

# Hydrogeological Atlas of Rajasthan



Chambal River Basin





# Hydrogeological Atlas of Rajasthan

# **Chambal River Basin**

## Contents:

| List of<br>Plates | Title  | Page No. |  |  |  |
|-------------------|--|----------|--|--|--|
| Plate I           | Administrative Map   | 2        |  |  |  |
| Plate II          | Topography   | 4        |  |  |  |
| Plate III         | Rainfall Distribution  | 4        |  |  |  |
| Plate IV          | Geological Map   | 6        |  |  |  |
| Plate V           | Geomorphological Map   | 6        |  |  |  |
| Plate VI          | Aquifer Map  | 8        |  |  |  |
| Plate VII         | Location of Ground Water Monitoring Stations                                 | 8        |  |  |  |
| Plate VIII        | Location of Exploratory Wells  | 10       |  |  |  |
| Plate IX          | Depth to Water Level (Pre-Monsoon 2010)                                      | 10       |  |  |  |
| Plate X           | Water Table Elevation (Pre-Monsoon 2010)                                     | 12       |  |  |  |
| Plate XI          | Water Level Fluctuation (Pre-Post Monsoon 2010)                              | 12       |  |  |  |
| Plate XII         | e XII Electrical Conductivity Distribution (Average Pre-<br>Monsoon 2005-09) |          |  |  |  |
| Plate XIII        | Chloride Distribution (Average Pre-Monsoon 2005-09)                          | 14       |  |  |  |
| Plate XIV         | Fluoride Distribution (Average Pre-Monsoon 2005-09)                          | 16       |  |  |  |
| Plate XV          | Nitrate Distribution (Average Pre-Monsoon 2005-09)                           | 16       |  |  |  |
| Plate XVI         | Depth to Bedrock   | 18       |  |  |  |
| Plate XVII        | Map of Unconfined Aquifer  | 18       |  |  |  |
| Plate XVIII       | Index Map Showing Alignment of Cross Sections                                | 20       |  |  |  |
| Plate XIX         | Cross Section Along A-A'   | 22       |  |  |  |
| Plate XX          | Cross Section Along B-B'   | 22       |  |  |  |
| Plate XXI         | Cross Section Along C-C'   | 24       |  |  |  |
| Plate XXII        | Cross Section Along D-D'   | 24       |  |  |  |
| Plate XXIII       | Cross Section Along E-E'   | 26       |  |  |  |
| Plate XXIV        | 3D Model   | 28       |  |  |  |
|                   | Glossary of terms  | 29       |  |  |  |



2013





#### Location:

Chambal River Basin is located in the south-eastern part of Rajasthan. It stretches between 23° 31' 03.91" to 26° 56' 03.72" North latitudes and between 74° 45' 15.00" to 78° 13' 33.86" East longitudes. It is bounded primarily by the Banas river basin in the west, partly by Mahi, Gambhir and Parbati river Basins. The eastern boundary is defined by Madhya Pradesh State where the rest of the catchment area of Chambal river lies. The Chambal basin extends over parts of Baran, Bhilwara, Bundi, Chittaurgarh, Dhaulpur, Jhalawar, Karauli, Kota, Pratapgarh, Sawai Madhopur and Tonk Districts. The total catchment area of the basin is approximately 31,239 km<sup>2</sup> within the state of Rajasthan (excluding Banas river basin which is tributary to Chambal River. River Chambal is a principal tributary of river Yamuna and originates in the Vindhyan ranges near Mhow in Indore District of Madhya Pradesh, entering through a deep gorge in Rajasthan at Chourasigarh, about 96 km upstream of Kota. The deep gorge extends up to Kota and the river then flows for about 226 km within Rajasthan in a north-easterly direction, and then forms the boundary between MP and Rajasthan for about 252 km.

#### Administrative Set-up:

Administratively, Chambal river basin extends over parts of Baran, Bhilwara, Bundi, Chittaurgarh, Dhaulpur, Jhalawar, Karauli, Kota, Pratapgarh, Sawai Madhopur and Tonk districts encompassing 41 Blocks and 5,786 towns and villages.

| S. No. | District Namo  | Area     | % of Basin | Total Number | Total Number of           |
|--------|----------------|----------|------------|--------------|---------------------------|
| 5. NO. | District Name  | (sq km)  | Area       | of Blocks    | <b>Towns and Villages</b> |
| 1      | Baran          | 6,993.9  | 22.4       | 7            | 1,213                     |
| 2      | Bhilwara       | 1,045.3  | 3.4        | 2            | 219                       |
| 3      | Bundi          | 5,610.2  | 18.0       | 5            | 827                       |
| 4      | Chittaurgarh   | 2,197.9  | 7.0        | 3            | 359                       |
| 5      | Dhaulpur       | 844.9    | 2.6        | 4            | 151                       |
| 6      | Jhalawar       | 6,315.3  | 20.2       | 6            | 1,608                     |
| 7      | Karauli        | 816.0    | 2.6        | 2            | 82                        |
| 8      | Kota           | 5,122.3  | 16.4       | 5            | 903                       |
| 9      | Pratapgarh     | 895.2    | 2.9        | 3            | 218                       |
| 10     | Sawai Madhopur | 952.2    | 3.1        | 2            | 121                       |
| 11     | Tonk           | 446.0    | 1.4        | 2            | 85                        |
|        | Total          | 31,239.2 | 100.0      | 41           | 5,786                     |

#### **Climate:**

Chambal river basin falls within Semi-arid to Sub-humid climatic regions. It is very cold from November to February while turning hot from March to June when the maximum temperature rises up to 48°C. The mean annual rainfall over basin is approximately 697 mm (year 2010). Most of the rainfall is received during the Monsoon months between June/July to September. Months of September and October are very pleasant before onset of winters.





European Union State Partnership Programme









High elevation areas surround the central low lying parts of basin from east, south and western sides. The river flows in the north eastern direction and a narrow part extends through Karauli and Dhaulpur districts. The minimum elevation in the basin is 111 m amsl in Dhaulpur district where the river drains out of the basin and the maximum elevation is approximately 605 m amsl in Bhilwara district. Nearly half of the basin is hilly while rest is undulating plains.

| District Name  | Min. Elevation<br>(m amsl) | Max. Elevation<br>(m amsl) |
|----------------|----------------------------|----------------------------|
| Baran          | 196.0                      | 547.3                      |
| Bhilwara       | 304.3                      | 605.3                      |
| Bundi          | 186.6                      | 547.0                      |
| Chittaurgarh   | 293.6                      | 604.1                      |
| Dhaulpur       | 111.3                      | 341.2                      |
| Jhalawar       | 245.9                      | 523.9                      |
| Karauli        | 131.0                      | 469.5                      |
| Kota           | 177.0                      | 517.0                      |
| Pratapgarh     | 437.0                      | 575.0                      |
| Sawai Madhopur | 164.7                      | 502.7                      |
| Tonk           | 217.1                      | 473.4                      |

#### Table: District wise minimum and maximum elevation

#### RAINFALL

The general distribution of rainfall across the Chambal river basin can be visualized from isohyets presented in the Plate III where most of the hilly areas seem to receive higher rainfalls (total annual rainfall in the range of 700-900mm) whereas, the central part received lower rainfall (between 400 to 700mm). The average annual rainfall for the year 2010, computed based on available station data is about 697 mm and Begun block had received highest rainfall measuring about 1,790 mm followed by Bijolia, 880 mm. The rainfall data for available rain gauge stations is presented below. Minimum rainfall was recorded in Sangod block (415.1 mm).

