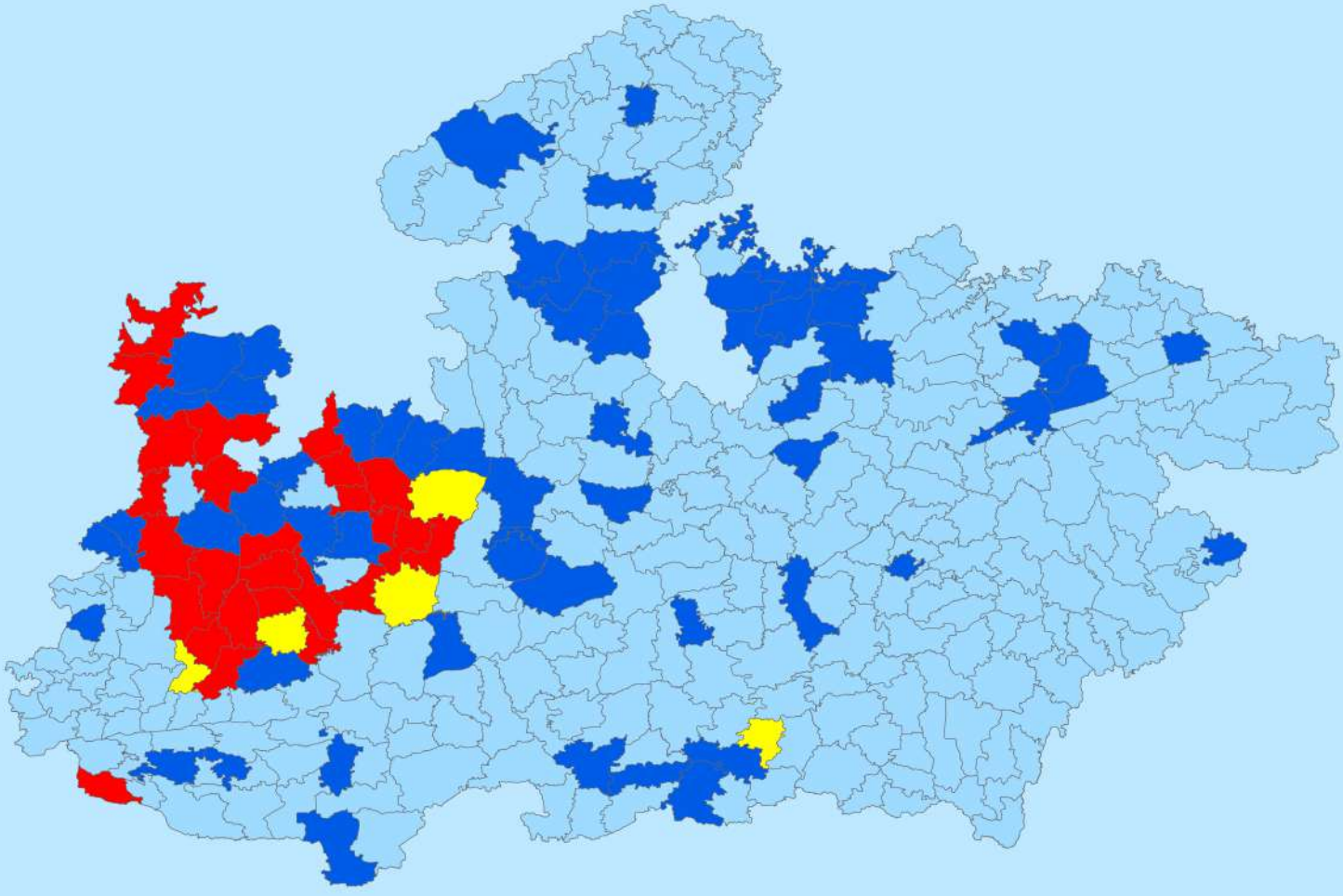
DYNAMIC GROUND WATER RESOURCES OF MADHYA PRADESH
(as on 2023)



Central Ground Water Board
North Central Region, Bhopal
Department of Water Resources, GR & RD
Ministry of Jal Shakti
Government of India

Ground Water Survey
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Government of Madhya Pradesh

BHOPAL
SEPTEMBER 2023

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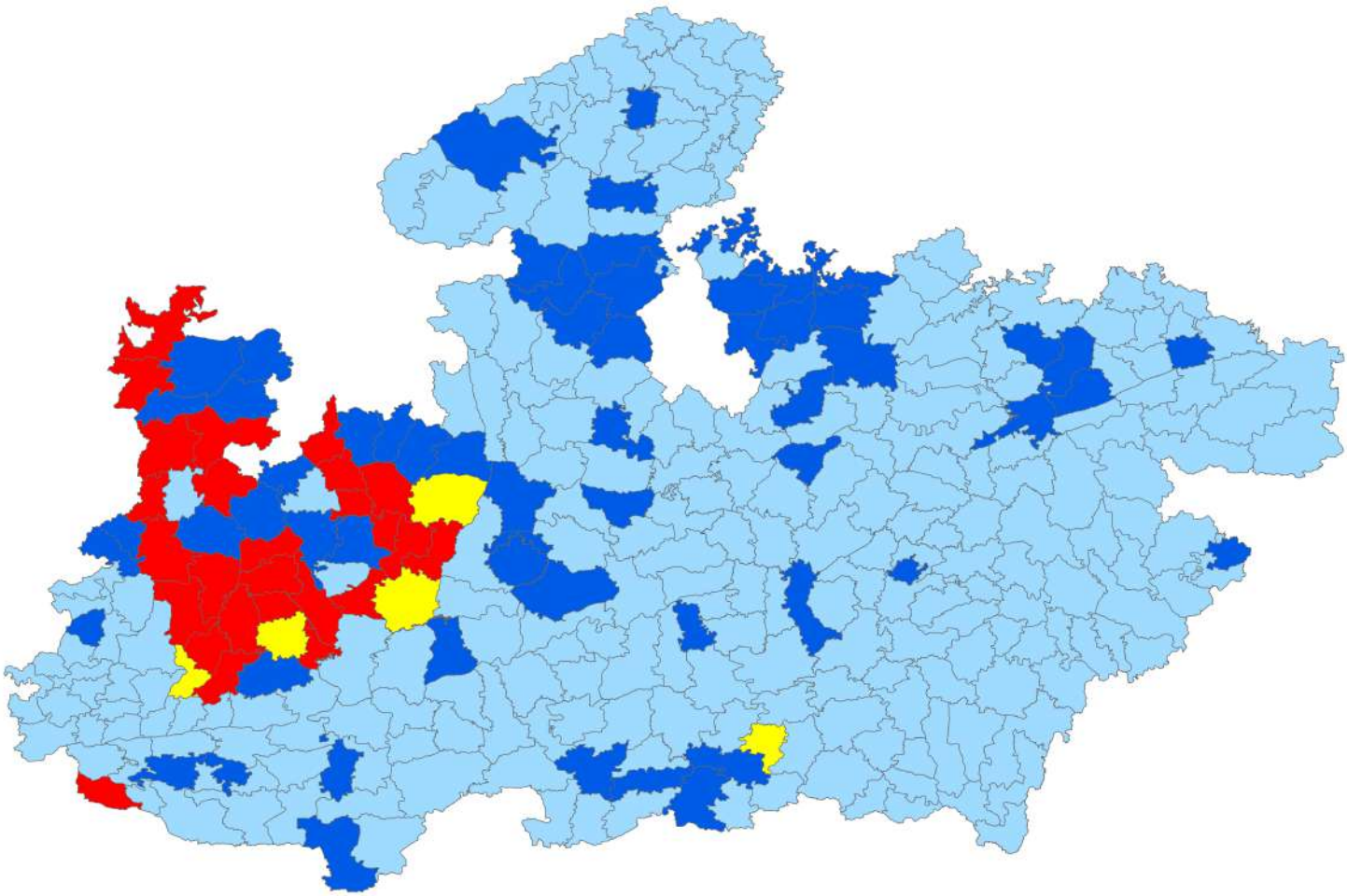

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BHOPAL
SEPTEMBER 2023

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प्रमुख सचिव
मध्य प्रदेश शासन
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अ. शा. पत्र क्र. 71 /प्र.स./ज.सं.वि./2024
दिनांक 10.01.2024

FOREWORD

Ground water resources play a vital role in sustaining livelihoods. Its ubiquitous occurrence, reliability and availability in all seasons have made it the primary buffer against drought, playing a pivotal role in ensuring the food security at all levels. Ground water has an important role in meeting the water requirements of agriculture, industrial and domestic sectors in India.

Ground water is annually replenishable resource but its availability is non-uniform in space and time. Hence, the sustainable development of ground water resources warrants precise quantitative assessment based on reasonably valid scientific principles.

National Water Policy, 2002 has also laid emphasis on periodic assessment of ground water resources on scientific basis. The policy also reiterates that the exploitable quantity of ground water should be limited to the amount, which is being recharged annually, more commonly known as "Dynamic Ground Water Resource".

The Dynamic Groundwater Resource Assessment of Madhya Pradesh has been jointly carried out by Ground Water Survey, Water Resource Department, Govt. of Madhya Pradesh and Central Ground Water Board, Govt. of India following the Groundwater Estimation Methodology, 2015 (GEC–2015). This report reveals that the overall stage of ground water extraction is 58.75% in Madhya Pradesh. Out of total 317 assessment units 226 assessment units fall in safe category, 60 assessment units fall under semi critical, 5 in critical and 26 fall in over exploited category.

All computations for the assessment of ground water resources have been automated and done in a GIS environment through a web based application i.e. "INDIA- GROUNDWATER RESOURCE ESTIMATION SYSTEM (IN-GRES)" developed by Central Ground Water Board in collaboration with IIT-Hyderabad.

I genuinely appreciate the work done by the officers of Central Ground Water Board and Ground Water Survey, Water Resource Department for their efforts in completing the assessment. I am hopeful that this report will be very useful for the administrators, planners and ground water professionals and will be helpful in ensuring optimal utilization and sustainability of ground water resource.

(Manish Singh)

ए. के. बिस्वाल
क्षेत्रीय निदेशक
A.K. Biswal
Regional Director

सत्यमेव जयते

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास एवं गंगा संरक्षण मंत्रालय
केन्द्रीय भूमिजल बोर्ड, उत्तर मध्य क्षेत्र, भोपाल
Government of India
Ministry of Jal Shakti
Department of Water Resources, R D & G R
Central Ground Water Board, North Central Region, Bhopal

PREFACE

The state of Madhya Pradesh is in the process of an accelerated development in the fields of irrigation and industrial activities and ground water occupies a key position in the developmental activities of the state. Although, ground water is a replenishable resource, over extraction of ground water, recurrent droughts, varied monsoon pattern etc., are leading to situation on which several blocks of the state have been categorized as over exploited to Semi- critical.

Assessment of Ground Water Resources of Madhya Pradesh is being done jointly by Central Ground Water Board and Ground Water Survey, Water Resources Department, Government of Madhya Pradesh as per the methodology recommended by the Ground Water Resource Estimation Committee-2015 constituted by the Govt. of India. All the computations for the assessment of Ground Water Resources have been done by a web based application "INDIA-GROUNDWATER RESOURCE ESTIMATION SYSTEM (IN-GRES) developed by CGWB in collaboration with IIT-Hyderabad.

The report titled 'Dynamic Ground Water Resources of Madhya Pradesh (as in 2023)' summarizes the results of the assessment, primarily in terms of resource availability, utilization and categorization of assessment units duly approved by the State Level Committee (SLC) constituted for the purpose. The report briefly describes salient features of previous assessments, ground water estimation methodology, rainfall distribution, physiography, geomorphology, land use land cover, drainage and basins hydrogeology, aquifer systems of Madhya Pradesh, ground water level scenario and hydrochemistry of the state in the first three chapters before describing various components of the ground water resource assessment, 2023 in some detail.

I am indebted to Shri Manish Singh, Principal Secretary, Water Resources Department, Government of Madhya Pradesh as well as Chairman of State Level committee for Ground Water Resource Estimation for his valuable guidance in accomplishing task of Ground Water Resource Estimation within the stipulated time frame. I express my sincere thanks to members of committee for approval of the report on "Dynamic Ground Water Resources of Madhya Pradesh (As on 2023)". I am obliged to Shri Shishir Kushwaha, Engineer in Chief, Water Resources Department, Government of Madhya Pradesh. under his supervision the entire work was accomplished. Thanks to Sh. G. P. Soni, Chief Engineer (BODHI), Water Resources Department, Government of Madhya Pradesh and Dr. Jitendra Jain, Superintending Geo-hydrologist, Ground Water Survey, Water Resources Department, Government of Madhya Pradesh for co-coordinating the work at state level.

A deep sense of gratitude is expressed to all the state Officers of Ground Water Survey, Water Resources Department, Government of Madhya Pradesh, who was associated with this work at one stage or the other.

I wish to place on record my appreciation of the untiring efforts of Sh. Chittaranjan Biswal, Scientist-C and the team of officers of Central Ground Water Board, North Central Region, Bhopal for completing the challenging task of Resource Assessment and compiling this informative report.

I hope that, this report will be useful to all the user agencies engaged in planning and development of ground water in the state.

Biswal

(A K Biswal)

DYNAMIC GROUND WATER RESOURCES OF MADHYA PRADESH, 2023

AT A GLANCE

1. Total Annual Ground Water Recharge (BCM)	: 35.47
2. Annual Extractable Ground Water Resource (BCM)	: 32.85
3. Annual Ground Water Extraction (BCM)	: 19.30
4. Stage of Ground Water Extraction (%)	: 58.75

CATEGORISATION OF ASSESSMENT UNITS

(Blocks/ Urban Areas)

S. N.	Category	Assessment Units		Annual Extractable Ground Water Resource		Recharge Worthy Area	
		Number	%	MCM	%	Sq KM	%
1	Safe	226	71.29	22773	69.32	190726	70.81
2	Semi-Critical	60	18.93	6120	18.63	51804	19.23
3	Critical	5	1.58	537	1.63	4249	1.58
4	Over-Exploited	26	8.20	3424	10.42	22555	8.37
5	Saline	0	0	0	0	0	0
Total		**317**		**32854**		**269334**	

C O N T E N T S

F I G U R E S

T A B L E S

EXECUTIVE SUMMARY

Dynamic Ground Water Resources Assessment is carried out at periodical intervals jointly by Central Ground Water Board, North Central Region, Bhopal and Ground Water Survey, Water Resource Department, Govt. of Madhya Pradesh under the guidance of State Level Committee and under the overall supervision of Central Level Expert Group. Such joint exercises have been taken up earlier in 1980, 1995, 2004,2009, 2011, 2013, 2017 2020 and 2022.

The assessment involves computation of Dynamic Ground Water Resources or Annual Extractable Ground Water Resource, total Current Annual Ground Water Extraction (utilization) and the percentage of utilization with respect to annual extractable resources (Stage of Ground Water Extraction). The assessment units (Blocks/ Urban areas) are categorized based on Stage of Ground Water Extraction, which are then validated with long-term water level trends. The assessment prior to that of year 2017 were carried out following Ground Water Estimation Committee (GEC) 97 Methodology, whereas after 2017, assessments are based on norms and guidelines of the GEC 2015 Methodology.

The main source of replenishable ground water resources is recharge from rainfall, which contributes to nearly 76 % of the total annual ground water recharge. A major part of the state receives rainfallmainly during SW Monsoon season spread over the months of mid-June to September. Over 99 % of the annual rainfall is received in the four rainy months for June to September only thereby leading to large variations on temporal scale.

Type of rock formations and their storage and transmission characteristics have a significant influence on ground water recharge. Ground water occurrence in the Hard rock formations which are occupying nearly 80% of the total geographical area of the state, are forming poor aquifers. Porous formations such as the alluvial formations in the Bhind (Chambal basin), Hoshangabad and Narsimhapur districts (Narmada basin) and also in Sheopur, Morena, Datia, Chhatarpur, Jabalpur, Katni, Khandwa, Burhanpur, Raisen, Sidhi and Balaghat districts and along rivers in some other districts on the other hand generally have high specific yields and are good repositories of ground water.

In the present assessment, the total annual ground water recharge has been assessed as 35.47 bcm. Keeping an allocation for natural discharge, the annual extractable ground water resource works outas 32.85 bcm. The total annual ground water extraction (as in 2023) has been assessed as 19.30 bcm. The average stage of ground water extraction for the state as a whole works out to be about 58.75%. The extraction of ground water for various uses in

different parts of the state is not uniform. Out of the total 317 assessment units (Blocks/ Urban areas) in the state, 26 units (8%) have been categorized as 'Over-Exploited' indicating GroundWater extraction exceeding the total Annual Extractable Resources. A total of 5 (2%) assessment units have been categorized as 'Critical', where the stage of ground water extraction is between 90-100 % of annual extractable resources available. There are 60 'Semi-Critical' units (19%), where the stage of ground water extraction is between 70 % and 90 % and 226 (71%) assessment units have been categorized as 'Safe ', where the stage of Ground water extraction is less than 70 %. Out of 32853.75 mcm of Total Annual Extractable Resources of the state, 3424.26 mcm (10.42 %) are under 'Over-Exploited', 537.1 mcm (1.63 %) are under 'Critical', 6119.62 mcm (18.63 %) are under 'Semi-Critical', 22772.77 mcm (69.32 %) are under 'Safe' category assessment units. Out of 269333.27 Sq Km of Recharge worthy area of the state, 22554.86 Sq Km (8.37 %) are under 'Over-Exploited', 4249.07 Sq Km (1.58 %) are under 'Critical', 51803.76 Sq Km (19.23 %) are under 'Semi-Critical', 190725.58 Sq Km (70.81%) are under 'Safe' category assessment units.

The total annual ground water recharge has increased from 35.24 to 35.47 bcm. The rise in groundwater recharge can be attributed to increased rainfall recharge and the implementation of water conservation structures. Accordingly, the annual extractable resource of Ground Water Resource Assessment, 2023 on comparison Ground Water Resource Assessment, 2022 shows an increase from 32.58 to 32.85 bcm. The groundwater extraction has increased from 19.25 to 19.30 bcm and the changes are attributed mainly to due to increase in the abstraction structures and increase in population. The overall stage of groundwater extraction has increased from 59.10% to 58.75%.

Almost all over-exploited assessment units falling in western part of Madhya Pradesh, which is known as "MALWA AREA" where ground water extraction has increased many folds during past decades. District wise analysis of data of annual extractable resource and annual ground water extraction indicate that four districts namely Indore, Mandsaur, Neemuch, Ratlam and Shajapur are districts where stage of ground water extraction is more than 100% as a whole.

CHAPTER 1

1.0 INTRODUCTION

Water is a fundamental resource for life. Sustainable development and efficient management of this scarce resource has become a challenge in Madhya Pradesh. Increasing population, growing urbanization and rapid industrialization combined with the need for raising agricultural production generates competing demands for water. Ground water has steadily emerged as the backbone of state agriculture and drinking water security. Ground water is an annually replenishable resource but its availability is non- uniform in space and time. Ground water available in the zone of water level fluctuation is replenished annually with rainfall being the dominant contributor. Hence, the sustainable utilization of ground water resources demands a realistic quantitative assessment of ground water availability in this zone based on reasonably valid scientific principles.

Agriculture is the main stay of the people of Madhya Pradesh. Water is essential for irrigation purposes, but its indiscriminate use can lead not only to shortages, but also to the deterioration of crop yields and soils. The impact of over extraction on dynamic resources of ground water resources is noticed in many places in Madhya Pradesh especially in western part called Malwa region. In these areas depletion of water levels, drying of wells and ground water quality problems are reported. The State has varied hydrogeological characteristics due to which ground water potential varies from place to place. Increasing urbanization and growing dependence on ground water for irrigation in the state has called for judicious and planned uses of ground water resources.

The dynamic ground water refers to the quantity of ground water available in the zone of water level fluctuation, which is active recharge zone and replenished annually. In addition to the dynamic ground water resource, there exists a limited ground water reservoir in the deeper zones below the active recharge zone and in the confined aquifers in Madhya Pradesh. The ground water exploitation primarily confines in the shallow aquifer. The sustainability of shallow aquifers plays an important role for the development of ground water structures. The sustainable development of ground water resources, therefore, warrants precise quantitative assessment of dynamic ground water resources based on the reasonably valid scientific principles.

1.1 PREVIOUS ASSESSMENTS

Ground Water Resources Estimation of the country was done for the first time in the year 1979. A committee known as Ground Water Over Exploitation Committee was constituted by

Agriculture Refinance and Development Corporation (ARDC) of Government of India Based on the methodology and norms recommended by the above committee ground water resources were assessed. Subsequently, necessity was felt to refine the methodologies and the "Ground Water Estimation Committee (GEC)" headed by the Chairman, CGWB came into existence. Based on the detailed Surveys and Studies carried out by the different Regions and Projects of CGWB, the committee recommended the revised methodology in 1984 (GEC- 84) for estimation of ground water resources.

Again in year 1997, Ground Water Estimation Committee revised its methodology and suggested the modified methodology for computation of ground water resource estimation, which was refined on the basis of studies of State Government agencies and CGWB. Based on GEC 1997, the dynamic ground water resources of Madhya Pradesh have been estimated for the state considering 2004, 2009, 2011 and 2013 as base years. The methodology underwent comprehensive revisions again in 2015 and a revised methodology, namely GEC 2015 methodology has been prescribed for ground water assessment. This methodology is being followed for assessment carried out from 2017 onwards. Salient details of status of ground water resources and categorization of assessment units in 2011, 2013, 2017, 2020, 2022 and 2023 are shown in **Table 1.1** and **Table1.2** respectively.

Table 1.1: Ground Water Resources Assessment 2011 to 2023

S. N	Ground Water Resources Assessment	2011	2013	2017	2020	2022	2023
1	Annual Ground Water Recharge (bcm)	35.04	35.98	36.42	36.16	35.24	35.47
2	Annual Extractable Ground Water Resource (bcm)	33.29	34.16	34.47	33.38	32.58	32.85
3	Total Ground Water Extraction (bcm)	18.83	19.36	18.88	18.97	19.25	19.30
4	Stage of Ground Water Extraction (%)	57	56.68	54.76	56.82	59.1	58.75

Table 1.2: Categorization of Assessment units from 2009 to 2023

S N	Categorization	2011	2013	2017	2020	2022	2023
1	Total Assessed units	313	313	313	317	317	317
2	Safe	218	228	240	233	226	226
3	Semi-critical	67	58	44	50	60	60
4	Critical	4	2	7	8	5	5
5	Over-Exploited	24	25	22	26	26	26
6	Saline	0	0	0	0	0	0

1.2 RE-ASSESSMENT OF GROUND WATER RESOURCES, 2023

The assessment of Ground water resources is carried out to determine the prevailing status of ground water resources in the state. It also helps assess the impact of the on-going ground water management practices on the groundwater resources. In 2022, Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti constituted a permanent Central Level Expert Group (CLEG) for over-all supervision of the re-assessment of ground water resources in the entire country as in 2022. The terms of reference of the committee include supervision of assessment of annual replenishable ground water resources and the status of utilization for reference year 2023. A copy of the Government Resolution is in **Appendix A**.

Ground water resources assessment for reference year 2023 in Madhya Pradesh have been carried out jointly by Central Ground Water Board (CGWB), North Central Region, Bhopal in association with Ground Water Survey, Water Resources Department, Government of M.P. under the supervision of State Level Committee (**Appendix B**), with technical guidance from Central Level Expert Group. The assessment carried out was approved by the State Level Committee (**Appendix E**). Based on the assessments the Report titled "Dynamic Ground Water Resources of Madhya Pradesh-2023" has been compiled. The report briefly describes salient features of previous assessments, ground water estimation methodology, rainfall distribution, physiography, geomorphology, land use land cover, drainage and basins hydrogeology, aquifer systems of Madhya Pradesh, ground water level and ground water quality scenario, and various components of the ground water resource assessment, 2023 in detail.

The report was reviewed and deliberated upon during the meeting of CLEG held on 27.09.2023, and was approved.

1.3 PROCEEDINGS OF THE RESOURCE ESTIMATION

A permanent State Level Technical Committee was constituted for approval of Ground Water Resources of Madhya Pradesh under the Chairmanship of Principal Secretary, Water Resources Department, Government of M.P. vide Memo No. F-15-21/Minor/31/290 dated 10.02.2022 for the assessment 2020-21 (**Appendix B**). The structure of Committee was with following nominees of different departments:

1	Principal Secretary, Water Resources Department, Government of M.P.	Chairman
2	Commissioner, Urban Development and Housing Department	Member
3	Commissioner, MGNREGA, Bhopal	Member
4	Director, Rajiv Gandhi Water Shed Mission	Member

5	General Manager, NABARD, Bhopal	Member
6	Engineer -in - Chief, Water Resources Department	Member
7	Engineer -in - Chief, Public Health Engineering Department	Member
8	Engineers -in - Chief, RES	Member
9	Director, Agriculture, Government of M.P.	Member
10	Director, Industries, Government of M.P.	Member
11	Director, Directorate Geology and Mining, Bhopal	Member
12	Chief Engineer, BODHI, Water Resources Department	Member
13	Superintending Geo-Hydrologist, GWSC, Circle Bhopal	Member
14	Regional Director, CGWB, NCR, Bhopal	Member Secretary

A Ground water assessment cell was constituted under guidance of Sh. M. S Dabar, Engineer in Chief, Water Resources Department, Govt. of M.P. and Sh A. K. Biswal, Regional Director, CGWB, NCR, Bhopal for the estimation.

First State Level Committee meeting was held on 19.04.2023 under the Chairmanship of Sh. S N Mishra, Additional Chief Secretary, Water Resources Department, Govt. of Madhya Pradesh. In the meeting Sh. Chittaranjan Biswal, Scientist-B, CGWB, NCR, Bhopal explained the overview of Ground Water Resource estimation, strategic plan, status of various activities related to Dynamic Ground Water Resource Estimation. The data will be provided by all the line departments by 31st July, 2023 and all attempts will be made to complete the Dynamic Groundwater resource estimation by the end of August 2022. The minutes of the meeting and the list of participants is enclosed as **Appendix D**.

Thereafter, the Groundwater resource estimation work was taken up jointly by CGWB, NCR, Bhopal and State Groundwater Survey, WRD under the supervision of Sh. A. K Biswal, Regional Director, CGWB, NCR, Bhopal, Sh. Shishir Kushwaha, Engineer in Chief and Sh. G. P. Soni, Chief Engineer (BODHI), Water Resources Department, Govt. of M.P and. The exercise was done through IN-GRES (India-Groundwater Resource Estimation System), a software solution developed by CGWB in collaboration with IIT-Hyderabad for the purpose of Resource Estimation Automation. Virtual as well as hands on training programs were conducted by CGWB showcasing INGRES features, data upload, trigger computations and approve the results. Sh. Chitta Ranjan Biswal, Scientist 'C', CGWB, NCR, Bhopal provided necessary guidance for computation of Groundwater Resource works and reconciliation of the entire exercises. Dr. Jitendra Jain, Superintending Engineer from Ground Water Survey, Water Resource Department coordinated and monitored the progress of the works done by officers of Ground Water Survey. The data uploaded in INGRES software by Officers of State Ground

Water Survey were checked, validated and discrepancies noticed were corrected under the direction of Sh. Chittaranjan Biswal, Scientist 'C', CGWB, NCR, Bhopal.

Second State level meeting was held on 17.08.2023 under the Chairmanship of Sh. Manish Singh, Principal Secretary, Water Resources Department, Govt. of Madhya Pradesh. Sh. Chitta Ranjan Biswal, Scientist 'C', CGWB, NCR, Bhopal presented the gist on Dynamic Ground Water Resource Assessment 2023. The resources were discussed thoroughly by the members of the committee and after discussion the Dynamic Ground Water Resource of Madhya Pradesh of 20223was approved. The minutes of the meeting and the list of participants is enclosed as **Appendix F**.

After approval from the state level committee the Dynamic Groundwater Resource got approved from Cental level Expert Group on 27.09.2023. The National Compaliation on Dynamic Ground Water Resource Estimation 2023 of India got approve from the Ministry of Jal Shakti on 01.12.2023. After approval from Minstry, the report of Dynamic Groundwater Resource of Madhya Pradesh 2023 was prepared by Sh. Chittaranjan Biswal Scientist 'B', CGWB, NCR, Bhopal under the guidance of Sh. A. K. Biswal, Regional Director, CGWB, NCR, Bhopal.

CHAPTER 2

2.0 GROUND WATER RESOURCE ESTIMATION METHODOLOGY

Ground water resource as in 2023 have been estimated following the guidelines mentioned in the GEC 2015 methodology using appropriate assumptions depending on data availability. The principal attributes of GEC 2015 methodology are given below:

The methodology recommends aquifer wise ground water resource assessment of both the Groundwater resources components, i.e., Replenish able ground water resources or Dynamic GroundWater Resources and In-storage Resources or Static Resources. Wherever the aquifer geometry has not been firmly established for the unconfined aquifer, the in-storage ground water resources have to be assessed in the alluvial areas down to the depth of bed rock or 300 m, whichever is less. In caseof hard rock aquifers, the depth of assessment would be limited to 100 m. In case of confined aquifers, if it is known that groundwater extraction is being done from this aquifer, the dynamic as well as in-storage resources are to be estimated. If it is firmly established that there is no ground water extraction from this confined aquifer, then only in-storage resources of that aquifer has to be estimated. Until aquifer geometry is established on appropriate scale, the existing practice of using watershed in hard rock areas and blocks/mandals/ firkas in soft rock areas may be continued.

It is also pertinent to add that as it is advisable to restrict the groundwater development as far as possible to annual replenish able resources, the categorization also takes into account the relation between the annual replenishment and groundwater development. An area devoid of ground water potential may not be considered for development and may remain safe whereas an area with good groundwater potential may be developed and may become over exploited over a period of time. Thus, water augmentation efforts can be successful in such areas, where the groundwater potential is high and there is scope for augmentation.

2.1 GROUND WATER ASSESSMENT OF UNCONFINED AQUIFER

Though the assessment of ground water resources includes assessment of dynamic and in-storage resources, the development planning should mainly focus on dynamic resource as it gets replenishedon an annual basis. Changes in static or in-storage resources normally reflect long-term impacts of ground water mining. Such resources may not be replenishable annually and may be allowed to be extracted only during exigencies with proper planning for augmentation in the succeeding excess rainfall years.

The methodology for ground water resources estimation is based on the principle of water balance as given below –

$$Inflow - Outflow = Change\ in\ Storage\ (of\ an\ aquifer) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Equation (1) can be further elaborated as –

$$\Delta S = R_{RF} + R_{STR} + R_C + R_{SWI} + R_{GWI} + R_{TP} + R_{WCS} \pm VF \pm LF - GE - T - E - B \qquad (2)$$

Where,

ΔS - Change in storage

RRF –Rainfall Recharge

R_{STR} - Recharge from stream channels

R_C - Recharge from canals

R_{SWI} - Recharge from surface water irrigation

R_{GWI} - Recharge from ground water irrigation

RTP - Recharge from Tanks & Ponds

R_{WCS} - Recharge from water conservation structures

VF - Vertical flow across the aquifer system

LF - Lateral flow along the aquifer system (through flow)

GE - Ground Water Extraction

T -Transpiration

E – Evaporation

B - Base flow

It is preferred that all the components of water balance equation should be estimated in an assessment unit. Due to lack of data for all the components in most of the assessment units, it is proposed that at present the water budget may be restricted to the major components only, taking into consideration certain reasonable assumptions. The estimation is to be carried out using lumped parameter estimation approach keeping in mind that data from many more sources if available may be used for refining the assessment.

2.1.1 Rainfall Recharge

It is recommended that ground water recharge should be estimated on ground water level fluctuation and specific yield approach since this method takes into account the response of ground water levels to ground water input and output components. This, however, requires adequately spaced representative water level measurement for a sufficiently long period. It is proposed that there should be at least three spatially well distributed observation wells in the assessment unit, or one observation well per 100 sq. Km. Water level data should also be

available for a minimum period of 5 years (preferably 10years), along with corresponding rainfall data. Regarding frequency of water level data, two water level readings, during pre and post monsoon seasons, are the minimum requirement. It would be ideal to have monthly water level measurements to record the peak rise and maximum fall in the ground water levels. In units or subareas where adequate data on ground water level fluctuations are not available as specified above, ground water recharge may be estimated using rainfall infiltration factor method only. The rainfall recharge during non-monsoon season may be estimated using rainfall infiltration factor method only.

2.1.1.1 Ground Water Level Fluctuation Method

The ground water level fluctuation method is to be used for assessment of rainfall recharge in the monsoon season. The ground water balance equation in non-command areas is given by

$$\Delta S = R_{RF} + R_{STR} + R_{SWI} + R_{GWI} + R_{TP} + R_{WCS} \pm VF \pm LF - GE - T - E - B \quad \text{.....(3)}$$

Where,

ΔS - Change is storage

R_{RF} - Rainfall recharge

R_{STR} - Recharge from stream channels

R_{SWI} - Recharge from surface water irrigation

R_{GWI}-Recharge from ground water irrigation

RTP - Recharge from Tanks & Ponds

R_{WCS} - Recharge from water conservation structures

VF - Vertical flow across the aquifer system

LF - Lateral flow along the aquifer system (through flow)

GE - Ground water extraction

T-Transpiration

E - Evaporation

B - Base flow

Whereas the water balance equation in command area will have another term i.e., Recharge due to canals (R_C) and the equation will be as follows:

$$\Delta S = R_{RF} + R_{STR} + R_C + R_{SWI} + R_{GWI} + R_{TP} + R_{WCS} \pm VF \pm LF - GE - T - E - B \quad \text{.....(4)}$$

A couple of important observations in the context of water level measurement must be followed. It is important to bear in mind that while estimating the quantum of ground water extraction, the depth from which ground water is being extracted should be considered. One should consider only the draft from the same aquifer for which the resource is being estimated. The change in storage can be estimated using the following equation:

$$\Delta S = \Delta h \times A \times SY \; \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (5)$$

Where,

ΔS - Change is storage

Δh - rise in water level in the monsoon season

A - Area for computation of recharge

S_Y - Specific Yield

Substituting the expression in equation (5) for storage increase ΔS in terms of water level fluctuationand specific yield, the equations (3) & (4) becomes (6) & (7) for non-command and command sub- units,

$$R_R = \Delta h \times A \times S_Y - R_{STR} - R_{SWI} - R_{GWI} - R_{TP} - R_{WCS} \pm VF \pm LF + GE + T + E + B \ldots\ldots\ldots\ldots (6)$$

$$R_R = \Delta h \times A \times S_Y - R_{STR} - R_{SWI} - R_C - R_{TP} - R_{WCS} \pm VF \pm LF + GE + T + E + B \ldots\ldots\ldots\ldots (7)$$

Where base flow/ recharge to from streams have not been estimated, the same is assumed to be zero. The rainfall recharge obtained by using equation (6) and (7) provides the recharge in any particular monsoon season for the associated monsoon season rainfall. This estimate is to be normalized for the normal monsoon season rainfall as per the procedure indicated below.

Normalization of Rainfall Recharge

Let R_i be the rainfall recharge and r_i be the associated rainfall. The subscript "i" takes values 1 to N where N is the number of years for which data is available. This should be at least 5. The rainfall recharge, R_i is obtained as per equation (6) & equation (7) depending on the sub-unit for which the normalization is being done.

After the pairs of data on R_i and r_i have been obtained as described above, a normalization procedure is to be carried out for obtaining the rainfall recharge corresponding to the normal monsoon season rainfall. Let r(normal) be the normal monsoon season rainfall obtained as the average of recent 30 to 50 years of monsoon season rainfall. Two methods are possible for the normalization procedure. The first method is based on a linear relationship between recharge and rainfall of the form

$$R = ar \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (8)$$

Where,

R =Rainfall recharge during monsoon season

r = Monsoon season rainfall

a = a constant

The computational procedure to be followed in the first method is as given below:

$$R_{RF}(Normal) = \frac{\sum_{i=1}^{N}[R_i \frac{r\,(Normal)}{ri}]}{N} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Where,

R_{RF} (normal) - Normalized Rainfall Recharge in the monsoon season,

R_i - Rainfall Recharge in the monsoon season for the i^{th} year

r(normal) - Normal monsoon season rainfall,

ri - Rainfall in the monsoon season for the ith year,

N - No. of years for which data is available.

The second method is also based on a linear relation between recharge and rainfall. However, thislinear relationship is of the form,

$R_{RF}(normal) = a \times r(normal) + b$ …… (10)

Where,

RF(normal) - Normalized Rainfall Recharge in the monsoon season

r(normal) - Normal monsoon season rainfall

a and b - constants.

The two constants 'a' and 'b' in the above equation are obtained through a linear regression analysis. The computational procedure to be followed in the second method is as given below:

$$a = \frac{NS_4 - S_1S_2}{NS_3 - S_1^2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

$$b = \frac{S_2 - aS_1}{N} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

Where,

$$S_1 = \sum_{i=1}^{N} r_i\,,\ S_2 = \sum_{i=1}^{N} r_i\,,\ S_3 = \sum_{i=1}^{N} r2_i\ ,\ S_4 = \sum_{i=1}^{N} R_1 r_i$$

2.1.1.2 Rainfall Infiltration Factor Method

The rainfall recharge estimation based on Water level fluctuation method reflects actual field conditions since it takes into account the response of ground water level. However, the ground waterextraction estimation included in the computation of rainfall recharge using water level fluctuation approach is often subject to uncertainties. Therefore, it is recommended to compare the rainfall recharge obtained from water level fluctuation approach with that estimated using rainfall infiltration factor method. Recharge from rainfall is estimated by using the following relationship –

$$= RFIF \times A \times \frac{R-a}{1000} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 13$$

Where,

A - Area in hectares

R_{RF} - Rainfall recharge in ham

RFIF - Rainfall Infiltration Factor

R - Rainfall in mm

a - Minimum threshold value above which rainfall induces ground Water recharge in mm

The threshold limit of minimum and maximum rainfall event which can induce recharge to the aquifer is to be considered while estimating ground water recharge using rainfall infiltration factor method. The minimum threshold limit is in accordance with the relation shown in equation (13) and the maximum threshold limit is based on the premise that after a certain limit, the rate of storm rain is too high to contribute to infiltration and they will only contribute to surface runoff. It is suggested that 10% of Normal annual rainfall may be taken as minimum rainfall threshold and 3000 mm as maximum rainfall limit. While computing the rainfall recharge, 10% of the normal annual rainfall is tobe deducted from the monsoon rainfall and balance rainfall would be considered for computation of rainfall recharge. The same recharge factor may be used for both monsoon and non-monsoon rainfall, with the condition that the recharge due to non-monsoon rainfall may be taken as zero, if the normal rainfall during the non-monsoon season is less than 10% of normal annual rainfall. In using the method based on the specified norms, recharge due to both monsoon and non-monsoon rainfall may be estimated for normal rainfall, based on recent 30 to 50 years of data.

2.1.1.3 Percent Deviation

After computing the rainfall recharge for normal monsoon season rainfall using the ground water level fluctuation method and rainfall infiltration factor method these two estimates have to be compared with each other. A term, Percent Deviation (PD) which is the difference between the two expressed as a percentage of the later is computed as

$$PD = \frac{R_R(\text{normal,wtfm}) - R_{RF}(\text{normal,rif m})}{R_{RF}(\text{normal,rif m})} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

Where,

R_{RF} (normal, wlfm) = Rainfall recharge for normal monsoon season rainfall estimated bythe ground water level fluctuation method

R_{RF} (normal, rifm) =Rainfall recharge for normal monsoon season rainfall estimated bythe rainfall infiltration factor method

The rainfall recharge for normal monsoon season rainfall is finally adopted as per the criteria givenbelow:

- If PD is greater than or equal to -20%, and less than or equal to +20%, R_{RF} (normal) is takenas the value estimated by the ground water level fluctuation method.
- If PD is less than -20%, R_{RF} (normal) is taken as equal to 0.8 times the value estimated by therainfall infiltration factor method.
- If PD is greater than +20%, R_{RF} (normal) is taken as equal to 1.2 times the value estimated bythe rainfall infiltration factor method.

2.1.2 Recharge from Other Sources

Recharge from other sources constitutes recharges from canals, surface water irrigation, ground water irrigation, tanks & ponds and water conservation structures in command areas where as in non-command areas it constitutes the recharge due to surface water irrigation, ground water irrigation, tanks & ponds and water conservation structures. The methods of estimation of recharge from different sources are as follows.

Table.2.1: Recharge from other sources formula

S N.	Source	Estimation Formula	Parameters
1	Recharge from Canals	$R_C = WA \times SF \times Days$	R_C = Recharge from CanalsWA = Wetted Area SF = Seepage Factor Days = Number of Canal Running Days
2	Recharge from Surface Water Irrigation	$R_{SWI} = AD \times Days \times RFF$	R_{SWI} = Recharge due to applied surface water irrigation AD = Average Discharge Days = Number of days' water is discharged to the Fields RFF = Return Flow Factor
3	Recharge from Ground Water Irrigation	$R_{GWI} = GE_{IRR} \times RFF$	R_{GWI} = Recharge due to applied ground water irrigation GE_{IRR} = Ground Water Extraction for Irrigation RFF = Return Flow Factor
4	Recharge dueto Tanks & Ponds	$R_{TP} = AWSA \times N \times RF$	R_{TP} = Recharge due to Tanks & PondsAWSA = Average Water Spread Area N = Number of days Water is available in the Tank/Pond RF = Recharge Factor

S N.	Source	Estimation Formula	Parameters
5	Recharge dueto Water Conservation Structures	$R_{WCS} = GS \times RF$	RWCS = Recharge due to Water Conservation Structures GS = Gross Storage = Storage Capacitymultiplied by number of fillings. RF = Recharge Factor

2.1.3 Evaporation and Transpiration

Evaporation can be estimated for the aquifer in the assessment unit if water levels in the aquifer are within the capillary zone. It is recommended to compute the evaporation through field studies. If field studies are not possible, for areas with water levels within 1.0mbgl, evaporation can be estimated using the evaporation rates available for other adjoining areas. If depth to water level is more than 1.0mbgl, the evaporation losses from the aquifer should be taken as zero.

Transpiration through vegetation can be estimated if water levels in the aquifer are within the maximum root zone of the local vegetation. It is recommended to compute the transpiration through field studies. Even though it varies from place to place depending on type of soil &vegetation, in the absence of field studies the following estimation can be followed. If water levels are within 3.5m bgl, transpiration can be estimated using the transpiration rates available for other areas. If it is greater than 3.5m bgl, the transpiration should be taken as zero.

For estimating evapotranspiration, field tools like Lysimeters can be used to estimate actual evapotranspiration. Usually agricultural universities and IMD carry out lysimeter experiments and archive the evapotranspiration data. Remote sensing based techniques like SEBAL (Surface Energy Balance Algorithm for Land) can be used for estimation of actual evapotranspiration. Assessing offices may apply available lysimeter data or other techniques for estimation of evapotranspiration. In case where such data is not available, evapotranspiration losses can be empirically estimated fromPET data provided by IMD.

2.1.4 Recharge during Monsoon Season

The sum of normalized monsoon rainfall recharge and the recharge from other sources and lateral and vertical flows into & out of the sub unit and stream inflows & outflows during monsoon seasonis the total recharge/ accumulation during monsoon season for the sub unit. Similarly, this is to be computed for all the sub units available in the assessment unit.

2.1.5 Recharge during Non-Monsoon Season

The rainfall recharge during non-monsoon season is estimated using rainfall infiltration factor Method only when the non-monsoon season rainfall is more than 10% of normal annual rainfall. Thesum of non-monsoon rainfall recharge and the recharge from other sources and lateral and vertical flows into & out of the sub unit and stream inflows & outflows during non-monsoon season is the total recharge/ accumulation during non-monsoon season for the sub unit. Similarly, this is to be computed for all the sub units available in the assessment unit.

2.1.6 Total Annual Ground Water Recharge

The sum of the recharge/ accumulations during monsoon and non-monsoon seasons is the total annual ground water recharge/ accumulations for the sub unit. Similarly, this is to be computed for all the sub units available in the assessment unit.

2.1.7 Annual Extractable Ground Water Resource (EGR)

The Annual Extractable Ground Water Resource (EGR) is computed by deducting the Total Annual Natural Discharge from Total Annual Ground Water Recharge.

The ground water base flow contribution limited to the ecological flow of the river should be determined which will be deducted from Annual Ground Water Recharge to determine Annual Extractable Ground Water Resources (EGR). The ecological flows of the rivers are to be determinedin consultation with Central Water Commission and other concerned river basin agencies. In case base flow contribution to the ecological flow of rivers is not determined then following assumptionis to be followed.

In the water level fluctuation method, a significant portion of base flow is already accounted for by taking the post monsoon water level one month after the end of rainfall. The base flow in the remaining non-monsoon period is likely to be small, especially in hard rock areas. In the assessment units, where river stage data are not available and neither the detailed data for quantitative assessment of the natural discharge are available, present practice (GEC 1997) of allocation of unaccountable natural discharges to 5% or 10% of annual recharge may be retained. If the rainfall recharge is assessed using water level fluctuation method this will be 5% of the annual recharge and if it is assessed using rainfall infiltration factor method, it will be 10% of the annual recharge. The balance will account for Annual Extractable Ground Water Resources (EGR).

2.1.8 Estimation of Ground Water Extraction

Ground water draft or extraction is to be assessed as follows.

$$GE_{ALL} = GE_{IRR} + GE_{DO} + GE_{IND} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \quad (15)$$

Where,

GE_{ALL} = Ground water extraction for all uses

GE_{IRR} = Ground water extraction for irrigation

GE_{DOM} = Ground water extraction for domestic uses

GE_{IND} = Ground water extraction for industrial uses

2.1.8.1 Ground Water Extraction for Irrigation (GE_{IRR})

The methods for estimation of ground water extraction are as follows.

***Unit Draft Method:* –** In this method, season-wise unit draft of each type of well in an assessment unit is estimated. The unit draft of different types (eg. Dug well, dug cum bore well, shallow tube well, deep tube well, bore well etc.) is multiplied with the number of wells of that particular type to obtain season-wise ground water extraction by that particular structure.

***Crop Water Requirement Method:* –** For each crop, the season-wise net irrigation water requirement is determined. This is then multiplied with the area irrigated by ground water abstraction structures. The database on crop area is obtained from Revenue records in Tehsil office, Agriculture Census and also by using Remote Sensing techniques.

***Power Consumption Method:* –**Ground water extraction for unit power consumption (electric) is determined. Extraction per unit power consumption is then multiplied with number of units of power consumed for agricultural pump sets to obtain total ground water extraction for irrigation.

2.1.8.2 Ground Water Extraction for Domestic Use (GEDOM)

There are several methods for estimation of extraction for domestic use (GEDOM). Some of the commonly adopted methods are described here.

***Unit Draft Method:* –** In this method, unit draft of each type of well is multiplied by the number of wells used for domestic purpose to obtain the domestic ground water extraction.

***Consumptive Use Method:* –** In this method, population is multiplied with per capita consumption usually expressed in litre per capita per day (lpcd). It can be expressed using following equation.

$G_{DO} = Population \times Consumptive\ Requirement \times Lg$ ..... (16)

Where,

L_g = Fractional Load on Ground Water for Domestic Water Supply.

The Load on Ground water can be obtained from the Information based on Civic water supply agencies in urban areas.

2.1.8.3 Ground Water Extraction for Industrial Use (GEIND)

The commonly adopted methods for estimating the extraction for industrial use are as below:

***Unit Draft Method*: -** In this method, unit draft of each type of well is multiplied by the number of wells used for industrial purpose to obtain the industrial ground water extraction.

Consumptive Use Pattern Method: – In this method, water consumption of different industrial units is determined. Numbers of Industrial units which are dependent on ground water are multiplied with unit water consumption to obtain ground water extraction for industrial use.

$$GE_{IND} = Number\ of\ Industrial\ Units \times Unit\ Water\ Consumption \times L_g \quad \ldots\ldots\ldots\ldots\ldots (17)$$

Where,

L_g = Fractional load on ground water for industrial water supply.

The load on ground water for industrial water supply can be obtained from water supply agencies in the Industrial belt.

Ground water extraction obtained from different methods need to be compared and based on field checks, the seemingly best value may be adopted. At times, ground water extraction obtained by different methods may vary widely. In such cases, the value matching the field situation should be considered. The storage depletion during a season, where other recharges are negligible can betaken as ground water extraction during that particular period.

2.1.9 Stage of Ground Water Extraction

The stage of ground water extraction is defined by.

$$\text{Stage of GW Extraction} = \frac{\text{Existing Gross GW Extraction for all Uses}}{\text{Annual Extractable GW Resources}} \times 100 \ldots\ldots\ldots (18)$$

The existing gross ground water extraction for all uses refers to the total of existing gross ground water extraction for irrigation and all other purposes. The stage of ground water extraction shouldbe obtained separately for command areas, non-command areas and poor ground water quality areas.

2.1.10 Validation of Stage of Ground Water Extraction

The assessment based on the stage of ground water extraction has inherent uncertainties. In view ofthis, it is desirable to validate the 'Stage of Ground Water Extraction' with long term trend of ground water levels.

Long term Water Level trends are prepared for a minimum period of 10 years for both pre-monsoon and post-monsoon period. If the ground water resource assessment and the trend of long term water levels contradict each other, this anomalous situation requires a review of the ground water resource computation, as well as the reliability of water level data. The mismatch conditions are enumerated below.

Table.2.2: Validation of Stage of Ground Water Extraction

Stage of GW Extraction	Ground Water Level Trend	Remarks
≤ 70%	Significant decline in both pre monsoon and post-monsoon long term trend.	Not acceptable and needs reassessment
> 100%	No significant decline in both pre-monsoon and post-monsoon long term trend.	Not acceptable and needs reassessment

2.1.11 Categorization of Assessment Unit

As emphasized in the National Water Policy, 2012, a convergence of Quantity and Quality of ground water resources is required while assessing the ground water status in an assessment unit. Therefore, it is recommended to separate estimation of resources where water quality is beyond permissible limits for the parameter salinity.

2.1.12 Categorization of Assessment Unit

The categorization based on status of ground water quantity is defined by Stage of Ground Water Extraction as given below:

Table.2.3: Categorization of Assessment Unit

Stage of Ground Water Extraction	Category
≤ 70%	Safe
> 70% and ≤90%	Semi-critical
> 90% and ≤100%	Critical
> 100%	Over Exploited

2.1.13 Allocation of Ground Water Resource for Utilization

The Annual Extractable Ground Water Resources are to be apportioned between domestic, industrial and irrigation uses. Among these, as per the National Water Policy, requirement for domestic water supply is to be accorded priority. This requirement has to be based on population as projected to the year 2025, per capita requirement of water for domestic use, and relative load on ground water for urban and rural water supply. In situations where adequate data is not available to make this estimate, the following empirical relation is recommended.

$$Alloc = 22 \times N \times L_g \ mm\ per\ year \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (19)$$

Where,

Alloc = Allocation for domestic water requirement

N = population density in the unit in thousands per sq. km.

L_g = fractional load on ground water for domestic water supply (≤ 1.0)

In deriving equation (19), it is assumed that the requirement of water for domestic use is 60 lpd per head. The equation can be suitably modified in case per capita requirement is different. If by chance, the estimation of projected allocation for future domestic needs is less than the current domestic extraction due to any reason, the allocation must be equal to the present day extraction. It cannever be less than the present day extraction as it is unrealistic.

2.1.14 Net Annual Ground Water Availability for Future Use

The water available for future use is obtained by deducting the allocation for domestic use and current extraction for Irrigation and Industrial uses from the Annual Extractable Ground Water Recharge. The resulting ground water potential is termed as the net annual ground water availabilityfor future use. The Net annual ground water availability for future use should be calculated separately for non-command areas and command areas. As per the recommendations of the R&D Advisory committee, the ground water available for future use can never be negative. If it becomes negative, the future allocation of Domestic needs can be reduced to current extraction for domestic use. Even then if it is still negative, then the ground water available for future uses will be zero.

2.2 GROUND WATER ASSESSMENT URBAN AREAS

The Assessment of Ground Water Resources in urban areas is similar to that of rural areas. Because of the availability of draft data and slightly different infiltration process and recharge due to other sources, the following few points are to be considered.

- Even though the data on existing ground water abstraction structures are available, accuracyis somewhat doubtful and individuals cannot even enumerate the well census in urban areas. Hence it is recommended to use the difference of the actual demand and the supply by surface water sources as the withdrawal from the ground water resources.
- The urban areas are sometimes concrete jungles and rainfall infiltration is not equal to that of rural areas unless and until special measures are taken in the construction of roads and pavements. Hence, it is proposed to use 30% of the rainfall infiltration factor proposed for urban areas as an adhoc arrangement till field studies in these areas are done and documented field studies are available.
- Because of the water supply schemes, there are many pipelines available in the urban areas and the seepages from these channels or pipes are huge in some areas. Hence this component is also to be included in the other resources and the recharge may be estimated. The percent losses may be collected from the individual water supply agencies, 50% of whichcan be taken as recharge to the ground water system.

- In the urban areas in India, normally, there is no separate channels either open or sub surface for the drainage and flash floods. These channels also recharge to some extent the ground water reservoir. As on today, there is no documented field study to assess the recharge. The seepages from the sewerages, which normally contaminate the ground water resources with nitrate also contribute to the quantity of resources and hence same percent as in the case of water supply pipes may be taken as norm for the recharge on the quantityof sewerage when there is sub surface drainage system. If estimated flash flood data is available, the same percent can be used on the quantum of flash floods to estimate the recharge from the flash floods. Even when the drainage system is open channels, till further documented field studies are done same procedure may be followed.
- It is proposed to have a separate ground water assessment for urban areas with population more than 10 lakhs.
- Wherever, the pre monsoon and post monsoon water levels are above mean sea level the dynamic component of the estimation will be same as other areas.
- If both these water levels are below sea level, the dynamic component should be taken as zero.
- Wherever, the post monsoon water table is above sea level and pre monsoon water table is below sea level the pre monsoon water table should be taken as at sea level and fluctuation is to be computed.
- The static or in storage resources are to be restricted to the minimum of 40 times the pre monsoon water table or the bottom of the aquifer.

2.3 NORMS TO BE USED IN THE ASSESSMENT

The committee recommends that the state agencies should be encouraged to conduct field studies and use these computed norms in the assessment. For conducting field studies, it is recommended to follow the field-tested procedures for computing the norms. There is the possibility of error creeping in at various levels in the field study and hence the committee is of the opinion to give a maximum and minimum values for all the norms used in the estimation. The committee can foresee the handicap of the state agencies which are not able to compute the norms by their own field study. In such cases, it suggests an average of the range of norms to be used as the recommended value for the norm.

2.3.1 Specific Yield

Recently under Aquifer Mapping Project, Central Ground Water Board has classified all the aquifers into 16 Principal Aquifers which in turn were divided into 42 Major Aquifers. Hence, it is required to assign Specific Yield values to all these aquifer units. The values recommended in the **Table 2.4** may be followed in the future assessments. The Major aquifer map can be obtained from Regional officesof Central Ground Water Board.

The recommended Specific Yield values are to be used for assessment, unless sufficient data based on field studies are available to justify the minimum, maximum or other intermediate values. The Norms suggested below are nothing but the redistribution of norms suggested by GEC-1997 methodology and hence people are encouraged to conduct field studies and strengthen the Norms database.

Table 2.4: Norms Recommended for Specific Yield

S.N.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Min (%)	Max (%)
		Code	Name				
1	Alluvium	AL01	Younger Alluvium (Clay/Silt/Sand/Calcareous concretions)	Quaternary	10	8	12
2	Alluvium	AL02	Pebble / Gravel/ Bazada/Kandi	Quaternary	16	12	20
3	Alluvium	AL03	Older Alluvium (Silt/Sand/Gravel/Lithomargic clay)	Quaternary	6	4	8
4	Alluvium	AL04	Aeolian Alluvium (Silt/ Sand)	Quaternary	16	12	20
5	Alluvium	AL05	Coastal Alluvium (Sand/Silt/Clay)	Quaternary	10	8	12
6	Alluvium	AL06	Valley Fills	Quaternary	16	12	20
7	Alluvium	AL07	Glacial Deposits	Quaternary	16	12	20
8	Laterite	LT01	Laterite / Ferruginous concretions	Quaternary	2.5	2	3
9	Basalt	BS01	Basic Rocks (Basalt) - Weathered, Vesicular or Jointed	Mesozoic to Cenozoic	2	1	3
10	Basalt	BS01	Basic Rocks (Basalt) - Massive, Poorly Jointed	Mesozoic to Cenozoic	0.35	0.2	0.5
11	Basalt	BS02	Ultra Basic - Weathered, Vesicular or Jointed	Mesozoic to Cenozoic	2	1	3
12	Basalt	BS02	Ultra Basic - Massive Poorly Jointed	Mesozoic to Cenozoic	0.35	0.2	0.5

S.N.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Min (%)	Max (%)
		Code	Name				
13	Sandstone	ST01	Sandstone/Conglomerate	Upper Palaeozoic to Cenozoic	3	1	5
14	Sandstone	ST02	Sandstone with Shale	Upper Palaeozoic to Cenozoic	3	1	5
15	Sandstone	ST03	Sandstone with shale/ coal beds	Upper Palaeozoic to Cenozoic	3	1	5
16	Sandstone	ST04	Sandstone with Clay	Upper Palaeozoic to Cenozoic	3	1	5
17	Sandstone	ST05	Sandstone/Conglomerate	Proterozoic to Cenozoic	3	1	5
18	Sandstone	ST06	Sandstone with Shale	Proterozoic to Cenozoic	3	1	5
19	Shale	SH01	Shale with limestone	Upper Palaeozoic to Cenozoic	1.5	1	2
20	Shale	SH02	Shale with Sandstone	Upper Palaeozoic to Cenozoic	1.5	1	2
21	Shale	SH03	Shale, limestone and sandstone	Upper Palaeozoic to Cenozoic	1.5	1	2
22	Shale	SH04	Shale	Upper Palaeozoic to Cenozoic	1.5	1	2
23	Shale	SH05	Shale/Shale with Sandstone	Proterozoic to Cenozoic	1.5	1	2
24	Shale	SH06	Shale with Limestone	Proterozoic to Cenozoic	1.5	1	2
25	Limestone	LS01	Miliolitic Limestone	Quarternary	2	1	3
26	Limestone	LS01	Karstified Miliolitic Limestone	Quarternary	10	5	15
27	Limestone	LS02	Limestone / Dolomite	Upper Palaeozoic to Cenozoic	2	1	3
28	Limestone	LS02	Karstified Limestone / Dolomite	Upper Palaeozoic to Cenozoic	10	5	15
29	Limestone	LS03	Limestone/Dolomite	Proterozoic	2	1	3
	Limestone	LS03	Karstified Limestone/Dolomite	Proterozoic	10	5	15

S.N.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Min (%)	Max (%)
		Code	Name				
31	Limestone	LS04	Limestone with Shale	Proterozoic	2	1	3
32	Limestone	LS04	Karstified Limestone with Shale	Proterozoic	10	5	15
33	Limestone	LS05	Marble	Azoic to Proterozoic	2	1	3
34	Limestone	LS05	Karstified Marble	Azoic to Proterozoic	10	5	15
35	Granite	GR01	Acidic Rocks (Granite, Syenite, Rhyolite etc.) - Weathered, Jointed	Mesozoic to Cenozoic	1.5	1	2
36	Granite	GR01	Acidic Rocks (Granite, Syenite, Rhyolite etc.)- Massive or Poorly Fractured	Mesozoic to Cenozoic	0.35	0.2	0.5
37	Granite	GR02	Granite, Syenite, Rhyolite etc.) - Weathered, Jointed	Proterozoic to Cenozoic	3	2	4
38	Granite	GR02	Acidic Rocks (Pegmatite, Granite, Syenite, Rhyolite etc.) - Massive, Poorly Fractured	Proterozoic to Cenozoic	0.35	0.2	0.5
39	Schist	SC01	Schist - Weathered, Jointed	Azoic to Proterozoic	1.5	1	2
40	Schist	SC01	Schist - Massive, Poorly Fractured	Azoic to Proterozoic	0.35	0.2	0.5
41	Schist	SC02	Phyllite	Azoic to Proterozoic	1.5	1	2
42	Schist	SC03	Slate	Azoic to Proterozoic	1.5	1	2
43	Quartzite	QZ01	Quartzite - Weathered, Jointed	Proterozoic to Cenozoic	1.5	1	2
44	Quartzite	QZ01	Quartzite - Massive, Poorly Fractured	Proterozoic to Cenozoic	0.3	0.2	0.4
45	Quartzite	QZ02	Quartzite - Weathered, Jointed	Azoic to Proterozoic	1.5	1	2
46	Quartzite	QZ02	Quartzite- Massive, Poorly Fractured	Azoic to Proterozoic	0.3	0.2	0.4
47	Charnockite	CK01	Charnockite - Weathered, Jointed	Azoic	3	2	4
48	Charnockite	CK01	Charnockite - Massive, Poorly Fractured	Azoic	0.3	0.2	0.4
49	Khondalite	KH01	Khondalites, Granulites - Weathered, Jointed	Azoic	1.5	1	2

S.N.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Min (%)	Max (%)
		Code	Name				
50	Khondalite	KH01	Khondalites, Granulites - Massive, Poorly Fractured	Azoic	0.3	0.2	0.4
51	Banded Gneissic Complex	BG01	Banded Gneissic Complex - Weathered, Jointed	Azoic	1.5	1	2
52	Banded Gneissic Complex	BG01	Banded Gneissic Complex - Massive, Poorly Fractured	Azoic	0.3	0.2	0.4
53	Gneiss	GN01	Undifferentiated metasedimentaries/ Undifferentiated metamorphic - Weathered, Jointed	Azoic to Proterozoic	1.5	1	2
54	Gneiss	GN01	Undifferentiated metasedimentaries/ Undifferentiated metamorphic - Massive, Poorly Fractured	Azoic to Proterozoic	0.3	0.2	0.4
55	Gneiss	GN02	Gneiss -Weathered, Jointed	Azoic to Proterozoic	3	2	4
56	Gneiss	GN02	Gneiss-Massive, Poorly Fractured	Azoic to Proterozoic	0.3	0.2	0.4
57	Gneiss	GN03	Migmatitic Gneiss - Weathered, Jointed	Azoic	1.5	1	2
58	Gneiss	GN03	Migmatitic Gneiss - Massive, Poorly Fractured	Azoic	0.3	0.2	0.4
59	Intrusive	IN01	Basic Rocks (Dolerite, Anorthosite etc.)- Weathered, Jointed	Proterozoic to Cenozoic	2	1	3
60	Intrusive	IN01	Basic Rocks (Dolerite, Anorthosite etc.) - Massive, Poorly Fractured	Proterozoic to Cenozoic	0.35	0.2	0.5
61	Intrusive	IN02	Ultrabasics (Epidiorite, Granophyre etc.)- Weathered, Jointed	Proterozoic to Cenozoic	2	1	3
62	Intrusive	IN02	Ultrabasics (Epidiorite, Granophyre etc.) - Massive, Poorly Fractured	Proterozoic to Cenozoic	0.35	0.2	0.5

2.3.2 Rainfall Infiltration Factor

It is recommended that to assign Rainfall Infiltration Factor values to all the aquifer units recently classified by the Central Ground Water Board. The values recommended in **Table 2.5** may be followed in the future assessments. The recommended Rainfall Infiltration Factor values are to be used for assessment, unless sufficient data based on field studies are available to justify the minimum, maximum or other intermediate values.

