111	74.23055556	704.9	5.8	699.1
61.	Kolhapur	Karvir	Wadipir	16.65416667	74.19722222	632.7	3.8	628.9
62.	Kolhapur	Karvir	Chinchawade Tarf Kale	16.70138889	74.07222222	559.8	1.9	557.9
63.	Kolhapur	Karvir	Khupire	16.70416667	74.13055556	576.3	1.7	574.6
64.	Kolhapur	Karvir	Kerli	16.75	74.18472222	551.7	3.7	548
65.	Kolhapur	Karvir	Shiye	16.77083333	74.25555556	546.3	6.9	539.4
66.	Kolhapur	Panhala	Navalavwadi	16.68055556	74.03444444	551	2	549
67.	Kolhapur	Panhala	Marali	16.7125	74.06805556	555.7	4.2	551.5
68.	Kolhapur	Panhala	Kisrul	16.7375	73.96527778	565.3	1.7	563.6
69.	Kolhapur	Panhala	Punal	16.75972222	74.05555556	562.4	1	561.4
70.	Kolhapur	Panhala	Salwadi	16.76666667	74.0125	556	1.3	554.7
71.	Kolhapur	Panhala	Kushire	16.76805556	74.19583333	591.3	1	590.3
72.	Kolhapur	Panhala	Pimple Thane	16.78277778	74.08194444	551.2	1.1	550.1
73.	Kolhapur	Panhala	Wadi-Ratnagiri	16.79583333	74.17638889	935.3	8.1	927.2
74.	Kolhapur	Panhala	Ambavade	16.81527778	74.13194444	736.3	8.8	727.5
75.	Kolhapur	Panhala	Jakhale	16.8375	74.19583333	600	2.6	597.4
76.	Kolhapur	Radhanagari	Hasane	16.35	73.8625	606	5.7	600.3
77.	Kolhapur	Radhanagari	Kasarwada	16.4	74.07777778	570.3	1.3	569

S/N	Dsitrict	Taluka	Village	latitude	longitude	altitude (m)	Static Water Level (mbgl) May_2020	RL
78.	Kolhapur	Radhanagari	Radhanagari	16.40972222	73.99305556	564.1	6	558.1
79.	Kolhapur	Radhanagari	Solankur	16.41388889	74.05	564		564
80.	Kolhapur	Radhanagari	Shelewadi	16.49444444	74.13194444	557.1	1.1	556
81.	Kolhapur	Radhanagari	Pungaon	16.51666667	74.0625	570	1.2	568.8
82.	Kolhapur	Radhanagari	Dhamod	16.53333333	74.03333333	596	2	594
83.	Kolhapur	Radhanagari	Mhasurli	16.58333333	73.97638889	576.3	3.7	572.6
84.	Kolhapur	Shahuwadi	Wadicharan	16.8875	74.04583333	557	1.2	555.8
85.	Kolhapur	Shahuwadi	Koparde	16.92083333	73.95027778	564.3	3	561.3
86.	Kolhapur	Shahuwadi	Wadgaon	16.92361111	74.03611111	562.8	10.8	552
87.	Kolhapur	Shahuwadi	Amba	16.97222222	73.79583333	600.7	8.7	592
88.	Kolhapur	Shahuwadi	Kotoli	16.99166667	73.96666667	564	3.7	560.3
89.	Kolhapur	Shirol	Danwad	16.59444444	74.61666667	537.3	3.6	533.7
90.	Kolhapur	Shirol	Takli	16.59583333	74.61805556	537.7	7.4	530.3
91.	Kolhapur	Shirol	Ghosarwad	16.60138889	74.55138889	539.1	6.6	532.5
92.	Kolhapur	Shirol	Kurundvad	16.67722222	74.58472222	538.4	2.3	536.1
93.	Kolhapur	Shirol	Ganeshwadi	16.70277778	74.62083333	537.3	3.9	533.4
94.	Kolhapur	Shirol	Shirol	16.73333333	74.60138889	549.7	3.3	546.4
95.	Kolhapur	Shirol	Nandani	16.74305556	74.54694444	550.9	7.9	543
96.	Kolhapur	Shirol	Kondigre	16.74583333	74.50333333	584	5.7	578.3
97.	Kolhapur	Shirol	Chipari	16.77083333	74.52083333	566	6	560
98.	Kolhapur	Shirol	Nimshirgaon	16.775	74.49166667	588	5.2	582.8

Annexure-III : Aquifer II depth to water level details in Kolhapur district

S/N	Village	Type_of_Well	Taluka	Lat	Long	SWL_mbgl
1	Gaganbawda	EW	Gaganbawda	16.542275	73.829922	41.77
2	Akurde	EW	Bhudargad	16.307473	74.103915	82
3	Kadgaon	EW	Gadhinglaj	16.248858	74.296702	21.4
4	Kondigre	EW	Shirol	16.748662	74.506761	100
5	Akurde	OW	Bhudargad	16.307421	74.103995	80
6	Tamnakwada	EW	Kagal	16.308417	74.293095	14.34
7	Awali	EW	Panhala	16.85496	74.08234	32
8	Kasba Sangaon	EW	Kagal	16.59265	74.36027	100
9	Kotoli	EW	Shahuwadi	16.991329	73.964803	11.24
10	Asandoli	EW	Gaganbawda	16.657511	73.940265	9
11	Mamdapur	EW	Bhudargad	16.214081	74.086557	62
12	Tamnakwada	OW	Kagal	16.308514	74.293162	12.5
13	Mamdapur	OW	Bhudargad	16.214106	74.086475	68
14	Asandoli	OW	Gaganbawda	16.657524	73.940118	9
15	Hamidwada	EW	Kagal	16.41442	74.27863	68
16	Shivdav	EW	Bhudargad	16.160791	73.954534	42.7
17	Shirale tarf Malkapur	EW	Shahuwadi	16.865898	73.935564	100
18	Shivdav	OW	Bhudargad	16.16078	73.954237	45
19	Kodoli	EW	Panhala	16.87082	74.215252	100
20	Shingnapur	EW	Karvir	16.707965	74.18	85

Annexure-IV: Details of PMP wells, Kolhapur district

Sr_no	District	Taluka	Village	Type of well	Long_dec	Lat_dec
1	Kolhapur	Panhala	Awali	Ew	74.08234	16.85496
2	Kolhapur	Shahuwadi	Anuskura	Ew	73.81259	16.779477
3	Kolhapur	Shahuwadi	Kotoli	Ew	73.964803	16.991329
4	Kolhapur	Shahuwadi	Shirale tarf malkapur	Ew	73.935564	16.865898
5	Kolhapur	Panhala	Kodoli	Ew	74.215252	16.87082
6	Kolhapur	Shirol	Kondigre	Ew	74.506761	16.748662
7	Kolhapur	Kagal	Kasba sangaon	Ew	74.36027	16.59265
8	Kolhapur	Gaganbawda	Gaganbawda	Ew	73.829922	16.542275
9	Kolhapur	Gaganbawda	Asandoli	Ew	73.940265	16.657511
10	Kolhapur	Gaganbawda	Asandoli	Ow	73.940118	16.657524
11	Kolhapur	Karvir	Shingnapur	Ew	74.18	16.707965
12	Kolhapur	Kagal	Hamidwada	Ew	74.27863	16.41442
13	Kolhapur	Bhudargad	Akurde	Ew	74.103915	16.307473
14	Kolhapur	Bhudargad	Akurde	Ow	74.103995	16.307421
15	Kolhapur	Bhudargad	Mamdapur	Ew	74.086557	16.214081
16	Kolhapur	Bhudargad	Mamdapur	Ow	74.086475	16.214106
17	Kolhapur	Bhudargad	Shivdav	Ew	73.954534	16.160791
18	Kolhapur	Bhudargad	Shivdav	Ow	73.954237	16.16078
19	Kolhapur	Gadhinglaj	Kadgaon	Ew	74.296702	16.248858
20	Kolhapur	Kagal	Tamnakwada	Ew	74.293095	16.308417
21	Kolhapur	Kagal	Tamnakwada	Ow	74.293162	16.308514
22	Kolhapur	Ajra	Pedrewadi	Ew	74.259321	16.146124
23	Kolhapur	Ajra	Hattivade	Ew	74.23353	16.119692
24	Kolhapur	Ajra	Lakudwadi	Mw	74.33472222	16.11666667
25	Kolhapur	Ajra	Maligre	Mw	74.28694444	16.12555556

26	Kolhapur	Ajra	Harur	Mw	74.3125	16.1375
27	Kolhapur	Ajra	Kowade	Mw	74.28333333	16.15
28	Kolhapur	Ajra	Khoratwadi	Mw	74.26666667	16.18194444
29	Kolhapur	Ajra	Vadakshiwale	Mw	74.21805556	16.19305556
30	Kolhapur	Ajra	Uttur	Mw	74.26111111	16.23888889
31	Kolhapur	Ajra	Sulgaon	Mw	74.26111111	16.23888889
32	Kolhapur	Bavda	Gaganbavada	Mw	73.82916667	16.54166667
33	Kolhapur	Bavda	Tisangi	Mw	73.98194444	16.68055556
34	Kolhapur	Bhudargad	Anap kh	Mw	74.00611111	16.1625
35	Kolhapur	Bhudargad	Deulwadi	Mw	74.07083333	16.17361111
36	Kolhapur	Bhudargad	Tiravade	Mw	74.07638889	16.20416667
37	Kolhapur	Bhudargad	Vengrul	Mw	74.09027778	16.22777778
38	Kolhapur	Bhudargad	Karadwadi	Mw	74.10694444	16.25277778
39	Kolhapur	Bhudargad	Madur	Mw	74.11944444	16.26666667
40	Kolhapur	Bhudargad	Helewadi	Mw	74.2	16.29027778
41	Kolhapur	Bhudargad	Phanaswadi	Mw	74.13611111	16.29305556
42	Kolhapur	Bhudargad	Nilpan	Mw	74.13333333	16.35555556
43	Kolhapur	Bhudargad	Madilge bk	Mw	74.15694444	16.36666667
44	Kolhapur	Bhudargad	Admapur	Mw	74.15833333	16.40555556
45	Kolhapur	Chandgad	Kodali	Mw	74.1875	15.8
46	Kolhapur	Chandgad	Hajagoli	Mw	74.33333333	15.80833333
47	Kolhapur	Chandgad	Surute	Mw	74.375	15.8375
48	Kolhapur	Chandgad	Mauje karve	Mw	74.34444444	15.90833333
49	Kolhapur	Chandgad	Tambulwadi	Mw	74.29583333	15.92777778
50	Kolhapur	Chandgad	Date	Mw	74.26388889	15.93055556
51	Kolhapur	Chandgad	Shirgaon	Mw	74.20972222	15.95138889
52	Kolhapur	Chandgad	Kanur kh	Mw	74.13055556	15.975
53	Kolhapur	Chandgad	Hindagaon	Mw	74.18333333	15.98305556
54	Kolhapur	Chandgad	Porewadi	Mw	74.28333333	15.98472222