Table: District wise total annual rainfall (based on year 2010 meteorological station recordings (http://waterresources.rajasthan.gov.in)

| S. No. | Rain gauge Stations | Total Monsoon<br>Rainfall (mm) | Total Non-Monsoon<br>Rainfall (mm) | Total Annual<br>Rainfall (mm) |
|--------|---------------------|--------------------------------|------------------------------------|-------------------------------|
| 1      | Antah               | 498.0                          | 85.0                               | 583.0                         |
| 2      | Atru                | 615.0                          | 53.0                               | 668.0                         |
| 3      | Bakani              | 660.5                          | 60.8                               | 721.3                         |
| 4      | Baran               | 560.0                          | 54.0                               | 614.0                         |
| 5      | Begun               | 1,624.0                        | 164.0                              | 1,788.0                       |
| 6      | Bhainsrodgarh       | 623.0                          | 70.0                               | 693.0                         |
| 7      | Bijolia             | 787.0                          | 93.0                               | 880.0                         |
| 8      | Chhabra             | 529.0                          | 33.0                               | 562.0                         |
| 9      | Chhipabarod         | 650.0                          | 38.0                               | 688.0                         |
| 10     | Digod               | 554.5                          | 84.0                               | 638.5                         |
| 11     | Dug                 | 518.0                          | 41.0                               | 559.0                         |
| 12     | Hindoli             | 658.0                          | 118.0                              | 776.0                         |

| S. No. | Rain gauge Stations | Total Monsoon<br>Rainfall (mm) | Total Non-Monsoon<br>Rainfall (mm) | Total Annual<br>Rainfall (mm) |
|--------|---------------------|--------------------------------|------------------------------------|-------------------------------|
| 13     | Jhalrapatan         | 484.6                          | 40.0                               | 524.6                         |
| 14     | Keshoraipatan       | 591.0                          | 87.0                               | 678.0                         |
| 15     | Khanpur             | 679.2                          | 67.0                               | 746.2                         |
| 16     | Kishanganj          | zanj 549.0 53.0                |                                    | 602.0                         |
| 17     | Ladpura             | adpura 515.0 5                 |                                    | 571.0                         |
| 18     | Manoharthana        | 514.1                          | 62.6                               | 576.7                         |
| 19     | Nainwa              | 489.0                          | 79.0                               | 568.0                         |
| 20     | Pirawa              | 665.0                          | 54.0                               | 719.0                         |
| 21     | Ramganjmandi        | 828.0                          | 19.0                               | 847.0                         |
| 22     | Sangod              | 356.1                          | 59.0                               | 415.1                         |
| 23     | Shahbad             | 535.0                          | 39.5                               | 574.5                         |
| 24     | Talera              | 595.0                          | 137.0                              | 732.0                         |















The Chambal river basin is covered predominantly by rocks belonging to the Vindhyan Super-Group and next by Alluvium. Bhilwara (Mangalwar Complex) Super Group rocks and

Deccan traps also cover parts of basin.

| Age   | Super Group    | Group- Formation                      | Lithology   |  |  |  |  |  |
|---|----------------|---------------------------------------|---|--|--|--|--|--|
| Sub-recent to Recent  | Alluvium       | Alluvium                              | Sand, silt, clay, gravels, Pebbles, kankar                    |  |  |  |  |  |
| xxxxxx  |                |                                       |   |  |  |  |  |  |
| Upper Cretaceous         Deccan Trap         Malwa         Lava flows with Inter-trappean shale, Chert, limestone |                |                                       |   |  |  |  |  |  |
|   | xx             |                                       |   |  |  |  |  |  |
| Linner Dre Cambrian to  |                | Bhander (Chambal Limestone)           | Sandstone, limestone Shale, conglomerate                      |  |  |  |  |  |
| Upper Pre-Cambrian to   | Upper Vindhyan | Rewa                                  | Sandstone, shale  |  |  |  |  |  |
| LOwer Callibrian  |                | Kaimur Sandstone, shale Conglomerates |   |  |  |  |  |  |
|   | XX             | x                                     | nityxxxxx   |  |  |  |  |  |
| Upper Pre- Cambrian to  | Lower Vindbyon | Somri                                 | Limestone shale Clausenitis hads Persellanite songlemerate    |  |  |  |  |  |
| Lower Cambrian  | Lower vinunyan | Senin                                 | Linestone, shale, Glauconnic Deus, Porcenanice, congiomerate  |  |  |  |  |  |
|   | XX             | x                                     | nityxxxxxx  |  |  |  |  |  |
| Archaoan  | Philwara       | Mangalwar Complex                     | Slate, dolomite, Marble, quartzite, Conglomerate Gneisses and |  |  |  |  |  |
| Archaean  | DIIIWdid       | Mangalwar Complex                     | migmatite   |  |  |  |  |  |

## GEOMORPHOLOGY

| Origin       | Landform Unit          | Description   |
|--------------|------------------------|---|
| Aeolian      | Eolian Plain           | Formed by aeolian activity, with sand dunes of varying height, size, slope. Long stretches of sand sheet. Gently sloping flat to undulating plain, comprised of fine to medium grained sand and silt. Also scattered xerophytic vegetation. |
|              | Sandy Plain            | Formed of aeolian activity, wind-blown sand with gentle sloping to undulating plain, comprising of coarse sand, fine sand, silt and clay.   |
|              | Buried Pediment        | Pediment covers essentially with relatively thicker alluvial, colluvial or weathered materials.   |
|              | Intermontane Valley    | Depression between mountains, generally broad & linear, filled with colluvial deposits.   |
| Denudational | Pediment               | Broad gently sloping rock flooring, erosional surface of low relief between hill and plain, comprised of varied lithology, criss-crossed by fractures and faults.   |
|              | Dissected Plateau      | Plateau, criss-crossed by fractures forming deep valleys.   |
|              | Alluvial Fan           | A fan shaped mass of sediment deposit at a point along a Nallah, river where there is a decrease in gradient.   |
|              | Alluvial Plain         | Mainly undulating landscape formed due to fluvial activity, comprising of gravels, sand, silt and clay. Terrain mainly undulating, produced by extensive deposition of alluvium.  |
|              | Alluvial Plain (Sandy) | Flat to gentle undulating plain formed due to fluvial activity, mainly consists of gravels, sand, silt and clay with unconsolidated material of varying lithology, predominantly sand along river.  |
| Fluvial      | Paleochannel           | Mainly buried on abandoned stream/river courses, comprising of coarse textured material of variable sizes.  |
|              | Valley Fill            | Formed by fluvial activity, usually at lower topographic locations, comprising of boulders, cobbles, pebbles, gravels, sand, silt and clay. The unit has consolidated sediment deposits.  |
|              | Ravine                 | Small, narrow, deep, depression, smaller than gorges, larger than gulley, usually carved by running water.  |
|              | Water logged/ Wetland  | Area submerged in water or area having very shallow water table. So that it submerges in water during rainy season.   |
| Structural   | Plateau                | Formed over varying lithology with extensive, flat, landscapes, bordered by escarpment on all sides. Essentially formed horizontally layered rocky marked by extensive flat top and steep slopes. It may be criss crossed by lineament.     |
| Hills        |                        | Hills and intervening valleys in hilly areas  |



Ground Water Department Rajasthan

European Union State Partnership Programme









Vindhyans constitute principal aquifers in the basin (sandstones around 35%, followed by shales and limestones around 10% each) mostly in the central parts of the basin. Basaltic aquifers are also significant as they occupy around 22% of the basin area, dominantly present in the southern part of the basin. Alluvial aquifers are present in Kota, Baran and Bundi districts towards northern parts of the basin.

