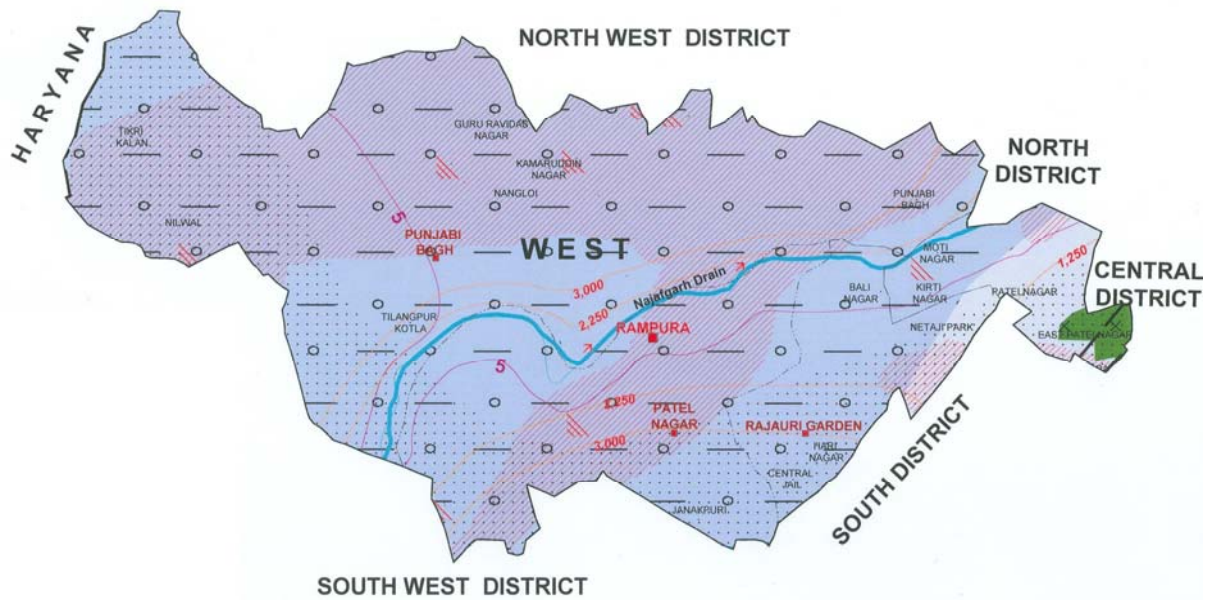




## GROUND WATER INFORMATION BOOKLET OF WEST DISTRICT, NCT, DELHI



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

**DISTRICT BROCHURE OF  
WEST DISTRICT, NCT DELHI**

**CONTENTS**

| <b>Chapter</b> | <b>Title</b>                             | <b>Page No.</b> |
|----------------|--|-----------------|
|                | DISTRICT AT A GLANCE                     | .....i          |
| 1.0            | INTRODUCTION                             | .....1          |
| 2.0            | RAINFALL & CLIMATE                       | .....2          |
| 3.0            | GEOMORPHOLOGY & SOIL TYPES               | .....2          |
| 4.0            | GROUND WATER SCENARIO                    | .....3          |
| 5.0            | GROUND WATER MANAGEMENT STRATEGY         | .....5          |
| 6.0            | GROUND WATER RELATED ISSUES AND PROBLEMS | .....6          |
| 7.0            | AREA NOTIFIED                            | .....6          |
| 8.0            | RECOMMENDATIONS                          | .....6          |

**PLATES:**

|    |  |         |
|----|--|---------|
| 1. | Hydrogeological Map  | .....7  |
| 2. | Sub-surface geological cross section along Tikri Kalan to Moti Nagar | .....9  |
| 3. | Depth to water Level Map (May, 2012)                                 | .....10 |
| 4. | Depth to Water Level Map (November, 2012)                            | .....11 |
| 5. | Electrical Conductivity Map  | .....12 |
| 6. | Nitrate Distribution Map   | .....13 |