An additional 2% of rainfall recharge factor may be used in such areas or parts of the areas where watershed development with associated soil conservation measures are implemented. This additional factor is subjective and is separate from the contribution due to the water conservation structures such as check dams, nalla bunds, percolation tanks etc. The norms for the estimation of recharge due to these structures are provided separately. This additional factor of 2% is at this stage,only provisional, and will need revision based on pilot studies.

The Norms suggested below are nothing but the redistribution of norms suggested by GEC-1997 methodology and hence people are encouraged to conduct field studies and strengthen the Norms database.

Table 2.5: Norms Recommended for Rainfall Infiltration Factor

S.N.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
1	Alluvium	AL01	Younger Alluvium (Clay/Silt/Sand/ Calcareous concretions)	Quaternary	22	20	24
2	Alluvium	AL02	Pebble / Gravel/ Bazada/ Kandi	Quaternary	22	20	24
3	Alluvium	AL03	Older Alluvium (Silt/Sand/Gravel/Lithomargic clay)	Quaternary	22	20	24
4	Alluvium	AL04	Aeolian Alluvium (Silt/ Sand)	Quaternary	22	20	24
5	Alluvium	AL05	Coastal Alluvium (Sand/Silt/Clay) -East Coast	Quaternary	16	14	18
5	Alluvium	AL05	Coastal Alluvium (Sand/Silt/Clay) - West Coast	Quaternary	10	8	12
6	Alluvium	AL06	Valley Fills	Quaternary	22	20	24
7	Alluvium	AL07	Glacial Deposits	Quaternary	22	20	24
8	Laterite	LT01	Laterite / Ferruginous concretions	Quaternary	7	6	8
9	Basalt	BS01	Basic Rocks (Basalt) - Vesicular or Jointed	Mesozoic to Cenozoic	13	12	14
9	Basalt	BS01	Basic Rocks (Basalt) - Weathered	Mesozoic to Cenozoic	7	6	8
10	Basalt	BS01	Basic Rocks (Basalt) - Massive Poorly Jointed	Mesozoic to Cenozoic	2	1	3
11	Basalt	BS02	Ultra Basic - Vesicular or Jointed	Mesozoic to Cenozoic	13	12	14
11	Basalt	BS02	Ultra Basic - Weathered	Mesozoic to Cenozoic	7	6	8

S.N.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
12	Basalt	BS02	Ultra Basic - Massive Poorly Jointed	Mesozoic to Cenozoic	2	1	3
13	Sandstone	ST01	Sandstone/Conglomerate	Upper Palaeozoic to Cenozoic	12	10	14
14	Sandstone	ST02	Sandstone with Shale	Upper Palaeozoic to Cenozoic	12	10	14
15	Sandstone	ST03	Sandstone with shale/ coal beds	Upper Palaeozoic to Cenozoic	12	10	14
16	Sandstone	ST04	Sandstone with Clay	Upper Palaeozoic to Cenozoic	12	10	14
17	Sandstone	ST05	Sandstone/Conglomerate	Proterozoic to Cenozoic	6	5	7
18	Sandstone	ST06	Sandstone with Shale	Proterozoic to Cenozoic	6	5	7
19	Shale	SH01	Shale with limestone	Upper Palaeozoic to Cenozoic	4	3	5
20	Shale	SH02	Shale with Sandstone	Upper Palaeozoic to Cenozoic	4	3	5
21	Shale	SH03	Shale, limestone and sandstone	Upper Palaeozoic to Cenozoic	4	3	5
22	Shale	SH04	Shale	Upper Palaeozoic to Cenozoic	4	3	5
23	Shale	SH05	Shale/Shale with Sandstone	Proterozoic to Cenozoic	4	3	5
24	Shale	SH06	Shale with Limestone	Proterozoic to Cenozoic	4	3	5
25	Limestone	LS01	Miliolitic Limestone	Quarternary	6	5	7
27	Limestone	LS02	Limestone / Dolomite	Upper Palaeozoic to Cenozoic	6	5	7
29	Limestone	LS03	Limestone/Dolomite	Proterozoic	6	5	7
31	Limestone	LS04	Limestone with Shale	Proterozoic	6	5	7
33	Limestone	LS05	Marble	Azoic to Proterozoic	6	5	7
35	Granite	GR01	Acidic Rocks (Granite,Syenite, Rhyolite etc.) - Weathered , Jointed	Mesozoic to Cenozoic	7	5	9
36	Granite	GR01	Acidic Rocks (Granite, Syenite, Rhyolite etc.)-Massive or Poorly Fractured	Mesozoic to Cenozoic	2	1	3
37	Granite	GR02	Acidic Rocks (Pegmatite, Granite, Syenite, Rhyolite etc.) - Weathered, Jointed	Proterozoic to Cenozoic	11	10	12
38	Granite	GR02	Acidic Rocks (Pegmatite, Granite, Syenite, Rhyolite etc.) - Massive, Poorly Fractured	Proterozoic to Cenozoic	2	1	3
39	Schist	SC01	Schist - Weathered, Jointed	Azoic to Proterozoic	7	5	9
40	Schist	SC01	Schist - Massive, Poorly Fractured	Azoic to Proterozoic	2	1	3
41	Schist	SC02	Phyllite	Azoic to Proterozoic	4	3	5
42	Schist	SC03	Slate	Azoic to Proterozoic	4	3	5
43	Quartzite	QZ01	Quartzite - Weathered, Jointed	Proterozoic to Cenozoic	6	5	7

S.N.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
44	Quartzite	QZ01	Quartzite - Massive, Poorly Fractured	Proterozoic to Cenozoic	2	1	3
45	Quartzite	QZ02	Quartzite - Weathered, Jointed	Azoic to Proterozoic	6	5	7
46	Quartzite	QZ02	Quartzite- Massive, Poorly Fractured	Azoic to Proterozoic	2	1	3
47	Charnockite	CK01	Charnockite - Weathered, Jointed	Azoic	5	4	6
48	Charnockite	CK01	Charnockite - Massive, Poorly Fractured	Azoic	2	1	3
49	Khondalite	KH01	Khondalites, Granulites - Weathered, Jointed	Azoic	7	5	9
50	Khondalite	KH01	Khondalites, Granulites - Mssive, Poorly Fractured	Azoic	2	1	3
51	Banded Gneissic Complex	BG01	Banded Gneissic Complex - Weathered, Jointed	Azoic	7	5	9
52	Banded Gneissic Complex	BG01	Banded Gneissic Complex - Massive, Poorly Fractured	Azoic	2	1	3
53	Gneiss	GN01	Undifferentiated metasedimentaries/ Undifferentiated metamorphic - Weathered, Jointed	Azoic to Proterozoic	7	5	9
54	Gneiss	GN01	Undifferentiated metasedimentaries/ Undifferentiated metamorphic - Massive, Poorly Fractured	Azoic to Proterozoic	2	1	3
55	Gneiss	GN02	Gneiss -Weathered, Jointed	Azoic to Proterozoic	11	10	12
56	Gneiss	GN02	Gneiss-Massive, Poorly Fractured	Azoic to Proterozoic	2	1	3
57	Gneiss	GN03	Migmatitic Gneiss - Weathered, Jointed	Azoic	7	5	9
58	Gneiss	GN03	Migmatitic Gneiss - Massive, Poorly Fractured	Azoic	2	1	3
59	Intrusive	IN01	Basic Rocks (Dolerite, Anorthosite etc.) - Weathered, Jointed	Proterozoic to Cenozoic	7	6	8
60	Intrusive	IN01	Basic Rocks (Dolerite, Anorthosite etc.) - Massive, Poorly Fractured	Proterozoic to Cenozoic	2	1	3
61	Intrusive	IN02	Ulrta Basics (Epidiorite, Granophyre etc.) - Weathered, Jointed	Proterozoic to Cenozoic	7	6	8
62	Intrusive	IN02	Ulrta Basics (Epidiorite, Granophyre etc.) - Massive, Poorly Fractured	Proterozoic to Cenozoic	2	1	3

2.3.3: Norms for Canal Recharge

Unlike other norms, the Recharge factor for calculating recharge due to canals is given in two units viz. ham/million m^2 of wetted area/day and cumecs per million m^2 of wetted area. As all

other norms are in ham, the committee recommends the norm in ham/million m^2 of wetted area for computing the recharge due to canals.

There is a wide variation in the values of the recharge norms proposed by GEC 1997.The Canal seepage norm is approximately 150 times the other recharge norms. In the absence of any field studies to refine the norms it is decided by the committee to continue with the same norms. The committee strongly recommends that each state agency must conduct one filed study at least one in each district before completing the first assessment using this methodology. The committee also suggests a recommended value and minimum and maximum values as in the case of other norms. Where specific results are available from case studies in some states, the adhoc norms are to be replaced by norms evolved from these results.

The Norms suggested in **Table 2.6** below are nothing but the rationalization and redistribution of norms suggested by GEC-1997 methodology and hence people are encouraged to conduct field studies and strengthen the Norms database.

Table 2.6: Norms Recommended for Recharge due to Canals

Formation	Canal Seepage factor (ham/day/million square meters of wetted area)		
	Recommended	Minimum	Maximum
Unlined canals in normal soils with some clay content along with sand	17.5	15	20
Unlined canals in sandy soil with some silt content	27.5	25	30
Lined canals in normal soils with some clay content along with sand	3.5	3	4
Lined canals in sandy soil with some silt content	5.5	5	6
All canals in hard rock area	3.5	3	4

2.3.4 Norms for Recharge Due to Irrigation

The Norms Suggested by GEC-1997 gives for only three ranges of water levels and it creates a problem in the boundary conditions. For instance, as a result of the variation in water level from 24.9 to 25.1m bgl in the adjoining blocks, change occurs in the return flow from irrigation in the range of 10% to 15%. Hence to reduce the discrepancy it is recommended to have linear relationship of the norms in between 10m bgl water level and 25m bgl water level. It is proposed to have the same norm of 10m bgl zone for all the water levels less than 10m. Similarly, the norm recommended for 25m may be used for the water levels more than 25m as well. The Recommended Norms are presented in **Table 2.7**.

For surface water, the recharge is to be estimated based on water released at the outlet. For

ground water, the recharge is to be estimated based on gross draft. Where continuous supply is used instead of rotational supply, an additional recharge of 5% of application may be used. Where specific results are available from case studies in some states, the adhoc norms are to be replaced by norms evolved from these results.

Table 2.7: Norms Recommended for Recharge from Irrigation

DTW m bgl	Ground Water		Surface Water	
	Paddy	Non-paddy	Paddy	Non-paddy
≤ 10	45.0	25.0	50.0	30.0
11	43.3	23.7	48.3	28.7
12	40.4	22.1	45.1	26.8
13	37.7	20.6	42.1	25.0
14	35.2	19.2	39.3	23.3
15	32.9	17.9	36.7	21.7
16	30.7	16.7	34.3	20.3
17	28.7	15.6	32.0	18.9
18	26.8	14.6	29.9	17.6
19	25.0	13.6	27.9	16.4
20	23.3	12.7	26.0	15.3
21	21.7	11.9	24.3	14.3
22	20.3	11.1	22.7	13.3
23	18.9	10.4	21.2	12.4
24	17.6	9.7	19.8	11.6
≥ 25	20.0	5.0	25.0	10.0

2.3.5 Norms for Recharge due to Tanks & Ponds

As the data on the field studies for computing recharge from Tanks & Ponds are very limited, it is recommended to follow the same norm as followed in GEC 1997 in future assessments also. Hence the norm recommended by GEC-2015 for Seepage from Tanks & Ponds is 1.4 mm / day.

2.3.6 Norms for Recharge due to Water Conservation Structures

Even though the data on the field studies for computing recharge from Water Conservation Structures are very limited, it is recommended that the Recharge from the water conservation structures is 40% of the Gross Storage based on the field studies by Non-Government Organizations. Hence, the norm recommended by GEC-2015 for the seepage from Water Conservation Structures is 40% of gross storage during a year which means 20% during monsoon season and 20% during non- monsoon Season.

2.3.7 Norm for Per Capita Requirement

As the option is given to use the actual requirement for domestic needs, the Requirement Norm recommended by the committee is 60 lpcd for domestic needs. This can be modified if the actual requirement is known.

2.3.8 Norm for Natural Discharges

The Discharge Norm used in computing Unaccounted Natural Discharge is 5% if water table fluctuation method is used or 10% if rainfall infiltration factor method is used for assessing the Rainfall recharge. This committee recommends to compute the base flow for each assessment unit. Wherever, there is no assessment of base flow, earlier norms recommended by GEC 1997 i.e. 5% or 10% of the Total Annual Ground Water Recharge as the Natural Discharges may be continued.

2.4 UNIT DRAFT

GEC-1997 methodology recommends to use well census method for computing the ground water draft. The norm used for computing ground water draft is the unit draft. The unit draft can be computed by field studies. This method involves selecting representative abstraction structure and calculating the discharge from that particular type of structure and collecting the information onhow many hours of pumping is being done in various seasons and number of such days during each season. The Unit Draft during a particular season can be computed using the following equation:

$$Unit\ Draft = Discharge\ in\ m^3/hr \times No.\ of\ pumping\ hours\ in\ a\ day \times No.\ of \quad \ldots (29)$$

One basic drawback in the methodology of computing unit draft is that there is no normalization procedure for the same. As per GEC-1997 guidelines, the recharge from rainfall is normalized for a normal rainfall. It means that even though the resources are estimated in a surplus rainfall year or in a deficit rainfall year, the assessment is normalised for a normal rainfall which is required for planning. For recharge from other sources, average figures/ values are taken. If the average figures are not available for any reason, 60% of the design figures are taken. This procedure is very much essential as the planning should be for average resources rather than for the recharge due to excess rainfall or deficit rainfall. But the procedure that is being followed for computing unit draft does not have any normalization procedure. Normally, if the year in which one collects the draft data in the field is an excess rainfall year, the abstraction from ground water will be less. Similarly, if the year of the computation of unit draft is a drought year the unit draft will be high. Hence, there is a requirement to devise a methodology that can be used for the normalization of unit draft figures. The following are the two simple techniques, which can be followed. If the unit draft values for one rainfall cycle are available for at least

10 years second method shown in equation 31 is to be followed or else the first method shown in equation 30 may be used.

$$Normalised\ Unit\ Draft = \frac{\text{Unit Draft} \times \text{Rainfall for the year}}{\text{Normal Rainfall}} \quad \text{.....(30)}$$

$$\text{Normalised Unit Draft} = \frac{-b \sum_{i=1}^{n} \text{Unit Draft}_i}{Number\ of\ Years} \quad \text{..... (31)}$$

Although GEC-1997 methodology recommends a default value for the unit drafts, each State is using its own values, generally after conducting field studies, even though without a documentation. Hence, it is felt that this norm may be computed by the state agency, which is going to assess the norms before commencement of the assessment. But it is strongly recommended that the field studies should be documented and submitted along with the results of the assessment.

2.5 INDIA -GROUNDWATER RESOURCE ESTIMATION SYSTEM (IN-GRES)

"INDIA-GROUNDWATER RESOURCE ESTIMATION SYSTEM (IN-GRES) is a Software/Web-based Application developed by CGWB in collaboration with IIT-Hyderabad. It will provide common and standardized platform for Ground Water Resource Estimation for the entire country and its pan- India operationalization (Central and State Governments). The system will take 'Data Input' through Excel as well as Forms, compute various ground water components (recharge, extraction etc.) and classify assessment units into appropriate categories (safe, semi-critical, critical and over-exploited). The Software uses GEC 2015 Methodology for estimation and calculation of Groundwater resources. It allows for unique and homogeneous representation of groundwater fluxes as well as categories for all the assessment units (AU) of the country.

URL of IN-GRES □http://ingres.iith.ac.in

CHAPTER 3

3.0 BACKGROUND

Madhya Pradesh is located in the central part of India or metaphorically, the heart of India. The State of Madhya Pradesh is a land-locked State, bordered on the west by Gujarat, on the northwest by Rajasthan, on the northeast by Uttar Pradesh, on the east by Chhattisgarh, and on the south by Maharashtra **(Fig 3.1)**. It has a geographical area of 3,08,252 Sq. km. and is situated between north latitudes 21° 04' and 26° 54' and east longitudes 74° 00' and 82° 50'. There are 52 districts and 313 Community Development blocks in Madhya Pradesh. The population of state as per census 2011 is 7.27 crores with a population density of 236 persons per sq.km area. Out of total population, 72.37% is rural. The important urban areas in the State are Bhopal, Indore, Jabalpur, and Gwalior.

Madhya Pradesh comprises several linguistically and culturally distinct regions, of which the major regions are:

- Malwa - A plateau region in the northwest of the state, north of the Vindhya Range, with its distinct language and culture. Indore is the major city of the region, while Ujjain is a town of historical importance. Bhopal, the capital city, lies on the extension of Malwa Region and on the edge of Bundelkhand region.
- Nimar (Nemar): The western portion of the Narmada River valley, lying south of the Vindhyas in the southwest portion of the state. This region comprises Khandwa, Khargone, Burhanpur and Barwani districts.
- Bundelkhand: A region of rolling hills and fertile valleys in the northern part of the state, which slopes down toward the Indo-Gangetic plain to the north. Gwalior is an historic center of the region. This region encompasses Datia, Sagar, Damoh, Panna, Chhatarpur and Tikamgarh Districts.
- Chambal: The north-western region. A mountainous region rich in red, soft, and fragile sandstone. The climate is harsh, and the area is known for murderous pirates who were active in hundreds in the late 1900s. This region comprises Sheopur, Morena and Bhind districts.
- Baghelkhand: A hilly region in the northeast of the state, which includes the eastern end of the Vindhya Range. Satna, Rewa and Sidhi districts lie in this Region.
- Mahakoshal (Mahakaushal): The southeastern portion of the state, which includes the eastern end of the Narmada river valley and the eastern Satpuras. Jabalpur is the most important city in the region. Katni and Jabalpur districts lie in this Region.

- Central Vindhya and Satpura region: Occupy most of the central Narmada river valley. Hoshangabad, Harda, Narsinghpur districts lie in this Region.

Central Ground Water Board (CGWB), North Central Region, Bhopal in association with Ground Water Survey Department, Water Resources Department, Government of M.P. has assessed dynamic ground water resources of Madhya Pradesh for 317 assessment units (313 blocks and 4 urban areas i.e. Bhopal, Indore, Jabalpur, Gwalior) **(Fig-3.1)** according to the methodology recommended by the Ground Water Estimation Committee constituted by Government of India (GEC 2015). The Present report quantifies the dynamic ground water resources of Madhya Pradesh State for the base year 2023.

3.1 RAINFALL

Madhya Pradesh experiences a tropical climate with wide variation in temperature. There are four seasons during the year. The summer season from March to Mid-June, the monsoon season from Mid-June to September, the post monsoon season in October-November, and the winter season from December to February, May is the hottest month, while January is the coldest.

Rainfall is the main source of recharge to ground water which contributes to nearly 76 % of the total annual ground water recharge, so rainfall pattern has an important impact on groundwater levels in the phreatic aquifer. A major part of the country receives rainfall mainly during SW Monsoon season spread over the months of June to September. Over 99 % of the annual rainfall is received in the four rainy months for June to September. August is the wettest month.

The district wise seasonal and annual rainfall observed during the year 2021 for the districts is given in **Table 3.1**. The district-wise observed monthly rainfall is given in **Table 3.2**. Annually as per 2021 rainfall data, the Guna District received the highest rainfall of 1827.3 mm where as Khargone District received the lowest rainfall of 679.6 mm.

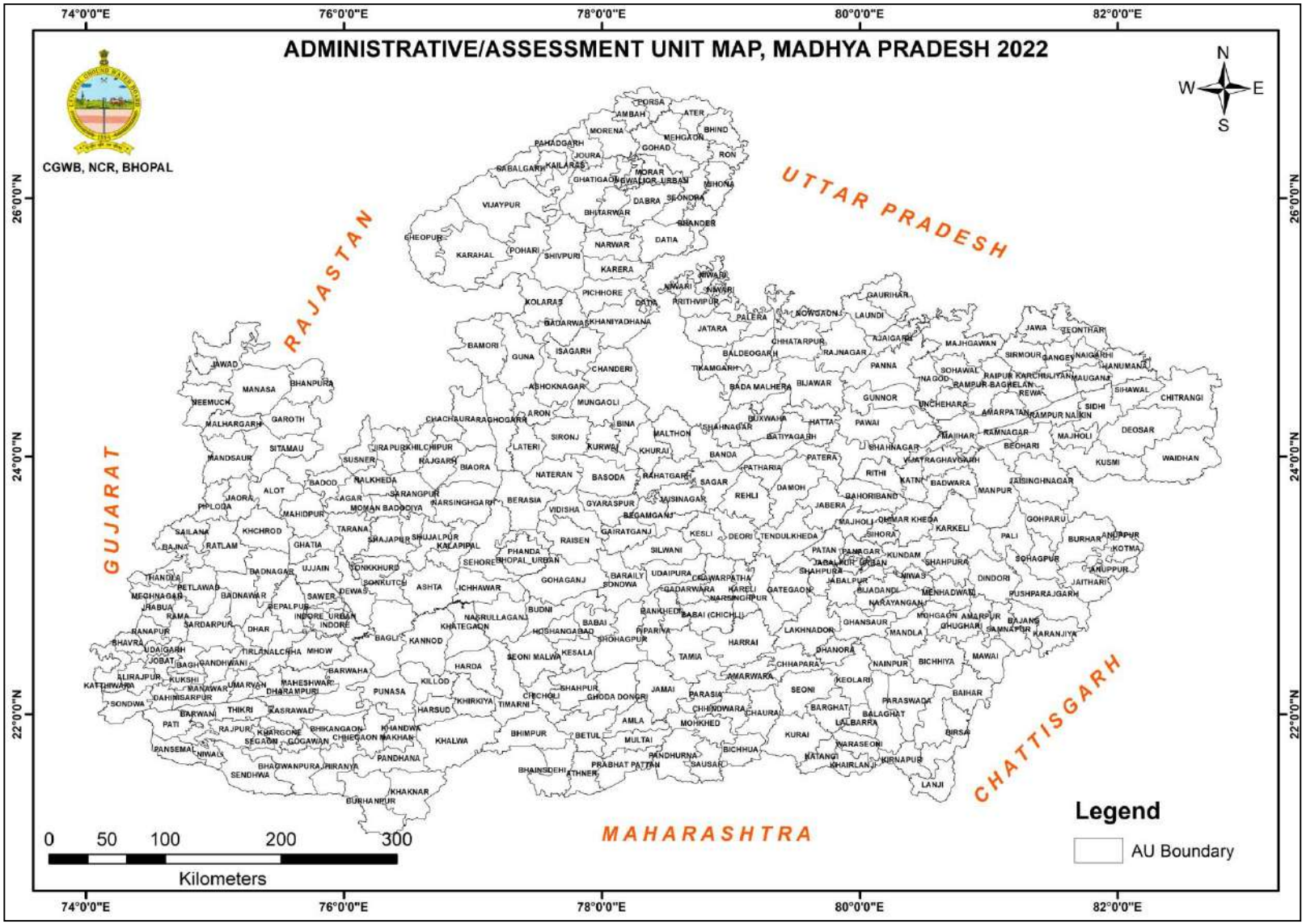


Fig 3.1: Administrative Map/ Assessment units of Madhya Pradesh

Table 3.1: District-wise seasonal and annual Rainfall (mm) - Year 2021 (Source: IMD)

S N	District	Winter	Pre-Monsoon	SW-Monsoon	Post-Monsoon	Annual
1	Agar-Malwa	3.1	50.1	1224.2	73.9	1351.3
2	Alirajpur	8.3	21.4	961.3	101.4	1092.4
3	Anuppur	42.3	91.9	1146.3	48.5	1329.1
4	Ashoknagar	2.3	75.5	1182.3	44	1304
5	Balaghat	26	51	985.5	58.9	1121.3
6	Barwani	8	16	644.1	87	755
7	Betul	13.9	62.1	1014.4	100.7	1191.1
8	Bhind	4.7	74.2	834.1	102.1	1015.1
9	Bhopal	4.4	87.8	979.8	75.1	1147.1
10	Burhanpur	1	12.6	777.4	144.2	935.1
11	Chhatarpur	6.4	67.7	719.4	48	841.5
12	Chhindwara	13.4	75.1	938.7	79.1	1106.3
13	Damoh	13.8	108.1	644.8	16.7	783.3
14	Datia	2.5	50.5	707.2	136.1	896.4
15	Dewas	4.4	12.8	961.4	82.2	1060.8
16	Dhar	10.3	4	650.5	110.9	775.7
17	Dindori	24.3	104.3	1088.4	59	1275.9
18	Guna	1.4	88.4	1632.5	105.1	1827.3
19	Gwalior	3.8	57	718.2	95.3	874.3
20	Harda	4	34.7	875.9	105	1019.6
21	Hoshangabad	3.3	35.1	1025.9	55.2	1119.4
22	Indore	9.4	35.3	836.6	154.8	1036.1
23	Jabalpur	12.2	74.1	718.9	40.9	846.3
24	Jhabua	18.2	11.4	829	54.2	912.7
25	Katni	2.9	93.1	708.2	24	828.2
26	Khandwa	4	11.8	837.5	96.3	949.5
27	Khargone	4.6	11.3	590.7	73	679.6
28	Mandla	24.3	87.5	1015.7	62	1189.5
29	Mandsaur	7.5	38.8	914.6	86.4	1047.3
30	Morena	4.5	74	658.2	40.3	777
31	Narsinghpur	2	30.4	882.4	28.2	943
32	Neemuch	23.3	89.9	1056.7	181.7	1351.6
33	Niwari	5	66.7	1027	124.7	1223.3
34	Panna	4.8	118.8	730.5	20.1	874.2
35	Raisen	3.5	67.9	1024.1	44.7	1140.1
36	Rajgarh	1.4	60.6	1194.3	83.8	1340
37	Ratlam	1.3	33.1	1035.4	76.9	1146.6
38	Rewa	0.6	120.3	1009.7	30.3	1160.8
39	Sagar	9.2	123.4	896.1	37.2	1065.9

S N	District	Winter	Pre-Monsoon	SW-Monsoon	Post-Monsoon	Annual
40	Satna	1.7	94.1	800.2	40.8	936.8
41	Sehore	1.8	36.2	944.8	101.7	1084.5
42	Seoni	26.4	119.1	784.1	61.2	990.7
43	Shahdol	12.6	111.2	971.7	44	1139.5
44	Shajapur	5.2	38.5	1066.5	79.1	1189.3
45	Sheopur	27.5	49.4	1344	200.8	1621.6
46	Shivpuri	2.3	84.1	1262.5	104.7	1453.5
47	Sidhi	1.4	139.7	992.2	12.8	1146
48	Singrauli	3.6	152.9	1255.9	28	1440.5
49	Tikamgarh	9	45.5	767.8	41.5	863.8
50	Ujjain	5.8	44	999.6	98	1147.3
51	Umaria	14.2	159.9	908.9	47.9	1130.9
52	Vidisha	5.6	81.7	1181.8	66.5	1335.6

Table 3.2: District wise monthly Rainfall-Year-2021 (Source: IMD)

S N	District	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	Anuppur	3.5	38.9	2.2	5.6	84.1	217.8	345.3	300.4	282.9	24.4	0	24.1
2	Balaghat	2.9	23.1	9.6	0.1	41.3	200.2	334.6	127.1	323.5	25.2	7.8	25.9
3	Chhatarpur	1.4	5	0.8	0	66.9	99.6	247.2	201.5	171.1	42.8	0	5.2
4	Chhindwara	2.7	10.6	8	2	65.1	273.3	245.7	153	266.8	46.7	16.5	15.8
5	Damoh	0.4	13.3	8.6	7	92.5	102	213.6	144.6	184.6	6.1	0	10.6
6	Dindori	0	24.3	7.3	3.9	93.1	227.2	388	214.2	259.1	30.1	6.6	22.3
7	Jabalpur	0	12.2	5.7	3.2	65.3	165.4	239.2	98.9	215.5	19.7	4.6	16.6
8	Katni	0	2.9	4.4	2.4	86.3	157.5	237.8	138.9	174.1	15.2	0	8.8
9	Mandla	2.1	22.2	8.6	0.7	78.2	273.8	297.9	194.7	249.3	30.1	9.3	22.6
10	Narsinghpur	0	2	8	0	22.4	319	245.6	141.4	176.4	18.2	0.4	9.6
11	Niwari	0	5	0	0	66.7	48.3	289	445.3	244.3	121.7	0	3
12	Panna	0.2	4.6	4.1	3.7	111	68.7	260.9	194.7	206.1	14.6	0	5.5
13	Rewa	0	0.6	0	1.3	119	250.3	214.1	327.9	217.5	16.7	0	13.6
14	Sagar	2	7.2	27.7	1.4	94.4	208.5	249.9	252.4	185.3	29.2	0	8
15	Satna	0	1.6	1.8	0.4	92	147.8	282.1	211.6	158.6	35.7	0	5.1
16	Seoni	5.8	20.6	6.8	1.4	110.9	220	233.4	109.2	221.5	45.7	0.3	15.2
17	Shahdol	0	12.6	2.8	4.7	103.7	238.2	261.4	296	176.1	26.7	0	17.3
18	Sidhi	0	1.4	2.4	0.3	137	290.1	247.4	301.6	153.1	5.9	0	6.9
19	Singrauli	1.3	2.3	0.5	1.3	151.1	323.6	338.7	378.7	214.8	22.9	0	5.1
20	Tikamgarh	5	4	5.8	2	37.8	101.3	195.5	274.8	196.3	40.5	0	1
21	Umaria	0.5	13.7	8.9	8.7	142.3	213.1	312.9	195.9	187	28.7	0	19.2
22	Agar-Malwa	3.1	0	0	0	50.1	85.4	401.9	348.3	388.6	72.1	0	1.8
23	Alirajpur	8.3	0	3.8	1.1	16.5	95.9	391.6	121.5	352.2	53.3	16.8	31.3
24	Ashoknagar	2.3	0	4.8	6.8	64	129.8	275.8	536	240.8	37.3	0	6.8
25	Barwani	8	0	0.1	0	15.8	72.3	151.4	150.4	270	47	14	26
26	Betul	1	12.9	15.7	5.4	41	228.7	378.8	168.7	238.1	78.7	15.4	6.7

S N	District	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
27	Bhind	2.3	2.3	13.1	1.9	59.2	39.9	434.7	179.1	180.4	98.6	1.1	2.5
28	Bhopal	4.4	0	29.6	2.2	56	289.9	204.7	259.6	225.5	71.7	0	3.4
29	Burhanpur	0.3	0.7	5.1	0.7	6.8	115.4	178.6	183.3	300.1	137.2	6.1	0.8
30	Datia	0.8	1.7	1.9	0	48.7	59.2	224.9	251.7	171.4	125.4	1.2	9.5
31	Dewas	3.2	1.2	5.4	0	7.4	195	244.3	227.8	294.3	80.2	0	2
32	Dhar	6.5	3.7	0	0	4	107	185.3	124.7	233.5	74.2	12.9	23.8
33	Guna	1.3	0.1	17.6	0	70.8	106.9	443	880.6	202	95.3	0.8	9
34	Gwalior	3.7	0.1	11	0.1	45.9	34.3	304.6	227.4	152	83.7	4.4	7.2
35	Harda	2.6	1.4	4.3	0	30.3	184.5	242.2	177.8	271.4	105	0	0
36	Hoshangabad	0.5	2.8	6.6	0	28.5	261.3	269.4	263.3	231.9	51.5	1.8	1.9
37	Indore	9.4	0	2.6	0	32.7	124.1	176.8	178	357.7	135.7	0	19.1
38	Jhabua	13.7	4.5	0	0	11.4	149.4	209.1	194	276.5	29.7	8.4	16.1
39	Khandwa	1.5	2.5	3.3	0	8.5	97	282.6	169.9	288	93.3	1.5	1.5
40	Khargone	1.5	3.1	2.9	0	8.5	92.7	149.3	114.8	233.9	58.4	1.2	13.4
41	Mandsaur	7.5	0	0	0	38.8	105.3	310.9	276.7	221.7	43.7	22.4	20.3
42	Morena	4.5	0	8	0	66	34.7	187.8	225.8	210	36.7	0.8	2.8
43	Neemuch	23.3	0	0	0	89.9	109	239.3	226	482.3	67	79.7	35
44	Raisen	1.3	2.1	24.7	0	43.2	255.1	231.3	320.5	217.3	34.3	0	10.4
45	Rajgarh	1.4	0	10.7	0	49.9	123.6	387.5	423.6	259.7	78.5	0	5.2
46	Ratlam	1.3	0	0	0	33.1	135.3	349.2	216.1	334.8	58.1	4.8	14
47	Sehore	0.5	1.3	12.2	0	24.1	231.6	255.6	206.7	251	101.2	0	0.5
48	Shajapur	5.2	0	9.8	0	28.7	150.8	361.4	262.5	291.8	78.2	0	0.9
49	Sheopur	27.5	0	4.1	0	45.3	40	420	717.9	166.1	168	19.2	13.5
50	Shivpuri	1.8	0.5	14.2	1.1	68.8	80.1	325.5	690.4	166.5	80.3	8.6	15.8
51	Ujjain	5.8	0	1	0	43	132.8	370.5	271.1	225.3	73.5	14.1	10.4
52	Vidisha	3	2.6	20.4	0.3	61	232.7	306	460.9	182.2	61.5	0.1	5

The normal annual rainfall for Madhya Pradesh is 1088 mm. The variation in normal annual rainfall is between 742.5 mm and 1471.6 mm. The rainfall decreases as we move from East to West and south to North. The highest normal annual rainfall occurs in Balaghat district (1471.6 mm) followed by Mandla, Annupur and Dindori districts, which are in southern and south eastern parts of State whereas lowest normal annual rainfall is recorded in 742.5 mm in Barwani district in the western part of Madhya Pradesh. The Normal annual rainfall map of Madhya Pradesh in shown in the **Fig 3.2**.

Table.3.3: District wise Normal Annual Rainfall

S.N	District	Normal Annual Rainfall (mm)	S.N	District	Normal Annual Rainfall (mm)
1	**Agar Malwa**	1036.1	27	**Khargone**	950.3
2	**Alirajpur**	912.8	28	**Mandla**	1427.7

S.N	District	Normal Annual Rainfall (mm)	S.N	District	Normal Annual Rainfall (mm)
3	**Anuppur**	1423.6	29	**Mandsaur**	753.7
4	**Ashoknagar**	926	30	**Morena**	753
5	**Balaghat**	1471.6	31	**Narsinghpur**	1191
6	**Barwani**	742.5	32	**Neemuch**	854.9
7	**Betul**	1145.55	33	**Panna**	1183
8	**Bhind**	951	34	**Raisen**	1207.3
9	**Bhopal**	1126.65	35	**Rajgarh**	972
10	**Burhanpur**	883.8	36	**Ratlam**	992.85
11	**Chhatarpur**	1092.7	37	**Rewa**	1141.5
12	**Chhindwara**	1139.25	38	**Sagar**	1205
13	**Damoh**	1176	39	**Satna**	1075.5
14	**Datia**	963.8	40	**Sehore**	1067.5
15	**Dewas**	1069	41	**Seoni**	1322
16	**Dhar**	856.5	42	**Shahdol**	1131.4
17	**Dindori**	1376.3	43	**Shajapur**	1036.1
18	**Guna**	1082	44	**Sheopur**	799.2
19	**Gwalior**	870	45	**Shivpuri**	994.9
20	**Harda**	1374	46	**Sidhi**	1154
21	**Hoshangabad**	1324.5	47	**Singrauli**	1120.2
22	**Indore**	976.8	48	**Tikamgarh**	943.6
23	**Jabalpur**	1279.45	49	**Ujjain**	861.5
24	**Jhabua**	865.4	50	**Umaria**	1242
25	**Katni**	1171.4	51	**Vidisha**	1135.3
26	**Khandwa**	951.65	52	**Niwari**	943.6

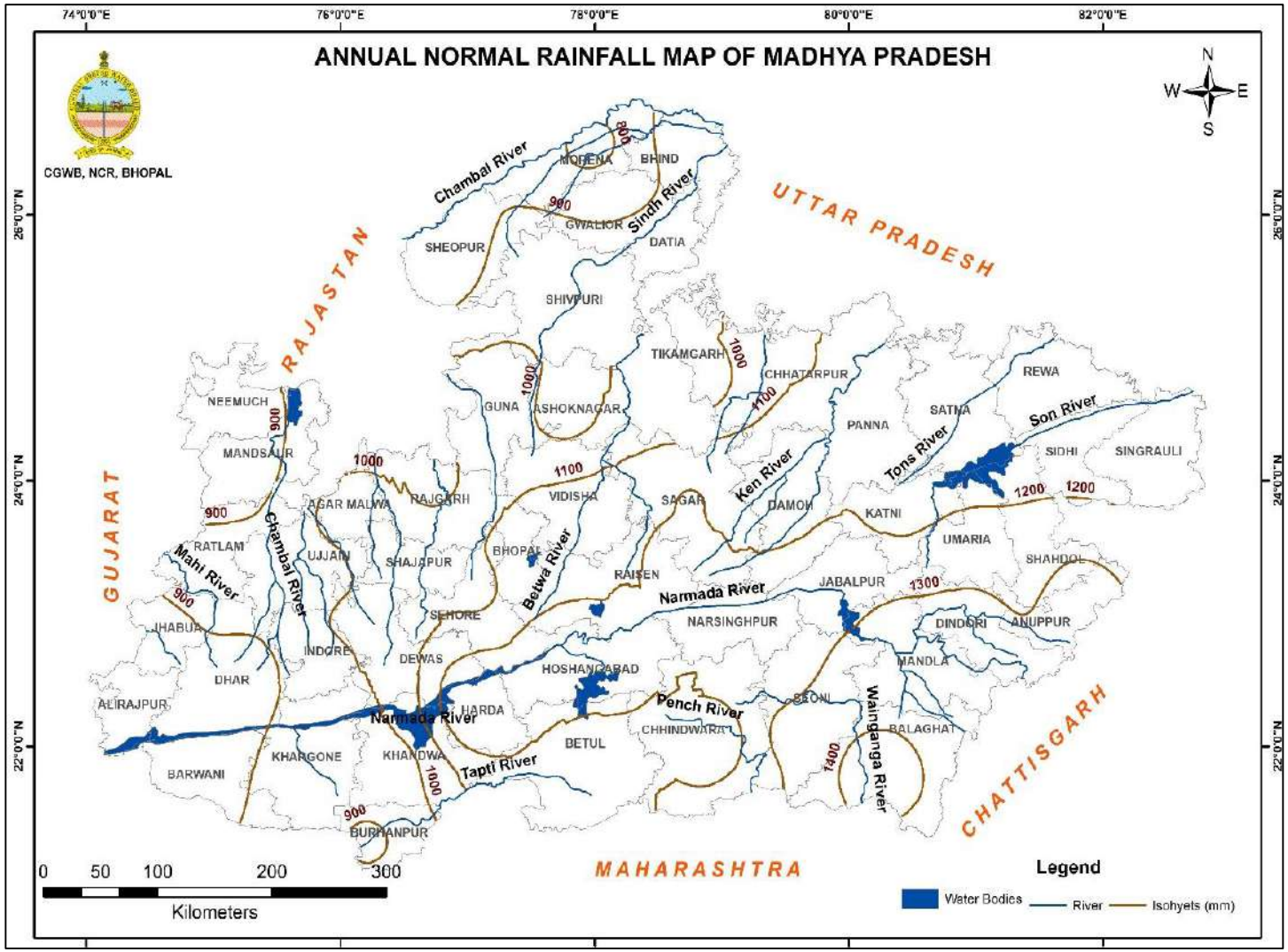


Fig 3.2: Annual Normal Rainfall Map, Madhya Pradesh

3.2 PHYSIOGRAPHY

The State exhibits six distinct physiographic units as follows:

- The Malwa Plateau
- The Satpura Range
- The Vindhyan Range
- The Mahakoshal Range
- The Bundelkhand Region
- The River valleys.

The Malwa Plateau marks the northern span of the Deccan Plateau and this region forms a part of the vast Deccan Plateau of Central India. The hill ranges run across the plateau. The Satpura Range located in the southern part of the State is E-W trending. It has an average elevation of 600 m amsl and highest elevation of 1350 m amsl. The Vindhyan range occupies in the northern and central part of the region and has ENE-WSW trend. The Mahakoshal Range also has a similar trend. The Vindhyan Range extends into the Malwa Plateau and Bundelkhand Region. The Vindhyan Range and Mahakoshal Range are separated from the Satpura Range by the Narmada River and vast tract of its basin area. The river valleys, other than the Narmada alluvial plain and Chambal alluvial plain, are very limited and form narrow belts along the rivers. Dhupgarh in Pachmarhi is on 1350 m amsl which is the highest elevation point in the state. The Physiography map of Madhya Pradesh is shown in the **Fig 3.3**.

3.3 GEOMORPHOLOGY

Major part of the state is occupied by pediment pediplain complex, dissected plateaus and dissected hills and valleys. Pediment Pediplain complex is the major landform covering about 180762 km^2 (nearly 59%), presently mostly in the western and northeastern side sparcely distributed in all other sides. The other major landform observed is moderate dissected plateau covering about 43709 km^2 (14.2%), highly dissected plateau in 11090 km^2 (3.5%), low dissected plateau in 8520 km^2 (2.8%), moderately dissected hills and valleys in 22012 km^2 (7.35%), low dissected hills and valleys in 6363 km^2 (2%). Dissected hills and valleys, flood plain and alluvial plain landforms are occupied very small part of the state. The geomorphology map of Madhya Pradesh is shown in the **Fig 3.4.**

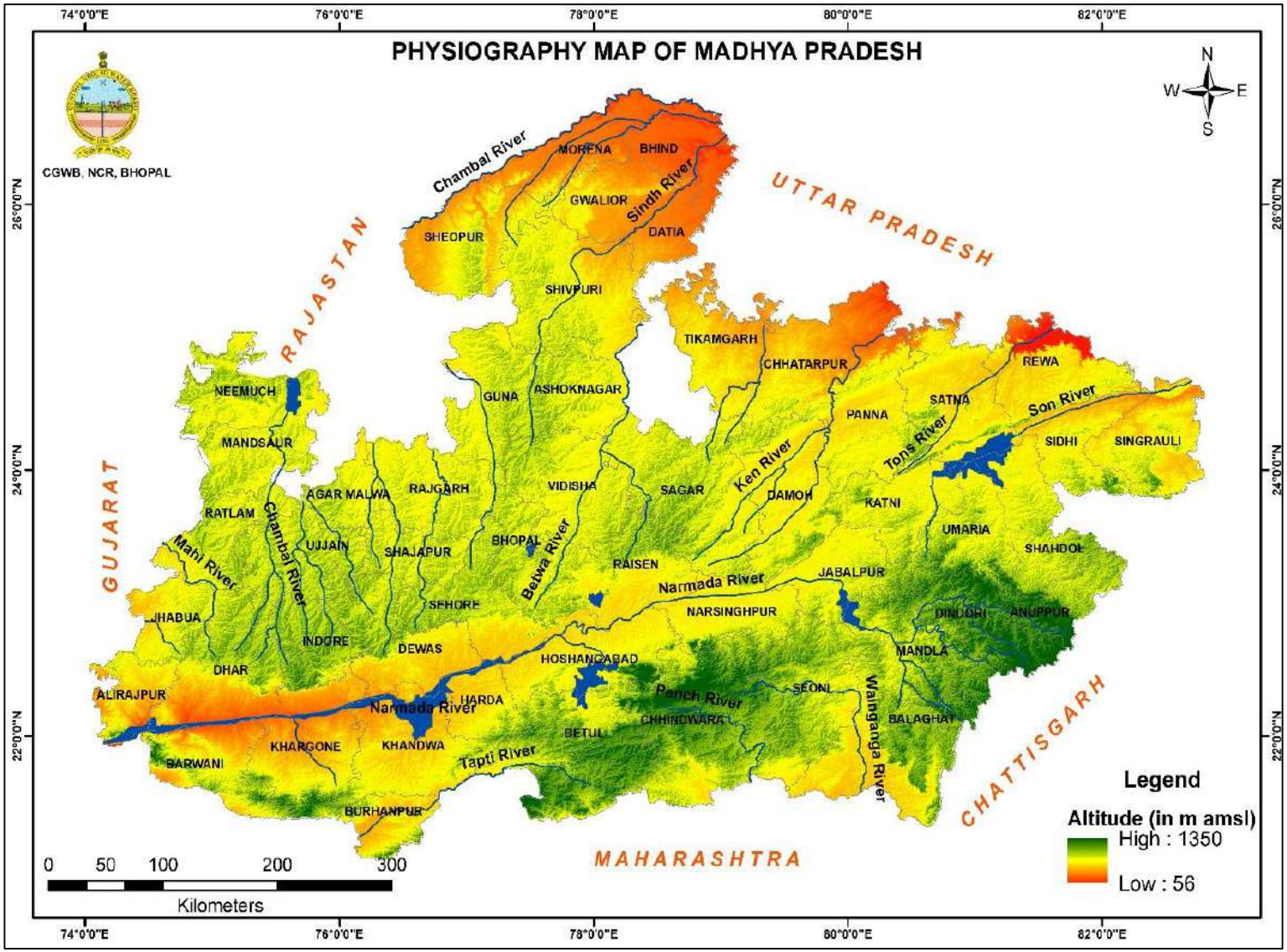


Fig 3.3: Physiography Map, Madhya Pradesh

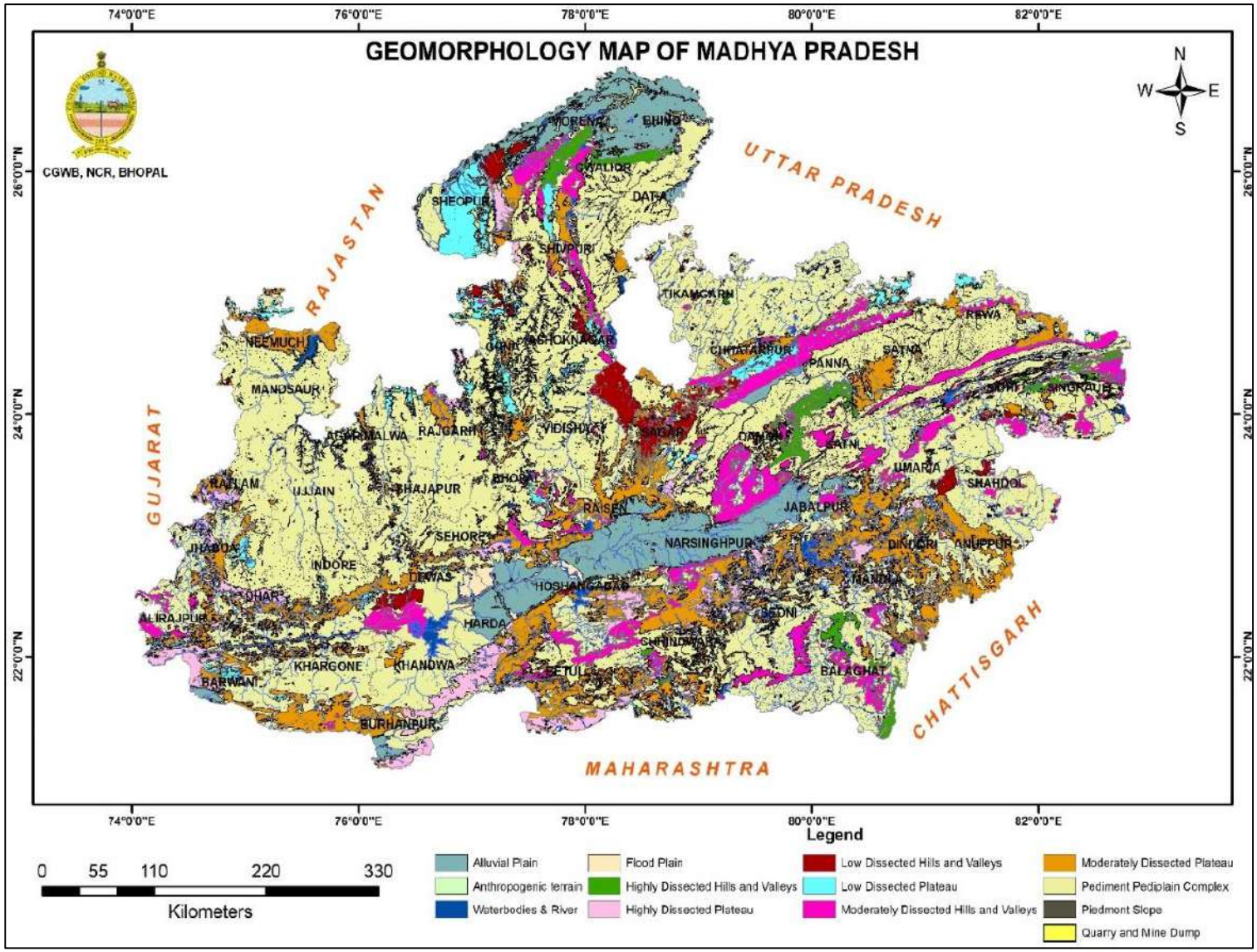


Fig 3.4: Geomorphology, Madhya Pradesh

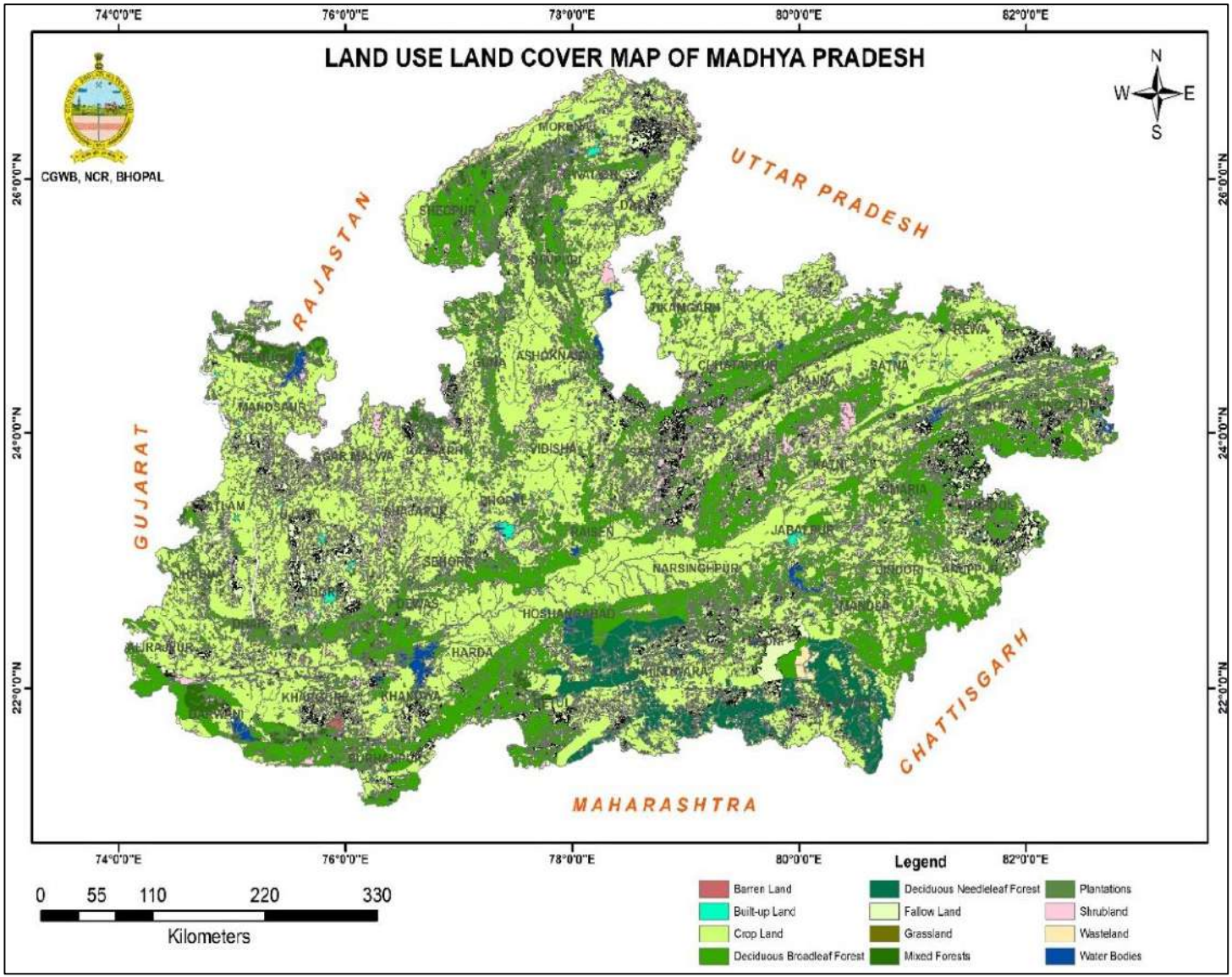


Fig 3.5: Land use Land Cover, Madhya Pradesh

3.4 LAND USE LAND COVER

Agriculture and forest are the prominent land use aspects in the state and forms 55 % and 28 % of total area respectively followed by the shrub land and water bodies. The spatial distribution of land use is presented in **Fig 3.5.** (as per Land Use Land cover data, NASA, USA).

3.5 DRAINAGE AND BASINS

Madhya Pradesh State represents great river basins and the watershed of a number of rivers. Catchments of many rivers of India lie in Madhya Pradesh. There are six river basins in Madhya Pradesh namely 1. Ganga Basin (1.1 Yamuna sub basin - Chambal sub-sub basin, Kunwari sindh sub-sub basin, Jamni sub-sub basin, Betwa sub-sub basin, Dhasan sub-sub basin, Ken sub-sub basin, Paisuni and Baidhan sub sub basin 1.2 Tons sub basin, 1.3 Sone sub basin), 2. Narmada Basin, 3. Godavari Basin, 4. Tapti Basin, 5. Mahi Basin and 6. Mahanadi Basin. The basins of Madhya Pradesh are shown in the **Fig 3.6**. As Madhya Pradesh is located in the center of India, most of the rivers are interstate rivers. The rivers namely, Chambal, Sindh, Betwa, Ken flows northward and meet with Yamuna, whereas the Sone River falls directly into Ganga. Narmada, Tapti and Mahi Rivers flow westward and meet Arabian Sea whereas Wainganga and Pench Rivers meet Godavari in the south. The Narmada (originating from Amarkantak) and Tapti (originating from Multai in Betul District) Rivers and their basins divide the state in two, with the northern part draining largely into the Ganga basin and the southern part into the Godavari and Mahanadi systems. The Vindhyas form the southern boundary of the Ganga basin, with the western part of the Ganga basin draining into the Yamuna and the eastern part directly into the Ganga itself. All the rivers, which drain into the Ganga, flow from south to north, with the Chambal, Kshipra, Kalisindh, Parbati, Kuno, Sind, Betwa, Dhasan and Ken Rivers being the main tributaries of the Yamuna. The land drained by these rivers is agriculturally rich, with the natural vegetation largely consisting of grass and dry deciduous forest types. The eastern part of the Ganga basin consists of the Son, the Tons and the Rihand Rivers, with the Son being the major tributary. This is also the junction point of the Satpura and the Vindhya Ranges, with the Maikal and Kaimur Hills being the fulcrum. The forests here are much richer than the thorn forests of the northwestern part of Madhya Pradesh. The Son River is of great significance in that it is the largest tributary going into the Ganga on the south bank and arising out of the hills of Madhya Pradesh rather than from the Himalayas. This river and its tributaries contribute the bulk of the monsoon flow into Ganga, because the north bank tributaries are all snow fed. The major tributary of the Ganga, the Son River, arises in one of the most important watersheds in India, the Maikal hills around Amarkantak. Three of the great

rivers of India, Narmada, Mahanadi and Son, are given birth to by these hills. This is also one of the few ranges in the state having a north south configuration. The Mahanadi itself, together with its tributaries such as Hasdeo, Mand and Kharun flows southeast into Chhattisgarh and converts that state into a green rice bowl. The upper Mahanadi catchment contains some of the finest forests in the state, ranging from mixed deciduous to teak, bamboo and sal. Just as the Mahanadi flows east from the Maikal hills and the Son flows north, the mighty Narmada charts a westerly course from these very hills. The Narmada flows through a rift valley, with the Vindhyas marching along its northern bank and the Satpuras along the southern. Its tributaries include Banjar, Tawa, Machna, Denwa and Sonbhardra Rivers. Taken in combination with its parallel sister river, the Tapti, which also flows through a rift valley, the Narmada - Tapti systems carry and enormous volume of water and provide drainage for almost a quarter of the land area of Madhya Pradesh.

The Satpuras, in the Gawligarh and Mahadeo hills, also contain a watershed, which is south facing. The Indrawati, Wainganga, Wardha, Pench, Kanhan and Penganga Rivers, discharge an enormous volume of water into the Godavari system. The Godavari is the lifeline of Andhra Pradesh, but the water which feeds it is a gift of the central India watershed.

3.6 HYDROGEOLOGICAL UNITS AND AQUIFER PARAMETERS

The State of Madhya Pradesh has varied hydrogeological characteristics due to which ground water potential differs from place to place. The area is underlain by various geological formations ranging in age from the Archaean to the Recent. Hard rock areas cover more than 80% of total land area of the State. These hard-rock areas show wide variations and complexities in nature and composition of rocks, geological structures, geomorphological set up and hydro meteorological conditions. The crystalline rocks of Archaean age like granite, gneiss, granulites, schist, quartzite and granitoids occupy about 14.7% of geographical area of the State.

