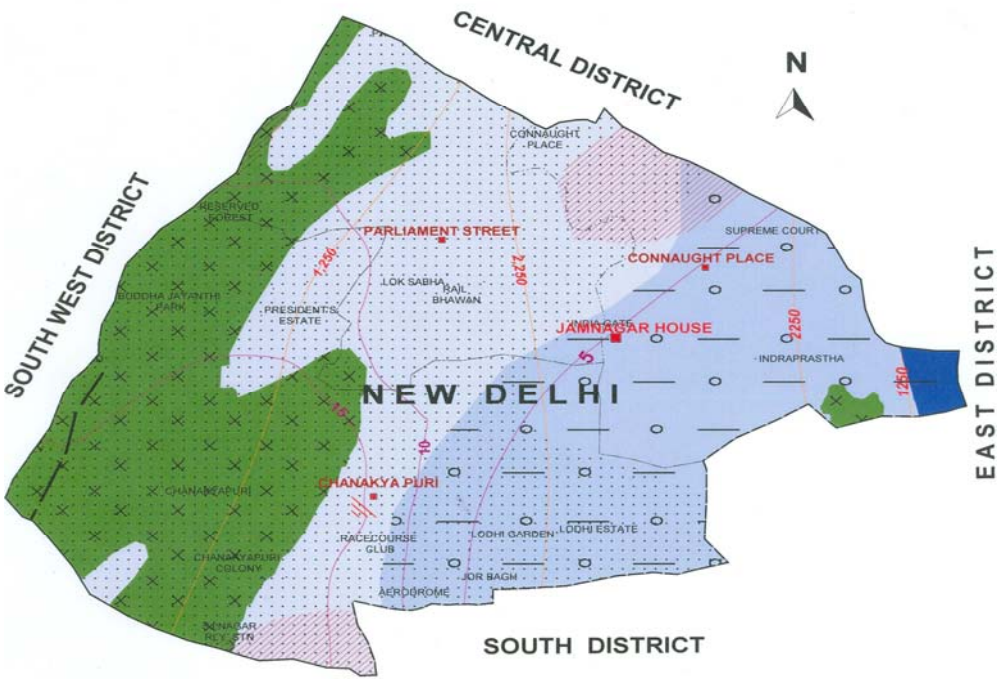
GROUND WATER INFORMATION BOOKLET OF NEW DELHI DISTRICT, NCT, DELHI



CENTRAL GROUND WATER BOARD
MINISTRY OF WATER RESOURCES
STATE UNIT OFFICE
NEW DELHI

DISTRICT BROCHURE OF
NEW DELHI DISTRICT, NCT DELHI

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PLATES:

DISTRICT AT A GLANCE

S.No.	ITEMS	STATISTICS
1.	**GENERAL INFORMATION**	
	i. Geographical Area (Sq. Km.)	35
	ii. Administrative Divisions (as on 31.03.2011)	
	a) Number of Tehsils	3
	b) Number of Towns	4
	c) Number of Villages	0
	iii. Population (as on 2011 Census)	
	a) Total Population	1,33,713
	b) Population Density (persons/sq. km)	3,820
	c) Number of households	30,385
	iv. Average Annual Rainfall (mm)	712 (Safdarjung)
2.	**GEOMORPHOLOGY**	
	Major Physiographic Units	Yamuna Flood Plain, Alluvial Plain Delhi Ridge
	Major Drainage	Yamuna River
3.	**LAND USE (Sq. Km.)**	
	a) Forest area	16.31
	b) Water bodies	0.002
4.	**MAJOR SOIL TYPES**	Sand and clay
5.	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.3.2013)**	
	a) Number of Dugwells	6
	b) Number of Piezometers	10
6.	**NUMBER OF GROUND WATER EXTRACTION STRUCTURES**	
	a) Dugwells	22
	b) Handpumps	664
	c) Tubewells/borewells	404
7.	**PREDOMINANT GEOLOGICAL FORMATIONS**	Quaternary Alluvium consisting mainly of sand of various grades, silt, clay and kankar

8.	**HYDROGEOLOGY & AQUIFER GROUP**	Alluvium and Quartzite
	Major water bearing formation	Sand and Kankar
	Pre-monsoon Depth to water level during May'2012	6.44 to 24.05 mbgl
	Post-monsoon Depth to water level during Nov'2012	6.11 to 25.05 mbgl
	Long term water level trend in 10 years (2003-2012) in m/yr	Pre monsoon : Fall (Range 0.04 to 2.58) Post monsoon : Fall (Range 0.03 – 3.11)
9.	**GROUND WATER QUALITY**	
	Presence of Chemical constituents more than permissible limit (e.g. EC, F, Fe)	EC (670 – 4984 µS/cm at 25^{o}C) Iron :1.45 mg/l
	Type of water	Mixed type
	Fresh/Saline Interface	40 m
10.	**DYNAMIC GROUND WATER RESOURCES (2011)- in MCM**	
	Annual Replenishable Ground Water Resources	7.97
	Gross Annual Ground Water Draft	6.49
	Stage of Ground Water Development	90.40%
	Number of Crtitical Tehsils	2
	No. of Semi Critical Tehsils	1
11.	**GROUND WATER CONTROL AND REGULATION**	The entire district has been notified by the Government of Delhi
12.	**GROUND WATER EXPLORATION BY CGWB (AS ON 31.3.2011)**	
	No. of wells drilled (EW, OW, PZ, SH, Total)	EW-9, PZ-10
	Depth range (m) drilled/constructed	43-151/20-106
	Depth of Bedrock (m)	5-91
	Discharge (liters per minute)	55-435
13.	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Ground water in deeper zones is saline. Depletion of ground water levels is attributed to over exploitation of ground water. Higher Iron content detected at Sunder Nursery area.

