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

## Bhokardan Taluka, Jalna District, Maharashtra

**Part-I**

मध्य क्षेत्र, नागपुर

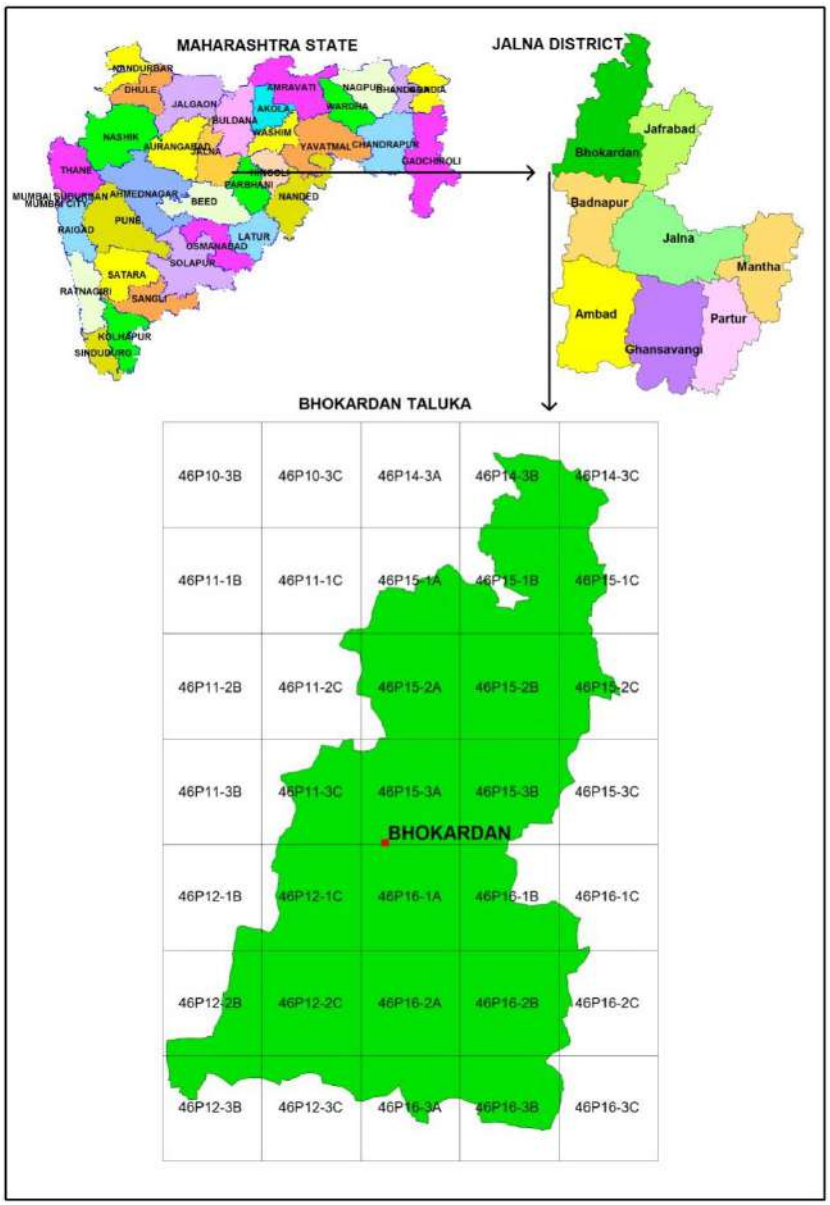
Central Region, Nagpur

Government of India

Ministry of Water Resources, River Development & Ganga Rejuvenation

CENTRAL GROUND WATER BOARD

# AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN OF BHOKARDAN TALUKA, JALNA DISTRICT MAHARASHTRA




CENTRAL REGION, NAGPUR

May 2016

# AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN OF BHOKARDAN TALUKA, JALNA DISTRICT, MAHARASHTRA

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# AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN OF BHOKARDAN TALUKA, JALNA DISTRICT, MAHARASHTRA

## 1. INTRODUCTION

In XII five year plan, National Aquifer Mapping (NAQUIM) had been taken up by CGWB to carry out detailed hydrogeological investigation on toposheet scale of 1:50,000. The NAQUIM has been prioritised to study Over-exploited, Critical and Semi-Critical talukas 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 ground water in aquifers.

The vagaries of rainfall, inherent heterogeneity & unsustainable nature of hard rock aquifers, over exploitation of once copious alluvial aquifers, lack of regulation mechanism has a detrimental effect on ground water scenario of the Country in last decade or so. Thus, prompting the paradigm shift from "**traditional groundwater development concept**" to "**modern groundwater management concept**".

Varied and diverse hydrogeological settings demand precise and comprehensive mapping of aquifers down to the optimum possible depth at appropriate scale to arrive at the robust and implementable ground water management plans. The proposed management planswill 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 State Govt. for its effective implementation.

### 1.1 Objective and Scope

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

- identifying the aquifer geometry,
- aquifer characteristics and their yield potential
- quality of water occurring at various depths,
- aquifer wise assessment of ground water resources
- preparation of aquifer maps and
- Formulate ground water management plan.

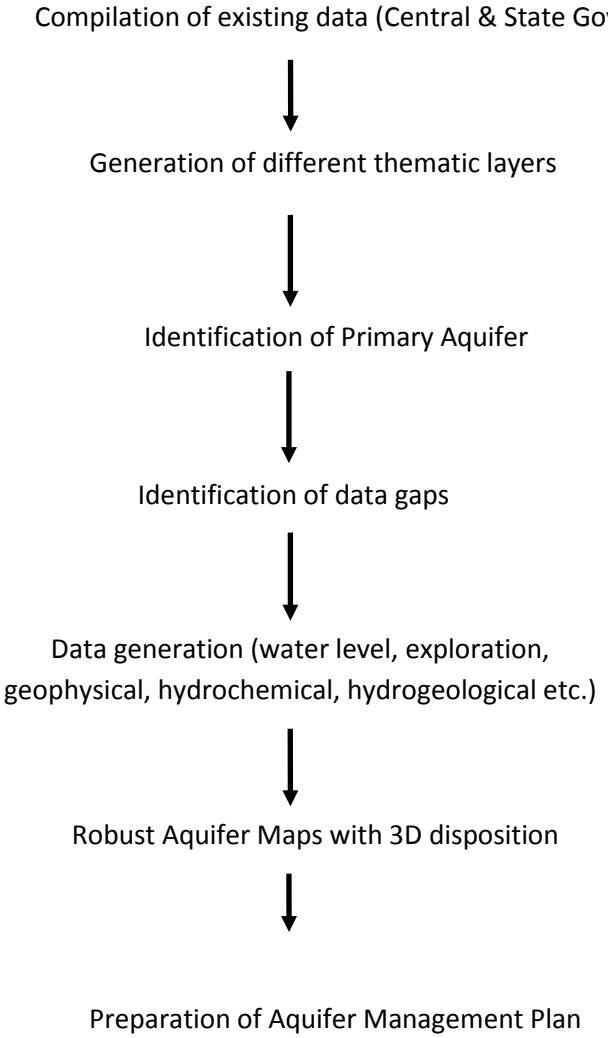
This clear demarcation of aquifers and their potential will help the agencies involved in water supply in ascertaining, how much volume of water is under their control. The robust and implementable ground water management plan will provide a **"Road Map"** to systematically manage the ground water resources for equitable distribution across the spectrum.

An area of 43,058 sq.km. was initially envisaged to be covered during the XII plan, which has been increased to 49,000 sq.km. to cover the gap areas as well as recent drought affected areas of Latur district.

## 1.2 Approach and Methodology

The ongoing activities of NAQUIM include toposheet wise micro-level hydrogeological data acquisition supported by geophysical and hydro-chemical investigations supplemented with ground water exploration down to the depths of 200 / 300 meters.

Considering the objectives of the NAQUIM, the data on various components was segregated, collected and brought on GIS platform by geo-referencing the available information for its utilisation for preparation of various thematic maps. The approach and methodology followed for Aquifer mapping is as given below:




## 1.3 Study area

Keeping in view the current demand and supply and futuristic requirement of water, Central Ground Water Board has initiated the National Aquifer Mapping Programme (NAQUIM)

in India during XII five year plan, with a priority to study Over-exploited, Critical and Semi-Critical Taluka. Out of which, Bhokardan taluka have been selected for NAQUIM having area of 1273 sq. kmin the year 2014-15. The Location map of the study area is presented in **Fig.1.1.** ThisTalukais categorized as Safeand taken up on request of State Government.

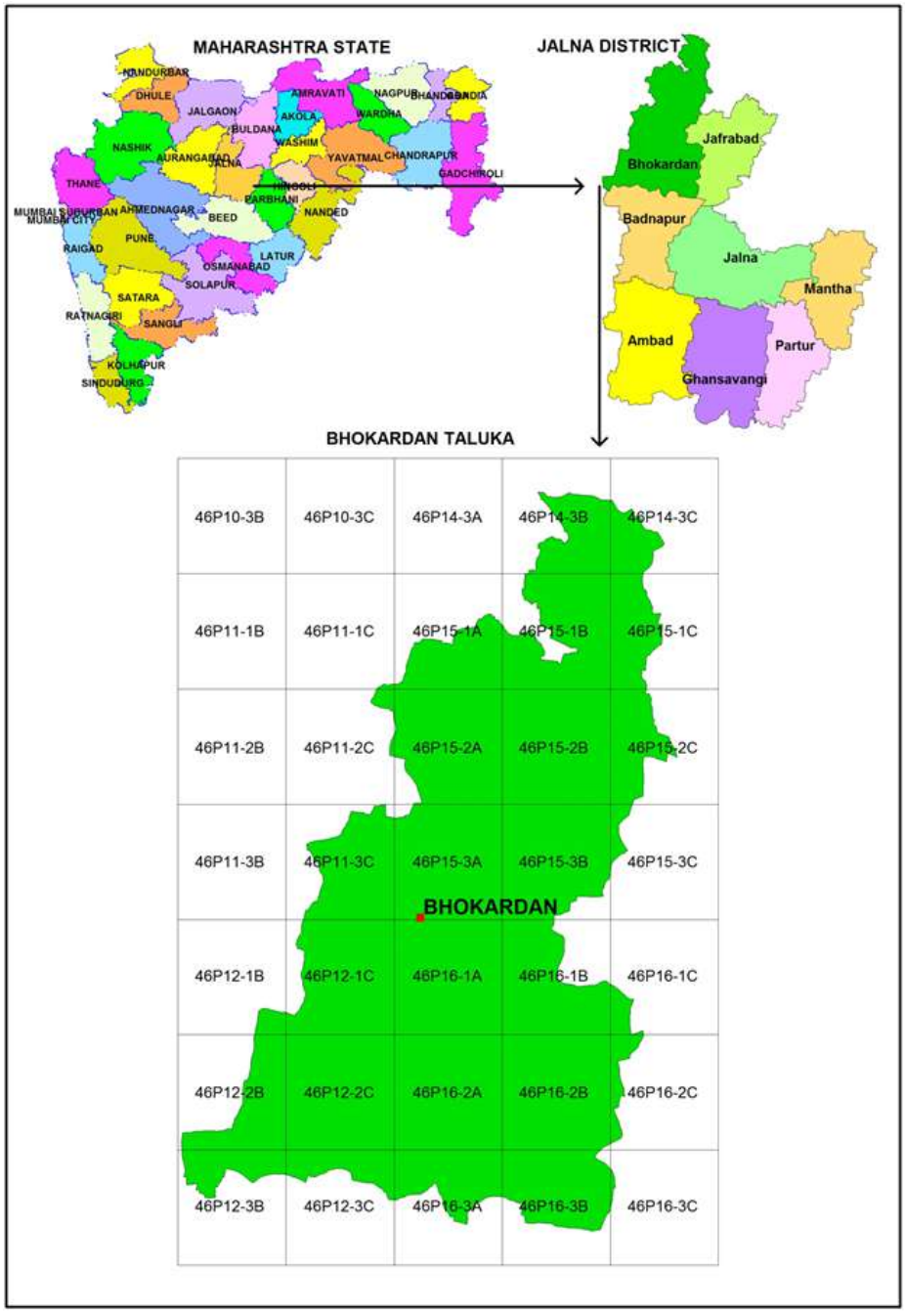



**Fig1.1: Location map, Bhokardan Taluka of Jalna district**

## 1.4 Data Adequecy and Data Gap Analysis.

The available data of the Exploratory wells drilled by Central Ground Water Board,Central Region, Nagpur, Geophysical Survey carried out in the area, Ground water monitoring stations and ground water quality stations monitored by Central Ground Water Board were compiled and analysed for adequacy of the same for the aquifer mapping studies. In addition to these the data on ground water monitoring stations and ground water quality stations of the State Govt. (GSDA) was also utilised for data adequacy and data gap analysis. The data adequacy and data gap analysis was carried out for each of the quadrant of the toposheets falling in the study area is mainlyin respect of following primary and essential data requirements:

**ExploratoryWells**

**GeophysicalSurveys**

**Ground Water Monitoringand**

**Ground Water Quality**

After taking into consideration, the available data of Ground Water Exploration, Geophysical survey, Ground Water Monitoring and Ground Water Quality, the data adequacy is compiled and the summarised details of required, existing and data gap of Exploratory wells, Ground Water monitoring and Ground water quality stations is given in **Table 1.1.**

**Table: 1.1 Data adequacy and Data Gap analysis**

| EXPLORATORY DATA | | | GEOPHYSICAL DATA | | | GWMONITORING DATA | | | GWQUALITYDATA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Req. | Exist. | Gap | Req | Exist. | Gap | Req. | Exist. | Gap | Req. | Exist. | Gap |
| 8 | 14 | 0 | 63 | 28 | 37 | 21 | 46 | 0 | 21 | 46 | 0 |

## 1.5 Rainfall and Climate

Agriculture in the area depends mainly on the rainfall from south-west monsoon. The area experiences the sub-tropical to tropical temperate monsoon climate. It was observed that the distribution of rainfall is more or less uniform over the area. The details of Rainfall analysis is given in **Annexure-I**. The rains usually start in the second week of June and last till the end of September. The intensity of rainfall is the highest in July. On the basis of rain fall analysis it is observed that:

- A total of 50 years of data has been used for Bhokardan taluka (1951-2015).
- The normal annual rainfall of Bhokardan taluka is 641.6 mm.
- During the year 2015, normal rainfall was recorded.
- The coefficient of variation in rainfall is observed as 31%.
- Normal rainfall has been received for 60 % of years at Bhokardan taluka of the total years, whereas excess rainfall has been received for 22% of years.
- The taluka have suffered moderate drought conditions in 8 % of years. Wheras, severe drought in 10% of the years.

The long term trend of rainfall was calculated and it is observed that there is a falling trend in Bhokardan taluka @ 1.853 mm/year.

Temperature during rainy season ranges from 21 to $30^0$ C. In winter season temperature fall appreciably and range from 10 to $25^0$C. In nights temperature range is 20 to $25^0$C with privilege of cool breeze.

The air is generally high over the district except during the southwest monsoon when the relative humidity is high. The summer months are the driest when the relative humidity is generally between 20 and 25 percent in the afternoon.

Winds are generally light to moderate with increase in speed during the later half of the hot season and in monsoon season. The winds blow predominantly from directions between west and north during the hot season. They are mostly from directions between southwest and northwest during the southwest monsoon season.

## 1.6 Physiography

The area can be broadly divided into four physiographic units i.e., the Ajanta Hill range,undulating plateau, Denudational slope and older flood plain.The altitude in Bhokardan taluka range between 534to 710mamsl.The major older flood plain is observed along Purna River. The physiography of the area is shown in **Fig. 1.2**

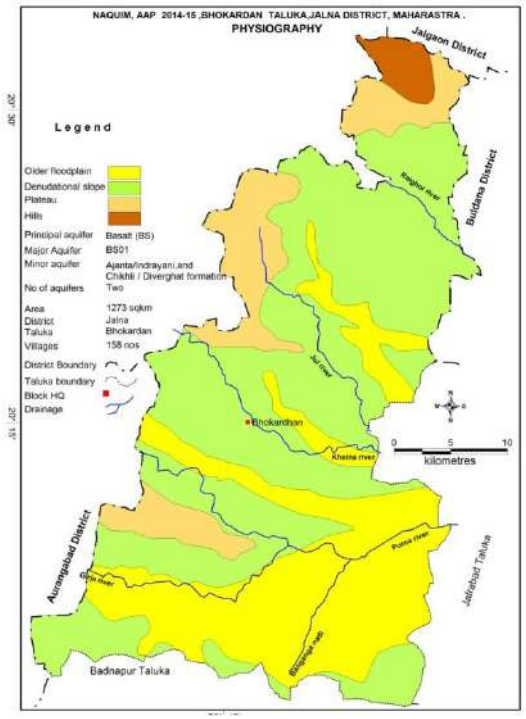



**Fig. 1.2: Physiography, Bhokardan Taluka, Jalna District**

## 1.7 Geomorphology

Geomorphologically, the area comprises of varied topographic features and landscapes consisting of moderately to gently sloping undulated topography. Major part of the taluka is occupied by slightly dissected to weathered plateau. The northern part of the area is occupied by Ajanta and Satmala hill ranges. A very small part of the area(North Eastern part)falls under the Tapi basin with the general slope towards Northeast. Rest of the taluka is having general slope towards major drainages of Godavari basin. The geomorphology of the area is shown in **Fig. 1.3**

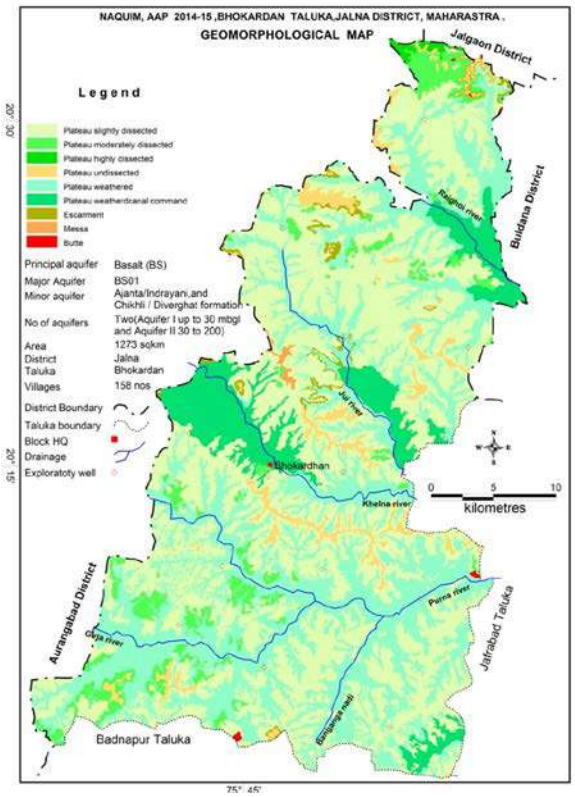



**Fig. 1.3: Geomorphology, Bhokardan Taluka, Jalna District**

## 1.8 Land Use, Agriculture, Irrigation and Cropping Pattern

The landuse details and the thematic map available with the MRSAC, Nagpur has been collected and analysed with reference to the present agricultural practices, various land use etc. It has been observed that the major parts of the area are covered by agricultural land. Forest covers very little area in the northern part. The built up area is reflected wherever settlements have come up. The thematic map on land use is shown in **Fig. 1.4**

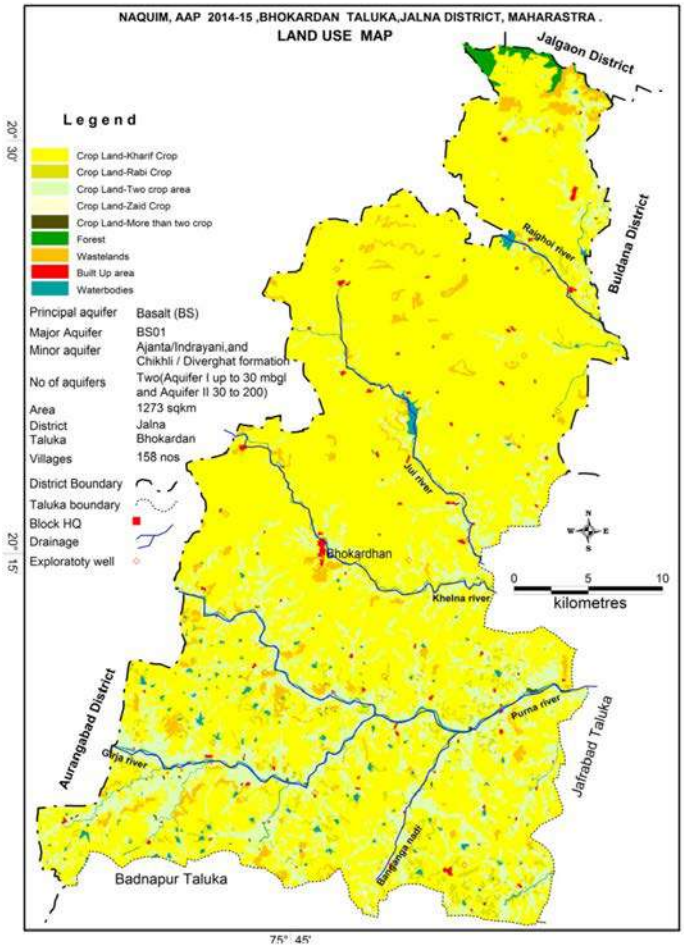



**Fig. 1.4: Landuse, Bhokardan Taluka, Jalna District**

## 1.9 Soil

Soil plays a very important role in the agricultural activities and forest growth of the area. The fertility of the soil from agricultural point of view depends upon the texture and structure which controls the retaining and transmitting capacity of moisture and various nutrients such as nitrogen, phosphorous and potassium present in the soil. The formation of the soil in the area is influenced by the climate, geology, vegetation and topography. The soil data and the thematic map of the area available with the MRSAC, Nagpur has been collected and analysed. It has been observed that the major part of the area is occupied by clayey and sandy soil. Maximum area of the taluka is covered by Clayey loamy soil with extremely shallow to very shallow depth. The Sandy clayeysoil is observed all along the major drainages. The soil varies both in texture and depth. Deep soils occur along plains of lower elevation, depressions and along river banks. These are dark black cotton soils.The thematic map on the soil distribution in the study area is shown in **Fig.1.5.**

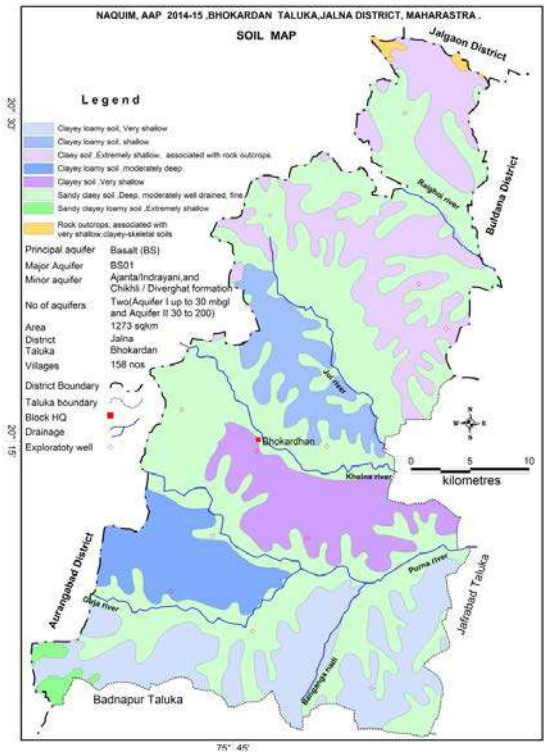



**Fig. 1.5: Soil, Bhokardan Taluka, Jalna District**

## 1.10 Hydrology and Drainage:

### 1.10.1 Hydrology

There are one major, onemedium and three bigger minor irrigation projects in the Bhokardan taluka. However, the State Govt. constructed a number of minor irrigation structures. As per the Irrigation Department, Govt. of Maharashtra, 8403 ha land was irrigated in Bhokardan Taluka through these irrigation structures. The details of irrigation projects are presented as **Table 1.2.**

**Table:1.2 Detalis of Major,Medium & Bigger minor structures and their command areas.**

| Sl No. | Name | Storage Capacity (MCM) | | Canal | | | Command area (Ha) | |
|---|---|---|---|---|---|---|---|---|
| | | Gross | Live | Length (Km.) | Width (m) | Discharge (Cumec) | Gross | By Latest Date |
| 1 | Chandai Eko | 2.82 | 2.45 | 4.5 | | 465.39 | 440 | 396 |
| 2 | Banegaon | 6.98 | 6.03 | left (6000) | | 974.26 | 860 | 773 |
| | | | | right (3000) | | | | |
| 3 | Palashkheda | 9.01 | 8.01 | left (10000) | | 929.02 | 1378 | 1240 |
| | | | | right (5000) | | | | |
| 4 | Jui (Major) | 6.03 | 0.52 | 16.65 | | | 3296 | 2636 |
| 5 | Dhamna (Medium) | 10.72 | Foundation Level | 16.03 | | | 2429 | 1973 |

*(Source: Irrigation Department, Govt. of Maharashtra)*

### 1.10.2 Drainage

Major Part of the area falls under the Godavari basin. The river Purna flows from the southern-central part of the areaand meets river Godavari in the neighbouring district. The river Khelna and Girja are other important tributaries of river Purna which flows through the area. The drainage map of Bhokardan taluka is shown in **Fig. 1.6**. A very small part of the arealocated in North Eastern part fallsunder the Tapi basin.The general slope of the area is towards Southeast.The drainage pattern in the area is sub-dendritic to dendritic. Depending on the drainage and geomorphology, thistalukas has been divided into 7 watersheds.