The basaltic rocks of Deccan lava flows are the predominant formations and occupy nearly 44.5% of total geographical area. The consolidated sedimentary rocks of Vindhyan Super Group and Mahakoshal (Cuddapah) Super Group of Proterozoic age occupy about 19.1% of total geographical area and the semi consolidated (Gondwana Formation) occupies about 6.7%. Recent unconsolidated alluvial sediments occupy about 14.4% of total geographical area. The Hydrogeological units of the state and their potential is described in **Table 3.4** and shown in **Fig 3.7.**

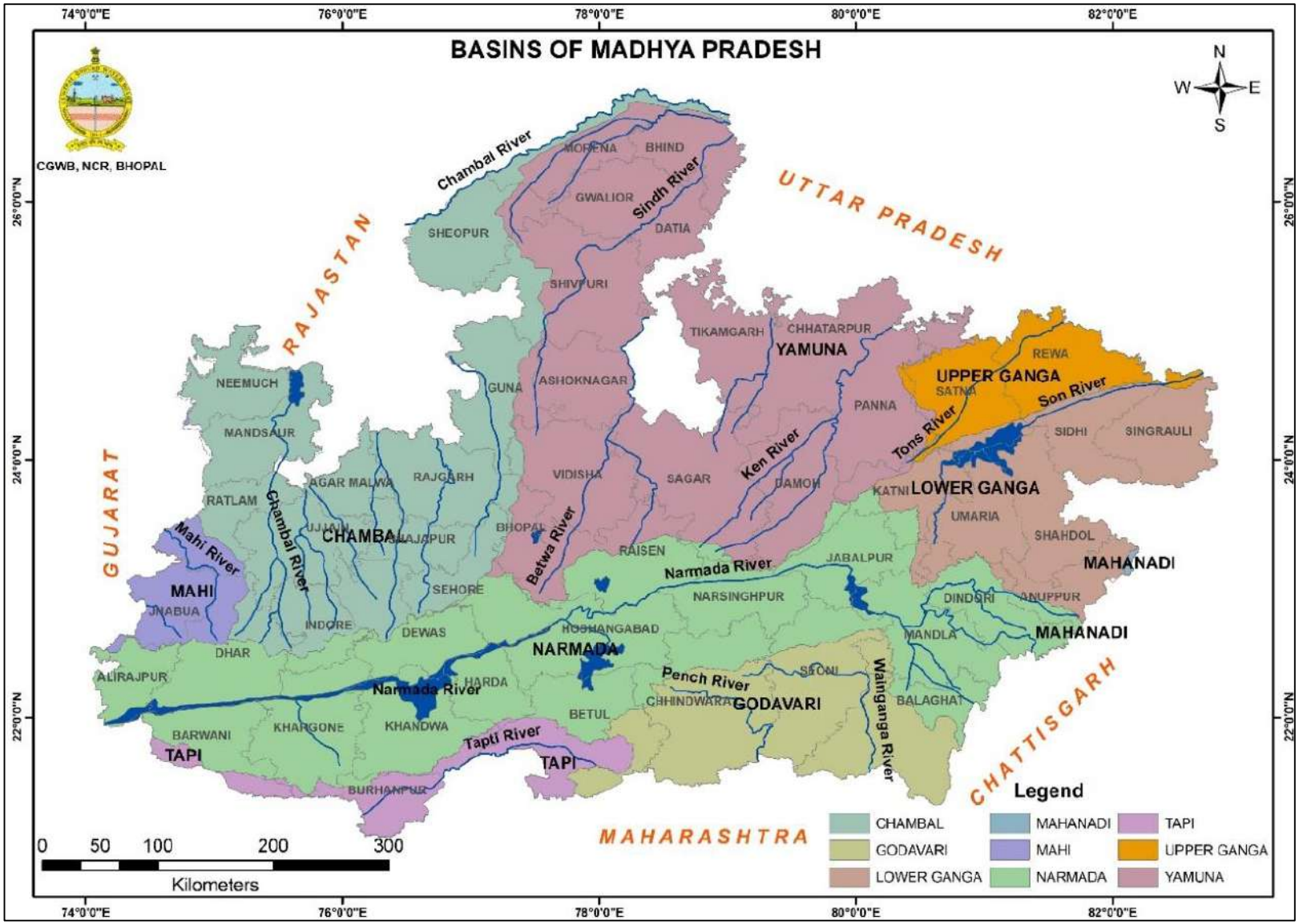
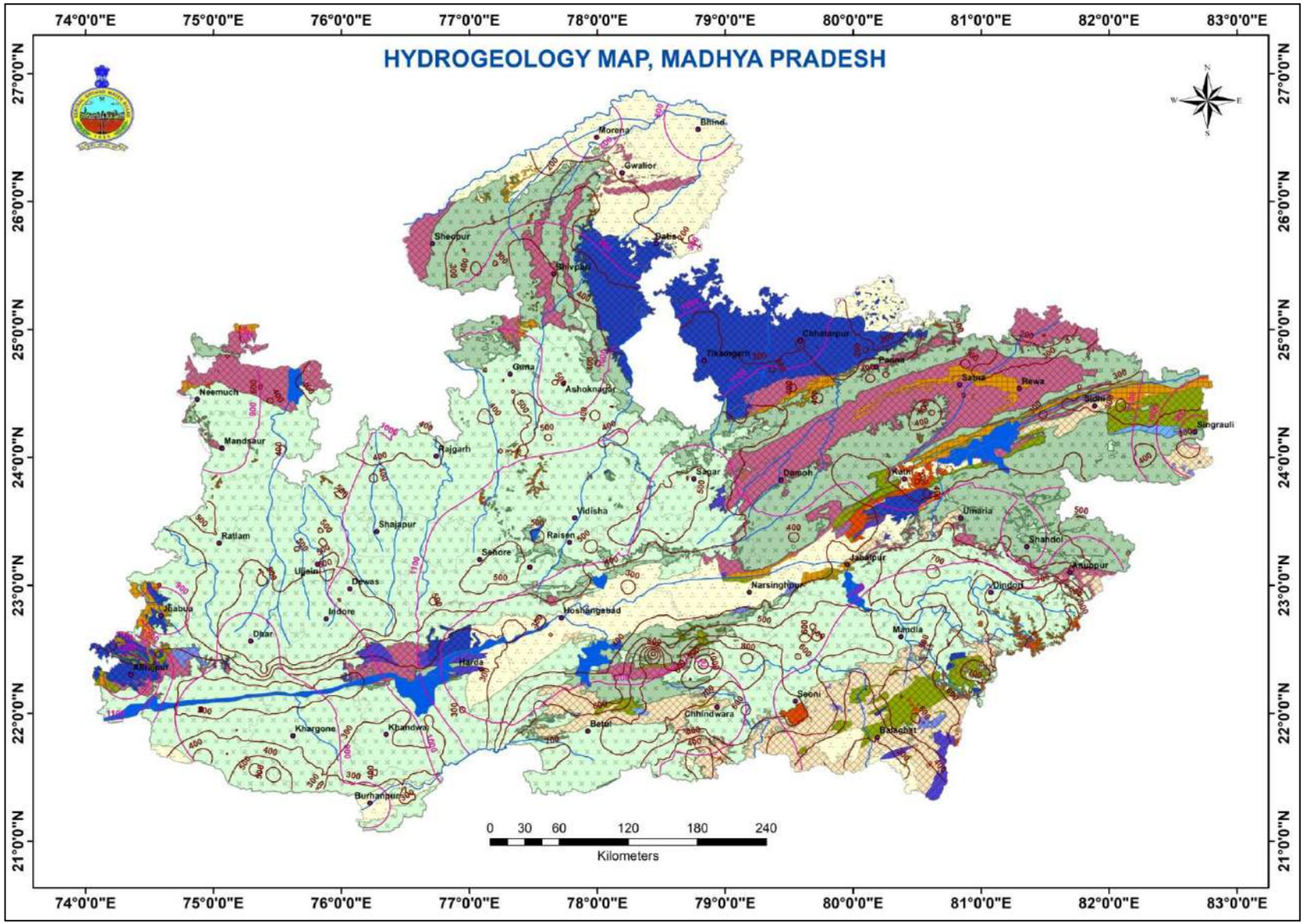


Fig 3.6: Basins and Major Rivers, Madhya Pradesh


HYDROGEOLOGY MAP, MADHYA PRADESH
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Morena
Bhind
Gwalior
Sheopur
Datia
Shivpuri
Chhatarpur
Tikamgarh
Panna
Satna
Rewa
Sidhi
Singrauli
Guna
Ashoknagar
Neemuch
Mandsaur
Rajgarh
Sagar
Damoh
Katni
Umaria
Vidisha
Raisen
Shajapur
Ratlam
Sehore
Jabalpur
Shahdol
Anuppur
Ujjain
Dewas
Narsinghpur
Dindori
Jhabua
Indore
Hoshangabad
Dhar
Mandla
Alirajpur
Harda
Seoni
Khargone
Khandwa
Betul
Chhindwara
Balaghat
Burhanpur
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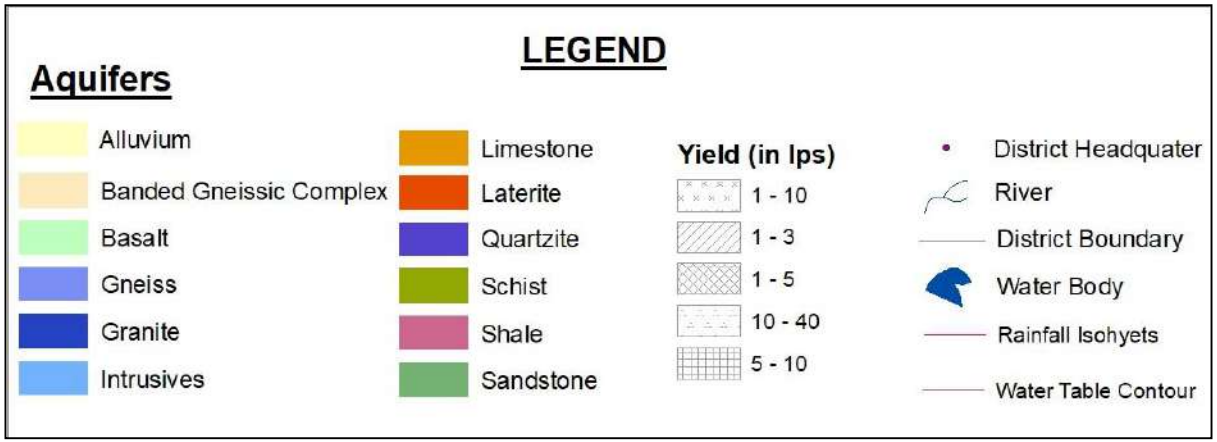


Fig 3.7: Hydrogeology Map, Madhya Pradesh

Table- 3.4: Hydro geological Units, their Potential and Groundwater Scenario, Madhya Pradesh

Geological Age	Group	Rock Formation	Surface Exposure Area (Approx.)	Occurrence and Hydrogeological Characters.
Pleistocene to Recent	Alluvial plains (older and Newer Alluvium)	Unconsolidated clays and silts, gravels and sands of different mix. Lenses of Peat and organic matter carbonate and siliceous concretions (Kankars)	38,000 Sq.Km.	Occur widespread in Bhind (Chambal basin), Hoshangabad and Narsimhapur districts (Narmada basin) and also in Sheopur, Morena, Datia, Chhatarpur, Jabalpur, Katni, Khandwa, Burhanpur, Raisen, Sidhi and Balaghat districts and along rivers in some other districts. Form very potential aquifers with a thick sequence of sandy aquifers down to great depths (>300 m.bgl). The aquifers are unconfined, semi-confined (leaky confined) or confined. The transmissivity up to 6700 m^2/day.Discharge is up to 30 lps. Specific yield is up to 12%.
Cretaceous to Eocene	Deccan Trap	Basalts	1,43,300 Sq.Km.	Occupy the Malwa plateau covering Neemuch, Mandsaur, Indore, Dhar, Ratlam, Shajapur, Sagar, Rajgarh, Sehore, Badwani, Khargone, Khandwa and Burhanpur districts and parts of Jhabua, Raisen, Guna, Ashoknagar, Vidisha, Bhopal, Sehore, Betul, Jabalpur, Katni, Hoshangabad, Harda, Narsimhapur, Chhindwara, Seoni, Dindori, Mandla, Shahdol and Anuppur districts. Weathered, Fractured and vesicular basaltic layers of Traps, inter-trappeans and infratrappeans form productive

Geological Age	Group	Rock Formation	Surface Exposure Area (Approx.)	Occurrence and Hydrogeological Characters.
	Bagh and Lameta Groups	Sandstone, cherty limestone	8,500 Sq.Km.	unconfined hallow aquifers and leaky confined/confined deeper aquifers. Discharge is upto 5 lps. (Infra trappeans are less productive). Transmissivity is up to 250 m^2/day.Sp.Yield up to 3%. Infra Trappean formation of Bagh & Lametas occurs in Dhar, Jhabua & Jabalpur districts and small patches in Sagar, Hoshangabad and Narsimhapur districts.
Palaezoic to Cretaceous	Gondwana super Group. Jabalpur, Mahadeva, Panchet, Raniganj, Barakars and Talchir Groups	Boulder beds, Sandstones, shales, clays, limestone, coal seams	28,000 Sq.Km.	Occur in Betul, Chhindwara, Narsimhapur, Hoshangabad, Jabalpur, Katni, Sidhi, Umaria, Shahdol and Anuppur districts. Possess moderate primary porosity. Groundwater occurs under phreatic as well as semi-confined to confined conditions. Free flowing conditions with free flow discharge of 150 to 200 lpm have been recorded in North-eastern part of Jabalpur district. The transmissivity is up to 300 m^2/day. Discharge is up to 8 lps. Specific yield is found up to 3 %.
Proteozoic	Vindhyan Super Group. Bhander, Rewa, Kaimur and Semri Groups. Mahakoshal (Cuddaph) Super Group Bijawar and Gwalior Groups.	Shales, Sandstones and limestones	58,700 Sq.Km.	Occur in Gwalior, Morena, Sheopur, Shivpuri, Guna, Ashoknagar, Rewa, Panna, Satna, Jabalpur, Katni, Damoh, Sagar, Chhatarpur, Raisen, Bhopal, Vidisha, Neemuch, Mandsaur and Dewas districts. Generally, devoid of any primary porosity. Weathering and denudation, structurally weak planes and fractures impart porosity and permeability in the rock mass. Solution cavities (Cavernous) in carbonate rocks, at places give rise to large groundwater storage/circulation. The transmissivity is up to 250 m^2/day. Discharge is up to 4 lps. Specific yield is found up to 3 %. In karstified limestone the specific yield is up to 10 %.

Geological Age	Group	Rock Formation	Surface Exposure Area (Approx.)	Occurrence and Hydrogeological Characters.
Archaeans	Older Metamorphics Sausar, Sakoli and Chilpi Groups. & Bundelkhand Granites.	Granitoid gneisses, schists, gneisses, quartzites and granites	31,500 Sq.Km.	Occur in Seoni, Balaghat, Shahdol, Anuppur, Mandla, Dindori, Sidhi, Rewa, Panna, Datia, Tikamgarh, Gwalior, Chhatarpur, Jabalpur, Katni, Jhabua and Shivpuri districts, as also parts of Chhindwara, Harda, Hoshangabad, Narsimhapur and Dewas districts. Do not posses primary porosity. Weathering, fracturing, jointing impart secondary porosity. Groundwater mostly occurs under under unconfined to semi confined conditions. Transmisivity is upto 100 m^2/day., Discharge is up to 2 lps and Specific yield is up to 2%.

3.6.1 Archaeans

Archaeans comprise old metamorphic, granites, gneisses and schist. They are hard and compact formations with low primary permeability, forming poor aquifers. Ground water occurs in these only in the weathered mantle and underlying fractured zone. Groundwater mostly occurs under under unconfined to semi confined conditions. Transmisivity is found upto 100 m2/day., Discharge is up to 2 lps and Specific yield is up to 2%.

3.6.2 Vindhyans

These are composed of sandstone, shale and limestone. The sandstone and shale are hard and compact and form poor aquifers. Ground water occurs in these in the weathered mantle and fractured zone. The limestone is different in its hydrogeological properties having large solution cavities, which give rise to immense secondary permeability. The transmissivity is found up to 250 m2/day. Discharge is up to 4 lps. Specific yield is found up to 3 %. In karstified limestone the specific yield is up to 10 %.

3.6.3 Gondwana

The Gondwanas are sedimentary formations rich in granular zones and form good aquifers. They support both dugwells and tubewells, capable of yielding 8 lps. The transmissivity is found up to 300 m2/day and Specific yield is found up to 3 %.

3.6.4 Infra Trappeans

The Bagh and Lameta beds and Nimar sandstone are also sedimentary formations but have a limited extent and poor to moderate permeability. The limestone and calcareous clays when karstified form productive aquifers. The corralling limestone, the marls and nodular limestone are hard and compact having poor permeability. The Nimar sandstone has intergranular porosity, joints, fracture, bedding planes, which give moderate scope for ground water movement. The depth of wells varies from 3 to 13 m and depth to water level between 2 to 12 m bgl.

3.6.5 Deccan Traps

These form the most important aquifers in the region. The weathered, fractured, jointed and vesicular units of basalts form moderate to good aquifers. Discharge is upto 5 lps. Transmissivity is up to 250 m2/day and Secific Yield is up to 3%. The Deccan Traps formations can be tapped by dug well, dug-cum-bore and bore wells. It is observed that the yield increases by 5-10 times when 10-15 m bores wells extending down to the lower vesicular and bore well are drilled at the base of dug wells. Yields of 400-600 m3/d can be obtained in this way. In some areas the control of doleritic dykes on occurrence of ground water is observed. Wells

located on the upstream side of these dykes produce yields. Also wells located on tectonic lineaments gave better yields.

3.6.6 Alluvium

It consists of unconsolidated gravel, sand, silt, clay in various proportions and has primary inter-granular porosity and permeability. Hence it is the most promising formation for ground water development. The thickness of alluvium varies from 10 to 318 m with aquifer thickness from 10 to 160 m being more in the Ganga basin than in the Narmada basin. The depth to water ranges from 5 to 30 m bgl. The transmissivity is high in the Ganga basin being upto 3000 m^2/d. In the Narmada basin transmissivity ranges between 83-283 m^2/d. the yields vary from 30 to 50 m^3/hr for shallow wells and 30-200 m^3/hr for deep wells in the Ganga basin. In the Narmada basin the yields are of the order of 15-30 m^3/hr in the phreatic zone and 70-200 m^3/hr in the deeper zone. In the Waingangā sub basin, the wells yield 60-600 m^3/d. In the Tapi basin, the yields are 25-95 m^3/d.

3.7 GROUND WATER LEVELS SCENARIO

3.7.1 Depth to Water Level

Groundwater level refers to underground surface below which the ground is wholly saturated with water. The upper surface of the zone of saturation is the water table. In case of wells penetrating confined aquifers, the water level represents the pressure or piezometric head at the point. The configuration of the water table depends upon topography, geology, climate water yielding and water bearing of rocks in the zones of aeration and saturation which control ground water recharge.

During the water year 2022-23, the existing monitoring wells (**Fig 3.8**) were monitored four times, i.e., during May 2022, August 2022, November 2022 and January 2023. With the field data, maps were prepared for visual interpretation of the behaviors of the ground water levels. Depth to ground water levels were demarcated into various zones in the ranges of less than 2 m, 2-5 m, 5-10 m, 10-20 m and more than 20 m. The description of the depth to water levels during pre-monsoon (May) and post monsoon (November) monitoring seasons is as follows:

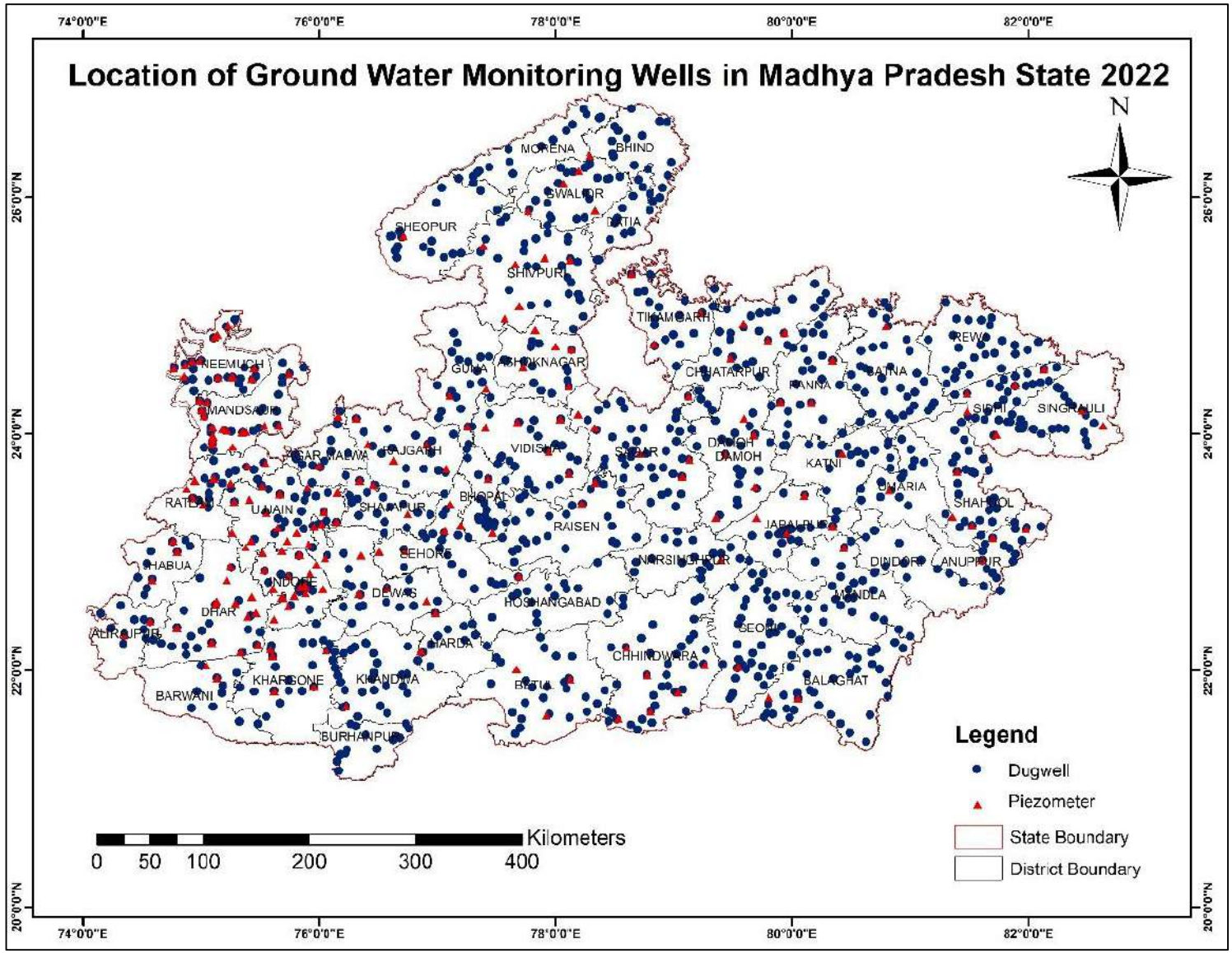


Fig 3.8: Location of Groundwater Monitoring Wells, Madhya Pradesh

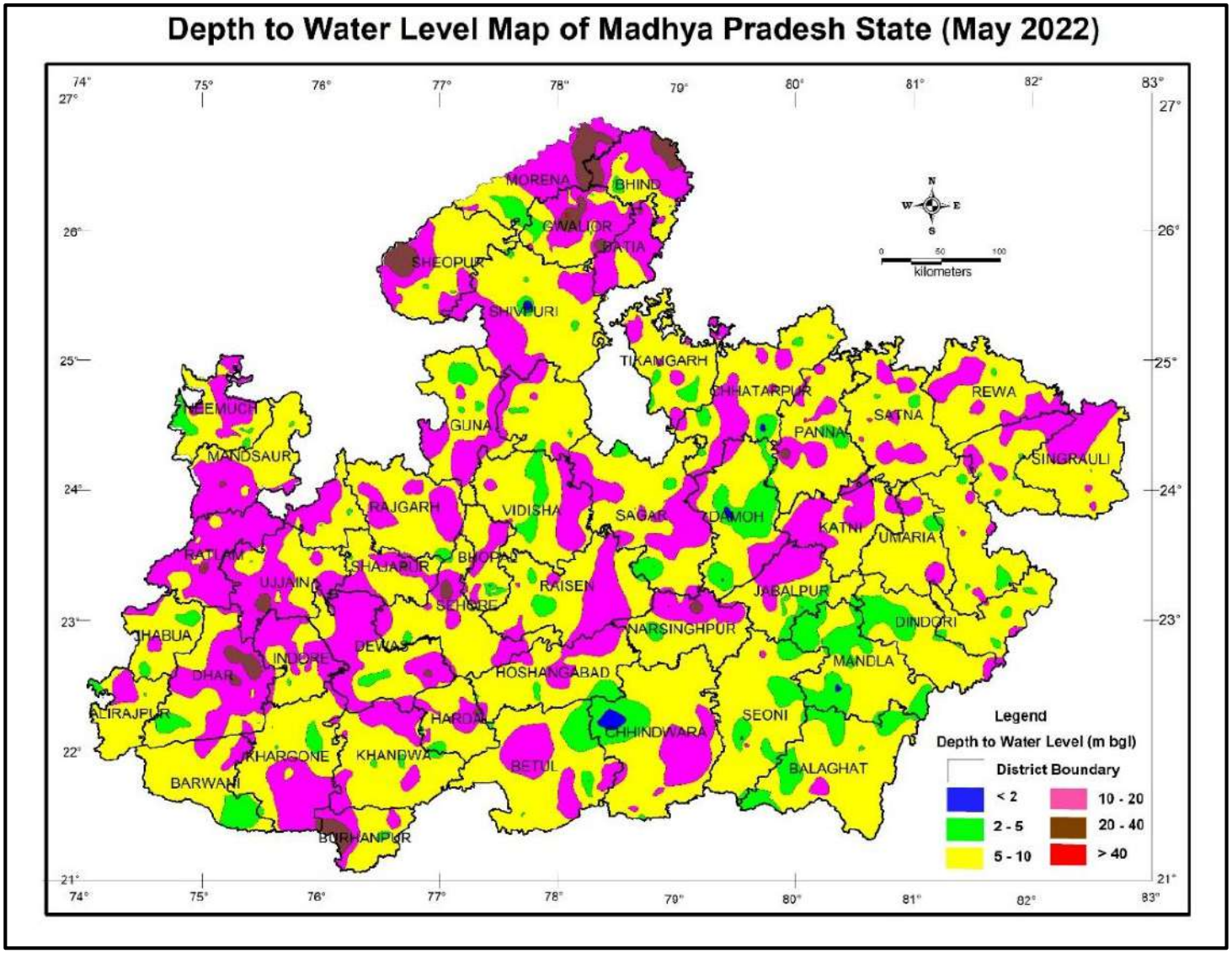


Fig 3.9: Pre monsoon Water level (May-2022), Madhya Pradesh

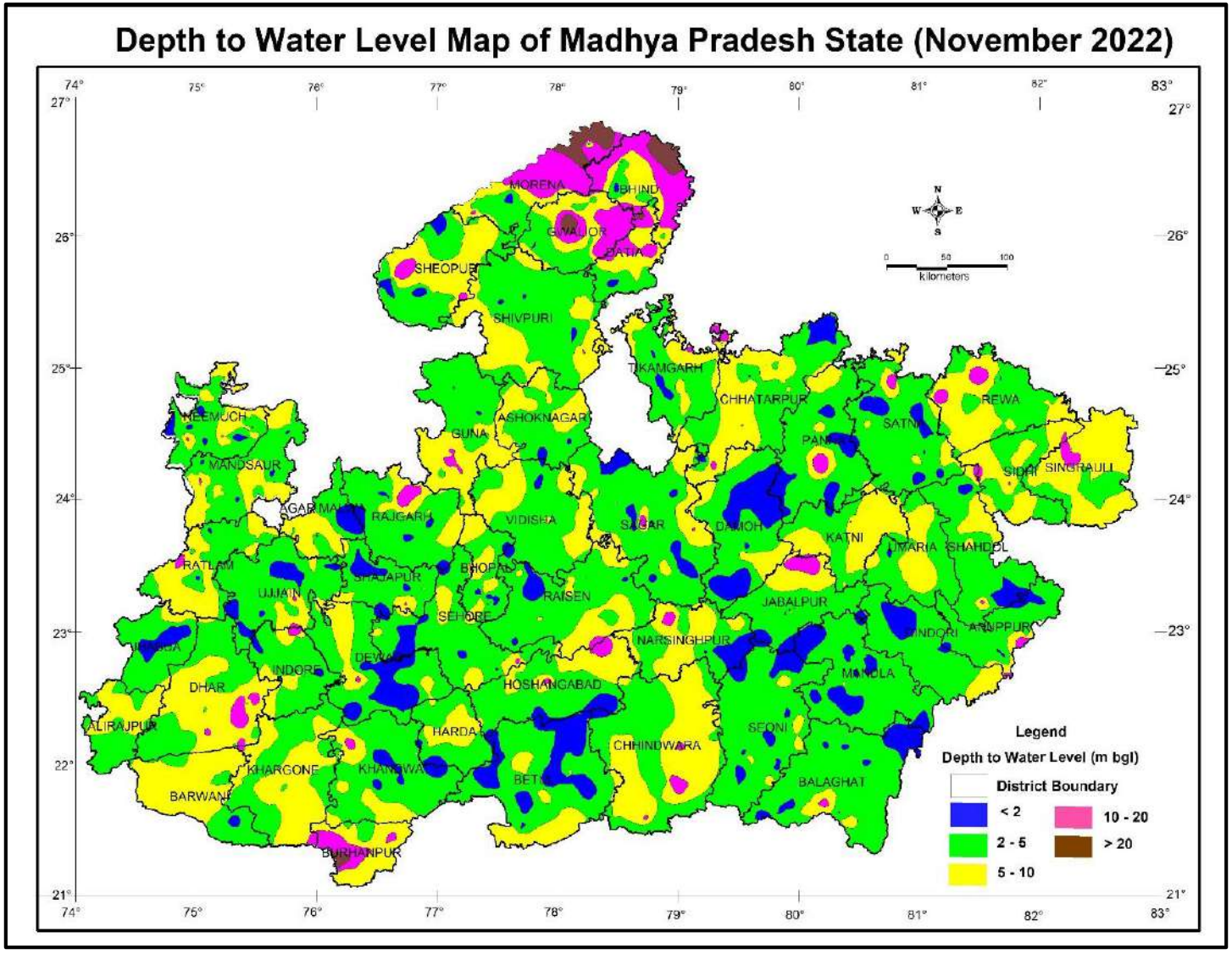


Fig 3.10: Post monsoon Water level (Nov-2022), Madhya Pradesh

3.7.1.1 Depth to Water Level: Pre-Monsoon (May- 2022)

Depth to Water levels ranges from 0.2 m bgl at Bhagora village, Shivpuri block, Shivpuri district to 44.62 m bgl at Nayagaon village, Ghatigaon block, Gwalior district. Very shallow water levels up to 2 m bgl are observed in very few wells (1.43% wells) and observed as small patches in parts of Shivpuri, Damoh, Mandla, Chindwara and Chhatarpur districts. About 15.44 % of the monitoring stations in the state have water levels ranging from 2-5 m bgl and occur in patches mostly in Central, Central-eastern and south eastern parts of state. Depth to water levels ranging from 5-10 m bgl is observed in 50.68% of the wells and they are spread in most parts of the State. Deeper groundwater levels ranging from 10-20 m bgl is observed in 29.75 % of the wells seen mostly in northern western, central, parts of the north-eastern parts, and in southwestern parts of the state in isolated patches. Groundwater levels of 20-40 m bgl are found in about 2.55 % of the wells found in Sheopur, Datia, Gwalior, Morena, Narsinghpur and Bhind confining to the northern part of the state and it is found in patches. Depth to Water level of more than 40 m bgl is found in 00.16 % of the wells and is found in the northern parts of the districts. The depth to water level map of Madhya Pradesh State for May 2022 is shown in **Fig 3.9**.

3.7.1.2 Depth to Water Level: Post-Monsoon (November-2022)

Depth to Water levels ranges from at ground level to 37.67 m bgl in Nayagaon village, Ghatigaon block, Gwalior district. Very shallow water levels up to 2 m bgl are seen in Betul, Sehore, Dewas, Jhabua, Agar Malwa, Shajapur, Ujjain, Damoh, Sagar, Raisen, Shahdol, Narsinghpur, Sheopur, Khandwa and Sagar, in pockets in many districts and about 19.12% of monitoring wells recorded water level less than 2 m bgl. About 47.79 % of monitoring wells spreading all over Madhya Pradesh state has recorded a water level in the depth range of 2-5 m bgl. Depth to water levels ranging 5-10 m bgl is noticed prominently in patches in all parts of the state and about 25.90 % of wells fall in this category. Deeper ground water levels ranging 10-20 m bgl are seen in northern part and in isolated patches in Dhar, Indore, Rajgarh, Burhanpur, Ratlam, Hosangabad, Chinndwara, Jabalpur, Rewa, Singrauli, Panna, Anuppur, and Balaghat districts and about 6.37 % of wells in the state fall in this category. Ground water levels of more than 20 m are found in about 0.78% of the wells and are seen in Bhind, Morena and Gwalior Districts. The depth to water level map of Madhya Pradesh State for November 2021 is shown in **Fig 3.10**.

3.8 HYDROCHEMISTRY OF GROUNDWATER

Water samples were collected from 1143 Ground Water Monitoring Wells during May 2022 and monitored for chemical quality of ground water (phreatic aquifer) and their location is

given in **Fig 3.8**. Detailed analysis of the chemical samples was carried out parameters namely: pH, Electrical Conductivity (EC), Carbonate, Bi-carbonate, Chloride, Fluoride, Nitrate, Sulphate, Phosphate, Total hardness, Calcium, Magnesium, Sodium and Potassium.

3.8.1 Salinity

The salinity of water is represented by electrical conductivity. Electrical conductivity is a numerical expression of the ability of water to conduct an electric current. It depends on the total concentration of the ionized substances dissolved in water and the temperature at which the measurement is made. Electrical conductivity increases by about 2% per degree Celsius rise in temperature. The mobility of the dissolved ions, their valencies and their concentration affect conductivity. As electrical conductivity is an index of salinity in water, high electrical conductivity means high salinity. High salinity not only imparts bad taste to drinking water but such water is not suitable for irrigation purposes as it leads to deposition of salt content in the soil and affects the fertility of soil in the absence of adequate soil management practices.

The water having electrical conductivity upto 1000 µSiem at 25°C may be considered fresh and suitable for drinking purpose. The Ground water quality of Madhya Pradesh is generally good as 61.07 % wells have electrical conductivity below 1000 µSiem at 25°C. The chemical quality of ground water of Madhya Pradesh is generally good as the perusal of the frequency distribution of electrical conductivity in Groundwater. **Table. 3.5** shows that 38% wells fall in the range of 1000-2000 µSiem at 25°C and only 1% wells have electrical conductivity more than 3000 µSiem at 25°C. The salinity tolerant crop may be grown in the area where electrical conductivity is more than 2000 µSiem 25°C.

Table 3.5: Frequency distribution of electrical conductivity in phreatic aquifer range

EC Range (µS/cm at 25°C)	**No. of Samples**	**%**
0-1000	698	61.07
1000-3000	433	37.88
>3000	12	1.05

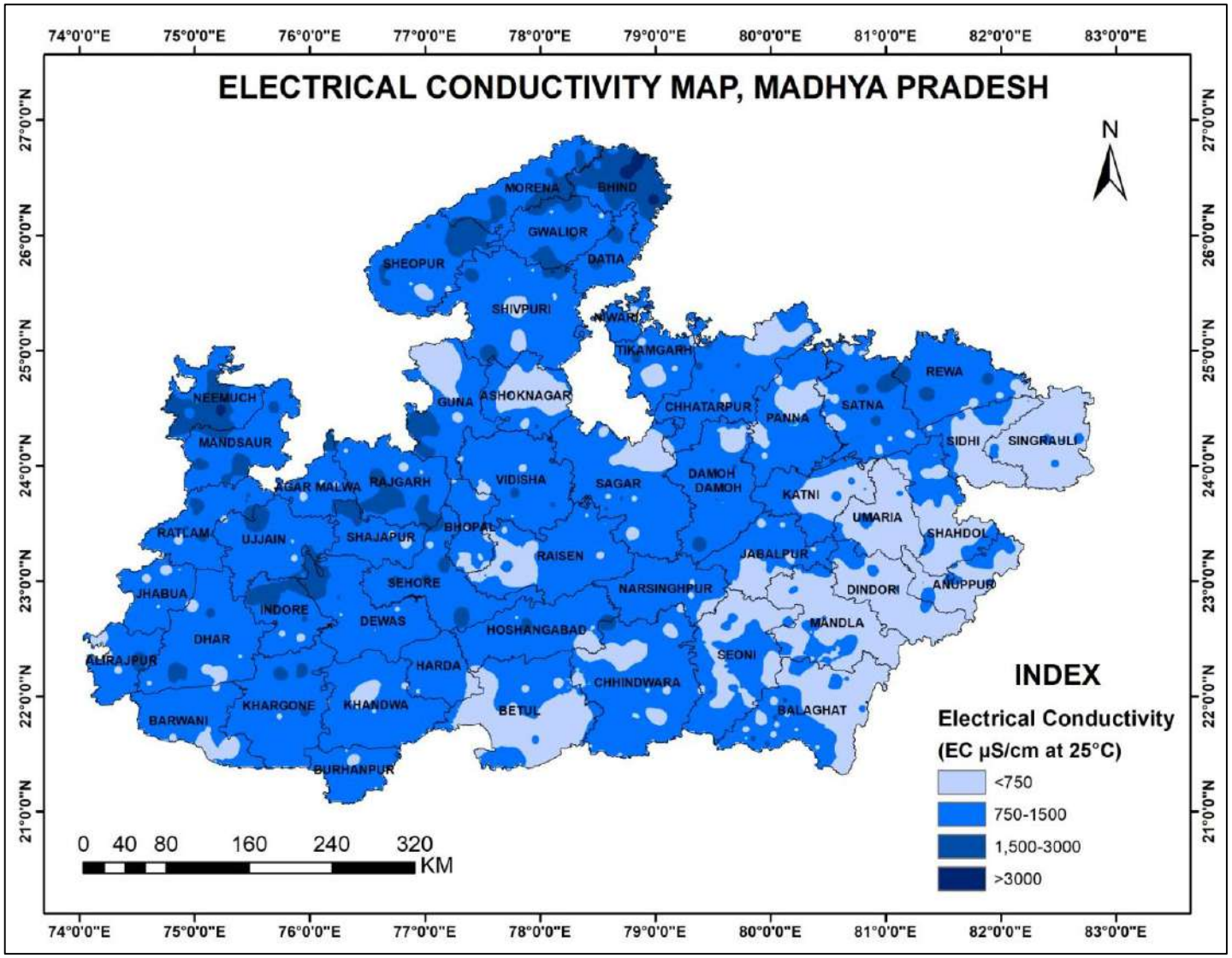


Fig 3.11: Electrical Conductivity in shallow aquifer, Madhya Pradesh

3.8.2 Fluoride

Generally, fluoride is present in low concentration in natural water. The presence of fluoride in ground water is very important from health point of view for human consumption as in low concentration; it prevents dental caries (upto 1.0 mg/l). However, the high concentration of fluoride above the permissible limit of 1.5 mg/l in drinking water (IS: 10500 Drinking water standards) is harmful for human consumption as it causes mottling of teeth and skeletal fluorosis. Its accumulation leads not only to high skeletal concentration, but also has crippling ill effects.

In Madhya Pradesh fluoride rich water in Groundwater occurs in Anuppur, Chhatarpur, Datia, Dindori, Neemuch, Seoni, Shajapur, and Singrauli districts. The distribution of fluoride in the State is shown in **Fig 3.12**. Flouride analysis reveals that there is no specific trend observed for distribution of Fluoride in the State. The maximum fluoride concentration has been observed at Kurri of Chhatarrpur district (1.95 mg/l).

Table 3.6: Frequency Distribution of Fluoride in Phreatic Aquifer

Fluoride Conc. Range (mg/l)	No. of Samples	%
< 1.00	1019	89.2
1.00-1.50	109	9.5
> 1.50	15	1.3

The frequency distribution of Fluoride is given in the **Table.3.6** shows that in 98.7% (1128 nos.) wells Fluoride concentration is within the desirable limit of 1.5 mg/l where as 1.5% (15 nos.) wells show Fluoride concentration above the maximum permissible limit of 1.5 mg/l.

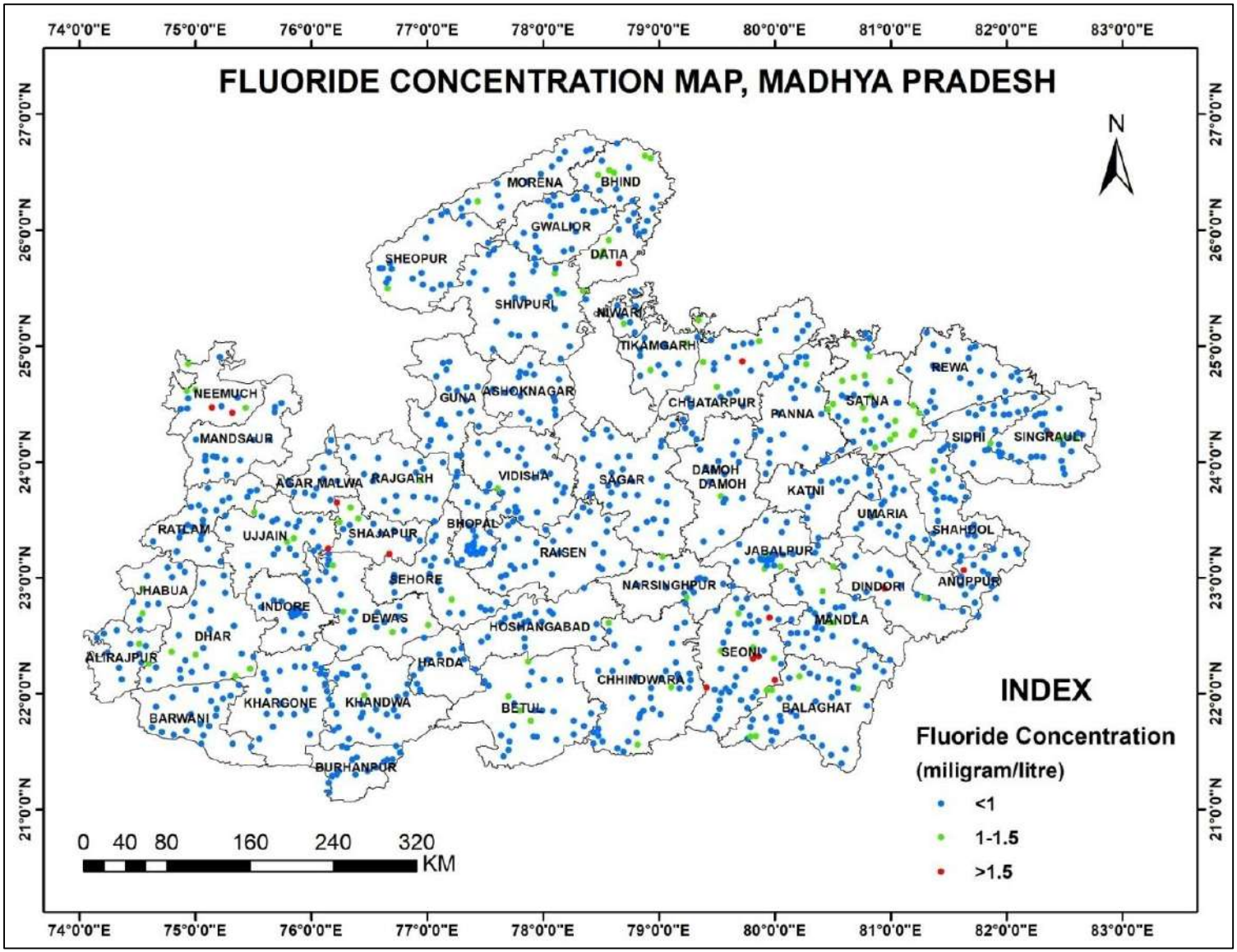


Fig 3.12: Fluoride Concentration in shallow aquifer, Madhya Pradesh

3.8.3 Nitrate

Undesirable changes in the natural quality of ground water due to anthropogenic activities of man are a matter of great concern. The contribution of atmospheric and geological sources for Nitrate in ground water is small in comparison to the sources related to pollution as a result of activities of man. Sewage and animal waste contain considerable amount of Nitrate and its discharge on land & subsequent leaching by rainfall causes enrichment of Nitrate in ground water. Similarly, agricultural sources such as excessive use of fertilizers, irrigation with wastewaters, legumes and farm yard wastes contribute nitrate to ground water.

Concentration of nitrate in excess of 45 mg/l in water is harmful for human consumption, particularly for infants as it may cause blue baby disease. The highest desirable and maximum permissible limit of nitrate is 45mg/l (IS: 10500 Drinking water standards). The locations of wells in Madhya Pradesh, where concentration of nitrate ion was more than 45 mg/l in ground water are shown in **Fig 3.13**. Perusal of frequency distribution of nitrate in ground water reveals that 76.29% (872 nos.) of wells have nitrate concentration within the permissible limit of 45mg/l, while 23.71% (271 nos.) well water contain nitrate in excess of 45 mg/l (**Table.3.7**).

Table 3.7: Frequency distribution of Nitrate in shallow aquifer

Nitrate Conc. Range (mg/l)	No. of Samples	%
< 45	872	76.29
>45	271	23.71

In Madhya Pradesh, nitrate concentration in Groundwater occurs in Agar Malwa, Alirajpur, Ashok Nagar, Balaghat, Barwani, Betul, Bhind, Bhopal , Burhanpur , Chhatarpur, Chhindwara, Damoh, Dewas, Dhar, Gwalior, Harda, Hoshangabad , Indore, Jabalpur, Jhabua, Katni, Khandwa, Khargone, Mandla, Mandsaur, Morena, Narsimhapur, Panna, Raisen, Rajgarh, Ratlam, Rewa, Sagar, Satna, Sehore, Seoni, Shahdol, Shajapur, Sheopur, Shivpuri, Sidhi, Tikamgarh, Ujjain, Umaria and Vidisha districts. The distribution of nitrate concentration in the State is shown in **Fig 3.13.** Very high nitrate concentration of 276 mg/l was found in the ground water sample from Bhagwara of Sheopur district.

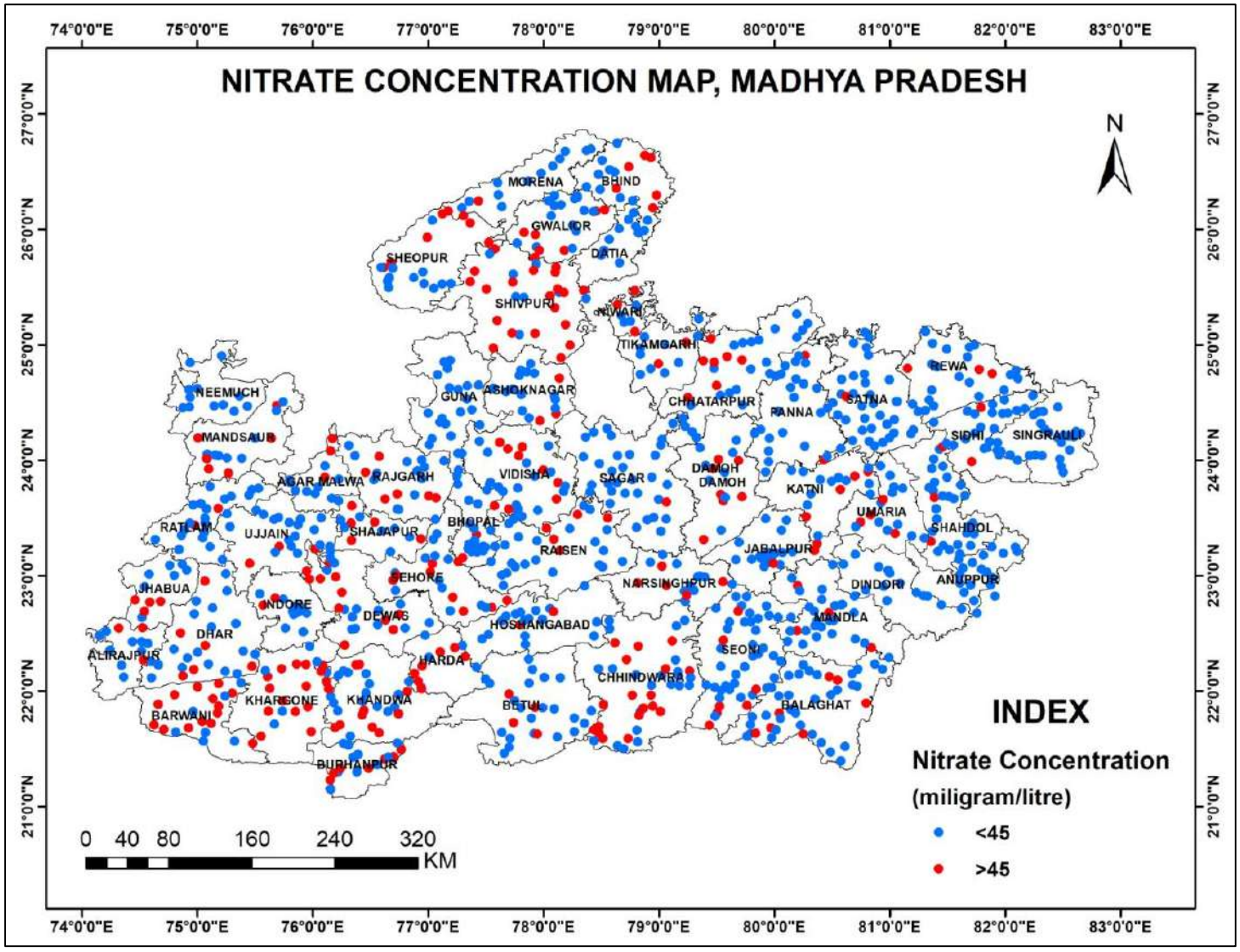


Fig 3.13: Nitrate Concentration in shallow aquifer, Madhya Pradesh

3.8.4 Total Hardness

Hardness is mainly caused by the presence of Calcium and Magnesium Bicarbonate, Sulphate and Chloride ions. As per Bureau of Indian Standard IS:10500: 2012 (Drinking water), the desirable limit of total hardness is 200 mg/l and permissible limit is 600 mg/l. Total Hardness in the shallow ground water in Madhya Pradesh ranges between 10 to 1485 mg/l (1485 mg/l in Dongarpur, Gwalior district). Most of the waters are calcium bicarbonate type attributing to temporary hardness of water. Permanent hardness of water caused by Calcium and Magnesium, Sulphate and Chloride can be removed by ion exchange.

Table 3.8: Frequency distribution of Total Hardness in shallow aquifer

Total Hardness Range (mg/l)	No. of Samples	%
<200	261	22.83
200-600	829	72.53
>600	53	4.64

The study of Total Hardness in ground water reveals that 53 nos. (5.20%) of well waters contain hardness more than the permissible limit of 600 mg/l and 829 nos. (72.53%) of well has total hardness above the desirable limit of 200 mg/l but below the permissible limit of 600 mg/l (**Table.3.8**).

3.8.5. Suitability for Irrigation

The crop productivity depends on the quality of the water used for irrigation. Water suitability for irrigation needs to be evaluated on the basis of hazards it can create in the soil, affecting yield & quality of crops. The potential hazards to crop growth are salinity, sodicity, alkalinity and toxicity.

3.8.6 Sodium absorption Ratio

Sodium Adsorption Ratio (SAR) is an estimate of the degree to which Sodium will be absorbed by soil from water. Sodium in irrigation, waters adversely affects soil structure and permissibility by replacing Ca and Mg ions.

$$SAR = \frac{Na^{+}}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

Where: Na+, Ca+2 and Mg+2 is expressed in meq/l

Table 3.9: Quality of Water on the basis of SAR values

SAR values	Sodium hazard class	Sample	% of samples	Remark
<10	S1	1130	98.86	Excellent
10 to 18	S2	12	1.05	Good
19 - 26	S3	1	0.09	Doubtful/fair poor

SAR values	Sodium hazard class	Sample	% of samples	Remark
>26	S4 and S5	0	0.00	Unsuitable

Table 3.9 shows that the quality of water samples as per SAR is good as 98.86% (1130 nos.) wells have SAR value below 10.

3.8.7 Residual Sodium Carbonate

Residual Sodium Carbonate (RSC): Equals the sum of bicarbonate and Carbonate ion concentration minus the sum of Calcium & Magnesium ions, when all the ions are expressed in meq/l.

$$RSC = (CO_3^{--} + HCO_3^{-}) - (Ca^{++} + Mg^{++})$$

According to Eaton (1950) and USSL (1954), irrigation waters containing residual sodium carbonate (RSC) above 2.5 meq/l are not suitable for irrigation purpose. Water containing 1.25 to 2.5 meq/l of RSC is marginally suitable & those containing less than 1.25 meq/l of RSC are safe. The water quality of Madhya Pradesh has been evaluated on the basis of RSC in in **Table 3.10**.

Table 3.10: Number of wells falling in different RSC ranges

RSC (epm)	No of samples	% of samples	Indication	Remark on quality
<1.25	958	83.81	Can be used safely	Good
1.25 - 2.50	100	8.75	Can be used with certain management	Doubtful
>2.50	85	7.44	Unsuitable for irrigation purposes	Unsuitable

Nearly 93 % (1058 Nos.) of dug well waters of Madhya Pradesh were found to have RSC values below 2.5 meq/l, which infers that the water is free from alkalinity hazards. However, 7.4 % (85 Nos.) of wells have RSC more than 2.5 meq/l. Excessive use of these high RSC waters for irrigation can adversely affect fertility of the soil in the area by making it alkaline, resulting at times in hardening of the soil due to deposition of sodium carbonate. For safe use of such waters gypsum requirement for different soils needs to be evaluated.

Maximum and minimum values and values exceeding desirable and permissible limit for drinking use of different parameters is shown in the **Table 3.11**.

Table 3.11: showing maximum and minimum values and values exceeding desirable and permissible limit for drinking use of different parameters

	BIS (desirable limit)	BIS (permissi ble limit)	Range of values (Min)	Range of values (Max)	Average	No. of samples exceeding desirable limit limit	% samples exceeding desirable limit limit	No. of samples exceeding permissible limit	% samples exceeding permissible limit
pH	6.5	8.5	6.54	8.30	7.65	0	0	0	0
TDS	500	2000	120	2919	644	713	62	11	1
Total Hardness	200	600	10	1485	303	815	71	53	5
Ca	75	200	2	516	85	497	43	47	4
Mg	30	100	1	146	22	106	9	1	0
Cl	250	1000	10	937	111	102	9	0	0
S04	200	400	4	189	22	0	0	0	0
N03	45	No relaxation	0	276	35	271	24	271	24
F	1	1.5	0.00	1.95	0.51	105	9	15	1
Total Alkalinity	200	600	24	1885	341	922	81	53	5

CHAPTER 4

4.0 COMPUTATION OF GROUND WATER RESOURCE

The Dynamic ground water resources (as in 2023) of Madhya Pradesh have been assessed jointly by Central Ground Water Board, North Central Region, Bhopal and Ground Water Survey, Water Resource Department, Govt. of Madhya Pradesh under the supervision of State Level Committee. The dynamic ground water resources are also known as Annual Ground Water Recharge, since it gets recharged every year from rainfall and other sources (secondary sources) such as applied irrigation water, surface water bodies, water conservation structures, etc. Methodology adopted for the assessment has been outlined in **Chapter 2** of this report. This section provides a summary of the Ground Water Resources Assessment 2023 (GWRA-2023) made for the state. Data of rainfall, ground water structures, canal, tanks ponds etc. are collected of five years from 2018 to 2022. The water level data are used from 2013 to 2022.

4.1 ASSESSMENT UNITS

In the current assessment year, the ground water resources have been computed for all 317 assessment units (313 administrative blocks and 4 urban areas i.e Bhopal, Indore, Gwalior and Jabalpur.) of Madhya Pradesh.

The following sub-units are taken into account for the computation of various figures in the methodology and have been considered as given below: -

4.1.1 Hilly Area

This sub-unit comprises of all portions of ground water assessment unit which have slopes greater than 20%. This sub-unit is characterized by more runoff and less ground water recharge, and hence has been excluded for ground water recharge computation.

4.1.2 Poor Ground Water Quality Area

There is no clear cut demarcated area of poor quality in the State for computation of ground water resources. Apart from this, statistical data of ground water structure is also not available. Hence this unit has not been considered for resource estimation.

4.1.3 Command and Non-Command Area

In the methodology, it is recommended that dynamic ground water resources estimation should be carried out for command area and non-command area separately. This has been followed. For computation of ground water resources of command area only medium and major command areas have been considered.

Block-wise total geographical areas, hilly area, command area, non-command area and area worthy for ground recharge are given in **Annexure I**, whereas district-wise geographical areas,

hilly area, command area, non-command area and area worthy for ground recharge are shown in **Table 4.1.**

Table 4.1: District wise Area Details

S.N.	District	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non-Command Area	Total		
1	Agar Malwa	11375	240201	251576	20617	272193
2	Alirajpur	0	305400	305400	26400	331800
3	Anuppur	0	294200	294200	78200	372400
4	Ashoknagar	20650	441594	462244	5150	467394
5	Balaghat	101503	790290	891793	31107	922900
6	Barwani	68712	298119	366831	175369	542200
7	Betul	26248	830202	856450	147850	1004300
8	Bhind	179891	266009	445900	0	445900
9	Bhopal	0	264800	264800	12437	277237
10	Burhanpur	11289	245761	257050	66250	323300
11	Chhatarpur	116640	673794	790434	78302	868736
12	Chhindwara	13311	871466	884777	296723	1181500
13	Damoh	57667	416952	474619	255981	730600
14	Datia	132097	134103	266200	2900	269100
15	Dewas	18544	558538	577082	125002	702084
16	Dhar	149070	663570	812640	2660	815300
17	Dindori	0	456000	456000	116500	572500
18	Guna	37209	580305	617514	21486	639000
19	Gwalior	131133	297167	428300	28100	456400
20	Harda	79150	190940	270090	62910	333000
21	Hoshangabad	253623	304729	558352	112048	670400
22	Indore	5376	376521	381897	7903	389800
23	Jabalpur	80876	362992	443868	78225	522093
24	Jhabua	17018	294235	311253	34747	346000
25	Katni	33404	433244	466648	22752	489400
26	Khandwa	92560	488886	581446	171004	752450
27	Khargone	156918	499979	656897	146103	803000
28	Mandla	31070	542920	573990	180410	754400
29	Mandsaur	74088	421552	495640	57366	553006
30	Morena	224789	213700	438489	58400	496889
31	Narsinghpur	52769	426331	479100	34200	513300
32	Neemuch	17976	357768	375744	44300	420044
33	Niwari	12830	139732	152562	3900	156462
34	Panna	32712	629763	662475	51025	713500
35	Raisen	58600	602340	660940	185700	846640
36	Rajgarh	0	615498	615498	0	615498

S.N.	District	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non-Command Area	Total		
37	Ratlam	8614	452986	461600	24500	486100
38	Rewa	85364	508396	593760	37600	631360
39	Sagar	40053	885365	925418	99782	1025200
40	Satna	47108	624998	672106	79910	752016
41	Sehore	95559	368413	463972	193828	657800
42	Seoni	71956	733064	805020	70780	875800
43	Shahdol	5047	492753	497800	86300	584100
44	Shajapur	0	340617	340617	6708	347325
45	Sheopur	71150	462330	533480	127120	660600
46	Shivpuri	69421	907628	977049	50751	1027800
47	Sidhi	48890	311515	360405	124995	485400
48	Singrauli	6602	444658	451260	115940	567200
49	Tikamgarh	26862	308676	335538	12800	348338
50	Ujjain	0	593933	593933	19090	613023
51	Umaria	0	421900	421900	32000	453900
52	Vidisha	76287	594483	670770	66330	737100
State Total (Ha)		**2952011**	**23981316**	**26933327**	**3890461**	**30823788**
State Total (Sq. Km)		**29520.11**	**239813.16**	**269333.3**	**38904.61**	**308237.9**

4.2 GROUND WATER RESOURCES OF MADHYA PRADESH

Groundwater resources of Madhya Pradesh State have been computed according to Methodology and norms described in **Chapter 2**. The assessment wise details have been provided in **Annexure (I to IV)**. The Salient features of the computations are given below.

4.2.1 Recharge from Rainfall

Recharge from rainfall has been computed separately for monsoon and non-monsoon periods as well as for command and non-command areas. Recharge from rainfall is mainly a function of geographical area of the district, normal monsoon rainfall and lithology of the area.

The recharge from rainfall during monsoon season has been computed using Water Level Fluctuation Method and Rainfall Infiltration Factor Method, whereas recharge from rainfall during non-monsoon period has been computed using Rainfall Infiltration Factor Method. Details of the Assessment unit-wise monsoon and non-monsoon Rainfall recharge have been given in **Annexure II**. District-wise recharge from rainfall is given in **Table.4.2**.

Non-monsoon rainfall recharge is taken into account in Annupur, Balaghat, Betul, Burhanpur, Chhindwara, Dindori, Mandla, Rewa, Satna, Seoni, Shahdol, Sidhi and Umaria districts, where non monsoon rainfall is more than 10% of the total annual rainfall. Total recharge from rainfall

in the State is of the order of 2707390 ham (27.07 bcm) which is approximately 76% of the total annual ground water recharge (**Fig 4.1**) with Hoshangabad district having the highest rainfall recharge of 130456 ham and Niwari district has minimum rainfall recharge of the order of 14460 ham.

4.2.2 Recharge from Other Sources

Total Recharge to ground water has several components, rainfall being the major one. The other component include seepage from canals, return flow from surface water irrigation, return flow from ground water irrigation, seepage from Tanks and Ponds, recharge from water conservation structures and in urban areas recharge from pipeline leakages for command area. For non–command area seepage from canals and return flow from surface water irrigation is not applicable. Assessment wise recharge from other sources has been given in **Annexure II**. District- wise recharge from other sources is given **Table 4.2**. Component of recharge from other sources is highest in Khandwa district (56943 ham) where maximum canal irrigation facility is available. Lowest value of recharge from other source is recorded in Anuppur (601 ham) and Dindori (907 ham). Total recharge from rainfall is 2707390 ham (27.07 bcm) whereas from other sources is 840018 ham (8.4 bcm). Assessment wise recharge from canals, surface water irrigation, ground water irrigation, seepage from Tanks and Ponds, water conservation structures and pipelines has been given in **Annexure III**. District- wise recharge from canals, surface water irrigation, ground water irrigation, seepage from Tanks and Ponds, water conservation structures and pipelines is given **Table 4.3**.The Ground Water Recharge from other resources scenario is shown in the **Fig.4.2**.

4.2.3 Recharge from All Sources

The overall contribution of rainfall (both monsoon & non-monsoon) recharge to state's total annual ground water recharge is 76 % and the share of recharge from 'Other sources' viz. canal seepage, return flow from irrigation, recharge from tanks, ponds and water conservation structures taken together is 24 % (**Fig 4.1**). The district wise comparison rainfall recharge and recharge from other sources is prepared and presented in **Fig.4.4** and district wise recharge from 'Other sources' viz. canal seepage, return flow from irrigation, recharge from tanks, ponds and water conservation structures is shown in **Fig.4.5.** Total replenishable ground water resources including rainfall recharge and recharge from other sources have been computed on assessment- wise and by adding up assessment wise figures of the respective districts which is presented in **Annexure II** and **Table. 4.2**. Total annual recharge from all sources in the State is of the order of 3547408.4 ham (35.47 bcm), with Hoshangabad district having the highest recharge of 179274 ham and Niwari district has minimum recharge of the order of 19644 ham.

