DYNAMIC GROUND WATER RESOURCES OF NCT DELHI, 2024

सत्यमेव जयते

Department of Urban Development
Government of NCT, Delhi

State Unit Office, Delhi
Central Ground Water Board
Department of Water Resources,
River Development & Ganga Rejuvenation
Ministry of Jal Shakti
Government of India

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FOREWORD

Groundwater is one of the most preferred sources of fresh water for various uses as it is ubiquitous in nature and low capital cost. The groundwater is being extravagantly used in Delhi for various purposes including domestic, industrial, irrigation and other unproductive purposes also. As a result, there is a steady decline in groundwater level in various parts of National capital Territory of Delhi. So this precious resources needs a judicious management for its realistic evaluation. Keeping this in view, Central Ground Water Board, State Unit Office, Delhi takes up the task of estimating the groundwater resource of NCT, Delhi at regular intervals. In this report, an attempt has been made to re-estimate the groundwater resource potential of NCT, Delhi and find out the status of groundwater extraction taking into consideration the various usages of groundwater in the capital city.

The re-estimation of groundwater resources was carried out based on the methodology of estimation of groundwater resources popularly known as GEC, 2015 taking into account up-to-date data from various agencies involved in groundwater extraction and management in NCT of Delhi. The current status of groundwater extraction is reflected in the category of various tehsils involving 33 (thirty three) tehsils and 1 (one) non-revenue unit "Nazul Land" as per existing administrative units. This report contains very useful data about groundwater resources and their development in NCT, Delhi.

I would like to appreciate all the officers of Central Ground Water Board, State Unit Office, Delhi for their relentless efforts under the guidance and suggestion of Shri S.K. Mohiddin, Regional Director, in bringing out this publication in such a short time which is no doubt an uphill task. I firmly believe that this report will cater to the needs and use of all administrators, planners, and other stakeholders involved in formulation of strategies and interventions of ground water development and management of NCT Delhi.

6.2.25

(Additional Chief Secretary)
Urban Development, GNCTD

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Central Ground Water Authority

PREFACE

Groundwater plays an important role in the Nation's economic growth and forms a vital component of our ecological system. India's agricultural productivity, industrial output, and domestic water supply are heavily reliant on groundwater. However, rising water demands have led to excessive groundwater extraction in many parts of Delhi, exceeding the annual replenishment leading to a decline in groundwater level. A thorough assessment of these hidden resources is essential for developing strategies for management and regulatory measures. Since 2022, it has been decided to carry out the estimation of the Dynamic Groundwater Resources of the nation every year to provide the planners, decision-makers, and all stakeholders with reliable data/information for taking timely measures for sustainable management of groundwater resources.

The assessment of dynamic groundwater resources of NCT Delhi is based on the Groundwater Estimation Methodology of 2015 (GEC-2015), which comprehensively factors in all relevant parameters contributing to groundwater recharge and extraction. The Dynamic Groundwater Resource Assessment of 2024 (GWRA 2024) for NCT Delhi is a collaborative effort involving both the respective State Govt. Departments and the Central Ground Water Board, utilizing the INDIA-Ground Water Resource Estimation System (IN-GRES) Software.

I extend my heartfelt appreciation to the dedicated officers of CGWB, SUO, Delhi for their significant role in compiling the data and conducting assessments for the state according to the planned schedule.

The valuable contributions of the CLEG and PSLC members in refining the Dynamic Ground Water Resource Assessment-2024, NCT Delhi Report are also acknowledged. I hope this report will serve as an important document for planners, decision-makers, and all concerned stakeholders in prioritizing actions necessary to ensure the sustainability of groundwater resources in the State.

31/01/2025
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Central Ground Water Board

PREFACE

Groundwater has emerged as an important source of water in the NCT, Delhi. In order to precisely estimate the groundwater resources available for various uses and judiciously plan the development of water supply programmes as well as to ensure food security, there is a need to assess the groundwater resources annually. In view of this, the Central Ground Water Board and Department of Urban Development, Government of NCT, Delhi take up the task of estimating the dynamic groundwater resources of NCT, Delhi annually based on GEC 2015 methodology.

The re-estimation of groundwater resources as of 2024 has been carried out using the methodology recommended by the Ground Water Estimation Committee (GEC-2015) and the updated data that various State and Central Government agencies provided. The present estimation has been done considering each Tehsil (Revenue) Sub-division as an assessment unit to have a more refined and accurate estimation. The current status of groundwater development is reflected in the category of various Tehsils, which are assigned taking into consideration both the stage of groundwater development and the trend of groundwater levels. The report on "Dynamic Ground Water Resources of NCT, Delhi as of 2024" contains very useful data pertaining to groundwater resources and their development in the State. I sincerely hope this report will be of immense help not only to planners administrators, researchers, and policymakers but also to the stakeholders in need of such information to make themselves aware of the availability of groundwater and help in formulating development and management strategy.

This report will serve as a useful tool for administrators, planners, and government authorities in decision support and planning of groundwater development schemes and management and regulation of this precious resource.

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Contents

List of Tables

List of Figures

DYNAMIC GROUND WATER RESOURCES OF NCT DELHI, 2024

AT A GLANCE

1.	Total Annual Ground Water Recharge	37989.37Ham
2.	Annual Extractable Ground Water Resources	34190.44 Ham
3.	Annual Ground Water Extraction	34454.46 Ham
4.	Stage of Ground Water Extraction	100.77 %

CATEGORIZATION OF ASSESSMENT UNITS

(Tehsils)

Sl.No	**Category**	**Number of Assessment Units**		**Recharge worthy Area**		**Annual Extractable Ground Water Resource**	
		Number	**%**	**Sq. Km**	%	**in bcm**	%
1	Safe	5	14.7 %	330.23	22.20	0.072	21.15
2	Semi Critical	2	5.9 %	41.94	2.82	0.012	3.56
3	Critical	13	38.2 %	481.41	32.36	0.128	37.51
4	Over-Exploited	14	41.2 %	634.02	42.62	0.129	37.78
5	Saline	-	-	-	-	-	-
	TOTAL	**34**	**100**	**1487.62**	**100**	**0.34**	**100**

EXECUTIVE SUMMARY

Ground Water Resource Assessment is carried out at periodical intervals by the Central Ground Water Board under the guidance of the respective Permanent State Level Committee on Ground Water Assessment at State Levels and under the overall supervision of the Central Level Expert Group (CLEG). Such joint exercises have been taken up earlier in 1980, 1995, 2004, 2009, 2011, 2013, 2017, 2022, and 2023. From the year 2022, the exercise is being carried out annually.

The assessment involves the computation of dynamic groundwater resources or Annual Extractable Ground Water Resources, 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 (Tehsils) are categorized based on the stage of Groundwater Extraction, which are then validated with long-term water level trends. The assessments prior to that of the year 2017 were carried out following the Ground Water Estimation Committee (GEC) 97 Methodology, whereas from 2017 onwards assessments are based on norms and guidelines of the GEC 2015 Methodology.

The main source of replenishable groundwater resources is recharge from rainfall, which contributes to nearly 31% of the total annual Groundwater recharge. The normal rainfall in NCT Delhi is 611.8 mm and the annual rainfall in the year 2023 is 746.58 mm. The rainfall in NCT Delhi increases from the southwest to the northwest. About 81% of the annual rainfall is received during the monsoon months of June, July, August, and September. The rest of the annual rainfall is received as winter rains and as thunderstorm rains in the pre and post-monsoon months. The variation in rainfall from year to year is large.

The rock formations exposed in the National Capital Territory of Delhi are mainly quartzite interbedded with thin bands of micaceous schist. These Proterozoic age rocks occur along the ridge, extending from Harchandpur (Haryana) in the South to Wazirabad (Delhi) in the North. Quaternary sediments consisting of alluvium deposits directly overlie the Proterozoic rocks. The highest of these is the erosional surface forming the top of denudational hills. The second surface is the Older Alluvial plain and the third is the depositional Younger Alluvial plain (Yamuna).

In the present assessment, the total annual Groundwater recharge in the N.C.T Delhi has been assessed as 37989.37 ham. Keeping an allocation for natural discharge, the annual extractable groundwater resource has been assessed as 34190.44 ham. The annual Ground Water Extraction (as in 2024) is 34454.46 ham. The average stage of Groundwater extraction for The N.C.T Delhi is 100.77%. Out of the total 34 assessment units (Tehsils) in the N.C.T Delhi, 14 units (41.2%) have been categorized as "Over Exploited" indicating groundwater extraction exceeding the annual replenished groundwater recharge. In 13 (38.2%) assessment units, the stage of groundwater extraction is between 90-100% and has been categorized as "Critical". There are 2 (5.9%) "Semi-critical" units, where the stage of groundwater extraction is between 70% and 90%, and 5 (14.7%) "Safe" units, where the stage of Groundwater extraction is less than 70%. The percentage of Over-Exploited and Critical administrative units is more than 50% of the total Assessment units. Similarly out of 1487.62 sq. km recharge-worthy area of the country, 634.02 sq km (42.62 %) are under "Over exploited", 481.41 sq km (32.36%) is under "Critical", 41.94 sq. km (2.82%) is under "Semi-Critical" and 330.23 sq. km (22.20%) is under "Safe" Category. Out of 0.34 bcm of total Annual Extractable Resources, 0.129 bcm (37.78%) is under "Over exploited", 0.128 bcm (37.51%) is under "Critical", 0.012 bcm (3.56%) is under "Semi-Critical" and 0.072 bcm (21.15 %) is under "Safe" Category assessment units.

In comparison to the Dynamic Ground Water Resource Assessment 2023, 3 assessment units have Deteriorated. The Alipur tehsil from Semi Critical (89.43 %) to Critical (98.65%), Punjabi Bagh tehsil from Semi Critical (88.39 %) to Critical (91.15%) and Mayur Vihar tehsil from Critical (98.91 %) to Over Exploited (101.52%).

The Over Exploited assessment units are mostly concentrated in the southern, Eastern, and southwestern parts of the state which includes parts of Kapashera, Vasant Vihar, Mehrauli, Saket, Delhi Cantonment, Rajouri Garden, Chanakyapuri, Karol Bagh, Narela, Karawal Nagar, Mayur Vihar, Vivek Vihar, Shahdara, and Yamuna Vihar. In most of the areas in the state, good continuous rainfall and management practices like groundwater augmentation and conservation measures taken up under Central and State Government initiatives have resulted in improvement in the groundwater situation.

CHAPTER 1

1.1 Introduction

Ground water Resources Estimation plays a pivotal role in effective implementation and monitoring of various guidelines issued by Govt. of India & State Governments. In view of the substantial changes observed in ground water resource scenario throughout the country, there is an emphasis has been laid in National Water Policy on periodic reassessment of groundwater resources of the entire country for quantification, sustainable development, and management.

The 'National Water Policy 2012 adopted by the Government of India regards water as a scarce natural resource, fundamental to life, livelihood, food security and sustainable development. It emphasizes that the efforts to develop, conserve, utilize and manage this resource must be guided by the national perspective. Correspondingly, safe water for drinking and sanitation is considered as pre-emptive needs, followed by high priority allocation for other basic domestic needs including needs of animals, achieving food security, supporting sustenance agriculture and minimum eco-system needs.

NCT Delhi being urban area wherein space for natural recharge is reducing abreast with infrastructural development both over the surface & under the surface posing challenges to planners and scientists to accurately assess the Dynamic Ground Water Resource of NCT Delhi. The subsurface infrastructure developments (construction of double/triple basements, underground metro tunnel, Station, roads etc.) are also causing an imbalance in the natural subsurface flow of groundwater

1.2 Previous Ground Water Resource Estimation of NCT Delhi

The Ground water Resources of NCT Delhi was estimated first time in the year 1991 as per GEC 1984 methodology taking into consideration then 9 districts area as 'Assessment Unit' and then in the year 2004 as per GEC 1997 methodology. Tehsil wise ground water resources estimation was undertaken during 2009, 2011, and 2013 for then 27 Tehsils of 9 districts of NCT Delhi and for 34 tehsils of 11 districts and 1 non-revenue district from 2017 onwards. The summarized details of all such previous resource estimations of NCT Delhi is presented in ***Table 1*** and depicted graphically in ***Fig 1.***

Table 1: Previous Ground Water Resource Estimation of NCT Delhi

Methodology	1991	2004	2009	2011	2013	2017	2020	2022	2023
	GEC 1984	GEC 1997				GEC 2015			
Total Annual Recharge (ham)	29154	29710	31501	31050	34192	30090	31811.76	41051.64	38153
Total Ground water Extraction (ham)	16840	47945	39619	39215	38785	35990	29032.77	36267.14	34151
Stage of Ground water Development (%)	58	161	125	126	113	119	101.4	98.16	99.13

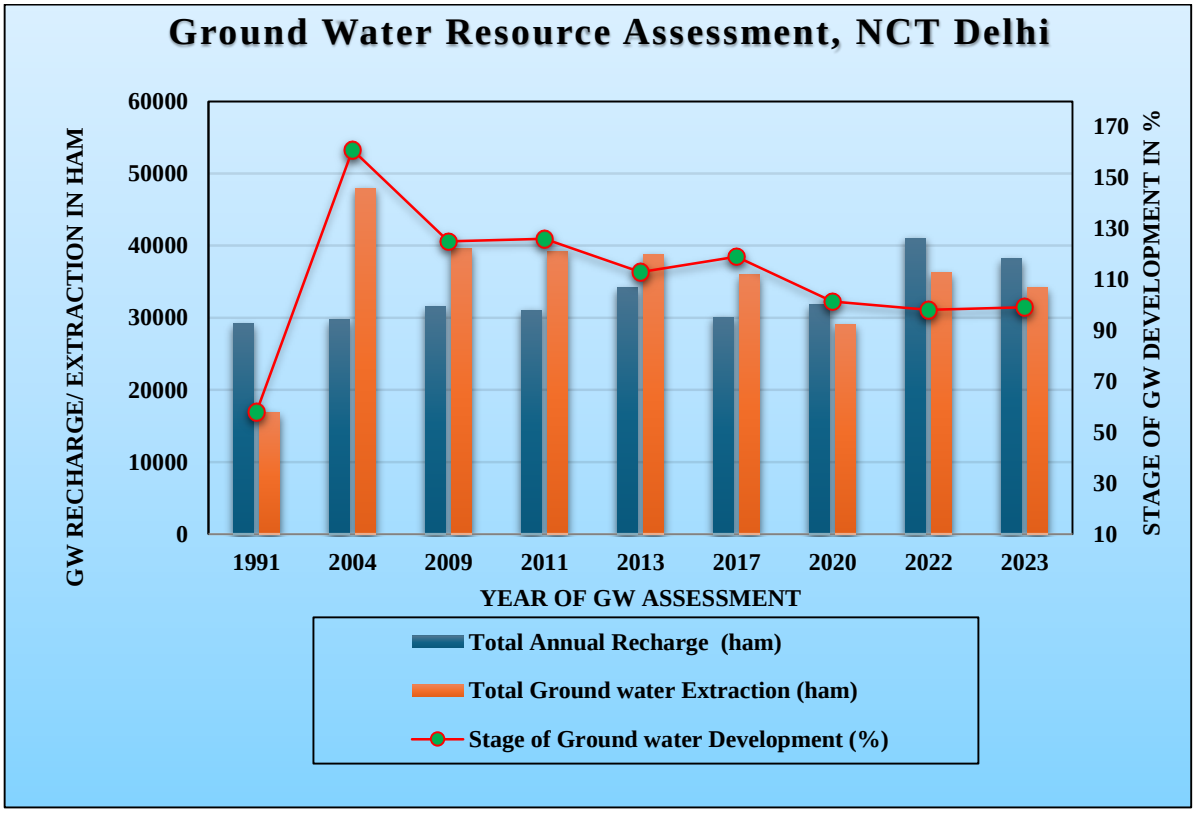


Figure 1: Ground water Resource Assessment

CHAPTER 2

2.1 Ground Water Resource Estimation Methodology

Ground water resources as in 2024 have been estimated following the guidelines mentioned in the GEC 2015 methodology using appropriate assumptions depending on data availability. The principal attributes of the GEC 2015 methodology are given below:

It is also important to add that as it is advisable to restrict groundwater development as far as possible to annual replenishable resources, the categorization also considers the relation between annual replenishment and groundwater development. An area devoid of groundwater 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. Thus, water augmentation efforts can be successful in such areas, where the groundwater potential is high and there is scope for augmentation.

2.2 Ground Water Assessment of Unconfined Aquifer

Though the assessment of groundwater resources includes the assessment of dynamic and in-storage resources, the development planning should mainly focus on dynamic resources as they get replenished on an annual basis. Changes in static or in-storage resources normally reflect the long-term impacts of groundwater 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.

2.2.1 Assessment of Annually Replenishable or Dynamic Ground Water Resources

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

$$\boldsymbol{Inflow - Outflow = Change\ in\ Storage(of\ an\ aquifer)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{1})$$

Equation (1) can be further elaborated as –

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

Where,

ΔS - Change is storage

R_{RF} - 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

R_{TP} - 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

Due to lack of data for all the components in most of the assessment units, at present the water budget has been assessed based on major components only, taking into consideration certain reasonable assumptions. The estimation has been 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.

2.2.2 Rainfall Recharge

Ground water recharge has been estimated on ground water level fluctuation and specific yield approach since this method considers the response of ground water levels to ground water input and output components. In units or subareas where adequate data on ground water level fluctuations are not available, ground water recharge is estimated using rainfall infiltration factor method only. The rainfall recharge during non-monsoon season has been estimated using rainfall infiltration factor method only.

2.2.3 Ground Water Level Fluctuation Method

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

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

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

R_{TP} - 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 have another term i.e., Recharge due to canals (R_C) and the equation is as follows:

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

The change in storage has been estimated using the following equation:

$$\boldsymbol{\Delta S = \Delta h \times A \times S_Y} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{5})$$

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 fluctuation and specific yield, the equations (3) & (4) becomes (6) & (7) for non-command and command sub-units,

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

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

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 has been 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 normalisation procedure is 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 normalisation procedure. The first method is based on a linear relationship between recharge and rainfall of the form

$$\boldsymbol{R = ar} \quad \ldots\ldots\ldots\ldots (\mathbf{8})$$

Where,

R = Rainfall recharge during monsoon season

r = Monsoon season rainfall

a = a constant

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

$$\boldsymbol{R_{RF}(normal) = \frac{\sum_{i=1}^{N}\left[R_i \frac{r(normal)}{r_i}\right]}{N}} \quad \ldots\ldots\ldots\ldots (\mathbf{9})$$

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

r_i- Rainfall in the monsoon season for the i^{th} 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, this linear relationship is of the form,

$$\boldsymbol{R_{RF}(normal) = a \times r(normal) + b} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(\mathbf{10})$$

Where,

R_{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 has been followed in the second method is as given below:

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

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

Where,

$$\boldsymbol{S_1 = \sum_{i=1}^{N} r_i \ , \quad S_2 = \sum_{i=1}^{N} R_i \ , \quad S_3 = \sum_{i=1}^{N} r_i^2 \ , \quad S_4 = \sum_{i=1}^{N} R_i r_i}$$

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 water extraction estimation included in the computation of rainfall recharge using water level fluctuation approach is often subject to uncertainties. Therefore, the rainfall recharge obtained from water level fluctuation approach has been compared with that estimated using rainfall infiltration factor method. Recharge from rainfall is estimated by using the following relationship –

$$\boldsymbol{R_{RF} = RFIF \times A \times \frac{(R - a)}{1000}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(\mathbf{13})$$

Where,

R_{RF} - Rainfall recharge in ham

A - Area in hectares

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 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. Thus, 10% of Normal annual rainfall has been taken as minimum rainfall threshold and 3000 mm as maximum rainfall limit. While computing the rainfall recharge, 10% of the normal annual rainfall has been deducted from the monsoon rainfall and balance rainfall is considered for computation of rainfall recharge. The same recharge factor is used for both monsoon and non-monsoon rainfall, with the condition that the recharge due to non-monsoon rainfall is 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 has been estimated for normal rainfall, based on recent 30 to 50 years of data.

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 is 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

$$\boldsymbol{PD = \frac{R_{RF}(normal, wtfm) - R_{RF}(normal, rifm)}{R_{RF}(normal, rifm)} \times 100} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{14})$$

Where,

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

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

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

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

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 used in the assessment as follows.

Table 2: Estimation Formula and Parameters

Sl. No.	Source	Estimation Formula	Parameters
1	Recharge from Canals	$R_C = WA \times SF \times Days$	R_C = Recharge from Canals WA = 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

Sl. No.	Source	Estimation Formula	Parameters
4	Recharge due to Tanks & Ponds	$R_{TP} = AWSA \times N \times RF$	R_{TP} = Recharge due to Tanks & Ponds AWSA = Average Water Spread Area N = Number of days Water is available in the Tank/Pond RF = Recharge Factor
5	Recharge due to Water Conservation Structures	$R_{WCS} = GS \times RF$	RWCS = Recharge due to Water Conservation Structures GS = Gross Storage = Storage Capacity multiplied by number of fillings. RF = Recharge Factor

Evaporation and Transpiration

Evaporation is estimated for the aquifer in the assessment unit if water levels in the aquifer are within the capillary zone. For areas with water levels within 1.0mbgl, evaporation is 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 is taken as zero.

Transpiration through vegetation has been estimated if water levels in the aquifer are within the maximum root zone of the local vegetation. If water levels are within 3.5mbgl, transpiration is estimated using the transpiration rates available for other areas. If it is greater than3.5m bgl, the transpiration has been taken as zero.

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 season is 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.

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. The sum 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.

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 computed for all the sub units available in the assessment unit.

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.

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, allocation of unaccountable natural discharges to 5% or 10% of annual recharge is considered. If the rainfall recharge is assessed using water level fluctuation method this has been taken 5% of the annual recharge and if it is assessed using rainfall infiltration factor method, 10% of the annual recharge is considered. The balance is account for Annual Extractable Ground Water Resources (EGR).

Estimation of Ground Water Extraction

Ground water draft or extraction is assessed as follows.

$$\boldsymbol{GE_{ALL} = GE_{IRR} + GE_{DOM} + GE_{IND}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{15})$$

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

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.

Ground Water Extraction for Domestic Use (GE_{DOM})

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.

$$GE_{DOM} = Population \times Consumptive\ Requirement \times L_g \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (16)$$

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.

Ground Water Extraction for Industrial Use (GE_{IND})

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.

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

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 be taken as ground water extraction during that particular period.

Stage of Ground Water Extraction

The stage of ground water extraction is defined by,

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

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 should be obtained separately for command areas, non-command areas and poor ground water quality areas.

Validation of Stage of Ground Water Extraction

The assessment based on the stage of ground water extraction has inherent uncertainties. In view of this, 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 3: Ground Water Level Trend

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

Categorization of Assessment Unit

Categorization of Assessment Unit Based on Quantity

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

Table 4: Stage of Ground Water Extraction values

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

Categorization of Assessment Unit Based on Quality

As it is not possible to categorize the assessment units in terms of the extent of quality hazard, based on the available water quality monitoring mechanism and database on ground water quality, the Committee recommends that each assessment unit, in addition to the Quantity based categorization (safe, semi-critical, critical and over-exploited) should bear a quality hazard identifier. If any of the three quality hazards in terms of Arsenic, Fluoride and Salinity are encountered in the assessment sub unit in mappable units, the assessment sub unit has been tagged with the particular Quality hazard.

Allocation of Ground Water Resource for 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. This requirement based on population has been 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 has been utilized.

$$\boldsymbol{Alloc = 22 \times N \times L_g mm\ per\ year} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{19})$$

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)

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 availability for future use. The Net annual ground water availability for future use is 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 has been projected as zero.

Additional Potential Resources under Specific Conditions

Potential Resource Due to Spring Discharge

Spring discharge occurs at the places where ground water level cuts the surface topography. The spring discharge is equal to the ground water recharge minus the outflow through evaporation and evapotranspiration and vertical and lateral sub-surface flow. Thus, Spring Discharge is a form of 'Annual Extractable Ground Water Recharge'. It is a renewable resource, though has not been used for Categorisation. Spring discharge measurement has been carried out by volumetric measurement of discharge of the springs. Spring discharges multiplied with time in days of each season will give the quantum of spring resources available during that season.

$$\boldsymbol{Potential\ ground\ water\ resource\ due\ to\ springs = Q \times No.of days} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{20})$$

Where,

Q = Spring Discharge

No of days = No of days spring yields.

Potential Resource in Waterlogged and Shallow Water Table Areas

In the area where the ground water level is less than 5m below ground level or in waterlogged areas, the resources up to 5m below ground level are potential and would be available for development in addition to the annual recharge in the area. The computation of potential resource to ground water reservoir in shallow water table areas has been done by adopting the following equation:

$$\boldsymbol{Potential\ groundwater\ resource\ in\ shallow\ water\ table\ areas} = (\mathbf{5} - \boldsymbol{D}) \times \boldsymbol{A} \times \boldsymbol{S_Y} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (\mathbf{21})$$

Where,

D = Depth to water table below ground surface in pre-monsoon period in shallow aquifers.

A = Area of shallow water table zone.

S_Y = Specific Yield

Potential Resource in Flood Prone Areas

Ground water recharge from a flood plain is mainly the function of the following parameters-

- Areal extent of flood plain
- Retention period of flood
- Type of sub-soil strata and silt charge in the river water which gets deposited and controls seepage

Since collection of data on all these factors is time taking and difficult, in the meantime, the potential resource from flood plain may be estimated on the same norms as for ponds, tanks and lakes. This has been calculated over the water spread area and only for the retention period using the following formula.

$$\boldsymbol{Potential\ groundwater\ resource\ in\ Flood\ Prone\ Areas} = \mathbf{1.4} \times \boldsymbol{N} \times \frac{\boldsymbol{A}}{\mathbf{1000}} \dots\dots\dots\dots (\mathbf{22})$$

Where,

N = No. of Days Water is Retained in the Area

A = Flood Prone Area

Apportioning of Ground Water Assessment from Watershed to Development Unit

Where the assessment unit is a watershed, there is a need to convert the groundwater assessment in terms of an administrative unit such as block/ taluka/ mandal. This has been done as follows.

