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भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga Rejuvenation

Government of India

**Report**

**on**

# AQUIFER MAPPING AND MANAGEMENT PLAN

## Gurdaspur District, Punjab

उत्तरी पश्चिम क्षेत्र, चंडीगढ़

North Western Region, Chandigarh


# AQUIFER MAPPING

# &

# MANAGEMENT PLAN

# GURDASPUR DISTRICT

# PUNJAB

**Central Ground Water Board**
**Ministry of Water Resources, River Development and Ganga Rejuvenation**
**Government of India**
**2016**

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# AQUIFER MAPPING AND GROUND WATER MANAGEMENT IN GURDASPUR & PATHANKOT DISTRICT, PUNJAB

**(3513 Sq.Km UNDER NAQUIFERUIM XII PLAN)**

## 1.0 INTRODUCTION

There has been a paradigm shift from "groundwater development" to "groundwater management" in the past two decades in the country. An accurate and comprehensive micro-level picture of ground water through Aquifer mapping in different hydrogeological settings would enable robust groundwater management plans in an appropriate scale. Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical field and laboratory analyses are applied to characterize the quantity, quality and sustainability of ground water in Aquifers. This would help achieving drinking water security, improved irrigation facility and sustainability in water resources development in large parts of rural India, and many parts of urban India.

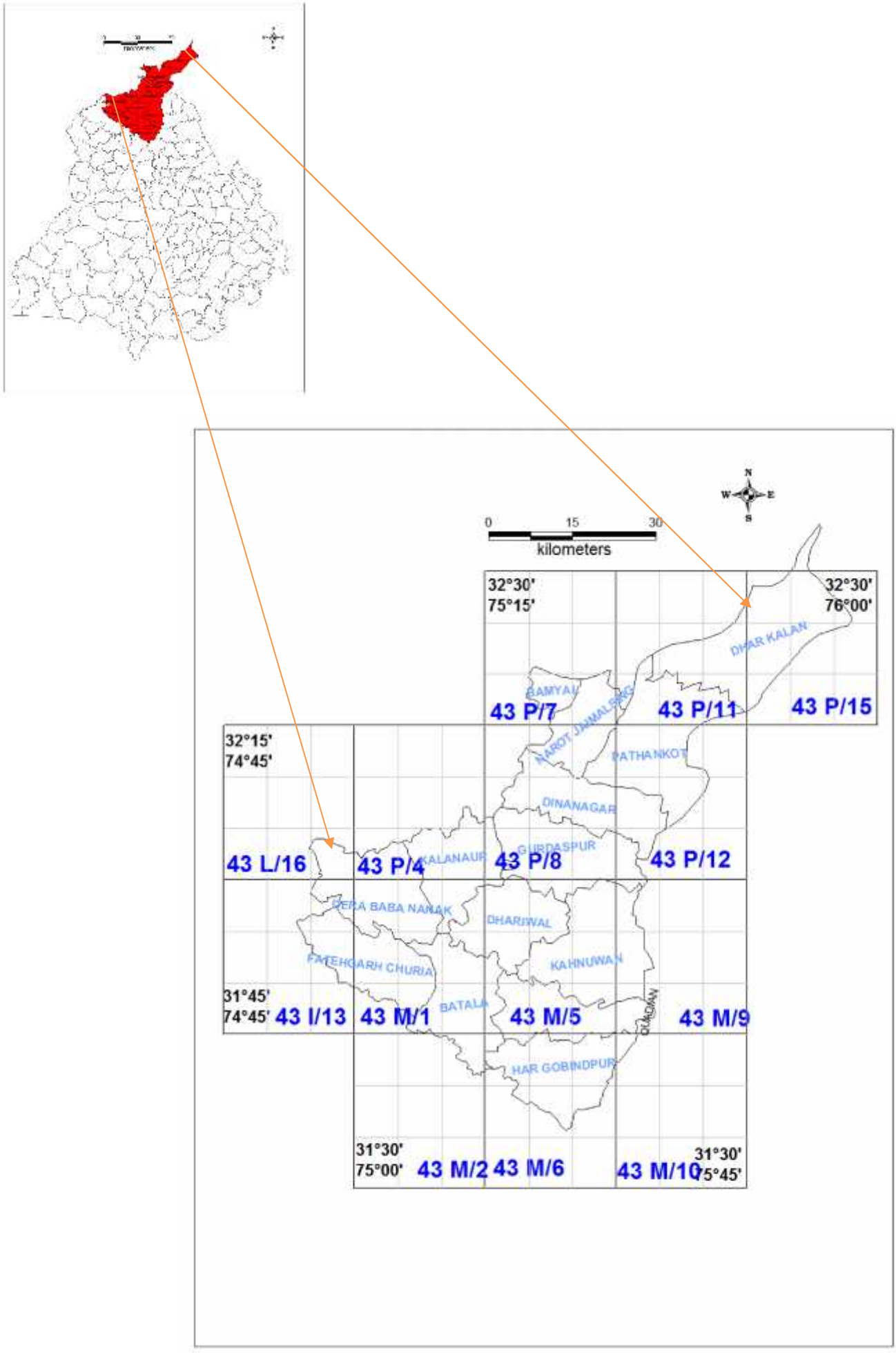
Central Ground Water Board (CGWB) implemented the Aquifer Mapping Programme in Punjab in four phases (**Fig. 1**) with the broad objective of preparing an Aquifer-wise management plan for the region. Various multi–disciplinary geo-scientific activities were undertaken in the study partly through in-house capacity of CGWB,DWRS,PSCTC and Private agencies for generation of additional micro-level hydrogeological data. This report primarily deals with Gurdaspur and Pathankot district of Punjab State (**Fig. 1**), covered under Phase-I.

The nature and character of sediments, their lateral and vertical extent and Aquifer system have been studied with the help of sub-surface geological sections prepared from the litho logs of the boreholes drilled in the Gurdaspur and Pathankot districts.The Upper Siwalik comprises boulders, cobbles and pebbles inter-bedded with buff to reddish brown clay. These are followed by finer sediments of 'Sirowal' comprising gravel, sand, silt and clay. The contact between Kandi and Sirowal was marked by presence of spring line, which has disappeared due to the declining of water levels. Depth to water level in the district ranges from 1.91 to 9.54 m (bgl) during pre-monsoon period and between 1.64 to 9.00 m bgl during post monsoon period in Pathankot District and 2.39 to 19.51 m below

ground level (bgl) during pre-monsoon period and between 2.50 to 19.46 m bgl during post monsoon period in Gurdaspur district respectively. Alluvium is expected to be more than 450 m as bedrock has not been encountered up to depth. The quality of ground water in both the district is fresh.

Central Ground Water Board has drilled 21ground water exploratory wells in the depth range of 84 to 375m and wells were constructed in the depth range of 74 to 355m bgl. The discharge ranges from 9731 lpm to 4300 lpm with a drawdown of 6 to 16.25m. At Chaunta free flowing conditions were encountered and free flow of 2105 lpm was recorded. The depth of exploratory boreholes Transmissivity of the Aquifers ranged from 142 $m^2$/day to 7720 $m^2$/day. The hydraulic conductivity values varied from 4.6 to 134m/day. The value of storage coefficient worked out to be $1.0 \times 10^{-3}$ to $4.03 \times 10^{-4}$

**Fig 1: Base Map of Gurdaspur & Pathankot Districts**



## 2. DATA COLLECTION AND GENERATION

### 2.1 Tube well Logs

The Lithologs of Exploratory Well/ Observation well/ Piezometer/ productive well s of CGWB, Punjab State Tubewell Corporation (PSTC) now as Punjab Water Resources Development and Management (PWRDM) and private wells have been collected and those supported electrical logs have been validate for Aquifer map preparation. The details are shown in table

Table 2. Data Availability of Exploration Wells of Pathankot & Gurdaspur districts

**PATHANKOT DISTRICT**

| Sl.No | Source of data | Depth Range (m) | | | |
|---|---|---|---|---|---|
| | | **< 100** | **100-200** | **200-300** | **>300** |
| 1 | CGWB | 6 | 1 | 0 | 1 |
| 2 | WR&ED | 4 | 0 | 0 | 0 |
| 3 | PRIVATE | 0 | 5 | 0 | 0 |
| **Total** | | **10** | **6** | **0** | **1** |

**GURDASPUR DISTRICT**

| Sl.No | Source of data | Depth Range (m) | | | |
|---|---|---|---|---|---|
| | | **< 100** | **100-200** | **200-300** | **>300** |
| 1 | CGWB | 1 | 0 | 3 | 8 |
| 2 | WR&ED | 0 | 11 | 2 | 0 |
| 3 | PRIVATE | 3 | 40 | 0 | 0 |
| **Total** | | **4** | **51** | **5** | **8** |