Volumetric estimates are dependent on the areal extent of the assessment units. In order to compare the ground water resource of different assessment units, the volumetric estimates of annual ground water recharge have been converted to depth units (m) by dividing the annual ground water recharge by the recharge worthy area of the respective assessment units (km^2). Spatial variation in annual ground water recharge (m) is shown in **Fig 4.6**.

4.2.4 Unaccounted Natural Discharge and Annual Extractable Ground Water Resource

The total annual ground water recharge of the area is the sum of monsoon and non-monsoon recharge. An allowance of 5% of total annual ground water recharge has been kept for natural discharge in the non-monsoon season, recharge is considered of WLF method is employed to compute rainfall recharge during monsoon season otherwise 10%. The balance ground water available accounts for existing net ground water availability for various uses and potential for future development. Assessment wise unaccounted natural discharge and Annual Extractable Ground Water Resource is given in **Annexure II** whereas district wise unaccounted natural discharge and Annual Extractable Ground Water Resource is given in **Table 4.2**. Total unaccounted natural discharge in the State is of the order of 262033 ham (2.62 bcm) with Hoshangabad district having the highest discharge of 15577 ham and Niwari district with lowest of 1523 ham. The total natural discharge in the state is about 7% of the total annual Groundwater recharge (**Fig 4.3**). The Annual Extractable Ground Water Resource in the state is 3285375 ham (32.85 bcm) with Hoshangabad district having the highest Annual Extractable Ground Water Resource of 163696 ham and Niwari with lowest of 18120 ham. The Annual Extractable Ground Water Resource in the state which is 93% of the total annual Groundwater recharge (**Fig 4.3**).

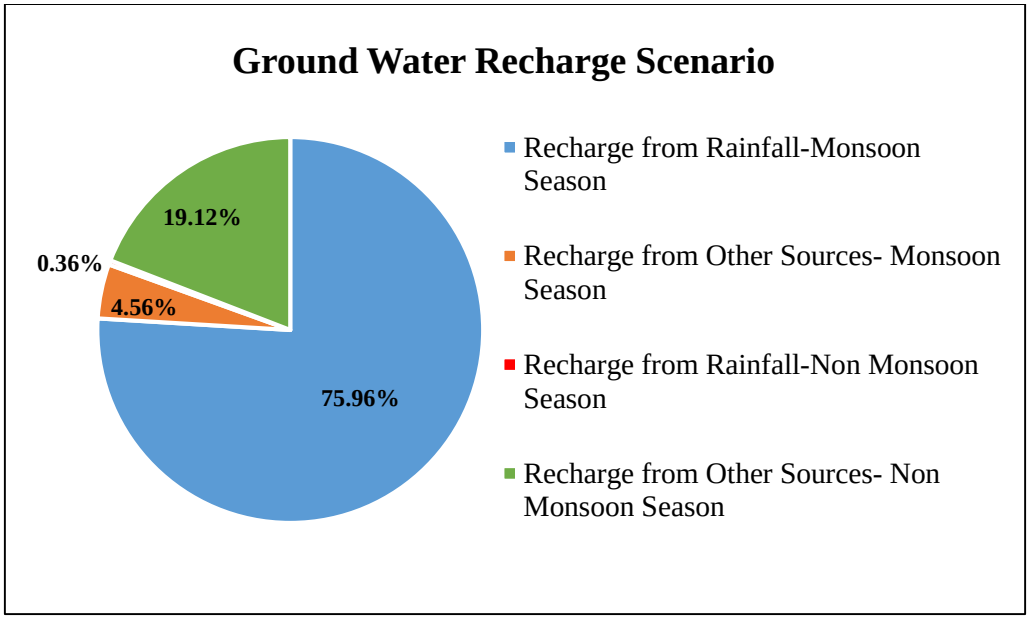


Fig. 4.1: Ground Water Recharge Scenario, Madhya Pradesh

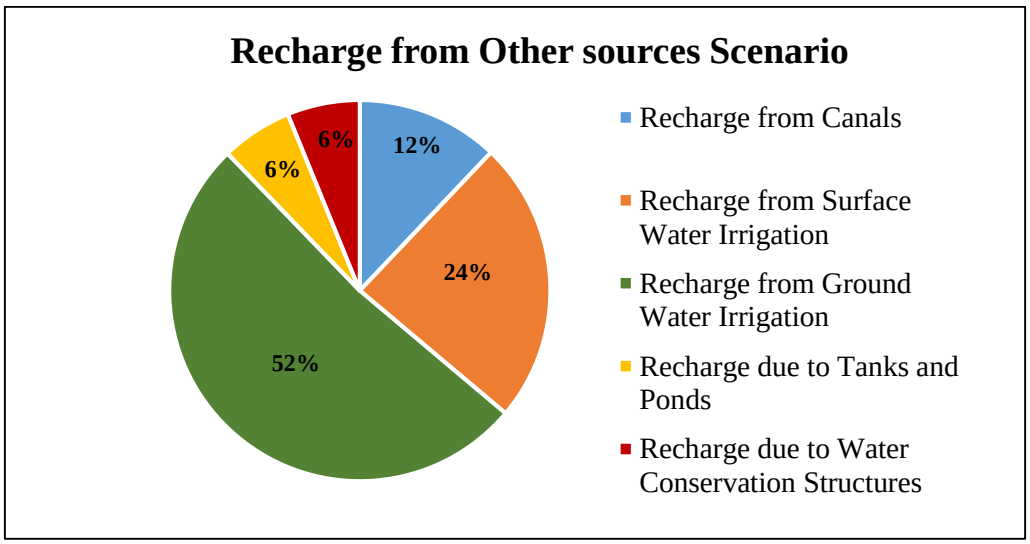


Fig. 4.2: Recharge from other Sources Scenario, Madhya Pradesh

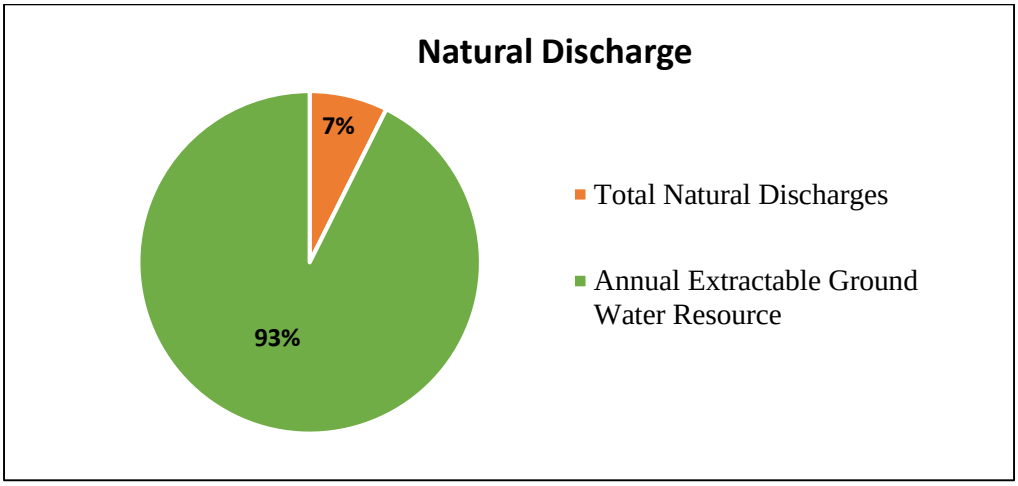
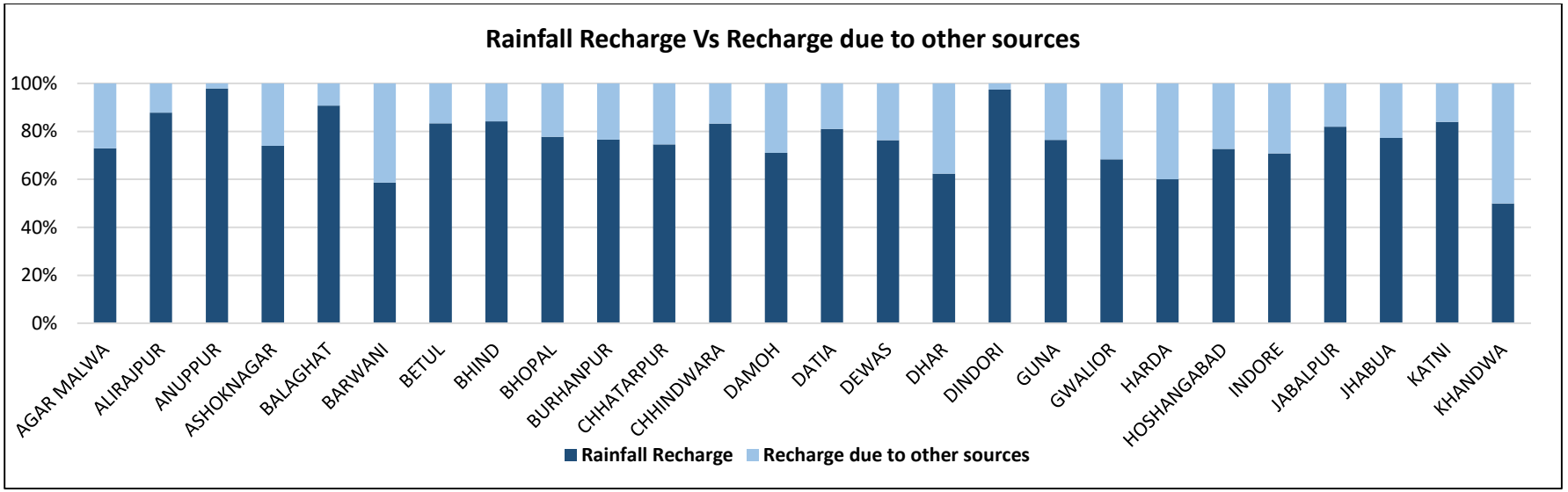


Fig. 4.3: Natural Discharge Vs Total Recharge



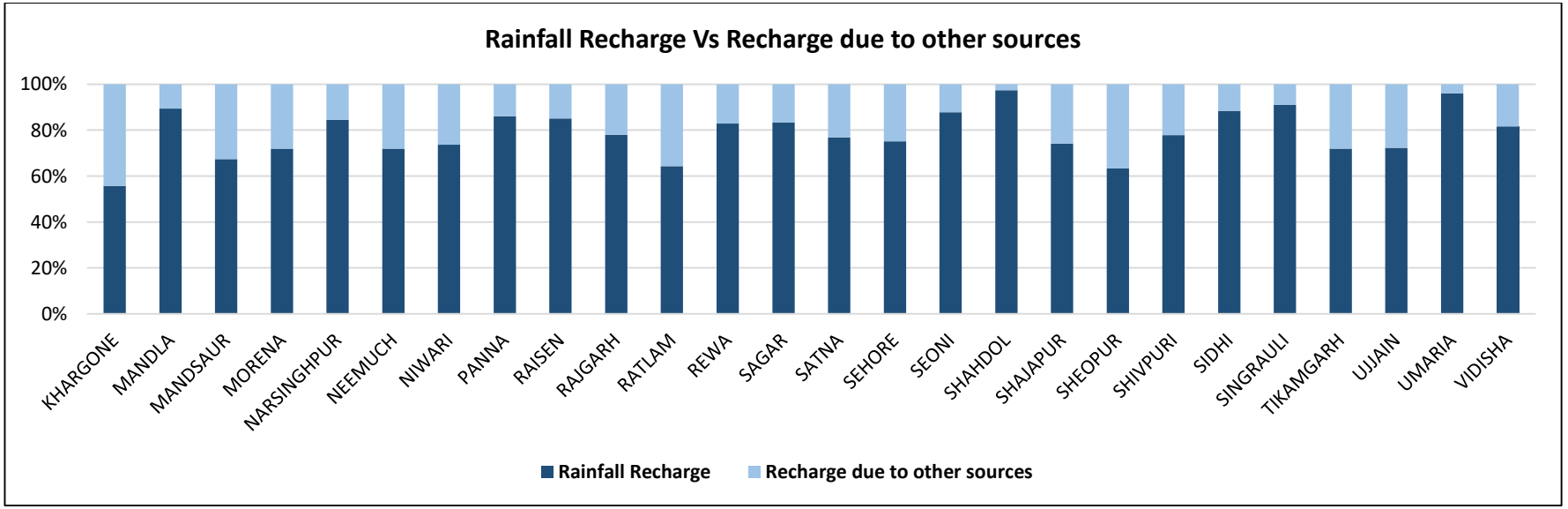


Fig.4.4: District wise Rainfall Recharge Vs Recharge from Other Sources

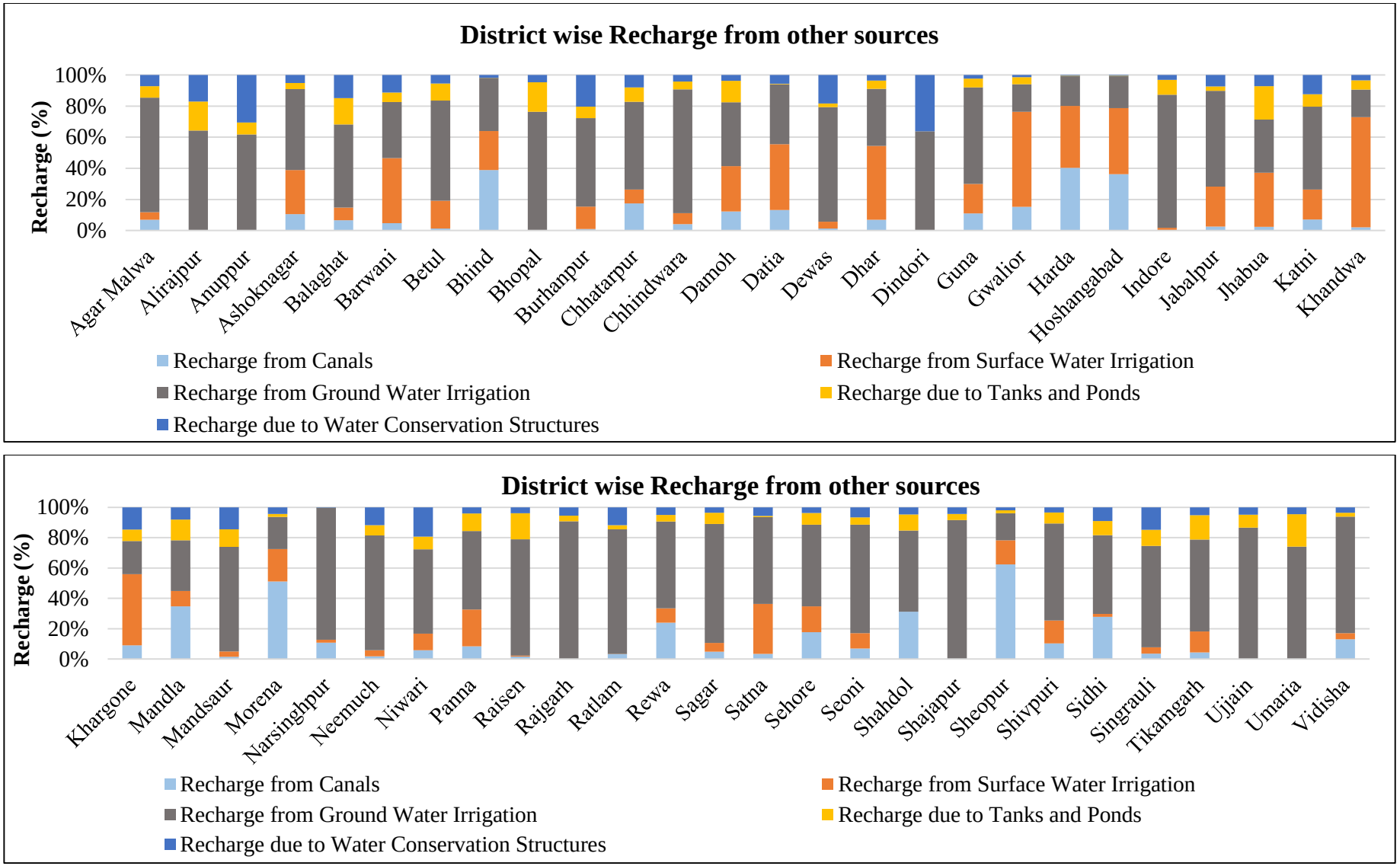


Fig.4.5: Comparison of District wise Recharge from other resource

Table 4.2 District wise Recharge, Madhya Pradesh

S. N.	District	Ground Water Recharge (ham)					Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
		Monsoon Season		Non-Monsoon Season		Total Annual Ground Water Recharge		
		Recharge from rainfall	Recharge from other Sources	Recharge from Rainfall	Recharge from other Sources			
1	**Agar Malwa**	31757.01	2604.03	0	9187.76	43548.8	3145.59	40403.21
2	**Alirajpur**	18876.87	770.93	0	1842.27	21490.07	1559.87	19930.2
3	**Anuppur**	26118.32	200.17	2107.1	400.77	28826.36	1832.62	26993.74
4	**Ashoknagar**	29228.49	2196.8	0	8067.76	39493.05	2668.71	36824.34
5	**Balaghat**	69810.74	3960.44	224.2	3158.61	77153.99	5204.94	71949.04
6	**Barwani**	32743.41	3706.25	0	19392.12	55841.78	3805.6	52036.18
7	**Betul**	85090.59	3707.86	2418.12	13682.15	104898.72	7148.41	97750.31
8	**Bhind**	82570.26	1679.99	0	13789.97	98040.22	8086.63	89953.59
9	**Bhopal**	31677.21	2441.93	0	6631.29	40750.43	2801.68	37948.75
10	**Burhanpur**	27844.06	1986.04	264.63	6586.68	36681.41	2718.56	33962.85
11	**Chhatarpur**	64676.93	5042.92	0	17041.54	86761.39	5861.63	80899.76
12	**Chhindwara**	86713.02	4167.05	604.31	13324.36	104808.74	7203.55	97605.19
13	**Damoh**	27977.31	2179.31	0	9222.16	39378.78	2802.61	36576.17
14	**Datia**	34922.82	908.75	0	7244.29	43075.86	2953.54	40122.32
15	**Dewas**	66076.9	5016.1	0	15456.72	86549.72	5605.14	80944.58
16	**Dhar**	86346.09	6948.91	0	45165.44	138460.44	10693.76	127766.67
17	**Dindori**	33813.45	277.72	288.23	628.8	35008.2	1750.4	33257.8
18	**Guna**	62490.49	4340.17	0	14851.05	81681.71	4367.12	77314.59
19	**Gwalior**	56193.02	7877.46	0	18174.39	82244.87	6471.15	75773.72
20	**Harda**	28181.73	2916.12	0	15859.07	46956.92	3009.31	43947.6
21	**Hoshangabad**	130455.74	7570.29	0	41247.63	179273.66	15577.28	163696.36
22	**Indore**	41623.6	4517.11	0	12608.31	58749.02	5312.66	53436.36

S. N.	District	Ground Water Recharge (ham)					Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
		Monsoon Season		Non-Monsoon Season		Total Annual Ground Water Recharge		
		Recharge from rainfall	Recharge from other Sources	Recharge from Rainfall	Recharge from other Sources			
23	**Jabalpur**	54728.53	3205.37	0	8795.3	66729.2	5432.37	61296.83
24	**Jhabua**	20152.36	1230.75	0	4700.23	26083.34	1802.86	24280.48
25	**Katni**	34347.6	1827.32	0	4750.49	40925.41	2896.22	38029.19
26	**Khandwa**	56949.53	4252.59	0	52690.25	113892.37	8696.11	105196.25
27	**Khargone**	54255.99	6263.73	0	36982.82	97502.54	5354.7	92147.84
28	**Mandla**	43130.31	1059.93	865.06	4178.82	49234.12	2461.69	46772.43
29	**Mandsaur**	47096.4	5924.83	0	16874.16	69895.39	6713.91	63181.48
30	**Morena**	50183.87	1569.49	0	18057.95	69811.31	5195.77	64615.54
31	**Narsinghpur**	104751.62	3201.53	0	15975.25	123928.4	11166.07	112762.33
32	**Neemuch**	28918.55	2792.12	0	8454.47	40165.14	4016.51	36148.63
33	**Niwari**	14459.5	1292.7	0	3891.47	19643.67	1523.55	18120.11
34	**Panna**	47030.15	1424.67	0	6206.71	54661.53	4060.04	50601.49
35	**Raisen**	79475.6	3545.99	0	10376.31	93397.9	6583.98	86813.92
36	**Rajgarh**	71614.53	4550.51	0	15698.2	91863.24	5339.02	86524.22
37	**Ratlam**	54707.36	7371.69	0	22937.37	85016.42	8113.75	76902.67
38	**Rewa**	44966.31	2007.67	283.37	7324.72	54582.07	4761.11	49820.96
39	**Sagar**	92434.64	3894.23	0	14470.03	110798.9	8427.56	102371.34
40	**Satna**	56099.46	2691.5	1151.73	14527.88	74470.57	5452.29	69018.27
41	**Sehore**	55598.77	3823.16	0	14546.01	73967.94	6473.35	67494.59
42	**Seoni**	61319.08	2229.07	2284.48	6595.87	72428.5	4034.98	68393.52
43	**Shahdol**	53203.74	327.6	1305.53	1133.92	55970.79	2798.53	53172.26
44	**Shajapur**	41301.49	3338.58	0	11063.98	55704.05	4235.84	51468.21
45	**Sheopur**	35367.05	1089.85	0	19374.62	55831.52	5156.95	50674.57

S. N.	District	Ground Water Recharge (ham)					Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
		Monsoon Season		Non-Monsoon Season		Total Annual Ground Water Recharge		
		Recharge from rainfall	Recharge from other Sources	Recharge from Rainfall	Recharge from other Sources			
46	**Shivpuri**	66541.87	3838.62	0	15047.29	85427.78	7107.83	78319.96
47	**Sidhi**	27340.89	799.27	392.3	2837.24	31369.7	2157.43	29212.27
48	**Singrauli**	33965.21	838.15	0	2519.96	37323.32	1866.17	35457.15
49	**Tikamgarh**	28753.79	2755.05	0	8434.69	39943.53	3514.7	36428.83
50	**Ujjain**	72131.6	5918.96	0	21647.62	99698.18	8325.12	91373.06
51	**Umaria**	34464.53	416.86	659.44	1032.75	36573.58	2334.23	34239.35
52	**Vidisha**	74063.34	3153.79	0	13676.72	90893.85	5450	85443.85
	Total (Ham)	**2694541.73**	**161651.93**	**12848.5**	**678366.24**	**3547408.4**	**262033.4**	**3285374.93**
	Total (Bcm)	**26.95**	**1.62**	**0.13**	**6.78**	**35.47**	**2.62**	**32.85**

Table 4.3: District wise Recharge from other source components

S.N.	District	Recharge from Canals (Ham)	Recharge from Surface Water Irrigation (Ham)	Recharge from Ground Water Irrigation (Ham)	Recharge due to Tanks and Ponds (Ham)	Recharge due to Water Conservation Structures (Ham)	Recharge due to Pipelines (Ham)	Total Recharge from Other Sources (Ham)
1	Agar Malwa	822.45	575.21	8666.67	883.32	844.14	0.00	11791.79
2	Alirajpur	0	0	1680.59	486.63	445.99	0.00	2613.21
3	Anuppur	0	0	370.89	46.48	183.57	0.00	600.94
4	Ashoknagar	1078.16	2912.64	5345.35	404.31	524.08	0.00	10264.54
5	Balaghat	476.37	573.54	3800.71	1212.68	1055.76	0.00	7119.06
6	Barwani	1078.61	9670.01	8344.33	1402.6	2602.84	0.00	23098.39
7	Betul	221.91	3097.01	11205.93	1909.74	955.43	0.00	17390.02
8	Bhind	6027.16	3860.51	5279.54	1.15	301.59	0.00	15469.95
9	Bhopal	0	0	5979.09	1490.14	369.38	1234.61	9073.22
10	Burhanpur	83.95	1240.89	4865.79	634.35	1747.72	0.00	8572.70
11	Chhatarpur	3858.06	1977.59	12434.66	2039.58	1774.57	0.00	22084.46
12	Chhindwara	708.57	1234.68	13928.52	867.38	752.26	0.00	17491.41
13	Damoh	1403.38	3311.6	4689.42	1568.61	428.50	0.00	11401.51
14	Datia	1081.84	3437.69	3144.21	26.34	462.96	0.00	8153.04
15	Dewas	267.81	884.88	15089.34	468.89	3761.90	0.00	20472.82
16	Dhar	3624.05	24737.15	19072.12	2826.52	1854.48	0.00	52114.32
17	Dindori	0	0	579.02	0	327.50	0.00	906.52
18	Guna	2114.45	3640.06	11902.21	1071.72	462.78	0.00	19191.22
19	Gwalior	3909.53	15623.83	4513.03	1184.57	360.98	459.90	26051.84
20	Harda	7578.09	7456.05	3603.85	53.03	84.18	0.00	18775.20
21	Hoshangabad	17689.76	20742.26	10016.31	125.64	243.93	0.00	48817.90
22	Indore	53.17	224.85	13605.4	1518.02	492.09	1231.88	17125.41

S.N.	District	Recharge from Canals (Ham)	Recharge from Surface Water Irrigation (Ham)	Recharge from Ground Water Irrigation (Ham)	Recharge due to Tanks and Ponds (Ham)	Recharge due to Water Conservation Structures (Ham)	Recharge due to Pipelines (Ham)	Total Recharge from Other Sources (Ham)
23	Jabalpur	291.37	2938.05	7057.8	326.86	839.10	547.50	12000.68
24	Jhabua	138.7	2064.42	2030.54	1266.34	430.98	0.00	5930.98
25	Katni	462.66	1270.17	3503.67	523.27	818.02	0.00	6577.79
26	Khandwa	1143.21	40331.92	10135.4	3336.37	1995.94	0.00	56942.84
27	Khargone	3888.87	20296.09	9431.52	3276.71	6353.34	0.00	43246.53
28	Mandla	1814.45	534.6	1752.07	714.93	422.71	0.00	5238.76
29	Mandsaur	327.6	793.15	15729.71	2643.73	3304.81	0.00	22799.00
30	Morena	10037.27	4177.61	4155.68	390.96	865.91	0.00	19627.43
31	Narsinghpur	2076.27	371.7	16650.35	3.64	74.84	0.00	19176.80
32	Neemuch	201.6	447.56	8518.25	753.44	1325.73	0.00	11246.58
33	Niwari	301.2	569.27	2880.01	428.99	1004.70	0.00	5184.17
34	Panna	641.86	1850.36	3942.77	886.03	310.35	0.00	7631.37
35	Raisen	225.28	91.09	10657	2412.92	535.99	0.00	13922.28
36	Rajgarh	0	0	18387.85	735.88	1125.00	0.00	20248.73
37	Ratlam	1008	19.44	24859.57	850.41	3571.61	0.00	30309.03
38	Rewa	2227.35	889.42	5343.07	409.17	463.41	0.00	9332.42
39	Sagar	889.62	1061.21	14391.62	1363.95	657.85	0.00	18364.25
40	Satna	594.07	5665.9	9854.57	136.58	968.27	0.00	17219.39
41	Sehore	3247.54	3124.33	9896.14	1411.58	689.57	0.00	18369.16
42	Seoni	608.95	897.08	6302.4	424.89	591.63	0.00	8824.95
43	Shahdol	456.58	0	781.14	154.4	69.38	0.00	1461.50
44	Shajapur	0	0	13195.71	571.79	635.06	0.00	14402.56
45	Sheopur	12744.8	3259.29	3650.51	395.05	414.82	0.00	20464.47

S.N.	District	Recharge from Canals (Ham)	Recharge from Surface Water Irrigation (Ham)	Recharge from Ground Water Irrigation (Ham)	Recharge due to Tanks and Ponds (Ham)	Recharge due to Water Conservation Structures (Ham)	Recharge due to Pipelines (Ham)	Total Recharge from Other Sources (Ham)
46	Shivpuri	1941.44	2851.83	12072.17	1377.97	642.50	0.00	18885.91
47	Sidhi	1008.65	71.88	1888.11	339.98	327.90	0.00	3636.52
48	Singrauli	120.77	138.29	2244.94	355.78	498.32	0.00	3358.10
49	Tikamgarh	477.01	1555.09	6785.71	1795.15	576.78	0.00	11189.74
50	Ujjain	0	0	23871.52	2355.38	1339.69	0.00	27566.59
51	Umaria	0	0	1073.75	310.58	65.29	0.00	1449.62
52	Vidisha	2190.09	687.27	12924.79	421.02	607.33	0.00	16830.50
State Total (Ham)		**101142.53**	**201157.47**	**432085.32**	**50595.45**	**51563.47**	**3473.89**	**840018.13**
State Total (bcm)		**1.01**	**2.01**	**4.32**	**0.51**	**0.52**	**0.03**	**8.40**

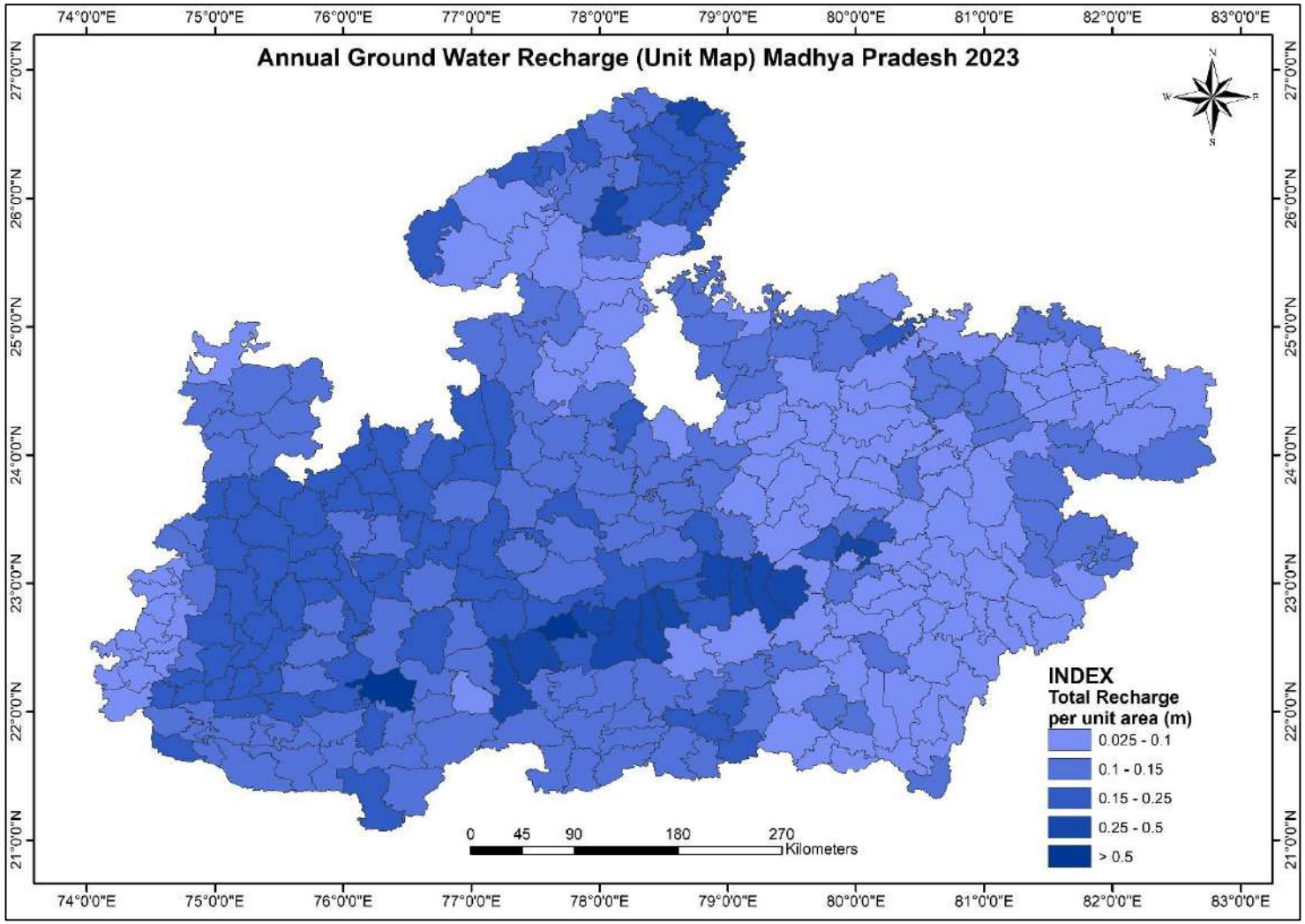


Fig. 4.6: Annual Groundwater Recharge per unit area, Madhya Pradesh

4.3 GROUND WATER EXTRACTION FOR ALL USES (DOMESTIC, IRRIGATION AND INDUSTRIAL)

Ground water extraction for various uses has been calculated separately for command and non-command areas. Details of assessment-wise groundwater extraction for various uses are given in **Annexure IV**. District-wise ground water extraction figures are also compiled and given in **Table 4.4**

Total extraction of ground water for all uses in state is calculated as 1930026 ham (19.30 bcm). From the **Table 4.4**, it is seen that maximum ground water extraction for all uses is 103926 ham in Ratlam district and minimum extraction of ground water for all uses is 4165 ham in Dindori district at eastern part of Madhya Pradesh. Comparison of ground water extraction for various uses reveals that extraction for irrigation accounts for more than 90% of total ground water extraction, whereas extraction for domestic is 9% and industrial extraction accounts for meager 1% of the total ground water extraction in the state. (**Fig 4.7**). The district wise comparison of Ground Water extraction from different sources is shown in **Fig.4.8.**

Volumetric estimates are dependent on the areal extent of the assessment units. In order to compare the total ground water extraction of different assessment units, the volumetric estimates of total ground water extraction have been converted to depth units (m) by dividing the total ground water extraction by the area of the respective assessment units (km^2). Spatial variation in total extraction (m) is shown in **Fig 4.9**.

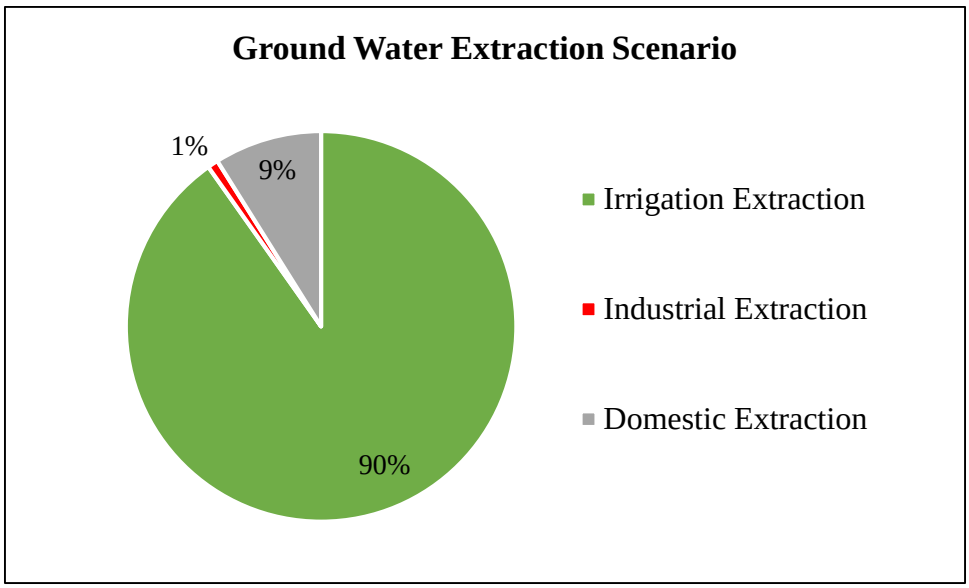
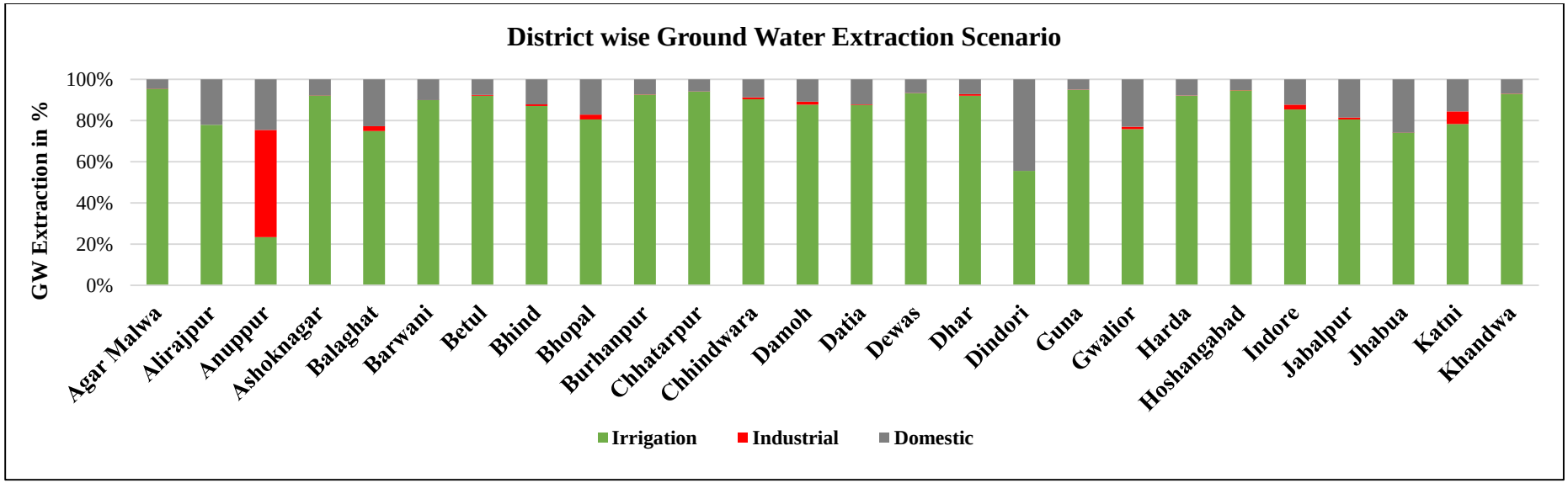


Fig.4.7: Ground Water Extraction Scenario



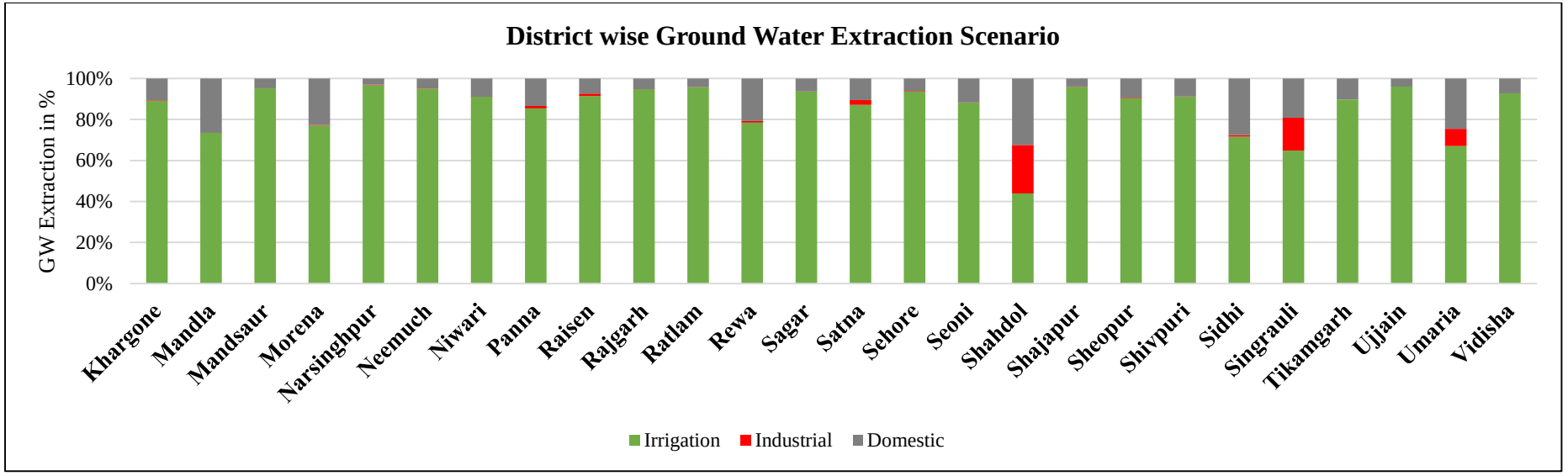


Fig.4.8: District wise Ground Water Extraction Scenario

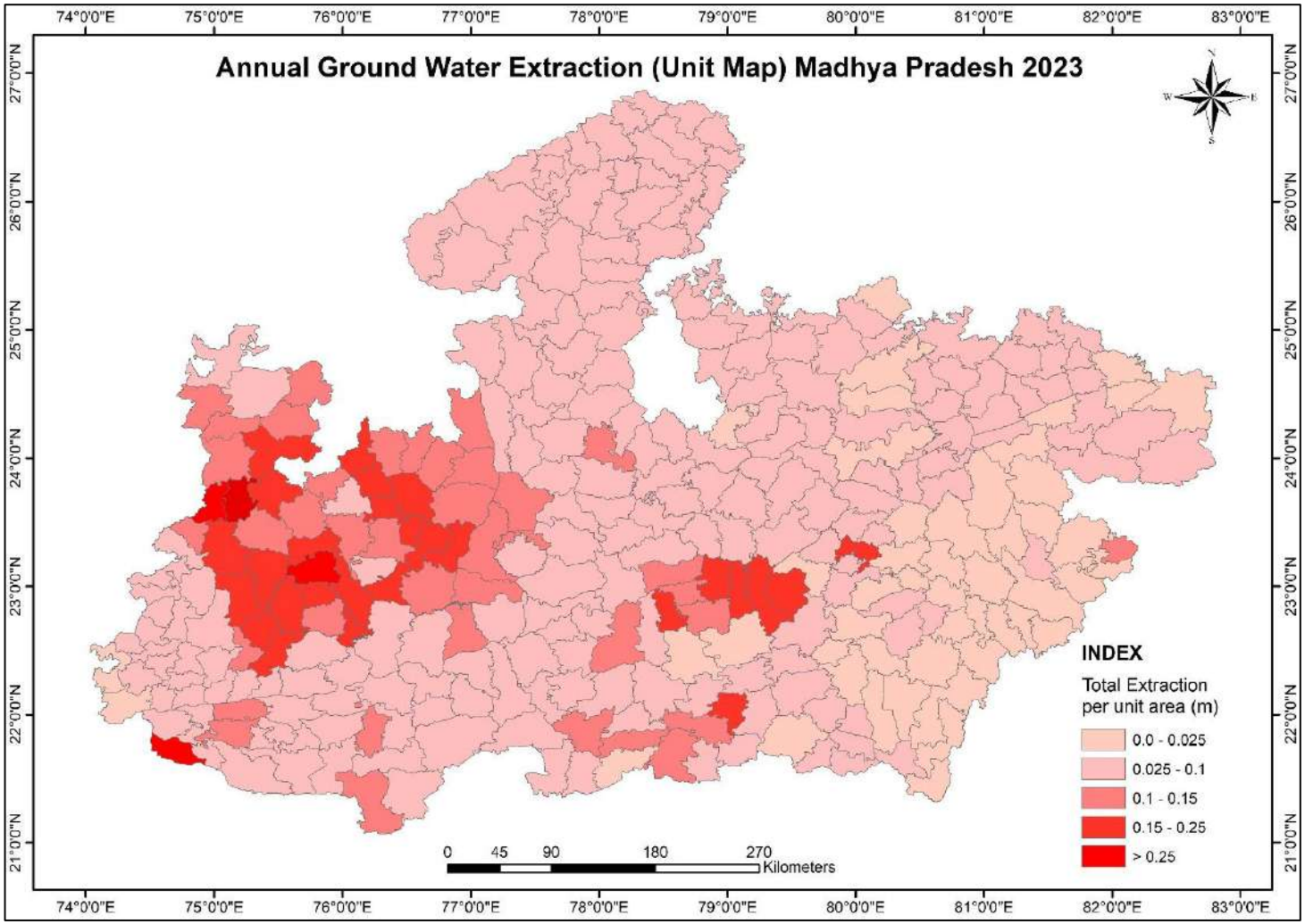


Fig. 4.9: Total Groundwater Extraction per unit area, Madhya Pradesh

Table 4.4: District -wise Ground Water Extraction for Various Uses and Stage of Ground WaterExtraction

S. N.	District	Current Annual Ground Water Extraction (ham)				Annual GW Allocation for Domestic use as on 2025 (Ham)	Net Ground Water Availability for future use (ham)	Stage of Ground Water Extraction (%)
		Irrigation	Industrial	Domestic	Total			
1	**Agar Malwa**	34666.65	3.67	1666.65	36336.96	1766.32	6513.75	89.94
2	**Alirajpur**	6722.33	0	1910.82	8633.15	2049.42	11158.44	43.32
3	**Anuppur**	1483.55	3303.32	1562.47	6349.33	1623.03	20583.85	23.52
4	**Ashoknagar**	21381.39	1.41	1824.21	23207.03	1927.85	13513.68	63.02
5	**Balaghat**	12657.22	400.93	3851.18	16909.36	4018.37	54872.5	23.5
6	**Barwani**	33377.29	37.99	3727.85	37143.14	4139.91	19039.54	71.38
7	**Betul**	44632.8	168.93	3726.52	48528.3	3917.52	49031.02	49.65
8	**Bhind**	25562.24	248.88	3562.49	29373.62	3758.17	60384.28	32.65
9	**Bhopal**	23916.38	686.41	5110.13	29712.91	5584.57	7761.4	78.3
10	**Burhanpur**	21940.49	35.42	1728.73	23704.63	1859.14	10127.82	69.8
11	**Chhatarpur**	49738.65	79.68	3105.27	52923.58	3324.12	27798.46	65.42
12	**Chhindwara**	55742.33	580.56	5400.1	61722.98	5674.98	35665.53	63.24
13	**Damoh**	18757.67	299.37	2331.94	21388.93	2735.18	14784	58.48
14	**Datia**	12664.84	33.36	1766.56	14464.77	1894.54	25529.57	36.05
15	**Dewas**	60357.41	95.48	4300.72	64753.63	4579.59	18015.08	80
16	**Dhar**	76853.59	635.01	6069.37	83557.97	6648.4	55147.1	65.4
17	**Dindori**	2316.18	0	1848.41	4164.57	1986.42	28955.23	12.52
18	**Guna**	47608.79	78.24	2532.84	50219.89	2715.98	26911.56	64.96
19	**Gwalior**	18052.15	270.78	5484.37	23807.29	6003.22	51447.58	31.42
20	**Harda**	14405.04	16.17	1243.99	15665.19	1330.85	28195.56	35.65
21	**Hoshangabad**	40065.19	18.64	2251.42	42335.23	2355.8	121256.8	25.86
22	**Indore**	54421.57	1500.83	7870.51	63792.93	8966.3	2547.06	119.38
23	**Jabalpur**	25295.9	318.94	5834.34	31449.17	6466.18	29704.16	51.31

S. N.	District	Current Annual Ground Water Extraction (ham)				Annual GW Allocation for Domestic use as on 2025 (Ham)	Net Ground Water Availability for future use (ham)	Stage of Ground Water Extraction (%)
		Irrigation	Industrial	Domestic	Total			
24	**Jhabua**	8065.63	0.44	2810.21	10876.28	3147.85	13066.56	44.79
25	**Katni**	14014.73	1116.18	2786.79	17917.68	2996.11	19902.19	47.12
26	**Khandwa**	40541.57	69.64	3025.19	43636.4	3243.92	61341.13	41.48
27	**Khargone**	37725.95	78.26	4518.09	42322.26	4866.61	49477.05	45.93
28	**Mandla**	7008.26	0.07	2537.96	9546.28	2690.49	37073.62	20.41
29	**Mandsaur**	62918.73	43.65	3105.12	66067.55	3244.75	6601.06	104.57
30	**Morena**	19963.18	86.34	5881.03	25930.52	6348.42	38217.62	40.13
31	**Narsinghpur**	72947.95	199.66	2347.59	75495.2	2452.96	37161.76	66.95
32	**Neemuch**	34072.98	29.85	1769.05	35871.88	1846.2	2846.5	99.23
33	**Niwari**	11520.12	5.79	1130.38	12656.29	1339.31	5254.88	69.85
34	**Panna**	15770.99	210.94	2477.82	18459.75	2635.57	31983.99	36.48
35	**Raisen**	42627.95	548.18	3417.8	46593.92	3727.52	39910.29	53.67
36	**Rajgarh**	73551.37	11.57	4120.76	77683.72	4534.9	9937.22	89.78
37	**Ratlam**	99438.31	37.38	4450.12	103925.8	6066.1	2377.85	135.14
38	**Rewa**	21372.19	185.73	5668.63	27226.55	6185.05	22077.99	54.65
39	**Sagar**	56806.95	80.78	3807.91	60695.66	4089.76	41393.84	59.29
40	**Satna**	39418.38	1084.31	4766.96	45269.69	5077.31	25470.08	65.59
41	**Sehore**	39055.28	117.47	2527.11	41699.87	2714.97	25606.86	61.78
42	**Seoni**	24964.82	4.91	3328.53	28298.24	3532.72	39891.08	41.38
43	**Shahdol**	3124.57	1673.31	2307.45	7105.33	2440.47	45933.91	13.36
44	**Shajapur**	52782.83	54.55	2182.07	55019.46	2288.53	2116.74	106.9
45	**Sheopur**	17631.34	44.79	1817.82	19493.95	1968.51	31029.92	38.47
46	**Shivpuri**	48288.67	42.99	4668.71	53000.39	5048.85	24939.43	67.67
47	**Sidhi**	7552.41	88.26	2908.38	10549.05	3157.52	18414.08	36.11

S. N.	District	Current Annual Ground Water Extraction (ham)				Annual GW Allocation for Domestic use as on 2025 (Ham)	Net Ground Water Availability for future use (ham)	Stage of Ground Water Extraction (%)
		Irrigation	Industrial	Domestic	Total			
48	**Singrauli**	8979.76	2219.69	2657.3	13856.77	2945.75	21311.92	39.08
49	**Tikamgarh**	26734.19	0	3074.02	29808.19	3746.52	5948.14	81.83
50	**Ujjain**	95485.93	57.77	3895.58	99439.27	4104.22	8999.19	108.83
51	**Umaria**	4294.94	540.07	1571.36	6406.36	1714.96	27689.39	18.71
52	**Vidisha**	51046	13.93	3969.72	55029.63	4260.54	30123.4	64.4
	Total(Ham)	**1740326**	**17460.5**	**172240.4**	**1930027**	**187742.3**	**1445042**	**58.75**
	Total(Bcm)	**17.4**	**0.17**	**1.72**	**19.3**	**1.88**	**14.45**	**58.75**

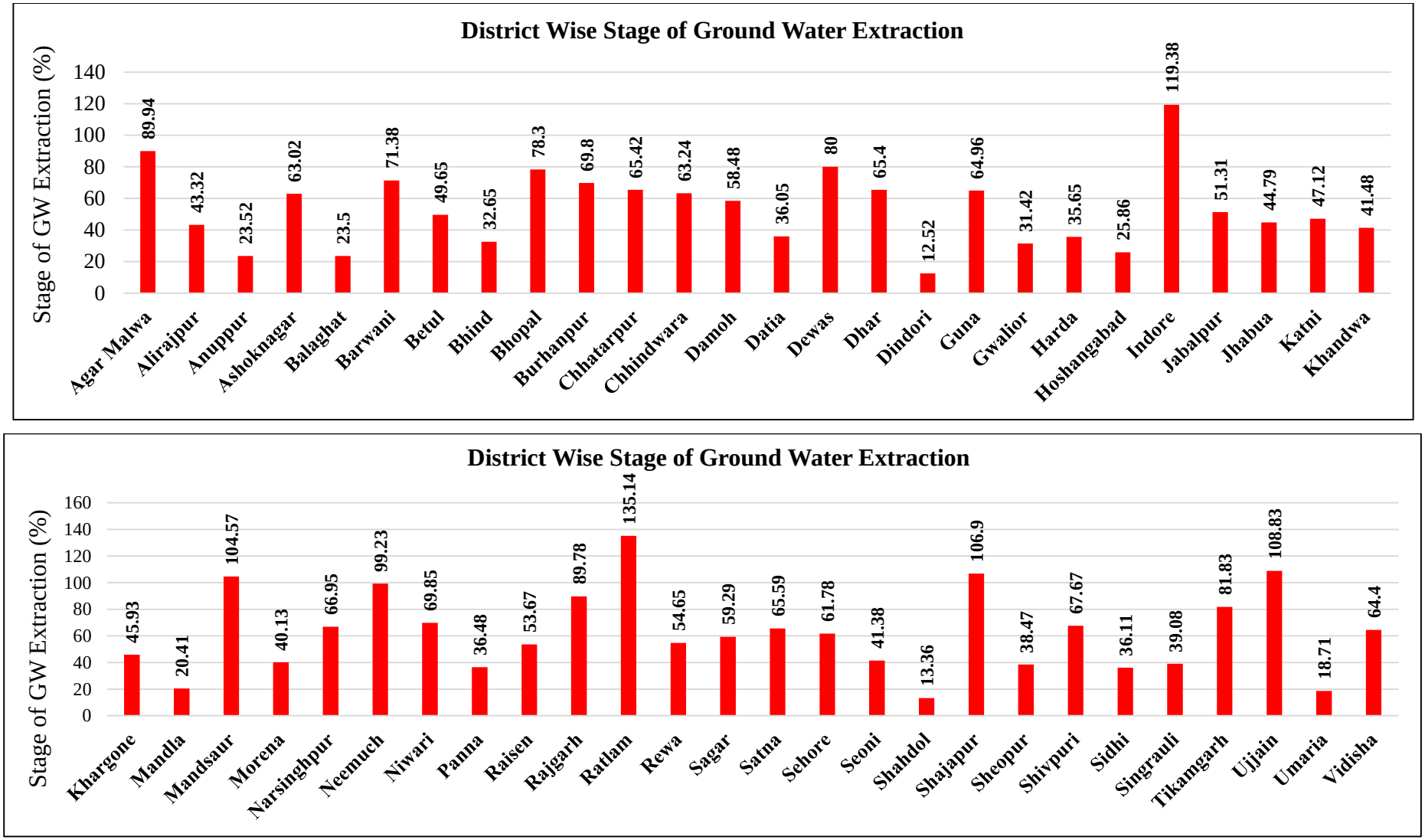


Fig.4.10: District wise Stage of Ground Water Extraction

4.4 STAGE OF GROUND WATER EXTRACTION

The overall stage of groundwater extraction in the state is 58.75 %. The stage of ground water extraction is very high in the districts of Indore, Mandsaur, Ratlam, Shajapur and Ujjain where it is more than 100%, which implies that in these districts the annual ground water consumption is more than annual extractable ground water resources. In the districts of Agar malwa, Barwani, Bhopal, Dewas, Rajgarh, and Tikamgarh the stage of ground water Extraction is between 70-90%. Neemuch district has stage of ground water extraction between 90 to 100 %. In rest of the districts, the stage of ground water extraction is below 70 %. The Ratlam (135.14%), Indore (119.38%), districts have highest ground water extraction and Dindori with 12.52% is lowest stage of extraction district in state. The district wise stage of Ground Water Extraction is given in the **Table.4.4** and in bar diagram shown in the **Fig.4.10**.

The Jaora block of Ratlam district has highest stage of Ground Water Extraction (170.51%) and tha Paraswada block of Balaghat district has lowest stage of Ground Water Extraction (4.63%). The Assesment unit wise stage of Ground Water Extraction is given in **Annexure IV.**

4.5 CATEGORIZATION OF ASSESSMENT UNITS

The distributions of various categorized assessment units are shown in the **Fig 4.12**. 226 blocks are falling under safe category, 60 blocks are falling in semi-critical category, 5 blocks of in critical category, and 26 blocks of the state are categorized as over-exploited. List of safe, semi-critical, critical and over-exploited area is given in **Annexure IV** and in **Annexure V**. Almost all over-exploited blocks are falling in western part of Madhya Pradesh, which is known as "MALWA AREA" where ground water extraction has increased many folds during past decades. In the state out of the total assessment units 8% of units are Over-exploited, 2% units are Critical, 19% of the units are Semi-critical and remaining 71% assessment units are categorized as Safe. (**Fig.4.11**).

Out of 32853.75 mcm of Total Annual Extractable Resources of the state, 3424.26 mcm (10.42 %) are under 'Over-Exploited', 537.1 mcm (1.63 %) are under 'Critical', 6119.62 mcm (18.63 %) are under 'Semi-Critical', 22772.77 mcm (69.32 %) are under 'Safe' category assessment units. Category wise annual extractable resources are given in **Table 4.5**. Out of 269333.27 Sq Km of Recharge worthy area of the state, 22554.86 Sq Km (8.37 %) are under 'Over-Exploited', 4249.07 Sq Km (1.58 %) are under 'Critical', 51803.76 Sq Km (19.23 %) are under 'Semi-Critical', 190725.58 Sq Km (70.81%) are under 'Safe' category assessment units.Category wise Recharge worthy area is given in **Table 4.6**.

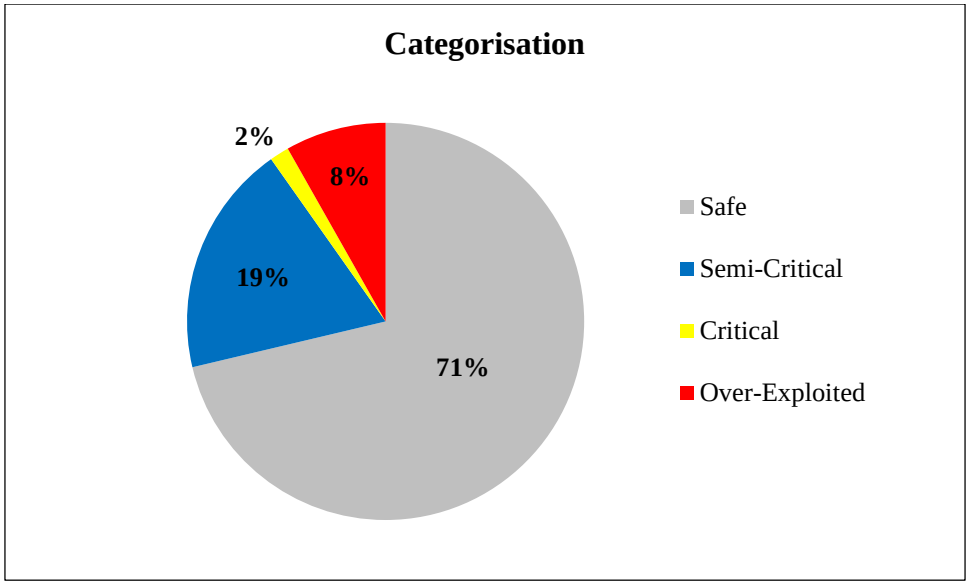


Figure 4.11: Categorisation of Assessment units

4.6 ALLOCATION OF GROUND WATER RESOURCES FOR DOMESTIC UTILISATION

The Annual Extractable Ground Water Resources are to be apportioned between domestic, industrial and irrigation uses. Among these, as per the National Water Policy, requirement for domestic water supply is to be accorded priority. So the allocation of Ground Water resources for domestic utilization as on 2025 is caluculated for all assessment units and given in **Annexure IV** and district wise allocation is given in the **Table 4.4**. It is seen that in Madhya Pradesh 187742 ham (1.88 bcm) ground water resource is allocated for domestic utilization.

4.7 GROUND WATER AVAILABLE FOR FUTURE USE

Assessment wise, data of Ground Water Available for future use is given in **Annexure-IV.**and district wise are shown in **Table 4.4**. From **Table 4.4**, it is seen that in Madhya Pradesh 1445042 ham (14.45 bcm) ground water is estimated to be available for future use.

4.8 QUALITY TAGGING

Quality assessment of Ground water is equally important as the quality assessment. But with the existing network of quality monitoring, it is not possible to categorize the area. There are so many problems in respect to type of attributes, also.some of the attributes are point data which can considered as varying linearly between two points. Hence for Madhya Pradesh it was decided to add a quality tag to the assessment sub unit. In the state the major sources of quality concern are Salinity and Fluoride. The quality tagged assessment units are given in the **Annexure VI**.

