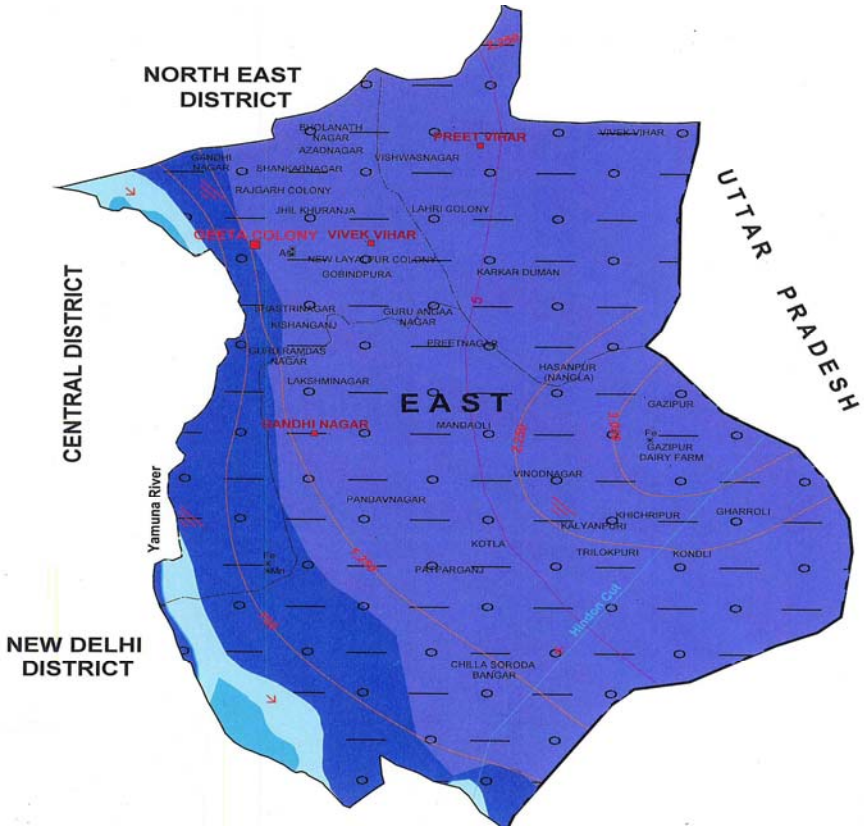
GROUND WATER INFORMATION BOOKLET OF EAST DISTRICT, NCT, DELHI



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

DISTRICT BROCHURE OF
EAST DISTRICT, NCT DELHI

CONTENTS

DISTRICT AT A GLANCE

S.No.	ITEMS	STATISTICS
1.	**GENERAL INFORMATION**	
	i. Geographical Area (Sq. Km.)	64
	ii. Administrative Divisions (as on 31.03.2011)	
	a) Number of Tehsils	3
	b) Number of Villages	8
	c) Number of Towns	3
	iii. Population (as on 2011 Census)	17,07,725
	a) Total Population	26,683
	b) Population Density (persons/sq. km)	3,54,385
	c) No. of Households	
	iv. Average Annual Rainfall (mm)	451 (Shahdara)
2.	**GEOMORPHOLOGY**	
	Major Physiographic Units	Yamuna Flood Plain, which is subdivided into Active Flood Plain and Older Flood Plain
	Major Drainage	Yamuna River
3.	**LAND USE (Sq. Km.)**	
	a) Forest area	2.99
	b) Water bodies	0.35
4.	**MAJOR SOIL TYPES**	Silty-clay to clayey silt along with sandy loam
5.	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.3.2013)**	
	a) Number of Dugwells	0
	b) Number of Piezometers	9
6.	**NUMBER OF GROUND WATER EXTRACTION STRUCTURES**	
	a) Dugwells	107
	b) Handpumps	5147

