केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय

भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga Rejuvenation

Government of India

Report

on

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN

Dhule and Sakri Taluka

Dhule District, Maharashtra

मध्यक्षेत्र, नागपुर

Central Region, Nagpur

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLANS, DHULE AND SAKRI BLOCKS, DHULE DISTRICT, MAHARASHTRA
(AAP 2017-18)

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DHULE DISTRICT AT A GLANCE

1. GENERAL INFORMATION			
	Geographical Area	:	8061 Sq. Km.
	Administrative Divisions (2011)	:	Taluka- 4, Dhule, Sakri, Shirpur and Sindkheda.
	Villages	:	683
	Population	:	2,050,862
	Average Annual Rainfall (2007-2016)	:	2531.64 mm
	Actual Rainfall 2017		1006.3 mm
2. GEOMORPHOLOGY			
	Major Physiographic unit	:	2; Tapi valley proper and the region of the dykes and residual hills of the Sahayadri Spurs
	Major Drainage	:	1; Tapi River
3. LAND USE (2011-12) (sources: mahasdb.maharashtra.gov.in/district Report)			
	Forest Area	:	2051 sq. km.
	Cultivable Area	:	4752 sq. km.
	Net Area Sown	:	4966 sq. km.
4.	**SOIL TYPE**	:	3; Deep fertile soils in Alluvial areas and medium deep coarse soils to shallow stony soils away from Tapi River in Basaltic areas.
5. PRINCIPAL CROPS (2008-09)			
	Cotton	:	883 sq. km.
	Bajri	:	1380 sq. km.
	Groundnut	:	375 sq. km.
	Jowar	:	382 sq. km.
	Wheat	:	220 sq. km.
6. IRRIGATION BY DIFFERENT SOURCES (2006-2007) **– Nos. / Potential Created (ha)**			
	Dugwells	:	59339/1194.41
	Borewells	:	7767/119.64
	Surface flow Schemes	:	1740/544.77
	Surface Lift Schems	:	2626/353
7. GROUND WATER MONITORING WELLS (2017)			
	Dugwells	:	37
	Piezometers	:	02
8. GEOLOGY			
	Recent	:	Alluvium
	Upper Cretaceous-Lower Eocene	:	Deccan Trap Basalt
	Middle - Upper Cretaceous	:	Bagh Beds
9. HYDROGEOLOGY			
	Water Bearing Formation	:	Basalt-Weathered/fractured/ jointed amygdaloidal/massive, under phreatic and

			semi-confined to confined conditions. Alluvium- Sand and Gravel under phreatic and semi-confined to confined conditions.
	Pre-monsoon Depth to Water Level (May-2017)	:	1.7 m bgl (Narwhal) – 20.6 m bgl (Hisala)
	Post-monsoon Depth to Water Level (Nov.-2017)	:	0.9 m bgl (Charanmal) – 19.1 m bgl (Hisala)
	Pre-monsoon Water Level Trend (2008-2017)	:	Rise : 0.0634 m bgl (Dhule) -- 0.8165 m bgl (Dhavda_Pz)
			Fall : 0.0424 m bgl (Sangivi) – Sakri2 m bgl (0.5290)
	Post-monsoon Water Level Trend (2008-2017)	:	Rise : 0.0034 m bgl (Dusane) - 0.53 m bgl (Walwadi)
			Fall : 0.19 m bgl (Sadgaon) – 0.002 m bgl (Dhamnar)
10. GROUND WATER EXPLORATION (March, 2013)			
	Wells Drilled	:	EW-11, OW-04, PZ-1+5
	Depth Range	:	41.1 to 250 m bgl
	Discharge	:	0.067 to 17.55 lps
11. GROUND WATER QUALITY			
	Good and suitable for drinking and irrigation purpose, however localized nitrate and fluoride contamination is observed.		
	Type of Water	:	Ca-HCO3 and Ca-Cl
12. DYNAMIC GROUND WATER RESOURCES(ham)- (2013)			
	Net Annual Ground Water Availability	:	70488.53
	Total Draft (Irrigation + Domestic+ Industrial)	:	36754.09
	Projected Demand (Domestic + Industrial)	:	3520.35
	Stage of Ground Water Development	:	52.14%
	Overall Category		**Safe**
16. MAJOR GROUND WATER PROBLEMS AND ISSUES			
	• The ground water exploitation has resulted in decline of water levels over the period of time. In premonsoon season, decline more than 0.20 m/year has been observed in Sakri taluka and in small patches in Dhule and Sindkheda talukas. In post-monsoon season, decline more than 0.20 m/year has been observed in major part of Sindkheda and Shirpur talukas and isolated parts of Sakri and Dhule talukas. • The stage of ground water development remains low despite increase in wells.		

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLANS, DHULE AND SAKRI BLOCKS, DHULE DISTRICT, MAHARASHTRA
(AAP 2017-18)

CONTENTS

LIST OF FIGURES

LIST OF TABLES AND ANNEXURES

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLANS, DHULE AND SAKRI BLOCK, DHULE DISTRICT, MAHARASHTRA

1.0 INTRODUCTION

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

The vagaries of rainfall, inherent heterogeneity & unsustainable nature of hard rock aquifers, over exploitation of once copious alluvial aquifers, lack of regulatory mechanism has a detrimental effect on ground water scenario in the Country over the 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 Dhule 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 Area under Study

Dhule district, formerly known as west Khandesh is located in northern part of Maharashtra State. It is bounded between north latitude 20°38' to 21°61' and east longitude 73°50' to 75°11'. The district is bounded by Nandurbar district in the north- west, Nashik district in south and Jalgaon district in east. The district headquarters is located at Dhule town. For administrative convenience, the district is divided into 4 talukas viz, Dhule, Sakri, Shirpur and Sindkheda. The district has a geographical area of 8061 sq. km. out of which 2051 sq.km. is covered by forest, whereas cultivable area is 4752 sq. km. and net sown area is 4966 sq. km. Agriculture is the main occupation of the people. The entire district forms a part of the Tapi basin. It has a total population of 2,050,862 as per 2011 census. The district has 4 towns and 683 villages. Tapi is the main river flowing through the district.

Since 1980, Central Ground Water Board has taken up several studies in the district. Keeping in view the current demand and supply and futuristic requirements of water,

Central Ground Water Board initiated the National Aquifer Mapping Programme (NAQUIM) in country during XII five-year plan, with a priority to study Over-exploited, Critical and Semi-Critical talukas. Hence, Dhule and Sakri talukas of Dhule district have been taken up to carry out detailed hydrogeological studies during the year 2017-18. Dhule district is categorized as safe as per Ground Water Resources Estimation as on March 2013. The Index and Administrative map of the study area is presented in **Figure 1 & 2**, respectively.

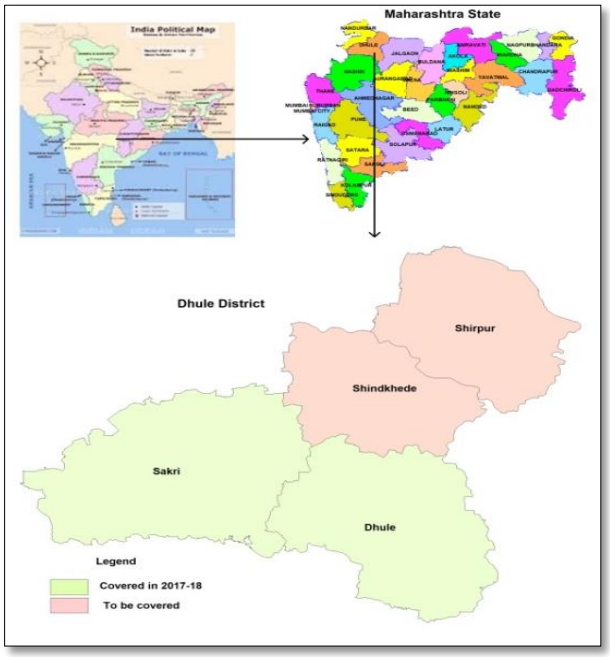


Figure 1. Index Map

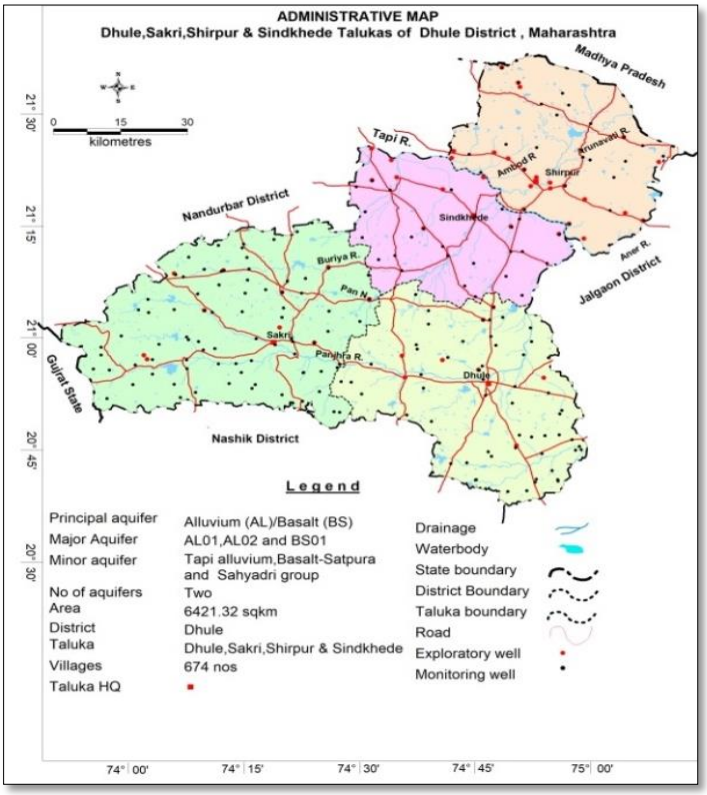


Figure 2. Administrative boundaries with existing exploratory and Ground Water Monitoring Wells

Ground water exploration has been carried out in the district in different phases, since 1957 covering alluvial and Deccan basalt occupied areas of the district to establish the aquifer geometry, disposition and potential of aquifers down to the depth of 200 m bgl. Exploratory wells have been constructed where the data gap existed and accordingly 9 bore wells were constructed during 2017-18 in the study area. Salient Features of Ground Water Exploration are given in **Annexure –I.**

1.2 Physiography, Drainage and Soil Types

As shown in **Figure 3**, the district can be broadly divided into following regions i) Satpura Region, ii) Tapi valley region iii) the region of the dykes and residual hills of the Sahyadri Spurs with eastward trending streams in between. The region of dykes and residual hills of the Sahyadri Spurs is observed in southern part of Sindkheda and entire Sakri and Dhule talukas. The district is drained by Tapi River and its tributaries. Tapi River flows westward through the central part of the district. Panjra and Aner rivers are the main tributaries of Tapi, flowing northward and southward respectively to join Tapi River

In the Tapi valley proper, the soils are deep black and extremely fertile except in some portions near the main river and its tributaries, which have cut down the land very badly and removed the top soil. Otherwise the soils grade from the deep fertile soils to coarse shallow to stony soils away from the river either northwards towards the Satpudas or south ward towards the residual hills and dykes.

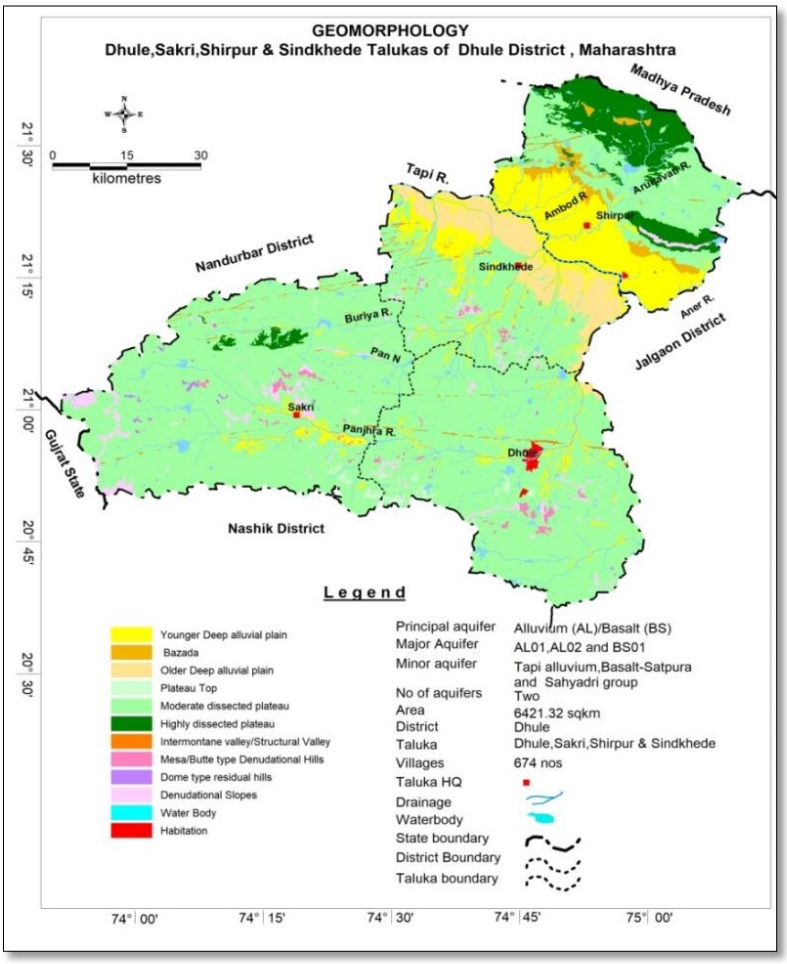


Figure 3: Physiography and Drainage

1.3 Climate and Rainfall

The Climate of the district is characterized by a hot summer and general dryness throughout the year except during the south-west monsoon season, i.e., June to September. The daily mean minimum temperature was 16°C and mean maximum temperature was 45°C. The annual average rain fall in mm ranges from 469.12 to 629.23.

The decadal average of annual rainfall is identified to be lowest in Dhule taluka (469 mm) and highest Shirpur taluka (629.23 mm) and the same is presented in **Table 1**. It is the minimum in the central parts of the district around Dhule and Sakri and Sindkhed and increases northwards and westwards (**Figure 4 & 5**). The study of negative departures of the annual rainfall over normal reveals that western and southern parts of the district experienced moderate and severe drought conditions for more than 20% of years. Hence this part occupying parts of Sakri and Dhule talukas can be categorized as drought area.

Table 1: Annual Rainfall Data (2007-2016) (mm)

Taluka	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
Dhule	668	492	568	641	500	467.3	842.9	597.7	512	501.5	469.12
Sakri	798	538	634	608	546	281	969.5	566.6	491.5	579.8	486.60
Shirpur	1061	624	922	965	610	433	1122.1	768.8	555.2	499	629.23
Shindkheda	747	398	748	533	533	543	973	544.7	571.1	362.7	504.61

(Source: www.agri.mah.nic.in)

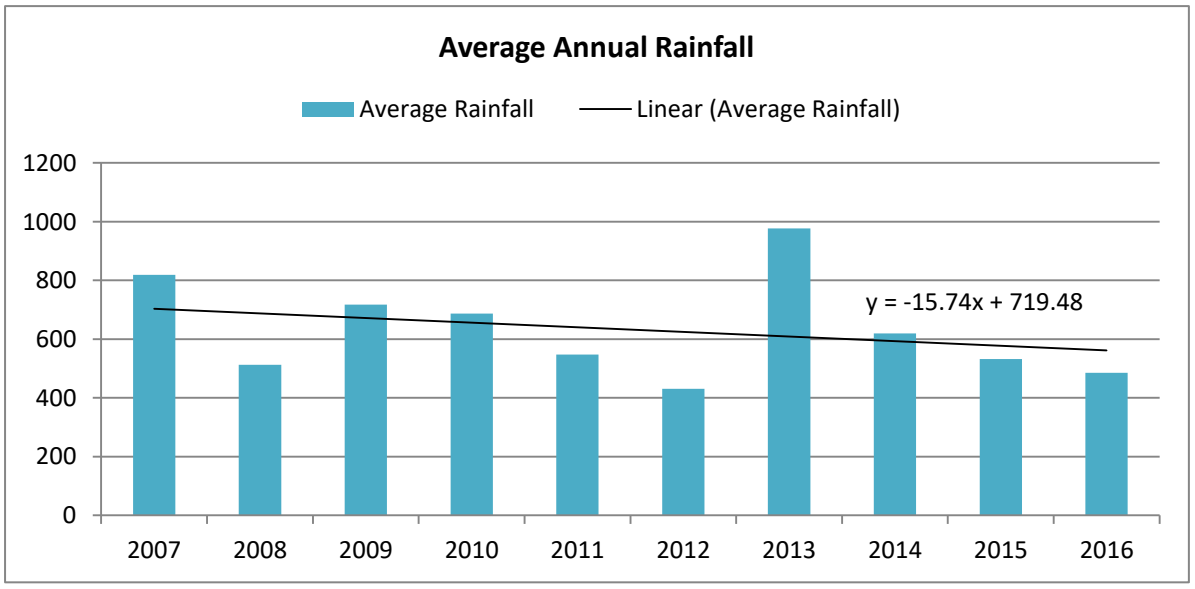


Figure 4: Average Annual Rainfall

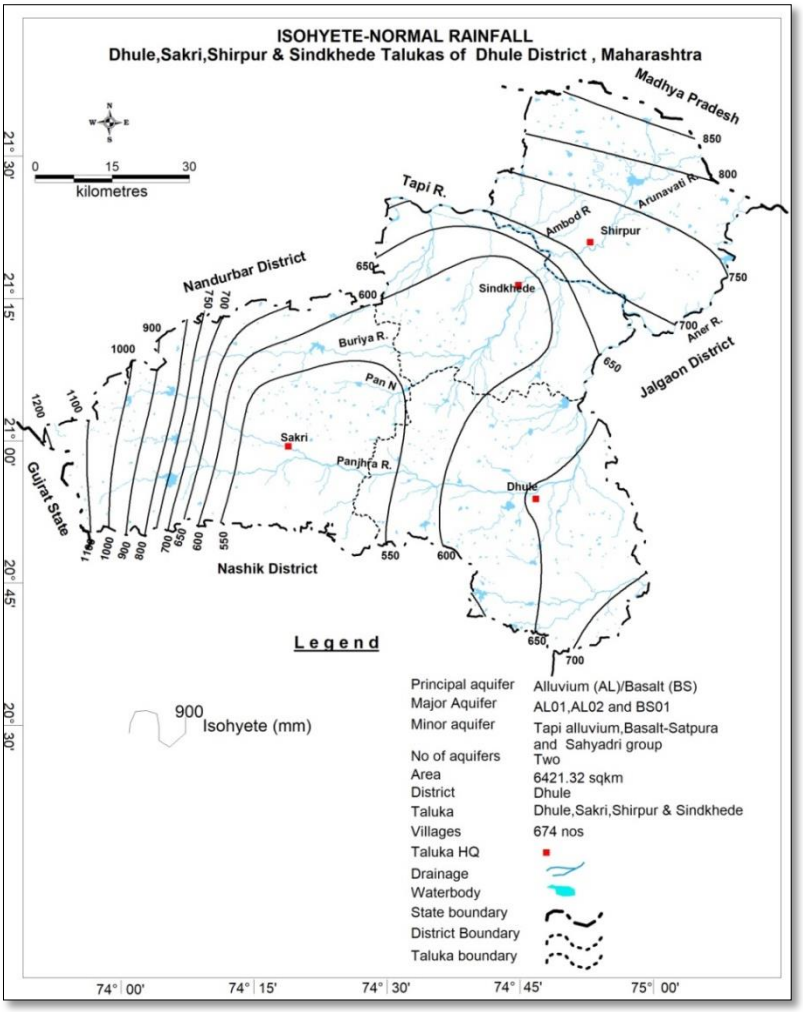


Figure 5. Isohyetal map of Dhule District

1.4 Geology

The major part of the district is occupied by Basaltic flows commonly known as Deccan Traps intruded by dykes of Upper Cretaceous-Lower Eocene age. Tapi Alluvial deposits are observed in Tapi River valley occupying parts of Sindkhed and Shirpur talukas. A small patch of Bagh Beds is exposed in northwestern portion of the district. The geological map of the district is presented in **Figure 6** and the sequence is presented in **Table 2**.

Bagh Beds

They are met within the nortwestern part of the district. The sandstones are fine to medium grained, pink in colour and hard compact in nature. They are overlain by Grey limestones. Between the overlying traps and the Bagh Beds there is a slight but distinct unconformity.

Deccan Trap Basalt

The Deccan Trap includes several flows of Basalt which are supposed to have extruded from fissure volcanoes. The flows have been grouped under the Massive Zeolitic, Vesicular and amygdaloidal types. The vesicular basalt occurs at the upper parts of the flow and the vesicles are generally round or ellipsoidal in shape. The Deccan trap in the district consists of a number of flows ranging in thickness between 15 and 50m. The different Lava flows are separated by Red bole or intertrappean beds. The flows have been intruded by

large number of dykes of doleritic composition. The dykes are aligned in an ENE-WSW direction and a few gave N-S or WNE-ESE trends. Basalt includes the "pahoehoe" and the "aa" types of flows, the former being very common.

Soft Rock Areas - Alluvium

Alluvial deposits of Tapi River valley occurs in long narrow basin, which are probably caused by faulting. About a 15% of the district is occupied by Alluvium. The alluvial tract is about 6.4 km wide around Torkhed and shirpur and about 12.8 km wide around Taloda north of the Tapi River. The alluvium ranges in thickness from paper-edge near its contact with the Trap to about 48.7 m in the eastern part of the basin. It consists of clays, silt, sand, gravels and boulders etc. The beds of sand and gravels are discontinuous and lenticular and pinch out laterally within short distance. They are mixed with large proportions of clayey material rendering delimiting of individuals granular horizons difficult.

Table 2: Generalized Geological sequence Dhule District

Age	Formation	Lithology
Recent	Alluvium	Clay, Silt, Sand, Gravel, Kanker etc.
Eocene to upper Cretaceous	Deccan traps	Basalt hard, massive, vesicular, amygdaloidal varieties with intertrappean.
----------Unconformity----------		
Upper Cretaceous	Bagh Beds	Sandstones, Shales and Limestones

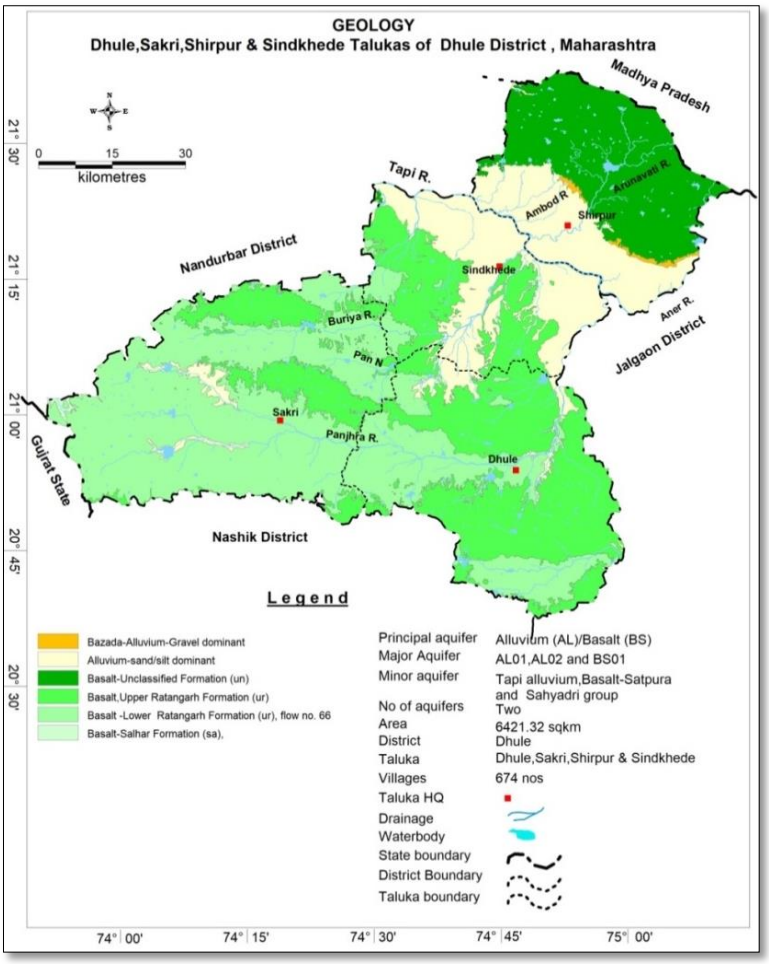


Figure 6: Geological Map

2.0 HYDROGEOLOGY

Alluvium and Basalt aquifers are the main aquifers in the district. Two aquifer Systems in Basalt and one in Alluvium are found to be prevailing in the district (**Figure 7**).

2.1 Major aquifer system

Hydrogeology of the district is depicted in **Figure 7**. The Deccan Trap includes several flows of Basalt which are supposed to have extruded from fissure volcanoes. The flows have been intruded by large number of dykes of doleritic composition. The dykes are aligned in an ENE-WSW direction and a few gave N-S or WNE-ESE trends. Basalt includes the "pahoehoe" and the "aa" types of flows, the former being very common. The ground water occurs in the near surface strata down to the depth of 20 m under unconfined conditions in the weathered zone, vesicular/amygdaloidal Basalt, jointed and fractured massive Basalt. The water bearing strata occurring below 30 m depth, beneath the red bole and dense massive Basalt exhibit semi-confined to confined conditions. On the elevated plateau tops having large areal extent, local water table develops in top most layers and the wells in such areas show rapid decline water levels in post-monsoon season and go dry during peak summer.

In the foot hills zone the water table is relatively shallow near the water courses and deep away from it and near the water divides. In the valleys and plains of river basin the water table aquifer occurs at shallow depth and the wells in such areas do not go dry and sustain perennial yield except in extreme summer or drought conditions. The yield of the dugwells varies from 60 to 125 m^3/day, whereas those of borewells vary from 2 to > 20 m^3/hr, however in most of the borewells it ranges between 22 to 10m^3 /hr.

Soft Rock Areas - Alluvium

Alluvial deposits of Tapi River valley occurs in long narrow basin, which are probably caused by faulting. About a 15% of the district is occupied by Alluvium. It consists of clays, silt, sand, gravels and boulders etc. The beds of sand and gravels are discontinuous and lenticular and pinch out laterally within short distance. They are mixed with large proportions of clayey material rendering delimiting of individuals granular horizons difficult. As per ground water exploration data Alluvium is encountered down to 100 m depth. Ground water occurs under water table, semi-confined and confined conditions in inter granular pore spaces of gravel and sand. The yield of the dugwells varies between 150 and 200 m^3/day and that of exploratory wells varies from 1.50 to 6.00 lps as per exploration data. The yields of the tubewells drilled by State ground water department/agency ranges from 20 to 250 m^3/hr.

Based on Ground Water Exploration, aquifer wise characteristics are given **Table 3**. Maps depicting depth of occurrence and fractured/Granular rock thickness and Aquifer wise yield potential maps are shown in **Figure 8**.