NEW DELHI DISTRICT, NCT DELHI

1.0 INTRODUCTION

1.1 ADMINISTRATIVE DETAILS

The New Delhi District lies in the heart of capital city of India. The area of the district includes the seat of Central Govt., Rashtrapati Bhawan, Prime Minister Office and residence, Central Govt. Offices, Foreign Embassies, residences of Ministers, Members of Parliament, Diplomat and Central Govt. Employees. The New Delhi district, covering a geographical area of 35 sq. km., is the second smallest district out of total nine districts in NCT, Delhi. The district is divided into three tehsils namely Chanakya Puri, Connaught Place and Parliament Street. There are 4 towns in the district. The whole district is urbanized.

The total population of the district is 1, 33,713 as per the census, 2011 and average population density is 3,820 persons per sq. km. The district has lowest population density in Delhi.

1.2 BASIN/SUB-BASIN:

The district falls in Yamuna sub-basin and forms part of the Ganga basin. The entire district is covered by Yamuna River water shed.

1.3 DRAINAGE:

The river Yamuna flowing in North-South direction controls the entire drainage system. The river has meandering courses with an abandoned channels in the form of stagnant water bodies along the course.

1.4 LAND USE:

The New Delhi district comprises mainly of the Lutyens Garden City, Connaught Place and part of the central ridge. It is primarily an institutional area having government offices, cultural buildings and embassy area. The only residential areas in the district are bunglow area i.e. Ministerial residences, Central Govt. Employee's residences and a few residential enclaves. Forest area of the district is 16.31 Sq. Km. A very small area (0.002 sq.km.) of the district is under water bodies.

1.5 STUDIES/ACTIVITES OF CGWB:

Central Ground Water Board had covered the entire district under Systematic Hydrogeological Surveys. The district which was formed in 1997, was part of the erstwhile City Block. Based on the Re-appraisal Hydrogeological survey carried out in 1983-84, CGWB, NWR had brought out a consolidated report on Hydrogeological conditions and Ground Water Development Potential of Union Territory of Delhi in 1989. In 1996 and 2009, reports highlighting development and augmentation of Ground Water Resources of the State were published by CGWB. The Dynamic Ground Resources of the district have been estimated in 2011 for understanding of ground water scenario. CGWB, SUO Delhi is also monitoring water level and quality regularly from the existing National Hydrograph Network Stations. The district was covered under Ground Water Exploration by Central Ground Water Board in 1973. A total of 9 exploratory wells and 10 piezometers/ observation wells have been drilled in the district. Salient features of ground water exploration in the district are furnished in Table 1.

Table 1: Salient features of ground water exploration

Type of well	No.	Depth drilled (m)	Depth constructed (m)	SWL (m)	Discharge (lpm)	Drawdown (m)	Sp. Capacity (lpm/m)	T (m^2/day)	S	EC (µS/cm at 25ºC
EW	9	51.8-105	39-100	1 – 15	55 - 435	21.26-31.45	1.74-19.85	-	-	600-2912
PZ/OW	10	43-151	20-106	1.64-15.1	99-225	-	-	-	-	880-6210

2.0 RAINFALL & CLIMATE

2.1 RAINFALL:

The average annual rainfall of the district is 712 millimetres. About 81% of the annual rainfall is received during the monsoon months of July, August and September. The rest of the rainfall is received as winter rain and as thunderstorm rain in the pre and post monsoon months. The variation of rainfall from year to year is large. On an average rain of 2.5 mm or more falls on 27 days in a year, of which, 19 days are during the monsoon months. Two to three days in June are rainy. In other months, except in November and in first half of December when it is practically rainless, rain falls on a day or two only in each month.

2.2 CLIMATE:

The climate of district is mainly influenced by its inland position and prevalence of air of the continental type during major part of the year. Extreme dryness with intensely hot summer and cold winter are characteristics of the climate. The cold season starts towards the latter half of November when both day and night temperatures drop rapidly with the advance of the season. January is the coldest month with the mean daily maximum temperature at 21.3ºC and the mean daily minimum temperature at 7.3ºC. May and June are the hottest months. In May and June, maximum temperature may sometimes reach 46 or 47ºC.