| Aquifer in Potential | Area     | % of Basin | Description of the unit /Occurrence   |
|----------------------|----------|------------|---|
| Zone                 | (sq km)  | Area       | Description of the unity occurrence   |
| Younger Alluvium     | 3,032.2  | 9.7        | It is largely constituted of Aeolian and Fluvial sand, silt, clay, gravel and pebbles in varying proportions. |
| Older Alluvium       | 683.2    | 2.2        | This litho unit comprises of mixture of heterogeneous fine to medium grained sand, silt and kankar.           |
| Limestone            | 2,892.1  | 9.3        | In general, it is fine to medium grained, grey, red yellowish, pink or buff in colour.                        |
| Vindhyan Sandstone   | 10,140.3 | 32.5       | Fine to medium grained, red colour and compact and at places.   |
| Phyllite             | 1,963.7  | 6.2        | These include meta sediments and represented by carbonaceous phyllite.  |
| Schist               | 836.4    | 2.7        | Medium to fine grained compact rock. The litho units are soft, friable and have closely spaced cleavage.      |
| Shale                | 3,097.9  | 9.9        | Grey, light green and purple in colour and mostly splintery in nature.  |
| Basalt               | 6,828.3  | 21.9       | Dark grey, olive green and green colour, compact, vesicular, amygdaloidal and weathered.                      |
| Quartzite            | 58.6     | 0.2        | Medium to coarse grained and varies from feldspathic grit to sericitic quartzite.                             |
| Gneiss               | 45.2     | 0.1        | Comprises of porphyritic and non porphyritic gneissic complex.  |
| Non Potential Zone   | 1,661.3  | 5.3        | Hills and reserve forests.  |
| TOTAL                | 31,239.2 | 100.0      |   |

## LOCATION OF GROUNDWATER MONITORING WELLS

The basin has a well distributed network of large number of groundwater monitoring stations (954) in the basin owned by RGWD (862) and CGWB (92); and 124 wells have been

recommended to be added to the existing network to effectively monitor ground water levels and water quality in the basin.

| District Name  | Existing<br>Monit | Ground<br>oring Sta | Water<br>tions | Recommended Additional<br>Ground Water Monitoring Stations |               |  |  |
|----------------|-------------------|---------------------|----------------|--|---------------|--|--|
|                | CGWB              | RGWD                | Total          | Water Level  | Water quality |  |  |
| Baran          | 16                | 154                 | 170            | -  | 5             |  |  |
| Bhilwara       | 2                 | 17                  | 19             | -  | -             |  |  |
| Bundi          | 18                | 206                 | 224            | -  | 3             |  |  |
| Chittaurgarh   | -                 | 33                  | 33             | -  | 1             |  |  |
| Dhaulpur       | 4                 | 25                  | 29             | -  | 21            |  |  |
| Jhalawar       | 22                | 225                 | 247            | -  | 9             |  |  |
| Karauli        | 1                 | -                   | 1              | 5  | 8             |  |  |
| Kota           | 18                | 160                 | 178            | 17   | 3             |  |  |
| Pratapgarh     | 5                 | 29                  | 34             | 37   | 1             |  |  |
| Sawai Madhopur | 5                 | 6                   | 11             | -  | 14            |  |  |
| Tonk           | 1                 | 7                   | 8              | -  | -             |  |  |
| Total          | 92                | 862                 | 954            | 59   | 65            |  |  |













## LOCATION OF EXPLORATORY WELLS



#### **CHAMBAL RIVER BASIN**

In all there are 339 exploratory wells present in the basin drilled in the past by RGWD (245) and CGWB (94) that form good basis for delineation of sub-surface aquifer distribution.

| District Name  | Ex   | ploratory \ | Nells |  |
|----------------|------|-------------|-------|--|
| District Name  | CGWB | RGWD        | Total |  |
| Baran          | 4    | 43          | 47    |  |
| Bhilwara       | -    | 3           | 3     |  |
| Bundi          | 26   | 57          | 83    |  |
| Chittaurgarh   | 2    | 4           | 6     |  |
| Dhaulpur       | 1    | 8           | 9     |  |
| Jhalawar       | 17   | 57          | 74    |  |
| Karauli        | 2    | -           | 2     |  |
| Kota           | 34   | 47          | 81    |  |
| Pratapgarh     | -    | 3           | 3     |  |
| Sawai Madhopur | 8    | 18          | 26    |  |
| Tonk           | -    | 5           | 5     |  |
| Total          | 94   | 245         | 339   |  |

## DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

The general depth to water level in the basin ranges from 10 to 30 meters below ground level, as seen all over the basin except the central part in Kota-Baran-Chhabra region. The

deeper water levels in the region mentioned above reaches 50m bgl in some areas.

| Depth to water level          |         | District wise area coverage (sq km)* |         |              |          |          |         |         |            |                   |       |          |
|-------------------------------|---------|--------------------------------------|---------|--------------|----------|----------|---------|---------|------------|-------------------|-------|----------|
| (m bgl)<br>Pre Monsoon - 2010 | Baran   | Bhilwara                             | Bundi   | Chittaurgarh | Dhaulpur | Jhalawar | Karauli | Kota    | Pratapgarh | Sawai<br>Madhopur | Tonk  | (sq km)  |
| < 10                          | 3,111.0 | 45.6                                 | 1,457.9 | 241.2        | 77.7     | 1,058.4  | -       | 1,203.1 | 22.4       | -                 | -     | 7,217.3  |
| 10 - 20                       | 2,672.3 | 583.5                                | 3,217.6 | 983.0        | 482.1    | 4,860.6  | 63.5    | 2,492.3 | 709.3      | 383.2             | 379.8 | 16,827.2 |
| 20 - 30                       | 707.3   | 191.5                                | 747.9   | 92.5         | 229.4    | 261.6    | 638.4   | 1,258.1 | 142.9      | 384.3             | 66.2  | 4,720.1  |
| 30 - 40                       | 334.0   | -                                    | 2.0     | 9.0          | 55.7     | 24.5     | 8.4     | 146.7   | -          | 63.5              | -     | 643.8    |
| 40 - 50                       | 116.0   | -                                    | -       | 2.0          | -        | 0.2      | -       | 22.1    | -          | 3.6               | -     | 143.9    |
| > 50                          | 25.5    | -                                    | -       | -            | -        | -        | -       | -       | -          | -                 | -     | 25.5     |
| Total                         | 6,966.1 | 820.6                                | 5,425.4 | 1,327.7      | 844.9    | 6,205.3  | 710.3   | 5,122.3 | 874.6      | 834.6             | 446.0 | 29,577.8 |

\* The area covered in the derived maps is less than the total basin area since the hills have been excluded from interpolation/contouring.