### 2.2 Ground Water Quality

The ground water in the district is alkaline in nature with low mineralization. The pH value ranges from 7.77 to 8.25 indicating a weak base type characteristic. Specific Conductance, a measure of total dissolved solids present in water, ranges from 235 to 1640 micromhos/cm at $25^0$C. The fluoride concentration in the entire district is within the permissible limit of 1.5 mg/L for drinking water as per BIS and it ranges from 0.12 to 1.16 mg/L. In general, Nitrate values are below the permissible limit with an exception at two villages, i.e. Batala (138 mg/L) and Kalanaur (146 mg/L). Iron, the essential for plant and animal growth, is below 1.0 mg/L in the entire area. Arsenic concentration above the prescribed BIS 2011 permissible limit of 0.01 mg/L is found in well waters located at Nishayra (0.015 mg/L), Behrampur (0.0113 mg/L), Galri (0.0201 mg/L) and Sri Hargobindpur (0.010 mg/L).

| S. No | Location | Block | District | Latitude | Longitude | Type of Well | As in mg/l | Fe in mg/l |
|---|---|---|---|---|---|---|---|---|
| 1 | Madipur | Fatehgarh Chudian | Gurdaspur | 31.8279 | 74.9423 | Dugwell | 0.017 | 0.1988 |
| 2 | Mullowali | Dere Baba Nanak | Gurdaspur | 31.9908 | 75.0075 | Tubewell | 0.027 | 1.0238 |
| 3 | Dera Baba Nanak | Dere Baba Nanak | Gurdaspur | 32.0333 | 75.0321 | Handpump | 0.001 | 2.9022 |
| 4 | Salehchak | Kalanam | Gurdaspur | 32.0486 | 75.1808 | Tubewell | 0.021 | 0.1539 |
| 5 | Kalanam | Kalanam | Gurdaspur | 32.0146 | 75.1478 | Handpump | 0.004 | 0.0247 |
| 6 | Bhagowal | Dhariwal | Gurdaspur | 31.9040 | 75.1683 | Tubewell | 0.005 | 0.0348 |
| 7 | Dhianpur | Dere Baba Nanak | Gurdaspur | 31.9225 | 75.0703 | Handpump | 0.003 | 0.9503 |
| 8 | Ghaniyake Banger | Fatehgarh Chudian | Gurdaspur | 31.8621 | 75.0583 | Handpump | 0.002 | 0.0882 |
| 9 | Dakoha | Sree Hargobindpur | Gurdaspur | 31.6578 | 75.3774 | Handpump | 0.001 | 2.0563 |
| 10 | Sri Hargobindpur | Sree Hargobindpur | Gurdaspur | 31.6877 | 75.4740 | Dugwell | 0.001 | 0.0301 |
| 11 | Bham | Sree Hargobindpur | Gurdaspur | 31.7598 | 75.4507 | Tubewell | 0.001 | BDL |
| 12 | Aulakhkalan | Qaddian | Gurdaspur | 31.7869 | 75.4866 | Handpump | 0.001 | 3.48 |
| 13 | Qaddian | Qaddian | Gurdaspur | 31.8255 | 75.3885 | Handpump | BDL | 0.4031 |
| 14 | Sathiali | Kahnuwal | Gurdaspur | 31.8839 | 75.4250 | Tubewell | BDL | 0.003 |
| 15 | Naushera | Dhariwal | Gurdaspur | 31.8866 | 75.2733 | Handpump | 0.001 | 0.0526 |
| 16 | Gurdaspur | Gurdaspur | Gurdaspur | 32.0334 | 75.3956 | Handpump | 0.002 | 0.2731 |
| 17 | Pandori Dham | Dina Nagar | Gurdaspur | 32.0572 | 75.5030 | Dugwell | 0.008 | 0.219 |
| 18 | Galri | Dina Nagar | Gurdaspur | 32.1260 | 75.3292 | Dugwell | 0.008 | 2.4525 |
| 19 | Dina Nagar | Dina Nagar | Gurdaspur | 32.1439 | 75.4734 | Handpump | 0.001 | 1.9549 |