3.0 GEOMORPHOLOGY & SOIL TYPES

3.1 GEOMORPHOLOGY:

Part of the district is under Older Alluvial Plain and Delhi ridge. This district has varied surface altitude due to Delhi Ridge. The ridge occupies the western border of the district. Nearly 10 sq. km area falling within the ridge area has an altitude ranging from 225 to 255 m amsl. Eastern part of the district is under Older Alluvial Plain, with general elevation ranging from 209 to 219 m amsl.

3.2 SOIL TYPES:

The district has clay, silt and fine to medium sand. The soil is mostly calcareous in nature.

4.0 GROUND WATER SCENARIO

4.1 GEOLOGY:

The New Delhi District is occupied by quartzite and Quaternary alluvial sediments. Quartzites are interbedded with mica schist and phyllites. The Alwar quartzites of Delhi System exposed in the area belong to Ajabgarh Group of Delhi Supergroup of Proterozoic to Cenozoic age. Quaternary sediments belong to Middle to Late Pleistocene Age.

4.2 HYDROGEOLOGY:

Water Bearing Formation:

Hydrogeological map of the district is presented in Plate-1. The sub-surface configuration of New Delhi district is different at various places. Subsurface disposition of aquifers is shown in Plate 2. The western part adjoining to Delhi ridge is characterized by marginal alluvium where 0- to 30 m thick veneer of alluvium overlies weathered and fractured quartzite rocks (Delhi Ridge).

The alluvium consists of clay, silt and fine to medium sand. A substantial amount of Kankar is also admixed with the clayey-silt below 20m depth. This is the main aquifer material found in these areas. The top soil zone predominantly consists of silty-clay material followed by thin partings of clayey-silt, sandy-silt and clay layers alternatively. Sandy-silt strata forms as favourable aquifer zone. In the western part of New Delhi district, covering areas of Rashtrapati Bhavan , Chanakyapuri, Shantipath, South and North Avenue and Connaught Place tubewells are tapping both alluvium as well as hard rock whereas in the eastern part, tubewells generally tap alluvium. The tubewells usually tap kankar zone admixed with clayey-silt and sandy-silt aquifer zone. The yield of the tubewells in the district ranges from 55 to 435 LPM. The depth of bedrock ranges from 5 to 91 m in the district.

Depth to water level:

Ground water in the area occurs both under water table as well as under semi-confined conditions. The depth to water level during pre monsoon in the district varies from 6.44 to 24.05 mbgl and during post-monsoon period, it varies from 6.11 to 25.05 mbgl (Plates 3 & 4). There is a wide variation in water level due to wide range of topographic relief. In the Yamuna flood plain area, depth to water level ranges from 5 to 8 m bgl whereas in the Delhi ridge area, it varies from 10 to 25 mbgl.

Seasonal Water level fluctuation:

Seasonal water level fluctuation has been computed from the water level data obtained from the ground water observation wells monitored in the area during pre-monsoon and post-monsoon period. Fluctuation in water level is the outcome of mainly the amount of rainfall received by the area and ground water withdrawal. The seasonal fluctuation in water level between pre and post monsoon shows rise in water level ranging from 0.22 to 1.22 m and fall ranging from 0.15 to 1.80 m.

Long Term Water level trend:

The long-term water level trend analysis in the district over the last 10 years period shows

i) a fall of 0.04 to 2.58 m during the pre-monsoon period and
ii) a fall of 0.03 to 3.11 m during the post-monsoon period.

4.3 GROUND WATER RESOURCES:

Tehsil wise ground water resource estimation using GEC, 1997 methodology by CGWB as on 31.03.2011 is given in Table 2. Total annually replenishable ground water resources of the district have been assessed as 797.29 ham, out of which net annual ground water availability has been assessed as 717.561 ham. Total annual ground water draft for all uses has been estimated to be 648.68 ham, with overall stage of ground water development at 90.40%. Out of 3 tehsils, 1 tehsil is falling under semi critical category whereas 2 fall under crtitical category.

Table 2: Tehsil wise ground water resources of New Delhi district (As on 2011)

Sl. No.	Tehsils	Annual ground water recharge (ham)	Net ground water availability (ham)	Existing annual gross ground water draft for irrigation (ham)	Existing annual gross ground water draft for domestic and industrial uses (ham)	Existing annual gross ground water draft for all uses (ham)	Stage of ground water development (in %)	Category of Tehsils
1.	Chanakay Puri	392.62	353.358	300.48	39.81	340.29	96.30	Critical
2.	Connaught Place	209.79	188.811	124.98	23.88	148.86	78.84	Semi Critical
3.	Parliament Street	194.88	175.392	128.15	31.39	159.53	90.96	Critical
	Total	797.29	717.561	553.61	95.08	648.68	90.40	Critical

4.4 GROUND WATER QUALITY:

Quality of ground water is fresh upto 40 mbgl. Below this depth, ground water is moderate to highly saline. Reported Iron content is 1.45 mg/l. The general ranges of various important chemical constituents in the ground water samples collected from New Delhi district are given in Table 3 :

Table 3: General ranges of various chemical constituents in ground water

Chemical Constituents	**Range**
pH	8.47-8.99
EC (µS/cm at 25ºC)	670-4984
Bicarbonate (mg/l)	119.26-305.85