A block may comprise of one or more watersheds, in part or full. First, the ground water assessment in the subareas, command, non-command and poor ground water quality areas of the watershed has been converted into depth unit (mm), by dividing the annual recharge by the respective area. The contribution of this subarea of the watershed to the block, is now calculated by multiplying this depth with the area in the block occupied by this sub-area.

The total ground water resource of the block has been presented separately for each type of sub-area, namely for command areas, non-command areas and poor ground water quality areas, as in the case of the individual watersheds.

2.3 Ground Water Assessment in 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, accuracy is somewhat doubtful and individuals cannot even enumerate the well census in urban areas. Hence the difference of the actual demand and the supply by surface water sources as the withdrawal from the ground water resources has been considered for the assessment.

- 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, 30% of the rainfall infiltration factor has been taken into consideration 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 has been included in the other resources and the recharge has also been considered. The percent losses have been collected from the individual water supply agencies, 50% of which has been considered 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 has been taken as norm for the recharge on the quantity of sewerage when there is sub surface drainage system. If estimated flash flood data is available, the same percent has been used on the quantum of flash floods to estimate the recharge from the flash floods.

- Urban areas with population more than 10 lakhs, has been considered as urban assessment unit while assessing the dynamic ground water resources.

2.3.1 Ground Water Assessment in Water Level Depletion Zones

There are areas where ground water level shows a decline even in the monsoon season. The reasons for this may be any one of the following: (a) There is a genuine depletion in the ground water regime, with ground water extraction and natural ground water discharge in the monsoon season (outflow from the region and base flow) exceeding the recharge. (b) There may be an error in water level data due to inadequacy of observation wells.

If it is concluded that the water level data is erroneous, recharge assessment has been made based on rainfall infiltration factor method. If, on the other hand, water level data is assessed as reliable, the ground water level fluctuation method has been applied for recharge estimation. As ΔS in equation 3& 4 is negative, the estimated recharge will be less than the gross ground water extraction in the monsoon season. It must be noted that this recharge is the gross recharge minus the natural discharges in the monsoon season. The immediate conclusion from such an assessment in water depletion zones is that the area falls under the over-exploited category which requires micro level study.

2.3.2 Norms Has Been Used In the Assessment

Specific Yield

Recently under Aquifer Mapping Project, Central Ground Water Board has classified all the aquifers into 14 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 5*** has been followed in the present assessments, unless sufficient data based on field studies are available to justify the minimum, maximum or other intermediate values

Table 5: Norms Recommended for Specific Yield

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		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
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

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
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	KarstifiedMiliolitic 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
30	Limestone	LS03	Karstified Limestone/Dolomite	Proterozoic	10	5	15
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	Acidic Rocks (Pegmatite, Granite,	Proterozoic to Cenozoic	3	2	4

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
			Syenite, Rhyolite etc.) - Weathered, Jointed				
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
50	Khondalite	KH01	Khondalites, Granulites - Mssive, 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 -	Azoic to Proterozoic	0.3	0.2	0.4

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
			Massive, Poorly Fractured				
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

Rainfall Infiltration Factor

The values mentioned in ***Table 6*** has been used in the present assessment. The recommended Rainfall Infiltration Factor values has been used for assessment, unless sufficient data based on field studies are available to justify the minimum, maximum or other intermediate values.

Table 6: Norms Recommended for Rainfall Infiltration Factor

Sl. No.	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

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
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
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

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
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

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
43	Quartzite	QZ01	Quartzite - Weathered, Jointed	Proterozoic to Cenozoic	6	5	7
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.) -	Proterozoic to Cenozoic	2	1	3

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
			Massive, Poorly Fractured				
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

Norms for Canal Recharge

The Norms suggested in ***Table-7*** has been used for estimating the recharge from Canals, where sufficient data based on field studies are not available.

Table 7: 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

Norms for Recharge Due to Irrigation

The Recommended Norms are presented in ***Table 8.***

Table 8: 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

DTW m bgl	Ground Water		Surface Water	
	Paddy	Non-paddy	Paddy	Non-paddy
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

Norms for Recharge due to Tanks & Ponds

As the data on the field studies for computing recharge from Tanks & Ponds are very limited, for Seepage from Tanks & Ponds has been used as 1.4 mm / day in the present assessment.

Norms for Recharge due to Water Conservation Structures

The data on the field studies for computing recharge from Water Conservation Structures are very limited, 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 is adopted.

Unit Draft

The 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 on how 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 is computed using the following equation:

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

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 are followed for normalization of Unit Draft. Areas where, unit draft values for one rainfall cycle are available for at least 10 years second method shown in equation 31 is followed or else the first method shown in equation 30 has been used.

$$\boldsymbol{Normalised\ Unit\ Draft} = \frac{\boldsymbol{Unit\ Draft \times Rainfall\ for\ the\ year}}{\boldsymbol{Normal\ Rainfall}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{30})$$

$$\boldsymbol{Normalised\ Unit\ Draft} = \frac{\sum_{i=1}^{n} \boldsymbol{Unit\ Draft_i}}{\boldsymbol{Number\ of\ Years}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{31})$$

2.3.3 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 provides common and standardized platform for Ground Water Resource Estimation for the entire country and its pan-India operationalization (Central and State Governments). The system takes '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

3.1 Rainfall

3.1.1 State Rainfall

The normal rainfall in NCT Delhi is 611.8 mm and annual rainfall in the year 2023 it is 746.58 mm. The rainfall in NCT Delhi increases from the southwest to the northwest ***Fig 2*** About 81% of the annual rainfall is received during the monsoon months of June, July, August and September. The rest of the annual rainfall is received as winter rains and as thunderstorm rain in the pre and post-monsoon months. The variation in rainfall from year to year is large.

Table 9: Rainfall in State (2023)

Month	Max Temp (°C)	Mini Temp (°C)	Relative Humidity (%)	Rainfall (mm) Normal	Rainfall (mm) 2023	Rainy Days	Eto (mm/d)
January	19.2	7	97	14.5	14.1	5	7.1
February	27.7	10.3	95	13.2	0	1	10.1
March	33.1	16.8	73	9.9	53.18	0	17.7
April	37.5	18.7	48	5.5	7.64	0	30
May	37.5	23.3	60	9.2	81.33	3	40
June	38.3	25.9	65	38.8	112.62	3	33.3
July	36.5	26.4	78	191.6	277.11	11	23.3
August	35.2	26.3	78	197.4	89.2	5	13.3
September	33.2	25.5	88	105.3	96.26	6	14.7
October	33.1	20.5	81	19.3	6.13	2	14.9
November	27.8	11.9	87	2.8	8.94	0	10.2
December	22.4	8.2	92	4.3	0.07	0	7.8
Total	**-**	**-**	**-**	**611.8**	**746.58**	**36**	**222.4**
Average	**31.79**	**18.4**	**78.5**				

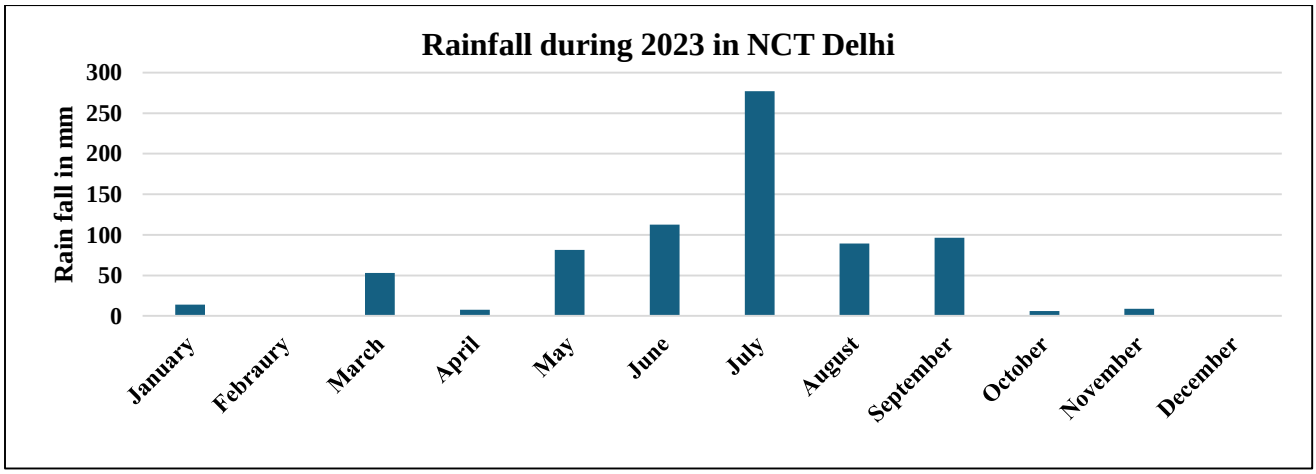


Figure 2: Rainfall in state (2023)

3.1.2 District-wise Rainfall in 2023

Table 10: District-wise Rainfall in 2023

Districts	2023		
	Pre-monsoon	Monsoon	Post Monsson
Central	215.94	920.54	29.64
East	138.22	553.51	14.02
NewDelhi	160.71	622.8	13.43
North	138.44	553.46	15.6
North East	104.8	450.5	14.9
North West	138.44	553.46	15.6
Shahdara	104.8	450.5	14.9
South	170.15	649.13	13.26
South East	170.15	649.13	13.26
South West	186.55	591.76	15.96
West	153.45	585.42	15.9
Nazuland	138.22	553.51	14.02

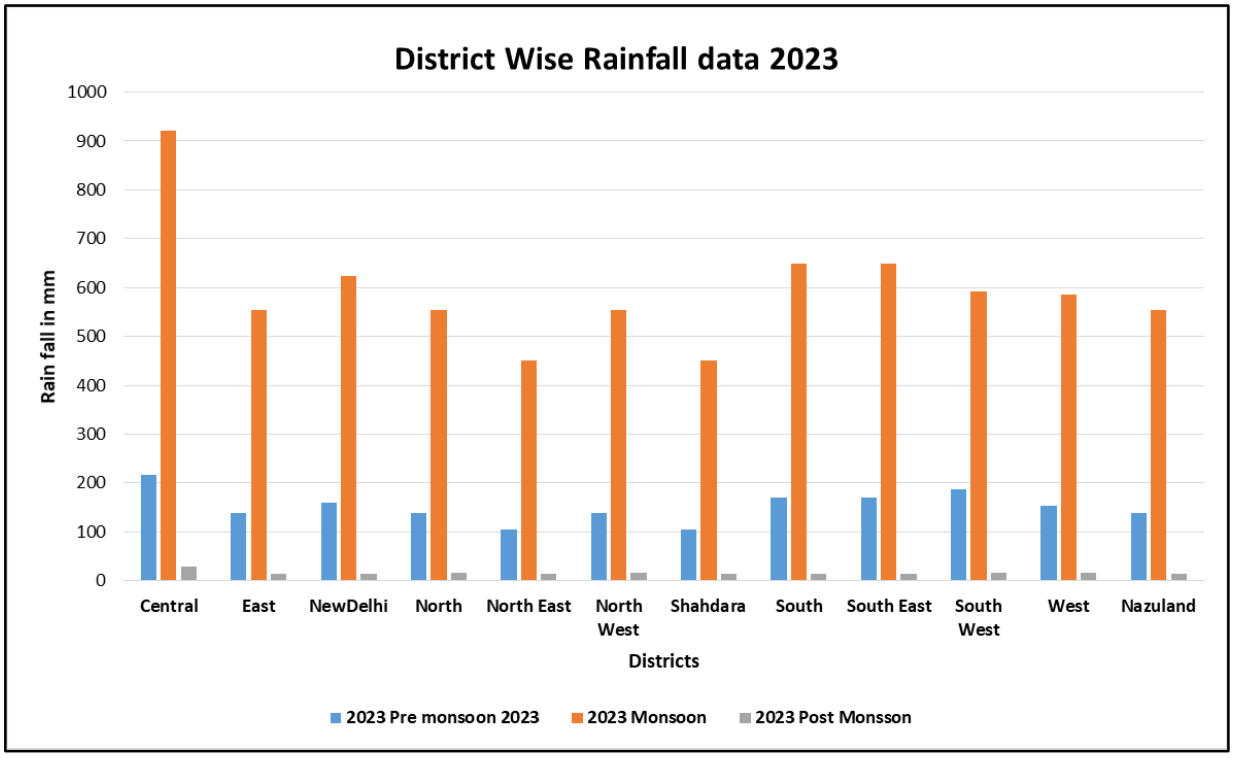


Figure 3: District-wise Rainfall in the state (2023)

3.1.3 District-wise Rainfall during Ground Water Assessment Year 2023-24

Table 11: District-wise Rainfall in 2023-24

District	Monsoon 2023	Post Monsson 2023	Pre Monsoon 2024
Central	920.54	29.64	57.98
East	553.51	14.02	32.73
NewDelhi	622.8	13.43	35.5
North	553.46	15.6	31.82
North East	450.5	14.9	28.6
North West	553.46	15.6	31.82
Shahdara	450.5	14.9	28.6
South	649.13	13.26	36.57
South East	649.13	13.26	36.57
South West	591.76	15.96	34.23
West	585.42	15.9	33.02
Nazuland	553.51	14.02	32.73

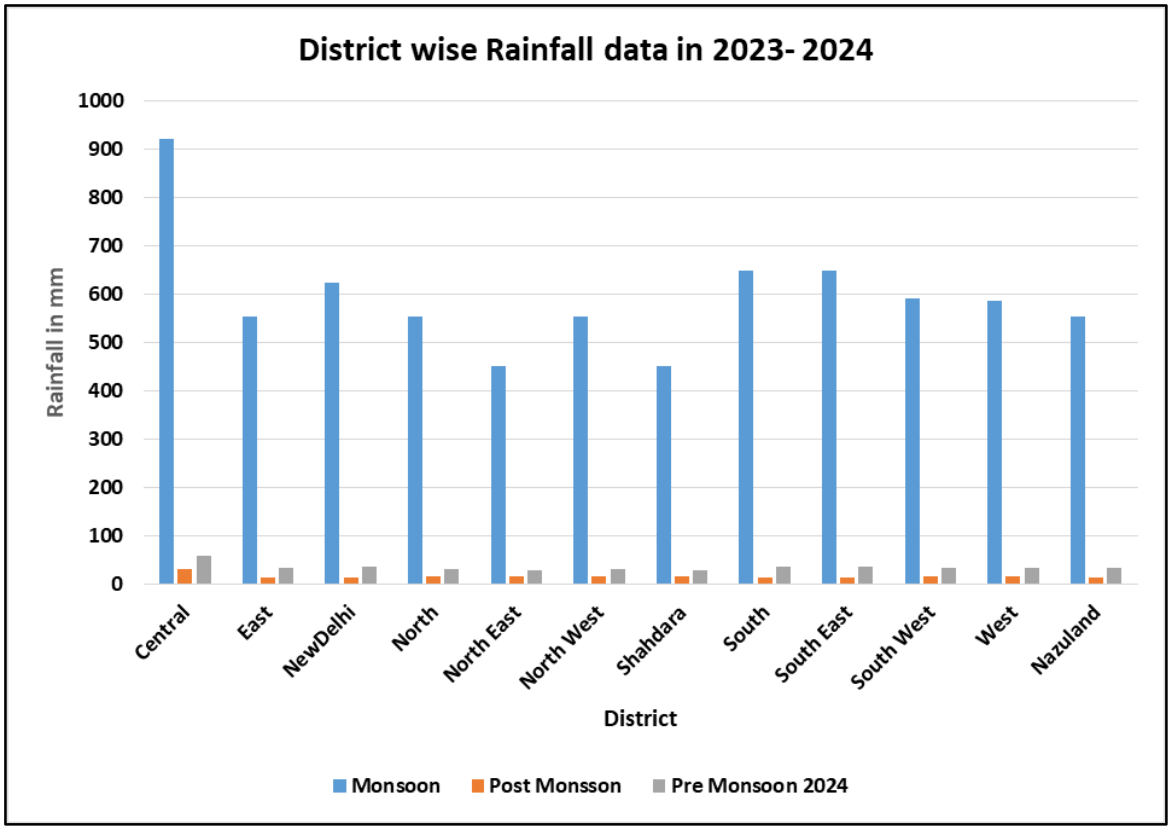


Figure 4: District-wise Rainfall in the state (2023-24)

3.1.4 State-wise Rainfall during Ground Water Assessment Year 2023-24

Table 12:State-wise Rainfall in 2023-24

Year	2023									2024		
Month	April	May	June	July	Aug	Sep	October	Nov	Dec	Jan	Feb	March
Rain Fall (mm)	7.64	81.33	112.62	277.11	89.2	96.26	6.13	8.94	0.07	0	0	27.36

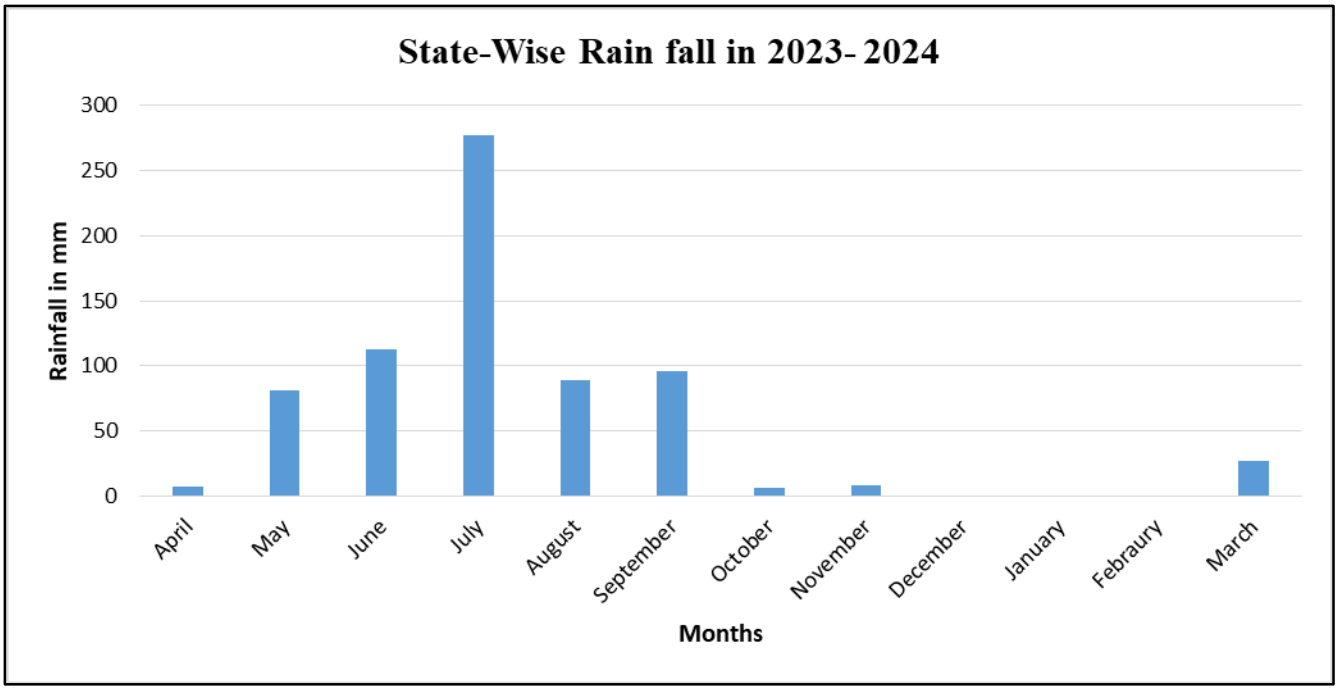


Figure 5: State-wise Rainfall in the state (2023-24)

CHAPTER 4

4.1 Hydrogeological Setup of NCT Delhi

4.1.1 Geomorphology

The ground water availability in NCT of Delhi indirectly relates with its distinct landform units, which in turn represent underlying intrinsic geological features. Map showing these landforms of NCT of Delhi are presented in ***Fig 6*** All these landforms of NCT, Delhi can be grouped into three broad geomorphic units: namely Rocky surface, Older Alluvial Plain and Flood Plain of Yamuna River.

Rocky Surface: The rocky surface represents structurally controlled relict linear ridges and isolated hillocks comprising of rocks of Delhi Supergroup. This distinct landform comprising of isolated hills is most prominent in the South- and South-Central parts, extends from Mahipalpur to Wazirabad in the north. Towards south of Mahipalpur the ridge gets bifurcated, one arm extends towards Mandi and further south while the other arm takes a turn towards southeast and extends uptoTughlakabad- Greater Kailash-Nehru Place and Okhla. It attains a maximum elevation of 362 m amsl which gradually diminishes towards north where rocks are exposed on the western bank of Yamuna near Wazirabad.

Older Alluvial Plain: The gently undulatory terrain on either side of the rocky surface is described as the Older Alluvial Plain. This surface is separated from the Yamuna Flood Plain by a bluff. Depending upon the morphological expressions/features, this unit is further divided into different subunits: namely, (i) Najafgarh Older Alluvial Plain, (ii) Delhi Older Alluvial Plain and (iii) Maidan Garhi Plain. Najafgarh Older Alluvial Plain occupying western and southwestern part of the region is partly covered by sand dunes and sandy sheets. The gently sloping surface including the covered pediment along the eastern flank of the ridge represents the Delhi Older Alluvial Plain. Maidan Garhi Plain is a relatively higher plain surface and forms part of Chattarpur Basin. A narrow zone of badland has formed mostly along the western margins of structural ridges due to intense development of gullies and rills.

Flood Plain of river Yamuna: The low-lying flat surface representing the Flood Plain of river Yamuna occupying northern, northeastern and eastern parts of the NCT is an important geomorphic unit. North of Narela, the width of flood plain varies from 15 to 17 km. The wider Older Yamuna flood plain indicates lateral migration of river Yamuna over large areas. This belt has good potential for

ground water development. It forms the erosional terrace. The Yamuna Active Flood Plain represents the wide belt bounded on both the sides by Eastern and Western bunds and is naturally prone to annual / periodic floods being in the flood way and flood fringe zone of river Yamuna. It forms depositional terrace and is characterized by abandoned channels, cut-off meanders, meander scrolls, point bars and channel bars. Presence of number of cut- off meanders in the Yamuna Flood Plain suggests oscillatory shifting of river. The lakes near Bhalaswa, Kondli and Khichdipur are remnants of large meanders.

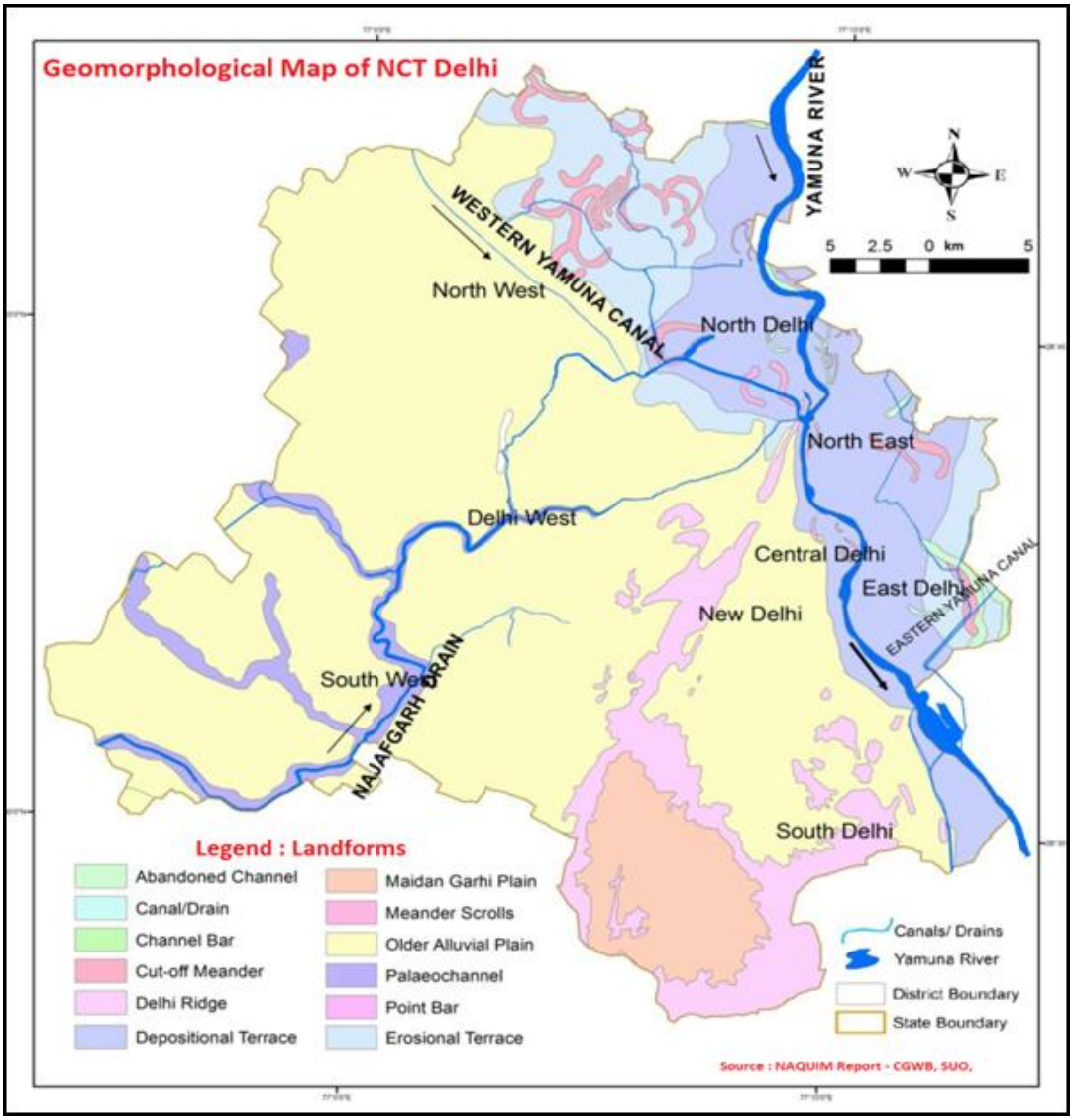


Figure 6: Geomorphological map of NCT Delhi

4.1.2 Geology

The rock formations exposed in the National Capital Territory of Delhi are mainly quartzite interbedded with thin bands of micaceous schist. These Proterozoic age rocks occur along the ridge, extending from Harchandpur (Haryana) in the South to Wazirabad (Delhi) in the North. Quaternary sediments consisting alluvium deposit directly overlie the Proterozoic rocks. Systematic geological and geomorphologic studies carried out by the Geologists of Geological Survey of India has revealed three Stratigraphic horizons and underlying three distinct lithostratigraphic units of NCT Delhi. The highest of these is the erosional surface forming the top of denudational hills. The second surface is Older Alluvial plain and the third is depositional Younger Alluvial plain (Yamuna). All three lithostratigraphic units corresponding them have undergone changes due to widespread and uncontrolled urban activity over the period. The geological map of Delhi after Kachroo and Bagchi (1999), showing these main units is shown in ***Fig 7*** and the generalized stratigraphy of NCT of Delhi is presented in ***Table 13.***

Table 13: Generalized Stratigraphic Units of NCT Delhi (compiled after GSI Study)

Alluvium	Newer Alluvium	Unconsolidated, inter-bedded lenses of sand, silt gravel and clay confined to narrow flood plains of Yamuna river and Aeolian deposit of South Delhi.
	Older Alluvium	Unconsolidated thickness varies upto 300m. Interbedded, inter-fingering deposits of sand, clay and kankar, poor to moderately sorted.
Delhi Super Group	Alwar Quartzite	Well stratified, thick bedded, brown to buff colour, hard and compact, intruded locally by pegmatite and quartz veins interbedded with mica schist.

