



## 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

## AQUIFER MAPPING REPORT

Tikamgarh District, Madhya Pradesh

उत्तरी मध्य क्षेत्र, भोपाल

North Central Region, Bhopal



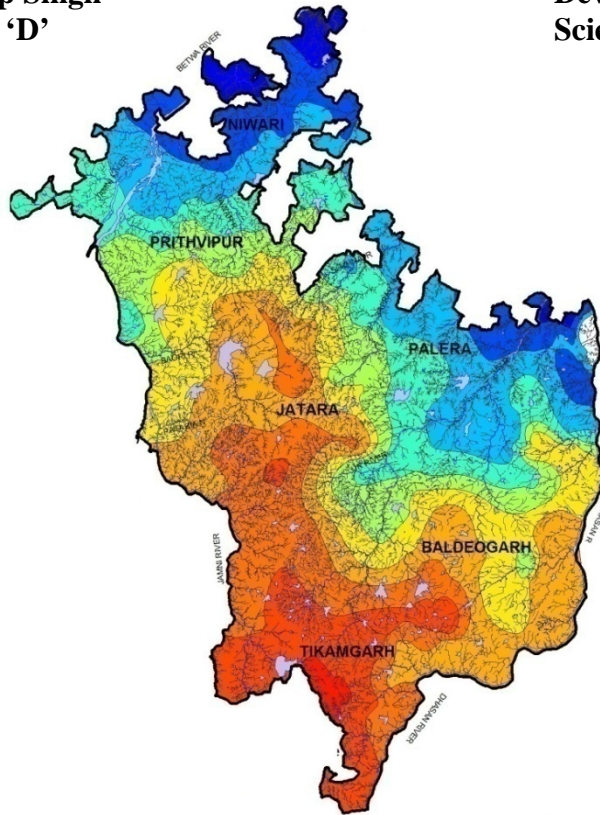
**Government of India**  
**Central Ground Water Board**  
**Ministry of Water Resources, River Development &**  
**Ganga Rejuvenation**

**GROUND WATER MANAGEMENT PLAN OFTIKAMGARH DISTRICT,  
MADHYA PRADESH**

By

**Bhanu Pratap Singh**  
Scientist 'D'

**Devendra Joshi**  
Scientist 'D'



**National Aquifer Mapping Programme**

**North Central Region**

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## PREFACE

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Aquifer mapping is as a multi-disciplinary scientific process, wherein a combination of geological, geophysical, hydrological and geochemical studies are applied to characterize the quantity, quality and sustainability of ground water. Systematic aquifer mapping is a procedure to improve our understanding of the hydrogeological framework of aquifer system.

Under the project on National Aquifer Mapping (NAQUIM) in XII & XIII Plan to formulate Sustainable Aquifer Management Plan, Central Ground Water Board (CGWB), North Central Region, Bhopal has taken up Tikamgarh district to prepare the 3-Dimensional Model and 2-Dimensional Aquifer Maps for the entire district and formulate Block-wise Aquifer Management Plan.

Tikamgarh district occupies an area of 5048 sq kms out of which the ground water recharge worthy area is 4881sq. kms, and the rest is covered by hilly and forest area. The major rivers flowing through the area includes the river Betwa, Jamni, &Dhasan.

The entire part of the district is covered by Granite & Gneisses. On the basis of the 121 Exploratory borewells drilled by CGWB, NCR under its Exploratory/NAQUIM program, it has been observed that the yield varies from 0.75 to 6 lps in granite. As per the Dynamic Ground Water Resource Assessment Report (2013), the Net Groundwater Availability in the district is 521.72MCM and ground water draft for all uses is 380.58MCM, resulting the stage of ground water development to be 72.95 % as a whole for district.

The Tikamgarh district falls under safe category. After the implementation of project interventions in the report, the stage of development is expected to improve by 38.18% i.e. from 72.95% to 34.77% for Tikamgarh district and additional area for the irrigation will be 649Ha. Tikamgarh district comprises of Six blocks, namely Baldeogarh, Jatara, Niwari, Palera, Prithvipur & Tikamgarh. As per the Management plan prepared under NAQUIM of all the Blocks of Tikamgarh District, Renovation/ de-silting of 283 Existing Tanks, 672 Recharge Shafts/Tube wells in Existing Tanks and 1983 Nala Bunds/Check Dams/Cement Plugs have been proposed and financial expenditure is expected to be Rs 290.10 Crores in Tikamgarh District for sustainable development and management of ground water resources.

Before finalization of this report a three tier evaluation mechanism is adopted. Presentations were made at Regional level & State level Coordination Committee, then the revised presentation were made before the Member and finally it was presented to National Level Expert Committee & after all corrections this report is prepared. Results of these comprehensive studies will contribute significantly to ground water sustainable management tools. It will not only enhance the long-term aquifer monitoring network, but would also help in building the conceptual and quantitative regional ground-water-flow models for planners, policy makers and other stakeholders.

I would like to place on record my appreciation for **B.P.Singh, Scientist ‘D’ & Devendra Joshi, Scientist ‘D’** for compilation of this report. I fondly hope that this report will serve as a valuable guide for sustainable development of ground water in Tikamgarh District, Madhya Pradesh.

**Parvinder Singh**  
(Regional Director)

## **Aquifer Mapping & Management Plan of Tikamgarh District, Madhya Pradesh**

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# 1.1 INTRODUCTION

## 1.1 Objectives, Scope of the Study, Approach and Methodology

### 1.1.1 Objectives-

- Define aquifer geometry on 1: 50,000 scale, type of aquifers, ground water regime behavior, hydraulic characteristics, and geochemistry of aquifer systems.
- Develop a dynamic system for Sustainable Management of ground water resources for an aquifer as a unit.

### 1.1.2 Scope of the Study-

Under NAQUIM, all the blocks of Tikamgarh district have been studied during the AAP2013-2016 and utilized existing data of ground water exploration, water level and water quality of NHS& key wells

Data collection, compilation, bringing entire data to GIS platform, data gap analysis and data generation

To establish the aquifer geometry & characteristics

Aquifer Management Plan.

### 1.1.3 Approach and Methodology-

- Entire blocks of Tikamgarh district has been covered by Granite/Gneisses.
- Area was divided grid wise and aquifer wise basic requirement for establishing aquifer geometry and characteristics upto 200 m where data generation is required& quality parameters specific to the area
- Preparation of Base Map on 1:50,000 scale, Geology and Geomorphology
- Compilation of existing data for mapping : Exploratory Data Availability, Geophysical Information
- Pre processing of Exploratory Data , Ground Water Level, Ground Water Quality

### METHODOLOGY FOR ARRIVING AT DATA GAP

### 1.1.4 Exploratory Data- (Desirable spatial scale – in 5' x 5' grids)

- Exploratory well of 200 m depth, 5 EW's and 5 OW's should be constructed at suitable locations, preferably one in central quadrant and one each in the four corner quadrants for establishing aquifer geometry and determining aquifer parameters.
- Aquifer performance test shall be conducted at all the five EW's tapping the fracture aquifer to estimate the aquifer hydraulic parameters and water quality .
- Existing exploratory Data and Data gap analysis

#### 1.1.5 Geophysical Data-

2 or 3 Profiling/VES/TEM having 200 meter interpretation depth should be carried out in each of the nine quadrants of the toposheet totaling 18 to 27 nos. in each sheet to decipher aquifer geometry) & use of existing geophysical data for Data gap analysis.

#### 1.1.6 Ground Water Monitoring Data- Data Required :5' x 5' grids

- i. For 1<sup>st</sup> aquifer (un-confined/Phreatic) two open dug wells are recommended for each quadrant of a topo sheet.
- ii. For 2<sup>nd</sup> and 3<sup>rd</sup> aquifer, the well-constructed in the Well field and special purpose wells may be used as piezometers for GW monitoring. Minimum four times monitoring annually.

#### 1.1.7 Ground Water Quality Data- Data Required 5' x 5' grids.

- i. For 1<sup>st</sup> aquifer (un-confined/Phreatic) one sample from open/dug wells are recommended for each quadrant of a toposheet.
- ii. For 2<sup>nd</sup> aquifer, the sample is to be collected from well-constructed in the Well field explained above and Special Purpose wells for GW Quality monitoring .Minimum two times monitoring initially is recommended.

#### 1.1.8 Data Generation-

Value addition of Geological map. Preparation of subsurface geology of the area .

Value addition of Geomorphological map

Analysis of Land use pattern,

Conduct additional required VES/TEM

Analysis of Water bodies of the area, Impact of Water bodies on surrounding, Ground Water Regime, Surface water –Groundwater interaction studies

Water level monitoring of key wells - 4 Times in a year for 3 Consecutive years ,

Exploratory drilling –Construction of EW,OW,PZ. Pump test of EW for determination of Aquifer Parameters, Piezometers construction for installation of A.W.L.R

Groundwater quality Data Generation :Collection of required water samples and analysis for Ground Water Quality Assessment

#### 1.1.9 Aquifer Map Preparation: 1:50,000 Scale- Map Showing Different Layers

### **Aquifer Wise Management Plan**

Aquifer wise ground water management through integration of various data / information in the form of thematic layers.

- Feasible areas for ground water development along with yield potential / Depth of drilling / safe yields etc.
- Feasible areas for rainwater harvesting and ground water recharge vis a vis aquifer storage available for recharge and surplus non committed surface water available for recharge.

## 1.2 Area Details-

Tikamgarh district lies at the centre of the historical and geographical region of Bundelkhand which lies in the northern part of the state and covers an area of 5048 Sq kms. It lies between North latitude 24°26' & 25°34' and east longitude 78°26' & 79°21', falling in Survey of India toposheet Nos 54K, 54L, 54O & 54P. The whole of the district lies above the Tropic of Cancer.

<b>Total Geographical Area (Sq km )</b>	<b>5048</b>
<b>Mappable Area(Sq km )</b>	<b>4881</b>
<b>Hilly/Forest (Sq km )</b>	<b>167</b>

Physical boundaries of the district are formed by Betwa and two of its tributaries Jamni and Dhasan. Betwa runs along the northern boundary of the district; Jamni traverses almost the entire western boundary to join Betwa near Orchha; Dhasan runs along much of the southern and eastern boundaries of the district. Tikamgarh is bounded by Chhatarpur in the east and south. The western and northern boundaries run along Lalitpur and Jhansi districts of Uttar Pradesh respectively.

### 1.2.1 Demographic Characteristics-

The total geographical area of the district is 5048 Sq. Km. It is administratively divided into Ten tehsils & six development blocks, viz Niwari, Jatara, Tikamgarh, Prithvipur, Baldeogarh and Palera (Fig 1.2.2). Tikamgarh has a population of 14,44,920 people as per (2011) census with 7,59,891 and 6,85,029 of the population comprising of Male and Female respectively. As regards to the geographical classification, the district has 13 towns in which nearly 17.68% of the population lives, while the rest 82.32% lives in the 963 inhabited villages comprising the rural areas. Table: 1.2.1 Population of Tikamgarh district

- Population density/sq km as per (2011) census is 286. There is a marked increase in the population density per sq km in last one decade i.e. from 239 in (2001) to 286 in (2011). In the last ten years (2001 to 2011), the percentage increase in population is 16.70%, and growth rate (2011) is about 20.1%. There are 963 villages in the district.

Table: 1.2.1 Population of Tikamgarh district





**Table 1.2.2:Administrative Divisions& Stage of development,District,Tikamgarh, M.P.**

<b>Block</b>	<b>Area</b>	<b>Category</b>	<b>Stage of Ground Water Development</b>	<b>No. of Towns</b>
	<b>(sq km)</b>		<b>%</b>	
<b>Baldeogarh</b>	<b>858.96</b>	<b>Semi-critical</b>	<b>78.52</b>	<b>3</b>
<b>Jatara</b>	<b>1008.60</b>	<b>Semi-critical</b>	<b>70.62</b>	<b>2</b>
<b>Niwari</b>	<b>606</b>	<b>Semi-critical</b>	<b>77.76</b>	<b>2</b>
<b>Palera</b>	<b>748.22</b>	<b>Semi-critical</b>	<b>77.13</b>	<b>1</b>
<b>Prithvipur</b>	<b>958.62</b>	<b>safe</b>	<b>56.21</b>	<b>2</b>
<b>Tikamgarh</b>	<b>867.60</b>	<b>Semi-critical</b>	<b>81.11</b>	<b>3</b>
<b>Total</b>	<b>5048</b>		<b>72.95</b>	<b>13</b>

### 1.2.3 Any other relevant Information-

#### Previous studies:

Prior to this study, the groundwater hydrogeology has been studied only in separate parts with many areas left untouched. As a result, there was no hydro-geologic framework developed so as to understand the regional effects of groundwater development in the area.

#### CGWB Activities

Systematic Hydrogeological Survey in Tikamgarh district was carried out by Sh. P.N. Singh and Sh. V.S. Verma during 1990-91.

Report on “Groundwater resources and development potential of Tikamgarh district” was prepared by Sh. R.N. Sharma in 1994.

Exploratory Drilling by Contractual drilling under accelerated exploratory drilling in the years 2001-02 and 2004-05.

District Ground Water Management and Development studies in Niwari, Jatara and Prithvipur block of Tikamgarh district by Sh. D.K. Rai, Sc ‘B’ in the Year 2005-06.

District Ground Water Management and Development studies in Tikamgarh, Palera and Baldeogarh block of Tikamgarh district by Sh. A.K. Jain, Sc ‘B’ in the year 2005-2006.

#### 1.2.4 Data availability, Data adequacy, Data Gap analysis and Data Generation-

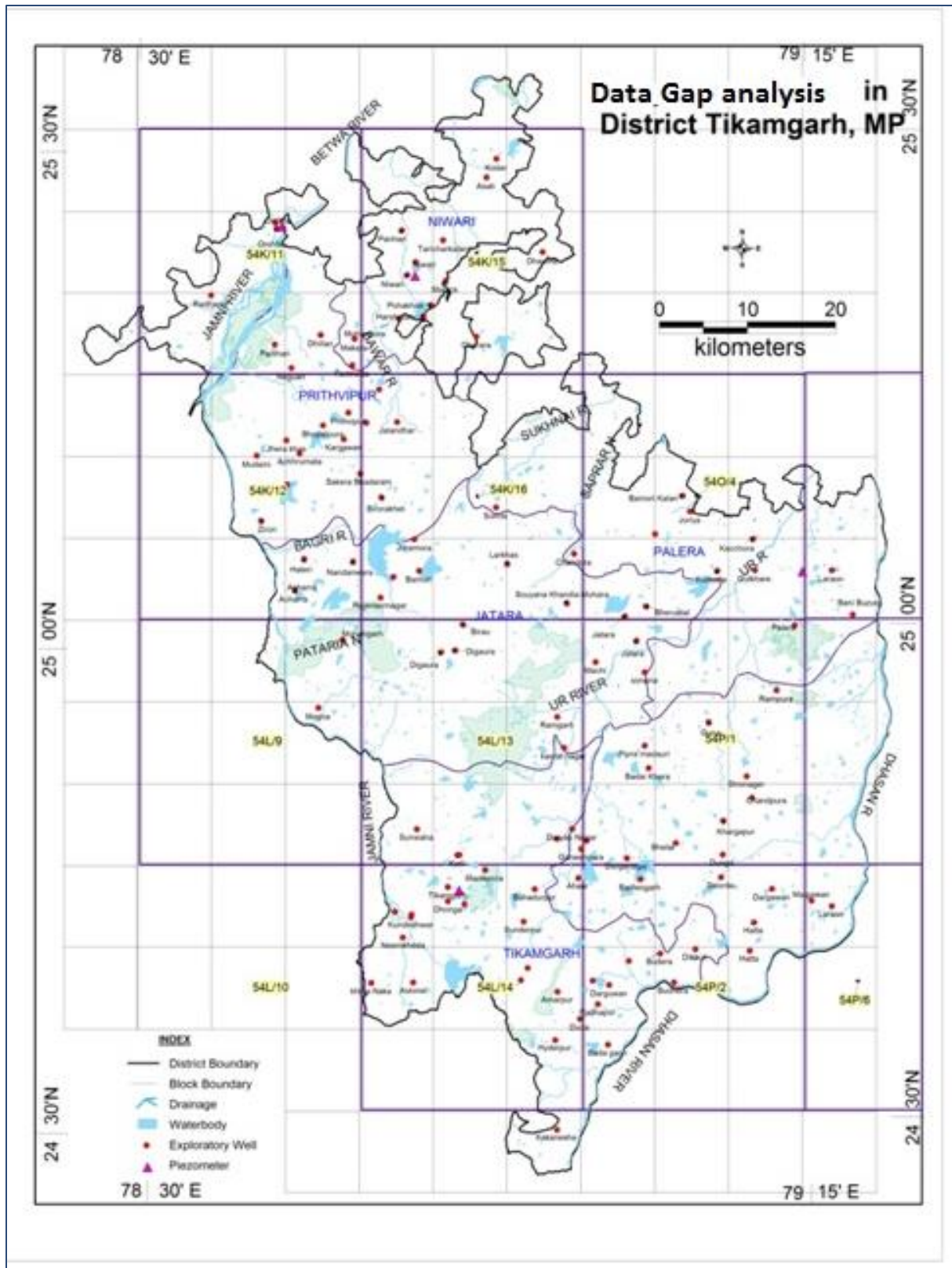
One of the important aspect of the aquifer mapping program was the synthesis of the large volume of data already collected during specific studies carried out by Central Ground Water Board and various Government organizations with a new data set generated, that broadly describe an aquifer system. The data were assembled, analyzed, examined, synthesized and interpreted from available sources. These sources were predominantly non-computerized data, which was converted into computer based GIS data sets. On the basis of available data, Data Gaps were identified.

The data gap analysis carried out helped to generate data from data-collection activities such as BDR of exploratory Wells, water level measurements and groundwater quality analysis done by CGWB & State Department

#### 1.2.5 Groundwater Exploration-

CGWB had drilled 23 exploratory wells through Private Contractor in 2001-02 & 30 exploratory wells in 2004-05. 6 exploratory wells were constructed through WAPCOS in 2012-13 prior to commencement of NAQUIM programme.

Fig.1.2.4 Data Gap Analysis



### 1.3 Rainfall-spatial, temporal and secular distribution-

The average annual rainfall of Tikamgarh district is about 1000 mm, based on average of 7 stations (**Table 1.3**). Rainfall increases from west to east and is lowest in the southwestern portion. About 91 % of the rainfall takes place from June to September, 7 - 8% takes place in the winter months and only about 2% in summer. It is only during the monsoon that surplus water for deep percolation is available in the district. The normal rainfall follows a normal distribution during the year.

Average annual number of rainy days varies between 40 to 47 during the four monsoon months and there were about 2 rainy days each in October- November and January-February. Rains in Tikamgarh thus follow the typical pattern of monsoon rainfall within a short period of time during the year. Conserving the water thus becomes of paramount importance. The people & Kings of Tikamgarh seem to have realized this long ago; their concern for conservation of water received during the plentiful rainy season is reflected in the extraordinary large number of exceedingly beautiful and sophisticated tanks that abound here.

From the rainfall analysis data of last 45 Years, it has been derived that the **district experiences a year of deficit rainfall once in every 2-3 years** and a year of excessive rainfall once in every 7 years.

The climate of Tikamgarh district is semi- tropical, characterized by hot summer and well distributed rainfall during the south west monsoon season. Mean monthly max. temperature of the district varies between 42<sup>0</sup>c in May, which is the hottest month and January is the coldest month with the temperature falling as low as 24.3<sup>0</sup>C. Mean monthly minimum temperature of the district varies between 26<sup>0</sup>c in June to 7<sup>0</sup>C in January .

The period from March to first week of June is the summer season. May is the hottest month when the temperature may go upto 45<sup>0</sup>C.

**Table 1.3: Average Rainfall in Tikamgarh district of last(08 years)**

Year	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	Total
2008-09	534.3	269.6	260.4	89.4	1.5	18.5	-	18.4	-	0.3	0.7	9.4	1150
2009-10	12	217.6	201.5	104.1	121	29.9	2.3	-	17.6	-	-	-	702.04
2010-11	17.3	213.5	214	121	5.3	19.8	0.7	-	2.7	-	-	3	599.5
2011-12	424	256.7	210.3	139.4	-	-	-	31.4	-	-	2.6	-	1064.4
2012-13	12.1	397.6	378.6	81.3	-	-	-	0.1	71	3.1	0.7	-	945.45
2013-14	153.72	473.17	512.17	31.83	80.00	1.50	12.33	63.50	45.00	10.00	0.83		1392.58
2014-15	35.67	168.00	166.67	60.00	4.00	-	29.20	39.20	14.60	54.10	18.50	-	590.13
2015-16	57.3	226.6	168.4	24.6	7.3	1.1	1.3	8.3	0.9	9.7		26.4	531.9

#### 1.4 Physiography/DEM/Topographic Elevation

Geographically, Tikamgarh forms nearly the centre of the Bundelkhand Region that lies between the Vindhyan plateau in the south and the great Ganga-Yamuna plains in the north. Like the region in general, the district has a distinct slope toward the north-east. The slope is relatively more marked in Tikamgarh district, because the southwestern parts of the district nearly touches the high Vindhyan plateau.

Average elevation above mean sea level of the southwestern part is around 350 meters; it gently drops to about 150 m in the northeast and it is gradually merging with the Ganga-Yamuna plain. The highest peak in the southwest rises to 403 meters. This is situated in the southern part of Tikamgarh tehsil. But there are several other spots in the western part of the district, with elevation of around 380 to 400 meters.(Fig:1.4.1 &1.4.2)

**Table 1.4 :Blockwise Elevation**

S No	Block	Maximum elevation	Minimum elevation
1.	Baldeogarh	320	220
2.	Jatara	320	260
3.	Niwari	240	220
4.	Palera	260	220
5.	Prithvipur	340	260
6.	Tikamgarh	>360	320

More significantly, however, there are several spot in the relatively lower northeastern part, with high elevations. The geomorphology of the district is marked by the presence of Inselbergs that rises much above the surrounding pediplains. Quartz Reefs that form high Linear Ridges which occasionally run over several kilometers, and also several denudational hills. The spots of high elevation, both in the southwestern and northeastern parts are all located on these elevated features.

The long continuous line of high gradient in the map are mainly along the linear ridges formed by the Quartz Reefs. In the Slope Map, such ridges, aligned in the northeast-southwest (NE-SW) direction are seen to be interspersed throughout the district and several of them run a long distance. Slope of these ridges is fairly steep, often rising to 15-35 percent range. Patches of steeper slope are however extremely rare.

Smaller but more dispersed patches of high gradient are seen where the Inselbergs rise high above the surrounding pediplains. The widespread patches of relatively less steep gradient in the map mostly indicate Inselbergs and pediment Inselberg complexes.

Denudational hills in several parts of the district are also indicated by similar patch of high gradient.



Fig.1.4.1

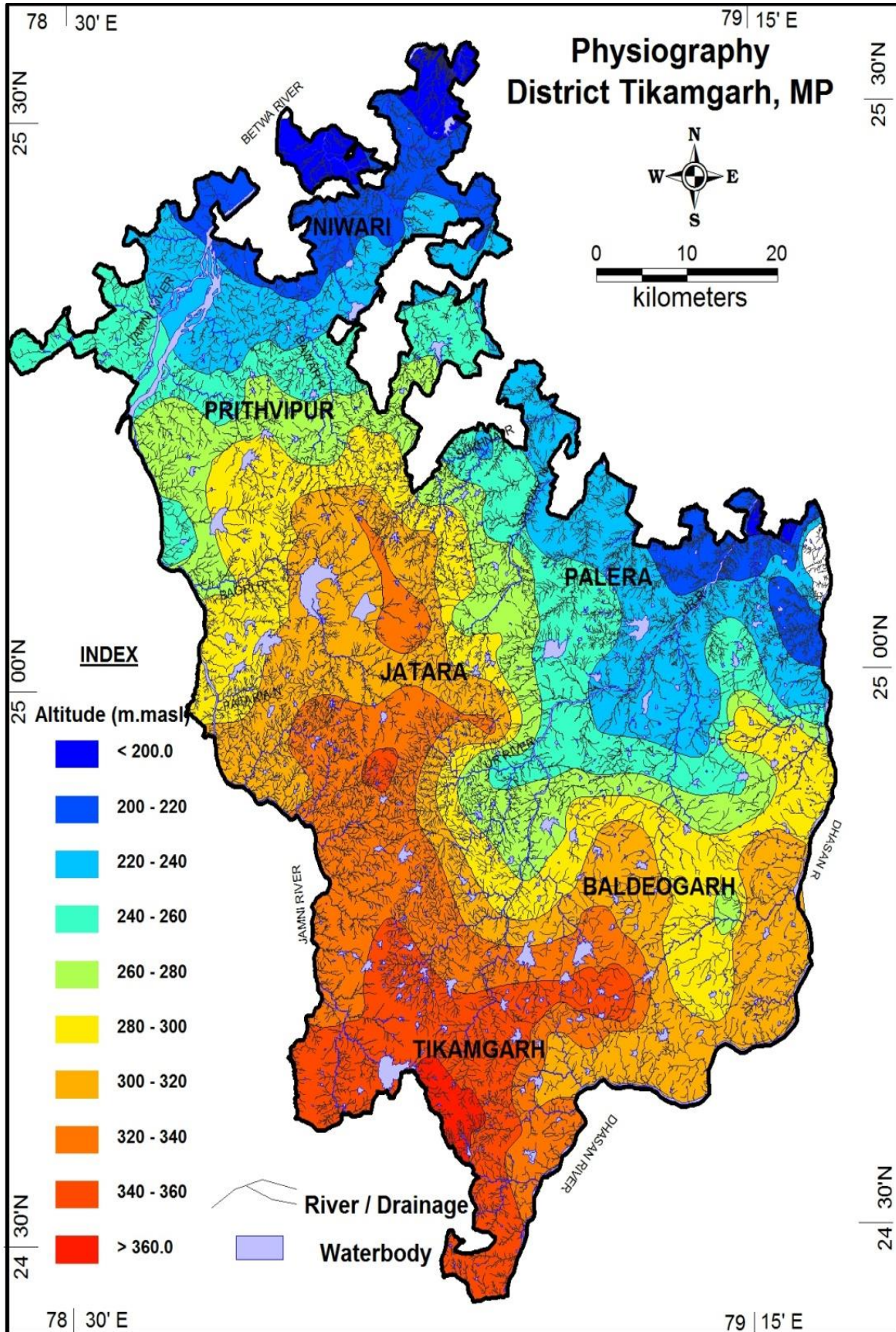
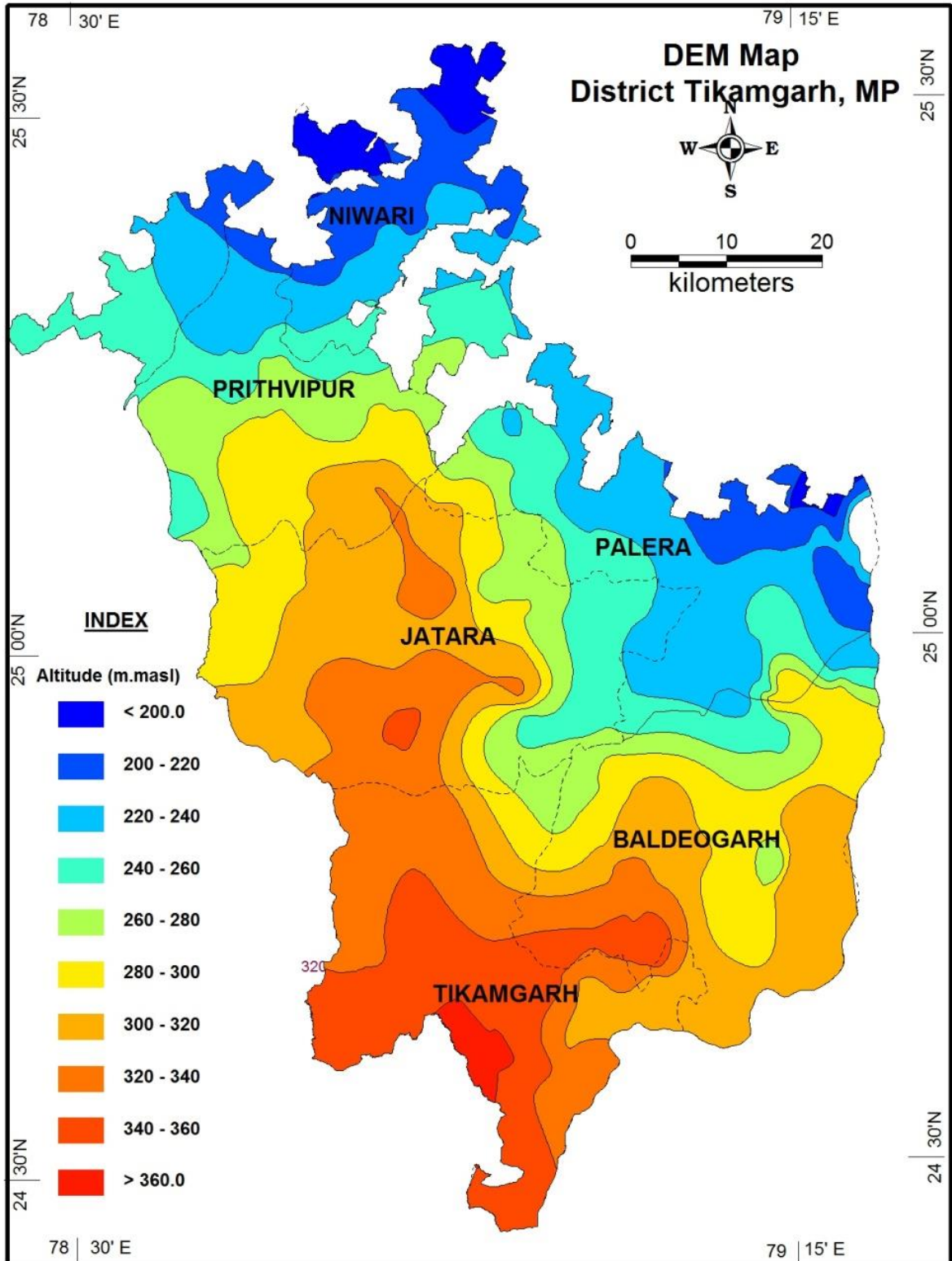


Fig.1.4.2





## 1.5 Geomorphology-

Geomorphologically, the district is dominated by pediplains formed by the erosion of Granites. Harder rock material resistant to erosion has taken the form of Inselbergs. Such Inselbergs, rising sharply from the surface in a conical form, are a distinctive feature of Tikamgarh.

The pediplains that cover three-fourth of the surface are moderately buried by weathered material offering good support for agriculture. Near Betwa and Jamni in the north, there is an extent of weathered bedrock with thin or no soil cover; such a landform is termed shallow Buried Pediment. (Fig: 1.5.1)

Around Jatara and Prithvipur towns, there are also stretches of shallow Buried pediment interspersed with Inselbergs; this landform is known as pediment Inselberg complex. To the north-east of Tikamgarh town, there are several small hills interspersed with patches of flat land. These Denudational Hills are higher in elevation than the Inselbergs.

Linear Ridges formed of Giant Quartz Veins, which have been mentioned earlier, form another distinctive landform of structural origin in the district. **These ridges act as barriers against the flow of surface and ground water.** Several large water-bodies in the district are built along these ridges.

**Table 1.5: Area of Geomorphic surface**

Geomorphology	Area in ha
Moderate Buried Pedi-plain	383,675
Shallow Buried pediment	12,371
Inselberg	44,778
Pediment Inselberg Complex	30,861
Denudational hill	9,025
Linear Ridge/ Dike	9,159
Rivers and Water-Bodies	15,057
<b>Total</b>	<b>504,926</b>

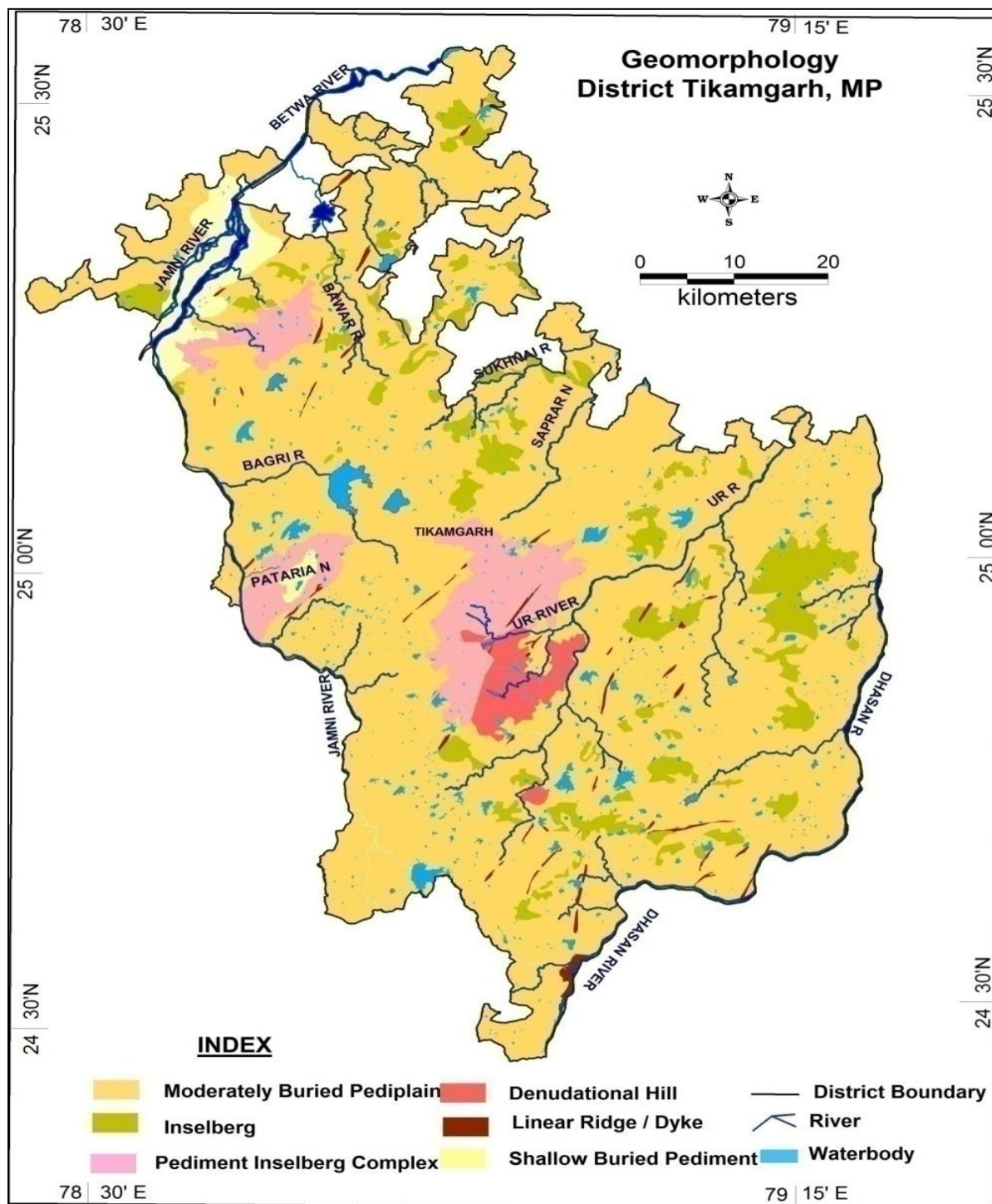
Geomorphologic features are directly controlled by the geological formations and their structures. They can be classified into two broad regions.