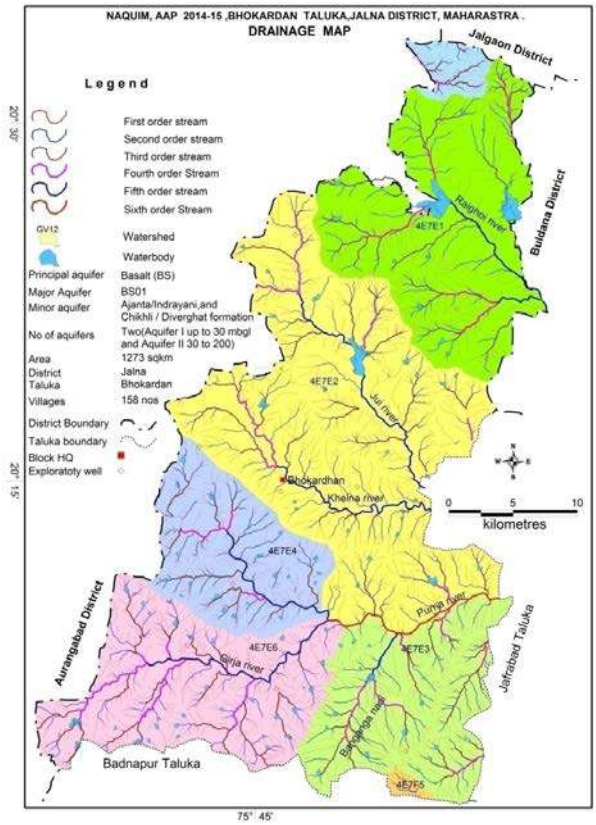



**Fig. 1.6: Drainage, Bhokardan Taluka, Jalna District**

## 1.11 Prevailing Water Conservation and Recharge Practices

The State Govt. has also constructed number of water conservation structures such as MI tanks (8), KT Weirs (54), percolation tank (92), UG Bandhara (83) etc. The area irrigated through these structures is 5521 ha. The details are presented in **Table 1.3.**

**Table – 1.3: Details of Water Conservation Structures constructed by State Govt.**

| Taluka | Minor Projets | KTW | PT | UG Bandhara/ Stoarage Tanks | Irrigation Wells | Net Area Irrigated (Ha) | Gross area irrigated |
|---|---|---|---|---|---|---|---|
| Bhokardan | 8 | 54 | 92 | 83 | 399 | 5521 | 10508 |

# 2. DATA COLLECTION AND GENERATION

The data collection from various agencies such as GSDA, Irrigation, Agriculture, Revenue, etc., was carried out. The data was collected and then compiled and validated so as to remove the discrepancies and make it utilisable on GIS platform.

## 2.1 Data Collection and Compilation

The data collection and compilation for various components was carried out as given below.

- Hydrogeological Data – Current and historical water levels along with water level trend data of 46 monitoring wells representing shallow aquifer of CGWB.
- Hydrochemical Data - Ground water quality data of 40 monitoring wells of CGWB representing shallow aquifer and data of 12 exploratory wellsrepresenting deeper aquifer.
- Exploratory Drilling – Ground water exploration data of 14 exploratory wells of CGWB down to the depth of 200 m bgl.
- Hydrology Data – Data on various irrigation projects, their utilisation status from Irrigation Dept.
- Hydrometeorological Data - Long term rainfall data for each of the taluka from Revenue Dept.
- Irrigation Data – Data on land under surface and ground water irrigation from Irrigation Dept. and Agriculture Dept.
- Water Conservation Structures – Numbers, type and storage potential of water conservation structures prevailing in the area.
- Cropping Pattern Data – Data on prevailing cropping pattern from Agriculture Dept.

## 2.2 Data Generation

Based on the data collected and existing data available with CGWB, data adequacy was worked out to decide the scope and extent of further data generation. The data requirement was optimised and considering the predominance of basaltic aquifers in the area, it was decided that the existing hydrogeological data is insufficient to generate the desired outputs of aquifer maps and management plan.

### 2.2.1 Ground Water Exploration

The drilling at Nine sites was done down to the depth ranges from 196.50 to 200 mbgl by deploying DTH/REL-06/119 to assess the lithological disposition of shallow aquifer (Aquifer-I) and deeper aquifer (Aquifer-II). The deeper aquifers are encountered in depth of 19.50 - 22.50, 178.40 - 181.40, however their yield was negligible, whereas the water level was recored as more than 100 mbgl. The details of exploratory wells are given in **Annexure-II.**

### 2.2.2 Ground Water Monitoring Wells

A total of 46 key observation wells (KOW) were established in addition to the existing GWMW to assess the ground water scenario of shallow aquifer (Aquifer-I) of the area. The depth of these dug well varies from 2.8 -26.22 mbgl. The pre monsoon depth to water level (May 2015) in these wells varies from 0.01 (Siphora) to 18.19 mbgl (Borgaon Taru). The post monsoon depth to water level (Nov. 2015) in

the dug well varies from 0.10 (Siphora and Avana) to 15.05 mbgl (Borgaon Taru). The details of water level data are given in **Annexure-III.**

### 2.2.3 Ground Water Quality

A total of 46 water samples were collected in addition to the existing GWMW to assess the ground water quality of shallow aquifer (Aquifer-I) of area. The EC values range between 328 to 2870 µmhos/cm. except few locations where Fluoride is more than 1.5 mg/l, rest of the area is having fluoride within desirable limt. Nitrate concentration more than 45 mg/l has been observed in alomost all the samples, due to anthropogenic activities. The details of chemical analysis is given in **Annexure-IV**.

### 2.2.4 Micro Level Hydrogeological Data Acquisition

In addition to the 46 KOW's, micro level hydrogeological data were also collected from 263 locations for deciphering the sub-surface lithological disposition, water level scenario and other hydrogeological inputs such as weathered thickness, EC, etc., of shallow aquifer (Aquifer-I). The details of dugwells inventoried for micro level data acquisition are given in **Annexure-V**.

### 2.2.5 Soil Infiltration Tests

To estimate the actual rate of infiltration of various soil cover and their impact on recharge to ground water, 6 infiltration tests have been conducted at Mehegaon, Jomala, Kothakoli, Nalni Budrukh, Baranjala, Janephalon various soil types. The data has been analyzed and the salient features of the infiltration tests are presented in **Table 2.1**, whereas the data is presented in **Annexure-VI** and the plots of soil infiltration tests are presented in **Fig. 2.1a to 2.1f**. The duration of the test ranged from 105 to 165 minutes, the depth of water infiltrated varied from 0.40 cm to 2.60 cm and the final infiltration rate in the area ranged from 0.80 cm/hr at Nalni Budrukh to 6.20 cm/hr at Baranjla Lokhande.

**Table 2.1: Salient Features of Infiltration Tests**

| S. No. | Village | Date | Duration (min) | Water Level (cm agl) | Final Infiltrated Water Depth (cm) | Final Infiltration Rate (cm/hr) |
|---|---|---|---|---|---|---|
| 1. | Mehegaon | 27.02.16 | 150 | 20 | 2.20 | 4.40 |
| 2. | Jomala | 29.02.16 | 105 | 17 | 2.60 | 5.20 |
| 3. | Kothakoli | 27.02.16 | 150 | 15 | 0.70 | 1.40 |
| 4. | Nalni Budrukh | 29.02.16 | 165 | 20 | 0.40 | 0.80 |
| 5. | Baranjala Lokhande | 28.02.16 | 165 | 17 | 3.10 | 6.20 |
| 6. | Janephal | 29.02.16 | 150 | 16 | 1.50 | 3.00 |

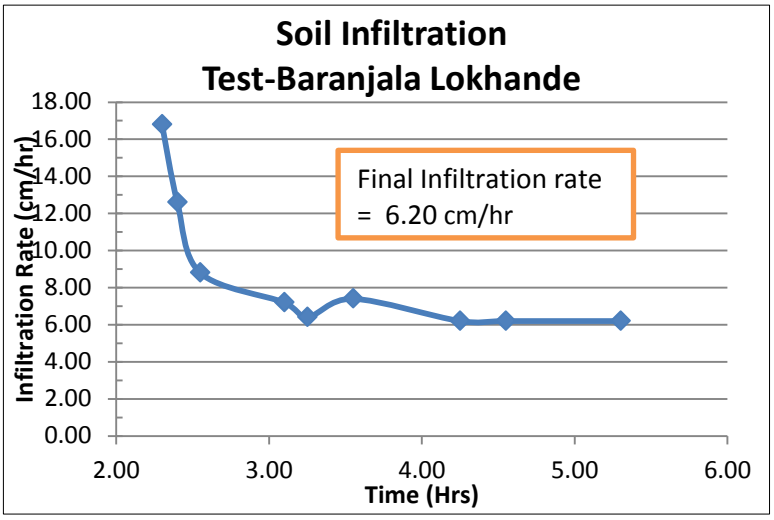



**Fig. 2.1 a**

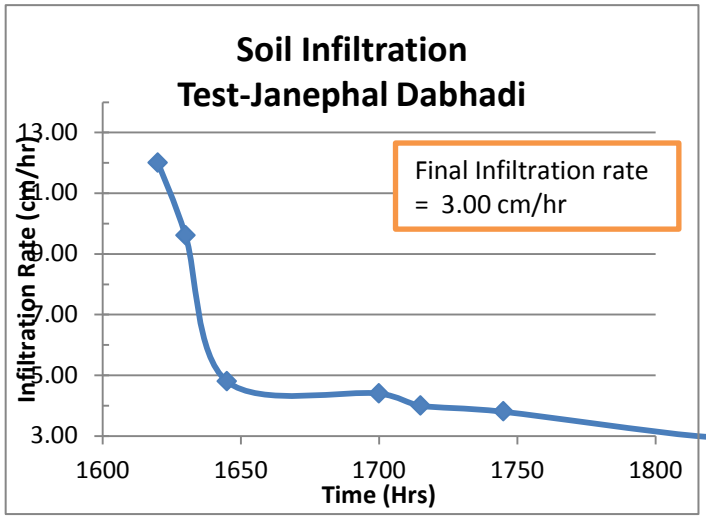



**Fig. 2.1 b**

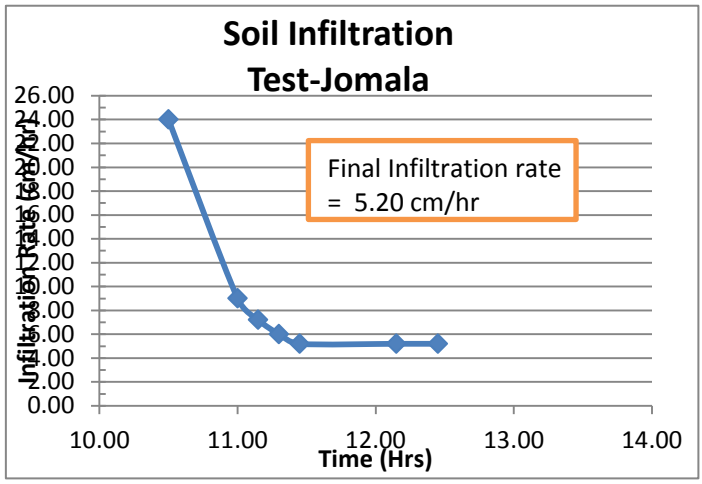



**Fig. 2.1 c**

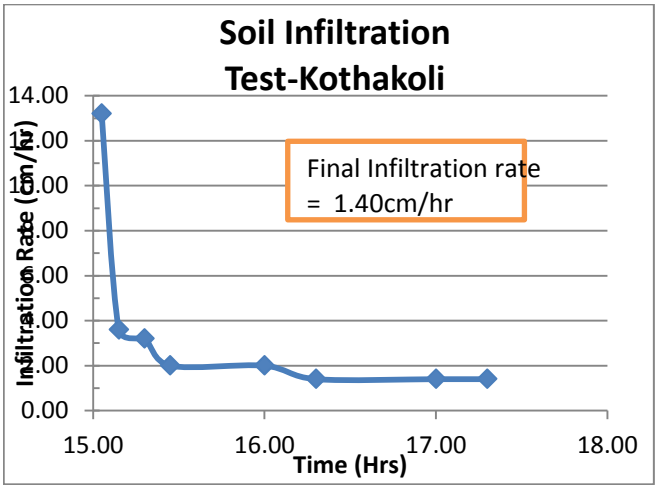



**Fig 2.1 d**

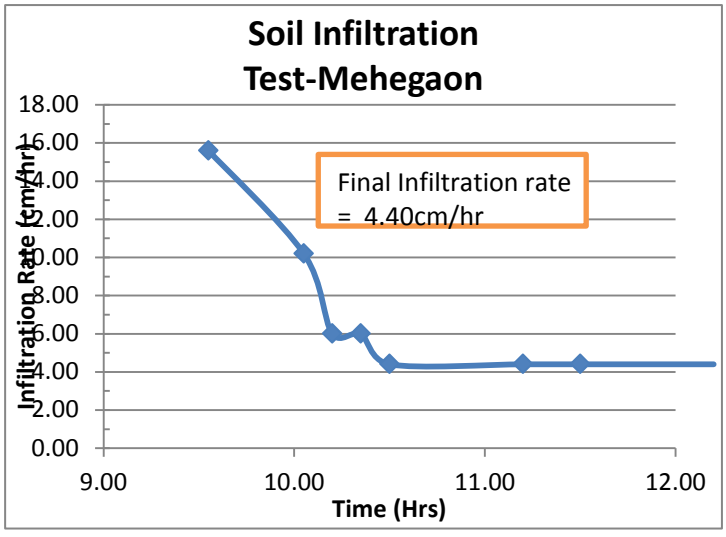



**Fig.2.1 e**

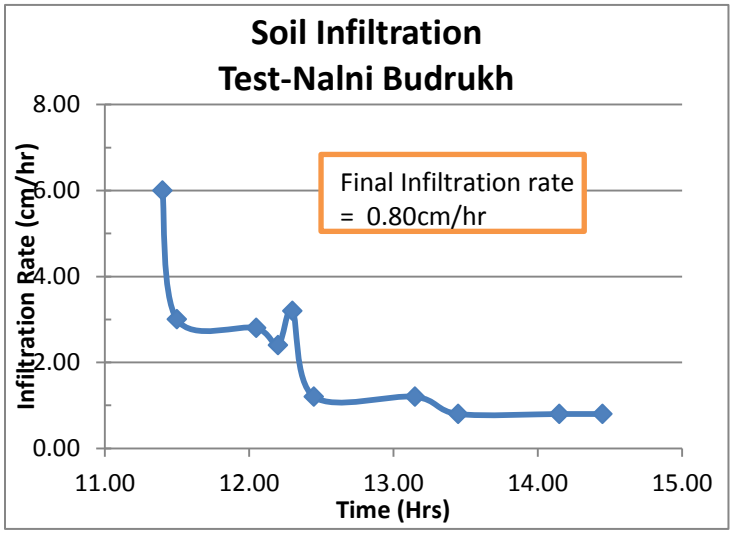



**Fig. 2.1 f**

### 2.2.6 Specific Yield Tests

To estimate the aquifer parameters of shallow aquifer (Aquifer-I) in the area, 6 pumping tests on open dug wells have been conducted. The data has been analyzed by Kumarswamy method, the salient features of pumping tests are given in **Table 2.2**. The discharge of the wells ranged from 240 to 396 lpm for pumping duration of 60 to 300 minutes.

The drawdown observed at the end of the pumping ranged from 1.01 to 4.4 m and the residual drawdown for the 1$^{st}$ minute was observed to be ranging from 0.07 to 3.55 m. The aquifer parameter values estimated by Kumarswamy method are observed to be well within the general range of values for weathered and jointed basalt i.e., the transmissivity value was observed from 97.21 to 9799.48 $m^2$/day, whereas the specific yield 0.020% to 0.094%, whereas specific capacity values ranged from 81.82 to 267.33 lpm/m.

**Table 2.2: Salient features of pumping tests – shallow aquifer (dug well) using Kumarswamy method**

| S. No. | Village | Diameter (m) | Depth (mbgl) | SWL (mbgl) | Q (lpm) | Pt (min) | DD (m) | RDD (m) | C (lpm/m) | T m2/day | Sy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Mahegaonwadi | 4.5 | 16 | 4.3 | 300 | 120 | 3.2 | 2.09 | 93.75 | 202.13 | 0.085 |
| 2 | Jomala | 7.4 | 16 | 14.3 | 270 | 60 | 1.01 | 0.25 | 267.33 | 9799.48 | 0.020 |
| 3 | Nalni | 4.6 | 15 | 9.85 | 240 | 120 | 1.05 | 0.59 | 228.57 | 352.40 | 0.090 |
| 4 | Janephal Dabhadi | 7 | 8 | 5.5 | 396 | 150 | 1.59 | 0.07 | 249.06 | 4194.37 | 0.061 |
| 5 | Khandala | 7 | 17 | 5.55 | 360 | 300 | 4.4 | 3.55 | 81.82 | 334.17 | 0.094 |
| 6 | Adgaon | 5 | 22.16 | 17.5 | 300 | 110 | 1.78 | 1.49 | 168.54 | 97.21 | 0.055 |

Here, SWL – Static Water Level, Q – Discharge, Pt - Pumping duration, D/D – Drawdown, RDD - Residual drawdown, C - Specific Capacity, T – Transmissivity, Sy - Specific Yield

However, the thematic layers for various themes needed to be procured and the following layers were procured from MRSAC. These thematic layers supported the primary database and provided precise information to assess the present ground water scenario and also to propose the future management plan.

Drainage
Physiography
Geomorphology
Soil
Land Use – Land Cover

# 3 Data Interpretation, Integration and Aquifer Mapping

The data collected and generated on various parameters viz., water levels, water quality, exploration, aquifer parameters, geophysical, hydrology, hydrometeorology, irrigation, thematic layers was interpreted and integrated. Based on this the various maps on hydrogeology, aquifer wise water level scenario both current and long term scenarios, aquifer wise ground water quality, 2-D and 3-D sub surface disposition of aquifers by drawing fence and lithological sections, aquifer wise yield potential, aquifer wise resources, aquifer maps were generated and as discussed in details.

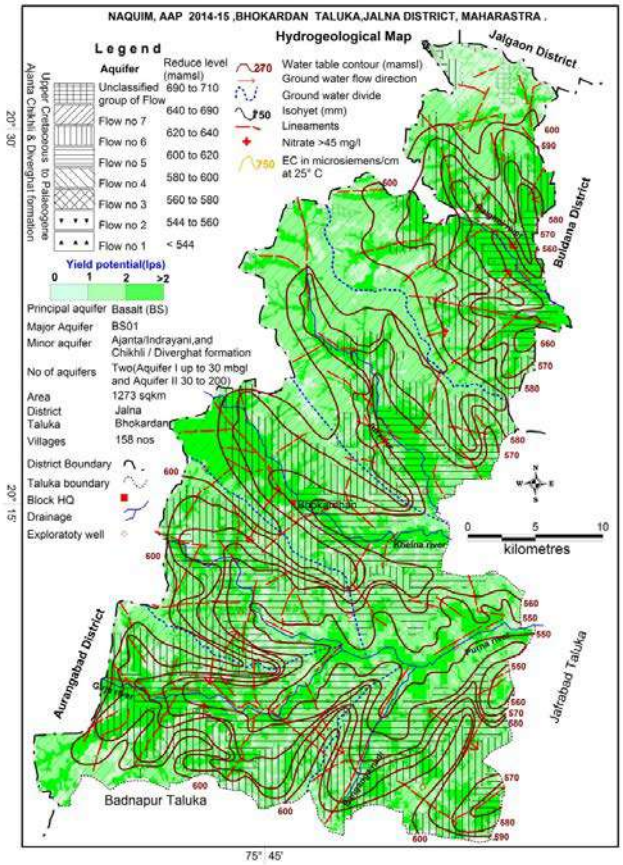



**Fig. 3.1: Hydrogeology, Bhokardan Taluka, Jalna District**

## 3.1 Hydrogeology

Hydrogeologically, the area occupied by Deccan traps with inter-trappean beds (**Fig. 3.1**). Eight basaltic lava flows of 'aa' type are exposed within the altitude of 544 to 690m.amsl in the area. Each lava flow comprises 3 units namely top vesicular basalt followed by fractured/massive basalt and bottom massive unit. Recent Alluvium is occupied along the Purna River and its major tributaries.

The yields of wells are functions of the permeability and transmissivity of aquifer encountered and varies with location, diameter and depth etc. There are three types of ground

water structures in the area i.e. dugwells, borewells and dug cum borewells (DCB). Their yield characteristics are described below.

Dugwells are generally used for both domestic water supply and irrigation purposes in this area. It is observed that the dugwells varying from 5.60 m to around 30 m in depth in basaltic lava flows can sustain assured water supply for domestic needs of about 500 people throughout the year. The yield of dugwells in basalt for irrigation purposes varies from 20 to 90 $m^3$/day. However, dugwells in alluvium and wells located in favourable area in basalt can yield upto 100 to 250 $m^3$/day.

Ground water is predominantly used for irrigation. State government has drilled large number of borewells fitted with hand pumps and electric motors for rural drinking water purposes in the area. Yields of borewells range from 90 to 150 lph. The ground water development in thistaluka is mostly through dugwells.

## 3.2 Occurrence of Ground Water in Basalt

The basaltic lava flows of Upper Cretaceous to Lower Eocene age occur in the area and consists of two units namely lower massive unit and upper vesicular unit occurring in layered sequence. The various flows are generally separated by bole/inter-trappean beds normally consists of clay.

Ground water occurs in unconfined state in shallow aquifer tapped by dugwells of 10 to 30 m depth, water levels are ranging from 1.25 to 19.00 m bgl and the yield of dug wells is obcerved 10 to 50 $m^3$/day. The deeper aquifer is also present in the area, which is being tapped by borewells upto 200 m bgl. The water level in deeper aquifer ranges from 11.4 to > 50 m bgl.