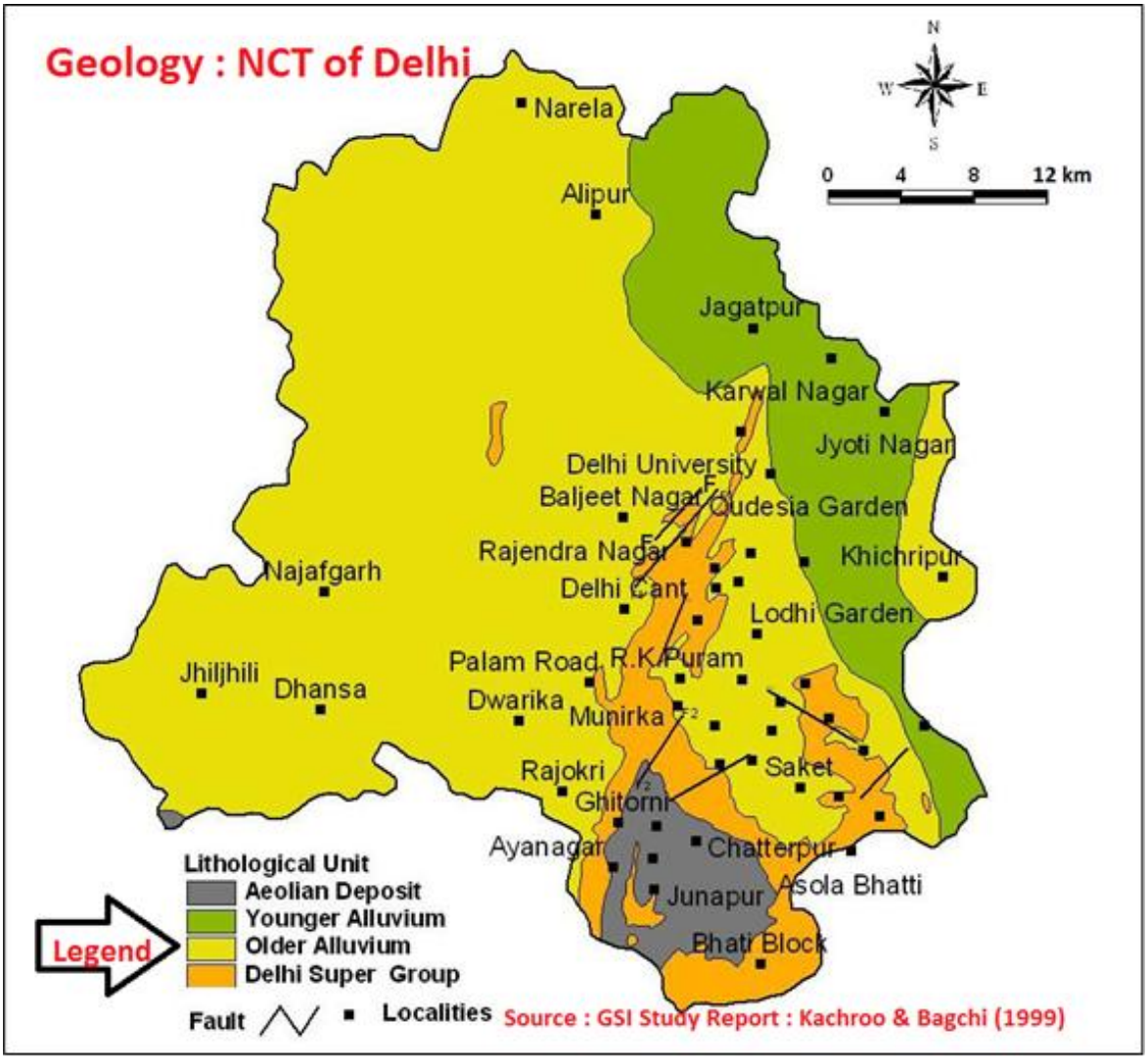


Figure 7: Geological Map NCT Delhi

In NCT Delhi region, exposures of the oldest litho-stratigraphic unit, the Delhi Quartzite ridge acts as main recharge zone to subsurface aquifer system. The Quaternary deposits in the form of aeolian and alluvial deposits are the major repository of ground water in the area. These two main hydrogeological units constitute main aquifer system for NCT Delhi.

Alluvium Aquifer

In NCT Delhi region, exposures of the oldest lithostratigraphic unit, the Delhi Quartzite ridge acts as main recharge zone to subsurface aquifer system. The Quaternary deposits in the form of aeolian and alluvial deposits constitute the major repository of ground water in the area. In the East of the ridge, the thickness of unconsolidated sediments gradually increases away from the ridge, with the maximum

reported thickness being 170 m. In the Southwestern, Western and Northern parts of the area, the thickness of sediments is more than 300 m except at Dhansa where the bedrock has been encountered at 297 m below land surface. In Chhattarpur basin, the maximum thickness of sediments is 116 m. The aeolian deposits of South Delhi are mainly comprised of loam, silty loam and sandy loam. The bedrock is overlain by these deposits. Older alluvial deposits consist mostly of interbedded, lenticular and inter fingering deposits of clay, silt, and sand along with kankar. These deposits are overlain by the newer alluvium, which occurs mostly in the flood plains of river Yamuna.

Hard Rock Aquifer

Quartzite is one of the most physically durable and chemically resistant rocks found in NCT of Delhi. The suits of quartzite and associated mica schist /phyllite bands of Delhi system have undergone multiple folding and different phases of metamorphism. When the mountain ranges are worn down by weathering and erosion, less-resistant and less-durable rocks are destroyed, but the quartzite remains. This is why Delhi Quartzite is so often the rock found as linear ridges ranges and covering their flanks as a litter of scree. One of the research study on weathering of Proterozoic quartzite in the semi-arid conditions around Delhi suggested that Quartzite being a resistant rock, dissolution of small amount of pyrites presence, by moving water produced a sulphate-bearing acidic solution and ferrous iron which reacted with aluminosilicate minerals and quartz respectively and has made the Delhi Quartzite porous and subsequent friable. The coupled weathering mechanism, from the core outward and also proceeded initially from fractures towards the inside, produced weathering rinds and subsequent physical erosion of loose sand, produced during rind development in the outermost zones, has given rise to features like tors, spheroids, gullies, cavities and small-scale caves on these quartzites. Thus, the terrain has acquired ruggedness in semi-arid conditions.

In one of the studies of GSI, it is reported three generations of folding in the rocks of Delhi. The fold axes of first-generation folds follow the trend of main ridge i.e. NNE-SSW, the second-generation folds trending NE-SW are observed at Tughlaqabad - Mehrauli area, and third generation fold trending NW-SE is observed at Anand Parbat. The rocks are highly jointed and two sets of conjugate vertical to sub-vertical joints have been reported. Another study of GSI has inferred a number of faults trending NNE-SSW, NE-SW and WNW-ESE.

4.1.3 Hydrogeology and Subsurface Aquifer Dispositions

Central Ground Water Board had been engaged in Ground Water Exploration in National Capital Territory of Delhi since its inception in 1972 and till date more than 327 boreholes are drilled out of which 151 are Exploratory Well (EW), 176 are Observation Well (OW) / Piezometers (Pz) / Slim holes. Locations of exploratory boreholes are shown in Fig. 13. All these boreholes were electrically logged to identify granular zones with fresh ground water and other lithological characteristics of subsurface litho units. All these studies have revealed that there is distinct variations in sub surface lithology characteristics and thickness of individual subunits of the main aquifer zone, within the Younger and Older alluvium deposits of NCT Delhi **(*refer Fig 8)*** which make the aquifer geometry of Delhi complicated and complex. Younger Alluvium confined to the flood plains of Yamuna River and also along the courses of major streams, comprises of clay/silt mixed with small mica flakes, and medium to coarse-grained sand and gravel whereas Older Alluvium comprises interbedded and lenticular deposits of clay, silt and sand ranging from very fine to very coarse with occasional kankar. In general, the Younger alluvium, the disposition of different sediments particularly the pervious layer constituting the unconfined aquifer is well delineated in the Yamuna flood plain area while in the older alluvium, the disposition of different lithological units is not well defined, and they are heterogeneous in nature, making it difficult to identify the deep aquifer zones which are regionally extensive, both vertically and laterally. In the Yamuna flood plain, Younger Alluvium thickness is about 40m thick and underlain with silty clay with kankar whereas the thickness of the Older Alluvium, mainly west of Delhi Ridge is highly variable and is dependent mainly on the configuration of the basement; at Shahbad Mohammadpur near IGI airport the thickness of the older alluvium is 560 meters overlying the bed rock. Whereas in areas underlain by hard rock units, mainly South, South East, Parts of New Delhi and Central district of NCT of Delhi, the aquifers are defined by the presence of fractured zones at different depths. These fractured zones at places are locally well defined but not regionally extensive.

The subsurface configuration of aquifers, in entire NCT of Delhi has been deciphered on basis of available lithological and geophysical logs of exploratory wells drilled by Central Ground Water Board under the Ground Water Exploration Programme. To mark the aquifer geometry, on the basis of these litholog data, the different sediments i.e. clay, silt, kankar and different grades of sand, and their admixture has been categorized as pervious (silt + kankar + sand) and impervious (mostly clay with

some silt + kankar). In the areas underlain by hard rock formation, upper most wreathed regolith and quartzite with fractured zones at different depths and associated mica schist bands constitutes unique Hard rock aquifer system.

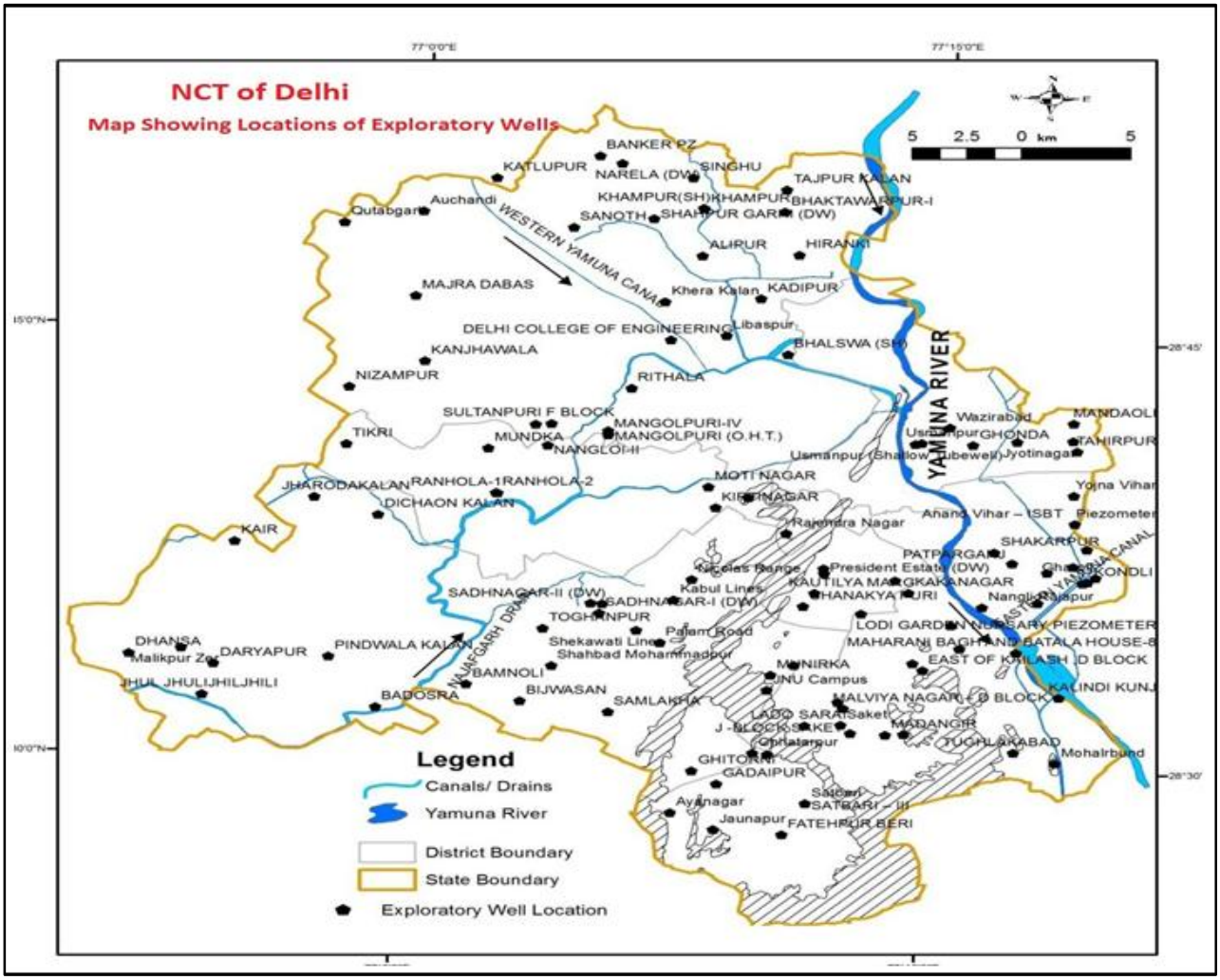


Figure 8: Location map of Exploratory Wells

In recent study taken by CGWB under NAQUIM Project, the detailed aquifer geometry on regional scale has been established in the NCT, Delhi. All available information about subsurface aquifer configuration, deciphered on basis lithological and geophysical logs of exploratory wells drilled by Central Ground Water Board under the Ground Water Exploration Programme along with interpreted records of various geophysical studies etc., are integrated to prepare the aquifer map. From the geological sections and fence diagrams prepared, principal aquifers in the area have been delineated by grouping the fine, medium, coarse sand and sand with gravels as sand. Top soil and silty clay or silt

at the surface have been grouped together. Weathered and fractured quartzite and the massive quartzite/ bedrock have been grouped together as weathered/ fractured quartzite (***Fig 9).***

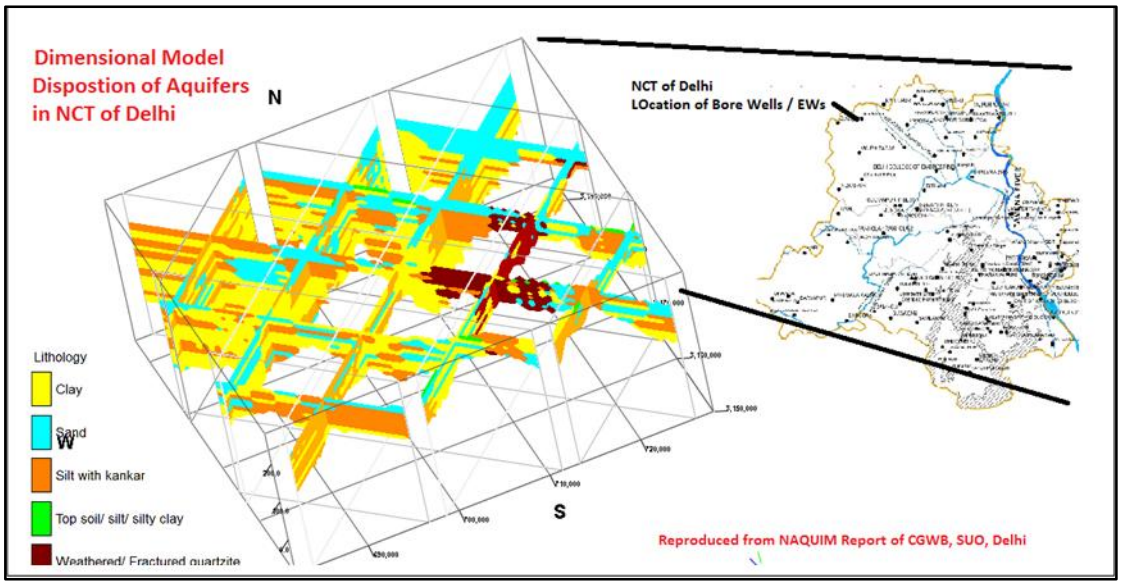


Figure 9: Aquifer Disposition Model

4.1.4 Fresh –Saline Ground Water Interface

Various hydrogeological and groundwater exploration studies in NCT of Delhi by CGWB has revealed that the thickness of fresh water in major part of the State varies from 20 to 40 m. It is also observed that no fresh water is available in a few pockets in Narela and Alipur tehsils of North District, Saraswati Vihar tehsil of Northwest district, Punjabi Bagh and Patel Nagar tehsils of West District, Najafgarh tehsil of Southwest district and Kalkaji tehsil of Southeast District (***Fig 10).***

In one of the recent studies undertaken under NAQUIM projects by WAPCOS, the granular zones (the aquifers) with varied resistivity were picked up from the combined interpretations of electrical resistivity (64 inches Normal) and gamma radioactivity logs of the boreholes drilled in the area. It shows that resistivity values greater than 10 ohm m to 50 ohm m represents predominately sand with fresh ground water. Resistivity less than 10 ohm m indicates predominately clay and kankar with saline water. Further lowering of resistivity values to 1 ohm m indicates further deterioration of water quality with depth. Resistivity of the order of 50 to 500 ohm m in hard rock (quartzite) area is represented by weathered/ fractured/ jointed quartzite which forms potential aquifer with potable water. In general, it is clear that fresh water sediments are followed by the saline water sediments in all over NCT of Delhi. The thickness of fresh water sediments is limited in major parts of NCT, Delhi. The depth to fresh-

saline water interface varies from 10 m bgl to 80 m bgl. Ground water quality below fresh saline water interface is saline all through up to the bedrock. At a few locations like Dhansa, Qutabgarh and Bankner, saline ground water is present at a very shallow depth. Panel diagram showing fresh-saline ground water interface in subsurface aquifer system of NCT of Delhi, is presented in ***Fig 11.***

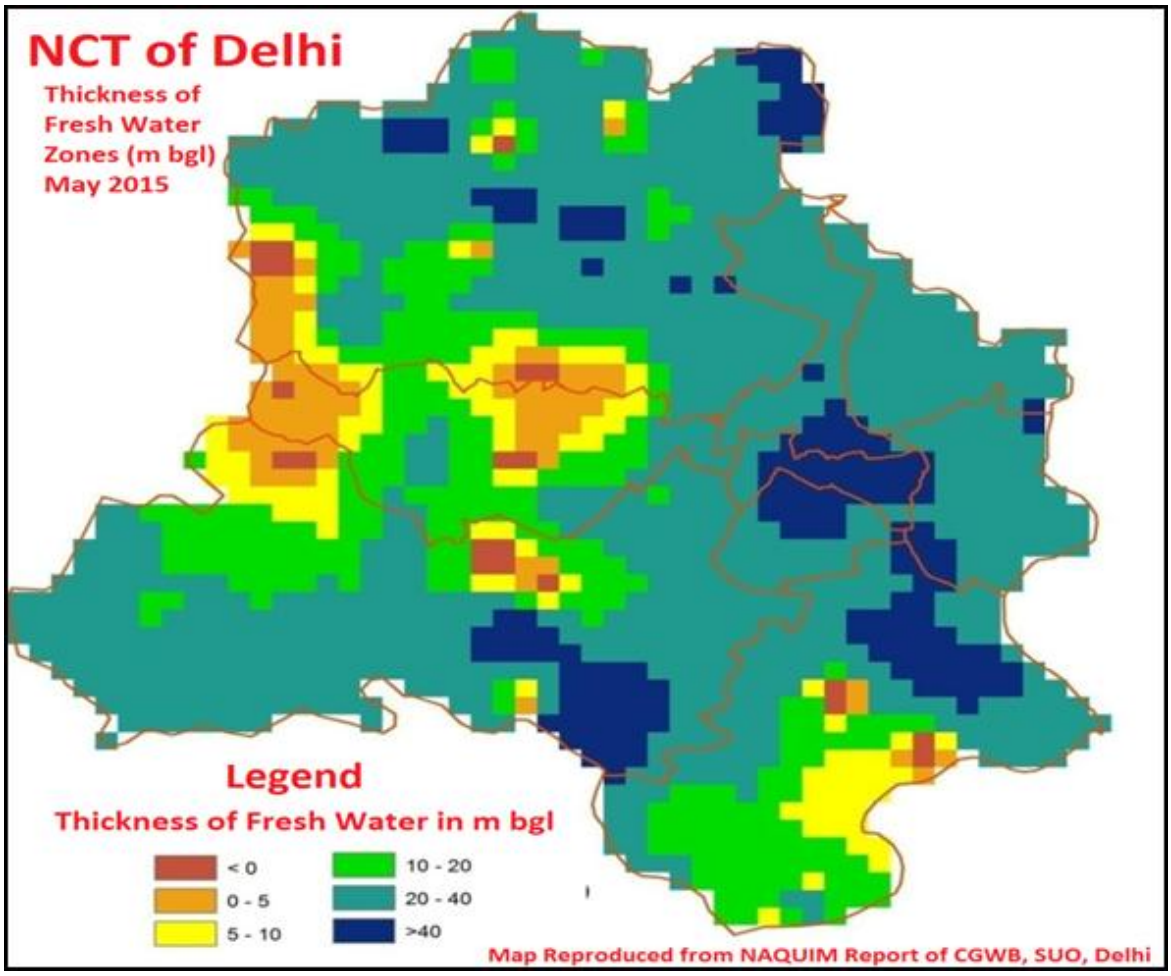


Figure 10: Thickness of Fresh Water

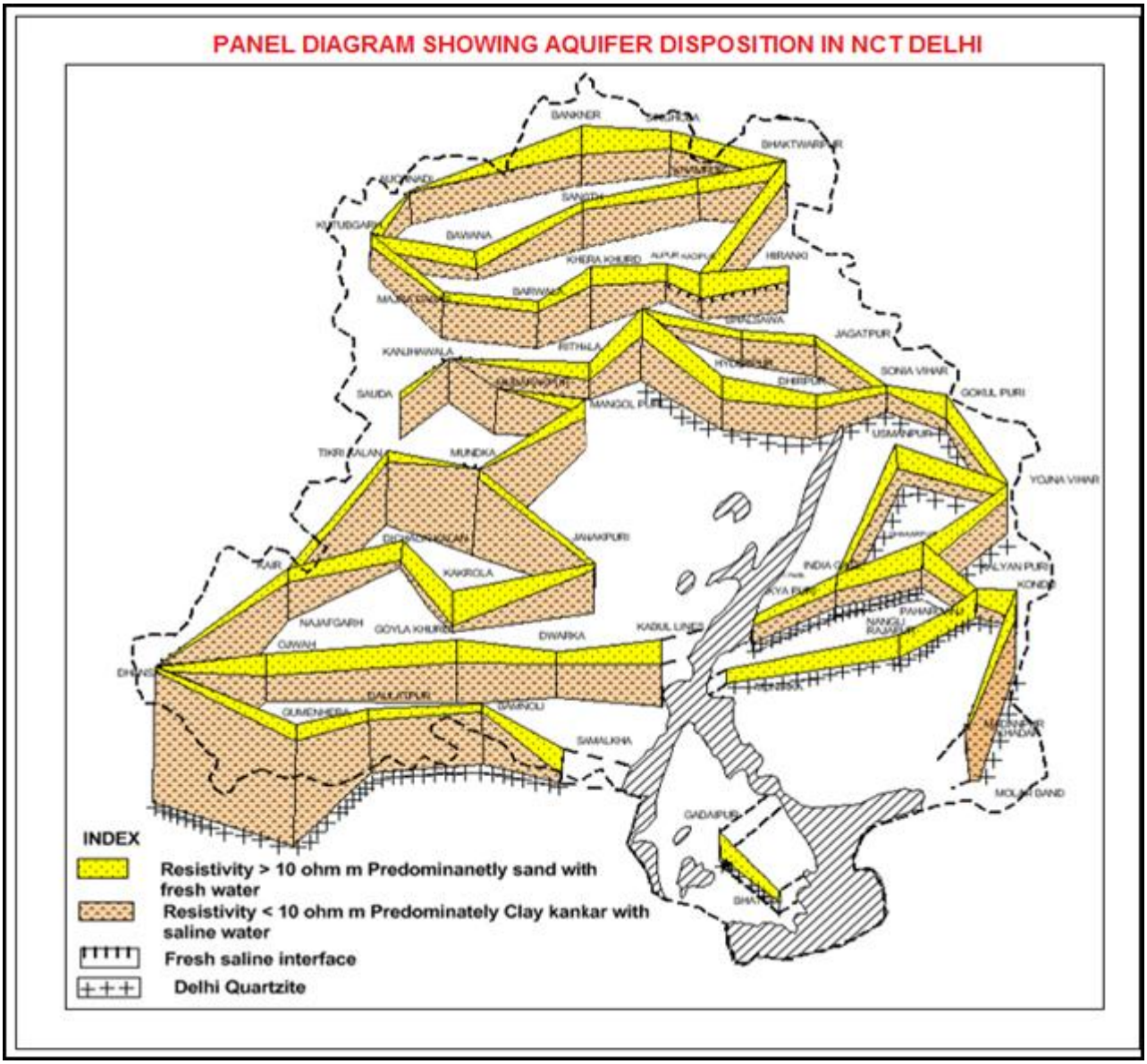


Figure 11: Panel Diagram of Aquifer Disposition

Perusal of ***Fig 11*** shows that in the South West district of NCT Delhi, bedrock is encountered at many places i.e. in Dhansa, Samalkha, Kabul lines, Jhuljhuli where fresh/saline water interface also varies greatly in entire area. All along the Najafgarh Drain and two depressions i.e., Gummanhera & Pindwalan Kalan, fresh water layer is somewhat deeper i.e. up to 35 m bgl but rest of the area is having thin layer of fresh water i.e. up to the depth 25 to 28 m bgl only. In the western parts of the district, the thickness of fresh water zone is limited. At a few locations like Dhansa, the saline ground water is present at a very shallow depth and as we move towards areas in the eastern part of the district, where hard rock is present, the thickness of fresh water aquifers is more, and fresh-saline water interface

occurs at deeper depth i.e. generally around 80 to 90 m bgl. At Rajokri, the depth of fresh-saline water interface has been observed to be 150 m bgl.