Chloride (mg/l)	46.70-592.57
Nitrate (mg/l)	12.7-373
Sulphate (mg/l)	50.3-750
Fluoride (mg/l)	0.42-1.42
Calcium (mg/l)	36.36-195.5
Magnesium (mg/l)	23.84-202.65
Total Hardness as $CaCO_3$ (mg/l)	211.31-1333.9
Sodium (mg/l)	50.91-789.1
Potassium (mg/l)	0.98-104.1
Iron (mg/l)	1.45

Electrical Conductivity in the district has been found to vary from 670 to 4984 µS/cm at 25ºC. EC in major part of the district is within 3000 µS/cm at 25ºC. EC in excess of 3000 µS/cm at 25ºC has been observed in the eastern part of the district (Plate 5). Fluoride concentration in ground water in the district is within the maximum permissible limit of 1.5 mg/l. Nitrate concentration in excess of maximum permissible limit of 45 mg/l is found in entire district except in the western part (Plate 6).

4.5 STATUS OF GROUND WATER DEVELOPMENT

At present level of ground water development is maximum (96.30%) in Chanakay Puri and is minimum (78.84%) at Connaught Place as indicated in Table 2 above. The district as a whole is categorized as Critical with ground water development at 90.40%.

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 GROUND WATER DEVELOPMENT:

As stated above, the district as a whole is categorized as Critical with stage of ground water development at 90.40%. This indicates the reality that the ground water resources of the district are stressed. In view of increasing extraction of ground water and consequent adverse environmental impacts, sustainable management of this precious natural resource is extremely important.

5.2 WATER CONSERVATION AND ARTIFICIAL RECHARGE:

In view of depleting ground water levels, it is essential that artificial recharge measures may be implemented on large scale. Recharge structures suitable in the area are shaft/trench with recharge well and recharge pit with/without bore in the alluvium area. While in the hard rock aquifer, suitable structures are shaft/trench with recharge well, recharge pit with/without bore and check dams/bunds.

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

6.1 DEPLETING GROUND WATER LEVEL & QUALITY:

The wells located in this district show declining trends during pre and post monsoon period.

Analysis of seasonal and long term water level data indicates declining water levels in the range of 0.15 to 1.80 m.

Water Quality is generally saline below 40 m depth. At some places, the depth of saline fresh water interface occurs beyond 70 m. High Iron content has been observed at India Gate, Lodhi Garden and Sunder Nursery area.