**DISTRICT BROCHURE**  
**WEST DISTRICT AT GLANCE**

| S.No.     | ITEMS  | STATISTICS                |
|-----------|--|---------------------------|
| <b>1.</b> | <b>GENERAL INFORMATION</b>   |                           |
|           | i. Geographical Area (Sq. Km.)   | 129                       |
|           | ii. Administrative Divisions (as on 31.03.2011)                                  |                           |
|           | a) Number of Tehsils   | 3                         |
|           | b) Number of Villages  | 13                        |
|           | c) Number of Towns   | 3                         |
|           | iii. Population (as on 2011 Census)  |                           |
|           | a) Total Population  | 25,31,583                 |
|           | b) Population Density (person/sq. km)  | 19,625                    |
|           | c) No. of households   | 5,23,703                  |
|           | iv. Average Annual Rainfall (mm)   | 337 (Nangloi)             |
| <b>2.</b> | <b>GEOMORPHOLOGY</b>   |                           |
|           | Major Physiographic Units  | Alluvial Plain, Quartzite |
|           | Major Drainage   | Najafgarh Drain           |
| <b>3.</b> | <b>LAND USE (Sq. Km.)</b>  |                           |
|           | a) Forest area   | 6.33                      |
|           | b) Water bodies  | 0.97                      |
| <b>4.</b> | <b>MAJOR SOIL TYPES</b>  | Sand and clay             |
| <b>5.</b> | <b>NUMBER OF GROUND WATER<br/>MONITORING WELLS OF CGWB<br/>(As on 31.3.2013)</b> |                           |
|           | a) Number of Dugwells  | 4                         |
|           | b) Number of Piezometers   | 9                         |

|     |  |   |
|-----|--|---|
| 6.  | <b>NUMBER OF GROUND WATER EXTRACTION STRUCTURES</b><br><br>a) Dugwells<br><br>b) Handpumps<br><br>c) Tubewell/borewell   | 238<br><br>21398<br><br>32313   |
| 7.  | <b>PREDOMINANT GEOLOGICAL FORMATIONS</b>   | Quaternary Alluvium consisting mainly of fine sand, silt, clay with kankar  |
| 8.  | <b>HYDROGEOLOGY &amp; AQUIFER GROUP</b><br><br>Major water bearing formation<br><br>Pre-monsoon Depth to water level during May'2012<br><br>Post-monsoon Depth to water level during Nov'2012<br><br>Long term water level trend in 10 years (2003-2012) in m/yr | Alluvium/Quartzite<br><br>Sand and Kankar<br><br>2.91 to 34.60 mbgl<br><br>2.82 to 34.86 mbgl<br><br>Pre monsoon : Fall<br>(Range 0.18 – 2.20)<br>Post monsoon : Fall<br>(Range 0.53 –2.12) |
| 9.  | <b>GROUND WATER QUALITY</b><br><br>Presence of Chemical constituents more than permissible limit (e.g. EC, F, Fe)<br><br>Type of water<br><br>Fresh/Saline Interface   | EC (825-27880 $\mu\text{s}/\text{cm}$ at 25°C)<br><br>Iron :15 mg/l, Flouride :2.22 mg/l<br><br>Na-Cl type<br><br>25-50 m   |
| 10. | <b>DYNAMIC GROUND WATER RESOURCES (2011)- in MCM</b><br><br>Annual Replenishable Ground Water Resources<br><br>Gross Annual Ground Water Draft<br><br>Stage of Ground Water Development<br><br>Number of OE Tehsils<br><br>No. of Semi Critical Tehsil           | 28.11<br><br>40.51<br><br>152.73 %<br><br>2<br><br>1  |

|     |   |   |
|-----|---|---|
| 11. | <b>GROUND WATER CONTROL AND REGULATION</b>  | The entire district has been notified by the Government of Delhi.   |
| 12. | <b>GROUND WATER EXPLORATION BY CGWB (AS ON 31.3.2011)</b><br><br>No. of wells drilled (EW, OW, PZ, SH, Total)<br><br>Depth range (m) drilled/constructed<br><br>Depth of Bedrock (m)<br><br>Transmissivity (m <sup>2</sup> /day)<br><br>Discharge (liters per minute) | EW-6, PZ-9<br><br>62 -308/33-66<br><br>Not Encountered<br><br>39-737<br><br>59-818  |
| 13. | <b>MAJOR GROUND WATER PROBLEMS AND ISSUES</b>   | The ground water in deeper zones is saline. Depletion of ground water levels is attributed to over exploitation of ground water. Higher Fluoride and Iron content at Nangloi. |

**DISTRICT BROCHURE**  
**WEST DISTRICT, NCT DELHI**

**1.0 INTRODUCTION**

**1.1 ADMINISTRATIVE DETAILS**

West Delhi is bound by the districts of North West on the north, North and Central districts on the east, South West district on the south, and Jhajjar district of Haryana on the west. It covers geographical area of 129 sq. km. The district is divided into three tehsils namely Patel Nagar, Rajouri Garden and Punjabi Bagh.

The district has a population of 25,31,583 as per the census, 2011 and average population density of 19,625 persons per Sq. Km.

**1.2 BASIN/SUB-BASIN:**

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

**1.3 DRAINAGE:**

The main drainage of the area is Najafgarh drain. Najafgarh drain originates from Najafgarh Jheel on Delhi Haryana Border and meets in River Yamuna.

