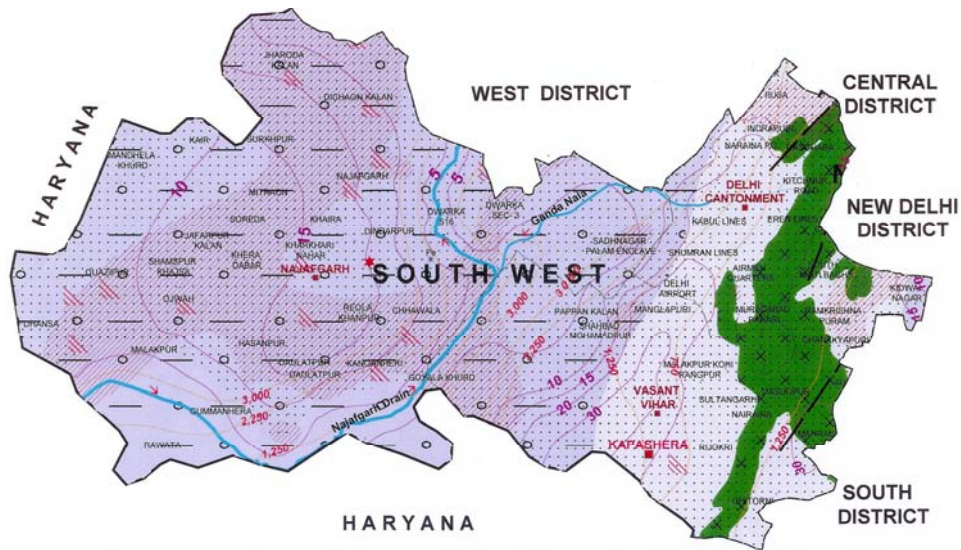




## GROUND WATER INFORMATION BOOKLET OF SOUTH WEST DISTRICT, NCT, DELHI



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

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

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

| S.No.     | ITEMS  | STATISTICS                |
|-----------|--|---------------------------|
| <b>1.</b> | <b>GENERAL INFORMATION</b>   |                           |
|           | i. Geographical Area (Sq. Km.)   | 420                       |
|           | ii. Administrative Divisions (as on 31.03.2011)                                  |                           |
|           | a) Number of Tehsils   | 3                         |
|           | b) Number of Villages  | 58                        |
|           | c) Number of Towns   | 6                         |
|           | iii. Population (as on 2011 Census)  |                           |
|           | a) Total Population  | 22,92,363                 |
|           | b) Population Density (person/sq. km)  | 5,458                     |
|           | c) No. of households   | 4,62,772                  |
|           | iv. Average Annual Rainfall (mm)   | 794 (Palam)               |
| <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   | 41.80                     |
|           | b) Water bodies  | 6.16                      |
| <b>4.</b> | <b>MAJOR SOIL TYPES</b>  | Sand, clay & kankar       |
| <b>5.</b> | <b>NUMBER OF GROUND WATER<br/>MONITORING WELLS OF CGWB<br/>(As on 31.3.2013)</b> |                           |
|           | a) Number of Dugwells  | 2                         |
|           | b) Number of Piezometers   | 31                        |

|     |  |  |
|-----|--|--|
| 6.  | <b>NUMBER OF GROUND WATER EXTRACTION STRUCTURES</b><br><br>a) Dugwells<br><br>b) Handpumps<br><br>c) Tubewell/borewell   | <br><br>443<br><br>9744<br><br>71283   |
| 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>2.40 to 53.17 mbgl<br><br>0.69 to 54.02 mbgl<br><br>Pre monsoon : Fall<br>(Range 0.30 – 6.90)<br>Post monsoon : Fall<br>(Range 0.07 – 6.08) |
| 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 (529-17240 $\mu$ S/cm at 25°C)<br>Iron :14 mg/l, Fluoride -2.05 mg/l<br><br>Na-Cl, Ca-Cl & Mixed type<br><br>25-35 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>97.52<br><br>127.78<br><br>139.99 %<br><br>3   |
| 11. | <b>GROUND WATER CONTROL AND REGULATION</b>   | The entire district has been notified by the Government of Delhi   |

|                   |  |  |
|-------------------|--|--|
| <p><b>12.</b></p> | <p><b>GROUND WATER EXPLORATION BY CGWB<br/>(AS ON 31.3.2011)</b></p> <p>No. of wells drilled (EW, OW, PZ, SH, Total)</p> <p>Depth range (m) drilled/constructed</p> <p>Depth of Bedrock (m)</p> <p>Discharge (liters per minute)</p> | <p>EW-29, PZ-47</p> <p>35 - 325/ 29 – 200</p> <p>4-300</p> <p>15 – 1079</p>  |
| <p><b>13.</b></p> | <p><b>MAJOR GROUND WATER PROBLEMS AND<br/>ISSUES</b></p>   | <p>The ground water in deeper zones is saline. Depletion of ground water levels is attributed to over exploitation of ground water. Higher Fluoride content at Najafgarh and higher Iron content at Daulatpur.</p> |