## WATER TABLE ELEVATION (PRE MONSOON 2010)

Water table elevation map Plate –X, shows large variation following the trends in topography which is marked by hills and low plains. It varies from less than 140m amsl (in Dhaulpur district) to about 520m amsl

(in Pratapgarh district). Predominant elevation range is between 220 to 260m amsl range wherein, 27% of the area falls under this region. Most of the remaining of the area has water table between 260 to 440m

amsl, spread over the Baran, Bhilwara, Bundi, Chittaurgarh, Jhalawar, Kota districts. Dhaulpur district has generally lowest water table elevation values in the basin.

| Depth to water table (m bgll) |         |          |         |              | District wi | se area cov | erage (sq | km)     |            |                |       | Total Area |
|-------------------------------|---------|----------|---------|--------------|-------------|-------------|-----------|---------|------------|----------------|-------|------------|
| Pre Monsoon - 2010            | Baran   | Bhilwara | Bundi   | Chittaurgarh | Dhaulpur    | Jhalawar    | Karauli   | Kota    | Pratapgarh | Sawai Madhopur | Tonk  | (sq km)    |
| < 140                         | -       | -        | -       | -            | 246.3       | -           | -         | -       | -          | -              | -     | 246.3      |
| 140 - 160                     | -       | -        | -       | -            | 161.9       | -           | -         | -       | -          | -              | -     | 161.9      |
| 160 - 180                     | 3.2     | -        | -       | -            | 33.6        | -           | 4.3       | -       | -          | -              | -     | 41.1       |
| 180 - 200                     | 11.9    | -        | 11.3    | -            | 33.6        | -           | 149.8     | 99.2    | -          | 178.7          | -     | 484.5      |
| 200 - 220                     | 57.4    | -        | 293.2   | -            | 26.9        | -           | 478.1     | 608.4   | -          | 352.0          | -     | 1,816.0    |
| 220 - 240                     | 659.9   | -        | 1,277.5 | -            | 94.6        | -           | 71.9      | 1,125.9 | -          | 169.2          | 34.5  | 3,433.5    |
| 240 - 260                     | 1,308.6 | -        | 1,730.7 | -            | 166.0       | 8.6         | 6.2       | 935.3   | -          | 103.4          | 223.2 | 4,482.0    |
| 260 - 280                     | 604.5   | -        | 627.2   | 10.0         | 69.3        | 256.1       | -         | 518.1   | -          | 12.0           | -     | 2,097.2    |
| 280 - 300                     | 508.4   | -        | 476.9   | 50.5         | 12.7        | 450.8       | -         | 705.8   | -          | 11.2           | 73.7  | 2,290.0    |
| 300 - 320                     | 682.5   | 98.7     | 375.9   | 374.1        | -           | 823.9       | -         | 468.3   | -          | 7.5            | 107.0 | 2,937.9    |
| 320 - 340                     | 975.6   | 203.4    | 108.6   | 159.2        | -           | 1,044.0     | -         | 192.6   | -          | 0.6            | 7.6   | 2,691.6    |
| 340 - 360                     | 730.4   | 62.8     | 71.8    | 204.9        | -           | 1,101.8     | -         | 147.6   | -          | -              | -     | 2,319.3    |
| 360 - 380                     | 593.1   | 52.4     | 67.7    | 208.0        | -           | 837.7       | -         | 153.6   | -          | -              | -     | 1,912.5    |
| 380 - 400                     | 319.8   | 32.1     | 81.2    | 137.6        | -           | 849.5       | -         | 159.1   | -          | -              | -     | 1,579.3    |
| 400 - 440                     | 479.0   | 63.8     | 168.5   | 55.2         | -           | 832.9       | -         | 8.4     | 6.8        | -              | -     | 1,614.6    |
| 440 - 480                     | 31.8    | 166.4    | 122.8   | 10.2         | -           | -           | -         | -       | 343.4      | -              | -     | 674.6      |
| 480 - 520                     | -       | 141.0    | 12.1    | 56.6         | -           | -           | -         | -       | 472.7      | -              | -     | 682.4      |
| > 520                         | -       | -        | -       | 61.4         | -           | -           | -         | -       | 51.7       | -              | -     | 113.1      |
| Total                         | 6,966.1 | 820.6    | 5,425.4 | 1,327.7      | 844.9       | 6,205.3     | 710.3     | 5,122.3 | 874.6      | 834.6          | 446.0 | 29,577.8   |

## WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

The Basin area is a mixture of hardrock aquifers and those formed within alluvium aquifers. Perusal of Plate XI reveals interesting correlation wherein the hardrock areas have shown positive fluctuation (i.e., rise in ground water levels in post monsoon period) to the tune of 2 to even 18m (Bundi, Kota, Chittaurgarh, and Sawai Madhopur being prominent), the alluvial areas of Bundi, Kota and Baran have shown significant areas having negative fluctuation (fall in water level in post monsoon period) between 0 to 4 m reaching even upto 6m in some areas.

| District Norma |      |          |          |         | District v | wise area c | overage (s | q km) with | in fluctuat | ion range (n | n)       |          |          |      | Total Area |
|----------------|------|----------|----------|---------|------------|-------------|------------|------------|-------------|--------------|----------|----------|----------|------|------------|
| District Name  | < -6 | -6 to -4 | -4 to -2 | -2 to 0 | 0 to 2     | 2 to 4      | 4 to 6     | 6 to 8     | 8 to 10     | 10 to 12     | 12 to 14 | 14 to 16 | 16 to 18 | > 18 | (sq km)    |
| Baran          | 3.5  | 9.4      | 114.1    | 1,043.6 | 2,631.7    | 2,122.5     | 727.2      | 214.0      | 63.2        | 30.5         | 5.9      | 0.5      | -        | -    | 6,966.1    |
| Bhilwara       | -    | -        | 1.3      | 16.8    | 109.6      | 97.1        | 49.2       | 79.8       | 168.6       | 135.3        | 112.5    | 35.1     | 13.7     | 1.6  | 820.6      |
| Bundi          | -    | -        | 57.9     | 448.1   | 564.9      | 793.1       | 1,185.3    | 996.5      | 677.2       | 246.2        | 181.4    | 144.0    | 116.5    | 14.3 | 5,425.4    |
| Chittaurgarh   | -    | -        | -        | -       | 84.8       | 298.2       | 417.1      | 185.6      | 167.8       | 109.5        | 48.5     | 16.2     | -        | -    | 1,327.7    |
| Dhaulpur       | 0.9  | 2.1      | 8.7      | 34.5    | 101.3      | 245.7       | 233.8      | 189.6      | 27.8        | 0.5          | -        | -        | -        | -    | 844.9      |
| Jhalawar       | 4.1  | 14.0     | 45.2     | 164.8   | 1,534.7    | 2,746.3     | 1,257.2    | 307.7      | 100.9       | 24.6         | 4.3      | 1.3      | 0.2      | -    | 6,205.3    |
| Karauli        | -    | -        | -        | -       | 112.5      | 407.4       | 178.7      | 11.7       | -           | -            | -        | -        | -        | -    | 710.3      |
| Kota           | 2.3  | 6.9      | 88.1     | 782.1   | 1,261.1    | 900.6       | 607.8      | 470.7      | 343.8       | 356.0        | 185.0    | 103.3    | 14.6     | -    | 5,122.3    |
| Pratapgarh     | -    | -        | -        | -       | 374.0      | 326.3       | 167.1      | 7.2        | -           | -            | -        | -        | -        | -    | 874.6      |
| Sawai Madhopur | 2.0  | 24.3     | 40.7     | 41.6    | 47.2       | 175.5       | 175.0      | 123.1      | 75.7        | 63.9         | 39.6     | 22.2     | 3.8      | -    | 834.6      |
| Tonk           | -    | -        | -        | -       | 16.4       | 170.5       | 71.5       | 57.6       | 71.7        | 37.8         | 10.6     | 6.3      | 3.6      | -    | 446.0      |
| Total          | 12.8 | 56.7     | 356.0    | 2,531.5 | 6,838.2    | 8,283.2     | 5,069.9    | 2,643.5    | 1,696.7     | 1,004.3      | 587.8    | 328.9    | 152.4    | 15.9 | 29,577.8   |



iround Water Departme Rajasthan

European Union State Partnership Programme











The Electrical Conductivity (at 25°C) distribution map is presented in Plate – XII. Interestingly, 92% of the basin area falls under the < 2000 mg/l category which is suitable for domestic and other purposes from EC point of view. Nearly 8% of the area falls in the 2000 to 4000 mg/l range and negligible area is seen to have over > 4000 mg/l of EC in ground water. Most of the low EC areas correspond to hard rock aquifers whereas the moderately high EC regions correspond to alluvial aquifers in plain areas. The small patch of high EC southwest of Jhalwar is however formed in Basaltic aquifer which may have local reasons for this.