55	Kolhapur	Chandgad	Adkur	Mw	74.26666667	16.0125
56	Kolhapur	Gadhinglaj	Nesari	Mw	74.32777778	16.05527778
57	Kolhapur	Gadhinglaj	Batkanangale	Mw	74.34166667	16.1
58	Kolhapur	Gadhinglaj	Kalavi katti	Mw	74.48194444	16.10833333
59	Kolhapur	Gadhinglaj	Mahagaon	Mw	74.35	16.14722222
60	Kolhapur	Gadhinglaj	Halkarni	Mw	74.46805556	16.16666667
61	Kolhapur	Gadhinglaj	Kasaba nool	Mw	74.44166667	16.20833333
62	Kolhapur	Gadhinglaj	Nangnur	Mw	74.48666667	16.23333333
63	Kolhapur	Gadhinglaj	Nilji	Mw	74.42916667	16.23611111
64	Kolhapur	Hatkanangale	Yalgud	Mw	74.4	16.59166667
65	Kolhapur	Hatkanangale	Rendal	Mw	74.43333333	16.62222222
66	Kolhapur	Hatkanangale	Korochi	Mw	74.43611111	16.73055556
67	Kolhapur	Hatkanangale	Shiroli	Mw	74.26666667	16.73333333
68	Kolhapur	Hatkanangale	Halondi	Mw	74.30416667	16.73333333
69	Kolhapur	Hatkanangale	Chokak	Mw	74.34583333	16.74166667
70	Kolhapur	Hatkanangale	Hatkanangale	Mw	74.42583333	16.74444444
71	Kolhapur	Hatkanangale	Majale	Mw	74.44222222	16.77166667
72	Kolhapur	Hatkanangale	Nej	Mw	74.42861111	16.80083333
73	Kolhapur	Hatkanangale	Minche	Mw	74.33333333	16.81666667
74	Kolhapur	Hatkanangale	Kumbhoj	Mw	74.43888889	16.82222222
75	Kolhapur	Hatkanangale	Pargaon	Mw	74.23583333	16.87666667
76	Kolhapur	Kagal	Murgud	Mw	74.19305556	16.39722222
77	Kolhapur	Kagal	Galgale	Mw	74.31666667	16.40833333
78	Kolhapur	Kagal	Undarwadi	Mw	74.10972222	16.40972222
79	Kolhapur	Kagal	Kurukali	Mw	74.24583333	16.42083333
80	Kolhapur	Kagal	Boravade	Mw	74.12777778	16.425
81	Kolhapur	Karvir	Kurukali	Mw	74.12027778	16.56777778
82	Kolhapur	Karvir	Kogil bk	Mw	74.2625	16.59583333
83	Kolhapur	Karvir	Jaital	Mw	74.18055556	16.60972222
84	Kolhapur	Karvir	Girgaon	Mw	74.23055556	16.61861111
85	Kolhapur	Karvir	Wadipir	Mw	74.19722222	16.65416667

86	Kolhapur	Karvir	Chinchawade tarf kale	Mw	74.07222222	16.70138889
87	Kolhapur	Karvir	Khupire	Mw	74.13055556	16.70416667
88	Kolhapur	Karvir	Kerli	Mw	74.18472222	16.75
89	Kolhapur	Karvir	Shiye	Mw	74.25555556	16.77083333
90	Kolhapur	Panhala	Navalavwadi	Mw	74.03444444	16.68055556
91	Kolhapur	Panhala	Marali	Mw	74.06805556	16.7125
92	Kolhapur	Panhala	Kisrul	Mw	73.96527778	16.7375
93	Kolhapur	Panhala	Punal	Mw	74.05555556	16.75972222
94	Kolhapur	Panhala	Salwadi	Mw	74.0125	16.76666667
95	Kolhapur	Panhala	Kushire	Mw	74.19583333	16.76805556
96	Kolhapur	Panhala	Pimple thane	Mw	74.08194444	16.78277778
97	Kolhapur	Panhala	Wadi-ratnagiri	Mw	74.17638889	16.79583333
98	Kolhapur	Panhala	Ambavade	Mw	74.13194444	16.81527778
99	Kolhapur	Panhala	Jakhale	Mw	74.19583333	16.8375
100	Kolhapur	Radhanagari	Hasane	Mw	73.8625	16.35
101	Kolhapur	Radhanagari	Kasarwada	Mw	74.07777778	16.4
102	Kolhapur	Radhanagari	Radhanagari	Mw	73.99305556	16.40972222
103	Kolhapur	Radhanagari	Solankur	Mw	74.05	16.41388889
104	Kolhapur	Radhanagari	Shelewadi	Mw	74.13194444	16.49444444
105	Kolhapur	Radhanagari	Pungaon	Mw	74.0625	16.51666667
106	Kolhapur	Radhanagari	Dhamod	Mw	74.03333333	16.53333333
107	Kolhapur	Radhanagari	Mhasurli	Mw	73.97638889	16.58333333
108	Kolhapur	Shahuwadi	Wadicharan	Mw	74.04583333	16.8875
109	Kolhapur	Shahuwadi	Koparde	Mw	73.95027778	16.92083333
110	Kolhapur	Shahuwadi	Wadgaon	Mw	74.03611111	16.92361111
111	Kolhapur	Shahuwadi	Amba	Mw	73.79583333	16.97222222
112	Kolhapur	Shahuwadi	Kotoli	Mw	73.96666667	16.99166667
113	Kolhapur	Shirol	Danwad	Mw	74.61666667	16.59444444
114	Kolhapur	Shirol	Takli	Mw	74.61805556	16.59583333
115	Kolhapur	Shirol	Ghosarwad	Mw	74.55138889	16.60138889

116	Kolhapur	Shirol	Kurundvad	Mw	74.58472222	16.67722222
117	Kolhapur	Shirol	Ganeshwadi	Mw	74.62083333	16.70277778
118	Kolhapur	Shirol	Shirol	Mw	74.60138889	16.73333333
119	Kolhapur	Shirol	Nandani	Mw	74.54694444	16.74305556
120	Kolhapur	Shirol	Kondigre	Mw	74.50333333	16.74583333
121	Kolhapur	Shirol	Chipari	Mw	74.52083333	16.77083333
122	Kolhapur	Shirol	Nimshirgaon	Mw	74.49166667	16.775
123	Kolhapur		Surute	Mw	74.375	15.8375
124	Kolhapur		Patne	Mw	74.23333333	15.8675
125	Kolhapur		Karve	Mw	74.34027778	15.89722222
126	Kolhapur		Naganwadi	Mw	74.25	15.93333333
127	Kolhapur		Nesari	Mw	74.33055556	16.05666667
128	Kolhapur		Ajra	Mw	74.2	16.11666667
129	Kolhapur		Halkarne	Mw	74.46944444	16.16944444
130	Kolhapur		Nitawade	Mw	74.05	16.23333333
131	Kolhapur		Gadhingalaj	Mw	74.35166667	16.24083333
132	Kolhapur		Uttur	Mw	74.25416667	16.25833333
133	Kolhapur		Pimpalgaon	Mw	74.21666667	16.29722222
134	Kolhapur		Murgud	Mw	74.18333333	16.38333333
135	Kolhapur		Radhanagari	Mw	73.99583333	16.40833333
136	Kolhapur		Surupali	Mw	74.23888889	16.41388889
137	Kolhapur		Solankur1	Mw	74.08333333	16.43333333
138	Kolhapur		Khindivarvade-1	Mw	74.05333333	16.45166667
139	Kolhapur		Shelewadi	Mw	74.13055556	16.49444444
140	Kolhapur		Gagan bauda	Mw	73.82944444	16.54166667
141	Kolhapur		Chuye	Mw	74.16861111	16.54416667
142	Kolhapur		Aslaj	Mw	73.89166667	16.60416667
143	Kolhapur		Washi	Mw	74.17916667	16.64027778

144	Kolhapur		Gokul shirgaon	Mw	74.275	16.64166667
145	Kolhapur		Shiradwad	Mw	74.48333333	16.66666667
146	Kolhapur		Kirve	Mw	73.9975	16.68833333
147	Kolhapur		Parkhandale	Mw	74.01666667	16.7
148	Kolhapur		Khupire	Mw	74.16805556	16.70944444
149	Kolhapur		Shiroli	Mw	74.28333333	16.73333333
150	Kolhapur		Undri	Mw	73.98611111	16.78111111
151	Kolhapur		Panhala	Mw	74.1	16.81666667
152	Kolhapur		Paijarwadi	Mw	74.08333333	16.84166667
153	Kolhapur		Pargaon -1	Mw	74.22694444	16.86222222
154	Kolhapur		Kini wathar	Mw	74.2975	16.87027778
155	Kolhapur		Wadicharan-1	Mw	74.0425	16.87972222
156	Kolhapur		Shahuwadi-1	Mw	73.94833333	16.90472222
157	Kolhapur		Amba	Mw	73.80694444	16.96777778