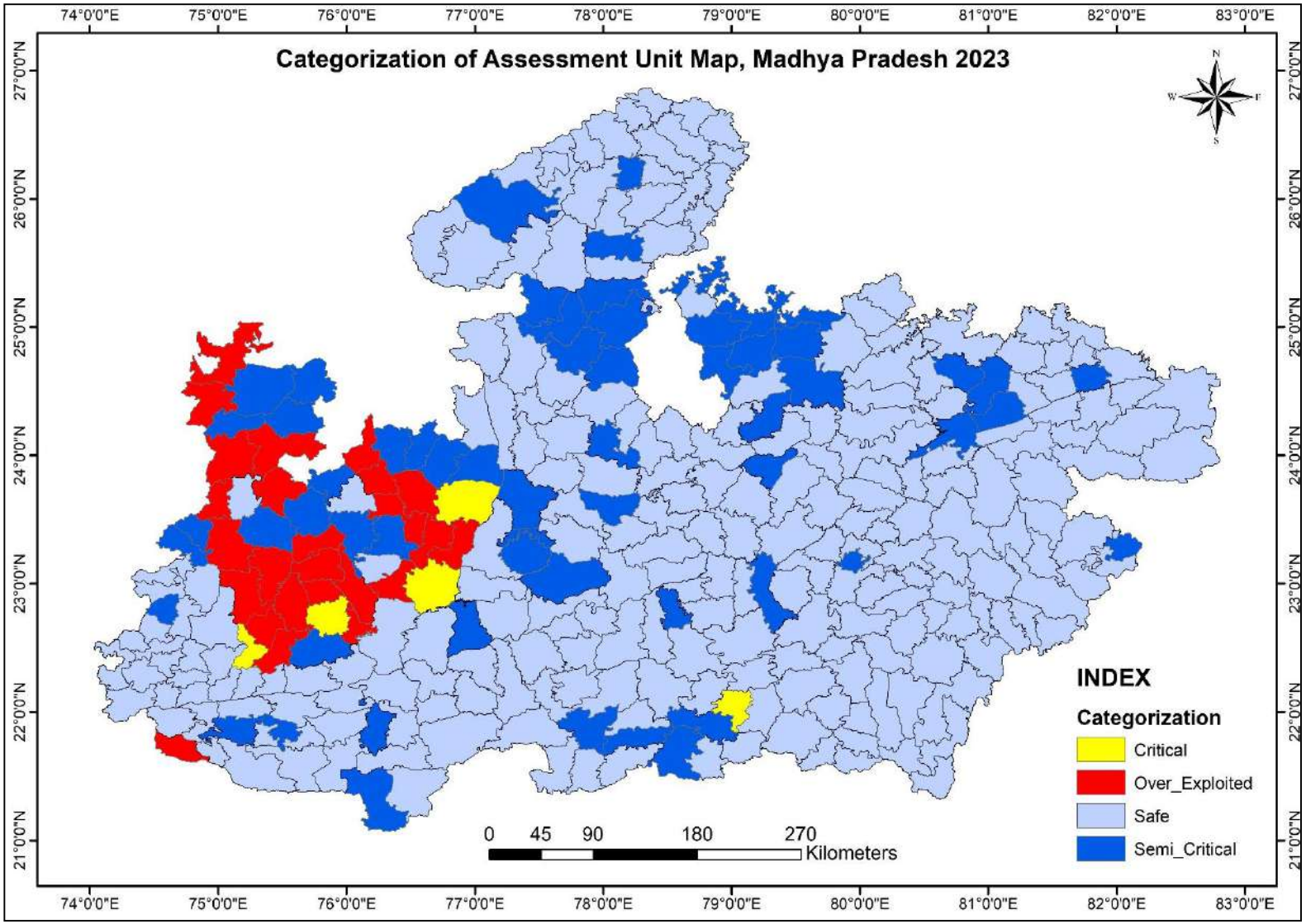


Figure 4.12: Categorisation of Assessment units in Madhya Pradesh

Table 4.5: Category wise Annual Extractable Ground Water Resource

S.N.	Name of District	Total Annual Extractable Resource of Assessed Units (in mcm)	Safe		Semi-Critical		Critical		Over-Exploited	
			Total Annual Extractable Resource (in mcm)	%	Total Annual Extractable Resource (in mcm)	%	Total Annual Extractable Resource (in mcm)	%	Total Annual Extractable Resource (in mcm)	%
1	**Agar Malwa**	404.03	108.3	26.81	104.57	25.88	-	-	191.16	47.31
2	**Alirajpur**	199.3	199.3	100	-	-	-	-	-	-
3	**Anuppur**	269.94	224.12	83.03	45.82	16.97	-	-	-	-
4	**Ashoknagar**	368.24	217.8	59.15	150.44	40.85	-	-	-	-
5	**Balaghat**	719.49	719.49	100	-	-	-	-	-	-
6	**Barwani**	520.36	356.7	68.55	102.51	19.7	-	-	61.16	11.75
7	**Betul**	977.5	722.52	73.91	254.99	26.09	-	-	-	-
8	**Bhind**	899.54	899.54	100	-	-	-	-	-	-
9	**Bhopal**	379.49	-	-	379.49	100	-	-	-	-
10	**Burhanpur**	339.63	165.32	48.68	174.31	51.32	-	-	-	-
11	**Chhatarpur**	809	434.9	53.76	374.1	46.24	-	-	-	-
12	**Chhindwara**	976.05	665.39	68.17	211.48	21.67	99.18	10.16	-	-
13	**Damoh**	365.76	308.65	84.39	57.11	15.61	-	-	-	-
14	**Datia**	401.22	401.22	100	-	-	-	-	-	-
15	**Dewas**	809.45	436.49	53.92	120.47	14.88	-	-	252.49	31.19
16	**Dhar**	1277.67	831.03	65.04	-	-	79.74	6.24	366.9	28.72
17	**Dindori**	332.58	332.58	100	-	-	-	-	-	-
18	**Guna**	773.15	773.15	100	-	-	-	-	-	-
19	**Gwalior**	757.74	708.4	93.49	49.34	6.51	-	-	-	-
20	**Harda**	439.48	439.48	100	-	-	-	-	-	-
21	**Hoshangabad**	1636.96	1453.86	88.81	183.1	11.19	-	-	-	-
22	**Indore**	534.36	-	-	106.83	19.99	59	11.04	368.53	68.97
23	**Jabalpur**	612.97	580.94	94.78	32.03	5.22	-	-	-	-

S.N.	Name of District	Total Annual Extractable Resource of Assessed Units (in mcm)	Safe		Semi-Critical		Critical		Over-Exploited	
			Total Annual Extractable Resource (in mcm)	%	Total Annual Extractable Resource (in mcm)	%	Total Annual Extractable Resource (in mcm)	%	Total Annual Extractable Resource (in mcm)	%
24	**Jhabua**	242.8	222.34	91.57	20.46	8.43	-	-	-	-
25	**Katni**	380.29	380.29	100	-	-	-	-	-	-
26	**Khandwa**	1051.96	933.15	88.71	118.81	11.29	-	-	-	-
27	**Khargone**	921.48	864.84	93.85	56.64	6.15	-	-	-	-
28	**Mandla**	467.72	467.72	100	-	-	-	-	-	-
29	**Mandsaur**	631.81	-	-	315.37	49.91	-	-	316.45	50.09
30	**Morena**	646.16	646.16	100	-	-	-	-	-	-
31	**Narsinghpur**	1127.62	916.14	81.25	211.48	18.75	-	-	-	-
32	**Neemuch**	361.49	-	-	113.02	31.26	-	-	248.47	68.74
33	**Niwari**	181.2	112.16	61.9	69.04	38.1	-	-	-	-
34	**Panna**	506.01	506.01	100	-	-	-	-	-	-
35	**Raisen**	868.14	776.26	89.42	91.88	10.58	-	-	-	-
36	**Rajgarh**	865.24	-	-	563.65	65.14	167.34	19.34	134.26	15.52
37	**Ratlam**	769.03	-	-	117.5	15.28	-	-	651.53	84.72
38	**Rewa**	498.21	461.18	92.57	37.03	7.43	-	-	-	-
39	**Sagar**	1023.71	1023.71	100	-	-	-	-	-	-
40	**Satna**	690.18	368.78	53.43	321.4	46.57	-	-	-	-
41	**Sehore**	674.95	543.1	80.47	-	-	131.84	19.53	-	-
42	**Seoni**	683.94	683.94	100	-	-	-	-	-	-
43	**Shahdol**	531.72	531.72	100	-	-	-	-	-	-
44	**Shajapur**	514.68	-	-	121.84	23.67	-	-	392.84	76.33
45	**Sheopur**	506.75	412.39	81.38	94.35	18.62	-	-	-	-
46	**Shivpuri**	783.2	322.2	41.14	461	58.86	-	-	-	-
47	**Sidhi**	292.12	292.12	100	-	-	-	-	-	-

S.N.	Name of District	Total Annual Extractable Resource of Assessed Units (in mcm)	Safe		Semi-Critical		Critical		Over-Exploited	
			Total Annual Extractable Resource (in mcm)	%	Total Annual Extractable Resource (in mcm)	%	Total Annual Extractable Resource (in mcm)	%	Total Annual Extractable Resource (in mcm)	%
48	**Singrauli**	354.57	354.57	100	-	-	-	-	-	-
49	**Tikamgarh**	364.29	-	-	364.29	100	-	-	-	-
50	**Ujjain**	913.73	-	-	473.26	51.79	-	-	440.47	48.21
51	**Umaria**	342.39	342.39	100	-	-	-	-	-	-
52	**Vidisha**	854.44	632.4	74.01	222.04	25.99	-	-	-	-
Grand Total		**32853.75**	**22772.77**	**69.32**	**6119.62**	**18.63**	**537.1**	**1.63**	**3424.26**	**10.42**

Table 4.6: Category wise Recharge worthy area

S.N.	Name of District	Total Recharge Worthy Area of Assessed Units (in sq.km)	Safe		Semi-Critical		Critical		Over-Exploited		Saline	
			Recharge Worthy Area of Assessed Units (in sq.km)	%	Recharge Worthy Area of Assessed Units (in sq.km)	%	Recharge Worthy Area of Assessed Units (in sq.km)	%	Recharge Worthy Area of Assessed Units (in sq.km)	%	Recharge Worthy Area of Assessed Units (in sq.km)	%
1	**Agar Malwa**	2515.76	654.46	26.01	700.83	27.86	-	-	1160.47	46.13	-	-
2	**Alirajpur**	3054	3054	100	-	-	-	-	-	-	-	-
3	**Anuppur**	2942	2602	88.44	340	11.56	-	-	-	-	-	-
4	**Ashoknagar**	4622.44	2462.59	53.27	2159.85	46.73	-	-	-	-	-	-
5	**Balaghat**	8917.93	8917.93	100	-	-	-	-	-	-	-	-
6	**Barwani**	3668.31	2646.15	72.14	730.36	19.91	-	-	291.8	7.95	-	-
7	**Betul**	8564.5	6663.5	77.8	1901	22.2	-	-	-	-	-	-
8	**Bhind**	4459	4459	100	-	-	-	-	-	-	-	-
9	**Bhopal**	2648	-	-	2648	100	-	-	-	-	-	-

S.N.	Name of District	Total Recharge Worthy Area of Assessed Units (in sq.km)	Safe		Semi-Critical		Critical		Over-Exploited		Saline	
			Recharge Worthy Area of Assessed Units (in sq.km)	%	Recharge Worthy Area of Assessed Units (in sq.km)	%	Recharge Worthy Area of Assessed Units (in sq.km)	%	Recharge Worthy Area of Assessed Units (in sq.km)	%	Recharge Worthy Area of Assessed Units (in sq.km)	%
10	**Burhanpur**	2570.5	1400.5	54.48	1170	45.52	-	-	-	-	-	-
11	**Chhatarpur**	7904.34	3938.28	49.82	3966.06	50.18	-	-	-	-	-	-
12	**Chhindwara**	8847.77	6631.89	74.96	1580.72	17.87	635.16	7.18	-	-	-	-
13	**Damoh**	4746.19	3842.82	80.97	903.37	19.03	-	-	-	-	-	-
14	**Datia**	2662	2662	100	-	-	-	-	-	-	-	-
15	**Dewas**	5770.82	3313.7	57.42	876.31	15.19	-	-	1580.81	27.39	-	-
16	**Dhar**	8126.4	5169	63.61	-	-	534	6.57	2423.4	29.82	-	-
17	**Dindori**	4560	4560	100	-	-	-	-	-	-	-	-
18	**Guna**	6175.14	6175.14	100	-	-	-	-	-	-	-	-
19	**Gwalior**	4283	3859.65	90.12	423.35	9.88	-	-	-	-	-	-
20	**Harda**	2700.9	2700.9	100	-	-	-	-	-	-	-	-
21	**Hoshangabad**	5583.52	4914.52	88.02	669	11.98	-	-	-	-	-	-
22	**Indore**	3818.97	-	-	1020.92	26.73	530	13.88	2268.05	59.39	-	-
23	**Jabalpur**	4438.68	4070.28	91.7	368.4	8.3	-	-	-	-	-	-
24	**Jhabua**	3112.53	2699.53	86.73	413	13.27	-	-	-	-	-	-
25	**Katni**	4666.48	4666.48	100	-	-	-	-	-	-	-	-
26	**Khandwa**	5814.46	4953.46	85.19	861	14.81	-	-	-	-	-	-
27	**Khargone**	6568.97	6074.57	92.47	494.4	7.53	-	-	-	-	-	-
28	**Mandla**	5739.9	5739.9	100	-	-	-	-	-	-	-	-
29	**Mandsaur**	4956.4	-	-	2438.83	49.21	-	-	2517.57	50.79	-	-
30	**Morena**	4384.89	4384.89	100	-	-	-	-	-	-	-	-
31	**Narsinghpur**	4791	3947	82.38	844	17.62	-	-	-	-	-	-
32	**Neemuch**	3757.44	-	-	1153	30.69	-	-	2604.44	69.31	-	-

S.N.	Name of District	Total Recharge Worthy Area of Assessed Units (in sq.km)	Safe		Semi-Critical		Critical		Over-Exploited		Saline	
			Recharge Worthy Area of Assessed Units (in sq.km)	%	Recharge Worthy Area of Assessed Units (in sq.km)	%	Recharge Worthy Area of Assessed Units (in sq.km)	%	Recharge Worthy Area of Assessed Units (in sq.km)	%	Recharge Worthy Area of Assessed Units (in sq.km)	%
33	**Niwari**	1525.62	939.62	61.59	586	38.41	-	-	-	-	-	-
34	**Panna**	6624.75	6624.75	100	-	-	-	-	-	-	-	-
35	**Raisen**	6609.4	5745	86.92	864.4	13.08	-	-	-	-	-	-
36	**Rajgarh**	6154.98	-	-	3881.98	63.07	1368	22.23	905	14.7	-	-
37	**Ratlam**	4616	-	-	973	21.08	-	-	3643	78.92	-	-
38	**Rewa**	5937.6	5490.3	92.47	447.3	7.53	-	-	-	-	-	-
39	**Sagar**	9254.18	9254.18	100	-	-	-	-	-	-	-	-
40	**Satna**	6721.06	3576.89	53.22	3144.17	46.78	-	-	-	-	-	-
41	**Sehore**	4639.72	3457.81	74.53	-	-	1181.91	25.47	-	-	-	-
42	**Seoni**	8050.2	8050.2	100	-	-	-	-	-	-	-	-
43	**Shahdol**	4978	4978	100	-	-	-	-	-	-	-	-
44	**Shajapur**	3406.17	-	-	883.07	25.93	-	-	2523.1	74.07	-	-
45	**Sheopur**	5334.8	3697.8	69.31	1637	30.69	-	-	-	-	-	-
46	**Shivpuri**	9770.49	4354.54	44.57	5415.95	55.43	-	-	-	-	-	-
47	**Sidhi**	3604.05	3604.05	100	-	-	-	-	-	-	-	-
48	**Singrauli**	4512.6	4512.6	100	-	-	-	-	-	-	-	-
49	**Tikamgarh**	3355.38	-	-	3355.38	100	-	-	-	-	-	-
50	**Ujjain**	5939.33	-	-	3302.11	55.6	-	-	2637.22	44.4	-	-
51	**Umaria**	4219	4219	100	-	-	-	-	-	-	-	-
52	**Vidisha**	6707.7	5056.7	75.39	1651	24.61	-	-	-	-	-	-
Grand Total		**269333.3**	**190725.6**	**70.81**	**51803.76**	**19.23**	**4249.07**	**1.58**	**22554.86**	**8.37**	**-**	**-**

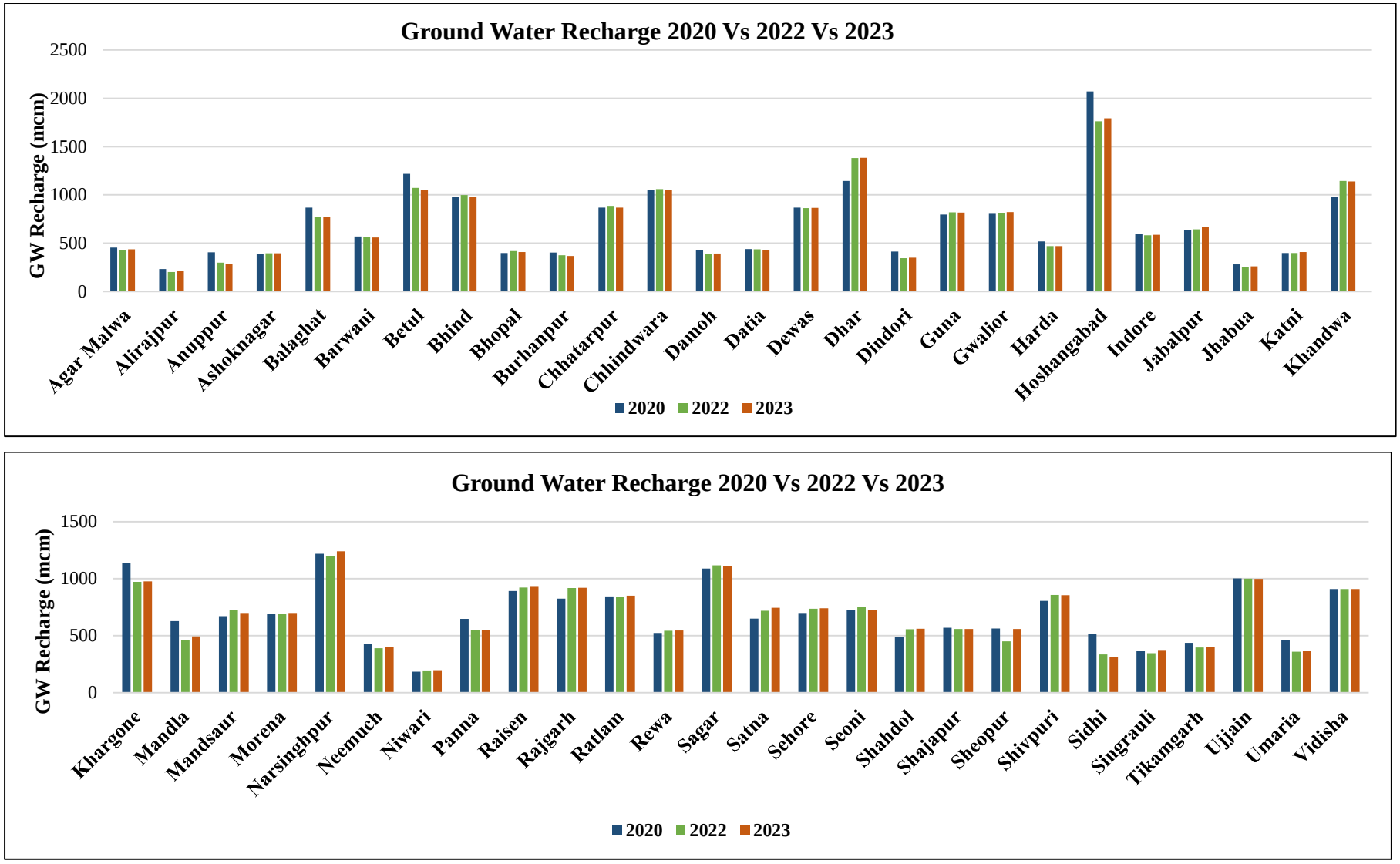
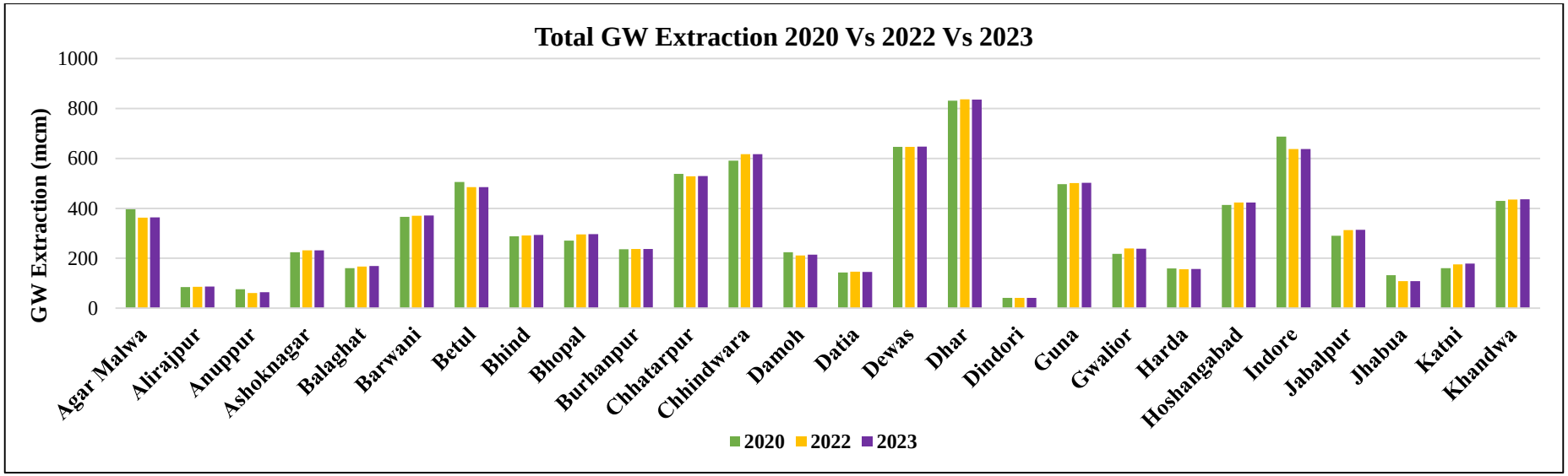


Fig.4.13: Disctrict wise Ground water Recharge Comparison



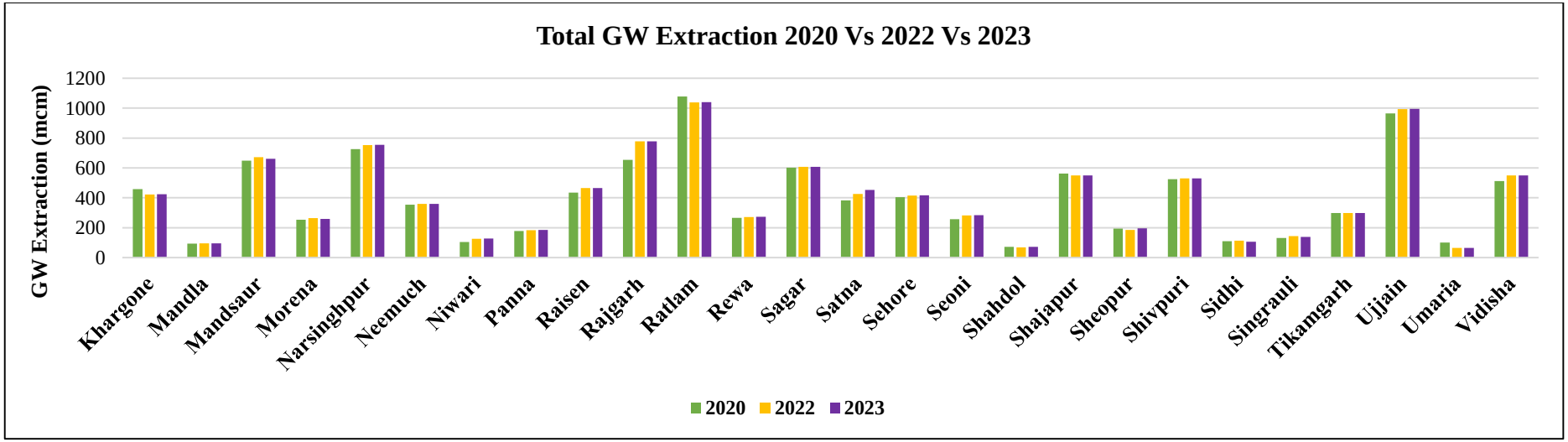


Fig.4.14: Disctrict wise Ground water Extraction Comparison

4.9 COMPARISON OF RESOURCE OF 2022 WITH BASE YEAR 2023

The total ground water recharge in the state for the year 2022 was 3524443 ham (35.24), while in 2023 the ground water recharge is 3547408 ham (35.47). In general, the reasons for increase can be attributed to increased rainfall recharge and implementation of water conservation structures. The recharge from other sources in the state in 2022 was 825585 ham (8.26 bcm) while in 2023 the recharge due to other sources is 840018 ham (8.40 bcm). The district wise comparison of the recharge in 2020, 2022 and 2023 is given in the **Fig.4.13.** The annual extractable resource in the state computed in 2022 was 3257963 ham (32.58 bcm) while in 2023 it is 3285375 ham (32.85 bcm).

The total groundwater extraction in the state for the year 2022 was 1925334 ham (19.25 bcm), but in the year 2023 total groundwater extraction is increased to 1930027 ham (19.30 bcm) due to the revision of well census data, population. The district wise comparison of Ground Water extraction in 2020, 2022 and 2023 is given in the **Fig.4.14.**

The stage of ground water extraction has reached to 58.75% as compared to 59.10% in assessment year 2022. In the assessment year-2023 there is no change in categorization as compared to 2022, 233 assessment units falling in safe category, 60 assessment units falling in semi-critical category, 05 assessment units in Critical category and 26 units in over-exploited category which remains same as previous assessment year.

The ground water resources of the individual block /assessment unit show wide variation in the resource available and stage of ground water extraction.

The assessment units improved or deteriorated from 2017 to 2023 assessment are given in **Table 4.7.** For comparison of ground water resources data computed using GEC'2015 analysis of district wise figures is made for year 2022 and 2023, which is given in **Table 4.8**.

Table 4.7: Comparison of Categorization of Improved and Deteriorated Assessment Units (2017 and 2022)

S. N	District	Assessment Unit	Stage of Ground Water Extraction (%) in 2017	Categorization in 2017	Stage of Ground Water Extraction (%) in 2023	Categorization in 2022
Improved						
1	DAMOH	Batiyagarh	73.37	semi_critical	64.31	safe
2	MANDSAUR	Bhanpura	96.48	critical	87.74	semi_critical
3	MANDSAUR	Malhargarh	93.97	critical	83.58	semi_critical
4	RAISEN	Sanchi	73.15	semi_critical	60.98	safe
5	SAGAR	Banda	70.38	semi_critical	58.12	safe

S. N	District	Assessment Unit	Stage of Ground Water Extraction (%) in 2017	Categorization in 2017	Stage of Ground Water Extraction (%) in 2023	Categorization in 2022
Deteriorated						
1	ANUPPUR	Kotma	7.31	safe	79.05	semi_critical
2	ASHOKNAGAR	Chanderi	56.78	safe	71.14	semi_critical
3	ASHOKNAGAR	Isagarh	67.06	safe	78.93	semi_critical
4	BHOPAL	Berasia	68.93	safe	75.41	semi_critical
5	BURHANPUR	Burhanpur	67.48	safe	73.81	semi_critical
6	CHHATARPUR	Bijawar	66.91	safe	71.22	semi_critical
7	CHHINDWARA	Chhindwara	88.5	semi_critical	99.43	critical
8	CHHINDWARA	Mohkheda	67.73	safe	75.59	semi_critical
9	DHAR	Tirla	87.6	semi_critical	95.62	critical
10	HOSHANGABAD	Bankhedi	68.56	safe	81.37	semi_critical
11	JHABUA	Jhabua	67.74	safe	83.27	semi_critical
12	NARSINGHPUR	Narsinghpur	67.48	safe	77.09	semi_critical
13	NEEMUCH	Jawad	96.1	critical	109.45	over_exploited
14	NEEMUCH	Neemuch	94.64	critical	107.22	over_exploited
15	RAJGARH	Rajgarh	67.88	safe	72.95	semi_critical
16	RAJGARH	Sarangpur	95.39	critical	110.63	over_exploited
17	REWA	Mauganj	65.62	safe	74.94	semi_critical
18	SATNA	Amarpatan	65.79	safe	74.85	semi_critical
19	SEHORE	Ashta	77.36	semi_critical	99.66	critical
20	SHAJAPUR	Kalapipal	97.33	critical	110.83	over_exploited
21	SHEOPUR	Vijaypur	63.7	safe	71.81	semi_critical
22	SHIVPURI	Kolaras	69.56	safe	74.05	semi_critical
23	VIDISHA	Gyaraspur	67.58	safe	70.27	semi_critical
24	VIDISHA	Kurwai	69.26	safe	75.8	semi_critical

Table 4.8: District -wise comparison of resource between 2022 and 2023

S. N.	District	Annual Extractable Groundwater Resource (ham)		Total Ground Water Extraction (ham)		Stage of Ground Water Extraction (%)	
		2022	2023	2022	2023	2022	2023
1	**Agar Malwa**	40085.67	40403.21	36310.9	36336.96	90.58	89.94
2	**Alirajpur**	18582.81	19930.2	8602.79	8633.15	46.29	43.32
3	**Anuppur**	28004.54	26993.74	6053.9	6349.33	21.62	23.52
4	**Ashoknagar**	36404.61	36824.34	23181.16	23207.03	63.68	63.02
5	**Balaghat**	70785.92	71949.04	16704.73	16909.36	23.6	23.5
6	**Barwani**	52314.59	52036.18	37065.94	37143.14	70.85	71.38
7	**Betul**	99244.6	97750.31	48475.3	48528.3	48.84	49.65
8	**Bhind**	91294.34	89953.59	29172.84	29373.62	31.95	32.65
9	**Bhopal**	38862.01	37948.75	29606.96	29712.91	76.18	78.3

S. N.	District	Annual Extractable Groundwater Resource (ham)		Total Ground Water Extraction (ham)		Stage of Ground Water Extraction (%)	
		2022	2023	2022	2023	2022	2023
10	**Burhanpur**	34605.71	33962.85	23674.78	23704.63	68.41	69.8
11	**Chhatarpur**	81465.66	80899.76	52872.8	52923.58	64.9	65.42
12	**Chhindwara**	99073.78	97605.19	61665.69	61722.98	62.24	63.24
13	**Damoh**	36077.15	36576.17	21156.64	21388.93	58.64	58.48
14	**Datia**	40304.29	40122.32	14577.93	14464.77	36.17	36.05
15	**Dewas**	80704.84	80944.58	64681.73	64753.63	80.15	80
16	**Dhar**	128641.78	127766.67	83662.84	83557.97	65.04	65.4
17	**Dindori**	32606.26	33257.8	4133.23	4164.57	12.68	12.52
18	**Guna**	76657.21	77314.59	50175.9	50219.89	65.45	64.96
19	**Gwalior**	74870.84	75773.72	23895.85	23807.29	31.92	31.42
20	**Harda**	42912.68	43947.6	15644.99	15665.19	36.46	35.65
21	**Hoshangabad**	161615.74	163696.36	42298.05	42335.23	26.17	25.86
22	**Indore**	52999.95	53436.36	63753.84	63792.93	120.29	119.38
23	**Jabalpur**	59726.79	61296.83	31244.65	31449.17	52.31	51.31
24	**Jhabua**	23348.92	24280.48	10813.8	10876.28	46.31	44.79
25	**Katni**	37236.74	38029.19	17536.65	17917.68	47.1	47.12
26	**Khandwa**	105370.85	105196.25	43572.82	43636.4	41.35	41.48
27	**Khargone**	92099.37	92147.84	42136.5	42322.26	45.75	45.93
28	**Mandla**	43590.69	46772.43	9509.63	9546.28	21.82	20.41
29	**Mandsaur**	65121.79	63181.48	67169.93	66067.55	103.15	104.57
30	**Morena**	63196.22	64615.54	26435.82	25930.52	41.83	40.13
31	**Narsinghpur**	110803.62	112762.33	75267.39	75495.2	67.93	66.95
32	**Neemuch**	35098.35	36148.63	35851.23	35871.88	102.15	99.23
33	**Niwari**	18001.02	18120.11	12625.12	12656.29	70.14	69.85
34	**Panna**	49601.45	50601.49	18308.74	18459.75	36.91	36.48
35	**Raisen**	85150.61	86813.92	46514.82	46593.92	54.63	53.67
36	**Rajgarh**	87119.98	86524.22	77817.23	77683.72	89.32	89.78
37	**Ratlam**	76080.83	76902.67	103784.5	103925.8	136.41	135.14
38	**Rewa**	49486.3	49820.96	27149.99	27226.55	54.86	54.65
39	**Sagar**	103184.22	102371.34	60641.65	60695.66	58.77	59.29
40	**Satna**	66512.51	69018.27	42559.47	45269.69	63.99	65.59
41	**Sehore**	67184.76	67494.59	41496.74	41699.87	61.77	61.78
42	**Seoni**	69625.5	68393.52	28246.69	28298.24	40.57	41.38
43	**Shahdol**	52389.57	53172.26	6884.07	7105.33	13.14	13.36
44	**Shajapur**	51495.34	51468.21	54991.68	55019.46	106.79	106.9
45	**Sheopur**	41351.53	50674.57	18572.93	19493.95	44.91	38.47
46	**Shivpuri**	78475.3	78319.96	52914.4	53000.39	67.43	67.67
47	**Sidhi**	30912.09	29212.27	11213.69	10549.05	36.28	36.11
48	**Singrauli**	32849.38	35457.15	14295.48	13856.77	43.52	39.08
49	**Tikamgarh**	36123.38	36428.83	29718.71	29808.19	82.27	81.83
50	**Ujjain**	91601.55	91373.06	99361.77	99439.27	108.47	108.83

S. N.	District	Annual Extractable Groundwater Resource (ham)		Total Ground Water Extraction (ham)		Stage of Ground Water Extraction (%)	
		2022	2023	2022	2023	2022	2023
51	**Umaria**	32238.77	34239.35	6376.02	6406.36	19.78	18.71
52	**Vidisha**	84870.33	85443.85	54952.98	55029.63	64.75	64.4
TOTAL (ham)		**3257963**	**3285375**	**1925334**	**1930027**	**59.1**	**58.75**
TOTAL (bcm)		**32.58**	**32.85**	**19.25**	**19.3**	**59.1**	**58.75**

CHAPTER-5

5.0 DISTRICT WISE GROUND WATER RESOURCE

The ground water conditions, its availability and utilization scenario and categorization of assessment units in different states are discussed in the previous chapter. District wise summaries are given below.

5.1 AGAR

Agar district is underlain by mainly Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 272193 ha of geographical area, 251576 ha (92%) is ground water recharge worthy area and 20617 ha (8%) is hilly area. There are four number of assessment units (block) in the district out of which Barod block falls under Semi-Critical category and Nalkhera and Susner fall in over exploited category. The highest stage of ground water development is computed as 124.44 % in Nalkhera block. The annual extractable groundwater resource in the district is 40403 ham and net ground water extraction for all uses is 36336 ham, making stage of ground water Extraction 89.93% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 6514 ham.

5.2 ALIRAJPUR

Alirajpur district is underlain by Archaean Granite-gneisses, phyllite Basaltic lava flows of Deccan trap and Bagh Bed. Dynamic Ground water resources of the district have been estimated for base year- 2023, on block wise basis. Out of 331800 ha of geographical area, 305400 ha (92%) is ground water recharge worthy area and 26400 ha (8%) is hilly area. There are six number of assessment units (block) in the district which fall under non-command category, there are no major irrigation projects in the district, and medium irrigation project for irrigation. All blocks of the district are categorized as safe blocks, and highest stage of ground water extraction is computed as 69.01 % for Bhabra Block. The annual extractable groundwater resource in the district is 19930 ham and total ground water extraction for all uses is 6722 ham, making stage of ground water Extraction 43.31% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 11158 ham.

5.3 ANUPPUR

Anuppur district is underlain by Archaean Granite-gneisses, Gondwanas sandstone-clays, Lametas and Deccan trap basalts. Dynamic ground water resources of Anuppur district have been estimated for base year – 2023, on block- wise basis. Out of 372400 ha of geographical

area, 294200 ha (79%) is ground water recharge worthy area and 78200 ha (21%) is hilly area. There are four number of assessment units (block) in the district which fall under non-command sub-unit, as there are no major and medium irrigation projects in the district. Highest stage of ground water Extarction is computed as 79.05% for Kotma Block. The annual extractable groundwater resource in the district is 26993 ham and ground water extraction for all uses is 1483 ham, making stage of ground water extraction 23.52% as a whole for district. After making allocation for future domestic for year 2025, balance available ground water for future use would be 20583 ham.

5.4 ASHOKNAGAR

Ashoknagar district is underlain by Deccan trap basalts, Vindhyan sandstone and Archaean granite-gneisses. Dynamic Ground water resources of the district have been estimated for base year -2023, on block- wise basis. Out of 467394 ha of geographical area, 462244 (98%) ha is ground water recharge worthy area and 5150 (2%) is hilly area. There are four numbers of assessment units (block) in the district having command area (4.46 %) and non-command area (95.54%). Out of four blocks of the district, two blocks are categorized as safe and two blocks are as semi-critical. Highest stage of ground water extraction is computed as 78.93 % in Ishagarh block. The annual extractable resource in the district is 36405 ham and gross ground water extraction for all uses is 23181 ham, making stage of ground water extraction 63.02% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 1928 ham.

5.5 BALAGHAT

Balaghat district is underlain by Archaean Granite, gneisses and phyllites. Dynamic Ground water resources of the district have been estimated for base year -2023, on block wise basis. Out of 922900 ha of geographical area, 891793 ha (97 %) is ground water recharge worthy area and 31107 ha (3%) is hilly area. There are ten numbers of assessment units (block) in the district which fall under command (11%) and non-command (89%) sub units. All blocks of the district are categorized as safe blocks, and highest stage of ground water extraction is computed as 56.13% for Katangi Block. The annual extractable ground water resource in the district is 71949 ham and ground water extraction for all uses is 12657 ham, making stage of ground water extraction 23.50% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 54872 ham.

5.6 BARWANI

Barwani district is underlain by, Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year-2023, on block-wise basis. Out of

542200 ha of geographical area, 366831 (68%) ha is ground water recharge worthy area and 175369 ha (32%) is hilly area. There are seven number of assessment units (block) in the district which fall under command and non-command sub-unit. Barwani, Niwali, Pati, Thikari and Sendhwa blocks of the district are categorized as safe blocks, Rajpur as semi critical, and Pansemal as over exploited with highest stage of ground water extraction which is computed as 138.33%. The annual extractable ground water resource in the district is 52036 ham and ground water extraction for all uses is 33377 ham, making stage of ground water extraction 71.37% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 19039 ham.

5.7 BETUL

Betul district is underlain by Archaeans Granite-gneisses, Gondwanas sandstone-clays, Lametas and Deccan trap basalts. Dynamic ground water resources of the district have been estimated for base year - 2023, on block-wise basis. Out of 1004300 ha of geographical area, 856450 ha (85%) is ground water recharge worthy area and 147850 ha (15%) is hilly area. There are ten numbers of assessment units (block) in the district which fall under command (3.41 %) and non-command (96.59%) sub units. All blocks of the district are categorized as safe blocks except Betul and Multai block. Multai block having highest stage of ground water extraction, which is computed as 82.75%, and Betul having 81.47% as Semi-Critical Category. The annual extractable ground water resource in the district is 97750 ham and ground water extraction for all uses is 44632 ham, making stage of ground water extraction 49.64% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 49031 ham.

5.8 BHIND

Bhind district is characterized by alluvial formation, Vindhyan Formation, and Gwalior Series. Dynamic Ground water resources of the district have been estimated for base year -2023, on block-wise basis. Out of 445900 ha of geographical area, 445900 ha (100%) is ground water recharge worthy area. There are six numbers of assessment units (block) in the district which fall under command (40%) and non-command (60%) sub units. All blocks of the district are categorized as safe blocks, and highest stage of ground water extraction is computed as 36.55% for Lahar Block. The annual extractable ground water resource in the district 89954 ham and ground water extraction for all uses is 25662 ham, making stage of ground water extraction 32.65% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 60384 ham.

5.9 BHOPAL

Bhopal district is underlain by Deccan trap basalts and Vindhyan sandstone. Dynamic ground water resources of the district have been estimated for base year -2023, on block wise basis. Out of 277237 ha of geographical area, 264800 ha (96%) is ground water recharge worthy area and 12437 ha (4%) is hilly area. There are three number of assessment units (two blocks and one urban area) in the district which fall under non-command sub unit. All assessment units of the district are categorized as Semi- Critical. Highest stage of ground water extraction is computed as 83.45 for Phanda. The annual extractable ground water resource in the district is 37948 ham and ground water extraction for all uses is 23916 ham, making stage of Ground water extraction 78.29 as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 7761 ham.

5.10 BURHANPUR

Burhanpur district is underlain by, Basaltic lava flows of Deccan trap and Tapi alluvium. Dynamic Ground water resources of the district have been estimated for base year -2023, on block-wise basis. Out of 323300 ha of geographical area, 257050 ha (80%) is ground water recharge worthy area and 66250 ha (20%) is hilly area. There are two number of assessment units (block) in the district which fall under command (4%) and non-command (96%) sub units. Burhanpur block is categorized as Semi-ctitical while Khakner is categorized as safe with highest stage of ground water extraction is computed as 73.81% for Burhanpur block. The annual extractable ground water resource in the district is 33962 ham and ground water etraction for all uses is 41940 ham, making stage of ground water extraction 69.75 % as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 10127 ham.

5.11 CHHATARPUR

About 65% of the district is occupied by Bundelkhand granite in northern & north central part with a thin soil cover. The exposure of Bijawars triangular in shape and constitute about 15% of the south eastern part of the district. Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 868736 ha of geographical area, 790434 ha (92%) is ground water recharge worthy area and 78302 ha (8%) is hilly area. There are eight number of assessment units (block) in the district which fall under non-command (86%) and command (14%) sub units. Badamalhara, Gaurihar, Loundi and Rajnagar blocks are in safe. Buxwaha, Chhatarpur, Nowgaon and Bijawar are under semi critical. Highest stage of ground water extraction is computed as 80.99 % for Nowgaon Block. Annual extractable ground water resource in the district 80899 ham and ground water extraction for all uses is

49738 ham, making stage of ground water extraction 65.42% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 27798 ham.

5.12 CHHINDWARA

Chhindwara district is underlain by Deccan trap basalts, Archaean granite-gneisses and Gondwanas sandstone-clays. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 1181500 ha of geographical area, 884777 ha (75%) is ground water recharge worthy area and 296723 ha (25%) is hilly area. There are eleven number of assessment units (block) in the district which fall under non-command (99 %) and command (1 % Morkhed and Sauser) sub units. Amarwara, Bichhua, Chourai, Harrai, Jamai, Sausar, Parasia and Tamia blocks of the district are categorized as safe blocks, Mohkhed, Pandurna are as semi critical, Chhindwada is categorized as critical. Highest stage of ground water extraction is computed as 99.43% for Chhindwara block. The annual extractable ground water resource in the district is 97605 ham and ground water extraction for all uses is 55742 ham, making stage of ground water extraction 63.23% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 35665 ham.

5.13 DAMOH

Damoh district is underlain mainly by Vindhyan Shale, Limestone and Sandstone. Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 730600 ha of geographical area, 474619 ha (65%) is ground water recharge worthy area and 255981 ha (35%) is hilly area. There are seven number of assessment units (block) in the district which fall under non-command (88 %) and command (12%) sub units. Damoh, Hatta, Jabera, Patera, Tedukheda, blocks of the district are categorized as safe blocks, and Pathariya as semi critical. The highest stage of ground water extration is computed as 80.47% in Pathariya block. The annual extractable ground water resource in the district is 36576 ham and ground water extraction for all uses is 18757 ham, making stage of ground water extraction 58.47% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 14783 ham.

5.14 DATIA

Datia district is characterized by alluvial formation, Bundelkhand Granite gneiss, and Gwalior Series Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 269100 ha of geographical area, 266200 ha (99%) is ground water recharge worthy area and 2900 (1%) is hilly area. There are three numbers of assessment units

(block) in the district which fall under command (49%) and non-command (51%) sub units. All blocks of the district are categorized as safe blocks with highest stage of ground water development of 53.26% in Datia block. The annual extractable ground water resource in the district 40122 ham and ground water extraction for all uses is 12664 ham, making stage of ground water extraction 36.05**%** as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 25529 ham.

5.15 DEWAS

Dewas district is underlain by Deccan trap basalts, Archaeans granite-gneisses and Vindhyan sandstone. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out 702084 ha of geographical area, 577082 ha (79 %) is ground water recharge worthy area and 125002 ha (21%) is hilly area. There are six number of assessment units (block) in the district which fall under non-command (97 %) and command (3% Bagli and Kannod) sub units. Bagli, Kannod and Tonkkhurd blocks of the district are categorized as safe blocks. Kategaon block of the district is categorized as semi critical block, Dewas and Sonkatch blocks as over exploited with highest stage of ground water extraction of 110.88% in Dewas block. The annual extractable ground water resource in the district is 80944 ham and ground water extraction for all uses is 60357 ham, making stage of ground water extraction 79.99% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 18015 ham.

5.16 DHAR

Dhar district is underlain by mainly Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 815300 ha of geographical area, 812640 ha (almost 100%) is ground water recharge worthy area and 2660 ha (less than 1%) is hilly area. There are thirteen number of assessment units (block) in the district which fall under non-command (82 %) and command (18 %) sub units. Bagh, Dahi, Dharampuri, Gandhwani, Kukshi, Manawar, Nisarpur, Sardarpur and Umraban blocks of the district are categorized as safe blocks. Tirla are categorized as critical and Badnawar, Dhar and Nalchha are categorized as over exploited with highest stage of ground water development is computed as 153.44% Dhar block. Annual extractable ground water resource in the district is 127766 ham and ground water extraction for all uses is 76853 ham, making stage of ground water extraction 65.39% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 55147 ham.

5.17 DINDORI

Dindori district is underlain by Deccan trap basalts. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 572500 ha of geographical area, 456000 ha (81%) is ground water recharge worthy area and 116500 ha (19%) is hilly area. There are seven number of assessment units (block) in the district which fall under non-command sub units. All blocks of the district are categorized as safe blocks, and highest stage of ground water extraction is computed as 16.97% for Shahpura Block. The annual extractable ground water resource in the district is 33257 ham and Ground Water extraction for all uses is 2316 ham, making stage of ground water extraction 12.52 % as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 28955 ham.

5.18 GUNA

Guna district is underlain by Deccan trap basalts, Vindhyan sandstone and laterites. Dynamic ground water resources of the district have been estimated for base year-2023 on block-wise basis. Out of 639000 ha of geographical area, 617514 ha (97%) is ground water recharge worthy area and 21486 ha (3%) is hilly area. There are five number of assessment units in the district which fall under non-command (94%) and command (6%) units. Presently all the blocks of the district are categorized as safe blocks. The highest stage of ground water development is computed as 69.63% in Chachaura block. The annual extractable ground water resource in the district is 77314 ham and ground water extraction for all uses is 47608 ham, making stage of ground water extraction 64.95% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 26911 ham.

5.19 GWALIOR

Gwalior district is characterized by Gwalior Series, Bundelkhand granite gneiss, Vindhyan sandstone and alluvial formations. Dynamic ground water resources of the district have been estimated for base year – 2023 on block-wise basis. Out of 456400 ha of geographical area, 428300 ha (94%) is ground water recharge worthy area and 28100 ha (6%) is hilly area. In the district there are total five number of assessment units (four blocks and one urban area), out of which three numbers of assessment units (Bhitarwar, Dabra and Ghatigaon) in the district fall under command (30%) and all five assessment units (Bhitarwar, Dabra, Ghatigaon and Morar) fall under non-command (70%) sub units. All assessment units of the district are categorized as safe blocks except the Gwalior_Urban area which comes under semi critical category with highest stage of ground water extraction of 76.92%. The annual extractable ground water

resource in the district is 75774 ham and ground water extraction for all uses is 18052 ham, making stage of ground water extraction 31.41% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 51447 ham.

5.20 HARDA

Harda district is characterized by alluvial formations and Deccan trap basaltic lava flow. Dynamic ground water resources of the district have been estimated for base year – 2023 on block-wise basis. Out of 333000 ha of geographical area, 270090 ha (81%) is ground water recharge worthy area and 62910 ha (19%) is hilly area. There are three numbers of assessment units in the district which fall under command (29%) and non-command (71%) categories sub units. All blocks of the district are categorized as safe blocks, with highest stage of ground water development of 67.89% in Khirkiya block. The annual extractable ground water resource in the district 43947 ham and ground water extraction for all uses is 14405 ham, making Stage of Ground water extraction 35.64% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 28195 ham.

5.21 HOSHANGABAD

Hoshangabad district is characterized by alluvial formations, Gondwana, Archaean and Deccan trap basaltic lava flow. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 670400 ha of geographical area, 558352 ha (83%) is ground water recharge worthy area and 112048 ha (17%) is hilly area. There are seven number of assessment units in the district which fall under command (45%) and non-command (55%) sub units. All blocks of the district are categorized as safe blocks, except Bankhedi, which is categorized as semi-critical with the highest stage of ground water extraction of 81.37%. The annual extractable ground water resource in the district 163696 ham and ground water extraction for all uses is 40065 ham, making stage of ground water extraction 25.86% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 121265 ham.

5.22 INDORE

Indore district is underlain by mainly Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 389800 ha of geographical area, 381897 ha (98%) is ground water recharge worthy area and 7,903 ha (2%) is hilly area. There are five number of assessment units (Depalpur, Indore,

Mhow, Sanwer and Indore_Urban) in the district which fall under non-command (99 %) and command (1% Mhow and Depalpur) sub units. Mhow block of the district is categorized as semi critical and Depalpur, Indore, Sanwer and the Indore_Urban also categorized as over exploited. The highest sage of ground water extraction is computed as 142.82% in Depalpur block. The annual extractable ground water resource in the district is 54436 ham and ground water extraction for all uses is 54421 ham, making stage of ground water extraction 119.38 % as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 2547 ham.

5.23 JABALPUR

Jabalpur district is underlain by Alluvium, Archaean granite, Basaltic lava flows of Deccan trap Bijawar and Vindhyan sandstone. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 522093 ha of geographical area, 443868 ha (83%) is ground water recharge worthy area and 78225 ha (17%) is hilly area. There are eight number of assessment units (seven blocks and one urban area) in the district which fall under non-command (82%- Kundam and Majholi) and command (18%) sub units. All the assessment units are categorized as safe except the Jabalpur_Urban area it is in semi-criticall category. The highest stage of ground water extraction is computed as 89% Jabalpur_Urban. The annual extractable ground water resource in the district is 61296 ham and ground water extraction for all uses is 25295 ham, making stage of ground water extraction 51.31% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 29704 ham.

5.24 JHABUA

Jhabua district is underlain by Archaeans granite-gneisses, phyllite and Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 346000 ha of geographical area, 311253 ha (90%) is ground water recharge worthy area and 34747 ha (10%) is hilly area. There are six number of assessment units (block) in the district which fall under non-command (95%) and command (5%) (Petlawad) categories. All blocks of the district are categorized as safe blocks, except Jhabua, which is categorized as semi critical and highest stage of ground water extraction is computed as 83.27% for Jhabua Block. The annual extractable ground water resource in the district is 24280 ham and ground water extraction for all uses is 8065 ham, making stage of ground water extraction 44.79% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 13066 ham.

5.25 KATNI

Katni district is underlain by Vindhyan sandstone, Bijawar Alluvium and Basaltic lava flows of Deccan trap and. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 489400 ha of geographical area, 466648 ha (95 %) is ground water recharge worthy area and 22752 ha (5%) is hilly area. There are six number of assessment units (block) in the district which fall under non-command (93 %) and command (7 %) sub units. All the blocks of the district are categorized as safe. Highest stage of ground water extractoion is computed as 62.40% for Vijayraghogarh. The annual extractable ground water resource in the district is 38029 ham and ground Water extraction for all uses is 14014 ham, making stage of ground water extraction 47.12% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 19902 ham.

5.26 KHANDWA

Khandwa district is underlain by mainly Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year – 2023 on block-wise basis. Out of 752450 ha of geographical area, 581446 ha (77%) is ground water recharge worthy area and 171004 ha (23%) is hilly area. There are seven number of assessment units (block) in the district which fall under non-command (85%) and command (15%, Chhegaon Makhan, Khandwa, Punasa and Pandhana) sub units. All the blocks except, Chhegaon Makhan are categorized as safe. Chhegaon Makhan block of the district is categorized as semi critical. The highest stage of ground water extraction is computed as 86.48% in Chhegaon Makhan. The annual extractable ground water resource in the district is 105196 ham and ground water extraction for all uses is 40541 ham, making Stage of Ground water extraction 41.48 % as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 61341 ham**.**

5.27 KHARGONE

Khargone district is underlain by mainly Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year – 2023 on block-wise basis. Out of 803000 ha of geographical area, 656897 ha (82 %) is ground water recharge worthy area and 146103 ha (18 %) is hilly area. There are nine number of assessment units (block) in the district which fall under non-command (74%) and command (26%) sub units. All the blocks are categorized as safe except Khargone. Khargone block of the district are categorized as semi-critical. The highest stage of ground water extraction is computed as 77.77 % in Khargone. The annual extractable ground water resource in the district is 92147 ham and ground water

extraction for all uses is 37725 ham, making stage of ground water extraction 45.92% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 49477 ham.

5.28 MANDLA

Mandla district is underlain by Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 754400 ha of geographical area, 573990 ha (83%) is ground water recharge worthy area and 180410 ha (17%) is hilly area. There are nine number of assessment units (block) in the district which fall under non-command (95 %) and command (5 %- Bichhiya, Mandla and Nainpur) sub units. All blocks of the district are categorized as safe blocks, and highest stage of ground water extraction is computed as 51.98% for Mohgaon Block. The annual extractable ground water resource in the district is 46772 ham and ground water extraction for all uses is 7008 ham, making Stage of Ground water extraction 20.41 % as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 37073 ham.

5.29 MANDSAUR

Mandsaur district is underlain by mainly Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 522938 ha of geographical area, 498468 ha (90%) is ground water recharge worthy area and 54470 ha (10 %) is hilly area. Garoth, Bhanpur and Malhargarh blocks of the district are categorized as semi critical, Mandsaur and Sitamua as over exploited. The highest stage of ground water extraction is computed as 130.97% Sitamau block. The annual extractable ground water resource in the district is 63181 ham and ground water extraction for all uses is 62918 ham, making stage of ground water extraction 104.56% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 6601 ham.

5.30 MORENA

Morena district is characterized by alluvial formation,Vindhyan Formation and Gwalior Series. Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 496889 ha of geographical area, 438489 ha (88 %) is ground water recharge worthy area and 58400 ha (12%) is hilly area. There are seven numbers of assessment units (block) in the district which fall under command (51 %) and non-command (49 %) sub units. All the seven blocks- ambah, Jaura, Kailaras, Morena, Pahadgarh, Porsa and Sabalgarh blocks are safe. The highest stage of ground water extraction is computed as 59.33% in Ambah

block. The annual extractable ground water resource in the district 64615 ham and ground water extraction for all uses is 19963 ham, making stage of ground water extraction 40.13% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 38217 ham.

5.31 NARSINGHPUR

Narsinghpur district is underlain by Alluvium, Gondwana sandstone, Bijawar and Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year – 2023 on block-wise basis. Out of 513300 ha of geographical area, 479100 ha (89%) is ground water recharge worthy area and 34200 ha (11%) is hilly area. There are six number of assessment units (block) in the district which fall under non-command (90%) and command (10%) sub units. Except Narsinghpur block, which is categorized as semi critical, all other blocks are categorized as Safe. The highest stage of ground water extraction is computed 77.09 % in Narsinghpur block. The annual extractable ground water resource in the district is 112762 ham and Ground Water extraction for all uses is 72947 ham, making stage of ground water extraction 66.95% as a whole for district. After making allocation for future domestic for year 2025, balance available ground water for future use would be 37161 ham.

5.32 NEEMUCH

Neemuch district is underlain by mainly Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year – 2023 on block-wise basis. Out of 420044 ha of geographical area, 375744 ha (89%) is ground water recharge worthy area and 44300 ha (11 %) is hilly area. There are three number of assessment units (block) in the district which fall under non-command. Jawad and Neemuch blocks of the district are categorized as over exploited and Manasa as semi critical. The highest stage of ground water extraction is computed as 109.45% in Jawad block. The annual extractable ground water resource in the district is 36148 ham and ground water extraction for all uses is 34072 ham, making stage of ground water extraction 99.23 % as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 2846 ham.

5.33 NIWARI

Niwari district is occupied by Bundelkhand granite with a thin soil cover. Dynamic ground water resources of the district have been estimated for base year- 2023 on block-wise basis. Out of 156462 ha of geographical area 152562 ha (97%) is ground water recharge worthy area and 3900 ha (3%) is hilly area. There are two number of assessment units (blocks) in the district which fall under non-command (89%) and command (11%) sub units. Niwari block is

categorized as Semi-Critical and Prithvipur as safe. Highest stage of ground water extraction is computed as 70.17% for Niwari block. The annual extractable ground water availability in the district 18120 ham and ground water extraction for all uses is 11520 ham, making stage of ground water extraction 69.84% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 5254 ham.

5.34 PANNA

Panna district is underlain by Vindhyan Shale, Limestone and Sandstone and Alluvium. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 713500 ha of geographical area, 662475 ha (93%) is ground water recharge worthy area and 51025 ha (7%) is hilly area. There are five number of assessment units (block) in the district which fall under non-command (95%) and command (5% Panna) sub units. All the blocks of the district are categorized as safe blocks. The highest stage of ground water extraction is computed as 41.31% in Gunnor block. The annual extractable ground water resource in the district 50601 ham and ground water extraction for all uses is 15770 ham, making stage of ground water extraction 36.48% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 31983 ham.

5.35 RAISEN

Raisen district is underlain by Basaltic lava flows of Deccan trap Vindhyan Sandstone and Alluvium. Dynamic Ground water resource estimation of the district has been computed for Base Year-2023, on block wise basis. Out of 846640 ha of geographical area, 660940 (78%) ha is ground water recharge worthy area and 185700 (22 %) is hilly area. There are seven number of assessment units (block) in the district which fall under non-command (92%) and command (8% Badi) sub units. All blocks of the district are categorized as safe except Obedullaganj which fall in semi critical category. The highest stage of ground water extraction is computed as 89.04% Obedullaganj block. The annual extractable ground water resource in the district 86813 ham and ground water extraction for all uses is 42627 ham, making stage of ground water extraction 53.67% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 39910 ham.

5.36 RAJGARH

Rajgarh district is underlain by mainly Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year 2023 on block-wise basis. Out

of 6,15,498 ha of geographical area, 6,15,498 ha (100 %) is ground water recharge worthy area. There are six number of assessment units (block) in the district which fall under non-command. Biora, Khilchipur, Rajgarh and Zeerapur blocks of the district are categorized as semi critical, Narsinghgarh block of the district is categorized as critical, Sarangpur categorized as Over-Exploited. The highest stage of ground water extraction is computed as 110.63 % in Sarangpur block. The annual extractable ground water resource in the district is 46524 ham and ground water extraction for all uses is 73551 ham, making stage of ground water extraction 89.78 % as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 9937 ham.

5.37 RATLAM

Ratlam district is underlain by Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 486100 ha of geographical area, 461600 ha (95 %) is ground water recharge worthy area and 24500 ha (5 %) is hilly area. There are seven number of assessment units (block) in the district which fall under non-command (98 %) and command (2% Bajna block) sub units. Alote, Jaora, Piploda and Ratlam blocks of the district are categorized as over exploited, Sailana and Bajna as semi critical. The highest stage of ground water extraction is computed as 170.51% in Jaora block. The annual extractable ground water resource in the district 76902 ham and ground water extraction for all uses is 99438 ham, making stage of ground water extraction 135.13% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 2377 ham.

5.38 REWA

Rewa district is underlain by Vindhyan Shale, Limestone and Sandstone and Alluvium. Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 631360 ha of geographical area, 593760 ha (93%) is ground water recharge worthy area and 37600 ha (7%) hilly area. All blocks, of the district are categorized as safe, except Mauganj which is categorized as semi critical. The highest stage of ground water extraction is computed as 74.94% in Mauganj block. The annual extractable ground water resource in the district is 49820 ham and ground water extraction for all uses is 21372 ham, making stage of ground water extraction 54.64% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for futureuse would be 22077 ham.

5.39 SAGAR

Sagar district is underlain by Basaltic lava flows of Deccan trap Vindhyan Sandstone and Alluvium. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 1025200 ha of geographical area, 925418 ha (90 %) is ground water recharge worthy area and 99782 ha (10 %) is hilly area. There are eleven number of assessment units (block) in the district which fall under non-command (95 %) and command (5 %) sub units. All the blocks are categorized as safe. The highest stage of ground water extraction is computed as 66.05% in Bina block. The annual extractable ground water resource in the district 102371 ham and ground water extraction for all uses is 56806 ham, making stage of ground water extraction 59.28% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 41393 ham.

5.40 SATNA

Satna district is underlain by Vindhyan Shale, Limestone and Sandstone and Alluvium. Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 752016 ha of geographical area, 672106 ha (89%) is ground water recharge worthy area and 779910 ha (11%) hilly area. There are nine number of assessment units (block) in the district which fall under non-command and command (Amarpatan, Nagod, Rampur baghelon, Sohawal, Uchehra blocks). Majhgawan, Nagod, Ramnagar and Unchehra blocks of the district are categorized as safe. While Amarpatan, Maihar, Rampur Baghelon and Sohawal blocks as semi critical. The highest stage of ground water Extraction is computed as 89.32% in Rampur Baghelon. The annual extractable ground water resource in the district is 69018 ham and ground water extraction for all uses is 39418 ham, making stage of ground water development 65.59% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 25470 ham.

5.41 SEHORE

Sehore district is underlain by Basaltic lava flows of Deccan trap, Vindhyan Sandstone and Alluvium. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 657800 ha of geographical area, 463972 ha (70%) is ground water recharge worthy area and 193828ha (30%) is hilly area. There are five number of assessment units (block) in the district which fall under non-command (80%) and command (20% Ashta, Budhni, Ichawar, Nasrullahganj & Sehore) sub units. Ashta block of the district are categorized as critical and rest of the blocks are safe. The highest stage of ground water development is computed as 93.50% Ashta block. The annual extractable ground water

resource in the district 67494 ham and ground water extraction for all uses is 39055 ham, making stage of ground water extraction 61.78% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 25606 ham.