**1.4 LAND USE:**

This district has residential colonies, industrial areas and commercial areas. There are 4 industrial areas in the district. The forest cover of the district is 6.33 sq. km. A small area of 0.97 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. 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 6 exploratory wells, 9 piezometers/ observation wells and 2 slim holes 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 <sup>2</sup> /day) | S | EC (μS/cm at 25°C) |
|--------------|-----|-------------------|-----------------------|------------|-----------------|--------------|----------------------|-------------------------|---|--------------------|
| EW           | 6   | 91-308            | 33-50                 | 3.44-18.5  | 59-818          | 2.4-17.98    | 3-143                | 39-235                  | - | 7524-19240         |
| PZ/OW        | 9   | 62-252.45         | 34-66                 | 3.28-17.65 | 59-630          | 0.24         | 245-907              | 435-737                 | - | 18580-21100        |
| SH           | 2   | 101               | -                     | -          | -               | -            | -                    | -                       | - | 17600              |

## 2.0 RAINFALL & CLIMATE

### 2.1 RAINFALL:

The average annual rainfall of the district is mm at 337 mm (Nangloi). About 81% of the annual rainfall is received during the monsoon months 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 rainfall 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 21.3°C and the mean daily minimum temperature at 7.3°C. May and June are the hottest months. In May and June maximum temperature may sometimes reach 46 or 47°C.

## 3.0 GEOMORPHOLOGY & SOIL TYPES

### 3.1 GEOMORPHOLOGY:

West district is under Yamuna Alluvial Plain. The slope of the area is towards Najafgarh Jheel. A very small patch area in the eastern part of the district is underlain by hard rock formation.

### 3.2 SOIL TYPES:

Major soil types of the district are sand, clay and kankar.

## **4.0 GROUND WATER SCENARIO**

### **4.1 GEOLOGY:**

The area is characterized by unconsolidated Quaternary alluvial deposits ranging in age from Middle to Late Pleistocene, which in turn is underlain by Precambrian meta-sediments of Delhi System. The alluvium comprises of sand, silt, clay mixed with kankar in varying proportions.

### **4.2 HYDROGEOLOGY:**

#### **Water Bearing Formation:**

Hydrogeological map of West district is presented in Plate 1. The aquifer system includes sand - fine to coarse grained admixed with kankars with little amount of clay and silt. Clay is sticky and plastic in nature, light grayish in colour, admixed with a little sand and kankars, fine to medium grained. Thickness of alluvium is 300 m or more in some parts of the district. Subsurface geological cross section along Tikri Kalan – Motio Nagar is depicted in Plate 2.

#### **Depth to water level:**

The depth to water level varies widely in this district. It ranges from 2.91 to 34.60 m bgl during pre monsoon period and 2.82 to 34.86 m bgl during post monsoon period. In most of the district depth to water level is within 10 m bgl. Deeper water levels (>20mbgl) are observed in eastern part of the district. Depth to water level maps during pre-monsoon and post-monsoon period are presented in Plates 3 and 4 respectively.

#### **Seasonal Water level fluctuation:**

The 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 taken from the ground water reservoir. The seasonal fluctuation in water level between pre and post monsoon shows rise in water level ranging from 0.29 to 1.34 m and fall ranging from 0.05 to 0.77 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 0.18 to 2.20 m during the pre-monsoon period and
- ii) a fall of 0.53 to 2.12 m in during the post-monsoon period.

### **4.2 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 2811.43 ham, out of which net annual ground water availability has been assessed as 2652.456 ham. Total annual ground water draft for all uses has been estimated to be 4051.2 ham, with



overall stage of ground water development at 152.73%. Out of 3 tehsils, 1 tehsil falls under semi critical category whereas 2 fall under over exploited category.

Table 2: Tehsil wise ground water resources of the 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.    | Patel Nagar    | 1067.24                            | 1013.878                                   | 73.81   | 1870.93   | 1944.74   | 191.81                                | Over-exploited |
| 2.    | Punjabi Bagh   | 1376.14                            | 1307.333                                   | 380.97  | 833.25  | 1214.22   | 92.88                                 | Semi-critical  |
| 3.    | Rajouri Garden | 368.05                             | 331.245                                    | 18.45   | 873.79  | 892.24  | 269.36                                | Over-exploited |
|       | Total          | 2811.43                            | 2652.456                                   | 473.23  | 3577.97   | 4051.2  | 152.73                                | Over-exploited |

#### 4.3 GROUND WATER QUALITY:

Ground water of the district is alkaline in nature. It is medium to highly saline. The general ranges of various important chemical constituents in ground water samples collected from the district are given in Table 3.