## 3.3 Water Level Scenario

### 3.3.1 Aquifer I-Depth to water level (May 2014)

The depth to water levels in Bhokardan Taluka during May 2014 ranges between 1.25 (Siphora) and 19.00 (Borgaon Taru) m bgl. Depth to water levels during premonsoon shows water level within 5 m bgl and observed in central and eastern part all along the major drainages, and also as isolated paches in north central and southern part, whereas water levels between 5-10 mbgl is observed in 60% area in thistaluka. The pre-monsoon depth to water level map is given in **Fig.3.2** and the water level data is presented as **Annexure-III.**

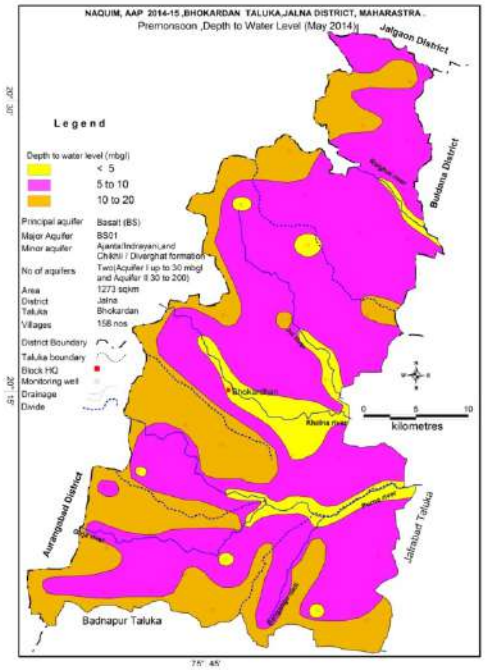



Fig. 3.2.Premonsoon Depth to Water Level (May 2014)

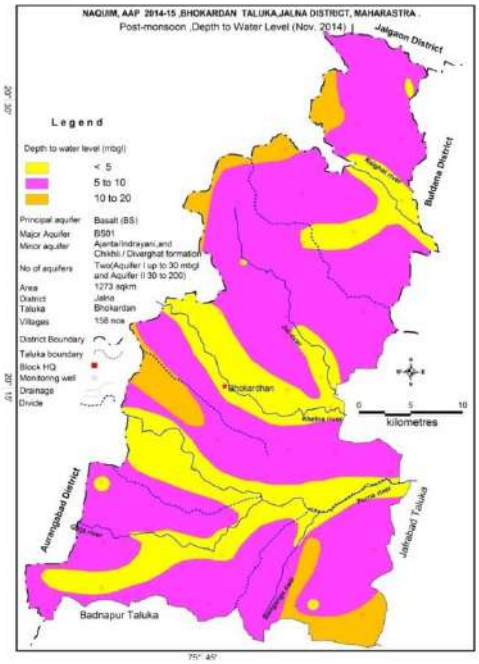



Fig. 3.3.Postmonsoon Depth to Water Level (Nov 2014)

### 3.3.2 Aquifer I-Depth to water level (Nov 2014)

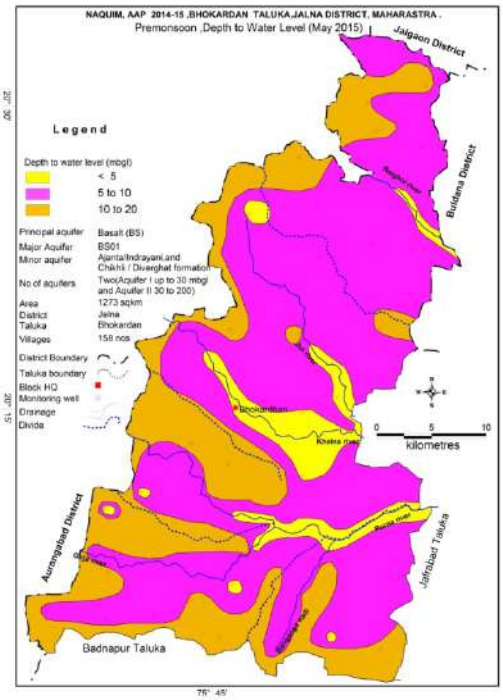
The depth to water levels in BhokardanTaluka during Nov 2014 ranges between 0.00 (Siphora) and 11.42 (Longaon) m bgl. Except small isolated patch in north western part, where the water level is more than 10 mbgl, rest of the area shows depth to water levels within 10 m bgl. The postmonsoon depth to water level map is given in **Fig.3.3**.

### 3.3.3 Aquifer I-Depth to water level (May 2015)

The depth to water levels in BhokardanTaluka during May 2015 ranges between 0.1 (Siphora) and 18.19 (Borgaon Taru) m bgl. Depth to water levels during premonsoon lies within 10 m bgl and observed all along major drainages from north to southern. Whereas, water levels between 10-20 mbgl is observed in 40% area in western and southern periphery of the Taluka. The premonsoon depth to water level map is given in **Fig.3.4**.

### 3.3.4 Aquifer I-Depth to water level (Nov 2015)

The depth to water levels in BhokardanTaluka during Nov 2015 ranges between 0.1 (Siphora and Avana) and 15.05 (Borgaon Taru) m bgl. Except isolated patch in western part, where water level is more than 10 mbgl, rest of the area shows depth to water levels during postmonsoon within 10 m bgl. The postmonsoon depth to water level map is given in **Fig.3.5**.



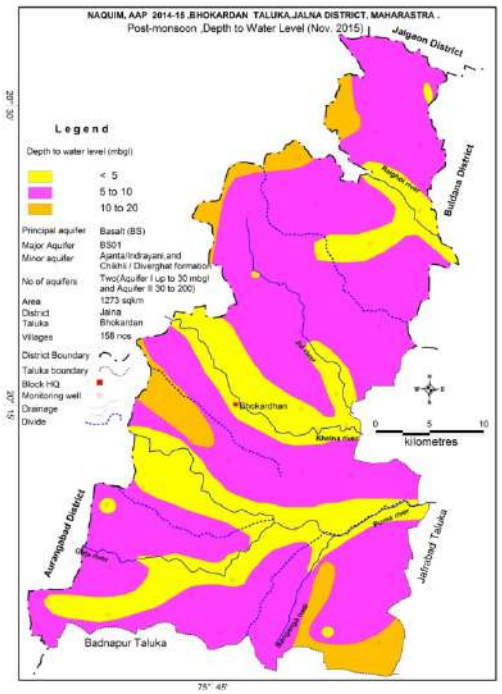
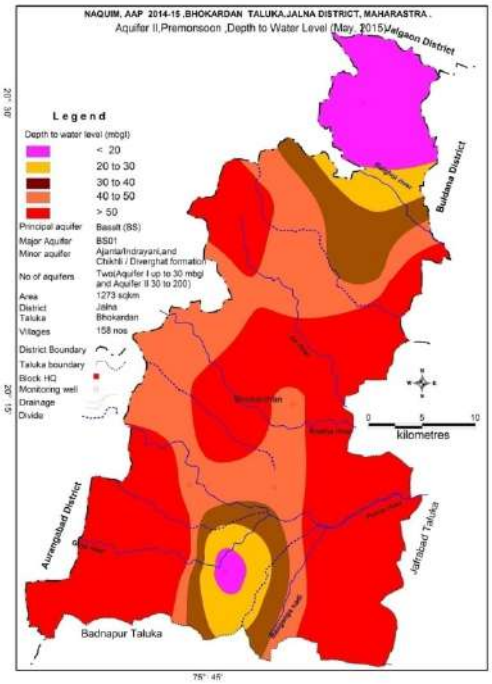




**Fig. 3.4.Pre-monsoon Depth to Water Level (May 2015)** **Fig. 3.5.Postmonsoon Depth to Water Level (Nov 2015)**

### 3.3.5 Aquifer-II- Depth to water level (May-2015)

The pre-monsoon (May 2015) in Aquifer-II, the deeper DTW (>50 m bgl) has been observed in eastern part and SE part of the Bhokardan taluka. The Shallow DTW (upto 20 m bgl) has been observed in northern part of the area, particularly in the vicinity of the hilly terrain. The water levels between 20-30 mbgl has been observed in northernpart and isolated paches in southern part followed by the water level 30-40 mbgl. The pre-monsoon depth to water level for Aquifer –II is given in **Fig.3.6** and the details are presented in **Annexure VII**.



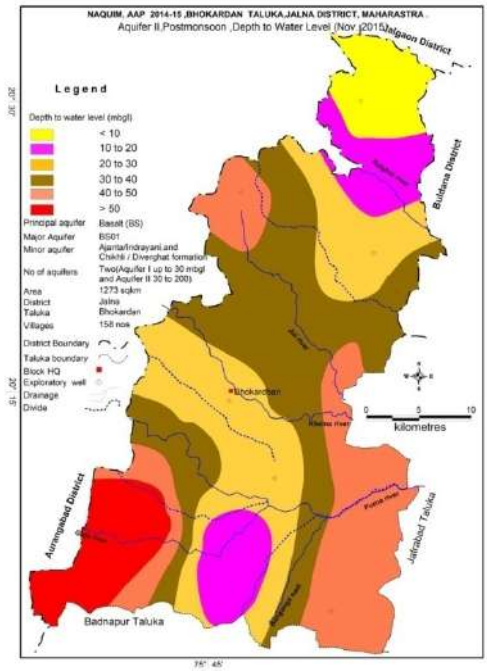




**Fig. 3.6. Aquifer-II, Premonsoon Depth to Water Level (May 2015)** **Fig. 3.6. Aquifer-II, Postmonsoon Depth to Water Level (Nov 2015)**

### 3.3.6 Aquifer-II- Depth to water level (Nov-2015)

The post-monsoon (Nov 2015) in Aquifer-II, the deeper DTW (>50 m bgl) has been observed in the extreme south west tip of the Bhokardan taluka. The Shallow DTW (upto 10 m bgl) has been observed in northernpart of the area, particularly in the vicinity of the hilly terrain. The water levels between 20-30 mbgl has been observed in central part extending from east to west followed by the water level 30-40 mbgl. The water levels between 40-50 mbgl has been observed in SE part with some isolated paches in NW part of the taluka. The post-monsoon depth to water level for Aquifer –II is given in **Fig.3.7**

### 3.3.7 Water Level Fluctuation

The water level measured during pre and post monsoon period (2014) was used to compute the seasonal fluctuation. In the area, number of wells and their percentage falling in each fluctuation range is presented in **Table 3.1**.

**Table 3.1: Seasonal fluctuation (May-14 vs Nov-14) in water level with percentage**

| No. of key wells | Seasonal fluctuation in water level m with % | | | | | |
|---|---|---|---|---|---|---|
| | 0 to 2 | 2 to 4 | 4 to 6 | 6 to 8 | 8 to 10 | > 10 m |
| 46 | 18 (39.13%) | 11 (23.91%) | 8 (17.39%) | 6 (13.04%) | 1 (2.17 %) | 2 (4.34%) |

It is observed that minimum water level fluctuation was observed at Bhokardan (0.04m) while maximum water level fluctuation was observedat Nimgaon (16.83m). The water level fluctuations are grouped under three categories and are discussed under.

0-2 m and 2-4 m - Less water level fluctuation
4-6 m and 6-8 m - Moderate water level fluctuation
8-10 m and >10 m - High water level fluctuation

Area with less water level fluctuation, about 63.04% wells (29wells) were showing the water level fluctuation less than 4m. The area with less water level fluctuation is observed in Dhavada, Gosegaon, Nanja, Khandala, Takli, Talegaon, Ekiphal, Hasnabad, Barangala Lokhande, Barangala Sable,Takli, Kedarkheda, Janephal, Chandai Thombri, Nalni Buzurg, Banegaon,

Palashkheda, Rajur, Longaon, Adgaon, Jalgaon, Pokhari, Valsawangi, Anva, Karajgaon, Paradh Badi, Sawangi, Bhokardan, Siphora in NE to SE part of the taluka.

Area with moderate water level fluctuation, about 30.43% wells (14 wells) were showing the water level fluctuation between 4 and 8m.In Bhokardan taluka it is observed in central part ofthe taluka.

Area with high water level fluctuation, about 6.52 % wells (3 wells) were showing the water level fluctuation more than 8m.It is observed in small isolated patches in Bhokardan Taluka.

### 3.3.8 Water Level Trend (2005-14)

Based on the CGWB's GWMW and Observation wells of GSDA, Jalna, the long-term trend of water levels for pre-monsoon and post-monsoon periods for the last ten years (2005-14) have been computed. The long term water level datat of 28 GWMW of CGWB and GSDA has been utilised. The maps depicting the spatial variation in long-term water level trend is presented as (**Fig 3.8 and 3.9**). The data is presented in **Annexure VIII**.

In pre monsoon the falling water level trend between 0.2 & 0.4 and 0.4 to 0.6 in northern, eastern and southern part of the taluka while rising trend between 0.02 & 0.2 has been observed in rest of the area.

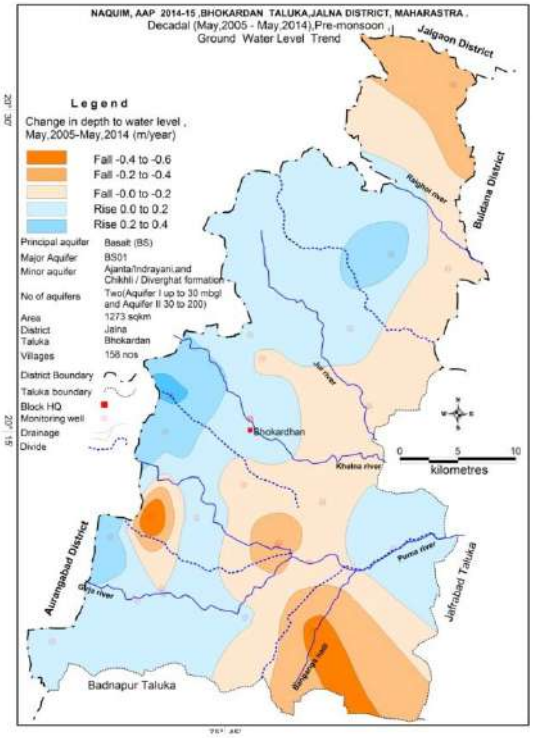



Fig 3.8 Premonsoon decadal water level trend (2005-14)

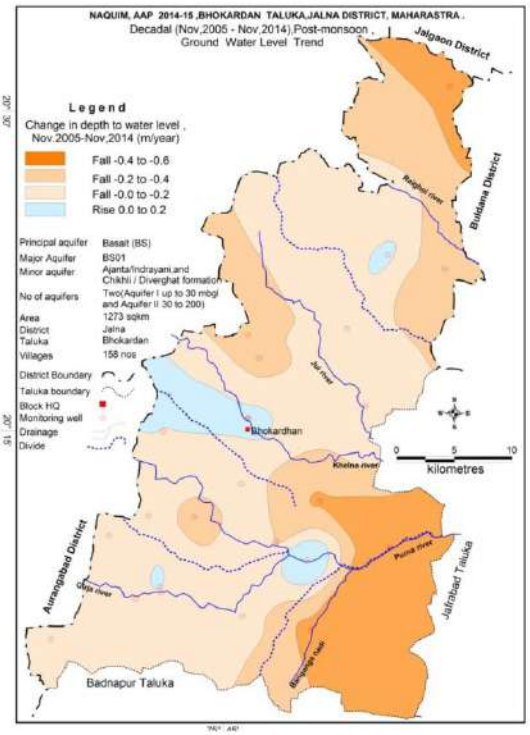



Fig 3.9 Postmonsoon decadal water level trend (2005-14)

In post monsoon, the rising water level trend in the range of 0 to 0.2m/yearhas been observed in central and western parts and occur as small patches while falling trend in the range from 0.0 to 0.6 m/year has been observed in almost entire taluka with maximum falling trend of 0.4 to 0.6 m/year confined tonorthern and southwestern part of the taluka.

### 3.3.9 Ground Water Flow

In a groundwater regime, the line joining points of equal head on the potentiometric surface(equipotential lines), were drawn based on the area of variation of the head of an aquifer. Based on the Water table elevation, ground water flow directions are demarcated (**Fig. 3.10**). It has been observed that

1) The Purna river and its tributaries Riaghoi, Jui, Khelna, Girja and Banganga and their tributaries constitute the principal drainage system in the area. The other nalas are seasonal emanating from the hilly terrain and form the main nalas and rivers. The drainage pattern is parallel and then sub dendritic to dendritic. The meandering of Purnariver indicates their mature stage of development. All the major drainages are flowing towards east meeting to main Godavari River.
2) The water table varies from 550 m amsl near Purnariverin eastern part to about 600 m amsltowards hilly area in northern and southern part.
3) The overall ground water movement is from northwest to southeast i.e. towards Purna river and its tributaries, maintaining the general flow direction of Godavari River.

It has been observed that the ground water flow directions follow the major drainage of Purnariverand topography of the area. This indicates the topographic control for the ground water movement. However, in northern, southern and western part of the study area, the ground water movement is control by structural discontinuity and also acts as a water divide.

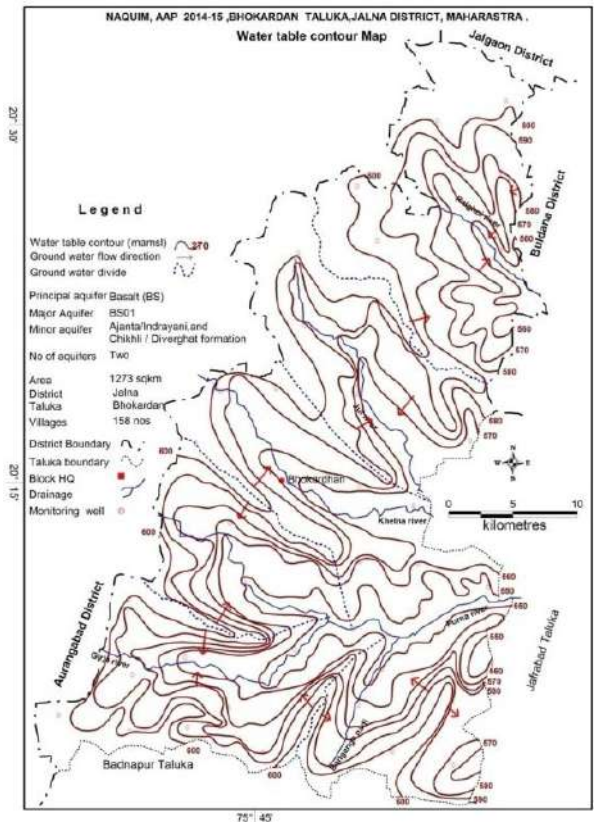



**Fig. 3.10 Ground water flow, Bhokardan Taluka, Jalna District**

## 3.4 Ground Water Quality

The suitability of ground water for drinking/irrigation/industrial purposes is determined keeping in view the effects of various chemical constituents present in water on the growth of human being, animals, various plants and also on industrial requirement. Though many ions are very essential for the growth of plants and human body but when present in excess, have an adverse effect on health and growth. For estimation of the quality of ground water, ground water samples from 40 KOW's (shallow dug wells representing phreatic aquifer) have been collected during pre-monsoon. Similarly for Aquifer – II, the ground water samples were collected during the drilling and pumping test activities of 12 exploratory constructed in Bhokardan. The ground water samples were analysed for major chemical constituents. The aquifer wise ranges of different chemical constituents present in ground water are given in **Table 3.2.**The details of water quality analysis of Aquifer I and II is given in **Annexure IV and IX** respectively.

**Table 3.2: Aquifer wise ranges of chemical constituents in Bhokardan**

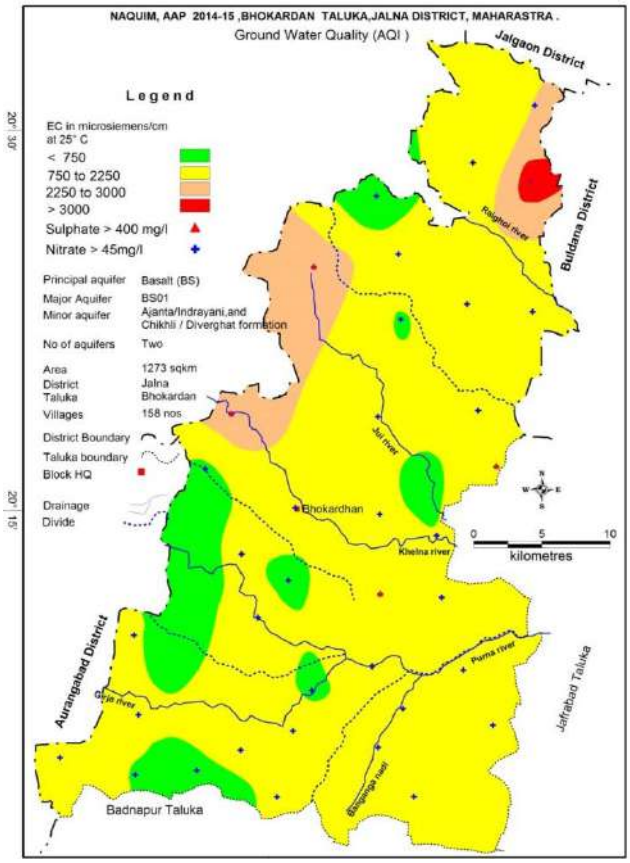
| Constituents | Shallow aquifer | | Deeper aquifer | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| pH | 7.6 | 8.8 | 7.1 | 8.3 |
| EC | 488 | 3134 | 373 | 2250 |
| TDS | 244 | 1567 | 214 | 1557 |
| TH | 180 | 1085 | 75 | 650 |
| Calcium | 34 | 244 | 24 | 132 |
| Magnesium | 17 | 149 | 2 | 8 |
| Potassium | 0.31 | 90.03 | 0.2 | 5 |
| Sodium | 19 | 408 | 8 | 483 |
| Carbonate | 0 | 9 | 0 | 9 |
| Bi-carbonate | 79 | 403 | 61 | 506 |
| Chloride | 53 | 560 | 32 | 603 |
| Sulphate | 20 | 606 | 35 | 439 |
| Nitrate | 10 | 60 | nd | 53 |
| Fluoride | 0.33 | 1.60 | 0.09 | 1.28 |

On perusal of above table, based on EC, out of 40 total samples of shallow aquifer, 82.50 % (33 samples) falls in excellent to Good category, where EC values in range between 0-1500, while only 3 samples (7.50 %) are falling permissible category, where EC values in range between 1500-2250 and only 10% (4 samples) falls in doubtful category, where EC is > 2250.

Out of 12exploratory wells drilled, a total of 12 samples of deeper aquifer were analysed,based on EC, out of 12 samples 83.33 % (10 samples) falls in excellent to Good category, where EC values in range between 0- 1500, while only 1 samples (8.33 %) are falling permissible category, where EC values in range between 1500-2250 and only 8.34% (1 samples) falls in doubtful category, where EC is > 2250.The iso-conductivity map of Aquifer I and II has been prepared and presented as **Fig 3.11** and **Fig 3.12**respectively.

On perusal of the **Fig 3.11** it is observed that the electrical conductivity for shallow aquifer in Bhokardan taluka is within Permissible Limit (750-2250 μMhos/cm @ 25°C) except few isolated patches, where Ec values are > 2250. Nitrate concentration of >45 mg/l is observed in almost all the KOW in Bhokardan taluka, where intense agricultutal activity is predominant. The high EC values are due to dumping of garbage and nearby accumulation cow dung.

Whereas, perusal of **Fig 3.12** for Aquifer-II shows that, the quality of water is good for both Drinking and agricultural activity.



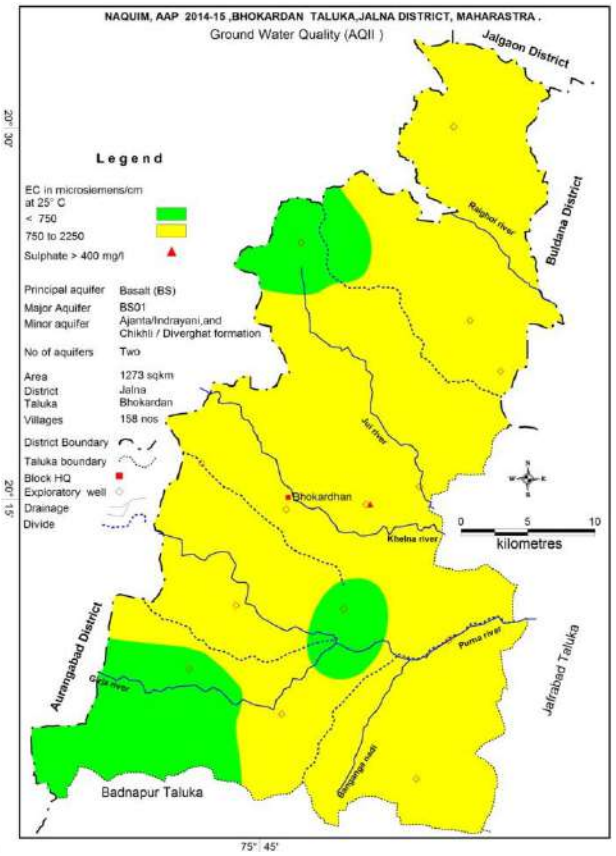




**Fig. 3.11: Aquifer-I, Iso conductivity, Bhokardan Taluka, Jalna District** **Fig. 3.12: Aquifer-II, Iso conductivity, Bhokardan Taluka, Jalna District**

## 3.5 3-D and 2-D Aquifer Disposition

The data generated from ground water monitoring wells, micro level hydrogeological inventories, exploratory and observation wells, various thematic layers was utilized to decipher the aquifer disposition of the area. This particularly includes the information on geometry of aquifers and hydrogeological information of these aquifers.The main type of formations observed in the area is Basalt. The aquifer units in each of the formation are listed below:

**Basalt–**

Aquifer - I upto 30m

Aquifer -II 30 to 145 m

The fence diagram indicating the disposition of various aquifers is presented in **Fig.3.13**.