1. The hill ranges.
2. The intermountain fertile valleys.

The hill ranges are made up of hard compact and resistant granite masses intruded by quartz reef. The height of hill range varies from 200 to 400 m amsl.

The intermountain valley is fertile and covered by colluvial and detrital of parent rock along with organic material. The thickness of alluvial fill varies from 10-16 meters. Thus, the important valleys in the district are:

1. Joramora – Madia valley sloping N-W
2. Majrakachhar to Dighaura Khurd village sloping north –west.
3. Mudeni to Dhoura valley trending northwards.
4. Bachchoda to Kistone valley trending northwards.



**Fig:1.5.1**

- Major Part of the district is covered by Moderately Burried Pedi-plain.
- Linear Ridges of Quartz Veins trending NE-SW act as barriers against flow of Surface & Ground water.

## **1.6 Land use-**

Geographical area of Tikamgarh according to the Madhya Pradesh Revenue Department is 504,002 hectares. Out of this, 68,789 hectares of land, forming 13.64 percent of the total area, is classified as forest. Of this, about 29 thousand is revenue forest and the remaining about 40 thousand is classified as reserved and protected forest.

The triennial average of net sown area for the period 2014-15 is 276,480 ha. This forms about 54.7 percent of the geographical area. Current and other fallows comprise another 66,503 ha, accounting for 13.23 percent of the area.

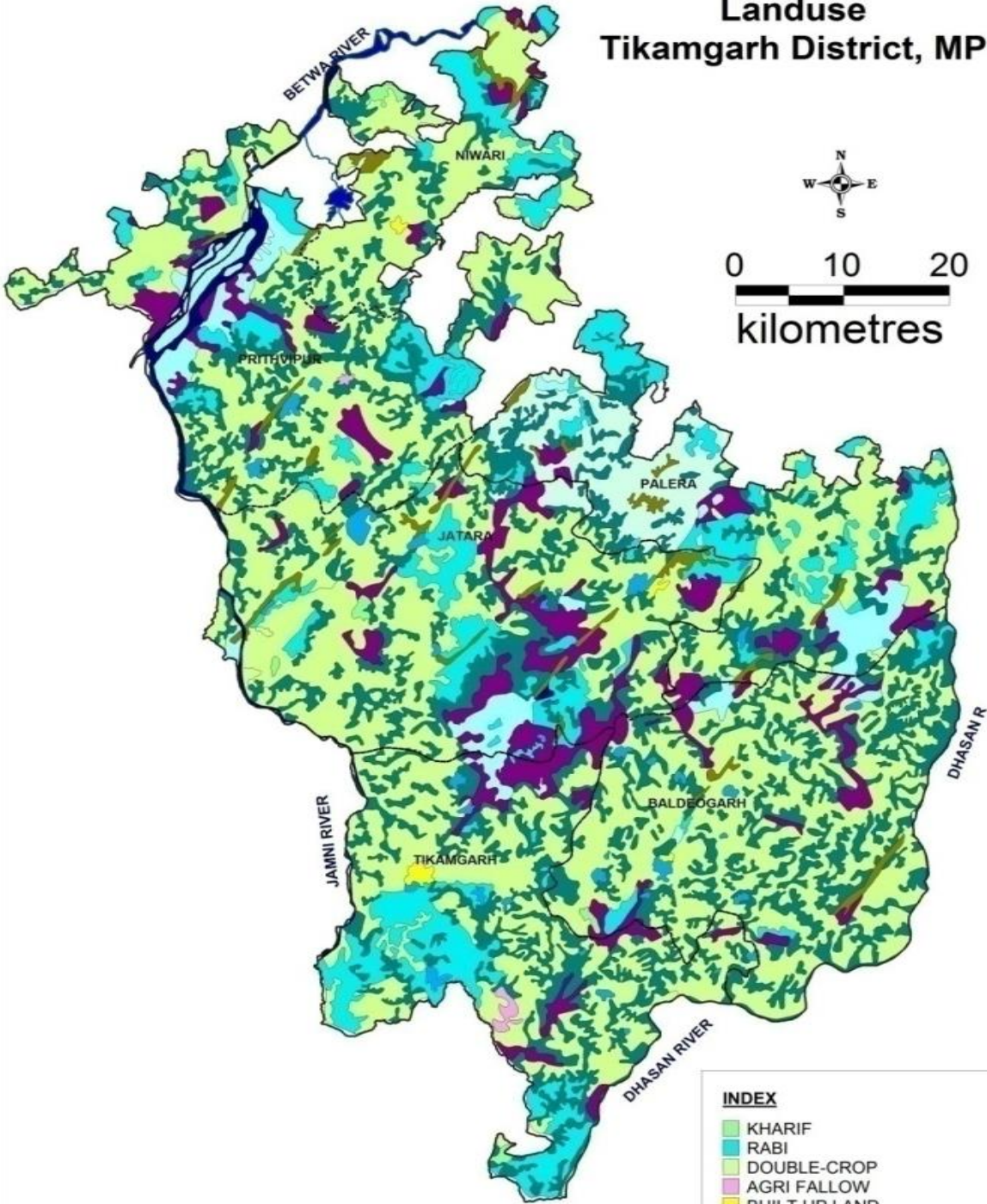
During the last few years, sowing has tended to decline and fallows have correspondingly risen. Taking net sown area and the fallows together, about 58 percent of the geographical area of the district is under cultivation.

This ratio is high compared to several other districts and the average of the state; in the state as a whole net sown area along with area under current and other fallows forms about 53 percent of the geographical area.

In addition to the cultivated and fallows land, the district has 22,165 ha, of culturable waste forming 4.40 percent of the area. This is also potentially cultivable. An area of 66,657 ha, forming 13.23 percent of the total, is classified as barren and uncultivable.

Pastures, including trees and groves, cover 23,788 ha, forming 4.72 percent of the land. The remaining 29,060 ha, forming 5.77 percent of the total, is under non-agricultural use.

# Landuse Tikamgarh District, MP



0 10 20



kilometres

**INDEX**

- KHARIF
- RABI
- DOUBLE-CROP
- AGRI FALLOW
- BUILT UP LAND
- DECID MOIST DRY
- FOREST BLANK
- LAKE / RESERVOIR / TANK
- RIVER orSTREAM
- SCRUB DEGRADED FOREST
- WASTE BARREN STONY SHEET



## 1.7 Soil

Soil of Tikamgarh belongs largely to the order of Entisols or Inceptisols, both of which are characterised by a weak development of horizon. Entisols have no profile development except a shallow marginal A-horizon; Inceptisols are somewhere better and have weak to moderate horizon development. Of 4.95 lakh hectares of area for which we have the soil-classification data, 1.60 lakh hectares falls in the order of Entisols and 3.14 lakh hectares in Inceptisols; only 21 thousand hectares of the area has richer soil belonging to the Alfisols.

Thus the soils of Tikamgarh in general, display weak development of horizon and have low organic content, but are fairly good at maintaining a humid moisture regime.

Soils derived from parent rocks are of three types i.e. black humus, granitic and yellowish grey colour with kankar. Soils are derived due to disintegration and decomposition of parent Rivers.

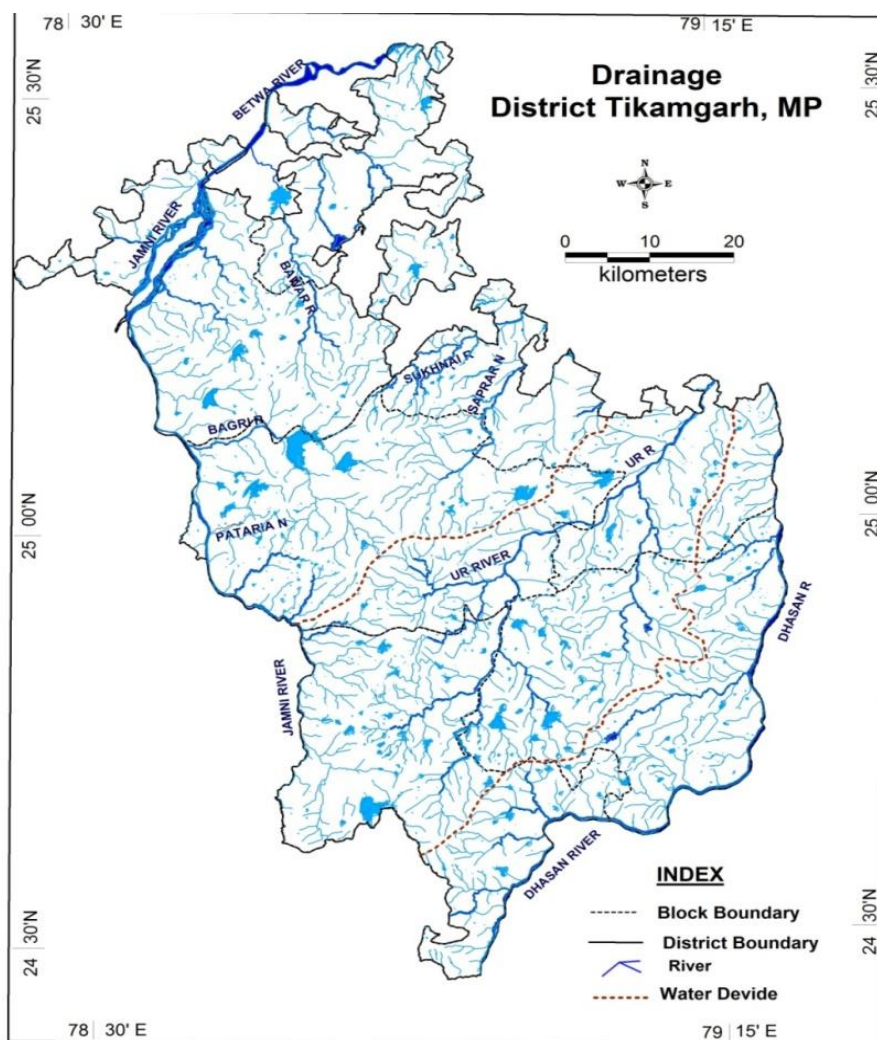
## 1.8 Hydrology and Drainage

**Drainage:** Tikamgarh, like almost all districts of India is criss-crossed and bounded by several rivers. **Betwa**, the greatest river of Bundelkhand, traverses a short distance of about 34 kilometers in the northwestern boundary of the district. Orchha, the capital of the earlier Orchha State, is on the bank of Betwa.

### Major Rivers: Betwa, Jamni & Dhasan.

**Jamni**, a substantial tributary of Betwa, traverses much of the western boundary of Tikamgarh. **Dhasan**, another large tributary of Betwa, flows along much of the southern and almost the entire eastern boundary of the district.

**Betwa** is one of the large tributaries of Yamuna. It rises from the Vindhya in Raisen district and traverses through Vidisha, Sagar, AshokNagar and Shivpuri before reaching Tikamgarh. Beyond Shivpuri, the river flows mainly through Uttar



Pradesh, except for the small stretch in Tikamgarh, and meets with Yamuna in Hamirpur district of that state.

**Dhasan** rises in sagar district. It enters Tikamgarh from Lalitpur and meets Betwa on its right bank in Jhansi of Uttar Pradesh. Jamni rises near Madanpur in Lalitpur and after flowing along the western boundary of Tikamgarh with Lalitpur meets Betwa on its right bank near Orchha town.

Drainage and River System due to the difference in altitudes, all the rivers in the district flow from south to north. The slope of the district is towards the north and the north east.

The drainage can be primarily divided in three major river basins, which are:

**A) Betwa basin:** Most of the region in this basin comprises of the Niwari block which makes the north western part of the district. It comprises of sub basins of two rivers namely Betwa and Jamni. The Bundelkhand plateau starts from the northern part of this basin. This river touches the boundary of the district at Badora village and flows along the boundary of the district for almost 14 kms, before flowing into the Tikamgarh district and re-entering Jhansi tehsil at Banguan village. In the district, this river has been dammed at Dhukuwa and Parischa..tributaries of Betwa: Besides Dhasan, some minor streams flowing from the hills of Moth, Jhansi and Mau-Ranipur tehsils form the tributaries of the Betwa river. An important stream is the Barwa which has been dammed to form Barwa Sagar lake in the district.

**B)Jamni basin:** This is a tributary of Betwa river, which flows across on the western boundary of the district, that forms the natural boundary of the district. The shape of this basin is in a form of strip which runs along the western boundary. The mean height of this region varies from 300 to 400 meters above mean sea level. At some places it is more than 400 mamsl.

**C)Dhasan:**Arising from Madhya Pradesh, this river enters the district through the Mau-Ranipur tehsil and forms its boundary with Mahoba and Hamirpur districts. The river has a rocky bed and its course is flanked by ravines, which grow highly complex as it approaches Betwa. The river has been dammed at Lahchura and Pahari and is used to divert water to irrigation canals.Important tributaries of the Dhasan are the Ur, Sukhnai, Lakheri and the Chainch. These are primarily monsoon rivers that cause floods during the monsoons but are usually completely dried up after the winters.

### 1.9 Agriculture, Irrigation& Cropping pattern:

Net sown area of Tikamgarh District is 2,76,480 ha as shown in table No1.9.1

**Table No.1.9.1 ; Net Sown Area of Tikamgarh District(2014-15)**

Area	Type of soil	Net Area sown	Area irrigated by surface water	Area Irrigated by GW
		Ha	Ha	Ha
Tikamgarh	Entisols,Inceptisols,	2,76,480	51,427	1,70,532

District	Alfisols			
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**Table No.1.9.2: Area Irrigated by Different Sources in Tikamgarh District.**

Block	Area Irrigated by		Total Area Irrigated by Ground Water	Area Irrigated by			Total Area Irrigated by Surface Water
	Dug wells	Tube wells		Tanks	Canals	River & Nala	
	Ha	Ha		Ha	Ha	Ha	
Baldeogarh	25860	3440	29300	2601	4897	2160	9658
Jatara	30583	4745	35328	3080	4233	2615	9928
Niwari	24735	1407	26142	2882	6590	2816	12288
Palera	33347	11382	44729	1931	3225	3754	8914
Prithvipur	34658	4215	38873	1918	2005	955	4878
Tikamgarh	18579	8019	26598	9410	4109	2889	16408
<b>Total</b>	<b>175315</b>	<b>33208</b>	<b>197170</b>	<b>21822</b>	<b>25059</b>	<b>15189</b>	<b>62074</b>

**Cropping pattern:**The summer (Kharif) crop is the main crop of Tikamgarh district. The crop is nourished by monsoon rains. The main Kharif crops of Tikamgarh district are the pulses of Urad & Moong-Moth and the oil-seeds crops of Groundnut (Moongphali), Soyabean & Til. Earlier, Paddy, jowar, Kodon-Kutki and several other millets were also grown but the area under summer cereals has declined. The main winter (Rabi) crops of the district are Wheat, Barley (Jau), Gram (chana), peas, lentil (masur) and Mastard-Rapeseed (Sarson- Rai).

### 1.10 Prevailing Water Conservation/Recharge Practices and any other relevant Information:

#### 1.10.1 Artificial Recharge Structures Constructed by State Agency

Agency	Check dams	Balram Talab	Stop dam	Dugwell recharge
PHED	20			
Agriculture		12		

MGNREGA		872	67	466
<b>Total</b>	<b>20</b>	<b>884</b>	<b>67</b>	<b>466</b>

#### 1.10.2 IWMP structures Constructed By Zila- Panchayat, Tikamgarh

Block	IWMP	stop dam	Earthen dam	Pond	Gabbion
Baldevgarh	IWMP V	26	13	2	3
	IWMP VI	22	4		
	IWMP VII	23		1	
Tikamgarh	IWMP VIII	10			
Total		81	17	3	3

#### 1.10.3 Irrigation Tanks in Tikamgarh(Water Resources Department)

S.No	Block	Tanks	Total Storage Capacity	Water spread area
			MCM	Ha
1	Baldeogarh	27	48.75	1636.11
2	Jatara	37	83.758	2565.5
3	Niwari	13	32.66	1113.43
4	Palera	20	8.64	292.5
5	Prithvipur	13	38.215	329.4
6	Tikamgarh	26	46.597	1958.54
<b>District Total</b>		<b>136</b>	<b>258.62</b>	<b>7895.48</b>

#### 1.10.4 Water Bodies of Tikamgarh

1.10.4.1 According to the District Gazettier, there were 962 tanks constructed during the Chandella period; of these 421 still survive. **Nandanwara** Tal in Jatara tahsil, created by placing a small dam across Bargi river as it passes through two hills, is also built by Bir Singh Dev. In its vastness, **Nandanwara** is said to be second only to the **Bara Tal of Bhopal**. The water spread area of 974 tanks (As per MPCST) is about 143.99sq km. As per Resource2013 Water Spread area in Command and Non Command which has been considered is about 69.45Sq km. only of 118 tanks. **(Table No. 1.10.4)**



**Table No.1.10.4:Water Spread areain Tikamgarh District.**

Blocks	TanksAs per Resource2013						As per MPCOST		
	Water Spread Command		Water Spread Non Command		Total	Total Water Spread Area	Water Spreadin Command Area in Sq.Km.	Tanks	Water Spread Area (Sq km)
	No	Area(Ha)	No	Area(Ha)	No	(Ha)		No	
Baldeogarh	4	899.71	21	618.19	25	1517.9	15.179	244	28.173
Jatara	4	922.58	24	399.37	28	1321.95	13.2195	229	41.373
Niwari	5	929.5	5	183.93	10	1113.43	11.1343	73	8.651
Palara	0	0	10	123.09	10	123.09	1.2309	147	15.429
Prithvipur	2	435.42	16	344.34	18	779.76	7.7976	82	22.625
Tikamgarh	4	1281.06	23	808.14	27	2089.2	20.892	199	27.738
<b>Total</b>	<b>19</b>	<b>4468.27</b>	<b>99</b>	<b>2477.06</b>	<b>118</b>	<b>6945.33</b>	<b>69.4533</b>	<b>974</b>	<b>143.990</b>

1.10.3.2Present irrigation tanks

The present irrigation tanks are 136 which are being in use.Total StorageCapacity of tanks is about 258.62MCM and their water spread area is 7895.48Ha(78.95 sq.km) (table 1.10.3.2)

**Table 1.10.3.2Present Irrigation Tanks**

S. No	Block	Tanks	Total storage capacity	Height range	Water spread area
			mcm	m	Ha
1	Baldeogarh	27	48.75	2.73-14.90	1636.11
2	Jatara	37	83.758	3.36-18.29	2565.5
3	Niwari	13	32.66	3.65-9.14	1113.43
4	Palera	20	8.64	3.36-11.58	292.5
5	Prithvipur	13	38.215	4.26-26.82	329.4
6	Tikamgarh	26	46.597	5.48-14.28	1958.54
<b>District Total</b>		<b>136</b>	<b>258.62</b>	<b>2.73-26.82</b>	<b>7895.48</b>

**Table: 1.10.4 Old Chandela Tanks having Irrigation Capacity of >40 ha (100Acre)which can be taken under RRR for optimum utilization of Irrigation capacity & construction of Recharge Shafts.**

S.no.	Name of the Tank	Block	Designed irrigation capacity (ha)	present irrigation capacity (ha)
1	Gukhrai	Baldeogarh	60	0
2	Talmau	Baldeogarh	60	0
3	Hata	Baldeogarh	60	0
4	Guna	Baldeogarh	40	18
5	Gora	Baldeogarh	40	12
6	Jatera	Baldeogarh	61	20
7	Luharra	Baldeogarh	61	40
8	Vaisa	Baldeogarh	40	18
9	Brishbhanpura	Baldeogarh	40	-
10	Bar	Baldeogarh	61	21
11	Pureniya	Baldeogarh	40	12
12	Hirapur	Baldeogarh	40	20
13	Gaitital	Baldeogarh	40	12
14	Barmatal	Jatara	50	0
15	Gor	Jatara	60	0
16	Chamra	Jatara	40	8
17	Bangaon	Jatara	60	10
18	Kodiya	Jatara	40	0
19	Umri	Niwari	61	-
20	Futera	Niwari	61	-
21	Parakhera	Niwari	72	-
22	Ladwari	Niwari	51	-
23	Gridhakhani	Niwari	60	0
24	Asati	Niwari	40	0
25	Tarichar	Niwari	40	0
26	Hirni Sagar	Palera	60	0
27	Gajadhar	Palera	50	4
28	Gurera	Palera	50	-
29	Kishanpura	Palera	70	0
30	Lidhaura	Palera	98	14
31	Lar-buzurg	Palera	100	25
32	Gona	Palera	50	12
33	Niwari	Palera	60	20
34	Chortangna	Palera	60	0
35	Toriya	Palera	60	15
36	Sakera big	Prithvipur	80	0
37	Chandrapura	Prithvipur	50	0
38	Astari	Prithvipur	48	-
39	kadhari	Prithvipur	61	-

40	Sakera Small	Prithvipur	72	-
41	Narguda	Tikamgarh	45	11
42	Maharajpura	Tikamgarh	50	-
43	Purainiya	Tikamgarh	100	20
44	Garora	Tikamgarh	45	20
45	Budera	Tikamgarh	40	20
46	Bamhori Nakiwan	Tikamgarh	40	20
47	Bindravan	Tikamgarh	50	25
48	Majna	Tikamgarh	80	25
49	Nayagaon	Tikamgarh	40	0

These tanks listed in Table:1.10.4 are recommended to be taken up under RRR for optimum utilization of these Tanks.

## 2.0 DATA COLLECTION & GENERATION

There was also a strong need for generating additional data to fill the data gaps to achieve the task of aquifer mapping.

### 2.1 Geology

Geologically, Tikamgarh is part of the Bundelkhand craton, which is formed of the oldest Granites and Gneisses of the Achaean age. As seen in the map here, the district is almost entirely composed of massive Granites. The Granites are criss-crossed by a number of Quartzite and Quartz Reef aligned in the northeast-southwest (NE-SW) direction.

In the southeast, running through Baldeograh and Palera tehsil, there are a couple of outcrops of Basic Dykes of Dolerite lying in the NE-SW direction; these are aligned orthogonally to the Quartz Reefs.

The river islands formed by the braiding of Jamni and Betwa in the northwest are composed of rich alluvial deposits that support the few patches of thick forests in the district.

As seen in map, there are hardly any significant lineaments in the district.

**Table 2.1: Area of various formations**

Formation	Area in ha.
Granite	4,78,705
Quartz Reef/ Quartzite	10,088
Basic Dike/ Pipe Rock	282
Rivers and Water-Bodies	15,893
<b>Total</b>	<b>5,04,968</b>

### 2.2 Hydrogeological data

#### 2.2.1 Aquifer System and Aquifer Parameters

Tikamgarh district comprising of Bundelkhand Granite and Gneisses, which are profusely intruded by quartz reefs and pegmatite's. Granite is generally flesh-red colour and coarse grained showing porphyritic texture. However, grey-coloured granite which appears to be metamorphosed into gneissic variety are also discernible in some blocks like Jatara, Baldeogarh, Palera etc. Both the pink and grey coloured granite have undergone intensive weathering. The long narrow ridges formed by quartz-reef are intrusive into the granite. The joints and fractures developed in the host granitic body are due to such intrusions.

**These quartz reefs act as water divides as well as cut off walls across the ground water flows.**

Thus the main factors which define the groundwater environs are: -

1. The nature and structure of Granitic rock.
2. Depth and nature of weathered mantle (overburden) overlying hard compact basement.
3. Size, intensity and inter connections of joints and fractures developed in the granitic rock.
  
4. Aerial extent and configuration of valleys between the quartz reefs.
5. Water holding and yielding capacity of the aquifers developed both in the overburden and fractured granite. Thus, thicker the overburden and intense is the weathering along with closer joint planes in granitic terrain, the more will be the ground water storage and yield.

From the Hydro-geological studies two distinct groundwater environs are found to exist in this district.

(a). Upland and Hilly tract of granite.

- This tract is formed by highly weathered product of granite amenable for faster percolation of rainwater and favors groundwater occurrences within 5 to 8 m bgl.
- The average yield of groundwater structures ranges from  $0.16 \text{ m}^3$  to  $0.2 \text{ m}^3/\text{hr}$ . The annual fluctuation of water level ranges from 2 to 2.5 m.

(b). Granitic tract between two intrusive bodies:

- This tract is influenced by the occurrence of quartz reefs.
- The granites have developed fractures and joints, which favors and act as good conduit for groundwater circulation and occurrence within the boundaries defined by quartz reefs.

The yield of the exploratory wells drilled to a depth of 200m ranges between 0.75 to 6.0 lps and the transmissivity values ranges between 12.87 to 145  $\text{m}^2/\text{day}$  and the Storage

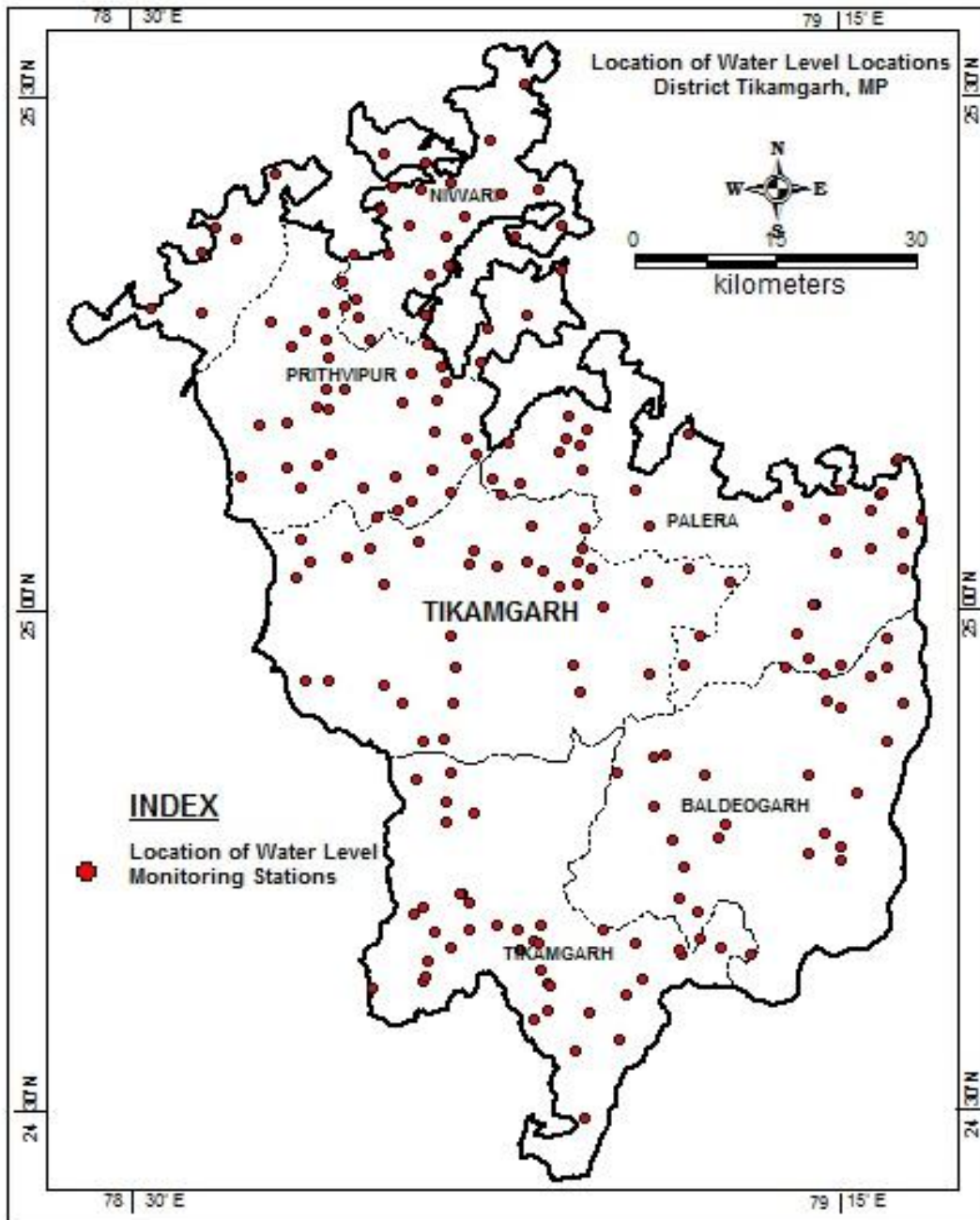
co-efficient of Joriya Exploratory well is  $4.78 \times 10^{-4}$

### 2.2.2 Ground Water Level Monitoring

Ground water levels form a very important parameter of the ground water system, as these are its physical reflection. The groundwater balance expresses itself in the change in water levels; hence a continuous record is important and useful. CGWB has 20 National Hydrograph Stations (NHS) and 07 Piezometers in Tikamgarh District. Due to large-scale ground water development the dug wells are drying up.

## Depth to Water Level

Central Ground Water Board has been carrying out water level monitoring of Ground Water monitoring wells (G.W.M.W), since more than last two decades. Water levels of these monitoring wells are being monitored four times in a year during the months of January, May, August and November. To study ground water regime of the area, pre-monsoon and post-monsoon depth to water level maps of the district has been prepared.