| Electrical Conductivity Ranges |         |       |       |       |         |       |         |        |       | District v | wise area | coverag | e (sq km | ı)    |         |       |       |       |         |         |       |       |          |
|--------------------------------|---------|-------|-------|-------|---------|-------|---------|--------|-------|------------|-----------|---------|----------|-------|---------|-------|-------|-------|---------|---------|-------|-------|----------|
| (µS/cm at 25°C)                | Bar     | an    | Bhil  | wara  | Bun     | ndi   | Chittau | urgarh | Dha   | ulpur      | Jhala     | war     | Kai      | rauli | Ko      | ta    | Prata | pgarh | Sawai M | adhopur | То    | nk    | (sg km)  |
| (Ave. of years 2005-09)        | Area    | % age | Area  | % age | Area    | % age | Area    | % age  | Area  | % age      | Area      | % age   | Area     | % age | Area    | % age | Area  | % age | Area    | % age   | Area  | % age | (,       |
| < 2000                         | 6,458.3 | 92.7  | 820.6 | 100.0 | 4,915.3 | 90.6  | 1,327.7 | 100.0  | 765.7 | 90.6       | 5,411.2   | 87.2    | 710.3    | 100.0 | 4,622.1 | 90.2  | 862.8 | 98.6  | 816.3   | 97.8    | 437.7 | 98.1  | 27,148.0 |
| 2000-4000                      | 478.6   | 6.9   | -     | -     | 510.1   | 9.4   | -       | -      | 65.8  | 7.8        | 712.2     | 11.5    | -        | -     | 500.1   | 9.8   | 11.8  | 1.4   | 18.3    | 2.2     | 8.3   | 1.9   | 2,305.2  |
| > 4000                         | 29.2    | 0.4   | -     | -     | -       | -     | -       | -      | 13.4  | 1.6        | 81.9      | 1.3     | -        | -     | 0.1     | -     | -     | -     | -       | -       | -     | -     | 124.6    |
| Total                          | 6,966.1 | 100.0 | 820.6 | 100.0 | 5,425.4 | 100.0 | 1,327.7 | 100.0  | 844.9 | 100.0      | 6,205.3   | 100.0   | 710.3    | 100.0 | 5,122.3 | 100.0 | 874.6 | 100.0 | 834.6   | 100.0   | 446.0 | 100.0 | 29,577.8 |

#### **CHLORIDE DISTRIBUTION**

Yellow coloured area in Plate – XIII represents the areas of low (< 250 mg/l) concentration of Chloride in ground water. This range is most widespread and almost entire basin shows low Chloride concentrations making the ground water suitable for all purposes. There is a small patch in the southwest of Jhalwar where apparently a single well had shown high concentration of Chloride (>1000 mg/l). Majority of patches of moderately high Chloride concentration are found in alluvial aquifers and the hardrock aquifers seem to contain good quality of ground water.

| Chloride Ranges         |         |       |       |       |         |       |         |        |       | District v | vise area | coverage | e (sq km | )     |         |       |       |       |         |         |       |       | Total Area |
|-------------------------|---------|-------|-------|-------|---------|-------|---------|--------|-------|------------|-----------|----------|----------|-------|---------|-------|-------|-------|---------|---------|-------|-------|------------|
| (mg/l)                  | Bar     | an    | Bhil  | wara  | Bur     | ndi   | Chittau | urgarh | Dha   | ulpur      | Jhala     | war      | Kai      | rauli | Ко      | ta    | Prata | pgarh | Sawai M | adhopur | То    | onk   | (ca km)    |
| (Ave. of years 2005-09) | Area    | % age | Area  | % age | Area    | % age | Area    | % age  | Area  | % age      | Area      | % age    | Area     | % age | Area    | % age | Area  | % age | Area    | % age   | Area  | % age | (sq kiii)  |
| < 250                   | 6,347.4 | 91.1  | 811.4 | 98.9  | 4,973.4 | 91.7  | 1,267.2 | 95.4   | 820.5 | 97.1       | 5,294.6   | 85.3     | 710.3    | 100.0 | 4,761.2 | 92.9  | 537.0 | 61.4  | 797.7   | 95.6    | 390.9 | 87.7  | 26,711.6   |
| 250 - 1000              | 614.6   | 8.8   | 9.2   | 1.1   | 452.0   | 8.3   | 60.5    | 4.6    | 24.4  | 2.9        | 856.1     | 13.8     | -        | -     | 361.1   | 7.1   | 337.6 | 38.6  | 36.9    | 4.4     | 55.1  | 12.3  | 2,807.5    |
| > 1000                  | 4.1     | 0.1   | -     | -     | -       | -     | -       | -      | -     | -          | 54.6      | 0.9      | -        | -     | -       | -     | -     | -     | -       | -       | -     | -     | 58.7       |
| Total                   | 6,966.1 | 100.0 | 820.6 | 100.0 | 5,425.4 | 100.0 | 1,327.7 | 100.0  | 844.9 | 100.0      | 6,205.3   | 100.0    | 710.3    | 100.0 | 5,122.3 | 100.0 | 874.6 | 100.0 | 834.6   | 100.0   | 446.0 | 100.0 | 29,577.8   |













European Union State Partnership Programme

#### **CHAMBAL RIVER BASIN**

The Fluoride concentration map (Plate – XIV) displays two isolated patches of high fluoride concentration (>3 mg/l) which are located around Jhalrapatan in the southern part and north of Dhaulpur in the extreme northeastern part of the basin. Apart from these two patches which together constitute less than 2% of the basin and the moderate concentration areas (1.5 to 3.0 mg/l) that occupy around 3.5% of the basin area, rest of the basin falls under low concentration zone (< 1.5 mg/l). Therefore, by and large the basin seems to be not much affected by Fluoride problem.

| Fluoride Ranges         |         |       |       |       |         |       |         |        |       | District | wise area | coverage | e (sq km | )     |         |       |       |       |         |         |       |       | Total Area |
|-------------------------|---------|-------|-------|-------|---------|-------|---------|--------|-------|----------|-----------|----------|----------|-------|---------|-------|-------|-------|---------|---------|-------|-------|------------|
| (mg/l)                  | Bara    | an    | Bhil  | wara  | Bun     | di    | Chittau | ırgarh | Dhau  | ulpur    | Jhala     | war      | Kar      | auli  | Ko      | ta    | Prata | pgarh | Sawai M | adhopur | То    | nk    | (ca km)    |
| (Ave. of years 2005-09) | Area    | % age | Area  | % age | Area    | % age | Area    | % age  | Area  | % age    | Area      | % age    | Area     | % age | Area    | % age | Area  | % age | Area    | % age   | Area  | % age |            |
| < 1.5                   | 6,725.7 | 96.5  | 811.2 | 98.9  | 4,996.6 | 92.1  | 1,327.7 | 100.0  | 672.1 | 79.5     | 6,122.2   | 98.7     | 710.2    | 100.0 | 5,105.6 | 99.7  | 874.6 | 100.0 | 829.4   | 99.4    | 306.7 | 68.8  | 28,482.0   |
| 1.5-3.0                 | 240.4   | 3.5   | 9.4   | 1.1   | 428.8   | 7.9   | -       | -      | 155.0 | 18.4     | 49.8      | 0.8      | 0.1      | -     | 16.7    | 0.3   | -     | -     | 5.2     | 0.6     | 139.3 | 31.2  | 1,044.7    |
| > 3.0                   | -       | -     | -     | -     | -       | -     | -       | -      | 17.8  | 2.1      | 33.3      | 0.5      | -        | -     | -       | -     | -     | -     | -       | -       | -     | -     | 51.1       |
| Total                   | 6,966.1 | 100.0 | 820.6 | 100.0 | 5,425.4 | 100.0 | 1,327.7 | 100.0  | 844.9 | 100.0    | 6,205.3   | 100.0    | 710.3    | 100.0 | 5,122.3 | 100.0 | 874.6 | 100.0 | 834.6   | 100.0   | 446.0 | 100.0 | 29,577.8   |