Annexure- V: Soil Infiltration Test Data

Soil Infiltration Test	
Date	10/3/2021
Unique ID No	SIT_Kolhapur-3
Location	Hamidwada - In the premises of GP land
Taluka	Kagal
District	Kolhapur
Coordinates	16.4190, 74.2794
Elevation / RL (mamsl)	570.15
Initial Water Level	17.8
Geology	Deccan Basalt

Sl.No.	Clock time	Duration(m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth(cm)	Infiltration rate(cm/hr)	Remarks
1	14.35	0	0	17.80	0.00	0.00	
2	14.40	5	5	18.00	0.20	2.40	
3	14.45	5	10	17.90	0.10	1.20	
4	14.55	10	20	17.90	0.10	0.60	
5	15.05	10	30	17.90	0.10	0.60	
6	15.15	15	16	18.00	0.20	0.80	
7	15.30	15	60	18.10	0.30	1.20	
8	15.45	15	75	18.20	0.40	1.60	
9	16.00	15	75	18.20	0.40	1.60	

Date	10/3/2021
Unique ID No	SIT_Kolhapur-2
Location	Kadgaon - 10 mtrs west of Jaywant Shewale house
Taluka	Gadhinglaj
District	Kolhapur
Coordinates	16.2483, 74.2962
Elevation / RL (mamsl)	570.41
Initial Water Level	17.5
Geology	Deccan Basalt

Sl.No.	Clock time	Duration(m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth(cm)	Infiltration rate(cm/hr)
1	11.10	0	0	17.50	0.00	0.00
2	11.15	5	5	18.80	1.30	15.60
3	11.20	5	10	19.30	1.80	21.60
4	11.30	10	20	19.50	2.00	12.00
5	11.40	10	30	19.70	2.20	13.20
6	11.55	15	16	20.00	2.50	10.00
7	12.10	15	60	20.30	2.80	11.20
8	12.25	15	75	20.30	2.80	11.20
9	12.40	15	75	20.30	2.80	11.20

Date	11.03.2021
Unique ID No	SIT_Kolhapur-4
Village	Asandoli
Location	In the premises of GP office
Taluka	Gaganbavda
District	Kolhapur
Coordinates	16.6575, 73.9405
Elevation / RL (mamsl)	558.87
Initial Water Level (cm)	14
Geology	Deccan Basalt
Soil type	Black cotton soil
Final Infiltration Rate (cm/hr)	

Sl.No.	Clock time	Duration(m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth(cm)	Infiltration rate(cm/hr)	Remarks
1	12.52	0	0	14.00	0.00	0.00	
2	12.57	5	5	16.00	2.00	24.00	
3	13.03	5	10	17.40	3.40	40.80	
4	13.13	10	20	19.00	5.00	30.00	
5	13.23	10	30	20.60	6.60	39.60	
6	13.38	15	45	22.50	8.50	34.00	
7	13.53	15	60	17.10	8.55	34.20	Refilled upto 14 cms
8	14.08	15	75	19.70	8.70	34.80	

9	14.28	20	95	22.50	11.23	33.69	
10	14.48	20	115	17.5	11.27	33.81	Refilled upto 14 cms
11	15.08	20	135	20.6	11.29	33.87	
12	15.38	30	165	23.8	14.30	28.60	
13	15.43	5	170	15.1	3.00	36.00	Refilled upto 14 cms
14	15.48	5	175	15.1	1.10	13.20	
15	15.53	5	180	15.1	1.10	13.20	
16	15.58	5	185	15.1	1.10	13.20	

Soil Infiltration Test	
Date	9/3/2021
Unique ID No	SIT_Kolhapur-1
Location	Awali - In the premises of Zp primary school
Taluka	Panhala
District	Kolhapur
Coordinates	16.8552, 74.0818
Elevation / RL (mamsl)	567.44
Initial Water Level	14.5
Geology	Deccan Basalt

Sl.No.	Clock time	Duration(m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth(cm)	Infiltration rate(cm/hr)	Remarks
1	15.50	0	0	14.50	0.00	0.00	
2	15.55	5	5	14.50	0.00	0.00	
3	16.00	5	10	14.80	0.30	3.60	
4	16.10	10	20	15.20	0.70	4.20	
5	16.20	10	30	15.40	0.90	5.40	

6	16.35	15	16	15.70	1.20	4.80	
7	16.50	15	60	16.30	1.80	7.20	
8	17.05	15	75	16.30	1.80	7.20	
9	17.25	15	75	16.30	1.80	7.20	

Annexure-VI: Water Level trend (2010-2020)

S/N	Agency	District	Tahsil	Village	Latitude	Longitude	Water Level 2020	Trend	Final trend
1.	GSDA	Kolhapur	Ajra	Lakudwadi	16.11666667	74.33472222	3.2	-0.124848485	0.124848485
2.	GSDA	Kolhapur	Ajra	Maligre	16.12555556	74.28694444	3.4	-0.106666667	0.106666667
3.	GSDA	Kolhapur	Ajra	Harur	16.1375	74.3125	2	0.011818182	-0.011818182
4.	GSDA	Kolhapur	Ajra	Kowade	16.15	74.28333333	3.5	-0.058032787	0.058032787
5.	GSDA	Kolhapur	Ajra	Khoratwadi	16.18194444	74.26666667	4.2	-0.117424242	0.117424242
6.	GSDA	Kolhapur	Ajra	Vadakshiwale	16.19305556	74.21805556	5	-0.142121212	0.142121212
7.	GSDA	Kolhapur	Ajra	Uttur	16.23888889	74.26111111	5.5	-0.301060606	0.301060606
8.	GSDA	Kolhapur	Ajra	Sulgaon	16.23888889	74.26111111	5.5	-0.121363636	0.121363636
9.	GSDA	Kolhapur	Bavda	Gaganbavada	16.54166667	73.82916667	9.9	0.051818182	-0.051818182
10.	GSDA	Kolhapur	Bavda	Tisangi	16.68055556	73.98194444	2.1	0.001515152	-0.001515152
11.	GSDA	Kolhapur	Bhudargad	Anap Kh	16.1625	74.00611111	6.7	-0.09	0.09
12.	GSDA	Kolhapur	Bhudargad	Deulwadi	16.17361111	74.07083333	3	0.185	-0.185
13.	GSDA	Kolhapur	Bhudargad	Tiravade	16.20416667	74.07638889	7.5	0.108939394	-0.108939394
14.	GSDA	Kolhapur	Bhudargad	Vengrul	16.22777778	74.09027778	4.7	-0.000787879	0.000787879
15.	GSDA	Kolhapur	Bhudargad	Karadwadi	16.25277778	74.10694444	9.8	0.006363636	-0.006363636
16.	GSDA	Kolhapur	Bhudargad	Madur	16.26666667	74.11944444	1.3	-0.098030303	0.098030303
17.	GSDA	Kolhapur	Bhudargad	Helewadi	16.29027778	74.2	4.4	-0.032272727	0.032272727
18.	GSDA	Kolhapur	Bhudargad	Phanaswadi	16.29305556	74.13611111	3	0.087424242	-0.087424242
19.	GSDA	Kolhapur	Bhudargad	Nilpan	16.35555556	74.13333333	2	-0.008636364	0.008636364
20.	GSDA	Kolhapur	Bhudargad	Madilge Bk	16.36666667	74.15694444	1.4	-0.046060606	0.046060606
21.	GSDA	Kolhapur	Bhudargad	Admapur	16.40555556	74.15833333	2.9	-0.063636364	0.063636364
22.	GSDA	Kolhapur	Chandgad	Kodali	15.8	74.1875	1.7	-0.026969697	0.026969697
23.	GSDA	Kolhapur	Chandgad	Hajagoli	15.80833333	74.33333333	7	0.107272727	-0.107272727
24.	GSDA	Kolhapur	Chandgad	Surute	15.8375	74.375	15	0.758571429	-0.758571429
25.	GSDA	Kolhapur	Chandgad	Mauje Karve	15.90833333	74.34444444	8.5	-0.017575758	0.017575758
26.	GSDA	Kolhapur	Chandgad	Tambulwadi	15.92777778	74.29583333	10.5	0.030909091	-0.030909091
27.	GSDA	Kolhapur	Chandgad	Date	15.93055556	74.26388889	4.1	0.038030303	-0.038030303
28.	GSDA	Kolhapur	Chandgad	Shirgaon	15.95138889	74.20972222	11	-0.201212121	0.201212121
29.	GSDA	Kolhapur	Chandgad	Kanur Kh	15.975	74.13055556	4.8	-0.000909091	0.000909091
30.	GSDA	Kolhapur	Chandgad	Hindagaon	15.98305556	74.18333333	8	0.000909091	-0.000909091