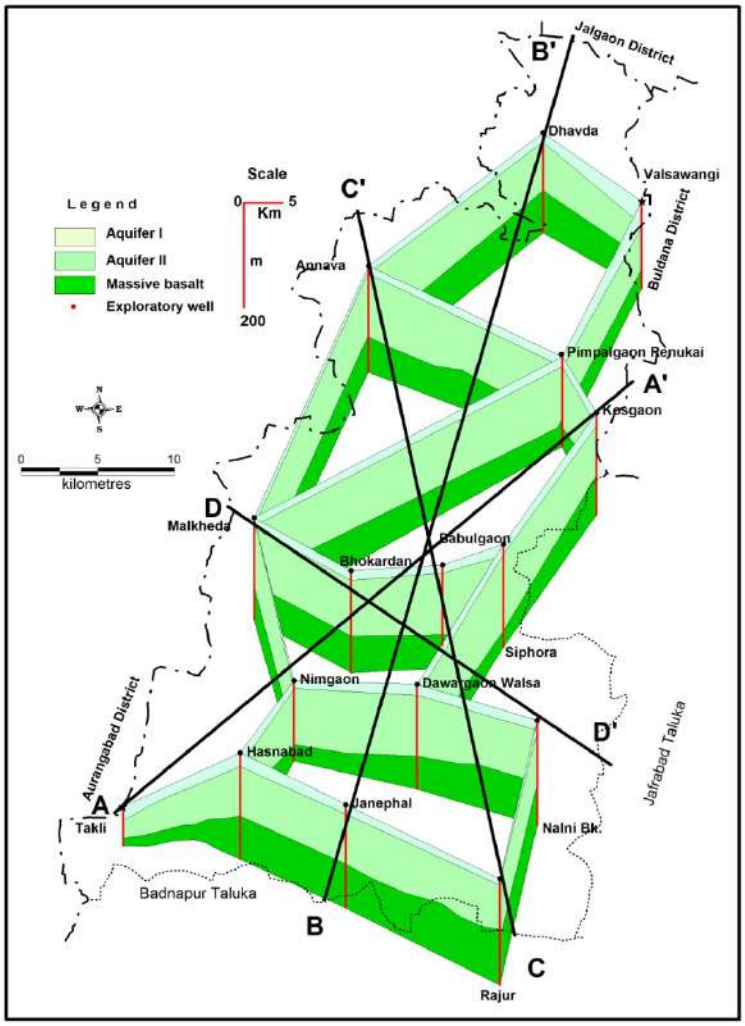
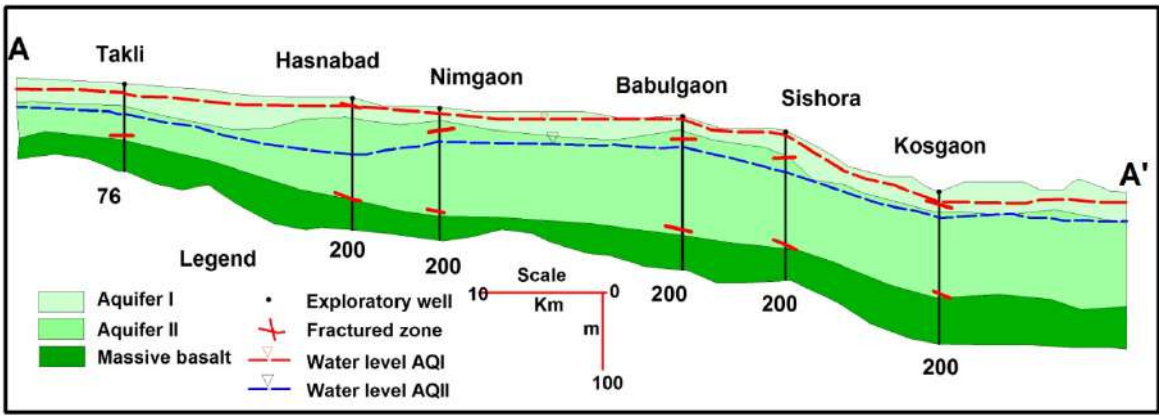
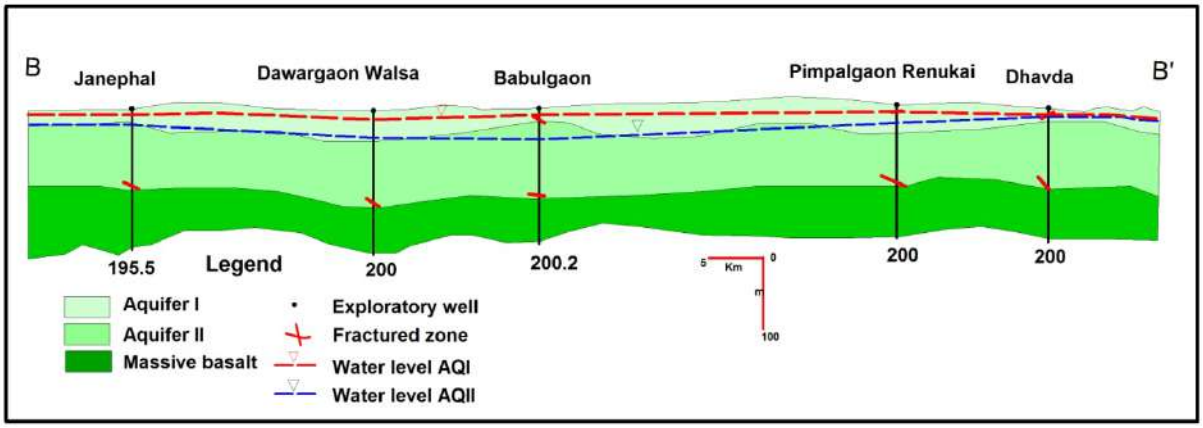



**Fig. 3.13: 3-D Fence diagram, Bhokardan taluka.**

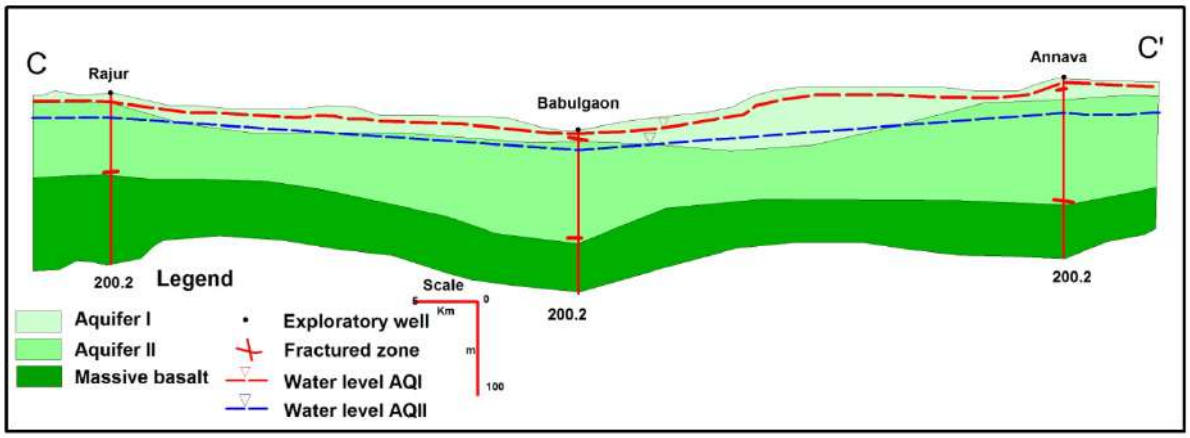
**Section A-A'**



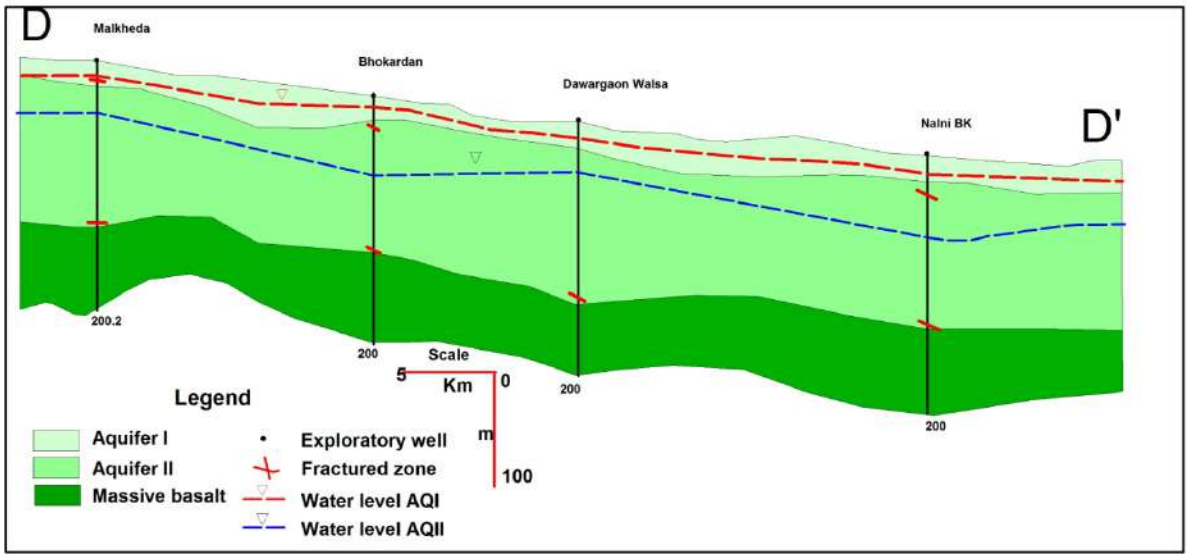
**Section B-B’**




**Section C-C**




**Section D-D’**

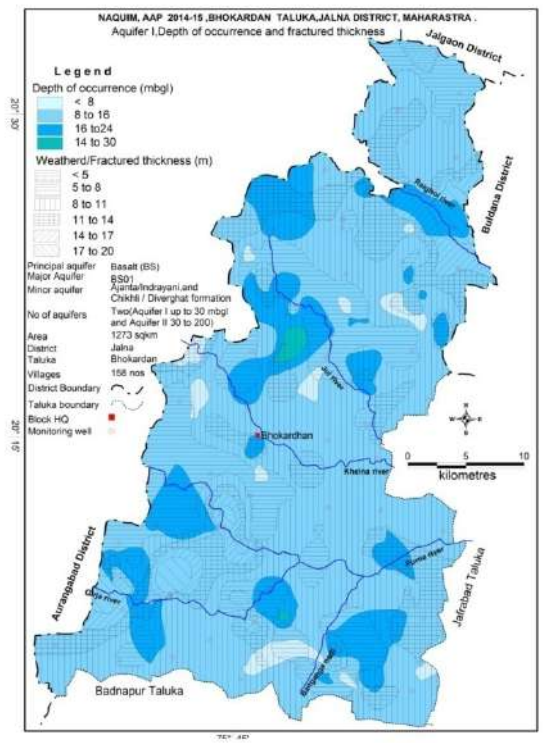


### 3.5.1 2D Aquifer Disposition

Basalt is the main rock type of the area and comprises two distinct units viz, upper vesicular unit and lower massive unit. The massive basalt is hard, compact and does not have primary porosity and hence impermeable. Weathering, jointing and fracturing induces secondary porosity in massive unit of basalt. In vesicular basalt, when vesicles are interconnected constitutes good primary porosity and when the vesicles are filled/ partly filled the porosity is limited. Ground water occurs under phreatic/ unconfined to semi-confined conditions in basalts. A total of 8 lava flows were demarcated based on GSI maps and ground water exploration.

Based on extensive analysis of historical data, micro level hydrogeological survey data generated and ground water exploration carried out, the following two types of aquifers can be demarcated and the details are given below:

**Aquifer I -** Unconfined aquifer, occursin Deccan trap basalt which is exposed in major parts of the taluka. This aquifer generally occursin the depth of 10 to 35m bgl in basalts.Based on field observations, map of Aquifer–I is generated and shown in **Fig 3.14.**



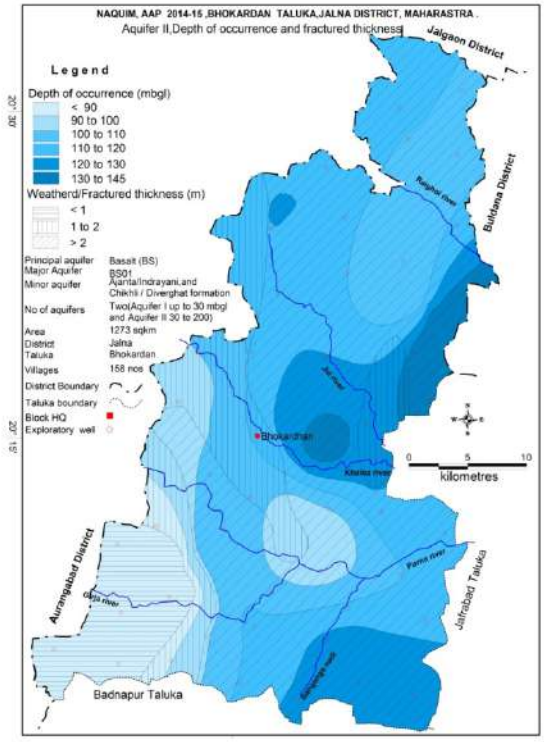




**Fig. 3.14: Depth of occurance and fractured rock thickness of Aquifer-I Fig. 3.15: Depth of occurance and fractured rock thickness of Aquifer-II**

**Aquifer II** – Semi-confined to confined aquifer. Generally occurs in Deccan trap basalt which is exposed in major parts.This aquifer generally occurs to the depth <200 mbgl.Based on Ground Water Exploration, map of Aquifer –IIshowing isopach as well as depicting Depth of occurrence and fracture thicknessis generated and shown in **Fig 3.15**. A perusal of Fig. 7.3 shows that the depth of occurance of fractures is limited upto 140 mbgl with a thickness of fractures range between 0.5 to 4 m.

### 3.5.2 Aquifer Group Thickness & Demarcation

**Aquifer-I**in the area predominantly consists of weathered fractured and jointed basalt and exposed almost covering entire area. The data collected during detailed well inventory have been used to understand the thickness of Aquifer-I i.e., unconfined shallow basaltic aquifer ranges from 0.5 to 4 m. Similarly, using the historical data of CGWB on ground water exploration and data generated during drilling and construction of exploratory wells in Bhokardhan area, an attempt has been made to decipher the deeper aquifer disposition. Ground water is present in pore spaces in the vesicular unit of each flow and in the jointed and fractured portions of massive unit. However, secondary porosity and permeability that has been developed dueof weathering and fracturing play a very important role in the storage and movement of ground water. Weathering not only produces granular materials but also widens the fractures, joint and shear zones and constitute ground water potential aquifers in the area.

**Aquifer-II** has been observed between the depth range of 35 m to 145 m bgl. Except the eastern and south western part where the fractured rock thickness of >1 m, rest of the area is having fractured rock thickness range between 2 - 3 m.

Based on above observations of Aquifer I and II, the aquifer group thickness map has been generated and shown in **Fig. 3.16.**

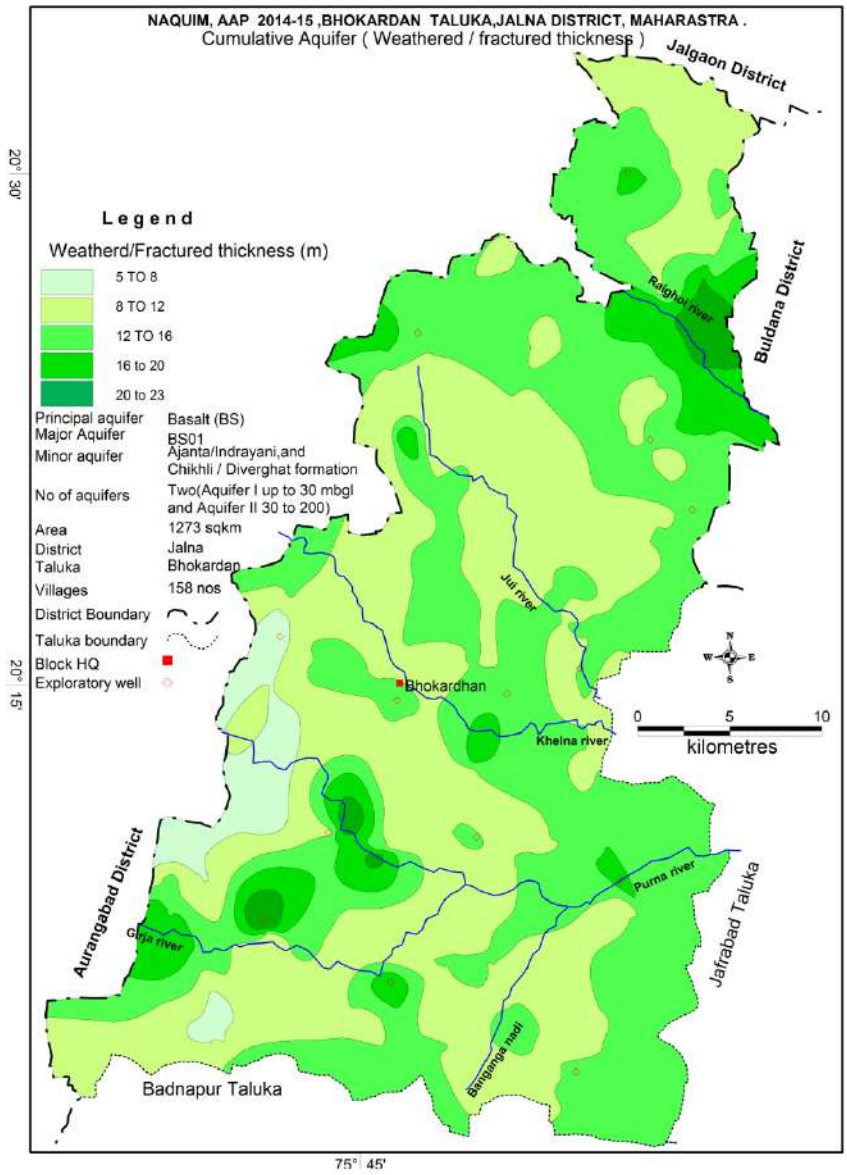



**Fig. 3.16: Aquifer group thickness (Thickness of granular/Fracture zones),Bhokardan Taluka, Jalna District**

### 3.5.3 Aquifer Parameters and Yield Potentials

The principle of pumping test is that if we pump water from an Exploratory well and measure the discharge and drawdown both in EW and OW, which is at a known distance, we can substitute these measurements to compute different aquifer prameters such as Transmissivity (T) Storativity (S) and yield potentials.

**Transmissivity (T):** It is defined as rate of flow under a unit hydraulic gradient through a cross-section of unit width over the saturated thickness of aquifer. It is expressed as $m^2$/day. The T value in Bhokardan Taluka range between0.41 to 100 $m^2$/day.

**Storativity (S):** It is the volume of water released from storage per unit surface area of the aquifer per unit decline in the hydraulic head normal to that surface. It is dimensionless property. The S value in Bhokardan Taluka range between 2.4 X $10^{-3}$ to 1.25 X $10^{-4}$

**Yield potential (Q):** A major part of the area is underlain by the Deccan Trap Basalt. The northern part of Bhokardan taluka, is primarily hilly and therefore has a poor ground water potential.Except in central and southern part along the rivers and valleys where the yield of wells is >50LPM, rest of the area is having low potential and wells may yield upto <50 LPM. The ground water in these areas can be developed through dugwells.

Deeper aquifer is limited and wherever aquifer exists, its sustainability is low.The central, western and notheastern part along the major rivers, the yield of borewells would be >60LPM. The yield potential map of Aquifer-I and Aquifer-II is shown in **Fig 3.17** and **3.18** respevtively.

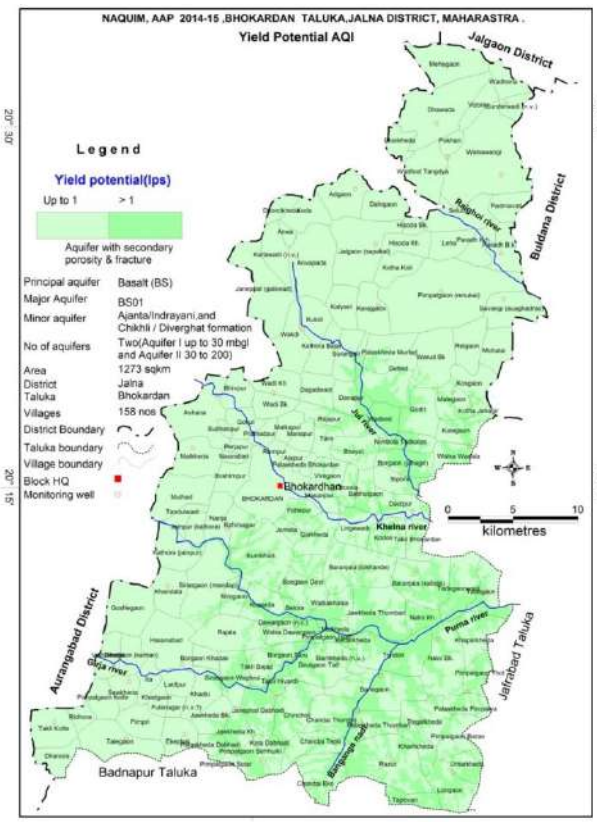



Fig. 3.17: Aquifer-I, Yield potential Map

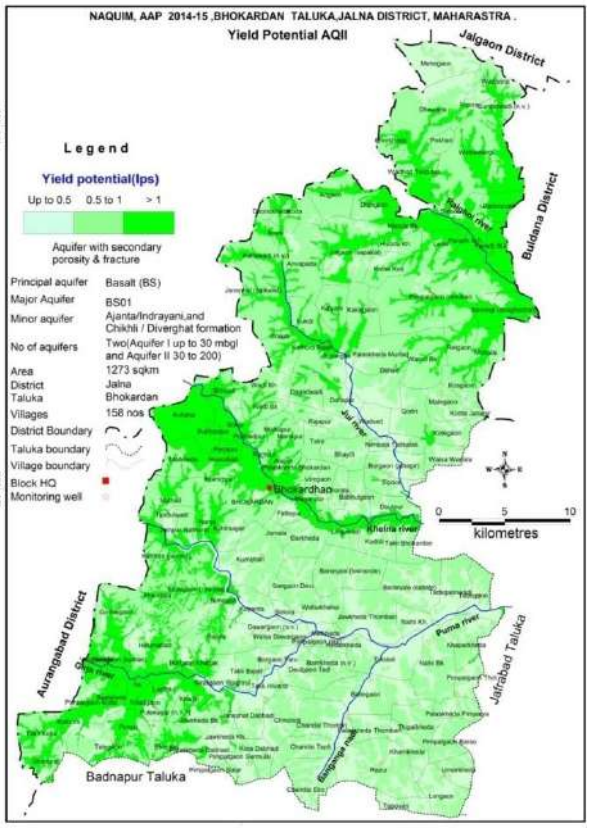



Fig. 3.18: Aquifer-II, Yield potential Map

### 3.5.4 3D Aquifer Disposition

The 3-D disposition of Basalt aquifer is shown in **Fig. 3.19.** The Aquifer-I is observed in the depth range of 10 to 30 m bgl with water levels of 1.25 to 19.00 m bgl and thickness of 5 to 20 m. The yield of the dugwells tapping this aquifer generally ranges 10 to 50 $m^3$/day. The Aquifer –II is observed in the depth range of 30to 145 m bgl with water levels of 11.4 to > 50 m bgl and thickness of 0.50 to 3 m. The yield of the borewells tapping this aquifer generally ranges upto 1lps.

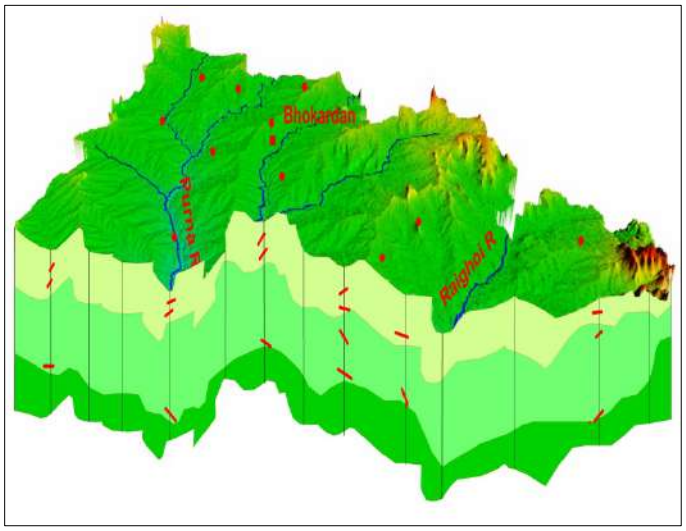



**Fig. 3.19:Schematic3-D Aquifer Disposition, Bhokardan taluka, Jalna district**

Based on filed survey and ground water exploration, the aquifer characteristic of Bhokardan takuka is given in **Table 3.3.**

**Table 3.3 Aquifer Characteristic of Bhokardan Taluka, Jalna District**

| Type of Aquifer | Formation | Depth range (mbgl) | SWL (mbgl) | Fractures / weathered Zones encountered (m bgl) | Fractures / weathered rocks Thickness (m) | Yield | Sp. Capacity | Aquifer parameter (Transmissivity – $m^2$/day) | Sy/S | Suitability for drinking/ irrigation |
|---|---|---|---|---|---|---|---|---|---|---|
| Aquifer -I | Deccan Trap- Weathered / Fractured Basalt | 10-30 | 1.25-19.00 | 5-30 | 5 to 20 | 10 to 50 $m^3$/day | 90 to 270 lpm/m | - | 0.02 | Yes for both (except Nitrate affected villages for drinking) |
| Aquifer -II | Jointed/ Fractured Basalt | 30-145 | 11.4-90 | 35 to 145 | 0.5 to 3 | 10-100 LPM | 0.5 to 2 hours | 5-30 | 0.0024 to 1.25 $x10^{-4}$ | Yes for both |

# 4.0 Ground Water Resources

The ground water resources have been assessed for two types of aquifer existing in the area i.e., Aquifer-I, Aquifer-II. The details of the assessment are discussed below.