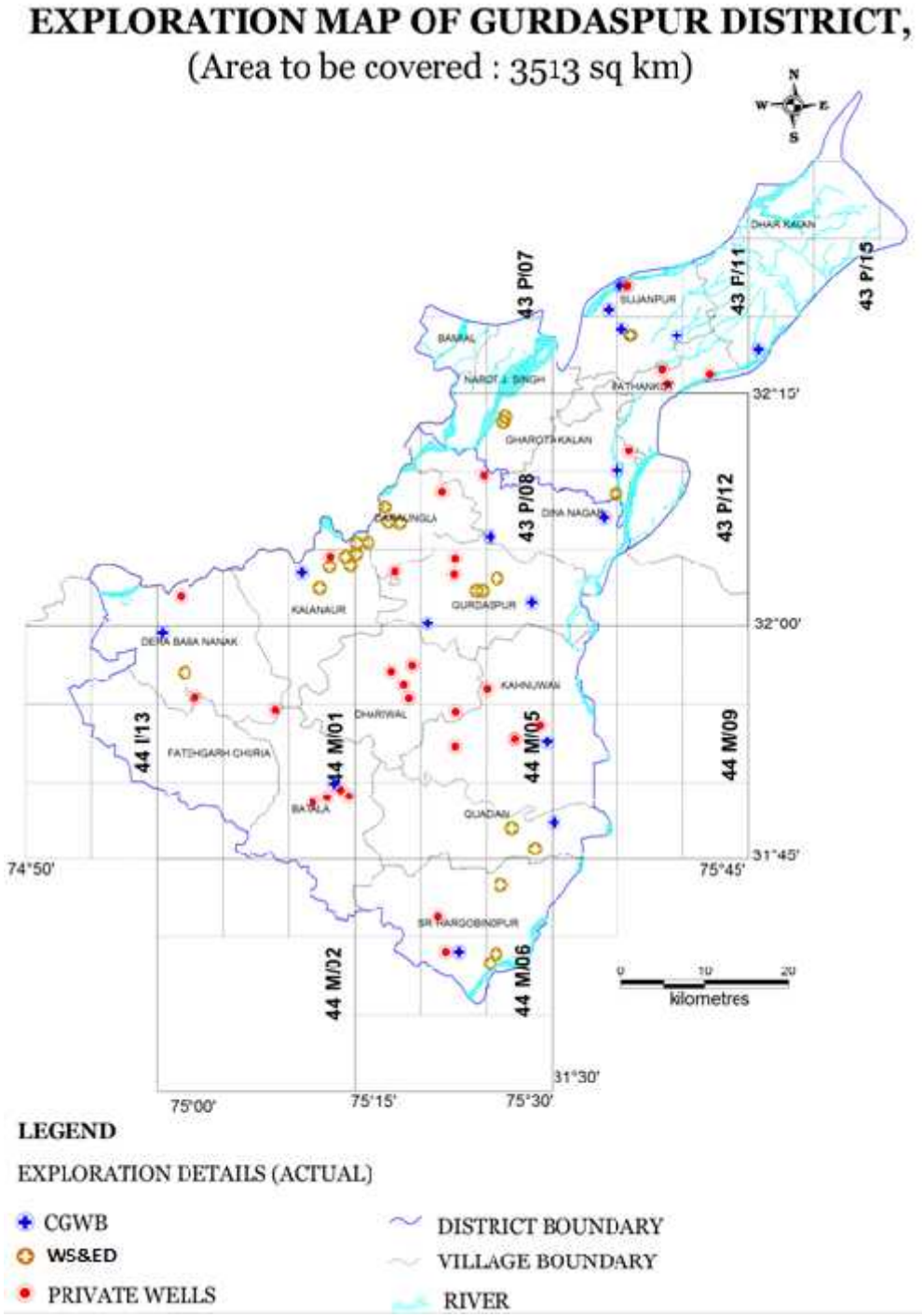
| S. No | District | Block | Location | **Latitude** | **Longitude** | **pH** | **EC in** | **$CO_3$** | **$HCO_3$** | **Cl** | **$SO_4$** | **$NO_3$** | **F** | **$PO_4$** | **Ca** | **Mg** | **Na** | **K** | **$SiO_2$** | **T.H** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Gurdaspur | Dere Baba Nanak | Mullowali | 31.9908 | 75.0075 | 7.97 | 608 | nil | 349 | 30 | BDL | BDL | 0.28 | BDL | 50 | 20 | 59 | 4.9 | 20 | 248 |
| 2 | Gurdaspur | Dere Baba Nanak | Dera Baba Nanak | 32.0333 | 75.0321 | 7.8 | 1602 | nil | 490 | 135 | 170 | 45 | 0.29 | BDL | 69 | 50 | 177 | 9.3 | 15 | 214 |
| 3 | Gurdaspur | Dere Baba Nanak | Dhianpur | 31.9225 | 75.0703 | 8.48 | 1106 | 46 | 289 | 117 | 130 | 61 | 0.23 | BDL | 25 | 27 | 162 | 99 | 30 | 158 |
| 4 | Gurdaspur | Dhariwal | Bhagowal | 31.9040 | 75.1683 | 8.28 | 421 | nil | 171 | 11 | 72 | 2.7 | 0.38 | BDL | 46 | 19 | 12 | 6.4 | 21 | 281 |
| 5 | Gurdaspur | Dhariwal | Naushera | 31.8866 | 75.2733 | 8.58 | 215 | 10 | 117 | 7.0 | BDL | 4.0 | 0.79 | BDL | 26 | 10 | 6.5 | 2.3 | 16 | 378 |
| 6 | Gurdaspur | Dina Nagar | Pandori Dham | 32.0572 | 75.5030 | 8.78 | 641 | 26 | 195 | 32 | 19 | 90 | 0.21 | 2.15 | 79 | 19 | 19 | 21 | 33 | 347 |
| 7 | Gurdaspur | Dina Nagar | Galri | 32.1260 | 75.3292 | 8.48 | 511 | 26 | 238 | 28 | 12 | 4.0 | 0.21 | BDL | 35 | 30 | 32 | 1.5 | 15 | 191 |
| 8 | Gurdaspur | Dina Nagar | Dina Nagar | 32.1439 | 75.4734 | 8.29 | 912 | nil | 359 | 92 | 40 | 37 | 0.41 | BDL | 46 | 53 | 84 | 0.8 | 17 | 174 |
| 9 | Gurdaspur | Fatehgarh Chudian | Madipur | 31.8279 | 74.9423 | 7.76 | 697 | nil | 403 | 23 | BDL | 2.7 | 0.32 | BDL | 55 | 16 | 78 | 7.3 | 22 | 128 |
| 10 | Gurdaspur | Fatehgarh Chudian | Ghaniyake Banger | 31.8621 | 75.0583 | 8.29 | 1094 | nil | 517 | 117 | BDL | 17 | 0.3 | BDL | 33 | 50 | 122 | 60 | 22 | 202 |
| 11 | Gurdaspur | Gurdaspur | Gurdaspur | 32.0334 | 75.3956 | 8.38 | 707 | 20 | 188 | 83 | 70 | 28 | 0.21 | BDL | 42 | 44 | 49 | 1.6 | 17 | 89 |
| 12 | Gurdaspur | Kahnuwal | Sathiali | 31.8839 | 75.4250 | 8.69 | 300 | 20 | 128 | 11 | 7.0 | 16 | 0.33 | BDL | 25 | 19 | 11 | 2.4 | 22 | 207 |
| 13 | Gurdaspur | Kalanam | Salehchak | 32.0486 | 75.1808 | 8.49 | 322 | 20 | 164 | 7 | BDL | BDL | 0.29 | BDL | 26 | 6.2 | 38 | 2.5 | 18 | 20 |
| 14 | Gurdaspur | Kalanam | Kalanam | 32.0146 | 75.1478 | 8.41 | 2096 | 46 | 282 | 255 | 175 | 259 | 0.21 | BDL | 37 | 62 | 213 | 209 | 22 | 117 |
| 15 | Gurdaspur | Qaddian | Aulakhkalan | 31.7869 | 75.4866 | 7.95 | 569 | nil | 376 | 9.0 | BDL | 22 | 0.21 | BDL | 81 | 25 | 15 | 3 | 23 | 248 |
| 16 | Gurdaspur | Qaddian | Qaddian | 31.8255 | 75.3885 | 8.11 | 356 | nil | 235 | 7.0 | BDL | 13 | 0.39 | BDL | 42 | 16 | 16 | 1.3 | 19 | 97 |
| 17 | Gurdaspur | Sree Hargobindpur | Dakoha | 31.6578 | 75.3774 | 8.17 | 494 | nil | 225 | 28 | BDL | 41 | 0.1 | BDL | 52 | 19 | 24 | 5.7 | 29 | 276 |
| 18 | Gurdaspur | Sree Hargobindpur | Sri Hargobindpur | 31.6877 | 75.4740 | 8.45 | 430 | 17 | 128 | 25 | 6.0 | 53 | 0.35 | BDL | 38 | 19 | 19 | 4.6 | 26 | 311 |
| 19 | Gurdaspur | Sree Hargobindpur | Bham | 31.7598 | 75.4507 | 8.12 | 406 | nil | 255 | 11 | BDL | 15 | 0.34 | BDL | 47 | 21 | 13 | 5.1 | 21 | 202 |

## 2.3 SPATIAL DATA DISTRIBUTION

### Data Distribution

The actual data of all the wells in the area are plotted on the map of 1:50000 scale with 5' x 5' grid (9km x 9km) and is shown in Fig: 9.The exploration data shows that majority of tube wells falls in the $I^{st}$ Aquifer and $II^{nd}$ Aquifer. After data validation, only selected the deepest well in each quadrant is plotted on the map of 1.50000 scale with 5' x 5' grid (9km x 9km) and is shown in Fig:10. The grids devoid of SH/PZ/EW are identified as data gaps and these are to be filled by data generation.

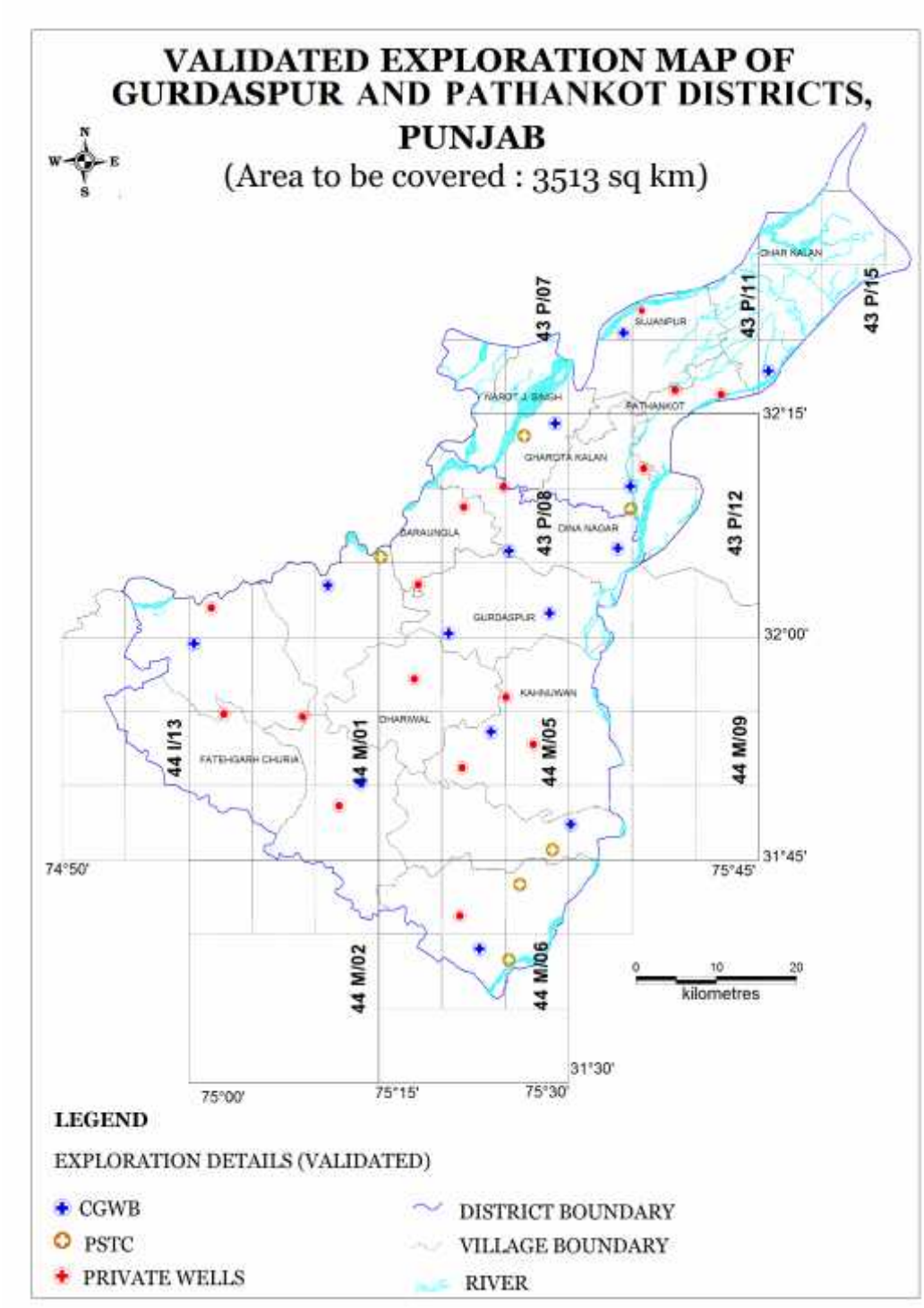
**Fig-2 Location of Exploratory Bore Holes**



## 2.4 DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING

All the available data have been validated for consideration to generate Aquifer map. The deepest well in each quadrant is selected and plotted on the map of 1.50000 scale with 5'X5'grid (9 x 9km) and is shown in Fig -3.