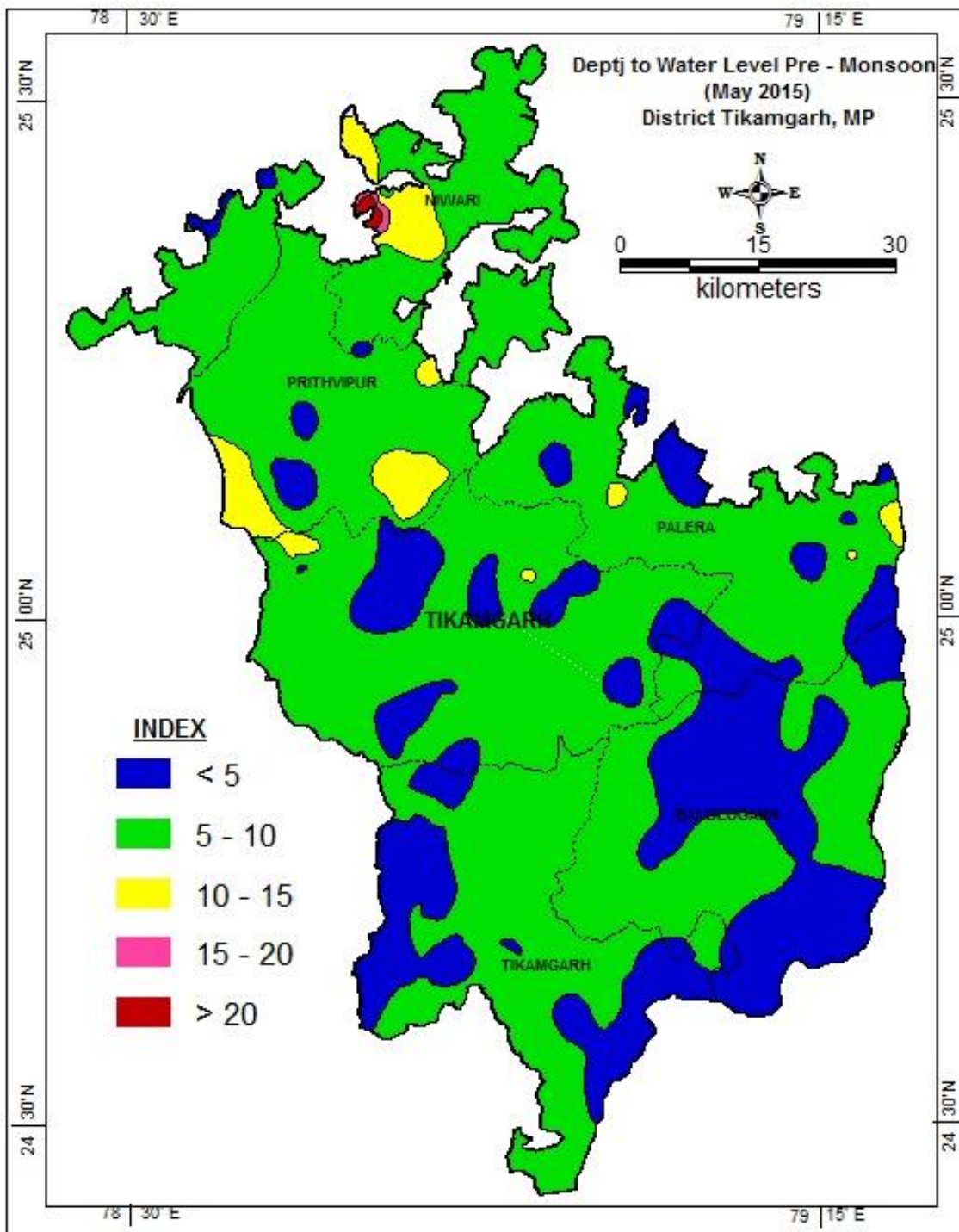


### 2.2.2.1 Water Levels-

#### Pre-monsoon (May 2015)

Depth to water level during pre-monsoon, 2015 ranged between 1.28m bgl at Bawari and 23.30m bgl at Naiguan. Water levels, in general fall between 5 - 10 m bgl. Shallow water levels of less than 5 m bgl occur in patches in the south-eastern&south-western part of the district falling in Tikamgarh, Baldeogarh, palera and Jatara blocks. Deeper water levels of more than 20 m was recorded at Naiguan in Niwari block. During May 2015, pre-monsoon depth to water level map of Tikamgarh district is shown in Fig 3

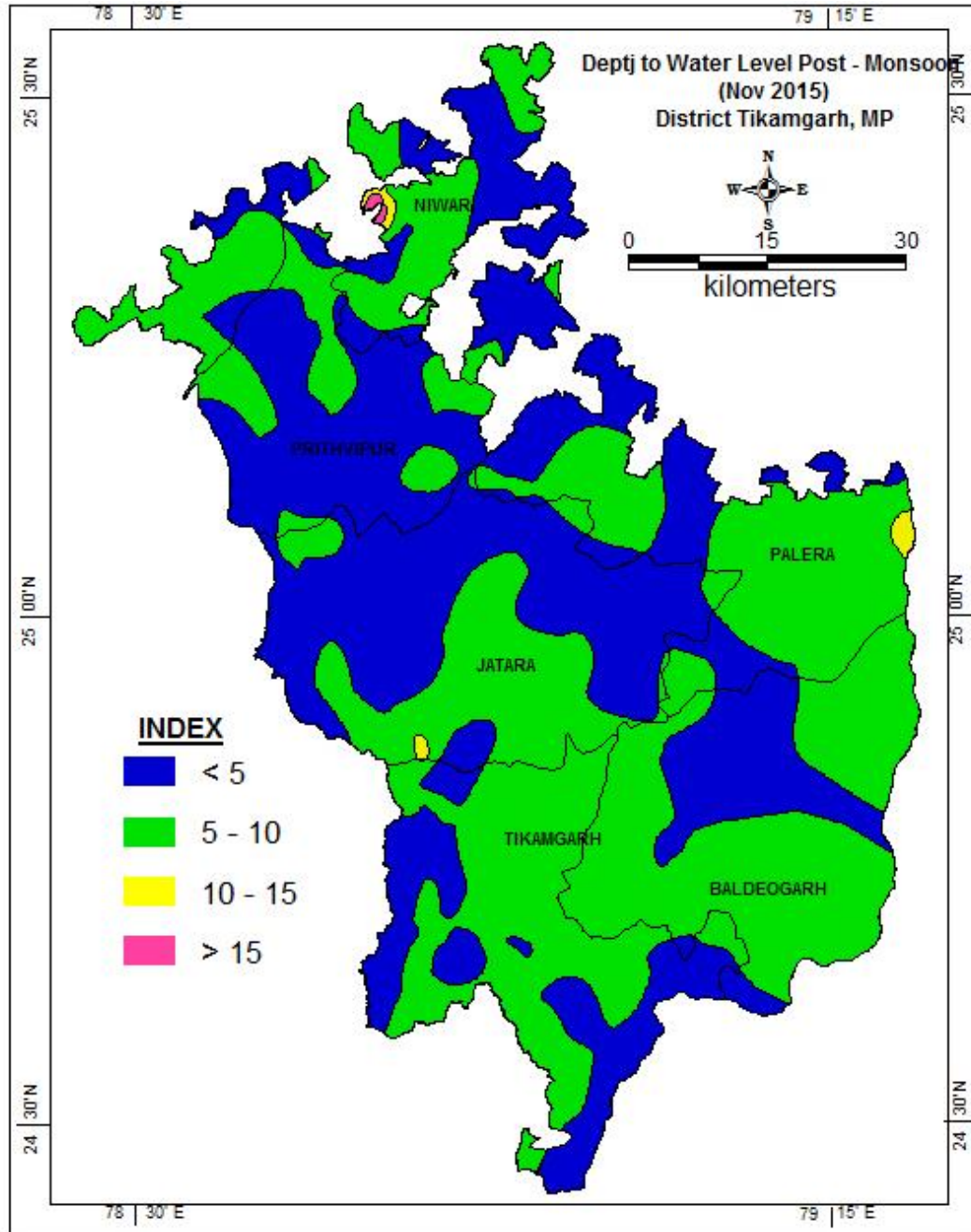
**Fig 3. Depth to water Level(Pre-monsoon)**



### Post Monsoon (November 2015)

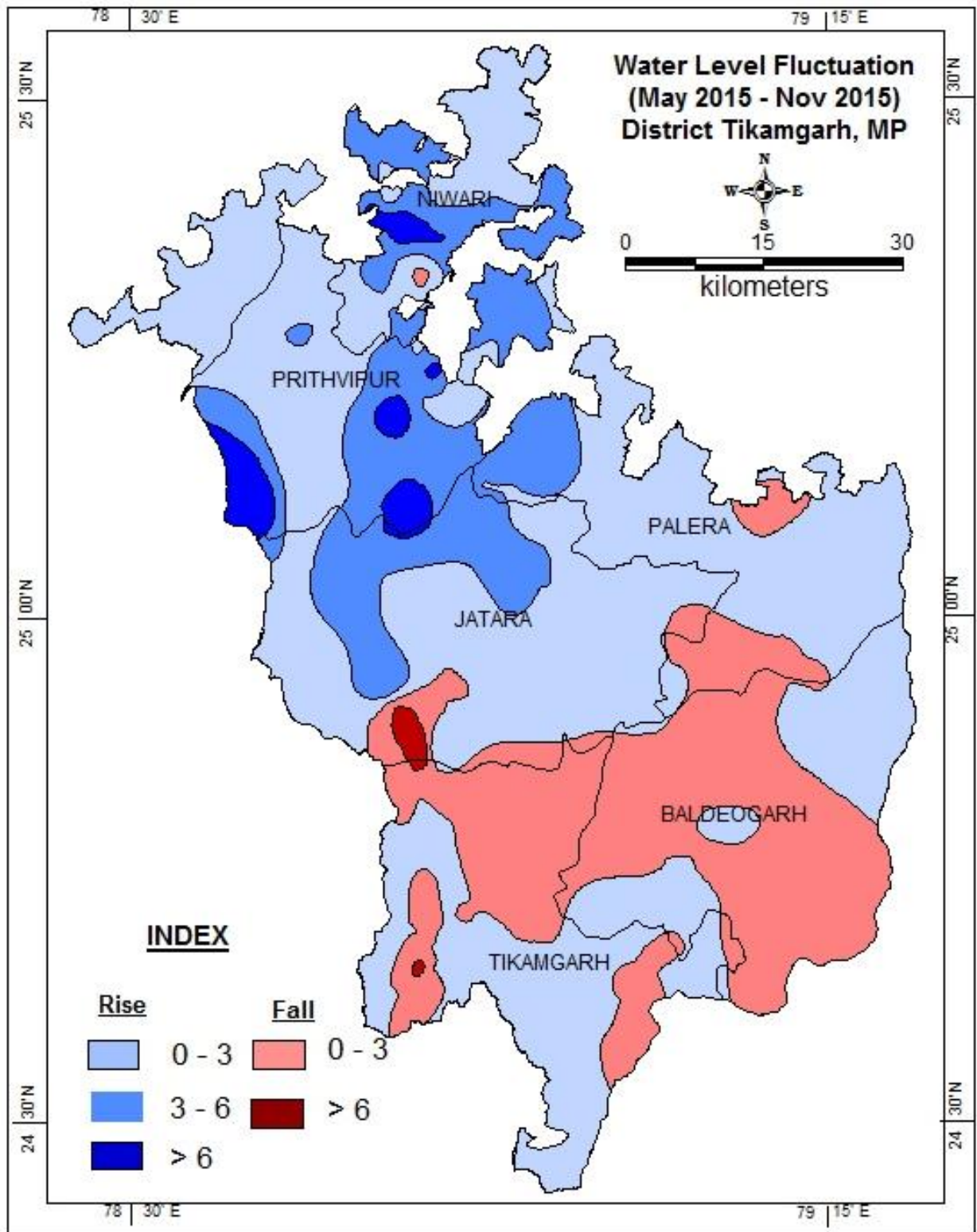
During post-monsoon period of the same year ie November 2015, the water levels varied from 0.71m bgl at Mazal to 17.05m bgl at Naiguan. The water level, in general lies between 2 to 10 m bgl during this period. Shallow water levels of less than 5 m bgl occur in parts of the district covering parts of Niwari, Prithvipur, Jatara, Palera, Tikamgarh & Baldeogarh blocks. Deep water levels above 10 m bgl was recorded at Naiguan the northern part in Niwari block as shown in Fig 5.

**Fig 4. Depth to Water Level (Post-monsoon)**





**Water level Fluctuation ( May 2015-Nov 2015) :**Water level fluctuation in most part of the



district shows a rise between 0-3 m & in paches rise between 3-6m in Niwari, Prithvipur, Jatara & Palera blocks and in small paches rise of >6m has been recorded between Pre-Post monsoon 2015 water levels. A fall of 0-3m has been recorded in patches in parts of Tikamgarh, Baldeogarh &



Palera blocks of Tikamgarh district&a fall of >6m has been recorded in very small isolated patches in parts of Jatara & Tikamgarh blocks.

**Fig 5. Water Level Fluctuation**

### 2.3 Ground water Quality

Ground water quality of Phreatic Aquifer in Tikamgarh district is assessed annually by CGWB on the basis of analysis of ground water samples collected from 21 no. of hydrograph stations in the district. On the basis of examination of data for the year 2015-16, as such, the suitability of ground water for potable uses with regard to its chemical quality has been deciphered and defined on the basis of the some vital characteristics of the water. The physical and chemical quality of ground water is important in deciding its suitability for drinking purposes. Water Quality Data of Tikamgarh District is shown in Table -2.3

**Table -2.3 Showing water Quality Data of Tikamgarh District (NHS 2015-16)**

S.N.	Location	pH	EC μS/cm @ 25 °C	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	NO <sub>3</sub>	F	PO <sub>4</sub>	TH	Ca	Mg	Na	K	SiO <sub>2</sub>
1	Baldeogarh	7.98	850	0	359	67	15	20	0.54	0.021	332	100	20	42	2.3	41
2	Bamori	8.06	645	0	305	42	2	14	0.98	0.02	122	29	12	93	1.5	34
3	Bawari	7.72	480	0	227	35	1	3	0.65	0.001	204	73	5	16	0.3	32
4	Birorakhet	7.67	1425	0	335	167	170	26	1.03	0.013	684	214	36	11	2.0	22
5	Digaura	7.62	2140	0	263	237	414	98	1.21	0.003	413	100	40	300	1.4	43
6	Jatara	7.80	753	0	245	27	34	120	2.2	0.025	230	53	24	66	1.0	36
7	Lidhaura	7.70	1738	0	365	177	265	43	0.45	0.003	321	67	37	250	2.1	45
8	Majna	7.58	1825	0	144	245	280	178	0.4	0.001	561	141	51	158	5.3	451
9	Manikpur	7.73	530	0	287	17	3	2	0.68	0.002	250	69	19	7.0	0.2	37
10	Mawai	7.64	2060	0	179	387	254	87	0.94	0.001	556	133	55	215	3.0	34
11	Nenguwan	7.80	1078	0	305	112	78	56	1.2	0.002	464	131	34	32	2.0	54
12	Niwari (New)	7.63	1110	0	275	85	165	43	1.03	0.013	362	94	31	85	6.7	39
13	Orchha	7.70	1235	0	317	60	111	190	0.5	0.001	429	78	57	84	2.0	45
14	Palera	7.50	1939	0	233	297	243	124	2.02	0.021	495	131	41	216	0.4	51
15	Prithvipur	7.87	873	0	245	65	85	65	1.06	0.001	296	69	30	64	0.9	39
16	Tikamgarh	7.45	1970	0	203.3	479.9	11	167	0.54	0.013	745	180	72	110	2.0	43

#### Suitability for Drinking and General Domestic Use

The pH value of all the water belonging to the Tikamgarh district ranged between 7.45 to 8.06 and did not show delineation of permissible limit for pH (6.5 to 8.5) described by BIS (2012).

The electrical conductivity of ground water based on the distribution of EC (Table – 2.3), it is observed that Tikamgarh district had predominance of EC ranging from 1000 to 2000 (Avg. 1290) μS/cm at 25<sup>0</sup>C indicating the quality of ground water belongs to average quality. About 81 % locations examined across the Tikamgarh had EC values greater than BIS acceptable limit i.e. 750 μS/cm at 25<sup>0</sup>C, therewith minimum as 480 μS/cm at 25<sup>0</sup>C.(Bawri) and maximum with 2140 μS/cm at 25<sup>0</sup>C.(Digaura).

Generally for the most water systems, CARBONATES (CO<sub>3</sub><sup>2-</sup>) are least predominant ions whereas BICARBONATES (HCO<sub>3</sub><sup>-</sup>) are the dominant anions. The concentration of carbonate ions

is functions of the pH value. The ground water of Tikangarh district were found to be absolutely free from carbonate ions.

A comparison of the findings with the BIS recommended level of bicarbonate (200 mg/l) for protection of human health indicated that Tikangarh District have been predominantly influenced by the presence of bicarbonate as 87.5% locations had HCO<sub>3</sub><sup>-</sup> ions >200 mg/l.

**Chloride (Cl<sup>-</sup>)** is a common anion of natural ground water apart from contribution from rain water and through natural activities of human beings.. The chloride concentration in the examined samples covering the Tikamgarh varied in between 17(Manikpur) to 480 (Tikamgarh) mg/l (Table-2.3).

**Sulphate(SO<sub>4</sub><sup>-</sup>)** inputs into groundwater and release from soils is necessary for a sulphur balance and future sulphate concentrations in groundwater. It has been reported that no adverse effect of Sulphate containing water is observed on human health except where its concentration is more than permissible limit for drinking water and associated with magnesium ions. Water belonging to Tikamgarh district gave apprehension for Sulphate pollution since 5 out of 16 locations (31.25%) viz. Digaura, Lidhaura, Majna and Palera reported to have SO<sub>4</sub><sup>2-</sup> concentration more than BIS acceptable limit (200 mg/l)

**Nitrate salts** are highly soluble in ground water whose presence is tied with nature's nitrogen cycle. The primary sources of nitrate introduction in ground water come from decomposing of animal and plant waste, septic systems, or agricultural field run-off from fields fertilized with ammonia. The BIS has set a desirable recommended limit of nitrate as 45 mg/l with no additional relaxation. The nitrate concentration in the ground water of Tikamgarh district ranges between 14 and 190 mg/l. It is evident from the table that 9 out of 16 locations had high NO<sub>3</sub><sup>-</sup> conc. greater than BIS desirable limit (45 mg/l) therewith maximum as 190mg/l at Orchha and minimum as 2 mg/l at Manikpur locatinons.

The fluoride concentration in the Tikamgarh district ranges between 0.45 to 2.2 mg/l. The fluoride concentration reveals that the ground water of Tikamgarh district is within permissible limit recommended by BIS i.e. 1.50 mg/l. **Fluoride** is best known for its use in small quantities to help reduce dental caries (cavity) frequency in teeth. The excessive intake of fluorine compounds over an extended period may cause yellowing of teeth, hypothyroidism, or brattling of bones and teeth (fluorosis). This study suggested (Table 2.3) that only two locations namely Jatara(2.20 mg/l) and Palera(2.02mg/l)reported fluoride concentration more than BIS permissible limit i.e. 1.5 mg/l.

In Tikamgarh district, Arsenic concentration was analysed from 15 ground water samples collected during May 2003 and Arsenic concentration was below detectable limit (BDL).

#### Ground Water Quality of Tikamgarh District

Out of 16 water samples collected from the Tikamgarh, 10 had calcium content greater than specified guideline of BIS (75 mg/l) with a minimum 29 mg/l found in Bamori and maximum as 214mg/l in Birorkhet.

**Magnesium (Mg<sup>2+</sup>)** may contribute undesirable tastes to drinking water. Sensitive people may find the taste unpleasant at 100 mg/l. Magnesium in drinking water may have a laxative effect, particularly with magnesium sulphate concentrations above 700 mg/l. Numerical guideline has been

prescribed for magnesium by BIS drinking water as 30 mg/l (acceptable limit). An overview of data pertaining to magnesium concentration (see Table 1) revealed that about 62.50% waters sampled from Tikamgarh district could not meet the BIS prescribed criteria (30 mg/l). **The least concentration as 5 mg/l was recorded in Bawari village whereas greatest concentration was found in Pirthvipur.**

**Hardness** is a useful that provides assessment of quality of water for households and industrial uses. Water hardness is measured by adding up the concentrations of calcium and magnesium and converting this value to an equivalent concentration of calcium carbonate (CaCO<sub>3</sub>). Water hardness for household use has been classified by **Sawyer and McCarty (1967)** as follows:

TH as CaCO <sub>3</sub>	Water Class(Mg/l)
Soft	< 75
Moderately Hard	75-150
Hard	150-300
Very Hard	>300

A perusal of table 2.3 that waters belonging to Tikamgarh can be classified as hard to very hard for household use for drinking purpose as in 15 out of 16 locations had total hardness (TH) higher than 200 mg/l which is the desirable limit set by BIS (2012). The optimum range of hardness for household use is from 75 to 150 mg/l.

### SUITABILITY OF WATER FOR IRRIGATION PURPOSE

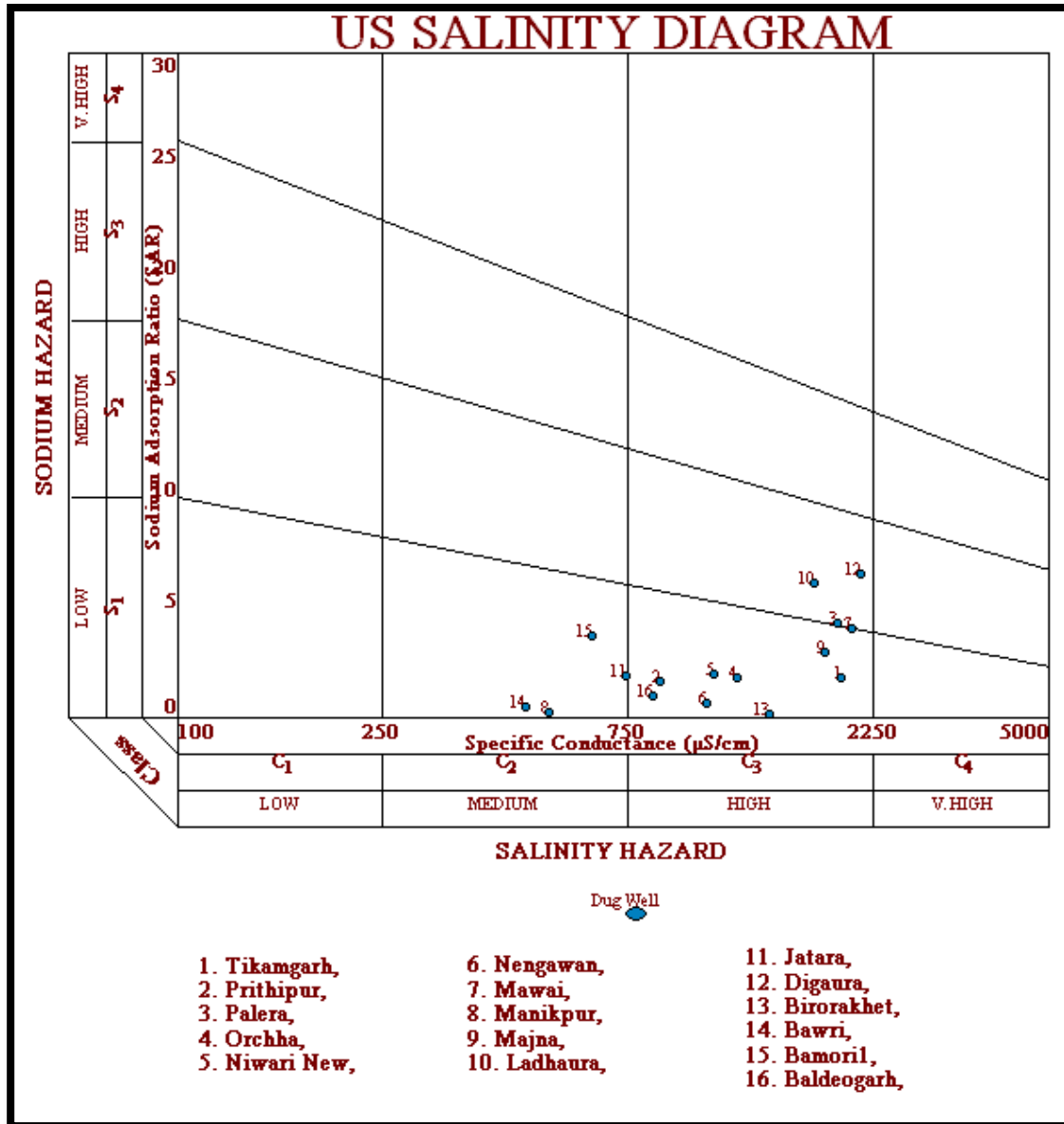
The concentration and composition of dissolved constituents in the groundwater determine its suitability for irrigation purpose also. It is generally based on the presence of salts, which affects the intake of water with other nutrients, by plants through osmosis. Besides affecting crop yield and soil physical conditions, irrigation water quality affects fertility needs, irrigation system performance and longevity and how the water can be applied Sodium concentration is an important criterion for classification of any type of water for irrigation use since sodium reacts with soil-complex by replacing other cations hence creating sodium hazards for soil as well as groundwater also.

A diagram for classifying waters for irrigation purpose was suggested by the U.S. Salinity Laboratory in 1954 that was a modification of its earlier classification given by Wilcox (1948) based on electrical conductivity ( $\mu\text{S}/\text{cm}$  at 250C) and sodium adsorption ration (SAR) is used nowadays which has four salinity and four sodium hazard classes.

The chemical data of all the water samples pertaining to Tikamgarh, was plotted on U.S. Salinity Laboratory diagram (Figure 1). It is evident from the diagram that the class C3-S1 (High Salinity & Low Sodium) acquired maximum numbers of wells (50%) namely Tikamgarh(1), Prithvipur(2), Orchha(4), Niwari(5), Nenguwan(6), Majna(9), Birorakhet(13) and Baldeogarh(16) indicating these waters should be used on soils with good drainage. Waters in the range of 750 to 2,250  $\mu$  mhos/cm are widely used, and satisfactory crop growth is obtained under good management and favorable drainage conditions, but saline conditions will develop if leaching and

drainage are inadequate. The four locations representing Palera(3), Mawai (7), Lidhaura(10) and Digaura (12) were grouped under C3-S2 (High Salinity & Moderate Sodium) class, which means that these water can be used on soils with good drainage. Special management practices are required for salinity control. Salt tolerance crops may be grown. Whereas class C2-S1 (Medium Salinity & Low Sodium) possessed 25 % wells vide list Manikpur(8), Jatara(11), Bawri(14) and Bamori(14) which implies that these waters can be used for irrigation purpose without any chances of development of soil salinity.

**Figure 2.3 : USSL Diagram of Tikamgarh district Showing Water Quality for Irrigation purpose.**



### GEOCHEMICAL CLASSIFICATION (HYDRO-CHEMICAL FACIES)

Piper diagram is an example of water quality diagrams, which are probably the most frequently used today. These diagrams are also useful for visually describing the differences in major ion chemistry in ground water flow system. The results of the hydro chemical analysis of water samples pertaining to Tikamgarh(See **Figure 2.3.1**) were plotted on Piper diagram.

The Piper diagram projected that out of 16 waters, 2 waters, namely **Ladhaura(10)** and **Digaura(12)** were found to be of **Alkali earth-Chloride type (Na-K-Cl)** or **Sodium –Chloride type** of water which means these are saline in nature and had permanent hardness since the concentration of sodium and potassium cations exceed over calcium and magnesium cations together and simultaneously the concentrations of  $\text{SO}_4^{2-}$  and  $\text{Cl}^-$  anions together were reported to be high as compared to  $\text{CO}_3^{2-}$  and  $\text{HCO}_3^-$  anions together.

Whereas the waters of **Tikamgarh(1) and Birorakhet(13)** were found to be of **Alkaline earth-Chloride type (Ca-Mg-Cl)** or **Calcium –Chloride type** of water which means these had permanent hardness since the concentration of calcium and magnesium cations exceed over sodium and potassium cations and simultaneously the concentrations of  $\text{SO}_4^{2-}$  and  $\text{Cl}^-$  anions collectively were reported to be high as compared to  $\text{CO}_3^{2-}$  and  $\text{HCO}_3^-$  anions. Waters belonging to **Manikpur(8), jatara(11), Bawri(14) and Baldeogarh(16)** were found to be **Calcium-Bicarbonate type**. The left over waters namely **Prithvipur(2), Palera(3), Orchha(4), Niwari (5), Nengawan(6), Mawai (7) and Majna(9)** constituting about 43.75% were found to be of mixed type of waters since none ion could dominate over other ions.

**Figure 2.3.1: Piper Diagram Showing Hydro-chemical Faces of Waters Collected from Tikamgarh (M.P.).**

# PIPER DIAGRAM

Legend :

Calcium - Chloride Type  
(Permanent Hardness)

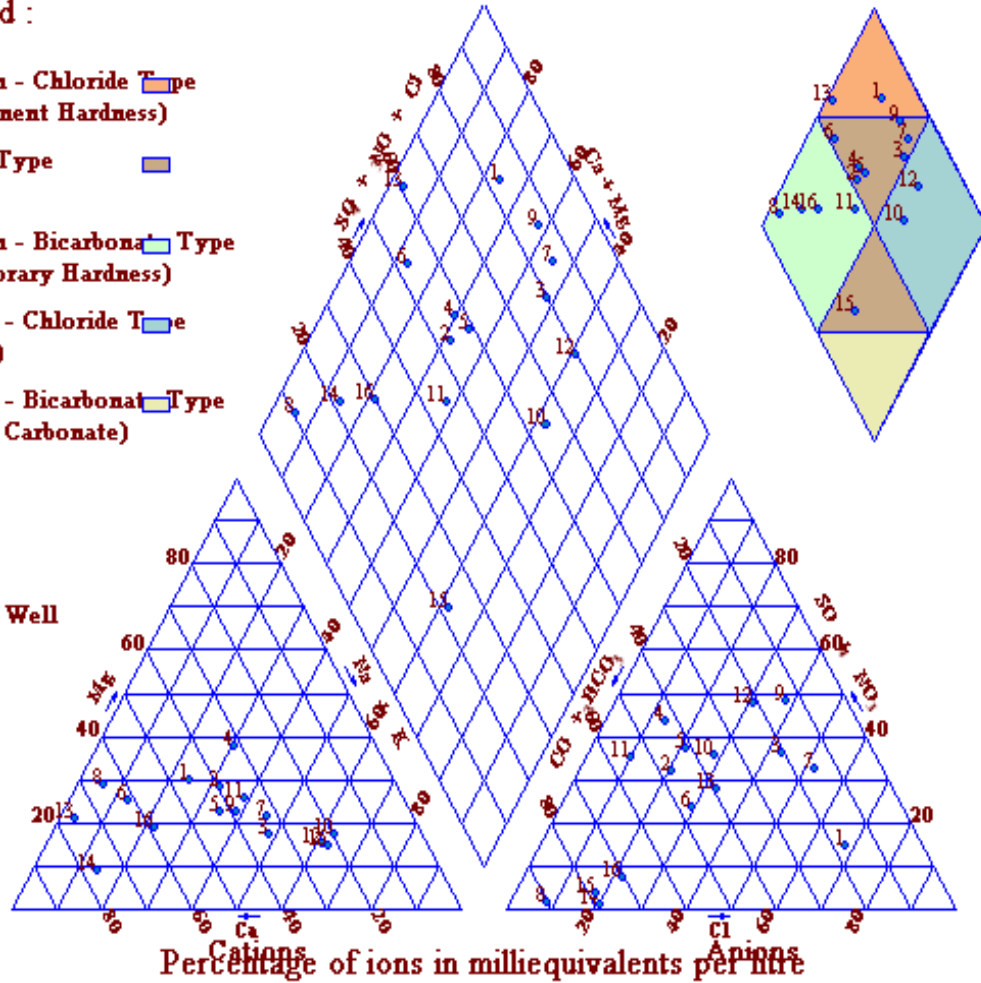
Mixed Type

Calcium - Bicarbonate Type  
(Temporary Hardness)

Sodium - Chloride Type  
(Saline)

Sodium - Bicarbonate Type  
(Alkali Carbonate)

• Dug Well



- 1. Tikamgarh,
- 2. Prithipur,
- 3. Palera,
- 4. Orchha,
- 5. Niwari New,

- 6. Nengawan,
- 7. Mawai,
- 8. Manikpur,
- 9. Majna,
- 10. Ladhaura,

- 11. Jatara,
- 12. Digaura,
- 13. Birorakhet,
- 14. Bawri,
- 15. Bamoril,
- 16. Baldeogarh,



Fig. No. 2.3.2

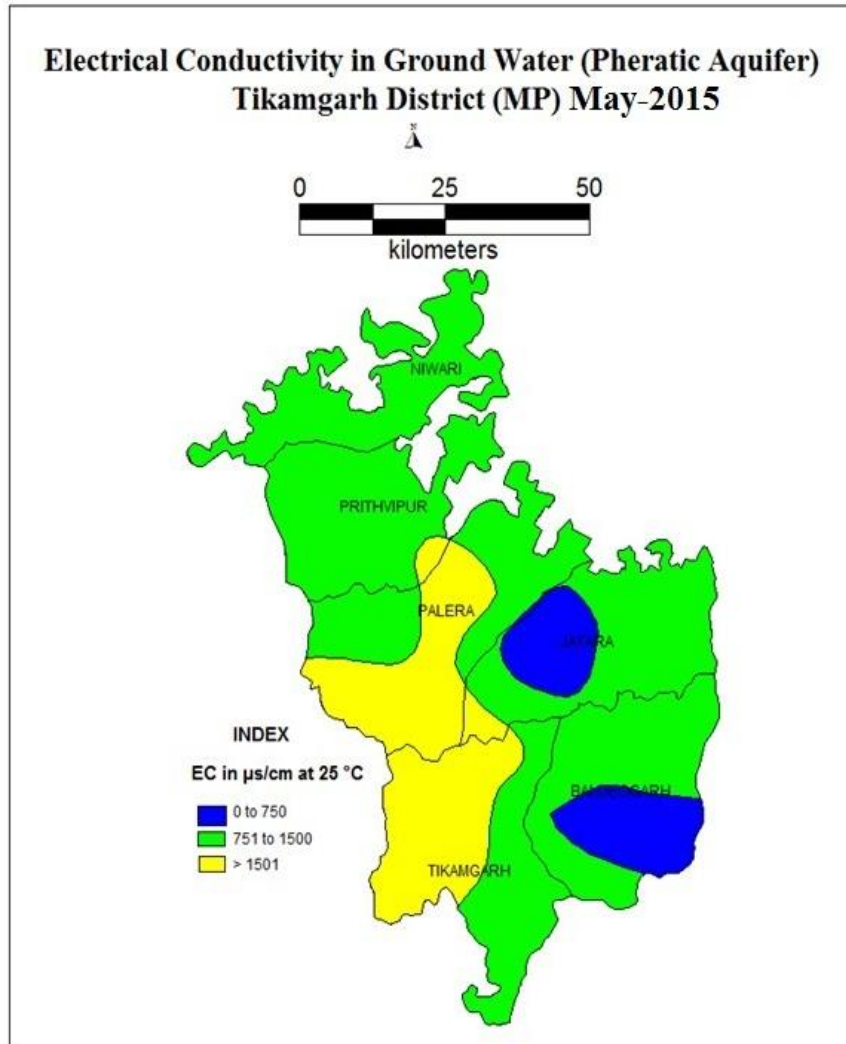
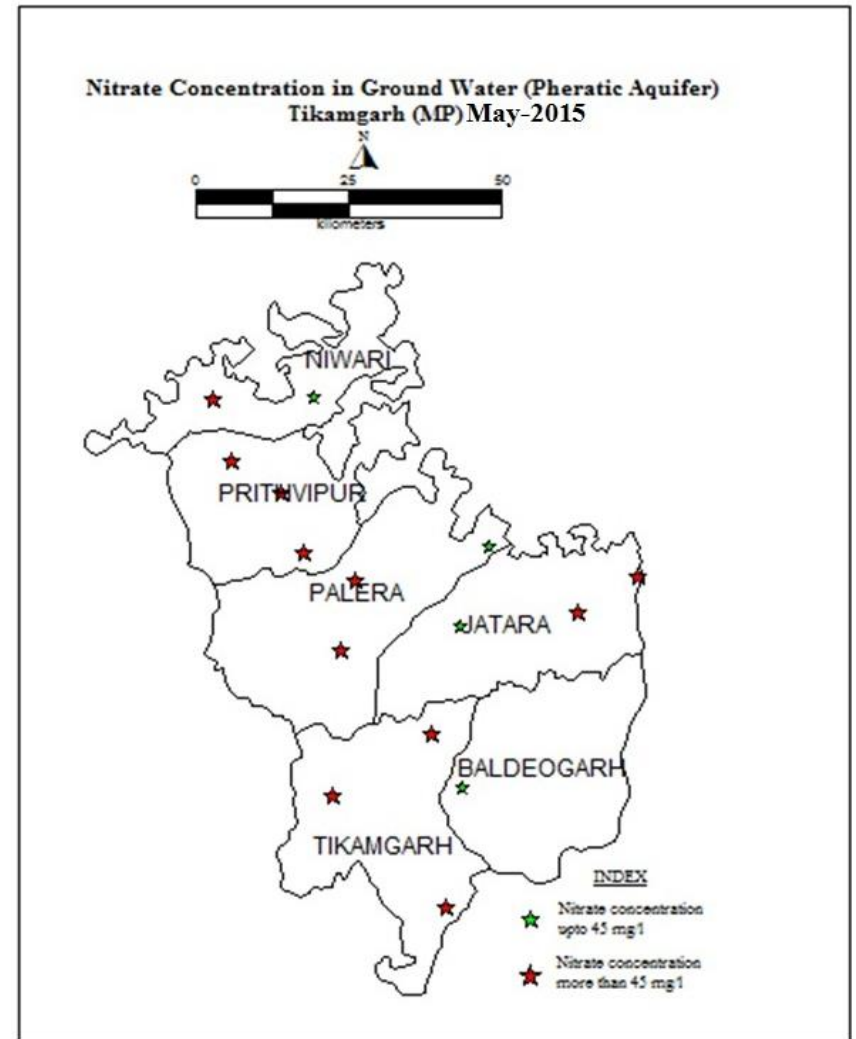