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

**1.0 INTRODUCTION**

**1.1 ADMINISTRATIVE DETAILS**

South West District is bounded by the West District on the north, Central District on the north-east, New Delhi and South Districts on the east, Gurgaon of Haryana state on the south and Jhajjar of Haryana on the west. The district has second largest geographical area of 420 sq. km. The district is divided into three tehsils namely Delhi Cantonment, Najafgarh and Vasant Vihar.

The district has a population of 22,92,363 as per the census, 2011 and average population density is 5458 persons per Sq. Km.

**1.2 BASIN/SUB-BASIN:**

The district falls in Yamuna sub-basin and forms part of the Ganga basin. The entire district falls in Yamuna River watershed.

**1.3 DRAINAGE:**

The major drainage of the district is Najafgarh Drain. Najafgarh drain originates from Najafgarh Jheel on Delhi - Haryana Border and meets the River Yamuna.

**1.4 LAND USE:**

South West District has Dwarka Sub City, which is the largest residential colony in Asia. Indira Gandhi International Airport is located in this district. Uttam Nagar, Vasant Kunj, Vikas Puri, Najafgarh, Bijwasan, Vasant Vihar, Janakpuri are prominent residential areas in the district. Delhi cantonment area, which has establishments of the Army, also lies in this district. The forest cover of the district is 41.80 sq. km. Approximately, 6.16 sq.km area 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 Najafgarh Block. Based on the Re-appraisal Hydrogeological survey carried out in 1983-84, CGWB, NWR had brought out a consolidated report on Hydrogeological condition 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 29 exploratory wells and 47 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 <sup>2</sup> /day) | S                     | EC (μS/cm at 25°C) |
|--------------|-----|-------------------|-----------------------|-----------|-----------------|--------------|----------------------|-------------------------|-----------------------|--------------------|
| EW           | 29  | 40.85-325         | 39-200                | 3.26-49.5 | 15.10-1079      | 3.48-20.8    | 6-169                | 11.07-118               | 0.46*10 <sup>-4</sup> | 489-27890          |
| PZ/OW        | 47  | 35-252            | 29-129                | 2.55-49.6 | 82-631          | 1.48-10.7    | 372                  | 191                     | -                     | 613-11030          |

## 2.0 RAINFALL & CLIMATE

### 2.1 RAINFALL:

The average annual rainfall of the district is 794 mm at Palam. 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 thunderstorm rain and as winter 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 including 19 days 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:

Major part of the district is under Yamuna Alluvial Plain and small part of the district has Quartzites on the eastern border of the district.

### 3.2 SOIL TYPES:

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

## **4.0 GROUND WATER SCENARIO**

### **4.1 GEOLOGY:**

The area is characterized by unconsolidated Quaternary alluvial deposits belonging to Middle to Late Pleistocene Age. The area comprises of silt and clay mixed with kankar in varying proportions. Only 18 sq km area is covered by denudational hills especially in the eastern part of the district.

### **4.2 HYDROGEOLOGY:**

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

Hydrogeological map of the district is shown in Plate 1. Geological cross sections along Kair – Nicholson Range and along Kair – Dwarka – R.K. Puram are presented in Plate 2. Thick pile of alluvium overlies the basement rock and consists of alternate layers of silt, clay, sand and kankar. Nearly fine to medium sand and silt grade sediments occur frequently up to the depth of 50 m along with buff coloured clayey bed admixed with coarse kankars. On the other hand, after the depth of 50 m, thickness of silty –clay and clay (Light yellow) beds with kankars increases with depth. The semi-plastic and plastic clay beds are also common at deeper depth i.e. 80 to 250 m bgl. The granular zone at deeper depth is not as frequent as in the shallower depth. The bed rock has been encountered at many places i.e. in Dhansa (297m), Pindwalakala (300m), Toghan pur(298m) and Jhuljhli(251m).