Table 3: Aquifer Characteristic of Dhule district

Major Aquifers	Basalt (Deccan Traps)		Alluvium (River Alluvium)
Type of Aquifer	Aquifer-I	Aquifer-II	Aquifer-I
Formation	Weathered/Fractured Basalt	Jointed / Fractured Basalt	Alluvium
Depth of Occurrence (mbgl)	5-35	30-198.5	10-77.6

Major Aquifers	**Basalt (Deccan Traps)**		**Alluvium (River Alluvium)**
Type of Aquifer	**Aquifer-I**	**Aquifer-II**	**Aquifer-I**
SWL (mbgl)	2.4 – 21	7.4-87.5	5.0-31.0
Weathered /Fractured rocks thickness (m)	5-20	0-12	8-30
Fractures encountered (mbgl)	Upto 35	Upto 198.5	Upto 77.6
Yield	0 to 100 m3/day	Up to 5.0 lps	25-100
Sustainability	1 to 2 hour	0.5 to 3 hour	2 to 5 Hours
Transmissivity (m^2/day)	9.25-89.04	10.85-131.11	70-170
Specific Yield/ Storativity (Sy/S)	0.019- 0.028	1.20 x 10-4. 3.57 x 10-4	0.06-0.1
Suitability for drinking/ irrigation	Suitable for both	Suitable for both except High EC	Suitable for both (except NO_3, F affected villages for drinking)

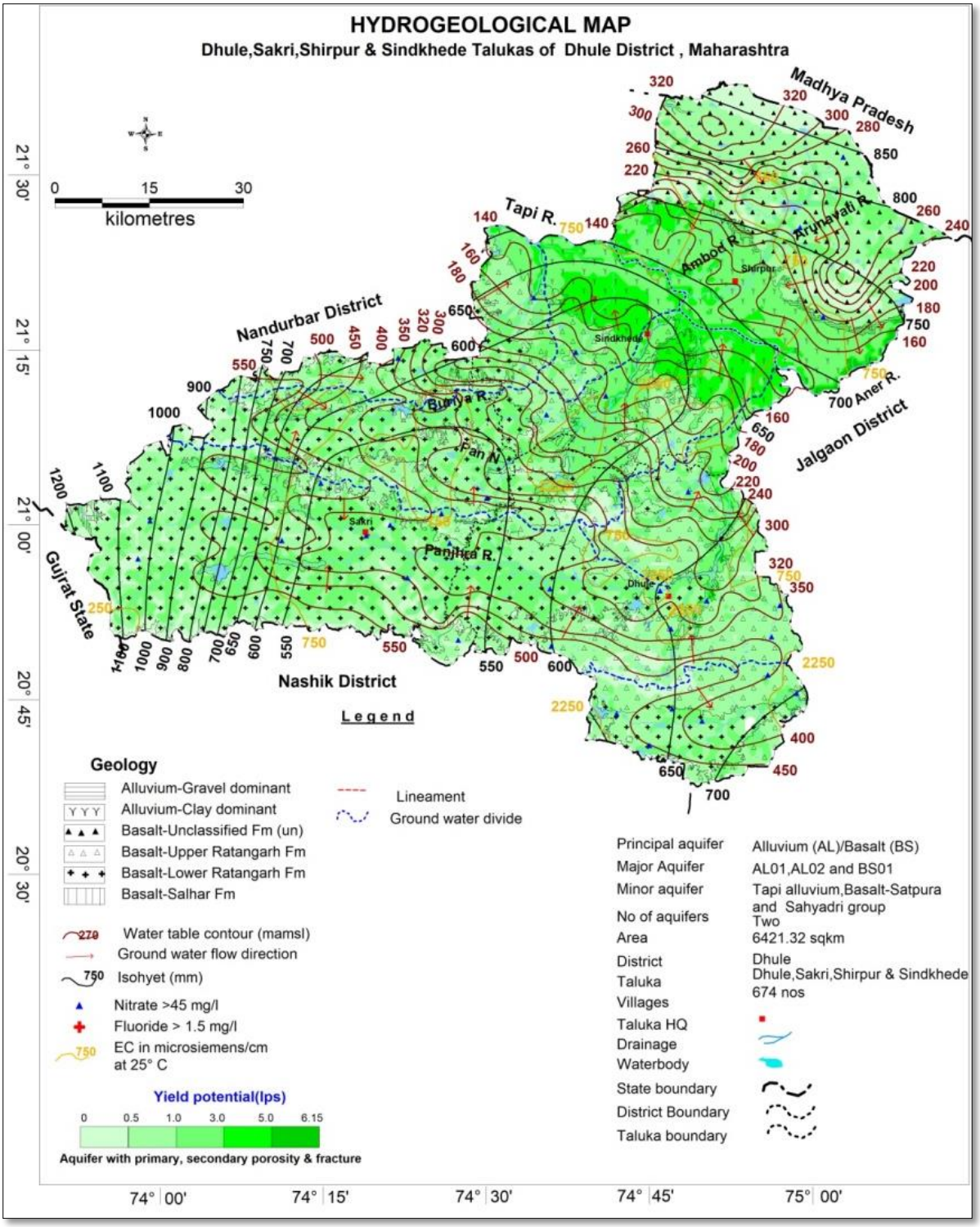
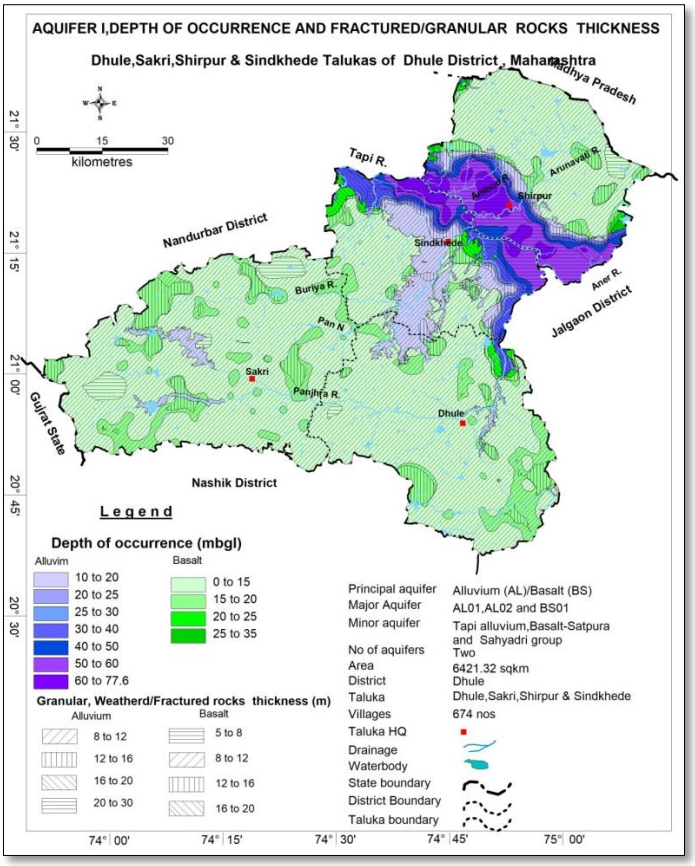


Figure 7. Hydrogeology



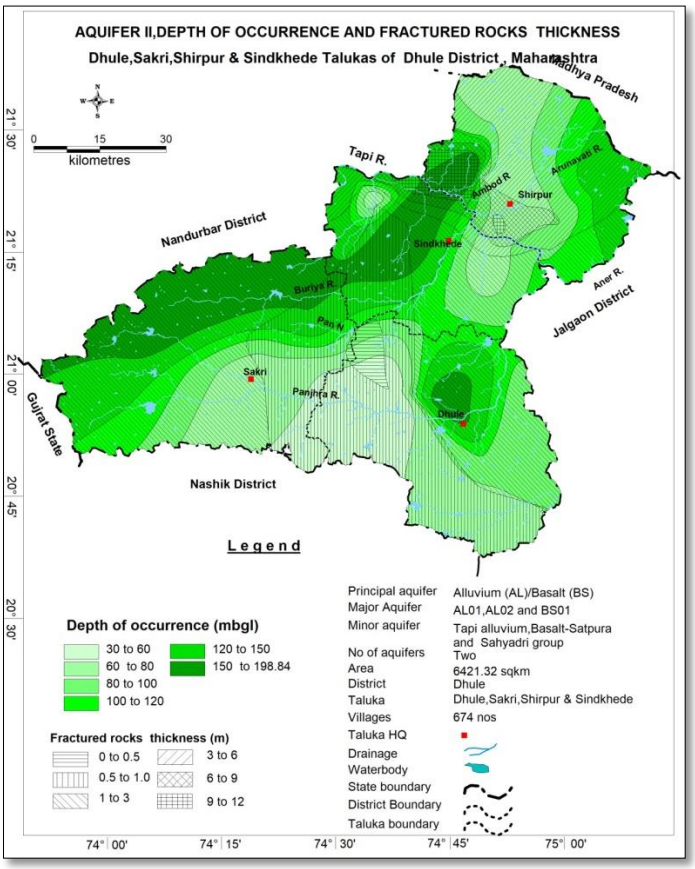


Figure 8: Aquifer wise Depth of occurrence and fractured/granular rock thickness

2.2 Aquifer Parameters

The aquifer parameters of shallow aquifer as determined during previous studies carried out by the Board are presented in **Table 4**. In Basalt transmissivity ranges from 6 to 96 m^2/day, the storativity varies between 0.017 to 0.0429 and the specific capacity ranges from 41 to 220 lpm/m of drawdown, whereas in Alluvium transmissivity is about 70 m^2/day and the specific capacity ranges from 173 to 616 lpm/m of drawdown. Aquifer wise yield potential is presented in **Figure 9a and 9b**.

Table 4: Aquifer Parameters

S. No.	Aquifer	Specific Capacity (lpm/m of drawdown)	Transmissivity (m^2/day)	Storativity
1.	Fractured and moderately weathered Massive Basalt	80 - 220	5.70 – 88.50	0.017 – 0.048
2.	Moderately to highly weathered Basalt	48 – 155	77 – 96	-
3.	Vesicular Amygdaloidal Basalt	41 – 112	11 – 56	0.0429
4.	Alluvium	173 – 616	70	-

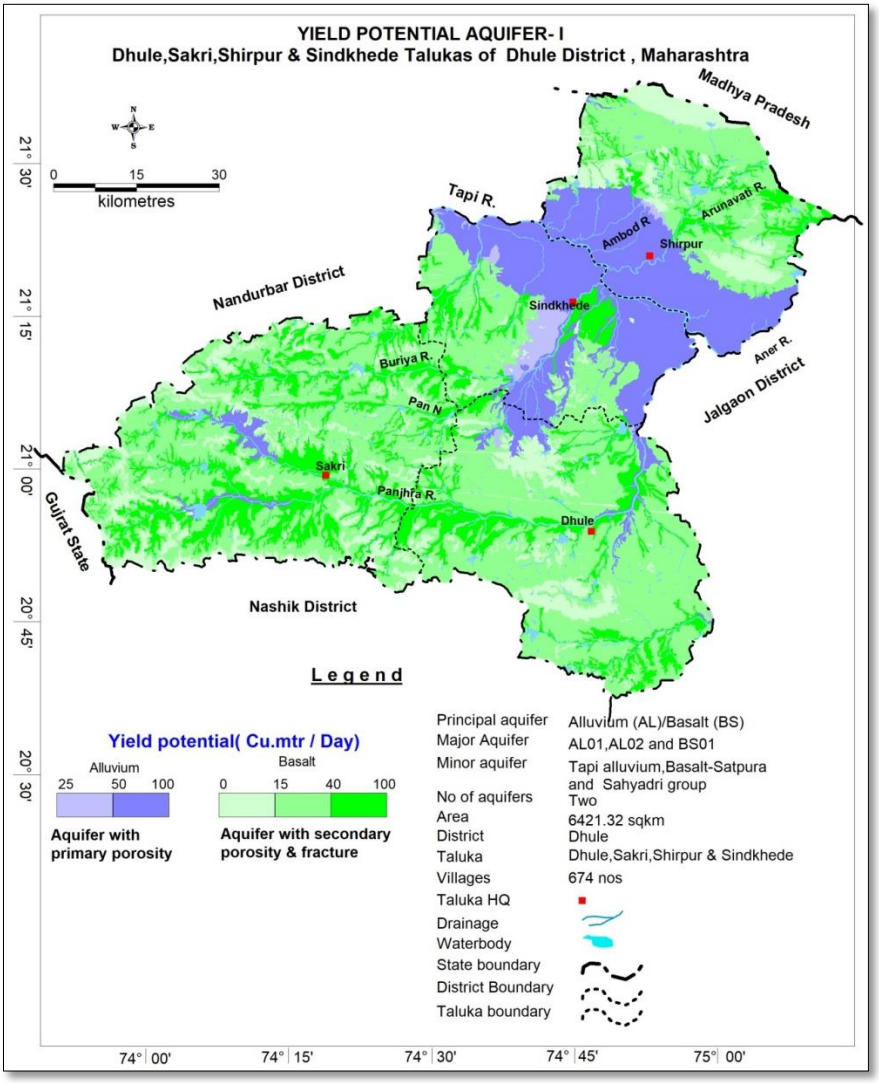


Figure 9a: Aquifer wise yield Potential (Basalt and Alluvium Aquifer)

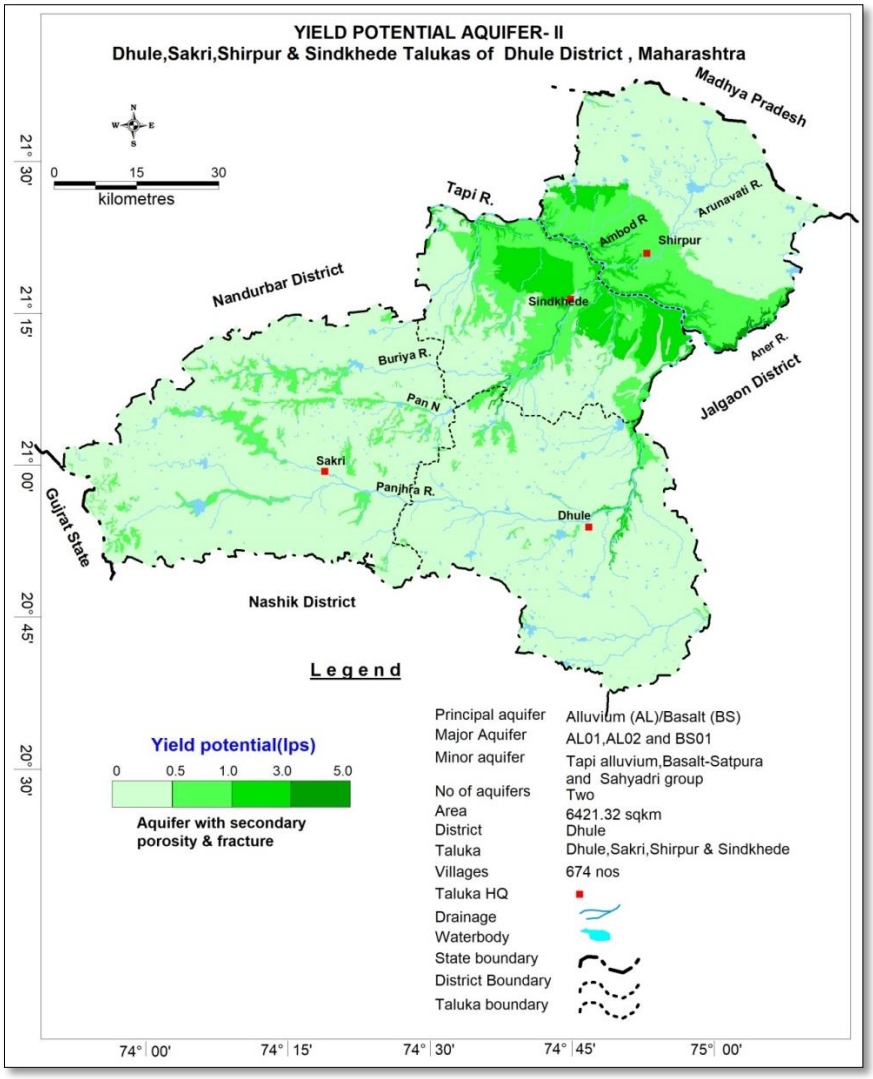


Figure 9b: Aquifer wise yield Potential (Basalt and Alluvium Aquifer)

2.3 3-D and 2-D Aquifer Disposition

Based on the existing data, aquifer disposition in 3D, Fence diagram, and several hydrogeological sections have been prepared along section lines shown in **Figure 10** and **11 (a, b, c, d**) to understand the subsurface disposition of aquifer system.

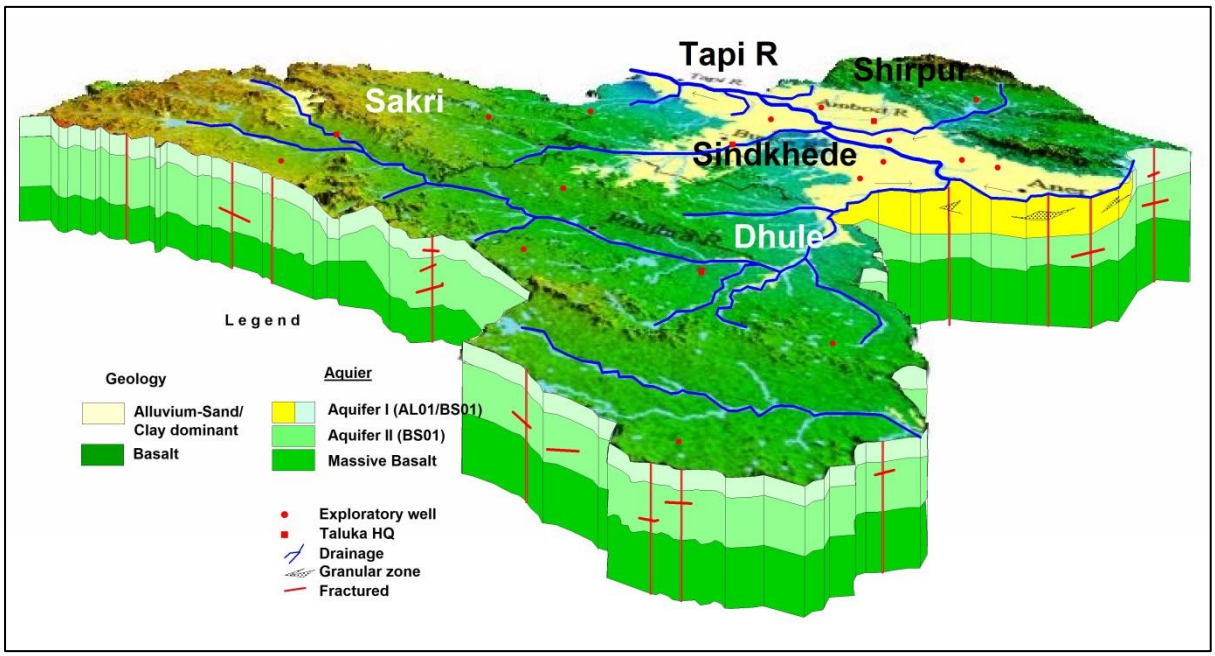


Figure. 10: 3D Aquifer Disposition

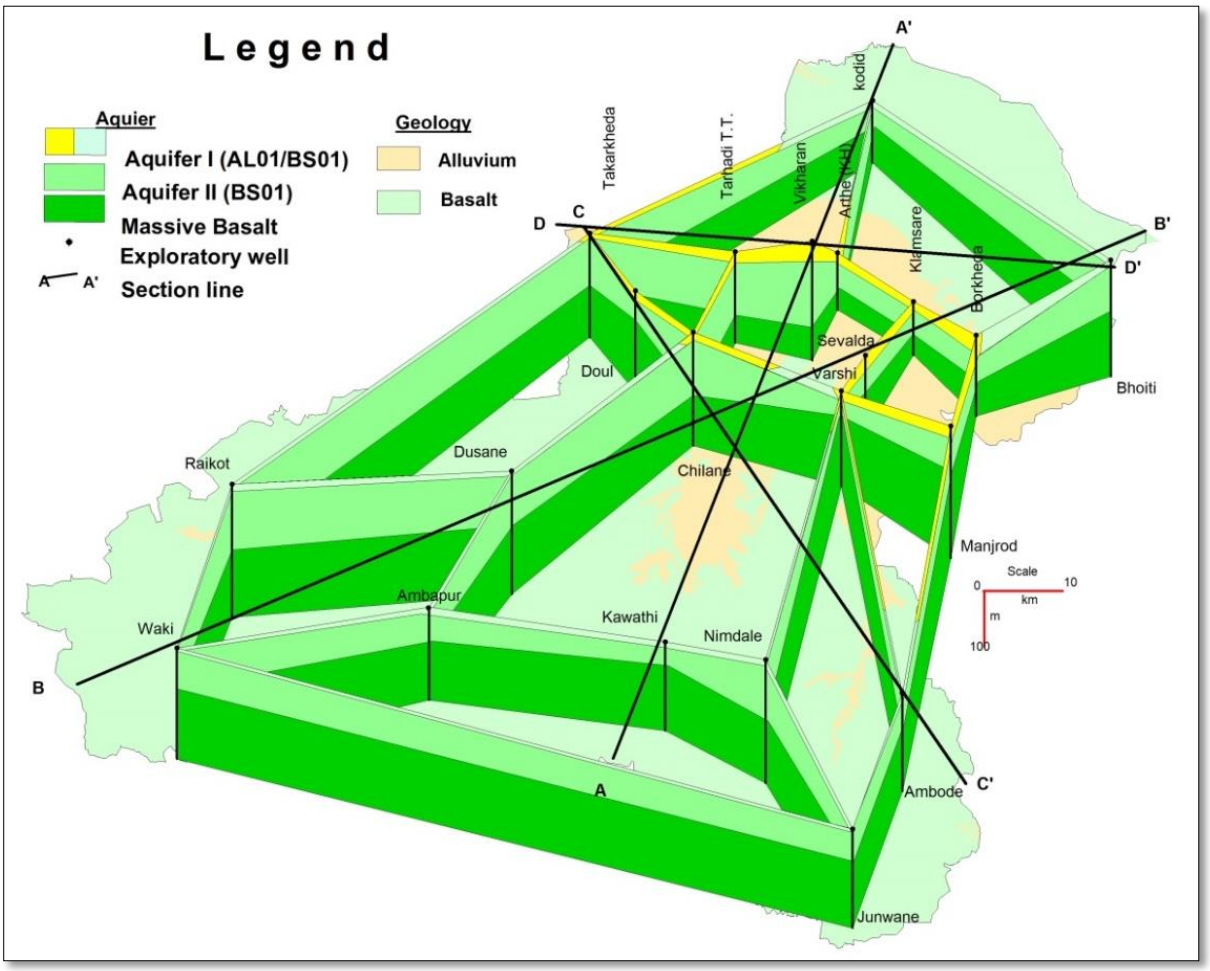


Figure. 11: 3D Fence Diagram

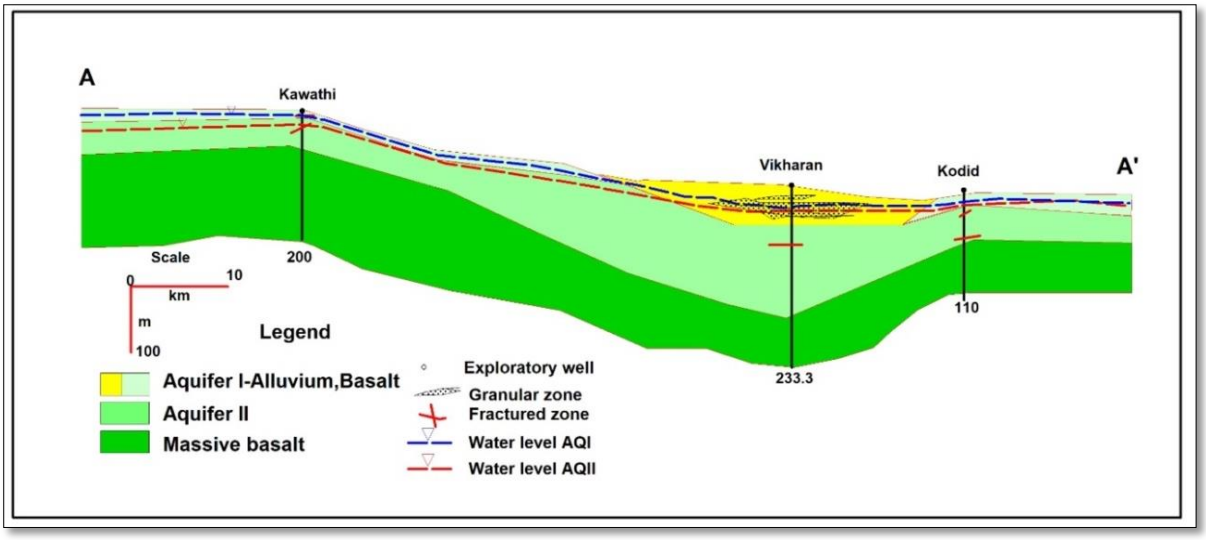


Figure. 11 (a): Lithological section A-A'

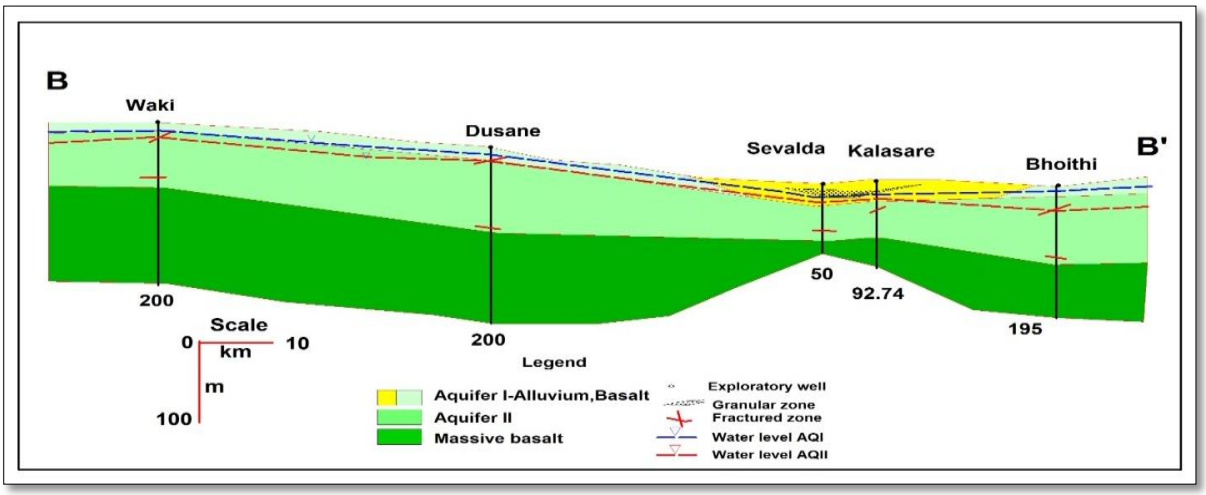


Figure. 11 (b): Lithological section B-B'

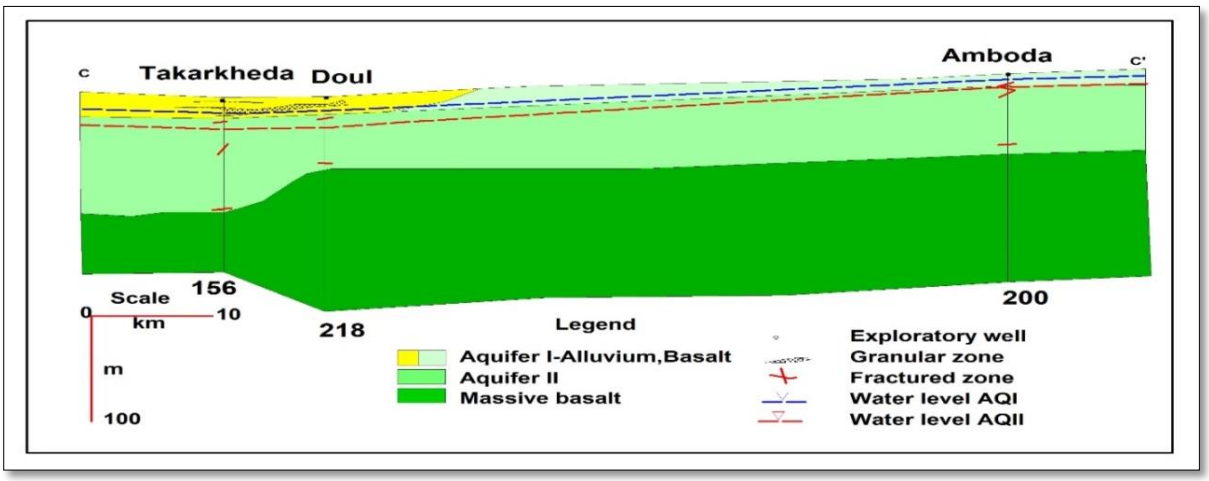


Figure. 11(c): Lithological section C-C'

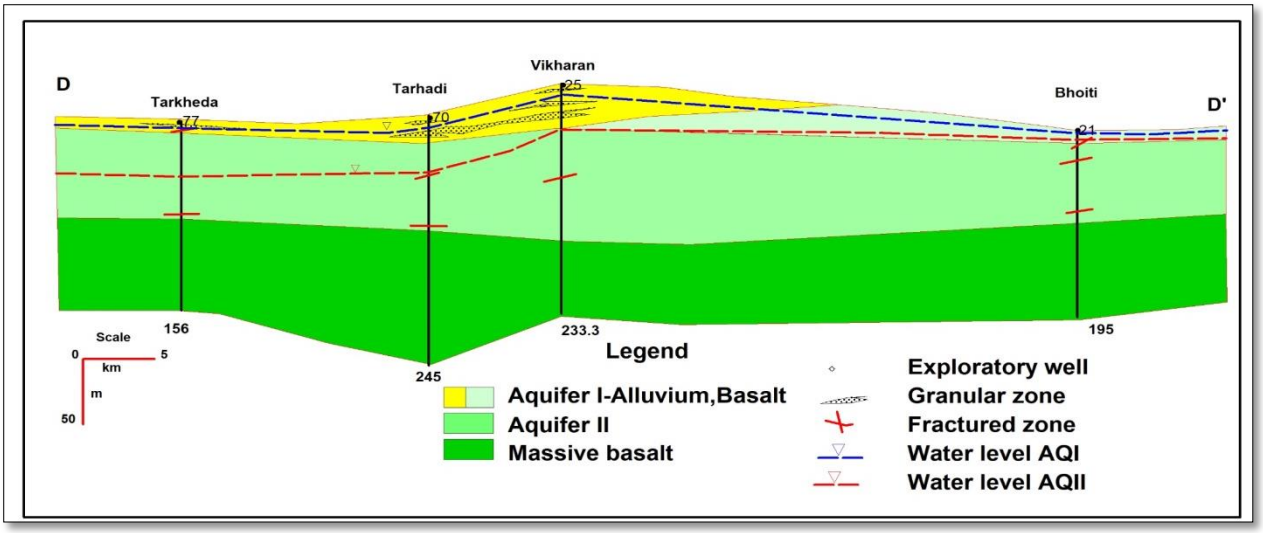


Figure.11 (d): Lithological section D-D'

3.0 WATER LEVEL SCENARIO

3.1 Depth to water level (Shallow Aquifer-I)

Central Ground Water Board periodically monitors 39 Ground Water Monitoring Wells (GWMW) stations in the Dhule district, four times a year i.e. in January, May (Pre-monsoon), August and November (Post-monsoon). Apart from this under NAQUIM study; 76 KOW were also established and monitored during the year 2017 (**Annexure II & III)**. 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 2017 and long-term water level trends (2008-2017) are given in **Annexure IV.**

3.1.1 Depth to Water Level – Pre-monsoon (May-2017)

The depth to water levels in Dhule District during May 2017 ranges between 1.7 (Narhwal, Dhule Taluka) and 20.6 mbgl (Hisala, Shirpur taluka). The depth to water levels less than 5 mbgl are observed mostly in small patches in parts of Sakri Taluka. The depth to Water levels between 5-10 mbgl are observed in South west parts of Sakri and Dhule talukas, Northern parts of Sirpur Taluka and talukas and in south (east-west) parts of Sindkhed Taluka. The depth to water level between 10 to 20 mbgl observed in almost entire area of the district. The Deeper water levels between 20 and 30 mbgl are observed in north-eastern part of the district covering most of Shirpur and Sindhkhed Taluka.one isolated patch is found in northern part of Sakri taluka The pre-monsoon depth to water level map is depicted in **Figure 12(a).**

3.1.2 Depth to Water Level – Post-monsoon (Nov-2017)

The depth to water levels in Dhule District during Nov. 2017 ranges between 0.9 (Charanmal, Sakri Taluka) and 19.1 mbgl (Hisala, Shirpur taluka). Shallow water levels within 5 m bgl are observed in southern part of the district covering parts of Sakri and Dhule talukas; whereas in some part of Sindkheda and Shirpur talukas. Water levels between 5 and 10 m bgl are observed in northern part of the district in Shirpur Taluka and central parts of the district covering parts of Sakri, Dhule and Sindkhed talukas. The depth to water level between 10 to 20 mbgl has been observed in major parts of Sindkhed and Shirpur talukas

and in patches in some parts of Sakri and Dhule taluka. Deeper water levels of more than 20 m bgl are observed in the district in few patches in the Shirpur taluka. Spatial variation in post monsoon depth to water levels is shown in **Figure 12(b)**

3.1.3 Seasonal Water Level Fluctuation (May-Nov. 2017)

It is observed that minimal water level fluctuation was measured at Dhule, Dhule taluka (0.15 m) while maximal water level fluctuation was measured at Laling, Dhule taluka (7.25 m). Rise in water level has been observed in most of the area of the district in the range of Rise 0-2, 2-4 and >4 m. Decline in water level was observed in the few parts of the district in the range of 0.1 to 3.2 m.