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

| Chemical Constituents    | Range         |
|--------------------------|---------------|
| pH                       | 7.3-9.3       |
| EC ( $\mu$ S/cm at 25°C) | 825-27880     |
| Bicarbonate (mg/l)       | 99.61-429.32  |
| Chloride (mg/l)          | 50.95-6156.16 |
| Nitrate (mg/l)           | 36.2-790      |
| Sulphate (mg/l)          | 81.2-3057.5   |
| Fluoride (mg/l)          | 0.26-2.22     |

|  |               |
|--|---------------|
| Calcium (mg/l)                             | 37.98-618.1   |
| Magnesium (mg/l)                           | 13.67-664.1   |
| Total Hardness as CaCO <sub>3</sub> (mg/l) | 194.78-5400.3 |
| Sodium (mg/l)                              | 82.56-3586    |
| Potassium (mg/l)                           | 2.05-1036     |
| Iron (mg/l)                                | 15            |

Electrical Conductivity in the district has been found to vary from 825 to 27880  $\mu\text{S}/\text{cm}$  at 25°C. EC in excess of 3000  $\mu\text{S}/\text{cm}$  at 25°C has been observed in the entire district except in the eastern and south eastern parts of the district (Plate 5). High Fluoride concentration in ground water upto 2.22 mg/l, more than the maximum permissible limit of 1.5 mg/l has been reported in the district. Nitrate concentration in all the samples collected from the district is more than the maximum permissible limit of 45 mg/l except those from south eastern part of the district (Plate 6).

#### **4.4 STATUS OF GROUND WATER DEVELOPMENT**

The present level of ground water development is maximum (269.36%) in Rajouri Garden and minimum (92.88%) in Punjabi Bagh as indicated in table above. The district as a whole is categorized as over exploited with ground water development at 152.73%.

#### **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 152.73%. 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 district.

## **6.0 GROUND WATER RELATED ISSUES AND PROBLEMS**

### **6.1 WATER LOGGING:**

Shallow water levels are observed within the range of 5m in the western & central part of the district, which are prone to water logging.

### **6.2 DEPLETING GROUND WATER LEVEL & QUALITY:**

The wells located in this district show declining trends during pre and post monsoon period which are attributed to over exploitation of ground water. Seasonal and long term water level data indicate a gradual declining of water levels.

The depth of fresh/saline water interface varies from 25 to 50 m.

High Iron content of 15 mg/l and Fluoride content of 2.22 mg/l have been observed at Nangloi.