**Fig 3: Validated Exploration Data of Gurdaspur District**



The topographic elevation values have been plotted to prepare the elevation contour map and is in fig 4.

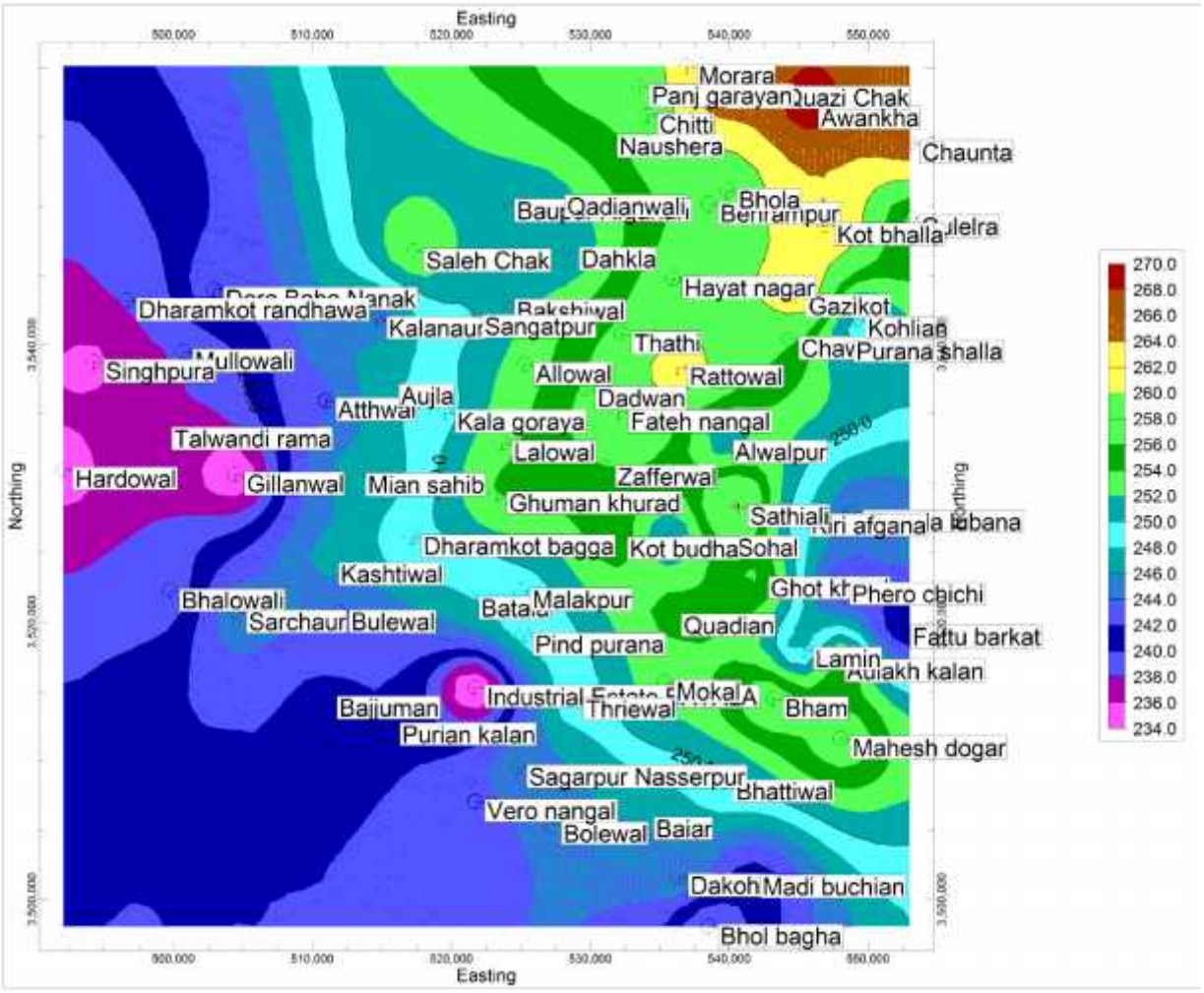



**Fig 4: Elevation Contour Map-Gurdaspur District**

The data is validated by selecting the deepest well in each quadrant with those supported electrical logs for preparation of Aquifer map and is shown below

## Table-2: Summery of Optimized Exploration Wells

**Data Validated:** The data is validated by selecting the deepest well in each quadrant with those supported electrical logs for preparation of Aquifer map and is shown below;

**PATHANKOT DISTRICT (Validated)**

| Sl.No | District | Block | Toposheet/Quadrant | Depth Range (m) | | | | | | | | Elevation (m amsl) | Source of data |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Location | < 100 | Location | 100-200 | Locati-on | 200-300 | Loca-tion | >300 | | |
| 1 | PATHANKOT | Pathankot | 2A 43P/11 | Attepur | 67 | | | | | | | 332 | CGWB |
| 2 | PATHANKOT | Gharota Kalan | 1A 43P/12 | Garhmal | 97.8 | | | | | | | 242 | CGWB |
| 3 | PATHANKOT | Dhar Kalan | 3A 43P/15 | Haryal | 74.5 | | | | | | | 409 | CGWB |
| 4 | PATHANKOT | Narot jamal Singh | 3B 43P/07 | Datyal | 47.24 | | | | | | | 264 | PSTC |
| 5 | PATHANKOT | Gharota Kalan | 1B 43P/12 | Gharota Kalan | 91.44 | | | | | | | 270 | PSTC |
| 6 | PATHANKOT | Pathankot | 2B 43P/11 | | | Madhopur II | 105 | | | | | 391 | PRIVATE |
| 7 | PATHANKOT | Pathankot | 3C 43P/11 | | | Mamoon Cantt | 160 | | | | | 360 | PRIVATE |
| 8 | PATHANKOT | Gharota Kalan | 1B 43P/12 | | | Najo Chak | 113 | | | | | 287 | PRIVATE |
| 9 | PATHANKOT | Pathankot | 3B 43P/11 | | | Shashtri Nagar,PNKT | 150 | | | | | 327 | PRIVATE |
| 10 | PATHANKOT | Narot jamal Singh | 1C 43P/08 | | | | | | | | 302.5 | 266.5 | CGWB |