Fig. No. 2.3.3



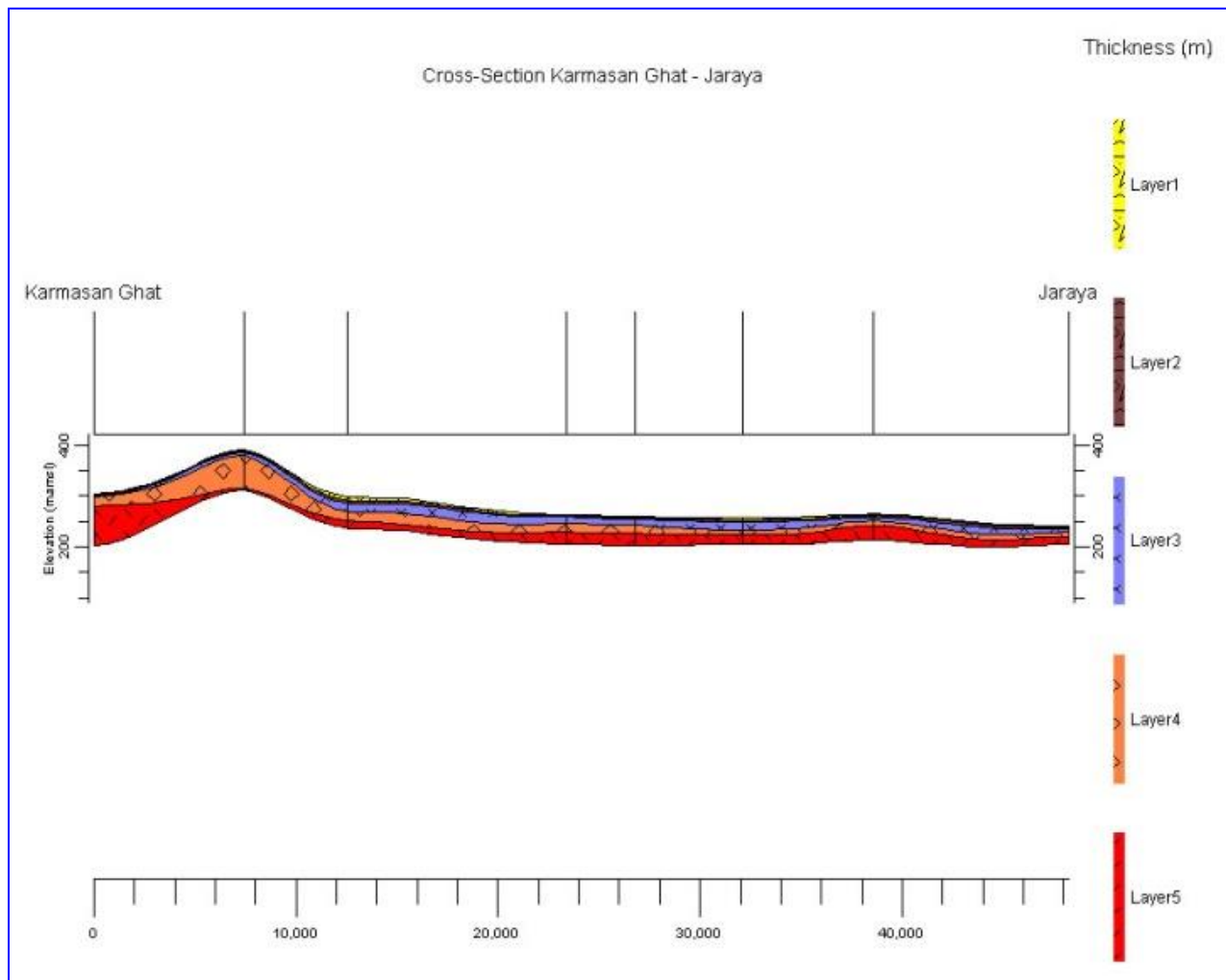
## 2.4 Geophysical Survey in Tikamgarh

The surface electrical resistivity methods are commonly used for hydrogeological investigation and have been applied in present study. Fig. 2.4.: Location map of VES in Tikamgarh

This procedure of measurements is known as Vertical Electrical Sounding (VES). The Schlumberger Vertical Electrical Sounding and Gradient Resistivity Profiling methods were used for mapping vertical and lateral variations in the formations. In the area of investigation total 36 number of VES were conducted. The location of the VES are shown in figure 1. The apparent resistivity values obtained from field are plotted on the log-log paper against the half-current electrode separation. The interpreted results of VES are shown in Table-2.4

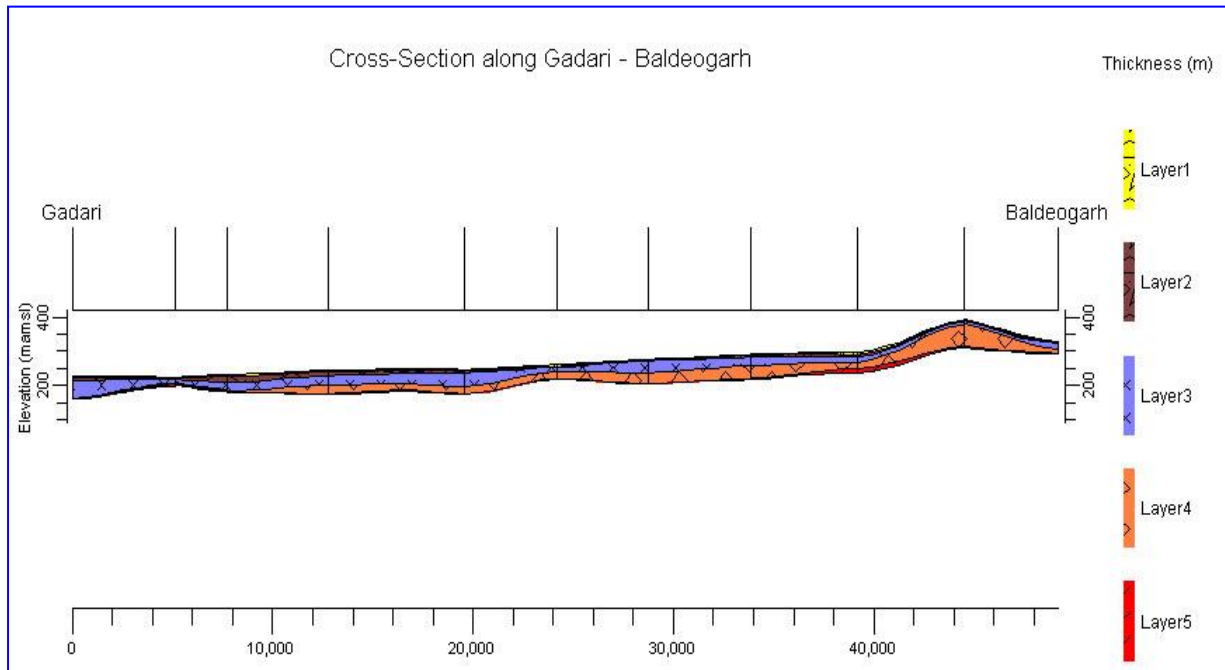
The order of resistivity varies from 5 ohm-m (Surface Soil) to 65000 ohm -m (Hard & Compact Rock). In general the ground water is available up to the depth of 25 to 50 mbgl only. Deep seated fracture zones could not be deciphered. Geophysical cross section have been prepared & given in Fig 2.4.1 to 2.4.3

**Fig. 2.4.1.: Geophysical cross section along Karmasonghat- \_Joriya**





**Fig 2.4.2: Geophysical Cross section along Gadari – Baldeogarh**



**Fig.2.4.3: Geophysical Cross section along Hridayanager - Chari -II**

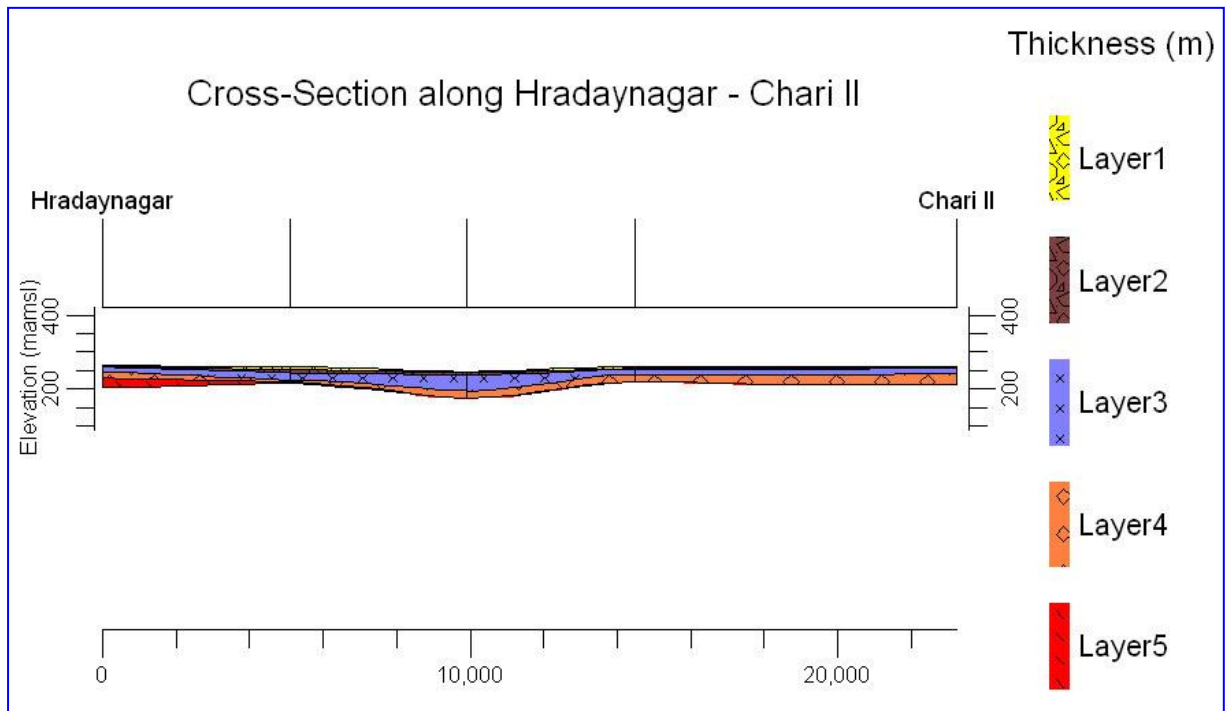
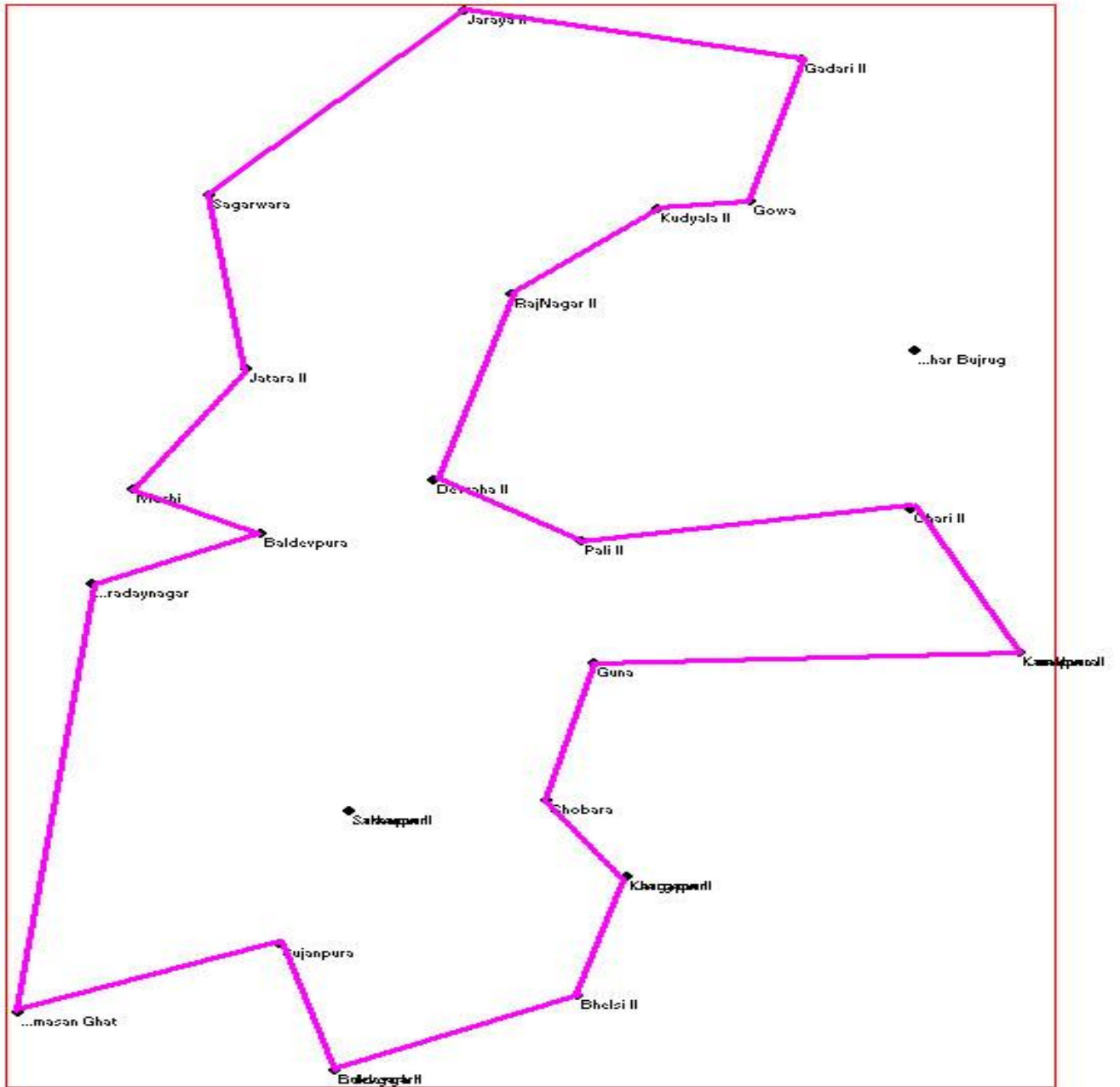
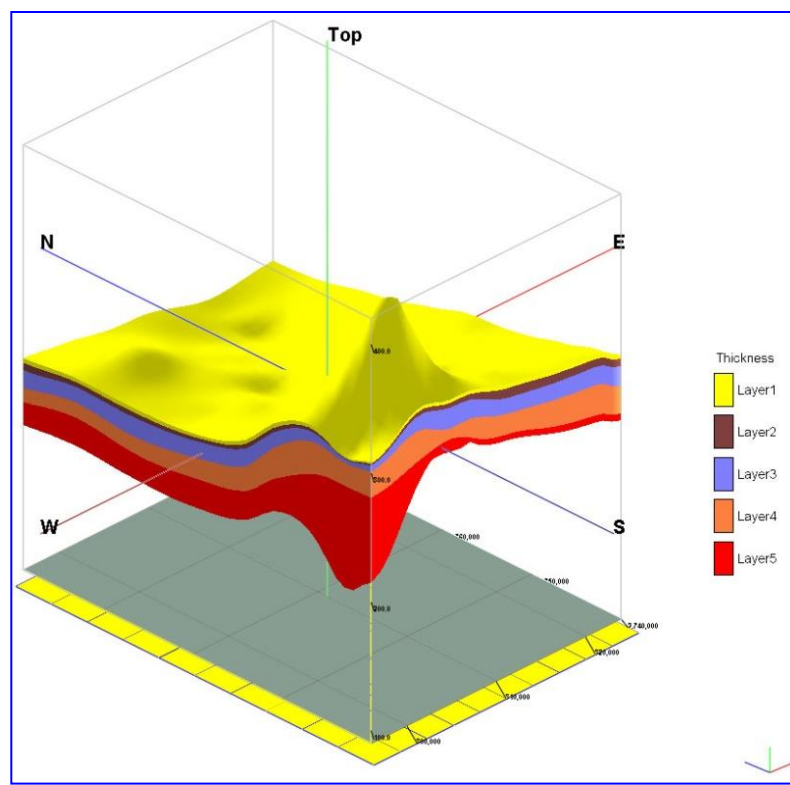
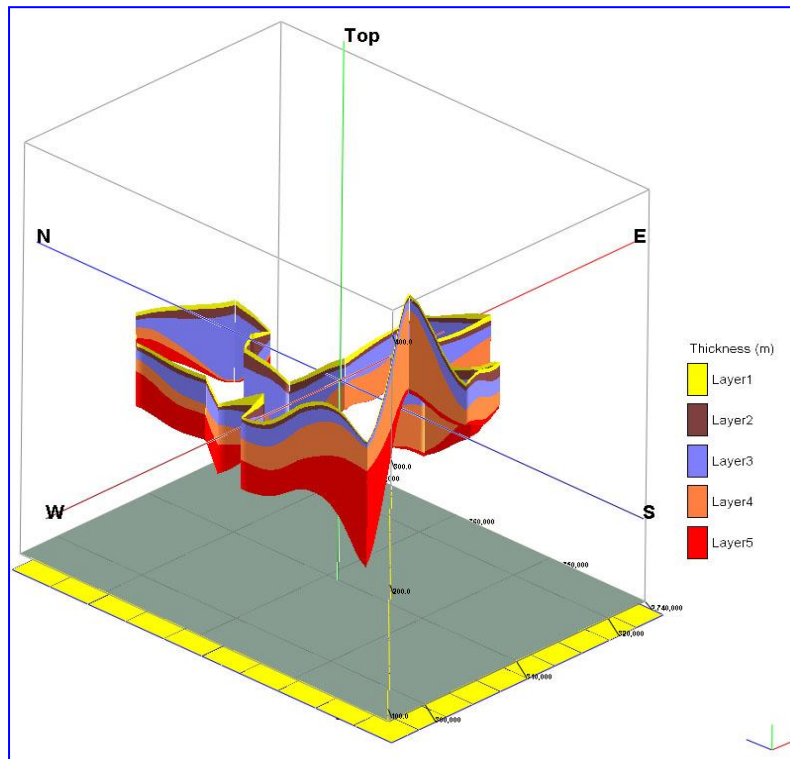


Fig. 2.4.4: Location of VES for 3\_D View



**Fig. 2.4.5: Three dimensional picture of formation on the basis of Resistivity Data interpretation**



**Table 2.4: VES Locations and interpreted Result**

Sr.No.	Location	Co-ordinates		Elevation	Goelectrical layers Resistivity						Goelectrical layers thickness					
		N	E		$\rho_1$	$\rho_2$	$\rho_3$	$\rho_4$	$\rho_5$	$\rho_6$	$h_1$	$h_2$	$h_3$	$h_4$	$h_5$	Total H
		DD	DD	mamsl	(in Ohm-m)						in m.					
1	Machi	24.96	79.01	258.4	5	2	720	4500	1600	15000	1.7	1.5	10	18	27	55
2	Hradaynagar	24.93	79.00	263.7	5	3	650	4000	1500	5000	1.5	2	12	18	25	58
3	Baldevpura	24.94	79.05	262.4	25	300	75	5			11	10	20			41
4	Sarkanpur	24.85	79.07	292.4	85	2500	7	4000			10	11	27			48
5	Sarkanpur II	24.85	79.07	292.4	80	550	130	4500	500	80	3.3	2.3	7.6	25	32	70
6	Sujanpura	24.81	19.05	411.2	340	1400	40	5500	1050		2.4	2.2	4.8	76.4		85
7	Karmasan Ghat	24.79	78.99	300.8	30	200	20	100	750	4500	1	0.5	2.5	17	83	104
8	Baldevgarh	24.77	79.07	325.2	20	75	15	3500	8500		1	1	2.5	11		15.5
9	Baldevgarh II	24.77	79.07	325.2	35	75	4500	9500			4	6	31			41
10	Bhelsi	24.79	79.13	315.9	700	130	10000				4.5	5.5				10
11	Bhelsi II	24.79	79.13	315.9	700	350	4500	8000	9500		3	14	22	16		55
12	Khargapur	24.83	79.15	287.3	1068	65	25000				1.2	11.8				13
13	Khargapur II	24.83	79.15	287.3	310	50	310	10000	1050	10000	2.5	4.5	6.2	43.5	41	97.5
14	Chobara	24.86	79.12	289.6	40	90	800	6500	9000		3.2	4.8	29	42		79
15	Guna	24.90	79.14	277.5	105	15	530	6300	5850		1.5	0.5	40	34.5		76.5
16	Devraha	24.96	79.09	243.1	22	195	510	440	9000		3.3	13.4	19.4	41.6		77.7



17	Devraha II	24.96	79.09	243.1	35	8	250	8740			1.2	1.5	78.5			81
18	Jatara	25.00	79.04	256.1	25	6	48000				1.3	1.9				3.2
19	Jatara II	25.00	79.04	256.1	17	85	5400	185	8500	4150	5	2.9	32	13	44	97
20	Sagarwara	25.05	79.03	266.1	6	50	2500	125	3500	9500	2.6	2.6	5	9.8	30	50
21	Jaraya	25.11	79.10	241.8	3.5	2.5	9000				2	1.5				3.5
22	Jaraya II	25.11	79.10	241.8	5	20	180	1800	2500	9500	4	3.6	8.6	18	30.6	65
23	RajNagar	25.02	79.11	245	225	75	115	6500			1.5	3	39			43.5
24	RajNagar II	25.02	79.11	245	90	140	555	3285	9500		6.3	21.5	20	59.5		107
25	Kudyala	25.05	79.15	232.5	7	555	53500				5.5	2.5	8			17
26	Kudyala II	25.05	79.15	232.5	13	225	9500	55000			7.5	46.5	44			98
27	Gowa	25.05	79.17	221.1	105	15000	125	1600	9500	1350	1	1	4	3	7	16
28	Gadari	25.10	79.19	225.5	12	10	16250				1.5	7.5				9
29	Gadari II	25.10	79.19	225.5	12	35	4500	9500			7	6	119			132
30	Lahar Bujrug	25.00	79.22	247.9	61	6	1150	6			2.5	3.5	9			15
31	Kamalpura	24.91	79.25	269.2	96	12.5	60000				2.2	2.6				4.8
32	Kamalpura II	24.91	79.25	269.2	40	230	65000	16850			7.5	6	16	40		69
33	Pali	24.94	79.13	260.8	25	6	25550				3.15	2				5
34	Pali II	24.94	79.13	260.8	22	77	6500	19500	9900		8	2	14	38		62
35	Chari	24.95	79.22	260.4	55	13000	113	52000			1	1	13			15
36	Chari II	24.95	79.22	260.4	85	6500	700	9500	650	65000	1	4	15	62		82

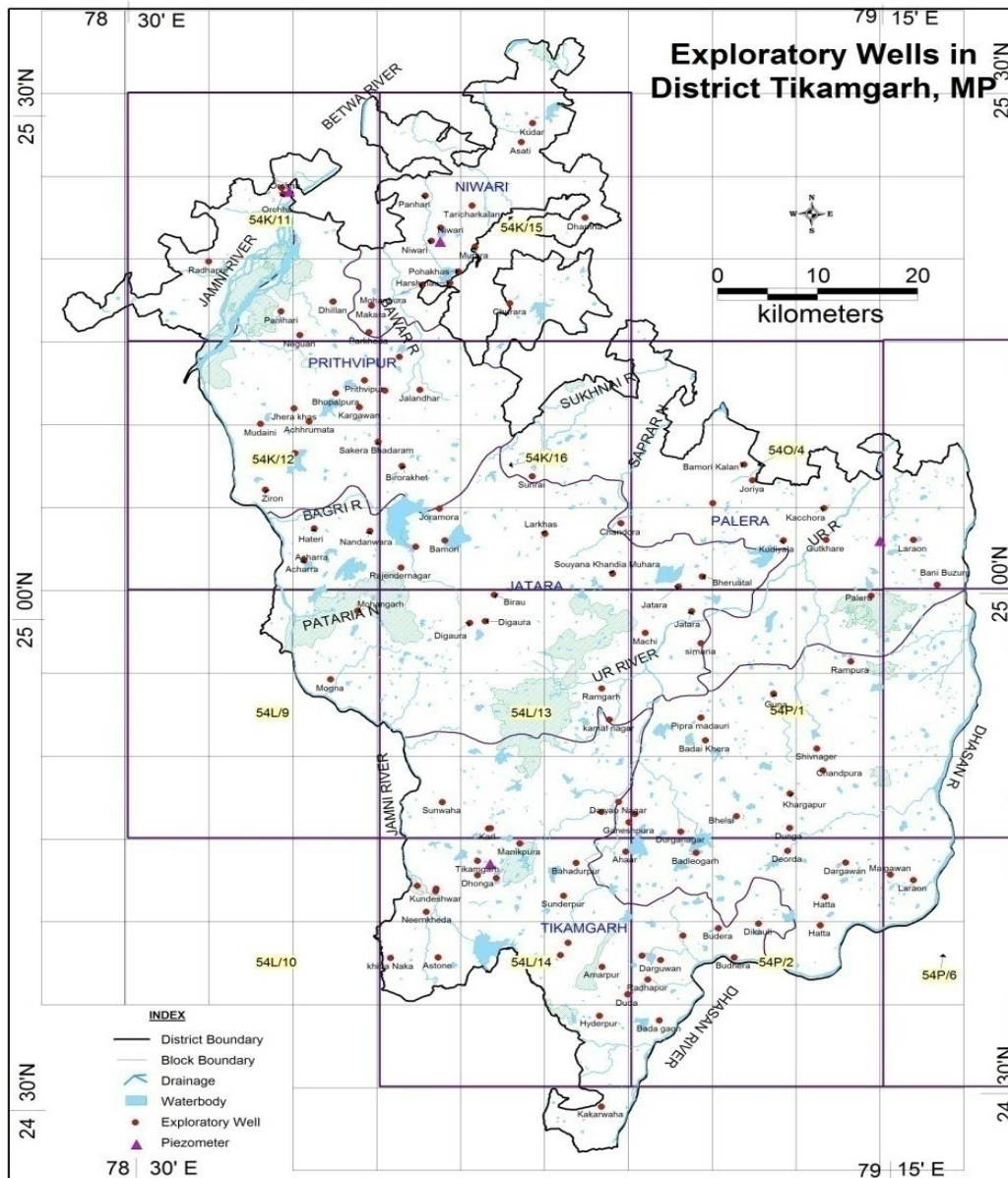
## 2.5 Exploratory Drilling-

CGWB under its exploration programme drilled 121 Exploratory wells and No. of exploratory wells drilled in each block varies from 11 to 36.

Year of construction	Number	
	EW	OW
2001-02	23	-
2004-05	30	-
2012-13	06	01
2013-14	30	06
2014-15	15	03
2015-16	01	01
2016-17	16	
<b>Total</b>	<b>121</b>	<b>11</b>

Block	Exploratory Well			
	Total EW	CGWB	WAPCOS	Out-sourcing
Baldeogarh	19	6	2	11
Jatara	22	9	2	11
Niwari	15	6	0	9
Palera	11	6	0	5
Prithvipur	18	10	0	8
Tikamgarh	36	22	2	12
<b>Total</b>	<b>121</b>	<b>59</b>	<b>6</b>	<b>56</b>

Fig .2.5. Exploratory wells in Tikamgarh District.

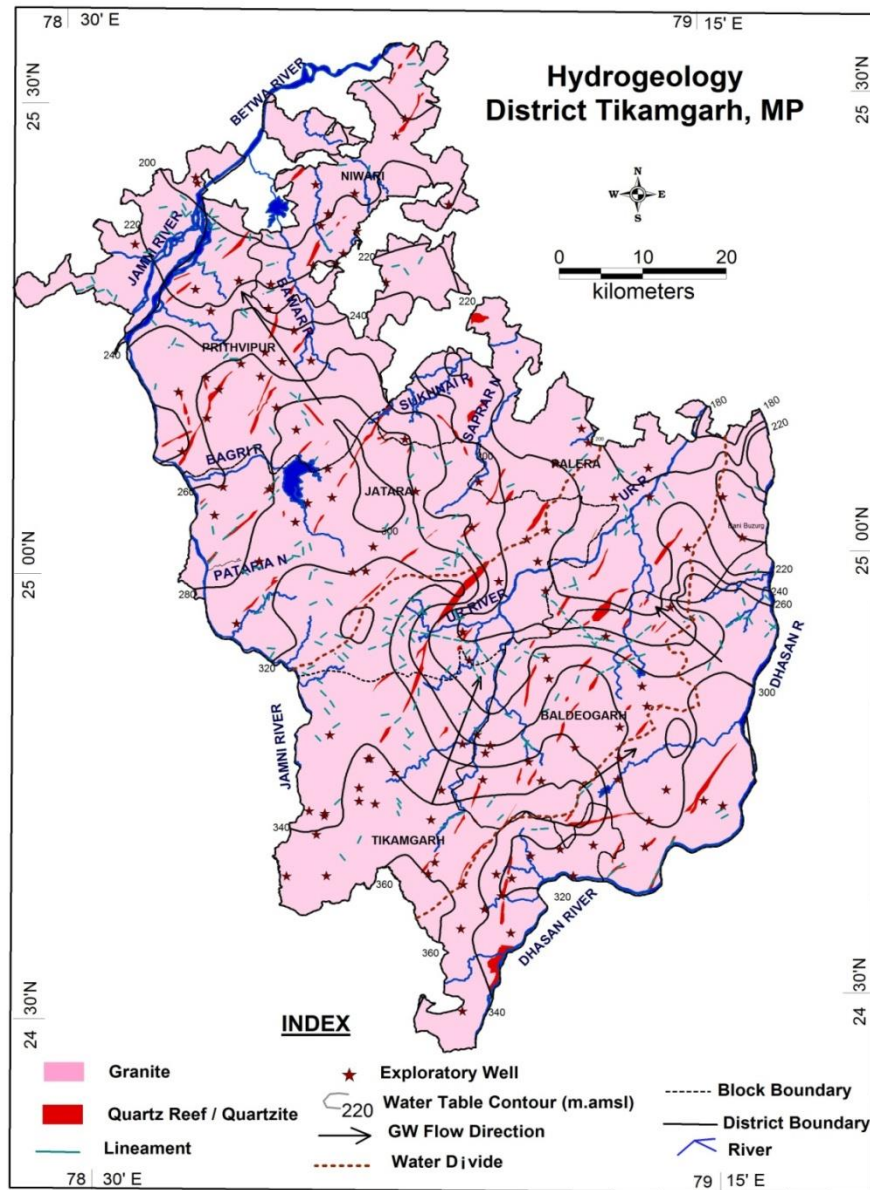


## Aquifer Parameters

Central Ground Water Board has drilled 53 exploratory wells in the district. Hydrogeological data of exploratory wells in the district is given in Table-4.

Perusal of Table-4 reveals that, the depth of these bore wells varies from 60.97 mbgl to 200 mbgl and Discharge of the bore well varies from less than 1 lps to 6.25 lps. Aquifer in these bore wells is generally jointed, fractured and weathered Granite. A hydrogeological map (Fig-2) of Tikamgarh district has been prepared on the basis of available data.