	c) Tubewells/borewells	12321
7.	**PREDOMINANT GEOLOGICAL FORMATIONS**	Quaternary Alluvium consisting mainly of sand of various grades, silt, clay and kankar
8.	**HYDROGEOLOGY & AQUIFER GROUP** Major water bearing formation Pre-monsoon Depth to water level during May'2012 Post-monsoon Depth to water level during Nov'2012 Long term water level trend in 10 years (2003-2012) in m/yr	Alluvium Sand, silt and kankar 3.60 to 15.74 mbgl 3.23 to 16.89 mbgl Pre monsoon : Fall (Range 0.62 – 2.81) Post monsoon : Fall (Range 0.34 – 4.88)
9.	**GROUND WATER QUALITY** Presence of Chemical constituents more than permissible limit (e.g. EC, F, Fe) Type of water Fresh/Saline Interface	 EC : 550 to 5084 µS/cm at 25ºC Iron :13 mg/l Ca, Na- Cl type 25-50 m
10.	**DYNAMIC GROUND WATER RESOURCES (2011)- in MCM** Annual Replenishable Ground Water Resources Gross Annual Ground Water Draft Stage of Ground Water Development No. of OE tehsils No. of semi-critical tehsils	 12.84 21.24 178.87% 2 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) Depth range (m) (m) drilled/constructed Depth of Bedrock (m) Discharge (liters per minute)	 EW-27, PZ-17 15 – 207/15-83 54->300 59-2339

	Transmissivity (m^2/day)	9-4036
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 at Nangli Rajapur.

DISTRICT BROCHURE OF
EAST DISTRICT, NCT DELHI

1.0 INTRODUCTION

1.1 ADMINISTRATIVE DETAILS

The East district is located east of Yamuna River, sharing border with Ghaziabad and Noida of Uttar Pradesh. The district was formed in 1997 and was part of the erstwhile Shahdara Block. East district covers a geographical area of 64 sq km and forms 4.34 % of total area of Delhi. For administrative convenience, the district is divided into three tehsils namely Gandhi Nagar, Preet Vihar and Vivek Vihar. There are 8 villages in the district, most of which are urban villages. This district lies in between two rivers i.e. Yamuna in the west and Hindon in the east (6 Km eastward from the Delhi border). It is flood prone district, due to over flow of river Yamuna during monsoon season.

According to 2011 census, the total population of the district is 17, 07,725 and average population density is 26,683 persons per sq km. The population density of the district is third highest in the State.

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 watershed.

1.3 DRAINAGE:

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

1.4 LAND USE:

The district has demarcated industrial areas in Patparganj and Jhilmil. Sanjay Lake, spreading over 0.17 sq km area, is the largest water body in the district. The district has small forested area of 2.99 sq km. Approximately, 0.35 sq km area of the district is under water bodies.

1.5 STUDIES/ACTIVITIES OF CGWB:

Central Ground Water Board had covered the entire district under Systematic Hydrogeological Surveys. 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 27 exploratory wells and 17 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	27	35.46 – 207.35	32 - 55	1.53 – 15.09	59 - 2339	2.34-21.09	18-581	9 - 4036	$0.7*10^{-4}$ – $7.06*10^{-3}$	721 - 3253
PZ/OW	17	15.5 - 200	15.5 - 83	2.1 – 14.51	59 - 1020	0.4 - 6	72 - 2550	79 - 1085		498 - 821

2.0 RAINFALL & CLIMATE

2.1 RAINFALL:

The average annual rainfall of the district is 451 mm at Shahdara. 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:

The East district is under Yamuna Alluvial Plain, which is sub divided into Active Flood Plain and Older Flood Plain. The district is prone to floods during the monsoon season.

The wide Older Yamuna flood plain indicates lateral migration of river Yamuna over large areas. This belt has good potential for ground water development. 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. The river Yamuna is the only perennial river flowing in southerly direction. Either side of the river Yamuna is marked by the extensive alluvial flood plain.

3.2 SOIL TYPES:

The district has silty-clay to clayey silt along with sandy loam type of soil. The soils are calcareous in nature.

4.0 GROUND WATER SCENARIO

4.1 GEOLOGY:

The geological formations underlying the district belong to Quaternary Age. Quaternary sediments are divided into Older Alluvium and Newer Alluvium. The older Alluvium is of Middle to Late Pleistocene Age and Newer Alluvium is of Recent Age. The older alluvium comprises of silt and clay mixed with kankar in varying proportions. The Newer Alluvium mainly consists of un-oxidised sands, silt and clay occurring on the Yamuna Flood Plain.

4.2 HYDROGEOLOGY:

Water Bearing Formation:

Hydrogeological map of the district is presented in Plate 1. The Yamuna flood plain and eastern border (proximity of Hindon river) shows a thick fine sand and sandy silt strata at shallower depth i.e. up to 60 m bgl (Plate 2). The finer sediments like clayey –silt, silty-clay and buff coloured clay along with Kankars also exist, as partings between granular zone. The deeper zones beyond 60 m depth are characterized by fine material and are lacking in granular zone. The basement rock condition in East district area is moderately uneven with gentle slope towards east. Even at Ghazipur , Kalyanpuri and Mayur Vihar, a mound like basement rock prevails within the depth range of 54 to 79 m bgl. The basement rock underlying Yamuna food plain in East Delhi District ranges in depth from 54 to 300 m bgl. Around Akhsar Dham temple, it ranges from 88 to 120m bgl.