3.2 Depth to water level (Deeper Aquifer-II)

3.2.1 Pre-monsoon Depth to Water Level (May-2017)

The depth to water level less than 10 mbgl is observed only in isolated parts of Shirpur taluka. The major parts of Sakri, Dhule, Sindkhed and Shirpur talukas show depth to water level between 20 and 40 mbgl. The deeper water level i.e., >40 mbgl are observed in Central part of the district and in some patches in the western and northern part of the district. The pre-monsoon depth to water level for Aquifer –II is given in **Figure 13 (a).**

3.2.2 Post-monsoon Depth to Water Level (Nov.-2017)

Depth to water level less than 10 m bgl has been observed in an isolated patch in the North-eastern part of the district in Sindkhed and shirpur talukas. The major part of the district shows deeper water levels ranging between 10 and 30 mbgl. The deepest water level of more than 30 mbgl is observed in the central part of the district covering parts of Dhule, Sakri and Sindkhed talukas also in small patch in north-western part of Sakri taluka and north-western part of Shirpur taluka. The post-monsoon depth to water level for Aquifer –II is given in **Figure 13 (b).**

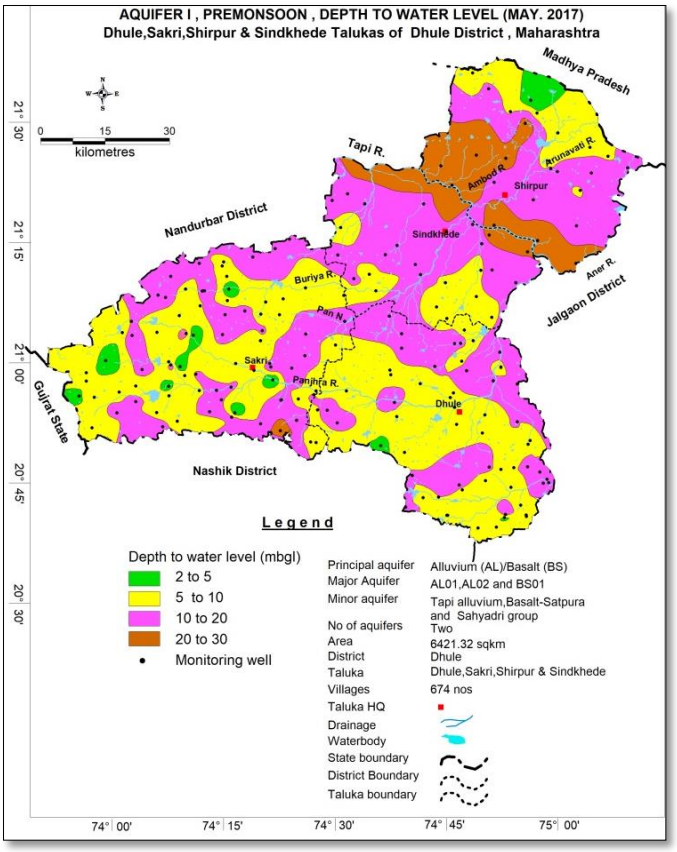


Figure 12 (a): DTWL shallow aquifer (May 2017)

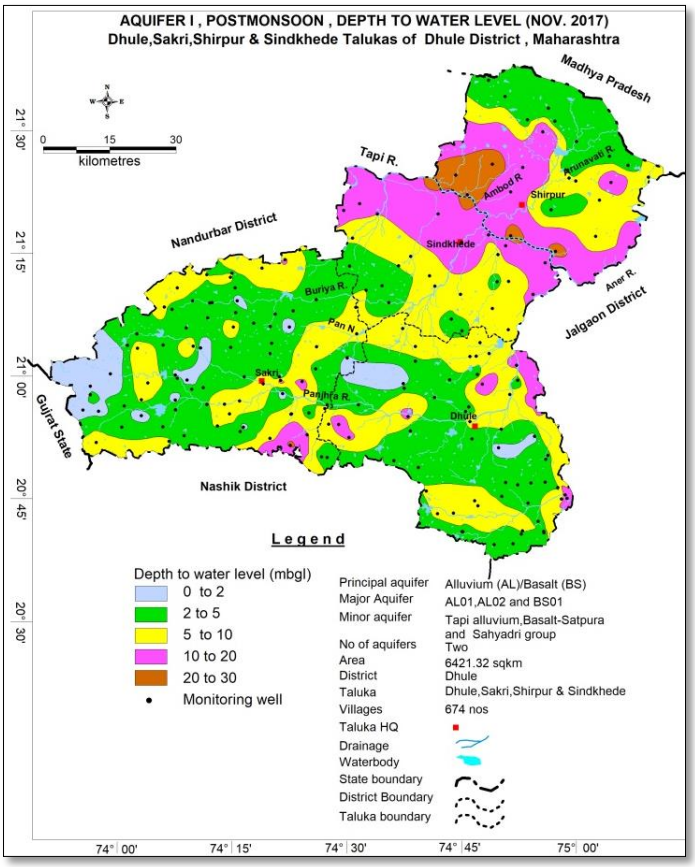


Figure 12 (b): DTWL shallow aquifer (Nov. 2017)

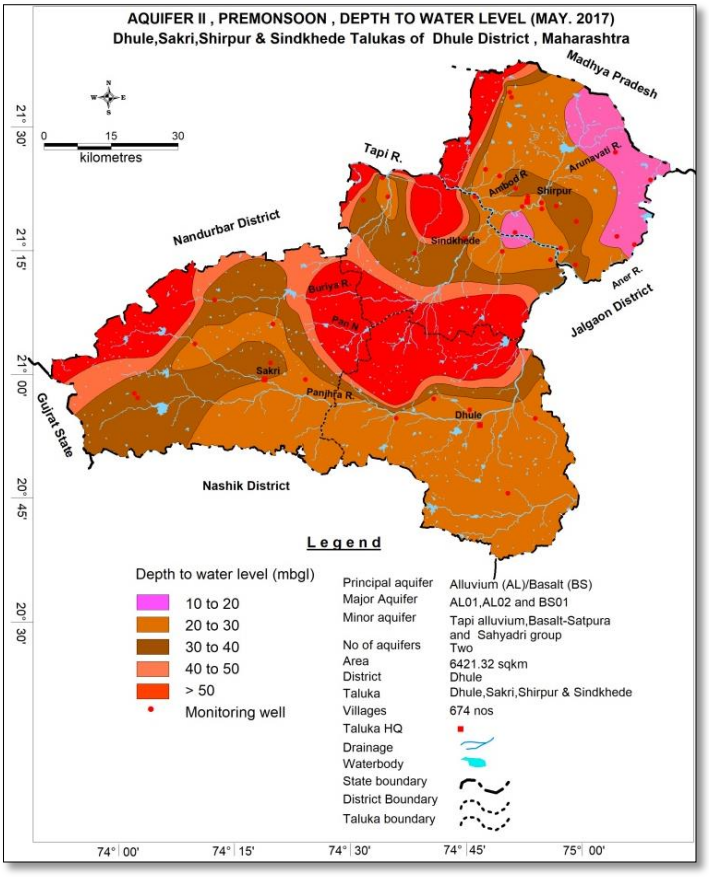


Figure 13(a): DTWL deeper aquifer (May 2017)

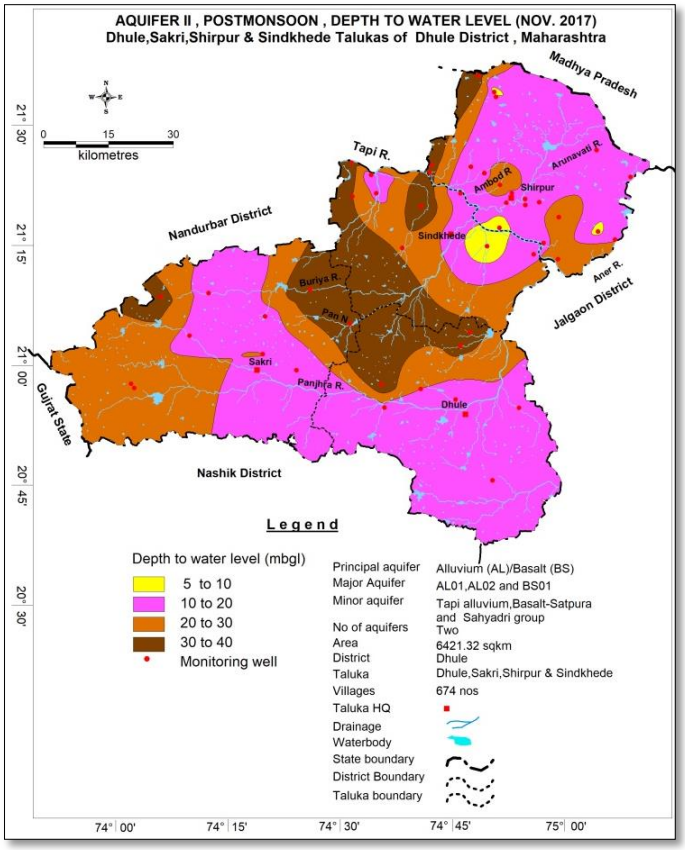


Figure 13(b): DTWL deeper aquifer (Nov. 2017)

Water Level Trend (2008-2017)

The decadal Water Level trend for Pre-monsoon and Post-monsoon (2008 to 2017) is presented in **Annexure IV** and depicted in **Figure 14 (a)** and **Figure 14 (b).** During Pre-monsoon period, falling trend is observed in major parts of the district. The fall in water level is seen in major parts of Dhule district, which is restricted to -0.6 to 0 m. Rise in water level, is seen in Northern, western & central parts of the districts. The rise is restricted from 0 to 0.4 m only. The rise is also observed as pockets in south eastern and North-west parts of Dhule Taluka. During Post-monsoon, a falling trend is observed in major parts of the district. The fall in water level trend is observed between -0.6 to 0 m/year. The rise in water level trend is observed between 0 to 0.4 m/year in the Northern, North-eastern & southern parts of the districts.

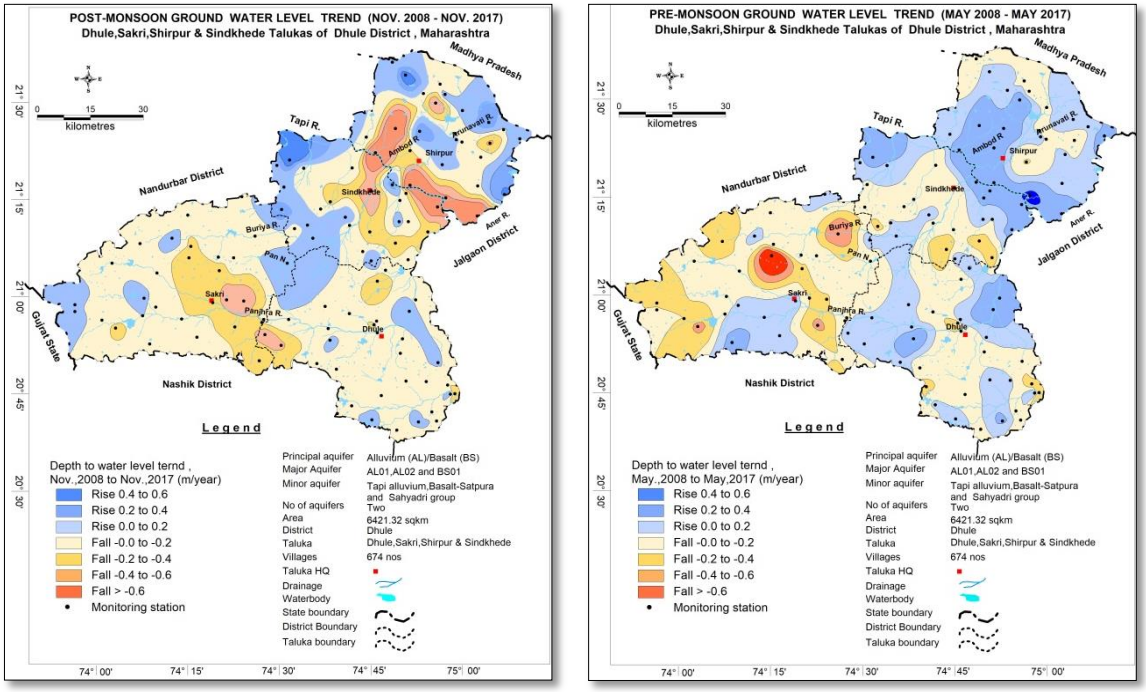


Figure.14 (a): Pre-mon decadal trend (08-17) Figure 14 (b): Post-mon decadal trend (08-17)

3.3 Hydrograph Analysis

The analysis of hydrographs shows that there is falling trend in pre-monsoon as well as post-monsoon period in the district. This may be due to low monsoon rainfall (as the monsoon rainfall is the only natural source of water for recharge to the ground water regime) and continuous increase in the groundwater draft (**Figure 15 a, b, c & d**).

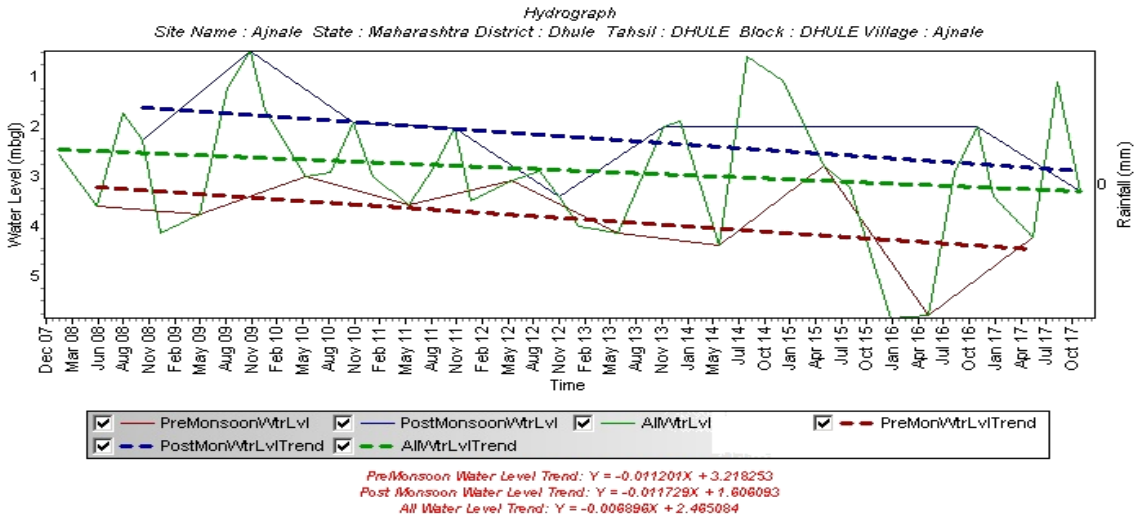


Figure 15 a: Hydrograph (2008-17), Ajnale, Dhule Taluka

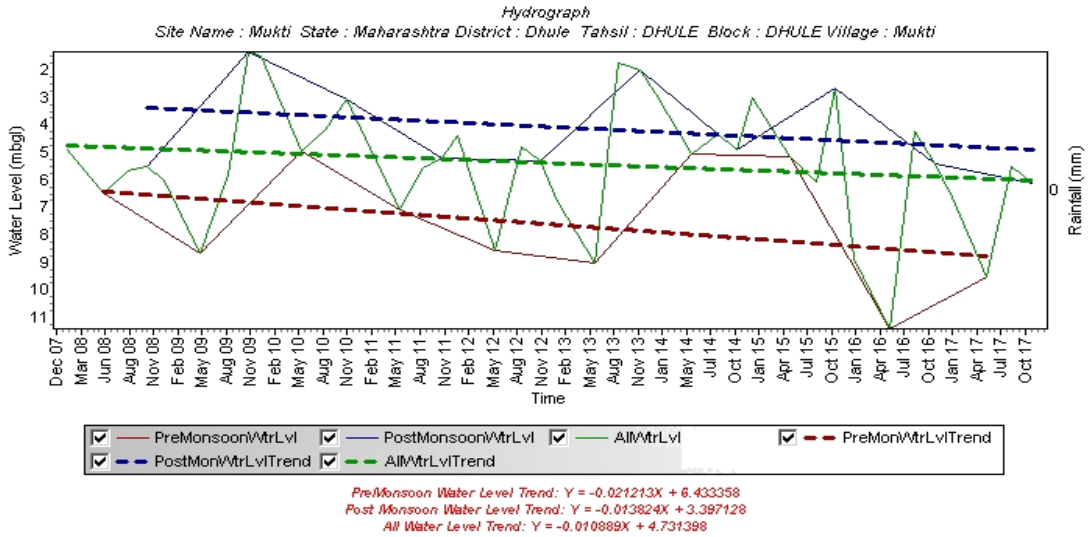


Figure 15 b: Hydrograph (2008-17), Mukti, Dhule Taluka

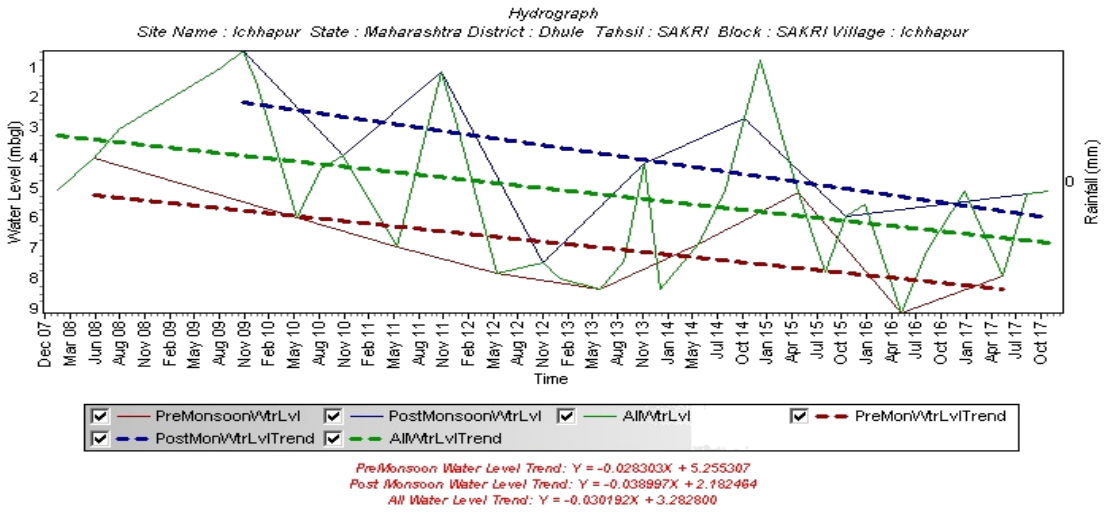


Figure 15 c: Hydrograph (2008-17), Ichalpur, Sakri Taluka

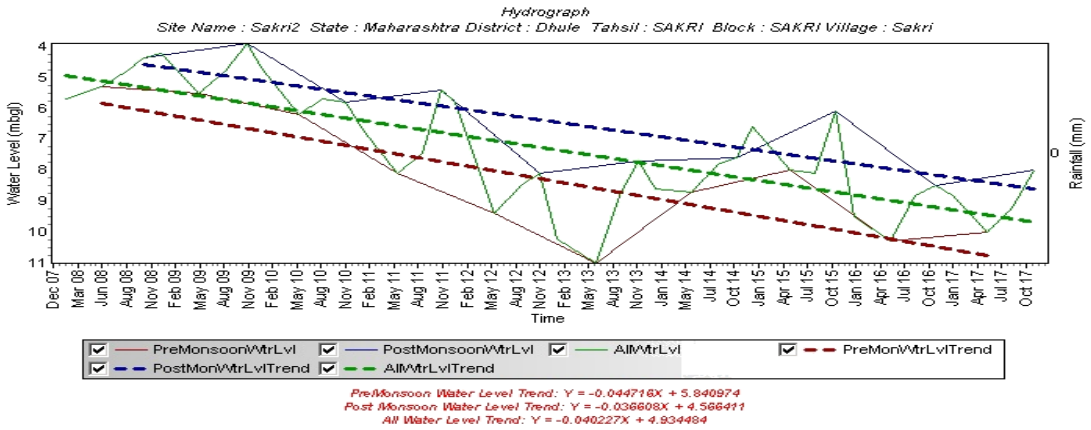


Figure 15 d: Hydrograph (2008-17), Sakri2, Sakri Taluka

4.0 GROUND WATER QUALITY

Water sampling is being done every year from GWM wells during pre-monsoon period (May). Ground water quality data of 26 monitoring wells of CGWB and 68 wells of GSDA representing shallow aquifer and 31 samples data from KOW's- 2017 representing shallow aquifer have been utilised to decipher the quality scenario of shallow aquifer. 44 exploratory-tubewells / borewells and 8 exploratory wells data from Exploration-2017 studies of CGWB, 24 borewells from GSDA representing deeper aquifer have been utilised to decipher the quality scenario of deeper aquifer. The aquifer wise ranges of different chemical constituents present in ground water are given in **Table 5**. The details of water quality analysis are given in **Annexure V and VI**.

Table 5: Aquifer wise ranges of chemical constituents in Dhule District

Constituents	Shallow aquifer		Deeper aquifer	
	Min	Max	Min	Max
pH	7	8.84	7	8.53
EC	235	5873	440	6300
TDS	181	3116	245	1150
TH	88	2440	95	1125
Calcium	9.6	669.33	10	240
Magnesium	1.2	238.4	2.4	127.7
Potassium	0.1	186	0	80
Sodium	8.1	433	10	910
Bi-carbonate	70.3	671	24	549
Chloride	16	1488.9	11	1904
Sulphate	0	410	0	463
Nitrate	0	355	0	120
Fluoride	0	1.5	0	1.02

4.1 Electrical Conductivity (EC)

Distribution of Electrical Conductivity in Shallow Aquifer

The concentration of EC in shallow aquifer varies between 328 µS/cm (Shenwad, Sakri taluka) and 5873 µS/cm (Avdhan, Dhule taluka). Out of 125 samples collected from dug wells, 59 samples are having EC in range of 200 to 1000 µS/cm; 51 samples are having EC in range of 1000 to 2000 µS/cm; 12 samples are having EC in range of 2000 to 4000 µS/cm and

only 3 samples have shown EC > 4000 µS/cm. It is observed that the concentration of high EC >3000 µS/cm has been observed in few parts of Dhule and Sindkhed taluka. The ground water is potable in almost all part of district except central part. The distribution of electrical conductivity in shallow aquifers is shown in **Figure 16 (a)** and analytical data is presented in **Table 6**.

Distribution of Electrical Conductivity in Deeper Aquifer

The concentration of EC in deep aquifer varies between 440 (Vikharam, Shirpur taluka) and 6300 µS/cm (Mangrod, Shirpur taluka). Out of 43 samples collected from tube wells/bore wells, 25 samples are having EC in range of 400 to 1000 µS/cm; 16 samples are having EC in range of 1000 to 3000 µS/cm and only 01 sample show very high EC more than 6000 µS/cm i.e., 6300 µS/cm (Mangrod, Shirpur taluka). It is observed that the concentration of high EC more than 3000 has been observed in Small parts of Sindkhed and Shirpur talukas. The ground water is potable in almost all parts of the district. The distribution of electrical conductivity in deeper aquifers is shown in **Figure 16 (b**) and analytical data is presented in **Table 6**.

Table 6: Aquifer wise Electrical conductivity data

S.No.	EC (µS/cm)	shallow aquifer		Deeper Aquifer	
		No. of samples	% of samples	No. of samples	% of samples
1	< 250	01	0.8	0	0
2	>250-750	37	29.6	19	44.2
3	>750-2250	78	62.4	22	51.2
4	2250-3000	06	4.8	02	4.6
5	3000-7500	03	2.4	0	0
6	>7500	0	0	0	0
Total samples		**125**	**100**	**43**	**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 Dhule District nitrate concentration varies between 0 to 355 mg/l. As per BIS (2012) the desirable limit is 45 mg/l. In shallow aquifer, 125 samples were analysed, out of this 32 water samples show the nitrate concentration exceeded 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, 43 wells analysed, out of this 02 water samples show that the nitrate concentration exceeded the desirable limit of 45 mg/l. The deeper aquifer are also affected by nitrate contamination, it may be due to percolation of nitrate contaminants from the ground surface as there are no other reasons for nitrate contamination in deeper aquifers. Aquifer wise nitrate concentration is given in **Table** 7.

4.3 Fluoride

In shallow aquifer, concentration of fluoride ranges from 0 to 1.5 mg/l. out of 125 samples analyzed, only 05 samples show fluoride concertation more than 1 mg/l. In shallow

aquifer, the highest concentration of fluoride is found in Sakri, Sakri taluka (1.5 mg/l). In Deeper Aquifer, concentration of fluoride ranges from 0 to 1.02 mg/l. Out of 43 samples analysed, none of the samples show fluoride concertation more than 1 mg/l. In Deeper aquifer, the highest concentration of fluoride is found in Chulane, Sindkhed taluka (1.02 mg/l). Aquifer wise fluoride concentration is given in **Table 7**.

Table 7: Aquifer wise nitrate and Fluoride concentration in Dhule District

	No_3 > 45 mg/l		**fluoride >1 mg/l**	
Taluka	No of samples Shallow Aquifer	No of samples Deeper Aquifer	No of samples Shallow Aquifer	No of samples Deeper Aquifer
Dhule	13	0	02	0
Sakri	11	0	02	0
Sindkhed	04	0	01	0
Shirpur	03	02	0	0
Grand Total	**31**	**02**	**05**	**0**

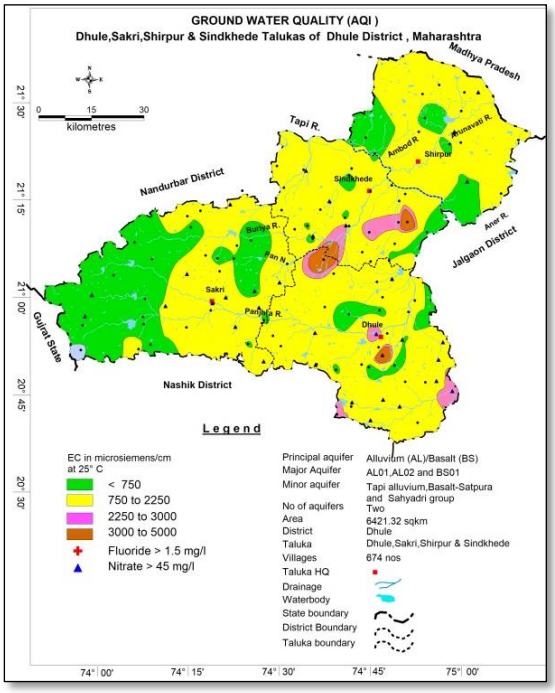


Figure 16 (a): Ground water quality, Aquifer-I

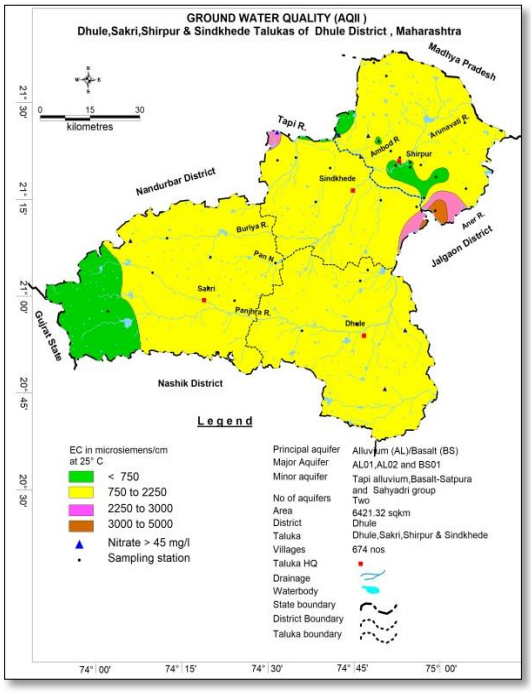


Figure 16 (b): Ground water quality, Aquifer-II

4.4 Suitability of ground water for drinking purpose

In shallow aquifer, 1.6 % samples are having TDS concentration more than maximum permissible limit (MPL) and 53 % 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 seen that maximum samples are within the maximum permissible limit for the parameters like TH, Ca, Mg, Cl, So_4 and No_3 indicating that the water is suitable for drinking purpose. Concentration of Chemical constituents in shallow Aquifer is given in **Table 8.**

In Deeper aquifer (**Table 9**), all samples are having TDS concentration within maximum permissible limit (MPL). The water from such area is fit for drinking purpose with proper treatment. It is also seen that maximum samples are within the maximum

permissible limit for the parameters like TH, Ca, Mg, Cl, SO_4 and NO_3 indicating that the water is suitable for drinking purpose with proper treatment.

Table 8: 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	-	125	0	0	123	98.4	02	1.6
TDS	500	2000	125	25	25	67	53.6	02	1.6
TH	300	600	125	57	45.6	53	42.4	15	12
Ca (mg/L)	75	200	125	67	53.6	51	40.8	07	5.6
Mg (mg/L)	30	100	125	37	29.6	77	61.6	11	8.8
Cl (mg/L)	250	1000	125	107	85.6	16	12.8	02	1.6
SO_4 (mg/L)	200	400	125	123	98.4	01	0.8	01	0.8
NO_3 (mg/L)	45	No relax	125	93	74.4	32	25.6	0	0
F (mg/L)	1	1.5	125	120	96	05	4	0	0

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

Table 9: 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	-	43	43	100	0	0	0	0
TDS	500	2000	35	18	51.43	17	48.57	-	-
TH	300	600	43	27	62.79	14	32.56	02	
Ca (mg/L)	75	200	43	31	72.10	11	25.58	01	
Mg (mg/L)	30	100	43	17	39.54	25	58.14	01	
Cl (mg/L)	250	1000	43	37	86.05	05	11.62	01	
SO_4 (mg/L)	200	400	41	39	95.12	02	4.88	-	-
NO_3 (mg/L)	45	No relax	36	34	94.45	02	5.6	-	-
F (mg/L)	1	1.5	36	36	100	0	0	0	0

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

4.5 Suitability of ground water for irrigation

The water used for irrigation is an important factor in productivity of crop, its yield and quality of irrigated 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 influence the water quality and its suitability for irrigation.