S/N	Agency	District	Tahsil	Village	Latitude	Longitude	Water Level 2020	Trend	Final trend
31.	GSDA	Kolhapur	Chandgad	Porewadi	15.98472222	74.28333333	13	0.015454545	-0.015454545
32.	GSDA	Kolhapur	Chandgad	Adkur	16.0125	74.26666667	1.6	-1.219479167	1.219479167
33.	GSDA	Kolhapur	Gadhinglaj	Nesari	16.05527778	74.32777778	3.3	0.041818182	-0.041818182
34.	GSDA	Kolhapur	Gadhinglaj	Batkanangale	16.1	74.34166667	7.5	-0.030909091	0.030909091
35.	GSDA	Kolhapur	Gadhinglaj	Kalavi Katti	16.10833333	74.48194444	6	-0.030757576	0.030757576
36.	GSDA	Kolhapur	Gadhinglaj	Mahagaon	16.14722222	74.35	1.1	-0.025454545	0.025454545
37.	GSDA	Kolhapur	Gadhinglaj	Halkarni	16.16666667	74.46805556	7.1	0.058787879	-0.058787879
38.	GSDA	Kolhapur	Gadhinglaj	Kasaba Nool	16.20833333	74.44166667	2.1	0.106515152	-0.106515152
39.	GSDA	Kolhapur	Gadhinglaj	Nangnur	16.23333333	74.48666667	3.9	0.214242424	-0.214242424
40.	GSDA	Kolhapur	Gadhinglaj	Nilji	16.23611111	74.42916667	2.7	0.113787879	-0.113787879
41.	GSDA	Kolhapur	Hatkanangale	Yalgud	16.59166667	74.4	6.9	0.276212121	-0.276212121
42.	GSDA	Kolhapur	Hatkanangale	Rendal	16.62222222	74.43333333	2.2	-0.26030303	0.26030303
43.	GSDA	Kolhapur	Hatkanangale	Korochi	16.73055556	74.43611111	4.2	-0.03030303	0.03030303
44.	GSDA	Kolhapur	Hatkanangale	Shiroli	16.73333333	74.26666667	7.7	-0.023787879	0.023787879
45.	GSDA	Kolhapur	Hatkanangale	Halondi	16.73333333	74.30416667	4.82	-0.019363636	0.019363636
46.	GSDA	Kolhapur	Hatkanangale	Chokak	16.74166667	74.34583333	4.3	-0.048787879	0.048787879
47.	GSDA	Kolhapur	Hatkanangale	Hatkanangale	16.74444444	74.42583333	7.8	0.235121212	-0.235121212
48.	GSDA	Kolhapur	Hatkanangale	Majale	16.77166667	74.44222222	8.1	0.186363636	-0.186363636
49.	GSDA	Kolhapur	Hatkanangale	Nej	16.80083333	74.42861111	5.2	-0.072878788	0.072878788
50.	GSDA	Kolhapur	Hatkanangale	Minche	16.81666667	74.33333333	4.4	-0.213030303	0.213030303
51.	GSDA	Kolhapur	Hatkanangale	Kumbhoj	16.82222222	74.43888889	1.6	0.132428571	-0.132428571
52.	GSDA	Kolhapur	Hatkanangale	Pargaon	16.87666667	74.23583333		-0.02	0.02
53.	GSDA	Kolhapur	Kagal	Murgud	16.39722222	74.19305556	0.9	-0.030151515	0.030151515
54.	GSDA	Kolhapur	Kagal	Galgale	16.40833333	74.31666667	2.9	0.015909091	-0.015909091
55.	GSDA	Kolhapur	Kagal	Undarwadi	16.40972222	74.10972222	2.1	0.051212121	-0.051212121
56.	GSDA	Kolhapur	Kagal	Kurukali	16.42083333	74.24583333	3.4	0.012878788	-0.012878788
57.	GSDA	Kolhapur	Kagal	Boravade	16.425	74.12777778	0.9	-0.026212121	0.026212121
58.	GSDA	Kolhapur	Karvir	Kurukali	16.56777778	74.12027778	1.4	0.057878788	-0.057878788
59.	GSDA	Kolhapur	Karvir	Kogil Bk	16.59583333	74.2625	2.2	0.058636364	-0.058636364
60.	GSDA	Kolhapur	Karvir	Jaital	16.60972222	74.18055556	1.6	-0.051212121	0.051212121
61.	GSDA	Kolhapur	Karvir	Girgaon	16.61861111	74.23055556	5.8	-0.330909091	0.330909091
62.	GSDA	Kolhapur	Karvir	Wadipir	16.65416667	74.19722222	3.8	-0.111515152	0.111515152

S/N	Agency	District	Tahsil	Village	Latitude	Longitude	Water Level 2020	Trend	Final trend
63.	GSDA	Kolhapur	Karvir	Chinchawade Tarf Kale	16.70138889	74.07222222	1.9	-0.153939394	0.153939394
64.	GSDA	Kolhapur	Karvir	Khupire	16.70416667	74.13055556	1.7	-0.022121212	0.022121212
65.	GSDA	Kolhapur	Karvir	Kerli	16.75	74.18472222	3.7	0.025030303	-0.025030303
66.	GSDA	Kolhapur	Karvir	Shiye	16.77083333	74.25555556	6.9	-0.666875	0.666875
67.	GSDA	Kolhapur	Panhala	Navalavwadi	16.68055556	74.03444444	2	-0.033939394	0.033939394
68.	GSDA	Kolhapur	Panhala	Marali	16.7125	74.06805556	4.2	0.272454545	-0.272454545
69.	GSDA	Kolhapur	Panhala	Kisrul	16.7375	73.96527778	1.7	-0.023787879	0.023787879
70.	GSDA	Kolhapur	Panhala	Punal	16.75972222	74.05555556	1	-0.121818182	0.121818182
71.	GSDA	Kolhapur	Panhala	Salwadi	16.76666667	74.0125	1.3	-0.047878788	0.047878788
72.	GSDA	Kolhapur	Panhala	Kushire	16.76805556	74.19583333	1	-0.012272727	0.012272727
73.	GSDA	Kolhapur	Panhala	Pimple Thane	16.78277778	74.08194444	1.1	-0.000454545	0.000454545
74.	GSDA	Kolhapur	Panhala	Wadi-Ratnagiri	16.79583333	74.17638889	8.1	0.051212121	-0.051212121
75.	GSDA	Kolhapur	Panhala	Ambavade	16.81527778	74.13194444	8.8	-0.008030303	0.008030303
76.	GSDA	Kolhapur	Panhala	Jakhale	16.8375	74.19583333	2.6	0.038939394	-0.038939394
77.	GSDA	Kolhapur	Radhanagari	Hasane	16.35	73.8625	5.7	-0.21830303	0.21830303
78.	GSDA	Kolhapur	Radhanagari	Kasarwada	16.4	74.07777778	1.3	0.008787879	-0.008787879
79.	GSDA	Kolhapur	Radhanagari	Radhanagari	16.40972222	73.99305556	6	0.127878788	-0.127878788
80.	GSDA	Kolhapur	Radhanagari	Solankur	16.41388889	74.05		0.126785714	-0.126785714
81.	GSDA	Kolhapur	Radhanagari	Shelewadi	16.49444444	74.13194444	1.1	0.034848485	-0.034848485
82.	GSDA	Kolhapur	Radhanagari	Pungaon	16.51666667	74.0625	1.2	-0.071212121	0.071212121
83.	GSDA	Kolhapur	Radhanagari	Dhamod	16.53333333	74.03333333	2	0.044691176	-0.044691176
84.	GSDA	Kolhapur	Radhanagari	Mhasurli	16.58333333	73.97638889	3.7	0.283272727	-0.283272727
85.	GSDA	Kolhapur	Shahuwadi	Wadicharan	16.8875	74.04583333	1.2	-0.016969697	0.016969697
86.	GSDA	Kolhapur	Shahuwadi	Koparde	16.92083333	73.95027778	3	-0.14769697	0.14769697
87.	GSDA	Kolhapur	Shahuwadi	Wadgaon	16.92361111	74.03611111	10.8	0.180757576	-0.180757576
88.	GSDA	Kolhapur	Shahuwadi	Amba	16.97222222	73.79583333	8.7	0.018181818	-0.018181818
89.	GSDA	Kolhapur	Shahuwadi	Kotoli	16.99166667	73.96666667	3.7	-0.253484848	0.253484848
90.	GSDA	Kolhapur	Shirol	Danwad	16.59444444	74.61666667	3.6	-0.173333333	0.173333333
91.	GSDA	Kolhapur	Shirol	Takli	16.59583333	74.61805556	7.4	-0.005454545	0.005454545
92.	GSDA	Kolhapur	Shirol	Ghosarwad	16.60138889	74.55138889	6.6	-0.216071429	0.216071429
93.	GSDA	Kolhapur	Shirol	Kurundvad	16.67722222	74.58472222	2.3	0.126805556	-0.126805556

S/N	Agency	District	Tahsil	Village	Latitude	Longitude	Water Level 2020	Trend	Final trend
94.	GSDA	Kolhapur	Shirol	Ganeshwadi	16.70277778	74.62083333	3.9	0.052121212	-0.052121212
95.	GSDA	Kolhapur	Shirol	Shirol	16.73333333	74.60138889	3.3	-0.076030303	0.076030303
96.	GSDA	Kolhapur	Shirol	Nandani	16.74305556	74.54694444	7.9	-0.367181818	0.367181818
97.	GSDA	Kolhapur	Shirol	Kondigre	16.74583333	74.50333333	5.7	-0.014393939	0.014393939
98.	GSDA	Kolhapur	Shirol	Chipari	16.77083333	74.52083333	6	0.043333333	-0.043333333
99.	GSDA	Kolhapur	Shirol	Nimshirgaon	16.775	74.49166667	5.2	0.005151515	-0.005151515
100.	CGWB	Kolhapur		Surute	15.8375	74.375		0.288333333	-0.288333333
101.	CGWB	Kolhapur		Patne	15.8675	74.23333333		0.086015038	-0.086015038
102.	CGWB	Kolhapur		Karve	15.89722222	74.34027778		-0.030333333	0.030333333
103.	CGWB	Kolhapur		Naganwadi	15.93333333	74.25		-0.282666667	0.282666667
104.	CGWB	Kolhapur		Nesari	16.05666667	74.33055556		-0.2265	0.2265
105.	CGWB	Kolhapur		Ajra	16.11666667	74.2		-0.123333333	0.123333333
106.	CGWB	Kolhapur		Halkarne	16.16944444	74.46944444		-0.073684211	0.073684211
107.	CGWB	Kolhapur		Nitawade	16.23333333	74.05		-0.176156069	0.176156069
108.	CGWB	Kolhapur		Gadhingalaj	16.24083333	74.35166667		-0.020666667	0.020666667
109.	CGWB	Kolhapur		Uttur	16.25833333	74.25416667		-0.724666667	0.724666667
110.	CGWB	Kolhapur		Pimpalgaon	16.29722222	74.21666667		-0.2395	0.2395
111.	CGWB	Kolhapur		Murgud	16.38333333	74.18333333		-0.059	0.059
112.	CGWB	Kolhapur		Radhanagari	16.40833333	73.99583333		-0.182	0.182
113.	CGWB	Kolhapur		Surupali	16.41388889	74.23888889		0.044333333	-0.044333333
114.	CGWB	Kolhapur		Solankur1	16.43333333	74.08333333		0.1095	-0.1095
115.	CGWB	Kolhapur		Khindivarvade-1	16.45166667	74.05333333		-0.105737705	0.105737705
116.	CGWB	Kolhapur		Shelewadi	16.49444444	74.13055556		0.040666667	-0.040666667
117.	CGWB	Kolhapur		Gagan bauda	16.54166667	73.82944444		-0.789833333	0.789833333
118.	CGWB	Kolhapur		Chuye	16.54416667	74.16861111		-0.56	0.56
119.	CGWB	Kolhapur		Aslaj	16.60416667	73.89166667		-0.214	0.214
120.	CGWB	Kolhapur		Washi	16.64027778	74.17916667		0.009166667	-0.009166667
121.	CGWB	Kolhapur		Gokul shirgaon	16.64166667	74.275		-0.030357143	0.030357143
122.	CGWB	Kolhapur		Shiradwad	16.66666667	74.48333333		0.206666667	-0.206666667
123.	CGWB	Kolhapur		Kirve	16.68833333	73.9975		-0.022857143	0.022857143
124.	CGWB	Kolhapur		Parkhandale	16.7	74.01666667		-0.087833333	0.087833333
125.	CGWB	Kolhapur		Khupire	16.70944444	74.16805556		0.653571429	-0.653571429