The discharge of tubewells located in Yamuna flood plains varies from 59 to 2339 lpm.

The Fresh –Saline water interface in Yamuna Flood Plain varies in depth from 32 to 50 m where as in rest of the area it varies from 25 to 38 m in depth.

Depth to water level:

Ground water observation wells established in the district are being monitored four times in a year. Pre-monsoon and post-monsoon water level data are collected during May and November months respectively. The depth to water level during pre monsoon water level in the district varies from 3.60 to 15.74 mgl and post monsoon water level varies from 3.23 to 16.89 mbgl. Shallower water levels are observed along the western border of the district and water levels are deeper as we move towards the east (Plates 3 and 4).

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 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 periods shows rise in water level ranging from 0.37 to 0.62 m and fall ranging from 0.05 to 1.15 m.

Long Term Water level trend:

The long-term water level trend analysis in East district over the last 10 years period shows
i) a fall of 0.62 to 2.81 m during the pre-monsoon period and
ii) a rise of 0.34 to 4.88 m during the post-monsoon period.

4.3 GROUND WATER RESOURCES:

Tehsil wise ground water resources as estimated using GEC, 1997 methodology by CGWB as on 31.03.2011 are given in Table 2. Total annually replenishable ground water resources of the district have been assessed as 1284.15 ham, out of which net annual ground water availability has been assessed as 1187.5 ham. Total annual ground water draft for all uses has been estimated to be 2124.1 ham, with overall stage of ground water development at 178.87%. Out of 3 tehsils, 1 tehsil is falling under semi critical category whereas 2 fall under over exploited category.

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

S.No.	Tehsil	Annual ground water recharge (ham)	Net annual 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 (%)	Category
1.	Gandhi Nagar	396.36	356.724	96.04	188.16	284.20	79.67	Semi-critical
2.	Preet Vihar	635.3	603.535	690.69	775.43	1466.12	242.92	Over-exploited
3.	Vivek Vihar	252.49	227.241	57.36	316.42	373.78	164.49	Over-exploited
	Total	1284.15	1187.5	844.09	1280.01	2124.1	178.87	Over-exploited

4.4 GROUND WATER QUALITY:

The ground water quality is generally fresh upto 25m depth and is moderate to highly saline in deeper aquifers. Iron is reported as 13 mg/l. The general ranges of various important chemical constituents in ground water samples collected from East district are given in Table 3.

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

Chemical Constituents	Range
pH	8.41-8.95
EC (µS/cm at 25ºC)	550-5084
Bicarbonate (mg/l)	106.63-221.67
Chloride (mg/l)	26.58-1234.97
Nitrate (mg/l)	5.84-213
Sulphate (mg/l)	15-569
Fluoride (mg/l)	0.24-0.83
Calcium (mg/l)	35.23-176.1
Magnesium (mg/l)	16.29-180
Total Hardness as $CaCO_3$ (mg/l)	0-1190.95
Sodium (mg/l)	29.69-741
Potassium (mg/l)	22.35-87.75
Iron (mg/l)	13

Electrical Conductivity in the district has been found to vary from 550 to 5084 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 northern 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 major part of the district is within the maximum permissible limit of 45 mg/l except northwestern and southern parts (Plate 6).

4.5 STATUS OF GROUND WATER DEVELOPMENT

At present level of ground water development is maximum (242.92%) in Preet Vihar and is minimum (79.67%) in Gandhi Nagar as indicated in Table 2 above. The district as a whole is categorized as over exploited with ground water development at 178.87%.

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 GROUND WATER DEVELOPMENT:

As stated above, the district as a whole is categorized as over exploited with stage of ground water development at 178.87%. 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 the depleting ground water levels in the eastern parts of the district, 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.

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

6.1 WATER LOGGING:

A considerable part of the district especially in the western part of the district faces problem of water logging due to shallow water levels during pre and post monsoon period. Such areas generally fall in the vicinity of river Yamuna, indicating excessive seepage from the river.