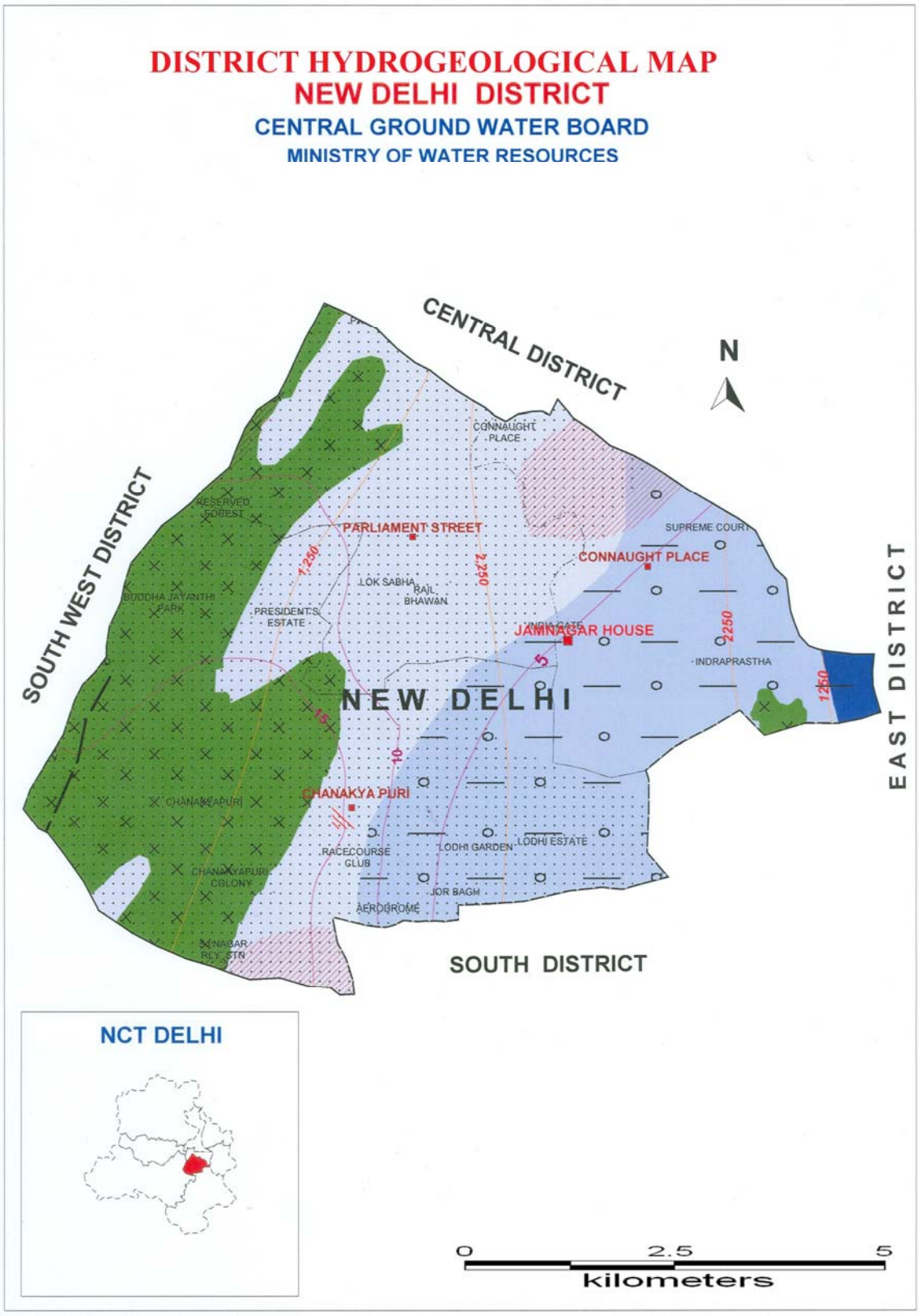
7.0 AREA NOTIFIED

The entire district has been notified by Hon'ble Lt. Governor of Delhi for regulation of ground water development.

8.0 RECOMMENDATIONS

1. Efforts should be made to arrest the declining ground water levels by preventing indiscriminate withdrawal of ground water and adopting roof top rain water harvesting and artificial recharge.
2. Monitoring of water levels and chemical quality on regular basis is essential.
3. The areas receiving drinking water supply from ground water sources should be monitored rigorously for quality consideration. The contaminants, if in the manageable range, should be removed by various techniques.

Plate 1: District Hydrogeological Map



NEW DELHI DISTRICT

LEGEND

	Wells feasible	Rigs suitable	Depth of Well (m)	Discharge (lpm)	Suitable Artificial Recharge Structures **
Soft Rock Aquifer	Tube Wells	Reverse / Direct Rotary	30-45*	300-450	Not Feasible
Soft Rock Aquifer	Tube Wells	Reverse / Direct Rotary	30-80*	150-360	Shaft/Trench with recharge well, Recharge Pit with/without bore
Hard Rock Aquifer	Tube Wells	DTH/ Rotary cum DTH	60-90*	90-240	Shaft/Trench with recharge well, Recharge Pit with/without bore, Check Dams/Bunds
Depth to Water level in m. (Pre-monsoon decadal mean, 2003-2012) 5		Electrical Conductivity (Micro mhos/cm at 25° C) 3000		Major river / Drain	Faults/Lineaments
Fluoride > Permissible limit (1.5 ppm)		Nitrate > Permissible limit (100 ppm)		Iron > Permissible Limit (1.0 ppm) / * Fe	
State boundary		District boundary		Tehsil boundary	
Tehsil head quarter		Over exploited block		Area feasible for Artificial Recharge structures	
District head quarter					

* Depth of the well is restricted to the availability of fresh water. ** Feasible in areas where depth to water level is more than 8 m below ground level. In soft rock formation recharge well may be constructed where water level is more than 15 m. bgl (meter below ground level).

OTHER INFORMATION

Name of State	Delhi
Name of District	New Delhi
Geographical Area	35 Sq.Km.
Major Geological Formation	Soft Rock - Younger/Older Alluvium Hard Rock -Quartzite
Major Drainage System	Yamuna
Population (as on 2011)	1.34 lakhs
No of Tehsils	3, Parliament Street, Connaught Place and Chanakyapuri
Replenishable Ground Water Resources (MCM)/ Draft (MCM)/ Stage of Ground Water Development (%)	Chanakyapuri-3.93/3.68/104
	Connaught Place-2.10/1.65/88
	Parliament Street-1.95/1.81/103
Average Annual Rainfall	Safdarjang — 712 mm
Range of Mean Daily Temperature	18 — 31 °C
Tehsil Showing Intensive Ground Water Development	Chanakyapuri and Parliament Street