5.42 SEONI

Seoni district is underlain by Deccan trap basalts and Archaeans granite-gneisses. Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 875800 ha of geographical area, 805020 ha (92%) is ground water recharge worthy area and 70780 ha (8 %) is hilly area. There are eight number of assessment units (block) in the district which fall under non-command (91%) and command (9% Barghat, Dhanora, Keolari and Seoni) sub units. All the blocks of the district are categorized as safe blocks. Chhapara is with highest stage of ground water extraction is computed as 69.64%. The annual extractable ground water resource in the district is 68393 ham and ground water extraction for all uses is 24963 ham, making stage of ground water extraction 41.38% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 39891 ham.

5.43 SHAHDOL

Shahdol district is underlain by Archaeans granite-gneisses, Gondwanas sandstone-clays, Lametas and Deccan trap basalts. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 584100 ha of geographical area, 497800 ha (85%) is ground water recharge worthy area and 86300 ha (15%) is hilly area. There are five number of assessment units (block) in the district which fall under non-command & command (Beohari) category. All blocks of the district are categorized as safe blocks, and highest stage of ground water extraction is computed as 25.38% for Sohagpur Block. The annual extractable ground water resource in the district is 53172 ham and ground water extraction for all uses is 3124 ham, making stage of ground water extraction 13.36% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 45933 ham.

5.44 SHAJAPUR

Shajapur district is underlain by mainly Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 347325 ha of geographical area, 340617 ha (98%) is ground water recharge worthy area and 6,708 ha (2%) is hilly area. There are four number of assessment units (blocks) in the district which fall under non-command. Mohan Berodia, and Kalapipal units are categorized

as over-exploited, whereas Shajapur unit is categorized as semi-critical of the district. The highest stage of ground water extraction is computed as 126.69% in Mohan Berodia block. The annual extractable ground water availability in the district is 51468 ham and ground water extraction for all uses is 52782 ham, making stage of ground water extraction 106.89 % as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 2116 ham**.**

5.45 SHEOPUR

Sheopur district is underlain by Vindhyan Sandstone and Alluvium. Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 660600 ha of geographical area, 533480 ha (81%) is ground water recharge worthy area and 127120 ha (19%) is hilly area. There are three number of assessment units (blocks) in the district which fall under non-command (87%) and two (Sheopur and Vijaypur) under command (13%) sub units. Karhal and Sheopur are categorises as safe and Vijayur is categiorised as semi critical in this year. The highest stage of ground water extraction is computed as 71.81% in Vijaypur block. The annual extractable ground water availability in the district 50674 ham and ground water extraction for all uses is 17631 ham, making stage of ground water extraction 38.47% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 31029 ham.

5.46 SHIVPURI

Shivpuri district is underlain by Budelkhand Granite, Basaltic lava flows of Deccan trap Vindhyan Sandstone and Alluvium. Dynamic ground water resources of the district have been estimated for base year – 2023 on block-wise basis. Out of 1027800 ha of geographical area, 977049 ha (95%) is ground water recharge worthy area and 50,751 ha (5%) is hilly area. There are eight number of assessment units (block) in the district which fall under non-command (93%) and seven also under command (7%) sub units. Karera, Shivpuri and Pohri blocks are categorized as safe whereas Badarwas, Khaniyadhana, Kolaras, Narwar and Pichor blocks of the district are categorized as semi critical. The highest stage of ground water extraction is computed as 83.83% in Khaniyadhana block. The annual extractable ground water availability in the district 78319 ham and ground water extraction for all uses is 48288 ham, making stage of ground water extraction 67.67% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 24939 ham.

5.47 SIDHI

Sidhi district is underlain by Vindhyan limestone sandstone, Archaean granite Gondwana sandstone and Alluvium Dynamic ground water resources of the district have been estimated for base year-2023 on block-wise basis. Out of 485400 ha of geographical area, 360405 ha (74%) is ground water recharge worthy area and 124995 ha (26%) is hilly area. There are five number of assessment units (block) in the district which fall under non-command (87%) and three under command (13%) sub units. All blocks of the district are categorized as safe. The highest stage of ground water extraction is computed as 67.69% Sidhi block. The annual extractable ground water availability in the district 29212 ham and ground water extraction for all uses is 7552 ham, making stage of ground water extraction 36.11% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 18414 ham.

5.48 SINGRAULI

Singrauli district is underlain by Archaean granite and Gondwana sandstone. Dynamic ground water resources of the district have been estimated for base year -2023 on block-wise basis. Out of 567200 ha of geographical area, 451260 ha (80%) is ground water recharge worthy area and 115940 ha (20%) is hilly area. There are three number of assessment units (block) in the district which fall under non-command (86%) and two under command (14% -Deosar, Waidhan) sub units. All the blocks of the district are categorized as safe. The highest stage of ground water extration is computed as 44.06% in Waidhan block. The annual extractable water availability in the district 35457 ham and ground water extraction for all uses is 8979 ham, making stage of ground water extraction 39.08% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 21311 ham.

5.49 TIKAMGARH

Tikamgarh district is occupied by Bundelkhand granite with a thin soil cover. Dynamic ground water resources of the district have been estimated for base year-2023 on block-wise basis. Out of 348338 ha of geographical area 335538 ha (97%) is ground water recharge worthy area and 12800 ha (3%) is hilly area. There are six number of assessment units (blocks) in the district which fall under non-command (92%) and command (8%) sub units. All blocks of the district are categorized as semi critical category. Highest stage of ground water extraction is computed as 87.43% for Jatara block. The annual extractable ground water availability in the district 36628 ham and ground water extraction for all uses is 26734 ham, making stage of ground

water extraction 81.83% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 5948 ham.

5.50 UJJAIN

Ujjain district is underlain by mainly Basaltic lava flows of Deccan trap. Dynamic ground water resources of the district have been estimated for base year-2023 on block-wise basis. Out of 613023 ha of geographical area, 593933 ha (97%) is ground water recharge worthy area and 19090 ha (3%) is hilly area. There are six number of assessment units (blocks) in the district which fall under non-command (100 %). Mahidpur, Tarana and Khachrod blocks of the district are categorized as semi critical. Badnagar, Ghatia and Ujjain blocks are categorized as over exploited. The highest stage of ground water extraction is computed as 151.30% in Ujjain block. The annual extractable ground water resource in the district is 91373 ham and ground water extraction for all uses is 95485 ham, making stage of ground water extraction 108.83% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 8999 ham.

5.51 UMARIA

Umaria district is underlain by Gondwana sandstone, Archaeans granite-gneisses, -clays, Lametas and Deccan trap basalts. Dynamic ground water resources of the district have been estimated for base year-2023 on block-wise basis. Out of 453900 ha of geographical area, 421900 ha (93%) is ground water recharge worthy area and 32,000 ha (7%) is hilly area. There are three number of assessment units (blocks) in the district which fall under non-command category. All blocks of the district are categorized as safe blocks, and highest stage of ground water extraction is computed as 28.12% for Karkeli Block. The annual extractable ground water resource in the district is 34239 ham and ground water extraction for all uses is 4294 ham, making stage of ground water extraction 18.71 % as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future irrigation use is 27689 ham.

5.52 VIDISHA

Vidisha district is underlain by Basaltic lava flows of Deccan trap and Vindhyan Sandstone. Dynamic ground water resources of the district have been estimated for base year-2023 on block-wise basis Out of 737100 ha of geographical area, 670770 ha (92%) is ground water recharge worthy area and 66,330 ha (8%) is hilly area. There are seven number of assessment units (block) in the district which fall under non-command (89%) and command (11%) sub units. Five blocks of the district are under safe category whereas two blocks are falling in Semi-

Critical Category. The highest stage of ground water extraction is computed as 75.80% in Kurwai block. The annual extractable ground water resource in the district 85443 ham and ground water extraction for all uses is 51046 ham, making stage of ground water extraction 64.40% as a whole for district. After making allocation for future domestic supply for year 2025, balance available ground water for future use would be 30123 ham.

CHAPTER 6

5.0 CONCLUSIONS

- GEC-2015 methodology has been developed for prevalent Indian conditions, on the basis of terrain characteristics and data availability. INDIA-GROUNDWATER RESOURCE ESTIMATION SYSTEM (IN- GRES) is a Software/Web-based Application developed by CGWB in collaboration with IIT-Hyderabad for assessment of ground water resources using GEC 2015 Methodology. Constraints in data availability have been overcome through realistic assumptions based on experience in the state.
- A conscious effort is required on the parts of the State/ Central agencies to acquire the requisite realistic data to map the changing groundwater scenario in the state.
- Total Annual Ground Water Recharge in the state (2023) has been assessed as 35.47 billion cubic meters (bcm). Ground water resources are replenished through rainfall and other sources like return flow from irrigation, canal seepage, recharge from water bodies, water conservation structures etc. The main source of annual ground water recharge is rainfall, which contributes nearly 76% of the Total Annual Ground Water Recharge.
- The Total Annual Extractable Ground Water Resource of the country has been assessed as 32.85 billion cubic meters (bcm), after keeping a provision for natural discharge.
- The Annual Ground Water Extraction of the state (2023) is 19.30 billion cubic meters (bcm), the largest user being irrigation sector.
- The Stage of ground water extraction for the entire state, which is the percentage of groundwater extraction with respect to Annual Extractable Ground Water Recharge, has been computed as 58.75%. The extraction pattern of ground water is not uniform across the state, resulting in ground water stressed conditions in some parts of the state while in some other areas; ground water extraction has been sub- optimal.
- Out of the total 317 assessment units (Blocks/ Urban areas) in the state, 26 units (8%) have been categorized as 'Over- Exploited', 5 units (2%) have been categorized as 'Critical', 50 units (19%) have been categorized as 'Semi-Critical' and 226 units (71%) have been categorized as 'Safe.'
- Out of 32853.75 mcm of Total Annual Extractable Resources of the state, 3424.26 mcm (10.42 %) are under 'Over-Exploited', 537.1 mcm (1.63 %) are under

'Critical', 6119.62 mcm (18.63 %) are under 'Semi-Critical', 22772.77 mcm (69.32 %) are under 'Safe' category assessment units.

- Out of 269333.27 Sq Km of Recharge worthy area of the state, 22554.86 Sq Km (8.37 %) are under 'Over-Exploited', 4249.07 Sq Km (1.58 %) are under 'Critical', 51803.76 Sq Km (19.23 %) are under 'Semi-Critical', 190725.58 Sq Km (70.81%) are under 'Safe' category assessment units.
- Almost all over-exploited assessment units falling in western part of Madhya Pradesh, which is known as "MALWA AREA" where ground water extraction has increased many folds during past decades.
- The total Annual Ground Water Recharge for the entire state, as in 2023 has increased by 0.23 bcm as compared to the last assessment (2022). The total Annual Extractable Ground Water Resources has also increased by 0.27 bcm. The Annual Ground Water Extraction for irrigation, domestic and Industrial uses increased by 0.05 bcm during this period. These variations are attributed mainly to to increased rainfall recharge, the implementation of water conservation structures, increase in the abstraction structures and increase in population, and changing ground water regime.
- It is further added that in the assessment units with low the ground water potential as indicated in 'Unit recharge map' (**Fig 4.6**), the ground water extraction is also less, thereby rendering these units as 'Safe'. Similarly, in the assessment units with good ground water potential, the ground water extraction is high which has resulted into Over-exploitation over a period. The water augmentation efforts can be successful in such areas, where the ground water potential is high and there is scope for augmentation.

6.1 INFERENCES FROM GROUND WATER RESOURCE ASSESSMENT

An analysis of assessment results leads us to the following inferences as the way forward in the assessment of Ground water resources.

6.1.1 Water balance Studies

Ground water is one of the several components of the Hydrologic Cycle, other important components being rainfall, surface water, soil moisture and evapotranspiration. Holistic water resources management interventions require proper understanding of the interactions between the different components of the hydrosphere. Studies for determining the Base flow and lateral flow components in the Water Balance equation need to be taken up to bring more accuracy to the Ground Water Resources Assessment.

6.1.2 Aquifer Charactersation and Parameter Estimation

One of the key elements that determine the accuracy of ground water resources assessment is the realistic estimation of the recharge and discharge parameters. It is recommended that more experimental studies be taken up for refining the norms of RIF, return flow from irrigation based on soil types and agro-climatic zone, recharge from water conservation and water bodies and more field studies for evaluation of specific yield values as well as its variation with depth.

6.1.3 Case Studies Linking Assessment with Management

It is recommended to take up case studies in various assessment units wherein quantitative evaluation of the ground water management interventions and consequent changes in the assessment results could be analysed. Such studies would help bring out the efficacy of various management interventions on the ground water regime.

6.1.4 Temporal availability of Ground Water Resources

Even though the GEC 2015 methodology advocates season-wise resource assessment, the estimation of recharge during monsoon and non-monsoon seasons may not be sufficient. Temporal variations in groundwater availability, particularly in hard rock terrain are not reflected in present practices. Hence, the assessment of temporal availability of ground water resources on the basis of available water columns can be attempted by considering the water levels measured frequently using Digital Water Level Recorders (DWLRs).

6.1.5 Creation of Database for Ground Water Resources Assessment and its Regular updating

GEC 2015 has devised the data structure of all the data elements (like water level, rainfall etc.) and norms (like Specific Yield, Rainfall Infiltration Factor etc.) with its name, type of data and its precision. The templates (excel sheets) for data collection/compilation for assessment through IN- GRES using GEC 2015 has also been devised. However, major challenges are lack of dedicated manpower as well as presence of State GW/Nodal Departments (in majority of States) at Districtlevel for understanding/analysis of data/information to be collected/compiled from different State Departments (like Agriculture, Irrigation, Water Supply, Industries, Water Conservation etc.). Of particular importance in this regard are data/information related to recharge from water bodies, water conservation/harvesting structures, return flow from applied irrigation and details of ground water extraction structures in use for irrigation, domestic and industrial purpose. These need to be collected/compiled and regularly updated at district/block level so that more realistic assessment of ground water resources could be accomplished.

6.1.6 Aquifer- Stream Interactions

Additional studies on aquifer-stream interactions are required to understand the contribution of ground water to streams and the requirement of environmental flows for sustainability of water resources and surrounding ecosystem.

6.1.7 Ground Water Modelling and Predictive Simulation

Besides the assessment of the dynamic ground water resources using norms prescribed in GEC 2015 methodology through automation, the concept of Ground water modelling must be included where predictive simulation can also be done. This would give an idea of the future availability of Ground water resources with respect to the changing climate and extraction patterns.

6.2 RECCOMENDATIONS

The dependency on groundwater has increased many folds during the recent years and the groundwater extraction for irrigation, domestic and industries have resulted in lowering of water levels, long-term water level declining trend and even drying up of wells. The best option lies in improving the recharge component in any well-defined administrative or natural boundary (Block/ Water shed) by an integrated scientific approach with people participatory program. Such program also needs to include cost effective structures and best practices possible without deteriorating the existing surface and ground water resources in terms of quantity and quality. In order to regulate the groundwater extraction, Central Ground Water Board in association with Ground Water Survey, Water Resource Department has computed Dynamic Groundwater Resources and categorized blocks as Over Exploited, Critical, Semi Critical and Safe.

Hence, there is an urgent need to implement artificial recharge schemes to augment ground water so that artificial recharge would be a part of Sustainable Management of ground water. The guidelines which can be used in the formulation of scheme proposal can be enumerated as follows.

Criteria for selection of priority area

1. Area characterized by significant declining post monsoon long term water level trend
2. Area characterized by deeper post monsoon water level.
3. The area having high stage of groundwater extraction and categorized as Over Exploited, Critical ground water assessment units.
4. The aquifer under stress needs to be considered for artificial recharge specially the weathered, fractured and jointed basaltic formations of malwa regions and priority also

be given for recharging at the recharge area of the confined aquifer, viz., crystalline-sedimentary contacts, palaeo-channels, upstream side of fractures/lineaments.

Annexure-I: assessment unit wise area Details

S. N	Assessment Unit	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non Command Area	Total		
1	**AGAR MALWA**					
	AGAR	11375	54071	65446	6994	72440
	BADOD	0	70083	70083	3515	73598
	NALKHEDA	0	56217	56217	4515	60732
	SUSNER	0	59830	59830	5593	65423
	DISTRICT TOTAL	**11375**	**240201**	**251576**	**20617**	**272193**
2	**ALIRAJPUR**					
	ALIRAJPUR	0	63900	63900	2500	66400
	BHABRA	0	31300	31300	2700	34000
	JOBAT	0	36900	36900	2000	38900
	KATTHIWARA	0	51600	51600	11700	63300
	SONDWA	0	87400	87400	4800	92200
	UDAIGARH	0	34300	34300	2700	37000
	DISTRICT TOTAL	**0**	**305400**	**305400**	**26400**	**331800**
3	**ANUPPUR**					
	ANUPPUR	0	55700	55700	3300	59000
	JAITHARI	0	84000	84000	13000	97000
	KOTMA	0	34000	34000	6000	40000
	PUSHPARAJGARH	0	120500	120500	55900	176400
	DISTRICT TOTAL	**0**	**294200**	**294200**	**78200**	**372400**
4	**ASHOKNAGAR**					
	ASHOKNAGAR	3506	121297	124803	0	124803
	CHANDERI	4799	104071	108870	4200	113070
	ISAGARH	3435	103680	107115	0	107115
	MUNGAOLI	8910	112546	121456	950	122406
	DISTRICT TOTAL	**20650**	**441594**	**462244**	**5150**	**467394**
5	**BALAGHAT**					
	BAIHAR	0	127451	127451	1709	129160
	BALAGHAT	18890	103066	121956	263	122219
	BIRSA	0	135798	135798	5745	141543
	KATANGI	11442	56237	67679	2100	69779
	KHAIRLANJI	13658	31730	45388	3400	48788
	KIRNAPUR	0	76240	76240	4800	81040
	LALBARRA	20858	49374	70232	1360	71592
	LANJI	21423	64473	85896	1230	87126
	PARASWADA	0	116750	116750	7300	124050

S. N	Assessment Unit	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non Command Area	Total		
	WARASEONI	15232	29171	44403	3200	47603
	DISTRICT TOTAL	**101503**	**790290**	**891793**	**31107**	**922900**
6	**BARWANI**					
	BARWANI	14552	41248	55800	20910	76710
	NIWALI	470	35091	35561	24049	59610
	PANSEMAL	4489	24691	29180	29860	59040
	PATI	1040	21552	22592	48628	71220
	RAJPUR	21413	51623	73036	4354	77390
	SENDHWA	9275	69472	78747	43783	122530
	THIKRI	17473	54442	71915	3785	75700
	DISTRICT TOTAL	**68712**	**298119**	**366831**	**175369**	**542200**
7	**BETUL**					
	AMLA	6438	101862	108300	3700	112000
	ATHNER	1457	51843	53300	32000	85300
	BETUL	3840	99160	103000	12000	115000
	BHAINSDEHI	2179	99821	102000	23700	125700
	BHIMPUR	0	97800	97800	17200	115000
	CHICHOLI	1336	38514	39850	9550	49400
	GHODA DONGRI	1560	112440	114000	16000	130000
	MULTAI	4850	82250	87100	21000	108100
	PRABHAT PATTAN	3326	103274	106600	6700	113300
	SHAHPUR	1262	43238	44500	6000	50500
	DISTRICT TOTAL	**26248**	**830202**	**856450**	**147850**	**1004300**
8	**BHIND**					
	ATER	16074	45126	61200	0	61200
	BHIND	25614	50586	76200	0	76200
	GOHAD	42770	60030	102800	0	102800
	LAHAR	31112	34488	65600	0	65600
	MEHGAON	31257	65643	96900	0	96900
	RON	33064	10136	43200	0	43200
	DISTRICT TOTAL	**179891**	**266009**	**445900**	**0**	**445900**
9	**BHOPAL**					
	BERASIA	0	136400	136400	6000	142400
	BHOPAL URBAN	0	38293	38293	4207	42500
	PHANDA	0	90107	90107	2230	92337
	DISTRICT TOTAL	**0**	**264800**	**264800**	**12437**	**277237**
10	**BURHANPUR**					

S. N	Assessment Unit	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non Command Area	Total		
	BURHANPUR	5866	111134	117000	61600	178600
	KHAKNAR	5423	134627	140050	4650	144700
	DISTRICT TOTAL	**11289**	**245761**	**257050**	**66250**	**323300**
11	**CHHATARPUR**					
	BADA MALHERA	8862	80638	89500	18735	108235
	BIJAWAR	1004	140839	141843	17200	159043
	BUXWAHA	1718	77395	79113	10920	90033
	CHHATARPUR	15093	78296	93389	12500	105889
	GAURIHAR	31119	59873	90992	1160	92152
	LAUNDI	18007	64254	82261	1920	84181
	NOWGAON	16033	66228	82261	9107	91368
	RAJNAGAR	24804	106271	131075	6760	137835
	DISTRICT TOTAL	**116640**	**673794**	**790434**	**78302**	**868736**
12	**CHHINDWARA**					
	AMARWARA	0	93955	93955	8245	102200
	BICHHUA	0	41384	41384	11316	52700
	CHAURAI	0	113973	113973	3227	117200
	CHHINDWARA	0	63516	63516	4784	68300
	HARRAI	0	127238	127238	83462	210700
	JAMAI	0	96604	96604	45796	142400
	MOHKHEDA	6380	64506	70886	6614	77500
	PANDHURNA	0	87186	87186	10014	97200
	PARASIA	0	69020	69020	9680	78700
	SAUSAR	6931	62382	69313	11487	80800
	TAMIA	0	51702	51702	102098	153800
	DISTRICT TOTAL	**13311**	**871466**	**884777**	**296723**	**1181500**
13	**DAMOH**					
	BATIYAGARH	4095	85087	89182	33318	122500
	DAMOH	13815	71085	84900	45500	130400
	HATTA	3998	45102	49100	37400	86500
	JABERA	12038	51362	63400	62800	126200
	PATERA	5851	51849	57700	14600	72300
	PATHARIA	4383	85954	90337	6663	97000
	TENDULHEDA	13487	26513	40000	55700	95700
	DISTRICT TOTAL	**57667**	**416952**	**474619**	**255981**	**730600**
14	**DATIA**					
	BHANDER	41252	23248	64500	1100	65600
	DATIA	42937	66163	109100	1800	110900

S. N	Assessment Unit	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non Command Area	Total		
	SEONDHA	47908	44692	92600	0	92600
	DISTRICT TOTAL	**132097**	**134103**	**266200**	**2900**	**269100**
15	**DEWAS**					
	BAGLI	3848	177000	180848	23692	204540
	DEWAS	0	99961	99961	783	100744
	KANNOD	14696	73396	88092	58208	146300
	KHATEGAON	0	87631	87631	26869	114500
	SONKUTCH	0	58120	58120	9980	68100
	TONKKHURD	0	62430	62430	5470	67900
	DISTRICT TOTAL	**18544**	**558538**	**577082**	**125002**	**702084**
16	**DHAR**					
	BADNAWAR	3420	100320	103740	2660	106400
	BAGH	4007	47193	51200	0	51200
	DAHI	2932	45268	48200	0	48200
	DHAR	0	60200	60200	0	60200
	DHARMPURI	28731	14169	42900	0	42900
	GANDHWANI	10733	62867	73600	0	73600
	KUKSHI	3377	30923	34300	0	34300
	MANAWAR	31555	23945	55500	0	55500
	NALCHHA	975	77425	78400	0	78400
	NISARPUR	20850	14450	35300	0	35300
	SARDARPUR	17730	110270	128000	0	128000
	TIRLA	0	53400	53400	0	53400
	UMARVAN	24760	23140	47900	0	47900
	DISTRICT TOTAL	**149070**	**663570**	**812640**	**2660**	**815300**
17	**DINDORI**					
	AMARPUR	0	44800	44800	11200	56000
	BAJANG	0	43600	43600	10900	54500
	DINDORI	0	94160	94160	23540	117700
	KARANJIYA	0	56480	56480	14120	70600
	MENHADWANI	0	52800	52800	15700	68500
	SAMNAPUR	0	52320	52320	13080	65400
	SHAHPURA	0	111840	111840	27960	139800
	DISTRICT TOTAL	**0**	**456000**	**456000**	**116500**	**572500**
18	**GUNA**					
	ARON	0	78883	78883	0	78883
	BAMORI	12640	145508	158148	700	158848
	CHACHAURA	5417	112815	118232	1086	119318

S. N	Assessment Unit	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non Command Area	Total		
	GUNA	4768	139347	144115	13700	157815
	RAGHOGARH	14384	103752	118136	6000	124136
	DISTRICT TOTAL	**37209**	**580305**	**617514**	**21486**	**639000**
19	**GWALIOR**					
	BHITARWAR	53133	30767	83900	6100	90000
	DABRA	60100	31200	91300	6100	97400
	GHATIGAON	17900	113090	130990	15900	146890
	GWALIOR URBAN	0	42335	42335	0	42335
	MORAR	0	79775	79775	0	79775
	DISTRICT TOTAL	**131133**	**297167**	**428300**	**28100**	**456400**
20	**HARDA**					
	HARDA	45650	46000	91650	13350	105000
	KHIRKIYA	0	79440	79440	44560	124000
	TIMARNI	33500	65500	99000	5000	104000
	DISTRICT TOTAL	**79150**	**190940**	**270090**	**62910**	**333000**
21	**HOSHANGABAD**					
	BABAI	89200	0	89200	0	89200
	BANKHEDI	0	66900	66900	12000	78900
	HOSHANGABAD	57400	0	57400	9500	66900
	KESALA	16570	64685	81255	7045	88300
	PIPARIYA	17000	69300	86300	12000	98300
	SEONI MALWA	58080	75827	133907	3593	137500
	SHOHAGPUR	15373	28017	43390	67910	111300
	DISTRICT TOTAL	**253623**	**304729**	**558352**	**112048**	**670400**
22	**INDORE**					
	DEPALPUR	1832	99127	100959	3241	104200
	INDORE	0	49821	49821	1179	51000
	INDORE URBAN	0	53000	53000	0	53000
	MHOW	3544	98548	102092	2608	104700
	SAWER	0	76025	76025	875	76900
	DISTRICT TOTAL	**5376**	**376521**	**381897**	**7903**	**389800**
23	**JABALPUR**					
	BARGI	13640	27350	40990	31804	72794
	JABALPUR URBAN	0	36840	36840	2609	39449
	KUNDAM	0	83200	83200	37800	121000
	MAJHOLI	0	62265	62265	0	62265
	PANAGAR	7500	19180	26680	0	26680

S. N	Assessment Unit	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non Command Area	Total		
	PATAN	29902	70498	100400	0	100400
	SHAHPURA	17834	29275	47109	6012	53121
	SIHORA	12000	34384	46384	0	46384
	DISTRICT TOTAL	**80876**	**362992**	**443868**	**78225**	**522093**
24	**JHABUA**					
	JHABUA	0	41300	41300	2700	44000
	MEGHNAGAR	0	45400	45400	4800	50200
	PETLAWAD	17018	74635	91653	6047	97700
	RAMA	0	45700	45700	13700	59400
	RANAPUR	0	38400	38400	2000	40400
	THANDLA	0	48800	48800	5500	54300
	DISTRICT TOTAL	**17018**	**294235**	**311253**	**34747**	**346000**
25	**KATNI**					
	BADWARA	9278	83580	92858	1342	94200
	BAHORIBAND	9348	88552	97900	0	97900
	DHIMAR KHEDA	0	84120	84120	8380	92500
	MURWARA	9278	56922	66200	0	66200
	RITHI	5500	45770	51270	12230	63500
	VIJAYRAGHAVGARH	0	74300	74300	800	75100
	DISTRICT TOTAL	**33404**	**433244**	**466648**	**22752**	**489400**
26	**KHANDWA**					
	BALDI	0	54524	54524	57176	111700
	CHHEGAON MAKHAN	3555	82545	86100	900	87000
	HARSUD	0	53847	53847	46203	100050
	KHALWA	0	97000	97000	51900	148900
	KHANDWA	4084	78391	82475	625	83100
	PANDHANA	18501	98499	117000	10200	127200
	PUNASA	66420	24080	90500	4000	94500
	DISTRICT TOTAL	**92560**	**488886**	**581446**	**171004**	**752450**
27	**KHARGONE**					
	BARWAHA	35020	98260	133280	13720	147000
	BHAGWANPURA	7917	44481	52398	79402	131800
	BHIKANGAON	17708	73772	91480	0	91480
	GOGAWAN	9693	31017	40710	0	40710
	JHIRANYA	5442	61027	66469	52431	118900
	KASRAWAD	44357	56843	101200	0	101200

S. N	Assessment Unit	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non Command Area	Total		
	KHARGONE	8510	40930	49440	0	49440
	MAHESHWAR	24134	58486	82620	0	82620
	SEGAON	4137	35163	39300	550	39850
	DISTRICT TOTAL	**156918**	**499979**	**656897**	**146103**	**803000**
28	**MANDLA**					
	BICHHIYA	5038	82882	87920	21980	109900
	BIJADANDI	0	60880	60880	15220	76100
	GHUGHARI	0	88080	88080	22020	110100
	MANDLA	7897	41463	49360	12340	61700
	MAWAI	0	117040	117040	29260	146300
	MOHGAON	0	32780	32780	9120	41900
	NAINPUR	18135	45715	63850	15950	79800
	NARAYANGANJ	0	35200	35200	8800	44000
	NIWAS	0	38880	38880	45720	84600
	DISTRICT TOTAL	**31070**	**542920**	**573990**	**180410**	**754400**
29	**MANDSAUR**					
	BHANPURA	20590	30058	50648	54470	105118
	GAROTH	25843	87177	113020	0	113020
	MALHARGARH	12931	67284	80215	416	80631
	MANDSAUR	4986	120700	125686	922	126608
	SITAMAU	9738	116333	126071	1558	127629
	DISTRICT TOTAL	**74088**	**421552**	**495640**	**57366**	**553006**
30	**MORENA**					
	AMBAH	51100	0	51100	0	51100
	JAORA	29553	27742	57295	11300	68595
	KAILARAS	29144	23150	52294	0	52294
	MORENA	45485	55615	101100	5600	106700
	PAHADGARH	25200	47800	73000	19200	92200
	PORSA	25307	20393	45700	9300	55000
	SABALGARH	19000	39000	58000	13000	71000
	DISTRICT TOTAL	**224789**	**213700**	**438489**	**58400**	**496889**
31	**NARSINGHPUR**					
	CHAWARPATHA	0	91900	91900	1400	93300
	CHICHLI	0	85600	85600	10400	96000
	GOTEGAON	20900	51900	72800	0	72800
	KARELI	13238	70162	83400	9900	93300
	NARSINGHPUR	18631	65769	84400	12500	96900
	SAIKHEDA	0	61000	61000	0	61000

S. N	Assessment Unit	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non Command Area	Total		
	DISTRICT TOTAL	**52769**	**426331**	**479100**	**34200**	**513300**
32	**NEEMUCH**					
	JAWAD	6502	150442	156944	5000	161944
	MANASA	6836	108464	115300	34300	149600
	NEEMUCH	4638	98862	103500	5000	108500
	DISTRICT TOTAL	**17976**	**357768**	**375744**	**44300**	**420044**
33	**NIWARI**					
	NIWARI	5289	53311	58600	2000	60600
	PRITHVIPUR	7541	86421	93962	1900	95862
	DISTRICT TOTAL	**12830**	**139732**	**152562**	**3900**	**156462**
34	**PANNA**					
	AJAIGARH	2762	87168	89930	1125	91055
	GUNNOR	2790	111227	114017	1600	115617
	PANNA	13514	184839	198353	6900	205253
	PAWAI	4738	132338	137076	20500	157576
	SHAHNAGAR	8908	114191	123099	20900	143999
	DISTRICT TOTAL	**32712**	**629763**	**662475**	**51025**	**713500**
35	**RAISEN**					
	BADI	58600	83200	141800	100	141900
	BEGAMGANJ	0	89300	89300	1900	91200
	GAIRATGANJ	0	74600	74600	17400	92000
	OBEDULLAGANJ	0	86440	86440	88500	174940
	SANCHI	0	105000	105000	31000	136000
	SILWANI	0	99600	99600	29300	128900
	UDAIPURA	0	64200	64200	17500	81700
	DISTRICT TOTAL	**58600**	**602340**	**660940**	**185700**	**846640**
36	**RAJGARH**					
	BIAORA	0	114800	114800	0	114800
	JIRAPUR	0	84498	84498	0	84498
	KHILCHIPUR	0	78400	78400	0	78400
	NARSINGHGARH	0	136800	136800	0	136800
	RAJGARH	0	110500	110500	0	110500
	SARANGPUR	0	90500	90500	0	90500
	DISTRICT TOTAL	**0**	**615498**	**615498**	**0**	**615498**
37	**RATLAM**					
	ALOT	0	94500	94500	0	94500
	BAJNA	8614	44886	53500	14700	68200
	JAORA	0	76300	76300	0	76300

S. N	Assessment Unit	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non Command Area	Total		
	PIPLODA	0	60400	60400	0	60400
	RATLAM	0	133100	133100	0	133100
	SAILANA	0	43800	43800	9800	53600
	DISTRICT TOTAL	**8614**	**452986**	**461600**	**24500**	**486100**
38	**REWA**					
	GANGEV	19423	39707	59130	0	59130
	HANUMANA	0	90470	90470	5600	96070
	JAWA	0	73400	73400	8000	81400
	MAUGANJ	0	44730	44730	8000	52730
	NAIGARHI	0	35790	35790	2000	37790
	RAMPUR KARCHULIYAN	19423	40387	59810	3000	62810
	REWA	25008	45412	70420	0	70420
	SIRMOUR	21510	64810	86320	5000	91320
	TEONTHAR	0	73690	73690	6000	79690
	DISTRICT TOTAL	**85364**	**508396**	**593760**	**37600**	**631360**
39	**SAGAR**					
	BANDA	3727	79403	83130	12170	95300
	BINA	410	81690	82100	500	82600
	DEORI	8997	77753	86750	14650	101400
	JAISINAGAR	2277	74213	76490	14810	91300
	KESLI	5789	60071	65860	13240	79100
	KHURAI	2199	88541	90740	2960	93700
	MALTHON	979	76901	77880	5920	83800
	RAHATGARH	1971	87097	89068	9432	98500
	REHLI	2137	99843	101980	10520	112500
	SAGAR	3187	104383	107570	9730	117300
	SHAHNAGAR	8380	55470	63850	5850	69700
	DISTRICT TOTAL	**40053**	**885365**	**925418**	**99782**	**1025200**
40	**SATNA**					
	AMARPATAN	2000	63231	65231	0	65231
	MAIIHAR	0	94400	94400	18172	112572
	MAJHGAWAN	0	139912	139912	24970	164882
	NAGOD	1750	89750	91500	3500	95000
	RAMNAGAR	0	50354	50354	9700	60054
	RAMPUR-BAGHELAN	31250	46344	77594	9800	87394
	SOHAWAL	10442	66750	77192	0	77192

S. N	Assessment Unit	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non Command Area	Total		
	UNCHEHARA	1666	74257	75923	13768	89691
	DISTRICT TOTAL	**47108**	**624998**	**672106**	**79910**	**752016**
41	**SEHORE**					
	ASHTA	7707	110484	118191	26066	144257
	BUDNI	29876	29897	59773	47738	107511
	ICHHAWAR	12022	40483	52505	58580	111085
	NASRULLAGANJ	35009	53833	88842	47680	136522
	SEHORE	10945	133716	144661	13764	158425
	DISTRICT TOTAL	**95559**	**368413**	**463972**	**193828**	**657800**
42	**SEONI**					
	BARGHAT	12285	56885	69170	2830	72000
	CHHAPARA	0	63240	63240	9860	73100
	DHANORA	11951	48949	60900	5800	66700
	GHANSAUR	0	83790	83790	12510	96300
	KEOLARI	25430	51840	77270	5430	82700
	KURAI	0	166970	166970	11330	178300
	LAKHNADON	0	154480	154480	15920	170400
	SEONI	22290	106910	129200	7100	136300
	DISTRICT TOTAL	**71956**	**733064**	**805020**	**70780**	**875800**
43	**SHAHDOL**					
	BEOHARI	5047	89453	94500	16500	111000
	BURHAR	0	111400	111400	23300	134700
	GOHPARU	0	81000	81000	12500	93500
	JAISINGHNAGAR	0	135900	135900	28000	163900
	SOHAGPUR	0	75000	75000	6000	81000
	DISTRICT TOTAL	**5047**	**492753**	**497800**	**86300**	**584100**
44	**SHAJAPUR**					
	KALAPIPAL	0	82567	82567	0	82567
	MOMAN BADODIYA	0	88176	88176	2229	90405
	SHAJAPUR	0	88307	88307	3479	91786
	SHUJALPUR	0	81567	81567	1000	82567
	DISTRICT TOTAL	**0**	**340617**	**340617**	**6708**	**347325**
45	**SHEOPUR**					
	KARAHAL	0	227180	227180	1520	228700
	SHEOPUR	60150	82450	142600	0	142600
	VIJAYPUR	11000	152700	163700	125600	289300
	DISTRICT TOTAL	**71150**	**462330**	**533480**	**127120**	**660600**

S. N	Assessment Unit	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non Command Area	Total		
46	**SHIVPURI**					
	BADARWAS	3424	111752	115176	6424	121600
	KARERA	13022	86878	99900	1500	101400
	KHANIYADHANA	20650	102594	123244	5956	129200
	KOLARAS	0	107491	107491	7709	115200
	NARWAR	12617	80183	92800	5600	98400
	PICHHORE	14559	88325	102884	6216	109100
	POHARI	2399	149119	151518	5782	157300
	SHIVPURI	2750	181286	184036	11564	195600
	DISTRICT TOTAL	**69421**	**907628**	**977049**	**50751**	**1027800**
47	**SIDHI**					
	KUSMI	0	70617	70617	62783	133400
	MAJHOLI	0	66784	66784	6916	73700
	RAMPUR NAIKIN	17110	77944	95054	24346	119400
	SIDHI	9500	52450	61950	22450	84400
	SIHAWAL	22280	43720	66000	8500	74500
	DISTRICT TOTAL	**48890**	**311515**	**360405**	**124995**	**485400**
48	**SINGRAULI**					
	CHITRANGI	0	171250	171250	23350	194600
	DEOSAR	2150	137960	140110	42090	182200
	WAIDHAN	4452	135448	139900	50500	190400
	DISTRICT TOTAL	**6602**	**444658**	**451260**	**115940**	**567200**
49	**TIKAMGARH**					
	BALDEOGARH	6579	75717	82296	3600	85896
	JATARA	7646	89014	96660	4200	100860
	PALERA	2468	69154	71622	3200	74822
	TIKAMGARH	10169	74791	84960	1800	86760
	DISTRICT TOTAL	**26862**	**308676**	**335538**	**12800**	**348338**
50	**UJJAIN**					
	BADNAGAR	0	123595	123595	0	123595
	GHATIA	0	64163	64163	0	64163
	KHCHROD	0	110178	110178	19090	129268
	MAHIDPUR	0	113453	113453	0	113453
	TARANA	0	106580	106580	0	106580
	UJJAIN	0	75964	75964	0	75964
	DISTRICT TOTAL	**0**	**593933**	**593933**	**19090**	**613023**
51	**UMARIA**					
	KARKELI	0	156000	156000	17000	173000

S. N	Assessment Unit	Total Geographical Area (ha)				
		Recharge Worthy Area (ha)			Hilly Area	Total
		Command Area	Non Command Area	Total		
	MANPUR	0	184600	184600	5300	189900
	PALI	0	81300	81300	9700	91000
	DISTRICT TOTAL	**0**	**421900**	**421900**	**32000**	**453900**
52	**VIDISHA**					
	BASODA	2241	106559	108800	13500	122300
	GYARASPUR	0	84100	84100	3100	87200
	KURWAI	0	81000	81000	2100	83100
	LATERI	0	89200	89200	9400	98600
	NATERAN	20211	77489	97700	15300	113000
	SIRONJ	13755	89945	103700	21800	125500
	VIDISHA	40080	66190	106270	1130	107400
	DISTRICT TOTAL	**76287**	**594483**	**670770**	**66330**	**737100**
	STATE TOTAL (Ha)	2952011	23981316	26933327	3890461	30823788
	STATE TOTAL (Sq Km)	**29520.11**	**239813.16**	**269333.27**	**38904.61**	**308237.88**

Annexure II: Ground Water Recharge Scenario

S.N.	Assessment Unit	Recharge from Rainfall- Monsoon Season (Ham)	Recharge from Other Sources- Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources- Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
1	**AGAR MALWA**							
	Agar	8334.04	639.23	0	2888.34	11861.61	1031.48	10830.13
	Badod	8730.68	551.85	0	1724.81	11007.34	550.37	10456.97
	Nalkheda	7456.04	696.72	0	2442.05	10594.81	1059.49	9535.32
	Susner	7236.25	716.23	0	2132.56	10085.04	504.25	9580.79
	DISTRICT TOTAL	**31757.01**	**2604.03**	**0**	**9187.76**	**43548.8**	**3145.59**	**40403.21**
2	**ALIRAJPUR**							
	Alirajpur	4552.42	166.06	0	409.75	5128.23	256.41	4871.82
	Bhabra	1579.05	115.57	0	275.92	1970.54	197.05	1773.49
	Jobat	1861.57	124.63	0	300.07	2286.27	228.63	2057.64
	Katthiwara	2603.17	93.44	0	249.2	2945.81	294.58	2651.23
	Sondwa	6198.36	118.42	0	337.74	6654.52	332.73	6321.79
	Udaigarh	2082.3	152.81	0	269.59	2504.7	250.47	2254.23
	DISTRICT TOTAL	**18876.87**	**770.93**	**0**	**1842.27**	**21490.07**	**1559.87**	**19930.2**
3	**ANUPPUR**							
	Anuppur	6927.9	29.48	514.94	40.64	7512.96	375.65	7137.31
	Jaithari	6924.66	75.58	628.01	197.98	7826.23	782.62	7043.61
	Kotma	4417.49	27.31	314.32	63.73	4822.85	241.14	4581.71
	Pushparajgarh	7848.27	67.8	649.83	98.42	8664.32	433.21	8231.11
	DISTRICT TOTAL	**26118.32**	**200.17**	**2107.1**	**400.77**	**28826.36**	**1832.62**	**26993.74**
4	**ASHOKNAGAR**							
	Ashoknagar	8393.61	460.92	0	1668.98	10523.51	526.18	9997.33

S.N.	Assessment Unit	Recharge from Rainfall- Monsoon Season (Ham)	Recharge from Other Sources- Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources- Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
	Chanderi	5356.25	360.15	0	1294.58	7010.98	385.2	6625.78
	Isagarh	7603.39	399.05	0	1351.38	9353.82	935.38	8418.44
	Mungaoli	7875.24	976.68	0	3752.82	12604.74	821.95	11782.79
	DISTRICT TOTAL	**29228.49**	**2196.8**	**0**	**8067.76**	**39493.05**	**2668.71**	**36824.34**
5	**BALAGHAT**							
	Baihar	9096.89	113.86	32.35	118.75	9361.85	936.19	8425.66
	Balaghat	9103.18	748.02	31.1	467.07	10349.37	932.31	9417.06
	Birsa	10324.78	130.34	34.7	105.75	10595.57	529.78	10065.79
	Katangi	4856.9	599.74	17.15	557.56	6031.35	548.69	5482.66
	Khairlanji	3662.37	349.28	11.22	375.65	4398.52	219.92	4178.6
	Kirnapur	6297.89	273.48	19.35	336.17	6926.89	346.35	6580.54
	Lalbarra	5956.02	843.16	17.12	464.14	7280.44	467.04	6813.4
	Lanji	8453.79	360.51	20.96	298.91	9134.17	570.87	8563.3
	Paraswada	8677.99	125.99	29.64	81.94	8915.56	445.78	8469.78
	Waraseoni	3380.93	416.06	10.61	352.67	4160.27	208.01	3952.25
	DISTRICT TOTAL	**69810.74**	**3960.44**	**224.2**	**3158.61**	**77153.99**	**5204.94**	**71949.04**
6	**BARWANI**							
	Barwani	4820.51	367.76	0	1749.17	6937.44	581.55	6355.89
	Niwali	3048.15	195.86	0	619.34	3863.35	193.18	3670.17
	Pansemal	3730.36	629.84	0	2379.64	6739.84	623.9	6115.94
	Pati	2042.24	251.85	0	514.23	2808.32	270.88	2537.44
	Rajpur	5952.64	1063.53	0	3774.07	10790.24	539.51	10250.73
	Sendhwa	6770.42	616.46	0	1928.51	9315.39	465.78	8849.61

S.N.	Assessment Unit	Recharge from Rainfall- Monsoon Season (Ham)	Recharge from Other Sources- Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources- Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
	Thikri	6379.09	580.95	0	8427.16	15387.2	1130.8	14256.4
	DISTRICT TOTAL	**32743.41**	**3706.25**	**0**	**19392.12**	**55841.78**	**3805.6**	**52036.18**
7	**BETUL**							
	Amla	11865.17	509.48	286.29	2248.76	14909.7	745.48	14164.22
	Athner	4986.76	237.38	157.77	867.69	6249.6	331.51	5918.09
	Betul	10434.37	768.91	283.26	2691.06	14177.6	708.88	13468.72
	Bhainsdehi	8934.8	310.5	301.93	1299.25	10846.48	1084.65	9761.83
	Bhimpur	8721.15	215.76	286.08	648.55	9871.54	493.58	9377.96
	Chicholi	4598.36	155.49	104.52	712.09	5570.46	540.37	5030.09
	Ghoda Dongri	13498.02	241.91	305.39	1006.77	15052.09	1505.2	13546.89
	Multai	9170.86	770.03	257.83	2519.73	12718.45	688.54	12029.91
	Prabhat Pattan	9344.92	306.02	315.55	928.55	10895.04	589.43	10305.61
	Shahpur	3536.18	192.38	119.5	759.7	4607.76	460.77	4146.99
	DISTRICT TOTAL	**85090.59**	**3707.86**	**2418.12**	**13682.15**	**104898.72**	**7148.41**	**97750.31**
8	**BHIND**							
	Ater	13274.43	223.45	0	2033.95	15531.83	1553.18	13978.65
	Bhind	11447.87	235.31	0	2518.43	14201.61	1120.88	13080.73
	Gohad	18314.5	456.09	0	3218.86	21989.45	1549.25	20440.2
	Lahar	10310.59	153.24	0	2044.28	12508.11	910	11598.11
	Mehgaon	19852.69	549.59	0	3599.8	24002.08	1972.6	22029.48
	Ron	9370.18	62.31	0	374.65	9807.14	980.72	8826.42
	DISTRICT TOTAL	**82570.26**	**1679.99**	**0**	**13789.97**	**98040.22**	**8086.63**	**89953.59**
9	**BHOPAL**							

S.N.	Assessment Unit	Recharge from Rainfall- Monsoon Season (Ham)	Recharge from Other Sources- Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources- Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
	Berasia	16331.01	915.03	0	2954.82	20200.86	1010.04	19190.82
	Bhopal Urban	3594.13	600.69	0	1071.53	5266.35	263.32	5003.03
	Phanda	11752.07	926.21	0	2604.94	15283.22	1528.32	13754.9
	DISTRICT TOTAL	**31677.21**	**2441.93**	**0**	**6631.29**	**40750.43**	**2801.68**	**37948.75**
10	**BURHANPUR**							
	Burhanpur	15035.9	946.54	131.36	3165.2	19279	1848.44	17430.56
	Khaknar	12808.16	1039.5	133.27	3421.48	17402.41	870.12	16532.29
	DISTRICT TOTAL	**27844.06**	**1986.04**	**264.63**	**6586.68**	**36681.41**	**2718.56**	**33962.85**
11	**CHHATARPUR**							
	Bada Malhera	9507.28	643.54	0	2979.57	13130.39	796.93	12333.46
	Bijawar	10859.1	679.44	0	1810.42	13348.96	674.68	12674.28
	Buxwaha	5360.49	451.66	0	1331.67	7143.82	714.39	6429.43
	Chhatarpur	7170.33	663.98	0	2214.3	10048.61	502.43	9546.18
	Gaurihar	6228.04	192.32	0	1161.3	7581.66	379.08	7202.58
	Laundi	5484.84	608.23	0	2551.17	8644.24	568.8	8075.44
	Nowgaon	5870.81	1021.97	0	2328.18	9220.96	461.05	8759.91
	Rajnagar	14196.04	781.78	0	2664.93	17642.75	1764.27	15878.48
	DISTRICT TOTAL	**64676.93**	**5042.92**	**0**	**17041.54**	**86761.39**	**5861.63**	**80899.76**
12	**CHHINDWARA**							
	Amarwara	8847.2	374.44	72.98	1243.96	10538.58	1053.85	9484.73
	Bichhua	5452.61	171.11	32.15	651.84	6307.71	315.39	5992.32
	Chaurai	10732.18	385.08	88.53	1479.75	12685.54	1268.56	11416.98
	Chhindwara	8000.32	575.52	47.06	1816.95	10439.85	521.99	9917.86

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	Harrai	7609.17	167.47	53.22	588.47	8418.33	420.91	7997.42
	Jamai	11036.22	173.95	71.88	724.95	12007	600.35	11406.65
	Mohkheda	7511.26	855.65	52.75	2661.18	11080.84	668.98	10411.86
	Pandhurna	8751.69	678.69	67.72	1802.99	11301.09	565.06	10736.03
	Parasia	7499.09	246.75	41.24	806	8593.08	859.3	7733.78
	Sausar	6462.48	439.37	37.1	1351.08	8290.03	414.49	7875.54
	Tamia	4810.8	99.02	39.68	197.19	5146.69	514.67	4632.02
	DISTRICT TOTAL	**86713.02**	**4167.05**	**604.31**	**13324.36**	**104808.74**	**7203.55**	**97605.19**
13	**DAMOH**							
	Batiyagarh	6238.18	335.29	0	1122.96	7696.43	415.9	7280.53
	Damoh	6378.77	360.15	0	1477.98	8216.9	725.19	7491.71
	Hatta	2132.49	353.86	0	700.76	3187.11	197.93	2989.18
	Jabera	2772.92	407.36	0	2985.27	6165.55	472.8	5692.75
	Patera	3169.35	227.57	0	739.76	4136.68	383.11	3753.57
	Patharia	4780.82	272.58	0	958.05	6011.45	300.58	5710.87
	Tendulheda	2504.78	222.5	0	1237.38	3964.66	307.1	3657.56
	DISTRICT TOTAL	**27977.31**	**2179.31**	**0**	**9222.16**	**39378.78**	**2802.61**	**36576.17**
14	**DATIA**							
	Bhander	10996.97	256.8	0	2810.59	14064.36	954.45	13109.91
	Datia	5368.02	257.77	0	1555.42	7181.21	359.06	6822.15
	Seondha	18557.83	394.18	0	2878.28	21830.29	1640.03	20190.26
	DISTRICT TOTAL	**34922.82**	**908.75**	**0**	**7244.29**	**43075.86**	**2953.54**	**40122.32**
15	**DEWAS**							

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	Bagli	17599.75	930.41	0	3039.92	21570.08	1102.86	20467.22
	Dewas	11871.73	990.45	0	3489.72	16351.9	817.6	15534.3
	Kannod	10103.27	710.38	0	2764.33	13577.98	813.74	12764.24
	Khategaon	10009.47	660.51	0	2010.99	12680.97	634.05	12046.92
	Sonkutch	7951.51	659.87	0	2182.86	10794.24	1079.43	9714.81
	Tonkkhurd	8541.17	1064.48	0	1968.9	11574.55	1157.46	10417.09
	DISTRICT TOTAL	**66076.9**	**5016.1**	**0**	**15456.72**	**86549.72**	**5605.14**	**80944.58**
16	**DHAR**							
	Badnawar	11986.02	948.2	0	4609.08	17543.3	1698.38	15844.92
	Bagh	5129.36	179.23	0	1312.48	6621.07	331.06	6290.01
	Dahi	5577.2	344.67	0	3597.03	9518.9	776.35	8742.55
	Dhar	7002.74	733.53	0	2935.31	10671.58	1067.16	9604.42
	Dharmpuri	3484.81	307.7	0	4280.45	8072.96	726.01	7346.95
	Gandhwani	6627.76	435.43	0	6027.6	13090.79	654.54	12436.25
	Kukshi	3701.42	155.08	0	1605.49	5461.99	273.1	5188.89
	Manawar	4947.18	410.61	0	4919.18	10276.97	513.85	9763.12
	Nalchha	9094.52	778.56	0	2601.12	12474.2	1233.42	11240.78
	Nisarpur	3570.39	245.86	0	2969.77	6786.02	339.29	6446.72
	Sardarpur	14305.38	1193.59	0	4582.4	20081.37	1744.55	18336.82
	Tirla	6211.73	817.16	0	1830.84	8859.73	885.97	7973.76
	Umarvan	4707.58	399.29	0	3894.69	9001.56	450.08	8551.48
	DISTRICT TOTAL	**86346.09**	**6948.91**	**0**	**45165.44**	**138460.44**	**10693.76**	**127766.67**
17	**DINDORI**							

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	Amarpur	3443.56	30.43	28.32	54.88	3557.19	177.86	3379.33
	Bajang	3189.21	26.44	27.56	46.17	3289.38	164.47	3124.91
	Dindori	6348.89	38.03	59.52	87.17	6533.61	326.68	6206.93
	Karanjiya	4726.19	38.63	35.7	75.97	4876.49	243.82	4632.67
	Menhadwani	4407.55	30.09	33.37	63.89	4534.9	226.74	4308.16
	Samnapur	4363.74	53.05	33.07	104.22	4554.08	227.7	4326.38
	Shahpura	7334.31	61.05	70.69	196.5	7662.55	383.13	7279.42
	DISTRICT TOTAL	**33813.45**	**277.72**	**288.23**	**628.8**	**35008.2**	**1750.4**	**33257.8**
18	**GUNA**							
	Aron	9844.23	416.21	0	1501.14	11761.58	588.08	11173.5
	Bamori	11880	1275.9	0	3639.19	16795.09	839.76	15955.33
	Chachaura	15243.57	731.06	0	2741.63	18716.26	935.82	17780.44
	Guna	12725.18	807.5	0	2289.33	15822.01	844.24	14977.77
	Raghogarh	12797.51	1109.5	0	4679.76	18586.77	1159.22	17427.55
	DISTRICT TOTAL	**62490.49**	**4340.17**	**0**	**14851.05**	**81681.71**	**4367.12**	**77314.59**
19	**GWALIOR**							
	Bhitarwar	14663.32	3450.16	0	7414.88	25528.36	1601.74	23926.62
	Dabra	11964.72	3290.76	0	6796.62	22052.1	1402.98	20649.12
	Ghatigaon	13166.06	461.4	0	2105.92	15733.38	1573.33	14160.05
	Gwalior Urban	4872.58	215.19	0	394.34	5482.11	548.21	4933.9
	Morar	11526.34	459.95	0	1462.63	13448.92	1344.89	12104.03
	DISTRICT TOTAL	**56193.02**	**7877.46**	**0**	**18174.39**	**82244.87**	**6471.15**	**75773.72**
20	**HARDA**							

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	Harda	11210.58	467.97	0	1550.68	13229.23	1322.92	11906.3
	Khirkiya	5991.15	110.38	0	858.82	6960.35	348.02	6612.33
	Timarni	10980	2337.77	0	13449.57	26767.34	1338.37	25428.97
	DISTRICT TOTAL	**28181.73**	**2916.12**	**0**	**15859.07**	**46956.92**	**3009.31**	**43947.6**
21	**HOSHANGABAD**							
	Babai	25728.24	904.71	0	5920.16	32553.11	3255.3	29297.81
	Bankhedi	15606.84	532.05	0	3134.86	19273.75	963.68	18310.07
	Hoshangabad	16556.07	2201.06	0	11264.83	30021.96	3002.19	27019.75
	Kesala	11268.51	1058.82	0	5768.29	18095.62	904.79	17190.83
	Pipariya	20061.78	481.09	0	1938.53	22481.4	2018.49	20462.91
	Seoni Malwa	32671.54	1832.64	0	10438.26	44942.44	4494.24	40448.2
	Shohagpur	8562.76	559.92	0	2782.7	11905.38	938.59	10966.79
	DISTRICT TOTAL	**130455.74**	**7570.29**	**0**	**41247.63**	**179273.66**	**15577.28**	**163696.36**
22	**INDORE**							
	Depalpur	12384.46	1678.99	0	4730.68	18794.13	1879.42	16914.71
	Indore	6148.64	763.55	0	2157.22	9069.41	906.94	8162.47
	Indore Urban	4938.44	586.67	0	1030.66	6555.77	655.58	5900.19
	Mhow	8769.46	674.32	0	1801.32	11245.1	562.26	10682.84
	Sawer	9382.6	813.58	0	2888.43	13084.61	1308.46	11776.15
	DISTRICT TOTAL	**41623.6**	**4517.11**	**0**	**12608.31**	**58749.02**	**5312.66**	**53436.36**
23	**JABALPUR**							
	Bargi	4356.26	202.53	0	687.93	5246.72	524.67	4722.05
	Jabalpur Urban	2977.45	196.3	0	384.73	3558.48	355.85	3202.63

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	Kundam	4183.18	177.01	0	329.11	4689.3	234.47	4454.83
	Majholi	7797.48	219.29	0	680.51	8697.28	869.73	7827.55
	Panagar	7189.8	534.5	0	1061.09	8785.39	772.57	8012.82
	Patan	12127.79	989.46	0	2939.38	16056.63	1232.89	14823.74
	Shahpura	8620.06	526.8	0	1400.09	10546.95	527.34	10019.61
	Sihora	7476.51	359.48	0	1312.46	9148.45	914.85	8233.6
	DISTRICT TOTAL	**54728.53**	**3205.37**	**0**	**8795.3**	**66729.2**	**5432.37**	**61296.83**
24	**JHABUA**							
	Jhabua	1750.9	160.42	0	362.32	2273.64	227.36	2046.28
	Meghnagar	2961.91	155	0	351.58	3468.49	346.85	3121.64
	Petlawad	8108.46	440.06	0	2988.24	11536.76	788.42	10748.34
	Rama	2163.78	178.64	0	366.74	2709.16	135.46	2573.7
	Ranapur	1790.99	110.44	0	225.22	2126.65	106.33	2020.32
	Thandla	3376.32	186.19	0	406.13	3968.64	198.44	3770.2
	DISTRICT TOTAL	**20152.36**	**1230.75**	**0**	**4700.23**	**26083.34**	**1802.86**	**24280.48**
25	**KATNI**							
	Badwara	6792.09	537.12	0	1402.43	8731.64	436.58	8295.06
	Bahoriband	7784.55	397.27	0	1078.14	9259.96	926	8333.96
	Dhimar Kheda	4892.13	165.65	0	337.2	5394.98	269.75	5125.23
	Murwara	5871.68	424.02	0	1009.22	7304.92	437.49	6867.43
	Rithi	3381.18	154.76	0	404.03	3939.97	197	3742.97
	Vijayraghavgarh	5625.97	148.5	0	519.47	6293.94	629.4	5664.54
	DISTRICT TOTAL	**34347.6**	**1827.32**	**0**	**4750.49**	**40925.41**	**2896.22**	**38029.19**

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26	**KHANDWA**							
	Baldi	5489.41	198.53	0	760.95	6448.89	322.45	6126.44
	Chhegaon Makhan	10147.47	542.16	0	2511.87	13201.5	1320.16	11881.34
	Harsud	4516.63	254.9	0	690.81	5462.34	273.12	5189.22
	Khalwa	9773.89	458.57	0	1405.09	11637.55	581.87	11055.68
	Khandwa	8262.24	466.88	0	1695.33	10424.45	521.23	9903.22
	Pandhana	11507.61	745.35	0	5030.78	17283.74	864.18	16419.55
	Punasa	7252.28	1586.2	0	40595.42	49433.9	4813.1	44620.8
	DISTRICT TOTAL	**56949.53**	**4252.59**	**0**	**52690.25**	**113892.37**	**8696.11**	**105196.25**
27	**KHARGONE**							
	Barwaha	10231.04	900.14	0	9899.58	21030.76	1051.54	19979.22
	Bhagwanpura	3983.88	877.45	0	2400.04	7261.37	476.1	6785.27
	Bhikangaon	8220.37	679.36	0	3629.61	12529.34	626.47	11902.87
	Gogawan	3690.34	246.8	0	1598.36	5535.5	276.76	5258.74
	Jhiranya	5432.77	1043.26	0	2470.4	8946.43	533.61	8412.82
	Kasrawad	8018.42	1106.63	0	9255.17	18380.22	919.01	17461.21
	Khargone	4095.85	406.62	0	1459.33	5961.8	298.1	5663.7
	Maheshwar	6820.29	588.54	0	4843.21	12252.04	612.6	11639.44
	Segaon	3763.03	414.93	0	1427.12	5605.08	560.51	5044.57
	DISTRICT TOTAL	**54255.99**	**6263.73**	**0**	**36982.82**	**97502.54**	**5354.7**	**92147.84**
28	**MANDLA**							
	Bichhiya	6869.04	198.31	132.5	1022.31	8222.16	411.11	7811.05
	Bijadandi	3986.83	28.94	91.75	64.28	4171.8	208.59	3963.21