# Table 3 GURDASPUR DISTRICT (Validated)

| Sl.No | District | Block | Toposheet/Quadrant | Depth Range (m) | | | | | | | | Elevation (m amsl) | Source of data |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Location | < 100 | Location | 100-200 | Location | 200-300 | Location | >300 | | |
| 1 | GURDASPUR | Sh Hargobindpur | 2C 44M/06 | Balarwal | 68.58 | | | | | | | 241 | PSTC |
| 2 | GURDASPUR | Quadian | 3C 44M/05 | Moor(Mithawan) | 80.77 | | | | | | | 258 | PSTC |
| 3 | GURDASPUR | Sh Hargobindpur | 1C 44M/06 | Cheema Khudi | 96.01 | | | | | | | 252 | PSTC |
| 4 | GURDASPUR | Sh Hargobindpur | 1B 44M/06 | | | Baiar | 125 | | | | | 246 | PRIVATE |
| 5 | GURDASPUR | Dinanagar | 1B 43P/08 | | | Birth Quazi Chak | 125 | | | | | 270 | PRIVATE |
| 6 | GURDASPUR | Dera Baba Nanak | 2B 44M/01 | | | Dalam | 125 | | | | | 246 | PRIVATE |
| 7 | GURDASPUR | Daraungla | 3A 43P/08 | | | Dahkla | 126.8 | | | | | 250 | PRIVATE |
| 8 | GURDASPUR | Khanuwan | 1B 44M/05 | | | Alwalpur | 128 | | | | | 249 | PRIVATE |
| 9 | GURDASPUR | Daraungla | 2B 43P/08 | | | Chitti | 128 | | | | | 258 | PRIVATE |
| 10 | GURDASPUR | Khanuwan | 2B 44M/05 | | | Kalu Sohal | 130 | | | | | 248 | PRIVATE |
| 11 | GURDASPUR | Dhariwal | 1A 44M/05 | | | Kalyanpur | 132.7 | | | | | 231 | PRIVATE |
| 12 | GURDASPUR | Fatehgarh churia | 2A 44M/01 | | | Gillanwal | 135 | | | | | 241 | PRIVATE |
| 13 | GURDASPUR | Kalanaur | 2A 43P/08 | | | Baupur Afganan | 141.73 | | | | | 251 | PSTC |
| 14 | GURDASPUR | Dera Baba Nanak | 3C 43P/04 | | | Dera Baba Nanak | 156.97 | | | | | 244 | PRIVATE |
| 15 | GURDASPUR | Batala | 3C 44M/01 | | | Industrial Estate BA | 200 | | | | | 244 | PRIVATE |
| 16 | GURDASPUR | Khanuwan | 2C 44M/05 | | | | | Kiri afgana | 254 | | | 248 | PRIVATE |
| 17 | GURDASPUR | Dera Baba Nanak | 1A 44M/01 | | | | | Mullowali | 255.58 | | | 238 | CGWB |
| 18 | GURDASPUR | Gurdaspur | 3C 43P/08 | | | | | Gazikot | 288.3 | | | 267 | CGWB |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | GURDASPUR | Sh Hargobindpur | 2B 44M/06 | | | | | Dakoha | 300 | | | 247 | CGWB |
| 20 | GURDASPUR | Kalanaur | 3A 43P/04 | | | | | | | Saleh Chak | 310 | | CGWB |
| 21 | GURDASPUR | Gurdaspur | 3B 43P/08 | | | | | | | Thathi | 312 | | CGWB |
| 22 | GURDASPUR | Dinanagar | 2C 43P/08 | | | | | | | Bhola | 313 | | CGWB |
| 23 | GURDASPUR | Batala | 2C 44M/01 | | | | | | | Batala | 315.7 | | CGWB |
| 24 | GURDASPUR | Quadian | 1A 44M/09 | | | | | | | Aulakh kalan | 375.3 | | CGWB |
| 25 | GURDASPUR | Dinanagar | 2A 43P/12 | Chaunta | 83.8 | | | | | | | | CGWB |
| 26 | GURDASPUR | Khanuwan | 2C 44M/05 | | | | | | | Sathiali | 302 | | CGWB |

# 3. HYDROGEOLOGY

## 3.1 PREVIOUS WORK

The main Aquifer group of the area is thick granular zones alternate with thick or thin clay lenses . The fresh Aquifer is water table and extends all over the area is composed of coarser sediments. In the north eastern and northern part , there are 5-6 Aquifers within 300m depth and ranges in the thickness from 20-65 m . These granular zones are laterally extensive in nature and composed of medium to coarse sands with gravel and pebbles cobbles etc. The clay beds area 5-12 m thick. In the central part 5-6 prominent granular zones have been encountered within the depth of 375m bgl . The thickness of granular zones is variable from 20-95m and the clay beds varies from 3-14m thick. Water levels of the area in pre monsoon period varies from 2.39(Khani Khui) to 18-93 . The shallowest water level area in the eastern and north eastern portion of Gurdaspur town. The deepest water levels are around Shri Hargobindpur and Fatehgarh Churrian. In the same way the post monsoon water levels are variable from 1.70m (Behram pur) to 16.76(Sri Hargobindpur) By comparing the pre monsoon and post monsoon water levels , it is seen that area above 10m depth to water is quite reduced around Kalanaur and Sri Hargobindpur but the area of of Dhar kalan block does not show much changes in the water levels because of Kandi /Siwaliks system and Hilly terrain. In the same way the area under water level in range of 2-5 m around Guurdaspur, Dinanagar, Narot Jaimal Singh is increased . It shows that there is extensive recharge by Ravi and Beas during monsoon. The monitoring of long term fluctuation for ten years reveals that in the pre monsoon period overall trend is declining in the ranges of

0.10(Dinanagar) to 2.40m/yr (Quandian where as in post monsoon the trend is declining to the tune of 0.66m(Pardori talab) to 6.39m(Dhianpur) The pre monsoon trend of 0.10 - 2.4m/yr is very nominal and in the post monsoon 6.6cm/yr to 64cm/yr . From the above trend it seems that the Ravi & Beas are continuously recharging the area during pre monsoon period because of perennial nature and in post monsoon the flow of the river is less here less recharge showing decline in water levels

## 3.2 Present NAQUIFERUIM study

To understand the sub surface lithology and its disposition, the lithological data of the optimized wells drilled by CGWB, PHED and Private Agencies is plotted using the RockWorks15 software and a lithological model has been prepared and is shown in fig. The

2D lithology map and 3D lithological fence diagram has been prepared using the lithology model and are shown in fig 5 & 6 respectively.

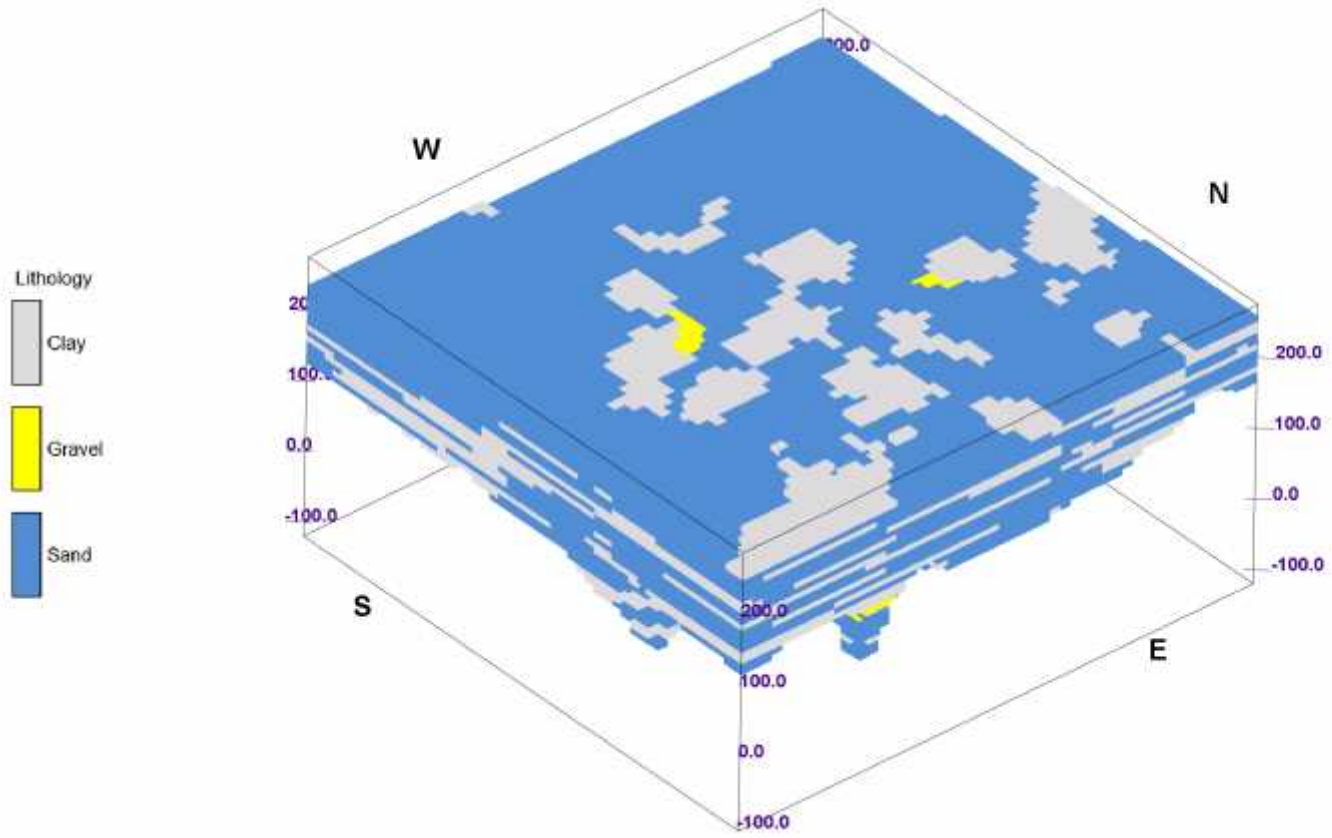



**Fig 5: 3-Dimension Lithological Model of Gurdaspur District**

To know the broad picture of the disposition, inter-relationship of granular zones, nature, geometry and extension of Aquifers in the Gurdaspur and Pathankot district, three-dimensional fence diagram have prepared by synthesizing the various sub-surface sections.