6.2 DEPLETING GROUND WATER LEVEL & QUALITY:

The wells located in the central and eastern parts of the district show continuous declining trend during pre and post monsoon period which is attributed to over exploitation of ground water.

Analysis of seasonal and long term water level data indicates a very gradual declining trend of water levels in the range of 0.05 to 1.15 m.

Higher nitrate content is reported at Nangli Rajapur. At places, higher EC values more than permissible limit have also been reported.

7.0 AREAS NOTIFIED

The entire district has been notified by the Government of Delhi for regulation of ground water development.

8.0 RECOMMENDATIONS

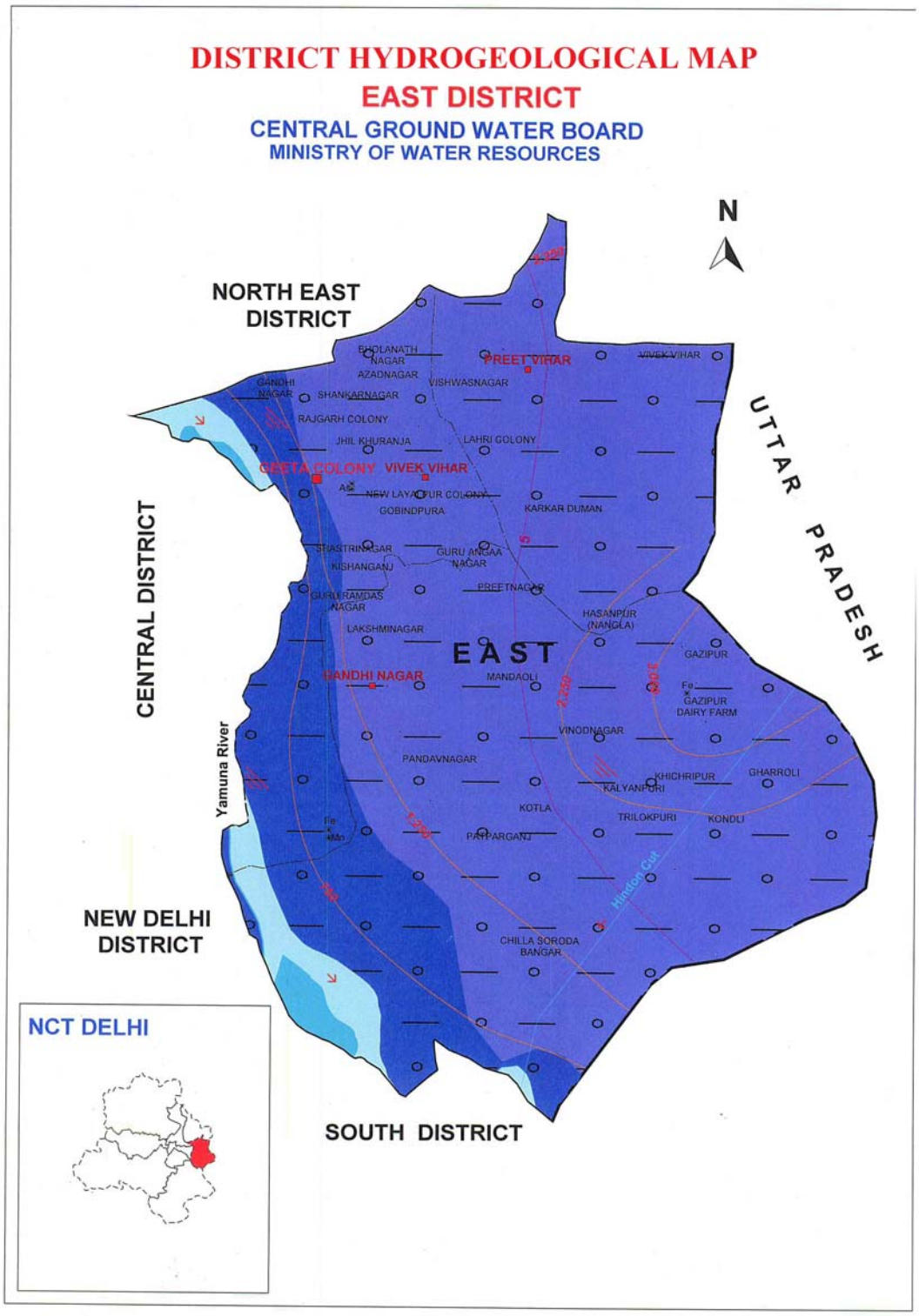
1. Efforts should be made to arrest the declining ground water levels by preventing indiscriminate withdrawal of ground water and adopting roof top rain water harvesting and artificial recharge.