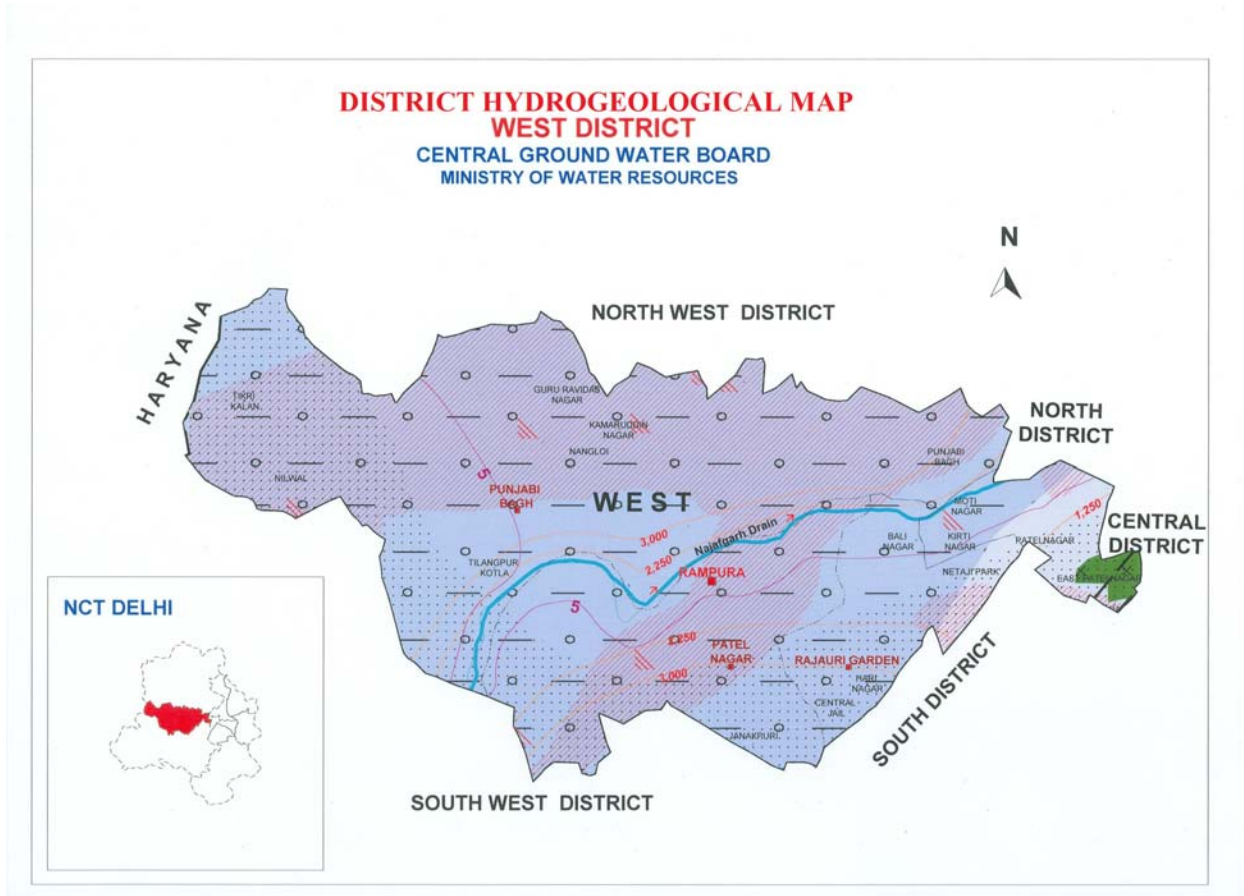
## **7.0 AREA NOTIFIED**

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

## **8.0 RECOMMENDATIONS**






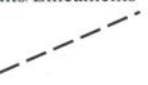








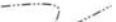

1. Efforts should be made to arrest the declining ground water levels by preventing indiscriminate withdrawal of ground water and adopting roof top rain water harvesting and artificial recharge.
2. Regular monitoring of water levels and chemical quality is essential.
3. Areas receiving drinking water 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**



## WEST DISTRICT

### LEGEND

|   | Wells feasible | Rigs suitable   | Depth of Well (m) | Discharge (lpm)   | Suitable Artificial Recharge Structures**  |
|---|----------------|---|-------------------|---|--|
| <br>Soft Rock Aquifer  | Tube Wells     | Reverse / Direct Rotary   | 25-45 *           | 120-300   | Shaft/Trench with recharge well, Recharge Pit with/without bore  |
| <br>Hard Rock Aquifer  | Tube Wells     | DTH/ Rotary cum DTH   | 60-120            | 90-180  | Shaft/Trench with recharge well, Recharge Pit with/without bore, Check Dams                              |
| Depth to Water level in m. (Pre-monsoon decadal mean, 2003-2012 )<br> 5  |                | Electrical Conductivity (Micro mhos/cm at 25° C)<br> 3000  |                   | Major river / Drain<br>   | Faults/Lineaments<br> |
| Fluoride > Permissible limit (1.5 ppm) <br><br>State boundary <br>Tehsil head quarter <br>District head quarter  |                | Nitrate > Permissible limit (100 ppm) <br><br>District boundary <br>Over exploited block  |                   | Iron > Permissible limit (1.0 ppm) / * Fe <br><br>Tehsil boundary <br>Area feasible for Artificial recharge structures  |  |

\* 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   | West  |
| Geographical Area  | 129 Sq. Km.   |
| Major Geological Formation   | Soft Rock - Older Alluvium<br>Hard Rock -Quartzite  |
| Major Drainage System  | Yamuna  |
| Population (as on 2011)  | 25.32 lakhs   |
| No of Tehsils  | 3, Punjabi Bagh, Patel Nagar, and Rajouri Garden  |
| Replenishable Ground Water Resources (MCM)/Draft (MCM)/ Stage of Development (%) | Punjabi Bagh — 13.76 /12.59/96.<br>Patel Nagar — 10.67/19.78/195.<br>Rajouri Garden — 3.68/9.16/276 |
| Average Annual Rainfall  | Nangloi - 337 mm  |
| Range of Mean Daily Temperature  | 18 — 32 °C  |
| Tehsil Showing Intensive Ground Water Development                                | Patel Nagar and Rajouri Garden  |