S/N	Agency	District	Tahsil	Village	Latitude	Longitude	Water Level 2020	Trend	Final trend
126.	CGWB	Kolhapur		Shiroli	16.73333333	74.28333333		-0.274	0.274
127.	CGWB	Kolhapur		Undri	16.78111111	73.98611111		-0.367123288	0.367123288
128.	CGWB	Kolhapur		Panhala	16.81666667	74.1		0.426666667	-0.426666667
129.	CGWB	Kolhapur		Paijarwadi	16.84166667	74.08333333		0.074883227	-0.074883227
130.	CGWB	Kolhapur		Pargaon -1	16.86222222	74.22694444		-0.023809524	0.023809524
131.	CGWB	Kolhapur		Kini wathar	16.87027778	74.2975		-0.798333333	0.798333333
132.	CGWB	Kolhapur		Wadicharan-1	16.87972222	74.0425		-0.365714286	0.365714286
133.	CGWB	Kolhapur		Shahuwadi-1	16.90472222	73.94833333		-0.15	0.15
134.	CGWB	Kolhapur		Amba	16.96777778	73.80694444		0.139097744	-0.139097744

Annexure-VII: Post-Monsoon Water Level Trend data of Kolhapur district.

S/N	District	Taluka	Site	latitude	Longitude	2020	Trend	Final Trend
1.	Kolhapur	Chandgad	Kodali	15.8	74.1875	0.70	-0.031515152	0.031515152
2.	Kolhapur	Chandgad	Hajagoli	15.80833333	74.33333333	1.80	-0.033636364	0.033636364
3.	Kolhapur		Surute	15.8375	74.375	4.90	-0.128571429	0.128571429
4.	Kolhapur	Chandgad	Mauje Karve	15.90833333	74.34444444	5.90	-0.019090909	0.019090909
5.	Kolhapur	Chandgad	Tambulwadi	15.92777778	74.29583333	5.80	-0.043030303	0.043030303
6.	Kolhapur	Chandgad	Date	15.93055556	74.26388889	2.00	-0.026666667	0.026666667
7.	Kolhapur	Chandgad	Shirgaon	15.95138889	74.20972222	9.00	-0.01	0.01
8.	Kolhapur	Chandgad	Kanur Kh	15.975	74.13055556	3.40	-0.051515152	0.051515152
9.	Kolhapur	Chandgad	Hindagaon	15.98305556	74.18333333	4.20	-0.068333333	0.068333333
10.	Kolhapur	Chandgad	Porewadi	15.98472222	74.28333333	11.10	-0.086212121	0.086212121
11.	Kolhapur	Chandgad	Adkur	16.0125	74.26666667	0.40	-0.873636364	0.873636364
12.	Kolhapur	Gadhinglaj	Nesari	16.05527778	74.32777778	1.50	-0.070606061	0.070606061
13.	Kolhapur	Gadhinglaj	Batkanangale	16.1	74.34166667	3.50	-0.046161616	0.046161616
14.	Kolhapur	Gadhinglaj	Kalavi Katti	16.10833333	74.48194444	0.70	-0.040277778	0.040277778
15.	Kolhapur	Ajra	Lakudwadi	16.11666667	74.33472222	1.60	-0.064545455	0.064545455
16.	Kolhapur	Ajra	Maligre	16.12555556	74.28694444	1.30	-0.054848485	0.054848485
17.	Kolhapur	Ajra	Harur	16.1375	74.3125	1.40	0.000606061	-0.000606061
18.	Kolhapur	Gadhinglaj	Mahagaon	16.14722222	74.35	0.40	0.026969697	-0.026969697
19.	Kolhapur	Ajra	Kowade	16.15	74.28333333	2.50	-0.085714286	0.085714286
20.	Kolhapur	Bhudargad	Anap Kh	16.1625	74.00611111	4.70	0.013939394	-0.013939394
21.	Kolhapur	Gadhinglaj	Halkarni	16.16666667	74.46805556	3.90	0.184090909	-0.184090909
22.	Kolhapur	Bhudargad	Deulwadi	16.17361111	74.07083333	1.20	0.058636364	-0.058636364
23.	Kolhapur	Ajra	Khoratwadi	16.18194444	74.26666667	1.30	-0.098484848	0.098484848

S/N	District	Taluka	Site	latitude	Longitude	2020	Trend	Final Trend
24.	Kolhapur	Ajra	Vadakshiwale	16.19305556	74.21805556	1.70	-0.020151515	0.020151515
25.	Kolhapur	Bhudargad	Tiravade	16.20416667	74.07638889	5.10	0.226363636	-0.226363636
26.	Kolhapur	Gadhinglaj	Kasaba Nool	16.20833333	74.44166667	0.30	0.024848485	-0.024848485
27.	Kolhapur	Bhudargad	Vengrul	16.22777778	74.09027778	3.40	-0.007727273	0.007727273
28.	Kolhapur	Gadhinglaj	Nangnur	16.23333333	74.48666667	2.00	-0.02969697	0.02969697
29.	Kolhapur	Gadhinglaj	Nilji	16.23611111	74.42916667	0.70	-0.03	0.03
30.	Kolhapur	Ajra	Uttur	16.23888889	74.26111111	1.90	-0.031060606	0.031060606
31.	Kolhapur	Ajra	Sulgaon	16.23888889	74.26111111	3.50	-0.078787879	0.078787879
32.	Kolhapur	Bhudargad	Karadwadi	16.25277778	74.10694444	8.05	0.108484848	-0.108484848
33.	Kolhapur	Bhudargad	Madur	16.26666667	74.11944444	0.60	-0.095	0.095
34.	Kolhapur	Bhudargad	Helewadi	16.29027778	74.2	1.60	-0.022727273	0.022727273
35.	Kolhapur	Bhudargad	Phanaswadi	16.29305556	74.13611111	1.80	-0.003030303	0.003030303
36.	Kolhapur	Radhanagari	Hasane	16.35	73.8625	3.50	-0.133030303	0.133030303
37.	Kolhapur	Bhudargad	Nilpan	16.35555556	74.13333333	1.40	0.00969697	-0.00969697
38.	Kolhapur	Bhudargad	Madilge Bk	16.36666667	74.15694444	0.90	0.035454545	-0.035454545
39.	Kolhapur	Kagal	Murgud	16.39722222	74.19305556	0.40	-0.040909091	0.040909091
40.	Kolhapur	Radhanagari	Kasarwada	16.4	74.07777778	0.20	-0.056666667	0.056666667
41.	Kolhapur	Bhudargad	Admapur	16.40555556	74.15833333	0.90	-0.008787879	0.008787879
42.	Kolhapur	Kagal	Galgale	16.40833333	74.31666667	3.00	0.107575758	-0.107575758
43.	Kolhapur	Radhanagari	Radhanagari	16.40972222	73.99305556	2.20	-0.080606061	0.080606061
44.	Kolhapur	Kagal	Undarwadi	16.40972222	74.10972222	0.90	-0.011212121	0.011212121
45.	Kolhapur	Radhanagari	Solankur	16.41388889	74.05		0.091428571	-0.091428571
46.	Kolhapur	Kagal	Kurukali	16.42083333	74.24583333	2.60	-0.031212121	0.031212121
47.	Kolhapur	Kagal	Boravade	16.425	74.12777778	0.40	-0.026060606	0.026060606
48.	Kolhapur	Radhanagari	Shelewadi	16.49444444	74.13194444	0.20	-0.006363636	0.006363636