**Fig2: Hydrogeological map of Tikamgarh M.P.**



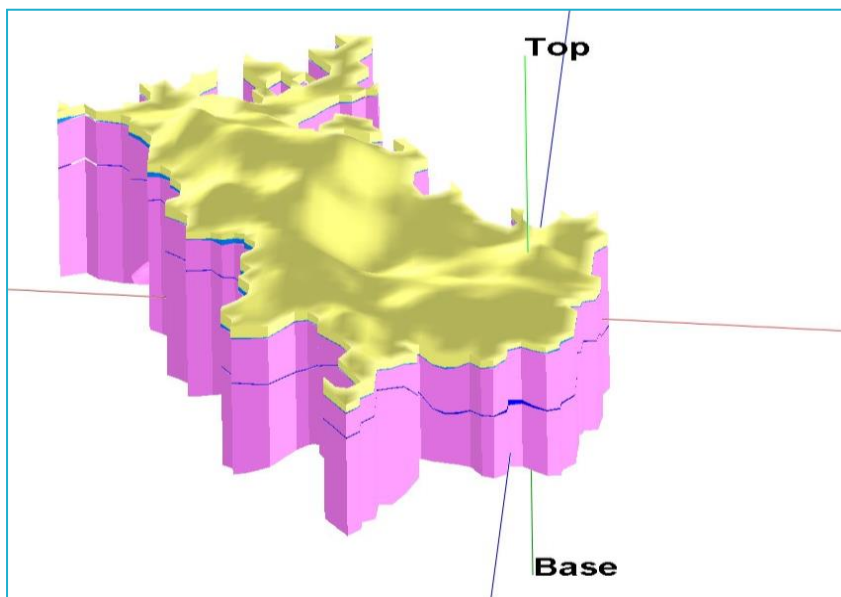
### 3.0 DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING

Result and interpretation of all studies and preparation of Aquifer maps ,2D&3D models

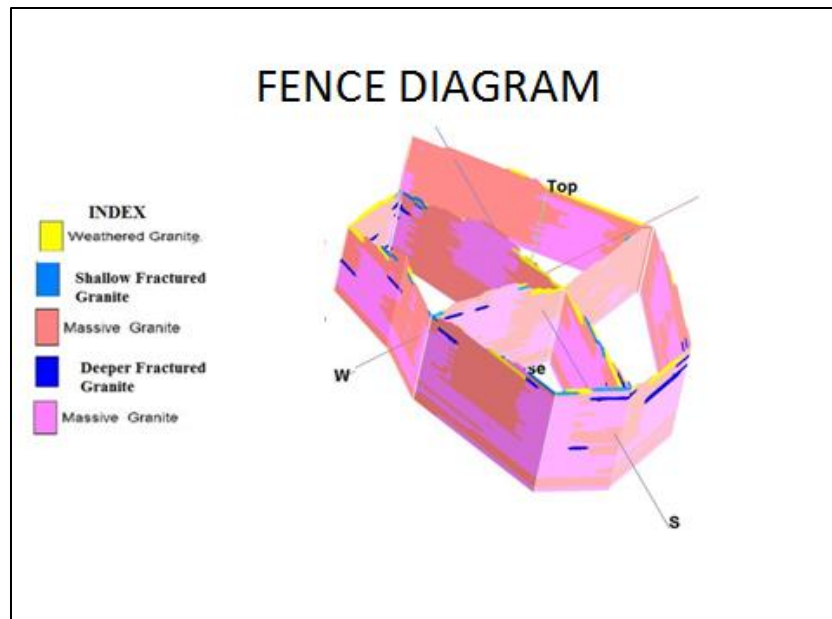
#### 3.1 Lithological Model :

Lithological data collected from CGWB bore wells, Piezometers,State ground water Piezometers etc. were studied and aquifer geometry and properties interpreted.Detailed Lithologs of boreholes were studied and compressed datain form of Rockworks data sheet was compiled.

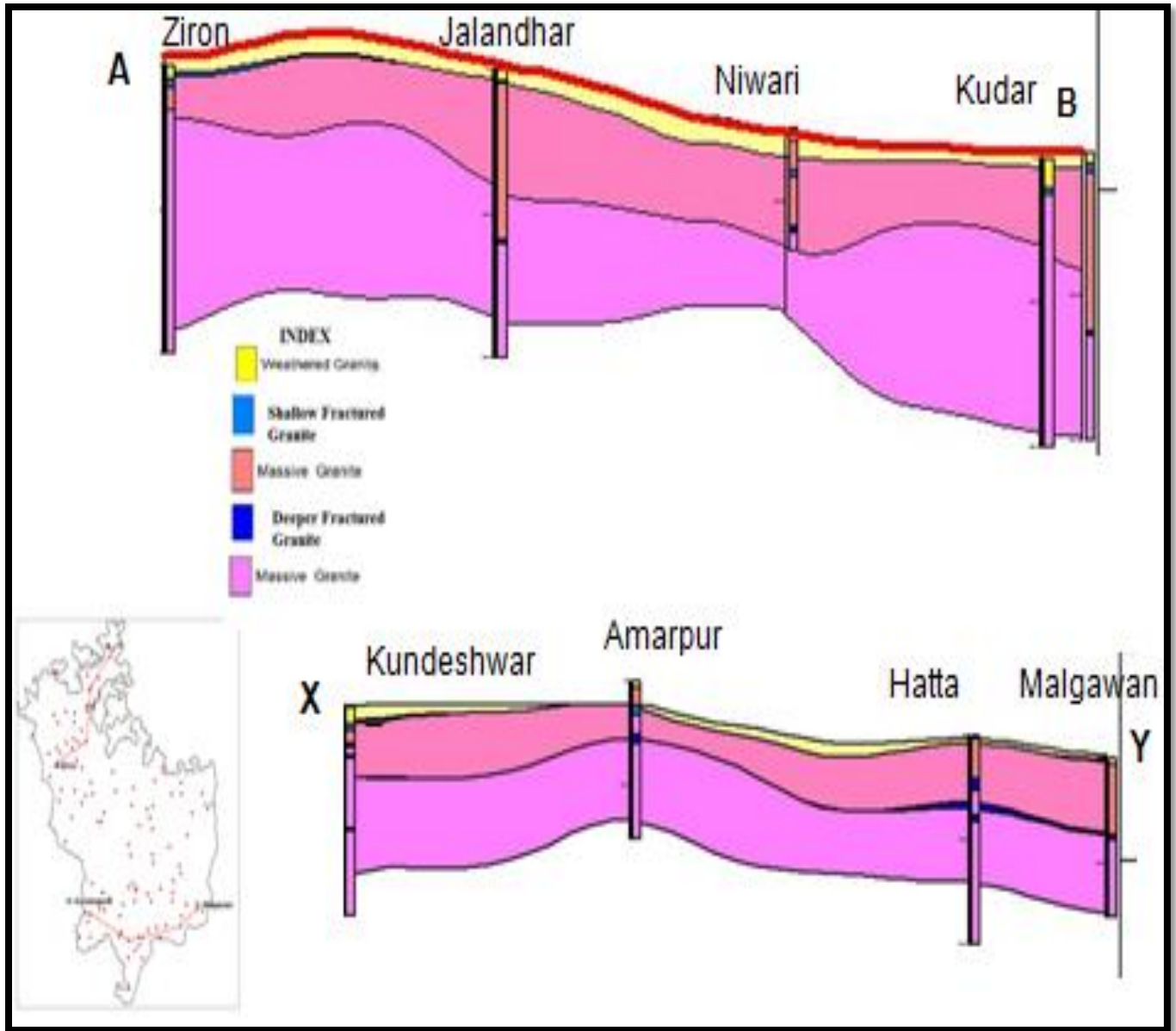
#### 3D Cross Section :Borehole Lithology,Regional Lithology&Aquifer disposition



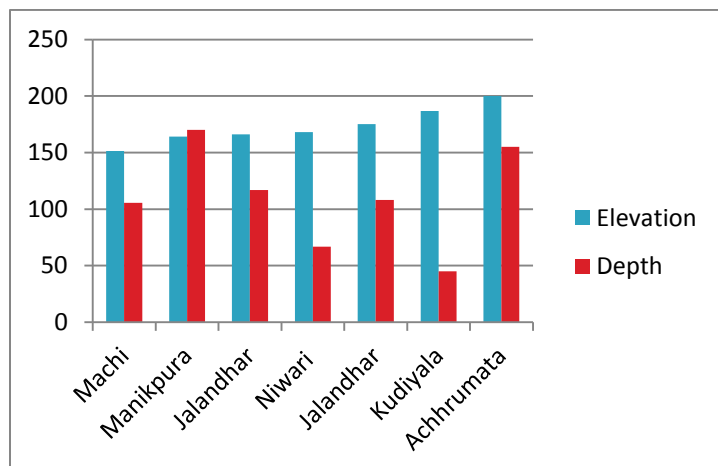
Fence Diagram: 3.1- Disposition of Lithology



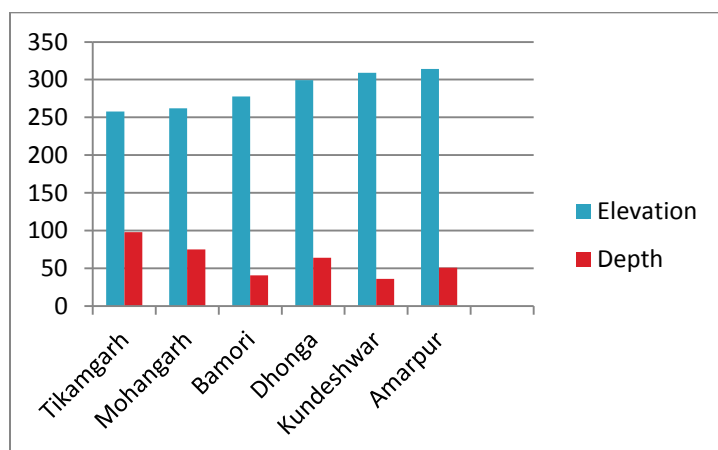
### 3.1.2 2D Cross Section :



## Deeper Aquifer disposition



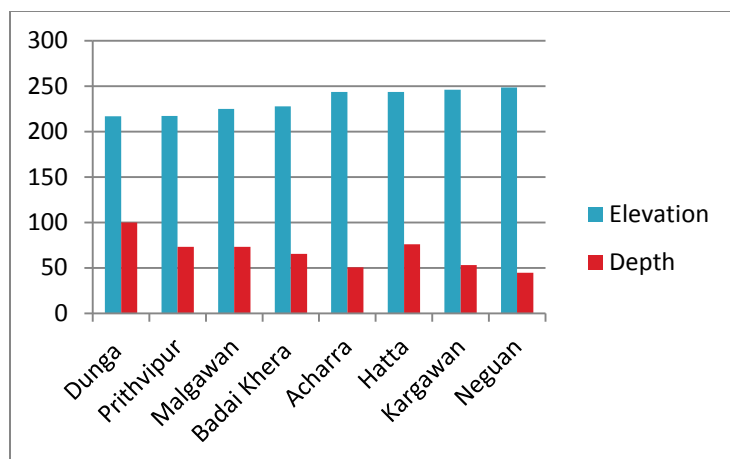
Exploratory well	Elevation of well	Deeper Aquifer disposition	
		Elevation ( m a msl)	Depth (mbgl)
Machi	256.8	151.3	105.5
Manikpura	334.10	164.1	170
Jalandhar	283.30	166.1	117
Niwari	242.50	168.2	66.8
Jalandhar	283.30	175.1	108
Kudiyala	231.8	186.8	45
Achhrumata	355.20	200.2	155



Tikamgarh	356.0	258	98
Mohangarh	337.0	262	75
Bamori	318.0	277.7	41
Dhonga	363.50	299.5	64
Kundeshwar	347.40	309	36
Amarpur	372.0	314	51

Dunga	316.60	216.6	100
Prithvipur	290.10	217.1	73
Malgawan	297.9	224.9	73
Badai			
Khera	293.0	227.5	65.5
Acharra	294.0	243.4	50.6
Hatta	319.6	243.6	76
Kargawan	299.10	246.1	53
Neguan	250.0	248.4	44.6





## 4.0 GROUND WATER RESOURCES

### 4.1 Dynamic Ground Water Resource & Draft :

The dynamic ground water resources of the Madhya Pradesh State assessed jointly by the CGWB and State Ground Water Departments under the supervision of the State level Committees. The base year of computation of the resources is as on March 2013.

The dynamic ground water resources are also known as Annual Replenishable Ground Water Resource since it gets replenished/ recharged every year. The Annual Replenishable Ground Water Resource for the Tikamgarh District has been assessed as 521.72MCM. The major source of ground water recharge is the monsoon rainfall. Blockwise Ground Water Resources of Tikamgarh district as on March, 2013 is given in Table 4.1.1. The contribution from other sources such as canal seepage, return flow from irrigation, seepage from water bodies etc in Annual replenishable Ground Water Resource during non-monsoon is 104.98MCM

The assessment of ground water draft is carried out based on the Minor Irrigation Census data and sample surveys carried out by the State Ground Water Department. The Annual Ground Water Draft of the entire district for 2012-13 has been estimated as 380.58MCM. Agriculture sector remained the predominant consumer of ground water resources. About 92.57% of total annual ground water draft i.e. 352.28MCM is for irrigation use. Only 28.30MCM is for Domestic & Industrial use which is about 7.43% of the total draft. An analysis of ground water draft figures indicates that in the district 72.95 % is stage of ground water development. The status of ground water development is high in the two blocks i.e Tikamgarh (81.11%) and Baldeogarh where the Stage of Ground Water Development is 78.25%,. In Prithvipur block the stage of ground water development is 56.21%..

**Table :4.1.1 Dynamic Ground Water Resources within (Zone of Fluctuation)**



S.No	Assessment Unit / Block	Net Ground Water Availability in	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground Water Draft for Domestic & Industrial Water Supply	Existing Gross Ground Water Draft for All Uses	Allocation For Domestic & Industrial Water Supply	Net Ground Water Availability for Future Irrigation	Stage of Ground Water Development in %
		Ham						
1	Baldeogarh	7878.31	5686.11	499.56	6185.67	1149.91	1042.29	78.52
2	Jatara	10326.68	6698.98	594.01	7292.99	990.88	2636.82	70.62
3	Niwari	7235.94	5216.03	410.67	5626.7	1023.93	995.98	77.76
4	Palera	7596.05	5409.45	449.7	5859.15	704.97	1481.63	77.13
5	Prathivipur	9743.74	5110.91	365.67	5476.58	953.97	3678.86	56.21
6	Tikamgarh	9391.49	7107.03	510.54	7617.57	1209.23	1075.23	81.11
	<b>District total</b>	<b>52172.21</b>	<b>35228.51</b>	<b>2830.15</b>	<b>38058.66</b>	<b>6032.89</b>	<b>10910.81</b>	<b>72.95</b>

## 4.2 Static Ground Water Resource & Draft -

4.2.1 Static Ground Water Resource of fractured formation below zone of fluctuation upto 30m depth is **144.34MCM** and 30-200 m bgl depth is computed as **165.954MCM**. **Total Static ground water resources of the district is 490.85MCM** and draft of dugwell /tube well is also calculated separately as **333.26MCM** and **19.02MCM** as given in table no 4.2.4. List of categorization of Blocks / Districts is given in Table No 4.1.

**Table No 4.2.1 Total Ground Water Resource**

Blocks	Baldeogarh	Jatara	Niwari	Palera	Pirthvipur	Tikamgarh	Total
<b>Shallow Aquifer</b>							
<b>Dynamic Resources (MCM)</b>	78.783	103.267	72.359	75.961	97.437	93.9149	521.722
<b>Static Resources (MCM)</b>	34.194	32.550	9.449	13.107	27.132	27.909	144.341
Total Resources (MCM)	<b>112.977</b>	<b>135.817</b>	<b>81.809</b>	<b>89.067</b>	<b>124.569</b>	<b>121.824</b>	<b>666.063</b>
<b>Irrigation Draft</b>	55.830	59.661	49.837	51.794	48.906	67.233	333.261
<b>Domestic+Industries</b>	4.996	5.940	4.107	4.497	3.657	5.105	28.302
GW Draft (MCM)	60.826	65.601	53.944	56.291	52.563	72.339	361.562
<b>Deeper Aquifer</b>							
<b>Static Resources (MCM)</b>	<b>27.981</b>	<b>32.864</b>	19.924	<b>24.351</b>	31.947	28.886	165.954
<b>GW Draft (MCM)</b>	1.031	7.328	2.323	<b>2.301</b>	2.203	3.837	19.024
Total GW Resources (MCM)	140.958	168.681	101.733	113.419	156.516	150.711	832.017
Gross Ground Water Draft (MCM)	61.857	72.930	56.267	58.592	54.766	76.176	380.587
Stage of Ground Water Development(%)	<b>78.52</b>	<b>70.62</b>	<b>77.76</b>	<b>77.130</b>	<b>56.210</b>	<b>81.110</b>	<b>72.95</b>
Category	<b>Semicritical</b>	<b>Semicritical</b>	<b>Semicritical</b>	<b>Semicritical</b>	<b>Safe</b>	<b>Semicritical</b>	<b>Semicritical</b>

#### 4.2.2 In-Storage Resource Static -shallow Aquifer

Static _shallow Aquifer	Unit	Baldeogarh	Jatara	Niwari	Palera	Pirthvipur	Tikamgarh	Total
Recharge worthy Area	Sq km	822.96	966.6	586	716.22	939.62	849.6	4881
Premonsoon (average) depth to water level	m	8.48	9.135	10.275	9.89	9.375	7.43	9.10
Av. depth of Dug well	m	11.25	11.38	11.35	11.11	11.3	9.62	11.00
Specific yield(Sy)%	Fraction	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Saturated thickness of aquifer (ST)	m	2.77	2.245	1.075	1.22	1.925	2.19	1.90
Resource (A * Sy * ST)	MCM	34.194	32.550	9.449	13.107	27.132	27.909	144.341

#### 4.2.3 Static \_Deep Aquifer

Static _Deep Aquifer	Unit	Baldeogarh	Jatara	Niwari	Palera	Pirthvipur	Tikamgarh	Total
Recharge worthy Area	Sq km	822.96	966.6	586	716.22	939.62	849.6	4881
Thickness of fracture in Deeper aquifer(2% of 170m)	m	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Specific yield(Sy)%	Fraction	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Resource (A * Sy * ST)	MCM	27.981	32.864	19.924	24.351	31.947	28.886	165.954

#### 4.2.4 Draft :

Draft	Unit	Baldeogarh	Jatara	Niwari	Palera	Pirthvipur	Tikamgarh	total
irrigation Draft	Mcm	56.861	66.990	52.160	54.095	51.109	71.070	352.285
Domestic+Industries	Mcm	4.996	5.940	4.107	4.497	3.657	5.105	28.302

Draft	Unit	Baldeogarh	Jatara	Niwari	Palera	Pirthvipur	Tikamgarh	Total
Dugwell	Mcm	55.83	59.66	49.84	51.79	48.91	67.23	333.26
Bore well	Mcm	1.03	7.33	2.32	2.30	2.20	3.84	19.02
Total	Mcm	56.86	66.99	52.16	54.09	51.11	71.07	352.29



## 5.0 GROUND WATER RELATED ISSUES

### 5.1 Major Ground Water Issues

- Area experience deficit rainfall once in every two to three years and facing moderate to Severe Drought .
- Aquifer having Limited Yield Potential
  - Shallow Aquifer : Low to medium potential in Granite & Gneisses.
  - Deeper Aquifer : Limited fracture thickness resulting into low yield of bore wells.
  - Quartz reefs which are running over several kilometers act as barrier against flow of surface & Ground water and sometimes high Yielding Wells are explored by CGWB in NAQUIM Project .
  - Ground Water Irrigated area of the district is about 77.63% .

### Important facts

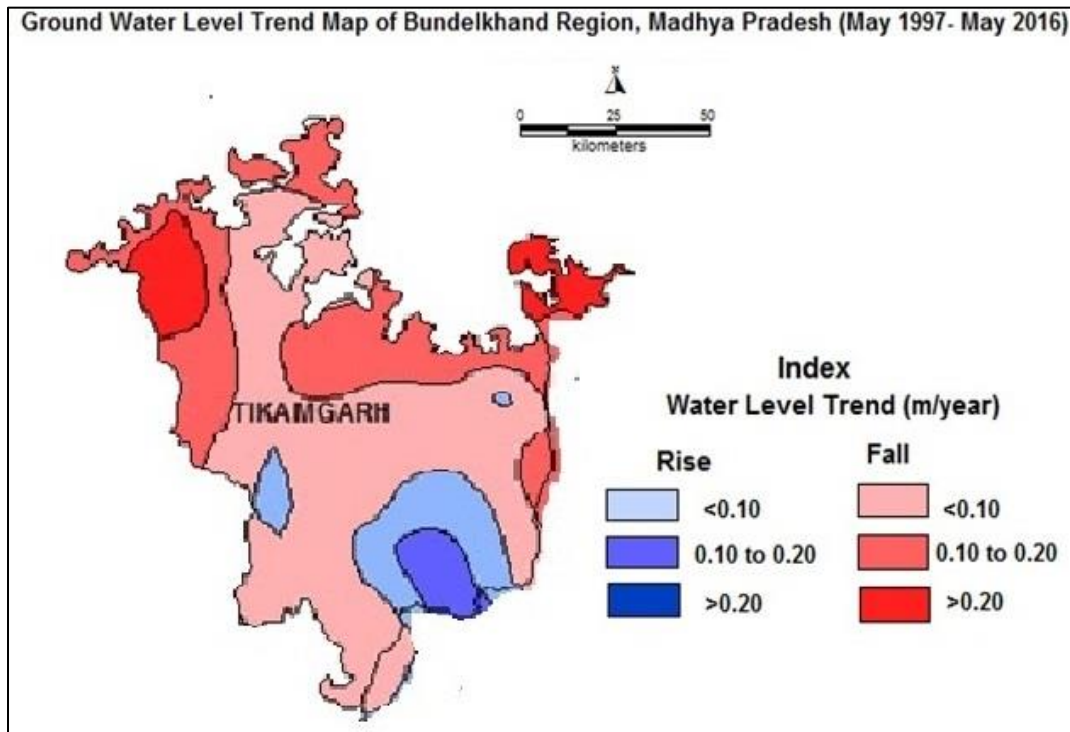
- 962 tanks constructed during Chandela's era, out of which 421 still survive and they are used for Irrigation. Renovation / De-silting of existing 49 Chandella's tanks each having Irrigation capacity of more than 40ha & other 372 Chandella's tanks having lesser irrigation capacity.
- 49 Chandella's tanks (like Baldeogarh, Bamhauri, Barana, Lidhaura, Jatara and Birsager etc.) having Irrigation Capacity of more than 40 hectares. Nandanwara tal (Jatara tehsil) is said to be second after Bada Talab, Bhopal.
- Major part of Socio –economy is dependent on Agriculture , 87.8% of rural population of district is dependent on Agriculture & 91.8% of the rural women works in Agriculture field.

### 5.1 Ground Water Depletion

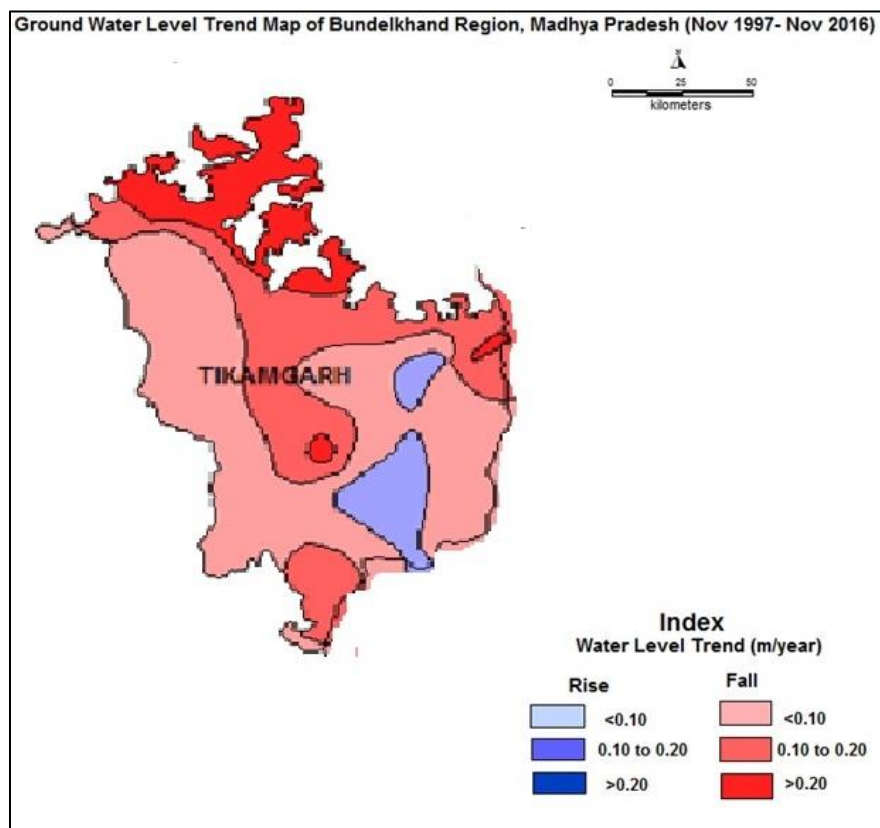
In last two decade (1997-2016), Tikamgarh District has shown growth in Agriculture sector , resulting pressure on ground water utilization . Groundwater is the only source of irrigation in 77.63 % of the area except irrigation from existing tanks. Farmers solely depend on groundwater for irrigation. Every year number and depth of bore wells are increasing. The yield of the dug wells in shallow aquifer (0-30 mbgl) is reduced due to over development of deep fractured aquifer by bore wells. The Phreatic aquifer is recharged during monsoon and the dug

wells sustains for 3 to 4 months only. The dug wells sustain only for 2 to 3 hours of pumping with a drawdown of 2 to 5 m.

Decline in groundwater level is observed  $>0.20$  m/yr in Niwari & Prithvipur Block and 0.10 to 0.20 m/yr in Prithvipur, Palera &  $<0.10$  m/yr in the area of Tikamgarh & Baldevgarh Blocks during pre monsoon period..



Decline in groundwater level is observed  $>0.20$  m/yr in Niwari Block and 0.10 to 0.20 m/yr in Prithvipur, Palera & Tikamgarh Blocks during Post monsoon period. The saturated thickness of the shallow aquifer in monsoon is 3 to 10 m. and Non-monsoon 0.5 to 1.5 m.



## 6.0 GROUND WATER MANAGEMENT STRATEGIES

### 6.1 Tikamgarh Ground Water Management Plan

The demand of fresh water for agriculture, drinking and industrial uses etc. has significantly increased due to population growth and socio-economic development. As surface water resources in the Tikamgarh are in-adequate, the dependability on ground water resources has increased substantially. This has resulted in rapid exploitation of ground water resources vis a vis depletion of ground water levels in various parts of the Tikamgarh.

#### 6.1.1 Area suitable for Ground Water Management Plan

Blocks	Total Geographical Area Sq km	Hilly Area Sq km	Recharge worthy area Sq km	Wet area (Sq km)			Area suitable for artificial recharge Sq km
				Command area	Water spread area of tanks	Total	
Baldeogarh	858.96	36	822.96	60.28	28.17	88.45	734.51
Jatara	1008.6	42	966.6	50.14	41.37	91.51	875.09
Niwari	606	20	586	52.89	8.65	61.54	524.46
Palera	748.22	32	716.22	0	15.43	15.43	700.79
Prithvipur	958.62	19	939.62	24.19	22.63	46.82	892.80
Tikamgarh	867.6	18	849.6	71.17	27.74	98.91	750.69
<b>Total</b>	<b>5048</b>	<b>167</b>	<b>4881</b>	<b>258.67</b>	<b>143.99</b>	<b>402.66</b>	<b>4478.34</b>

The district is under stress due to rapid exploitation of ground water resources, resulting into continuous depletion. Thus there is urgent need for taking up suitable water management interventions based on integrated approach, which on one hand includes augmentation of ground water resources through appropriate techniques, and on the other hand requires the adoption of suitable water conservation measures, such as ensuring water use efficiency through creation of additional water storage facility, maintenance/ renovation of existing water bodies etc. Water awareness and capacity building of the stakeholders are also the important attributes of water management interventions as envisaged in the National Water Policy.



Artificial recharge to ground water is one of the most efficient, scientifically proven and cost effective technology to mitigate the problems of over exploitation of ground water resources. The technology serves as a means for restoring the depleted ground water storage, ameliorate the ground water quality problems and also enhance the sustainability of wells in the affected areas. A detailed knowledge of geology, hydrogeology, land use pattern, geomorphology and hydro-meteorological features are however, essential for selection of appropriate artificial recharge techniques as well as design and sites of ground water recharge structures.

As per directions of Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India, preparation of Aquifer Management Plan for Tikamgarh District in the State has been prepared and shown in Table 6.1.2 and financial out lay plan is also shown in Table 6.1.3.

Block wise Management Plan has also been prepared. Each Plan discusses the broad framework of ground water situation in the block, status of water availability (both surface and ground water), identification of feasible areas for interventions, feasibility of artificial recharge and other water conservation structures, their design considerations, numbers and cost estimates. The expected outcomes of the proposed interventions have also been elucidated and given in table no 17.

As Tikamgarh District having **Stage Of Development 85.26%** after proposed intervention **Stage Of Development will be 62.59%**.

### 6.1.2 Management plan for Artificial Recharge

Area suitable for recharge (sq KM)	Average post-monsoon water level (m)	Unsaturated zone (m)	Average SP. Yield (%)	Sub-surface storage (mcm)	Surface water required (mcm)	Surface water (Run-off) available (mcm)	Non-committed Run-off (mcm)	Existing major Water conservation tank 'S	Recharge shaft/ Tube well	NB / CD / CP	Renovation of Village Ponds (Under RRR)
4478	6.66	3.66	0.015	240.23	319.50	1119.46	335.84	283	672	1983	702

Table No6.1.3 :Financial Outlay Plan

Existing major Water conservation tanks to be renovated		NB/ CD/ CP		Recharge shaft/ Tube well		Renovation of Village Ponds (Under RRR)		Total Cost (Rs in crores)
structure	cost	structure	cost	structure	cost	structure	cost	cost
Nos	(crores)	Nos	(crores)	Nos	(crores)	Nos	(crores)	
283	28.30	1983	198.3	672	6.72	702	35.10	290.10

## 6.2 INTERVENTION OF TECHNOLOGY

### 6.2.1 The Sprinkler irrigation technology

Rising demand for irrigation water amid concerns of growing water scarcity has brought into renewed focus, the need for improving water use efficiency and raising crop water productivity. Great emphasis is being made on achieving water conservation through various demand side management interventions encompassing technological options and policy measures. Given the difficulties and political concerns associated with bringing about effective policy reforms to achieve the objective of water conservation, this emphasis has generally focused on technological solutions backed by soft policy interventions to aid and facilitate adoption of technological solutions by farmers.

Micro irrigation technologies such as **drip and sprinkler** systems are being increasingly promoted as technological solutions for achieving water conservation. Of the two technologies, drip irrigation, in its various forms, has been a relatively more important mode of micro irrigation in India. Enough empirical evidences are available from different parts of the country to suggest that drip technology saves water and is cost effective and has significant economic and social benefits. Drip irrigation saves water and electricity for pumping water, useless labour and leads to higher crop productivity.

Farmers in India generally practice flood irrigation resulting in low water application and use efficiency. The estimated surface irrigation water use efficiency in India is 35-40%. With deteriorating surface water infrastructure and rapid declines in ground water levels in large parts of the country, and in the face of increasing demand for water from all sectors of the economy, there is a widespread concern for using the available water more efficiently. Micro-irrigation systems, comprised of drip and sprinkler technologies, have emerged as an effective tool for water conservation and improving water use efficiency. While drip irrigation is ideally suited for horticulture crops such as pomegranates, grapes, mangoes, bananas, guava, coco-nuts, amla, and cash crops such as sugarcane. It is being used for cultivation of other crops as well.

**Sprinklers** are generally useful in undulating land planted with cereal crops. Despite substantial efforts in promoting demand side management technologies, in practice, drip and sprinkler technologies have been slow to be accepted by farmers. Of the two, drip irrigation is the more preferred technology.