**Plate 2: Sub-surface geological cross section along Tikri Kalan - Moti Nagar**

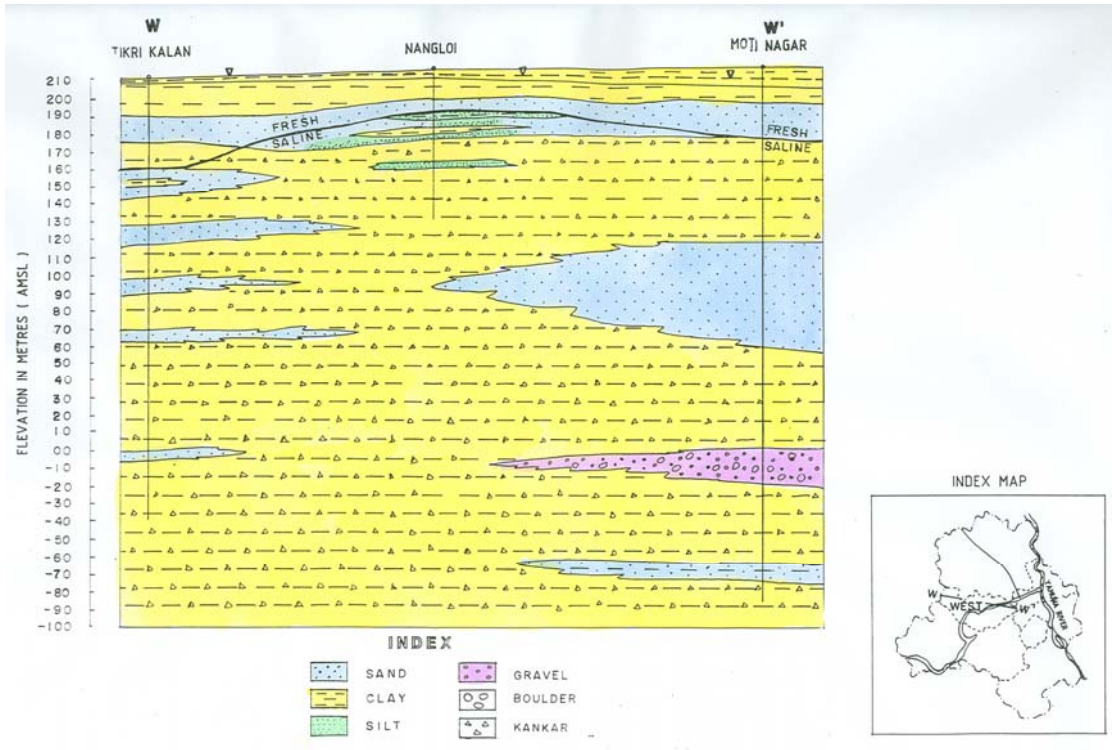


Plate 3: Depth to Water Level Map during Pre-monsoon (May, 2012)