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	Ghughari	6149.57	51.86	132.75	91.95	6426.13	321.3	6104.83
	Mandla	3654.87	173.44	74.39	687.5	4590.2	229.5	4360.7
	Mawai	8908.46	78.06	176.39	219.49	9382.4	469.12	8913.28
	Mohgaon	2184.32	83.56	49.4	243.79	2561.07	128.05	2433.02
	Nainpur	5263.37	249.53	96.23	1417.66	7026.79	351.34	6675.45
	Narayanganj	2625.56	114.96	53.05	234.4	3027.97	151.4	2876.57
	Niwas	3488.29	81.27	58.6	197.44	3825.6	191.28	3634.32
	DISTRICT TOTAL	**43130.31**	**1059.93**	**865.06**	**4178.82**	**49234.12**	**2461.69**	**46772.43**
29	**MANDSAUR**							
	Bhanpura	4572.41	823.18	0	2175.61	7571.2	598.67	6972.53
	Garoth	10826.04	1408.24	0	3289.72	15524	1552.39	13971.61
	Malhargarh	7582.49	1404.3	0	2652.74	11639.53	1046.79	10592.74
	Mandsaur	12039.29	1098.74	0	3811.23	16949.26	1694.92	15254.34
	Sitamau	12076.17	1190.37	0	4944.86	18211.4	1821.14	16390.26
	DISTRICT TOTAL	**47096.4**	**5924.83**	**0**	**16874.16**	**69895.39**	**6713.91**	**63181.48**
30	**MORENA**							
	Ambah	5519.37	138.67	0	1908.27	7566.31	756.63	6809.68
	Jaora	7640.35	210.76	0	2919.66	10770.77	538.54	10232.23
	Kailaras	6413.06	283.09	0	1860.23	8556.38	566.13	7990.25
	Morena	10225.32	351.68	0	2366.14	12943.14	647.16	12295.98
	Pahadgarh	6975.5	190.16	0	2415.63	9581.29	958.13	8623.16
	Porsa	4936.11	68.98	0	1403.18	6408.27	640.83	5767.44
	Sabalgarh	8474.16	326.15	0	5184.84	13985.15	1088.35	12896.8

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	DISTRICT TOTAL	**50183.87**	**1569.49**	**0**	**18057.95**	**69811.31**	**5195.77**	**64615.54**
31	**NARSINGHPUR**							
	Chawarpatha	21716.54	495.05	0	1660.42	23872.01	2387.2	21484.81
	Chichli	16965.83	412.29	0	2172.45	19550.57	1955.06	17595.51
	Gotegaon	17529.39	682.74	0	3155.08	21367.21	1829.26	19537.95
	Kareli	18637.71	752.24	0	2935.03	22324.98	2232.51	20092.47
	Narsinghpur	18271.89	610.01	0	4348.93	23230.83	2082.9	21147.93
	Saikheda	11630.26	249.2	0	1703.34	13582.8	679.14	12903.66
	DISTRICT TOTAL	**104751.62**	**3201.53**	**0**	**15975.25**	**123928.4**	**11166.07**	**112762.33**
32	**NEEMUCH**							
	Jawad	8408.4	809.8	0	2872.12	12090.32	1209.03	10881.29
	Manasa	9248.88	878.5	0	2430.12	12557.5	1255.75	11301.75
	Neemuch	11261.27	1103.82	0	3152.23	15517.32	1551.73	13965.59
	DISTRICT TOTAL	**28918.55**	**2792.12**	**0**	**8454.47**	**40165.14**	**4016.51**	**36148.63**
33	**NIWARI**							
	Niwari	5054.65	503.64	0	1708.76	7267.05	363.36	6903.69
	Prithvipur	9404.85	789.06	0	2182.71	12376.62	1160.19	11216.42
	DISTRICT TOTAL	**14459.5**	**1292.7**	**0**	**3891.47**	**19643.67**	**1523.55**	**18120.11**
34	**PANNA**							
	Ajaigarh	16123.22	400.07	0	1773.07	18296.36	1829.64	16466.72
	Gunnor	5155.76	288.75	0	886.28	6330.79	596.93	5733.86
	Panna	11089.78	234.1	0	1171.55	12495.43	698.28	11797.15
	Pawai	8821.3	285.89	0	1267.43	10374.62	518.74	9855.88

S.N.	Assessment Unit	Recharge from Rainfall- Monsoon Season (Ham)	Recharge from Other Sources- Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources- Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
	Shahnagar	5840.09	215.86	0	1108.38	7164.33	416.45	6747.88
	DISTRICT TOTAL	**47030.15**	**1424.67**	**0**	**6206.71**	**54661.53**	**4060.04**	**50601.49**
35	**RAISEN**							
	Badi	21930.92	1044.21	0	1834.11	24809.24	2108.31	22700.93
	Begamganj	9118.91	353.65	0	1205.47	10678.03	533.9	10144.13
	Gairatganj	7495.08	327.25	0	1044.25	8866.58	886.66	7979.92
	Obedullaganj	7447.64	547.77	0	1676.01	9671.42	483.57	9187.85
	Sanchi	11878.07	449.72	0	1567.95	13895.74	694.79	13200.95
	Silwani	11241.09	462.51	0	1715.19	13418.79	670.94	12747.85
	Udaipura	10363.89	360.88	0	1333.33	12058.1	1205.81	10852.29
	DISTRICT TOTAL	**79475.6**	**3545.99**	**0**	**10376.31**	**93397.9**	**6583.98**	**86813.92**
36	**RAJGARH**							
	Biaora	13990.01	879.77	0	3061.34	17931.12	896.56	17034.56
	Jirapur	10379.43	561.65	0	1932.63	12873.71	643.68	12230.03
	Khilchipur	9039.72	519.18	0	2082.2	11641.1	582.05	11059.05
	Narsinghgarh	13283.22	1026.19	0	3305.03	17614.44	880.72	16733.72
	Rajgarh	13668.69	779.63	0	2437.22	16885.54	844.28	16041.26
	Sarangpur	11253.46	784.09	0	2879.78	14917.33	1491.73	13425.6
	DISTRICT TOTAL	**71614.53**	**4550.51**	**0**	**15698.2**	**91863.24**	**5339.02**	**86524.22**
37	**RATLAM**							
	Alot	12135.84	1064.33	0	3684.08	16884.25	1688.43	15195.82
	Bajna	3610.06	910.89	0	2183.66	6704.61	578.55	6126.06
	Jaora	9798.56	1429.23	0	5282.68	16510.47	1651.05	14859.42

S.N.	Assessment Unit	Recharge from Rainfall- Monsoon Season (Ham)	Recharge from Other Sources- Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources- Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
	Piploda	7756.66	1036.16	0	3848.99	12641.81	1264.18	11377.63
	Ratlam	17092.91	2451.47	0	6811.1	26355.48	2635.55	23719.93
	Sailana	4313.33	479.61	0	1126.86	5919.8	295.99	5623.81
	DISTRICT TOTAL	**54707.36**	**7371.69**	**0**	**22937.37**	**85016.42**	**8113.75**	**76902.67**
38	**REWA**							
	Gangev	3281.98	229.15	21.43	971.16	4503.72	377.02	4126.7
	Hanumana	6890.87	131.68	40.56	347.17	7410.28	741.03	6669.25
	Jawa	7929.19	129.91	46.67	513.6	8619.37	861.94	7757.43
	Mauganj	3406.97	141.34	20.05	546.07	4114.43	411.44	3702.99
	Naigarhi	2360.01	69.52	13.89	337.64	2781.06	278.1	2502.96
	Rampur Karchuliyan	3142.71	358.34	20.86	1506.23	5028.14	354.38	4673.76
	Rewa	3956.49	343.55	27.06	1383.37	5710.47	285.53	5424.94
	Sirmour	4146.38	414.03	34.86	981	5576.27	367.83	5208.44
	Teonthar	9851.71	190.15	57.99	738.48	10838.33	1083.84	9754.49
	DISTRICT TOTAL	**44966.31**	**2007.67**	**283.37**	**7324.72**	**54582.07**	**4761.11**	**49820.96**
39	**SAGAR**							
	Banda	9598.27	455.78	0	1274.98	11329.03	1105.78	10223.25
	Bina	10599.52	319.82	0	1683.43	12602.77	630.14	11972.63
	Deori	7551.4	387.18	0	1390.41	9328.99	932.91	8396.08
	Jaisinagar	8874.65	426.15	0	1326.77	10627.57	531.38	10096.19
	Kesli	8466.17	494.9	0	1491.15	10452.22	522.61	9929.61
	Khurai	8428.8	268.08	0	981.56	9678.44	967.85	8710.59
	Malthon	6837.49	176.91	0	725.26	7739.66	773.96	6965.7

S.N.	Assessment Unit	Recharge from Rainfall-Monsoon Season (Ham)	Recharge from Other Sources-Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources- Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
	Rahatgarh	8268.49	310.25	0	1116.24	9694.98	484.75	9210.23
	Rehli	5888.41	342.44	0	936.1	7166.95	358.34	6808.61
	Sagar	13508.74	363.31	0	1670.1	15542.15	1554.21	13987.94
	Shahnagar	4412.7	349.41	0	1874.03	6636.14	565.63	6070.51
	DISTRICT TOTAL	**92434.64**	**3894.23**	**0**	**14470.03**	**110798.9**	**8427.56**	**102371.34**
40	**SATNA**							
	Amarpatan	5698.97	404.94	101.72	2403.05	8608.68	788.65	7820.03
	Maiihar	5758.88	176.16	129.63	862.07	6926.74	346.34	6580.4
	Majhgawan	11453.08	306.8	277.62	907.16	12944.66	647.23	12297.43
	Nagod	8216.28	514.66	158.93	2682.18	11572.05	578.61	10993.44
	Ramnagar	5629.93	100.06	99.39	415.75	6245.13	624.51	5620.62
	Rampur-Baghelan	5630.26	446.67	114.99	3197.93	9389.85	938.98	8450.87
	Sohawal	7798.47	506.78	143.89	1871.48	10320.62	1032.05	9288.56
	Unchehara	5913.59	235.43	125.56	2188.26	8462.84	495.92	7966.92
	DISTRICT TOTAL	**56099.46**	**2691.5**	**1151.73**	**14527.88**	**74470.57**	**5452.29**	**69018.27**
41	**SEHORE**							
	Ashta	10748.41	931.59	0	2969.36	14649.36	1464.94	13184.42
	Budni	6864.69	457.39	0	4045.14	11367.22	967.48	10399.74
	Ichhawar	6504.88	426.91	0	1221.08	8152.87	483.97	7668.9
	Nasrullaganj	10391.02	786.2	0	3043.44	14220.66	999.18	13221.48
	Sehore	21089.77	1221.07	0	3266.99	25577.83	2557.78	23020.05
	DISTRICT TOTAL	**55598.77**	**3823.16**	**0**	**14546.01**	**73967.94**	**6473.35**	**67494.59**
42	**SEONI**							

S.N.	Assessment Unit	Recharge from Rainfall- Monsoon Season (Ham)	Recharge from Other Sources- Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources- Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
	Barghat	5457.94	272	196.29	1025.55	6951.78	404.78	6547
	Chhapara	5193.44	330.48	179.46	808.67	6512.05	325.61	6186.44
	Dhanora	4156.19	107.9	172.82	343.86	4780.77	239.04	4541.73
	Ghansaur	6430.76	119.03	237.78	270.2	7057.77	352.89	6704.88
	Keolari	5991.97	229.59	219.28	661.32	7102.16	602.2	6499.96
	Kurai	13047.56	203.02	473.83	678.57	14402.98	720.15	13682.83
	Lakhnadon	12913.64	324.69	438.38	942.09	14618.8	730.94	13887.86
	Seoni	8127.58	642.36	366.64	1865.61	11002.19	659.37	10342.82
	DISTRICT TOTAL	**61319.08**	**2229.07**	**2284.48**	**6595.87**	**72428.5**	**4034.98**	**68393.52**
43	**SHAHDOL**							
	Beohari	5745.96	140.43	139.82	640.69	6666.9	333.33	6333.57
	Burhar	13468.21	29.28	329.65	54.74	13881.88	694.09	13187.79
	Gohparu	10068.83	21.51	239.7	50.5	10380.54	519.03	9861.51
	Jaisinghnagar	15741.94	85.63	402.16	245.96	16475.69	823.79	15651.9
	Sohagpur	8178.8	50.75	194.2	142.03	8565.78	428.29	8137.49
	DISTRICT TOTAL	**53203.74**	**327.6**	**1305.53**	**1133.92**	**55970.79**	**2798.53**	**53172.26**
44	**SHAJAPUR**							
	Kalapipal	10950.83	825.01	0	2949.35	14725.19	1472.52	13252.67
	Moman Badodiya	9606.26	907.29	0	3352.7	13866.25	693.31	13172.94
	Shajapur	9926.2	743.52	0	2155.46	12825.18	641.26	12183.92
	Shujalpur	10818.2	862.76	0	2606.47	14287.43	1428.75	12858.68
	DISTRICT TOTAL	**41301.49**	**3338.58**	**0**	**11063.98**	**55704.05**	**4235.84**	**51468.21**
45	**SHEOPUR**							

S.N.	Assessment Unit	Recharge from Rainfall-Monsoon Season (Ham)	Recharge from Other Sources-Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources- Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
	Karahal	11707.98	429.92	0	1433.78	13571.68	1357.17	12214.51
	Sheopur	16240.76	264.33	0	15744.66	32249.75	3224.98	29024.77
	Vijaypur	7418.31	395.6	0	2196.18	10010.09	574.8	9435.29
	DISTRICT TOTAL	**35367.05**	**1089.85**	**0**	**19374.62**	**55831.52**	**5156.95**	**50674.57**
46	**SHIVPURI**							
	Badarwas	9577.09	686.78	0	2230.26	12494.13	1202.58	11291.55
	Karera	6015.72	351.06	0	1623.27	7990.05	399.5	7590.55
	Khaniyadhana	7482.45	646.3	0	2129.06	10257.81	1025.79	9232.02
	Kolaras	9044.91	378.74	0	1472.03	10895.68	1089.57	9806.11
	Narwar	6511.48	534.51	0	2353.05	9399.04	939.91	8459.14
	Pichhore	5230.32	419.26	0	2046.76	7696.34	384.81	7311.53
	Pohari	12172.51	391.53	0	1533.88	14097.92	1409.79	12688.13
	Shivpuri	10507.39	430.44	0	1658.98	12596.81	655.88	11940.93
	DISTRICT TOTAL	**66541.87**	**3838.62**	**0**	**15047.29**	**85427.78**	**7107.83**	**78319.96**
47	**SIDHI**							
	Kusmi	7776.26	114.94	115.54	394.86	8401.6	420.08	7981.52
	Majholi	5578.06	110.9	69.67	350.99	6109.62	610.97	5498.65
	Rampur Naikin	6056.65	202.03	90.25	889.2	7238.13	361.91	6876.22
	Sidhi	3654.37	221.76	57.36	607.09	4540.58	256.49	4284.09
	Sihawal	4275.55	149.64	59.48	595.1	5079.77	507.98	4571.79
	DISTRICT TOTAL	**27340.89**	**799.27**	**392.3**	**2837.24**	**31369.7**	**2157.43**	**29212.27**
48	**SINGRAULI**							
	Chitrangi	7830.86	211.86	0	474.32	8517.04	425.86	8091.18

S.N.	Assessment Unit	Recharge from Rainfall-Monsoon Season (Ham)	Recharge from Other Sources-Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources- Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
	Deosar	11946.75	246.05	0	724.52	12917.32	645.86	12271.46
	Waidhan	14187.6	380.24	0	1321.12	15888.96	794.45	15094.51
	DISTRICT TOTAL	**33965.21**	**838.15**	**0**	**2519.96**	**37323.32**	**1866.17**	**35457.15**
49	**TIKAMGARH**							
	Baldeogarh	7294.24	537.27	0	1670.8	9502.31	950.23	8552.08
	Jatara	8801.94	725.97	0	2613.23	12141.14	1214.13	10927.01
	Palera	5077.07	454.48	0	1590.51	7122.06	356.09	6765.97
	Tikamgarh	7580.54	1037.33	0	2560.15	11178.02	994.25	10183.77
	DISTRICT TOTAL	**28753.79**	**2755.05**	**0**	**8434.69**	**39943.53**	**3514.7**	**36428.83**
50	**UJJAIN**							
	Badnagar	14615.83	1230.65	0	5295.69	21142.17	2114.22	19027.95
	Ghatia	9217.38	957.39	0	3318.41	13493.18	1349.32	12143.86
	Khchrod	15677.3	812.16	0	2941.38	19430.84	971.54	18459.3
	Mahidpur	13416.48	1052.62	0	3393.99	17863.09	1786.31	16076.78
	Tarana	10221.43	749.42	0	2492.39	13463.24	673.16	12790.08
	Ujjain	8983.18	1116.72	0	4205.76	14305.66	1430.57	12875.09
	DISTRICT TOTAL	**72131.6**	**5918.96**	**0**	**21647.62**	**99698.18**	**8325.12**	**91373.06**
51	**UMARIA**							
	Karkeli	9278.95	205.13	181.25	445.51	10110.84	1011.09	9099.75
	Manpur	17454.13	186.63	328.92	512.22	18481.9	924.1	17557.8
	Pali	7731.45	25.1	149.27	75.02	7980.84	399.04	7581.8
	DISTRICT TOTAL	**34464.53**	**416.86**	**659.44**	**1032.75**	**36573.58**	**2334.23**	**34239.35**
52	**VIDISHA**							

S.N.	Assessment Unit	Recharge from Rainfall- Monsoon Season (Ham)	Recharge from Other Sources- Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources- Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
	Basoda	11463.6	506.48	0	1858.65	13828.73	691.44	13137.29
	Gyaraspur	9715.25	404.89	0	1522.07	11642.21	582.11	11060.1
	Kurwai	9638.9	490.55	0	1600.7	11730.15	586.51	11143.64
	Lateri	8117.76	321.64	0	999.64	9439.04	943.9	8495.14
	Nateran	9569.01	370.57	0	1481.55	11421.13	1004.41	10416.72
	Sironj	11390.25	505.21	0	2444.53	14339.99	717	13622.99
	Vidisha	14168.57	554.45	0	3769.58	18492.6	924.63	17567.97
	DISTRICT TOTAL	**74063.34**	**3153.79**	**0**	**13676.72**	**90893.85**	**5450**	**85443.85**
	STATE TOTAL (Ham)	**2694541.73**	**161651.93**	**12848.5**	**678366.24**	**3547408.4**	**262033.4**	**3285374.93**
	STATE TOTAL (bcm)	**26.95**	**1.62**	**0.13**	**6.78**	**35.47**	**2.62**	**32.85**

Annexure III: Recharge from Other Sources

SN	Assessment Unit	Recharge from Canals (in Ham)	Recharge from Surface Water Irrigation (in Ham)	Recharge from Ground Water Irrigation (in Ham)	Recharge due to Tanks and Ponds (in Ham)	Recharge due to Water Conservation Structures (in Ham)	Recharge due to Pipelines (in Ham)	Total Recharge from Other Sources (in Ham)
1	**AGAR MALWA**							
	Agar	822.45	575.21	1480.82	405.69	243.392	0	3527.562
	Badod	0	0	1949.45	152.79	174.424	0	2276.664
	Nalkheda	0	0	2889.66	30.19	218.922	0	3138.772
	Susner	0	0	2346.74	294.65	207.404	0	2848.794
	DISTRICT TOTAL	**822.45**	**575.21**	**8666.67**	**883.32**	**844.142**	**0**	**11791.792**
2	**ALIRAJPUR**							
	Alirajpur	0	0	377.82	92.09	105.9	0	575.81
	Bhabra	0	0	247.71	81.38	62.4	0	391.49
	Jobat	0	0	272	95.94	56.76	0	424.7
	Katthiwara	0	0	240.37	66.81	35.462	0	342.642
	Sondwa	0	0	348.2	48.5	59.468	0	456.168
	Udaigarh	0	0	194.49	101.91	126	0	422.4
	DISTRICT TOTAL	**0**	**0**	**1680.59**	**486.63**	**445.99**	**0**	**2613.21**
3	**ANUPPUR**							
	Anuppur	0	0	25.6	7.01	37.51	0	70.12
	Jaithari	0	0	216.68	13	43.886	0	273.566
	Kotma	0	0	59.61	6.83	24.596	0	91.036
	Pushparajgarh	0	0	69	19.64	77.574	0	166.214
	DISTRICT TOTAL	**0**	**0**	**370.89**	**46.48**	**183.566**	**0**	**600.936**
4	**ASHOKNAGAR**							
	Ashoknagar	78	343.51	1537.49	16.74	154.154	0	2129.894
	Chanderi	63.7	343.51	1095.13	58.33	94.066	0	1654.736

SN	Assessment Unit	Recharge from Canals (in Ham)	Recharge from Surface Water Irrigation (in Ham)	Recharge from Ground Water Irrigation (in Ham)	Recharge due to Tanks and Ponds (in Ham)	Recharge due to Water Conservation Structures (in Ham)	Recharge due to Pipelines (in Ham)	Total Recharge from Other Sources (in Ham)
	Isagarh	19	23.09	1554.84	16.72	136.772	0	1750.422
	Mungaoli	917.46	2202.53	1157.89	312.52	139.09	0	4729.49
	DISTRICT TOTAL	**1078.16**	**2912.64**	**5345.35**	**404.31**	**524.082**	**0**	**10264.542**
5	**BALAGHAT**							
	Baihar	0	0	53.3	7.99	171.324	0	232.614
	Balaghat	97.4	99.12	548.3	359.19	111.086	0	1215.096
	Birsa	0	0	34.47	37.26	164.36	0	236.09
	Katangi	76.46	74.13	790.59	137.58	78.542	0	1157.302
	Khairlanji	35.47	14.96	519.64	69.59	85.282	0	724.942
	Kirnapur	0	0	484.27	37.26	88.122	0	609.652
	Lalbarra	102.21	183.53	565.34	375.78	80.44	0	1307.3
	Lanji	108.09	92.36	346.94	32.79	79.238	0	659.418
	Paraswada	0	0	31.84	58.37	117.712	0	207.922
	Waraseoni	56.74	109.44	426.02	96.87	79.654	0	768.724
	DISTRICT TOTAL	**476.37**	**573.54**	**3800.71**	**1212.68**	**1055.76**	**0**	**7119.06**
6	**BARWANI**							
	Barwani	153.87	893.91	712.84	18.09	338.206	0	2116.916
	Niwali	3.76	37.5	538.17	11.13	224.634	0	815.194
	Pansemal	89.67	370.82	2004.09	123.7	421.208	0	3009.488
	Pati	9.77	88.83	302.28	25.18	340.018	0	766.078
	Rajpur	249.08	1352.11	2103.88	703.15	429.392	0	4837.612
	Sendhwa	62.71	622.73	924.43	467.76	467.348	0	2544.978
	Thikri	509.75	6304.11	1758.64	53.59	382.036	0	9008.126
	DISTRICT TOTAL	**1078.61**	**9670.01**	**8344.33**	**1402.6**	**2602.842**	**0**	**23098.392**

SN	Assessment Unit	Recharge from Canals (in Ham)	Recharge from Surface Water Irrigation (in Ham)	Recharge from Ground Water Irrigation (in Ham)	Recharge due to Tanks and Ponds (in Ham)	Recharge due to Water Conservation Structures (in Ham)	Recharge due to Pipelines (in Ham)	Total Recharge from Other Sources (in Ham)
7	**BETUL**							
	Amla	50.89	640.74	1731.92	201.79	132.89	0	2758.23
	Athner	7.1	181.96	674.8	167.11	74.102	0	1105.072
	Betul	19.36	463.44	2624.92	252.31	99.944	0	3459.974
	Bhainsdehi	32.48	331.26	878.68	287.13	80.2	0	1609.75
	Bhimpur	0	0	644.87	117.44	102.006	0	864.316
	Chicholi	20.52	96.42	617.4	74.12	59.114	0	867.574
	Ghoda Dongri	15.94	381.02	558.84	143.42	149.46	0	1248.68
	Multai	39.36	427.68	2395.77	363.71	63.248	0	3289.768
	Prabhat Pattan	22.44	438.57	517.7	155.68	100.186	0	1234.576
	Shahpur	13.82	135.92	561.03	147.03	94.284	0	952.084
	DISTRICT TOTAL	**221.91**	**3097.01**	**11205.93**	**1909.74**	**955.434**	**0**	**17390.024**
8	**BHIND**							
	Ater	726.51	496.91	978.48	0	55.51	0	2257.41
	Bhind	1158.47	693.94	861.41	0	39.916	0	2753.736
	Gohad	2101.2	140.94	1356.76	1.15	74.898	0	3674.948
	Lahar	822.29	670.62	663.55	0	41.052	0	2197.512
	Mehgaon	1132.03	1805.37	1131.09	0	80.894	0	4149.384
	Ron	86.66	52.73	288.25	0	9.322	0	436.962
	DISTRICT TOTAL	**6027.16**	**3860.51**	**5279.54**	**1.15**	**301.592**	**0**	**15469.952**
9	**BHOPAL**							
	Berasia	0	0	3392.28	181.55	296.01	0	3869.84
	Bhopal Urban	0	0	0	437.61	0.00	1234.61	1672.22

SN	Assessment Unit	Recharge from Canals (in Ham)	Recharge from Surface Water Irrigation (in Ham)	Recharge from Ground Water Irrigation (in Ham)	Recharge due to Tanks and Ponds (in Ham)	Recharge due to Water Conservation Structures (in Ham)	Recharge due to Pipelines (in Ham)	Total Recharge from Other Sources (in Ham)
	Phanda	0	0	2586.81	870.98	73.37	0	3531.16
	DISTRICT TOTAL	**0**	**0**	**5979.09**	**1490.14**	**369.378**	**1234.6125**	**9073.2205**
10	**BURHANPUR**							
	Burhanpur	64.28	666.25	2302.05	301.72	777.422	0	4111.72
	Khaknar	19.67	574.64	2563.74	332.63	970.298	0	4460.98
	DISTRICT TOTAL	**83.95**	**1240.89**	**4865.79**	**634.35**	**1747.72**	**0**	**8572.7**
11	**CHHATARPUR**							
	Bada Malhera	782.34	759.35	1707.72	216.07	157.63	0	3623.11
	Bijawar	20.68	16.31	2193.93	70.3	188.64	0	2489.86
	Buxwaha	36.59	81	1230.44	63.12	372.18	0	1783.33
	Chhatarpur	419.04	449.6	1678.96	172.04	158.644	0	2878.28
	Gaurihar	485.38	266.33	404.42	7.43	190.06	0	1353.62
	Laundi	1277.45	127.01	1210.25	409.87	134.826	0	3159.41
	Nowgaon	470.64	78.62	1635.32	975.01	190.55	0	3350.14
	Rajnagar	365.94	199.37	2373.62	125.74	382.036	0	3446.71
	DISTRICT TOTAL	**3858.06**	**1977.59**	**12434.66**	**2039.58**	**1774.566**	**0**	**22084.456**
12	**CHHINDWARA**							
	Amarwara	0	0	1443.11	93.03	82.262	0	1618.40
	Bichhua	0	0	700.09	111.76	11.104	0	822.95
	Chaurai	0	0	1823.25	29.52	12.06	0	1864.83
	Chhindwara	0	0	2227.22	24.61	140.64	0	2392.47
	Harrai	0	0	699.86	21.74	34.334	0	755.93
	Jamai	0	0	840.05	5.03	53.826	0	898.91
	Mohkheda	562.97	889.38	1851.22	74.82	138.43	0	3516.82

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	Pandhurna	0	0	2281.5	150.8	49.384	0	2481.68
	Parasia	0	0	1007.3	10.77	34.68	0	1052.75
	Sausar	145.6	345.3	875.13	270.64	153.78	0	1790.45
	Tamia	0	0	179.79	74.66	41.76	0	296.21
	DISTRICT TOTAL	**708.57**	**1234.68**	**13928.52**	**867.38**	**752.26**	**0**	**17491.41**
13	**DAMOH**							
	Batiyagarh	89.83	151.2	995.32	86.86	135.046	0	1458.26
	Damoh	129.38	606.31	836.06	245.54	20.848	0	1838.14
	Hatta	48.38	162	382.07	410.87	51.292	0	1054.61
	Jabera	898.03	1483.49	536.59	410.05	64.488	0	3392.65
	Patera	27.93	172.8	597.52	130.64	38.44	0	967.33
	Patharia	21.77	54	1038.46	47.66	68.746	0	1230.64
	Tendulheda	188.06	681.8	303.4	236.99	49.64	0	1459.89
	DISTRICT TOTAL	**1403.38**	**3311.6**	**4689.42**	**1568.61**	**428.5**	**0**	**11401.51**
14	**DATIA**							
	Bhander	133.57	1954.45	835.32	11.75	132.304	0	3067.39
	Datia	324.92	492.12	761.48	11.49	223.188	0	1813.20
	Seondha	623.35	991.12	1547.41	3.1	107.47	0	3272.45
	DISTRICT TOTAL	**1081.84**	**3437.69**	**3144.21**	**26.34**	**462.962**	**0**	**8153.042**
15	**DEWAS**							
	Bagli	17.67	57.29	3260.62	69.49	565.262	0	3970.33
	Dewas	0	0	3969.23	46.84	464.096	0	4480.17
	Kannod	250.14	827.59	1677.58	200.12	519.278	0	3474.71
	Khategaon	0	0	2405.24	16.34	249.922	0	2671.50

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	Sonkutch	0	0	2348.22	74.31	420.198	0	2842.73
	Tonkkhurd	0	0	1428.45	61.79	1543.142	0	3033.38
	DISTRICT TOTAL	**267.81**	**884.88**	**15089.34**	**468.89**	**3761.898**	**0**	**20472.818**
16	**DHAR**							
	Badnawar	184.31	432.35	4660.31	206.44	73.86	0	5557.27
	Bagh	79.06	860.92	378.1	142.64	30.994	0	1491.71
	Dahi	351.21	2810.98	591.58	51.49	136.44	0	3941.70
	Dhar	0	0	3491.49	21.69	155.652	0	3668.83
	Dharmpuri	504.26	3336.71	412.26	321.72	13.2	0	4588.15
	Gandhwani	224.53	5079.4	773.32	172.5	213.276	0	6463.03
	Kukshi	60.42	1196.99	369.93	62.43	70.8	0	1760.57
	Manawar	241.52	4146.37	663.08	173.76	105.06	0	5329.79
	Nalchha	28.59	135.3	3013.5	110.61	91.68	0	3379.68
	Nisarpur	230.05	2426.84	482.84	23.64	52.26	0	3215.63
	Sardarpur	880.57	1851.49	1910.71	1032.59	100.62	0	5775.98
	Tirla	0	0	1837.25	96.89	713.856	0	2648.00
	Umarvan	839.53	2459.8	487.75	410.12	96.78	0	4293.98
	DISTRICT TOTAL	**3624.05**	**24737.15**	**19072.12**	**2826.52**	**1854.478**	**0**	**52114.32**
17	**DINDORI**							
	Amarpur	0	0	40.43	0	44.888	0	85.32
	Bajang	0	0	31.01	0	41.596	0	72.61
	Dindori	0	0	81.24	0	43.966	0	125.21
	Karanjiya	0	0	61.78	0	52.83	0	114.61
	Menhadwani	0	0	55.9	0	38.07	0	93.97

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	Samnapur	0	0	84.67	0	72.6	0	157.27
	Shahpura	0	0	223.99	0	33.554	0	257.54
	DISTRICT TOTAL	**0**	**0**	**579.02**	**0**	**327.504**	**0**	**906.52**
18	**GUNA**							
	Aron	0	0	1830.07	2.86	84.426	0	1917.36
	Bamori	992.9	999.73	2390.64	440.32	91.492	0	4915.08
	Chachaura	297.44	60.59	2960.41	63.51	90.746	0	3472.70
	Guna	394.68	169.29	2342.25	69.87	120.748	0	3096.84
	Raghogarh	429.43	2410.45	2378.84	495.16	75.37	0	5789.25
	DISTRICT TOTAL	**2114.45**	**3640.06**	**11902.21**	**1071.72**	**462.782**	**0**	**19191.222**
19	**GWALIOR**							
	Bhitarwar	1685.54	7708.36	1108.01	281.21	81.91	0	10865.03
	Dabra	1483.02	7341.3	961.6	216.32	85.132	0	10087.37
	Ghatigaon	740.97	574.17	755.18	372.05	124.95	0	2567.32
	Gwalior Urban		0	0	149.63		459.9	609.53
	Morar		0	1688.24	165.36	68.988	0	1922.59
	DISTRICT TOTAL	**3909.53**	**15623.83**	**4513.03**	**1184.57**	**360.98**	**459.9**	**26051.84**
20	**HARDA**							
	Harda	301.59	85.05	1525.07	53.03	53.91	0	2018.65
	Khirkiya	0	0	952.56	0	16.638	0	969.20
	Timarni	7276.5	7371	1126.22	0	13.628	0	15787.35
	DISTRICT TOTAL	**7578.09**	**7456.05**	**3603.85**	**53.03**	**84.176**	**0**	**18775.20**
21	**HOSHANGABAD**							
	Babai	2641.44	3510	659.99	0	13.432	0	6824.86

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	Bankhedi		0	3643.92	0	22.99	0	3666.91
	Hoshangabad	5695.9	6804	946.89	0	19.102	0	13465.89
	Kesala	3234.86	2532.6	943.06	54.79	61.798	0	6827.11
	Pipariya	213.63	196.37	1887.41	64.01	58.194	0	2419.61
	Seoni Malwa	3864.18	7446.6	927.18	0	32.936	0	12270.90
	Shohagpur	2039.75	252.69	1007.86	6.84	35.474	0	3342.61
	DISTRICT TOTAL	**17689.76**	**20742.26**	**10016.31**	**125.64**	**243.926**	**0**	**48817.90**
22	**INDORE**							
	Depalpur	3.86	159.89	5814.63	363.91	67.374	0	6409.66
	Indore	0	0	2678.98	189.91	51.872	0	2920.76
	Indore Urban	0	0	0	209.85	175.6	1231.875	1617.33
	Mhow	49.31	64.96	1875.95	400.24	85.186	0	2475.65
	Sawer	0	0	3235.84	354.11	112.06	0	3702.01
	DISTRICT TOTAL	**53.17**	**224.85**	**13605.4**	**1518.02**	**492.092**	**1231.875**	**17125.41**
23	**JABALPUR**							
	Bargi	35.87	158.58	589.14	67.69	39.18	0	890.46
	Jabalpur Urban	0	0	0	12.17	21.366	547.5	581.04
	Kundam	0	0	256.25	23.89	225.976	0	506.12
	Majholi	0	0	766.59	6.39	126.82	0	899.80
	Panagar	15.88	16.96	1368.82	94.32	99.61	0	1595.59
	Patan	127.71	1914.48	1735.71	42.02	108.924	0	3928.84
	Shahpura	87.44	204.35	1504.03	46.41	84.666	0	1926.90
	Sihora	24.47	643.68	837.26	33.97	132.562	0	1671.94
	DISTRICT TOTAL	**291.37**	**2938.05**	**7057.8**	**326.86**	**839.104**	**547.5**	**12000.68**

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24	**JHABUA**							
	Jhabua	0	0	315.42	127.22	80.1	0	522.74
	Meghnagar	0	0	321.34	135.38	49.86	0	506.58
	Petlawad	138.7	2064.42	569.96	559.76	95.46	0	3428.30
	Rama	0	0	285.76	210.6	49.02	0	545.38
	Ranapur	0	0	201.53	63.69	70.44	0	335.66
	Thandla	0	0	336.53	169.69	86.1	0	592.32
	DISTRICT TOTAL	**138.7**	**2064.42**	**2030.54**	**1266.34**	**430.98**	**0**	**5930.98**
25	**KATNI**							
	Badwara	148.13	513.11	879.37	78.74	320.192	0	1939.54
	Bahoriband	145.6	345.3	586.41	270.64	127.458	0	1475.41
	Dhimar Kheda	0	0	296.21	95.42	111.212	0	502.84
	Murwara	162.78	305	772.47	53.03	139.968	0	1433.25
	Rithi	6.15	106.76	349.56	15.24	81.074	0	558.78
	Vijayraghavgarh	0	0	619.65	10.2	38.112	0	667.96
	DISTRICT TOTAL	**462.66**	**1270.17**	**3503.67**	**523.27**	**818.016**	**0**	**6577.79**
26	**KHANDWA**							
	Baldi	0	0	813	0	146.47	0	959.47
	Chhegaon Makhan	26.27	231.72	2464.69	108.83	222.526	0	3054.04
	Harsud	0	0	649.52	8.49	287.692	0	945.70
	Khalwa	0	0	1515.94	152.1	195.62	0	1863.66
	Khandwa	7.52	231.84	1498.39	7.8	416.67	0	2162.22
	Pandhana	172.06	2558.86	2227.36	392.05	425.806	0	5776.14

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	Punasa	937.36	37309.5	966.5	2667.1	301.152	0	42181.61
	DISTRICT TOTAL	**1143.21**	**40331.92**	**10135.4**	**3336.37**	**1995.936**	**0**	**56942.84**
27	**KHARGONE**							
	Barwaha	1223.18	6696.95	1757.74	382.63	739.218	0	10799.72
	Bhagwanpura	122.27	891.87	654.75	481.02	1127.588	0	3277.50
	Bhikangaon	328.35	1780.35	1204.82	511.23	484.214	0	4308.96
	Gogawan	214.69	689.46	705.92	15.45	219.644	0	1845.16
	Jhiranya	173.58	412.54	970.01	679.69	1277.832	0	3513.65
	Kasrawad	1104.43	6207.86	1323.3	580.51	1145.694	0	10361.79
	Khargone	183.36	163.08	1005.26	178.85	335.392	0	1865.94
	Maheshwar	467.16	2980.1	1160.17	263.34	560.97	0	5431.74
	Segaon	71.85	473.88	649.55	183.99	462.788	0	1842.06
	DISTRICT TOTAL	**3888.87**	**20296.09**	**9431.52**	**3276.71**	**6353.34**	**0**	**43246.53**
28	**MANDLA**							
	Bichhiya	488.76	232.2	284.35	147.89	67.422	0	1220.62
	Bijadandi	0	0	56.7	14.46	22.054	0	93.21
	Ghughari	0	0	61.36	35.99	46.466	0	143.82
	Mandla	275.07	151.2	230.18	147.89	56.604	0	860.94
	Mawai	0	0	235.71	0	61.842	0	297.55
	Mohgaon	0	0	264.46	17.01	45.888	0	327.36
	Nainpur	1050.62	151.2	255.62	160.37	49.378	0	1667.19
	Narayanganj	0	0	180.23	124.45	44.676	0	349.36
	Niwas	0	0	183.46	66.87	28.384	0	278.71
	DISTRICT TOTAL	**1814.45**	**534.6**	**1752.07**	**714.93**	**422.714**	**0**	**5238.76**

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29	**MANDSAUR**							
	Bhanpura	121.8	279.94	1453.95	729.76	413.34	0	2998.79
	Garoth	67.2	139.97	2860.66	453.97	1176.162	0	4697.96
	Malhargarh	92.4	186.62	2084.88	669.88	1023.256	0	4057.04
	Mandsaur	25.2	93.31	4128.56	322.56	340.348	0	4909.98
	Sitamau	21	93.31	5201.66	467.56	351.706	0	6135.24
	DISTRICT TOTAL	**327.6**	**793.15**	**15729.71**	**2643.73**	**3304.812**	**0**	**22799.00**
30	**MORENA**							
	Ambah	1412.28	264.67	330.84	3.89	35.26	0	2046.94
	Jaora	1590.32	789.41	587.27	34.72	128.7	0	3130.42
	Kailaras	784.25	546.34	621.51	41.48	149.732	0	2143.31
	Morena	833.84	636.12	856.85	198.17	192.84	0	2717.82
	Pahadgarh	1496.22	328.92	597.09	49.1	134.454	0	2605.78
	Porsa	1149.24	116.57	103.67	38.78	63.894	0	1472.15
	Sabalgarh	2771.12	1495.58	1058.45	24.82	161.028	0	5511.00
	DISTRICT TOTAL	**10037.27**	**4177.61**	**4155.68**	**390.96**	**865.908**	**0**	**19627.43**
31	**NARSINGHPUR**							
	Chawarpatha	0	0	2140.34	0.91	14.222	0	2155.47
	Chichli	0	0	2568.24	1.32	15.184	0	2584.74
	Gotegaon	860.62	129.6	2841.21	0.09	6.3	0	3837.82
	Kareli	355.04	112.5	3210.19	0	9.54	0	3687.27
	Narsinghpur	860.61	129.6	3956.79	0	11.948	0	4958.95
	Saikheda	0	0	1933.58	1.32	17.642	0	1952.54
	DISTRICT TOTAL	**2076.27**	**371.7**	**16650.35**	**3.64**	**74.836**	**0**	**19176.80**

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32	**NEEMUCH**							
	Jawad	121.8	223.78	2837.08	139.16	360.092	0	3681.91
	Manasa	58.8	139.97	2139.16	418.89	551.792	0	3308.61
	Neemuch	21	83.81	3542.01	195.39	413.848	0	4256.06
	DISTRICT TOTAL	**201.6**	**447.56**	**8518.25**	**753.44**	**1325.732**	**0**	**11246.58**
33	**NIWARI**							
	Niwari	184.75	389.77	1055.92	245.32	336.644	0	2212.40
	Prithvipur	116.45	179.5	1824.09	183.67	668.058	0	2971.77
	DISTRICT TOTAL	**301.2**	**569.27**	**2880.01**	**428.99**	**1004.702**	**0**	**5184.17**
34	**PANNA**							
	Ajaigarh	71.47	358.02	1544.04	126.33	73.28	0	2173.14
	Gunnor	59.39	324.86	428.31	309.95	52.518	0	1175.03
	Panna	122.53	358.02	766.69	111.73	46.674	0	1405.64
	Pawai	150.37	388.26	753.78	194.57	66.34	0	1553.32
	Shahnagar	238.1	421.2	449.95	143.45	71.54	0	1324.24
	DISTRICT TOTAL	**641.86**	**1850.36**	**3942.77**	**886.03**	**310.352**	**0**	**7631.37**
35	**RAISEN**							
	Badi	225.28	91.09	749.55	1762.99	49.41	0	2878.32
	Begamganj	0	0	1419.22	11.42	128.482	0	1559.12
	Gairatganj	0	0	1192.21	67.89	111.392	0	1371.49
	Obedullaganj	0	0	1771.31	392.75	59.714	0	2223.77
	Sanchi	0	0	1831.63	115.58	70.452	0	2017.66
	Silwani	0	0	2087.49	7.71	82.506	0	2177.71

SN	Assessment Unit	Recharge from Canals (in Ham)	Recharge from Surface Water Irrigation (in Ham)	Recharge from Ground Water Irrigation (in Ham)	Recharge due to Tanks and Ponds (in Ham)	Recharge due to Water Conservation Structures (in Ham)	Recharge due to Pipelines (in Ham)	Total Recharge from Other Sources (in Ham)
	Udaipura	0	0	1605.59	54.58	34.038	0	1694.21
	DISTRICT TOTAL	**225.28**	**91.09**	**10657**	**2412.92**	**535.994**	**0**	**13922.28**
36	**RAJGARH**							
	Biaora	0	0	3609.81	94	237.298	0	3941.11
	Jirapur	0	0	2291.57	59.57	143.142	0	2494.28
	Khilchipur	0	0	2380.08	106.44	114.868	0	2601.39
	Narsinghgarh	0	0	3818.88	187.38	324.964	0	4331.22
	Rajgarh	0	0	2791.75	261.96	163.144	0	3216.85
	Sarangpur	0	0	3495.76	26.53	141.58	0	3663.87
	DISTRICT TOTAL	**0**	**0**	**18387.85**	**735.88**	**1124.996**	**0**	**20248.73**
37	**RATLAM**							
	Alot	0	0	4361.21	41.06	346.132	0	4748.40
	Bajna	1008	19.44	1189.91	274.92	602.278	0	3094.55
	Jaora	0	0	6234.35	237.38	240.172	0	6711.90
	Piploda	0	0	4729.59	26.64	128.914	0	4885.14
	Ratlam	0	0	7283.15	205.88	1773.538	0	9262.57
	Sailana	0	0	1061.36	64.53	480.58	0	1606.47
	DISTRICT TOTAL	**1008**	**19.44**	**24859.57**	**850.41**	**3571.614**	**0**	**30309.03**
38	**REWA**							
	Gangev	149.88	318.7	601.05	46.66	84.022	0	1200.31
	Hanumana	0	0	354.82	37.19	86.834	0	478.84
	Jawa	0	0	601.99	0	41.522	0	643.51
	Mauganj	0	0	558.55	88.44	40.426	0	687.42
	Naigarhi	0	0	376.52	0	30.648	0	407.17

SN	Assessment Unit	Recharge from Canals (in Ham)	Recharge from Surface Water Irrigation (in Ham)	Recharge from Ground Water Irrigation (in Ham)	Recharge due to Tanks and Ponds (in Ham)	Recharge due to Water Conservation Structures (in Ham)	Recharge due to Pipelines (in Ham)	Total Recharge from Other Sources (in Ham)
	Rampur Karchuliyan	693.68	503.74	603.48	11.93	51.748	0	1864.58
	Rewa	899.18	48.79	653.31	104.48	21.162	0	1726.92
	Sirmour	484.61	18.19	717.13	106.24	68.866	0	1395.04
	Teonthar	0	0	876.22	14.23	38.186	0	928.64
	DISTRICT TOTAL	**2227.35**	**889.42**	**5343.07**	**409.17**	**463.414**	**0**	**9332.42**
39	**SAGAR**							
	Banda	71.13	1.25	1500.98	118.31	39.09	0	1730.76
	Bina	13.89	3.69	1901.91	33.27	50.48	0	2003.24
	Deori	102.83	174.96	1209.91	244.97	44.918	0	1777.59
	Jaisinagar	55.82	2.16	1561.63	110.93	22.374	0	1752.91
	Kesli	145.58	21.6	1520.71	234.9	63.26	0	1986.05
	Khurai	17.63	5.4	1106.74	59.23	60.636	0	1249.64
	Malthon	12.48	3.4	789.21	50	47.078	0	902.17
	Rahatgarh	12.87	2.16	1320.81	51.45	39.204	0	1426.49
	Rehli	68.44	27.81	920.56	62.71	199.022	0	1278.54
	Sagar	34.27	10.8	1848.79	73.91	65.638	0	2033.41
	Shahnagar	354.68	807.98	710.37	324.27	26.146	0	2223.45
	DISTRICT TOTAL	**889.62**	**1061.21**	**14391.62**	**1363.95**	**657.846**	**0**	**18364.25**
40	**SATNA**							
	Amarpatan	18.27	1283.87	1317.36	31.61	156.88	0	2807.99
	Maiihar	0	0	972	4.41	61.828	0	1038.24
	Majhgawan	0	0	1040.17	46.29	127.492	0	1213.95
	Nagod	18.27	1283.87	1746.59	18.93	129.178	0	3196.84
	Ramnagar	0	0	465.75	5.56	44.504	0	515.81

SN	Assessment Unit	Recharge from Canals (in Ham)	Recharge from Surface Water Irrigation (in Ham)	Recharge from Ground Water Irrigation (in Ham)	Recharge due to Tanks and Ponds (in Ham)	Recharge due to Water Conservation Structures (in Ham)	Recharge due to Pipelines (in Ham)	Total Recharge from Other Sources (in Ham)
	Rampur-Baghelan	334.91	1496.39	1715.77	10.71	86.828	0	3644.61
	Sohawal	204.35	385.47	1577.62	0.14	210.674	0	2378.25
	Unchehara	18.27	1216.3	1019.31	18.93	150.888	0	2423.70
	DISTRICT TOTAL	**594.07**	**5665.9**	**9854.57**	**136.58**	**968.272**	**0**	**17219.39**
41	**SEHORE**							
	Ashta	201.14	399.96	2926.96	198.29	174.602	0	3900.95
	Budni	2039.92	1233.36	908.86	256.87	63.52	0	4502.53
	Ichhawar	54.42	111.96	1227.28	114.41	139.914	0	1647.98
	Nasrullaganj	800.07	939.49	1408.78	531.16	150.14	0	3829.64
	Sehore	151.99	439.56	3424.26	310.85	161.396	0	4488.06
	DISTRICT TOTAL	**3247.54**	**3124.33**	**9896.14**	**1411.58**	**689.572**	**0**	**18369.16**
42	**SEONI**							
	Barghat	216.91	114.29	833.65	14	118.71	0	1297.56
	Chhapara	0	0	994.68	39.11	105.368	0	1139.16
	Dhanora	25.94	108.04	269.91	14.59	33.272	0	451.75
	Ghansaur	0	0	334.31	25.7	29.216	0	389.23
	Keolari	176.4	343.69	314.96	14.72	41.144	0	890.91
	Kurai	0	0	760.61	27.58	93.402	0	881.59
	Lakhnadon	0	0	1168.93	20.57	77.276	0	1266.78
	Seoni	189.7	331.06	1625.35	268.62	93.238	0	2507.97
	DISTRICT TOTAL	**608.95**	**897.08**	**6302.4**	**424.89**	**591.626**	**0**	**8824.95**
43	**SHAHDOL**							
	Beohari	456.58	0	230.18	79.96	14.402	0	781.12
	Burhar	0	0	55.08	15.96	12.986	0	84.03

SN	Assessment Unit	Recharge from Canals (in Ham)	Recharge from Surface Water Irrigation (in Ham)	Recharge from Ground Water Irrigation (in Ham)	Recharge due to Tanks and Ponds (in Ham)	Recharge due to Water Conservation Structures (in Ham)	Recharge due to Pipelines (in Ham)	Total Recharge from Other Sources (in Ham)
	Gohparu	0	0	56.86	11.69	3.452	0	72.00
	Jaisinghnagar	0	0	277.02	23.35	31.212	0	331.58
	Sohagpur	0	0	162	23.44	7.332	0	192.77
	DISTRICT TOTAL	**456.58**	**0**	**781.14**	**154.4**	**69.384**	**0**	**1461.50**
44	**SHAJAPUR**							
	Kalapipal	0	0	3551.29	83.81	139.264	0	3774.36
	Moman Badodiya	0	0	4058.18	63.03	138.774	0	4259.98
	Shajapur	0	0	2339.77	330.45	228.76	0	2898.98
	Shujalpur	0	0	3246.47	94.5	128.258	0	3469.23
	DISTRICT TOTAL	**0**	**0**	**13195.71**	**571.79**	**635.056**	**0**	**14402.56**
45	**SHEOPUR**							
	Karahal	0	0	1521.96	307.32	34.42	0	1863.70
	Sheopur	12023.91	3138.48	690.05	26.93	129.614	0	16008.98
	Vijaypur	720.89	120.81	1438.5	60.8	250.784	0	2591.78
	DISTRICT TOTAL	**12744.8**	**3259.29**	**3650.51**	**395.05**	**414.818**	**0**	**20464.47**
46	**SHIVPURI**							
	Badarwas	175.09	399.81	2194.31	86.93	60.908	0	2917.05
	Karera	502.67	411.29	805.19	193.48	61.706	0	1974.34
	Khaniyadhana	292.6	369.49	1761.84	221.49	129.938	0	2775.36
	Kolaras	0	0	1707.56	56.55	86.652	0	1850.76
	Narwar	553.43	593.21	1446.77	196.47	97.67	0	2887.55
	Pichhore	197.11	723.79	1263.3	212.48	69.348	0	2466.03
	Pohari	137.79	129.6	1412.55	182.89	62.58	0	1925.41

SN	Assessment Unit	Recharge from Canals (in Ham)	Recharge from Surface Water Irrigation (in Ham)	Recharge from Ground Water Irrigation (in Ham)	Recharge due to Tanks and Ponds (in Ham)	Recharge due to Water Conservation Structures (in Ham)	Recharge due to Pipelines (in Ham)	Total Recharge from Other Sources (in Ham)
	Shivpuri	82.75	224.64	1480.65	227.68	73.694	0	2089.41
	DISTRICT TOTAL	**1941.44**	**2851.83**	**12072.17**	**1377.97**	**642.496**	**0**	**18885.91**
47	**SIDHI**							
	Kusmi	0	0	430.92	22.58	56.308	0	509.81
	Majholi	0	0	380.16	14.53	67.202	0	461.89
	Rampur Naikin	540.54	23.96	393.77	72.06	60.9	0	1091.23
	Sidhi	69.65	23.96	515.33	145.3	74.61	0	828.85
	Sihawal	398.46	23.96	167.93	85.51	68.882	0	744.74
	DISTRICT TOTAL	**1008.65**	**71.88**	**1888.11**	**339.98**	**327.902**	**0**	**3636.52**
48	**SINGRAULI**							
	Chitrangi	0	0	436.05	107.27	142.86	0	686.18
	Deosar	45.36	41.94	686.81	45.32	151.132	0	970.56
	Waidhan	75.41	96.35	1122.08	203.19	204.33	0	1701.36
	DISTRICT TOTAL	**120.77**	**138.29**	**2244.94**	**355.78**	**498.322**	**0**	**3358.10**
49	**TIKAMGARH**							
	Baldeogarh	159.37	197.75	1465.28	301.83	83.848	0	2208.08
	Jatara	124.46	450.58	2206.13	340.81	217.226	0	3339.21
	Palera	59.46	462.02	1192.1	207.43	123.976	0	2044.99
	Tikamgarh	133.72	444.74	1922.2	945.08	151.732	0	3597.47
	DISTRICT TOTAL	**477.01**	**1555.09**	**6785.71**	**1795.15**	**576.782**	**0**	**11189.74**
50	**UJJAIN**							
	Badnagar	0	0	6356.76	90.26	79.32	0	6526.34
	Ghatia	0	0	3822.01	215.91	237.89	0	4275.81
	Khchrod	0	0	3164.86	341.6	247.088	0	3753.55

S N	Assessment Unit	Recharge from Canals (in Ham)	Recharge from Surface Water Irrigation (in Ham)	Recharge from Ground Water Irrigation (in Ham)	Recharge due to Tanks and Ponds (in Ham)	Recharge due to Water Conservation Structures (in Ham)	Recharge due to Pipelines (in Ham)	Total Recharge from Other Sources (in Ham)
	Mahidpur	0	0	3251.29	827.1	368.22	0	4446.61
	Tarana	0	0	2625.16	254.15	362.492	0	3241.80
	Ujjain	0	0	4651.44	626.36	44.68	0	5322.48
	DISTRICT TOTAL	**0**	**0**	**23871.52**	**2355.38**	**1339.69**	**0**	**27566.59**
51	**UMARIA**							
	Karkeli	0	0	381.03	234.93	34.686	0	650.65
	Manpur	0	0	605.88	64.95	28.024	0	698.85
	Pali	0	0	86.84	10.7	2.582	0	100.12
	DISTRICT TOTAL	**0**	**0**	**1073.75**	**310.58**	**65.292**	**0**	**1449.62**
52	**VIDISHA**							
	Basoda	20.67	10.91	2234.94	46.27	52.348	0	2365.14
	Gyaraspur	0	0	1862.51	2.7	61.75	0	1926.96
	Kurwai	0	0	2023.06	7.61	60.576	0	2091.25
	Lateri	0	0	1076.2	40.26	204.816	0	1321.28
	Nateran	114.92	16.04	1510.72	111.46	98.982	0	1852.12
	Sironj	511.95	143.86	2107.41	125.69	60.83	0	2949.74
	Vidisha	1542.55	516.46	2109.95	87.03	68.03	0	4324.02
	DISTRICT TOTAL	**2190.09**	**687.27**	**12924.79**	**421.02**	**607.332**	**0**	**16830.50**
	STATE TOTAL (Ham)	**101142.53**	**201157.47**	**432085.32**	**50595.45**	**51563.47**	**3473.89**	**840018.13**
	STATE TOTAL (bcm)	**1.01**	**2.01**	**4.32**	**0.51**	**0.52**	**0.03**	**8.40**

Annexure IV: Ground Water Extraction Scenario

SN	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
1	**AGAR MALWA**								
	Agar	5923.27	0	562.20	6485.45	603.42	4303.46	59.88	safe
	Badod	7797.81	3.6719	421.44	8222.9	445.22	2210.29	78.64	semi_critical
	Nalkheda	11558.65	0	307.57	11866.22	322.52	0	124.44	over_exploited
	Susner	9386.93	0	375.45	9762.39	395.16	0	101.90	over_exploited
	DISTRICT TOTAL	**34666.65**	**3.67**	**1666.65**	**36336.96**	**1766.32**	**6513.75**	**89.94**	
2	**ALIRAJPUR**								
	Alirajpur	1511.28	0	333.82	1845.1	351.08	3009.46	37.87	safe
	Bhabra	990.82	0	233.03	1223.85	243.49	539.18	69.01	safe
	Jobat	1088.01	0	328.34	1416.35	374.66	594.97	68.83	safe
	Katthiwara	961.48	0	272.76	1234.25	285.62	1404.12	46.55	safe
	Sondwa	1392.79	0	500.44	1893.23	542.84	4386.16	29.95	safe
	Udaigarh	777.95	0	242.42	1020.37	251.73	1224.55	45.26	safe
	DISTRICT TOTAL	**6722.33**	**0**	**1910.8188**	**8633.15**	**2049.42**	**11158.44**	**43.32**	
3	**ANUPPUR**								
	Anuppur	102.384	43.3574	376.23762	521.97	390.82	6600.76	7.31	safe
	Jaithari	866.7	22.703	483.18408	1372.59	501.91	5652.29	19.49	safe
	Kotma	238.464	3237.259	146.13651	3621.86	151.8	954.19	79.05	semi_critical
	Pushparajgarh	276	0	556.90824	832.91	578.5	7376.61	10.12	safe
	DISTRICT TOTAL	**1483.548**	**3303.319**	**1562.46645**	**6349.33**	**1623.03**	**20583.85**	**23.52**	

SN	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
4	**ASHOKNAGAR**								
	Ashoknagar	6149.95	1.37	551.49	6702.81	584.87	3261.14	67.05	safe
	Chanderi	4380.52	0.00	332.99	4713.50	353.54	1891.73	71.14	semi_critical
	Isagarh	6219.37	0.00	425.10	6644.47	446.58	1752.49	78.93	semi_critical
	Mungaoli	4631.56	0.04	514.64	5146.25	542.86	6608.32	43.68	safe
	DISTRICT TOTAL	**21381.39**	**1.41**	**1824.21**	**23207.03**	**1927.85**	**13513.68**	**63.02**	
5	**BALAGHAT**								
	Baihar	174.31	0.00	270.73	445.04	282.48	7968.87	5.28	safe
	Balaghat	1800.41	76.73	471.50	2348.65	491.97	7047.94	24.94	safe
	Birsa	113.22	72.16	324.16	509.54	338.23	9542.18	5.06	safe
	Katangi	2622.78	32.14	422.48	3077.41	440.83	2386.90	56.13	safe
	Khairlanji	1729.92	83.55	375.00	2188.49	391.28	1973.83	52.37	safe
	Kirnapur	1590.14	0.00	448.06	2038.19	467.52	4522.89	30.97	safe
	Lalbarra	1908.25	21.54	435.51	2365.30	454.41	4429.20	34.72	safe
	Lanji	1165.57	0.00	443.42	1608.99	462.67	6935.06	18.79	safe
	Paraswada	104.54	12.72	275.19	392.44	287.13	8065.40	4.63	safe
	Waraseoni	1448.07	102.09	385.14	1935.31	401.85	2000.23	48.97	safe
	DISTRICT TOTAL	**12657.22**	**400.93**	**3851.18**	**16909.36**	**4018.37**	**54872.50**	**23.5**	
6	**BARWANI**								
	Barwani	2851.35	3.36	504.31	3359.03	563.29	2937.88	52.85	safe
	Niwali	2152.68	0.00	342.29	2494.97	386.72	1130.77	67.98	safe

SN	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
	Pansemal	8016.31	4.16	439.93	8460.39	476.48	716.92	138.33	over_exploited
	Pati	1209.16	0.00	538.36	1747.53	642.41	685.86	68.87	safe
	Rajpur	8415.54	6.19	593.53	9015.27	631.60	2382.07	87.95	semi_critical
	Sendhwa	3697.67	16.59	922.13	4636.38	1026.64	4108.72	52.39	safe
	Thikri	7034.58	7.70	387.30	7429.57	412.77	7077.32	52.11	safe
	DISTRICT TOTAL	**33377.29**	**37.99**	**3727.85**	**37143.14**	**4139.91**	**19039.54**	**71.38**	
7	**BETUL**								
	Amla	6927.71	17.52	483.38	7428.62	519.05	6699.93	52.45	safe
	Athner	2699.19	0.00	290.57	2989.75	310.86	2908.05	50.52	safe
	Betul	10499.72	50.05	423.17	10972.94	454.77	2464.18	81.47	semi_critical
	Bhainsdehi	3514.71	0.00	362.30	3877.02	381.74	5865.37	39.72	safe
	Bhimpur	2388.42	0.00	414.61	2803.03	445.38	6544.16	29.89	safe
	Chicholi	2469.61	0.00	209.47	2679.08	214.98	2345.50	53.26	safe
	Ghoda Dongri	2235.38	95.48	545.51	2876.39	553.93	10662.08	21.23	safe
	Multai	9583.08	2.37	369.65	9955.10	377.49	2066.97	82.75	semi_critical
	Prabhat Pattan	2070.82	1.75	316.90	2389.48	325.41	7907.62	23.19	safe
	Shahpur	2244.15	1.75	310.97	2556.89	333.91	1567.16	61.66	safe
	DISTRICT TOTAL	**44632.80**	**168.93**	**3726.52**	**48528.30**	**3917.52**	**49031.02**	**49.65**	
8	**BHIND**								
	Ater	4350.59	0.00	685.93	5036.51	723.61	8904.46	36.03	safe
	Bhind	3737.15	15.87	588.58	4341.59	620.90	8706.82	33.19	safe