S/N	District	Taluka	Site	latitude	Longitude	2020	Trend	Final Trend
49.	Kolhapur	Radhanagari	Pungaon	16.51666667	74.0625	0.50	-0.108909091	0.108909091
50.	Kolhapur	Radhanagari	Dhamod	16.53333333	74.03333333	1.10	-0.098060606	0.098060606
51.	Kolhapur	Bavda	Gaganbavada	16.54166667	73.82916667	7.30	-0.044545455	0.044545455
52.	Kolhapur	Karvir	Kurukali	16.56777778	74.12027778	0.50	-0.021969697	0.021969697
53.	Kolhapur	Radhanagari	Mhasurli	16.58333333	73.97638889	1.50	0.056666667	-0.056666667
54.	Kolhapur	Hatkanangale	Yalgud	16.59166667	74.4	3.10	-0.071212121	0.071212121
55.	Kolhapur	Shirol	Danwad	16.59444444	74.61666667	1.00	0.013870968	-0.013870968
56.	Kolhapur	Karvir	Kogil Bk	16.59583333	74.2625	1.00	-0.186727273	0.186727273
57.	Kolhapur	Shirol	Takli	16.59583333	74.61805556	3.00	-0.112096774	0.112096774
58.	Kolhapur	Karvir	Jaital	16.60972222	74.18055556	1.00	-0.059848485	0.059848485
59.	Kolhapur	Karvir	Girgaon	16.61861111	74.23055556	1.40	-0.047575758	0.047575758
60.	Kolhapur	Hatkanangale	Rendal	16.62222222	74.43333333	0.80	-0.038787879	0.038787879
61.	Kolhapur	Karvir	Wadipir	16.65416667	74.19722222	0.80	0.001515152	-0.001515152
62.	Kolhapur	Shirol	Kurundvad	16.67722222	74.58472222	0.60	0.059677419	-0.059677419
63.	Kolhapur	Bavda	Tisangi	16.68055556	73.98194444	1.80	0.026666667	-0.026666667
64.	Kolhapur	Panhala	Navalavwadi	16.68055556	74.03444444	1.30	-0.027030303	0.027030303
65.	Kolhapur	Karvir	Chinchawade Tarf Kale	16.70138889	74.07222222	1.00	-0.02469697	0.02469697
66.	Kolhapur	Shirol	Ganeshwadi	16.70277778	74.62083333	1.20	-0.038790323	0.038790323
67.	Kolhapur	Karvir	Khupire	16.70416667	74.13055556	1.00	-0.042424242	0.042424242
68.	Kolhapur	Panhala	Marali	16.7125	74.06805556	2.20	-0.001969697	0.001969697
69.	Kolhapur	Hatkanangale	Korochi	16.73055556	74.43611111	1.00	0.087878788	-0.087878788
70.	Kolhapur	Hatkanangale	Shiroli	16.73333333	74.26666667	2.00	0.012121212	-0.012121212
71.	Kolhapur	Hatkanangale	Halondi	16.73333333	74.30416667	2.80	0.052727273	-0.052727273
72.	Kolhapur	Shirol	Shirol	16.73333333	74.60138889	1.80	-0.112424242	0.112424242
73.	Kolhapur	Panhala	Kisrul	16.7375	73.96527778	1.10	-0.02030303	0.02030303

S/N	District	Taluka	Site	latitude	Longitude	2020	Trend	Final Trend
74.	Kolhapur	Hatkanangale	Chokak	16.74166667	74.34583333	1.80	-0.058484848	0.058484848
75.	Kolhapur	Shirol	Nandani	16.74305556	74.54694444	2.80	-0.577575758	0.577575758
76.	Kolhapur	Hatkanangale	Hatkanangale	16.74444444	74.42583333	3.70	-0.032424242	0.032424242
77.	Kolhapur	Shirol	Kondigre	16.74583333	74.50333333	2.20	0.067419355	-0.067419355
78.	Kolhapur	Karvir	Kerli	16.75	74.18472222	1.80	-0.090945946	0.090945946
79.	Kolhapur	Panhala	Punal	16.75972222	74.05555556	0.20	-0.092878788	0.092878788
80.	Kolhapur	Panhala	Salwadi	16.76666667	74.0125	1.50	-0.002272727	0.002272727
81.	Kolhapur	Panhala	Kushire	16.76805556	74.19583333	3.00	0.024545455	-0.024545455
82.	Kolhapur	Karvir	Shiye	16.77083333	74.25555556	4.30	-0.365909091	0.365909091
83.	Kolhapur	Shirol	Chipari	16.77083333	74.52083333	2.00	-0.00030303	0.00030303
84.	Kolhapur	Hatkanangale	Majale	16.77166667	74.44222222	2.20	-0.011575758	0.011575758
85.	Kolhapur	Shirol	Nimshirgaon	16.775	74.49166667	4.20	-0.026969697	0.026969697
86.	Kolhapur	Panhala	Pimple Thane	16.78277778	74.08194444	0.50	-0.080909091	0.080909091
87.	Kolhapur	Panhala	Wadi-Ratnagiri	16.79583333	74.17638889	6.20	-0.056363636	0.056363636
88.	Kolhapur	Hatkanangale	Nej	16.80083333	74.42861111	2.10	0.08969697	-0.08969697
89.	Kolhapur	Panhala	Ambavade	16.81527778	74.13194444	2.70	-0.021818182	0.021818182
90.	Kolhapur	Hatkanangale	Minche	16.81666667	74.33333333	1.00	-0.012424242	0.012424242
91.	Kolhapur	Panhala	Jakhale	16.8375	74.19583333	0.50	-0.022969697	0.022969697
92.	Kolhapur	Hatkanangale	Pargaon	16.87666667	74.23583333	1.90	-0.306666667	0.306666667
93.	Kolhapur	Shahuwadi	Wadicharan	16.8875	74.04583333	0.90	-0.104848485	0.104848485
94.	Kolhapur	Shahuwadi	Koparde	16.92083333	73.95027778	1.10	0.095454545	-0.095454545
95.	Kolhapur	Shahuwadi	Wadgaon	16.92361111	74.03611111	6.00	0.220030303	-0.220030303
96.	Kolhapur	Shahuwadi	Amba	16.97222222	73.79583333	5.20	-0.066060606	0.066060606
97.	Kolhapur	Shahuwadi	Kotoli	16.99166667	73.96666667	2.60	-0.061515152	0.061515152
98.	Kolhapur		Ajra	16.11666667	74.2	8.5	0.144189189	-0.144189189

S/N	District	Taluka	Site	latitude	Longitude	2020	Trend	Final Trend
99.	Kolhapur		Amba	16.96777778	73.80694444	4.7	0.019102941	-0.019102941
100.	Kolhapur		Aslaj	16.60416667	73.89166667	6.2	-0.035818182	0.035818182
101.	Kolhapur		Chuye	16.54416667	74.16861111	1.2	0.31547619	-0.31547619
102.	Kolhapur		Gadhingalaj	16.24083333	74.35166667	0.9	0.113709677	-0.113709677
103.	Kolhapur		Gagan bauda	16.54166667	73.82944444	7.8	-0.143030303	0.143030303
104.	Kolhapur		Gokul shirgaon	16.64166667	74.275	3.2	0.180545455	-0.180545455
105.	Kolhapur		Halkarne	16.16944444	74.46944444	2.9	0.123151515	-0.123151515
106.	Kolhapur		Kanur Khurd	15.96527778	74.11083333	4.2	0.294047619	-0.294047619
107.	Kolhapur		Karve	15.89722222	74.34027778	6.7	0.057419355	-0.057419355
108.	Kolhapur		Khindivarvade-1	16.45166667	74.05333333	1.1	-0.199099099	0.199099099
109.	Kolhapur		Khupire	16.70944444	74.16805556	1.3	-0.120484848	0.120484848
110.	Kolhapur		Kini wathar	16.87027778	74.2975	3.9	0.145333333	-0.145333333
111.	Kolhapur		Kirve	16.68833333	73.9975	0.6	-0.131547619	0.131547619
112.	Kolhapur		Murgud	16.38333333	74.18333333	0.8	-0.128484848	0.128484848
113.	Kolhapur		Naganwadi	15.93333333	74.25	2.9	0.084242424	-0.084242424
114.	Kolhapur		Nesari	16.05666667	74.33055556	0.3	-0.14830303	0.14830303
115.	Kolhapur		Nitawade	16.23333333	74.05	1.2	-0.508108108	0.508108108
116.	Kolhapur		Paijarwadi	16.84166667	74.08333333	3.05	0.372747748	-0.372747748
117.	Kolhapur		Panhala	16.81666667	74.1	6.1	0.560969697	-0.560969697
118.	Kolhapur		Pargaon -1	16.86222222	74.22694444	3.23	0.213108108	-0.213108108
119.	Kolhapur		Parkhandale	16.7	74.01666667	0.2	-0.076909091	0.076909091
120.	Kolhapur		Patne	15.8675	74.23333333	6.7	0.065575758	-0.065575758
121.	Kolhapur		Pimpalgaon	16.29722222	74.21666667	1.4	-0.038181818	0.038181818
122.	Kolhapur		Radhanagari	16.40833333	73.99583333	5.5	0.083151515	-0.083151515
123.	Kolhapur		Shahuwadi-1	16.90472222	73.94833333	4.5	-0.196721311	0.196721311

S/N	District	Taluka	Site	latitude	Longitude	2020	Trend	Final Trend
124.	Kolhapur		Shelarwadi	16.93416667	73.91444444	2.2	-0.266666667	0.266666667
125.	Kolhapur		Shelewadi	16.49444444	74.13055556	3.7	0.274848485	-0.274848485
126.	Kolhapur		Shiradwad	16.66666667	74.48333333	4.7	-0.155298651	0.155298651
127.	Kolhapur		Shiroli	16.73333333	74.28333333		-0.0725	0.0725
128.	Kolhapur		Solankur1	16.43333333	74.08333333	1.1	-0.021451613	0.021451613
129.	Kolhapur		Surupali	16.41388889	74.23888889	2.2	-0.101515152	0.101515152
130.	Kolhapur		Surute	15.8375	74.375	5.4	-0.028181818	0.028181818
131.	Kolhapur		Undri	16.78111111	73.98611111	3	0.034354839	-0.034354839
132.	Kolhapur		Uttur	16.25833333	74.25416667	0.1	-0.227272727	0.227272727
133.	Kolhapur		Wadicharan-1	16.87972222	74.0425	1.2	-0.046311475	0.046311475
134.	Kolhapur		Washi	16.64027778	74.17916667	3.8	0.017878788	-0.017878788

Annexure-VIII: Results of Chemical analysis of Ground Water Samples, Shallow Aquifers (May 2019)