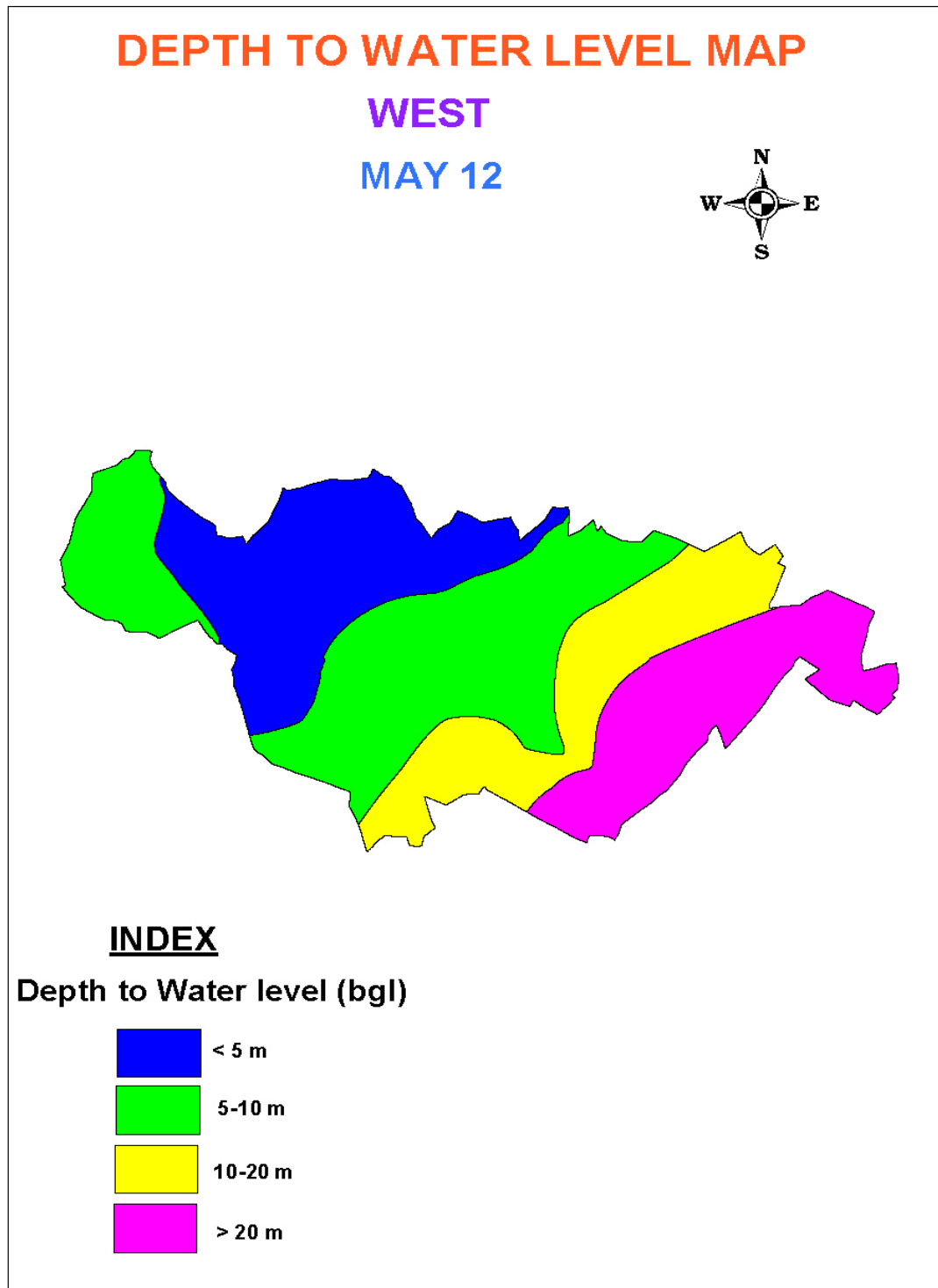


Plate 4: Depth to water Level Map during Post-monsoon (November, 2012)