In West district, the depth of fresh-saline interface varies from 25 to 50 m bgl. The depth of fresh water zone varies from 10 to 45mbgl. The thickness of fresh water aquifers is more at places like Dichaon Kalan and Kakrola and fresh-saline interface is at deeper depths. While in the areas around Janakpuri, Mundka, the saline water is present at shallow depths.

In South district, depth of fresh-saline water interface varies from 75 to 100 mbgl. The thickness of fresh water zone varies from 30 to 85 m. At locations like Gadaipur, Bhatti and Munirka, fresh water aquifers are followed by hard rock (Delhi quartzite). In Southeast district, at places around Madanpur Khadar, the thickness of fresh water zones is limited. Here, fresh water aquifers are followed by saline water zone and bedrock is encountered at depth of around of 300 m.

In North West district, the depth of fresh-saline water interface varies greatly. The thickness of fresh water aquifers is limited in this district. At locations like Auchandi, Qutabgarh&Bankner, the saline water is present at shallower depths. In areas along Yamuna Flood Plain, fresh-saline water interface is at deeper depth i.e., around 40 to 70 m bgl, whereas in rest of the area it is 22 to 40 m. No bedrock has been observed up to the depth of 250 mbgl.

In Northeast district, thickness of fresh water aquifers is more in areas around Yamuna Flood Plain. The depth of fresh-saline water interface in Yamuna Flood Plain ranges between 32 and 50 mbgl whereas in rest of the area, it ranges from 25 to 38 m bgl.

In New Delhi and Central Districts, fresh water sediments are followed by saline water and then by quartzites (Delhi Ridge). In East & Shahdara districts, thickness of fresh water aquifers is more at locations like Kalyanpuri, Kondli and Shakurpur up to 60 mbgl.

Basement Topography

The configuration of the basement rock topography, below variable thickness of alluvium of NCT of Delhi, worked out based on subsurface geological data generated from exploratory drilling and supplementary geophysical data input revels its uneven basement topography in NCT Delhi area ***Fig 12.***

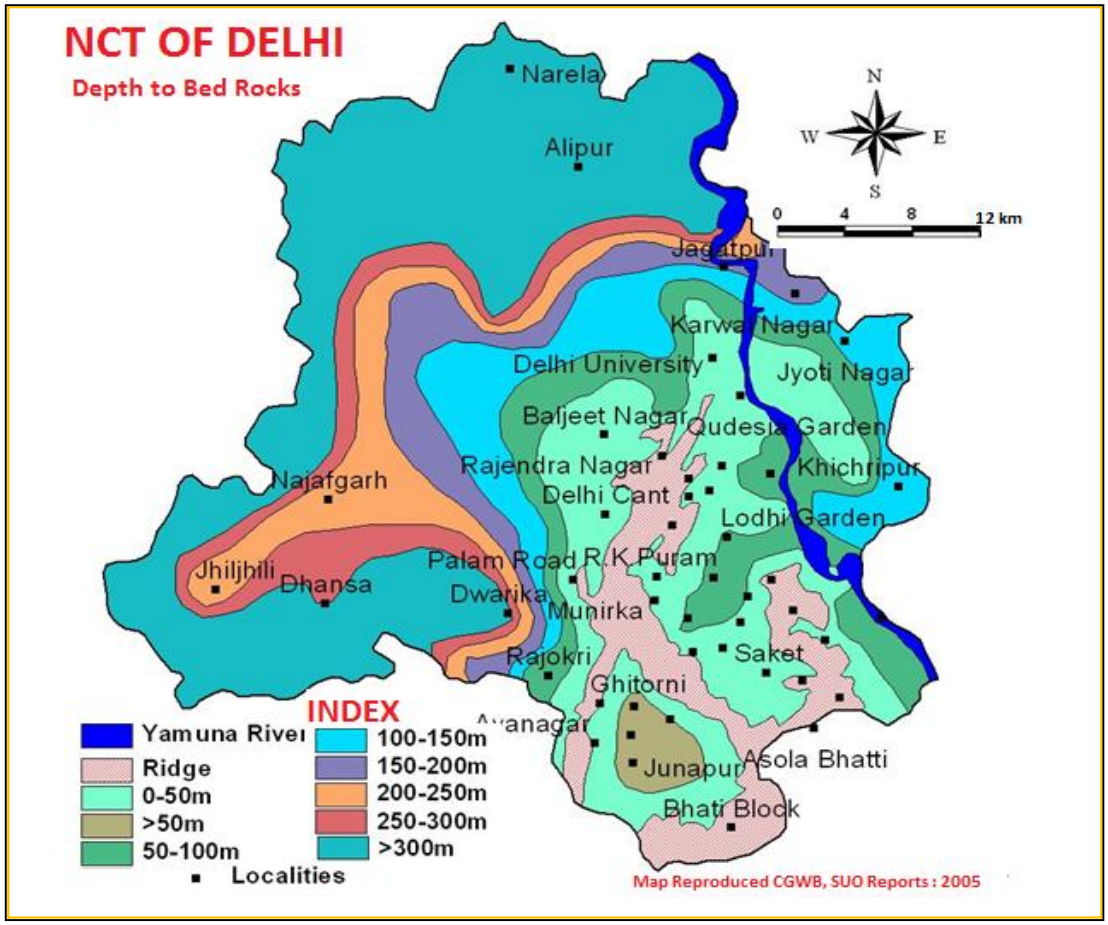


Figure 12: Depth to Bed Rock

CHAPTER 5

5.1 Ground Water Level Scenario In NCT of Delhi

5.1.1 Groundwater Level Scenario (2023)

5.1.1.1 Groundwater level data of pre-monsoon 2023

The Depth to groundwater level recorded in NCT Delhi during May-2023 ranges from 1.08 m bgl at Bhalaswa lake to 66.84 m bgl at Gadaipur. A map showing May 2023 groundwater levels in NCT of Delhi is given in ***Fig 13*** and areas under various depth zones is presented in ***Fig 14.*** Around 15 % of NCT Delhi have shallow water levels up to 5 m bgl which falls in parts of North West, North, West, Central, South West & South East. Deep water levels of 20 mbgl to 66 mbgl is observed in around 17 % of NCT Delhi, which falls mainly in South & New Delhi districts & small pockets of South East, North East, South West and Shahdara districts. In rest of NCT Delhi, i.e. 68 % of areas have water level ranging between 5 m bgl to 20 m bgl.

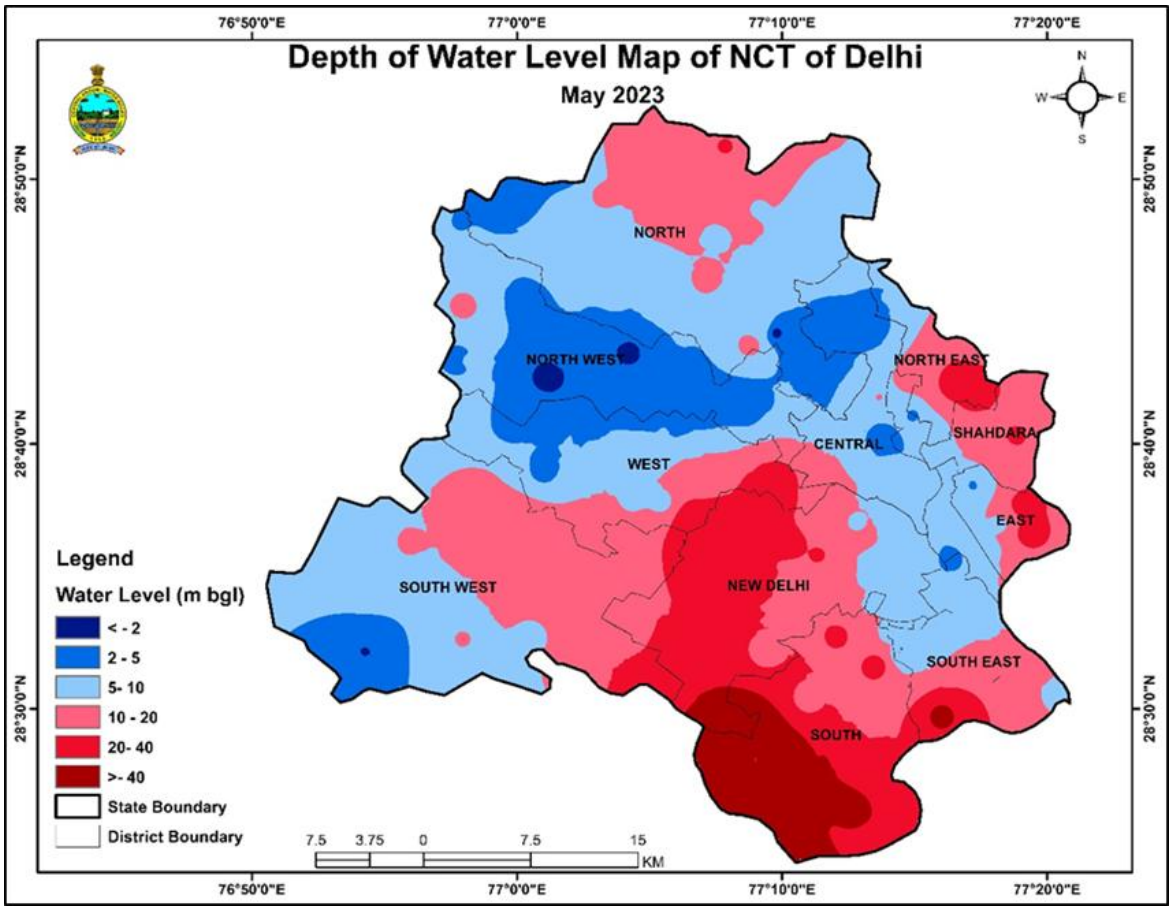


Figure 13: Depth to water level map May 2023

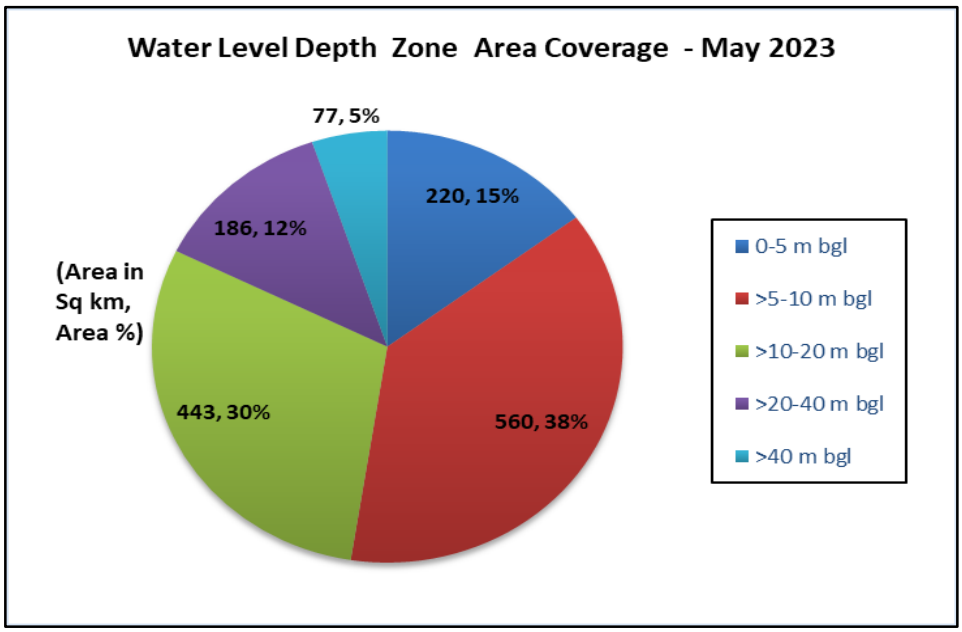


Figure 14: Area Coverage of water zone in May 2023

5.1.1.2 Groundwater level data for post-monsoon 2023

The Depth to water level recorded in NCT Delhi during November-2023 ranges from 0.84 mbgl at Rohini Sector 23 to 67.41 mbgl at Gadaipur. A map showing November 2023 groundwater levels in NCT of Delhi is given in ***Fig 15*** and areas under various depth zones are presented in ***Fig 16.*** Around 18 % of NCT Delhi, which falls in parts of North West, North, West, Southwest and small pockets of Central districts have shallow water level up to 5 m bgl. Deep water levels of 20 to 67 mbgl were observed in around 19 % of NCT Delhi, which falls in South, New Delhi, South East, Shahdara, East & North districts. In the rest of NCT Delhi, 63 % of areas have water levels in the range of 5 to 20 mbgl.

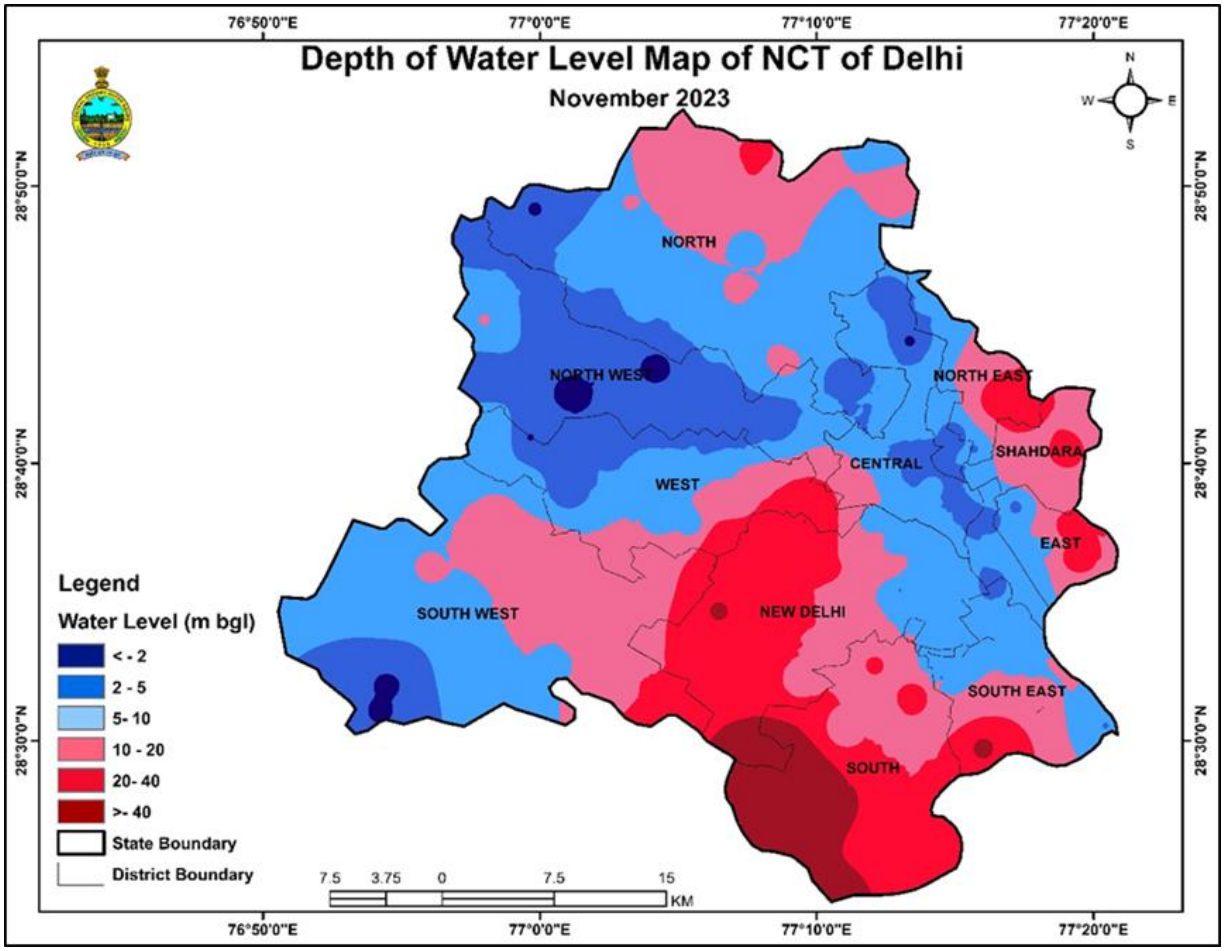


Figure 15: Depth to water level map November 2023

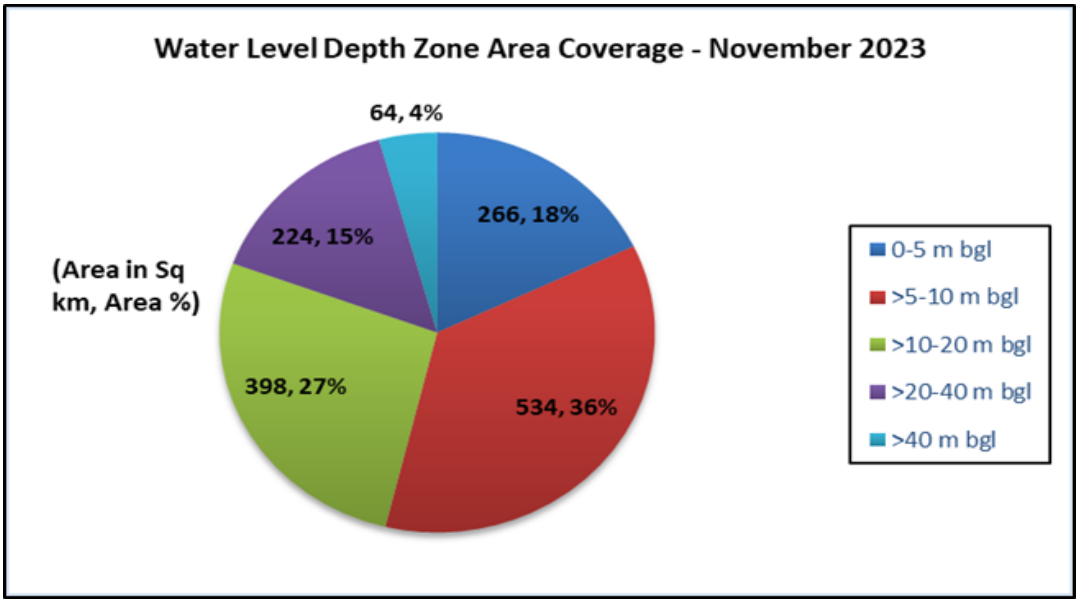


Figure 16: Area Coverage of water zone in November 2023

5.1.2 Fluctuation of Groundwater Level

5.1.2.1 Comparison of Pre-monsoon 2023 to Pre-monsoon 2022

The fluctuation of water level between May-2022 and May-2023 of NCT Delhi shows that some part of New Delhi district and South district show a considerable rise of >4 m and rise >2-4m in water level whereas most of the state shows water level rise between 0 m to 2m. The northeastern part of the state shows mostly fall in water level between 0 m to 2m. Nearly 42 % of the area of NCT Delhi shows a rise in water level while 58 % of area shows fall in water level ***Fig 17 & Fig 18.***

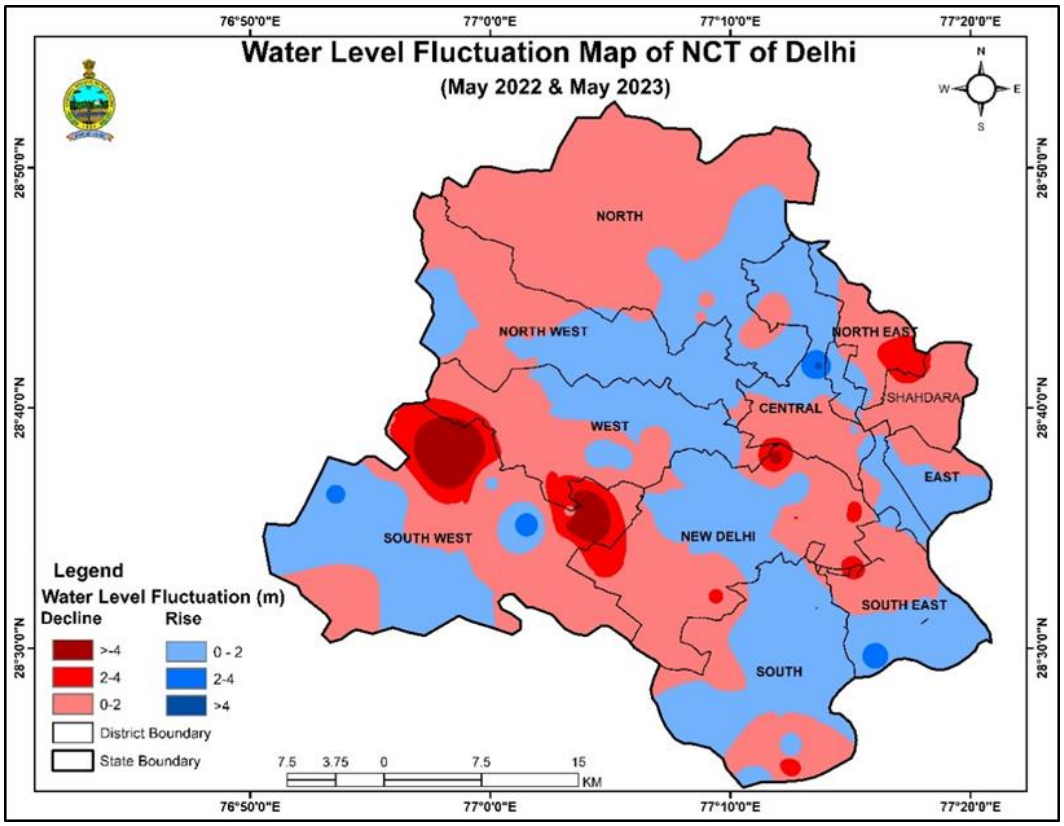


Figure 17: Annual Fluctuation map May 2022-May 2023

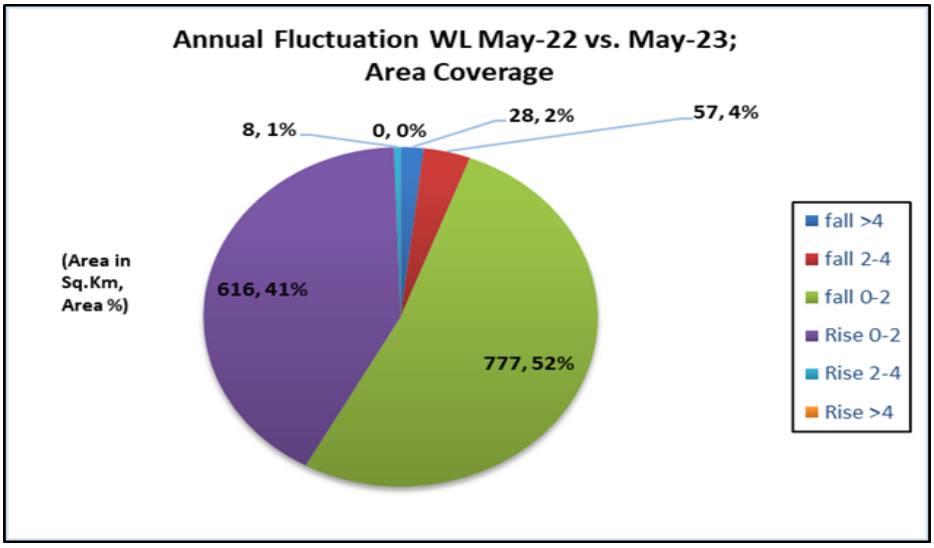


Figure 18: Area cover in Annual Fluctuation map May 2022-May 2023

5.1.2.2 Comparison of November 2023 to November 2022

Comparing water level data from November 2022 to November 2023, it is revealed that 48 % of monitoring stations show a rise in water level. The remaining 52 % of monitoring stations show a fall in water level ***Fig 19*** Nearly 36 % of NCT Delhi areas show a rise while 64 % of areas show fall ***Fig 20.***