## 4.1 Ground Water Resources – Aquifer-I

The ground water resource assessment has been carried out and the salient features of the resources are given in **Table 4.1, 4.2 and 4.3** and the map depicting the taluka wise distribution of ground water resources and categorisation of the talukas is presented in **Fig 4.1**.

As per **Table-4.1**, out of the total 127300 ha area, recharge worthy areas are 4155.00 ha in command areas and 123161.26 ha in non-command areas.

**Table-4.1: Ground Water Recharge Worthy Areas for Resource Estimation**

| Taluka | Predominant Formation | Total Geographical Area (ha) | Hilly Area (ha) | Ground Water Recharge Worthy Area | |
|---|---|---|---|---|---|
| | | | | Command area (ha) | Non-command area (ha) |
| Bhokardan | Basalt | 127300 | 00 | 4155 | 123161.26 |
| **Total** | **Basalt** | **127300** | **00** | **4155** | **123161.26** |

### Recharge Component

During the monsoon season, the rainfall recharge is the main recharge parameter, which is estimated as the sum total of the change in storage and gross draft. The change in storage is computed by multiplying groundwater level fluctuation between pre and post monsoon periods with the area of assessment and specific yield. Monsoon recharge can be expressed as:-

$R = h \times Sy \times A + DG$

where,

h = rise in water level in the monsoon season, Sy = specific yield

A = area for computation of recharge, DG = gross ground water draft

The monsoon ground water recharge has two components- rainfall recharge and recharge from other sources. The other sources of groundwater recharge during monsoon season include seepage from canals, surface water irrigation, tanks and ponds, ground water irrigation, and water conservation structures.

During the non-monsoon season, rainfall recharge is computed by using Rainfall Infiltration Factor (RIF) method. Recharge from other sources is then added to get total non-monsoonrecharge.

The season wise and taluka wise assessment of recharge from various components such as rainfall and other sources for various units was done and presented in **Table-4.2** and **Fig.4.1**. The recharge from rainfall contributes maximum component (10483.94 ham) during monsoon season and recharge from other sources during monsoon (634.94ham).The total annual ground water recharge is 13882.07 ham and net ground water availability after natural discharge is 13177.83ham.

**Table-4.2: Recharge Components evaluated for Resource Estimation**

| Administrative Unit | Command / Non-Command / Total | Recharge from rainfall during monsoon season (ham) | Recharge from other sources during monsoon season (ham) | Recharge from rainfall during non-monsoon season (ham) | Recharge from other sources during non-monsoon season (ham) | Total Annual Ground Water Recharge (ham) | Provision for Natural Discharges (ham) | Net Annual Ground Water Availability (ham) |
|---|---|---|---|---|---|---|---|---|
| Bhokardan | Command | 344.83 | 50.41 | 0.00 | 252.50 | 647.75 | 32.39 | 615.36 |
| Bhokardan | Non Command | 10139.11 | 584.53 | 31.02 | 2479.67 | 13234.32 | 671.85 | 12562.47 |
| **Bhokardan** | **Total** | **10483.94** | **634.94** | **31.02** | **2732.17** | **13882.07** | **704.23** | **13177.83** |

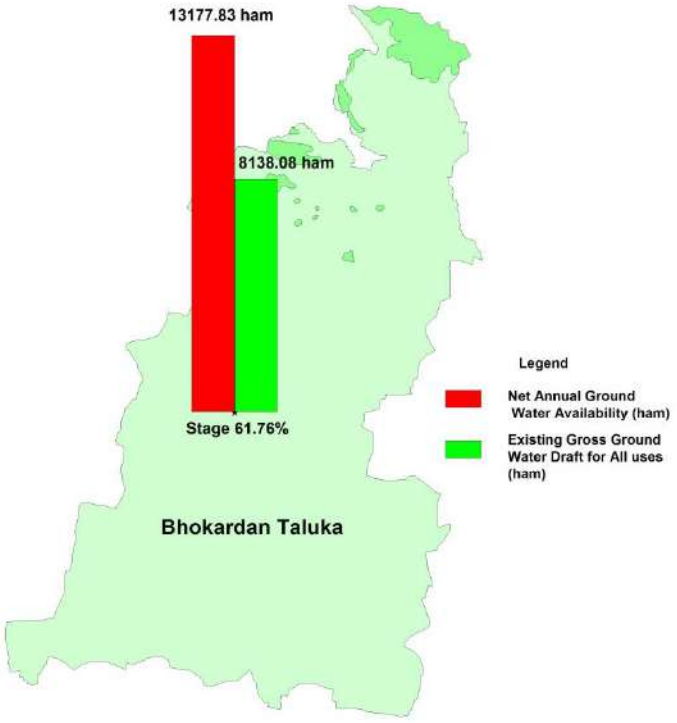



**Fig.4.1: Ground water resources and categorization**

Perusal of **Table 4.3** shows the net annual ground water availability comes to be 13177.83ham. The annual gross draft for all uses is estimated at 8138.08ham with irrigation sector being the major consumer having a draft of 7871.08ham. The annual draft for domestic and industrial uses was 267ham. The allocation for domestic & industrial requirement supply up to next 25 years is about 537.78ham.

The perusal of table indicates that the talukais categorised as **Safe**having stage of development is 61.76%.

**Table- 4.3: Ground Water Resources Availability, Draft and Stage of GW Development**

| Taluka | Command/ Non-command | 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 |
|---|---|---|---|---|---|---|---|---|
| Bhokardan | Command | 615.36 | 297.34 | 21.12 | 318.45 | | | |
| | Non Command | 12562.47 | 7573.74 | 245.88 | 7819.62 | | | |
| | **Total** | **13177.83** | **7871.08** | **267.00** | **8138.08** | **537.78** | **4808.00** | **61.76/Safe** |

## 4.2 Ground Water Resources – Aquifer-II

The ground water resource of the aquifer –II was also estimated to have the corret quantification of resources so that proper management strategy can be framed. To assess these resources, the area was divided into polygons based on water level and the thickness of aquifer –II in that particular polygon (if present), then the storativity value for the nearest exploratory well was taken into consideration. By applying the formula of deeper ground water resource estimation as given by CHQ during the static ground water resources was utilised i.e.,

GWR = Area x Thickness of aquifer x Storativity

By applying above formula, the ground water resources of aquifer-II were estimated and are presented below in **Table- 4.4.** Thus the total resources of aquifer-II have been estimated as **7.71MCM**.

**Table- 4.4: Ground Water Resources of Aquifer-II.**

| SN | Mean fractured rock thickness(m) | Area (sqkm) | Storativity | GW resource of AQII (mcm) |
|---|---|---|---|---|
| 1 | 0.75 | 112.123 | 0.0024 | 0.2018 |
| 2 | 2 | 98.8017 | 0.0024 | 0.4742 |
| 3 | 1.5 | 55.3796 | 0.0024 | 0.1994 |
| 4 | 2 | 35.7466 | 0.0024 | 0.1716 |
| 5 | 1.5 | 30.3539 | 0.0024 | 0.1093 |
| 6 | 1.5 | 62.00291 | 0.0024 | 0.2232 |
| 7 | 3 | 878.9 | 0.0024 | 6.3281 |
| | **Total** | | | **7.71** |

# 5 GROUND WATER RELATED ISSUES

The study area forms part of Godavari Basin. Ground water draft during the period from 2008 to 2011 has been increased, but from 2011 to 2013, it is showing decrease in ground water draft due to chage in irrigation practices and very limited agricultural activities in postmonsoon. Long term water level trend has shown declining water level trend. The major issues afflicting the areas are discussed below.

## 5.1 Declining Water Level Trends

The ground water exploitation has resulted also resulted in declining of water levels over the period of time.At present, the premonsoon declining water level trend of more than 0.20 m/year has been observed in about 182.29 sq.km whereas, postmonsoon declining water level trend of more than 0.20 m/year has been observed in about 493.10 sq.kmarea during 2006-15. (**see Fig.3.8 and 3.9**).

## 5.2 Water Scarcity (Drought Prone Taluka)

Bhokardan taluka comes under drought prone area with acute shortage of both drinking and agricultural purposes. Most of the villages are tanker fed right from December onwards. Only 193 sq. km area is covered by double crop area in southern part of the taluka all along catchment of Purna sub-basin.

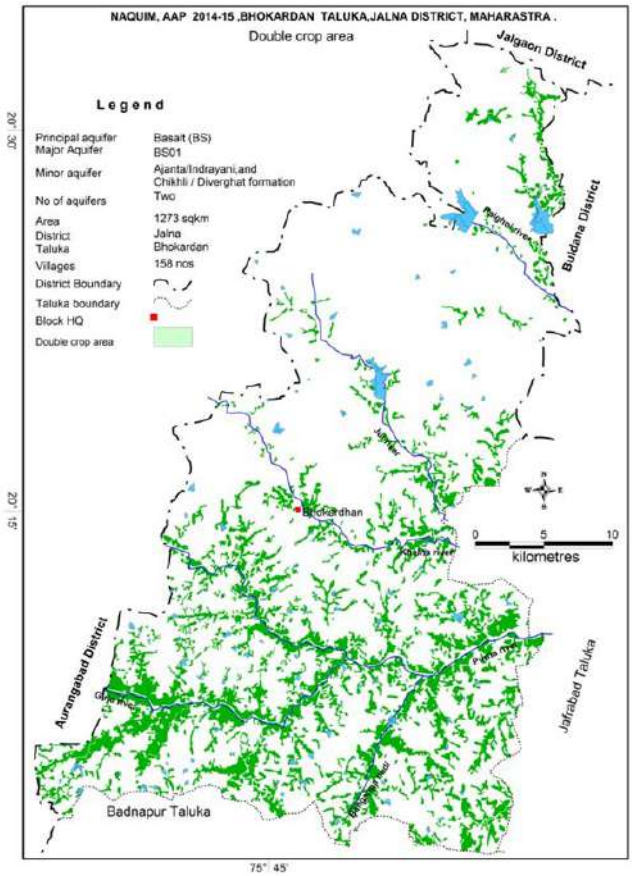



**Fig.5.1: Double crop area (193 sq. km.)**

# 6 MANAGEMENT STRATEGY

A through study was carried out based on data gap analysis, data generated in-house, data acquired from State Govt. departments and maps procurred from MRSAC & GSI, an integrated approach was adopted while preparing aquifer management plan of Bhokardan Taluka of Jalna district which is categorised as Safe. Based on geomorphology, soil, land use, field data and lithological details, following management plan is carried out and the detailed aquifer management plan for Bhokardan Taluka ofJalna district is prepared and presented in **Table 6.1** . The present ground water resources and draft scenario of Bhokardan taluka is shown in **Fig. 6.1.**

## 6.1 Aquifer Mamnegemnt Plan for Bhokardan Taluka

The geographical area of Bhokrdan Taluka is 1273 sq. km., the stage of ground water development is **61.76 %**and categorised as Safe. The annual ground water resource available is 131.77 MCM and the gross ground water draft for all uses is 81.38 MCM. The major issues identified in Bhokardan Taluka are declining water levels, limited aquifer potential and water scarcity (drought prone area), tanker fed.

*To manage the resources, demand for agricultural and domestic requirement has been brought out with respect to Supply.*

The Agricultural **demand** in rainfed area is worked out as 109.80 MCM. The agricultural demand from ground water and surface water is 78.71 and 31.09 MCM respectively. Whereas, the domestic demand for Ground water and surface water is 2.00 and 0.67 MCM.

The Agricultural **supply** in rainfed area is 109.80 MCM due to monsoon. The agricultural supply from ground water and surface water is 78.71 and 31.09 MCM respectively. Whereas, the domestic supply for Ground water and surface water is 2.00 and 0.67 MCM.The present Demand –Supply gap is NIL.The management plan to generate additional resources is shown in **Fig 6.2.**

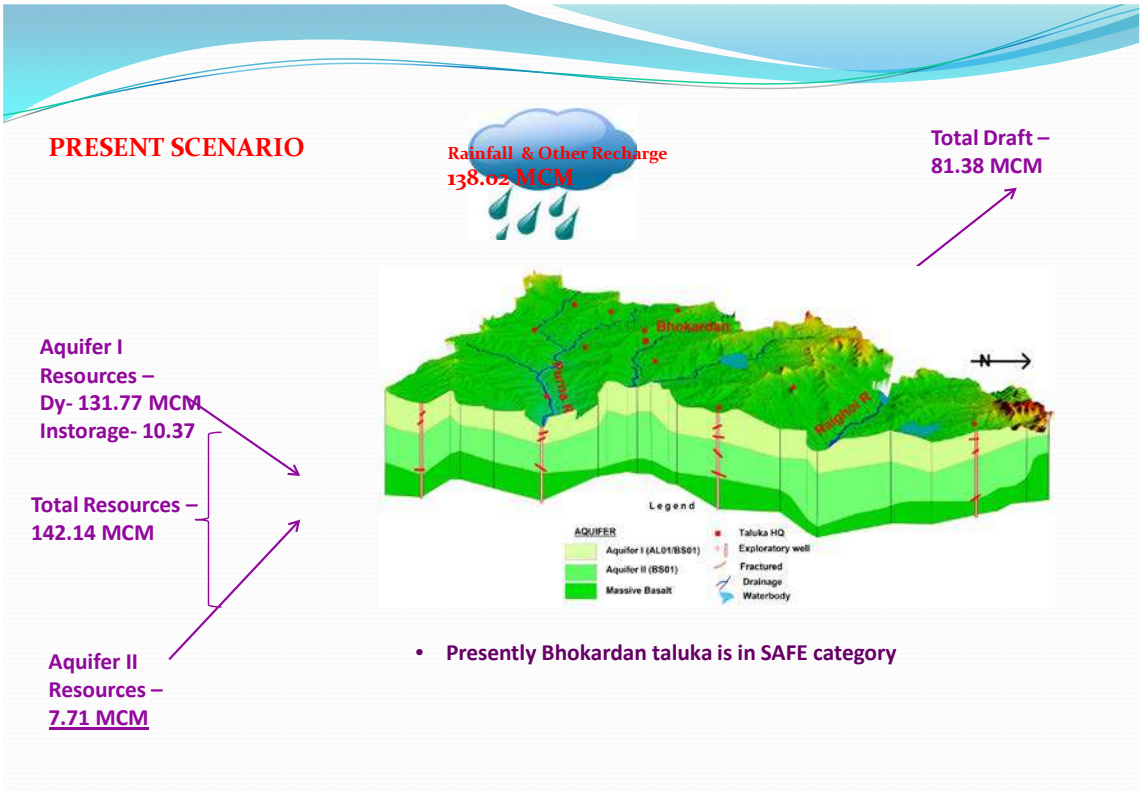



**Fig 6.1 Present ground water resources and draft scenario in Bhokardan Taluka.**

**Supply side interventions** proposed to bring stage of ground water development upto 70% through Rainwater harvesting and artificial recharge. The volume of unsaturated granular zone available in Bhokardan taluka is worked out as 1300.98 MCM. The recharge potential available in the area is 26.02 MCM. The surface surplus runoff availability is 14.54 MCM. Therefore, the surface runoff of 14.54 MCM is considered. For this, a total of 51 percolation tank and 145 Check dams are required as recharge measures. The volume of water expected to be conserved/recharged @75% efficiency is 7.65 MCM through Percolation tank and 3.26 MCM through Check dams.The cost estimate for 51 percolation tank and 145 check dams are Rs. 76.50 and Rs.43.50 corers respectively.The location of artificial recharge structures proposed are given in **Annexure X** and **XI** and shown in**Fig 6.3.** The additional area of 40.67 sq. km. proposed under assured Ground water irrigation is shown in **Fig 6.4.**

The rainwater harvesting in urban areas can be adopted in 25% of the household with 50 Sq. m roof area.A total of 1.30 MCM potential can be generated by taking 80% runoff coefficient.The estimated cost for rainwater harvesting through roof top is calculated as

Rs.94.56 corers. Hence this technique is not economically viable and therefore it is not recommended.

Overall total volume of water expected to be recharged or conserved by artificial recharge is 10.91 MCM with a cost estimate of Rs. 120 corers, excluding Roof top rain water harvesting which is not economically viable. The aquifer management plan for Bhokardan taluka is given in **Table 1.12**

**No Demand side intervention is proposed.**

**Table 6.1: AQUIFER MANAGEMENT PLAN OF BHOKARDAN TALUKA, JALNA DISTRICT**

| | | |
|---|---|---|
| Block | Bhokardan | |
| District | Jalna | |
| State | Maharashtra | |
| Area | 1273 | |
| Major issues identified | declining wl<br>limited aquifer potential<br>water scarcity - lean period | |
| Stage of gw development | 61.76% | |
| Annual available resource (mcm) | 131.78 | |
| Gross annual draft (mcm) | 81.38 | |
| Domestic rquirement (mcm) | 2.67 | |
| **Demand (mcm)** | | |
| Agricultural demand -gw | 78.71 | |
| Agricultural demand -sw | 31.09 | |
| Domestic demand - gw | 2.00 | |
| Domestic demand - sw | 0.67 | |
| Total demand(mcm) | 112.47 | |
| **Supply (mcm)** | | |
| Agricultural supply -gw | 78.71 | |
| Agricultural supply -sw | 31.09 | |
| Domestic supply - gw | 2.00 | |
| Domestic supply - sw | 0.67 | |
| Total supply(mcm) | 112.47 | |
| **Demand - supply gap (mcm)** | 0.00 | |
| **Present demand - supply gap (mcm)** | 0.00 | |
| Ground Water Resourvces available to bring stage of development upto 70% after | 15.52 | |

| | | |
|---|---|---|
| development | | |
| **Interventions proposed to deal with development** | | |
| **Ground water development** | | |
| **Ground water development plan** | | |
| Proposed structures | Dug well(@ rs.2.50 lakh, av. Unite draft 1.57 ham | |
| First two year-4.70 mcm resources available (up to 40 % stage of gw development ) | 300 | |
| Estimated expenditure (rs. In cr.) | 7.5000 | |
| Next two year-5.49 mcm resources available (up to 50% stage of gw development ) | 350 | |
| Estimated expenditure (rs. In cr.) | 8.7500 | |
| Next two year-5.33 mcm resources available (up to 50% stage of gw development ) | 340 | |
| Estimated expenditure (rs. In cr.) | 8.5000 | |
| Total gw abstraction structures | 990 | |
| Grand total estimated expenditure (rs. In cr.) | 24.7500 | |
| **TOTAL RESOURCES AVAILABLE AFTER DEVELOPMENT (MCM)** | 15.52 | |
| **Supply side interventions** | | |
| Rainwater harvesting and artificial recharge | | |
| Volume of unsaturated granular zone (mcm) | 1300.98 | |
| Recharge potential (mcm) | 26.02 | |
| Surface water requirement @ 75% efficiency (mcm) | 34.61 | |
| Availability of surplus surface runoff (mcm) | 14.54 | |

| | | |
|---|---|---|
| Surplus runoff considered for planning (mcm) | 14.54 | |
| Proposed structures | Percolation tank (@ rs.150 lakh, av. Gross capacity-100 tcm*2 fillings = 200 tcm) | Check dam (@ rs.30 lakh, av. Gross capacity-10 tcm * 3 fillings = 30 tcm) |
| Number of strcutures | 51 | 145 |
| Volume of water expected to be conserved / recharged @ 75% effeciency (mcm) | 7.65 | 3.26 |
| Estimated expenditure (rs. In cr.) | 76.50 | 43.50 |
| Rtrwh - urban areas | | |
| Households to be covered (25% with 50 m2 considering roof top area) | 63040 | |
| Total rwh potential (mcm) | 1.63 | |
| Rainwater harvested / recharged @ 80% runoff co-efficient | 1.30 | |
| Estimated expenditure (rs. In cr.) @ rs. 15000/- per hh | 94.56 | Economically not viable & not recommended |
| Total volume of water expected to be recharged/conserved by ar | 10.91 | |
| Total estimated expn. For ar | 120.00 | |
| Demand side interventions | | |
| Proposed cropping pattern change | None | |
| Area proposed to be covered (sq.km.)<br>40% of sugarcane area | - | |
| Volume of water expected to be conserved (mcm). Sugarcane requirement - 2.45 m, pomegranate with drip - 0.7 m, wue - 1.75 m | - | |
| Estimated expenditure | - | |

| | | |
|---|---|---|
| Micro irrigation techniques | | |
| 50% of double crop area (124.22) proposed to be covered under drip (sq.km.) | | |
| Volume of water expected to be saved (mcm). Surface flooding req- 0.90 m. Drip req. - 0.50, wue- 0.4 m | 0.00 | |
| Estimated expenditure (rs. In cr.) @ rs. 25,000/- per acre | 0.00 | |
| Alternate sources | | |
| Alternative ground water sources | Nil | Nil |
| Location and other details of the sources | Nil | Nil |
| Volume of water expected to be served from these sources | Nil | Nil |
| Alternative surface water sources | | |
| gw resources available after implementing above measures and respources available to bring development upto 70% | 26.44 | |
| Additional area (sq.km.) Proposed to be brought under assured gw irrigation with av. Cwr of 0.65 m or | 40.67 | |
| Rise in wl (m/yr) | | |
| Regulatory measures | Regulation of wells below 80 m | |