In Gurdaspur and Pathankot district, Aquifer group embodies a number of granular zones alternating with thick or thin clay lenses. The major clay zones intervening Aquifer groups pinch out against the Aquifer groups at a few places and within these clay zones the sand beds also occur. The marker horizons are traced all over the area by connecting their tops and bottoms.

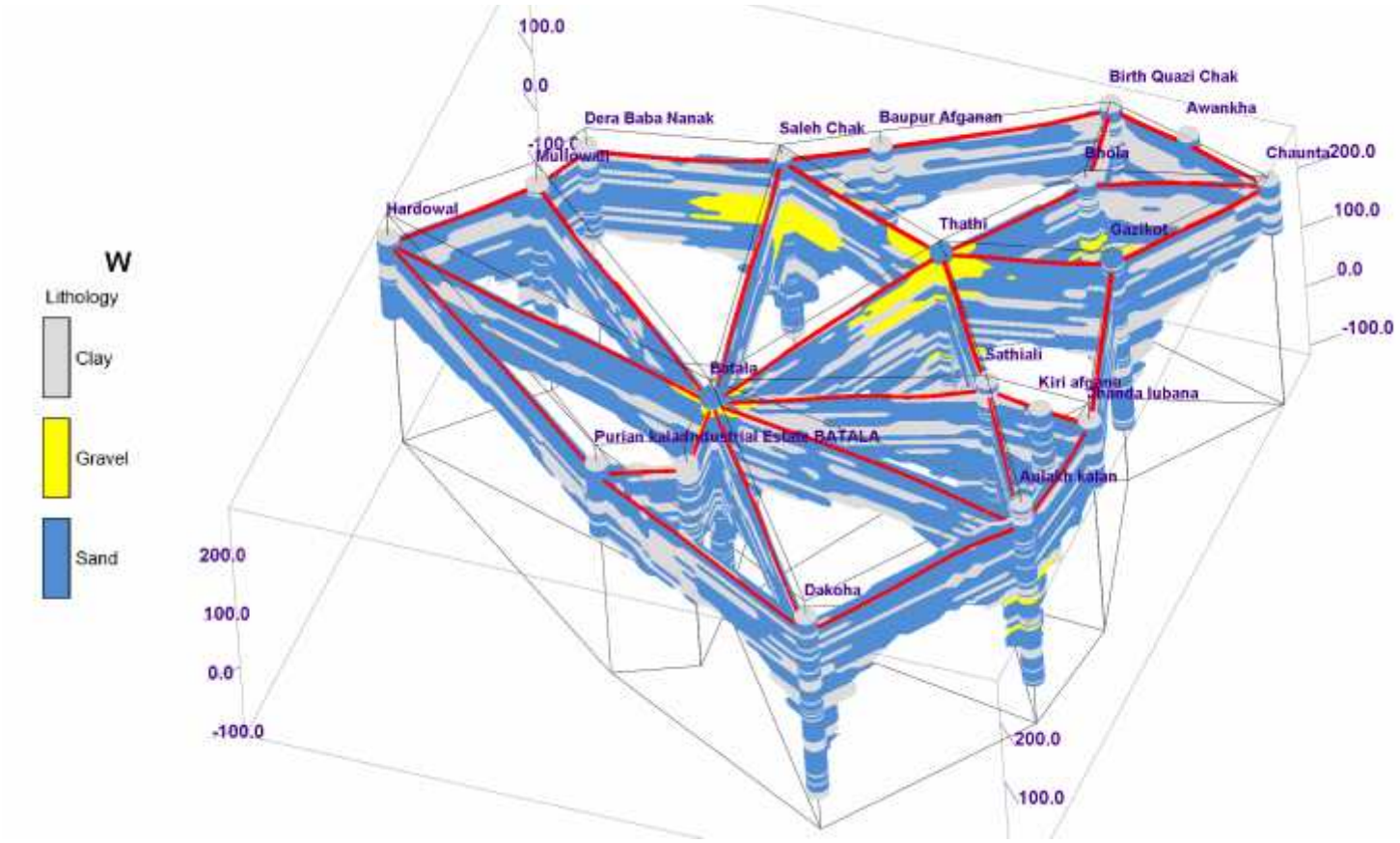



**Fig 6: 3 Dimension Lithological Fence of Gurdaspur District**

## 3.3 Aquifer Geometry

The first Aquifer is water table and extends all over the area is composed mainly of less coarse sediments as compared to other groups. This Aquifer is overlain by a thin clay layer of about 0.5 to 2.5 m thick and is also underlain by clayey group which is about 3-6 m thick. In the northeastern part, there are 5-6 Aquifers within 300 m depth and ranges in thickness from 20-65 m. These granular zones are laterally extensive in nature. The Aquifer material is mainly composed of medium to coarse sand with beds of gravel at places. In the extreme northern part i.e. at Taragarh and Chaunta the Aquifer material consists of gravels, pebbles,

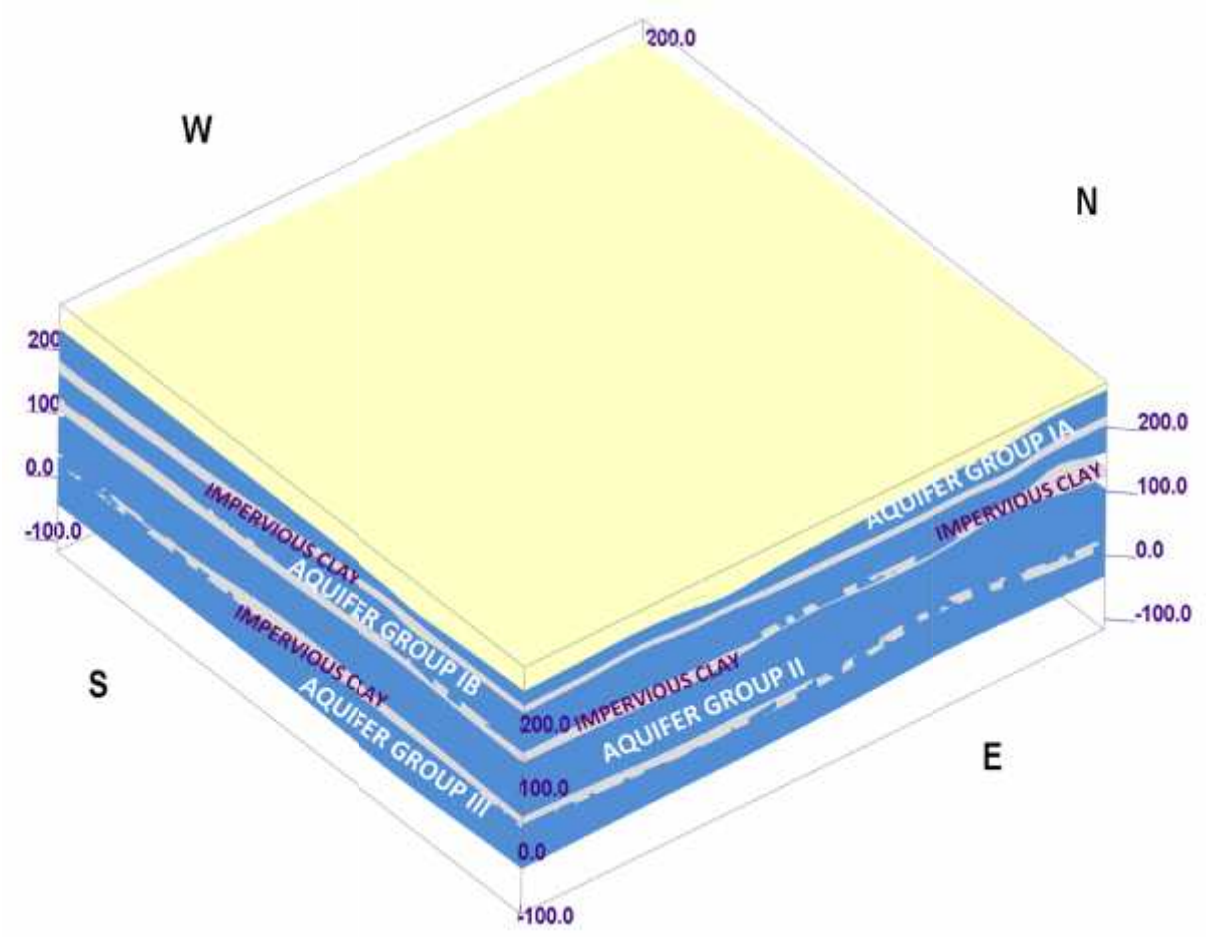
and boulder. Here the Aquifers are separated by clay beds, which vary in thickness from 5-12 m. The clay beds pinch out in the easterly direction in the extreme northern part of the area.