To reduce the ground water draft in Tikamgarh District & bring the stage of G.W. development from Semi-critical to Safe category, it is proposed that total irrigated Area which is about 2,18,436 ha & irrigated by ground water, if 50% of this area i.e 1,09,218 ha is to be irrigated by using sprinklers, then total ground water saved in one year is about 87.37 MCM. The block wise area proposed for irrigation through sprinkles is given in table 6.2.2

**Table:6.2.2GroundWaterResourcesafterIntervention(outcomeofNAQUIM)**

<b>Block</b>	<b>Net GW Availability</b>	<b>GW Draft for Irrigation</b>	<b>GW Draft for Domestic &amp; Industrial</b>	<b>Gross Draft</b>	<b>Present Stage of Development</b>	<b>Saving by Sprinklar irrigation</b>	<b>Additional created by AR</b>	<b>Total GW availability</b>	<b>Draft after sprinkler irrigation</b>	<b>Stage of development after intervention</b>
	<b>MCM</b>				<b>%</b>	<b>MCM</b>				<b>%</b>
<b>Baldeogarh</b>	<b>78.780</b>	<b>56.860</b>	<b>4.990</b>	<b>61.850</b>	<b>78.52</b>	<b>14.68</b>	<b>23.137</b>	<b>101.917</b>	<b>42.18</b>	<b>41.39</b>
<b>Jatara</b>	<b>103.270</b>	<b>66.990</b>	<b>5.940</b>	<b>72.930</b>	<b>70.62</b>	<b>14.21</b>	<b>34.916</b>	<b>138.186</b>	<b>52.78</b>	<b>38.19</b>
<b>Niwari</b>	<b>72.360</b>	<b>52.160</b>	<b>4.110</b>	<b>56.270</b>	<b>77.76</b>	<b>12.07</b>	<b>34.693</b>	<b>107.053</b>	<b>40.09</b>	<b>37.45</b>
<b>Palera</b>	<b>75.960</b>	<b>54.090</b>	<b>4.500</b>	<b>58.590</b>	<b>77.13</b>	<b>17.37</b>	<b>61.555</b>	<b>137.515</b>	<b>36.72</b>	<b>26.70</b>
<b>Prithivipur</b>	<b>97.440</b>	<b>51.110</b>	<b>3.66</b>	<b>54.770</b>	<b>56.21</b>	<b>15.88</b>	<b>48.881</b>	<b>146.321</b>	<b>35.23</b>	<b>24.08</b>
<b>Tikamgarh</b>	<b>93.910</b>	<b>71.070</b>	<b>5.110</b>	<b>76.180</b>	<b>81.11</b>	<b>13.17</b>	<b>37.047</b>	<b>130.957</b>	<b>57.9</b>	<b>44.21</b>
<b>Total</b>	<b>521.72</b>	<b>352.28</b>	<b>28.31</b>	<b>380.59</b>	<b>72.95</b>	<b>87.37</b>	<b>240.23</b>	<b>761.95</b>	<b>264.91</b>	<b>34.77</b>

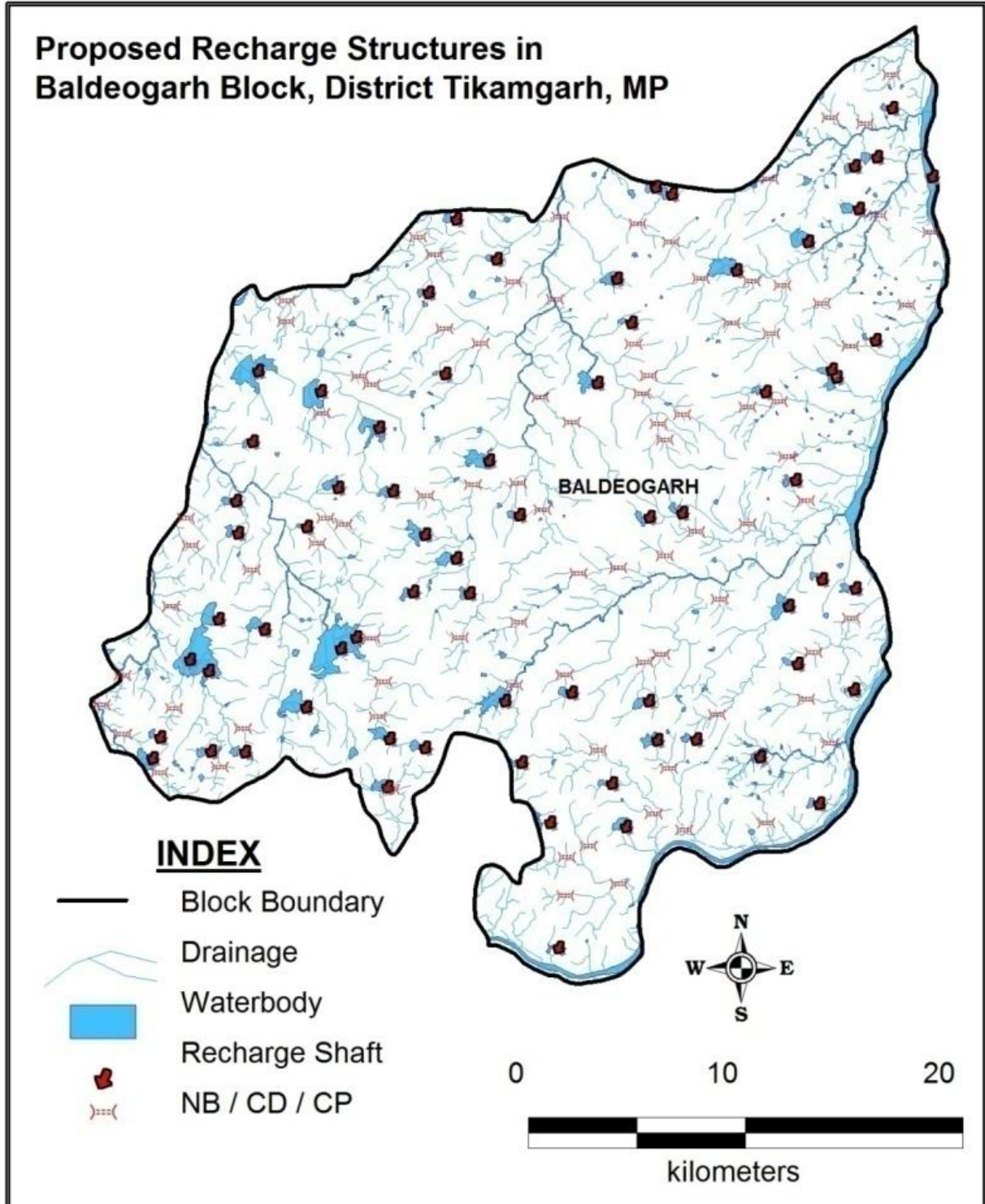
## **7.0 BLOCK WISE MANAGEMENT PLAN**

**Table: 7.1 Management Plan of Baldeogarh Block**

<b>Area in</b>	<b>Sq Km</b>	<b>858.96</b>
Rainfall in	m	0.7815
Area Suitable for Recharge in	Sq Km	734.51
Average Post Monsoon DTW in	mbgl	5.10
Unsaturated Zone in	m	2.10
Average Specific Yield	in %	0.015
Sub Surface Storage Available	mcm	23.137
Surface Water Required	mcm	30.77
Runoff Available	mcm	183.63
Non committed Runoff available	mcm	55.09
No. of Recharge Shaft/ Tube Wells	No.	62
Renovation of existing water conservation tank	No.	31
No. of NB/CD/CP	No.	215
Renovation of Village Ponds (Under RRR)		212

<b>GROUND WATER RESOURCE OF BALDEOGARH BLOCK</b>	
<b>Phreatic Aquifer</b>	
<b>Dynamic Resources (MCM)</b>	78.783
<b>Static Resources (MCM)</b>	34.194
<b>Total Resources (MCM)</b>	112.977
<b>Irrigation Draft</b>	
	55.830
<b>Domestic + Irrigation Draft</b>	
	4.996
<b>Total Ground Water Draft</b>	
	60.826
<b>Phreatic Aquifer</b>	
<b>Static Resources (MCM)</b>	27.981
<b>Ground Water Draft</b>	1.031184
<b>TOTAL GROUND WATER RESOURCES (MCM)</b>	<b>140.954</b>
<b>GROUND WATER DRAFT (MCM)</b>	<b>61.857</b>
<b>STAGE OF GROUND WATER DEVELOPMENT (%)</b>	<b>78.52</b>
<b>CATEGORY</b>	<b>Semi Critical</b>

## Proposed Recharge Structures in Baldeogarh Block, District Tikamgarh, MP



Proposed Artificial Recharge Structures, Baldeogarh Block, Tikamgarh District

**Table:7.2Water Bodies/Tanks of Baldeograh block**

S.no	Block	Tanks	storage capacity	Hight	Water spread area	Max. irr. Cap.
			MCM	m	Ha	Ha
1	Baldeogarh	Arora	0.49	7.92	17.64	98
2	Baldeogarh	Balwantpur	1.69	12.49	21.21	78
3	Baldeogarh	Bhitarwar	1.53	7.01	95.64	71
4	Baldeogarh	Chanderi	0.41	4.87	14.49	26
5	Baldeogarh	Chhidari	0.38	7.01	15.33	56
6	Baldeogarh	Dadgaon	0.31	4.57	11.13	55
7	Baldeogarh	Deri	0.76	10.67	44.94	209
8	<b>Baldeogarh</b>	<b>Dhanera</b>	<b>0.38</b>		13.65	
9	Baldeogarh	Dudiyankhera	1.6	14.9	95.55	
10	Baldeogarh	Dushiyaara	0.44	6.1	15	
11	Baldeogarh	Futer	0.46	6.4	25.83	88
12	Baldeogarh	Gwalsager	9.69	2.73	370	686
13	Baldeogarh	Hanumatpura	0.42	7.31	13.6	1232
14	Baldeogarh	Jarua	4.776	15.75	147.84	
15	Baldeogarh	Jhinguon	0.341	6.1	8.61	
16	Baldeogarh	Kariyapatha	2.763	14.5	97.02	
17	Baldeogarh	Khodera	3.22	12.49	114.87	77
18	Baldeogarh	Kotra	0.46	4.26	16.15	65
19	Baldeogarh	Kudiyala	0.26	6.09	17.35	
20	Baldeogarh	Lakhera	0.61	7.31	21.63	56
21	Baldeogarh	Madansager Ahaar	11.46	13.1	267	1185
22	Baldeogarh	Madarkha	0.36	10.67	12.5	90
23	Baldeogarh	Matol	1.84	7.62	22.26	191
24	Baldeogarh	Ranital Bhelsi	0.55	6.25	23.94	
25	Baldeogarh	Ratansager	0.44	9.14	19.95	70
26	Baldeogarh	Sarkanpur	1.84	9.15	68.04	237
27	Baldeogarh	Vindhwasini	1.27	13.72	44.94	
<b>Total</b>			<b>48.75</b>		<b>1636.11</b>	

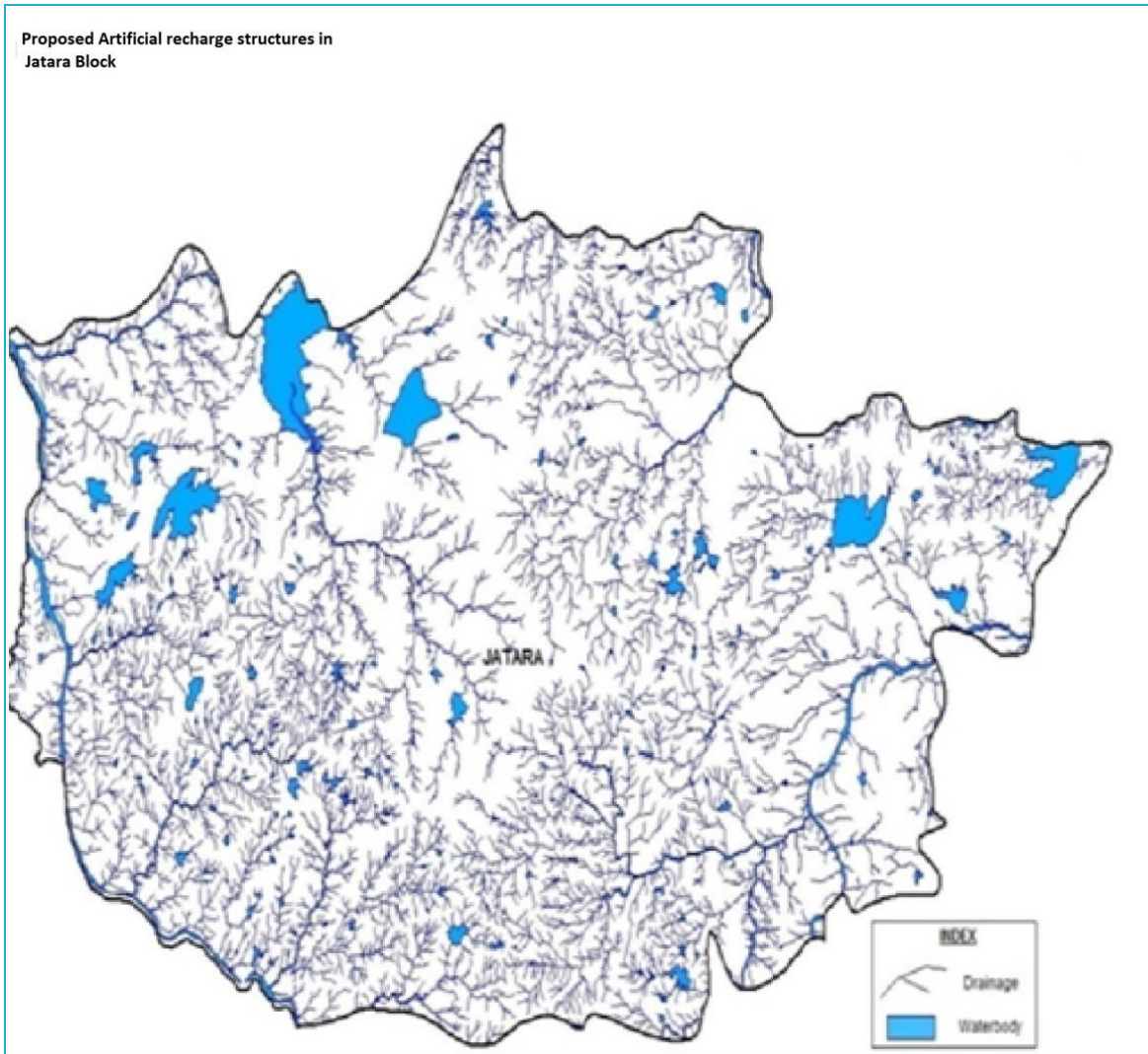
**Table: 7.3 Management Plan of Jatara Block**

Area	Sq Km	1008.60
Rainfall	mm	0.7815
Area Suitable for Recharge	Sq Km	875.09
Average Post Monsoon DTW	mbgl	5.66
Unsaturated Zone	m	2.66
Average Specific Yield in	%	0.015
Sub Surface Storage Available	mcm	34.916
Surface Water Required	mcm	46.44
Runoff Available	mcm	252.15
Non committed Runoff available	mcm	218.77
No. of Recharge Shaft/ Tube Wells	No	93
Renovation of existing water conservation tank	No	46
No. of NB/CD/CP	No	325
Renovation of Village Ponds (Under RRR)	No	153

**Ground Water Resources of Jatara Block**

<b>Phreatic Aquifer</b>	Dynamic Resources	mcm	103.267
	Instorage	mcm	32.550
	Total Resources	mcm	135.817
	Irrigation Draft	mcm	59.661
	Domestic+Industrial Draft	mcm	5.940
	Total GW Draft	mcm	65.601
<b>Deeper Aquifer</b>	Static Resources	mcm	32.864
	GW Draft	mcm	7.32888
Total GW Resources		mcm	168.681
Gross Ground Water Draft		mcm	72.930
Stage of Ground Water Development			70.62
Category			Semi-critical





Type of Structure	Number	@ Rs /structures	Cost INR in Crores
Renovation of existing water conservation tank	46	Rs ten Lakh	4.60
Recharge Shaft/ Tube Wells	93	Rs Five Lakh	4.65
NB/CD/CP	325	Rs ten Lakh	32.5
Renovation of Village Ponds (Under RRR)	153	Rs five Lakh	7.65
<b>Total Cost</b>			<b>Rs 49.40 Crores</b>

## IMPACT

Dynamic Ground Water Resources	Additional GW Resources Created	Total GW Resources	Area Under GW Irrigation	Saving by intervention of Sprinkler irrigation	Stage of GW Development before intervention	Stage of GW Development After intervention before increasing Irrigated Area
mcm	mcm	mcm	mcm	mcm	%	%
103.27	34.916	138.186	301.63	14.21	70.62	38.19

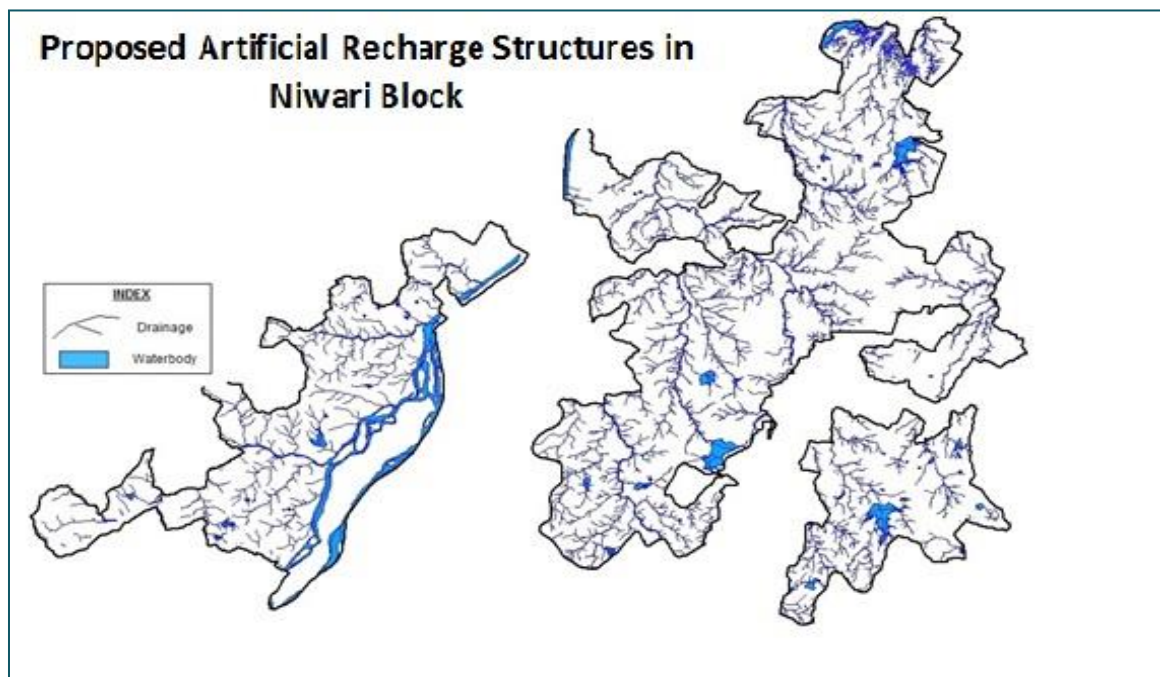
### Water Bodies /tanks of Jatara Block

S.no	Block	Tanks	storage capacity	Hight	Water spread area	Max. irr. Cap.
			MCM	m	Ha	Ha
1	Jatara	Acharra	0.4	4.57	9.6	94
2	Jatara	Baharu	1.44	9.6	35.25	
3	Jatara	Bairki nala	0.2	7.92	6.75	
4	Jatara	Berawar	0.89	5.03	6.75	
5	Jatara	Barana Bamhauri	0.86	4.87	188.28	1013
6	Jatara	Brishbhanpur	0.38	6.4	35.31	184
7	Jatara	Chandera	0.3	4.27	7.65	3251
8	Jatara	Chaturkari	0.15	6.1	10.95	
9	Jatara	Chutki	0.43	7.62	10.8	
10	Jatara	Dharamsagar	11.9	13.71	308.1	1500
11	Jatara	Digaura	0.79	4.6	25.21	100
12	Jatara	Dargaon khurd	0.33	3.36	17.4	77
13	Jatara	Dargaon kalan	0.37	4.81	8.55	40
14	Jatara	Kiratwari	0.85	12.19	16.2	
15	Jatara	Kumaharudi	0.89	13.7	121.1	
16	Jatara	Mandansagar	12.23	18.29	175.6	1151
17	Jatara	Mohangarh	3.21	5.57	130	
18	Jatara	Padama sager	2.98	15.94	129.5	

19	Jatara	Palera	1.13	10.28	8.4	
20	Jatara	Pateriya	0.89	7.62	18	
21	Jatara	Para	0.33			27
22	Jatara	Kariapatha	3.588	14.5		
23	Jatara	Samdua	0.58	6.15	11.7	
24	Jatara	Shahpur	0.24	6.09	6.15	
25	<b>Jatara</b>	<b>Vairawar</b>	<b>0.19</b>		6.15	
26	<b>Jatara</b>	<b>Vilwari</b>	<b>0.32</b>		8.1	
27	Jatara	Meno Weir			6.75	
28	Jatara	Ghoora	3.29	9.14	45.6	195
29	Jatara	Bandka Muharra	0.48		14.55	
30	Jatara	Ramnagar	0.81		12.15	52
31	Jatara	Morpariya	0.38		9.6	
32	Jatara	Dushyara	0.44	6.1	17.28	96
33	Jatara	Gidhwasan	1.39	12.5	21.24	
34	Jatara	Kumhedi	3.25	13.7	81.85	
35	<b>Jatara</b>	<b>Nandanwara</b>	<b>23.75</b>	<b>17.68</b>	936	1677
36	Jatara	Mohangarh	3.21	5.57	108	
37	Jatara	Tudiyara	0.89	6.10	10.98	
			<b>83.758</b>		<b>2565.5</b>	

### Management Plan of Niwari Block

Area	Sq Km	606.00
Rainfall	mm	0.7815
Average Post Monsoon DTW	mbgl	7.41
Unsaturated Zone	m	4.41
Average Specific Yield in	%	0.015
Sub Surface Storage Available	mcm	34.693
Surface Water Required	mcm	46.14
Runoff Available	mcm	131.12
Non committed Runoff available	mcm	39.333
No. of Recharge Shaft/ Tube Wells	No	79
Renovation of existing water conservation tank	No	39
No. of NB/CD/CP	No	275
Renovation of Village Ponds (Under RRR)	No	42



## Ground Water Resources of Niwari

<b>Phreatic Aquifer</b>		
Dynamic Resources	<b>mcm</b>	<b>72.359</b>
Static Resources	<b>mcm</b>	<b>09.449</b>
Total Resources	<b>mcm</b>	<b>81.809</b>
Irrigation Draft	<b>mcm</b>	<b>49.837</b>
Domestic+Industrial Draft	<b>mcm</b>	<b>04.107</b>
Total GW Draft		<b>53.944</b>
<b>Deeper Aquifer</b>		
Static Resources (MCM)	<b>mcm</b>	<b>19.924</b>
GW Draft (MCM)	<b>mcm</b>	<b>02.323</b>
Total GW Resources	<b>mcm</b>	<b>101.733</b>
Gross Ground Water Draft	<b>mcm</b>	<b>56.267</b>
Stage of Ground Water Development	<b>%</b>	<b>77.76</b>
Category		<b>Semi-critical</b>

## Management Plan

Type of Structure	N0.	@ Rs/structure	Cost INR in Crores
Renovation of existing water conservation tank	39	Rs ten Lakh	3.90
Recharge Shaft/ Tube Wells	79	Rs Five Lakh	3.95
NB/CD/CP	275	Rs ten Lakh	27.5
Renovation of Village Ponds (Under RRR)	42	Rs five Lakh	2.10
<b>Total Cost</b>			<b>42.03</b>

## IMPACT

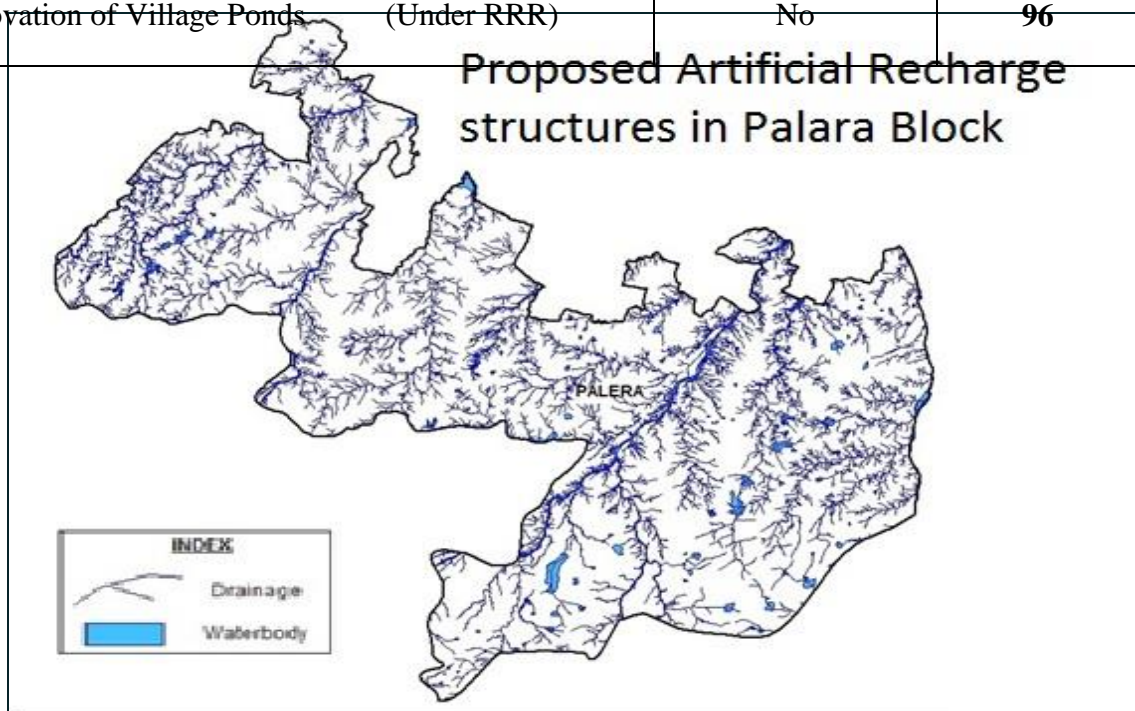
Dynamic Ground Water Resources	Additional GW Resources Created	Total GW Resources	Area Under GW Irrigation (ha)	Saving by intervention of Sprinkler irrigation (MCM)	Stage of GW Development before intervention	Stage of GW Development After intervention before increasing Irrigated
mcm	mcm	mcm	Ha	mcm	%	%
<b>72.360</b>	<b>34.693</b>	<b>107.053</b>	<b>30163</b>	<b>12.07</b>	<b>77.76</b>	<b>37.45</b>

**Water Bodies/Tanks in Niwari block**

S. No.	Block	Tanks	storage capacity	Hight	Water spread area	Max. irr. Cap.
			mcm	m	Ha	Ha
1	Niwari	Barua Nala	16.483		359.1	
2	Niwari	Ghughasi	0.39	4.57	28.68	227
3	Niwari	Niwari	0.89	4.57	44.25	170
4	Niwari	Putarikhera	0.33		19.26	
5	Niwari	Sakuli	0.89	5.18	7.35	59
6	Niwari	satighat	2.913		98.64	
7	Niwari	Sindur Sagar, kudar	2.58	9.14	73.08	525
8	Niwari	Teharka Tank	6.68	12.8	195.28	914
9	Niwari	Ladpura	0.54	3.9	0	4
10	Niwari	Bhitri lift irrigation			203.4	
11	Niwari	Desa kheda			84.39	
12	Niwari	Daratha	0.215	3.65	14.22	48
13	Niwari	Madwa Ladwari	0.756	7.62	14.56	
			<b>32.667</b>		<b>1113.43</b>	

## Management Plan of Palara Block

<b>Area</b>	<b>Sq Km</b>	<b>748.22</b>
Rainfall	mm	<b>0.7815</b>
Area Suitable for Recharge	Sq Km	<b>729.29</b>
Average Post Monsoon DTW	mbgl	<b>8.86</b>
Unsaturated Zone	m	<b>5.86</b>
Average Specific Yield in	%	<b>0.015</b>
Sub Surface Storage Available	mcm	<b>61.555</b>
Surface Water Required	mcm	<b>81.87</b>
Runoff Available	mcm	<b>175.07</b>
Non committed Runoff available	mcm	<b>52.52</b>
No. of Recharge Shaft/ Tube Wells	No	<b>105</b>
Renovation of existing water conservation tank	No	<b>53</b>
No. of NB/CD/CP	No	<b>368</b>
Renovation of Village Ponds (Under RRR)	No	<b>96</b>



### Ground Water Resources of Palera Block

<b>Phreatic Aquifer</b>		
Dynamic Resources	mcm	<b>75.961</b>
Static Resources	mcm	<b>13.107</b>
Total Resources	mcm	<b>89.067</b>
▪ Irrigation Draft	mcm	<b>51.794</b>
▪ Domestic+Industrial Draft	mcm	<b>4.497</b>
<b>Total GW Draft</b>	mcm	<b>56.291</b>
<b>Deeper Aquifer</b>		
Static Resources (MCM)	mcm	<b>24.351</b>
GW Draft (MCM)	mcm	<b>2.301</b>
Total GW Resources	mcm	<b>113.419</b>
Gross Ground Water Draft	mcm	<b>58.592</b>
Stage of Ground Water Development	%	<b>77.130</b>
✓ <b>Category</b>		<b>Semi-critical</b>

### Management Plan

<b>Type of Structure</b>	<b>Number</b>	<b>@ Rs/structure</b>	<b>Cost INR in Crores</b>
Renovation of existing water conservation tank	53	Rs ten Lakh	5.30
Recharge Shaft/ Tube Wells	105	Rs Five Lakh	5.25
NB/CD/CP	368	Rs ten Lakh	36.8
Renovation of Village Ponds (Under RRR)	96	Rs five Lakh	4.80
<b>Total Cost</b>		<b>Rs 52.15 Crores</b>	

### IMPACT



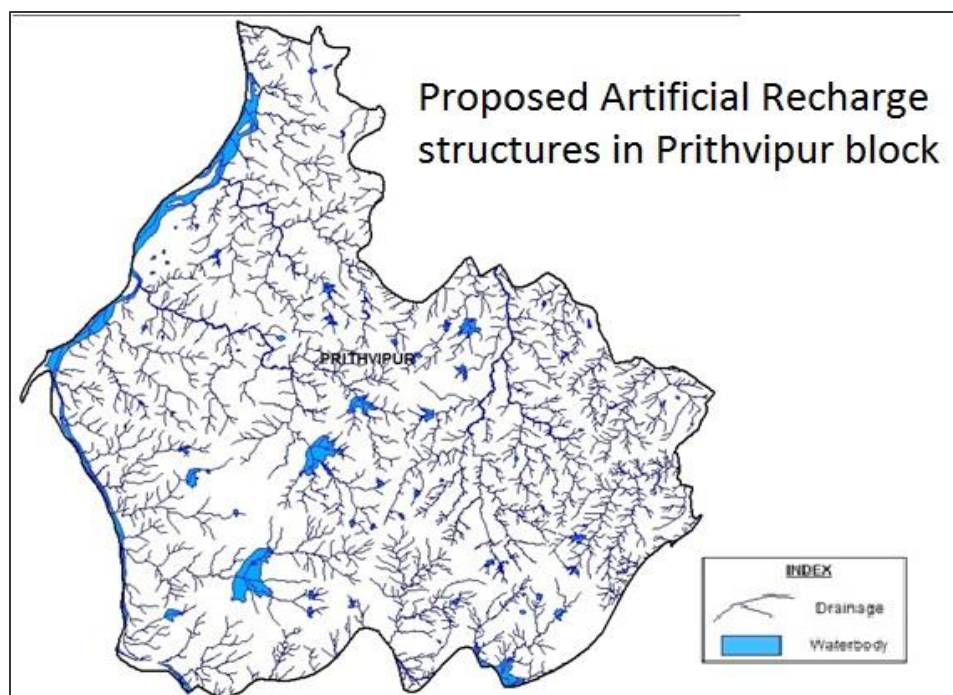
Dynamic Ground Water Resources	Additional GW Resources Created	Total GW Resources	Area Under GW Irrigation	saving by intervention of Sprinkler irrigation	Stage of GW Development before intervention	Stage of GW Development After intervention before increasing Irrigated Area
mcm	mcm	mcm	Ha	mcm	%	%
75.960	61.555	137.515	45414	17.37	77.13	26.70

### Water Bodies/Tanks in PaleraBlock

S.no	Block	Tanks	storage capacity	Hight	Water spread area	Max. irr. Cap.
			mcm	m	Ha	Ha
1	Palera	Atrar	0.21	5.18	20	
2	Palera	Bandka Murra Tank	0.48	6.1	16.12	
3	Palera	Morpariya	0.36	3.36	9.6	64
4	Palera	Para	0.33	6.55	12.16	54
5	Palera	Ramnager	0.81	7.31	30.51	77
6	Palera	Chaturkari Tank	0.196	5.35	10.95	
7	Palera	Fatera	1.73	11.28	17.13	
8	Palera	Darnera			18.01	
9	Palera	Badgaon			11.11	
10	Palera	Kharon	0.178	5	11.1	
11	Palera	Motal			5.16	
12	Palera	Purenia			19	134
13	Palera	Chitanala	1.03	11.28	28.5	
14	Palera	Bilwari	0.89	7.01	8.1	
15	Palera	Futera	0.7	11.58	17.85	
16	Palera	Kandwa	0.3	6.71	8.4	64
17	Palera	Kharon	0.29	4.57	7.5	47
18	Palera	Purenिया	0.36	5.18	9.15	181
19	Palera	Ramsager	0.4	5.98	12.15	80
20	Palera	Chutki Talab	0.43	7.62	20	
			<b>8.694</b>		<b>292.5</b>	

### Management Plan of Prithvipur Block

<b>Area</b>	Sq Km	958.62
<b>Rainfall</b>	mm	0.7815
<b>Area Suitable for Recharge</b>	Sq Km	892.8
<b>Average Post Monsoon DTW</b>	mbgl	6.65
<b>Unsaturated Zone</b>	m	3.65
<b>Average Specific Yield</b>	%	0.015
<b>Sub Surface Storage Available</b>	mcm	48.881
<b>Surface Water Required</b>	mcm	65.01
<b>Runoff Available</b>	mcm	223.20
<b>Non committed Runoff available</b>	mcm	66.96
<b>No. of Recharge Shaft/ Tube Wells</b>	No	130
<b>Renovation of existing water conservation tank</b>	No	65
<b>No. of NB/CD/CP</b>	No	455
<b>Renovation of Village Ponds (Under RRR)</b>	No	18



### Ground Water Resources of Prithvipur

<b>Phreatic Aquifer</b>		
Dynamic Resources	mcm	<b>97.437</b>
Static Resources	mcm	<b>27.132</b>
Total Resources	mcm	<b>124.569</b>
Irrigation Draft	mcm	<b>48.906</b>
Domestic+Industrial Draft	mcm	<b>3.657</b>
Total GW Draft	mcm	<b>52.563</b>
<b>Deeper Aquifer</b>		
Static Resources	mcm	<b>31.947</b>
GW Draft	mcm	<b>2.2032</b>
Total GW Resources	mcm	<b>156.516</b>
Gross Ground Water Draft	mcm	<b>54.766</b>
Stage of Ground Water Development	%	<b>56.210</b>
Category		<b>Safe</b>

### Management Plan

Type of Structure	Number	@ Rs/structure	Cost INR in Crores
Renovation of existing water conservation tank	65	Rs ten Lakh	6.50
Recharge Shaft/ Tube Wells	130	Rs Five Lakh	6.5
NB/CD/CP	455	Rs ten Lakh	45.5
Renovation of Village Ponds (Under RRR)	18	Rs five Lakh	0.90
Total Cost			Rs 59.40 Crores