Plate 2: Sub-surface geological cross section of New Delhi District, Delhi

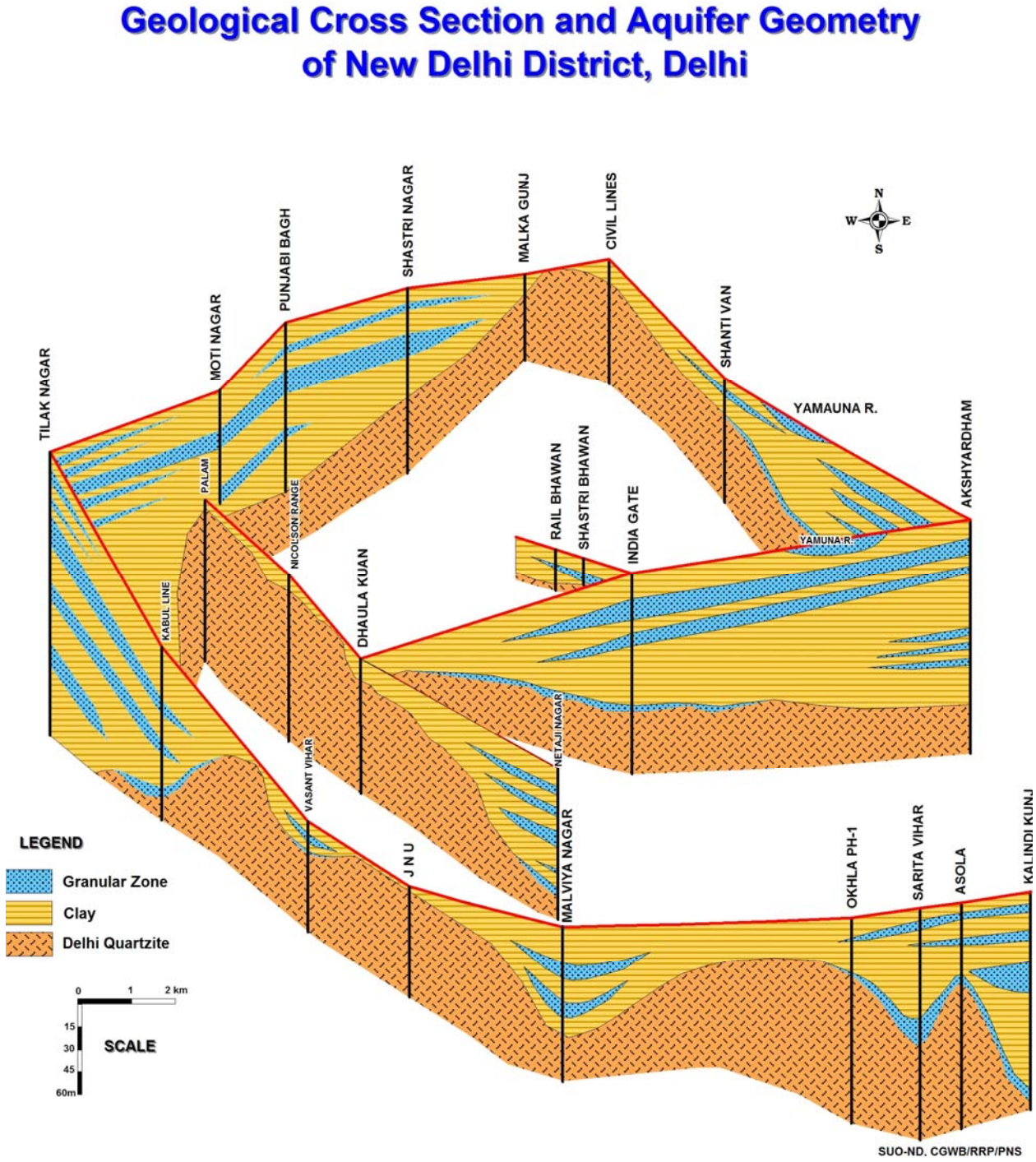


Plate 3: Depth to Water Level Map during Pre-monsoon (May, 2012)