#### NITRATE DISTRIBUTION

High nitrate concentration in ground water renders it unsuitable for agriculture purposes. Plate – XV shows distribution of Nitrate in groundwater. Except for the central part of the basin i.e., within Baran – Kota – Bundi – Tonk region, that has low concentration of Nitrates in ground water, the basin has scattered patches of high (> 100 mg/l) and moderately high (50-100 mg/l) concentration of Nitrates in ground water. Such high concentration patches are seen in east, south and northwestern parts of the basin around Baran, Jhalawar, Mandi Rajdrapur, Bhilwara, Hindoli, Khandar, Dhaulpur etc.

| Nitrate Ranges          |         |       |       |       |         |       |         |        | I     | District v | wise area | coverage | e (sq km | ı)    |         |       |       |       |         |         |       |       |            |
|-------------------------|---------|-------|-------|-------|---------|-------|---------|--------|-------|------------|-----------|----------|----------|-------|---------|-------|-------|-------|---------|---------|-------|-------|------------|
| (mg/l)                  | Bar     | an    | Bhil  | wara  | Bun     | di    | Chittau | ırgarh | Dha   | ulpur      | Jhala     | war      | Kar      | auli  | Ко      | ta    | Prata | pgarh | Sawai M | adhopur | То    | nk    | lotal Area |
| (Ave. of years 2005-09) | Area    | % age | Area  | % age | Area    | % age | Area    | % age  | Area  | % age      | Area      | % age    | Area     | % age | Area    | % age | Area  | % age | Area    | % age   | Area  | % age |            |
| < 50                    | 5,374.3 | 77.1  | 500.7 | 61.0  | 4,355.8 | 80.3  | 842.5   | 63.5   | 721.2 | 85.4       | 3,060.7   | 49.3     | 197.8    | 27.8  | 3,980.3 | 77.7  | 324.6 | 37.1  | 543.9   | 65.2    | 239.8 | 53.8  | 20,141.6   |
| 50-100                  | 1,358.3 | 19.5  | 264.7 | 32.3  | 932.5   | 17.2  | 485.2   | 36.5   | 104.2 | 12.3       | 2,822.7   | 45.5     | 512.5    | 72.2  | 941.7   | 18.4  | 546.0 | 62.4  | 247.9   | 29.7    | 194.6 | 43.6  | 8,410.3    |
| > 100                   | 233.5   | 3.4   | 55.2  | 6.7   | 137.1   | 2.5   | -       | -      | 19.5  | 2.3        | 321.9     | 5.2      | -        | -     | 200.3   | 3.9   | 4.0   | 0.5   | 42.8    | 5.1     | 11.6  | 2.6   | 1,025.9    |
| Total                   | 6,966.1 | 100.0 | 820.6 | 100.0 | 5,425.4 | 100.0 | 1,327.7 | 100.0  | 844.9 | 100.0      | 6,205.3   | 100.0    | 710.3    | 100.0 | 5,122.3 | 100.0 | 874.6 | 100.0 | 834.6   | 100.0   | 446.0 | 100.0 | 29,577.8   |















Plate – XVI represents depth to bed rock distribution below ground level. A perusal of map reveals that in general, the depth to bedrock in the basin is very shallow being encountered at a depth of less than 40m bgl indicating limited thickness of weathered/fractured material or alluvial cover present in the basin in order to form promising aquifers. The bedrock is deepest in the northeastern edge of the basin around Dhaulpur where depths of >60m bgl are seen reaching up to even 100m bgl.

| Donth to Rodrock |         |          |         | [            | District wise | area cover | age (sq kı | m)      |            |                   |       | Total Area |
|------------------|---------|----------|---------|--------------|---------------|------------|------------|---------|------------|-------------------|-------|------------|
| (m bgl)          | Baran   | Bhilwara | Bundi   | Chittaurgarh | Dhaulpur      | Jhalawar   | Karauli    | Kota    | Pratapgarh | Sawai<br>Madhopur | Tonk  | (sq km)    |
| < 20             | 4,792.1 | 396.9    | 3,293.5 | 871.7        | -             | 4,352.2    | 70.3       | 3,290.1 | 106.2      | -                 | 188.3 | 17,361.3   |
| 20-40            | 2,145.5 | 350.9    | 1,968.5 | 259.5        | 3.7           | 1,756.1    | 474.4      | 1,832.2 | 768.4      | 802.9             | 257.3 | 10,619.4   |
| 40-60            | 28.5    | 57.2     | 163.4   | 196.5        | 394.5         | 97.0       | 165.6      | -       | -          | 31.7              | 0.4   | 1,134.8    |
| 60-80            | -       | 15.6     | -       | -            | 273.2         | -          | -          | -       | -          | -                 | -     | 288.8      |
| 80-100           | -       | -        | -       | -            | 102.0         | -          | -          | -       | -          | -                 | -     | 102.0      |
| > 100            | -       | -        | -       | -            | 71.5          | -          | -          | -       | -          | -                 | -     | 71.5       |
| Total            | 6,966.1 | 820.6    | 5,425.4 | 1,327.7      | 844.9         | 6,205.3    | 710.3      | 5,122.3 | 874.6      | 834.6             | 446.0 | 29,577.8   |

#### **UNCONFINED AQUIFER**

Hydrogeological properties are different for alluvial and hard rock aquifers and therefore, this aquifer has been mapped as two separate regions viz, unconfined aquifers in alluvial and in hard rock areas. Good aquifer thickness is seen in Bundi, Kota and Dhaulpur districts whereas the rest of the districts largely do not have any significant alluvial aquifers. In hardrock areas however, the weathered/fractured zone is widespread and forms aquifers in the basin as seen by good thicknesses of 20-70m is seen in Bhilwara, Bundi, Dhaulpur, Jhalawar and Karauli.

#### Alluvial areas

| District Name  | District wise area<br>Aquifer thickne | (sq km) within<br>ss range (m) | Total Area |
|----------------|---------------------------------------|--------------------------------|------------|
|                | < 10                                  | 10-20                          |            |
| Baran          | 326.9                                 | -                              | 326.9      |
| Bhilwara       | -                                     | -                              | -          |
| Bundi          | 747.4                                 | 516.4                          | 1,263.8    |
| Chittaurgarh   | -                                     | -                              | -          |
| Dhaulpur       | 446.6                                 | 102.7                          | 549.3      |
| Jhalawar       | -                                     | -                              | -          |
| Karauli        | 142.8                                 | -                              | 142.8      |
| Kota           | 1,342.4                               | 206.9                          | 1,549.3    |
| Pratapgarh     | -                                     | -                              | -          |
| Sawai Madhopur | 192.7                                 | 14.9                           | 207.6      |
| Tonk           | -                                     | 20.3                           | 20.3       |
| Total          | 3,198.8                               | 861.2                          | 4,060.0    |