4.5.1 Electrical Conductivity (EC)

The amount of dissolved ions in the water is best represented by the parameter electrical conductivity. The classification of water for irrigation based on the EC values is given in **Table 10** 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 conditions. The water may be used for irrigation purpose with permeable soils having adequate drainage so as to provide considerable leaching and very salt tolerant crops should be selected.

Table 10: Classification of Ground water for Irrigation based on EC values

sl.	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	01	0.9	0	0
2	Medium Salinity Water	>250-750	37	30	19	44
3	High Salinity Water	>750-2250	78	62	22	51
4	Very High Salinity Water	> 2250	09	7.1	02	5
		Total	**125**	**100**	**43**	**100**

In both the aquifers, maximum numbers of samples fall under the category of medium to high 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

4.5.2 Sodium Absorption Ratio (SAR)

Excess of sodium in water render it unsuitable for irrigation on soil containing exchangeable Calcium and Magnesium ions. Soil containing exchangeable Calcium and Magnesium takes up sodium of irrigation water in exchange for Calcium and Magnesium, the ratio reflects the Sodium hazard. The SAR indicates the relative activity of the Sodium ions in exchange reactions with the soil. The main problem with high sodium concentration is its effect on soil permeability; hardening of soil & water irrigation system. Sodium also contributes directly to the total salinity of the water and may be toxic to sensitive crops such as fruit trees. The higher value of SAR indicates soil structure damage.

In shallow aquifer, out of 125 samples analyzed, all the samples are having SAR value less than 10. Whereas in deeper aquifer out of 77 samples analysed, only two samples are having values more than 10. The classification of ground water samples based on SAR values for its suitability for irrigation purpose is shown in **Table 11**.

Table 11: Classification of Ground water for Irrigation based on SAR values

Characteristics	Quality	SAR value							
		< 10		10-18		18-26		> 26	
		Good		Good to Permissible		Doubtful		Bad (Unsuitable)	
	Total Number of GW samples	No	%	No	%	No	%	No	%
Shallow Aquifer	125	125	100%	-	-	-	-	-	-
Deeper Aquifer	77	75	97%	2	-	-	-	-	-
Total	**202**	**200**	**99%**	**2**	**-**	**-**	**-**	**-**	**-**

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 Dhule District based on GEC-97 methodology. Taluka wise ground water resources are of shallow aquifer is given in **Table 11 a**, and graphical representations of the resources on the map are shown in **Figure 17**.

As per the Ground Water Resources estimation of Dhule taluka, the net annual ground water availability comes to be 193.10 MCM. The gross draft for all uses is estimated at 128.13 MCM with irrigation sector being the major consumer having a draft of 123.94 MCM. The domestic and industrial water requirements are worked at 7.93 MCM. The net ground water availability for future irrigation is estimated at 61.21 MCM. The overall stage of ground water development is 66.35 %. The taluka falls under “Safe” category. Similarly, the net annual ground water availability comes to be 202.84 MCM. The gross draft for all uses is estimated at 97.26 MCM with irrigation sector being the major consumer having a draft of 92.00 MCM. The domestic and industrial water requirements are worked at 10.31 MCM. The net ground water availability for future irrigation is estimated at 102.93 MCM. The overall stage of ground water development is 47.95 %. The taluka falls under “Safe” category.

5.2 Ground Water Resources – Aquifer-II

The ground water resources of Aquifer-II (Basalt and Alluvium) were also assessed to have the correct quantification of resources so that proper management strategy can be framed. Taluka wise summarized Ground Water Resources of Aquifer-II are given in **Table 12 b**.

Table 12 a: Ground water resources (2013), Aquifer-I (Shallow aquifer)

Assessment unite	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground Water Draft for All uses	Provision for domestic and industrial requirement supply to 2025	Net Ground Water Availability for future irrigation development	Stage of Ground Water Development (%)/Category
Dhule	193.10	123.94	4.19	128.13	7.93	61.21	66.35
Sakri	202.84	92.00	5.25	97.26	10.31	102.93	47.95
Total	395.95	215.94	9.44	225.38	18.24	164.14	

Table 12 b: Taluka wise summarized Ground Water Resources of Aquifer-II (Deeper aquifer)

Taluka	mean thickness (m)	Area (sq km)	Piezometric head (m)	Sy	S	Resource above confining layer (MCM)	Resource in confining aquifer (MCM)	Total Resource (MCM)
Dhule	0.5	86.95	25	0.005	0.00012	0.261	0.217	0.478
Dhule	0.75	875.96	18	0.0025	0.000157	2.475	1.642	4.118
Dhule	2	863.89	20	0.0025	0.000157	2.713	4.319	7.032
Sakri	0.5	7.59	50	0.005	0.00012	0.046	0.019	0.064
Sakri	0.75	595.53	20	0.0025	0.000157	1.870	1.117	2.987
Sakri	2	1364.37	20	0.005	0.000157	4.284	13.644	17.928
Total						11.649	20.959	32.607

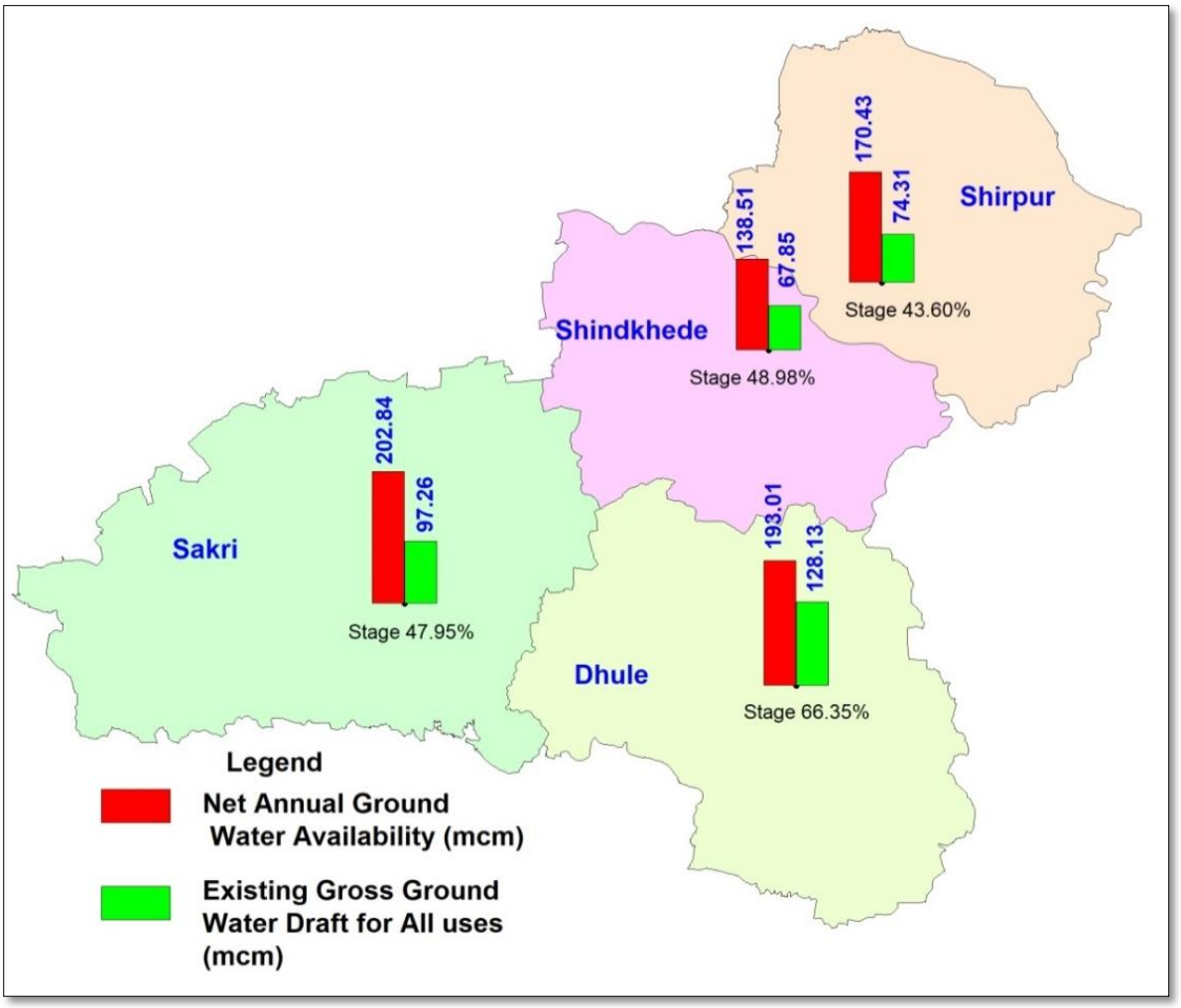


Figure 17: Ground Water Resources 2013, Dhule district

6.0 GROUND WATER RELATED ISSUES

6.1 Declining Water Levels

The ground water exploitation has resulted in decline of water levels over the period of time. In premonsoon season, decline more than 0.20 m/year has been observed in Sakri taluka and in small patches in Dhule and Sindkheda talukas. In post-monsoon season, decline more than 0.20 m/year has been observed in major part of Sindkheda and Shirpur talukas and isolated parts of Sakri and Dhule talukas.

6.2 Low Ground water development

The stage of ground water development remains low despite increase in wells. There is large scope ground water development to meet the irrigation demand. About 63.2 MCM ground water available for development after the Stage of ground water development is brought to 70%.

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 5 mbgl and the specific yield of the aquifer. The **Table 13** gives the district wise volume available for the recharge.

Table 13: Area feasible and volume available for Artificial Recharge

Taluka	Area identified for AR (WL>5) (sq km) (Total Area)	Area identified for AR (WL>5) (sq km)		volume of unsaturated zone (Total) (MCM)	
		Hard Rock	Alluvium	Hard Rock	Alluvium
Dhule	927.02	897.35	29.67	1794.7	59.34
Sakri	570.78	570.78	0	1141.57	0

The total unsaturated volume available for artificial recharge is 2994.91 MCM and it ranges from 1853.34 MCM in Dhule taluka to 1141.57 MCM in Sakri taluka. The available surplus runoff can be utilized for artificial recharge through construction of percolation tanks, Check dams at suitable sites. The number of percolation tanks and check dams are decided based on the number of suitable streams available in the district.

Thus, after taking into consideration all the factors, only 15.31 MCM of surplus water can be utilised for recharge, which is given in **Table 14**. This surplus water can be utilized for constructing 149 check dams and 54 percolation tanks at suitable sites. This intervention should lead to recharge @ 75% efficiency of about 11.46 MCM/year. Tentative locations of

these structures are given in **Figure 18** and details also given in **Annexures VII and VIII**.

The rainwater harvesting in urban areas can be adopted in 25% (of the household area 65216) with 50 Sq. m roof area. A total of 1.47 MCM potential can be generated by taking 80% runoff coefficient. The estimated cost for rainwater harvesting through rooftop is calculated as Rs. 97.83 crore. Hence, this technique is not economically viable and therefore it is not recommended.

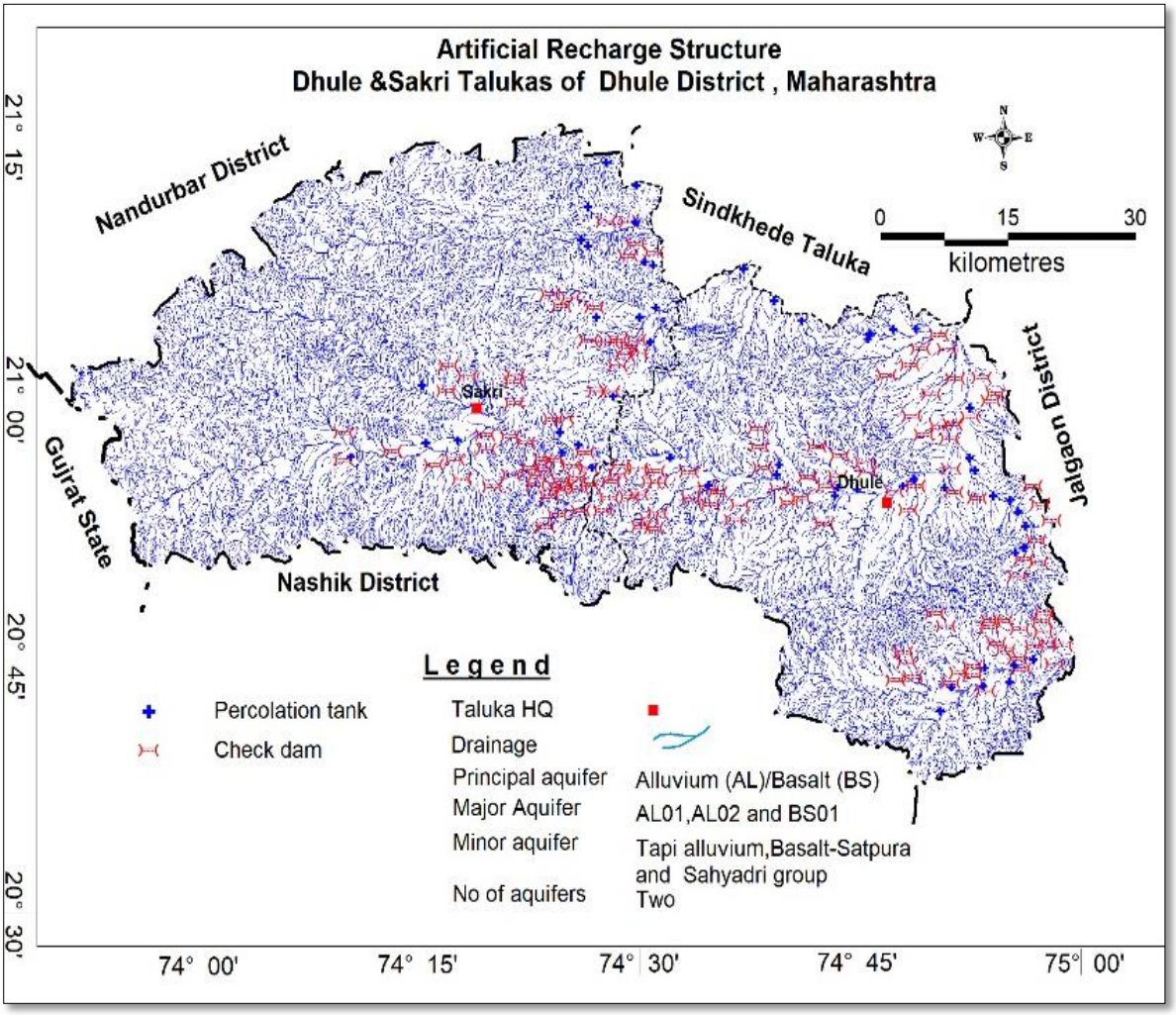


Figure 18: Proposed Artificial Recharge structures

Table 14: Proposed Recharge Structures

Taluka	Area identified for AR (WL>5) (sq km) Total area	volume of unsaturated zone (Total) (MCM)		surface water required for AR (reciprocal of 75% efficiency) (MCM)		Availability of Surplus surface runoff (MCM)	Per sq.km. availability of surplus run-off/ surface water (MCM)	Proposed number of structures		volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	
		Hard Rock	Alluvium	Hard Rock	Alluvium			PT	CD	PT	CD
Dhule	927.02	1794.7	59.34	167.51	5.54	9.36	0.0104	33	91	4.95	2.05
Sakri	570.78	1141.57	0	30.44	0	5.95	0.0104	21	58	3.15	1.31

7.2 Demand Side Management

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.

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 both the blocks as given in the **Table 15**.

Table 15: Expected benefits after management options

Block	Water Recharged by Supply side intervention (MCM)	Water saving by demand side interventions (MCM)	Net Ground water availability (MCM)	Total ground water draft (MCM)	Ground water resources after supply side management (MCM)	Ground water Draft after demand side management (MCM)	Expected stage of Development (%)
Dhule	7.00	0.57	193.10	128.12	200.1	127.55	**64.03**
Sakri	4.46	2.85	202.84	97.26	207.3	94.41	**46.92**
Total	**11.46**	**3.42**	**395.94**	**225.38**	**407.4**	**221.96**	**55.46**

7.4 Development Plan

The ground water development plan is recommended to bring the stage of development up to 70%. Balance ground water resources available for ground water development after the stage of development is brought up to 70% after implementing above measures is 63.21 MCM.

The development plan is proposed to bring stage of ground water development up to 70 % and details are given in **Table 16**.

Table 16. Development plan details

Taluka	Net Ground water availability (MCM)	Ground water resources after supply side management (MCM)	Ground water Draft after demand side management (MCM)	Expected stage of Development (%)	Balance GWR available for GW Development after STAGE OF GWD is brought to 70% (MCM)	Proposed No. of DW @1.5 ham for 90% of GWR Available)	Proposed No. of BW @1.5 ham for 10% of GWR Available)	Additional Area (sq.km.) proposed to be brought under assured GW irrigation with av. CWR of 0.65 m after 70% stage of GWD is achieved (Sq.Km)
Dhule	193.10	200.1	127.55	64.03	12.51	7	1	19.24
Sakri	202.84	207.3	94.41	46.92	50.70	30	4	77.99
Total	395.94	407.4	221.46	55.46	63.21	37	05	97.23

8.0 SUM UP

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 Dhule and Sakri blocks of Dhule district during the AAP 2017-18.

Dhule district has an area of 8061 sq. km., out of which 2051 sq.km is covered by forest. The entire district forms a part of the Tapi basin. Geologically, the area is occupied by Basalt and local river Alluvium. The stage of ground water development varies from 43.60 % (Shirpur) to 66.35% (Dhule). The overall stage of ground water development for the district is 52.14 % (safe category). The area has witnessed declining water level, irregular rainfall, frequent droughts and low yield potential aquifers are the major issues in the district.

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.

As a part of Supply Side Management, a total 33 Percolation tanks and 91 Check dams are proposed, in Dhule block whereas, 21 Percolation tanks and 58 Check dams are proposed, in Sakri block which will augment ground water resources to the tune of 6.97MCM (4.95 MCM by Percolation tanks and, 2.02 MCM by Check dams) in Dhule block whereas ground water resources to the tune of 4.46 MCM (3.15 MCM by Percolation tanks and, 1.31 MCM by Check dams) in Sakri block.

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.

The ground water development plan has been proposed in view of the developing additional ground water resources available after supply side interventions to bring the stage of ground water development up to 70%. In Dhule block the 12.51 MCM volume of ground water generated can bring 19.24 sq km additional area under assured ground water irrigation with average crop water requirement of 0.65 m by constructing 7 Dug wells and 1 Borewell. In Sakri block, the 50.70 MCM volume of ground water generated can bring 77.99 sq. km additional area under assured ground water irrigation with average crop water requirement of 0.65 m by constructing 30 Dug wells and 4 Borewells.

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.

BLOCK WISE AQUIFER MAPS AND MANAGEMENT PLAN

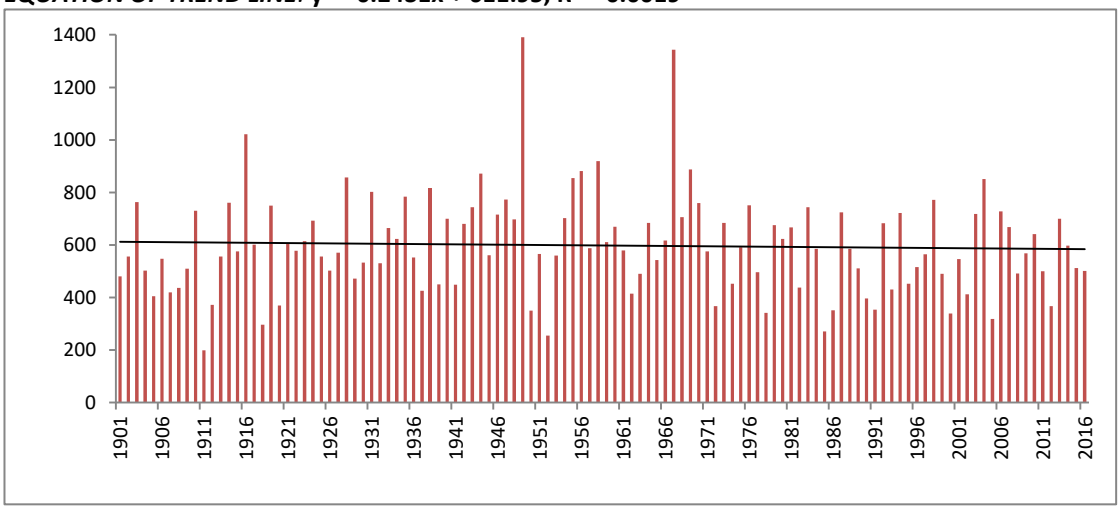
1. DHULE BLOCK
2. SAKRI BLOCK

9.0 AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, DHULE BLOCK, DHULE DISTRICT, MAHARASHTRA

1. SALIENT FEATURE		
1.1 Introduction		
Block Name		**DHULE**
Geographical Area (Sq. Km.)		1,971.81
Population (2011)		8,40,655
Climate		Tropical Monsoon
1.2 Rainfall Analysis		
Normal Rainfall		597.7 mm
Annual Rainfall (2016)		501.5 mm
Decadal Average Annual Rainfall (2007-16)		469.12 mm
Long Term Rainfall Analysis (1901-2016)	Falling Trend 0.243 mm/year Probability of Normal/Excess Rainfall- 61% & 17%, Probability of Drought (Moderate/Severe)-: 19 % Moderate & 3 % Severe.	

Rainfall Trend Analysis (1901 To 2016):

EQUATION OF TREND LINE: **y = -0.2431x + 611.95, R^2 = 0.0019**



1.3. Geomorphology & Geology	
Geomorphic Unit	Tapi valley proper and the region of the dykes and residual hills of the Sahyadri Spurs with eastward trending streams in between.
Geology	Alluvium (sand/ silt and clay alternating beds)., Age: Recent to Sub-recent Deccan Traps (Basalt), Age: Upper Cretaceous to Lower Eocene

1.4. Hydrology & Drainage		
Drainage	Tapi River and its tributaries - Panjra and Aner Rivers	
Hydrology	Major project	Nil
	Bigger Minor Irrigation Project (>100 Ha.)	Completed: - 01 medium project, 129 PT, 15 KT Weir; 1 LIS;
	Minor Irrigation Project (<100 Ha.)	**Completed**: -20 MI Project;

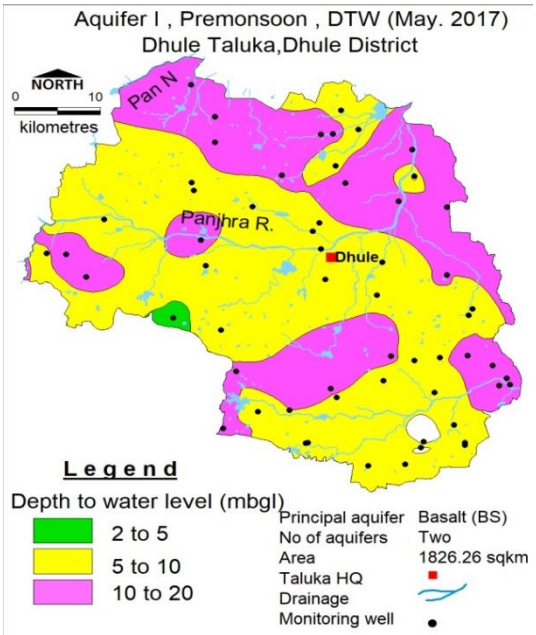
1.5. Land Use, Agriculture, Irrigation & Cropping Pattern(2008-09)	
Geographical Area	198825 ha
Forest Area	54372 ha
Cultivable Area	117305 ha
Net Sown Area	112985 ha

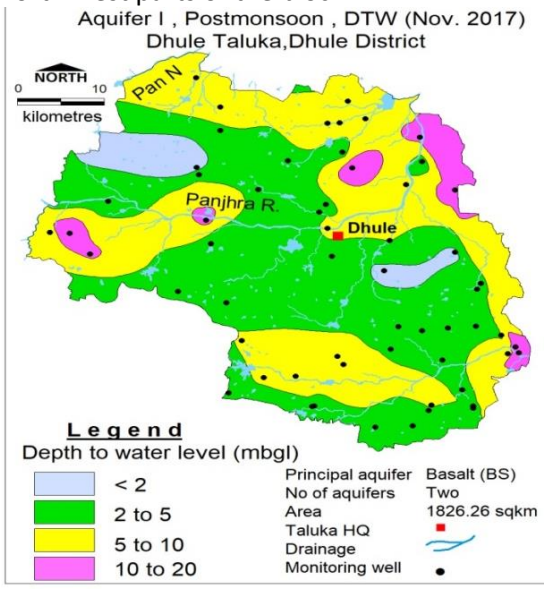
Double Cropped Area		3552 ha
Area under Irrigation	Surface Water	0
	Ground Water	9725 ha
Principal Crops *(Reference year 2008-09)*	**Crop Type**	**Area (Sq. Km.)**
	Jawar	12926 ha
	Wheat	2332 ha
	Cereals	39799 ha
	Cotton	40853 ha
	Oil Seeds	2468 ha
	Sugarcane	207 ha

1.6. Water Level Behavior

1.6.1 Aquifer – I (Shallow/Phreatic Aquifer)

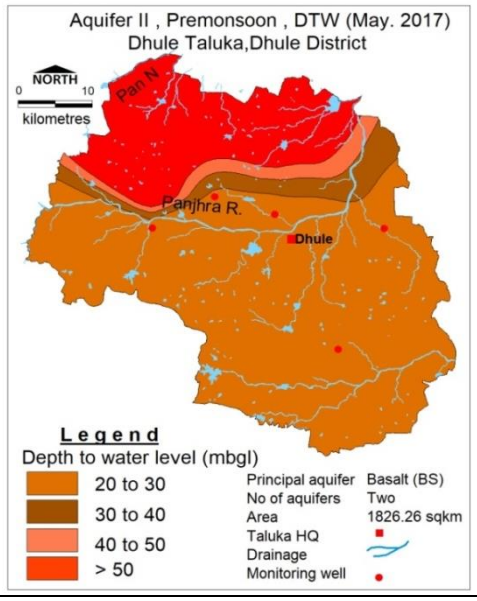
Pre-Monsoon (May-2017)	**Post-Monsoon (November-2017)**
Water level less than 10 mbgl is observed in major part of the block, while water level in the range of 10 to 20 mbgl is observed in north, north-east and south-east part of the block	Water level less than 10 mbgl is observed in major part of the block, while water level in the range of 10 to 20 mbgl is observed in isolated small patches in north-east and north west parts of the block.

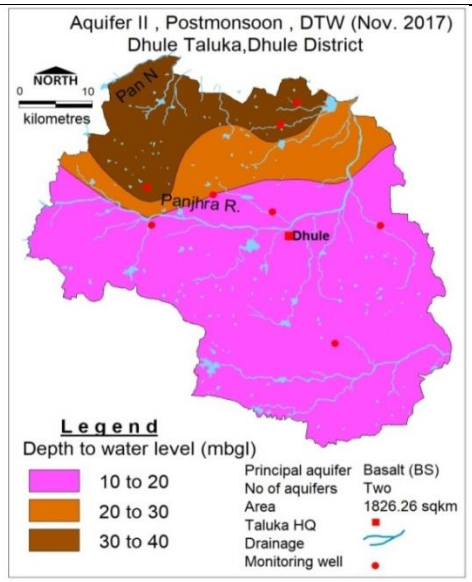




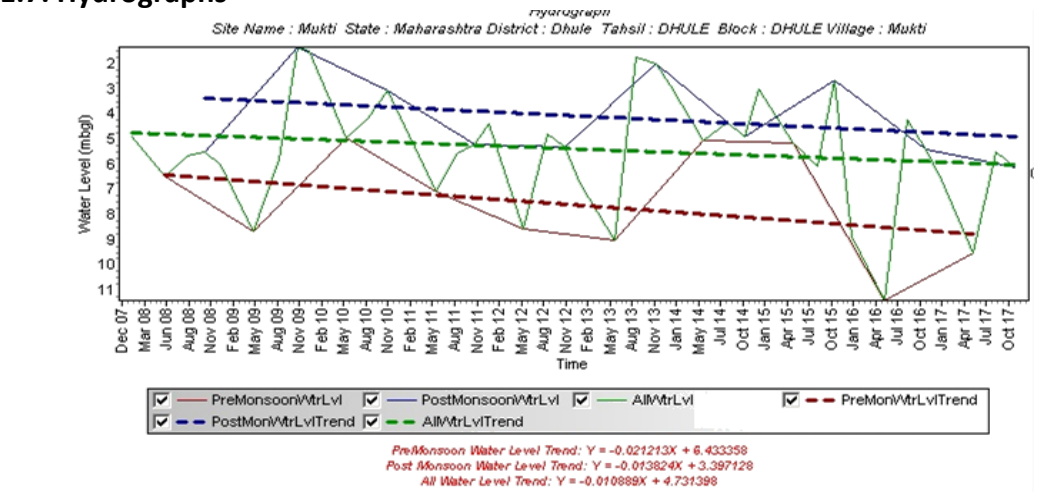
1.6.2 Aquifer – II (Semi Confined / Confined / Deeper Aquifer)

Pre-Monsoon (May-2017)	**Post-Monsoon (November-2017)**
Water level <10 mbgl is observed in major part of the block while water level between 10 to 20 mbgl is observed in northern part of the block and in isolated patches in the southern half of the taluka.	Water level <10 mbgl is observed over the major part of the block while water level between 10 to 20 mbgl is observed in small isolated patches in north-east and north-western part of the block.