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

Depth to water level of the district shows large variation. Shallow water level is observed in the south western part of the district while deeper water levels are observed in the eastern part of the district. The depth to water level during pre monsoon period in the district ranges from 2.40 to 53.17 m bgl and during post monsoon period, it varies from 0.69 to 54.02 m bgl. Depth to water level maps during pre-monsoon and post-monsoon periods 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 periods. Fluctuation in water level is the 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 0.25 to 7.18 m and fall ranging from 0.05 to 1.27 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 0.30 to 6.90 m during the pre-monsoon period and
- ii) a fall of 0.07 to 6.08 m in during the post-monsoon period.



#### 4.2 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 9751.58 ham, out of which net annual ground water availability has been assessed as 9127.013 ham. Total annual ground water draft for all uses has been estimated to be 12777.7 ham, with overall stage of ground water development at 139.99%. All the 3 tehsils are falling under over exploited category.

Table 2: Tehsil wise ground water resources of the 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.      | Delhi Cantonment | 891.82                             | 802.638                             | 369.03  | 1475.28   | 1844.31   | 229.78                                   | Over-exploited      |
| 2.      | Najafgarh        | 7011.81                            | 6661.2195                           | 5787.03   | 2601.46   | 8388.49   | 125.93                                   | Over-exploited      |
| 3.      | Vasant Vihar     | 1847.95                            | 1663.155                            | 303.91  | 2240.99   | 2544.90   | 153.02                                   | Over-exploited      |
|         | Total            | 9751.58                            | 9127.013                            | 6459.97   | 6317.73   | 12777.7   | 139.99                                   | Over-exploited      |

#### 4.3 GROUND WATER QUALITY:

Ground water is saline at deeper depths. Higher Iron content of 14 mg/l has been reported at Daulatpur. Higher fluoride content of 2.05 mg/l is observed at Najafgarh. 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                       | 8.15-9.38     |
| EC ( $\mu$ S/cm at 25°C) | 529-17240     |
| Bicarbonate (mg/l)       | 123.46-355.83 |
| Chloride (mg/l)          | 31.57-5639.53 |

|  |               |
|--|---------------|
| Nitrate (mg/l)                             | 11.3-462      |
| Sulphate (mg/l)                            | 2.3-1950      |
| Fluoride (mg/l)                            | 0.2-2.05      |
| Calcium (mg/l)                             | 15.35-429.9   |
| Magnesium (mg/l)                           | 21.62-1376.73 |
| Total Hardness as CaCO <sub>3</sub> (mg/l) | 0-3807.88     |
| Sodium (mg/l)                              | 62.67-3318    |
| Potassium (mg/l)                           | 0.1-99.4      |
| Iron (mg/l)                                | 14            |

Electrical Conductivity in the district has been found to vary from 529 to 17240  $\mu\text{S}/\text{cm}$  at 25°C (Plate 5). Fluoride concentration in ground water in the district varies from 0.2 to 2.05 mg/l. Higher Nitrate concentration upto 462 mg/l is observed in the district (Plate 6).

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

The present level of ground water development is maximum (229.78%) in Delhi Cantonment whereas minimum level of development (125.93%) has been assessed in Najafgarh as indicated in table 2 above. The district as a whole is categorized as over exploited with ground water development at 139.99%.

#### **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 139.99%. 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 district.

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

### **6.1 WATER LOGGING:**

Shallow water levels are observed in the south western part of the district, which is prone to water logging.

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

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

Seasonal and long term water level data indicate declining water levels.

The line of fresh-saline water interface also varies greatly in the entire area. All along the Najafgarh Drain and two depressions (Gumanhera Village & Pindwalan Kalan ) somewhat deep fresh water layer i.e. up to 35m bgl exists 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 Eastern part characterized by hard rock, the fresh –saline water interface rests at deeper depth i.e. around 80 to 90 m bgl.

Higher Iron content of 14 mg/l is reported at Daulatpur. Higher fluoride content of 2.05 mg/l is observed at Najafgarh.