2. Regular monitoring of water levels and chemical quality is essential.

3. 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.

4. In areas prone to water logging, development of ground water should be encouraged.

Plate 1: District Hydrogeological Map



EAST DISTRICT

LEGEND

	Wells feasible	Rigs suitable	Depth of Well (m)	Discharge (lpm)	Suitable Artificial Recharge Structures **
Soft Rock Aquifer	Tube Wells	Reverse / Direct Rotary	25-45*	1200-1800	Not Feasible
Soft Rock Aquifer	Tube Wells	Reverse / Direct Rotary	25-40*	900-1200	Shaft/Trench with recharge well, Recharge Pit with/without bore
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					

Average depth to water level in the major part of the district is about 5 meters below ground level.
* 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.

OTHER INFORMATION

Name of State	Delhi
Name of District	East
Geographical Area	64 Sq.Km.
Major Geological Formation	Soft Rock Younger/Older Alluvium
Major Drainage System	Yamuna
Population (as on 2011)	17.08 lakhs
No of Tehsils	3, Gandhi Nagar, Vivek Vihar and Preet Vihar,
Replenishable Ground Water Resources (MCM)/ Draft (MCM)/ Stage of Ground Water Development (%)	Gandhi Nagar – 3.96/2.96/83 Preet Vihar– 6.35/15.24/253 Vivek Vihar – 2.53/3.88/171
Average Annual Rainfall	Shahdara - 451 mm
Range of Mean Daily Temperature	18 - 31°C
Tehsil Showing Intensive Ground Water Development	Preet Vihar and Vivek Vihar

Plate 2: Sub-surface geological cross section along Geeta Colony – Nagli Rajapur and Nagli Rajapur - Gazipur