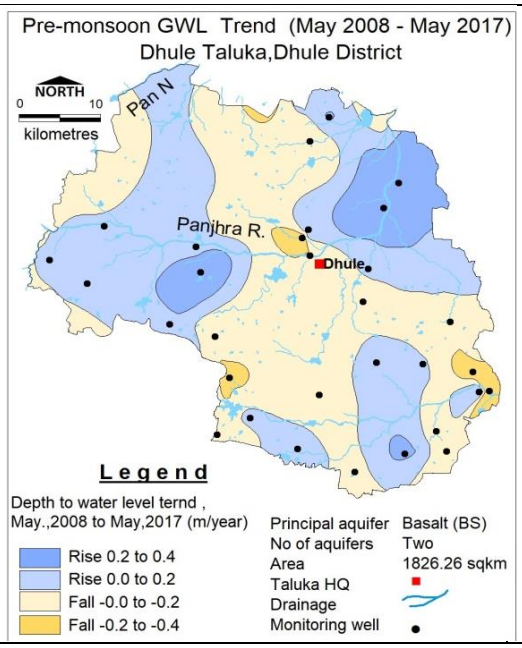
1.7. Hydrographs

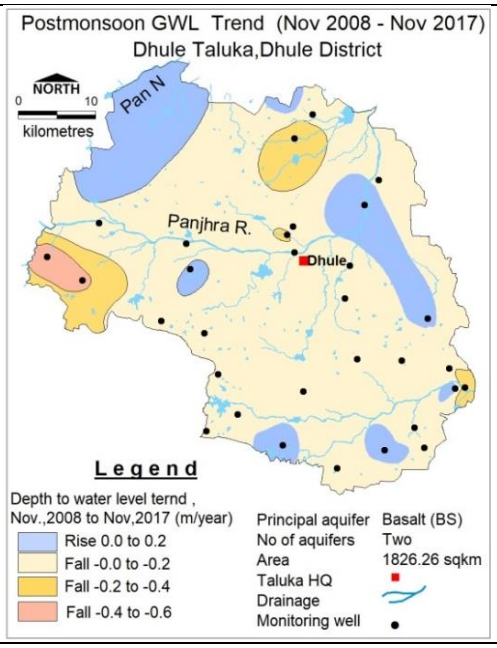


Hydrograph shows Pre-monsoon declining (falling) water level trend @ 0.0212 m/year	Hydrograph shows Post- monsoon declining (falling)water level trend @ 0.0138m/year

1.8. Water Level Trend (2008-17)

Pre-Monsoon trend Rising 0.033 to 0.3491 m/year Falling 0.3887 to 0.0055 m/year	**Post-Monsoon trend** Rising 0.0111 to 0.4734 m/year Falling 0.1892 to 0.0059 m/year
Pre-Monsoon Water Level Trend (2008-2017) Major part of the block shows falling trend up to 0.2 m/year and >0.2m/year are found in isolated small patches in central, south-east and south-west part of the block while rising trend upto 0.2 m/year has been observed in isolated parts in the block.	**Post-Monsoon Water Level Trend (2008-2017)** Major part of the block shows Falling trend < 0.2 m/year and from 0.2 to 0.4 m/year are found in isolated small patches in north and north western part of the block while >0.4 m/year are found in an isolated patch in western part of the block. The rising trend upto 0.2 m/year has been observed in north-east and north-west part and in small isolated patches in northern part of the block.





2. Ground Water Issues

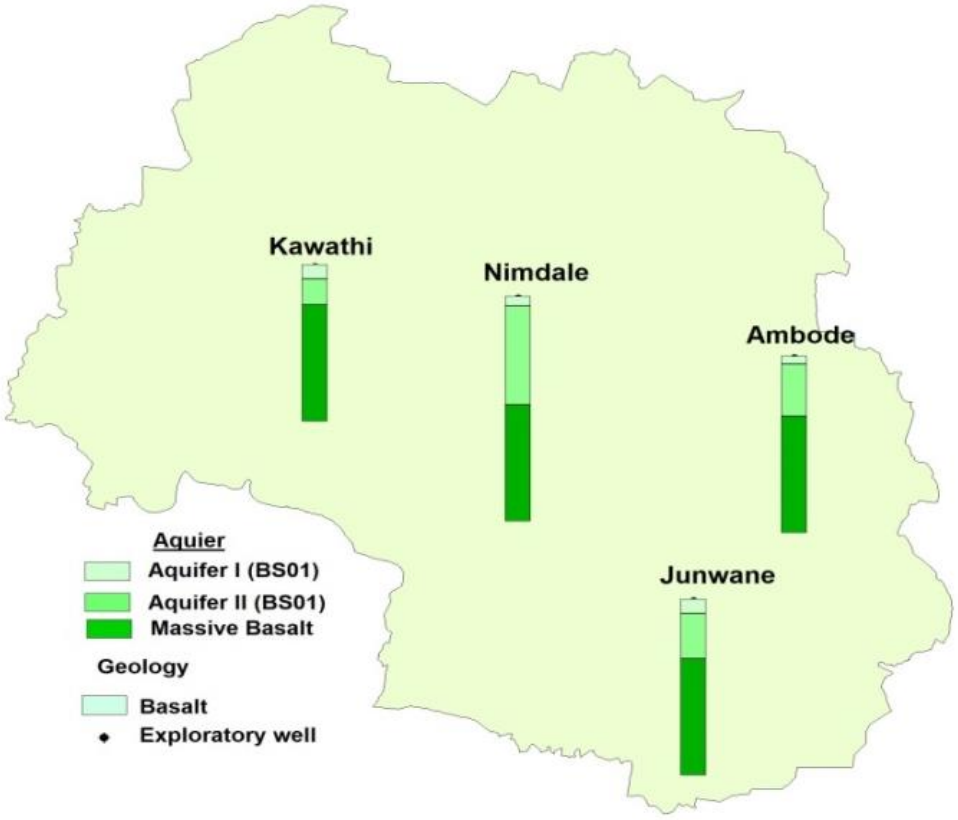
Declining WL, irregular rainfall, frequent droughts, Limited Aquifer Potential

3. Aquifer Disposition

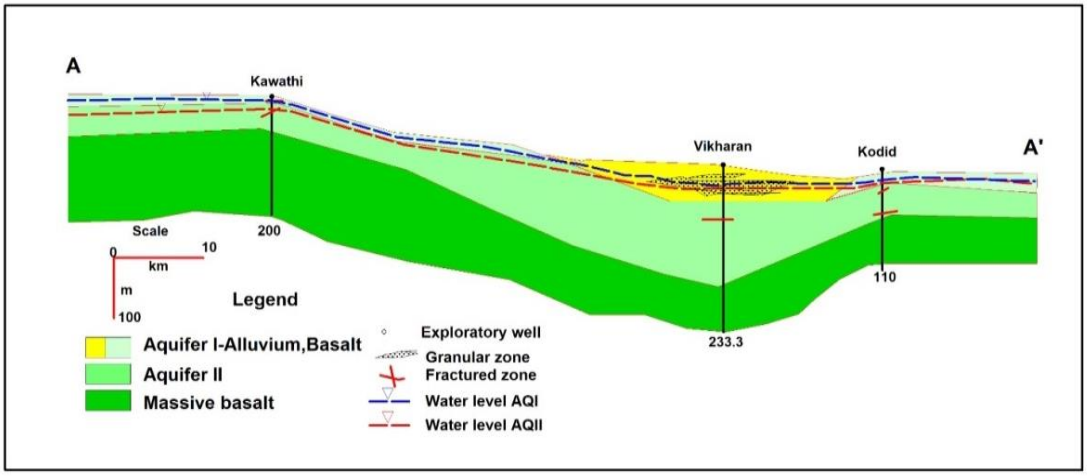
3.1. Number of Aquifers

- **Basalt –Aquifer-I** (Shallow/unconfined) weathered/Fractured Basalt,
- **Basalt - Aquifer-II** (Semi Confined / Confined / Deeper Aquifer) Jointed/Fractured Basalt)
- **Alluvium - Aquifer-I** (Tapi River Alluvium clays, silt, sand, gravels and boulders etc.)

3.2. Lithological Disposition



3.3. Cross Sections



3.4. Aquifer Characteristics

Type of Aquifer (Phreatic / Semiconfined / Confined)	**Aquifer-I**		**Aquifer-II**
	Alluvium (Tapi River Alluvium clays, silt, sand, gravels & boulders etc.)	**Deccan Trap Basalt** (weathered / Fractured)	**Deccan Trap Basalt** (Jointed/Fractured)
Depth of Occurrence (mbgl)	10-30	5-35	30-198.5
Granular/ Weathered / fractured rocks thickness (m)	8-20	5-20	0-12
Yield	25-75 m3/day	0-100 m3/day	Upto 5.0 lps
Specific yield/Storativity (S)	0.06-0.1	0.019-0.028	1.20 x 10-4. 3.57 x 10-4
Transmissivity (T) m^2/day	70-170	9.25-89.04	10.85-131.11

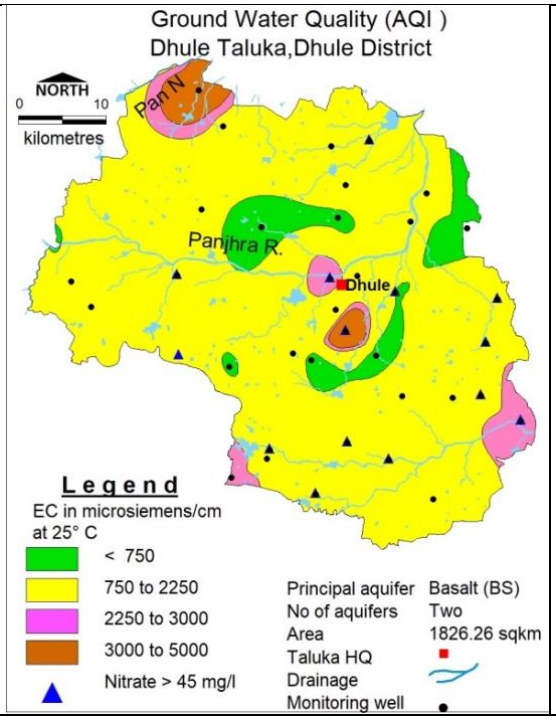
4. GROUND WATER QUALITY

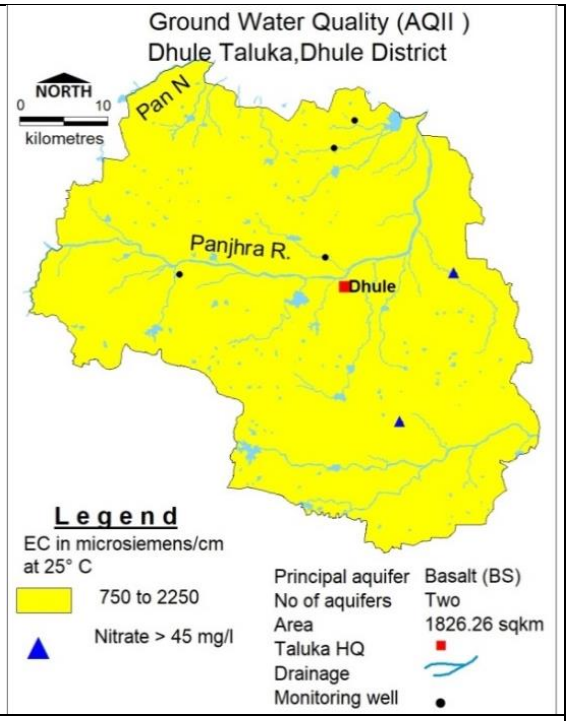
4.1 Phreatic Aquifer (Aquifer-I)

EC < 750 µS/cm has been observed in central and north-east part of the block in patches. EC from 750 to 2250 µS/cm has been observed in major part of block. EC >2250 µS/cm has been observed in isolated patches in central, north-west, south-east and south-west part of the block. Ground water in the major part of block is suitable for irrigation purpose with proper salinity control measures. However the water from such area is not fit for drinking purpose without treatment. Few villages are also affected by Nitrate contamination.

4.2 Semiconfined /Confined Aquifer (Aquifer II)

EC > 2250 µS/cm is observed in almost all areas of the block. Ground water is suitable for irrigation purpose with proper salinity control measures. However the water from such area is also not fit for drinking purpose without treatment. Few villages are also affected by Nitrate contamination.





5. GROUND WATER RESOURCE	
5.1 Aquifer-I/ Phreatic Aquifer (Alluvium & Basalt)	
Ground Water Recharge Worthy Area (Sq. Km.)	1826.26
Total Annual Ground Water Recharge (MCM)	204.10
Natural Discharge (MCM)	10.999
Net Annual Ground Water Availability (MCM)	193.10
Existing Gross Ground Water Draft for irrigation (MCM)	123.94
Existing Gross Ground Water Draft for domestic and industrial water supply(MCM)	4.19
Existing Gross Ground Water Draft for All uses(MCM)	128.13
Provision for domestic and industrial requirement supply to 2025(MCM)	7.93
Net Ground Water Availability for future irrigation development(MCM)	61.21
Stage of Ground Water Development (%)	66.35%
Category	SAFE

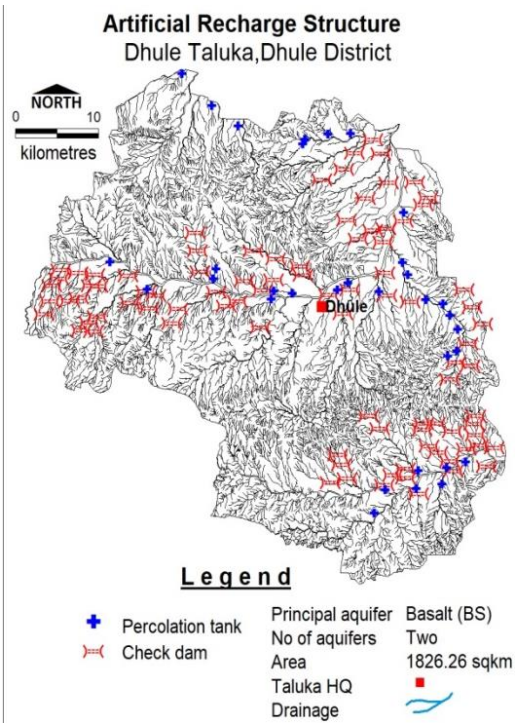
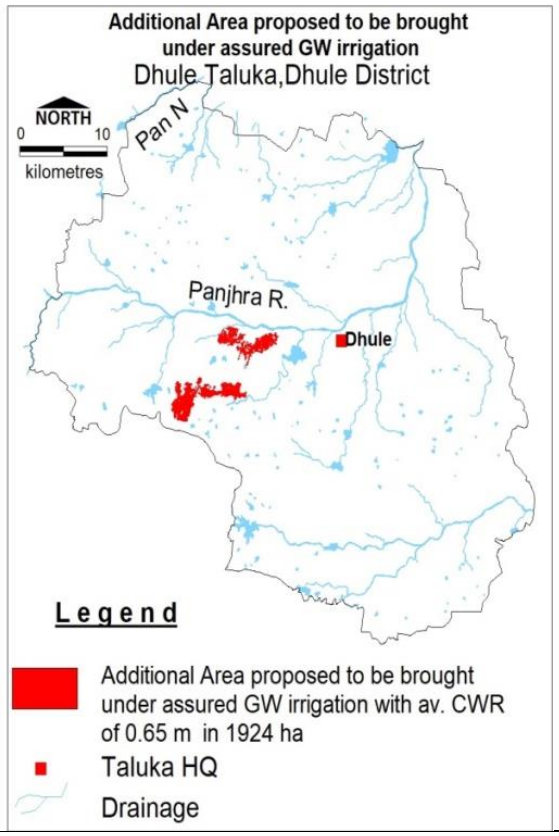
5.2 Aquifer-II (Semiconfined/Confined Aquifer (Basalt))

Total Area (Sq. Km.)	Mean aquifer thickness (m)	Sy	Piezometric Head (m above confining layer)	Total Resource (MCM)
86.95	0.5	0.005	25	0.478
875.96	0.75	0.0025	18	4.118
863.89	2.0	0.0025	20	7.032

6.0. GROUND WATER RESOURCE MANAGEMENT	
Available Resource (MCM)	193.10
Gross Annual Draft (MCM)	128.13
SUPPLY SIDE MANAGEMENT	
DEMAND (MCM)	
Agricultural demand -GW	123.94
Agricultural demand -SW	0.00
Domestic demand - GW	4.19
Domestic demand - SW	1.05
Total Demand(MCM)	**129.18**

SUPPLY (MCM)			
Agricultural Supply -GW			123.94
Agricultural Supply -SW			0.00
Domestic Supply - GW			4.19
Domestic Supply - SW			1.05
Total Supply			**129.18**
Area of Block (Sq. Km.)			1826.26
Rainwater Harvesting and Artificial Recharge			
Volume of unsaturated granular zone (MCM)			1794.70
Recharge Potential (MCM)			35.89
Surface water requirement @ 75% efficiency (MCM)			47.86
Availability of Surplus surface runoff (MCM)			9.36
Surplus runoff considered for planning (MCM) @ 100%	9.36	7.02	
Proposed Structures	Percolation Tank , Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam , Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)	
Number of Structures	33	91	
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	4.95	2.05	
RTRWH Structures – Urban Areas			
Households to be covered (25% with 50 m^2area)			41486
Total RWH potential (MCM)			1.17
Rainwater harvested / recharged @ 80% runoff co-efficient			0.94
Estimated Expenditure (Rs. in Cr.) @ Rs. 15000/- per HH			62.23
RTRWH in Urban Areas is Economically not viable & Not Recommended			
Total volume of water expected to be recharged/conserved by AR			7.00
Stage of ground water development after implementation of artificial recharge			64.03
Ground water available TO BRING STAGE OF GWD UPTO 70%			11.94
6.2. DEMAND SIDE INTERVENTIONS			
Proposed Cropping Pattern change			None
Micro irrigation techniques			
Sugarcane crop area (2.07) ,about 1.0 sqkm area is ground water irrigated, 100 % ground water irrigated (1.0 sqkm) proposed to be covered under Drip (sq.km.)			1
Volume of Water expected to be saved (MCM). Surface Flooding req- 2.45 m. Drip Req. - 1.88, WUE- 0.57 m			0.57
Estimated Expenditure (Rs. in Cr.) @ Rs. 60,000/- per acre			1.48
Alternate Sources			Nil
6.3. Expected Benefits			
Net Ground Water Availability (MCM)			193.10
GW resources available after Supply side interventions (MCM)			200.1
Ground Water Availability after Supply side intervention			11.94
Existing Ground Water Draft for All Uses (MCM)			128.12
GW draft after Demand Side Interventions (MCM)			127.55
Present stage of Ground Water Development (%)			66.35
Expected Stage of Ground Water Development after interventions (%)			64.03
Alternate Water Sources Available			Nil

6.4. Development Plan	
Volume of water available for GWD to 70% (MCM)	12.21
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	750
Proposed Number of BW (@ 1.5 ham for 10% of GWR Available)	84
Additional Area (sq.km.) proposed to be brought under assured GW irrigation with av. CWR of 0.65 m	19.246

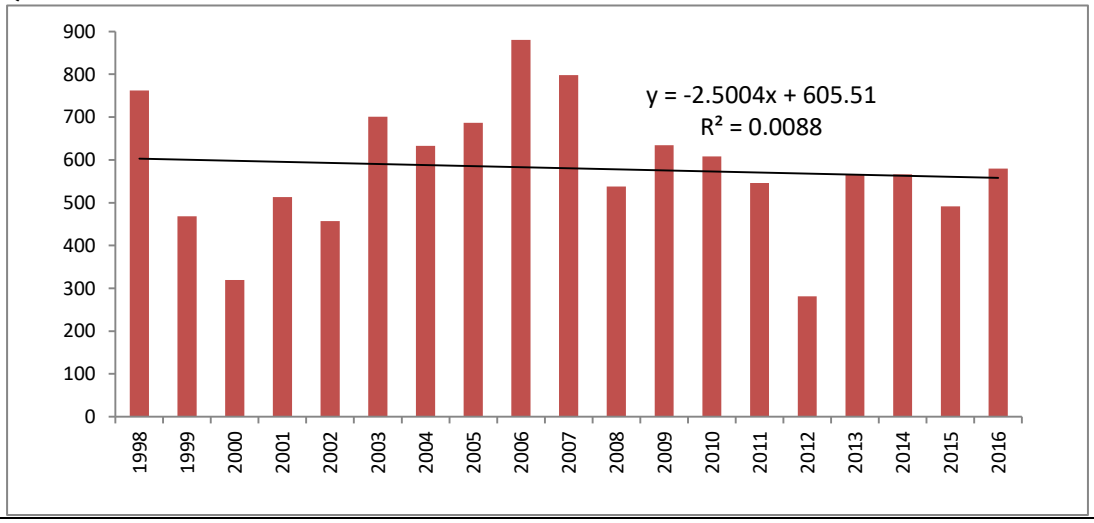
Proposed locations for AR structures	**Additional area proposed to be bought under assured GW irrigation**
	

10.0 AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, SAKRI BLOCK, DHULE DISTRICT, MAHARASHTRA

1. SALIENT FEATURE		
1.1 Introduction		
Block Name		**SAKRI**
Geographical Area (Sq. Km.)		1967.67
Population (2011)		464913
Climate		Tropical Monsoon
1.2 Rainfall Analysis		
Normal Rainfall		770.4 mm
Annual Rainfall (2017)		502.8 mm
Decadal Average Annual Rainfall (2008-17)		486.60 mm
Long Term Rainfall Analysis (1998-2016)	Falling Trend 2.5 mm/year Probability of Normal/Excess Rainfall- 61% & 17%. Probability of Drought (Moderate/Severe)-: 19 % Moderate & 3 % Severe.	

Rainfall Trend Analysis (1998 To 2016)

EQUATION OF TREND LINE: Y= -2.5004x + 605.51



1.3. Geomorphology &Geology		
Geomorphic Unit	Tapi valley proper and the region of the dykes and residual hills of the Sahyadri Spurs with eastward trending streams in between.	
Geology	Alluvium (Graveliferous and sand/ silt and clay alternating beds), Age: Recent to Sub-recent Deccan Traps (Basalt), Age: Upper Cretaceous to Lower Eocene	
1.4. Hydrology & Drainage		
Drainage	Tapi river, with its tributary Panjhara & Buriya river constitute the drainage system in the area. The drainage pattern is mainly dendritic, sub dendritic to sub parallel. Overall direction of surface water drainage is from northwest to southeast.	
Hydrology	Bigger Minor Irrigation Project (>100 Ha.)	**Completed: -**5 Medium Projects; 06 LIS; 10 KT weirs; 135 PT;
	Minor Irrigation Project (<100 Ha.)	**Completed**: -12 MI projects;

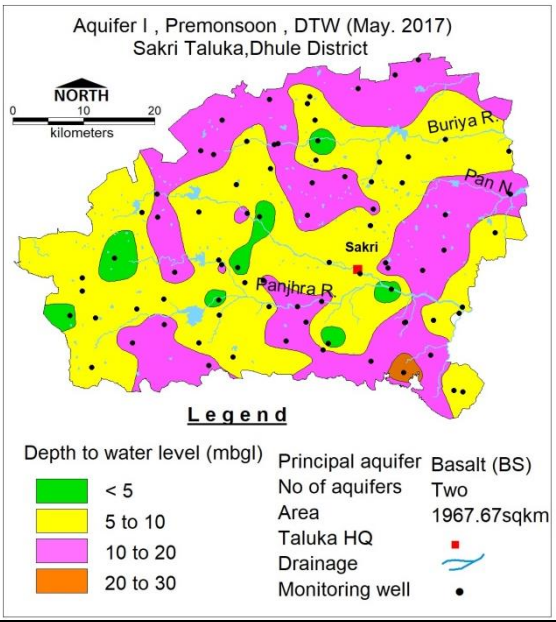
1.5. Land Use, Agriculture, Irrigation & Cropping Pattern(Area in sq km)		
Geographical Area		**2441.1**
Forest Area		736.77
Cultivable Area		1436.81
Net Sown Area		1112.72
Double Cropped Area		65.32
Area under Irrigation	Surface Water	30.9
	Ground Water	152.85
Principal Crops *(Reference year 2013-14)*	**Crop Type**	**Area (Sq. Km.)**
	Rice	12442 ha
	Wheat	6164
	Cereals	45732
	Cotton	349892
Horticultural Crops	Oil Seeds	6879
	Sugarcane	3545

1.6 Water Level Behavior

1.6.1 Aquifer – I (Unconfined/Shallow/Phreatic Aquifer)

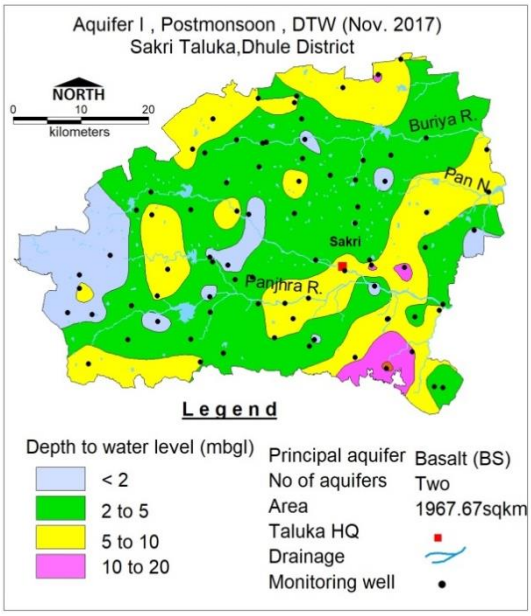
Pre-Monsoon Water Level (May 2017)

Water level less than 5 mbgl is observed in small pockets in central, south-east, south-west part of the block. Water levels between 5 to 20 mbgl is observed in major part of the block while water level >20 mbgl is observed in small isolated patch in south-eastern part of the block.



Post-Monsoon Water Level (Nov. 2017)

Water level less than 2 mbgl is observed in small pockets in south-east and south-west parts of the block. Water level between 2 – 10 mbgl is observed in in major part of the block. Water level between 10 to 20 mbgl is observed small isolated patches in south-eastern part of the block.



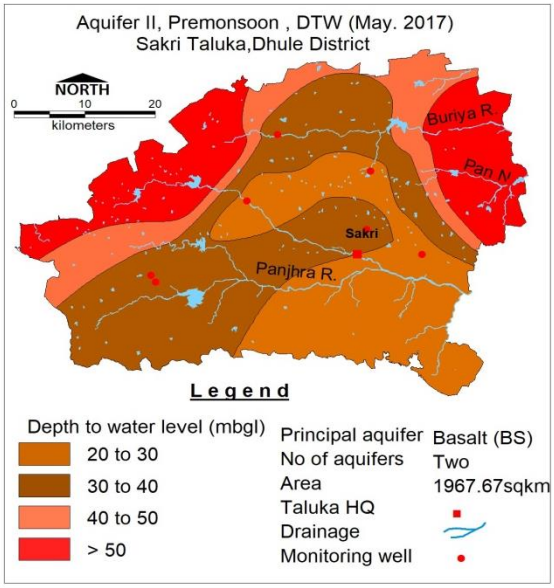
1.6.2 Aquifer – II (Semi Confined / Confined / Deeper Aquifer)

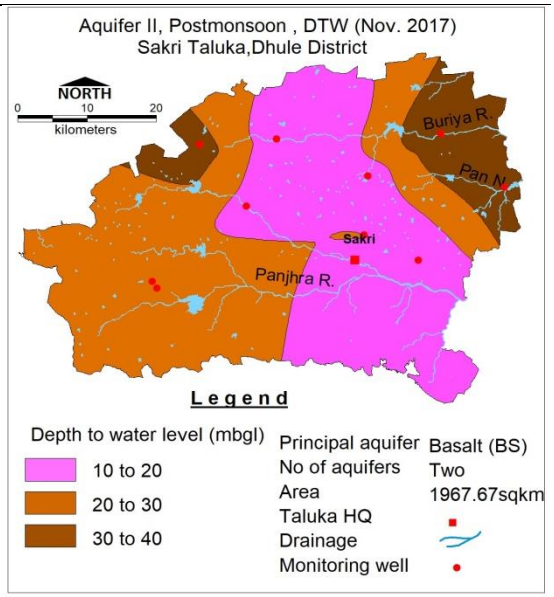
Pre-Monsoon Water Level (May 2017)

Water level between 20 to 40 mbgl is observed in major part of the block while water level >40 mbgl is observed in north western and north eastern parts of the block.

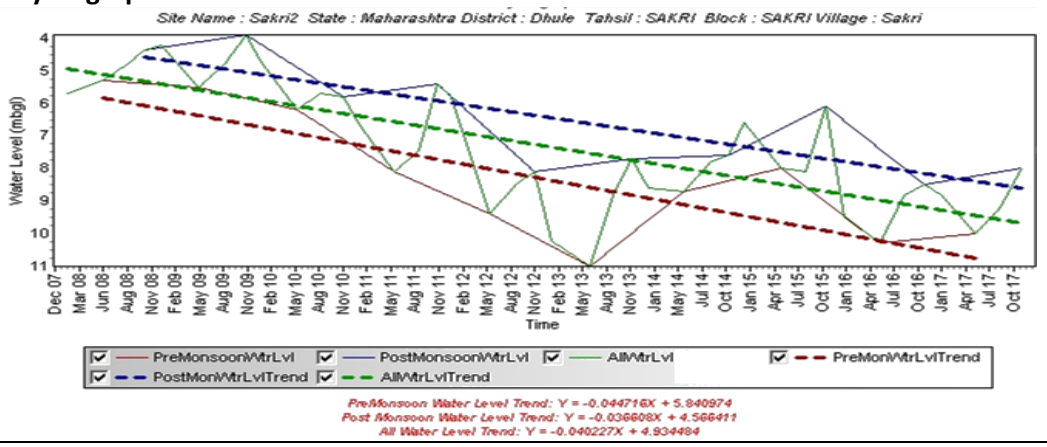
Post-Monsoon Water Level (Nov. 2017)

Water level between 10 – 20 mbgl is observed in north and south and central parts of the block; 20 to 30 mbgl is observed in major part of the block while >30 mbgl is observed in small patches in north western and North eastern part of the block.