S/N	District	Tahsil	Village	WELL id	Latitude	Longitude	EC	NO3	F
1.	Kolhapur	Ajra	Ajra	K/KL-001	16.11666667	74.2	409	17	0.02
2.	Kolhapur	Hatkanangale	Shiroli	K/KL-002	16.73333333	74.28333333	1271	34	0.03
3.	Kolhapur	Bhudargad	Murgud	K/KL-004	16.38333333	74.18333333	780	31	0.06
4.	Kolhapur	Hatkanangale	Shiradwad	K/KL-005	16.66666667	74.48333333	928	11	0.02
5.	Kolhapur	Panhala	Panhala	K/KL-006	16.81666667	74.1	230	9	0.03
6.	Kolhapur	Chandgad	Naganwadi	K/KL-007	15.93333333	74.25	104	3	0.04
7.	Kolhapur	Bavda	Partangale	K/KL-008	16.7	74.01666667	618	22	0.01
8.	Kolhapur	Gadhinglaj	Gadinglaj	K/KL-010	16.24083333	74.35166667	568	12	0.03
9.	Kolhapur	Hatkanangale	Kini wathar	K/KL-012	16.87027778	74.2975	1321	22	0.06
10.	Kolhapur	Shahuwadi	Amba	K/KL-013	16.96777778	73.80694444	225	11	0.02
11.	Kolhapur	Panhala	Paijarwadi	K/KL-015	16.84166667	74.08333333	108	18	0.03
12.	Kolhapur	Bavda	Gagan bauda	K/KL-016	16.54166667	73.82944444	160	12	0.05
13.	Kolhapur	Karvir	Gokul shirgaon	K/KL-017	16.64166667	74.275	687	19	1.2
14.	Kolhapur	Bhudargad	Nitawade	K/KL-018	16.23333333	74.05	512	33	0.03
15.	Kolhapur	Bhudargad	Authur	K/KL-019	16.25833333	74.25416667	852	28	0.07
16.	Kolhapur	Gadhinglaj	Nesari	K/KL-022	16.05666667	74.33055556	205	19	0.04
17.	Kolhapur	Chandgad	Karve	K/KL-023	15.89722222	74.34027778	221	12	0.06
18.	Kolhapur	Karvir	Khupire	K/KL-025	16.70944444	74.16805556	527	15	0.05
19.	Kolhapur	Kagal	Surupali	K/KL-029	16.41388889	74.23888889	498	26	0.03
20.	Kolhapur	Bhudargad	Pimpalgaon	K/KL-030	16.29722222	74.21666667	677	18	0.04
21.	Kolhapur	Radhanagari	Radhanagari	K/KL-032	16.40833333	73.99583333	441	10	0.01
22.	Kolhapur	Chandgad	Patne	K/KL-033	15.8675	74.23333333	670	10	0.03
23.	Kolhapur	Karvir	Washi	K/KL-034	16.64027778	74.17916667	446	35	0.13

S/N	District	Tahsil	Village	WELL id	Latitude	Longitude	EC	NO3	F
24.	Kolhapur	Chandgad	Surute	K/KL-035	15.8375	74.375	372	31	0.06
25.	Kolhapur	Gadhinglaj	Halkarne	K/KL-036	16.16944444	74.46944444	1116	11	0.05
26.	Kolhapur	Radhanagari	Shelewadi	K/KL-037	16.49444444	74.13055556	519	5	0.12
27.	Kolhapur	Bavda	Aslaj	K/KL-039	16.60416667	73.89166667	48	2	0.05
28.	Kolhapur	Radhanagari	Solankur1	K/KL-043	16.43333333	74.08333333	221	12	0.06
29.	Kolhapur	Hatkanangale	Pargaon -1	K/KL-044	16.86222222	74.22694444	520	14	0.19
30.	Kolhapur	Radhanagari	Khindivarvade-1	K/KL-045	16.45166667	74.05333333	216	11	0.01
31.	Kolhapur	Shahuwadi	Wadicharan-1	K/KL-046	16.87972222	74.0425	450	36	0.06
32.	Kolhapur	Shahuwadi	Shelarwadi	K/KL-047	16.93416667	73.91444444	129	7	0.05
33.	Kolhapur	Bavda	Kirve	K/KL-048	16.68833333	73.9975	151	33	0.06
34.	Kolhapur	Chandgad	Kanura Khurd	K/KL-049	15.96527778	74.11083333	381	12	0.07
35.	Kolhapur	Karvir	Cheye	K/KL-050	16.54416667	74.16861111	333	16	0.04
36.	Kolhapur	Shahuwadi	Shahuwadi-1	K/KL-052	16.90472222	73.94833333	356	13	0.92
37.	Kolhapur	Kagal	Kagal	K/KL-053	16.58055556	74.31194444	743	42	0.25
38.	Kolhapur	Shirol	Shirol	K/KL-054	16.73805556	74.60416667	3699	62	1.02
39.	Kolhapur	Bhudargad	Madigi Budrukh1	K/KL-055	16.36444444	74.15166667	296	14	0.44
40.	Kolhapur	Chandgad	Shirgaon1	K/KL-056	15.945	74.20888889	718	34	0.99

Annexure IX: Results of Chemical analysis of Ground Water Samples, Deeper Aquifers (May 2019)

S/N	Taluka	Location	Lat	Long	pH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F
1	Panhala	Kodoli EW	16.87082	74.215252	7.9	692	367	120	34	9	90	0.2	0	366.1	14	12	9.8	0.29
2	Shirol	Kondigre EW	16.748662	74.506761	7.4	2286	1522	1000	361	24	5.7	0.06	0	695.6	11	300	41	0.99
3	Kagal	Kasba Sangaon EW	16.59265	74.36027	6.9	3105	1645	1100	397	27	1.4	0.04	0	671.2	11	280	14	0.29
4	Gaganbawda	Gaganbawda EW	16.542275	73.829922	7.4	237	123	90	10	16	2.1	0.72	0	73.22	14	5	4	0.56
5	Gaganbawda	Asandoli EW	16.657511	73.940265	9.1	150	79	60	10	9	10	0.78	0	61.02	21	3	5.7	0.55
6	Gaganbawda	Asandoli OW	16.657524	73.940118	8.2	146	78	50	14	4	9.9	0.7	0	67.12	11	4	6	0.55
7	Karvir	Shingnapur EW	16.707965	74.18	8	292	154	125	12	23	2.9	0.5	0	109.8	7.1	13	6.8	0.77
8	Gadhinglaj	Kadgaon EW	16.248858	74.296702	7.7	1716	965	530	206	4	105	10.9	0	518.7	121	98	6.2	0.7
9	Gadhinglaj	Tamnakwada EW	16.308417	74.293095	6.4	353	187	175	30	24	0.3	0.14	0	115.9	11	45	11.3	1.2
10	Gadhinglaj	Tamnakwada OW	16.308514	74.293162	8.4	351	182	145	24	21	11	1.02	18	183.1	14	4	6	1.6
11	Bhudargad	Hamidwada EW	16.41442	74.27863	8.1	258	135	105	20	13	8.9	0.71	0	122	7.1	3	23	2.8
12	Bhudargad	Akurde EW	16.307473	74.103915	7.6	292	154	100	10	18	11	1.6	47	115.9	11	20	11.3	2.6
13	Bhudargad	Akurde OW	16.307421	74.103995	12	213	131	75	8	13	11	1.5	23	85.43	11	2	9.9	1.47
14	Bhudargad	Mamdapur EW	16.214081	74.086557	8.7	242	128	75	10	12	8.7	1.8	12	61.02	14	3	31	1.19

1	Bhudargad	Mamdapur OW	16.214106	74.086475	8.3	170	91	65	14	7	6.2	0.3	0	73.22	11	4	6	1.1
1	Bhudargad	Shivdav EW	16.160791	73.954534	8.1	198	104	95	12	16	2.6	1.7	0	61.02	25	5	7.6	1.2
1	Bhudargad	Shivdav OW	16.16078	73.954237	8.3	173	91	45	8	6	7.4	0.5	0	42.71	14	2	11.6	0.65
1	Panhala	Awali EW	16.85496	74.08234	8.1	357	189	80	18	9	12	0.8	12	91.53	11	8	2.9	0.75
1	Shahuwadi	Shirale EW/1	16.865898	73.935564	8.3	245	130	75	8	13	9.4	1.9	12	91.53	14	2	6.3	1
2	Shahuwadi	Shirale EW/2	16.865898	73.935564	8.3	212	112	80	6	16	7.9	0.35	18	91.53	7.1	4	2.8	1.25
2	Shahuwadi	Kotoli EW/1	16.991329	73.964803	8.4	383	203	160	36	17	12	1.6	0	158.7	28	-	6.9	0.48
2	Shahuwadi	Kotoli EW/2	16.991329	73.964803	7.8	440	233	140	28	17	11	0.56	0	158.7	14	-	22.7	0.62

Annexure-X: Groundwater Resources Assessment of Kolhapur district.