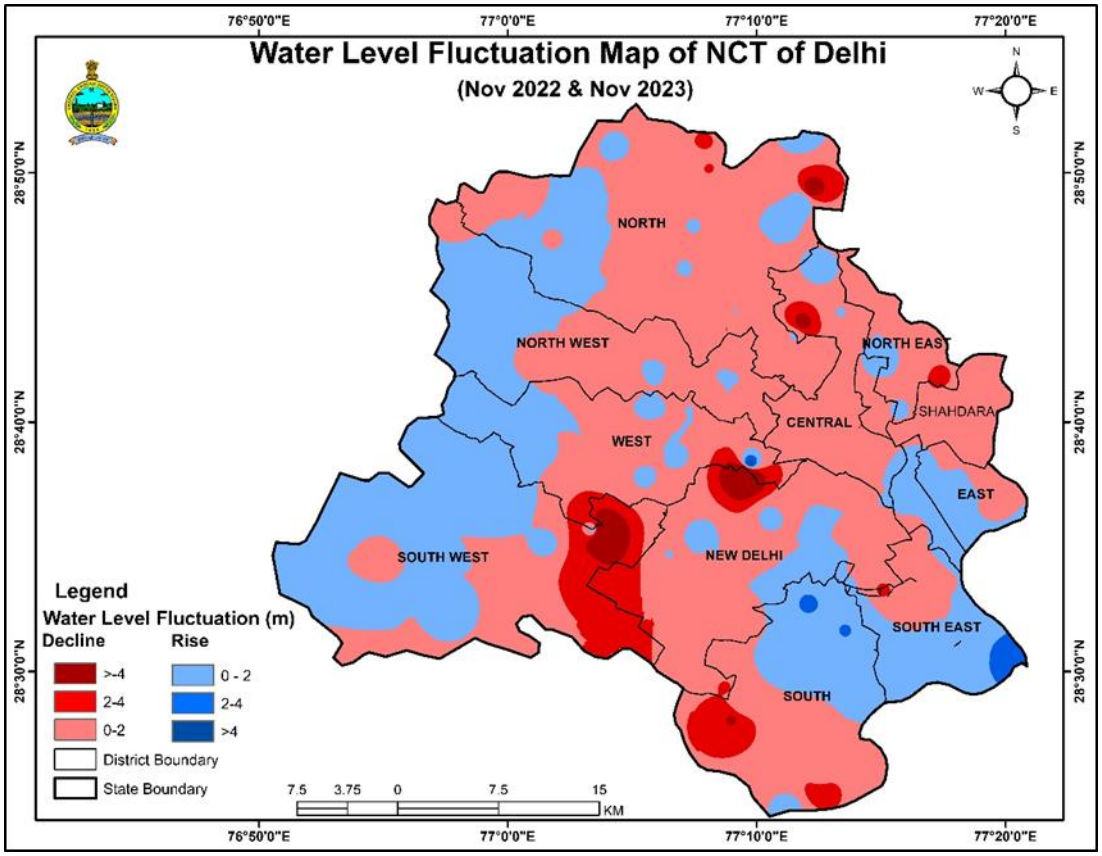


Figure 19: Annual Fluctuation map Nov 2022-Nov 2023

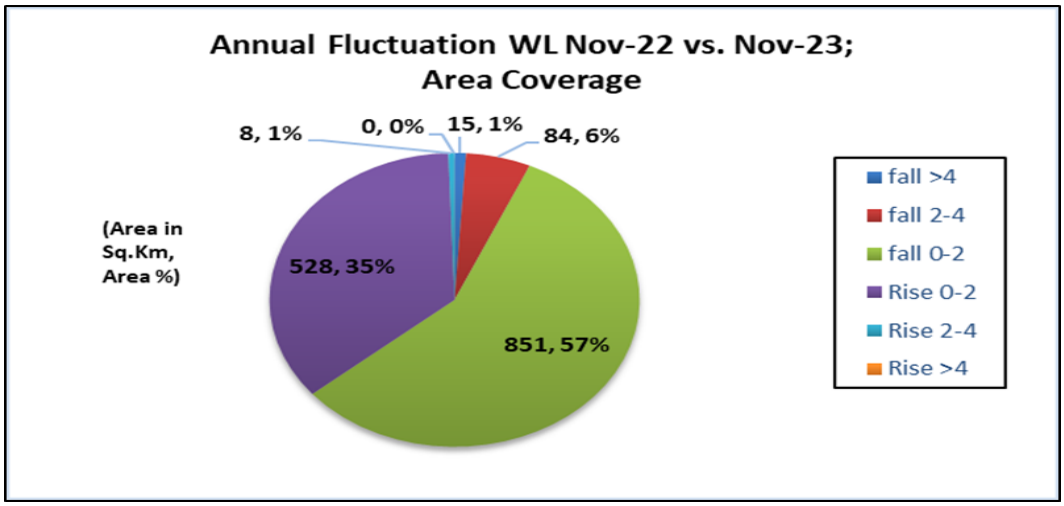


Figure 20: Area cover in Annual Fluctuation map Nov 2022-Nov 2023

5.1.2.3 Comparison of Pre-Monsoon 2023 with Decadal Mean of Pre-Monsoon (2013 to 2022)

Comparing the water level data of May 2023 with the 10-year mean water level of May (2013 to 2022), the change in water level ranges from -13.66 m to 17.70 m. Nearly 30 % of monitoring wells show a fall in water level of May 2023 when comparing the decadal mean of May water level of 2013-22,

whereas the rest 70 % of wells show a rise in water levels. The rise was mainly confined to the South-West, West, New Delhi, Central, South and South East. Chart showing the extent of areas having a change in rise and fall, computed from map grid, is presented in ***Fig 21 &Fig 22.***

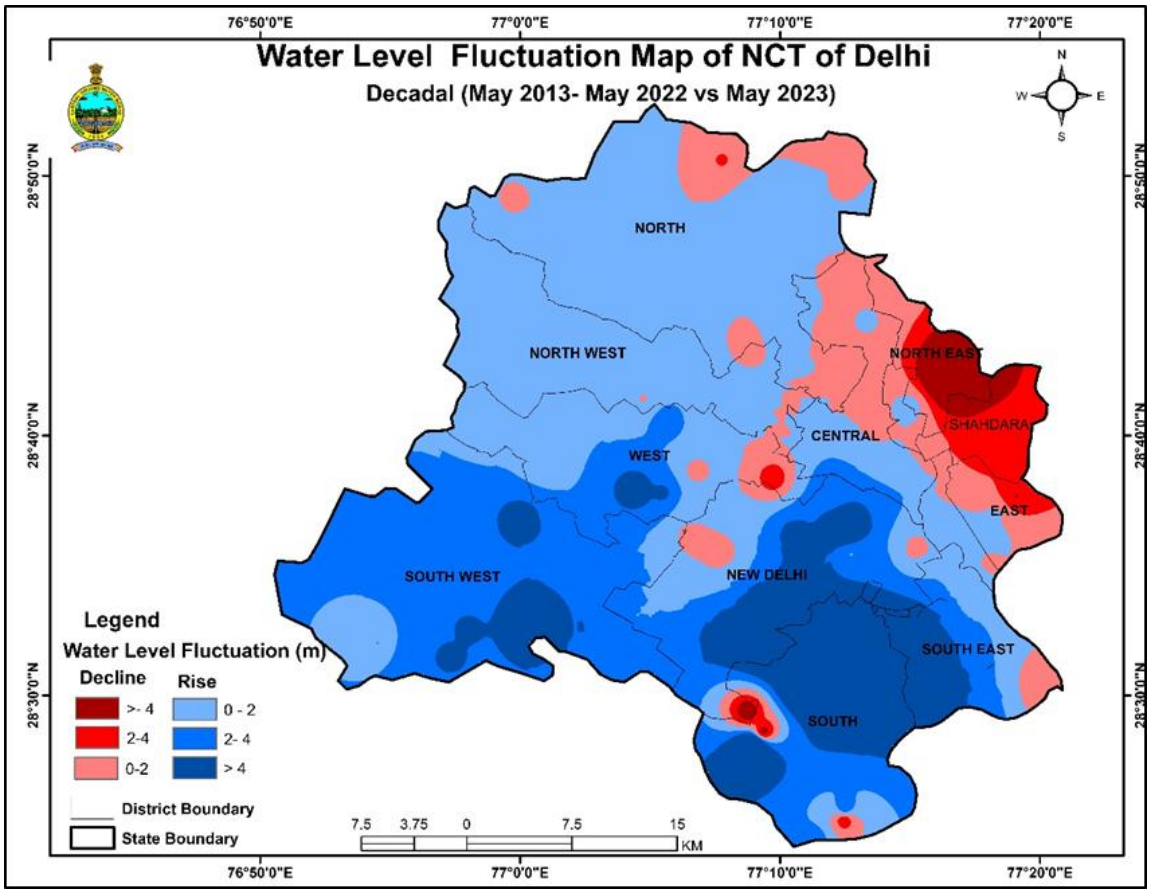


Figure 21: Decadal Fluctuation map May 2022-May 2023

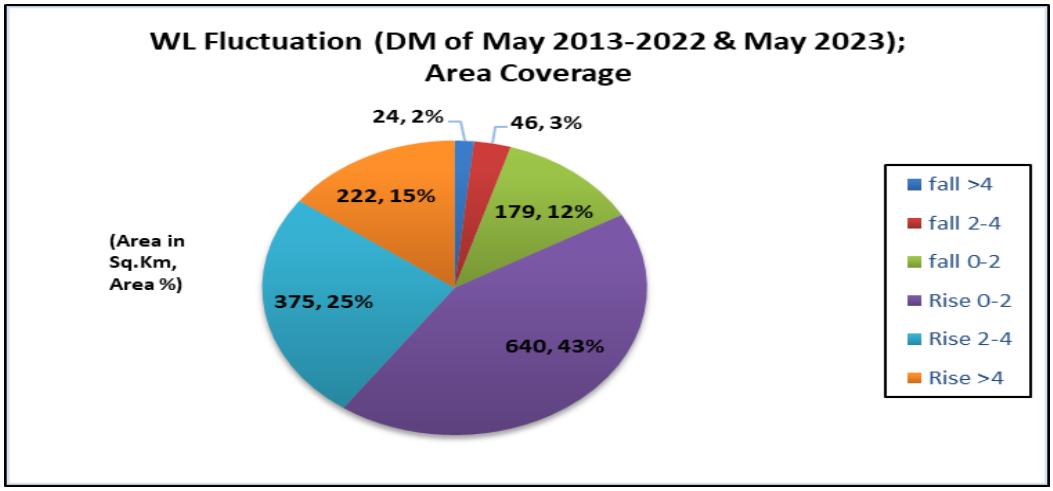


Figure 22: Area cover in Annual Fluctuation map May 2022-May 2023

5.1.2.4 Comparison of Post-Monsoon 2023 with Decadal Mean of Post-Monsoon (2013 to 2022)

Comparing the water level data of November 2023 with the 10-year mean water level of November (2013 to 2022), the change in water level ranges from -17.79 m to 16.97 m. Nearly 78 % of monitoring wells show in rise of water level of November 2023, comparing the decadal mean of the November water level of 2013-22, whereas rest 22 % of monitoring wells show a fall of water level ***Fig 23.*** A chart showing the extent of areas having a change in rise and fall, computed from the map grid is presented in ***Fig 24.***

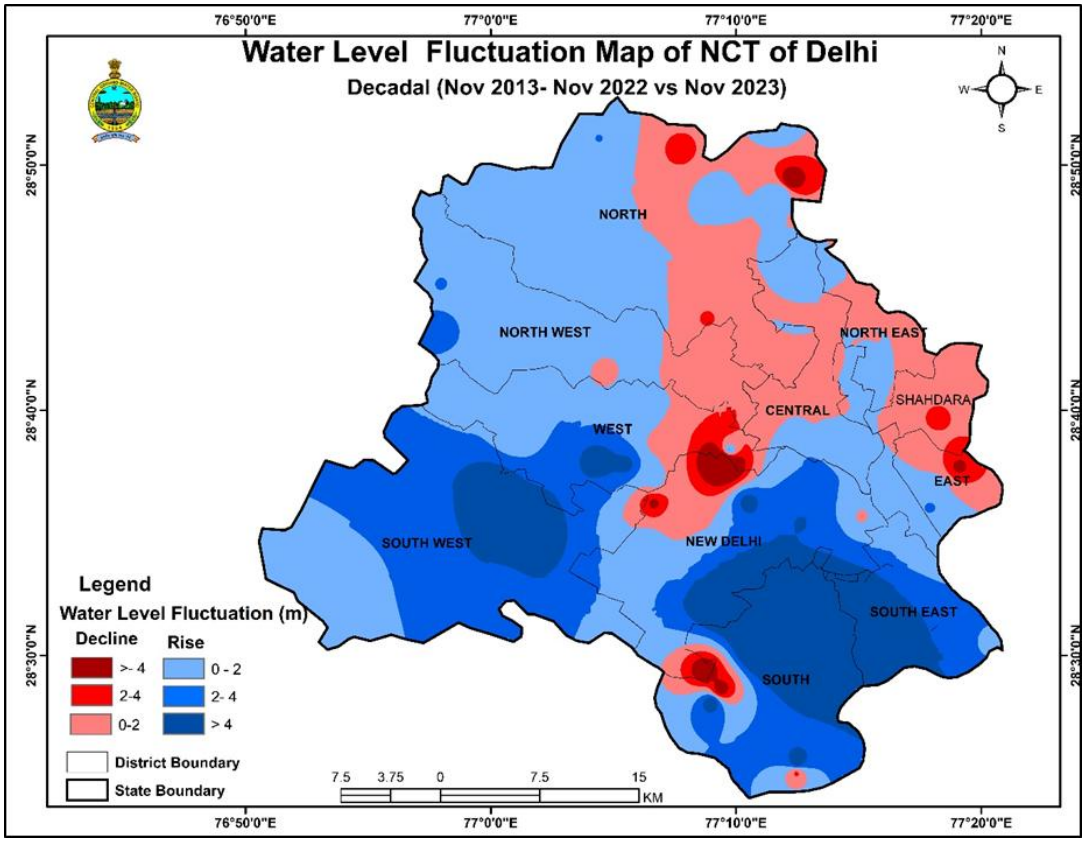


Figure 23: Decadal Fluctuation map Nov 2022-Nov 2023

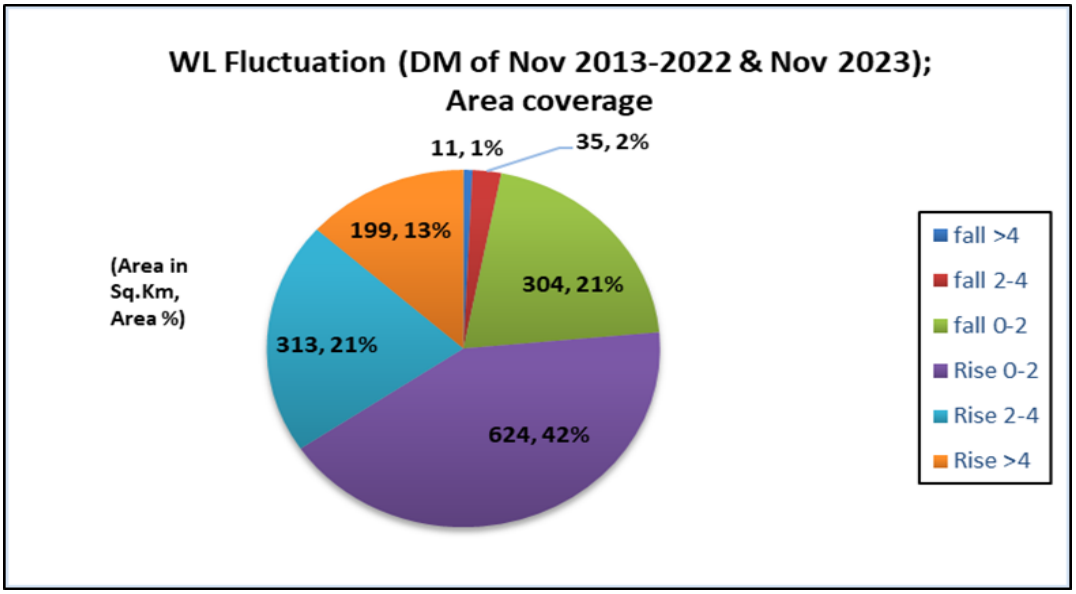


Figure 24: Area cover in Decadal Fluctuation map Nov 2022-Nov2023

CHAPTER 6

6.1 Ground Water Resources of NCT Delhi

6.1.1 Annual Ground Water Recharge

The annual groundwater recharge includes the components of rainfall recharge and recharge from other sources like canal/drain seepage, return flow from irrigation, seepage from domestic water supply and recharge from water conservation structure. The Annual Groundwater Recharge for NCT Delhi 2024 is estimated as 37989.37 ham. Assessment unit-wise details of estimation are presented in ***Annexure VI (column 5 to 7).***

6.1.2 Annual Extractable Ground Water Resources

The annual extractable groundwater recharge as defined in GEC 2015 methodology, involving component of monsoon & non-monsoon recharge and excluding components for natural discharge for the environment, following GEC 2015 norms has been estimated for NCT Delhi is 34190.44 ham. Assessment unit wise details of estimation are presented in ***Annexure VI (column 9).***

6.1.3 Annual Total Ground Water Extraction

During the year under report, almost all departments & Institutions of NCT Delhi have provided geo-referenced extraction data which has been further distributed over Tehsil layer by CGWB to find out tehsil wise extraction. The running hours and discharge have been averaging out as demand of Software. Industrial extraction data was not provided and have been considered on pro rata basis.

The total ground water extraction as defined in GEC 2015 methodology, involving component of domestic ground water extraction, irrigation extraction and industrial extraction has been estimated for NCT Delhi is 34454.46 ham. Assessment unit wise details of ground water extraction are presented in ***Annexure VI (Column 10 to 13).***

6.1.4 Stage of Groundwater Extraction

The Stage of Ground Water Extraction as on 2024 in NCT Delhi varies from 63.96 % in Nazulland to 146.33 % in Yamuna Vihar tehsil of North East District. The overall Stage of Groundwater Extraction in NCT Delhi as on 2024 is 100.77 %. The information on Stage of Ground Water Extraction is given in ***Annexure VI (column 16).***

As per recommendation of GEC 2015 methodology, the Dynamic Groundwater Resources (fresh quality) be planned for future ground water management. Out of 34 new assessment units of NCT Delhi, 5 are categorized as 'Safe', 2 as 'Semi Critical', 13 as 'Critical' and rest 14 as 'Over Exploited'. A summarized data on categorization all 34 assessment units of NCT Delhi is presented in ***Annexure VI (column 17).*** A map showing categorization of assessment units (Tehsils of NCT Delhi) is presented in ***Fig 27.***

6.1.5 Annual Allocation for Domestic use and Net Ground Water Availability for future use

Annual Allocation for Domestic use for 2025 has been estimated as 27815.65 ham, for entire NCT Delhi. The Assessment unit wise Annual Allocation for Domestic Use as on 2025 is presented in ***Annexure VI column 14***. The Net Ground Water Availability for future use in NCT Delhi is 2414.96 ham ***(Annexure VI column 15).***