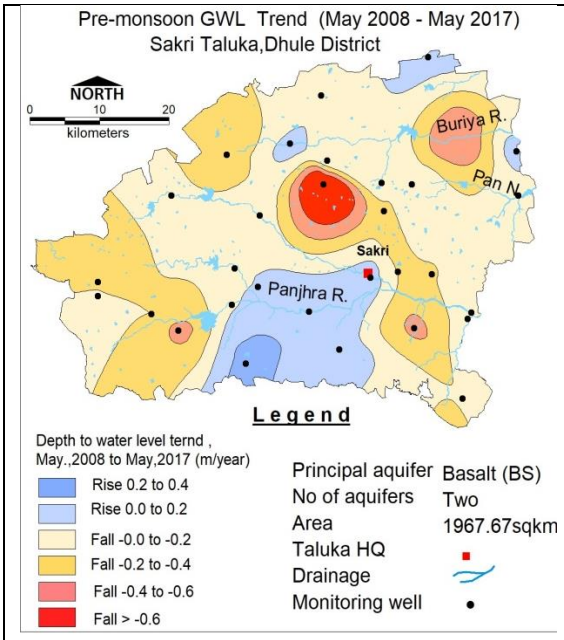


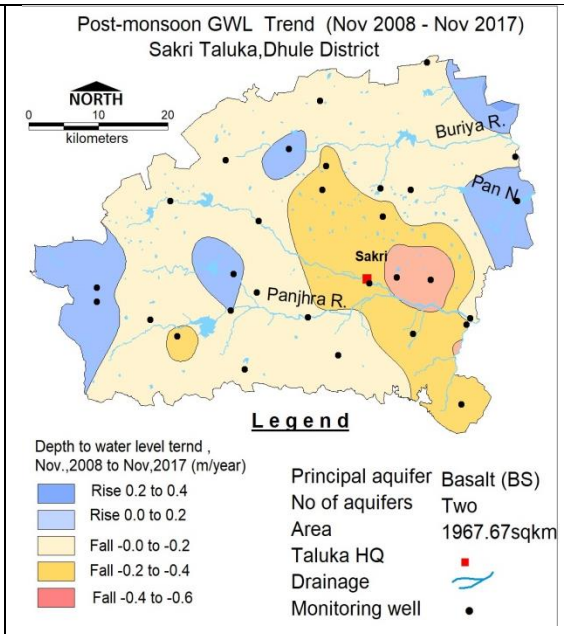
1.7. Hydrograph



1.8. Ground Water Level Trend (2008-2017)

Hydrograph shows Pre-monsoon falling trend @ 0.044 m/year	Hydrograph shows Post-monsoon Falling trend @ 0.036 m/year
Pre-Monsoon trend Rising 0.0091 to 0.8533 m/year Falling 0.2467 to 0.0179 m/year	**Post-Monsoon trend** Rising 0.0034 to 0.5285 m/year Falling 0.1438 to 0.0015 m/year
Premonsoon Water level Trend (2008-17) Declining trend up to 0.4 m/year is observed in almost entire block; decline in water level >0.4 m/year has been observed in central and eastern part of the block in isolated patches. Rising water level trend has been observed in southern parts and in isolated patches in eastern part of the block.	**Postmonsoon Water level Trend (2008-17)** Declining trend up to 0.4 m/year is observed in almost entire block; significant decline in water level > 0.4 m/year has been observed in South -eastern part of the block in an isolated patch. Rising water level trend has been observed in eastern and western part of the block and north eastern part in small patches.





2. Ground Water Issues

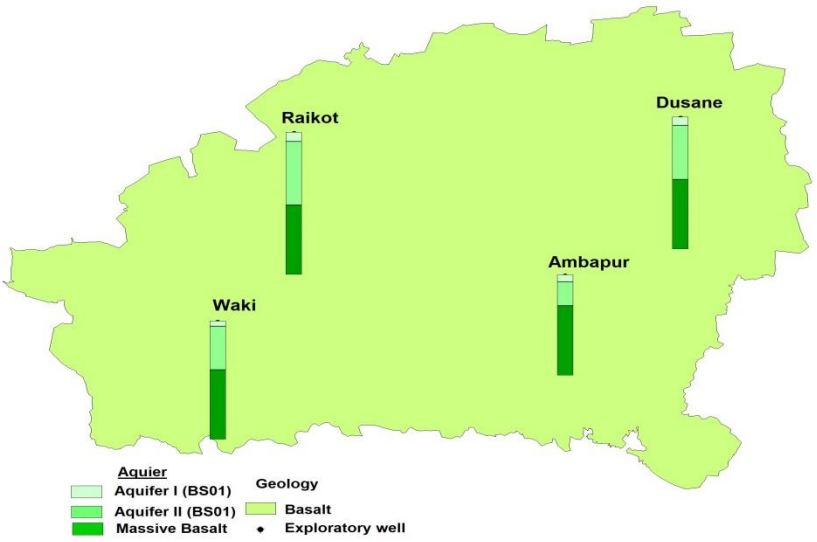
Declining WL, irregular rainfall, frequent droughts, Limited Aquifer Potential

3. Aquifer Disposition

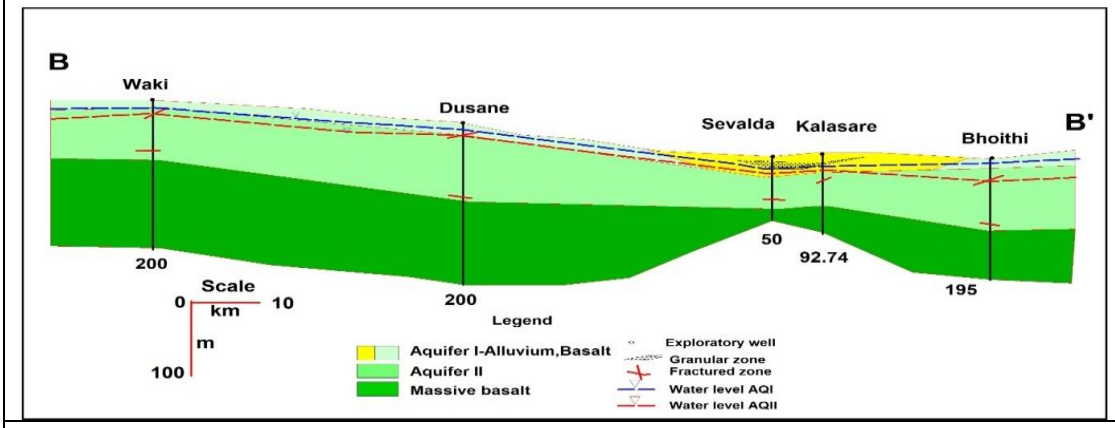
3.1. Number of Aquifers

- **Basalt –Aquifer-I** (Shallow/unconfined) weathered/Fractured Basalt,
- **Basalt - Aquifer-II** (Semi Confined / Confined / Deeper Aquifer) Jointed/Fractured Basalt)
- **Alluvium - Aquifer-I** (Tapi River Alluvium clays, silt, sand, gravels and boulders etc.)

3.2. Aquifer Disposition



3.3. Cross Sections

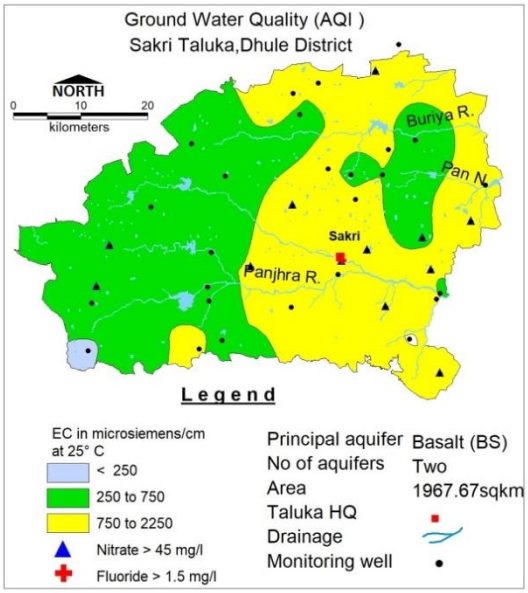


3.4 Aquifer Characteristics

Major Aquifers	Aquifer-I		Aquifer-II
Type of Aquifer	**Alluvium** (Tapi River Alluvium clays, silt, sand, gravels & boulders etc.)	**Deccan Trap Basalt** (weathered / Fractured)	**Alluvium** (Tapi River Alluvium clays, silt, sand, gravels & boulders etc.)
Depth of Occurrence (mbgl)	10-40	5-35	30-198.5
Granular / Weathered / Fractured rocks Thickness (m)	8-20	5 to 20	0-12
Yield (m^3/day)	25-100	0 to 100 m3/day	Upto 5.0 lps
Specific yield/ Storativity (S)	0.06-0.1	0.019- 0.028	1.20 x 10-4. 3.57 x 10-4
Transmissivity (T) m^2/day	70-170	9.25-89.04	10.85-131.11

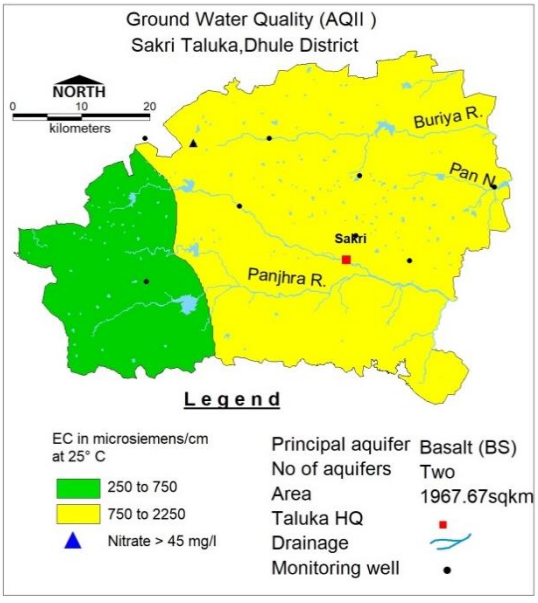
4. GROUND WATER QUALITY

4.1 Phreatic Aquifer (Aquifer-I)



EC upto 750 µS/cm has been observed in major part of block suitable for all purpose. Ground water in southern part of the block

4.2 Semiconfined/Confined Aquifer (Aquifer II)



EC >750 µS/cm is observed in major part of block. Ground water in eastern parts of the

is affected by Nitrate water from such area is not fit for drinking purpose without treatment. EC > 750 µS/cm is observed in north central, north east and north west part of the block which is suitable for irrigation purpose only with proper salinity control measures. In Sakri village Fluoride contamination is seen.	block shows EC <750 µS/cm, which is suitable for irrigation purpose however the water from such area is also fit for drinking purpose without treatment. Few Villages are also affected by Nitrate contamination in north western part of the block.

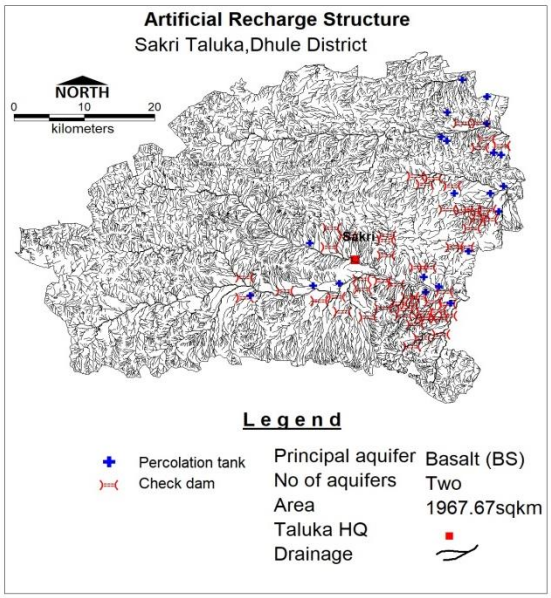
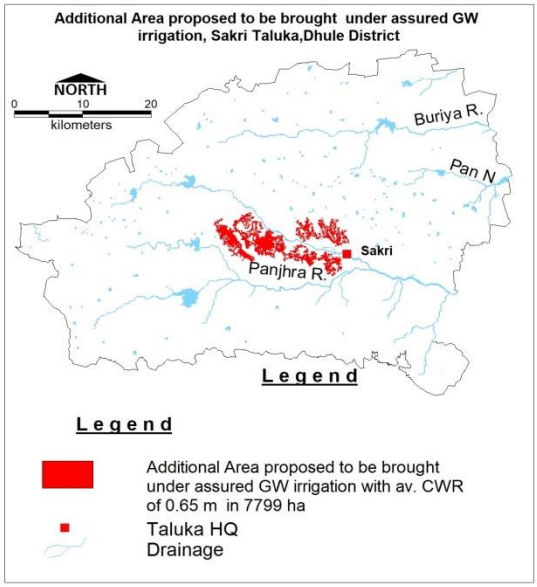
5. GROUND WATER RESOURCES	
5.1 Aquifer-I/ Phreatic Aquifer (Basalt & Alluvium)	
Ground Water Recharge Worthy Area (Sq. Km)	1967.67
Total Annual Ground Water Recharge (MCM)	214.39
Natural Discharge (MCM)	11.551
Net Annual Ground Water Availability (MCM)	202.84
Existing Gross Ground Water Draft for irrigation (MCM)	92.00
Existing Gross Ground Water Draft for domestic and industrial water supply (MCM)	5.25
Existing Gross Ground Water Draft for All uses (MCM)	97.26
Provision for domestic and industrial requirement supply to 2025(MCM)	10.31
Net Ground Water Availability for future irrigation development(MCM)	102.93
Stage of Ground Water Development (%)	**47.95%**
Category	**SAFE**

5.2 Aquifer-II (Semiconfined/Confined Aquifer (Basalt))				
Total Area (Sq. Km.)	**Mean aquifer thickness (m)**	**Sy**	**Piezometric Head (m above confining layer)**	**Total Resource (MCM)**
7.59	0.5	0.005	50	0.064
595.53	0.75	0.0025	20	2.987
1364.37	2	0.005	20	17.928

6.0. GROUND WATER RESOURCE MANAGEMENT	
Available Resource (MCM)	202.84
Gross Annual Draft (MCM)	97.26
6.1. Supply Side Management	
SUPPLY (MCM)	
Agricultural Supply -GW	92
Agricultural Supply -SW	20
Domestic Supply - GW	5.26
Domestic Supply - SW	1.315
Total Supply	**118.575**
Area of Block (Sq. Km.)	1967.67
Area suitable for Artificial recharge(Sq. Km)	570.78

Type of Aquifer	Hard Rock	Soft Rock
Area feasible for Artificial Recharge(WL >5mbgl) (Sq. Km.)	570.78	0
Volume of Unsaturated Zone (MCM)	1141.57	0
Average Specific Yield	0.02	
Volume of Sub surface Storage Space available for Artificial Recharge (MCM)	22.83	-
Surplus water Available (MCM)	0.0104	-

Proposed Structures	Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures	21	58
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	3.15	1.31
RTRWH Structures – Urban Areas		
Households to be covered (25% with 50 m^2 area)		23730
Total RWH potential (MCM)		0.67
Rainwater harvested / recharged @ 80% runoff co-efficient		0.67/0.54
RTRWH in urban areas is economically not viable & not recommended		
Total volume of water expected to be recharged/conserved by AR		4.46
Stage of ground water development after implementation of artificial recharge		46.92
Ground water available to bring stage of GWD UPTO 70%		47.85
6.2. Demand Side Management		
i. Proposed Cropping Pattern change		None
ii. Micro irrigation techniques		
Sugarcane crop area (2.07) ,about 1.0 sq km area is ground water irrigated, 100 % ground water irrigated (1.0 sq km) proposed to be covered under Drip (sq.km.)		5
Volume of Water expected to be saved (MCM). Surface Flooding req- 2.45 m. Drip Req. - 1.88, WUE- 0.57 m		2.85
Estimated Expenditure (Rs. in Cr.) @ Rs. 60,000/- per acre		7.41
Alternate Sources		Nil
6.3. Expected Benefits		
Net Ground Water Availability (MCM)		202.84
GW resources available after Supply side interventions (MCM)		207.30
Ground Water Availability after Supply side intervention		47.85
Existing Ground Water Draft for All Purposes (MCM)		97.26
GW draft after Demand Side Interventions (MCM)		94.41
Present stage of Ground Water Development (%)		47.95
Expected Stage of Ground Water Development after interventions (%)		46.92
Alternate Water Sources Available		Nil
6.4. Development Plan		
Volume of water available for GWD to 70% (MCM)		50.70
Proposed Number of DW(@ 1.5 ham for 90% of GWR Available)		3042
Proposed Number of BW(@ 1.5 ham for 10% of GWR Available)		338
Additional Area (sq.km.) proposed to be brought under assured GW irrigation with av. CWR of 0.65 m		78
Regulatory Measures	**Regulation of wells below 60 m**	

Proposed AR Structures	**Additional area proposed to be bought under assured GW irrigation**
	

ANNEXURES

Annexure-I: Salient Features of Ground Water Exploration in Dhule and Sakri taluka, Dhule District

Sl. No.	Taluka	Village	Altitude	Year	Date of Completion	Type	Geology	Aquifer	Drilling depth	Casing	AQ Zones
1	Dhule	Ambode	254	2017-18	26.09.2017	EW	Basalt	WB	200	5.5	5.50-7.40
2	Dhule	Dusane	340.2	2017-18	28-07-2017	EW	Basalt	FMB	200	30	153.00-154,.00
3	Dhule	Kawathi	347.7	2017-18	18-07-2017	EW	Basalt	Massive Basalt	200	30	No water Bearing Zone encountered
4	Dhule	Nimdale	339	2017-18	28.10.2017	EW	Basalt	FMB	200	18	167-169
5	Sakri	Ambapur	487.3	2017-18	09.08.2017	EW	Basalt	WB	200	30	16.80 – 19.80
6	Sakri	Junwane	342.9	2017-18	19.09.2017	EW	Basalt	WB	200	30	19.60-22.60
7	Sakri	Raikot	630	2017-18	29-08-2017	EW	Basalt	FMB	200	30	40.90 - 44.00 ,178.20 – 181.20
8	Sakri	Waki	592.1	2017-18	07.09.2017	EW	Basalt	FB	200	11.5	123.00-126.00
9	Sakri	Waki PZ	592.1	2017-18	02.09.2017	PZ	Basalt	WB	37.9	17.5	10.40-13.50

Annexure II: Details of KOWs in Dhule Taluka of Dhule District

S. no	Well no.	Location	Taluka	Agency name	Toposheet	Elevation (mamsl)	Formation	Aquifer	Well. Depth (m)	Height of MP (magl)	Diameter (m)	Lining	DTW (mbgl) May-17	Spot EC	DTW (mbgl) Nov.-17	Spot EC
1	40	Burzad	Dhule	CGWB	46K12-2	-	Deccan Trap	WB	9.1	0.3	-	4.8	8.9	745	3.4	537
2	13	Chande	Dhule	CGWB	46L14-2	339	Deccan Trap	WB	13.4	0		5.3	12.4	1311	6.4	1373
3	33	Chinchkhede	Dhule	CGWB	46L13-2C		Deccan Trap	WB	9.8	0.6		6.2	7.9	1578	4.7	2267
4	43	Chinchwar	Dhule	CGWB	46K12-2	143	Deccan Trap	WB	12.75	0.3		7.6	12.7	2160	4.7	5800
5	27	Deobhane	Dhule	CGWB	46L14-1A	307	Deccan Trap	FMB	9.2	0.8	4.5	6.1	7.9	1280	3.1	751
6	45	Deur Kh.	Dhule	CGWB	46L5-2C	386	Deccan Trap	WB	18.3	0.6	6	6.6	15.85	1889	13.3	1986
7	38	Dhadre	Dhule	CGWB	46L10-2	-	Deccan Trap	WB	10.4	0.6	5	6.2	8.5	2204	9.6	2561
8	26	Dhamani	Dhule	CGWB	46L13-2		Deccan Trap	F/J B	18.1	0.3	12	9	13.2	2432	Dry	
9	29	Dhanur	Dhule	CGWB	46K16-2	204	Deccan Trap	WB	9.8	0.6		3.2	4.55	1134	7.9	1294
10	10	Gadtar	Dhule	CGWB	46L13-2		Deccan Trap	WB	6.1	0.4	2	5	5.4	1808	4.8	2195
11	36	Hadsuni	Dhule	CGWB	46L13-3B	-	Deccan Trap	WB	7	0.4	7	3	6.8	1562	3.3	2020
12	37	Hendrun	Dhule	CGWB	46L14-1A	-	Deccan Trap	WB	8.2	1	7	3.25	7.6	1070	8.9	1262
13	11	Junwane	Dhule	CGWB	46L13-2	538	Deccan Trap	F/J B	8.3	0		3.9	6.4	697	4.8	1069
14	32	Kasvihir	Dhule	CGWB	46L13-2		Deccan Trap	FB	13	1	5	3.2	10.2	487	1.85	416
15	30	Kauthal	Dhule	CGWB	46K16-2	833	Deccan Trap	FMB	16.7	1	6	10.15	15.35	845	10.7	1110
16	39	Kulthe	Dhule	CGWB		-	Deccan Trap	WB	7.6	0.7	3	3.7	3.95	102	5.8	1248
17	34	Kundane (velhane)	Dhule	CGWB	46L13-2		Deccan Trap	WB	11.3	0		5.6	11.1	1574	3.1	924
18	14	Mordad	Dhule	CGWB	46L14-1C		Deccan Trap	FMB	12.1	0.9		3	7.6	777	5.1	718
19	44	Navalane	Dhule	CGWB	46L9-2	341	Deccan Trap	WB	6.5	0.75	3.5	4	5.8	3328	0.7	3372
20	31	Nawri	Dhule	CGWB	46L13-1B	236	Deccan Trap	JB	17.7	0.3	7	4.9	Dry		11.6	704
21	42	Nikumbhe	Dhule	CGWB	46K12-3B	353	Deccan Trap	FMB	14.8	0.7		4	12.25	1887	6.4	2470
22	35	Nimgul	Dhule	CGWB	46L13-2	-	Deccan Trap	WB	16.9	0.8	7	13	14.6	2739	11.4	1857
23	41	Rami	Dhule	CGWB	46K12-3B		Deccan Trap	FMB	15.35	0.8	6.5	5.8	15.11	426	1.2	575
24	28	Sarvad	Dhule	CGWB	46K16-3A	217	Deccan Trap	WB	12.1	0.6	2.5	1.8	10.7	2602	8.9	3020
25	12	Shirud	Dhule	CGWB	46L14-2	309	Deccan Trap	FB	12.4	0.3	4	2.65	7.45	1138	4	1057
26	46	Wadel	Dhule	CGWB	46L9-1C		Deccan Trap	WB	12.25	0.3			10.35	822	4.2	623

Annexure III: Details of KOWs in Sakri Taluka of Dhule District

SN	Taluka	Village	Toposheet	Geology	Aquifer	Elevation (mamsl)	Well. Depth (m)	Pump (hp)	DTW (mbgl) May-17	Spot EC	DTW (mbgl) Nov-17	Spot EC
1	Sakri	Shevali da				423	13.2		13		11.5	
2	Sakri	Phophade	46K8-2B	BS01	WJB	394.4	7.1	7.5	7	780	2.8	800
3	Sakri	Shewali (d)	46L5-1B	BS01	JAB	390.8	5.7		2.4	910	1.3	900
4	Sakri	Chail				492	4.91		2.8		1.7	
5	Sakri	Dhavali Vihir (n.v.)	46K8-2	BS01	WJB	471.3	4.5	3	3.1	920	1.8	900
6	Sakri	Sakri				417	12.2		8.8		7.3	
7	Sakri	Malpur	46L5-2	BS01	JMB	441.3	13.3	5	10.5	630	8.8	635
8	Sakri	Dhavali Vihir(n.v.)	46L1-2	BS01	JMB	518.8	7		2.7	940	1	1000
9	Sakri	Karanjati (n.v.)	46G16-3C	BS01	weath Basalt	654.7	4.5	3	2.9	380	1	360
10	Sakri	Malangaon (n.v.)	46K4-2	BS01	WJB	508.4	4.8	3	3.1	560	1.2	580
11	Sakri	Sayane				448	11.2		11		9	
12	Sakri	Shenwad	46H13-2C	BS01	JB	668.6	10.5		8.1	260	5.9	270
13	Sakri	Chinchkheda				369.8	13.2		11		8.8	
14	Sakri	Khandbare	46K4-3B	BS01	WJMB	576.6	12.6	5	6.4	450	4.2	480
15	Sakri	Phopare				300.8	8.2		7.95		5.5	
16	Sakri	Pimpalner				509.8	6.5		4.1		1.6	
17	Sakri	Akkalpada				366.3	7.6		6		3.5	
18	Sakri	Kawathe	46L5-2	BS01	wjmb	438.3	5.4	3	5.4		2.8	820
19	Sakri	Pimpalner	46L1-2	BS01	JMB	526.1	11		6.4	470	3.7	490
20	Sakri	Forest	46L1-1A	BS01		564			8		5.3	
21	Sakri	Mhasdi Pr.ner	46L5-2	BS01	Weath Jointed MB	442.7	14.1	5	13	870	10.2	860
22	Sakri	Vitai	46L5-2A	BS01	JMB	522	11		11		8.2	760
23	Sakri	Shewali (m)	46L5-2C	BS01	JMB	536	10.5		5.1	872	2.2	860
24	Sakri	Vaskhedi				502	7.9		6		3.1	
25	Sakri	Kharadbari (n.v.)	46K4-2	BS01	wjmb	556.4	12.4	5	6.1	460	3.1	480
26	Sakri	Korde	46K4-2	BS01	WJMB	526.3	9.8	3	9.3	710	6.2	750
27	Sakri	Khairkhunda	46H13-2	BS01	Weath Jointed AB	560.3	5.5	3	4.6	247	1.4	260
28	Sakri	Kasare	46L1-1C	BS01	JMB	472.2	11.5	5	10.3	800	6.9	790
29	Sakri	Dhamnar	46L5-1B	BS01	JMB	431.1	11.1	5	10.4	1580	6.9	1560

SN	Taluka	Village	Toposheet	Geology	Aquifer	Elevation (mamsl)	Well. Depth (m)	Pump (hp)	DTW (mbgl) May-17	Spot EC	DTW (mbgl) Nov-17	Spot EC
30	Sakri	Shelbari				601.3	8.4		5.5		2	
31	Sakri	Nizampur				470.7	11.2		7.5		4	
32	Sakri	Dahiwel				506.2	12.4		10.8		7	
33	Sakri	Rojgaon				406	6.6		5.3		1.4	
34	Sakri	Balhane	46L1-2B	BS01	Weath jointed Basalt	578	8.8	3	7.9	1260	4	1210
35	Sakri	Gartad (n.v.)	46K4-2	BS01	JMB	620.2	6.8	3	6.1	347	2.1	330
36	Sakri	Vasmar	46L5-2	BS01	Weath Jointed MB	402.9	10.3		8	600	4	
37	Sakri	Forest	46L1-1A	BS01		597.9			11		7	
38	Sakri	Dusane				344	8.7		6.5		2.5	
39	Sakri	Shevali (R)				547.7	11		8		4	
40	Sakri	Chadwel Korde				509.7	10.5		9.1		4.9	
41	Sakri	Akhade	46K8-2B	BS01	WJB	435.4	10.9	3	7.1	910	2.6	900
42	Sakri	Chhadwel (k)	46K8-1A	BS01	WJB	515.7	15.7	5	7	570	2.4	500
43	Sakri	Umarpata				567.3	8.4		7		2.3	
44	Sakri	Kalgaon	46L5-2	BS01	Weath Jointed MB	492.4	32	5	25	900	20.1	910
45	Sakri	Surpan	46L1-1C	BS01	JMB	475.1	12.2		9.7	740	4.8	720
46	Sakri	Mavajipada (n.v.)	46K4-2	BS01	WJMB	542.9	14.7	5	8.3	470	3.4	490
47	Sakri	Samode				505.3	10.5		8.3		3.4	
48	Sakri	Bhamer	46K8-3A	BS01	Fractured Basalt	524.6	11.5	5	8.2	1090	3.2	1100
49	Sakri	Dhangai	46K4-3B	BS01	WJAB	517.3	9	3	7	340	1.9	380
50	Sakri	Hatti Bk.	46K12-2	BS01	JMB	344.9	8.9	3	7.2	1410	1.9	1380
51	Sakri	Mahir				420.4	18		16		10.6	
52	Sakri	Nawapada (n.v.)	46K4-2C	BS01	JAB	514.1	11.8	3	10.4	450	4.7	420
53	Sakri	Vitawe	46K4-2	BS01	JMB	562.7	11.1		10.9	725	5	750
54	Sakri	Jamkhel	46K4-2	BS01	WJAB	626.5	17.8	5	13.9	370	8	400
55	Sakri	Bhamer				573.7	11.7		10.6		4.5	
56	Sakri	Basraval				573	7.6		7.4		1.3	
57	Sakri	Nagaziri (n.v.)	46K4-2C	BS01	WJMB	553	10.1	3	9.8	890	3.4	910
58	Sakri	Aichale				293.6	14.1		11.5		5	
59	Sakri	Petale	46K8-1A	BS01	JB	444.2	13.7		13.6	780	6.8	770