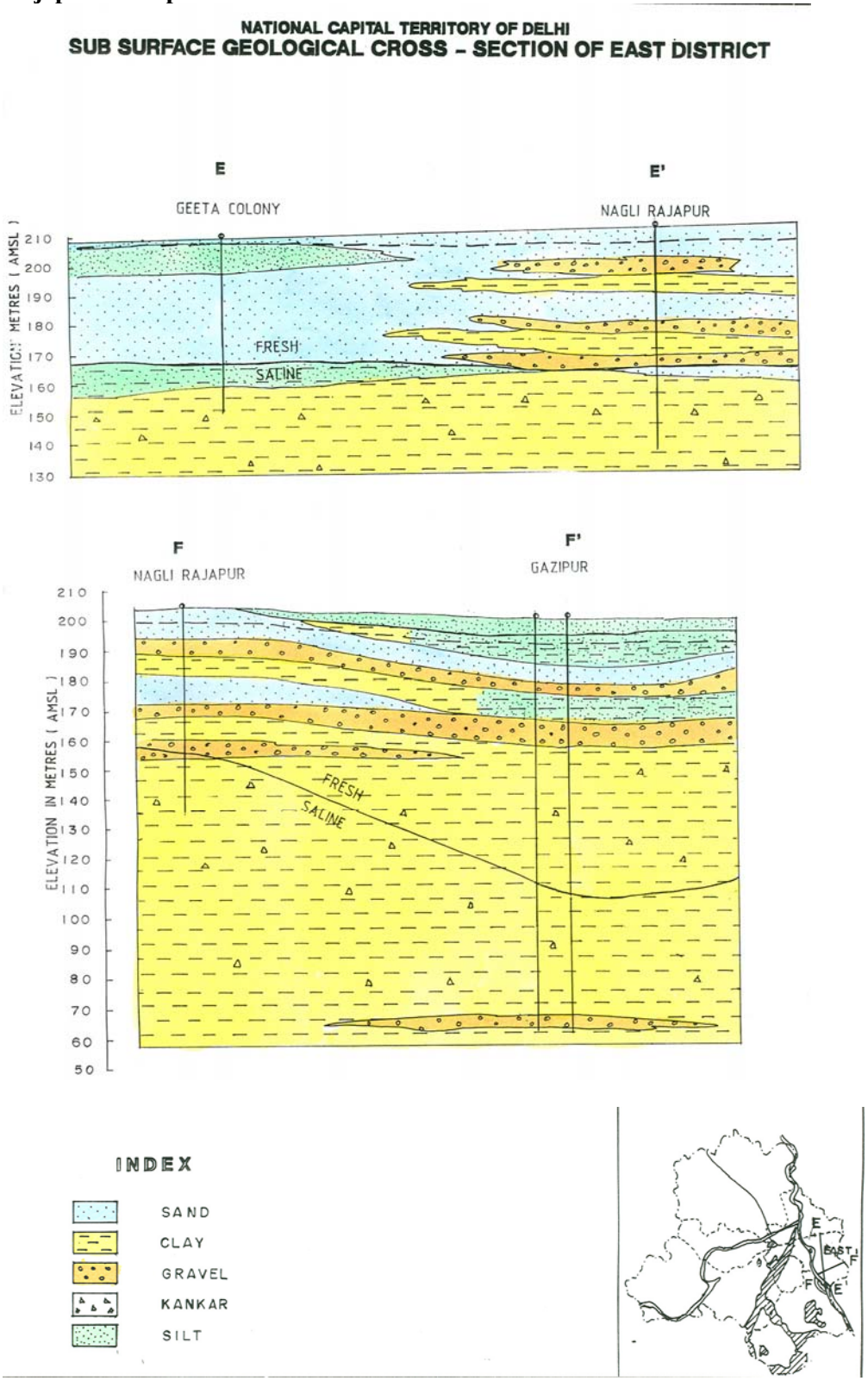


Plate 3: Depth to Water Level Map during Pre-monsoon (May, 2012)