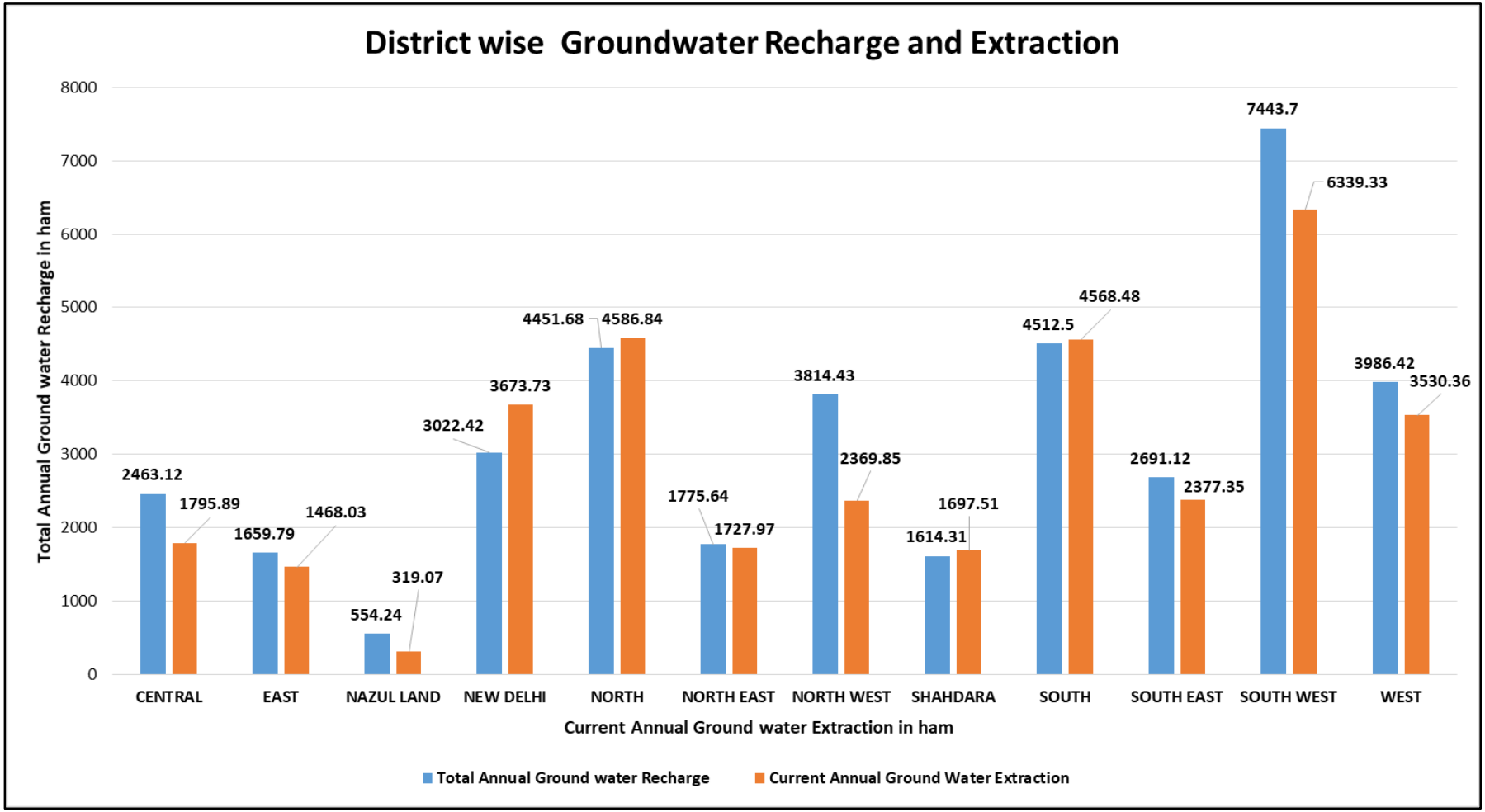


Figure 25: District Wise Groundwater Recharge & Extraction

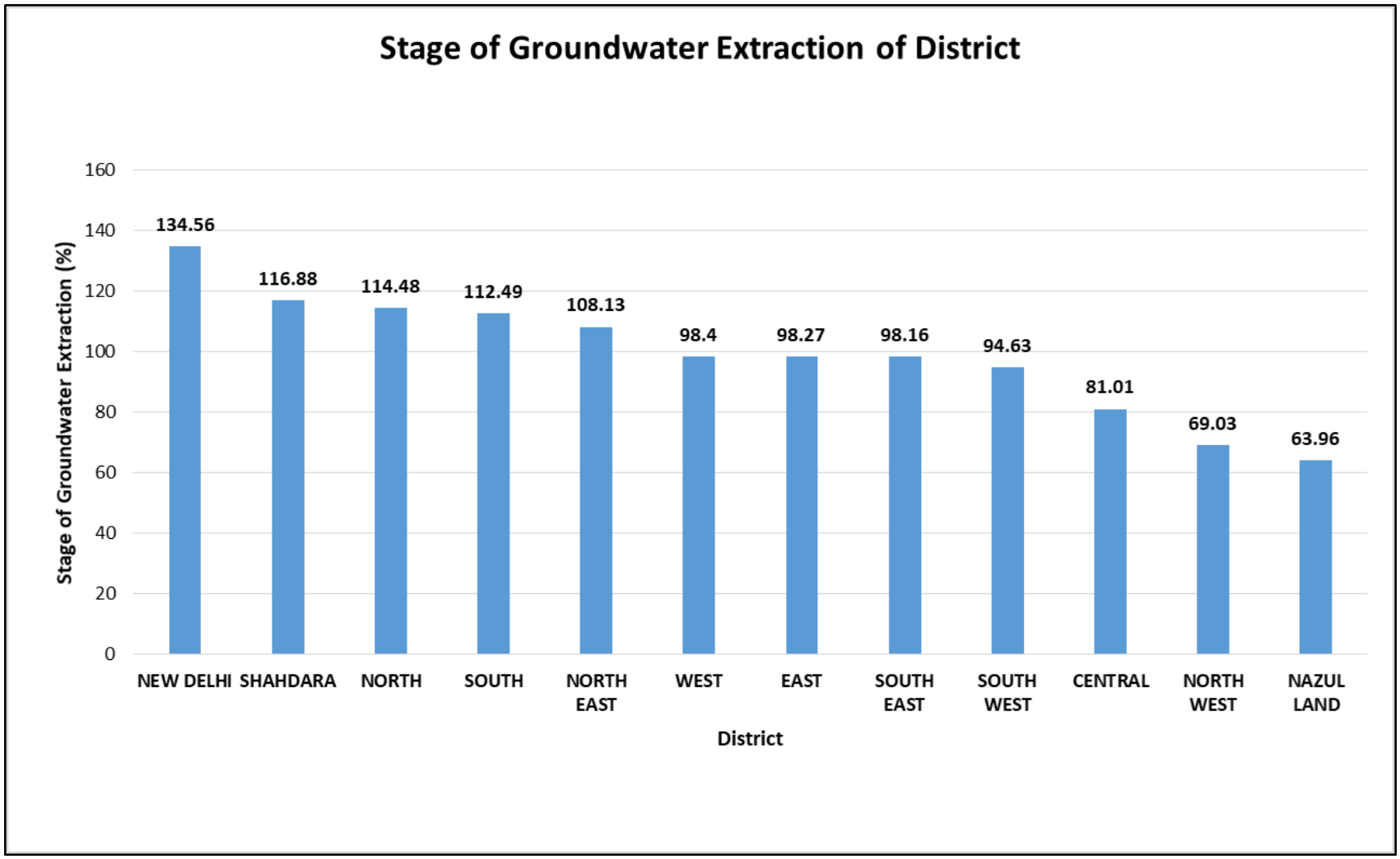
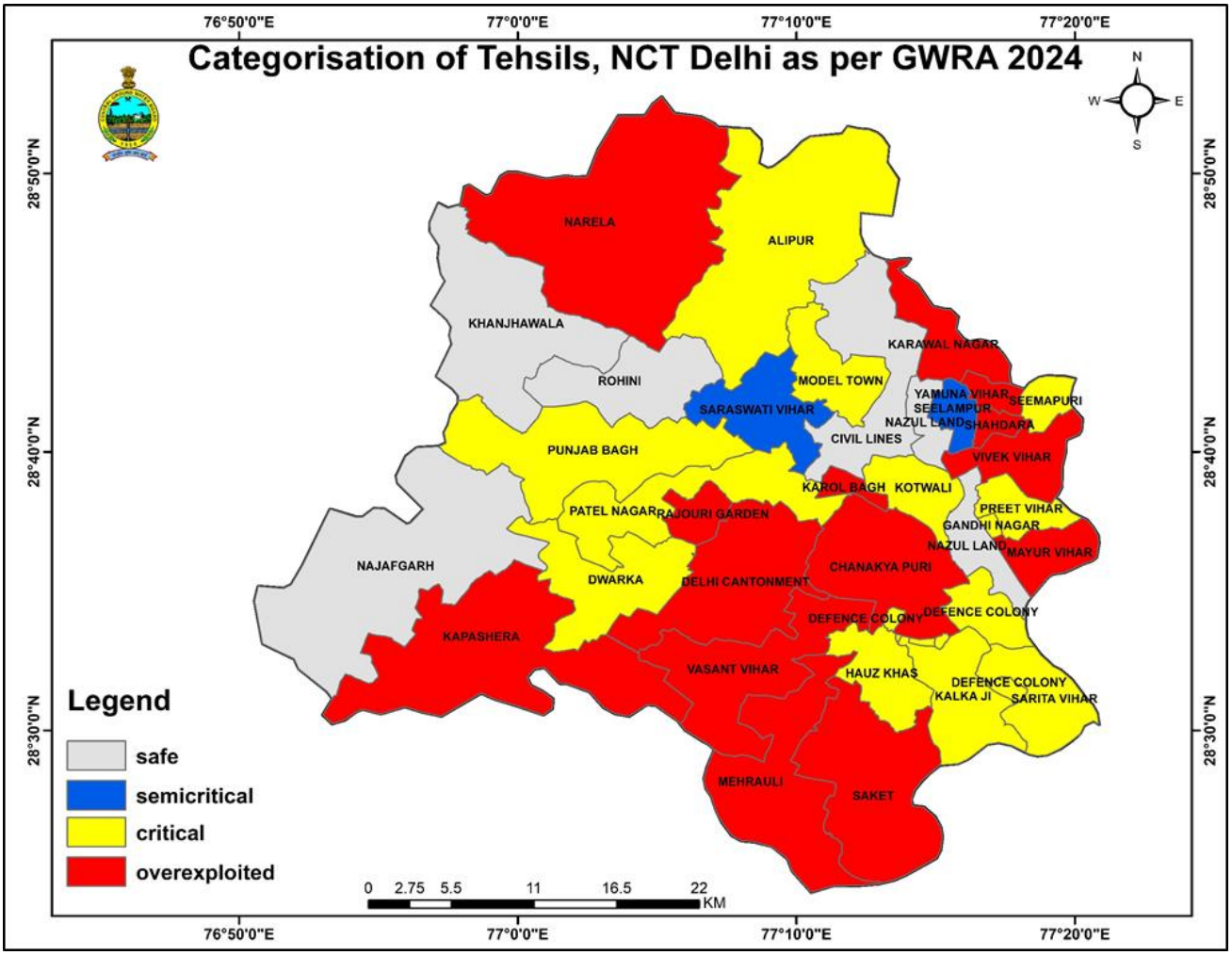


Figure 26: Stage of Groundwater Extraction District Wise

6.2 Categorization of Assessment Units



6.3 Comparison with Previous Assessment

The comparison of GWRE 2024 with the previous estimates of 1991, 2004, 2009, 2011, 2013, 2017, 2020 & 2023 has been presented in the Table No. 14 shows a decline trend. This is on account of more refined methodology and refined database over the period. From year 2004 onward more refined GEC 1997 methodology was in vogue for next three assessments. Moreover, the database on which computation were carried out was updated continuously. In year 2013, data pertaining to canals / drains were updated which reflected as positive impact on the total ground water recharge. Further, there was reduction in domestic Ground Water Extraction which was attributed to the increased piped (surface)

water supply by DJB during the period of assessment. The regulation on drilling of new bore wells in whole NCT Delhi has also contributed to lesser dependency on groundwater and all these factors led of slightly lower development.

Comparison of present GWRE 2024 with earlier estimates is presented in ***Fig 28.***

Table 14: Comparison of present GWRE 2024 with earlier estimates

Methodology	1991	2004	2009	2011	2013	2017	2020	2022	2023	2024
	GEC 1984	GEC 1997				GEC 2015				
Total Annual Recharge (ham)	29154	29710	31501	31050	34192	30090	31811.76	41051.64	38153	37989
Total Ground water Extraction (ham)	16840	47945	39619	39215	38785	35990	29032.77	36267.14	34151	34190
Stage of Ground water Development (%)	58	161	125	126	113	119	101.4	98.16	99.13	100.7

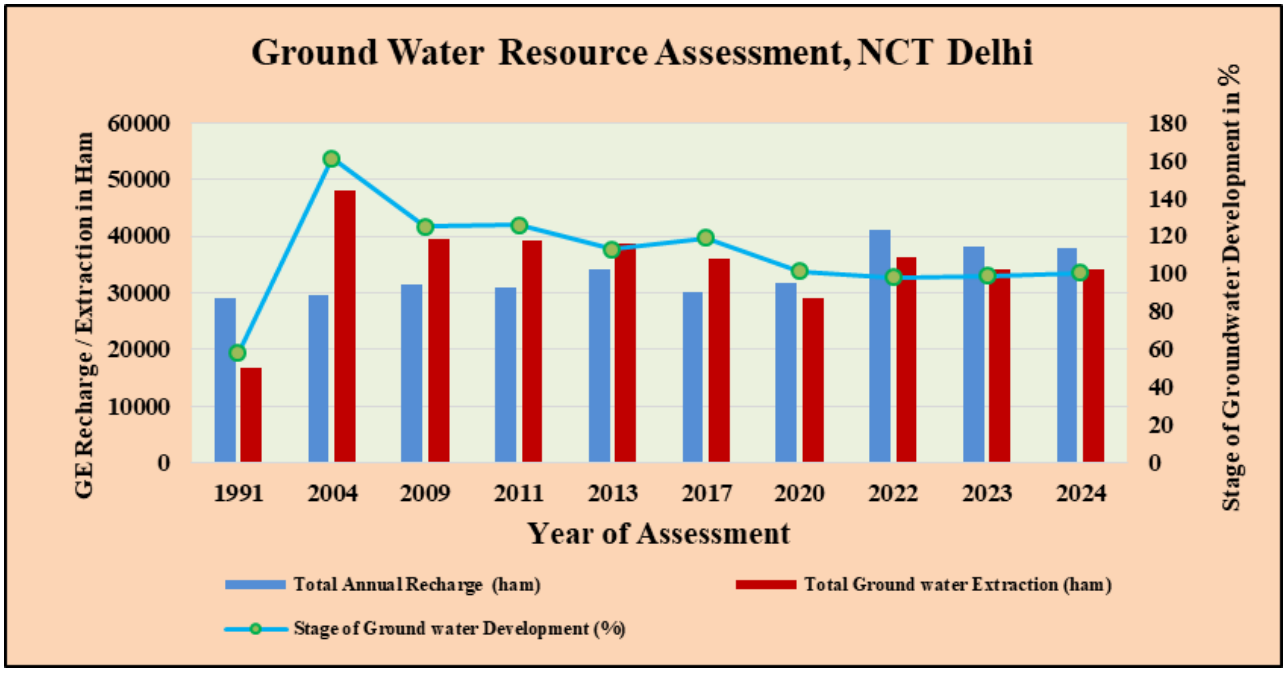


Figure 27: Categorization of Assessment Units

Perusal of above, table 14 and figure 28 reveals that the stage of ground water extraction for NCT Delhi, from year 2009 onward when refined GEC Methodology is adopted for tehsil wise resource

estimation, has remained changing (more improvement). Compared to estimate of year 2009, 2011, 2013, 2017 and 2020 there is less annual replenishable recharge in present (GWRE 2024) & 2023 estimates. The reduced groundwater recharge compared to the earlier estimation can be corroborated with diminishing average annual rainfall over last five years and extreme climate events despite refinement of data pertaining to recharge from water conservation structure. This can further be collaborated with the significant decreasing trend in annual rainfall in NCT Delhi areas, as per analysis of rainfall data study report of IMD. Similarly, reduced ground water extraction compared to the earlier estimate can be attributed less dependency on ground water resources over the period of assessment, for drinking water supply in NCT Delhi by implementation/coverage of large additional pockets by piped water supply of DJB. Moreover, increased urbanization also resulted less ground water extraction for agriculture uses. However, overall development status remained around 99 %, i.e., extraction is almost equal to the annual replenishable recharge.

CHAPTER 7

7.1 Conclusions

It can be concluded that Dynamic Ground Water Resource of NCT Delhi is improving in certain districts of NCT Delhi because of implementation of interventions suggested by Hon'ble NGT, CGWB, the use of treated water for Irrigation, improvement of water supply of Delhi Jal Board and less dependency on groundwater.

As far as geo-referenced data of ground water extraction & water conservation structures is concerned this is most vital input to INGRES for groundwater estimation, all departments of NCT Delhi & Govt. of India, are recommended to maintain meticulous records of ground water extraction & water conservation to be used in GWRE 2025.

ANNEXURES

Annexure-I Groundwater resources availability, utilization, and stage of extraction (as in 2024)

S.No	DISTRICT	Assessment Unit	Area in (sq km)	Ground Water Recharge (ham)			Total Natural Discharge (Ham)	Annual Extractable Groundwater Resources (ham)	Annual Ground Water Extraction(ham)				Allocation of Groundwater Resources For future Domestic Utilisation (han)	Net Annual Ground Water Availability for Future Use (ham)	Stage of Groundwater Extraction (%)
				Recharge from Rainfall	Recharge from other sources	Total Annual Groundwater Recharge			Irrigation	Industrial	Domestic	Total			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	CENTRAL	CIVIL LINES	54.54	278.47	1308.46	1586.93	158.693	1428.237	209.82	0	778.9632	988.7832	778.96	439.46	69.23
2	CENTRAL	KAROL BAGH	5.125	21.31	146.29	167.6	16.76	150.84	19.17	0	161.46	180.626	744.35	0	119.75
3	CENTRAL	KOTWALI	19.64	58.62	649.97	708.59	70.859	637.731	19.58	0	606.9	626.484	606.9	11.25	98.24
4	EAST	GANDHI NAGAR	1.389	6.06	83.36	89.42	8.942	80.478	2.56	0	70.3	72.86	227.56	7.62	90.53
5	EAST	MAYUR VIHAR	16.77	74.96	737.09	812.05	81.205	730.845	70.98	0	670.9536	741.9336	670.95	0	101.52
6	EAST	PREET VIHAR	13.44	59.38	698.95	758.32	75.832	682.48	45.45	0.2	607.59	653.24	607.59	29.24	95.72
7	NAZUL LAND	NAZUL LAND	25.79	373.62	180.62	554.24	55.424	498.816	232.8	0	86.27303	319.073	86.27	179.75	63.96
8	NEW DELHI	CHANAKYAPURI	35.08	305.31	335.86	641.17	64.117	577.053	370.26	0	373.1863	743.4463	373.19	0	128.84
9	NEW DELHI	DELHI CANTONMENT	65.8	323.48	805.48	1128.96	112.896	1016.064	171.25	2.2	1124.257	1297.711	1124.26	0	127.72
10	NEW DELHI	VASANT VIHAR	57.21	485.42	766.87	1252.29	125.229	1127.061	145.35	0	1487.219	1632.574	1487.22	0	144.85
11	NORTH	ALIPUR	118.18	755.2	1081.72	1836.92	183.692	1653.228	249.96	0	1380.92	1630.879	1380.92	22.35	98.65
12	NORTH	MODEL TOWN	25.38	99.66	473.41	573.07	57.307	515.763	66.15	0.3	442.0541	508.5041	472.7	7.25	98.59
13	NORTH	NARELA	147.58	1174.15	867.54	2041.69	204.169	1837.521	175.7	50.01	2221.76	2447.463	2221.76	0	133.19
14	NORTH EAST	KARAWAL NAGAR	21.14	90.2	587.72	677.91	67.791	610.11	73.95	0	647.312	721.262	647.31	0	118.22
15	NORTH EAST	SEELAMPUR	8.959	38.05	769.58	807.63	80.763	726.867	38.77	0	585.9045	624.6775	585.9	102.19	85.94
16	NORTH EAST	YAMUNA VIHAR	5.573	19.78	270.32	290.1	29.01	261.09	42	0	340.0367	382.0367	340.04	0	146.33
17	NORTH WEST	KANJHAWALA	80.39	841.12	179.63	1020.75	102.075	918.675	96.6	0	532.343	628.943	1007.38	289.73	68.46
18	NORTH WEST	ROHINI	40.98	238.53	2011.64	2250.17	225.017	2025.153	238.32	0	1073.927	1312.247	1073.93	712.9	64.8
19	NORTH WEST	SARASWATI VIHAR	32.99	160.45	383.06	543.51	54.351	489.159	176.4	0.56	251.7023	428.6623	331.38	60.5	87.63
20	SHAHDARA	SEEMAPURI	7.243	28.14	521.71	549.85	54.985	494.865	53.13	0	437.8729	491.0049	437.87	3.86	99.22
21	SHAHDARA	SHAHDARA	4.902	16.54	401.23	417.77	41.777	375.993	22.4	0	438.4795	460.8825	468.25	0	122.58
22	SHAHDARA	VIVEK VIHAR	22.44	70.26	576.43	646.69	64.669	582.021	262.89	0.5	482.2358	745.6278	482.24	0	128.11
23	SOUTH	HAUZ KHAS	24.72	131.83	973.57	1105.4	110.54	994.86	191.14	0	797.3764	988.5139	797.38	6.34	99.36
24	SOUTH	MEHRAULI	61.16	316.38	815.98	1132.36	113.236	1019.124	71	0	1210.879	1281.879	1210.88	0	125.78
25	SOUTH	SAKET	71.97	723.13	1551.61	2274.74	227.474	2047.266	447.76	0	1850.328	2298.088	1850.33	0	112.25
26	SOUTH EAST	DEFENCE COLONY	39.38	230.45	782.1	1012.53	101.253	911.28	90.52	1.6	792.7673	884.8873	792.77	26.39	97.1
27	SOUTH EAST	KALKAJI	33.94	248.42	767	1015.42	101.542	913.878	23.25	7.5	870.8667	901.6119	870.87	12.26	98.66
28	SOUTH EAST	SARITA VIHAR	30.2	199.64	463.54	663.17	66.317	596.86	106.4	3.64	480.8124	590.8524	480.81	6.01	98.99
29	SOUTH WEST	DWARKA	67.84	496.01	2037.22	2533.23	253.323	2279.907	1014.9	0	1259.086	2273.986	1259.09	5.92	99.74
30	SOUTH WEST	KAPASHERA	108.79	1130.78	1153.99	2284.77	228.477	2056.293	1703.66	0	711.2266	2414.887	821.21	0	117.44
31	SOUTH WEST	NAJAFGARH	128.53	1359.86	1265.84	2625.7	262.57	2363.13	1262.9	0	387.5617	1650.462	777.59	322.64	69.84
32	WEST	PATEL NAGAR	26.46	357.17	1237.04	1594.21	159.421	1434.789	287.63	0.5	1121.784	1409.909	1121.78	24.88	98.27
33	WEST	PUNJABI BAGH	73.6	991.56	821.87	1813.43	181.343	1632.087	404.92	0.1	1082.643	1487.663	1082.64	144.42	91.15
34	WEST	RAJOURI GARDEN	10.48	55.72	523.06	578.78	57.878	520.902	39.43	0	593.3686	632.8006	593.37	0	121.48
Total			1487.611	**11759.66**	**26229.76**	**37989.37**	**3798.937**	**34190.44**	**8427**	**67.11**	**25960.35**	**34454.46**	**27815.65**	**2414.96**	**100.77**

Annexure-II District-wise groundwater resources availability, utilization, and stage of extraction (as in 2024)

DYNAMIC GROUND WATER RESOURCES OF NCT DELHI, 2024												
DISTRICT	Groundwater Recharge (ham)			Total Natural Discharge (Ham)	Annual Extractable Groundwater Resources (ham)	Current Annual Ground Water Extraction (ham)				Allocation of Groundwater Resource For future Domestic Utilisation (ham)	Net Annual Ground Water Availability for Future Use (ham)	Stage of Groundwater Extraction (%)
	Recharge from Rainfall	Recharge from other sources	Total Annual Groundwater Recharge			Irrigation	Industrial	Domestic	Total			
CENTRAL	358.4	2104.72	2463.12	246.31	2216.81	248.57	0	1547.32	1795.89	2130.21	450.71	81.01
EAST	140.4	1519.39	1659.79	165.99	1493.8	118.99	0.2	1348.84	1468.03	1506.1	36.86	98.27
NAZUL LAND	373.62	180.62	554.24	55.42	498.82	232.8	0	86.27	319.07	86.27	179.75	63.97
NEW DELHI	1114.21	1908.21	3022.42	302.24	2720.18	686.87	2.2	2984.66	3673.74	2984.67	0	135.05
NORTH	2029.01	2422.67	4451.68	445.17	4006.51	491.8	50.31	4044.73	4586.85	4075.38	29.6	114.48
NORTH EAST	148.03	1627.61	1775.64	177.57	1598.07	154.72	0	1573.25	1727.98	1573.25	102.19	108.13
NORTH WEST	1240.1	2574.33	3814.43	381.45	3432.98	511.32	0.56	1857.97	2369.85	2412.69	1063.13	69.03
SHAHDARA	114.94	1499.37	1614.31	161.42	1452.89	338.43	0.5	1358.59	1697.54	1388.36	3.86	116.84
SOUTH	1171.34	3341.16	4512.5	451.24	4061.26	709.9	0	3858.58	4568.49	3858.59	6.34	112.47
SOUTH EAST	678.51	2012.61	2691.12	269.1	2422.02	220.17	12.74	2144.45	2377.36	2144.45	44.66	98.16
SOUTH WEST	2986.65	4457.05	7443.7	744.37	6699.33	3981.46	0	2357.87	6339.33	2857.89	328.56	94.63
WEST	1404.45	2581.97	3986.42	398.65	3587.77	731.98	0.6	2797.8	3530.37	2797.79	169.3	98.40
Total	11759.66	26229.71	37989.37	3798.93	34190.44	8427	67.11	25960.35	34454.5	**27815.65**	**2414.96**	**100.77**

Annexure-III(A) Categorization of Tehsils in NCT Delhi (as in 2024)

S. No	Name of Assessed Unit	Safe		Semi-critical		Critical		Over exploited	
		No	%	No	%	No	%	No	%
1	ALIPUR					1	100		
2	CHANAKYAPURI							1	100
3	CIVIL LINES	1	100						
4	DEFENCE COLONY					1	100		
5	DELHI CANTONMENT							1	100
6	DWARKA					1	100		
7	GANDHI NAGAR					1	100		
8	HAUZ KHAS					1	100		
9	KALKAJI					1	100		
10	KANJHAWALA	1	100						
11	KAPASHERA							1	100
12	KARAWAL NAGAR							1	100
13	KAROL BAGH							1	100
14	KOTWALI					1	100		
15	MAYUR VIHAR							1	100
16	MEHRAULI							1	100
17	MODEL TOWN					1	100		
18	NAJAFGARH	1	100						
19	NARELA							1	100
20	NAZULLAND	1	100						
21	PATEL NAGAR					1	100		
22	PREET VIHAR					1	100		
23	PUNJABI BAGH					1	100		
24	RAJOURI GARDEN							1	100
25	ROHINI	1	100						
26	SAKET							1	100
27	SARASWATI VIHAR			1	100				
28	SARITA VIHAR					1	100		
29	SEELAMPUR			1	100				
30	SEEMAPURI					1	100		
31	SHAHDARA							1	100
32	VASANT VIHAR							1	100
33	VIVEK VIHAR							1	100
34	YAMUNA VIHAR							1	100
TOTAL	**34**	**5.00**	**14.71**	**2.00**	**5.88**	**13.00**	**38.24**	**14.00**	**41.18**

Annexure III (B) District Wise Categorization for NCT Delhi (as in 2024)

S. No	Name of District	Total no of Assessed Unit	Safe		Semi-critical		Critical		Over exploited	
			No	%	No	%	No	%	No	%
1	CENTRAL	3	1	33.33			1	33.33	1	33.33
2	EAST	3		0			2	66.67	1	33.33
3	NAZUL LAND	1	1	100				0		0
4	NEW DELHI	3		0				0	3	100
5	NORTH	3		0			2	66.67	1	33.33
6	NORTH EAST	3		0	1	33.33		0	2	66.67
7	NORTH WEST	3	2	66.67	1	33.33		0		0
8	SHAHDARA	3		0		0	1	33.33	2	66.67
9	SOUTH	3		0		0	1	33.33	2	66.67
10	SOUTH EAST	3		0		0	3	100		0
11	SOUTH WEST	3	1	33.33		0	1	33.33	1	33.33
12	WEST	3		0		0	2	66.67	1	33.33
	Total	**34**	**5**	**14.71**	**2**	**5.88**	**13**	**38.24**	**14**	**41.18**

Annexure III (C) Annual Extractable Ground Water Resource of Assessment Units under Different Category for NCT Delhi (as in 2024)

S. No	Name of Assessed Units	Total Annual Extractable Resource of Assessed Units (in Mcm)	Safe		Semi-critical		Critical		Over exploited	
			Annual Extractable Resource (in Mcm)	%	Annual Extractable Resource (in Mcm)	%	Annual Extractable Resource (in Mcm)	%	Annual Extractable Resource (in Mcm)	%
1	ALIPUR	16.53					16.53	100		
2	CHANAKYAPURI	5.77						0	5.77	100
3	CIVIL LINES	14.28	14.28	100				0		0
4	DEFENCE COLONY	9.11		0			9.11	100		0
5	DELHI CANTONMENT	10.16		0				0	10.16	100
6	DWARKA	22.80		0			22.80	100		0
7	GANDHI NAGAR	0.80		0			0.80	100		0
8	HAUZ KHAS	9.95		0			9.95	100		0
9	KALKAJI	9.14		0			9.14	100		0
10	KANJHAWALA	9.19	9.19	100				0		0
11	KAPASHERA	20.56		0				0	20.56	100
12	KARAWAL NAGAR	6.10		0				0	6.10	100
13	KAROL BAGH	1.51		0				0	1.51	100
14	KOTWALI	6.38		0			6.38	100		0
15	MAYUR VIHAR	7.31		0				0	7.31	100
16	MEHRAULI	10.19		0				0	10.19	100
17	MODEL TOWN	5.16		0			5.16	100		0
18	NAJAFGARH	23.63	23.63	100				0		0
19	NARELA	18.38		0				0	18.38	100
20	NAZUR LAND	4.99	4.99	100				0		0
21	PATEL NAGAR	14.35		0			14.35	100		0
22	PREET VIHAR	6.82		0			6.82	100		0
23	PUNJABI BAGH	16.32		0			16.32	100		0
24	RAJOURI GARDEN	5.21		0				0	5.21	100
25	ROHINI	20.25	20.25	100				0		0
26	SAKET	20.47		0				0	20.47	100
27	SARASWATI VIHAR	4.89		0	4.89	100		0		0
28	SARITA VIHAR	5.97		0		0	5.97	100		0
29	SEELAMPUR	7.27		0	7.27	100		0		0
30	SEEMAPURI	4.95		0		0	4.95	100		0
31	SHAHDARA	3.76		0		0		0	3.76	100
32	VASANT VIHAR	11.27		0		0		0	11.27	100
33	VIVEK VIHAR	5.82		0		0		0	5.82	100
34	YAMUNA VIHAR	2.61		0		0		0	2.61	100
Total		**341.90**	**72.34**	**21.16**	**12.16**	**3.56**	**128.28**	**37.52**	**129.12**	**37.76**