SN	Taluka	Village	Toposheet	Geology	Aquifer	Elevation (mamsl)	Well. Depth (m)	Pump (hp)	DTW (mbgl) May-17	Spot EC	DTW (mbgl) Nov-17	Spot EC
60	Sakri	Khargaon	46L1-2	BS01	Jointed amygdaloidal Basalt	622.6	10.8	5	10.4	290	3.5	320
61	Sakri	Pargaon	46L1-2B	BS01	WJAB	636.7	12.4		12.1	820	5.15	780
62	Sakri	Kudashi				589.9	9.6		9.5		2.5	
63	Sakri	Aichale	46K8-2	BS01	JMB	342	17.8	5	17.4	860	10.2	800
64	Sakri	Kalambhir	46L5-1B	BS01	JAB	439.2	17.3	5	10.2	960	3	1000
65	Sakri	Dighawe	46L1-2	BS01	WJB	508.6	17	5	12.3	920	5.1	890
66	Sakri	Dholipada	46L1-1C	BS01	JMB	520.5	13.2	5	10.1	790	2.7	810
67	Sakri	Domkani	46K4-2	BS01	WJB	629.8	13.3	5	11.7	800	4.1	810
68	Sakri	Kalambe	46H13-2	BS01	JAB	630	12.3	5	9.4	390	1.75	370
69	Sakri	Chhail	46L5-2A	BS01	WJB	503.1	14.9	5	10.3	1240	2.6	1270
70	Sakri	Sutare				585.1	13.1		10.2		2.3	
71	Sakri	Jebapur				524.3	11.5		11.5		3.4	
72	Sakri	Dhamnar				434	20.2		18.1		9.5	
73	Sakri	Pangan	46K4-1B	BS01		658.3			17.7		9	
74	Sakri	Brahmanwell				509	13		13		4.3	
75	Sakri	Runmali	46K8-2	BS01	JB	482	13.2		11	940	2	990
76	Sakri	Lagadwal				598	13		12.2		3	
77	Sakri	Lonkhede				297	12.6		12.55		6	
78	Sakri	Ubhand	46K8-3C	BS01	JMB	443.6	15.6		13.5	640	3.9	630
79	Sakri	Khampada				574.8	12.1		10.8		1.1	
80	Sakri	Mhasale	46K8-3C	BS01	JMB	401.8	15.8	5	13.6	780	8	720
81	Sakri	Domkani				528.3	21.1		17.2		6.2	
82	Sakri	Raikot	46K4-2	BS01	JMB	613.1	14.5		12.6	370	6	400

Annexure IV: Water Level of Ground water monitoring wells (2017) with long term trend (2008-2017)

S. No.	Taluka	Village	Aquifer Type	water level (m bgl)		Pre-monsoon Water level trend(m/year)		Post-monsoon water level trend(m/year)	
				Pre-monsoon	Post-monsoon	Rise	Fall	Rise	Fall
1.	Dhule	Achande	Unconfined	8.9	3.80	0.032967			-0.00592
2.	Dhule	Ajanle	Unconfined	4.6	2.00		-0.07005	0.024479	
3.	Dhule	Avadhan	Unconfined	9	4.50		-0.17747	0.046177	
4.	Dhule	Babre	Unconfined	12.9	4.50	0.009066		0.082292	
5.	Dhule	Bendrepada	Unconfined	11.39	3.10		-0.08791	0.130644	
6.	Dhule	Borkund	Unconfined	9.6	1.70	0.341758		0.13708	
7.	Dhule	Borvihir	Unconfined	11.15	3.70	0.283752			-0.00939
8.	Dhule	Deour Bk	Unconfined	9.2	8.50	0.164505		0.158886	
9.	Dhule	Dhule	Unconfined	9.5	5.70	0.27456		0.31888	
10.	Dhule	Fagane	Unconfined	7	5.00	0.111264		0.029693	
11.	Dhule	Hendrun	Unconfined	11.9	5.60		-0.1077	0.106292	
12.	Dhule	Japi	Unconfined	13	6.00		-0.05941		-0.12474
13.	Dhule	Khede	Unconfined	13.2	11.00	0.105721		0.181281	
14.	Dhule	Khordad	Unconfined	7.3	4.50		-0.07225	0.092839	
15.	Dhule	Kulthe	Unconfined	5.5	2.50	0.063187		0.277214	
16.	Dhule	Mehergaon	Unconfined	7.2	4.50	0.090659		0.091406	
17.	Dhule	Mordad	Unconfined	7.1	4.70		-0.10258	0.473391	
18.	Dhule	Nandale bk	Unconfined	9	4.60	0.417857		0.334375	
19.	Dhule	Nandre	Unconfined	12	10.30	0.188736		0.136071	
20.	Dhule	Ner	Unconfined	5.9	3.40	0.853261		0.375911	
21.	Dhule	Nimdale	Unconfined	7.2	4.50	0.584382		0.157292	
22.	Dhule	Nimgul	Unconfined	13	11.30		-0.02143	0.103178	
23.	Dhule	Pur (Purmepada)	Unconfined	7.7	5.50	0.149011		0.071745	
24.	Dhule	Sadgaon	Unconfined	6.3	3.50		-0.38571		-0.18924
25.	Dhule	Sarwad	Unconfined	11.1	9.00	0.165385			-0.03203
26.	Dhule	Sonewadi	Unconfined	10.5	5.20	0.443966		0.236842	
27.	Dhule	Songir	Unconfined	9.6	7.00		-0.11429	0.193898	
28.	Dhule	Tarwade	Unconfined	4.5	2.00	0.093956		0.149036	
29.	Dhule	Udane	Unconfined	6.6	2.40	0.200458		0.054818	
30.	Dhule	Vani kh	Unconfined	12.7	9.20		-0.09258		-0.04462
31.	Dhule	Velhane bk	Unconfined	9.6	2.30	0.306319		0.196354	

S. No.	Taluka	Village	Aquifer Type	water level (m bgl)		Pre-monsoon Water level trend(m/year)		Post-monsoon water level trend(m/year)	
				Pre-monsoon	Post-monsoon	Rise	Fall	Rise	Fall
32.	Dhule	Vishvanath	Unconfined	4.6	3.40	0.118132			-0.14388
33.	Dhule	Walwadi	Unconfined	8.2	4.00	0.205706		0.528516	
34.	Sakri	Aichale	Unconfined	11.5	5.00		-0.04368	0.017328	
35.	Sakri	Akkalpada	Unconfined	6	3.50	0.141758		0.031982	
36.	Sakri	Basraval	Unconfined	7.4	1.30	0.053846		0.159801	
37.	Sakri	Bhamer	Unconfined	10.6	4.50		-0.1772	0.429229	
38.	Sakri	Brahmanwell	Unconfined	13	4.30		-0.00549	0.011081	
39.	Sakri	Chadwel Korde	Unconfined	9.1	4.90	0.148352		0.133441	
40.	Sakri	Chail	Unconfined	2.8	1.70	0.334066		0.25983	
41.	Sakri	Chinchkheda	Unconfined	11	8.80	0.019231		0.101568	
42.	Sakri	Dahiwel	Unconfined	10.8	7.00		-0.09286	0.0375	
43.	Sakri	Dhamnar	Unconfined	18.1	9.50	0.011742			-0.00156
44.	Sakri	Domkani	Unconfined	17.2	6.20		-0.03049	0.079079	
45.	Sakri	Dusane	Unconfined	6.5	2.50	0.009066		0.003385	
46.	Sakri	Jebapur	Unconfined	11.5	3.40	0.148901		0.063133	
47.	Sakri	Khampada	Unconfined	10.8	1.10		-0.05879	0.228529	
48.	Sakri	Kudashi	Unconfined	9.5	2.50		-0.01798	0.085938	
49.	Sakri	Lagadwal	Unconfined	12.2	3.00	0.18956		0.314635	
50.	Sakri	Lonkhede	Unconfined	12.55	3.00		-0.10824	0.193914	
51.	Sakri	Mahir	Unconfined	16	10.60		-0.2467	0.069141	
52.	Sakri	Nizampur	Unconfined	7.5	4.00	0.193726		0.242188	
53.	Sakri	Phopare	Unconfined	7.95	5.50	0.201923		0.521875	
54.	Sakri	Pimpalner	Unconfined	4.1	1.60	0.22967		0.116066	
55.	Sakri	Rojgaon	Unconfined	5.3	1.40		-0.20676	0.166667	
56.	Sakri	Sakri	Unconfined	8.8	7.30	0.164011		0.015755	
57.	Sakri	Samode	Unconfined	8.3	3.40		-0.24368		-0.0524
58.	Sakri	Sayane	Unconfined	11	9.00		-0.38874		-0.02142
59.	Sakri	Shelbari	Unconfined	5.5	2.00	0.142182			-0.04125
60.	Sakri	Shevali (R)	Unconfined	8	4.00		-0.19231		-0.05551
61.	Sakri	Shevali da	Unconfined	11.8	11.50	0.099176		0.229427	
62.	Sakri	Sutare	Unconfined	10.2	2.30		-0.00934	0.061231	
63.	Sakri	Umarpata	Unconfined	7	2.30		-0.37857	0.034785	
64.	Sakri	Vaskhedi	Unconfined	6	3.10	0.349104		0.237437	

Annexure V : Chemical analysis of ground water samples, Shallow aquifers

Agency	Taluka	Village	pH	EC (µS/cm)	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Fe	SAR
GSDA	Shirpur	Ambe	7.64	1800	1170	468	100.8	52.5	178.2	54.5	0.0	294.0	310.0	202	0	0	0.06	3.58
GSDA	Sakri	Jebapur	7.49	373	242	184	35.2	23.3	19.4	0.1	0.6	191.4	34.0	12.2	0	0	0	0.62
GSDA	Sakri	Shelbari	7.2	442	288	212	38.4	28.2	29.3	0.1	0.3	231.6	48.2	17	0	0	0.22	0.87
GSDA	Sakri	Khampada	8.35	1071	696	218	48	23.8	102.0	2.7	10.6	165.2	154.0	60	0	0	0.32	3.00
GSDA	Sakri	Isarde	7.8	862	560	236	67.2	16.5	98.0	0.2	0.0	176.9	169.0	76	0	0.4	0.86	2.77
GSDA	Sakri	Gondas	7.23	834	542	415	136.4	18.0	50.5	0.3	0.0	463.6	67.0	43	0	0.51	0.44	1.08
GSDA	Sakri	Sakri	7.8	1264	822	270	50.4	35.0	75.0	0.3	0.0	268.4	119.0	21	0	1.5	0.42	1.98
GSDA	Sakri	Bhamer	7.79	955	623	310	64	36.5	34.4	0.2	0.0	258.6	58.0	38.2	0	0	0.28	0.85
GSDA	Sakri	Rojegaon	8.41	742	482	232	33.6	36.0	24.9	0.1	3.6	148.3	36.0	16.8	0	0.39	0.4	0.71
GSDA	Sakri	Aichale	7.86	1869	1215	462	86	60.0	166.0	0.5	0.0	488.0	214.0	40	0	1.18	0.57	3.36
GSDA	Sakri	Chinchkheda	7.97	1390	904	360	110.4	20.4	76.0	0.1	0.0	380.6	138.0	35.9	0	0	0	1.74
GSDA	Sakri	Akkalpada	8.37	455	296	88	20.8	8.7	24.2	0.3	1.5	70.3	32.0	3	0	0.05	0.1	1.12
GSDA	Shinakheda	Dhavde	7.92	1393	905	274	28.8	49.1	136.0	0.5	0.0	253.8	190.0	82	0	0	0.34	3.57
GSDA	Dhule	Nandre	7.51	1139	740	208	33.6	30.1	85.4	0.5	0.0	189.1	156.0	18	0	0	0.3	2.58
GSDA	Dhule	Ner	7.63	830	540	263	46.4	35.7	52.3	1.1	0.0	259.9	74.0	27	0	0.55	0.1	1.40
GSDA	Shinakheda	Karle	8.74	1262	820	164	9.6	34.0	120.0	0.5	7.9	148.6	184.0	35	0	0	0.88	4.08
GSDA	Shinakheda	Malpur	8.21	1109	721	258	31.2	43.7	62.9	0.9	0.0	253.8	90.0	58	0	0	0.14	1.70
GSDA	Sakri	Lonkhede	8.5	1292	827	312	42	51.0	186.0	1.0	0.0	352.0	162.0	106	0	0.8	0.1	4.56
GSDA	Shinakheda	Satare	7.89	1648	1055	540	129.6	52.5	120.0	1.1	0.0	475.8	160.0	64.5	0	0.74	0.2	2.25
GSDA	Shinakheda	Dondaicha	8.26	1385	903	318.6	33.6	57.0	80.0	0.2	0.0	366.0	106.0	32	0	0	0.42	1.95
GSDA	Sindkheda	Degaon	8.5	648	415	208	52.8	18.5	20.8	0.6	4.4	147.5	28.0	27.7	0	0.26	0.2	0.63
GSDA	Shinakheda	Shevade	8.05	567	363	148	52.8	3.9	15.6	0.8	1.6	148.4	22.0	10.2	0	0.33	0.2	0.56
GSDA	Dhule	Ajanale	7.7	2110	1370	400	96.4	38.6	182.0	186.0	0.0	502.6	323.0	115	0	0	0.24	3.96
GSDA	Shinakheda	Varzadi	8.1	1995	1277	520	46	98.0	225.0	0.8	0.0	244.0	386.0	118	0	0.6	0.1	4.30
GSDA	Dhule	Mehergaon	7.6	990	634	325	80	30.4	65.0	2.0	0.0	183.0	124.0	78	0	0.8	0.017	1.57
GSDA	Shinakheda	Methi	8.11	720	431	256	20.8	49.6	61.2	0.3	3.4	282.5	80.0	34	0	0	0.6	1.66
GSDA	Dhule	Sadgaon	7.59	701	456	226	45.6	27.2	48.2	3.6	0.7	204.2	68.0	25.3	0	0	0.01	1.39
GSDA	Dhule	Bendrapada	8.19	2700	1755	520	57.6	91.4	433.0	1.7	0.0	347.7	630.0	124.2	0	0.67	0.07	8.26
GSDA	Shinakheda	Salve	7.63	706	459	255	45.2	34.5	46.0	0.5	0.9	214.1	88.0	17	0	0.55	0.53	1.25
GSDA	Dhule	Nimdale	8.34	527	382	180	32	24.3	11.5	0.1	3.0	144.9	16.0	28.2	0	1.22	0.22	0.37
GSDA	Shinakheda	Chimthane	8.37	1413	847	392	36.8	72.9	134.0	6.5	10.6	189.6	250.0	133	0	0	0.06	2.94
GSDA	Shinakheda	Dalwade	8.16	542	352	191	61.56	9.0	40.2	2.8	2.5	185.4	53.2	26	0	0	0.44	1.26
GSDA	Dhule	Purmepada	7.86	961	625	264	48.4	34.7	55.0	8.5	12.0	225.7	77.0	50	0	0.48	0.3	1.47

Agency	Taluka	Village	pH	EC (µS/cm)	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Fe	SAR
GSDA	Shinakheda	Virdel	8.84	1811	1181	370	23.2	75.8	142.0	7.9	48.0	226.9	255.0	69	0	0	0.22	3.21
GSDA	Dhule	Khordad	8.2	2015	1310	672	144.8	75.3	150.0	9.6	0.0	671.0	237.0	62	0	0.65	0.8	2.52
GSDA	Shinakheda	Dangurne	8.19	843	505	328	44.8	52.5	66.1	3.9	0.0	275.7	98.0	83.6	0	0	0.08	1.59
GSDA	Shirpur	Bhatane	8.3	608	389	232	40	32.0	42.0	1.3	8.0	272.0	48.0	27	0	0.4	0.3	1.20
GSDA	Shinakheda	Khalane	7.26	2580	1720	472	75.2	69.0	150.0	1.0	0.0	366.0	236.0	82	0	0.89	0.37	3.00
GSDA	Shinakheda	Shinkheda	7.9	1244	809	272	64	27.2	118.0	1.5	0.0	167.1	220.0	76	0	0	0.9	3.11
GSDA	Shinakheda	Sindkheda	7.44	1020	663	368	88.4	35.7	64.0	0.4	0.0	292.8	123.0	53	0	1.38	0.13	1.45
GSDA	Shinakheda	Sandle	7.65	1290	775	376	54.4	58.3	110.0	10.1	0.0	263.5	156.0	175	0	0	0.4	2.47
GSDA	Shirpur	Khmkheda	7.6	654	425	373	67.2	49.8	52.0	0.6	1.6	438.3	70.0	18	0	0.35	0.12	1.17
GSDA	Dhule	Sarwad	8.43	1607	1045	457	59.6	74.8	155.6	3.9	4.8	237.9	236.0	57	0	0.15	0.11	3.17
GSDA	Sakri	Dhamanar	7.81	1438	935	488	68.8	76.8	99.0	0.6	0.0	229.4	186.0	0	0	0	0.2	1.95
GSDA	Dhule	Dhule	7.41	1490	971	643	64.4	117.1	120.1	0.3	0.0	527.0	175.0	101	0	0.13	0.29	2.06
GSDA	Shinakheda	Vaghadi	7.79	749	487	268	41.6	39.9	36.9	0.8	1.6	272.4	60.0	35.5	0	0	0.2	0.98
GSDA	Shinakheda	Sukvad	7.41	2200	1450	592	97.2	84.8	134.0	0.7	0.0	400.2	257.0	165	0	0.7	0.31	2.39
GSDA	Sindkheda	Kalmadi	8.29	854	555	268	19.2	53.5	40.0	0.3	0.0	247.7	76.0	36	0	0	0.2	1.06
GSDA	Shinakheda	Nardana	7.7	2615	1700	545	84.4	81.2	260.5	1.0	0.0	248.9	492.0	145	0	0.6	0.38	4.85
GSDA	Shinakheda	Varshi	8.14	1437	920	376	54.4	58.3	137.0	0.7	0.0	323.3	180.0	59.2	0	0.05	0.1	3.07
GSDA	Dhule	Borhivir	7.18	1485	960	714	67.2	132.7	83.5	1.1	0.0	634.4	158.0	77	0	0.1	0.11	1.36
GSDA	Shinakheda	Dabhashi	7.59	1576	1028	466	68.8	71.4	32.0	1.4	0.0	444.1	52.0	37.6	0	0	0.01	0.64
GSDA	Shinakheda	Varud	7.45	4580	2970	955	247.6	81.6	405.0	44.0	0.0	579.5	752.0	185	0	0.98	0.23	5.70
GSDA	Dhule	Japi	7.58	1033	672	297	41.2	47.1	75.5	2.7	0.0	295.2	119.0	36	0	0.25	0.04	1.91
GSDA	Dhule	Vishwanath	7.1	1678	1094	515	111.6	57.3	106.0	26.0	0.0	501.4	201.4	40	0	0	0.9	2.03
GSDA	Dhule	Talwada	7.27	1363	886	394	94.4	38.4	73.0	1.4	0.0	292.8	134.0	85	0	0.66	1.12	1.60
GSDA	Shirpur	Nimzari	7.8	862	562	316	58.4	41.3	21.8	8.5	0.0	352.6	42.0	21	0	0	0.22	0.53
GSDA	Shirpur	Boradi	7.7	998	649	410	67.2	58.8	46.0	0.4	0.0	481.9	63.0	15	0	0.84	0.515	0.99
GSDA	Dhule	Velahane	7.64	2170	1410	660	80	111.8	175.0	12.8	0.0	219.6	300.0	0	0	0	0.01	2.96
GSDA	Shinakheda	Betavad	7.8	578	379	128	33.6	10.7	48.0	0.5	0.7	112.3	65.0	28.6	0	0	0.03	1.84
GSDA	Sakri	Umarpata	7.34	347	226	168	44.8	13.6	13.6	0.6	0.4	187.6	24.0	5.8	0	0	0	0.46
GSDA	Shirpur	Umarde	7.12	1016	662	368	92.4	33.3	47.5	2.5	0.0	366.0	84.0	22	0	0.5	0.73	1.08
GSDA	Shirpur	Sule	7.9	720	468	294	50.4	40.8	30.3	0.3	1.0	344.0	39.0	10	0	0.6	0.43	0.77
GSDA	Shirpur	Hadakhed	7.33	1185	773	400	116.8	26.2	57.9	0.1	0.0	346.5	102.0	56	0	0	0.03	1.26
GSDA	Shirpur	Fattepur	7	1437	937	388	80.8	45.2	68.0	0.2	0.0	324.5	120.0	59.6	0	0	0.01	1.50
GSDA	Shirpur	Savangi	7.67	820	534	315	58.8	40.8	48.0	1.7	0.0	353.8	63.0	22	0	0.4	0.41	1.18
GSDA	Shirpur	Mohide	7.9	1223	795	394	52.4	63.9	112.0	1.5	0.0	518.5	148.0	27	0	0.83	0.74	2.45
GSDA	Shirpur	Higaon	7.55	1283	834	289	73.6	25.5	68.0	0.3	24.0	256.2	88.0	26	0	0.87	0.32	1.74

Agency	Taluka	Village	pH	EC (µS/cm)	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Fe	SAR
NHS2016	Sakri	Burdi Pada		365	193	190	48.096	17.0	29.0	2.8	9.0	85.4	95.7	10	45	0.2		0.91
NHS2016	Sakri	Pimpalner		484	257	235	54.108	24.3	27.4	20.1	0.0	244.0	39.0	41	17	0.17		0.78
NHS2016	Sakri	Sakri2		1474	782	345	46.092	55.9	200.1	0.7	0.0	549.0	212.7	35	71	0.54		4.68
NHS2016	Sakri	Nizampur		504	267	195	52.104	15.8	57.6	0.5	0.0	201.3	67.4	9	33	0.24		1.79
NHS2016	Sakri	Dusane		342	181	145	50.1	4.9	30.5	1.2	0.0	189.1	28.4	20	27	0.45		1.10
NHS2016	Sakri	Ichhapur		1195	632	415	72.144	57.1	114.2	0.5	0.0	463.6	88.6	50	144	0.45		2.44
NHS2016	Shindkhede	Dondaicha-1		1673	885	220	38.076	30.4	172.0	0.3	0.0	597.8	234.0	50	80	0.44		5.04
NHS2016	Shindkhede	Shewade		821	435	285	56.112	35.2	92.7	0.4	0.0	317.2	109.9	20	55	0.47		2.39
NHS2016	Dhule	Kusumba		1314	696	220	34.068	32.8	213.0	0.9	0.0	475.8	134.7	30	140	0.51		6.24
NHS2016	Dhule	Ajnale		1667	884	430	48.096	75.3	114.1	11.3	0.0	524.6	159.5	46	61	0.29		2.39
NHS2016	Shindkhede	Methi		2130	1128	780	132.26	109.4	117.3	1.5	0.0	292.8	382.9	50	291	0.34		1.83
NHS2016	Shindkhede	Chimthane		2388	1266	950	180.36	121.5	174.0	17.4	0.0	427.0	496.3	60	285	0.14		2.45
NHS2016	Dhule	Purmepada(pur)		1656	878	515	96.192	66.8	123.0	1.7	18.0	274.5	258.8	48	184	0.29		2.36
NHS2016	Dhule	Laling		494	261	245	64.128	20.7	28.1	4.4	0.0	298.9	31.9	17	40	0.51		0.78
NHS2016	Dhule	Dhule		2837	1504	865	144.28	122.7	161.3	77.0	12.0	445.3	446.7	58	355	1.22		2.38
NHS2016	Dhule	Nangaon		642	341	255	62.124	24.3	59.1	7.0	0.0	305.0	81.5	8	24	0.51		1.61
NHS2016	Dhule	Avdhan		5873	3116	2440	669.33	187.1	205.0	76.5	0.0	213.5	1488.9	50	321	0.15		1.80
NHS2016	Dhule	Narwhal		555	293	235	48.096	27.9	57.7	2.4	0.0	335.5	60.3	7	34	0.41		1.64
NHS2016	Dhule	Borkund		2148	1137	730	108.21	111.8	201.0	1.8	0.0	488.0	361.6	54	320	0.38		3.23
NHS2016	Dhule	Phagne		749	397	295	52.104	40.1	78.4	0.8	0.0	402.6	88.6	13	52	0.38		1.98
NHS2016	Shirpur	Samaryapada		540	286	235	50.1	26.7	65.0	0.9	0.0	366.0	46.1	10	36	0.51		1.84
NHS2016	Dhule	Mukti		1820	963	460	162.32	13.4	218.0	3.5	0.0	561.2	219.8	60	120	0.35		4.41
NHS2016	Shirpur	Hadakhed		840	446	370	76.152	43.7	66.1	0.5	0.0	256.2	109.9	40	64	0.32		1.49
NHS2016	Shirpur	Saver		733	389	325	128.25	1.2	56.0	0.6	0.0	329.4	88.6	33	50	0.41		1.35
NHS2016	Shirpur	Palasner		1980	1047	610	86.172	96.0	180.8	85.9	0.0	494.1	226.9	58	229	0.34		3.18
NHS2016	Shirpur	Hisala		820	435	330	48.096	51.0	90.2	2.0	0.0	445.3	106.4	40	37	0.24		2.16
KOW2017	Sakri	Shenwad	7.2	235		124.5	59.8	15.7	8.1	0.7	0	136.6	28.3	12	10	0.13		0.24
KOW2017	Sakri	Kalambe	7.6	340		159.4	104.6	13.3	10.1	0.7	0	122	23.1	10	26	0.91		0.25
KOW2017	Sakri	Karanjati (n.v.)	7.4	420		174.3	104.6	16.9	17.9	5.5	0	185.4	33.4	14	60	0.12		0.43
KOW2017	Sakri	Jamkhel	7.6	432		209.2	139.4	16.9	14.5	0.7	0	229.4	23.1	16	32	0.15		0.31
KOW2017	Sakri	Raikot	7.7	296		179.3	99.6	19.4	11.7	2.5	0	170.8	25.7	18	20	0.16		0.28
KOW2017	Sakri	Pargaon	7.9	835		283.9	149.4	32.7	32.4	0.6	0	434.3	25.7	30	11	0.45		0.62
KOW2017	Sakri	Pimpalner	7.8	535		229.1	139.4	21.8	13.5	0.7	0	234.2	23.1	12	33	0.27		0.28
KOW2017	Sakri	Kharadbari (n.v.)	7.8	475		214.1	139.4	18.2	15	1.3	0	175.7	20.6	12	41	0.21		0.32
KOW2017	Sakri	Dholipada	7.8	792		338.6	169.3	41.1	28.7	0.7	0	380.6	41.1	20	80	0.43		0.51

Agency	**Taluka**	**Village**	**pH**	**EC** (µS/cm)	**TDS**	**TH**	**Ca**	**Mg**	**Na**	**K**	**CO_3**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**F**	**Fe**	**SAR**
KOW2017	Sakri	Kasare	7.9	1429		517.9	139.4	92	80.8	1.2	0	414.8	161.9	66	40	0.33		1.30
KOW2017	Sakri	Domkani	7.7	920		353.6	189.2	39.9	47.9	1.9	0	414.8	64.3	47	90	0.37		0.83
KOW2017	Sakri	Chhadwel (k)	7.5	620		149.4	109.6	9.7	42.7	0.8	0	102.5	82.2	44	36	0.33		1.05
KOW2017	Sakri	Runmali	7.6	952		273.9	129.5	35.1	51.2	2.4	0	107.4	177.3	80	30	0.28		1.03
KOW2017	Sakri	Kalambhir	7.9	997		343.6	144.4	48.4	69.9	0.5	0	239.1	51.4	43	130	0.5		1.28
KOW2017	Sakri	Aichale	7.8	1483		453.2	109.6	83.5	75.1	1.5	0	346.5	151.6	34	200	0.45		1.31
KOW2017	Sakri	Dhamnar	7.6	1710		547.8	164.3	93.2	60.6	1.9	0	312.3	197.9	88	200	0.25		0.93
KOW2017	Sakri	Phophade	8	827		278.9	114.5	39.9	54.5	1.8	0	302.6	54	27	41	0.43		1.12
KOW2017	Sakri	Mhasdi Pr.ner	7.9	727		259	94.6	39.9	52	1.7	0	312.3	41.1	18	21	0.28		1.13
KOW2017	Sakri	Ubhand	7.8	615		219.1	114.5	25.4	23.4	0.6	0	229.4	30.8	28	64	0.24		0.51
KOW2017	Sakri	Shewali (m)	7.9	905		298.8	119.5	43.6	32.4	8.7	0	209.8	74.5	32	60	0.33		0.64
KOW2017	Dhule	Deur Kh.	8.1	1575		512.9	114.5	96.8	68.8	0.7	0	483.1	185	70	11	0.4		1.14
KOW2017	Sakri	Hatti Bk.	7.7	1574		298.8	209.2	21.8	169.6	2.4	0	239.1	280.1	118	48	0.37		2.98
KOW2017	Dhule	Rami	7.7	4503		1603.6	622.5	238.4	118.1	2	0	253.8	1102.6	410	22	0.22		1.02
KOW2017	Dhule	Nikumbhe	7.8	1858		617.5	124.5	119.8	81.7	0.6	0	522.2	205.6	180	26	0.2		1.25
KOW2017	Dhule	Kulthe	7.9	1063		318.7	89.6	55.7	63.7	1.5	0	307.4	95.1	65	50	0.85		1.30
KOW2017	Dhule	Burzad	7.8	749		313.7	134.5	43.6	29.5	3.4	0	336.7	33.4	24	20	0.28		0.56
KOW2017	Dhule	Hendrun	8.1	1295		348.6	94.6	61.7	86	3.2	0	361.1	128.5	69	50	0.44		1.69
KOW2017	Dhule	Dhanur	8.1	1080		278.9	59.8	53.2	92.8	1.8	0	307.4	115.7	69	50	0.43		2.10
KOW2017	Dhule	Kundane (velhane)	7.9	1592		542.8	278.9	64.1	45.6	25.2	0	297.7	143.9	80	270	0.22		0.64
KOW2017	Dhule	Chinchkhede	7.5	1520		617.5	209.2	99.2	33.3	1.3	0	346.5	172.2	68	190	0.19		0.47
KOW2017	Dhule	Nimgul	7.8	2710		991	204.2	191.2	90.2	1.7	0	434.3	503.7	200	120	0.29		1.09