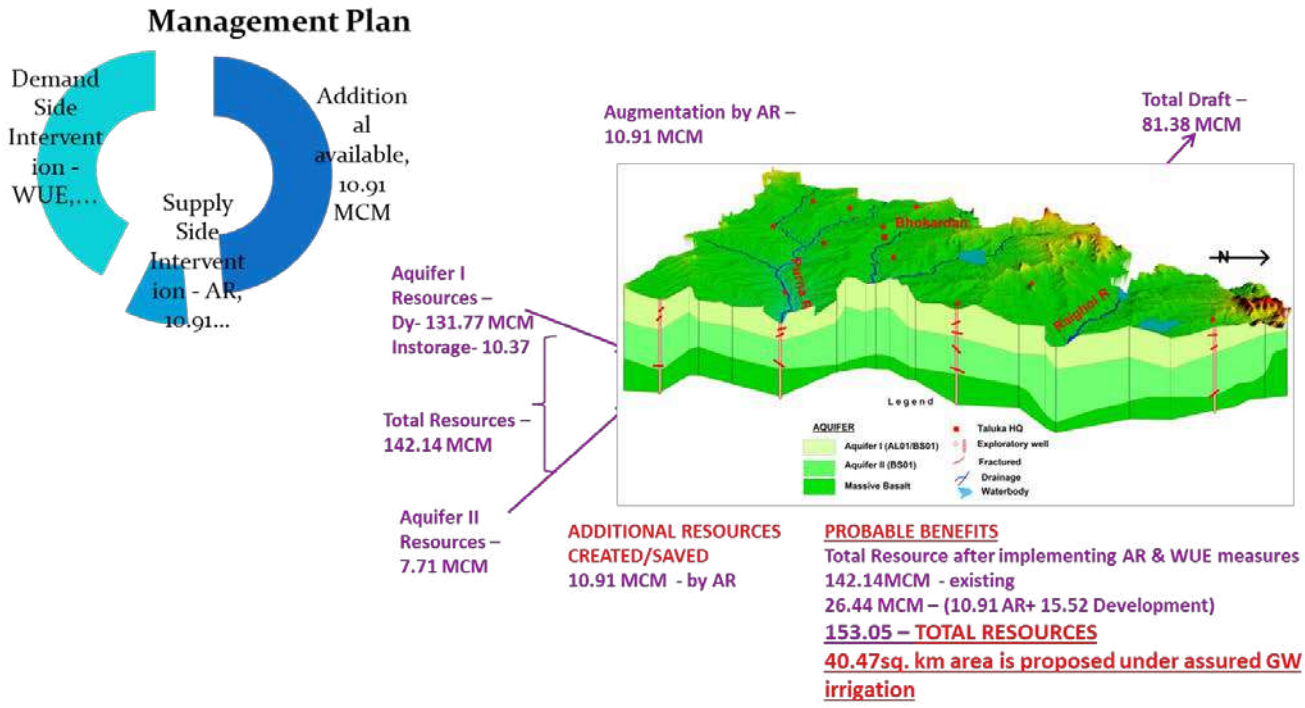



**Fig 6.2 Aquifer Management Plan to generate additional Resource in Bhokardan Taluka.**

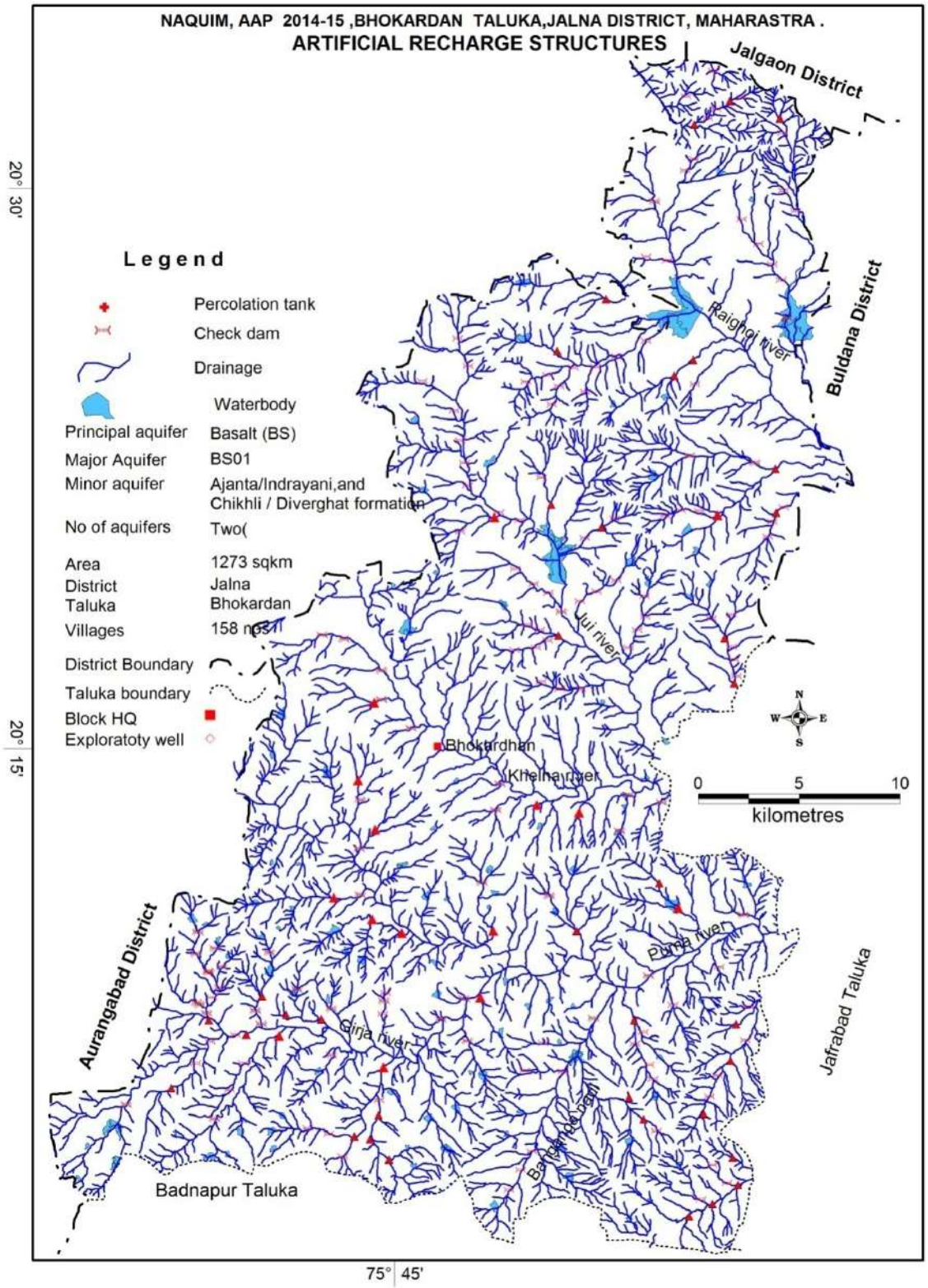



**Fig 6.3 Supply side intervention for proposed Artificial Recharge structures in Bhokardan Taluka.**

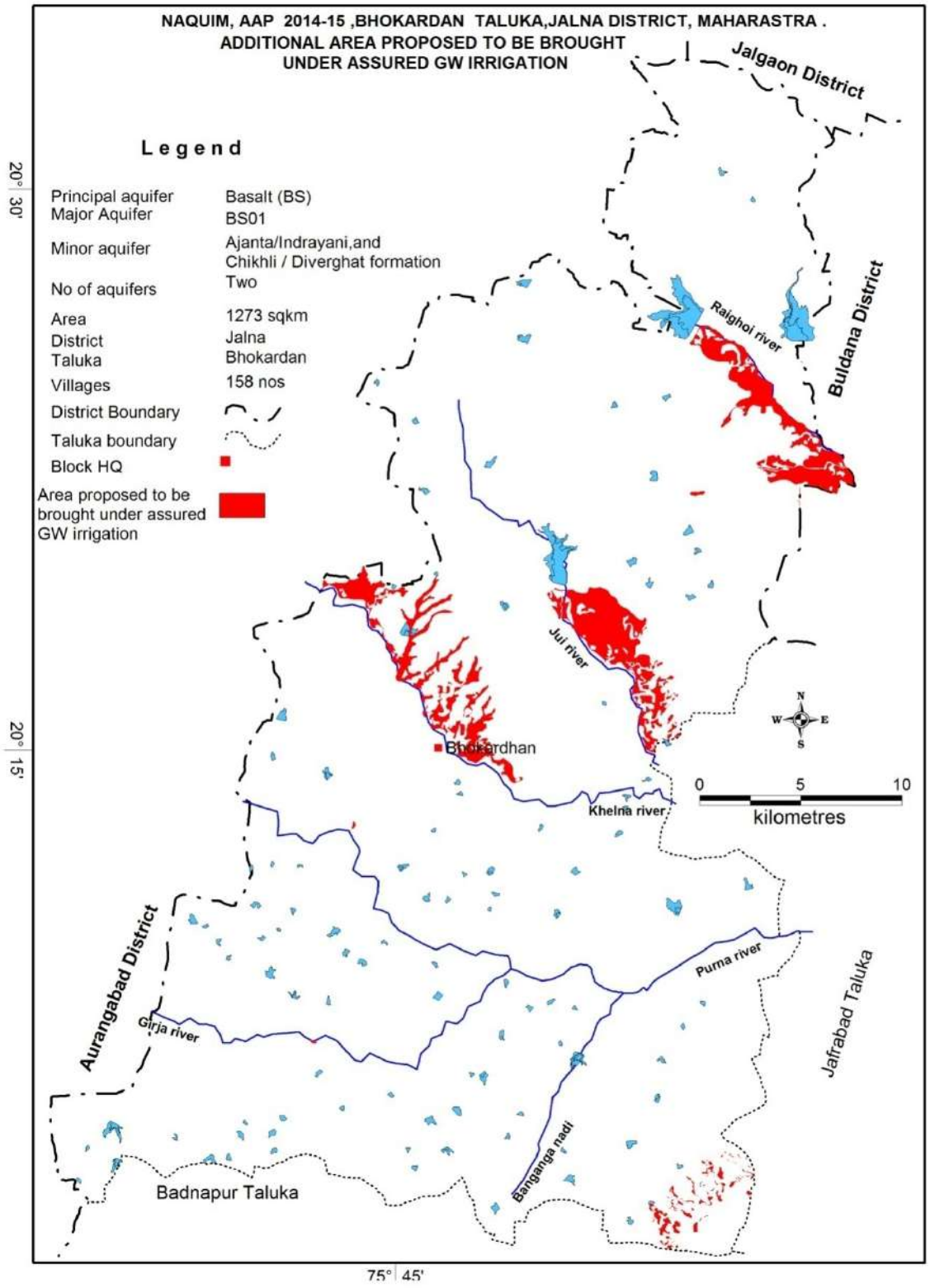



**Fig 6.4 Location of Proposed additional area of 40.67 sq.km under assured GW irrgation in Bhokardan Taluka.**

# 7. SUM UP & RECOMMENDATIONS

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

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

The study area is spanning over 1273 sq.km. Geologically the area is occupied by Basalt . The stage of ground water development is 61.76%. The area has witnessed ground water depletion and water scarcity in Lean period (Tanker fed). As per rainfall analysis, the area comes under drought prone affected. The declining water level trend of more than 0.20 m/yr has been observed in 493.10 sq.km. during post-monsoon. The area receives less rainfall and are completely dependent on ground water irrigation. The increasing allurement towards cash crops and decreasing availability of water have compelled the farmers to shift from traditional irrigation methods to micro irrigation techniques like drip irrigation. At present the area under double crop is 193 sq. km. and irrigated through ground water.

Ground water management plan has been prepared with the objective to arrest the declining trend and to reduce the water scarcity period by applying supply side interventions. The supply side interventions are proposed to construct 51 Percolation tank and 145 check dam with a cost estimate of 120 cr. This will generate additional 10.91 MCM water resources. Presently the taluka is having stage of development is 61.76%. The ground water resources available to bring stage of development upto 70% after development is 15.52 MCM. The total resources available is 26.43 MCM. This will bring an area of 40.67 sq.km. under assured ground water irrigation.

Thus the focus of proposed management plan was to use ground water very effectively with supply and demand side interventions. The perusal of above ground water management plan lays stress on adopting micro-irrigation techniques and artificial recharge measures.

However, considering the low storage potential of hard rock aquifer in the area this ground water development should also be coupled with ground water augmentation plan, so that there is no stress on ground water regime of the area.

Root top Rain water harvesting is not recommended, as the volume of water harvested would be 1.30 MCM with an estimate cost of Rs. 94.56 corers. As , it is not economically viable and hence not recommended.

No demand side interventions are proposed.

## 7.1 Tangible and Non Tangible Benefits

The timely and proper implementation of the above suggested management plan will have many tangible and non-tangible benefits for Bhokardan taluka. Some of the major benefits are listed below.

The proposed construction of the artificial recharge structures viz., 51 percolation tanks and 145 check dams at the estimated cost of Rs. 120 crores to augment the ground water resources to the tune of 10.91 MCM and the ground water resources available to bring stage of development upto 70% after development is 15.52 MCM. The total resource available is 26.43 MCM. This will bring an area of 40.67 sq.km. under assured ground water irrigation considering an average crop water requirement of 0.65 m.

The implementation of above water conservation, artificial recharge and RTRWH measures will have a positive impact on drinking water sources of the area. It will ensure that the wells don't go dry during summer/lean/stress period in the areas of implementation and sufficient ground water availability is there in the wells even during the summer season. Thus the drinking and domestic water sources will be strengthened. These measures will also be able to arrest the decline in water levels of Aquifer-I and raise the water levels in Aquifer-II.

The probable benefits of the proposed management plan after implementing above recharge measures will be help in arrest the declining trend and will reduce the water scarcity period in Bhokardantaluka. Further ground water resources of 26.43 MCM will be available for utilisation.

These interventions also need to be supported by regulation of deeper aquifer and hence it is recommended to regulate/ban deeper tubewells/borewellsof more than 80 m depth in thistaluka, so that the deeper ground water resources are protected for future generation and also serve as ground water sanctuary in times of distress/drought.

No demand side interventions are proposed.

IEC activities and capacity building activities needs to be aggressively propagated to establish the institutional framework for participatory groundwater management.

**Annexure-I**

**Rinfall Analysis of Bhokardan Taluka**

PERIOD = 1951 TO 2015

NO OF YEARS = 50

NORMAL RAINFALL = 641.6 mm

STANDARD DEVIATION = 199 mm

COEFF OF VARIATION = 31 %

SLOPE = -1.853 mm/year

INTERCEPT = 700.8 mm

EQUATION OF TREND LINE: Y= -1.853 X +700.8

| YEAR | ANNUAL | DEP% | CATEGORY |
|---|---|---|---|
| 1951 | 844.9 | + 32 | EXCESS |
| 1952 | 326.4 | -49 | MODERATE |
| 1953 | 765 | + 19 | NORMAL |
| 1954 | 748.4 | + 17 | NORMAL |
| 1955 | 760 | + 18 | NORMAL |
| 1956 | 893.8 | + 39 | EXCESS |
| 1957 | 673.5 | + 5 | NORMAL |
| 1958 | 1042.6 | + 62 | EXCESS |
| 1959 | 804.4 | + 25 | EXCESS |
| 1960 | 498.5 | -22 | NORMAL |
| 1961 | 724.5 | + 13 | NORMAL |
| 1962 | 708.8 | + 10 | NORMAL |
| 1963 | 923.9 | + 44 | EXCESS |
| 1964 | 615.1 | -4 | NORMAL |
| 1965 | NA | NA | NA |
| 1966 | NA | NA | NA |
| 1967 | 627.3 | -2 | NORMAL |
| 1968 | 553.5 | -14 | NORMAL |
| 1969 | NA | NA | NA |
| 1970 | 612.6 | -5 | NORMAL |
| 1971 | 486.7 | -24 | NORMAL |

| | | | |
|---|---|---|---|
| 1972 | 275.7 | -57 | SEVERE |
| 1973 | 658.3 | + 3 | NORMAL |
| 1974 | 589.4 | -8 | NORMAL |
| 1975 | 1042.6 | + 62 | EXCESS |
| 1976 | 575.3 | -10 | NORMAL |
| 1977 | 817.7 | + 27 | EXCESS |
| 1978 | 687.1 | + 7 | NORMAL |
| 1979 | 941.4 | + 47 | EXCESS |
| 1980 | 703 | + 10 | NORMAL |
| 1981 | 448.8 | -30 | MODERATE |
| 1982 | 267 | -58 | SEVERE |
| 1983 | 552.7 | -14 | NORMAL |
| 1984 | 275.3 | -57 | SEVERE |
| 1985 | 287 | -55 | SEVERE |
| 1986 | NA | NA | NA |
| 1987 | NA | NA | NA |
| 1988 | NA | NA | NA |
| 1989 | NA | NA | NA |
| 1990 | NA | NA | NA |
| 1991 | NA | NA | NA |
| 1992 | NA | NA | NA |
| 1993 | NA | NA | NA |
| 1994 | NA | NA | NA |
| 1995 | NA | NA | NA |
| 1996 | NA | NA | NA |
| 1997 | NA | NA | NA |
| 1998 | 889.5 | + 39 | EXCESS |
| 1999 | 673.5 | + 5 | NORMAL |
| 2000 | 436.2 | -32 | MODERATE |
| 2001 | 658.6 | + 3 | NORMAL |
| 2002 | 646 | + 1 | NORMAL |
| 2003 | 657 | + 2 | NORMAL |
| 2004 | 541.5 | -16 | NORMAL |

| | | | |
|---|---|---|---|
| 2005 | 630.2 | -2 | NORMAL |
| 2006 | 988 | + 54 | EXCESS |
| 2007 | 521.3 | -19 | NORMAL |
| 2008 | 577.5 | -10 | NORMAL |
| 2009 | 556 | -13 | NORMAL |
| 2010 | 778.2 | + 21 | NORMAL |
| 2011 | 460.4 | -28 | MODERATE |
| 2012 | 298.8 | -53 | SEVERE |
| 2013 | 846 | + 32 | EXCESS |
| 2014 | 561.3 | -13 | NORMAL |
| 2015 | 627.8 | -2 | NORMAL |

| CATEGORY | NUMBER OF YEARS | %OF TOTAL YEARS |
|---|---|---|
| **DEPARTURES** | | |
| POSITIVE | 25 | 50 |
| NEGATIVE | 25 | 50 |
| **DROUGHTS** | | |
| MODERATE | 4 | 8 |
| SEVERE | 5 | 10 |
| ACUTE | 0 | 0 |
| **NORMAL & EXCESS R/F** | | |
| NORMAL | 30 | 60 |
| EXCESS | 11 | 22 |

Rainfall departure: EXCESS: > +25; NORMAL: +25 TO -25; MODERATE: -25 TO -50; SEVERE: -50 TO -75; ACUTE: < -74

**Annexure-II**

**Salient Features of Ground water exploration in Bhokardan taluka, Jalna district.**

| Sl. No. | Name of site | Topo sheet No | Latitude | Longitude | Elevation | Total Depth (mbgl) | Casing (mbgl) | Thickness of Fracture (m) | Zones (mbgl) | Aquifer | SWL (mbgl) | Q (lps) | DD (m) | T | S | EC | F | NO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Hasnabad | 46P/12 | 20.1353 | 75.6997 | 584 | 200 | 29.5 | 0.5 | | | | **Traces** | | | | | | |
| 2 | Janephal | 46P/16 | 20.1047 | 75.7658 | 570.4 | 196.5 | 19.5 | 3 | 108-111 | FMB | 17 | <0.14 | | | | 1294 | 0.1 | 2 |
| 3 | Pimpalgaon Renukai | 46P/16 | 20.3697 | 75.9011 | 602.2 | 200 | 19.5 | 2 | | | | **Traces** | | | | 915 | 0.4 | 51 |
| 4 | Dhavda | 46P/14 | 20.5003 | 75.8894 | 609.9 | 200 | 19.5 | 3 | 35-38 & 108-111 | FMB | 11.4 | <0.14 | | | | 1057 | 0.2 | 46 |
| 5 | Dawargaon Walsa | 46P/16 | 20.1756 | 75.8106 | 574.5 | 200 | 19.5 | 2 | | | | **Traces** | | | | | | |
| 6 | Siphora | 46P/15 | 20.2581 | 75.8647 | 563.5 | 200 | 19.5 | 1 | | | | **Traces** | | | | 1346 | 1.28 | ND |
| 7 | Nalni Bk. | 46P/16 | 20.1544 | 75.8858 | 547.8 | 200 | 19.5 | 3 | | | | **Traces** | | | | | | |
| 8 | Kosgaon | 46P/15 | 20.3356 | 75.9231 | 591.4 | 200 | 19.5 | 3 | | | | **Traces** | | | | | | |
| 9 | Bhokardan | 46P/15 | 20.2425 | 75.7692 | 596 | 200 | 19.5 | 1 | | | | **Traces** | | | | | | |
| 10 | Malkheda | 46P/11 | 20.2736 | 75.7083 | 623.7 | 200.2 | 5.06 | 2 | | | | **Traces** | | | | | | |
| 11 | Nimgaon | 46P/12 | 20.1778 | 75.7333 | 573.5 | 200.2 | 10.73 | 3 | | | | **Traces** | | | | | | |
| 12 | Annava | 46P/15 | 20.4219 | 75.7800 | 634.4 | 200.2 | 5.16 | 2 | | | | **Traces** | | | | | | |
| 13 | Babulgaon | 46P/16 | 20.2458 | 75.8264 | 576.6 | 200.2 | 5.04 | 5 | | | | **Traces** | | | | | | |
| 14 | Rajur | 46P/16 | 20.0611 | 75.8625 | 618.1 | 200.2 | 5.26 | 3 | | | | **Traces** | | | | | | |

**Annexture -III**

**Aquifer-I, Depth to water level data, Bhokardan taluka, Jalna district.**

| Sl No | Village | Elevation (mamsl) | Latitude | Longitude | Depth (m) | Depth of Curbing ( mbgl) | MP (magl) | May-14 (mbgl) | Nov-14 (mbgl) | May-15 (mbgl) | Nov-15 (mbgl) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Wadhona | 622.5 | 20.5162 | 75.9374 | 13.14 | 6.02 | 0.95 | 11.20 | 4.75 | 12 | 5.6 |
| 2 | Dhavada | 606.7 | 20.5021 | 75.8862 | 14.48 | 3.1 | 0.40 | 9.32 | 8.18 | 10 | 7.2 |
| 3 | Malkheda | 628.8 | 20.2771 | 75.7059 | 13 | 2.18 | 0.70 | 6.22 | 11.35 | 6.8 | 11.7 |
| 4 | Avana | 604.2 | 20.3135 | 75.7243 | 14.39 | 7.06 | 0.62 | 8.15 | 0.10 | 7.19 | 0.1 |
| 5 | Gosegaon | 600.2 | 20.1678 | 75.6559 | 11.32 | 6.35 | 0.20 | 5.15 | 4.21 | 4.91 | 5.09 |
| 6 | Nanja | 575.4 | 20.2212 | 75.7314 | 13.5 | 0 | 0.00 | 12.10 | 10.40 | 12.35 | 10.04 |
| 7 | Khandala | 595 | 20.1817 | 75.6876 | 11.52 | 3.3 | 0.80 | 4.00 | 2.45 | 4.21 | 2.98 |
| 8 | Nimgaon | 566.1 | 20.1794 | 75.743 | 25 | 10.35 | 1.40 | 18.75 | 1.92 | 19 | 0.98 |
| 9 | Takli | 616 | 20.0872 | 75.6038 | 15.1 | 2.73 | 0.30 | 5.68 | 4.58 | 6.4 | 3.88 |
| 10 | Savkheda | 580.7 | 20.1154 | 75.6589 | 18 | 1.78 | 0.57 | 11.55 | 9.35 | 10.88 | 9.9 |
| 11 | Talegaon | 609.4 | 20.076 | 75.6566 | 12 | 3.73 | 0.25 | 8.85 | 4.97 | 8 | 4.3 |
| 12 | Ekiphal | 593.8 | 20.0789 | 75.6999 | 8.8 | 3.07 | 0.00 | 7.92 | 5.15 | 8.4 | 5 |
| 13 | Javkheda BK | 577.7 | 20.0923 | 75.7308 | 15.23 | 12.05 | 0.60 | 10.97 | 6.95 | 11.8 | 7.56 |
| 14 | Hasnabad | 569.9 | 20.1273 | 75.6981 | 10 | 9.03 | 1.00 | 11.00 | 6.50 | 11.3 | 7.4 |
| 15 | Kumbhari | 588.6 | 20.204 | 75.7643 | 11.85 | 2.9 | 0.55 | 11.15 | 6.40 | 12 | 6.18 |
| 16 | Babulgaon | 577.2 | 20.2473 | 75.8284 | 13.61 | 2.85 | 1.05 | 5.10 | 3.92 | 4.19 | 4.49 |
| 17 | Barangala Lokhande | 574.6 | 20.1947 | 75.8288 | 15.31 | 3.85 | 0.57 | 4.33 | 6.80 | 5 | 6.3 |
| 18 | Barangala Sable | 566.4 | 20.1926 | 75.8721 | 12.3 | 7.88 | 0.37 | 7.51 | 6.30 | 7.4 | 6.89 |
| 19 | Takli | 559.3 | 20.2333 | 75.8685 | 5.65 | 4.67 | 1.10 | 6.02 | 3.15 | 6.4 | 3.88 |
| 20 | Tadegaon | 543.1 | 20.1764 | 75.9238 | 22.13 | 8.37 | 0.45 | 7.47 | 6.00 | 7.49 | 6.76 |
| 21 | Borgaon Taru | 554.8 | 20.1315 | 75.7807 | 21.75 | 12.8 | 1.00 | 19.00 | 14.20 | 18.19 | 15.05 |
| 22 | Kedarkheda | 557.7 | 20.1472 | 75.8231 | 2.8 | 1.6 | 0.30 | 2.05 | 2.89 | 3 | 2.1 |
| 23 | Janephal | 569.1 | 20.1049 | 75.7675 | 8.65 | 5.1 | 0.50 | 4.10 | 2.36 | 4 | 1.98 |
| 24 | Chandai Thombri | 571.2 | 20.0941 | 75.8274 | 11.85 | 4.97 | 1.15 | 10.30 | 7.39 | 10.8 | 8.05 |

| Sl No | Village | Elevation (mamsl) | Latitude | Longitude | Depth (m) | Depth of Curbing ( mbgl) | MP (magl) | May-14 (mbgl) | Nov-14 (mbgl) | May-15 (mbgl) | Nov-15 (mbgl) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | Nalni Buzurg | 556.8 | 20.1449 | 75.8872 | 10.75 | 7.8 | 0.45 | 6.70 | 6.30 | 6.3 | 5.88 |
| 26 | Banegaon | 561.6 | 20.1193 | 75.8447 | 11.14 | 0 | 0.00 | 10.10 | 10.05 | 10.3 | 9.78 |
| 27 | Palashkheda | 571.9 | 20.1086 | 75.908 | 8.73 | 3.62 | 0.10 | 6.45 | 5.90 | 6.54 | 6.13 |
| 28 | Pimpalgaon | 588 | 20.0615 | 75.7563 | 11.85 | 3.12 | 0.00 | 11.83 | 5.23 | 11.33 | 4.75 |
| 29 | Rajur | 630.3 | 20.0617 | 75.8526 | 18.62 | 5.35 | 0.35 | 4.65 | 4.25 | 5 | 3.6 |
| 30 | Longaon | 588.8 | 20.0526 | 75.898 | 13.74 | 2.76 | 0.44 | 10.30 | 11.42 | 11.09 | 12.01 |
| 31 | Adgaon | 610.9 | 20.4567 | 75.8262 | 22.16 | 7.45 | 0.90 | 14.20 | 11.70 | 14.7 | 12.3 |
| 32 | Jalgaon | 602.1 | 20.4184 | 75.8415 | 12 | 5 | 0.30 | 7.40 | 6.99 | 7.2 | 6.65 |
| 33 | Pokhari | 605.2 | 20.4784 | 75.894 | 15.9 | 11.8 | 0.30 | 12.43 | 9.94 | 12.21 | 9.56 |
| 34 | Valsawangi | 592.7 | 20.4665 | 75.934 | 12.55 | 5.94 | 0.53 | 7.65 | 6.40 | 7.81 | 7.05 |
| 35 | Anva | 624 | 20.4101 | 75.7823 | 7 | 4.42 | 0.44 | 4.09 | 6.46 | 4.99 | 6 |
| 36 | Wakdi | 611.6 | 20.3594 | 75.7875 | 11.48 | 0 | 0.00 | 7.40 | 2.91 | 7.3 | 3.91 |
| 37 | Karajgaon | 614.1 | 20.3755 | 75.8433 | 12.2 | 0.9 | 0.30 | 4.40 | 1.98 | 5.1 | 2.9 |
| 38 | Pimpalgaon Renukai | 592.6 | 20.3854 | 75.8898 | 11.23 | 5.5 | 0.33 | 8.47 | 3.95 | 8.4 | 4.9 |
| 39 | Paradh Badi | 574 | 20.4121 | 75.9337 | 25 | 6 | 0.20 | 8.30 | 3.65 | 9 | 4 |
| 40 | Sawangi | 573 | 20.3806 | 75.9358 | 26.22 | 10.63 | 0.85 | 9.78 | 7.73 | 9.01 | 8 |
| 41 | Bhokardan | 582 | 20.2516 | 75.7692 | 10.06 | 2.31 | 0.30 | 2.84 | 2.88 | 2 | 2.3 |
| 42 | Wadi Buzurg | 609.8 | 20.3154 | 75.7657 | 22.93 | 8.85 | 0.55 | 15.15 | 3.95 | 15.67 | 3.95 |
| 43 | Danapur | 582.1 | 20.3114 | 75.8271 | 12.23 | 2.7 | 0.45 | 11.45 | 8.12 | 12 | 9.2 |
| 44 | Siphora | 572.2 | 20.2596 | 75.8595 | 7.82 | 1.6 | 0.65 | 1.25 | 0.20 | 1.5 | 0.32 |
| 45 | Kolgaon | 592.1 | 20.3157 | 75.8978 | 15.1 | 0 | 0.00 | 10.85 | 8.00 | 10.89 | 8.91 |
| 46 | Valsa | 571.7 | 20.2787 | 75.9106 | 14.38 | 6.57 | 0.95 | 7.48 | 6.80 | 7.8 | 7.33 |