S N	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
	Gohad	6221.57	84.63	644.78	6950.98	680.20	13453.80	34.01	safe
	Lahar	3751.92	0.00	487.43	4239.35	514.21	7331.98	36.55	safe
	Mehgaon	5384.97	148.38	809.47	6342.83	853.94	15642.18	28.79	safe
	Ron	2116.05	0.00	346.29	2462.36	365.31	6345.04	27.90	safe
	DISTRICT TOTAL	**25562.24**	**248.88**	**3562.49**	**29373.62**	**3758.17**	**60384.28**	**32.65**	
9	**BHOPAL**								
	Berasia	13569.12	53.50	852.31	14474.93	914.81	4653.39	75.43	semi_critical
	Bhopal Urban	0.00	31.38	3727.90	3759.27	4088.58	883.08	75.14	semi_critical
	Phanda	10347.26	601.53	529.92	11478.71	581.18	2224.93	83.45	semi_critical
	DISTRICT TOTAL	**23916.38**	**686.41**	**5110.13**	**29712.91**	**5584.57**	**7761.40**	**78.3**	
10	**BURHANPUR**								
	Burhanpur	11685.54	35.07	1144.95	12865.54	1233.65	4476.32	73.81	semi_critical
	Khaknar	10254.95	0.35	583.79	10839.09	625.49	5651.50	65.56	safe
	DISTRICT TOTAL	**21940.49**	**35.42**	**1728.73**	**23704.63**	**1859.14**	**10127.82**	**69.8**	
11	**CHHATARPUR**								
	Bada Malhera	6830.89	0.00	484.51	7315.39	518.66	4983.92	59.31	safe
	Bijawar	8775.70	0.00	250.33	9026.03	267.97	3630.61	71.22	semi_critical
	Buxwaha	4921.78	46.28	234.62	5202.69	251.16	1210.20	80.92	semi_critical
	Chhatarpur	6715.87	0.00	269.13	6985.01	288.10	2542.20	73.17	semi_critical
	Gaurihar	1617.67	0.00	484.90	2102.56	519.08	5065.84	29.19	safe
	Laundi	4840.99	0.00	451.52	5292.49	483.34	2751.13	65.54	safe

SN	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
	Nowgaon	6541.28	32.67	521.04	7094.98	557.76	1669.35	80.99	semi_critical
	Rajnagar	9494.47	0.73	409.21	9904.43	438.05	5945.21	62.38	safe
	DISTRICT TOTAL	**49738.65**	**79.68**	**3105.27**	**52923.58**	**3324.12**	**27798.46**	**65.42**	
12	**CHHINDWARA**								
	Amarwara	5772.45	28.5065	416.07	6217.02	438.23	3245.55	65.55	safe
	Bichhua	2800.4	0	222.23	3022.63	231.48	2960.44	50.44	safe
	Chaurai	7293	0	470.61	7763.61	487.04	3636.94	68.00	safe
	Chhindwara	8908.866	46.866	905.80	9861.54	964.01	56.32	99.43	critical
	Harrai	2799.44	0	371.73	3171.17	399.49	4798.49	39.65	safe
	Jamai	3360.24	169.2122	603.92	4133.37	627.12	7250.08	36.24	safe
	Mohkheda	7433.04	11.096	426.62	7870.76	444.37	2523.35	75.59	semi_critical
	Pandhurna	9126	32.2295	464.86	9623.09	477.07	1100.73	89.63	semi_critical
	Parasia	4029.2	284	752.21	5065.41	794.97	2625.61	65.50	safe
	Sausar	3500.53	8.5045	432.28	3941.32	441.96	3924.54	50.05	safe
	Tamia	719.16	0.14235	333.76	1053.06	369.24	3543.48	22.73	safe
	DISTRICT TOTAL	**55742.33**	**580.56**	**5400.10**	**61722.98**	**5674.98**	**35665.53**	**63.24**	
13	**DAMOH**								
	Batiyagarh	3981.27	276.05	424.67	4681.98	452.35	2570.87	64.31	safe
	Damoh	3344.21	4.72	227.99	3576.91	239.47	3903.32	47.74	safe
	Hatta	1528.29	0.00	323.19	1851.46	338.71	1122.20	61.94	safe
	Jabera	2146.34	0.00	269.25	2415.59	282.32	3264.09	42.43	safe

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	Patera	2390.13	0.00	43.90	2434.02	313.45	1050.00	64.85	safe
	Patharia	4153.84	18.25	423.42	4595.51	448.41	1090.36	80.47	semi_critical
	Tendulheda	1213.60	0.35	619.53	1833.46	660.47	1783.16	50.13	safe
	DISTRICT TOTAL	**18757.67**	**299.37**	**2331.94**	**21388.93**	**2735.18**	**14784.00**	**58.48**	
14	**DATIA**								
	Bhander	2910.54	0.00	419.51	3330.04	449.90	9749.48	25.40	safe
	Datia	2891.92	33.36	707.91	3633.20	759.20	3137.66	53.26	safe
	Seondha	6862.38	0.00	639.14	7501.53	685.44	12642.43	37.15	safe
	DISTRICT TOTAL	**12664.84**	**33.36**	**1766.56**	**14464.77**	**1894.54**	**25529.57**	**36.05**	
15	**DEWAS**								
	Bagli	13042.53	0.00	805.99	13848.53	855.76	6568.92	67.66	safe
	Dewas	15876.91	87.09	1259.80	17223.80	1331.89	0.00	110.88	over_exploited
	Kannod	6710.32	0.00	739.28	7449.59	808.99	5244.94	58.36	safe
	Khategaon	9620.96	0.00	536.63	10157.59	582.09	1843.87	84.32	semi_critical
	Sonkutch	9392.88	8.40	624.79	10026.07	654.93	0.00	103.20	over_exploited
	Tonkkhurd	5713.81	0.00	334.24	6048.05	345.93	4357.35	58.06	safe
	DISTRICT TOTAL	**60357.41**	**95.48**	**4300.72**	**64753.63**	**4579.59**	**18015.08**	**80**	
16	**DHAR**								
	Badnawar	18641.25	152.06	589.23	19382.55	619.43	569.05	122.33	over_exploited
	Bagh	1512.35	0.00	381.88	1894.22	438.19	4339.48	30.11	safe
	Dahi	2931.54	0.00	265.73	3197.27	276.03	5534.98	36.57	safe

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	Dhar	13965.98	242.25	528.76	14737.00	560.92	0.00	153.44	over_exploited
	Dharmpuri	1649.03	0.51	494.65	2144.20	526.97	5170.43	29.18	safe
	Gandhwani	3093.28	71.87	426.65	3591.80	457.49	8813.61	28.88	safe
	Kukshi	1479.71	0.00	292.45	1772.16	309.15	3400.03	34.15	safe
	Manawar	2652.31	43.33	471.56	3167.20	505.39	6562.09	32.44	safe
	Nalchha	12053.99	124.26	895.06	13073.30	1086.24	192.12	116.30	over_exploited
	Nisarpur	1931.36	0.00	234.51	2165.87	247.56	4267.80	33.60	safe
	Sardarpur	7642.83	0.73	848.77	8492.34	929.18	9764.07	46.31	safe
	Tirla	7348.97	0.00	275.22	7624.19	303.22	321.57	95.62	critical
	Umarvan	1950.99	0.00	364.88	2315.87	388.63	6211.87	27.08	safe
	DISTRICT TOTAL	**76853.59**	**635.01**	**6069.37**	**83557.97**	**6648.40**	**55147.10**	**65.4**	
17	**DINDORI**								
	Amarpur	161.70	0.00	204.14	365.83	219.38	2998.26	10.83	safe
	Bajang	124.03	0.00	235.41	359.43	252.99	2747.90	11.50	safe
	Dindori	325.00	0.00	365.52	690.52	392.81	5489.12	11.12	safe
	Karanjiya	247.15	0.00	238.69	485.83	256.51	4129.02	10.49	safe
	Menhadwani	223.60	0.00	227.27	450.87	244.24	3840.32	10.47	safe
	Samnapur	338.70	0.00	238.07	576.77	255.84	3731.84	13.33	safe
	Shahpura	896.00	0.00	339.32	1235.32	364.65	6018.77	16.97	safe
	DISTRICT TOTAL	**2316.18**	**0.00**	**1848.41**	**4164.57**	**1986.42**	**28955.23**	**12.52**	

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18	**GUNA**								
	Aron	7320.28	0.00	282.36	7602.64	294.11	3559.11	68.04	safe
	Bamori	9562.56	0.04	472.87	10035.47	507.97	5884.76	62.90	safe
	Chachaura	11841.61	0.00	538.47	12380.08	568.43	5370.40	69.63	safe
	Guna	9369.01	77.91	620.74	10067.66	668.77	4862.08	67.22	safe
	Raghogarh	9515.34	0.29	618.40	10134.04	676.70	7235.21	58.15	safe
	DISTRICT TOTAL	**47608.79**	**78.24**	**2532.84**	**50219.89**	**2715.98**	**26911.56**	**64.96**	
19	**GWALIOR**								
	Bhitarwar	4432.02	3.29	204.65	4639.95	219.12	19272.20	19.39	safe
	Dabra	3846.41	9.53	413.27	4269.21	416.97	16376.21	20.68	safe
	Ghatigaon	3020.75	163.07	600.77	3784.58	674.03	10302.21	26.73	safe
	Gwalior Urban	0.00	0.00	3795.16	3795.16	4189.31	744.59	76.92	semi_critical
	Morar	6752.97	94.90	470.52	7318.39	503.79	4752.37	60.46	safe
	DISTRICT TOTAL	**18052.15**	**270.78**	**5484.37**	**23807.29**	**6003.22**	**51447.58**	**31.42**	
20	**HARDA**								
	Harda	5920.56	0.00	427.92	6348.47	457.79	5527.96	53.32	safe
	Khirkiya	4082.40	0.00	406.70	4489.10	435.10	2094.83	67.89	safe
	Timarni	4402.08	16.17	409.38	4827.62	437.96	20572.77	18.98	safe
	DISTRICT TOTAL	**14405.04**	**16.17**	**1243.99**	**15665.19**	**1330.85**	**28195.56**	**35.65**	
21	**HOSHANGABAD**								
	Babai	2639.95	0.07	302.11	2942.12	316.11	26341.69	10.04	safe

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	Bankhedi	14575.68	0.00	322.81	14898.49	337.77	3396.62	81.37	semi_critical
	Hoshangabad	3787.56	2.33	257.27	4047.16	269.20	22960.66	14.98	safe
	Kesala	3772.22	10.76	281.04	4064.03	294.07	13113.77	23.64	safe
	Pipariya	7549.63	5.48	336.48	7891.57	352.08	12555.74	38.57	safe
	Seoni Malwa	3708.72	0.00	431.76	4140.47	451.77	36287.72	10.24	safe
	Shohagpur	4031.42	0.00	319.97	4351.39	334.80	6600.57	39.68	safe
	DISTRICT TOTAL	**40065.19**	**18.64**	**2251.42**	**42335.23**	**2355.80**	**121256.77**	**25.86**	
22	**INDORE**								
	Depalpur	23258.52	78.19	821.43	24158.13	877.35	201.51	142.82	over_exploited
	Indore	10715.89	200.43	689.62	11605.93	711.00	0.00	142.19	over_exploited
	Indore Urban	0.00	1016.90	4755.89	5772.79	5596.04	127.40	97.84	critical
	Mhow	7503.81	58.98	872.25	8435.06	901.88	2218.15	78.96	semi_critical
	Sawer	12943.35	146.34	731.32	13821.02	880.03	0.00	117.36	over_exploited
	DISTRICT TOTAL	**54421.57**	**1500.83**	**7870.51**	**63792.93**	**8966.30**	**2547.06**	**119.38**	
23	**JABALPUR**								
	Bargi	2356.56	0.00	574.91	2931.47	601.79	1763.70	62.08	safe
	Jabalpur Urban	0.00	85.98	2764.38	2850.36	3252.72	352.27	89.00	semi_critical
	Kundam	1025.00	0.00	317.38	1342.38	332.21	3097.62	30.13	safe
	Majholi	3066.34	0.07	401.31	3467.72	420.07	4341.07	44.30	safe
	Panagar	4706.16	16.50	608.95	5331.61	637.41	2652.75	66.54	safe
	Patan	5919.03	0.07	334.43	6253.53	350.06	8554.58	42.19	safe

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	Shahpura	5363.24	179.01	484.35	6026.59	506.99	3970.38	60.15	safe
	Sihora	2859.57	37.30	348.63	3245.51	364.93	4971.79	39.42	safe
	DISTRICT TOTAL	**25295.90**	**318.94**	**5834.34**	**31449.17**	**6466.18**	**29704.16**	**51.31**	
24	**JHABUA**								
	Jhabua	1261.68	0.07	442.22	1703.97	480.52	304.01	83.27	semi_critical
	Meghnagar	1285.38	0.00	566.79	1852.17	673.82	1162.44	59.33	safe
	Petlawad	2223.32	0.37	662.48	2886.16	749.20	7775.45	26.85	safe
	Rama	1143.03	0.00	365.45	1508.48	395.90	1034.77	58.61	safe
	Ranapur	806.09	0.00	290.63	1096.72	316.91	897.32	54.28	safe
	Thandla	1346.13	0.00	482.65	1828.78	531.50	1892.57	48.51	safe
	DISTRICT TOTAL	**8065.63**	**0.44**	**2810.21**	**10876.28**	**3147.85**	**13066.56**	**44.79**	
25	**KATNI**								
	Badwara	3517.47	56.91	558.08	4132.46	600.00	4120.68	49.82	safe
	Bahoriband	2345.63	266.73	547.49	3159.85	588.61	5132.99	37.92	safe
	Dhimar Kheda	1184.87	0.00	489.45	1674.32	526.22	3414.14	32.67	safe
	Murwara	3089.88	240.40	337.54	3667.82	362.89	3174.26	53.41	safe
	Rithi	1398.28	0.00	350.14	1748.40	376.43	1968.28	46.71	safe
	Vijayraghavgarh	2478.60	552.15	504.09	3534.83	541.96	2091.84	62.40	safe
	DISTRICT TOTAL	**14014.73**	**1116.18**	**2786.79**	**17917.68**	**2996.11**	**19902.19**	**47.12**	
26	**KHANDWA**								
	Baldi	3252	0	107.57	3359.56	108.13	2766.32	54.84	safe

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	Chhegaon Makhan	9858.76	16.9344	399.79	10275.48	421.29	1584.36	86.48	semi_critical
	Harsud	2598.09	0	192.37	2790.47	194.52	2396.6	53.77	safe
	Khalwa	6063.75	0	651.62	6715.37	721.56	4270.37	60.74	safe
	Khandwa	5993.55	33.653	510.44	6537.65	543.28	3332.73	66.02	safe
	Pandhana	8909.43	0	659.57	9569	718.86	6791.26	58.28	safe
	Punasa	3865.98	19.053	503.84	4388.87	536.28	40199.49	9.84	safe
	DISTRICT TOTAL	**40541.57**	**69.64**	**3025.19**	**43636.40**	**3243.92**	**61341.13**	**41.48**	
27	**KHARGONE**								
	Barwaha	7030.96	18.20	765.55	7814.71	804.77	12125.29	39.11	safe
	Bhagwanpura	2618.98	0.00	574.26	3193.23	641.27	3525.03	47.06	safe
	Bhikangaon	4819.26	7.26	523.37	5349.89	575.71	6500.64	44.95	safe
	Gogawan	2823.70	0.00	299.48	3123.18	307.74	2127.3	59.39	safe
	Jhiranya	3880.01	0.00	616.18	4496.18	698.15	3834.67	53.44	safe
	Kasrawad	5293.19	37.80	603.11	5934.1	640.53	11489.69	33.98	safe
	Khargone	4020.98	15.00	368.55	4404.52	382.95	1244.78	77.77	semi_critical
	Maheshwar	4640.64	0.00	538.56	5179.21	569.63	6429.16	44.50	safe
	Segaon	2598.22	0.00	229.02	2827.24	245.86	2200.49	56.05	safe
	DISTRICT TOTAL	**37725.95**	**78.26**	**4518.09**	**42322.26**	**4866.61**	**49477.05**	**45.93**	
28	**MANDLA**								
	Bichhiya	1137.38	0.00	397.08	1534.45	420.94	6252.74	19.64	safe
	Bijadandi	226.80	0.00	200.98	427.78	213.06	3523.35	10.79	safe

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	Ghughari	245.43	0.00	252.98	498.41	268.18	5591.22	8.16	safe
	Mandla	920.70	0.07	460.48	1381.24	488.16	2951.78	31.67	safe
	Mawai	942.84	0.00	262.78	1205.62	278.57	7691.87	13.53	safe
	Mohgaon	1057.86	0.00	206.80	1264.66	219.23	1155.93	51.98	safe
	Nainpur	1022.49	0.00	358.57	1381.07	380.13	5272.82	20.69	safe
	Narayanganj	720.90	0.00	228.33	949.23	242.05	1913.62	33.00	safe
	Niwas	733.86	0.00	169.96	903.82	180.17	2720.29	24.87	safe
	DISTRICT TOTAL	**7008.26**	**0.07**	**2537.96**	**9546.28**	**2690.49**	**37073.62**	**20.41**	
29	**MANDSAUR**								
	Bhanpura	5815.78	14.60	287.27	6117.66	299.12	1633.04	87.74	semi_critical
	Garoth	11442.60	0.00	607.51	12050.12	666.28	1862.72	86.25	semi_critical
	Malhargarh	8339.53	10.29	503.40	8853.23	519.99	1722.92	83.58	semi_critical
	Mandsaur	16514.19	16.83	1049.67	17580.70	1078.86	550.08	115.25	over_exploited
	Sitamau	20806.63	1.93	657.28	21465.84	680.50	832.30	130.97	over_exploited
	DISTRICT TOTAL	**62918.73**	**43.65**	**3105.12**	**66067.55**	**3244.75**	**6601.06**	**104.57**	
30	**MORENA**								
	Ambah	3308.40	0.00	731.71	4040.11	773.60	2727.68	59.33	safe
	Jaora	2610.96	0.04	732.43	3343.43	762.38	6858.85	32.68	safe
	Kailaras	2291.76	1.83	593.64	2887.24	645.06	5051.59	36.13	safe
	Morena	3644.18	39.22	2100.47	5783.85	2349.05	6263.55	47.04	safe
	Pahadgarh	2388.36	0.00	432.03	2820.39	447.89	5786.91	32.71	safe

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	Porsa	2073.48	0.00	640.28	2713.76	673.14	3020.82	47.05	safe
	Sabalgarh	3646.03	45.26	650.46	4341.74	697.30	8508.22	33.67	safe
	DISTRICT TOTAL	**19963.18**	**86.34**	**5881.03**	**25930.52**	**6348.42**	**38217.62**	**40.13**	
31	**NARSINGHPUR**								
	Chawarpatha	14268.96	22.05	418.30	14709.30	437.08	6756.73	68.46	safe
	Chichli	10272.96	17.74	409.62	10700.32	428.01	6876.80	60.81	safe
	Gotegaon	11364.84	0.07	432.45	11797.36	451.85	7721.19	60.38	safe
	Kareli	12840.77	18.76	333.12	13192.65	348.08	6884.86	65.66	safe
	Narsinghpur	15827.18	65.70	410.95	16303.84	429.39	4825.65	77.09	semi_critical
	Saikheda	8373.24	75.34	343.15	8791.73	358.55	4096.53	68.13	safe
	DISTRICT TOTAL	**72947.95**	**199.66**	**2347.59**	**75495.20**	**2452.96**	**37161.76**	**66.95**	
32	**NEEMUCH**								
	Jawad	11348.32	29.04	531.70	11909.05	550.16	351.17	109.45	over_exploited
	Manasa	8556.62	0.00	432.64	8989.26	453.11	2292.02	79.54	semi_critical
	Neemuch	14168.04	0.81	804.71	14973.57	842.93	203.31	107.22	over_exploited
	DISTRICT TOTAL	**34072.98**	**29.85**	**1769.05**	**35871.88**	**1846.20**	**2846.50**	**99.23**	
33	**NIWARI**								
	Niwari	4223.75	5.79	614.53	4844.07	739.91	1934.24	70.17	semi_critical
	Prithvipur	7296.37	0.00	515.84	7812.22	599.40	3320.64	69.65	safe
	DISTRICT TOTAL	**11520.12**	**5.79**	**1130.38**	**12656.29**	**1339.31**	**5254.88**	**69.85**	
34	**PANNA**								

SN	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
	Ajaigarh	6176.12	0.00	396.72	6572.84	421.98	9868.62	39.92	safe
	Gunnor	1713.24	17.31	638.02	2368.57	678.64	3324.67	41.31	safe
	Panna	3066.77	17.31	453.40	3537.48	482.26	8230.81	29.99	safe
	Pawai	3015.10	175.97	492.65	3683.72	524.01	6140.80	37.38	safe
	Shahnagar	1799.77	0.35	497.03	2297.14	528.68	4419.09	34.04	safe
	DISTRICT TOTAL	**15770.99**	**210.94**	**2477.82**	**18459.75**	**2635.57**	**31983.99**	**36.48**	
35	**RAISEN**								
	Badi	2998.19	0.00	598.06	3596.25	636.49	19066.25	15.84	safe
	Begamganj	5676.89	0.07	332.17	6009.13	358.32	4108.85	59.24	safe
	Gairatganj	4768.85	0.00	363.12	5131.96	399.15	2811.93	64.31	safe
	Obedullaganj	7085.23	313.54	782.05	8180.82	896.00	893.08	89.04	semi_critical
	Sanchi	7326.50	234.57	489.16	8050.23	520.80	5119.08	60.98	safe
	Silwani	8349.97	0.00	412.58	8762.53	437.71	3960.19	68.74	safe
	Udaipura	6422.33	0.00	440.67	6863.00	479.05	3950.91	63.24	safe
	DISTRICT TOTAL	**42627.95**	**548.18**	**3417.80**	**46593.92**	**3727.52**	**39910.29**	**53.67**	
36	**RAJGARH**								
	Biaora	14439.25	0.01	649.85	15089.10	711.12	1884.19	88.58	semi_critical
	Jirapur	9166.28	0.04	450.63	9616.96	487.76	2575.94	78.63	semi_critical
	Khilchipur	9520.30	0.00	407.89	9928.19	436.01	1102.74	89.77	semi_critical
	Narsinghgarh	15275.52	0.36	1217.55	16493.43	1380.34	77.50	98.56	critical
	Rajgarh	11166.98	0.75	535.02	11702.77	576.66	4296.85	72.95	semi_critical

S N	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
	Sarangpur	13983.03	10.42	859.82	14853.27	943.01	0.00	110.63	over_exploited
	DISTRICT TOTAL	**73551.37**	**11.57**	**4120.76**	**77683.72**	**4534.90**	**9937.22**	**89.78**	
37	**RATLAM**								
	Alot	17444.85	2.59	695.15	18142.59	806.35	0.00	119.39	over_exploited
	Bajna	4759.65	0.04	562.99	5322.69	655.41	1512.93	86.89	semi_critical
	Jaora	24937.40	0.37	399.40	25337.17	440.24	0.00	170.51	over_exploited
	Piploda	18918.37	0.00	371.64	19290.01	395.68	0.00	169.54	over_exploited
	Ratlam	29132.62	34.24	1984.20	31151.06	3255.08	0.00	131.33	over_exploited
	Sailana	4245.42	0.15	436.74	4682.29	513.34	864.92	83.26	semi_critical
	DISTRICT TOTAL	**99438.31**	**37.38**	**4450.12**	**103925.81**	**6066.10**	**2377.85**	**135.14**	
38	**REWA**								
	Gangev	2404.20	20.74	299.80	2724.74	309.33	1392.43	66.03	safe
	Hanumana	1419.28	5.18	771.04	2195.50	840.65	4404.14	32.92	safe
	Jawa	2407.92	0.00	610.44	3018.36	665.55	4683.96	38.91	safe
	Mauganj	2234.20	3.88	536.92	2775.00	584.59	880.32	74.94	semi_critical
	Naigarhi	1506.09	6.24	206.83	1719.16	220.92	769.71	68.69	safe
	Rampur Karchuliyan	2413.91	16.85	822.50	3253.25	905.72	1337.29	69.61	safe
	Rewa	2613.22	68.04	1044.54	3725.80	1150.13	1593.55	68.68	safe
	Sirmour	2868.50	51.84	646.23	3566.58	703.49	1584.60	68.48	safe
	Teonthar	3504.87	12.96	730.33	4248.16	804.67	5431.99	43.55	safe
	DISTRICT TOTAL	**21372.19**	**185.73**	**5668.63**	**27226.55**	**6185.05**	**22077.99**	**54.65**	

S N	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
39	**SAGAR**								
	Banda	5623.62	35.84	282.53	5941.99	286.19	4277.60	58.12	safe
	Bina	7572.91	0.91	334.44	7908.26	342.91	4055.90	66.05	safe
	Deori	4754.05	0.00	359.29	5113.35	369.09	3272.93	60.90	safe
	Jaisinagar	6224.80	0.00	259.25	6484.05	274.51	3596.88	64.22	safe
	Kesli	6003.29	0.00	330.18	6333.47	347.62	3578.70	63.78	safe
	Khurai	4419.53	0.11	539.16	4958.80	673.37	3617.58	56.93	safe
	Malthon	3140.00	0.00	419.80	3559.80	450.54	3375.16	51.10	safe
	Rahatgarh	5269.76	11.50	273.19	5554.45	289.27	3639.70	60.31	safe
	Rehli	3669.14	20.49	272.88	3962.51	275.66	2843.32	58.20	safe
	Sagar	7349.35	11.92	403.44	7764.71	427.19	6199.48	55.51	safe
	Shahnagar	2780.49	0.00	333.76	3114.27	353.41	2936.59	51.30	safe
	DISTRICT TOTAL	**56806.95**	**80.78**	**3807.91**	**60695.66**	**4089.76**	**41393.84**	**59.29**	
40	**SATNA**								
	Amarpatan	5269.49	30.80	552.80	5853.09	588.78	1930.96	74.85	semi_critical
	Maiihar	3888.00	1038.01	857.47	5783.49	913.30	741.08	87.89	semi_critical
	Majhgawan	4160.70	15.50	633.90	4810.11	675.17	7446.05	39.11	safe
	Nagod	6986.37	0.00	564.83	7551.21	601.61	3405.45	68.69	safe
	Ramnagar	1863.00	0.00	429.13	2292.14	457.07	3300.54	40.78	safe
	Rampur-Baghelan	6863.08	0.00	685.19	7548.26	729.80	2889.86	89.32	semi_critical
	Sohawal	6310.48	0.00	579.22	6889.72	616.93	2361.13	74.17	semi_critical

S N	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
	Unchehara	4077.26	0.00	464.41	4541.67	494.65	3395.01	57.01	safe
	DISTRICT TOTAL	**39418.38**	**1084.31**	**4766.96**	**45269.69**	**5077.31**	**25470.08**	**65.59**	
41	**SEHORE**								
	Ashta	11648.57	59.00	619.90	12327.47	664.38	812.47	93.50	critical
	Budni	3462.13	31.06	210.12	3703.30	222.39	6684.17	35.61	safe
	Ichhawar	4846.42	5.89	410.86	5263.17	434.86	2381.73	68.63	safe
	Nasrullaganj	5470.09	0.00	464.35	5934.46	514.43	7236.94	44.88	safe
	Sehore	13628.06	21.51	821.88	14471.47	878.91	8491.55	62.86	safe
	DISTRICT TOTAL	**39055.28**	**117.47**	**2527.11**	**41699.87**	**2714.97**	**25606.86**	**61.78**	
42	**SEONI**								
	Barghat	3089.84	0.00	495.16	3585.00	525.57	2931.59	54.76	safe
	Chhapara	3978.72	1.39	328.26	4308.37	348.40	1857.93	69.64	safe
	Dhanora	1079.60	0.00	226.98	1306.57	240.90	3221.24	28.77	safe
	Ghansaur	1337.25	0.00	380.66	1717.91	404.01	4963.62	25.62	safe
	Keolari	1259.85	0.00	422.15	1682.00	448.05	4792.06	25.88	safe
	Kurai	3042.42	0.00	311.91	3354.33	331.04	10309.37	24.51	safe
	Lakhnadon	4675.74	0.00	509.24	5184.98	540.47	8671.65	37.33	safe
	Seoni	6501.38	3.52	654.16	7159.08	694.28	3143.62	69.22	safe
	DISTRICT TOTAL	**24964.82**	**4.91**	**3328.53**	**28298.24**	**3532.72**	**39891.08**	**41.38**	
43	**SHAHDOL**								
	Beohari	920.72	0.00	497.57	1418.29	526.25	4886.60	22.39	safe

SN	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
	Burhar	220.32	750.95	536.56	1507.84	567.49	11649.02	11.43	safe
	Gohparu	227.45	0.00	285.98	513.43	302.47	9331.59	5.21	safe
	Jaisinghnagar	1108.08	0.00	492.06	1600.14	520.43	14023.39	10.22	safe
	Sohagpur	648.00	922.36	495.28	2065.63	523.83	6043.31	25.38	safe
	DISTRICT TOTAL	**3124.57**	**1673.31**	**2307.45**	**7105.33**	**2440.47**	**45933.91**	**13.36**	
44	**SHAJAPUR**								
	Kalapipal	14205.13	34.60	448.02	14687.76	471.53	0.00	110.83	over_exploited
	Moman Badodiya	16232.72	0.07	456.44	16689.23	476.09	0.00	126.69	over_exploited
	Shajapur	9359.10	18.97	657.14	10035.22	689.10	2116.74	82.36	semi_critical
	Shujalpur	12985.88	0.91	620.46	13607.25	651.81	0.00	105.82	over_exploited
	DISTRICT TOTAL	**52782.83**	**54.55**	**2182.07**	**55019.46**	**2288.53**	**2116.74**	**106.9**	
45	**SHEOPUR**								
	Karahal	6087.84	0.00	348.33	6436.17	380.20	5746.47	52.69	safe
	Sheopur	5433.55	44.79	803.85	6282.19	864.40	22682.02	21.64	safe
	Vijaypur	6109.95	0.00	665.64	6775.59	723.91	2601.43	71.81	semi_critical
	DISTRICT TOTAL	**17631.34**	**44.79**	**1817.82**	**19493.95**	**1968.51**	**31029.92**	**38.47**	
46	**SHIVPURI**								
	Badarwas	8777.23	0.00	530.60	9307.83	573.80	1940.52	82.43	semi_critical
	Karera	3220.77	38.33	674.07	3933.17	728.96	3602.49	51.82	safe
	Khaniyadhana	7047.36	0.00	691.95	7739.32	748.29	1436.36	83.83	semi_critical
	Kolaras	6830.25	0.00	431.41	7261.65	466.53	2509.34	74.05	semi_critical

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	Narwar	5787.07	0.00	576.87	6363.94	623.84	2048.23	75.23	semi_critical
	Pichhore	5053.19	0.00	577.58	5630.77	624.61	1633.73	77.01	semi_critical
	Pohari	5650.17	0.00	663.88	6314.05	717.94	6320.02	49.76	safe
	Shivpuri	5922.63	4.66	522.35	6449.66	564.88	5448.74	54.01	safe
	DISTRICT TOTAL	**48288.67**	**42.99**	**4668.71**	**53000.39**	**5048.85**	**24939.43**	**67.67**	
47	**SIDHI**								
	Kusmi	1723.68	0.00	227.33	1951.01	246.81	6011.03	24.44	safe
	Majholi	1520.64	0.00	428.76	1949.40	465.49	3512.52	35.45	safe
	Rampur Naikin	1575.08	87.92	657.25	2320.27	713.55	4499.65	33.74	safe
	Sidhi	2061.29	0.34	838.43	2900.05	910.25	1312.22	67.69	safe
	Sihawal	671.72	0.00	756.61	1428.32	821.42	3078.66	31.24	safe
	DISTRICT TOTAL	**7552.41**	**88.26**	**2908.38**	**10549.05**	**3157.52**	**18414.08**	**36.11**	
48	**SINGRAULI**								
	Chitrangi	1744.20	622.00	1010.76	3376.97	1118.73	4606.24	41.74	safe
	Deosar	2747.25	150.54	931.34	3829.13	1035.43	8338.24	31.20	safe
	Waidhan	4488.31	1447.15	715.19	6650.67	791.59	8367.44	44.06	safe
	DISTRICT TOTAL	**8979.76**	**2219.69**	**2657.30**	**13856.77**	**2945.75**	**21311.92**	**39.08**	
49	**TIKAMGARH**								
	Baldeogarh	5778.65	0.00	579.69	6358.33	703.73	2069.71	74.35	semi_critical
	Jatara	8723.26	0.00	830.15	9553.40	956.48	1247.28	87.43	semi_critical
	Palera	4747.60	0.00	794.29	5541.90	922.50	1095.86	81.91	semi_critical

S N	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
	Tikamgarh	7484.68	0.00	869.89	8354.56	1163.81	1535.29	82.04	semi_critical
	DISTRICT TOTAL	**26734.19**	**0.00**	**3074.02**	**29808.19**	**3746.52**	**5948.14**	**81.83**	
50	**UJJAIN**								
	Badnagar	25427	0.00438	647.47	26074.47	678.79	0	137.03	over_exploited
	Ghatia	15288	7.15	366.51	15661.65	387.34	0	128.97	over_exploited
	Khchrod	12659.4	3.3945	800.09	13462.89	837.35	4959.15	72.93	semi_critical
	Mahidpur	13005.17	0	641.98	13647.14	683.45	2388.17	84.89	semi_critical
	Tarana	10500.6	18.19379	594.87	11113.67	619.41	1651.87	86.89	semi_critical
	Ujjain	18605.76	29.03	844.66	19479.45	897.88	0	151.30	over_exploited
	DISTRICT TOTAL	**95485.93**	**57.77**	**3895.58**	**99439.27**	**4104.22**	**8999.19**	**108.83**	
51	**UMARIA**								
	Karkeli	1524.10	359.71	674.79	2558.59	736.45	6479.50	28.12	safe
	Manpur	2423.52	0.23	651.29	3075.04	710.81	14423.24	17.51	safe
	Pali	347.33	180.13	245.28	772.73	267.70	6786.65	10.19	safe
	DISTRICT TOTAL	**4294.94**	**540.07**	**1571.36**	**6406.36**	**1714.96**	**27689.39**	**18.71**	
52	**VIDISHA**								
	Basoda	8286.61	0.07	839.08	9125.75	931.30	3919.32	69.46	safe
	Gyaraspur	7450.06	0.15	322.01	7772.20	337.91	3272.00	70.27	semi_critical
	Kurwai	8092.22	0.00	354.27	8446.49	357.01	2694.41	75.80	semi_critical
	Lateri	4304.79	0.00	427.75	4732.54	471.70	3718.65	55.71	safe
	Nateran	6042.86	0.00	498.56	6541.43	524.50	3849.35	62.80	safe

S N	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
	Sironj	8429.67	0.19	654.33	9084.19	702.31	4490.82	66.68	safe
	Vidisha	8439.80	13.52	873.72	9327.03	935.81	8178.85	53.09	safe
	DISTRICT TOTAL	**51046.00**	**13.93**	**3969.72**	**55029.63**	**4260.54**	**30123.40**	**64.4**	
	STATE TOTAL (Ham)	**1740325.6**	**17460.5**	**172240.36**	**1930026.51**	**187742.3**	**1445041.6**	**58.75**	
	STATE TOTAL (bcm)	**17.40**	**0.17**	**1.72**	**19.30**	**1.88**	**14.45**	**58.75**	

Annexure V: Categorisation of Assessment Unit, 2023

S.N.	Name of District	S.N.	Name of Semi-Critical Assessment Units	S.N.	Name of Critical Assessment Units	S.N.	Name of Over-Exploited Assessment Units
1	**AGAR MALWA**	1	Badod			1	Nalkheda
						2	Susner
2	**ANUPPUR**	1	Kotma				
3	**ASHOKNAGAR**	1	Isagarh				
		2	Chanderi				
4	**BARWANI**	1	Rajpur			1	Pansemal
5	**BETUL**	1	Betul				
		2	Multai				
6	**BHOPAL**	1	Berasia				
		2	Bhopal Urban				
		3	Phanda				
7	**BURHANPUR**	1	Burhanpur				
8	**CHHATARPUR**	1	Buxwaha				
		2	Chhatarpur				
		3	Bijawar				
		4	Nowgaon				
9	**CHHINDWARA**	1	Mohkheda	1	Chhindwara		
		2	Pandhurna				
10	**DAMOH**	1	Patharia				
11	**DEWAS**	1	Khategaon			1	Sonkutch
						2	Dewas
12	**DHAR**			1	Tirla	1	Nalchha
						2	Dhar
						3	Badnawar
13	**GWALIOR**	1	Gwalior Urban				

S.N.	Name of District	S.N.	Name of Semi-Critical Assessment Units	S.N.	Name of Critical Assessment Units	S.N.	Name of Over-Exploited Assessment Units
14	**HOSHANGABAD**	1	Bankhedi				
15	**INDORE**	1	Mhow	1	Indore Urban	1	Depalpur
						2	Indore
						3	Sawer
16	**JABALPUR**	1	Jabalpur Urban				
17	**JHABUA**	1	Jhabua				
18	**KHANDWA**	1	Chhegaon Makhan				
19	**KHARGONE**	1	Khargone				
20	**MANDSAUR**	1	Malhargarh			1	Mandsaur
		2	Bhanpura			2	Sitamau
		3	Garoth				
21	**NARSINGHPUR**	1	Narsinghpur				
22	**NEEMUCH**	1	Manasa			1	Neemuch
						2	Jawad
23	**NIWARI**	1	Niwari				
24	**RAISEN**	1	Obedullaganj				
25	**RAJGARH**	1	Rajgarh	1	Narsinghgarh	1	Sarangpur
		2	Biaora				
		3	Jirapur				
		4	Khilchipur				
26	**RATLAM**	1	Sailana			1	Alot
		2	Bajna			2	Ratlam
						3	Piploda
						4	Jaora
27	**REWA**	1	Mauganj				

S.N.	Name of District	S.N.	Name of Semi-Critical Assessment Units	S.N.	Name of Critical Assessment Units	S.N.	Name of Over-Exploited Assessment Units
28	**SATNA**	1	Rampur-Baghelan				
		2	Maiihar				
		3	Amarpatan				
		4	Sohawal				
29	**SEHORE**			1	Ashta		
30	**SHAJAPUR**	1	Shajapur			1	Kalapipal
						2	Moman Badodiya
						3	Shujalpur
31	**SHEOPUR**	1	Vijaypur				
32	**SHIVPURI**	1	Badarwas				
		2	Kolaras				
		3	Pichhore				
		4	Khaniyadhana				
		5	Narwar				
33	**TIKAMGARH**	1	Palera				
		2	Baldeogarh				
		3	Jatara				
		4	Tikamgarh				
34	**UJJAIN**	1	Tarana			1	Ghatia
		2	Mahidpur			2	Badnagar
		3	Khchrod			3	Ujjain
35	**VIDISHA**	1	Gyaraspur				
		2	Kurwai				

ABSTRACT

Total No. of Assessed Units	Number of Semicritical Assessment Units	Number of Critical Assessment Units	Number of Over Exploited Assessment Units
317	60	5	26

Annexure VI: Quality Tagging

S.N.	Name of District	S.N.	Name of Assessment Units affected by Fluoride	S.N.	Name of Assessment Units affected by Arsenic	S.N.	Name of Assessment Units affected by Salinity
1	**ALIRAJPUR**	1	Alirajpur				
2	**BHIND**					1	Mehgaon
						2	Gohad
3	**CHHINDWARA**	1	Mohkheda				
		2	Chhindwara				
		3	Parasia				
		4	Bichhua				
		5	Chaurai				
		6	Tamia				
		7	Sausar				
		8	Jamai				
		9	Amarwara				
		10	Pandhurna				
4	**DHAR**	1	Tirla				
		2	Nalchha				
		3	Umarvan				
		4	Manawar				
		5	Dhar				
		6	Badnawar				
		7	Bagh				
		8	Gandhwani				
		9	Nisarpur				
		10	Sardarpur				
		11	Dahi				
		12	Dharmpuri				
5	**JHABUA**	1	Jhabua				
		2	Ranapur				
		3	Petlawad				
		4	Rama				
		5	Thandla				
6	**MANDLA**	1	Mohgaon				
		2	Ghughari				
		3	Mandla				

S.N.	Name of District	S.N.	Name of Assessment Units affected by Fluoride	S.N.	Name of Assessment Units affected by Arsenic	S.N.	Name of Assessment Units affected by Salinity
7	**RATLAM**	1	Sailana				
		2	Bajna				
8	**SEHORE**	1	Ashta				
		2	Sehore				
		3	Nasrullaganj				
		4	Ichhawar				
9	**SEONI**	1	Ghansaur				
		2	Kurai				
		3	Chhapara				
		4	Seoni				
		5	Keolari				
		6	Barghat				
10	**SHAJAPUR**	1	Kalapipal				
		2	Moman Badodiya				
		3	Shajapur				
		4	Shujalpur				
11	**VIDISHA**	1	Vidisha				

ABSTRACT

Total No. of Assessed Units	Number of Assessment Units affected by Fluoride	Number of Assessment Units affected by Arsenic	Number of Assessment Units affected by Salinity
50	48	0	2

Appendix-A: Government Resolution on constitution of Permanent Central Level Expert Group (CLEG) for overall re-assessment of Ground Water Resources of the country, (as in 2023)

(TO BE PUBLISHED IN THE GAZETTE OF INDIA PART-I, SECTION -I)

No. T-13014/1/2019-GW Section
Government of India
Ministry of JAL SHAKTI
Department of Water Resources, River Development & Ganga Rejuvenation
****

Shram Shakti Bhavan, Rafi Marg,
New Delhi, Dated: 08.02.2022

RESOLUTION

Sub: Constitution of Central Level Expert Group (CLEG) for periodic re-assessment of ground water resources of the country.

The State-wise annual assessment of Dynamic Ground Water Resources for the entire country are made based on the methodology and norms recommended by Ground Water Resources Estimation Committee (GEC) 1997 and 2015. There are changes in ground water scenario in various parts of the country because of various interventions by Government/public. Groundwater being a dynamic resource, its periodic assessment in the country can help the policy makers/planners to take suitable timely intervention for sustainable management of this precious resource. Accordingly, a Central Level Expert Group (CLEG) is hereby constituted for over-all supervision of the assessment of ground water resources in the entire country for each Water Year. The composition and Terms of Reference of the Expert Group are as follows:-

1. **Composition:**

S.No	Designation and Name of Department	Committee
1.	Chairman, CGWB	**Chairman**
2.	Member(RM), CWC	**Member**
3.	Member (CGWA), CGWB	**Member**
4.	Director, NIH, Roorkee or representative	**Member**
5.	Joint Secretary, Ministry of Agriculture & Farmer Welfare or his nominee.	**Member**
6.	Joint Secretary, Department of Drinking Water Supply & Sanitation, Ministry of Jal Shaktior his nominee.	**Member**
7.	Joint Secretary, Ministry of Housing and Urban Affairs or his nominee.	**Member**
8.	Representative of Department of Civil Engg., Indian Institute of Technology-Hyderabad	**Member**
9.	Member(South), CGWB	**Member Secretary**

T-13014/1/2019-GW Section

/2022/GW Section

Ordered that a copy of the Resolution published be communicated to this Ministry for record.

(Ashish Kumar)
Director (GW)

आशीष कुमार/ASHISH KUMAR
निदेशक/Director
जल संसाधन, नदी विकास एवं गंगा संरक्षण मन्त्रालय
Ministry of Water Resources, River Development
& Ganga Rejuvenation
भारत सरकार/Govt. of India
नई दिल्ली/New Delhi-110001

To
The Manager,
Government of India Press,
Faridabad (Haryana).

Copy to:

1. PS to Minister (JAL SHAKTI)
2. PS to MoS (JAL SHAKTI)
3. PS to MoS (JAL SHAKTI)
4. Sr PPS to Secretary (DoWR, RD & GR)
5. PPS to Joint Secretary (IC & GW)
6. All members concerned.
7. Chairman, CGWB, Faridabad.
8. Member (S), CGWB and Member Secretary of the CLEG, CGWB, CHQ, Faridabad for information and necessary action.

Copy also to:
NIC for uploading the Resolution on Ministry's website.

Appendix-B: Constitution of Permanent State Level Committee(as in 2023)

Government of Madhya Pradesh
Water Resources Department
Mantralaya
Vallabh Bhawan, Bhopal

ORDER

Memo No. F-15-21/Minor/31/290 Bhopal dated 10/02/2022

Subject:-Assessment of Annual Ground Water Resources-constitution of State Level Committee for re-assessment of ground water resources.

The last assessment of ground water resources for the state was made in the year 2020 based on the Methodology adopted by the Ground Water Resources Estimation Committee-2015. With a view to re-assess the ground water resources for the year 2022 as well as in future, the State Level Committee is constituted as under :-

i.	Additional Chief secretary/ Principal Secretary WRD	Chairman
ii.	Commissioner, Urban Development and Housing Department	Member
iii.	Commissioner, MNREGA, Bhopal	Member
iv.	Director, Rajeev Gandhi Water Shed Mission	Member
v.	General Manager, NABARD, Bhopal	Member
vi.	Engineer-in-Chief, Water Resources Department	Member
vii.	Engineer-in-Chief, Public health & Engineering Department	Member
viii.	Engineer-in-Chief, RES	Member
ix.	Director, Agriculture	Member
x.	Director, Directorate Geology & Mining, Bhopal	Member
xi.	Director, Industries	Member
xii.	Chief Engineer, BODHI, Water Resources Department	Member
xiii.	Superintending Geo-Hydrologist, GWSC, Circle Bhopal	Member
xiv.	Regional Director, CGWB	Member Secretary

The committee may co-opt any other Member(s)/special invitee(s), if necessary. The broad terms of reference of the Committee would be as follow:-

i. To estimate Annual replenishable ground water resources of the state in accordance with the Ground Water Resources Estimation Methodology.

ii. To estimate the status of utilization of the annual replenishable ground water resources.

The Committee will submit its report within six months from the date of its constitution. Expenditure on account of TA /DA to official Members of the Committee will be met from the source from which they draw their salaries and that of non-official Members, will be borne by the Water Resources Department.

10/2/2022

(V.S.Tekam)
Deputy Secretary,
Govt. of M.P.Water Resources Deptt.

Endt. No. F-15-21/Minor/31/291 Bhopal, Dated 10/02/2022

Copy forward to:-

1. OSD, Hon'ble Minister/ State Minister, Govt. of MP, Water Resources Department, Bhopal.
2. P. A. to Additional chief Secretary, Govt. of MP, Water Resources Department, Bhopal.
3. Commissioner, Urban Development and Housing Department, Bhopal.
4. Commissioner, MNREGA, Bhopal
5. Director, Rajiv Gandhi Water Shed Mission, Bhopal.
6. General Manager, NABARD
7. Engineer-in-Chief, Water Resources Department, Bhopal.
8. Engineer-in-Chief, Public health & Engineering Department, Bhopal.
9. Engineer-in-Chief, RES, Bhopal.
10. Director, Agriculture, Govt. of MP, Bhopal.
11. Director, Industries, Govt. of MP, Bhopal.
12. Director, Directorate Geology & Mining, Bhopal
13. Chief Engineer, BODHI, Water Resources Department, Bhopal.
14. Superintending Geo-Hydrologist, GWSC, Circle Bhopal.
15. Regional Director, CGWB, Paryawas Bhawan, Bhopal.

For information and necessary action.

09/2/22

Deputy Secretary,
Govt. of M.P.Water Resources Deptt.

Appendix-C: Minutes of First State Level Committee Meeting

Minutes of First meeting of State Level Committee (SLC) for "Ground Water Resources Estimation-2023" held on 19.04.2023

The meeting of the first State Level Committee for Ground Water Resources Estimation-2023 was held in the Hall no. E-211, VB-3, Vallabh Bhawan, Bhopal on 19th April, 2023 at 15:00 hrs. The meeting was chaired by Sh. S N Misra, Additional Chief Secretary, Water Resources Department, Govt of Madhya Pradesh. The meeting was attended by committee members from Urban Development and Housing Department, MGNREGA, Rajeev Gandhi Water Shed Mission, National Bank for Agriculture and Rural Development, Water Resource Department, Public Health Engineering Department, Directorate Geology and Mining, Madhya Pradesh Industrial Development Corporation and Madhya Pradesh Pollution Control Board. The list of officers attended the meeting is enclosed in Annexure-I.

Sh. A K Biswal, Regional Director, CGWB, NCR, Bhopal welcomed all the Members of State Level Committee and participants. With permission of chair, a presentation on "Overview of Ground Water Resource Estimation, Strategic Plan and Status of various activities related to Ground Water Resource Estimation -2023" was made by Sh. Chittaranjan Biswal, Scientist-C, CGWB, NCR, Bhopal.

The presentations were followed by detailed discussions on various aspects of the resource assessment of 2023.

Important action points emerged from the discussions are listed below:

- Ground Water quality tagging of the Ground water quality deteriorated assessment units on the basis of Public Health and Engineering Data. (Action: Public Health Engineering Department, Madhya Pradesh)
- Madhya Pradesh Pollution Control Board, Bhopal (MPPCB) is requested to expedite data collection of GW Extraction (for industrial uses), as these data are available exclusively in the CTO letter issued by MPPCB, Bhopal to the industries.
- Surface water supply through pipelines, Paved and unpaved area details, details of Rooftop rain water harvesting and other artificial structures for urban assessment units to be provided by Urban Development and Housing Department.
- Assessment unit wise Amrit Sarovar data and other water conservation data to be provided by MGNREGA.
- Progress of work to be monitored on a regular basis by Central Ground Water Board, North Central Region, Bhopal and Ground Water Survey, Water Resource Department, Bhopal to ensure completion of re-assessment of ground water resources of Madhya Pradesh and approval by State Level Committees timely.

Sh. Chittaranjan Biswal, Scientist-C with permission of chair presented the NAQUIM reports of 13 districts. Chairman of the committee appreciated the work carried out by CGWB, NCR, Bhopal. The chair mentioned that the reports may be shared with district administration and disseminated to general public in simple language. The committee approved the reports prepared by CGWB under National Aquifer Mapping Program.

Further Chittaranjan Biswal, Scientist-C also presented the studies that are going to take up by CGWB, NCR under NAQUIM 2.0 AAP-2023-24 in front of the committee. The NAQUIM 2.0 are as follows:

- Springshed management studies in Anuppur and Dindori district
- Bhopal Urban studies
- Ujjain Industry areas
- Water stressed area- Alot block of Ratlam district

Further the prevention of children falling into abandoned/open tube wells /bore wells also discussed in the meeting. The chairman of the committee advised CGWB to prepare a SOP/ guidelines for this.

The meeting ended with thanks to the Chair.

A K Biswal
Member Secretary of SLC

Put up for approval

Appendix-D: Minutes of Second SCL meeting and approval of GWRA-2023

Minutes of Second meeting of 2nd Quarterly Dialogue Event for the state of Madhya Pradesh held on 17.08.2023

The Second Quarterly Dialogue Event was held with water sector departments of Madhya Pradesh in the hall no F-326, VB-3, Bhopal on 17th August 2023 at 15:30 hrs. The meeting was chaired by Sh. Manish Singh, Principal Secretary, Water Resource Department, Govt. of Madhya Pradesh. The meeting was attended by officers from Central water Commission Urban Development and Housing Department, MGNREGA, RES, Water Resource Department, Public Health Engineering Department, Farmer Welfare and Agriculture Development Department, Directorate Geology and Mining, Madhya Pradesh Industrial Development Corporation, Madhya Pradesh Pollution Control Board, Central Pollution Control Board, National Institute of Hydrology. The list of officers attended the meeting is enclosed in Annexure-I.

The agenda for this meeting includes –

1) Approval of "Ground Water Resources Estimation-2023" Madhya Pradesh by State Level Committee (SLC).
2) NAQUIM 2.0
3) Surface Water Project Works.

Sh. A K Biswal, Regional Director, CGWB, NCR, Bhopal welcomed all the members present in the meeting.

1. Ground Water Resources Estimation-2023 Madhya Pradesh

With the permission of the chair, a presentation on "**Ground Water Resources Estimation-2023 of Madhya Pradesh**" was made by Sh. Chittaranjan Biswal, Scientist-C, CGWB, NCR, Bhopal. The gist of the Dynamic Groundwater Resource Estimation 2023 is given below:

Total Number of assessment units in the	313 blocks + 4 Urban areas (Bhopal, Indore, Gwalior
Total Annual Ground Water Recharge	35.47
Annual Extractable Ground Water	32.85
Annual Ground Water Extraction (bcm)	19.30
Stage of Ground Water Extraction (%)	58.75
No of Over-Exploited Assessment units	26
No of Critical assessment units	5
No of Semi-Critical assessment units	60
No of Safe assessment units	226

The Ground Water Resources Estimation-2023 of Madhya Pradesh was discussed thoroughly by the committee members and after discussion the **Ground Water Resources Estimation-2023 of Madhya Pradesh was approved by the committee.**

Important action points emerged from the discussions of GWRA-2023 are listed below:

- The improvement in category of Indore Urban (over-exploited in 2020 to critical in 2023) need to be communicated with the Urban Development and Housing Department of the Indore City.
- A focused and co-ordinated planning is required for identified water stressed blocks so that the water supply schemes under Amrut 2.0 and Jal Jeevan Mission have sustainable water supply.
- The Madhya Pradesh Madhya Kshetra Vidyut Vitaran Co. Ltd may be included in the committee.

2. NAQUIM 2.0

The four priority areas that are finalised and consented in the 2nd Quarterly Dialogue Event meeting for NAQUIM 2.0 were discussed.

1. Springshed Study: Anuppur and Dindori district
2. Urban area: Bhopal
3. Industrial area: Ujjain
4. Water stressed area: Alot block (Ratlam block)

Important action points emerged from the discussions of NAQUIM 2.0 are listed below:

- The state government requested to include Over-exploited and water stressed **Jaora block** of Ratlam district in NAQUIM 2.0 priority area.
- National Institute of Hydrology (NIH), Bhopal agreed to support CGWB, NCR Bhopal in completing the scientific studies in Jaora block as mentioned above.

Apart from this some other points also raised in the meeting as follows;

- MPIDC (Madhya Pradesh Industrial Development Cooperation) is requested to provide site for construction of piezometer in their industrial areas.
- The SOP for preventing Children from falling in borewell in Madhya Pradesh should be prepared in consultation with the state government.

Further a presentation was made by Sh. Neelam Narolia, Director, Central Water Commission, Madhya Pradesh regarding the progress of various surface water projects being carried out in Madhya Pradesh.

The meeting ended with thanks to the Chair.

Biswal 29/8/23

A K Biswal
Regional Director, CGWB
Member Secretary of SLC

Chairman for approval please

approved.

29/8

Appendix-E: Minutes of CLEG meeting and approval of GWRA-2023

Minutes of Meeting of Central Level Expert Group for Re-assessment of Ground Water Resources of India for 2023 (held through Hybrid Mode)

Date: 27.09.2023

The meeting of the Central Level Expert Group (CLEG) for re-assessment of the Ground Water Resources of India for 2023 was held under the Chairmanship of Shri Satish Kumar, Chairman, Central Ground Water Board (CGWB) through Video Conferencing on 27.09.2023 at 04.00p.m. The list of participants is attached (Annexure).

Shri. Satish Kumar, Chairman, CGWB & Chairman, CLEG, welcomed all the Members of Central Level Expert Group and participants. He briefed the participants about the Ground Water Resource Assessment 2023 and congratulated all Officers of State GW/Nodal Departments, Regional offices of CGWB and IIT Hyderabad for their sincere efforts for completion of GW Resource Assessment for 2023 through web based application ''INDIA-GROUNDWATER RESOURCE ESTIMATION SYSTEM (IN-GRES)''.

A brief presentation on findings of 'National Compilation on Ground Water Resources of India,2023' was made by Dr. Ratikanta Nayak, Regional Director, CGWB, CHQ, Faridabad. It was informed that all the States/UTs have successfully assessed their ground water resources jointly with CGWB. State Level Committees (SLCs) of 30 States/UTs have approved the GW Resource Assessment for their respective States/UTs. The GWRA-2023 for Chhattisgarh, Punjab, Telangana, Chandigarh, Dadra & Nagar Haveli, Daman & Diu, Jammu & Kashmir are yet to be approved by their respective States/UTs. However, the results of joint assessment of State Government and CGWB have been considered for National Compilation of Dynamic Ground Water Resources of India, 2023.

Salient features of the national scenario of dynamic ground water resources of India, based on the outputs of assessment as in 2023 in respect of 36 States and outputs of assessment as in 2023 in respect of India were presented and discussed. The members appreciated the work done by CGWB, State Departments and IIT Hyderabad and expressed their agreement with the whole process of assessment and outcome of 'National Compilation on Ground Water Resources of India,2023'.

The presentation was followed by discussions and few points are listed below.

	Actionable point	Action taken/ to be taken by
1	Quality Tagging of Assessment Units	In the National Report of Dynamic Ground Water Resources of India-2023, an annexure of Quality Tagging of Assessment Units is already included.

2	Analysis of Recharge from Other Sources	A detailed analysis to be carried out by the Resource cell, CGWB, CHQ Faridabad for various components of Recharge from Other Sources.

The Members of CLEG approved the Ground Water Resource Assessment -2023 of India.

Smt. T.S. Anitha Shyam, Member (South) and Member Secretary of the committee appreciated the efforts of Officers at CHQ, Faridabad for timely compilation of National Report. She appreciated the CLEG members for their valuable inputs which have helped in the realistic assessment of ground water resources in the country.

The meeting ended with thanks to the Chair.

INSPIRATION

Sh. Manish Singh
Principal Secretary, Water Resource Department, Govt. of Madhya Pradesh
Dr. Sunil Kumar Ambast
Chairman, Central Ground Water Board

GUIDANCE

Sh A K Biswal
Regional Director, CGWB, NCR, Bhopal
Sh. Shishir Kushwaha
Engineer in Chief, Water Resource Department
Sh. G P Soni
Chief Engineer (BODHI), Water Resource Department

PRINCIPAL CONTRIBUTOR

Sh. Chittaranjan Biswal
Scientist-C, CGWB, NCR, Bhopal

OTHER CONTRIBUTORS

Central Ground Water Board, North Central Region

Sh. Pradip Roy, Scientist-B
Ms. Saumya Choudhary, Scientist-B
Sh. Kodali Laxman Pradip, Asistant Hydrogeologist
Ms. Saumya Siddharth, Asistant Geophysicist

Ground Water Survey, Water Resource Department

Dr Jitendra Jain, Superitending Geohydrologist

GWALIOR DIVISION

Sh. Alok Kulshresth, Senior Geohydrologist
Mrs Sonali Singh, Asistant Engineer
Sh. D P Bamoriya, Sub Engineer
Sh. H S Shakya, Sub Engineer
Sh. R K Gupta, Sub Engineer
Sh. S S Mishra, Sub Engineer

JABALPUR, BALAGHAT AND REWA DIVISION

Dr. S K Patel, Assistant Geophysicist

KHANDWA DIVISION

Sh. Safdar Hussain Safdari, Senior Geohydrologist
Sh. Sanjay Mahajan, Assistant Geohydrologist
Sh. Pankaj Chouhan, Assistant Geohydrologist
Sh. Sudesh Deokata, Assistant Geohydrologist

Sh. Prakash Vyas, Assistant Geohydrologist
Sh. Shanka Lal Ladhe, Sub Engineer

SAGAR DIVISION

Sh. R K Sahu, Senior Geohydrologist
Sh. S. S. Ahirwar, Assistant Geophysicist
Sh. Vikas Pimpalkar, Assistant Geohydrologist
Sh. Satish Namdev, Assistant Geohydrologist
Sh. Kulwant Singh, Sub Engineer
Sh. A K Khare, Sub Engineer
Sh. Sanjay Jodhpurkar, Assistant Geohydrologist
Sh. Neeraj Sharma, Sub Engineer

UJJAIN DIVISION

Sh. Sudhir Kumar Sharma, Senior Geohydrologist
Sh Prakash Choudhary, Assistant Geohydrologist
Sh. S S Waskel, Assistant Geohydrologist
Sh. K S Sisodiya, Assistant Geohydrologist
Sh. Hemant Kumar Devara, Assistant Geohydrologist
Sh. Ajaya Jain, Assistant Geohydrologist

R E F E R E N C E S

1 Dynamic Ground Water Resources of Madhya Pradesh (2009), CGWB ,NCR, Govt Of India and GWS, WRD, Govt. of MP

2 Dynamic Ground Water Resources of Madhya Pradesh (2011), CGWB ,NCR, Govt Of India and GWS, WRD, Govt. of MP

3 Dynamic Ground Water Resources of Madhya Pradesh (2013), CGWB ,NCR, Govt Of India and GWS, WRD, Govt. of MP

4 Dynamic Ground Water Resources of Madhya Pradesh (2017), CGWB ,NCR, Govt Of India and GWS, WRD, Govt. of MP

5 Dynamic Ground Water Resources of Madhya Pradesh (2020), CGWB ,NCR, Govt Of India and GWS, WRD, Govt. of MP

6 Dynamic Ground Water Resources of Madhya Pradesh (2022), CGWB ,NCR, Govt Of India and GWS, WRD, Govt. of MP

7 Ground Water Year Book (2022), Madhya Pradesh, CGWB, NCR, Govt. of India

8 Rainfall Statistics of India (2021), India Meteorological Department, Govt. of India

A B B R E V I A T I O N S

bcm	Billion Cubic Meter
C	Command
CGWB	Central Ground Water Board
CLEG	Central Level Expert Group for overall reassessment of ground water resource of the country
cm	Centimeter
DOWR, RD & GR	Department of Water Resources, River Development & GangaRejuvenation, Ministry of Jal Shakti, Govt. of India
GEC-1984	Ground Water Estimation Committee, 1984
GEC-1997	Ground Water Resources Estimation Committee, 1997
GWRA- 2015	Ground Water Resources Estimation Committee, 2015
GWS	Ground Water Survey
ham	Hectare meter
IMD	India Meteorological Department
LPA	Long Period Average
lps	Litres per second
m	Meter
m bgl	Meter below ground level
mcm	Million cubic Meter
m ham	Million hectare meter
mm	Millimeter
NABARD	National Bank for Agricultural and Rural Development
NC	Non Command
Sq. m	Square Meter
WRD	Water Resource Department

CENTRAL GROUND WATER BOARD
North Central Region, Bhopal
Department of Water Resources, GR & RD
Ministry of Jal Shakti
Government of India
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&
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