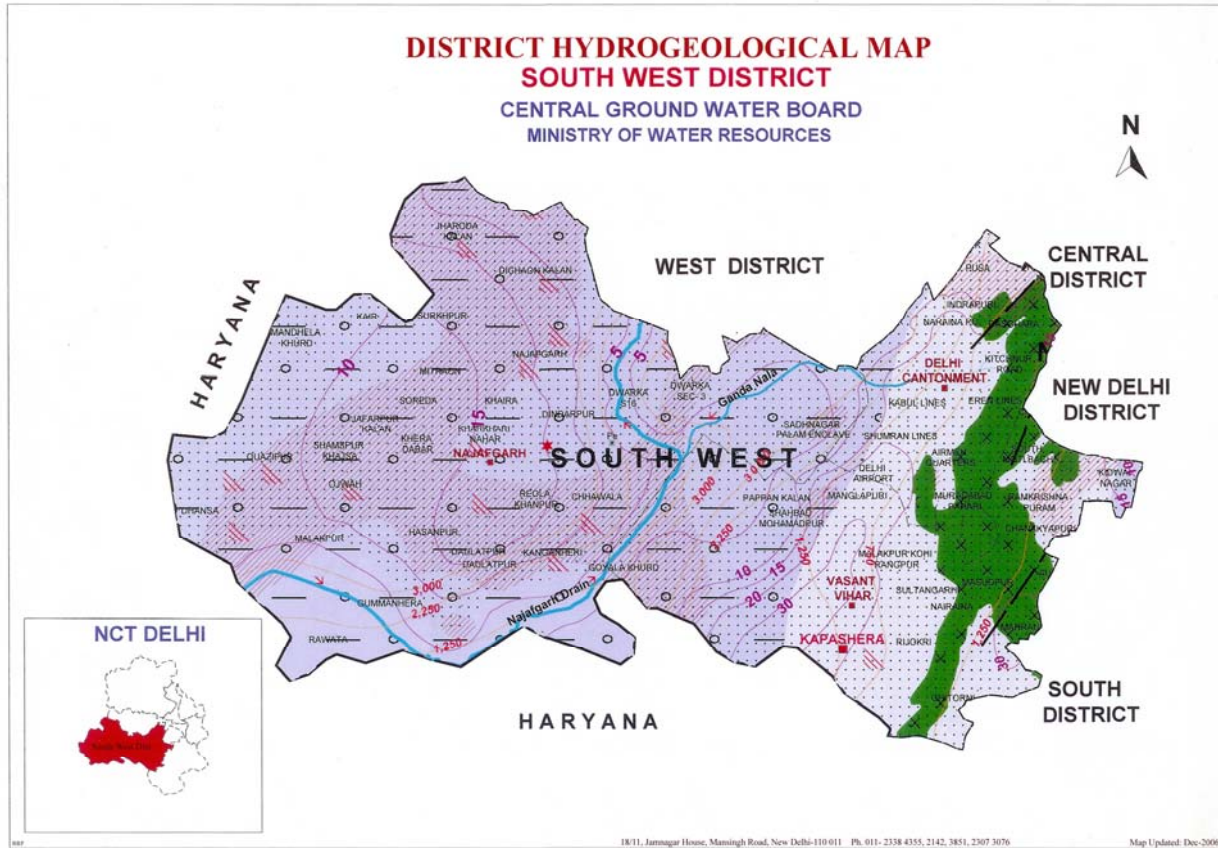
## **7.0 AREA NOTIFIED**

The entire district has been notified by Hon'ble Lt. Governor of Delhi.

## **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



## SOUTHWEST 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   | 30-90 *           | 120-400   | 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/Bunds                        |
| Depth to Water level in m. (Pre-monsoon decadal mean, 2003-2012)<br> |                | Electrical Conductivity (Micro mhos/cm at 25° C)<br> |                   | Major river / Drain<br>                                 | Faults/Lineaments<br> |
| Fluoride > Permissible limit (1.5 ppm)<br>                          |                | Nitrate > Permissible limit (100 ppm)<br>           |                   | Iron > Permissible limit (1.0 ppm) / * Fe<br>         |  |
| State boundary<br>   |                | District boundary<br>                              |                   | Tehsil boundary<br>                                  |  |
| Tehsil head quarter<br>District head quarter<br>                   |                | Over exploited block<br>                           |                   | Area feasible for Artificial Recharge structures<br> |  |

\* 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   | Southwest   |
| Geographical Area  | 420 Sq.Km.  |
| Major Geological Formation   | Alluvium - Older Alluvium<br>Hard Rock - Quartzite  |
| Major Drainage System  | Yamuna  |
| Population (as on 2011)  | 22.92 lakhs   |
| No of Tehsils  | 3, Najafgarh, Delhi Cantt. and Vasant Vihar   |
| Replenishable Ground Water Resources (MCM)/ Draft (MCM)/ Stage of Ground Water Development (%) | Delhi Cantt.- 8.92/18.08/225<br>Najafgarh- 70.12/82.97/125<br>Vasant Vihar- 18.48/24.64/148 |
| Average Annual Rainfall  | Palam - 794 mm  |
| Range of Mean Daily Temperature  | 18-32°C   |
| Tehsil Showing Intensive Ground Water Development  | All the three tehsils   |