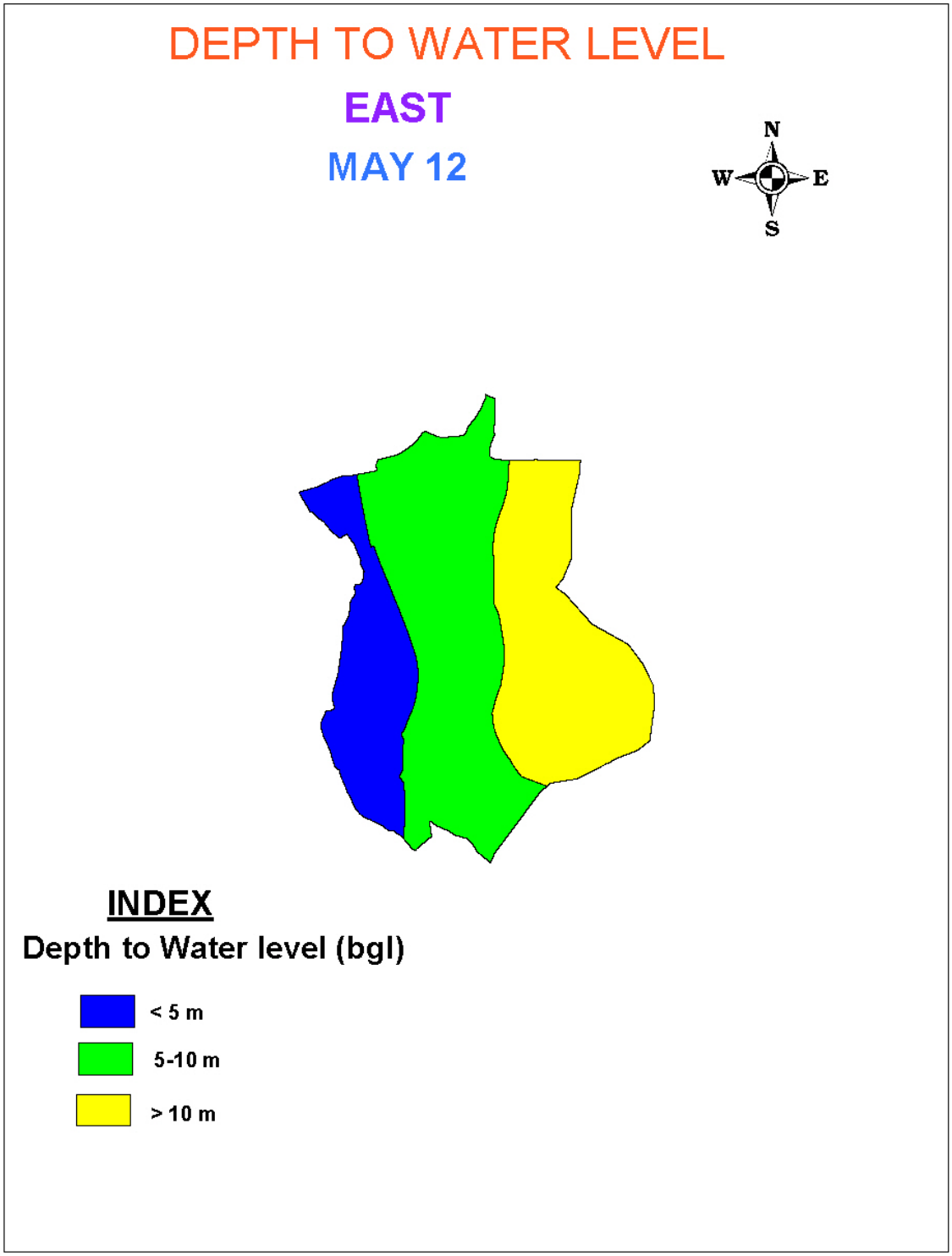


Plate 4: Depth to water Level Map during Post-monsoon (November, 2012)

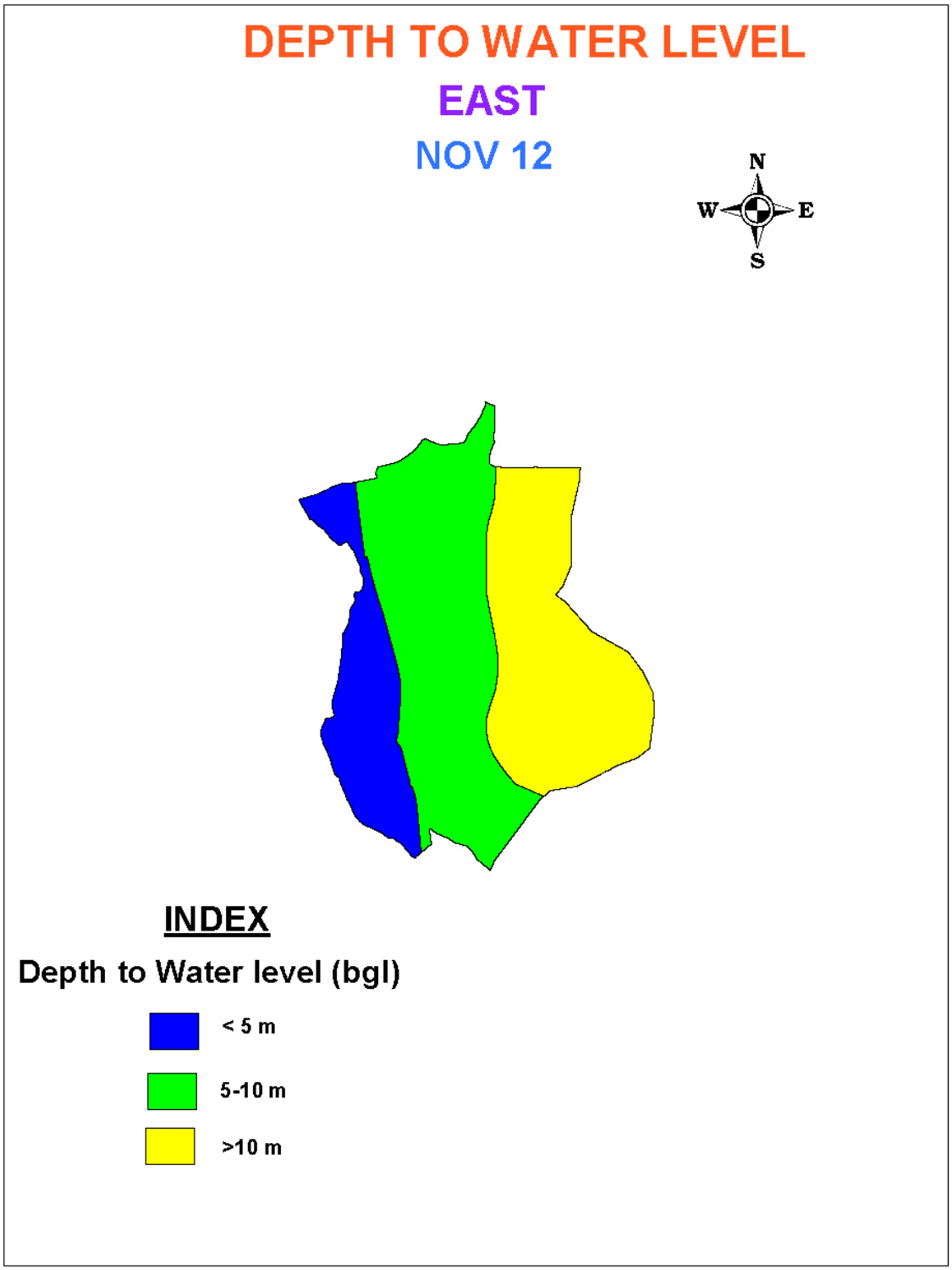


Plate 5: Electrical Conductivity Map (May, 2012)