**Annexure-IV**

## Aquifer-I, Ground water quality of Bhokardan taluka, Jalna district.

| S. No | Location/ID | Latitute | Longtitude | pH | EC µS/cm @ 25°C | TDS | TH | Ca | Mg | Na | K | CO3 | HCO3 | Cl | NO3 | SO4 | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | WADI | 20.2787 | 75.9106 | 8 | 1960 | 980 | 665 | 132 | 81 | 76 | 33.78 | 0 | 122 | 273 | 52 | 606 | 0.51 |
| 2 | AVANA-8 | 20.3135 | 75.7243 | 7.8 | 2988 | 1494 | 1085 | 188 | 149 | 184 | 16.79 | 0 | 183 | 560 | 60 | 543 | 0.64 |
| 3 | WALSAWANG | 20.4665 | 75.934 | 7.9 | 3134 | 1567 | 1040 | 244 | 105 | 116 | 12.74 | 0 | 98 | 525 | 57 | 515 | 0.4 |
| 4 | BARANJALA | 20.1947 | 75.8288 | 7.8 | 1827 | 913.5 | 460 | 100 | 51 | 97 | 1.48 | 0 | 256 | 301 | 54 | 502 | 0.59 |
| 5 | ANVA | 20.4101 | 75.7823 | 7.9 | 2796 | 1398 | 490 | 72 | 75 | 408 | 7.25 | 0 | 171 | 432 | 54 | 408 | 0.47 |
| 6 | WALSAWANGI | 20.5162 | 75.9374 | 7.6 | 2272 | 1136 | 850 | 204 | 83 | 84 | 7.36 | 0 | 79 | 390 | 52 | 354 | 0.77 |
| 7 | BHOKARDAN | 20.2516 | 75.7692 | 8.8 | 1103 | 551.5 | 365 | 80 | 40 | 82 | 1.55 | 0 | 214 | 177 | 50 | 241 | 0.59 |
| 8 | BKD-35 | 20.0617 | 75.8526 | 7.7 | 971 | 485.5 | 370 | 66 | 50 | 49 | 1.09 | 0 | 207 | 138 | 52 | 207 | 0.73 |
| 9 | JALGAON | 20.4184 | 75.8415 | 7.8 | 1329 | 664.5 | 400 | 72 | 53 | 72 | 28.88 | 0 | 275 | 149 | 52 | 190 | 0.48 |
| 10 | JANEPHAL | 20.1049 | 75.7675 | 7.9 | 1265 | 632.5 | 345 | 84 | 33 | 72 | 21.89 | 0 | 403 | 177 | 52 | 190 | 1.34 |
| 11 | TAKLI | 20.0872 | 75.6038 | 7.7 | 1126 | 563 | 490 | 124 | 44 | 21 | 0.31 | 0 | 226 | 135 | 54 | 190 | 0.51 |
| 12 | KEDARKHEDA | 20.1472 | 75.8231 | 7.8 | 1127 | 563.5 | 390 | 90 | 40 | 51 | 4.22 | 0 | 317 | 184 | 48 | 184 | 0.59 |
| 13 | KODBGAON | 20.3157 | 75.8978 | 8 | 985 | 492.5 | 410 | 90 | 45 | 39 | 0.88 | 0 | 140 | 89 | 54 | 179 | 0.56 |
| 14 | JAVKHEDA | 20.0923 | 75.7308 | 7.7 | 942 | 471 | 400 | 92 | 41 | 35 | 0.88 | 0 | 183 | 167 | 52 | 172 | 1.4 |
| 15 | 30-BKD | 20.0941 | 75.8274 | 7.8 | 1575 | 787.5 | 360 | 66 | 47 | 68 | 91.03 | 0 | 268 | 167 | 57 | 165 | 0.73 |
| 16 | TAKLI | 20.2333 | 75.8685 | 7.9 | 790 | 395 | 320 | 50 | 47 | 27 | 4.12 | 0 | 171 | 110 | 52 | 163 | 0.59 |
| 17 | SAWANGI | 20.3806 | 75.9358 | 7.7 | 884 | 442 | 345 | 66 | 44 | 47 | 3.18 | 0 | 226 | 106 | 52 | 158 | 0.64 |
| 18 | NIMGAON | 20.1794 | 75.743 | 7.8 | 1108 | 554 | 380 | 62 | 55 | 55 | 1.53 | 0 | 262 | 160 | 54 | 156 | 0.64 |
| 19 | GOSHEGAO | 20.1678 | 75.6559 | 7.7 | 788 | 394 | 280 | 56 | 34 | 47 | 8.61 | 0 | 256 | 110 | 48 | 154 | 0.54 |
| 20 | NADNI | 20.1449 | 75.8872 | 7.87 | 920 | 460 | 340 | 78 | 35 | 46 | 2.35 | 0 | 207 | 156 | 54 | 154 | 0.47 |
| 21 | BABULGAON | 20.2473 | 75.8284 | 7.8 | 1180 | 590 | 455 | 106 | 46 | 42 | 1.05 | 0 | 238 | 160 | 54 | 152 | 0.91 |
| 22 | BARANJALA | 20.1926 | 75.8721 | 7.7 | 1138 | 569 | 470 | 120 | 41 | 35 | 4.40 | 0 | 250 | 117 | 54 | 133 | 0.64 |
| 23 | PIMPALGAON | 20.3854 | 75.8898 | 7.8 | 1389 | 694.5 | 500 | 86 | 69 | 52 | 2.08 | 0 | 214 | 177 | 54 | 129 | 0.44 |
| 24 | POKHARA | 20.4784 | 75.894 | 7.6 | 1399 | 699.5 | 555 | 120 | 62 | 28 | 1.77 | 0 | 171 | 156 | 52 | 126 | 0.4 |

| S. No | Location/ID | Latitute | Longtitude | pH | EC µS/cm @ 25°C | TDS | TH | Ca | Mg | Na | K | CO3 | HCO3 | Cl | NO3 | SO4 | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | ADGAON | 20.4567 | 75.8262 | 7.8 | 1340 | 670 | 385 | 68 | 52 | 71 | 28.58 | 0 | 238 | 160 | 52 | 117 | 0.51 |
| 26 | DANAPUR | 20.3114 | 75.8271 | 8 | 986 | 493 | 290 | 76 | 24 | 74 | 2.02 | 0 | 146 | 128 | 52 | 101 | 0.44 |
| 27 | BKD-33 | 20.1086 | 75.908 | 7.6 | 828 | 414 | 315 | 90 | 22 | 36 | 2.65 | 0 | 207 | 78 | 52 | 97 | 0.54 |
| 28 | NANJA | 20.2212 | 75.7314 | 7.8 | 839 | 419.5 | 320 | 66 | 38 | 43 | 1.31 | 0 | 220 | 121 | 54 | 89 | 0.64 |
| 29 | BANEGAON | 20.1193 | 75.8447 | 7.7 | 899 | 449.5 | 350 | 86 | 33 | 31 | 1.49 | 0 | 189 | 145 | 52 | 82 | 0.47 |
| 30 | EKEFAL | 20.0789 | 75.6999 | 7.8 | 644 | 322 | 250 | 56 | 27 | 31 | 5.86 | 0 | 201 | 85 | 46 | 77 | 0.47 |
| 31 | TALEGAON | 20.076 | 75.6566 | 8.2 | 743 | 371.5 | 265 | 72 | 21 | 40 | 2.33 | 9 | 183 | 110 | 54 | 71 | 0.64 |
| 32 | SIPORA | 20.2596 | 75.8595 | 8.1 | 527 | 263.5 | 180 | 42 | 18 | 28 | 1.47 | 0 | 153 | 82 | 26 | 62 | 0.44 |
| 33 | KARAJGAON | 20.3755 | 75.8433 | 7.8 | 724 | 362 | 295 | 56 | 38 | 33 | 0.43 | 0 | 250 | 57 | 50 | 55 | 0.33 |
| 34 | SAVKHEDA | 20.1154 | 75.6589 | 7.8 | 785 | 392.5 | 350 | 106 | 21 | 19 | 0.90 | 0 | 220 | 89 | 54 | 52 | 1.66 |
| 35 | PARAJ | 20.1086 | 75.908 | 7.8 | 826 | 413 | 340 | 52 | 51 | 40 | 0.89 | 0 | 232 | 82 | 52 | 51 | 0.37 |
| 36 | KHANDALA | 20.1817 | 75.6876 | 7.9 | 488 | 244 | 200 | 38 | 26 | 23 | 0.57 | 0 | 244 | 53 | 10 | 45 | 0.54 |
| 37 | PIMPALGAON | 20.0615 | 75.7563 | 7.7 | 769 | 384.5 | 335 | 76 | 35 | 31 | 1.31 | 0 | 238 | 71 | 52 | 41 | 0.54 |
| 38 | BORGAON TARU | 20.1315 | 75.7807 | 7.8 | 675 | 337.5 | 230 | 34 | 35 | 42 | 1.53 | 0 | 275 | 78 | 48 | 36 | 0.59 |
| 39 | NALKHEDA | 20.2771 | 75.7059 | 8 | 667 | 333.5 | 220 | 36 | 32 | 67 | 4.66 | 0 | 336 | 121 | 52 | 28 | 0.47 |
| 40 | 21-BKD | 20.204 | 75.7643 | 7.8 | 625 | 312.5 | 245 | 70 | 17 | 31 | 1.23 | 0 | 250 | 60 | 52 | 20 | 0.64 |

**Annexure-V**
**Micro level Hydrogeological data**

**Annexure-VI**

**Soil Infiltration Test Data**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | **28/2/16** | | | | | | |
| Unique ID No | **SITNQJL-3** | | | | | | |
| Location | **Baranjala Lokhande -In the field of Rustamrao Lokhande** | | | | | | |
| Taluka | **Bhokardan** | | | | | | |
| Coordinates | **20 11 31, 75 49 30.5** | | | | | | |
| Elevation / RL (mamsl) | **575** | | | | | | |
| Initial Water Level | **16** | | | | | | |
| Geology | **Deccan Basalt** | | | | | | |
| **Sl.No.** | **Clock time** | **Duration(m)** | **Cumulative time (minutes)** | **Water Level depth(cm)** | **Infiltrated water Depth(cm)** | **Infiltration rate(cm/hr)** | **Remarks** |
| **1** | **2.30** | **5** | **5** | **17.40** | **1.40** | **16.80** | |
| **2** | **2.40** | **10** | **15** | **19.50** | **2.10** | **12.60** | |
| **3** | **2.55** | **15** | **30** | **21.70** | **2.20** | **8.80** | |
| **4** | **3.10** | **15** | **45** | **23.50** | **1.80** | **7.20** | |
| **5** | **3.25** | **15** | **60** | **25.10** | **1.60** | **6.40** | |
| **6** | **3.55** | **30** | **75** | **19.70** | **3.70** | **7.40** | **Filled Upto 16** |
| **7** | **4.25** | **30** | **105** | **22.80** | **3.10** | **6.20** | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **8** | **4.55** | **30** | **135** | **25.90** | **3.10** | **6.20** | |
| **9** | **5.30** | 30 | **165** | **29.00** | **3.10** | **6.20** | |

| | |
|---|---|
| Date | **29/2/16** |
| Unique ID No | **SITNQJL-1** |
| Location | **Janephal Dabhadi- 100 mtrs west of village in the field of Bhausaheb Misal** |
| Taluka | **Bhokardan** |
| District | **Jalna** |
| Coordinates | **20 06 2.2, 75 45 46.6** |
| Elevation / RL (mamsl) | **376** |
| Initial Water Level | **16 cms** |
| Geology | **HWB** |

| **Sl.No.** | **Clock time** | **Duration(m)** | **Cumulative time (minutes)** | **Water level depth(cm)** | **Infiltrated water Depth(cm)** | **Infiltration rate(cm/hr)** | **Remarks** |
|---|---|---|---|---|---|---|---|
| **1** | **16:20** | **5** | **5** | **17.00** | **1.00** | **12.00** | |
| **2** | **16:30** | **10** | **15** | **17.60** | **1.60** | **9.60** | |
| **3** | **16:45** | **15** | **30** | **18.80** | **1.20** | **4.80** | |
| **4** | **17:00** | **15** | **45** | **19.90** | **1.10** | **4.40** | |
| **5** | **17:15** | **15** | **60** | **20.90** | **1.00** | **4.00** | |
| **6** | **17:45** | **30** | **90** | **22.40** | **1.50** | **3.00** | |
| **7** | **18:15** | **30** | **120** | **23.90** | **1.50** | **3.00** | |
| **8** | **18:45** | **30** | **150** | **25.40** | **1.50** | **3.00** | |

| | |
|---|---|
| Date | **28/2/16** |
| Unique ID No | **SITNQJL-4** |
| Location | **Jomala -In the field of Mahadev Namdev Phalke** |
| Taluka | **Bhokardan** |
| District | **Jalna** |
| Coordinates | **20 14 12, 75 46 34** |
| Elevation / RL (mamsl) | **596** |
| Initial Water Level | **17** |
| Geology | **Deccan Basalt** |

| **Sl.No.** | **Clock time** | **Duration(m)** | **Cumulative time (minutes)** | **Water level depth(cm)** | **Infiltrated water Depth(cm)** | **Infiltration rate(cm/hr)** | **Remarks** |
|---|---|---|---|---|---|---|---|
| **1** | **10.50** | **5** | **5** | **19.00** | **2.00** | **24.00** | |
| **2** | **11.00** | **10** | **15** | **20.50** | **1.50** | **9.00** | |
| **3** | **11.15** | **15** | **30** | **22.30** | **1.80** | **7.20** | |
| **4** | **11.30** | **15** | **45** | **23.80** | **1.50** | **6.00** | |
| **5** | **11.45** | **15** | **60** | **25.10** | **1.30** | **5.20** | |
| **6** | **12.15** | **30** | **75** | **19.60** | **2.60** | **5.20** | **Filled Upto 17** |
| **7** | **12.45** | **30** | **105** | **22.20** | **2.60** | **5.20** | |

| | |
|---|---|
| Date | **27/2/16** |
| Unique ID No | **SITNQJL-6** |
| Location | **Kotha Koli -In the field of Bharat Shivrang Salve** |
| Taluka | **Bhokardan** |
| District | **Jalna** |
| Coordinates | **20 24 45.8, 75 51 45.8** |
| Elevation / RL (mamsl) | **603** |
| Initial Water Level | **15** |
| Geology | **Deccan Basalt** |

| Sl.No. | Clock time | Duration(m) | Cumulative time (minutes) | Water level depth(cm) | Infiltrated water Depth(cm) | Infiltration rate(cm/hr) | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | 15.05 | 5 | 5 | 16.10 | 1.10 | 13.20 | |
| 2 | 15.15 | 10 | 15 | 16.70 | 0.60 | 3.60 | |
| 3 | 15.30 | 15 | 30 | 17.50 | 0.80 | 3.20 | |
| 4 | 15.45 | 15 | 45 | 18.00 | 0.50 | 2.00 | |
| 5 | 16.00 | 15 | 60 | 18.50 | 0.50 | 2.00 | |
| 6 | 16.30 | 30 | 90 | 19.20 | 0.70 | 1.40 | |
| 7 | 17.00 | 30 | 120 | 19.90 | 0.70 | 1.40 | |
| | 17.30 | 30 | 150 | 20.60 | 0.70 | 1.40 | |

| | |
|---|---|
| Date | **27/2/16** |
| Unique ID No | **SITNQJL-6** |
| Location | **Mehegaon wadi** |
| Taluka | **Bhokardan** |
| District | **Jalna** |
| Coordinates | **20 31 48.9, 75 53 26.7** |
| Elevation / RL (mamsl) | **608** |
| Initial Water Level | **20** |
| Geology | **Deccan Basalt** |

| **Sl.No.** | **Clock time** | **Duration(m)** | **Cumulative time (minutes)** | **Water level depth(cm)** | **Infiltrated water Depth(cm)** | **Infiltration rate(cm/hr)** | **Remarks** |
|---|---|---|---|---|---|---|---|
| **1** | **9.55** | **5** | **5** | **21.30** | **1.30** | **15.60** | |
| **2** | **10.05** | **10** | **15** | **23.00** | **1.70** | **10.20** | |
| **3** | **10.20** | **15** | **30** | **24.50** | **1.50** | **6.00** | |
| **4** | **10.35** | **15** | **45** | **26.00** | **1.50** | **6.00** | |
| **5** | **10.50** | **15** | **60** | **27.10** | **1.10** | **4.40** | |
| **6** | **11.20** | **30** | **90** | **29.30** | **2.20** | **4.40** | |
| **7** | **11.50** | **30** | **120** | **22.20** | **2.20** | **4.40** | **Filled 20 cms** |
| | **12.20** | **30** | **150** | **24.40** | **2.20** | **4.40** | |

| | |
|---|---|
| Date | **29/2/16** |
| Unique ID No | **SITNQJL-2** |
| Location | **Nalni Budrukh - In the field of manda Suryavanshi** |
| Taluka | **Bhokardan** |
| District | **Jalna** |
| Coordinates | **20 09 6.1, 75 53 1.5** |
| Elevation / RL (mamsl) | **554** |
| Initial Water Level | **20** |
| Geology | **Deccan Basalt** |

| **Sl.No.** | **Clock time** | **Duration(m)** | **Cumulative time (minutes)** | **Water level depth(cm)** | **Infiltrated water Depth(cm)** | **Infiltration rate(cm/hr)** | **Remarks** |
|---|---|---|---|---|---|---|---|
| **1** | **11.40** | **5** | **5** | **20.50** | **0.50** | **6.00** | |
| **2** | **11.50** | **10** | **15** | **21.00** | **0.50** | **3.00** | |
| **3** | **12.05** | **15** | **30** | **21.70** | **0.70** | **2.80** | |
| **4** | **12.20** | **15** | **45** | **22.30** | **0.60** | **2.40** | |
| **5** | **12.30** | **15** | **60** | **20.80** | **0.80** | **3.20** | **Filled upto 20** |
| **6** | **12.45** | **15** | **75** | **21.10** | **0.30** | **1.20** | |
| **7** | **13.15** | **30** | **105** | **21.70** | **0.60** | **1.20** | |
| **8** | **13.45** | **30** | **135** | **22.10** | **0.40** | **0.80** | |
| **9** | **14.15** | 30 | **165** | **22.50** | 0.40 | **0.80** | |

**Annexure-VII**

**Aquifer-II, Depth to water level, Bhokardan taluka, Jalna district**

| SN | Exploratory site | Type of well | Toposheet | Latitude | Longitude | RL | Drilled deph | Casing | Pre DTW | Post DTW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Hasnabad | EW | 46P/12 | 20.1353 | 75.6997 | 584 | 200 | 29.5 | 90 | 55 |
| 2 | Janephal | EW | 46P/16 | 20.1047 | 75.7658 | 570.4 | 196.5 | 19.5 | 17 | 10 |
| 3 | Pimpalgaon Renukai | EW | 46P/16 | 20.3697 | 75.9011 | 602.2 | 200 | 19.5 | 35 | 22 |
| 4 | Dhavda | EW | 46P/14 | 20.5003 | 75.8894 | 609.9 | 200 | 19.5 | 11.4 | 8 |
| 5 | Dawargaon Walsa | EW | 46P/16 | 20.1756 | 75.8106 | 574.5 | 200 | 19.5 | 42 | 25 |
| 6 | Siphora | EW | 46P/15 | 20.2581 | 75.8647 | 563.5 | 200 | 19.5 | 70 | 43 |
| 7 | Nalni Bk. | EW | 46P/16 | 20.1544 | 75.8858 | 547.8 | 200 | 19.5 | 70 | 43 |
| 8 | Kosgaon | EW | 46P/15 | 20.3356 | 75.9231 | 591.4 | 200 | 19.5 | 60 | 35 |
| 9 | Bhokardan | EW | 46P/15 | 20.2425 | 75.7692 | 596 | 200 | 19.5 | 65 | 28 |
| 10 | Malkheda | EW | 46P/11 | 20.2736 | 75.7083 | 623.7 | 200.2 | 5.06 | 40 | 28 |
| 11 | Nimgaon | EW | 46P/12 | 20.1778 | 75.7333 | 573.5 | 200.2 | 10.73 | 45 | 32 |
| 12 | Annava | EW | 46P/15 | 20.4219 | 75.78 | 634.4 | 200.2 | 5.16 | 52 | 42 |
| 13 | Babulgaon | EW | 46P/16 | 20.2458 | 75.8264 | 576.6 | 200.2 | 5.04 | 45 | 31 |
| 14 | Rajur | EW | 46P/16 | 20.0611 | 75.8625 | 618.1 | 200.2 | 5.26 | 56 | 44 |