Annexure- III (D) District Wise Annual Extractable Ground Water Resource for NCT Delhi under Different Category (as in 2024)

S. No	Name of District	Total Annual Extractable Resource of Assessed Units (in Mcm)	safe		semi-critical		Critical		Over exploited	
			Annual Extractable Resource (in Mcm)	%	Annual Extractable Resource (in Mcm)	%	Annual Extractable Resource (in Mcm)	%	Annual Extractable Resource (in Mcm)	%
1	**CENTRAL**	22.17	14.28	64.43			6.38	28.77	1.51	6.8
2	**EAST**	14.94					7.63	51.08	7.31	48.92
3	**NAZUL LAND**	4.99	4.99	100						
4	**NEW DELHI**	27.3							27.3	100
5	**NORTH**	40.07					21.69	54.14	18.38	45.86
6	**NORTH EAST**	15.98			7.27	45.48			8.71	54.52
7	**NORTH WEST**	34.33	29.44	85.75	4.89	14.25				
8	**SHAHDARA**	14.52					4.95	34.07	9.58	65.96
9	**SOUTH**	40.61					9.95	24.5	30.66	75.5
10	**SOUTH EAST**	24.22					24.22	100		
11	**SOUTH WEST**	66.99	23.63	35.27			22.8	34.03	20.56	30.69
12	**WEST**	35.88					30.67	85.48	5.21	14.52
	Total	**342**	**72.34**	**21.15**	**12.16**	**3.56**	**128.28**	**37.52**	**129.22**	**37.76**

Annexure- III (E) Recharge Worthy Area of Assessment units under Different Category for NCT Delhi (as in 2024)

S. No	Name of Assessed Units	Total Recharge Worthy Area of Assessed Units (in aq.km)	Safe		Semi-critical		Critical		Over exploited	
			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	ALIPUR	118.18					118.18	100		
2	CHANAKYAPURI	35.08							35.08	100
3	CIVIL LINES	54.54	54.54	100						
4	DEFENCE COLONY	39.38					39.38	100		
5	DELHI CANTONMENT	65.8							65.8	100
6	DWARKA	67.84					67.84	100		
7	GANDHI NAGAR	1.39					1.39	100		
8	HAUZ KHAS	24.72					24.72	100		
9	KALKAJI	33.94					33.94	100		
10	KANJHAWALA	80.39	80.39	100						
11	KAPASHERA	108.79							108.79	100
12	KARAWAL NAGAR	21.14							21.14	100
13	KAROL BAGH	5.13							5.13	100
14	KOTWALI	19.64					19.64	100		
15	MAYUR VIHAR	16.77							16.77	100
16	MEHRAULI	61.16							61.16	100
17	MODEL TOWN	25.38					25.38	100		
18	NAJAFGARH	128.53	128.53	100						
19	NARELA	147.58							147.58	100
20	NAZUL LAND	25.79	25.79	100						
21	PATEL NAGAR	26.46					26.46	100		
22	PREET VIHAR	13.44					13.44	100		
23	PUNJABI BAGH	73.6					73.6	100		
24	RAJOURI GARDEN	10.48							10.48	100
25	ROHINI	40.98	40.98	100						
26	SAKET	71.97							71.97	100
27	SARASWATI VIHAR	32.99			32.99	100				
28	SARITA VIHAR	30.2					30.2	100		
29	SEELAMPUR	8.96			8.96	100				
30	SEEMAPURI	7.24					7.24	100		
31	SHAHDARA	4.9							4.9	100
32	VASANT VIHAR	57.21							57.21	100
33	VIVEK VIHAR	22.44		0					22.44	100
34	YAMUNA VIHAR	5.57							5.57	100
	Total	**1487.61**	**330.23**	**22.2**	**41.95**	**2.82**	**481.41**	**32.36**	**634.02**	**42.62**

Annexure III (F) District Wise Recharge Worthy Area under Different Category for the NCT Delhi (as in 2024)

S. No	Name of District	Total Recharge Worthy Area of Assessed Units (in aq.km)	safe		semi-critical		Critical		Over exploited	
			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	CENTRAL	79.31	54.54	68.77			19.64	24.77	5.13	6.46
2	EAST	31.6					14.83	46.93	16.77	53.07
3	NAZUL LAND	25.79	25.79	100						
4	NEW DELHI	158.09							158.09	100
5	NORTH	291.14					143.56	49.31	147.58	50.69
6	NORTH EAST	35.67			8.96	25.11			26.71	74.89
7	NORTH WEST	154.36	121.37	78.63	32.99	21.37				
8	SHAHDARA	34.59					7.24	20.94	27.34	79.04
9	SOUTH	157.85					24.72	15.66	133.13	84.34
10	SOUTH EAST	103.52					103.52	100		
11	SOUTH WEST	305.16	128.53	42.12			67.84	22.23	108.79	35.65
12	WEST	110.54					100.06	90.52	10.48	9.48
	Total	**1487.61**	**330.23**	**22.2**	**41.94**	**2.82**	**481.41**	**32.36**	**634.02**	**42.62**

Annexure IV (A) Categorization of Over Exploited, Critical and Semi Critical Tehsils (as in 2024)

CATEGORIZATION OF ASSESSMENT UNITS, 2024							
S. No	**Name of District**	**S. No**	**Name of Semi-Critical Assessment Unit**	**S. No**	**Name of Critical Assessment Unit**	**S. No**	**Name of Over-Exploited Assessment Unit**
1	CENTRAL			1	KOTWALI	1	KAROL BAGH
2	EAST			1	GANDHI NAGAR	1	MAYUR VIHAR
				2	PREET VIHAR		
3	NEW DELHI					1	CHANAKYAPURI
						2	DELHI CANTONMENT
						3	VASANT VIHAR
4	NORTH			1	ALIPUR	1	NARELA
				2	MODEL TOWN		
5	NORTH EAST	1	SEELAMPUR			1	KARAWAL NAGAR
						2	YAMUNA VIHAR
6	NORTH WEST	1	SARASWATI VIHAR				
7	SHAHDARA			1	SEEMAPURI	1	SHAHDARA
						2	VIVEK VIHAR
8	SOUTH			1	HAUZ KHAS	1	MEHRAULI
						2	SAKET
9	SOUTH EAST			1	DEFENCE COLONY		
				2	KALKAJI		
				3	SARITA VIHAR		
10	SOUTH WEST			1	DWARKA	1	KAPASHERA
11	WEST			1	PATEL NAGAR	1	RAJOURI GARDEN
				2	PUNJABI BAGH		
ABSTRACT							
Total No. of Assessed Units		**Number of Semi critical Assessment Units**		**Number of Critical Assessment Units**		**Number of Over Exploited Assessment Units**	
34		2		13		14	

Annexure IV (B) Quality problems in Assessment units (as in 2024)

S.No	DISTRICT	Assessment Unit	Area in (sq km)	Category	Quality
1	NORTH	ALIPUR	118.18	critical	Salinity/F
2	NEW DELHI	CHANAKYAPURI	35.08	over_exploited	F
3	CENTRAL	CIVIL LINES	54.54	safe	As
4	SOUTH EAST	DEFENCE COLONY	39.38	critical	As
5	NEW DELHI	DELHI CANTONMENT	65.8	over_exploited	Salinity
6	SOUTH WEST	DWARKA	67.84	critical	Salinity/F
7	EAST	GANDHI NAGAR	1.39	critical	
8	SOUTH	HAUZ KHAS	24.72	critical	
9	SOUTH EAST	KALKAJI	33.94	critical	
10	NORTH WEST	KANJHAWALA	80.39	safe	Salinity/F
11	SOUTH WEST	KAPASHERA	108.79	over_exploited	Salinity
12	NORTH EAST	KARAWAL NAGAR	21.14	over_exploited	
13	CENTRAL	KAROL BAGH	5.13	over_exploited	
14	CENTRAL	KOTWALI	19.64	critical	
15	EAST	MAYUR VIHAR	16.77	over_exploited	As
16	SOUTH	MEHRAULI	61.16	over_exploited	
17	NORTH	MODEL TOWN	25.38	critical	Salinity
18	SOUTH WEST	NAJAFGARH	128.53	safe	Salinity/As
19	NORTH	NARELA	147.58	over_exploited	Salinity/F
20	NAZUL LAND	NAZUR LAND	25.79	safe	
21	WEST	PATEL NAGAR	26.46	critical	Salinity
22	EAST	PREET VIHAR	13.44	critical	As
23	WEST	PUNJABI BAGH	73.6	critical	Salinity
24	WEST	RAJOURI GARDEN	10.48	over_exploited	Salinity
25	NORTH WEST	ROHINI	40.98	safe	Salinity/F
26	SOUTH	SAKET	71.97	over_exploited	F
27	NORTH WEST	SARASWATI VIHAR	32.99	semi_critical	Salinity/F
28	SOUTH EAST	SARITA VIHAR	30.2	critical	
29	NORTH EAST	SEELAMPUR	8.96	semi_critical	
30	SHAHDARA	SEEMAPURI	7.24	critical	
31	SHAHDARA	SHAHDARA	4.9	over_exploited	
32	NEW DELHI	VASANT VIHAR	57.21	over_exploited	Salinity
33	SHAHDARA	VIVEK VIHAR	22.44	over_exploited	F
34	NORTH EAST	YAMUNA VIHAR	5.57	over_exploited	
Total			**1487.61**		

Annexure IV (C) List of Saline Assessment units: Nil

Annexure V (A) Summary of Assessment units improved or deteriorated from 2023 to 2024 assessment

Improved List of assessment units from GWRE 2023

COMPARISON OF CATEGORIZATION OF ASSESSMENT UNITS (2023 AND 2024)						
NCT DELHI						
S. No	Name of District	Name of Assessment Unit	Stage of Ground Water Extraction (%) in 2023	Categorization in 2023	Stage of Ground Water Extraction (%) in 2024	Categorization in 2024
Improved (NIL)						

Deteriorated List of assessment units from GWRE 2023

COMPARISON OF CATEGORIZATION OF ASSESSMENT UNITS (2022 AND 2023)						
NCT DELHI						
S. No	Name of District	Name of Assessment Unit	Stage of Ground Water Extraction (%) in 2022	Categorization in 2022	Stage of Ground Water Extraction (%) in 2023	Categorization in 2023
Deteriorated (3 assessment units)						
1	North	Alipur	89.43	semi critical	98.65	critical
2	West	Punjabi bagh	88.39	semi critical	91.15	critical
3	East	Mayur vihar	98.91	critical	101.52	overexploited

Annexure V (B) Comparison of categorization of assessment units (2023 to 2024)

District	Assessment Unit	GWRA 2023		GWRA 2024	
		Category	Stage of development (%)	Category	Stage of development (%)
CENTRAL	CIVIL LINES	Safe	68.3	Safe	69.23
CENTRAL	KAROL BAGH	Over Exploited	114.46	Over Exploited	119.75
CENTRAL	KOTWALI	Critical	94.22	Critical	98.24
EAST	GANDHI NAGAR	Critical	91.45	Critical	90.53
EAST	**MAYUR VIHAR**	**Critical**	**98.91**	**Over Exploited**	**101.52**
EAST	PREET VIHAR	Critical	90.38	Critical	95.72
NAZUL LAND	NAZUL LAND	Safe	68.43	Safe	63.96
NEW DELHI	CHANAKYAPURI	Over Exploited	131.45	Over Exploited	128.84
NEW DELHI	DELHI CANTONMENT	Over Exploited	125.18	Over Exploited	127.72
NEW DELHI	VASANT VIHAR	Over Exploited	153.13	Over Exploited	144.85
NORTH	**ALIPUR**	**Semi Critical**	**89.43**	**Critical**	**98.65**
NORTH	MODEL TOWN	Critical	96.79	Critical	98.59
NORTH	NARELA	Over Exploited	131.79	Over Exploited	133.19
NORTH EAST	KARAWAL NAGAR	Over Exploited	113.79	Over Exploited	118.22
NORTH EAST	SEELAMPUR	Semi Critical	85.16	Semi Critical	85.94
NORTH EAST	YAMUNA VIHAR	Over Exploited	144.12	Over Exploited	146.33
NORTH WEST	KANJHAWALA	Safe	68.08	Safe	68.46
NORTH WEST	ROHINI	Safe	61.11	safe	64.8
NORTH WEST	SARASWATI VIHAR	Semi Critical	83.56	Semi Critical	87.63
SHAHDARA	SEEMAPURI	Critical	99.14	Critical	99.22
SHAHDARA	SHAHDARA	Over Exploited	119.68	Over Exploited	122.58
SHAHDARA	VIVEK VIHAR	Over Exploited	126.37	Over Exploited	128.11
SOUTH	HAUZ KHAS	Critical	99.82	Critical	99.36
SOUTH	MEHRAULI	Over Exploited	117.9	Over Exploited	125.78
SOUTH	SAKET	Over Exploited	116.31	Over Exploited	112.25
SOUTH EAST	DEFENCE COLONY	Critical	98.38	Critical	97.1
SOUTH EAST	KALKAJI	Critical	95.6	Critical	98.66
SOUTH EAST	SARITA VIHAR	Critical	99.9	Critical	98.99
SOUTH WEST	DWARKA	Critical	99.83	Critical	99.74
SOUTH WEST	KAPASHERA	Over Exploited	114.64	Over Exploited	117.44
SOUTH WEST	NAJAFGARH	Safe	69.58	Safe	69.84
WEST	PATEL NAGAR	Critical	96.53	Critical	98.27
WEST	**PUNJABI BAGH**	**Semi Critical**	**88.89**	**Critical**	**91.15**
WEST	RAJOURI GARDEN	Over Exploited	120.68	Over Exploited	121.48

Annexure VI Assessment Unit Wise Report (Attribute Table)

S.No	DISTRICT	Assessment Unit	Area in (sq km)	Ground Water Recharge(ham)			Total Natural Discharge (Ham)	Annual Extractable Groundwater Resources (ham)	Annual Ground Water Extraction(ham)				Allocation of Ground water Resources For future Domestic Utilisation (han)	Net Annual Ground Water Availability for Future Use (ham)	Stage of Ground water Extraction (%)	Category	Quality
				Recharge from Rainfall	Recharge from other sources	Total Annual Ground water Recharge			Irrigation	Industrial	Domestic	Total					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	CENTRAL	CIVIL LINES	54.54	278.47	1308.46	1586.93	158.693	1428.237	209.82	0	778.9632	988.7832	778.96	439.46	69.23	Safe	As
2	CENTRAL	KAROL BAGH	5.125	21.31	146.29	167.6	16.76	150.84	19.17	0	161.46	180.626	744.35	0	119.75	Over Exploited	
3	CENTRAL	KOTWALI	19.64	58.62	649.97	708.59	70.859	637.731	19.58	0	606.9	626.484	606.9	11.25	98.24	Critical	
4	EAST	GANDHI NAGAR	1.389	6.06	83.36	89.42	8.942	80.478	2.56	0	70.3	72.86	227.56	7.62	90.53	Critical	
5	EAST	MAYUR VIHAR	16.77	74.96	737.09	812.05	81.205	730.845	70.98	0	670.9536	741.9336	670.95	0	101.52	Over Exploited	As
6	EAST	PREET VIHAR	13.44	59.38	698.95	758.32	75.832	682.48	45.45	0.2	607.59	653.24	607.59	29.24	95.72	Critical	AS
7	NAZUL LAND	NAZUL LAND	25.79	373.62	180.62	554.24	55.424	498.816	232.8	0	86.27303	319.073	86.27	179.75	63.96	Safe	
8	NEW DELHI	CHANAKYAPURI	35.08	305.31	335.86	641.17	64.117	577.053	370.26	0	373.1863	743.4463	373.19	0	128.84	Over Exploited	F
9	NEW DELHI	DELHI CANTONMENT	65.8	323.48	805.48	1128.96	112.896	1016.064	171.25	2.2	1124.257	1297.711	1124.26	0	127.72	Over Exploited	Salinity
10	NEW DELHI	VASANT VIHAR	57.21	485.42	766.87	1252.29	125.229	1127.061	145.35	0	1487.219	1632.574	1487.22	0	144.85	Over Exploited	Salinity
11	NORTH	ALIPUR	118.18	755.2	1081.72	1836.92	183.692	1653.228	249.96	0	1380.92	1630.879	1380.92	22.35	98.65	Critical	Salinity/F
12	NORTH	MODEL TOWN	25.38	99.66	473.41	573.07	57.307	515.763	66.15	0.3	442.0541	508.5041	472.7	7.25	98.59	Critical	Salinity/F
13	NORTH	NARELA	147.58	1174.15	867.54	2041.69	204.169	1837.521	175.7	50.01	2221.76	2447.463	2221.76	0	133.19	Over Exploited	Salinity
14	NORTH EAST	KARAWAL NAGAR	21.14	90.2	587.72	677.91	67.791	610.11	73.95	0	647.312	721.262	647.31	0	118.22	Over Exploited	
15	NORTH EAST	SEELAMPUR	8.959	38.05	769.58	807.63	80.763	726.867	38.77	0	585.9045	624.6775	585.9	102.19	85.94	Semi Critical	
16	NORTH EAST	YAMUNA VIHAR	5.573	19.78	270.32	290.1	29.01	261.09	42	0	340.0367	382.0367	340.04	0	146.33	Over Exploited	
17	NORTH WEST	KANJHAWALA	80.39	841.12	179.63	1020.75	102.075	918.675	96.6	0	532.343	628.943	1007.38	289.73	68.46	Safe	Salinity/F
18	NORTH WEST	ROHINI	40.98	238.53	2011.64	2250.17	225.017	2025.153	238.32	0	1073.927	1312.247	1073.93	712.9	64.8	Safe	Salinity/F
19	NORTH WEST	SARASWATI VIHAR	32.99	160.45	383.06	543.51	54.351	489.159	176.4	0.56	251.7023	428.6623	331.38	60.5	87.63	Semi Critical	Salinity/F
20	SHAHDARA	SEEMAPURI	7.243	28.14	521.71	549.85	54.985	494.865	53.13	0	437.8729	491.0049	437.87	3.86	99.22	Critical	
21	SHAHDARA	SHAHDARA	4.902	16.54	401.23	417.77	41.777	375.993	22.4	0	438.4795	460.8825	468.25	0	122.58	Over Exploited	
22	SHAHDARA	VIVEK VIHAR	22.44	70.26	576.43	646.69	64.669	582.021	262.89	0.5	482.2358	745.6278	482.24	0	128.11	Over Exploited	F
23	SOUTH	HAUZ KHAS	24.72	131.83	973.57	1105.4	110.54	994.86	191.14	0	797.3764	988.5139	797.38	6.34	99.36	Critical	
24	SOUTH	MEHRAULI	61.16	316.38	815.98	1132.36	113.236	1019.124	71	0	1210.879	1281.879	1210.88	0	125.78	Over Exploited	F
25	SOUTH	SAKET	71.97	723.13	1551.61	2274.74	227.474	2047.266	447.76	0	1850.328	2298.088	1850.33	0	112.25	Over Exploited	
26	SOUTH EAST	DEFENCE COLONY	39.38	230.45	782.1	1012.53	101.253	911.28	90.52	1.6	792.7673	884.8873	792.77	26.39	97.1	Critical	As
27	SOUTH EAST	KALKAJI	33.94	248.42	767	1015.42	101.542	913.878	23.25	7.5	870.8667	901.6119	870.87	12.26	98.66	Critical	
28	SOUTH EAST	SARITA VIHAR	30.2	199.64	463.54	663.17	66.317	596.86	106.4	3.64	480.8124	590.8524	480.81	6.01	98.99	Critical	
29	SOUTH WEST	DWARKA	67.84	496.01	2037.22	2533.23	253.323	2279.907	1014.9	0	1259.086	2273.986	1259.09	5.92	99.74	Critical	Salinity/F
30	SOUTH WEST	KAPASHERA	108.79	1130.78	1153.99	2284.77	228.477	2056.293	1703.66	0	711.2266	2414.887	821.21	0	117.44	Over Exploited	Salinity
31	SOUTH WEST	NAJAFGARH	128.53	1359.86	1265.84	2625.7	262.57	2363.13	1262.9	0	387.5617	1650.462	777.59	322.64	69.84	Safe	Salinity/AS
32	WEST	PATEL NAGAR	26.46	357.17	1237.04	1594.21	159.421	1434.789	287.63	0.5	1121.784	1409.909	1121.78	24.88	98.27	Critical	Salinity
33	WEST	PUNJABI BAGH	73.6	991.56	821.87	1813.43	181.343	1632.087	404.92	0.1	1082.643	1487.663	1082.64	144.42	91.15	Critical	Salinity
34	WEST	RAJOURI GARDEN	10.48	55.72	523.06	578.78	57.878	520.902	39.43	0	593.3686	632.8006	593.37	0	121.48	Over Exploited	Salinity
			1487.611	**11759.66**	**26229.76**	**37989.37**	**3798.937**	**34190.44**	**8427**	**67.11**	**25960.35**	**34454.46**	**27815.65**	**2414.96**	**100.77**	**Over Exploited**	

Annexure VII Minutes of the Meetings of the SLC Committee.

State Ground Water Coordination Committee, NCT Delhi

Government of NCT of Delhi
Department of Urban Development
10th Level C-Wing, Delhi Sachivalaya
I.P. Estate, New Delhi – 110002

F.16 (554)/UD/W/2015/Vol.-II/314-316 Dated: 07/03/2023

Sub: Assessment of annual ground water recharge Constitution of State Level Committee for Ground Water Resources Assessment, 2023 of NCT OF Delhi.

The last assessment of state wise Annual Ground Water Resources for the entire country was carried out during 2022 following the Ground Water Estimation Methodology -2015. Since then significant changes have been observed in ground water scenario in different parts of the country. As per the directives of Ministry of Jal Shakti, the Ground Water Resources Assessment for the year 2023 is to be carried out by CGWB and State Ground Water Departments following the Ground Water Estimation Methodology-2015. In order to steer the assessment at the state level, Chief Secretary, Delhi has approved the constitution of a permanent State Level Committee with the following composition in National Capital Territory of Delhi:-

1.	Secretary, Urban Development Department, GNCTD	Chairman
2.	Commissioner, Department of Industries, GNCTD	Member
3.	Chief Executive Officer, Delhi Cantonment Board	Member
4.	Member (Water Supply), Delhi Jal Board	Member
5.	Member (Engineering), Delhi Development Authority	Member
6.	Chief Engineer (Civil-I), New Delhi Municipal Council	Member
7.	Chief Engineer, Zone-I, I&FC, GNCTD	Member
8.	Chief Engineer, Zone-II, I&FC, GNCTD	Member
9.	Chief Engineer, Delhi Municipal Corporation	Member
10.	Director, Department of Environment, GNCTD	Member
11.	Joint Director (Agriculture), Development Department, GNCTD	Member
12.	General Manager, NABARD	Member
13.	Superintending Engineer (RWH), Delhi Jal Board	Member
14.	Garrison Engineer (Utility), Water Supply, MES	Member
15.	Office In-Charge, State Unit Office, Central Ground Water Board	Member Secretary

Term of Reference:

i. To estimate the annual ground water recharge of the state for water in accordance with the approved latest methodology and adopting improved procedure and practices wherever possible for the sake of achieving greater accuracy of assessment.
ii. To estimate the status of utilization of the annual extractable ground water resource as in the specified water year.
iii. To supervise the compilation of a State Level report on assessment of ground water resources and status of its utilization as in the specific reference year.
iv. Any other aspect relevant to the terms referred above.

Time Frame: The Committee will submit its report in a TIME BOUND manner regularly.

Expenditure: 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 (if any), will be borne by the Urban Development Department.

(Rajesh Kumar)
Deputy Secretary (Water)

9/3/23

Wearing Mask, Washing Hands and follow Social Distancing

F. 6 (554)/UD/W/2015/Vol.-II/ 314-316 Dated: 07/03/2023

Copy forward to the following for information and further necessary action please:-

1. All concerned officers for information and necessary action.
2. Joint Secretary (Admn./IC&GW & CVO) & Project Coordinator, Govt. of India, Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation, Shram Shakti Bhawan, Rafi Marg, New Delhi-110001.
3. P.S. to Pr. Secretary, Urban Development Department, GNCT of Delhi.

Deputy Secretary (Water)

Wearing Mask, Washing Hands and follow Social Distancing

Minutes of the first meeting of State Groundwater Coordination Committee

Government of NCT of Delhi
Department of Urban Development
10th Level C-Wing, Delhi Sachivalaya
I.P. Estate, New Delhi
Ph-011-23392343

F.No. 16 (554)/UD/W/2015/Vol.II/021357726/ 2580–2600 Dated: 29/04/2024

Minutes of the 1st meeting of Permanent State Level Committee for Ground Water Resource Estimation of NCT of Delhi as on March, 2024 held on 19.04.2024 at 10:30 AM under the Chairmanship of Addl. Chief Secretary (Urban Development), Government of NCT Delhi.