#### Hardrock areas:

|                   |          | District w | vise area ( | sq km) v | within A | quifer t | hickness | range ( | m)    |      | Total Area |
|-------------------|----------|------------|-------------|----------|----------|----------|----------|---------|-------|------|------------|
| District Name     | <10      | 10-20      | 20-30       | 30-40    | 40-50    | 50-60    | 60-70    | 70-80   | 80-90 | > 90 | (sq km)    |
| Baran             | 6,498.9  | 140.3      | -           | -        | -        | -        | -        | -       | -     | -    | 6,639.2    |
| Bhilwara          | 277.4    | 245.4      | 123.6       | 78.4     | 57.6     | 33.9     | 4.3      | -       | -     | -    | 820.6      |
| Bundi             | 3,039.1  | 777.6      | 241.0       | 88.5     | 15.4     | -        | -        | -       | -     | -    | 4,161.6    |
| Chittaur-garh     | 1,092.8  | 234.0      | 0.9         | -        | -        | -        | -        | -       | -     | -    | 1,327.7    |
| Dhaulpur          | -        | -          | -           | 44.8     | 134.9    | 48.5     | 29.5     | 23.4    | 14.5  | -    | 295.6      |
| Jhalawar          | 4,031.3  | 1,126.7    | 683.0       | 245.4    | 72.5     | 44.1     | 2.3      | -       | -     | -    | 6,205.3    |
| Karauli           | -        | 451.8      | 68.8        | 13.2     | 24.8     | 8.9      | -        | -       | -     | -    | 567.5      |
| Kota              | 3,570.8  | 2.2        | -           | -        | -        | -        | -        | -       | -     | -    | 3,573.0    |
| Pratapgarh        | 718.2    | 146.6      | 9.8         | -        | -        | -        | -        | -       | -     | -    | 874.6      |
| Sawai<br>Madhopur | 506.4    | 110.6      | 10.0        | -        | -        | -        | -        | -       | -     | -    | 627.0      |
| Tonk              | 277.3    | 121.0      | 18.5        | 7.7      | 1.2      | -        | -        | -       | -     | -    | 425.7      |
| Total             | 20,012.2 | 3,356.2    | 1,155.6     | 478.0    | 306.4    | 135.4    | 36.1     | 23.4    | 14.5  | -    | 25,517.8   |













## **CROSS SECTIONS**



#### **CHAMBAL RIVER BASIN**

Several hydrogeologic cross sections have been drawn to better depict the sub-surface distribution of lithology. These sections have been overlaid with geological maps and structural faults if there are any have been transferred for verification of their impact on sub-surface material disposition. The alignment of the cross sections is shown in Plate – XVIII and corresponding sections are presented in Plates – XIX to XXIII. The broad alignment of the sections is as given below:

| Name of Section Line | Orientation  |
|----------------------|--------------|
| Section AA'          | NW – SE      |
| Section BB'          | NW – SE      |
| Section CC'          | SW – NE      |
| Section DD'          | NW – SE      |
| Section EE'          | NW – SE – NE |













## **CROSS SECTIONS**



#### **CHAMBAL RIVER BASIN**

#### Section A-A':

The A-A' section (Plate – XIX) trends in NW-SE direction stretching to a distance of about 175 kms. The section depicts the disposition of different layers of sand, clay, limestone along with basalt. The lithologs of 8 boreholes along with surrounding well information is taken while preparing the section. On perusal of the cross section, it is revealed that while the southeastern part of the basin subsurface is predominantly Basaltic in nature, central part is dominated by Shales and west by Sandstones of Vindhyan period.

The water level varies from 290m amsl to 360m amsl following the surface topography as observed from the 2010 pre monsoon season.

#### Section B-B':

The B-B' (Plate – XX) section is has been chosen to represent a NW-SE profile and covers a length of about 225km, perpendicular to the Chambal river flow direction. The lithologs of 6 boreholes along with surrounding well information is taken while preparing the section. In the central part of the section where Chambal river is intersected, about 30m of alluvial material is deposited. At 50 km of the profile a fault i.e., Great Boundary Fault (F) is present that separates phyllites to its west from Vindhyan shales and sandstones to its east.

Ground water level varies from 225m amsl to 325m amsl in this profile.















#### Section C-C':

The C-C' (Plate – XXI) section has been selected across the basin trending SW-NE, for a distance of about 150 km in the western part of the basin. The lithologs of 6 boreholes along with surrounding well information is taken while preparing the section. Roughly in the middle of the section a fault is seen which actually is the Great Boundary Fault (F) and cuts across the section. To the west of this fault, phyllites are present in the subsurface whereas in the east of the fault, Vindhyan shales and sandstones are present. Within the Vindhyans, the Chambal river flows and alluvial clay is deposited alongside the river to further east.

The ground water level in this section varies from 175m amsl to 320m amsl.

#### Section D-D':

The section D-D' (Plate – XXII) is the longest of the sections plotted in the area and cover a length of 325 km trending in SW-NE direction. The lithologs of 5 boreholes along with surrounding well information is taken into consideration while preparing the section. Basalt is predominant in the 0-200 km length of the section while 200 to 325 km stretch depicts mainly the alternating layers of shale and sandstone of Vindhyan period in the sub-surface.

Ground water level varies from 325m amsl to 500m amsl in this section.













## **CROSS SECTIONS**



#### **CHAMBAL RIVER BASIN**

#### Section E-E':

The E-E' section (Plate – XXIII) is the second largest section plotted in the area, covering a length of 300 km that initially trends in NW-SE and later turns NE. The lithologs of 8 boreholes along with surrounding well information is taken while preparing the section. Vindhyan Super Group rocks of Shale intercalated with sandstone are present in the sub-surface overlain by thin cover of top soil. Two tentative faults apparently separate the central Basaltic intrusive deposits with surrounding Vindhyans.

Ground water level in this section varies from 300 m amsl to 400 m amsl.













## **3D MODEL OF AQUIFERS**



#### **CHAMBAL RIVER BASIN**

The continuous litho-stratigraphic model has been developed using Rockworks software for the Chambal river basin using interpolation techniques on the data of scattered wells given as an input.

The (Plate – XXIV) presents the 3D model depicting the various litho-stratigraphic units in the entire river basin. With this model it is apparent that beneath the top soil there is a persistent weathered and fractured hard rock material is present that acts as unconfined aquifer. The limestone aquifer is found overlain by basalt in the southern part of the basin. The sandstone formation is present in the south eastern part of the basin is overlain by basalt and underlain by shale formation. Phyllite is present all over the basin as a continuous formation is overlain by limestone in the south and shale in the east and basalt in rest of the area.