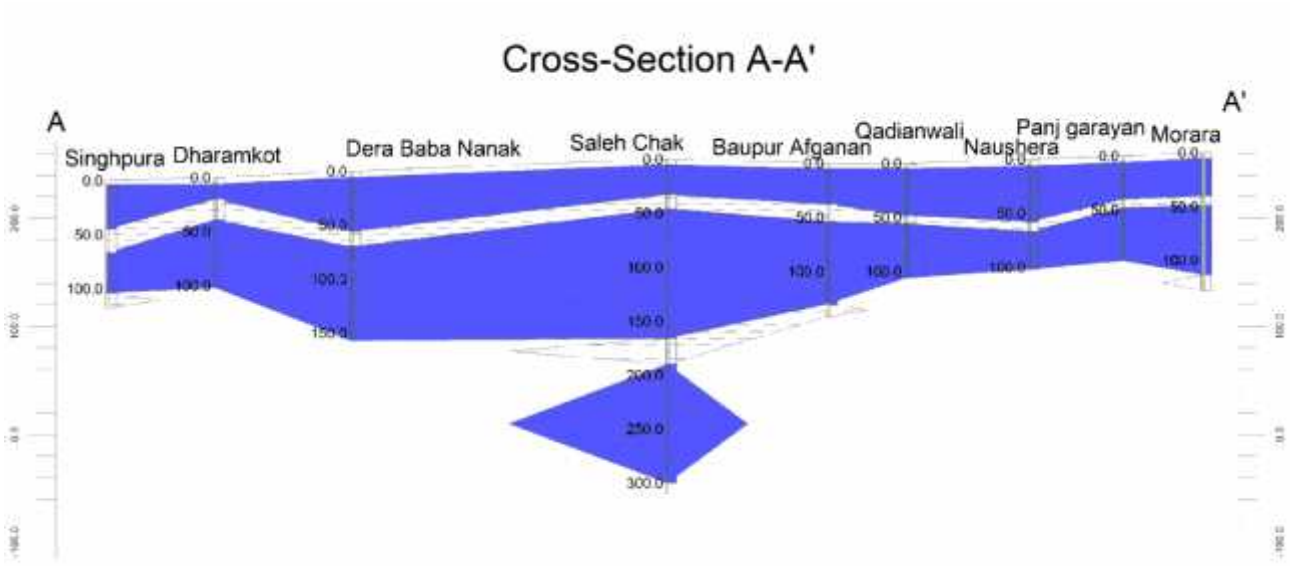
In the central part, 5-6 prominent granular zones have been encountered within a depth of 300-375 m bgl. The thickness of granular zones varies from 20-95 m and within the granular zones thin streaks of clays also occur. The thickness of clay beds varies from 3-14 m. The thickness of water table Aquifer varies from 20-40 m and it extends upto 50 mbgl. The granular material mainly consists of fine to medium sand.

**Table: 3 Aquifer Group depth and thickness ranges of Gurdaspur District**

| Gurdaspur District | | | | | | |
|---|---|---|---|---|---|---|
| **Sl.No** | **Aquifer Group** | **Depth Range (m)** | | **Thickness Range (m)** | | **Average Thickness (m) as per available data** |
| | | **Min** | **Max** | **Min** | **Max** | |
| 1 | Aquifer Group I | 8 | 135 | 45 | 135 | 84 |
| 2 | Aquifer Group II | 64 | 302 | 41 | 201.3 | 87 |
| 3 | Aquifer Group III | 185 | 346 | 60 | 131 | 90 |
| 4 | Aquifer Group IV | 292 | 375 | 7 | 21 | 14 |

**Fig 7: 3-Dimension Aquifer model - Gurdaspur District**




Cross-Section A-A'
A
A'
Singhpura
Dharamkot
Dera Baba Nanak
Saleh Chak
Baupur Afganan
Qadianwali
Naushera
Panj garayan
Morara

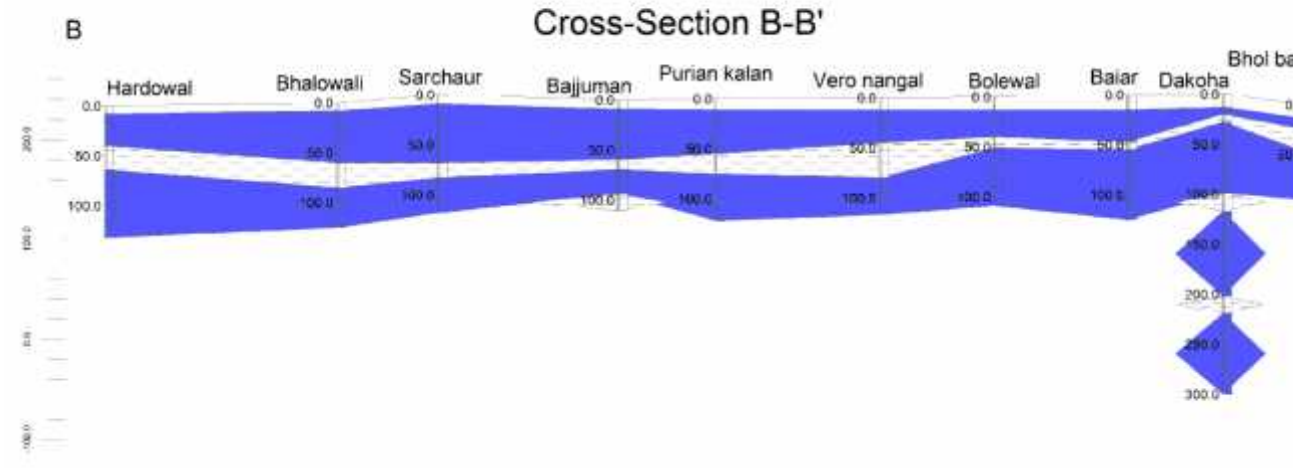
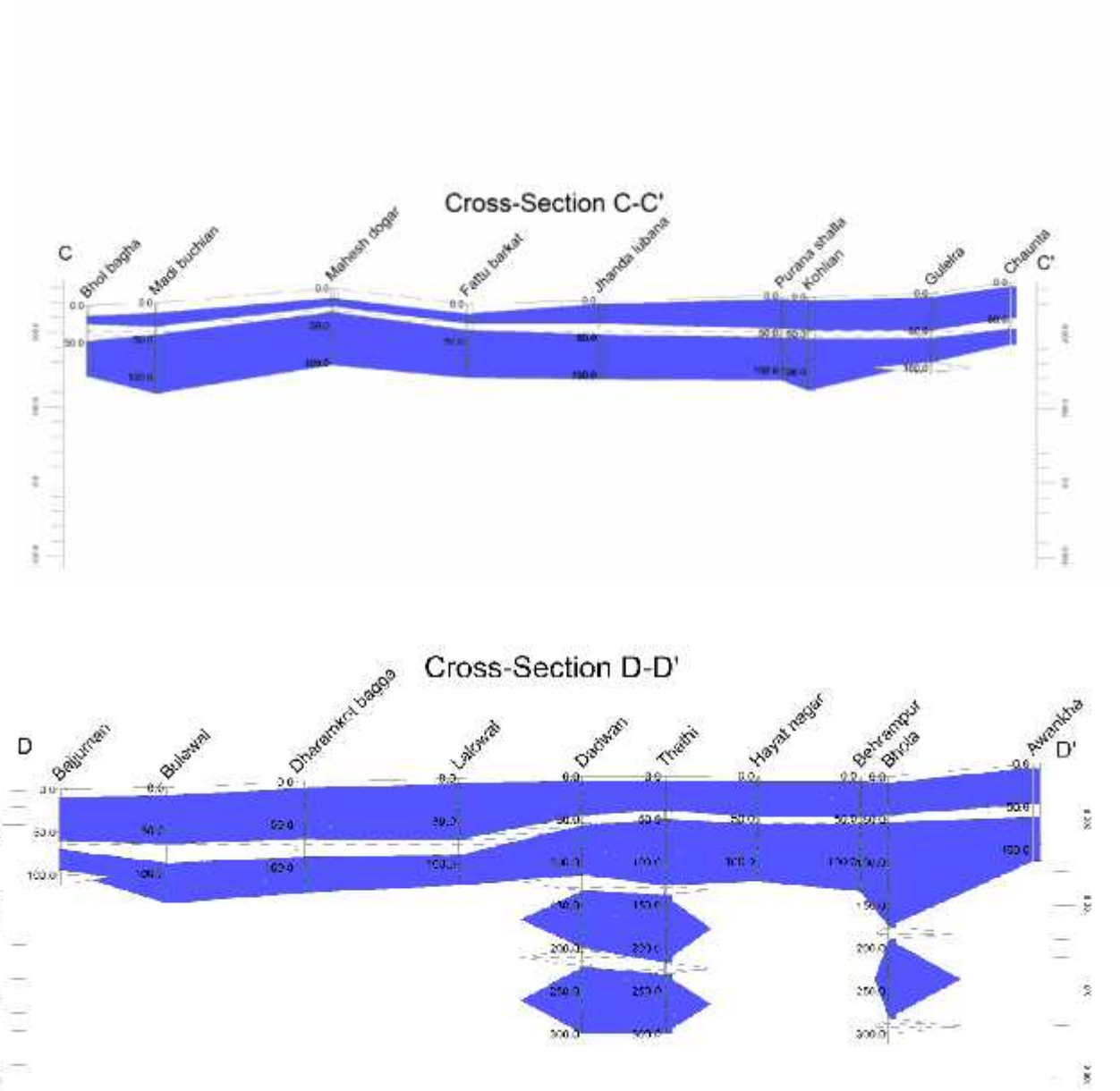