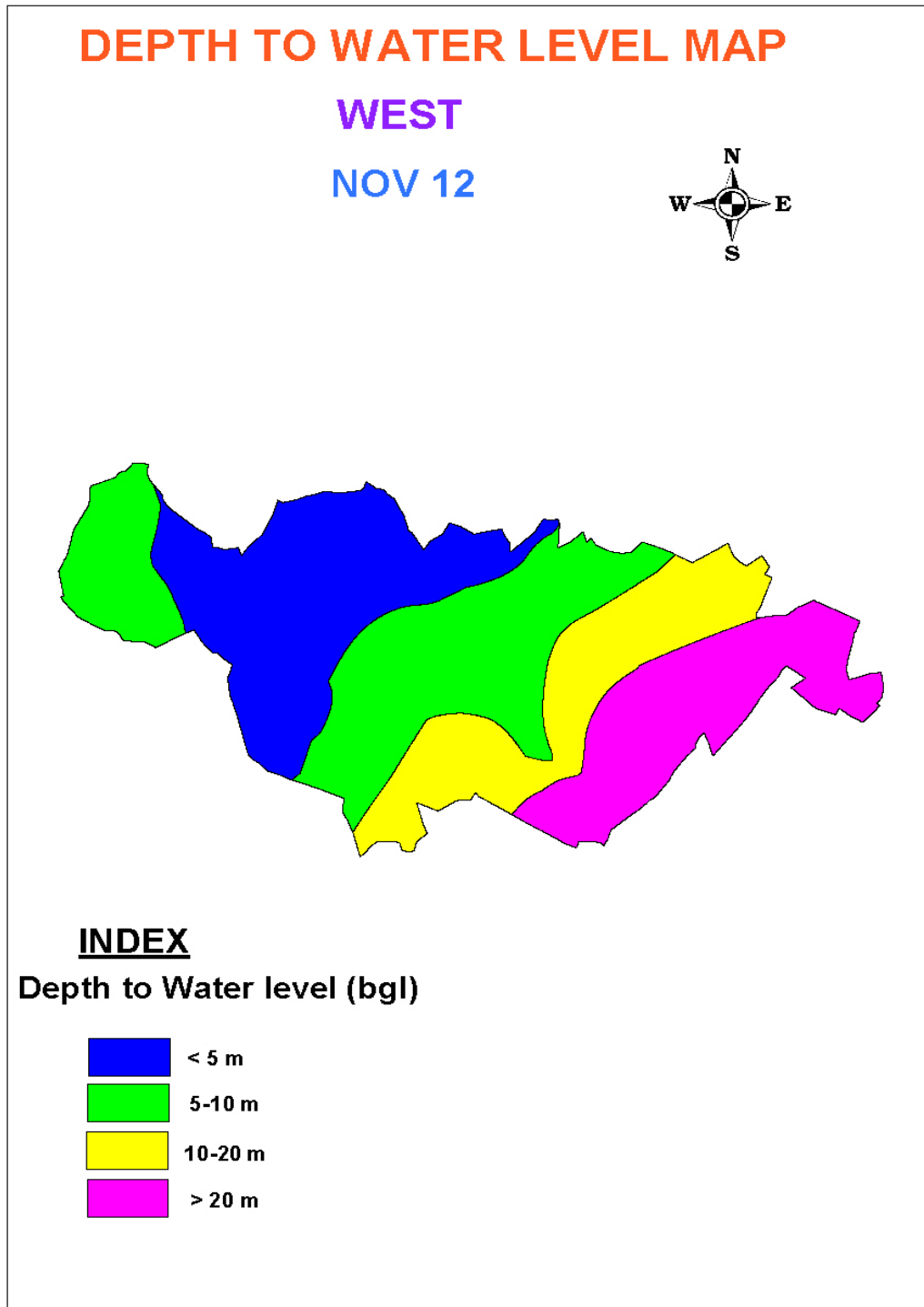




Plate 5: Electrical Conductivity Map (May, 2012)

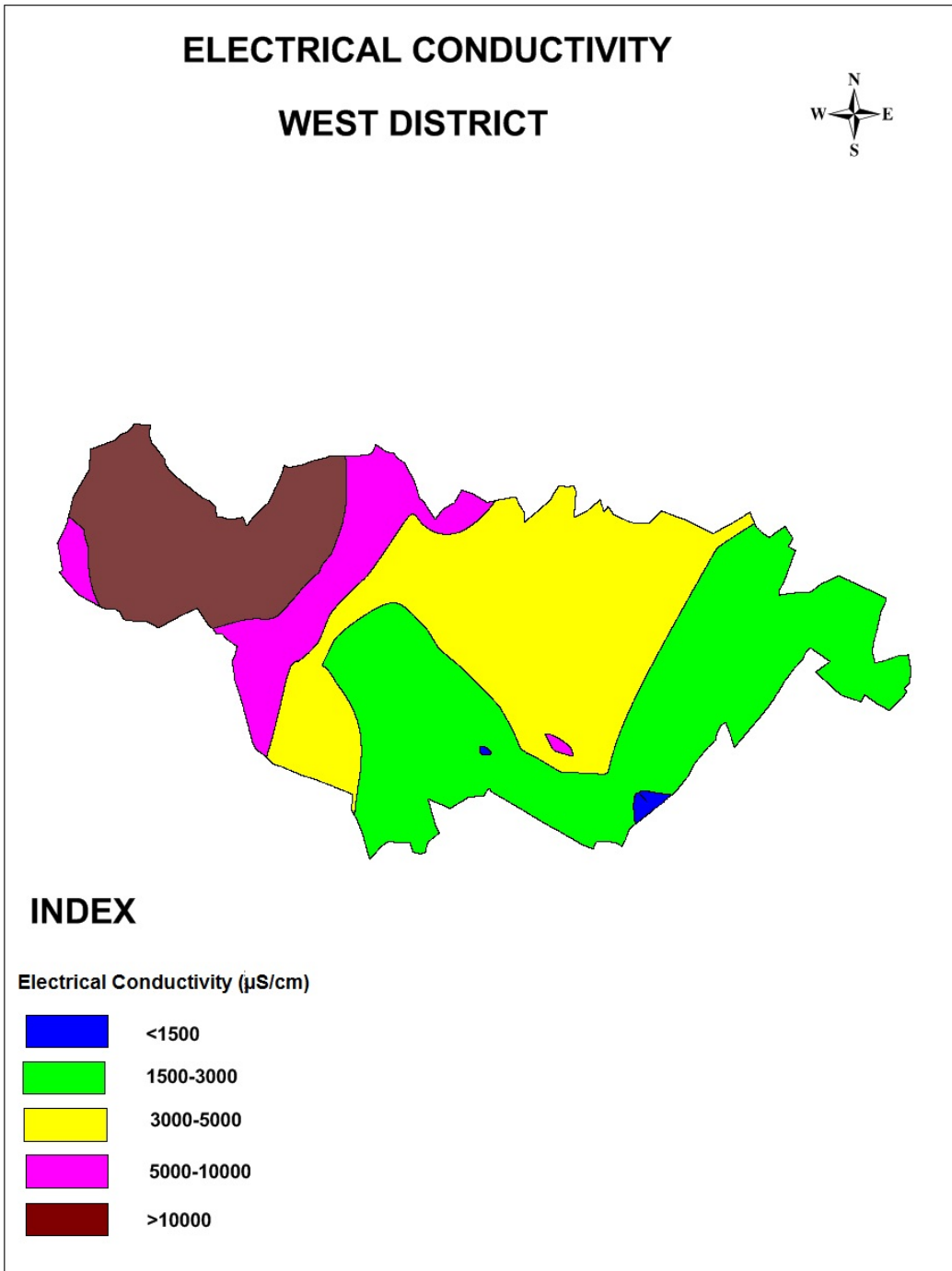


Plate 6: Nitrate distribution map (May, 2012)