Plate 2 : Subsurface geological cross sections of South West District

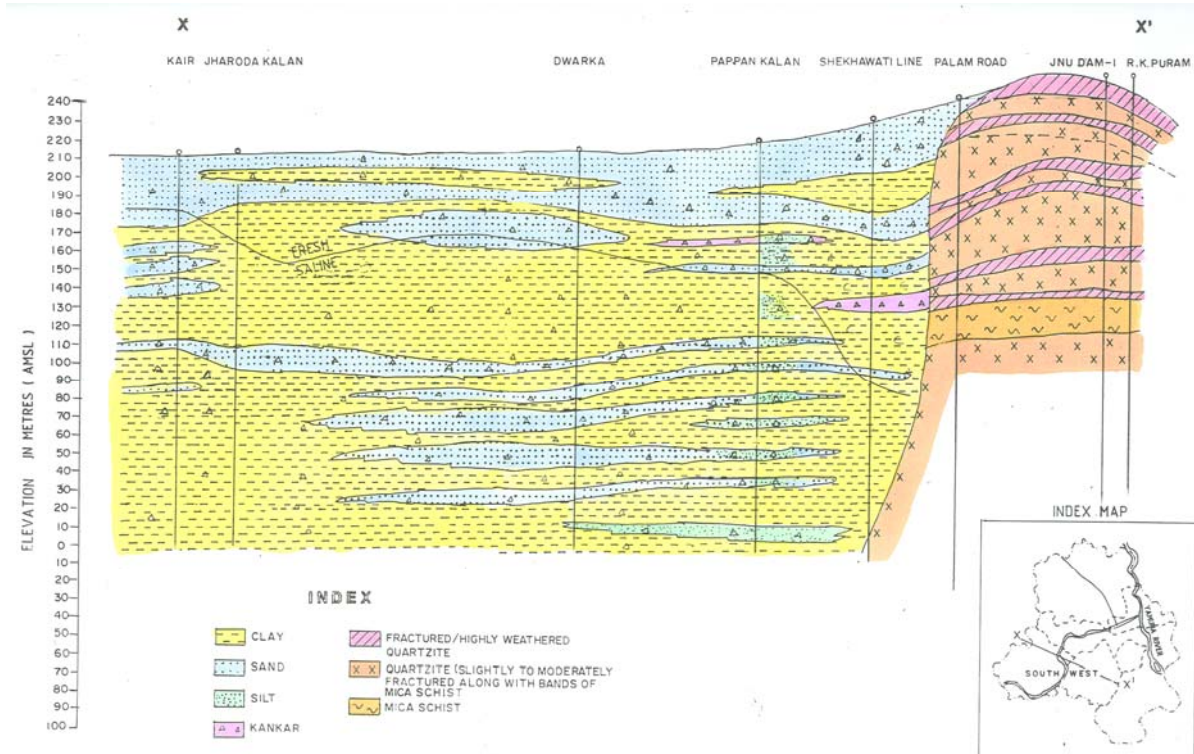
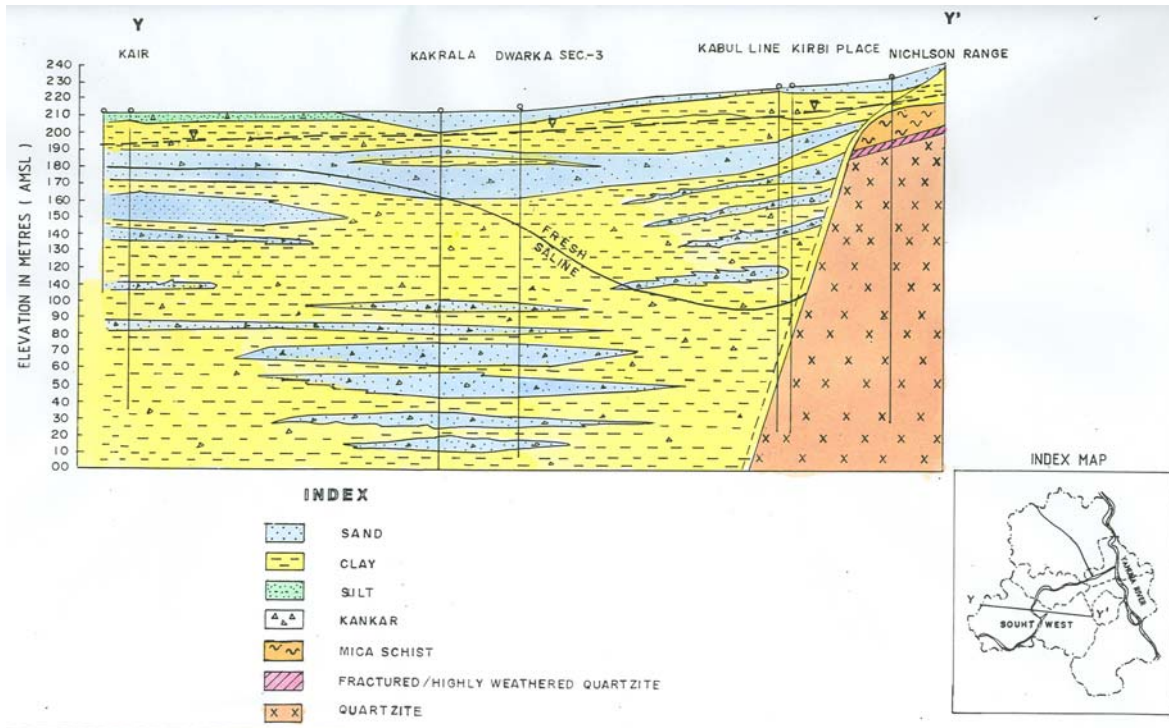