First meeting of GWRA-2024 was held on 19.04.2024 at 10:30 AM under the chairmanship of Addl. Chief Secretary (Urban Development). The meeting began with the formal introduction of all the participants. The list of participants is attached as **Annexure-I**.

At the very outset, Sh. S.K. Mohiddin, Head of Office, Central Ground Water Board, State Unit Office, New Delhi welcomed all the members of State Level Committee for "Ground Water Resources Estimation of NCT of Delhi 2024". He also briefed about the agenda points of the meeting which is attached as **Annexure-II**. Subsequent decisions made during the meeting are outlined below:

- Sh. S.K. Mohiddin, Head of Office briefed about Ground Water Resource Estimation of NCT of Delhi to be carried out as on March 2024 through power point presentation. He gave a brief overview of the Ground Water Resource Estimation Methodology 2015 and the different data required from line departments. He provided a summary of GWRE 2023 and presented the comparison of Stage of ground water extraction as on March 2023 since 2004 highlighting the changes in the categorization of assessment units.
- Addl. Chief Secretary (UD) proposed that members of the SLC, specifically those from Delhi Cantonment Board, MES, DDA, and the Development Department (Agriculture), who were not present in the first meeting, should participate in the subsequent meetings.
- It was also proposed to include the Revenue Department, which is responsible for issuing NOCs for groundwater abstraction in the NCT of Delhi, as a member of the Permanent SLC. Urban Development was directed to commence the necessary procedures for incorporating Principal Secretary/Additional Chief Secretary of Revenue Department as a member of Permanent SLC.
- Sh. S.K. Mohiddin informed that excel sheet for data collection has been e-mailed to all line department, however, data has only been submitted by CPWD. Additional Chief Secretary (UD) directed all the concerned organization to submit the data by 30th April 2024 to ensure completion of the GWRA 2024 within the designated timeframe i.e. 30th July, 2024.
- It was also proposed by Sh. S.K. Mohiddin that piezometer (DWLR) that are installed by DJB and I&FC Department under NHP shall share the data with CGWB. It was emphasized by Addl. Chief Secretary (UD) that the concerned department shall ensure the operational status of these installed piezometers with DWLR, and login credentials shall be shared with CGWB. In case, an online facility

S.K.B. 1/5/24

Sh. Kunti Mishra, Sci 'B'

डायरी सं. / Diary No. 120
दिनांक / Date 02/05/2024
के.भू.ज.बो. / G.G.W.B.

is unavailable, monthly monitoring reports of water levels should be shared. Similar instructions were also provided to DMRC regarding water level data.

- Agencies such as DSIIDC, PWD, DMRC, GSDL and Revenue Department which deals with the subject of ground water directly or indirectly shall be invited as Special Invitee in the subsequent meetings.
- It was decided that the data concerning check dams shall be supplied by I&FC Department.
- Sh. S.K. Mohiddin put forward a proposal for a study titled "Evaluation of Groundwater Quality in Aquifers Adjacent to the Najafgarh Drain" as part of the NAQUIM 2.0 studies. This study aims to assess the quality of groundwater in aquifers located near the Najafgarh Drain, considering potential implications for water resources and environmental health. Following discussion, the proposal received unanimous approval from all members present, with no objections raised.
- It was informed by Sh. S.K. Mohiddin that 109 nos. of new piezometers are to be established in NCT of Delhi. Currently, 88 sites have been identified, with 28 sites receiving approval from various State and Central government departments. A notable challenge resides in New Delhi District, where coordination with the cantonment area is lacking. To address this, the Additional Chief Secretary (UD) proposed sending a DO letter, endorsed by ACS, to all relevant departments to expedite site selection for piezometer installation. The relevant draft letter to be provided by CGWB.

At the end, Additional Chief Secretary (UD) underscored the importance of the relevant department submitting the data to CGWB by April 30th, 2024. Additionally, it was stressed by the Additional Chief Secretary (UD) that all members of the SLC should endeavor to attend the meeting in person rather than through proxy representation.

The meeting ended with a vote of thanks to the chair.

(Arvind Jain)
Dy. Secretary (Water)

F.No. 16 (554)/UD/W/2015/Vol.II/021357726/2580-2600 Dated: 29/04/2024

1. The Divisional Commissioner, Revenue Department, 5 Sham Nath Marg, Prem Kunj, Civil Lines, Delhi-110054.
2. The Commissioner, Department of Industries, 419, Udyog Sadan, FIF, Patparganj, Delhi-110092.
3. The Principal Secretary, Public Works Department, 12th Floor, MSO Building, ITO, New Delhi-110002.
4. The Managing Director, DSIIDC, N-36, Bombay Life Building, Connaught Place, New Delhi-110001.
5. The Managing Director (IAS), Geospatial Delhi Ltd., Govt. of NCT of Delhi, 3rd Level, 'C' Wing, Vikas Bhawan –II, Civil Lines, Delhi -110054.

6. The Managing Director (IAS), Delhi Metro Rail Corporation Ltd., Metro Bhawan, Fire Brigade Lane, Barakhamba Lane, New Delhi – 110001.

7. The Chief Executive Officer, Delhi Cantonment Board, Sadar Bazar, Delhi Cantt. – 110010.

8. The Member (Water Supply), Delhi Jal Board, Varunalaya, Phase-II, Jhandewalan, New Delhi.

9. The Member (Engineering), Delhi Development Authority, Vikas Sadan, INA, Delhi.

10. The Chief Engineer (Civil-I), NDMC, Palika Kendra, Sansad Marg, New Delhi.

11. The Chief Engineer, Zone –I, I&FC Deptt., L.M. Bund office complex, Shastri Nagar, Delhi-31.

12. The Chief Engineer, Zone –II, I&FC Deptt., L.M. Bund office complex, Shastri Nagar, Delhi-31.

13. Sh. D.D. Gulati, Chief Engineer, Delhi Municipal Corporation, Dr. S.P.M. Civic Centre, JLN Marg, Minto Road, New Delhi.

14. The Director, Environment Deptt., 6th level, C-Wing, Delhi Secretariat, New Delhi.

15. The Joint Director (Agriculture), Development Department, 11th level, MSO Building, ITO, New Delhi.

16. The General Manager, NABARD, NABARD Tower, 24 - Rajender Place, New Delhi.

17. The Superintending Engineer (RWH), Delhi Jal Board, Varunalaya, Phase-II, Jhandewalan, New Delhi – 110005.

18. The Garrison Engineer (Utility), Water Supply, MES, Delhi Cantonment Board, Delhi – 110010.

19. The Office In charge, State Unit Office, Central Ground Water Board, West Block-2, Wing-3, Sector-1, R.K. Puram, New Delhi-110066.

Copy for information to: -

1. PS to Pr. Secretary, UD, 9th Level, C-Wing, Delhi Secretariat, New Delhi.
2. PA to Special Secretary-I, UD, 9th Level, C-Wing, Delhi Secretariat, New Delhi.

Dy. Secretary (Water)

Sub: Meeting on 19/04/2024 at 10:30 PM, First meeting of State Level Committee for Ground Water Resources Assessment 2024.

Sl. No.	Name & Designation	Department	Email & Contact No.	Signature
1.	S.K. MOHIDDIN SCD'2 OIC	CGWB, New Delhi	ricnd-cgwb@nic.in 9560599977	S.K.M.
2.	JITENDRA KUMAR SE IFC-IV	IFC	ifcfciv@gmail.com 9958872957	
3.	VIKASH SINGHAL JGM/ Env	DMRC	vikas.3687@dmrc.org 9958786027	
4.	Dilip Kumar AE(Civil)	NDMC	9953538832 dknddmajeer@gmail.com	
5.	N.K. Meena AE(CIVIL)	NDMC	9717844584 meenanand1460@gmail.com	
6.	H.K. Chawla	DJB	acegw@gmail.com 9650144393	
7.	Rakesh Kr Sharma	DJB	RAINWATERHARVESTING2013@gmail.com 9650899440	
8.	A.K. Singh	MCD	eeqcndmcak@gmail.com 7290029620	
9.	D.S. Malik.	MCD.	7669279909.	
10.	Meenakshi Meena Actm	NABARD	delhi@nabard.org	
11.	Dr. KRITI MISHRA SC-C	CGWB, SUO	kriti.mishra-cgwb@nic.in	
12.	V. Praveen Kumar ~~AHG~~	CGWB, SUO	vandlabu.pgm-cgwb@nic.in	
13.	Nigam Agarwal Director (Env)	Environment	direnv.delhi@nic.in	
14.	BIRJESH KUMAR	DJB	Rainwaterharvesting2013@gmail.com	
15.				
16.				
17.				
18.				

Minutes of the Second meeting of State Groundwater Coordination Committee.

Government of NCT of Delhi
Department of Urban Development
10th Level C-Wing, Delhi Sachivalaya
I.P. Estate, New Delhi
Ph-011-23392343

F.No. 16 (554)/UD/W/2015/Vol.II/021769849/3438-3458 Dated: 28/08/2024

Minutes of Second Meeting of Permanent State Level Committee on "GROUND WATER RESOURCES ASSESSMENT-2024", under the Chairmanship of Additional Chief Secretary (UD), Department of Urban Development, Government of NCT, Delhi

Second meeting of GWRA – 2024 was held in the conference room of Urban Development Department, Govt. of NCT of Delhi under the chairmanship of Additional Chief Secretary, Urban Development, Shri. Manish Kumar Gupta, at 11.30 AM on 22.08.2024. The meeting began with the formal introduction of all the participants from the different organizations of the Government of NCT, Delhi and Central Ground Water Board. List of participants is attached herewith as **annexure-I**.

The main Agenda discussed is as follows:

- Inclusion of new members in PSLC
- Water Logging issues in NCT, Delhi
- Summary of Ground water Resource Assessment, 2024.

Additional Chief Secretary, Urban Development, Shri. Manish Kumar Gupta has released the "Bulletin on Ground Water Quality in Shallow Aquifers of NCT of Delhi during May 2023". Sh. Manish Kumar Gupta, Additional Chief Secretary, (UD) has enquired about the department wise data submission and problems for not submitting the data. Sh. S K Mohiddin, Regional Director, SUO, Delhi has discussed about the inclusion of departments i.e. CWC, GSDL, PWD, Forest Department, Revenue Department and DMRC by making an amendment in the Permanent State Level Committee, which was constituted vide letter no. F-16(554)/UD/W/2015/Vol.-II/021769849/3346-3363 dated 12-08-2024 by Department of Urban Development, GNCTD. He also explained the Status of GWRA preparation till date which is as follows:

1. Delhi Jal Board (Nodal Agency for coordination):Data received
2. NDMC (New Delhi Municipal Corporation): No data is received but data submitted in earlier estimation was used.
3. MCD (Municipal Corporation of Delhi): No data is received but data submitted in earlier estimation was used.
4. Delhi Cantonment Board: No data is received but data submitted in earlier estimation was used.
5. I & FC (Irrigation & Flood Control Board): Updated Data received
6. Forest Department: No data is received but data submitted in earlier estimation was used.
7. DMRC (Delhi Metro Rail Corporation): DMRC Recharge Data Received
   CPWD (Central Public Works Department): Recharge data Received.
8. IMD (Indian Meteorological Department): Rainfall data received up to March,2024
9. PWD (Public Works Department): No data is received
10. GSDL (Geospatial Delhi Limited): No data is received but data submitted in earlier estimation was used.
11. NWIC (National Water Informatics Centre): Data available
12. DPCC (Delhi Pollution Control Committee): No data is received

S.K. 4/9/24
Ms Prachi Gupta, Sc-D / Sh. Praveen Kr, AHG.

SRO No. 481
दिनांक / Date 04/09/2024
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13. Industrial (DSIIDC) (Delhi State Industrial and Infrastructure Development Corporation Limited): No data is received but data submitted in earlier estimation was used.
14. Census Department: 2011 data used

The following decisions have been taken:

1. Delhi Cantonment, Water Supply (MES), Agriculture Department and DDA have not attended in the meeting, So D.O. letters on behalf of Additional Chief Secretary, U.D should be sent to all these departments.

2. MCD representative has mentioned that data of extraction and recharge for 2023-24 will provide as per the proforma within 2 to 3 days.

3. NDMC representative has mentioned that they would get data from water supply department and submit as early as possible.

4. The chair has directed to Department of Environment, GNCTD for providing updated data of extraction and recharge from DPCC and Forest department.

5. Additional Chief Secretary has directed to forward proformas to the departments so that the data may be submitted.

6. Regional director, CGWB has mentioned about 11,115 Voluntary disclosed bore wells data has not been used as yield of these tube wells are not provided. Moreover, location of these tube wells, tehsil wise is not given. Addl. Chief Secretary (UD) has directed to DJB and Environment department to make a policy to regularise or seal the voluntary disclosed bore wells.

7. Regional director, CGWB has stated that areas in parts of Delhi like Pragati Maidan-Jungpura and GK-II areas water logging taking place. So in these areas extraction of shallow ground water is required.

Addl. Chief Secretary (UD) has directed all the organizations to submit the data as early as possible so that the GWRA, 2024 will be completed in time.

The meeting ended with vote of thanks to the chair.

(Arvind Jain)
Dy. Secretary (Water)

F.No. 16 (554)/UD/W/2015/Vol.II/021769849/3438-3458 Dated: 28/08/2024

1. The Divisional Commissioner, Revenue Department, 5 Sham Nath Marg, Prem Kunj, Civil Lines, Delhi-110054.

2. The Commissioner, Department of Industries, 419, Udyog Sadan, FIF, Patparganj, Delhi-110092.

3. The Principal Secretary, Public Works Department, 12th Floor, MSO Building, ITO, New Delhi-110002.

4. The Managing Director, DSIIDC, N-36, Bombay Life Building, Connaught Place, New Delhi-110001.

5. The Managing Director (IAS), Geospatial Delhi Ltd., Govt. of NCT of Delhi, 3rd Level, 'C' Wing, Vikas Bhawan –II, Civil Lines, Delhi -110054.

6. The Managing Director (IAS), Delhi Metro Rail Corporation Ltd., Metro Bhawan, Fire Brigade Lane, Barakhamba Lane, New Delhi – 110001.

7. The Chief Executive Officer, Delhi Cantonment Board, Sadar Bazar, Delhi Cantt. – 110010.

8. The Member (Water Supply), Delhi Jal Board, Varunalaya, Phase-II, Jhandewalan, New Delhi.

9. The Member (Engineering), Delhi Development Authority, Vikas Sadan, INA, Delhi.

10. The Chief Engineer (Civil-I), NDMC, Palika Kendra, Sansad Marg, New Delhi.

11. The Chief Engineer, Zone –I, I&FC Deptt., L.M. Bund office complex, Shastri Nagar, Delhi-31.

12. The Chief Engineer, Zone –II, I&FC Deptt., L.M. Bund office complex, Shastri Nagar, Delhi-31.

13. Sh. D.D. Gulati, Chief Engineer, Delhi Municipal Corporation, Dr. S.P.M. Civic Centre, JLN Marg, Minto Road, New Delhi.

14. The Director, Environment Deptt., 6th level, C-Wing, Delhi Secretariat, New Delhi.

15. The Joint Director (Agriculture), Development Department, 11th level, MSO Building, ITO, New Delhi.

16. The General Manager, NABARD, NABARD Tower, 24 - Rajender Place, New Delhi.

17. The Superintending Engineer (RWH), Delhi Jal Board, Varunalaya, Phase-II, Jhandewalan, New Delhi – 110005.

18. The Garrison Engineer (Utility), Water Supply, MES, Delhi Cantonment Board, Delhi – 110010.

19. The Office in charge, State Unit Office, Central Ground Water Board, West Block-2, Wing-3, Sector-1, R.K. Puram, New Delhi-110066.

Copy for information to: -

1. PS to Pr. Secretary, UD, 9th Level, C-Wing, Delhi Secretariat, New Delhi.
2. PA to Special Secretary-I, UD, 9th Level, C-Wing, Delhi Secretariat, New Delhi.

Dy. Secretary (Water)

Minutes of the third meeting of State Groundwater Coordination Committee

Government of NCT of Delhi
Department of Urban Development
10th Level C-Wing, Delhi Sachivalaya
I.P. Estate, New Delhi
Ph-011-23392343

F.No. 16 (554)/UD/W/2015/Vol.II/021769849/3807-3829 Dated: 11 /10/2024

Minutes of Final Meeting of Permanent State Level Committee on "GROUND WATER RESOURCES ASSESSMENT-2024", under the Chairmanship of Additional Chief Secretary (UD), Department of Urban Development, Government of NCT, Delhi

Date: 03.10.2024 at 2.30 PM.

Venue: Conference Room, Secretary (UD), 9th Level, C-Wing, Urban Development Department, Delhi Secretariat, New Delhi.

The final meeting of GWRA – 2024 was held in the conference room of the Urban Development Department, Govt. of NCT of Delhi under the chairmanship of Additional Chief Secretary, Urban Development, Shri. Navin Kumar Choudhary, at 2.30 PM on 03.10.2024. After a formal introduction of all the participants from the different organizations of the Government of NCT, Delhi, and Central Ground Water Board the discussions were initiated. The list of participants is attached herewith as **annexure-I**.

The main Agenda discussed is as follows:

- Approval of Ground Water Resource Assessment 2024.

Additional Chief Secretary, Urban Development, Shri. Navin Kumar Choudhary enquired about the department-wise presence of members and data submission. Shri S. K. Mohiddin, Regional Director, SUO, Delhi informed that after the D.O. letter from ACS, Urban Development, all the departments submitted the data. He also discussed the inclusion of additional departments i.e. CWC, GSDL, PWD, Forest Department, Revenue Department, and DMRC by amending the Permanent State Level Committee, which was constituted vide letter no. F-16(554)/UD/W/2015/Vol.-II/021769849/3346-3363 dated 12-08-2024 by Department of Urban Development, GNCTD. Additional Chief Secretary (UD) suggested that the proposal is considered as approved and from next meeting onwards they may be invited to PSLC meetings as regular members.

Approval of GWRE, 2024 of NCT Delhi

Shri S.K. Mohiddin, Regional Director, CGWB gave a brief presentation on the final studies done for GWRE – 2024 by CGWB. He explained that the GWRE, 2024 has been carried out through In-GRESS Software based on the data supplied by all the participatory departments.

Further, he mentioned that as per the data received from all the participatory departments and field observations of CGWB, the study of GWRE – 2024 has been done precisely within the time frame given by the CGWB, HQ, Faridabad. He also conveyed thanks to all the participatory departments for sharing their data. As per the GWRE – 2024, the total groundwater recharge is 37,989.37 Ham and the annual extractable groundwater resource is 34,190.44 Ham. The groundwater extraction for all purposes is 34,454.5 Ham. The Stage of groundwater extraction is 100.77%.

The district – wise GWRE – 2024 is as follows:

District	Annual Extractable Ground Water Resource (ham)	Annual Ground Water Extraction (ham)				Stage of GW Development(%)
		Domestic	Industrial	Irrigation	Total	
CENTRAL	222216.808	1547.32	0	248.57	1795.89	81.01
EAST	1493.82	1348.84	0.2	118.99	1468.03	98.27
NEW DELHI	2720.178	2984.67	2.2	686.86	3673.73	135.05
NORTH	4006.512	4044.73	50.31	491.81	4586.85	114.48
NORTH EAST	1598.085	1573.25	0	154.72	1727.97	108.13
NORTH WEST	3432.987	1857.97	0.56	511.32	2369.85	69.03
SHAHDARA	1452.879	1358.59	0.5	338.42	1697.51	116.84
SOUTH	4061.25	3857.71	0	709.9	4567.61	112.47
SOUTH EAST	2422.035	2144.45	12.74	220.17	2377.36	98.16
SOUTH WEST	6699.33	2357.88	0	3981.46	6339.34	94.63
WEST	3587.778	2797.79	0.6	731.98	3530.37	98.40
NAZUL LAND	498.816	86.27	0	232.8	319.07	63.97
Total	**34190.48**	**25959.47**	**67.11**	**8427**	**34453.58**	**100.77**

In a comparison of the Categorization of assessment units with GWRA-2023, there is a change in the category in 3 assessment units, which have shown deterioration.

The following decisions have been taken:

1. The UD department will send a DO letter to the CEO (DJB) regarding identifying the leakage points and preparing a complete mapping of pipelines. Delhi Jal Board (Water Supply) should stop the leakages of supply water so that groundwater extraction will be reduced.

2. In Over Exploited Tehsils (OE), construction of RTRWHS should be compulsory in all Government and private buildings to increase Groundwater recharge. Also, an implementable notification must be issued for buildings having more than 100 m^2 area. However, it has been seen that IDMC is already taking up the matter under the Chairmanship of Chief Secretary Delhi.

3. The chairman directed to MCD, for Horticulture purposes only STP water should be used and not Groundwater. NDMC and DJB have to take responsibility for providing STP water through tankers or pipelines. The chair has proposed to stop dependency on groundwater within one year for horticulture purposes.

4. The chairman directed DJB to write a letter to the Ministry of Jal Shakti for providing at least a 40% cost as central share for the construction of RTRWH structures in all government office buildings.

5. The Chairman has advised the Directorate of Environment to notify the guidelines as early as possible for the regulation of the groundwater in line with the guidelines notified by the MoJS

for control and regulation of groundwater extraction with pan-India applicability on 24.09.2020 and amendments dated 29.03.2023.

6. In areas, where extraction is more, NOC for groundwater extraction should be only issued when they have to maintain the balance of the quantity of extraction water and the same or more than extraction, rain water has to be recharged. Otherwise, no NOC will be issued.

7. The chairman directed that the Stage of Ground Water Extraction (SOE) should not go beyond 99 %,in areas, where extraction is more, NOC for groundwater extraction should be issued subject to the condition that they have to maintain the balance of the quantity of extraction water and the same or more than extraction, rain water has to be recharged. Otherwise, no NOC will be issued, for that proper regulations need to be issued.

After detailed deliberations on GWRE, 2024, the same was approved by the Permanent State Level Committee (PSLC). Further, the Addl. Chief Secretary (UD) congratulated the CGWB for the efforts taken for the GWRE 2024.

Addl. Chief Secretary (UD) directed all the organizations to come up with proper measures for the regulation of GW. After three weeks meeting will be organized with all PSLC members.

The meeting ended with a vote of thanks to the chair.

Dy. Secretary (Water)

F.No. 16 (554)/UD/W/2015/Vol.II/021769849/ 3805 – 3825 Dated: 11 /10/2024

1. The Divisional Commissioner, Revenue Department, 5 Sham Nath Marg, Prem Kunj, Civil Lines, Delhi-110054.
2. The Commissioner, Department of Industries, 419, Udyog Sadan, FIF, Patparganj, Delhi-110092.
3. The Principal Secretary, Public Works Department, 12th Floor, MSO Building, ITO, New Delhi-110002.
4. The Managing Director, DSIIDC, N-36, Bombay Life Building, Connaught Place, New Delhi-110001.
5. The Managing Director (IAS), Geospatial Delhi Ltd., Govt. of NCT of Delhi, 3rd Level, 'C' Wing, Vikas Bhawan –II, Civil Lines, Delhi -110054.
6. The Managing Director (IAS), Delhi Metro Rail Corporation Ltd., Metro Bhawan, Fire Brigade Lane, Barakhamba Lane, New Delhi – 110001.
7. The Chief Executive Officer, Delhi Cantonment Board, Sadar Bazar, Delhi Cantt. – 110010.
8. The Member (Water Supply), Delhi Jal Board, Varunalaya, Phase-II, Jhandewalan, New Delhi.
9. The Member (Engineering), Delhi Development Authority, Vikas Sadan, INA, Delhi.

10. The Chief Engineer (Civil-I), NDMC, Palika Kendra, Sansad Marg, New Delhi.

11. The Chief Engineer, Zone –I, I&FC Deptt., L.M. Bund office complex, Shastri Nagar, Delhi-31.

12. The Chief Engineer, Zone –II, I&FC Deptt., L.M. Bund office complex, Shastri Nagar, Delhi-31.

13. Sh. D.D. Gulati, Chief Engineer, Delhi Municipal Corporation, Dr. S.P.M. Civic Centre, JLN Marg, Minto Road, New Delhi.

14. The Director, Environment Deptt., 6th level, C-Wing, Delhi Secretariat, New Delhi.

15. The Joint Director (Agriculture), Development Department, 11th level, MSO Building, ITO, New Delhi.

16. The General Manager, NABARD, NABARD Tower, 24 - Rajender Place, New Delhi.

17. The Superintending Engineer (RWH), Delhi Jal Board, Varunalaya, Phase-II, Jhandewalan, New Delhi – 110005.

18. The Garrison Engineer (Utility), Water Supply, MES, Delhi Cantonment Board, Delhi – 110010.

19. The Office In charge, State Unit Office, Central Ground Water Board, West Block-2, Wing-3, Sector-1, R.K. Puram, New Delhi-110066.

Copy for information to: -

1. OSD to Hon'ble Lt. Governor, Delhi.
2. OSD to Hon'ble Chief Minister, Delhi
3. OSD to Chief Secretary, Delhi
4. PS to Addl. Chief Secretary, UD, 9th Level, C-Wing, Delhi Secretariat, New Delhi.
5. PA to Special Secretary-I, UD, 9th Level, C-Wing, Delhi Secretariat, New Delhi.

Dy. Secretary (Water)

Meeting on 03/10/2024 at 02:30 PM, on GROUND WATER RESOURCES ASSESSMENT, 2024

4731C

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12.	Pramod Bisht	NDMC	9810461201	
13.	Mukesh Kr CE II	I&FC	9958430057	
14.	ANIL KUMAR CE-I	LRPC	9958858537	
15.	Sunil Kumar	DPA	8588829288	
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17.	SANJAY SHARMA D.S	UD	9810146406	
18.	Rajveer Dasa SO	UD	9971684837	

References:

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