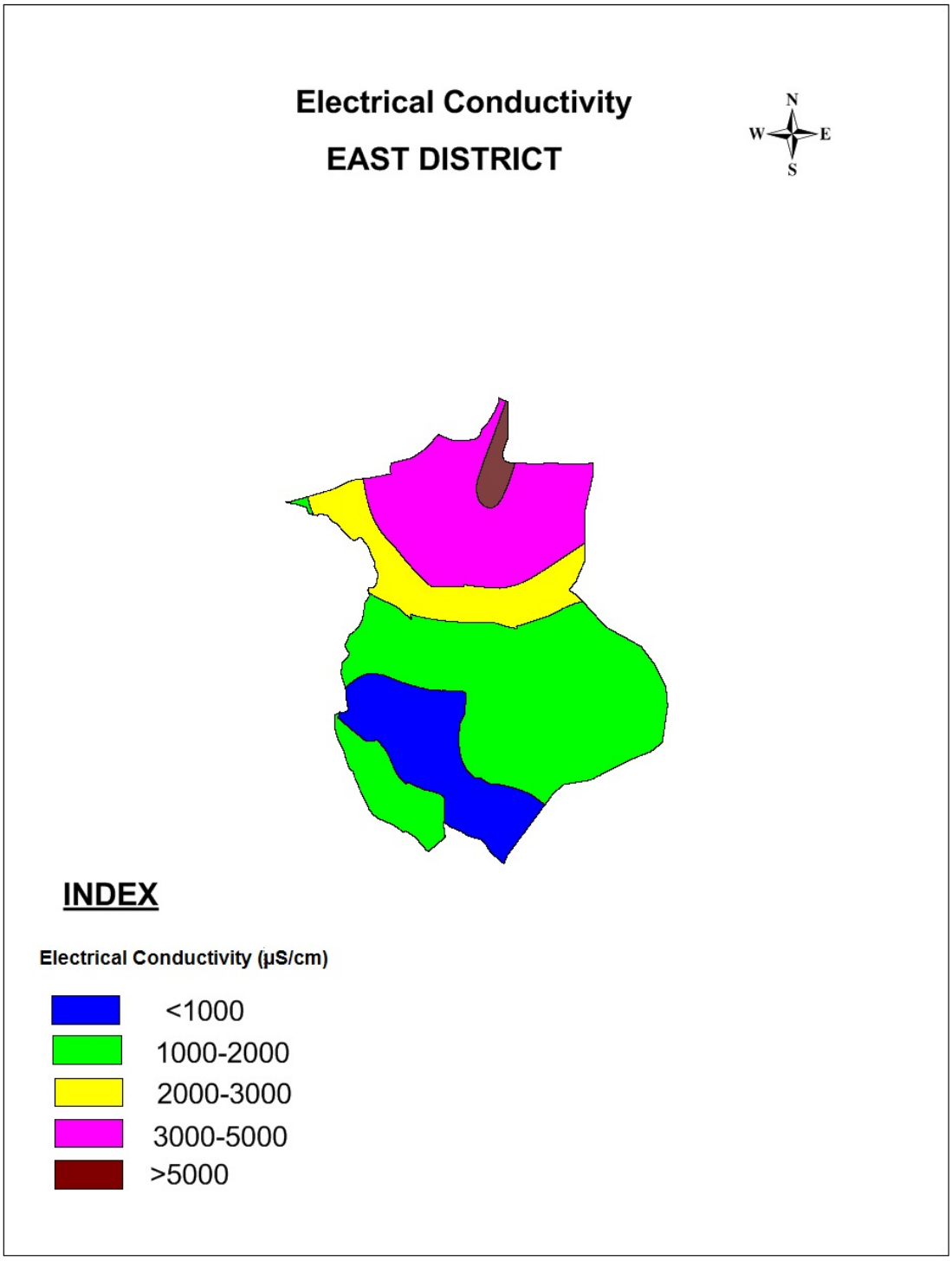


Plate 6: Nitrate distribution map (May, 2012)