Plate 3: Depth to Water Level Map during Pre-monsoon (May, 2012)

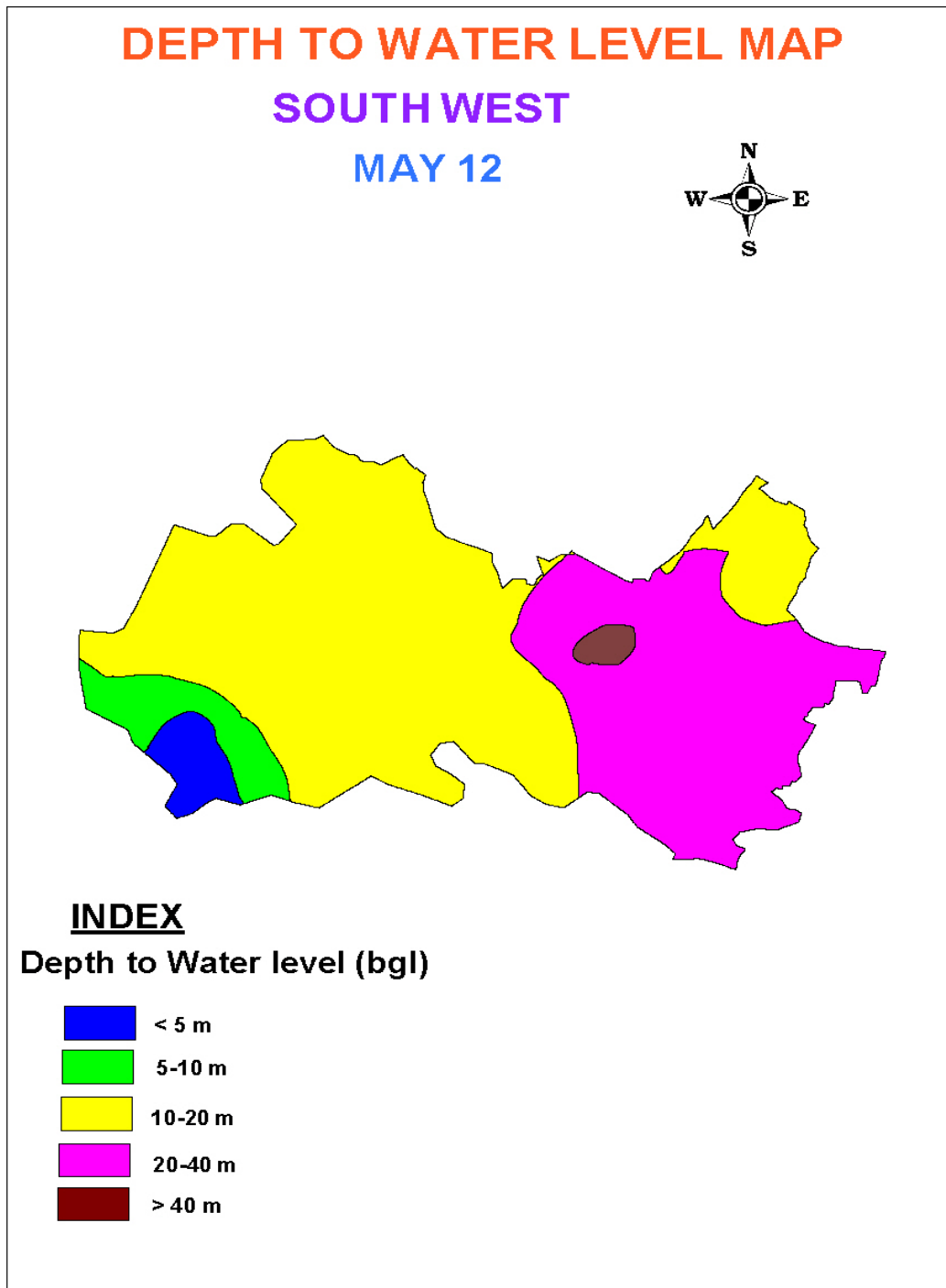


Plate 3: Depth to Water