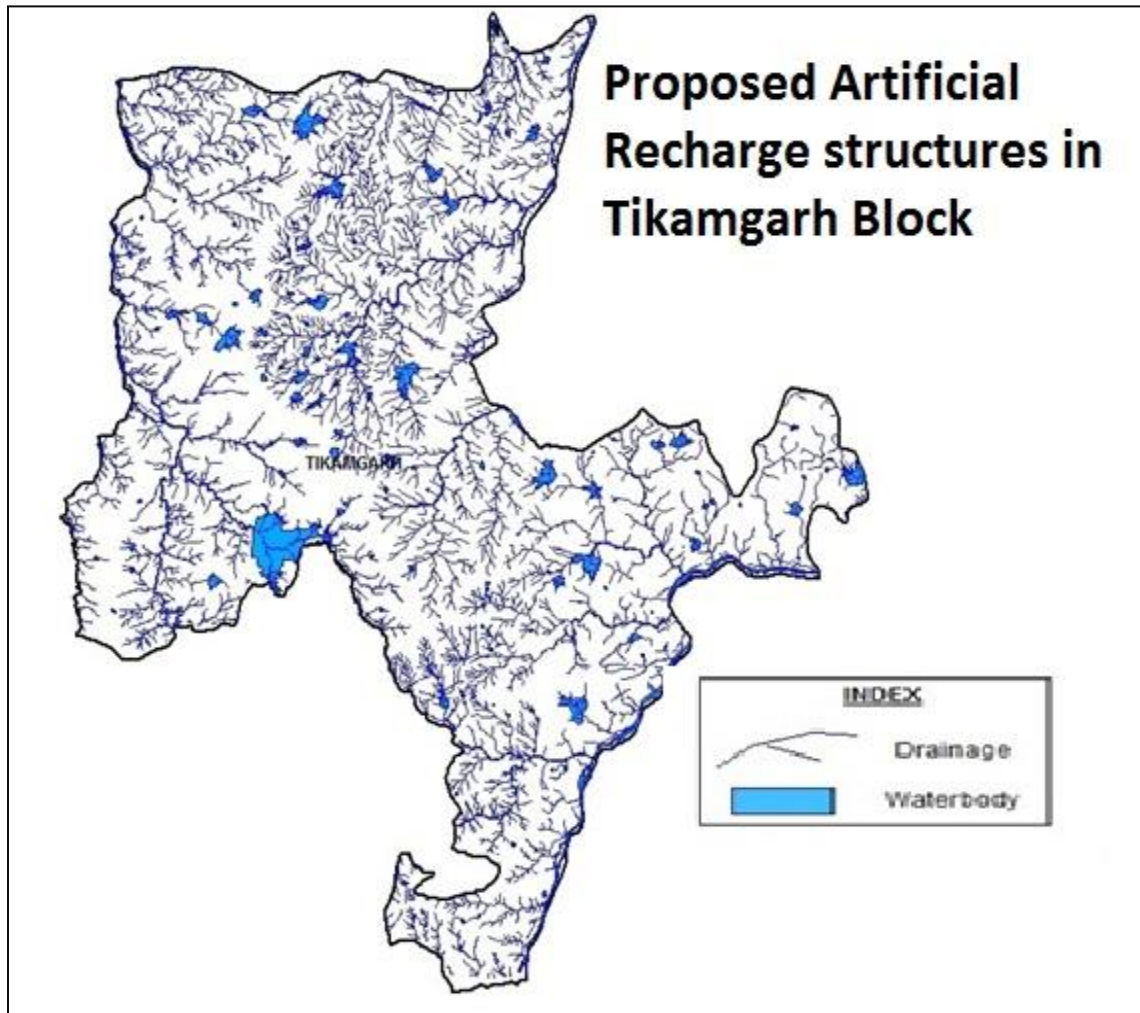
### IMPACT

Dynamic Ground Water Resources	Additional GW Resources	Total GW Resources	Area Under GW Irrigation	Saving by intervention of Sprinkler irrigation	Stage of GW Development before intervention	Stage of GW Development After intervention before increasing Irrigated Area
mcm	mcm	mcm	Ha	mcm	%	(%)
97.440	48.881	146.321	39705	15.88	56.21	24.08
S.No	Block	Tanks	storage capacity	Hight	Water spread area	Max. irr. Cap.
			mcm	m	Ha	Ha
1	Prithvipur	Atarra	0.591	4.26	14.58	
2	Prithvipur	Banjari	1		32.4	
3	Prithvipur	Dargaon kalan	0.61		10.26	8
4	Prithvipur	Dighora	0.79		16.74	
5	Prithvipur	Dudiyara	0.23			
6	Prithvipur	Dumduma	3.25	9.15	11.52	
7	Prithvipur	Jaron	6.494	7.92	84.6	103

8	<b>Prithvipur</b>	<b>Patriya</b>	<b>0.61</b>		16.74	
9	Prithvipur	Simara	0.51	4.87	11.7	
10	<b>Prithvipur</b>	<b>Barana Bahmaori</b>	<b>6.86</b>			
11	<b>Prithvipur</b>	<b>Brishbhanpura</b>	<b>1.86</b>			
12	Prithvipur	Virsager	14.47	26.82	130.86	296
13	Prithvipur	Majaal	0.94	7.87		
			38.215		329.4	

### Management Plan of Tikamgarh Block

<b>Area</b>	<b>Sq Km</b>	<b>867.60</b>
<b>Rainfall</b>	mm	<b>0.7815</b>
<b>Area Suitable for Recharge</b>	Sq Km	<b>750.69</b>
<b>Average Post Monsoon DTW</b>	mbgl	<b>6.29</b>
<b>Unsaturated Zone in</b>	m	<b>3.29</b>
<b>Average Specific Yield</b>	%	<b>0.015</b>
<b>Sub Surface Storage Available</b>	mcm	<b>37.047</b>
<b>Surface Water Required</b>	mcm	<b>49.27</b>
<b>Runoff Available</b>	mcm	<b>187.67</b>
<b>Non committed Runoff available</b>	mcm	<b>30</b>
<b>No. of Recharge Shaft/ Tube Wells</b>	No	<b>99</b>
<b>Renovation of existing water conservation tank</b>	No	<b>49</b>
<b>No. of NB/CD/CP</b>	No	<b>345</b>
<b>Renovation of Village Ponds (Under RRR)</b>	No	<b>181</b>



### IMPACT

#### Management Plan

Type of Structure	Number	@ Rs/structure	Cost INR in Crores
Renovation of existing water conservation tank	49	Rs ten Lakh	4.90
Recharge Shaft/ Tube Wells	99	Rs Five Lakh	4.95
NB/CD/CP	345	Rs ten Lakh	34.5
Renovation of Village Ponds (Under RRR)	181	Rs five Lakh	9.05
<b>Total Cost</b>			<b>Rs 53.40 Crores</b>

### Water Bodies/Tanks of Tikamgarh block

S.No	Block	Tanks	storage capacity	Hight	Water spread area	Max. Irr. Cap.
			MCM	m	Ha	Ha
1	Tikamgarh	Astone	0.37	5.48	22	84
2	Tikamgarh	Bagaj mata	4.18	14.28	166.5	
3	Tikamgarh	Bela tal	0.46	9.24	13.32	
4	Tikamgarh	Chhotatal laxmanpura	0.335	5.8	7.74	
5	Tikamgarh	Deep sager	4.01	12.19	80	173
6	Tikamgarh	Dikoli	0.19	3.35	7.56	
7	Tikamgarh	Duda	0.74	6.3	15.48	

Dynamic Ground Water Resources (MCM)	Additional GW Resources Created (MCM)	Total GW Resources (MCM)	Area Under GW Irrigation (ha)	Saving by intervention of Sprinkler irrigation (MCM)	Stage of GW Development before intervention (%)	Stage of GW Development After intervention before increasing Irrigated Area (%)	
mcm	mcm	mcm	Ha	mcm	%	(%)	
<b>93.910</b>	<b>37.047</b>	<b>130.957</b>	<b>32937</b>	<b>13.17</b>	<b>81.11</b>	<b>44.21</b>	
8	Tikamgarh	Hanuman sagar		0.6	6.1	56	57
9	Tikamgarh	Hiranager Bawari Tank		0.34	9.15	77	37
10	Tikamgarh	Lahar		1.823	12.25	61.2	
11	Tikamgarh	Lar		0.47	10.67	14.4	101
12	Tikamgarh	Mahnedra sagar		2.42	6.4	49.5	181
13	Tikamgarh	Mamon		0.51	9.15	15	70
14	Tikamgarh	Nanhi Tehari		0.45	9.14	13.5	80
15	Tikamgarh	Para		0.35	5.8	7.92	
16	Tikamgarh	Pokhnatal		2.07	9.75	98	224
17	Tikamgarh	Preamsager Mawai		0.22	7.01	8.46	40
18	Tikamgarh	Raira Mawai		0.38	7.5	16	82
19	Tikamgarh	<b>Rajendra Sagar</b>		<b>16.992</b>	<b>14</b>	546.48	
20	Tikamgarh	Rigora		2.58	6.3	55.8	
21	Tikamgarh	Sidhkhad		1.634	12.42	34.56	

22	Tikamgarh	Sunara	0.29	5.48	35	53
23	Tikamgarh	Teela danta	2.813		77.76	
24	Tikamgarh	Upatsager	1.94	9.14	28.8	261
25	Tikamgarh	Jamni Canal			437.22	
26	Tikamgarh	Madarkha Talao	0.43	10.67	13.14	13.14

## **CONCLUSION AND RECOMMENDATIONS**

- Tikamgarh District occupies an area of 5048 Sq.Kms and recharge worthy area is 4881 sq. kms., and the rest is covered by hilly and forest area. It comprises of six blocks, namely Baldeogarh ,Jatara, Niwari, Palera, Prithvipur and Tikamgarh.
- The major rivers flowing through the area includes Betwa, Jamni and, Dhasan,
- The entire district is covered by Bundelkhand Granite and Gneisses and dissected by Quartz reef. Basic dykes of Dolerite lying in NE-SW direction are aligned orthogonally to the Quartz reef in Baldeogarh & Palera blocks.
- Linear ridges of Quartz Veins trending NE-SW act as barriers against flow of Surface and Ground water.
- Dependency of Irrigation is on Ground Water and 77.63% of irrigation is met from Ground Water and 22.37 % of irrigation by surface water.



- 962 tanks constructed during Chandela's Era, out of which 421 still survive and they are used for Irrigation. Renovation / De-silting of Existing 49 Chandella's tanks each having Irrigation capacity of more than 40ha & other 372 Chandella's tanks having lesser irrigation capacity.
- Major Socio-economy of the District is dependent on Agriculture. 87.8% of rural population of district is dependent on Agriculture & 91.8% of the rural women works in Agriculture field.
- The Phreatic aquifer is recharged during monsoon and sustains for **2-6 hrs /day for** 3-4 months. The yield ranges between 0.50 to 3.0 lps.
- Decline in ground water level is observed >0.20 m/yr in Niwari & Prithvipur Block and 0.10 to 0.20 m/yr in Jatara & Palera & < 0.10 m/yr in the area of Tikamgarh & Baldevgarh Blocks during pre monsoon period.
- Decline in groundwater level is observed >0.20 m/yr in Niwari Block and 0.10 to 0.20 m/yr in Prithvipur, Palera & Tikamgarh Blocks during Post monsoon period. The saturated thickness of the shallow aquifer in monsoon is 3 to 10 m. and 0.5 to 1.5 m during Non-monsoon period.
- Tikamgarh district had predominance of EC ranging from 1000 to 2000 (Avg. 1290)  $\mu\text{S}/\text{cm}$  at 25<sup>0</sup>C indicating the quality of ground water belonging to average quality.
- On the basis of the 121 Exploratory borewells drilled by CGWB, NCR under its Exploratory/NAQUIM program, it has been observed that the yield varies from **0.75-6.0** lps in Deeper aquifer of fractured Granite. Transmissivity and Storage coefficient ranges between 12.87-145 m<sup>2</sup>/day and  $4.78 \times 10^{-4}$  respectively.
- As per the Dynamic Ground Water Resource Assessment (2013), the net ground water availability in the district is 521.72 MCM and ground water draft for all uses is 380.58 MCM, resulting the stage of ground water development to 72.95% as a whole. The Tikamgarh district falls under semi critical category.
- 5 semi critical out of 6 Blocks having stage of development ranging between 70.62% in Jatara to 81.11% in Tikamgarh block. Prithvipur block falls under Safe category having stage of development 56.21 % .
- After the interventions suggested, the stage of development is expected to improve by 38.18% i.e. from 72.95 % to 34.77 % for Tikamgarh district.
- As per the Management plan prepared under NAQUIM for all the blocks of Tikamgarh District, a total number of 283 renovation of existing major water conservation Tanks, 672

Recharge Shafts/Tube wells and 1983 Nala Bunds/Check Dams/Cement Plugs & 702 renovation of village ponds under RRR have been suggested .

- Financial expenditure is expected to be Rs 290.10 Crores in Tikamgarh District for sustainable development and management of Ground Water Resources.
- The number of artificial recharge structure and financial estimation has been proposed based on the CGWB NAQUIM studies . It may be different from the field conditions as well as Changes in dynamic Ground water resources.

**Proposal for implementation in Phase manner:**

It is recommended that implementation of the intervention would be done inPhase manner. In first Phase ,renovation of existing major water conservation Tanks with construction of recharge shafts in semi critical blocks namely Tikamrgah & Baldeogarh and in second phase planning cover Niwari & Palera blocks and third Phase planning would cover Jatara & Prithvipur blocks along with construction of Nala Bunds/Check Dams/Cement Plugs and renovation of village ponds under RRR.

**Annexure -I  
Blockwise Rainfall Data**

Rainfall (mm) of Tikamgarh Rain gauge station									
Month	2008-09	2009-10	2010-2011	2011-12	2012-13	2013-14	2014-15	2015-16	Average
June	754	40	15	606	27	170	86	84	222.75
July	262	238	201	299	461	622	199	167	306.125
Aug.	313	205	191	305	404	476	360	219	309.125
Sept.	57	117	157	207	69	5	95	62	96.125
Oct.	13	152	16	-	-	76	0	5	32.75
Nov.	5	52	13	-	-	-	-	-	8.75
Dec.	31	4	-	-	-	19	58	-	14
Jan.	-	-	-	7	-	64	31	15	14.625
Feb.	-	23	4	-	86	79	16	2	26.25
March	-	-	-	-	8	25	44	42	14.875

April	5	-	-	9	5	9	18	-	5.75
May	17	-	8	-	-	-	-	22	5.875

### 2 Rainfall (mm) of Baldeogarh Rain gauge station

Month	2008-09	2009-10	2010-2011	2011-12	2012-13	2013-14	2014-15	2015-16	Average
June	756	15	13	412.4	6	85	0	58	168.175
July	200	120	220	334.6	450	264	149	217	244.325
Aug.	149	218	12	197	250	638	172	282	239.75
Sept.	8	118		146	51	0	4	53	47.5
Oct.	-	98	129	-	-	9	16	8	32.5
Nov.	-	11	-	-	-	-	-	-	1.375
Dec.	-	-	7	-	-	2	9	-	2.25
Jan.	3	-	-	4	-	22	31	15	9.375
Feb.	-	3	-	-	46	65	21	2	17.125
March	-	-	2	-	-	13	37	42	11.75
April	5	-	-	9	5	-	0	-	2.375
May	17	2	8	-	-	-	-	5.5	4.0625

### 3 Rainfall (mm) of Jatara Rain gauge station

Month	2008-09	2009-10	2010-2011	2011-12	2012-13	2013-14	2014-15	2015-16	Average
June	317	-	5	395	20	95	30	80	195.875
July	409	326	175	270	487	462	103	249	528.375
Aug.	305	141	166	164	468	453	138	47	414.75
Sept.	140	110	69	158	75	45	52	25	137.25
Oct.	-	98	-	-	-	60	5	15	32.25
Nov.	-	11	3	-	-	7	-	-	3.875
Dec.	-	-	-	-	-	10	59	2	17.75
Jan.	16	-	-	2	-	85	46	7	37
Feb.	-	3	2	-	86	64	26	2	45.375
March	-	-	-	-	14	6	70	5	23.75
April	-	-	-	-	-	-	0	-	0
May	-	-	-	-	-	-	-	30	7.5

### 4 Rainfall (mm) of Palera Rain gauge station

Month	2008-09	2009-10	2010-2011	2011-12	2012-13	2013-14	2014-15	2015-16	Average
June	472	15	24	444	20	221	9	54	253.875
July	304	233	253	351	431	523	147	153	531.625
Aug.	327	141	171	216	464	608	126	123	485.5
Sept.	159	111	100	184	110	30	61	9	157.25

Oct.	-	208	12	-	-	88	3	15	55.5
Nov.	1	44	12	-	-	-	-	-	8.625
Dec.	-	2	-	-	-	5	5	-	2.75
Jan.	38	-	-	5	-	95	22	2	35.75
Feb.	-	0.5	3	-	86	38	9	-	34.0625
March	-	-	-	-	-	4	55	4	15.75
April	-	-	-	-	-	-	13	-	3.25
May	-	-	-	-	-	-	-	7	253.875

<b>5 Rainfall (mm) of Niwari Rain gauge station</b>									
Month	2008-09	2009-10	2010-2011	2011-12	2012-13	2013-14	2014-15	2015-16	Average
June	530	-	28	308.2	0	123	16	63	200.8
July	275	136	275	214.2	351.4	528	175	243	498.025
Aug.	238	285	192	236	497	478	71	142	469.375
Sept.	176	81	192	107.6	120.6	62	55	20	171.425
Oct.	-	109	-	-	-	128	0	2	46.125
Nov.	58	27	64	-	-	-	-	8	28.625
Dec.	-	2	4.2	-	-	13	5	-	5.8
Jan.	6	-	-	70	-	58	57	8	49
Feb.	-	27	2	-	73.2	24	9	-	30.425
March	2	-	-	-	-	12	72	9	23.5
April	-	-	-	-	-	5	31	-	9
May	17	-	5	-	-	-	-	83	24.125

<b>6 Rainfall (mm) of Prithvipur Rain gauge station</b>									
Month	2008-09	2009-10	2010-2011	2011-12	2012-13	2013-14	2014-15	2015-16	Average
June	526	5	27.9	395	12	228.3	73	24	256.425
July	207	261	244	181	349	440.2	235	356	509.8
Aug.	285	229	368	179	306	420	133	167	457.5
Sept.	68	77	134	58	60	49	93.5	2	117.25
Oct.	-	105	5	-	-	119	0	0	44.125
Nov.	10	9	1	-	-	2	-	-	3.125
Dec.	-	-	-	-	-	25	39	-	16
Jan.	13	-	+	80	-	57	48.3	-	47.95
Feb.	-	18	6	-	67	44.5	7	-	33.375
March	-	-	-	-	-	6.5	47	0	13.375

April	-	-	-	-	-	-	24	-	6
May	5	-	-	-	-	-	-	11	3.375

Rainfall (mm) of Orchha Rain gauge station									
Month	2008-09	2009-10	2010-2011	2011-12	2012-13	2013-14	2014-15	2015-16	Average
June	541	-	8	407.5	0			38	181
July	231	210	126.5	147.1	254			301	262.275
Aug.	206	191	287.6	174.2	261			199	280.075
Sept.	18	107	65.6	115.1	83			1	81.8
Oct.	-	81.09	4	-	-			6	12.63625
Nov.	56	24.3	39	-	-			-	19.7875
Dec.	-	4	1	-	-			-	0.75
Jan.	21	-	-	52	1			3	16.625
Feb.	-	19.6	-	-	59			-	17.2
March	-	-	-	-	-			2	0.5
April	-	-	-	9	-			-	2.25

## Annexure –II

### WATER LEVEL DATA OF KEY WELLS INVENTORIED DURING 2013-14

S No	Village	Block	Total depth	Water level_Pre	Water level_Post	Long	Lat	RL
			m	mbgl				m amsl
1	Satgawan	Jatara	14.7	NA	5.27	78.92	25.04	296.6
2	Sitapur	Jatara	16.5	10.55	4.60	78.93	25.03	284.1
3	Mohara	Jatara	7.82	4.9	3.15	78.97	25.02	287
4	Nandanwara	Jatara	9.2	6.3	3.20	78.75	25.06	310.2
5	Gaurakhera	Prithvipur	8.2	6.6	3.40	78.76	25.09	310.6
6	Jeora Mora	Prithvipur	18.58	13.4	3.80	78.80	25.10	314.1
7	Sakera	Prithvipur	13.4	11.8	6.44	78.82	25.13	331.9
8	Gotet	Jatara	9.2	5.7	2.85	78.92	25.08	294.8

9	Shahpur	Jatara	8.5	4.2	3.56	78.95	25.02	288.5
10	Maniyan	Prithvipur	13.4	9.3	4.46	78.84	25.11	329.9
11	Manretha	Prithvipur	10.3	10	4.77	78.87	25.15	305.1
12	Chomon	Prithvipur	9.7	7.1	3.85	78.86	25.17	298.7
13	Para Khera	Prithvipur	10.4	7.6	4.56	78.75	25.12	306.3
14	Niwari Bhata	Niwari	18.78	12	4.90	78.79	25.38	221.3
15	Kishorpura	Niwari	18.5	8.7	7.84	78.84	25.42	212.6
16	Pipra	Niwari	14.76	14	9.42	78.81	25.41	221.1
17	Mudara	Niwari	15.3	11.9	5.85	78.83	25.37	237.7
18	Tarichar Kalan	Niwari	11.4	6.6	3.60	78.89	25.41	230.8
19	Sakooli Kherat (Shivrampura)	Niwari	7.4	6.2	4.29	78.88	25.46	211
20	Sendri	Niwari	10.3	8	5.38	78.92	25.51	194.5
21	Patharam	Niwari	7.6	7.5	4.65	78.93	25.41	227.4
22	Thona	Niwari	7.1	6.1	2.52	78.91	25.36	234.5
23	Dhamna	Niwari	9.02	6.2	2.55	78.95	25.38	225
24	Ghughsi	Prithvipur	8.8	7.9	5.45	78.96	25.33	246.3
25	Tehrka	Prithvipur	10.3	7.5	3.54	78.92	25.29	266.5
26	Naigawan	Niwari	24.5	23.3	17.05	78.77	25.39	224.9
27	Biharipura	Niwari	12.5	8.6	8.00	78.78	25.41	215.2
28	Bijaur Khirk	Niwari	14.18	10.27	7.10	78.77	25.45	204.1
29	Mohanpura	Niwari	12.85	7.7	3.10	78.81	25.44	206.1
30	Poha Khas	Niwari	9.85	7.8	3.64	78.77	25.35	224.3
31	Churara	Niwari	10	8.9	5.90	78.84	25.34	238.3
32	Niwari RS (Harash Mau)	Niwari	10.64	8.94	9.55	78.82	25.33	246.8
33	Jhingora	Prithvipur	13.85	8.88	5.46	78.81	25.29	252.1
34	Siya	Prithvipur	10.65	5.57	2.76	78.81	25.26	256.7
35	Khiston	Prithvipur	9.26	7.94	3.76	78.80	25.23	272
36	Jalandhar	Prithvipur	9.4	8.5	1.72	78.79	25.20	278.5
37	Geliwara	Prithvipur	9.8	7.7	5.10	78.82	25.20	293.2
38	Gelunda	Prithvipur	11.35	9.3	4.65	78.82	25.17	304.7
39	Sorka	Prithvipur	14.25	14.15	7.55	78.83	25.24	277.4
40	Astari	Prithvipur	13.1	8.75	8.30	78.87	25.24	285.3
41	Raipura Khas (Rawatpur)	Prithvipur	8.84	7.04	2.14	78.88	25.27	265.9
42	Bhadrai	Prithvipur	11.86	8.74	3.10	78.90	25.16	275.5
43	Bari	Prithvipur	9.66	8.76	5.79	78.88	25.13	306.3
44	Sunrai	Jatara	8.26	6.54	3.35	78.89	25.11	313.2
45	Jarua	Jatara	16.05	8.24	5.34	78.91	25.12	306.7
46	Marguwan	Jatara	12.3	6.36	NA	78.86	25.04	328.5
47	Appawal	Jatara	9.1	6.18	NA	78.86	25.05	327.7
48	Eson	Jatara	8.06	4.3	NA	78.89	25.04	329.3
49	Garruali	Jatara	9	4.2	NA	78.99	25.04	279.7
50	Bijrauta	Jatara	10.18	4.95	NA	78.97	25.04	276.9
51	Paitpura	Jatara	10.72	6.5	NA	78.98	25.06	272.5
52	Chandera	Jatara	11.65	8.47	NA	78.98	25.08	285.1
53	Siaani	Jatara	9.05	4.92	NA	78.98	25.13	256.1
54	Nuna	Palera	11.6	7.84	NA	78.98	25.17	255.2

55	Mahewa Chakra No. 4	Palera	8	6.65	NA	78.96	25.19	245.2
56	Moapariya	Palera	6.95	4.58	NA	78.95	25.15	267.1
57	Daryapura	Palera	5.95	3.78	NA	78.97	25.16	250.9
58	Paigakhera	Palera	7.9	4.86	NA	78.96	25.17	261.9
59	Rajendernagar	Jatara	10.6	4	NA	78.77	25.02	316
60	Garar Ka Khirk	Jatara	10	4.92	NA	78.78	25.10	312
61	Birora Khet	Prithvipur	14.1	10.75	NA	78.78	25.13	323.2
62	Ladwari	Prithvipur	8.92	4.78	NA	78.75	25.26	256
63	Asati Khas	Niwari	10.8	7.54	NA	78.85	25.39	224.8
64	Barana	Jatara	10.9	1.53	NA	78.80	25.06	311
65	Gora Gusai	Prithvipur	14.1	9.32	NA	78.83	25.22	284.2
66	Pacher	Palera	10	6.5	NA	79.32	24.91	243.6
67	Chhidara	Palera	10	9	NA	79.28	24.93	247
68	Ramnagar	Palera	9	7.1	NA	79.25	24.94	284.6
69	Chanderi	Baldegarh	10.5	7.1	NA	79.27	24.82	286.6
70	Bharnpur	Baldegarh	14.5	7.2	NA	79.30	24.87	252.8
71	Ramsagra	Palera	7	4.5	NA	79.30	24.94	239.4
72	Deri	Baldegarh	8.5	2.3	NA	79.25	24.90	263
73	Khajrar	Baldegarh	7.58	2.5	NA	79.23	24.78	278
74	Dotgora	Palera	9.5	4.31	NA	79.30	24.97	243
75	Alampura	Palera	14.2	7.2	NA	79.32	25.07	222
76	Kubri	Palera	9	4.48	NA	79.32	25.04	214
77	Beni Buzurig	Palera	11.79	10.29	NA	79.28	25.06	235.7
78	Laraun	Palera	10	3.3	NA	79.25	25.05	224.4
79	Toria	Palera	11.95	7.2	NA	79.23	25.09	218
80	Khera	Palera	17.75	9.03	NA	79.25	25.12	206
81	Para	Palera	7.16	4.56	NA	79.28	25.10	223
82	Hirapur	Baldegarh	12.47	7.1	NA	79.25	24.76	279.00
83	Harinagar	Baldegarh	9.2	1.85	NA	79.25	24.75	277.00
84	Harpura	Jatara	12.3	5.3	4.8	79.09	25.04	259.50
85	Hridaynagar	Jatara	13.3	6.4	5.2	79.05	25.08	256.10
86	Jatara	Jatara	11.54	6.2	4.8	79.05	25.03	262.10
87	Khargupura	Jatara	13.1	5.8	3.2	79.34	24.08	354.10
88	Khargupura	Jatara	13.5	12.8	10.5	79.34	25.09	209.50
89	Lal Khurd	Jatara	14	7	6.4	79.36	24.29	476.50
90	Lal Khurd	Jatara	12	5.9	4.5	79.09	25.04	259.50
91	Larkhurd	Jatara	11.2	5.4	5.1	78.98	24.92	268.00
92	Machi	Jatara	12.45	6.2	5.8	78.97	24.94	334.40
93	Machi	Jatara	14.1	4.7	3.5	79.05	24.93	263.70
94	Machi	Jatara	11.3	4.65	3.7	79.15	25.20	221.90
95	Vagetpura	Jatara	10.5	5.8	4.5	79.00	25.00	274.60
96	Barana	Palera	11	6.1	5.7	79.13	25.03	235.90
97	Barana	Palera	13.8	4.7	3.46	79.38	25.10	238.50
98	Deri	Palera	9	7.4	6.2	79.24	24.91	266.50
99	Goa	Palera	14	3.3	3.1	79.31	25.14	201.40
100	Kacchora	Palera	9.5	5.4	4.9	79.36	25.29	194.00
101	Kalra	Palera	14.8	7.4	5.8	79.24	25.24	192.40

102	Kanjana	Palera	13	7.8	6.2	79.32	25.34	187.00
103	Khajri	Palera	12.5	5.6	4.7	79.29	25.11	211.10
104	Khajri	Palera	12	10	9.2	79.29	25.11	216.90
105	Kheya	Palera	13.8	7.2	4.5	79.40	25.11	223.60
106	Lahar Bujurg	Palera	14.8	7.8	6.3	79.22	25.00	263.70
107	Nagri	Palera	9.8	2.5	1.6	79.32	25.34	185.00
108	Pahari Buzurg	Palera	7.6	4.1	3.8	79.09	25.17	228.80
109	PahariBujurg	Palera	12.1	10.4	8.24	79.03	25.12	252.00
110	Palera	Palera	13.8	6.9	4.6	79.22	25.00	264.00
111	Patharguawn	Palera	10	9	7.2	79.40	25.11	222.70
112	Pratapnagar	Jatara	15.4	12.5	10.2	79.15	25.18	218.40
113	Pucha Khirak	Palera	10.8	3	1.5	79.35	25.14	205.90
114	Rampura Niwari	Palera	15	7.6	4.5	79.36	25.14	207.80
115	Goa	Palera	14.8	3.1	2.78	79.31	25.15	203.80
116	Karmashan Ghat	Baldevgarh	12	<b>3.4</b>	4.1	79.10	24.97	239.10
117	Karmashan	Baldevgarh	12	<b>3.3</b>	5.12	79.22	24.95	248.70
118	Baldevgarh	Baldevgarh	13.4	7.3	7.8	79.19	25.10	227.00
119	Baldevgarh	Baldevgarh	14.9	<b>3</b>	3.6	79.11	24.83	314.90
120	Baldevgarh	Baldevgarh	14.3	6	6.1	79.08	24.94	253.50
121	Sujanpura	Baldevgarh	14.4	7.4	7.11	79.08	24.94	253.20
122	Sujanpura	Baldevgarh	14.3	3.3	4.1	80.60	25.04	177.50
123	Sarkanpur	Baldevgarh	14.1	<b>3.6</b>	3.85	79.19	24.94	243.60
124	Banver	Baldevgarh	13.3	6.4	6.75	79.23	24.93	304.90
125	Chowara	Baldevgarh	14.3	8.45	8.52	79.21	24.97	237.70
126	Khargapur	Baldevgarh	9.5	<b>3.3</b>	4.51	79.35	25.00	229.10
127	Phuter	Baldevgarh	12.3	<b>5.6</b>	5.9	79.39	24.97	238.20
128	Kita Kheda	Baldevgarh	13.9	<b>3.8</b>	4.1	79.19	25.10	228.90
129	Baldevgarh	Baldevgarh	11.8	5.5	5.12	79.19	25.10	227.00
130	Bhelsi	Baldevgarh	8.4	5.6	5.14	79.13	24.79	315.90
132	Baldevgarh	Baldevgarh	5.4	<b>3.4</b>	4.12	79.07	24.77	328.70
134	Hanumanthpura	Baldevgarh	9.1	6.54	7.04	79.12	24.77	328.10
135	Malgawn	Baldevgarh	7.4	<b>5.4</b>	5.87	79.22	24.76	292.00
137	Sarkanpur II	Baldevgarh	6.24	4.85	5.05	79.06	24.85	296.70
139	Banyani	Baldevgarh	9.2	6.1	6.5	79.01	24.84	285.90
140	Sujanpura	Baldevgarh	13.1	6.4	6.87	79.05	24.80	305.20
142	Sarkanpura	Baldevgarh	10.8	8.1	8.92	79.05	24.85	296.40
143	Rampur	Baldevgarh	5.7	<b>4.6</b>	4.78	79.22	24.83	292.00
144	Baswan	Niwari	8.45	6.13	4.2	78.73	25.35	224.10
145	Jugyai	Niwari	11.87	7.68	5.65	78.72	25.32	242.80
146	Nimkheda	Niwari	12.63	8.89	6.57	78.74	25.30	243.40
147	Makara	Niwari	10.15	7.47	4.92	78.74	25.29	253.30
148	Kunwarpura	Niwari	7.87	5.08	3.6	78.73	25.30	249.60
149	Dhillan	Niwari	12.17	8.31	6.19	78.70	25.29	254.40
150	Jugalpura	Niwari	6.05	5.73	1.35	78.69	25.27	245.30
151	Neguan	Niwari	12.05	5.81	3.36	78.67	25.26	253.10
152	Chandpura	Niwari	8.75	5.8	4.07	78.65	25.28	247.00