**Annexure-VIII**

**Aquifer-I, Pre and Post Monsoon water level trend, Bhokardan taluka, Jalna district.**

| SN | District | Taluka | Village | Y | X | Pre trend | Trend | Post trend | Trend |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Jalna | Bhokardan | Alapur | 20.25917 | 75.77083333 | -0.38 | Rising | -0.37 | Rising |
| 2 | Jalna | Bhokardan | Baranjala lokhande | 20.195 | 75.83055556 | -0.27 | Rising | 0.41 | Falling |
| 3 | Jalna | Bhokardan | Baranjala(lokhande) | 20.195 | 75.83055556 | 0.38 | Falling | 0.41 | Falling |
| 4 | Jalna | Bhokardan | Bhokardan | 20.25972 | 75.77055556 | 0.20 | Falling | 0.06 | Falling |
| 5 | Jalna | Bhokardan | Bhokardan | 20.25972 | 75.77083333 | -0.11 | Rising | 0.21 | Falling |
| 6 | Jalna | Bhokardan | Borgaon jahagir | 20.26944 | 75.86861111 | 0.12 | Falling | 0.01 | Falling |
| 7 | Jalna | Bhokardan | Chandai Thombri | 20.09444 | 75.82361111 | 0.43 | Falling | 0.44 | Falling |
| 8 | Jalna | Bhokardan | Dehad | 20.32972 | 75.85333333 | -0.09 | Rising | 0.06 | Falling |
| 9 | Jalna | Bhokardan | Gosegaon | 20.16806 | 75.655 | -0.26 | Rising | 0.17 | Falling |
| 10 | Jalna | Bhokardan | Hasnabad | 20.12778 | 75.69722222 | 0.01 | Falling | -0.03 | Rising |
| 11 | Jalna | Bhokardan | Ita | 20.11833 | 75.67722222 | -0.14 | Rising | 0.16 | Falling |
| 12 | Jalna | Bhokardan | Janefal dhabadi | 20.105 | 75.76611111 | -0.01 | Rising | 0.13 | Falling |
| 13 | Jalna | Bhokardan | Kedarkheda | 20.14833 | 75.81944444 | 0.10 | Falling | -0.17 | Rising |
| 14 | Jalna | Bhokardan | Khandala | 20.18333 | 75.68777778 | 0.55 | Falling | 0.11 | Falling |
| 15 | Jalna | Bhokardan | Kumbhari | 20.20833 | 75.76527778 | 0.06 | Falling | 0.14 | Falling |
| 16 | Jalna | Bhokardan | Latifpur | 20.12361 | 75.69861111 | -0.06 | Rising | 0.16 | Falling |
| 17 | Jalna | Bhokardan | Malkapur | 20.30667 | 75.78055556 | 0.02 | Falling | 0.26 | Falling |
| 18 | Jalna | Bhokardan | Malkheda | 20.27778 | 75.705 | -0.42 | Rising | -0.06 | Rising |
| 19 | Jalna | Bhokardan | Muthad | 20.24944 | 75.7 | -0.25 | Rising | 0.00 | Falling |
| 20 | Jalna | Bhokardan | Nalani Kh | 20.15889 | 75.88888889 | -0.11 | Rising | 0.56 | Falling |
| 21 | Jalna | Bhokardan | Pimpalgaon Renukai | 20.3875 | 75.8875 | -0.25 | Rising | -0.01 | Rising |
| 22 | Jalna | Bhokardan | Sawangi Awghadrao | 20.37639 | 75.93472222 | 0.12 | Falling | 0.37 | Falling |
| 23 | Jalna | Bhokardan | Shriasgaon mandap | 20.1825 | 75.72638889 | -0.09 | Rising | 0.23 | Falling |
| 24 | Jalna | Bhokardan | Takli kolte | 20.08667 | 75.60666667 | -0.12 | Rising | 0.08 | Falling |
| 25 | Jalna | Bhokardan | Wadhona | 20.51944 | 75.93888889 | 0.28 | Falling | 0.43 | Falling |
| 26 | Jalna | Bhokardan | Wakadi | 20.32472 | 75.77083333 | -0.05 | Rising | 0.26 | Falling |
| 27 | Jalna | Bhokardan | Walsa khalsa | 20.16333 | 75.79444444 | 0.38 | Falling | 0.22 | Falling |
| 28 | Jalna | Bhokardan | Walsadawargaon | 20.16111 | 75.79305556 | 0.32 | Falling | 0.07 | Falling |

**Annexure-IX**

**Aquifer-II, Ground water quality, Bhokardan taluka, Jalna district.**

| SN | Location | Type of Sample | Latitude | Longitude | pH | EC µS/cm | TDS | TH | Ca | Mg | Na | K | $CO_3$ | $HCO_3$ | Cl | $SO_4$ | $NO_3$ | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Nimgaon | EW | 20.1778 | 75.7333 | 7.1 | 2550 | 1557 | 210 | 80 | 2 | 483 | 3.0 | 0 | 61 | 603 | 346 | 3 | 0.44 |
| 2 | Rajur | EW | 20.0611 | 75.8625 | 7.3 | 1140 | 690 | 75 | 24 | 4 | 222 | 5.0 | 0 | 220 | 170 | 118 | 35 | 0.90 |
| 3 | Babulgaon | EW | 20.2458 | 75.8264 | 7.5 | 2190 | 1298 | 650 | 132 | 78 | 200 | 2.0 | 0 | 348 | 220 | 439 | 53 | 0.44 |
| 4 | Janephal Zone-II | EW | 20.1047 | 75.7658 | 7.7 | 1294 | 700 | 430 | 40 | 80 | 34 | 1 | 0 | 92 | 149 | 394 | 2 | 0.10 |
| 5 | Dhavda EW | EW | 20.5003 | 75.8894 | 7.7 | 1057 | 605 | 425 | 42 | 78 | 27 | 0.3 | 0 | 305 | 85 | 118 | 46 | 0.20 |
| 6 | Janephal Zone-I | EW | 20.1047 | 75.7658 | 8 | 600 | 343 | 250 | 30 | 43 | 17 | 0.2 | 0 | 153 | 50 | 80 | 31 | 0.10 |
| 7 | Pimpalgaon Renukai | EW | 20.3697 | 75.9011 | 8 | 915 | 520 | 425 | 86 | 51 | 8 | 0.3 | 0 | 183 | 85 | 135 | 51 | 0.40 |
| 8 | Siphora | EW | 20.2581 | 75.8647 | 8.3 | 1346 | 848 | 635 | 128 | 77 | 8 | 0.66 | 3 | 159 | 255 | 128 | ND | 1.28 |
| 9 | Hasnabad | EW | 20.1353 | 75.6997 | 8.3 | 329 | 214 | 120 | 42 | 4 | 48 | 1.91 | 9 | 85 | 74 | 35 | 10 | 0.23 |
| 10 | Nalni Bk. | EW | 20.1544 | 75.8858 | 7.6 | 1330 | 743 | 260 | 40 | 39 | 181 | 0.2 | 0 | 506 | 43 | 158 | 28 | 0.71 |
| 11 | Dawargaon Walsa | EW | 20.1756 | 75.8106 | 7.8 | 373 | 242 | 75 | 26 | 2 | 42 | 0.35 | 0 | 98 | 32 | 46 | 11 | 0.09 |
| 12 | Annava | EW | 20.4219 | 75.78 | 7.8 | 650 | 423 | 215 | 44 | 26 | 17 | 0.94 | 0 | 104 | 92 | 51 | 10 | 0.09 |

**Annexure X**

**Location of proposed Check Dams in Bhokardan taluka, Jalna district**

| SN | Longitude | Latitude | Diatrict | Taluka | Village |
|---|---|---|---|---|---|
| 1 | 75.6717 | 20.0976 | Jalna | Bhokardan | Pimpri |
| 2 | 75.7088 | 20.0805 | Jalna | Bhokardan | Ekephal |
| 3 | 75.7188 | 20.0779 | Jalna | Bhokardan | Palaskheda Dabhadi |
| 4 | 75.7427 | 20.0929 | Jalna | Bhokardan | Jawkheda Kh. |
| 5 | 75.6613 | 20.1505 | Jalna | Bhokardan | Goshegaon |
| 6 | 75.6667 | 20.1432 | Jalna | Bhokardan | Deulgaon (kaman) |
| 7 | 75.6635 | 20.1388 | Jalna | Bhokardan | Deulgaon (kaman) |
| 8 | 75.6556 | 20.1093 | Jalna | Bhokardan | Sawkheda |
| 9 | 75.6624 | 20.119 | Jalna | Bhokardan | Sawkheda |
| 10 | 75.6745 | 20.1221 | Jalna | Bhokardan | Ita |
| 11 | 75.7256 | 20.0678 | Jalna | Bhokardan | Palaskheda Dabhadi |
| 12 | 75.6785 | 20.1093 | Jalna | Bhokardan | Khadgaon |
| 13 | 75.8209 | 20.1184 | Jalna | Bhokardan | Banegaon |
| 14 | 75.8045 | 20.0527 | Jalna | Bhokardan | Chandai Eko |
| 15 | 75.8102 | 20.0618 | Jalna | Bhokardan | Chandai Eko |
| 16 | 75.8156 | 20.0702 | Jalna | Bhokardan | Chandai Tepli |
| 17 | 75.812 | 20.106 | Jalna | Bhokardan | Banegaon |
| 18 | 75.8302 | 20.1057 | Jalna | Bhokardan | Banegaon |
| 19 | 75.7445 | 20.1314 | Jalna | Bhokardan | Sirasgaon Waghrul |
| 20 | 75.7459 | 20.1408 | Jalna | Bhokardan | Rajala |
| 21 | 75.8284 | 20.4114 | Jalna | Bhokardan | Jalgaon (sapakal) |
| 22 | 75.7999 | 20.3552 | Jalna | Bhokardan | Kukdi |
| 23 | 75.8095 | 20.3518 | Jalna | Bhokardan | Kathora Bajar |
| 24 | 75.8202 | 20.3709 | Jalna | Bhokardan | Kalyani |
| 25 | 75.8127 | 20.4134 | Jalna | Bhokardan | Jalgaon (sapakal) |
| 26 | 75.8231 | 20.4164 | Jalna | Bhokardan | Jalgaon (sapakal) |
| 27 | 75.8352 | 20.4198 | Jalna | Bhokardan | Jalgaon (sapakal) |
| 28 | 75.8248 | 20.4034 | Jalna | Bhokardan | Jalgaon (sapakal) |
| 29 | 75.8409 | 20.4091 | Jalna | Bhokardan | Jalgaon (sapakal) |
| 30 | 75.8459 | 20.4201 | Jalna | Bhokardan | Hisoda Kh. |
| 31 | 75.8555 | 20.4248 | Jalna | Bhokardan | Hisoda Kh. |
| 32 | 75.8698 | 20.4318 | Jalna | Bhokardan | Hisoda Bk. |
| 33 | 75.7802 | 20.4329 | Jalna | Bhokardan | Koda |
| 34 | 75.7852 | 20.4205 | Jalna | Bhokardan | Anvapada |
| 35 | 75.7849 | 20.3672 | Jalna | Bhokardan | Kukdi |
| 36 | 75.7834 | 20.3773 | Jalna | Bhokardan | Wakdi |
| 37 | 75.7813 | 20.3873 | Jalna | Bhokardan | Anvapada |
| 38 | 75.7784 | 20.4007 | Jalna | Bhokardan | Anvapada |
| 39 | 75.7634 | 20.4138 | Jalna | Bhokardan | Karlawadi (n.v.) |
| 40 | 75.7813 | 20.3468 | Jalna | Bhokardan | Wakdi |
| 41 | 75.8134 | 20.3053 | Jalna | Bhokardan | Danapur |

| | | | | | |
|---|---|---|---|---|---|
| 42 | 75.8191 | 20.3029 | Jalna | Bhokardan | Danapur |
| 43 | 75.8231 | 20.2982 | Jalna | Bhokardan | Rajapur |
| 44 | 75.8173 | 20.2949 | Jalna | Bhokardan | Rajapur |
| 45 | 75.8073 | 20.2939 | Jalna | Bhokardan | Rajapur |
| 46 | 75.8198 | 20.2798 | Jalna | Bhokardan | Bhaydi |
| 47 | 75.8288 | 20.2765 | Jalna | Bhokardan | Bhaydi |
| 48 | 75.8388 | 20.2765 | Jalna | Bhokardan | Bhaydi |
| 49 | 75.8406 | 20.3438 | Jalna | Bhokardan | Palaskheda Murtad |
| 50 | 75.8384 | 20.3156 | Jalna | Bhokardan | Dehed |
| 51 | 75.8463 | 20.32 | Jalna | Bhokardan | Dehed |
| 52 | 75.8077 | 20.33 | Jalna | Bhokardan | Kathora Bajar |
| 53 | 75.8163 | 20.3233 | Jalna | Bhokardan | Danapur |
| 54 | 75.8234 | 20.3193 | Jalna | Bhokardan | Danapur |
| 55 | 75.9187 | 20.1345 | Jalna | Bhokardan | Khaparkheda |
| 56 | 75.8998 | 20.0946 | Jalna | Bhokardan | Palaskheda Pimpalya |
| 57 | 75.9038 | 20.104 | Jalna | Bhokardan | Palaskheda Pimpalya |
| 58 | 75.917 | 20.1197 | Jalna | Bhokardan | Pimpalgaon Thot |
| 59 | 75.873 | 20.1023 | Jalna | Bhokardan | Banegaon |
| 60 | 75.8713 | 20.1087 | Jalna | Bhokardan | Banegaon |
| 61 | 75.8645 | 20.118 | Jalna | Bhokardan | Banegaon |
| 62 | 75.8684 | 20.1234 | Jalna | Bhokardan | Tondoli |
| 63 | 75.8827 | 20.1355 | Jalna | Bhokardan | Nalni Bk. |
| 64 | 75.9045 | 20.1522 | Jalna | Bhokardan | Khaparkheda |
| 65 | 75.9013 | 20.0641 | Jalna | Bhokardan | Umarkheda |
| 66 | 75.9084 | 20.0561 | Jalna | Bhokardan | Umarkheda |
| 67 | 75.8959 | 20.0487 | Jalna | Bhokardan | Longaon |
| 68 | 75.8748 | 20.0792 | Jalna | Bhokardan | Thigalkheda |
| 69 | 75.8952 | 20.3558 | Jalna | Bhokardan | Warud Bk |
| 70 | 75.8691 | 20.318 | Jalna | Bhokardan | Godri |
| 71 | 75.8616 | 20.2949 | Jalna | Bhokardan | Godri |
| 72 | 75.8655 | 20.3029 | Jalna | Bhokardan | Godri |
| 73 | 75.8695 | 20.3086 | Jalna | Bhokardan | Godri |
| 74 | 75.9009 | 20.3079 | Jalna | Bhokardan | Malegaon |
| 75 | 75.9105 | 20.3096 | Jalna | Bhokardan | Malegaon |
| 76 | 75.9105 | 20.2952 | Jalna | Bhokardan | Kolegaon |
| 77 | 75.9116 | 20.2895 | Jalna | Bhokardan | Kolegaon |
| 78 | 75.9127 | 20.2821 | Jalna | Bhokardan | Kolegaon |
| 79 | 75.8788 | 20.3538 | Jalna | Bhokardan | Warud Bk |
| 80 | 75.8863 | 20.3562 | Jalna | Bhokardan | Warud Bk |
| 81 | 75.9277 | 20.3444 | Jalna | Bhokardan | Mohalai |
| 82 | 75.9298 | 20.3511 | Jalna | Bhokardan | Mohalai |
| 83 | 75.9352 | 20.3575 | Jalna | Bhokardan | Mohalai |
| 84 | 75.8548 | 20.3525 | Jalna | Bhokardan | Palaskheda Murtad |
| 85 | 75.8555 | 20.325 | Jalna | Bhokardan | Dehed |

| 86 | 75.8991 | 20.5313 | Jalna | Bhokardan | Dhawada |
|---|---|---|---|---|---|
| 87 | 75.9298 | 20.466 | Jalna | Bhokardan | Walsawangi |
| 88 | 75.9234 | 20.4751 | Jalna | Bhokardan | Walsawangi |
| 89 | 75.893 | 20.4124 | Jalna | Bhokardan | Leha |
| 90 | 75.903 | 20.5353 | Jalna | Bhokardan | Mehegaon |
| 91 | 75.9152 | 20.5404 | Jalna | Bhokardan | Mehegaon |
| 92 | 75.9016 | 20.5524 | Jalna | Bhokardan | Mehegaon |
| 93 | 75.8888 | 20.541 | Jalna | Bhokardan | Mehegaon |
| 94 | 75.8884 | 20.5079 | Jalna | Bhokardan | Dhawada |
| 95 | 75.8927 | 20.5129 | Jalna | Bhokardan | Dhawada |
| 96 | 75.9409 | 20.4898 | Jalna | Bhokardan | Walsawangi |
| 97 | 75.9352 | 20.4988 | Jalna | Bhokardan | Walsawangi |
| 98 | 75.9348 | 20.5246 | Jalna | Bhokardan | Wadhona |
| 99 | 75.8798 | 20.4677 | Jalna | Bhokardan | Wadhod Tangdya |
| 100 | 75.8698 | 20.4694 | Jalna | Bhokardan | Wadhod Tangdya |
| 101 | 75.9341 | 20.459 | Jalna | Bhokardan | Walsawangi |
| 102 | 75.9152 | 20.4861 | Jalna | Bhokardan | Walsawangi |
| 103 | 75.7158 | 20.3003 | Jalna | Bhokardan | Avhana |
| 104 | 75.7262 | 20.2986 | Jalna | Bhokardan | Avhana |
| 105 | 75.744 | 20.2845 | Jalna | Bhokardan | Gokul |
| 106 | 75.744 | 20.2715 | Jalna | Bhokardan | Nasirabad |
| 107 | 75.7579 | 20.2587 | Jalna | Bhokardan | BHOKARDAN |
| 108 | 75.8004 | 20.234 | Jalna | Bhokardan | Masanpur |
| 109 | 75.7983 | 20.2223 | Jalna | Bhokardan | Garkheda |
| 110 | 75.8572 | 20.2129 | Jalna | Bhokardan | Kodoli |
| 111 | 75.8614 | 20.2289 | Jalna | Bhokardan | Dautpur |
| 112 | 75.8771 | 20.2256 | Jalna | Bhokardan | Takli Bhokardan |
| 113 | 75.6567 | 20.1677 | Jalna | Bhokardan | Goshegaon |
| 114 | 75.6557 | 20.158 | Jalna | Bhokardan | Goshegaon |
| 115 | 75.6619 | 20.1498 | Jalna | Bhokardan | Goshegaon |
| 116 | 75.6575 | 20.1354 | Jalna | Bhokardan | Deulgaon (kaman) |
| 117 | 75.6607 | 20.1317 | Jalna | Bhokardan | Deulgaon (kaman) |
| 118 | 75.6839 | 20.1327 | Jalna | Bhokardan | Hasanabad |
| 119 | 75.6867 | 20.1268 | Jalna | Bhokardan | Hasanabad |
| 120 | 75.7037 | 20.1422 | Jalna | Bhokardan | Hasanabad |
| 121 | 75.7199 | 20.1335 | Jalna | Bhokardan | Borgaon Khadak |
| 122 | 75.7451 | 20.137 | Jalna | Bhokardan | Takli Bajad |
| 123 | 75.7722 | 20.1288 | Jalna | Bhokardan | Borgaon Taru |
| 124 | 75.7833 | 20.138 | Jalna | Bhokardan | Borgaon Taru |
| 125 | 75.665 | 20.1605 | Jalna | Bhokardan | Goshegaon |
| 126 | 75.656 | 20.1362 | Jalna | Bhokardan | Deulgaon (kaman) |
| 127 | 75.668 | 20.1523 | Jalna | Bhokardan | Goshegaon |
| 128 | 75.6907 | 20.1586 | Jalna | Bhokardan | Hasanabad |
| 129 | 75.8738 | 20.4939 | Jalna | Bhokardan | Dhawada |
| 130 | 75.9369 | 20.4417 | Jalna | Bhokardan | Padmavati |

| | | | | | |
|---|---|---|---|---|---|
| 131 | 75.9216 | 20.377 | Jalna | Bhokardan | Pimpalgaon (renukai) |
| 132 | 75.8905 | 20.3804 | Jalna | Bhokardan | Pimpalgaon (renukai) |
| 133 | 75.8295 | 20.3108 | Jalna | Bhokardan | Danapur |
| 134 | 75.7338 | 20.1845 | Jalna | Bhokardan | Nimgaon |
| 135 | 75.7335 | 20.205 | Jalna | Bhokardan | Sirasgaon (mandap) |
| 136 | 75.7338 | 20.2267 | Jalna | Bhokardan | Kshirsagar |
| 137 | 75.7917 | 20.1899 | Jalna | Bhokardan | Soegaon Devi |
| 138 | 75.8238 | 20.1839 | Jalna | Bhokardan | Baranjala (lokhande) |
| 139 | 75.9162 | 20.1755 | Jalna | Bhokardan | Tadegaon |
| 140 | 75.6225 | 20.0908 | Jalna | Bhokardan | Ridhora |
| 141 | 75.6646 | 20.0844 | Jalna | Bhokardan | Pimpri |
| 142 | 75.7203 | 20.1129 | Jalna | Bhokardan | Khadki |
| 143 | 75.7849 | 20.1193 | Jalna | Bhokardan | Deulgaon Tad |
| 144 | 75.8448 | 20.1293 | Jalna | Bhokardan | Tondoli |
| 145 | 75.8709 | 20.1484 | Jalna | Bhokardan | Tondoli |

**Annexure XI**

**Location of proposed Percolation Tanks in Bhokardan taluka, Jalna district**

| SN | Longitude | Latitude | District | Taluka | Village |
|---|---|---|---|---|---|
| 1 | 75.9098 | 20.1108 | Jalna | Bhokardan | Pimpalgaon Thot |
| 2 | 75.897 | 20.087 | Jalna | Bhokardan | Pimpalgaon Barao |
| 3 | 75.8902 | 20.0412 | Jalna | Bhokardan | Longaon |
| 4 | 75.9012 | 20.0469 | Jalna | Bhokardan | Longaon |
| 5 | 75.9134 | 20.0553 | Jalna | Bhokardan | Umarkheda |
| 6 | 75.9123 | 20.1272 | Jalna | Bhokardan | Pimpalgaon Thot |
| 7 | 75.9109 | 20.0673 | Jalna | Bhokardan | Umarkheda |
| 8 | 75.8641 | 20.1289 | Jalna | Bhokardan | Tondoli |
| 9 | 75.8684 | 20.0847 | Jalna | Bhokardan | Khamkheda |
| 10 | 75.8616 | 20.0944 | Jalna | Bhokardan | Thigalkheda |
| 11 | 75.6796 | 20.1225 | Jalna | Bhokardan | Ita |
| 12 | 75.6617 | 20.1289 | Jalna | Bhokardan | Deulgaon (kaman) |
| 13 | 75.6439 | 20.0984 | Jalna | Bhokardan | Pimpalgaon Kolte |
| 14 | 75.731 | 20.077 | Jalna | Bhokardan | Jawkheda Kh. |
| 15 | 75.7424 | 20.0864 | Jalna | Bhokardan | Jawkheda Kh. |
| 16 | 75.7474 | 20.0666 | Jalna | Bhokardan | Pimpalgaon Sermulki |
| 17 | 75.7385 | 20.0757 | Jalna | Bhokardan | Jawkheda Kh. |
| 18 | 75.6871 | 20.1396 | Jalna | Bhokardan | Hasanabad |
| 19 | 75.6985 | 20.1312 | Jalna | Bhokardan | Hasanabad |
| 20 | 75.7153 | 20.1292 | Jalna | Bhokardan | Borgaon Khadak |
| 21 | 75.8366 | 20.1687 | Jalna | Bhokardan | Jawkheda Thombari |
| 22 | 75.8759 | 20.1901 | Jalna | Bhokardan | Baranjala (sabale) |
| 23 | 75.9116 | 20.2791 | Jalna | Bhokardan | Walsa Wadala |
| 24 | 75.8927 | 20.5286 | Jalna | Bhokardan | Dhawada |
| 25 | 75.8274 | 20.4276 | Jalna | Bhokardan | Jalgaon (sapakal) |
| 26 | 75.8506 | 20.4507 | Jalna | Bhokardan | Dahigaon |
| 27 | 75.883 | 20.4165 | Jalna | Bhokardan | Leha |
| 28 | 75.892 | 20.4236 | Jalna | Bhokardan | Leha |
| 29 | 75.9312 | 20.3751 | Jalna | Bhokardan | Savangi (auaghadrao) |
| 30 | 75.9316 | 20.3553 | Jalna | Bhokardan | Mohalai |
| 31 | 75.8484 | 20.349 | Jalna | Bhokardan | Palaskheda Murtad |
| 32 | 75.8245 | 20.359 | Jalna | Bhokardan | Surangali |
| 33 | 75.8281 | 20.3005 | Jalna | Bhokardan | Danapur |
| 34 | 75.9069 | 20.2995 | Jalna | Bhokardan | Malegaon |
| 35 | 75.9334 | 20.5313 | Jalna | Bhokardan | Wadhona |
| 36 | 75.9094 | 20.539 | Jalna | Bhokardan | Mehegaon |
| 37 | 75.8179 | 20.2243 | Jalna | Bhokardan | Lingewadi |
| 38 | 75.8379 | 20.221 | Jalna | Bhokardan | Kodoli |
| 39 | 75.7404 | 20.27 | Jalna | Bhokardan | Nasirabad |
| 40 | 75.7328 | 20.2354 | Jalna | Bhokardan | Nanja |
| 41 | 75.9037 | 20.3538 | Jalna | Bhokardan | Relgaon |
| 42 | 75.7977 | 20.3528 | Jalna | Bhokardan | Kukdi |

| | | | | | |
|---|---|---|---|---|---|
| 43 | 75.797 | 20.1682 | Jalna | Bhokardan | Soegaon Devi |
| 44 | 75.7909 | 20.1384 | Jalna | Bhokardan | Deulgaon Tad |
| 45 | 75.7396 | 20.1733 | Jalna | Bhokardan | Nimgaon |
| 46 | 75.7535 | 20.1672 | Jalna | Bhokardan | Koparda |
| 47 | 75.741 | 20.2135 | Jalna | Bhokardan | Kshirsagar |
| 48 | 75.7213 | 20.183 | Jalna | Bhokardan | Sirasgaon (mandap) |
| 49 | 75.6953 | 20.1214 | Jalna | Bhokardan | Latifpur |
| 50 | 75.7449 | 20.1073 | Jalna | Bhokardan | Janephal Dabhadi |
| 51 | 75.8852 | 20.1786 | Jalna | Bhokardan | Baranjala (sabale) |