Level Map during Post-monsoon (Nov, 2012)

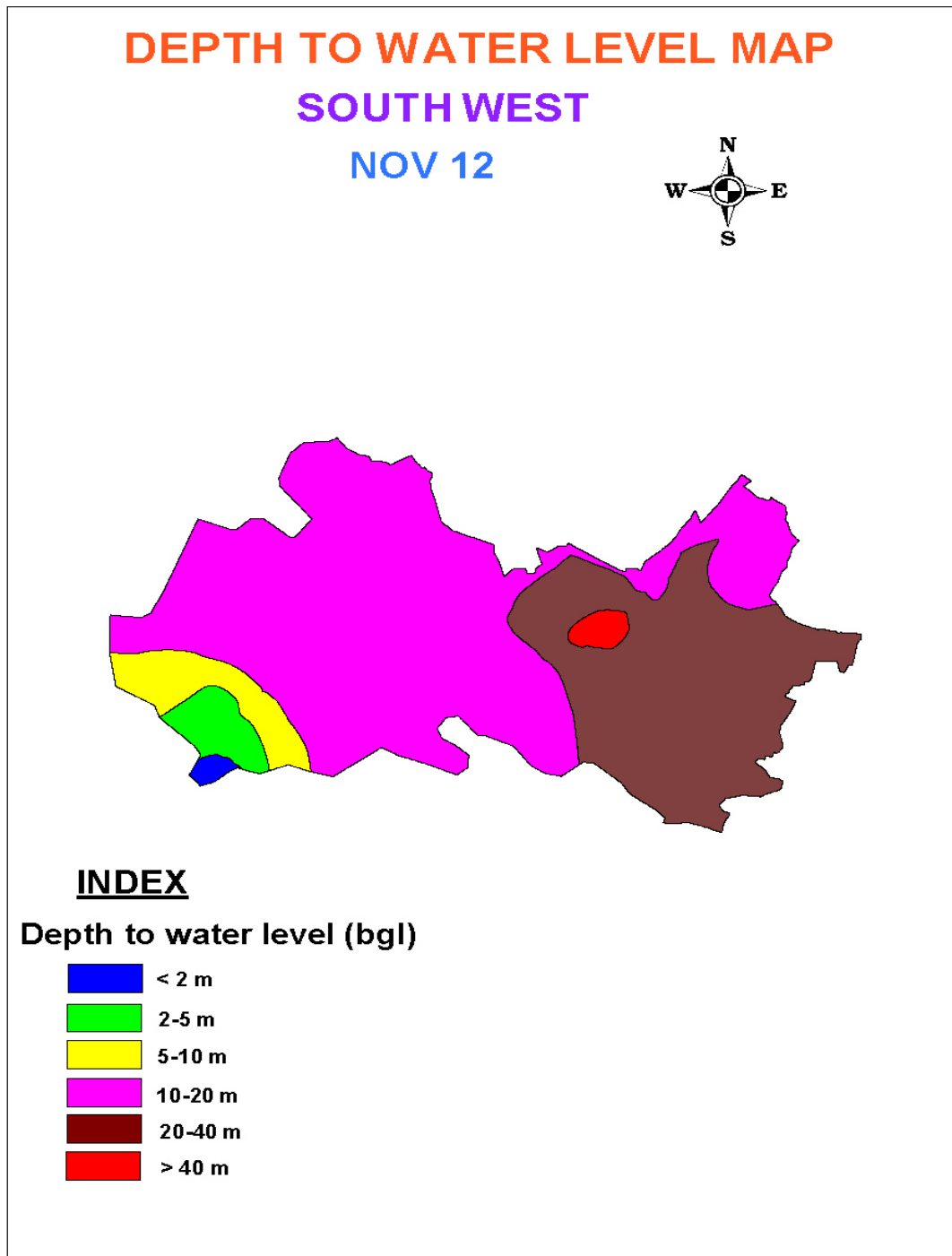




Plate 5: Electrical Conductivity Map (May, 2012)