S/N	Assessment Unit Name	Longitude	Latitude	Annual Extractable Ground Water Recharge (MCM)	Current Annual Ground Water Extraction(MCM)	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/ Semicritical/ Safe)	Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction (Ham)
1.	Ajra	74.202928000	16.107942000	79.03	34.34	43.45	Safe	7903.21	3434.00
2.	Bhudargad	74.147490000	16.308228000	64.46	26.48	41.08	Safe	6446.43	2648.24
3.	Chandgad	74.189953000	15.927014000	143.95	73.87	51.31	Safe	14394.83	7386.70
4.	Gadhinglaj	74.348803000	16.215842000	121.20	69.87	57.65	Safe	12120.09	6986.75
5.	Gagan Bawda	73.852006000	16.537921000	35.42	6.62	18.68	Safe	3542.40	661.82
6.	Hatkanangale	74.406943000	16.728350000	107.60	62.92	58.47	Safe	10760.40	6292.10
7.	Kagal	74.317844000	16.587765000	121.64	48.03	39.49	Safe	12164.45	4803.25
8.	Kolhapur (Karvir)	74.223052000	16.704561000	129.60	51.82	39.98	Safe	12959.58	5181.64
9.	Panhala	74.118859000	16.806534000	92.61	43.44	46.91	Safe	9261.32	4344.07
10.	Radhanagari	73.970672000	16.407112000	157.34	41.17	26.17	Safe	15733.53	4116.73
11.	Shahuwadi	73.925303000	16.907543000	61.64	18.37	29.80	Safe	6163.77	1837.09
12.	Shirol	74.604744000	16.732964000	106.34	36.16	34.01	Safe	10634.14	3616.49

Annexure-XI: Location of proposed Percolation tanks in Kolhapur district

S/N	District	Taluka	Village	Type	Longitude	Latitude
1.	Kolhapur	Hatkanangle	Bhadole	Percolation Tank	74.34665	16.85961
2.	Kolhapur	Hatkanangle	Kini	Percolation Tank	74.29184	16.8694
3.	Kolhapur	Kagal	Anur	Percolation Tank	74.2652	16.45093
4.	Kolhapur	Karvir	Mudsingi	Percolation Tank	74.31276	16.68716
5.	Kolhapur	Panhala	Dewale	Percolation Tank	74.11321	16.86607
6.	Kolhapur	Panhala	Satave	Percolation Tank	74.11338	16.89198
7.	Kolhapur	Panhala	Shahapur	Percolation Tank	74.13972	16.85573
8.	Kolhapur	Radhanagari	Bujawade	Percolation Tank	74.03177	16.40449
9.	Kolhapur	Radhanagari	Konoli Tarf Asandoli	Percolation Tank	73.9516	16.54638
10.	Kolhapur	Radhanagari	Padali	Percolation Tank	73.97629	16.42325
11.	Kolhapur	Radhanagari	Piral	Percolation Tank	73.9871	16.44451
12.	Kolhapur	Radhanagari	Radhanagari	Percolation Tank	73.97878	16.41418
13.	Kolhapur	Shahuwadi	Akurle	Percolation Tank	73.99566	16.96311
14.	Kolhapur	Shahuwadi	Savarde Kh.	Percolation Tank	73.98093	16.92055
15.	Kolhapur	Shirol	Danoli	Percolation Tank	74.48756	16.79534
16.	Kolhapur	Shirol	Danoli	Percolation Tank	74.50032	16.80261
17.	Kolhapur	Shirol	Danoli	Percolation Tank	74.51363	16.80561
18.	Kolhapur	Shirol	Danoli	Percolation Tank	74.48494	16.80864
19.	Kolhapur	Shirol	Danoli	Percolation Tank	74.48873	16.82248
20.	Kolhapur	Shirol	Danoli	Percolation Tank	74.51233	16.83225
21.	Kolhapur	Shirol	Danoli	Percolation Tank	74.49305	16.83299
22.	Kolhapur	Shirol	Jainapur	Percolation Tank	74.50597	16.78412
23.	Kolhapur	Shirol	Kothali	Percolation Tank	74.53472	16.81868
24.	Kolhapur	Shirol	Tamadalge	Percolation Tank	74.46452	16.78034

25.	Kolhapur	Shirol	Tamadalge	Percolation Tank	74.46295	16.78746

Annexure-XII: Location of proposed check dam in Kolhapur district

SN	District	Taluka	Village	Type	Longitude	Lattitude
1.	Kolhapur	Hatkanangle	Ambap	Check dam	74.25346	16.84692
2.	Kolhapur	Hatkanangle	Hatkanangale	Check dam	74.45095	16.75783
3.	Kolhapur	Hatkanangle	Kumbhoj	Check dam	74.4153	16.82065
4.	Kolhapur	Hatkanangle	Narande	Check dam	74.39149	16.82148
5.	Kolhapur	Hatkanangle	Padali	Check dam	74.24533	16.83485
6.	Kolhapur	Hatkanangle	Tilwani	Check dam	74.41808	16.71311
7.	Kolhapur	Kagal	Arjunwada	Check dam	74.27178	16.37411
8.	Kolhapur	Kagal	Savarde Bk.	Check dam	74.1908	16.44707
9.	Kolhapur	Karvir	Gokul Shirgaon (CT)	Check dam	74.27607	16.63895
10.	Kolhapur	Karvir	Kandalgaon	Check dam	74.25743	16.65071
11.	Kolhapur	Karvir	Sangwade	Check dam	74.32193	16.66014
12.	Kolhapur	Karvir	Ujalaiwadi (CT)	Check dam	74.26169	16.65884
13.	Kolhapur	Panhala	Amatewadi	Check dam	74.11414	16.88043
14.	Kolhapur	Panhala	Awali	Check dam	74.0804	16.8465
15.	Kolhapur	Panhala	Borivade	Check dam	74.06754	16.84203
16.	Kolhapur	Panhala	Borpadale	Check dam	74.11775	16.82928
17.	Kolhapur	Panhala	Borpadale	Check dam	74.11473	16.83507
18.	Kolhapur	Panhala	Injole	Check dam	74.06923	16.81295
19.	Kolhapur	Panhala	Jeeur	Check dam	74.0812	16.82033
20.	Kolhapur	Panhala	Jeeur	Check dam	74.09275	16.83346
21.	Kolhapur	Panhala	Paijarwadi	Check dam	74.09148	16.84231
22.	Kolhapur	Panhala	Shindewadi	Check dam	74.09119	16.8697
23.	Kolhapur	Radhanagari	Bujawade	Check dam	74.02186	16.40106
24.	Kolhapur	Radhanagari	Chandre	Check dam	74.12632	16.47941
25.	Kolhapur	Radhanagari	Chandre	Check dam	74.12579	16.49264

SN	District	Taluka	Village	Type	Longitude	Lattitude
26.	Kolhapur	Radhanagari	Durgmanwadi	Check dam	73.97273	16.45346
27.	Kolhapur	Radhanagari	Keloshi Bk.	Check dam	73.96887	16.53749
28.	Kolhapur	Radhanagari	Kurhadwadi	Check dam	74.09695	16.49126
29.	Kolhapur	Radhanagari	Padali	Check dam	73.98017	16.43191
30.	Kolhapur	Radhanagari	Padali	Check dam	73.96763	16.44734
31.	Kolhapur	Radhanagari	Radhanagari	Check dam	74.01871	16.4077
32.	Kolhapur	Radhanagari	Shiroli	Check dam	74.02203	16.41388
33.	Kolhapur	Radhanagari	Talgaon	Check dam	73.9599	16.48956
34.	Kolhapur	Radhanagari	Thikpurli	Check dam	74.09753	16.50043
35.	Kolhapur	Radhanagari	Turambe	Check dam	74.11754	16.45247
36.	Kolhapur	Radhanagari	Turambe	Check dam	74.10474	16.46215
37.	Kolhapur	Shahuwadi	Ameni	Check dam	73.98095	16.95284
38.	Kolhapur	Shahuwadi	Ameni	Check dam	73.97928	16.96167
39.	Kolhapur	Shahuwadi	Bhedasgaon	Check dam	74.00182	16.97432
40.	Kolhapur	Shahuwadi	Bhedasgaon	Check dam	74.00114	16.97861
41.	Kolhapur	Shahuwadi	Mangaon	Check dam	73.99336	16.94764
42.	Kolhapur	Shahuwadi	Shivare	Check dam	74.00033	16.94243
43.	Kolhapur	Shirol	Chipari	Check dam	74.50476	16.7599
44.	Kolhapur	Shirol	Danoli	Check dam	74.50842	16.79424
45.	Kolhapur	Shirol	Danoli	Check dam	74.50542	16.79505
46.	Kolhapur	Shirol	Danoli	Check dam	74.49906	16.79592
47.	Kolhapur	Shirol	Danoli	Check dam	74.51436	16.79956
48.	Kolhapur	Shirol	Danoli	Check dam	74.47442	16.80019
49.	Kolhapur	Shirol	Danoli	Check dam	74.49087	16.80322
50.	Kolhapur	Shirol	Danoli	Check dam	74.4733	16.80468
51.	Kolhapur	Shirol	Danoli	Check dam	74.47997	16.80798
52.	Kolhapur	Shirol	Danoli	Check dam	74.48282	16.81464

SN	District	Taluka	Village	Type	Longitude	Lattitude
53.	Kolhapur	Shirol	Danoli	Check dam	74.49408	16.81522
54.	Kolhapur	Shirol	Danoli	Check dam	74.5031	16.81882
55.	Kolhapur	Shirol	Danoli	Check dam	74.48001	16.82721
56.	Kolhapur	Shirol	Danoli	Check dam	74.47551	16.83389
57.	Kolhapur	Shirol	Jainapur	Check dam	74.50998	16.78152
58.	Kolhapur	Shirol	Jainapur	Check dam	74.50938	16.78762
59.	Kolhapur	Shirol	Kavathesar	Check dam	74.48129	16.85423
60.	Kolhapur	Shirol	Kavathesar	Check dam	74.47371	16.85509
61.	Kolhapur	Shirol	Kondigre	Check dam	74.49298	16.74228
62.	Kolhapur	Shirol	Kondigre	Check dam	74.49564	16.75615
63.	Kolhapur	Shirol	Kothali	Check dam	74.52191	16.79921
64.	Kolhapur	Shirol	Kothali	Check dam	74.52495	16.80859
65.	Kolhapur	Shirol	Nimshirgaon	Check dam	74.48553	16.76215
66.	Kolhapur	Shirol	Nimshirgaon	Check dam	74.49548	16.7851
67.	Kolhapur	Shirol	Nimshirgaon	Check dam	74.49196	16.78523
68.	Kolhapur	Shirol	Nimshirgaon	Check dam	74.47679	16.78626
69.	Kolhapur	Shirol	Nimshirgaon	Check dam	74.48153	16.78767
70.	Kolhapur	Shirol	Nimshirgaon	Check dam	74.48926	16.78996
71.	Kolhapur	Shirol	Tamadalge	Check dam	74.45286	16.7826
72.	Kolhapur	Shirol	Tamadalge	Check dam	74.4498	16.78766
73.	Kolhapur	Shirol	Tamadalge	Check dam	74.47023	16.78958
74.	Kolhapur	Shirol	Tamadalge	Check dam	74.46039	16.79351