Annexure VI : Chemical analysis of ground water samples, deeper aquifers

Agency	Taluka	Village	pH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Fe	SAR
GWE	Shirpur	Vikharan	7.5	1830	NA	160.0	10.0	33	325.0	40.0	0	24	489	150	62.0	0.82		11.14
GWE	Shirpur	Mangrod	7.3	6300	NA	1125.0	240.0	127.7	910.0	80.0	0	37	1904	463	5.0	1		11.79
GWE	Sindkheda	Takarkheda	7.5	2900	NA	675.0	186.0	51.1	340.0	30.0	0	85	745	282.2	45.0	0.12		5.69
GWE	Shirpur	Tarhadi	7.2	1300	NA	200.0	76.0	2.4	200.0	25.0	0	92	344	55	53.0	0.65		6.15
GWE	Shirpur	Borkheda	7.7	600	420	95.0	12.0	16	122.0	4.0	0	122	142	62	NA	NA		5.42
GWE	Shirpur	Borkheda	7.74	600	420	95	12	16	122	4	0	122	142	62	0	0	0.1	5.42
GWE	Sindkheda	Chulane	7.5	2000	NA	405.0	80.0	49.9	275.0	20.0	0	122	504	163.6	38.0	1.02		5.94
GSDA	Shirpur	Shirpur	7.61	545	355	200	48	19.4	20.6	0.6	0.7	177.3	28	21.7	0	0	0.0	0.63
GSDA	Sakri	Jaithane	7.75	1081	703	252	52.8	29.2	94.9	0.9	0.0	179.3	128	28.3	0	0.05	0.1	2.60
GWE	Shirpur	Vikharam	7	440	NA	200.0	40.0	24.3	10.0	2.0	0	183	35	15	10.0	0.08		0.31
GWE	Akkalkuwa	Rajmohi	7.8	560	310	255.0	46.0	34	28.0	0.8	12	201	28	2	NA	NA		0.76
GWE	Akkalkuwa	Rajmohi	7.8	560	310	255	46	34	28	0.8	12	201	28	2	0	0	0	0.76
	Taloda	Ichagavhan	7.1	350	350	275	62	29	20	1	0	204	46	30	0	0	0	0.53
GWE	Taloda	Ichagavhan	7.1	660	350	275.0	62.0	29	20.0	1.0	0	204	46	30	NA	NA		0.53
GSDA	Dhule	Songir	7.49	1128	733	296	89.6	17.5	58.5	0.7	0.0	208.6	110	67.1	0	0	0.0	1.48
GWE		Roykot	7.2	762	403	347	63	45.0	14.0	0.8	0.0	214.0	55	45	120	0.15		0.33
GWE	Shirpur	Klamsare	8.2	510	270	105.0	14.0	17	69.0	BDL	0	219	36	24	NA	NA		2.93
GWE	Shirpur	Klamsare	8.23	510	270	105	14	17	69	0	0	219	36	24	0	0	0	2.93
GWE		Ambapur	7.9	1043	552	301	86	21.0	85.0	1	0.0	220.0	163	86	44	0.49		2.13
GWE	Shirpur	Klamsare	8.25	510	292	120	10	23	69	0	0	232	11	62	0	0	0.1	2.74
GWE	Shirpur	Klamsare	8.3	510	292	120.0	10.0	23	69.0	BDL	0	232	11	62	NA	NA		2.74
GSDA	Shirpur	Thalner	8.03	701	457	272	40.8	41.3	25.0	3.3	0.0	257.4	36	20.1	0	0	0.0	0.66
GWE	Taloda	Sirve	7.8	440	245	200.0	46.0	21	19.0	1.0	0	262	12	5	NA	NA		0.58
GWE	Taloda	Sirve	7.8	440	245	200	46	21	19	1	0	262	12	5	0	0	0	0.58
GSDA	Shinakheda	Takarkhede	7.6	1382	898	294	84	20.4	140.0	2.2	0.0	262.3	190	95	0	0.97	0.1	3.55
GSDA	Dhule	Walwadi	7.4	1285	835	324	57.6	43.7	83.6	0.4	0.0	263.5	138	48	0	0	0.3	2.02
GWE	Shirpur	Kalamsare	7.6	610	301	185.0	30.0	27	55.0	1.4	0	268	32	11	10.0	0.57		1.75
GSDA	Shinakheda	Methi	7.53	1149	747	270	38	42.5	56.5	0.5	0.0	274.5	81	18	0	0.85	3.1	1.50
GSDA	Sakri	Lonkhede	8.53	937	609	392	56	61.2	62.2	0.1	37.0	281.1	116	52	0	0	0.4	1.37
GSDA	Sakri	Mahir	8	846	550	300	82	23.1	51.0	0.1	0.0	286.7	91	36	0	0.89	1.2	1.28
GSDA	Shirpur	Ajanad	7.9	857	557	273	48.4	36.9	70.1	1.5	0.0	286.7	112	10	0	0.48	0.5	1.85
GSDA	Shirpur	Tembhe Bk.	7.74	708	460	285	69.2	27.2	34.6	1.2	0.4	294.6	56	12	0	0.3	0.3	0.89
GWE	Sindkheda	Varshi	7.3	1180	NA	110.0	28.0	9.7	225.0	20.0	0	305	184	72.5	32.0	0.37		9.33

Agency	Taluka	Village	pH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Fe	SAR
GWE	Akkalkuwa	Jamli	7.6	530	290	250.0	64.0	22	19.0	1.6	0	311	25	3	NA	NA		0.52
GWE	Akkalkuwa	Jamli	7.6	530	290	250	64	22	19	1.6	0	311	25	3	0	0	0	0.52
GSDA	Shinakheda	Mahalsar	8.03	1225	799	320	74	32.8	124.0	6	0.0	311.1	182	55	0	0.2	0.2	3.01
GSDA	Dhule	Kusumba	8.09	865	562	292	46.4	42.8	68.0	0.8	0.0	319.6	100	28.6	0	0	0.0	1.73
GWE	Shirpur	Tarhadi	8.06	600	330	235	22	43	47	1.17	0	323	25	30	0	0	0.1	1.34
GWE	Shirpur	Tarhadi	8.1	600	330	235.0	22.0	43	47.0	1.2	0	323	25	30	NA	NA		1.34
GWE	Taloda	Rajhave	7.6	580	325	250.0	62.0	23	31.0	1.0	0	329	29	10	NA	NA		0.85
	Taloda	Rajhave	7.6	580	325	250	62	23	31	1	0	329	29	10	0	0	0	0.85
GWE	Shahada	Mahhasvad	8.16	630	350	185	20	33	53	2.7	0	329	28	0	0	0	0.1	1.69
GWE	Shahada	Mahhasvad	8.2	630	350	185.0	20.0	33	53.0	2.7	0	329	28	NA	NA	NA		1.69
GSDA	Shirpur	Tardi	7.77	1120	728	336	50.4	51.0	91.0	0.5	0.0	347.7	160	13	0	0.4	0.2	2.16
GSDA	Shirpur	Khambale	7.15	1053	787	384	91.2	37.9	46.9	0.3	0.0	347.7	82	43.1	0	0	0.0	1.04
GSDA	Sakri	Bramnhavel	7.58	1074	698	431	63.2	66.3	65.0	0.8	0.0	350.1	123	95	0	0.55	6.8	1.36
GWE	Shahada	Mahasvad	8.05	580	325	215	30	24	46	1.95	0	354	28	0	0	0	0.1	1.52
GWE	Shahada	Mahasvad	8.1	580	325	215.0	30.0	24	46.0	2.0	0	354	28	NA	NA	NA		1.52
GWE	Shirpur	Arthe (KH)	7.87	650	360	220	20	40	56	16	0	360	42	0	0	0	0.1	1.66
GWE	Shirpur	Arthe (KH)	7.9	650	360	220.0	20.0	40	56.0	16.0	0	360	42	NA	NA	NA		1.66
GSDA	Sakri	Dahival	7.53	1027	670	372	48	61.2	51.3	0.1	0.0	363.6	70	37.7	0	0	0.0	1.16
v	Shirpur	Arthe (KH)	7.57	660	375	225	22	40	52	25	0	366	28	25	0	0	0.1	1.53
GWE	Shirpur	Arthe (KH)	7.6	660	375	225.0	22.0	40	52.0	25.0	0	366	28	25	NA	NA		1.53
GSDA	Shirpur	Gadhadeo	7.29	904	589	356	64	47.6	28.7	1	0.0	369.7	39	25.3	0	0	0.0	0.66
GSDA	Dhule	Sarwad	8.05	1580	1027	423	101.2	41.3	141.1	2.8	9.6	380.6	240	60	0	0.15	0.3	2.98
GWE		Waki	7.9	703	373	245	31	40.0	55.0	1.9	0.0	381.0	35	18	8	0.45		1.54
GWE	Shahada	Aurangpur	7.9	610	340	205.0	26.0	34	63.0	BDL	0	384	25	NA	NA	NA		1.91
GWE	Shahada	Aurangpur	7.9	610	340	205	26	34	63	0	0	384	25	0	0	0	0	1.91
GSDA	Shirpur	Dahivad	7.59	1535	987	488	80	70.0	95.5	6	0.0	385.5	180	83	0	0.58	0.5	1.88
GWE		Waki	7.7	708	375	265	31	45.0	54.0	1.8	0.0	393.0	45	21	6	0.49		1.45
GSDA	Shirpur	Wagjadi	7.22	1323	860	381	92.4	36.5	70.0	0.5	0.0	396.5	107	48	0	0.7	0.1	1.56
GWE	Shirpur	Borkheda	8.05	530	350	175	18	32	81	0	0	397	18	0	0	0	0.1	2.65
GWE	Shirpur	Borkheda	8.1	530	350	175.0	18.0	32	81.0	BDL	0	397	18	NA	NA	NA		2.65
GWE	Taloda	GoNAala	8	700	410	260.0	16.0	54	71.0	0.8	0	397	60	3	NA	NA		1.91
GWE	Taloda	Gondala	8	700	410	260	16	54	71	0.8	0	397	60	3	0	0	0	1.91
GSDA	Shinakheda	Varpada	7.57	1770	1150	552	56	100.1	162.0	0.6	0.0	400.2	272	0	0	0	0.1	3.00
GSDA	Shirpur	Kolid	7.7	838	545	352	96.8	26.7	48.0	0.2	0.0	408.7	84	12	0	0.48	0.0	1.11
GWE	Shahada	Vagoda	8	844	540.16	240	42	33	80	0	0	415	39	0	0	0	0	2.24

Agency	Taluka	Village	pH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Fe	SAR
GWE	Taloda	Vagoda	8	844	NA	240.0	42.0	33	80.0	BDL	0	415	39	NA	NA	NA		2.24
GWE	Sindkheda	Doul	7.3	1800	NA	325.0	20.0	66.9	260.0	45.0	0	415	379	46.6	13.0	0.78		6.27
GSDA	Shirpur	Palasner	7.3	1419	926	440	144	19.4	91.3	0.3	0.0	452.6	134	47	0	0	0.0	1.89
GWE		Ambode	7.8	947	502	357	37	63.0	57.0	1.6	0.0	458.0	50	35	54	0.56		1.32
GWE	Shahada	Malohi	8.27	800	440	138	16	23	152	0.78	0	470	46	10	0	0	0.1	5.70
GWE	Shahada	Malohi	8.3	800	440	138.0	16.0	23	152.0	0.8	0	470	46	10	NA	NA		5.70
GWE		Junwane	7.3	1080	572	403	35	75.0	67.0	1.8	0.0	470.0	62	56	66	0.62		1.46
GWE	Taloda	Kharwad	7.5	1275	710	265.0	46.0	36	177.0	12.0	0	549	138	15	NA	NA		4.74
GWE	Taloda	Kharwad	7.5	1275	710	265	46	36	177	12	0	549	138	15	0	0	0	4.74

Annexure VII : Location of proposed Percolation tanks

SN	Village	Taluka	District	X	Y	Type of structure
1	Kusumbe	Dhule	Dhule	74.5772	20.9144	Percolation tank
2	Mahal Raiwat	Dhule	Dhule	74.5338	20.9411	Percolation tank
3	Wadgaon	Dhule	Dhule	74.8731	20.9407	Percolation tank
4	Ambode	Dhule	Dhule	74.8999	20.9039	Percolation tank
5	Nandale Kh.	Dhule	Dhule	74.928	20.8885	Percolation tank
6	Fagne	Dhule	Dhule	74.8453	20.9119	Percolation tank
7	Dhule	Dhule	Dhule	74.8099	20.9203	Percolation tank
8	Morane Pr. Laling	Dhule	Dhule	74.721	20.9046	Percolation tank
9	Malane	Dhule	Dhule	74.8788	20.9288	Percolation tank
10	Ambode	Dhule	Dhule	74.9197	20.9002	Percolation tank
11	Bhirdane	Dhule	Dhule	74.9252	20.8492	Percolation tank
12	Bhirdane	Dhule	Dhule	74.9355	20.8538	Percolation tank
13	Mukati	Dhule	Dhule	74.937	20.8749	Percolation tank
14	Shirud	Dhule	Dhule	74.8909	20.7373	Percolation tank
15	Dhamangaon	Dhule	Dhule	74.9457	20.7454	Percolation tank
16	Shirud	Dhule	Dhule	74.9242	20.7398	Percolation tank
17	Dondwad	Dhule	Dhule	74.8528	20.7183	Percolation tank
18	Ratanpura (N. V)	Dhule	Dhule	74.84	20.6953	Percolation tank
19	Shirud	Dhule	Dhule	74.8886	20.7192	Percolation tank
20	Khordad	Dhule	Dhule	74.9187	20.7239	Percolation tank
21	Sutare Pada (N.V.)	Dhule	Dhule	74.6541	20.9245	Percolation tank
22	Sutare Pada (N.V.)	Dhule	Dhule	74.6571	20.9343	Percolation tank
23	Nakane	Dhule	Dhule	74.7237	20.9123	Percolation tank
24	Nakane	Dhule	Dhule	74.7453	20.9105	Percolation tank
25	Dhule	Dhule	Dhule	74.7977	20.914	Percolation tank
26	Behed	Dhule	Dhule	74.6175	21.1251	Percolation tank
27	Bamburle.pr.ner.	Dhule	Dhule	74.6518	21.0937	Percolation tank
28	Wadne	Dhule	Dhule	74.6824	21.0741	Percolation tank
29	Nandane	Dhule	Dhule	74.7596	21.061	Percolation tank
30	Songir	Dhule	Dhule	74.7866	21.0659	Percolation tank
31	Dapura	Dhule	Dhule	74.8124	21.0666	Percolation tank
32	Nandane	Dhule	Dhule	74.7576	21.0563	Percolation tank
33	Vishwanath	Dhule	Dhule	74.8741	20.9894	Percolation tank
34	Nagpur (ko)	Sakri	Dhule	74.293	20.9579	Percolation tank
35	Malpur	Sakri	Dhule	74.2569	20.9551	Percolation tank
36	Gavhanipada	Sakri	Dhule	74.1712	20.9416	Percolation tank
37	Ashtane	Sakri	Dhule	74.2524	21.0113	Percolation tank
38	Dusane	Sakri	Dhule	74.4401	21.1467	Percolation tank
39	Chinchkhede	Sakri	Dhule	74.4454	20.9315	Percolation tank
40	Mhasale	Sakri	Dhule	74.4504	21.0773	Percolation tank
41	Chhavadi	Sakri	Dhule	74.4995	21.0773	Percolation tank
42	Vasmar	Sakri	Dhule	74.4113	20.9462	Percolation tank
43	Tamaswadi	Sakri	Dhule	74.4083	20.9664	Percolation tank
44	Vasmar	Sakri	Dhule	74.4293	20.9537	Percolation tank
45	Hatti Bk.	Sakri	Dhule	74.5115	21.0534	Percolation tank
46	Malkhede	Sakri	Dhule	74.4694	21.0005	Percolation tank
47	Balsane	Sakri	Dhule	74.4947	21.1696	Percolation tank
48	Balsane	Sakri	Dhule	74.4955	21.2056	Percolation tank
49	Indawe	Sakri	Dhule	74.4614	21.2278	Percolation tank
50	Dusane	Sakri	Dhule	74.4406	21.1846	Percolation tank
51	Kadre	Sakri	Dhule	74.5143	21.1283	Percolation tank
52	Kadre	Sakri	Dhule	74.5045	21.1313	Percolation tank
53	Lonkhede	Sakri	Dhule	74.5178	21.0869	Percolation tank
54	Dusane	Sakri	Dhule	74.4326	21.1524	Percolation tank

Annexure VIII : Location of proposed check dam

SN	Village	Taluka	District	X	Y	Structure
1	Deur Kh.	Dhule	Dhule	74.4878	20.9023	Checkdam
2	Bhadane	Dhule	Dhule	74.4981	20.905	Checkdam
3	Mahal Pandhari	Dhule	Dhule	74.5125	20.917	Checkdam
4	Mahal Londha	Dhule	Dhule	74.5209	20.9168	Checkdam
5	Aklad	Dhule	Dhule	74.5556	20.9268	Checkdam
6	Chaugaon	Dhule	Dhule	74.5797	20.8952	Checkdam
7	Kusumbe	Dhule	Dhule	74.5876	20.9072	Checkdam
8	Bhadane	Dhule	Dhule	74.4976	20.9298	Checkdam
9	Deur Bk.	Dhule	Dhule	74.4645	20.9016	Checkdam
10	Bhadane	Dhule	Dhule	74.4668	20.9173	Checkdam
11	Bhadane	Dhule	Dhule	74.4752	20.9239	Checkdam
12	Bhadane	Dhule	Dhule	74.4776	20.9325	Checkdam
13	Nandre	Dhule	Dhule	74.501	20.8736	Checkdam
14	Nandre	Dhule	Dhule	74.5102	20.8815	Checkdam
15	Lohgad	Dhule	Dhule	74.5196	20.8871	Checkdam
16	Chaugaon	Dhule	Dhule	74.5577	20.9001	Checkdam
17	Kusumbe	Dhule	Dhule	74.5763	20.9116	Checkdam
18	Deur Bk.	Dhule	Dhule	74.4582	20.8896	Checkdam
19	Mahal Pandhari	Dhule	Dhule	74.5172	20.9278	Checkdam
20	Kusumbe	Dhule	Dhule	74.6133	20.8946	Checkdam
21	Dahyane	Dhule	Dhule	74.7084	20.8763	Checkdam
22	Nandre	Dhule	Dhule	74.5154	20.8724	Checkdam
23	Gotane	Dhule	Dhule	74.606	20.8804	Checkdam
24	War	Dhule	Dhule	74.7241	20.9229	Checkdam
25	Gondur	Dhule	Dhule	74.7	20.9514	Checkdam
26	Gondur	Dhule	Dhule	74.7262	20.943	Checkdam
27	Bhokar	Dhule	Dhule	74.7577	20.9273	Checkdam
28	Bhokar	Dhule	Dhule	74.754	20.9357	Checkdam
29	Khede	Dhule	Dhule	74.6385	20.9309	Checkdam
30	Mehergaon	Dhule	Dhule	74.6354	20.9515	Checkdam
31	Mehergaon	Dhule	Dhule	74.6333	20.9691	Checkdam
32	War	Dhule	Dhule	74.711	20.9128	Checkdam
33	War	Dhule	Dhule	74.69	20.9216	Checkdam
34	Kundane-war	Dhule	Dhule	74.6821	20.902	Checkdam
35	Khede	Dhule	Dhule	74.669	20.8971	Checkdam
36	Khede	Dhule	Dhule	74.6574	20.9108	Checkdam
37	Sarvad	Dhule	Dhule	74.8055	21.0308	Checkdam
38	Kauthal	Dhule	Dhule	74.857	21.0176	Checkdam
39	Dhanur	Dhule	Dhule	74.848	21.046	Checkdam
40	Japi	Dhule	Dhule	74.8507	20.9597	Checkdam
41	Nyahalod	Dhule	Dhule	74.8543	20.973	Checkdam
42	Dhamani	Dhule	Dhule	74.8081	20.9813	Checkdam
43	Kapadne	Dhule	Dhule	74.8302	21.0024	Checkdam
44	Dhule	Dhule	Dhule	74.8039	20.8901	Checkdam
45	Varkhede	Dhule	Dhule	74.8123	20.9131	Checkdam
46	Arni	Dhule	Dhule	74.8554	20.9072	Checkdam
47	Arni	Dhule	Dhule	74.8528	20.9298	Checkdam
48	Deobhane	Dhule	Dhule	74.7798	21.0205	Checkdam
49	Dhanur	Dhule	Dhule	74.8176	21.0465	Checkdam
50	Tamaswadi	Dhule	Dhule	74.8386	21.0598	Checkdam
51	Dhule	Dhule	Dhule	74.7876	20.9079	Checkdam

SN	Village	Taluka	District	X	Y	Structure
52	Biladi	Dhule	Dhule	74.8218	20.9628	Checkdam
53	Nyahalod	Dhule	Dhule	74.8391	20.9711	Checkdam
54	Hendrun	Dhule	Dhule	74.7982	20.752	Checkdam
55	Borvihir	Dhule	Dhule	74.847	20.7773	Checkdam
56	Borvihir	Dhule	Dhule	74.8341	20.7896	Checkdam
57	Shirud	Dhule	Dhule	74.8617	20.7319	Checkdam
58	Shirud	Dhule	Dhule	74.8766	20.729	Checkdam
59	Dondwad	Dhule	Dhule	74.8522	20.7221	Checkdam
60	Ratanpura (N.v.)	Dhule	Dhule	74.8092	20.7282	Checkdam
61	Hendrun	Dhule	Dhule	74.8021	20.7422	Checkdam
62	Hendrun	Dhule	Dhule	74.7895	20.7245	Checkdam
63	Shirud	Dhule	Dhule	74.8766	20.738	Checkdam
64	Shirud	Dhule	Dhule	74.8916	20.7137	Checkdam
65	Mukati	Dhule	Dhule	74.9536	20.8959	Checkdam
66	Mukati	Dhule	Dhule	74.9449	20.9131	Checkdam
67	Mohadi Pr.dangari	Dhule	Dhule	74.8874	21.0186	Checkdam
68	Mohadi Pr.dangari	Dhule	Dhule	74.9026	21.0029	Checkdam
69	Sukawad Pr. Dangari	Dhule	Dhule	74.8974	20.996	Checkdam
70	Vishwanath	Dhule	Dhule	74.8743	20.9803	Checkdam
71	Malane	Dhule	Dhule	74.8822	20.9015	Checkdam
72	Dhamangaon	Dhule	Dhule	74.9278	20.7456	Checkdam
73	Bodgaon	Dhule	Dhule	74.9612	20.7609	Checkdam
74	Bodgaon	Dhule	Dhule	74.9572	20.7712	Checkdam
75	Babre	Dhule	Dhule	74.9554	20.782	Checkdam
76	Babre	Dhule	Dhule	74.9583	20.7898	Checkdam
77	Nimgul	Dhule	Dhule	74.9793	20.7584	Checkdam
78	Bodgaon	Dhule	Dhule	74.9473	20.7577	Checkdam
79	Velhane	Dhule	Dhule	74.9307	20.7746	Checkdam
80	Velhane	Dhule	Dhule	74.911	20.7825	Checkdam
81	Velhane	Dhule	Dhule	74.9142	20.754	Checkdam
82	Shirud	Dhule	Dhule	74.932	20.7358	Checkdam
83	Nimgul	Dhule	Dhule	74.9701	20.7402	Checkdam
84	Velhane	Dhule	Dhule	74.9042	20.7604	Checkdam
85	Velhane	Dhule	Dhule	74.8958	20.7761	Checkdam
86	Velhane	Dhule	Dhule	74.8976	20.7825	Checkdam
87	Savali	Dhule	Dhule	74.9512	20.8387	Checkdam
88	Mukati	Dhule	Dhule	74.9662	20.8798	Checkdam
89	Bhirdai	Dhule	Dhule	74.9488	20.8601	Checkdam
90	Anchade	Dhule	Dhule	74.9278	20.8257	Checkdam
91	Chinchkhede	Dhule	Dhule	74.9349	20.8424	Checkdam
92	Chinchkhede	Sakri	Dhule	74.4369	20.9457	Checkdam
93	Vasmar	Sakri	Dhule	74.4217	20.9327	Checkdam
94	Vasmar	Sakri	Dhule	74.4101	20.9185	Checkdam
95	Dhamnar	Sakri	Dhule	74.3812	20.914	Checkdam
96	Dhamnar	Sakri	Dhule	74.3899	20.9395	Checkdam
97	Dhamnar	Sakri	Dhule	74.3894	20.929	Checkdam
98	Dhamnar	Sakri	Dhule	74.3833	20.9226	Checkdam
99	Dhamnar	Sakri	Dhule	74.3757	20.931	Checkdam
100	Dhamnar	Sakri	Dhule	74.3537	20.9241	Checkdam
101	Datarti	Sakri	Dhule	74.37	20.9552	Checkdam
102	Datarti	Sakri	Dhule	74.3526	20.9611	Checkdam
103	Nandwan	Sakri	Dhule	74.3253	20.9494	Checkdam

SN	Village	Taluka	District	X	Y	Structure
104	Nandwan	Sakri	Dhule	74.324	20.9628	Checkdam
105	Mhasdi Pr.ner	Sakri	Dhule	74.4143	20.9113	Checkdam
106	Chinchkhede	Sakri	Dhule	74.428	20.9209	Checkdam
107	Chinchkhede	Sakri	Dhule	74.4414	20.9297	Checkdam
108	Mhasdi Pr.ner	Sakri	Dhule	74.4422	20.9143	Checkdam
109	Mhasdi Pr.ner	Sakri	Dhule	74.4322	20.8895	Checkdam
110	Behed	Sakri	Dhule	74.3324	20.9126	Checkdam
111	Kalgaon	Sakri	Dhule	74.3925	20.8733	Checkdam
112	Mhasdi Pr.ner	Sakri	Dhule	74.4065	20.8848	Checkdam
113	Mhasdi Pr.ner	Sakri	Dhule	74.4306	20.9108	Checkdam
114	Dhamnar	Sakri	Dhule	74.3967	20.903	Checkdam
115	Vasmar	Sakri	Dhule	74.407	20.9106	Checkdam
116	Vasmar	Sakri	Dhule	74.402	20.9383	Checkdam
117	Shewali (D)	Sakri	Dhule	74.3571	20.9938	Checkdam
118	Tamaswadi	Sakri	Dhule	74.4015	20.9781	Checkdam
119	Tamaswadi	Sakri	Dhule	74.4138	20.9783	Checkdam
120	Ubhand	Sakri	Dhule	74.4511	21.005	Checkdam
121	Aine	Sakri	Dhule	74.4658	21.005	Checkdam
122	Hatti Bk.	Sakri	Dhule	74.4744	21.03	Checkdam
123	Hatti Bk.	Sakri	Dhule	74.4826	21.0398	Checkdam
124	Hatti Bk.	Sakri	Dhule	74.4876	21.0482	Checkdam
125	Hatti Bk.	Sakri	Dhule	74.496	21.055	Checkdam
126	Nagpur (u)	Sakri	Dhule	74.4416	21.0548	Checkdam
127	Hatti Bk.	Sakri	Dhule	74.4645	21.0533	Checkdam
128	Hatti Bk.	Sakri	Dhule	74.4747	21.0545	Checkdam
129	Hatti Bk.	Sakri	Dhule	74.4976	21.0418	Checkdam
130	Kalambhir	Sakri	Dhule	74.3568	21.0141	Checkdam
131	Kalambhir	Sakri	Dhule	74.3584	21.021	Checkdam
132	Mhasale	Sakri	Dhule	74.4212	21.0962	Checkdam
133	Bhamer	Sakri	Dhule	74.4107	21.0884	Checkdam
134	Vehergaon	Sakri	Dhule	74.3975	21.0996	Checkdam
135	Kawathe	Sakri	Dhule	74.2804	21.0055	Checkdam
136	Perejpur	Sakri	Dhule	74.2825	21.0305	Checkdam
137	Perejpur	Sakri	Dhule	74.3041	21.0197	Checkdam
138	Nagpur (ko)	Sakri	Dhule	74.2894	20.9393	Checkdam
139	Shenpur	Sakri	Dhule	74.2185	20.9472	Checkdam
140	Mhasdi Pr.pimpalner	Sakri	Dhule	74.1633	20.9648	Checkdam
141	Gavhanipada	Sakri	Dhule	74.1633	20.9384	Checkdam
142	Malpur	Sakri	Dhule	74.2657	20.9339	Checkdam
143	Nadse	Sakri	Dhule	74.2978	20.9197	Checkdam
144	Mhasale	Sakri	Dhule	74.4479	21.0864	Checkdam
145	Balsane	Sakri	Dhule	74.4869	21.1697	Checkdam
146	Balsane	Sakri	Dhule	74.4609	21.1696	Checkdam
147	Satmane	Sakri	Dhule	74.5154	21.1397	Checkdam
148	Balsane	Sakri	Dhule	74.4857	21.1367	Checkdam
149	Balsane	Sakri	Dhule	74.4947	21.1487	Checkdam

Aquifer I Resources – Dy- 395.95 MCM

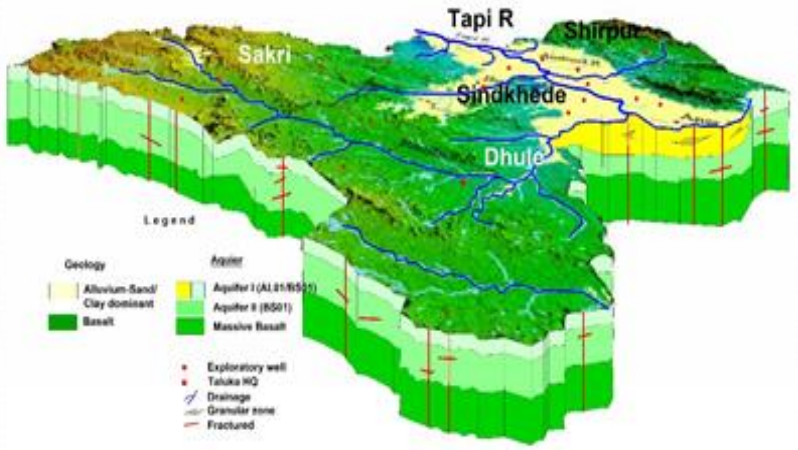
Aquifer II Resources – 32.61 MCM

Total Resources – 428.56 MCM

GW quantum saved by WUE – 3.42 MCM

Total Draft – 225.39 MCM

Augmentation by AR – 11.45 MCM



GW SENAREO AFTER IMPLEMENTING Artificial Recharge & aqvailable GWR to bring SOD UPTO 70%

GWA 428.56+11.45 MCM by AR = 440.01 MCM

GWR available to develop up to 70%= 59.78

WUE Measures

GW saved by WUE measures: 3.42 MCM

GWR available to develop GW UPTO 70%

Total = 63.2 MCM

PROBABLE BENEFITS AFTER IMPLEMENTING AR & WUE MEASURES

- About 9724 ha of additional Area can also be brought under assured GW irrigation from 63.2 MCM of Balance GWR available for GW Development after STAGE OF GWD is brought to 70% (safe category)
- Enhance availability of GWR after supply side intervention & Demand side intervention