153	Daretha	Prithvipur	8	6.55	5.2	78.71	25.26	267.80
154	Bindpura	Prithvipur	17.55	9.35	8.31	78.7064	25.21	287.10
155	Atara	Prithvipur	11.1	7.61	5.85	78.71	25.25	284.80
156	Bindpura	Prithvipur	10.75	7.2	5.3	78.73	25.21	292.10
157	Madwa Rajgarh	Prithvipur	7.25	6.05	5.05	78.71	25.20	299.30
158	Jhera khas	Prithvipur	12	6.73	4.9	78.66	25.18	293.70
159	Semra	Prithvipur	11.05	8.45	5.27	78.64	25.18	293.40
160	Mawai	Prithvipur	15.75	6.77	4.06	78.71	25.15	306.50
161	Ghurara	Prithvipur	9.05	4.52	2.99	78.70	25.14	299.50
162	Mazal	Prithvipur	10.3	3.05	0.71	78.68	25.12	292.20
163	Jeron Khas	Prithvipur	6.25	4.38	1.55	78.67	25.14	290.80
164	Majra kharai	Prithvipur	18.85	12.58	1.43	78.62	25.13	279.10
165	Hateri	Jatara	13.25	11.3	9.56	78.68	25.07	301.70
166	Brishbhanpura	Jatara	13.3	4.46	2.11	78.69	25.05	296.40
167	Dhano	Jatara	10.35	9.6	4.45	78.73	25.05	312.70
168	Acharra	Jatara	7.35	6.41	4.09	78.67	25.03	300.60
169	Mohangarh	Jatara	10	3.67	2.54	78.67	25.99	176.20
170	Mastapur	Jatara	8.35	5.5	3.62	78.68	24.93	315.30
171	Bhaungarh	Jatara	8.85	6.69	6.44	78.71	24.93	317.00
172	Pratappura	Niwari	6.15	4.9	3.93	78.65	25.43	217.20
173	Jamunia	Niwari	10.25	8.66	6.46	78.61	25.36	245.70
174	Gujara khurd	Niwari	6.35	4.03	3.2	78.59	25.37	243.70
175	Mador	Niwari	11.05	5.66	5	78.57	25.29	257.90
176	Chakarpur	Niwari	10.75	8.58	7.9	78.52	25.29	266.10
177	Orchha	Niwari	14.55	8.01	7.56	78.57	25.35	259.40
178	Beersagar	Prithvipur	7.3	1.62	1.37	78.70	25.20	285.30
180	Madhuvan	Tikamgarh	10.3	5.12	6.48	78.81	24.70	343.7
181	Kundeshwar	Tikamgarh	7.4	4.64	4.41	78.80	24.70	348
182	Nachanwara	Tikamgarh	8.85	5.07	5.15	78.80	24.83	337.7
183	Aston	Tikamgarh	10.4	5.92	6.09	78.81	24.63	358
184	Karmari	Tikamgarh	9	5.62	5.59	78.09	24.64	431
185	Khumaraukhiri a	Tikamgarh	5.78	3.8	3.27	78.76	24.62	356.3
186	Tikamgarh	Tikamgarh	10.65	6	6.125	78.85	24.72	356.3
187	Tikamgarh	Tikamgarh	7.6	2.54	1.59	78.85	24.72	359.6
188	Paporaji	Tikamgarh	8.7	6.58	6.79	78.86	24.71	361
189	Patha	Tikamgarh	10.7	6.8	6.2	78.89	24.69	365.8
190	Gudanwara	Tikamgarh	12	7.05	6.87	78.91	24.66	373.7
191	Samarra	Tikamgarh	12.9	8.8	6.83	78.93	24.64	371
192	Madanpur	Tikamgarh	7.5	6.8	3.77	78.94	24.63	373
193	Amarpur	Tikamgarh	5.6	2.9	2.44	78.98	24.60	350.3
194	Badagaon	Tikamgarh	6	3.28	3.46	79.02	24.57	344.7
195	Dargawan	Tikamgarh	12.23	7.5	7.3	79.03	24.62	331.3
196	Meran	Tikamgarh	8.2	4.4	6.78	79.04	24.63	321.3
197	Budera	Tikamgarh	7.7	1.76	0.95	79.08	24.66	319
198	Sagoni	Tikamgarh	8.45	4.7	4	78.86	24.68	359.6
199	Pahari tilwaran	Tikamgarh	13.77	6.04	6.11	78.82	24.68	352.7

200	Aston	Tikamgarh	11.6	6.65	7.13	78.81	24.63	357.4
201	Jurawan	Tikamgarh	6	2	1.6	78.84	24.66	355
202	Amanjhor	Tikamgarh	9	4.45	4.31	78.91	24.68	366
203	Sunderpur	Tikamgarh	8.15	5.95	6.23	78.93	24.69	353
204	Laharbuzurg	Tikamgarh	10	6.1	5.73	79.00	24.68	359.3
205	Adhakiburaia	Tikamgarh	10.6	6.42	5.84	79.03	24.67	331
206	Budera	Tikamgarh	8	1.54	3.37	79.08	24.66	324.4
207	Ananthpura	Tikamgarh	8	4.48	3.83	78.83	24.79	344.3
208	Paharikhurd	Tikamgarh	9.1	7.15	1.96	78.65	24.81	318
209	Harpura	Tikamgarh	12	4.22	7.1	78.81	24.65	354.8
210	Tapariyankari	Tikamgarh	15	6.05	6.45	78.86	24.80	351.4
211	Alampur	Tikamgarh	11.55	8	8.05	78.83	24.81	341
212	Heeranagar	Tikamgarh	9.7	6.86	6.4	78.66	24.83	310
213	Bawari	Tikamgarh	7.1	1.28	1.52	78.84	24.84	341.3
214	Batawaha	Jatara	12.2	6	11.48	78.81	24.87	336.8
215	Pathela ki khirk	Jatara	10.7	2.8	5.47	78.79	24.91	329.7
216	Gor	Jatara	12.3	8.14	3.04	78.77	24.92	346.3
217	Ramnagar	Jatara	10.4	8	6.25	78.83	24.87	342.7
218	Barmatal	Jatara	8.6	5.27	5.26	78.84	24.91	355
219	Preamnagar	Jatara	9.27	5.1	5.15	78.84	24.94	343.9
220	Digaura	Jatara	10.65	5.5	5.03	78.84	24.97	329.7
221	Bugpura	Tikamgarh	10.6	4.69	3.7	78.93	24.67	364
222	Bhagalpur	Tikamgarh	11.85	7.24	6.54	78.93	24.67	363.3
223	Ajnor	Tikamgarh	8.2	6.13	5.61	78.94	24.63	371.7
224	Sapon	Tikamgarh	9	8.2	7.5	78.94	24.60	388.7
225	Ratanganj	Tikamgarh	11.5	7.86	7.13	78.93	24.59	385.3
226	Dunda	Tikamgarh	14.8	8.75	7.65	78.97	24.56	358
227	Shukali	Tikamgarh	14	5.5	4.74	78.98	24.99	355
228	Bariyadhonga	Tikamgarh	6.85	5.9	2.8	78.09	24.67	441
229	Patari	Tikamgarh	5.9	2.02	1.85	79.10	24.67	323
230	Dikoli	Tikamgarh	10.9	6.3	4.01	79.13	24.66	321
231	Lamera	Baldevgarh	11	3.9	5.14	79.16	24.66	312.9
232	Gukhrai	Baldevgarh	10	8.61	7.65	79.10	24.70	376
233	Talmau	Baldevgarh	15.65	8.85	7.65	79.08	24.71	367
234	Kailpura	Baldevgarh	12.1	8.4	6.9	79.08	24.74	347.8

**Annexure –III**  
**Water Quality Monitoring**

S. No.	Location	Source	pH	EC	CO3	HCO3	Cl	SO4	NO3	F	PO4	TH	Ca	Mg	Na	K	SiO2
245	Banni Buzurg	DW	8.34	340	18	85	21	42	32	0.22	0.018	125	22	17	20	0.8	52
246	Garruli	DW	8.09	495	0	85	64	75	12	0.32	0.008	200	44	22	21	1.6	54
247	Alampura	DW	8.17	645	0	244	67	10	21	0.42	NIL	235	28	40	40	1.5	53
248	Kubri	DW	8.02	347	0	122	21	12	39	0.4	NIL	145	36	13	13	0.6	50
249	Datgora	DW	7.95	930	0	61	131	194	34	0.29	0.012	410	104	36	25	0.4	48
250	Laraun	DW	7.78	558	0	67	82	86	24	0.37	0.09	235	64	18	20	0.6	65
251	Toria	DW	7.95	426	0	189	14	29	10	0.28	0.01	180	24	29	15	0.7	48
252	Khera	DW	7.9	427	0	195	18	20	10	0.34	0.09	175	24	28	17	1.2	52
253	Para	DW	9.38	497	60	146	57	35	15	0.95	0.025	85	14	12	36	67	57

## Annexure-IV

### DETAILS OF EXPLORATORY WELLS CONSTRUCTED BY CONTRACTUAL DRILLING UNDER DROUGHT ASSISTANCE IN TIKAMGARH DISTRICT (2001-2002).

S No.	Location	Depth Drilled (m)	Zones Tapped	Geology	Static Water Level (mbgl)	Tested Discharge (lps)	Draw Down (m)
1	Orchha	200	16.59-32.59, 117.13-126.77	Granite	7.95	1.0	33.0
2	Tarichar Kalan	200		Granite	-	Dry	-
3	Murara	182.92	16.59-21.16, 66.86-71.43	Granite	6.63	1.0	1.17
4	Pohakhas	60.97	9.74-14.31, 28.02-32.59	Granite	-	2.0	-
5	Prithvipur	152.43	30.30-34.87, 73.72-78.29	Granite	0.85	1.0	33.0
6	Niwari	83.84	28.00-32.59, 66.86-83.84	Granite	7.14	1.0	2.22
7	Achhrumata	200	14.31-16.59, 155.98-165.12	Granite	4.91	1.0	19.73
8	Mudrani	110.71	7.5-11.5(0.8) 16.21 (1.5) 34.0-38.0 (3.2)	Granite	7.41	1.0	0.47
9	Birora Khet	200	5.0-7.50(0.5), 12-14 (2.0)	Granite	4.17	1.0	0.6
10	Churara	187.97		Granite	-	Dry	-
11	Joramora	187.97	9.50-16.00 (2.0) 21-25.50 (0.5)	Granite	7.68	1.0	9.97
12	Manakpura	200		Granite	-	Dry	-
13	Nandanwara	200	28.00-32.00, 73.00-82.00	Granite	3.04	1.0	17.0

14	Bamori	200	21.00-28.00, 41.00-50.00	Granite	8.55	1.6	0.55
15	Samarra	200	9.00-16.00, 28.00-34.00 80.00-92.00	Granite	7.51	1.0	8.86
16	Mogna	187.97		Granite	-	Meager	-
17	Digora	187.97		Granite	-	Dry	-
18	Lar	200		Granite	-	Dry	-
19	Birou	200	3.5-5.0, 16.00-21.00	Granite	8.33	1.0	23.0
20	Budhera	162.12	12.00-16.00(1.2lps)	Granite	11.0	1.0	6.0
21	Malgawan	151.41		Granite	>60	1.0	-
22	Hatta	200	41.00-53.00, 76.00-82.00	Granite	13.49	1.0	32.0
23	Radhapur	114.85		Granite	-	Dry	-

**Details of Exploratory Wells constructed By Contractual drilling in Tikamgarh District (M.P) during (2004-05)**

Sr no	Location	Depth Drilled	Zones tapped	Static water level	Discharge	Draw down/ Discharge	Aquifer material
		(m)	(m)	(mbgl)	(m <sup>3</sup> /hr)	(m)/ (lpm)	
1	TikamgarhTown	178.73	9.5-16.0, 98-105	5.5	7.2	2.4/68	Weathered & Fractured Granite
2	Dunga	125.59	9.5-14, 100-105	4.70	37.8	0.5/375	Sand Boulder Cobble & Fractured Granite
3	Khargapur	174.16	24-32	6.80	5.4	-	Fractured Granite
4	Dhonga	183.030	6-7.5, 18-30, 64-74	5.58	7.2	2.50/42	Weathered & Fractured Granite
5	Manikpura	200	170-184	132.0	4.32	-	Fractured Granite
6	Larkhas	200	9.5-12.0	116.0	2.16	-	Fractured Granite
7	Amarpur	151.31	24-32, 51-60	9.12	19.44	5.5/250	Negligible
8	Badagaon	178.73	5-10, 24-28	5.60	9.36	-	Weathered & Fractured Granite
9	Doda	114.75	24-30	7.5	32.4	0.5/250	Weathered & Fractured Granite
10	Hyderpur	192.00	23-28	15.00	1.44	-	Weathered & Fractured Granite
11	Ganeshpura	192.44	17-28	5.70	7.92	-	Weathered & Fractured Granite
12	Baldeogarh	32.49	17-30	4.73	64.8	2.28/240	Sand Boulder Cobble & Fractured Granite
13	Palera	183.30	16-25	3.04	17.28	4.30/214	Weathered & Fractured Granite
14	Jatara	200	10-12	5.93	5.4	-	Fractured Granite
15	Chandora	200	11.50-18.0	8.5	12.6	-	Weathered & Fractured Granite
16	Bherua Tal	137.60	9.5-18.50	4.03	21.6	3.0/350	Sand
17	Kari	200	9-15	8.5	7.2	-	Weathered & Fractured Granite
18	Mohangarh	200	18-23, 75-80	2.05	17.28	3.00/288	Weathered & Fractured Granite
19	Hateri	200	7.5-8.5	9.00	4.32	-	Fractured Granite
20	Bandha	200	19-22	8.50	3.6	-	Fractured Granite
21	Kargawan	192.44	14-19, 53-62	5.08	12.6	1.5/88	Weathered & Fractured Granite
22	Bhopalpura	200	Dry	-	-	-	-

23	Ziron	200	8.5-15.0	3.5	12.6	3.5/250	Weathered & Fractured Granite
24	Sakera Bhadram	200	15-18	14.60	5.4	-	Weathered & Fractured Granite
25	Garar	200	16-18	5.06	5.4	-	Weathered & Fractured Granite
26	Harshmau	200	18-25	8.50	4.68	-	Weathered & Fractured Granite
27	Mohanpura	200	Dry	-	-	-	Weathered & Fractured Granite
28	Panhari	200	10-12	20.0	0.72	-	Weathered & Fractured Granite
29	Parkheda	200	16-18,23-28,173- 178	3.85	21.6	8.5/214	Weathered & Fractured Granite
30	Asati	200	20-26	12.60	5.4	-	Weathered & Fractured Granite

**Details of Ground Water Exploration in Tikamgarh District( 2013-2014)**

S. No.	Name	Long	Lat	Block	T.SNo.	Location	Type	Elevation (mamsl)	Total Depth (m)	Zones tapped (m)	Formation	SWL (mbgl)	Discharge (lps)	Drawdown (m)
E-1	Badai Khera (Sarkanpur)	79.07 33	24.84 84	Baldevgarh	54P/1	In the premises of Primary Government school	EW	293	200	7.90-10.90, 65.80-68.90	Granite	7.6	2.5	-
E-2	Badai Khera (Sarkanpur)	79.07 33	24.84 84	Baldevgarh	54P/1	In the premises of Primary Government school	OW	293	99.4	10.90-14.00	Granite	8.1	2	-
E-3	Guna	79.14 09	24.89 52	Baldevgarh	54P/1	In the premises of Government school	EW	270. 2	200.0	Nil	Granite	Dry	Nil	
E-4	Machi	79.01 35	24.95 65	Jatara	54P/1	In the premises of Primary Government school	EW	256. 8	200.0	10.90-14.00 105.50-108.50	Granite	7	1.5	
E-5	Rampura	79.21 76	24.92 77	Baldevgarh	54P/1	In the premises of Primary Government school	EW	274. 4	200.0	Nil	Granite	Dry	Nil	
E-6	Chandpura	79.19	24.81 81	Baldevgarh	54P/1	In the premises of Primary Government school	EW	303	200.0	7.90-11.00	Granite	12.5	Negligible	
E-7	Kudiyala	79.15 073	25.04 929	Palera	54O/4	In the premises of Primary Government school	EW	231. 8	200.0	44.50-47.60	Granite	2	3.5	
E-8	Kudiyala	79.15 073	25.04 929	Palera	54O/4	In the premises of Primary Government school	OW	231. 8	123.8	4.90-7.90 59.80-62.80 96.00-98.40	Granite	2.1	3.5	
E-9	Durganagar	79.04 89	24.75 65	Baldevgarh	54P/1	In the premises of Primary Government school	EW	318. 1	200.0	Nil	Granite	Dry	Nil	
E-10	Pratapnagar	79.08 07	25.08 7	Jatara	54O/4	Govt. land near to Temple road going to	EW	252. 7	141.3	13.20-16.20	Granite	7.4	3	



						kajna well constructed in the Right hand side								
E-11	Pratapnagar	79.08 07	25.08 7	Jatara	54O/4	Govt. land near to Temple road going to kajna well constructed in the Right hand side	OW	252. 7	31.5	11.10- 13.20	Granite	6.1	2.5	
E-12	Kacchora	79.19 12	25.08 19	Palera	54O/4	By the side of road adjacent to well	EW	219. 9	200.0	26.20- 29.20 71.90- 75.00	Granite	11.8	Negligible	
E-13	Bamori Kalan	79.11 184	25.12 574	Jatara	54O/4	behind govt primary school,	EW	240. 2	196.2	Nil	Granite	Dry	Negligible	
1	Jalandhar EW I	78.79	25.20 1	Prithvipur	54K/16	RHS of Prithvipur – Teharka road. Infront of Govt Primary School Adiwasi, Jalandhar. About 6 km from Prithvipur	EW	283. 1	200.1	108- 111.7	Granite	3.4	1.4	-
2	Jalandhar EW II	78.79	25.20 1	Prithvipur	54K/16	RHS of Prithvipur – Teharka road. Infront of Govt Primary School Adiwasi, Jalandhar. About 6 km from Prithvipur	EW	283. 1	200.1	7-9, 108- 117-120	Granite	1.7	0.44	-
3	Kudar	78.90 2	25.46 9	Niwari	54K/15	LHS of Kudar village road from Mudara to Sendri raod, near Gate	EW	227	200.1	8.00- 14.10, 123.90- 127.00	Granite	4.9	0.38	
4	Rajendra nagar	78.77 1	25.02 2	Jatara	54K/16	RHS of Bamhori – Mohangarh road, infront of newly constructed Anganwari Kendra & near Mataji mandir. About 5 km from Bamhori on Mohangarh road.	EW	317. 2	200.1	8-11, 20.20- 23.20	Granite	10	0.14	
5	Sunrai (Lakhanpura )	78.90 1	25.11 4	Palera	54K/16	Infront of Naveen Secondary School, Sunrai on Sunrai – Lakhanpura road. About 1 km from Sunrai on	EW	316. 9	200.1	Nil	Granite	Dry	Nil	

						Kharon road, near kmstone Lidhaura -6.								
6	Dhamna	78.95 4	25.37 4	Niwari	54K/15	Near Govt Sr Secondary School, Dhamna. RHS of Urdaura – Dhamna village road. About 6 km from Urdaura (Jhansi – Chhattarpur road).	EW	228.3	203.2	Nil	Granite	Dry	Nil	
7	Niwari	78.81	25.36 4	Niwari	54K/15	Inside campus of PG College, Niwari	EW	235	200.1	8-11, 44.60- 50.70, 87.30- 90.30, 184.90- 191.00	Granite	4.6	2.5	
8	Niwari	78.81	25.36 4	Niwari	54K/15	Inside campus of PG College, Niwari	OW	235	129	8-11, 69-72, 111.7- 114.7	Granite	3.75	4.3	
52	Prithvipur	78.44	25.12	Prithvipur	54K/16	Sheep Extn. centre	EW		201.1 0	4-8-90.	Granite		0.1	
53	Orchha	78.57	25.35	Prithvipur	54k/16	Opp. Police Station	EW		201.7 0	12.60- 15.60	Granite		0.1	
54	Jerakhas	78.66	25.18	Tikamgarh	54K/12	Govt. middle School	EW		201.3 0	8.0-9.0	Granite		Negligible	
55	Achhara EW I	78.67	25.02	Tikamgarh		In premises of Govt. Hr. Sec. School	EW		87.20		Granite			
56	AchharaEW II	78.67	25.02	Tikamgarh		In premises of Govt. Hr. Sec. School	EW		200.0 0		Granite			
57	Achhara	78.67	25.02	Tikamgarh		In premises of Govt. Hr. Sec. School	OW		30.00		Granite			
58	Dhilla 1	78.70	25.28	Tikamgarh	54K/11	Govt. high school	EW		150.0 0		Granite			
59	Dhilla 2	78.70	25.28	Tikamgarh	54K/11	Opp. Old panchayat building	EW		201.2 0		Granite			
60	Nandanwara	78.70	25.29	Tikamgarh	54k/12		EW		203.0	8-14.10	Granite	5.50	1.5	

								0	123-127				
61	Jiraon Khalsa	78.70	25.14	Tikamgarh			EW	202.30		Granite			
62.	Neguan	78.70	25.25	Tikamgarh		In premises of Govt. Hr. Sec. School	EW	200.20		Granite		Dry	
63	Bhaswan			Tikamgarh			EW	202.30		Granite			
64	Radhapur	78.58	25.33	Niwari	54k/11	Opp. Govt.primary school	EW	299	203.10	17-20.10	Granite		-
64	Makara	78.74	25.28	Tikamgarh	54K/11	Opp. Govt.middle school.	EW		201.10		Granite		
44	Bani Buzurg	79.31	25.00	Palera	54P/5	Near Govt Sr Secondary School,	EW	233.0	13.0		Granite		
45	Bani Buzurg	79.31	25.00	Palera	54P/5	Near Govt Sr Secondary School,	EW	233.0	200.0		Granite	5.1	4.43
50	Laraon	79.28	25.05	Palera	54O/8	Govt.Girls Primary school Laraon,on the Nowgaon palera road.	EW	226.0	196.2		Granite	3.75	4.3
51	Laraon	79.28	25.05	Palera	54O/8	Govt.Girls Primary school Laraon,on the Nowgaon palera road.	OW	226.0	104.7		Granite	3.75	4.3

### Details of Ground Water Exploration in Tikamgarh District 2014-2015

S. No.	Name	Long	Lat	Block	Topo sheet No.	Location	Type	Total Depth (m)	Zones tapped (m)	Formation	SWL mbgl	Discharge (Ips)
E-14	Budera	79.08	24.65	Baldevgarh	54P/2	In the Premises of Panchayat Bhawan	EW	200.3	Nil	Granite	Dry	Nil
E-15	Hatta	79.19	24.69	Tikamgarh	54P/2	In the premises of Govt.school	EW	200.3	11.20-14.30, 99.70-102.70	Granite	11.34	3
E-16	Hatta	79.19	24.69	Tikamgarh	54P/2	In the premises of Govt.school	OW	200	11.20-14.30, 99.70-102.70	Granite	12.78	1.5
E-17	Dargawan	79.2	24.72	Tikamgarh	54P/2	In the premises of Govt.school	EW	179	Nil	Granite	6.84	0.14
E-18	Daryaon Nagar	78.9	24.78	Baldevgarh	54L/13	In the premises of Govt.school	EW	203	14-17.00	Granite		0.5
E-19	Janakpur	78.97	24.77	Baldevgarh	54L/13	In the premises of Govt.school	EW	203	Nil	Granite	16.2	0.80
E-20	Ahaar	78.99	24.73	Tikamgarh	54L/13	In the premises of Govt.school	EW	201	14.00-17.0	Granite	Dry	megree
E-21	Madumaar	78.86	24.70	Tikamgarh	54L/14	In the premises of Govt.school	EW	200	26.20-29.20	Granite	12.1	2.9
E-22	Madumaar	78.86	24.70	Tikamgarh	54L/14	In the premises of Govt.school	OW	99.4	75.00-78.0	Granite	11.8	1
E-23	Samarra	78.93	24.64	Tikamgarh	54L/14	In the Premises of Panchayat Bhawan	EW	200	Nil	Granite	Dry	Nil
E-24	Dargawan	79.02	24.62	Tikamgarh	54L/14	In front of Temple	EW	200	78-81.10	Granite	Nil	0.5
E-25	Kakarwaha			Tikamgarh		In the premises of Govt.school	EW	203.1	4.80-7.90	Granite	Nil	meger
E-26	Khiriya Naka	78.76	24.62	Tikamgarh	54L/14	In the premises of Govt.school	EW	200	Nil	Granite	Dry	Nil
E-27	Kundeshwar	78.80	24.69	Tikamgarh	54L/14	In the Premises of Agriculture	EW	200	24-26.20	Granite	7.8	3

						University						
E-28	Kundeshwar	78.80	24.69	Tikamgarh	54L/14	In the Premises of Agriculture University	OW	62.8	24-30	Granite	8.1	2.5
E-29	Neemkhera	78.79	24.67	Tikamgarh	54L/14	In the premises of Neemkhed devi temple	EW	200	10.90-14,44.50-47.50	Granite	13.1	1.5
E-30	Sunderpur	78.93	24.69	Tikamgarh	54L/14	In the premises of Govt.school	EW	200	Nil	Granite	Nil	Nil

S No	Name	Latitude	Longitude	Block	Type	Total Depth (m)	Zones tapped/ Fractures Encountered (m)	Fromation/ Aquifer Material	SWL (mbgl)	Discharge (lps)
1	Hatta	24.69	79.19	Tikamgarh	OW	200	11.20-14.30, 99.70-102.70	Granite	6.81A	0.51
2	Kundeshwar	24.69	78.80	Tikamgarh	OW	62.8	24-30	Granite	8.1	2.5
3	Madumar	24.71	78.86	Tikamgarh	OW	99.4	75.00-78.0	Granite	11.8	1

### Observation wells Drilled in 2014-15

**Annexure V:- Details of Exploratory wells drilled in Tikamgarh district.**

S.No	Block	location	Total Depth (mbgl)	Elevation m amsl	Latitude	Longitude	Discharge (lps)
1	BALDEOGARH	Ahaar	201	328.4	78.994	24.736	0.14
2	BALDEOGARH	Badleogarh	32.49	333.5	79.064	24.735	4
3	BALDEOGARH	Bamori	200	318.7	78.815	25.05	9.6
4	BALDEOGARH	Birau	200	335.6	78.864	24.995	1
5	BALDEOGARH	Darguwan	200.3	319.4	79.029	24.627	0.14
6	BALDEOGARH	Dhamna	203.2	228.3	78.954	25.374	0
7	BALDEOGARH	Dhonga	123.69	363.5	78.847	24.713	0.7
8	BALDEOGARH	Gutkhare	200		79.193	25.05	0.14
9	BALDEOGARH	Harshmau	200	239.9	78.822	25.307	1.3
10	BALDEOGARH	Hateri	200	298.8	78.685	25.061	1.2
11	BALDEOGARH	Hatta	200	319.6	79.187	24.662	1
12	BALDEOGARH	Janakpur	203	303	78.97	24.776	0.8
13	BALDEOGARH	Lar	200	326.4	79.01	24.632	0
14	BALDEOGARH	Laraon	196.2	233	79.28	25.05	4
15	BALDEOGARH	Manakapura	200	343.2	78.787	24.702	0
16	BALDEOGARH	Murara	182.92	235.6	78.844	25.345	1
17	BALDEOGARH	Shivnager	200		79.184	24.84	0.7
18	BALDEOGARH	SouryanaKhandia Muhara	200		78.981	25.016	Dry
19	JATARA	Acharra	200	294	78.675	25.03	1.25
20	JATARA	Acharra	87.2	294	78.675	25.03	2.3
21	JATARA	Bandha	200	306.7	78.786	25.043	1
22	JATARA	Bheruatal	137.6	257.2	79.07	25.013	5.83
23	JATARA	Birorakhet	200	318.6	78.772	25.124	3.5
24	JATARA	Budhera	200.3	320.4	79.102	24.63	4
25	JATARA	Durganagar	200	318.1	79.049	24.757	0
26	JATARA	Ganeshpura	192.44	311.2	78.997	24.766	2.2
27	JATARA	Jatara	200	268	79.06	24.978	1.5
28	JATARA	Kacchora	200	219.9	79.12	25.11	5.5
29	JATARA	Kakarwaha	203.1	355	78.97	24.48	0.14
30	JATARA	Karmasanghat	200	318.7	79.003	24.774	1.12
31	JATARA	Mogna	187.97	312.5	78.701	24.91	1
32	JATARA	Mohangarh	200	337	78.728	24.979	4.8
33	JATARA	Neemkheda	200	345.1	78.796	24.676	1.5
34	JATARA	Neguan	202.2	250	78.67	25.256	0.14
35	JATARA	Orchha	197.11	226	78.638	25.35	0.5
36	JATARA	Orchha	201.7	257	78.574	25.35	0.5
37	JATARA	Ramgarh	202.3		78.969	24.901	0.14
38	JATARA	Ziron	200	286.4	78.636	25.1	4.16

39	JATARA	Panihari	200		78.652	25.28	0.41
40	JATARA	Tikamgarh town	178.73		78.86	24.76	1.13
41	NIWARI	Asati	200	222.1	78.89	25.45	1.5
42	NIWARI	Daryao Nagar	203	301.2	78.987	24.786	0.5
43	NIWARI	Digaura	187.97	335.4	78.855	24.968	0
44	NIWARI	Larkhas	200	296.6	78	25.028	0.6
45	NIWARI	Mudaini	110.71	278.1	78.632	25.167	6.5
46	NIWARI	Niwari	83.84	242.5	78.801	25.351	3.5
47	NIWARI	Pohakhas	60.92	241.6	78.828	25.32	2.5
48	NIWARI	Pratapnagar	141.3	252.7	79.081	25.087	3
49	NIWARI	Prithvipur	152.43	290.1	78.735	25.21	0.65
50	NIWARI	Prithvipur	201.1	295	78.755	25.2	0.5
51	NIWARI	Radhapur	201.8	243	78.58	25.33	0
52	NIWARI	Rampura	200	274.4	79.218	24.928	0
53	NIWARI	SakeraBhadaram	200	320.3	78.749	25.149	1.5
54	NIWARI	Sunrai	200.1	316.9	78.901	25.114	0
55	NIWARI	Dikauli	202.3		79.126	24.664	0
56	PALERA	Bani-Buzurg	200	226	79.31	25	4.43
57	PALERA	Bhopalpura	200	296.7	78.706	25.198	0
58	PALERA	Dargawan	179	306.7	79.213	24.725	0.5
59	PALERA	Hyderpur	192	373.5	78.968	24.571	2.6
60	PALERA	Khargapur	174.16	303.3	79.157	24.795	1.5
61	PALERA	khiria Naka	200	356.4	78.761	24.63	0
62	PALERA	Kudiyala	200	231.8	79.151	25.049	3.5
63	PALERA	Machi	200	256.8	79.014	24.957	1.5
64	PALERA	Manikpura	200	334.1	78.889	24.745	1.2
65	PALERA	Radhapur	114.85	328.6	79.016	24.608	0.7
66	PALERA	Jatara	202.3		79.047	25.003	0.85
67	PRITHVIPUR	Achhrumata	200	355.2	78.68	25.169	1
68	PRITHVIPUR	Budera	165.12	304.2	79.086	24.659	0
69	PRITHVIPUR	Chandora	200	266.1	78.989	25.067	3.5
70	PRITHVIPUR	Digaura	200	332.4	78.84	24.967	0.62
71	PRITHVIPUR	Duda	114.75	339	78.996	24.593	4.16
72	PRITHVIPUR	Jalandhar	200.1	283.3	78.79	25.201	1.4
73	PRITHVIPUR	Jalandhar	200.1	283.3	78.79	25.201	0.44
74	PRITHVIPUR	Jherakhas	202.3	291	78.665	25.182	0.14
75	PRITHVIPUR	Joramora	187.97	314.6	78.809	25.081	3.5
76	PRITHVIPUR	Kargawan	192.44	299.1	78.73	25.184	1.46
77	PRITHVIPUR	Kari	200	350.7	78.858	24.76	2
78	PRITHVIPUR	Niwari	200.1	231.5	78.81	25.364	4.3
79	PRITHVIPUR	Palera	183.3	266	79.238	24.994	3.56
80	PRITHVIPUR	Parkheda	200	267.9	78.739	25.259	3.56

81	PRITHVIPUR	Rajendernagar	200.1	317.3	78.771	25.022	0.4
82	PRITHVIPUR	Sunderpur	200	351.2	78.932	24.692	0
83	PRITHVIPUR	Sunwaha	202.5		78.812	24.786	0.14
84	PRITHVIPUR	Bhelsi	200		79.104	24.777	0
85	TIKAMGARH	Amarpur	151.31	372	78.971	24.621	4.16
86	TIKAMGARH	Badagaon	178.73	334.1	79.027	24.567	2.6
87	TIKAMGARH	BadaiKhera	200	293	79.073	24.848	2.5
88	TIKAMGARH	BamoriKalan	196.2	240.2	79.112	25.126	0
89	TIKAMGARH	Chandpura	200	303	79.19	24.818	0.14
90	TIKAMGARH	Churara	187.97	259.7	78.874	25.287	0
91	TIKAMGARH	Dhillan	200	245	78.704	25.29	abandoned
92	TIKAMGARH	Dhillan	148.4	245	78.704	25.29	0
93	TIKAMGARH	Dunga	123.69	316.6	79.157	24.76	6.25
94	TIKAMGARH	Guna	200	270.2	79.141	24.895	0
95	TIKAMGARH	Gurar	200	281.3	78.77	25.234	1.5
96	TIKAMGARH	Hatta	200.3	314.4	79.192	24.691	3.5
97	TIKAMGARH	JeronKhalsa	202.3	294	78.666	25.137	6.3
98	TIKAMGARH	Joriya	200				5.5
99	TIKAMGARH	Kudar	200.1	227	78.902	25.469	0.38
100	TIKAMGARH	Kundeshwar	200	347.4	78.805	24.697	1.7
101	TIKAMGARH	Kundeshwar(PZ)	202.3		78	24.077	0.5
102	TIKAMGARH	Laraon	79.28	226	79.28	24.708	4.3
103	TIKAMGARH	Madumar	200	366.5	78.866	24.71	2.9
104	TIKAMGARH	Makara	200	279.8	78.742	25.286	0.5
105	TIKAMGARH	Malgawan	151.41	297.9	79.257	24.713	1
106	TIKAMGARH	Mohanpura	200	254	78.797	25.306	0
107	TIKAMGARH	Nandanwara	200	330.4	78.74	25.059	1
108	TIKAMGARH	Nandanwara	203.1	245	78.703	25.29	0.14
109	TIKAMGARH	Panhari	202.3	215.3	78.795	25.396	0.2
110	TIKAMGARH	Samarra	200	372.9	78.929	24.632	3.5
111	TIKAMGARH	Samarra	200	360.2	78.937	24.645	0.14
112	TIKAMGARH	Taricharkalan	200	228.8	78.842	25.386	0
113	TIKAMGARH	Tikamgarh Bus stand	178.73	356	78.847	24.727	0.5
114	TIKAMGARH	Sudadharampura	202.3		79.051	24.652	0.5
115	TIKAMGARH	kamalnagar	200		78.978	24.869	Dry
116	TIKAMGARH	simaria	202.5		79.069	24.946	0
117	TIKAMGARH	Pipramadauri	202.3		79.069	24.871	2.5
118	TIKAMGARH	Deorda	202.3		79.155	24.737	1.9
119	TIKAMGARH	Astone	202.3		78.808	24.63	0
120	TIKAMGARH	Bahadurpur	202.3		78.945	24.725	0