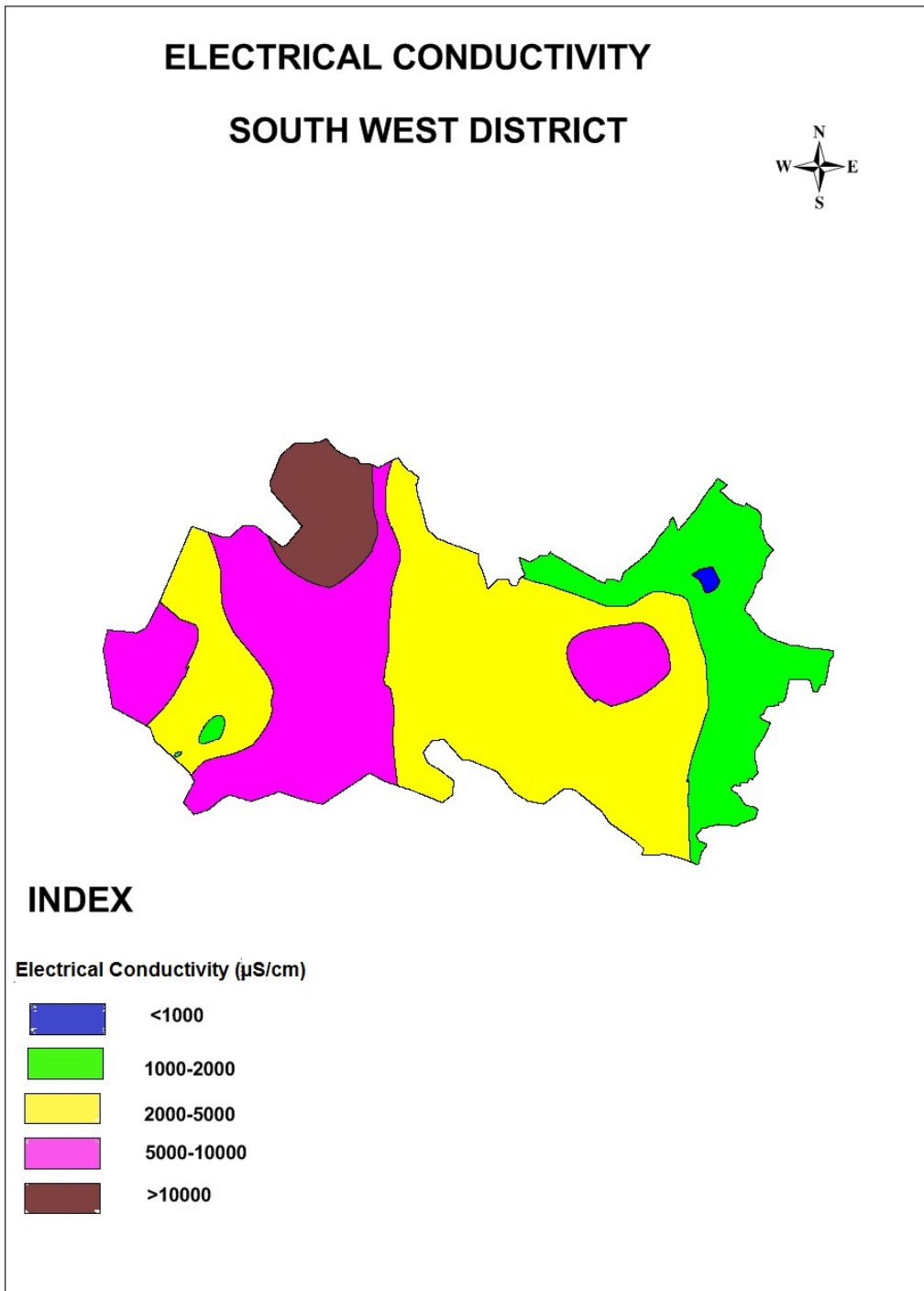


Plate 6: Nitrate distribution map (May, 2012)