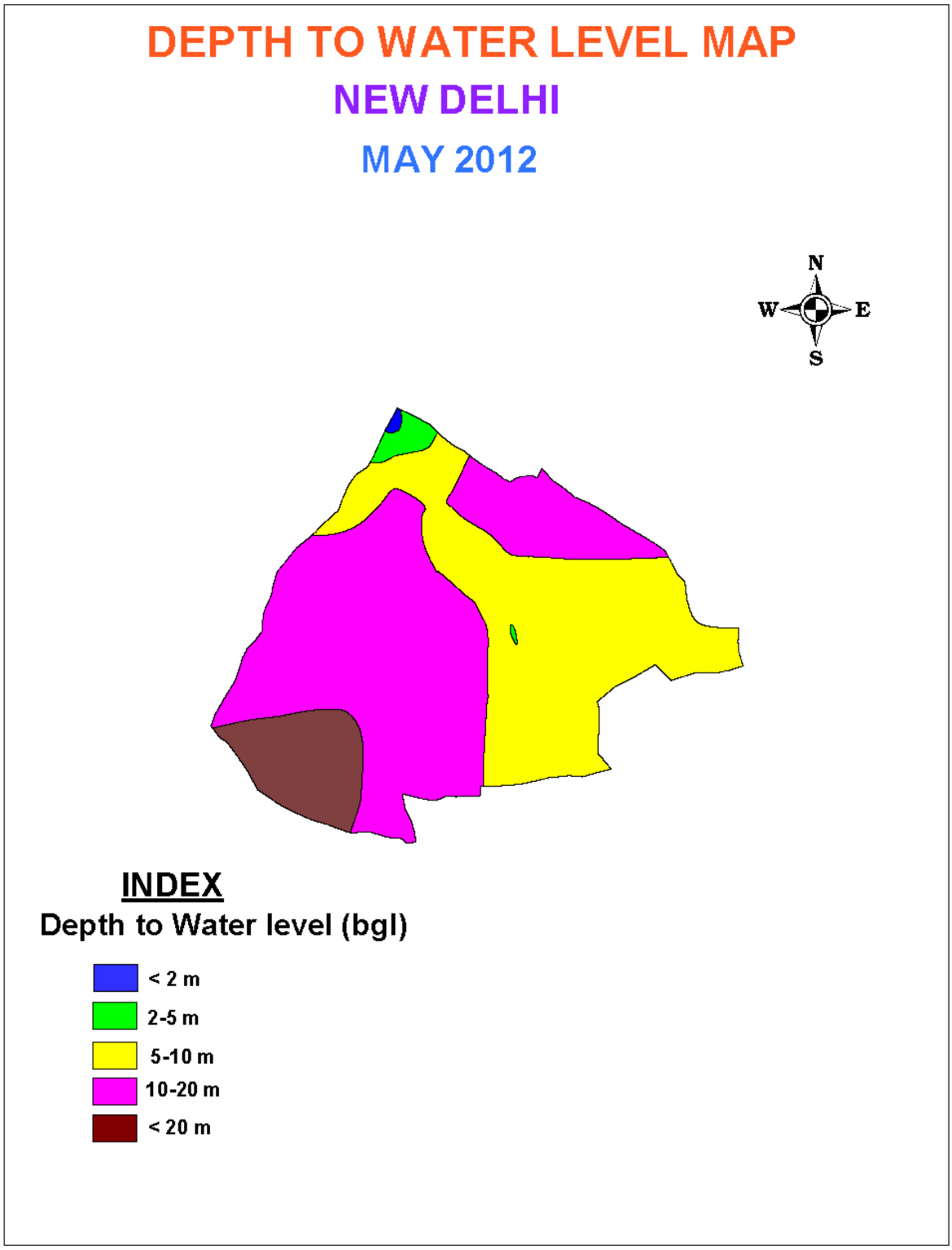


Plate 4: Depth to water Level Map during Post-monsoon (November, 2012)