## **Glossary of terms**

| S. No. | Technical Terms     | Definition   |
|--------|---------------------|--|
| 1      |                     | A saturated geological formation which has good permeability to      |
| 1      | AQUIFER             | supply sufficient quantity of water to a Tube well, well or spring.  |
| 2      | ARID CLIMATE        | Climate characterized by high evaporation and low precipitation.     |
| 3      | ARTIFICIAL RECHARGE | Addition of water to a groundwater reservoir by man-made activity    |
|        |                     | The sum total of all atmospheric or meteorological influences        |
| 4      | CLIMATE             | principally temperature, moisture, wind, pressure and evaporation    |
|        |                     | of a region.   |
| -      |                     | A water bearing strata having confined impermeable overburden. In    |
| 5      | CONFINED AQUIFER    | this aquifer, water level represents the piezometric head.           |
| 6      | CONTANANATION       | Introduction of undesirable substance, normally not found in water,  |
| 6      | CONTAMINATION       | which renders the water unfit for its intended use.                  |
| 7      | DRAWDOWN            | The drawdown is the depth by which water level is lowered.           |
| 8      | FRESH WATER         | Water suitable for drinking purpose.                                 |
| 9      | GROUND WATER        | Water found below the land surface.                                  |
| 10     |                     | A hydro-geologic unit containing one large aquifer or several        |
| 10     | GROUND WATER BASIN  | connected and interrelated aquifers.                                 |
|        | GROUNDWATER         | The natural infiltration of surface water into the ground.           |
| 11     | RECHARGE            |  |
| 12     | HARD WATER          | The water which does not produce sufficient foam with soap.          |
|        | HYDRAULIC           | A constant that serves as a measure of permeability of porous        |
| 13     | CONDUCTIVITY        | medium.  |
| 14     | HYDROGEOLOGY        | The science related with the ground water.                           |
| 15     | HUMID CLIMATE       | The area having high moisture content.                               |
| 16     | ISOHYET             | A line of equal amount of rainfall.                                  |
| 17     | METEOROLOGY         | Science of the atmosphere.   |
| 18     | PERCOLATION         | It is flow through a porous substance.                               |
| 19     | PERMEABILITY        | The property or capacity of a soil or rock for transmitting water.   |
|        |                     | Value of hydrogen-ion concentration in water. Used as an indicator   |
| 20     | рН                  | of acidity ( $pH < 7$ ) or alkalinity ( $pH > 7$ ).                  |
| 21     | PIEZOMETRIC HEAD    | Elevation to which water will rise in a piezometers.                 |
|        |                     | It is a natural or artificial process by which water is added from   |
| 22     | RECHARGE            | outside to the aquifer.  |
|        |                     | Amount of water which can be extracted from groundwater without      |
| 23     | SAFE YIELD          | producing undesirable effect.  |
| 24     | SALINITY            | Concentration of dissolved salts.                                    |
|        |                     | An area is considered semiarid having annual rainfall between 10-20  |
| 25     | SEMI-ARID           | inches.  |
|        | SEMI-CONFINED       | Aguifer overlain and/or underlain by a relatively thin semi-pervious |
| 26     | AQUIFER             | laver.   |
|        |                     | Quantity of water which is released by a formation after its         |
| 27     | SPECIFIC YIELD      | complete saturation.   |
|        | TOTAL DISSOLVED     | Total weight of dissolved mineral constituents in water per unit     |
| 28     | SOLIDS              | volume (or weight) of water in the sample.                           |
| L      |                     |  |

| S. No. | Technical Terms    | Definition   |
|--------|--------------------|--|
|        |                    | It is defined as the rate of flow through an aquifer of unit width and |
| 29     | TRANSMISSIBILITY   | total saturation depth under unit hydraulic gradient. It is equal to   |
|        |                    | product of full saturation depth of aquifer and its coefficient of     |
|        |                    | permeability.  |
| 30     | UNCONFINED AQUIFER | water table forms the upper boundary of the aquifer.                   |
|        |                    | The zone below the land surface in which pore space contains both      |
| 31     | UNSATURATED ZONE   | water and air.   |
| 32     | WATER CONSERVATION | Optimal use and proper storage of water.                               |
| 33     | WATER RESOURCES    | Availability of surface and ground water.                              |
| 34     | WATER RESOURCES    | Planned development, distribution and use of water resources.          |
|        | MANAGEMENT         |  |
| 35     | WATER TABLE        | Water table is the upper surface of the zone of saturation at          |
| 26     |                    | atmospheric pressure.  |
| 30     |                    | The ground in which all pores are completely filled with water.        |
| 37     |                    | Flow of free ions in the water at 25c mu/cm.                           |
|        |                    | A Vertical Projection showing sub-surface formations encountered in    |
| 38     | CROSS SECTION      | a specific plane.  |
| 20     |                    | A structure showing all three dimensions i.e. length, width and        |
| 39     | 3-D PICTURE        | depth.   |
| 40     | GWD                | Ground Water Department  |
| 41     | CGWB               | Central Ground Water Board   |
| 42     | CGWA               | Central Ground Water Authority   |
| 43     | SWRPD              | State Water Resources Planning Department                              |
| 44     | EU-SPP             | European Union State Partnership Programme                             |
| 45     | TOPOGRAPHY         | Details of drainage lines and physical features of land surface on a   |
| 46     | GEOLOGY            | Map.<br>The science related with the Farth                             |
| 40     | GEOMORPHOLOGY      | The description and interpretation of land forms                       |
|        |                    | Monitoring of Ground Water level from the selected                     |
| 48     | PRE MONSOON SURVEY | DKW/Piezometer before Monsoon (carried out between 15th May            |
|        |                    | to 15th June)  |
|        |                    | Monitoring of Ground Water level from the selected                     |
| 49     |                    | DKW/Piezometer after Monsoon (carried out between 15th                 |
|        | JURVET             | October to 15th November)  |
| 50     | PIFZOMETER         | A non-pumping small diameter bore hole used for monitoring of          |
|        |                    | static water level.  |
| 51     | GROUND WATER       | Change in static water level below ground level.                       |
| 52     |                    | The static water level found in water fined any ifer                   |
| 52     |                    | Hard & compact rock opcountered below land Surface                     |
| 55     |                    | Dug wells selected on grid basis for monitoring of state water level   |
| 54     | STATION            | bug wens selected on grid basis for monitoring of state water level.   |
| 55     | EOLIAN DEPOSITS    | Wind-blown sand deposits   |

(Contd...)













A A A KAR KAR AN AN

| S No | Myths   | Facts   |
|------|---|---|
| 1    | What is Ground Water  | Water which occurs below the land in geological   |
|      | an underground lake   | formations/rocks is Ground water  |
|      | <ul> <li>a net work of underground rivers</li> </ul>                                    |   |
|      | <ul> <li>a bowl filled with water</li> </ul>  |   |
| 2    | Ground Water occurs everywhere beneath the Land Surface                                 | Not really, it depends on the nature of rock formation  |
| 3    | There is a relationship between ground water<br>and surface water                       | Not all the places. Near streams/rivers there is relation   |
| 4    | Groundwater is not renewable resource   | It is renewable source and every year it is being recharged<br>through rain/applied irrigation etc  |
| 5    | Ground water is unlimited and deeper you drill more discharge                           | It is limited to annual recharge from rain/applied irrigation.<br>The discharge may not increase if you go deeper   |
| 6    | Ground Water moves rapidly  | The movement of ground water is very slow   |
| 7    | Ground water pumped from wells is thousands of years old                                | Generally the ground water being tapped through wells is a few years old  |
| 8    | If water taste good—it is safe to drink   | It may have other chemicals e.g. fluoride, nitrates etc which are harmful   |
| 9    | Water from free flowing tube wells is very<br>pure                                      | This water can also be contaminated so test before use  |
| 10   | If I recharge my TW/DW/HP it will not benefit<br>me                                     | It will also benefit you and also adjoing wells   |
| 11   | There is no static ground water resources in Rajasthan                                  | Rajasthan is also having Static GW resources, and being<br>tapped in most of areas as GW annual withdrawal is more<br>than annual recharge  |
| 12   | I cannot meet annual cooking and drinking<br>water requirement by rain water harvesting | The water requirement for drinking and cooking is only 8<br>lit/day. You can harvest this water for family of 5 persons<br>from roof top or paved area of 75 Sq m to meet annual<br>requirement |
| 13   | You can increase ground water recharge  | This can be done by harvesting the rain water and storing<br>in sub surface reservoir (GW) by constructing the recharge<br>structures   |
| 14   | You cannot use abandoned TW/HP/DW for ground water recharge                             | These should be used as recharge structures as harvested<br>rain water is directly put into GW reservoir  |
| 15   | Putting waste near HP/TW will not cause any problem                                     | Such actions will pollute wells and water   |

11

-



**Rolta India Limited** 

Central & Registered Office Rolta Tower A, Rolta Technology Park, MIDC, Andheri (East), Mumbai - 400 093 Tel : +91 (22) 2926 6666, 3087 6543 Fax : +91 (22) 2836 5992 Email : indsales@rolta.com

www.rolta.com

.