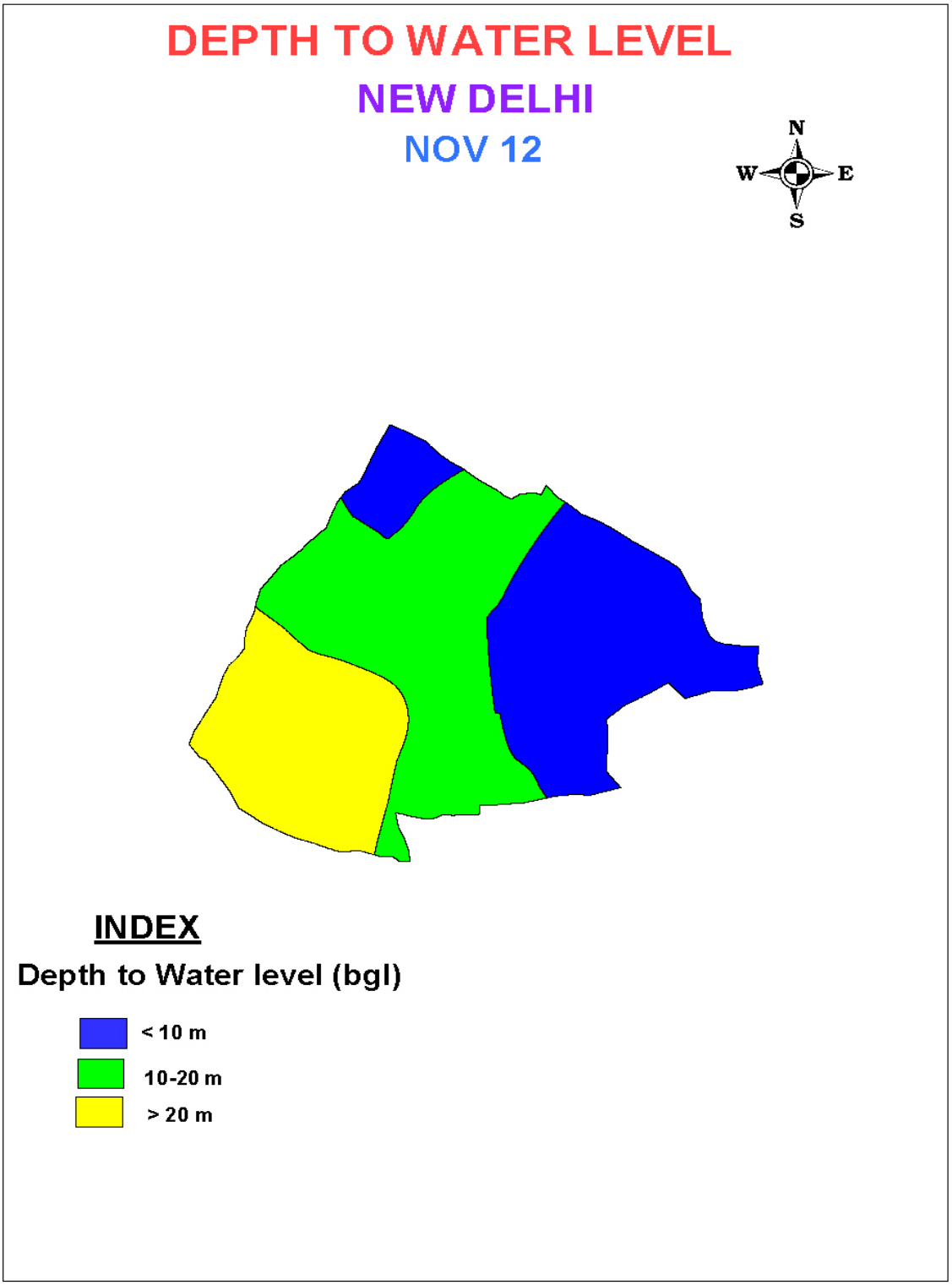


Plate 5: Electrical Conductivity Map (May, 2012)

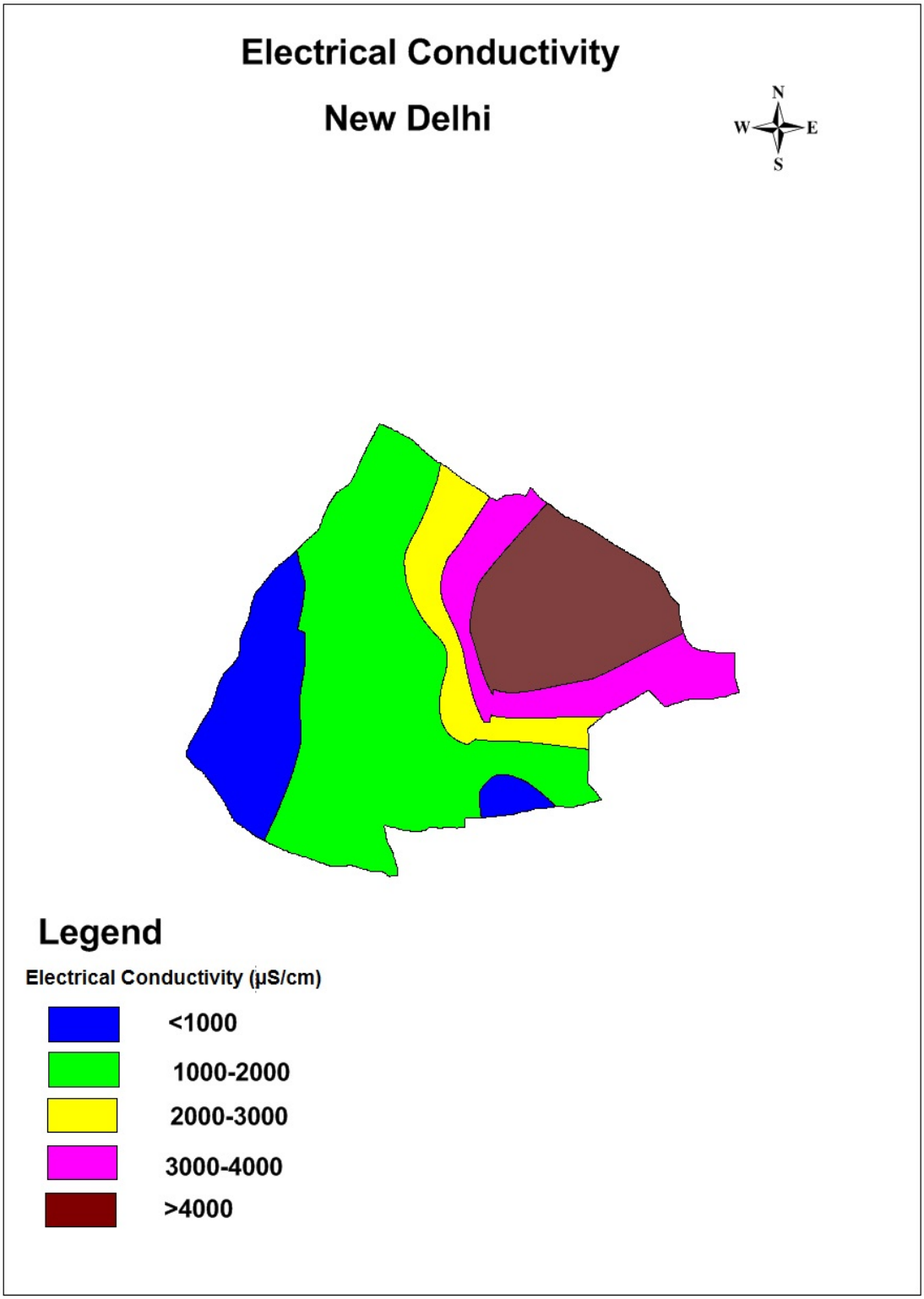


Plate 6: Nitrate distribution map (May, 2012)