Cross-Section B-B'
B
B'
Hardowal
Bhalowali
Sarchaur
Bajjuman
Purian kalan
Vero nangal
Bolewal
Baiar
Dakoha
Bhol bagha

**Fig 8: Cross sections of Aquifer Map of Gurdaspur District**



# 4. GROUND WATER RESOURCES

Ground water resource estimation of the area have been carried out by taking Dynamic and In-storage resources of unconfined Aquifer and confined Aquifers present upto 300m depth. The assessment of Dynamic and In-storage Ground Water Resources of the study area have been carried out jointly by CGWB, Water Resources & Environment Directorate, Department of Irrigation on the basis of Groundwater Estimation Committee (GEC 1997) methodology based on data available and as per the revised methodology for the year 2013.

The occurrence of potential Aquifers (productive granular zones) upto 300 m depth has been demarcated on basis of Aquifer wise subsurface mapping. The total saturated thickness of granular zones was derived from the exploratory borehole data of a particular block. The granular zones occurring below the zone of water level fluctuation up to the first confining layer has been considered as static unconfined zone. The ground water resource of this zone has been calculated considering 12% specific yield of the formation. The specific yield value for the unconfined Aquifer has been taken as 60% of 0.12 which comes as 0.072 whereas for the confined Aquifer, the Storativity value has been considered. Since the specific yield is likely to reduce with increase in depth due to compaction of overlying sediments.

Hence, the major data elements considered in this estimation are thickness of granular zones, specific yield, Storativity and area of fresh water. It has been observed that in some of the blocks sufficient data on probable occurrence of granular zones was not available. In those cases, the existing exploratory data of adjoining block/district has been either extrapolated or interpolated to derive such parameters required for estimation. This assessment of total groundwater resources has been computed based on the available data with CGWB Water Resources & Environment Directorate, Department of Agriculture, and Punjab Water Resource Management & Development Corporation, Punjab

## 4.1 Unconfined Aquifers

## Dynamic Resources

As per Groundwater Resources Estimation 2013, the ground water development in Gurdaspur district comprising 10 blocks, ground water draft has exceeded the available recharge by more than 100% in 8 blocks thus have been categorized as **over exploited** however in **Gurdaspur** which is **semi-Critical** and Dina nagar which is **Safe** in category.

Overall Stage of ground water development in the Gurdaspur district has been assessed to be **124%**.

Table 4: Dynamic Ground Water Resource & Development Potential of Gurdaspur district (as on 31.03.2013)

| Assessment Unit/ Block | Net Annual Ground Water Availability | Existing Gross Ground Water Draft for irrigation | Existing Gross Ground Water Draft for domestic and industrial water supply | Existing Gross Ground Water Draft for All uses | Provision for domestic, and industrial requirement supply to 2025 | Net Ground Water Availability for future irrigation development | Stage of Ground Water Development (%) |
|---|---|---|---|---|---|---|---|
| BATALA | **17609** | **25430** | **1084** | **26514** | **1268** | **-9088** | **151** |
| DINA NAGAR | **11139** | **11241** | **270** | **11511** | **326** | **-428** | **103** |
| FATEHGARH CHURIAN | **18649** | **24516** | **323** | **24839** | **379** | **-6246** | **133** |
| GURDASPUR | **18808** | **14918** | **1069** | **15987** | **1254** | **2637** | **85** |
| KAHNUWAN | **20554** | **25199** | **303** | **25502** | **371** | **-5016** | **124** |
| KALANAUR | **13360** | **17354** | **186** | **17541** | **227** | **-4221** | **131** |
| QADIAN | **11991** | **15158** | **241** | **15398** | **291** | **-3458** | **128** |
| SRI HARGOBINDPUR | **15407** | **17474** | **337** | **17811** | **398** | **-2464** | **116** |
| DERA BABA NANAK | **17691** | **24468** | **338** | **24806** | **405** | **-7183** | **140** |
| DHARIWAL | **19263** | **23214** | **313** | **23527** | **380** | **-4331** | **122** |
| **Total (ham)** | **164473** | **198971** | **4466** | **203437** | **5301** | **-39799** | **124** |

Table 5: Dynamic Ground Water Resource & Development Potential of Gurdaspur district (as on 31.03.2013)

| Assessment Unit/ Block | Net Annual Ground Water Availability | Existing Gross Ground Water Draft for irrigation | Existing Gross Ground Water Draft for domestic and industrial water supply | Existing Gross Ground Water Draft for All uses | Provision for domestic, and industrial requirement supply to 2025 | Net Ground Water Availability for future irrigation development | Stage of Ground Water Development (%) |
|---|---|---|---|---|---|---|---|
| BAMYAL | **1698** | **1302** | **99** | **1401** | **122** | **275** | **82** |
| DHAR KALAN | **5890** | **878** | **246** | **1124** | **300** | **4712** | **19** |
| PATHANKOT | **18555** | **11190** | **1229** | **12419** | **1441** | **5924** | **67** |
| NAROT JAIMAL SINGH | **5815** | **5128** | **252** | **5380** | **310** | **377** | **93** |
| **Total (ham)** | **31959** | **18497** | **1827** | **20324** | **2173** | **11288** | **64** |

The ground water development in Pathankot district, all the blocks are in **Safe** category. Stage of ground water development in the Pathankot district has been assessed to be **64%**.

## In-storage Ground Water Resources

As per revised guidelines recommended by the Central Level Expert Group on ground water resources assessment, the resources are separately considered as dynamic and in-storage unconfined. In case of alluvial area, the in-storage resources of unconfined Aquifer have been computed based on specific yield of the Aquifer as detailed below:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| In-storage Ground Water resources (unconfined Aquifer) | = | Thickness of the Aquifer (granular/productive zone) below the zone of water level fluctuation down to the bottom layer of unconfined Aquifer | x | Sp. Yield of the Aquifer | x | Areal extent of the Aquifer | |

## 4.2 Confined Aquifer

The availability of ground water resources in confined Aquifer have two components: Storage under pressure (using Storativity concept) and Storage under desaturated (gravity drainage) condition (using Specific Yield concept) (source: Assessment of Ground Water Resources; A Review of International Practices, 2014) and is shown in Fig 9. However, since ground water withdrawals from confined Aquifer are known to have serious environmental degradation effects, the preliminary assessment of ground water resources in confined Aquifer is restricted to the estimation of ground water storage under pressure conditions only but here the storage under de-saturation is also computed.

**Storativity Concept:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ii) | In-storage Ground Water resources (within the Peizometer) | = | Thickness of the water column in Peizometer of particular confined Aquifer up to the top layer of same confined Aquifer | × | Storativity of the confined Aquifer | × | Areal extent of the confined Aquifer group |

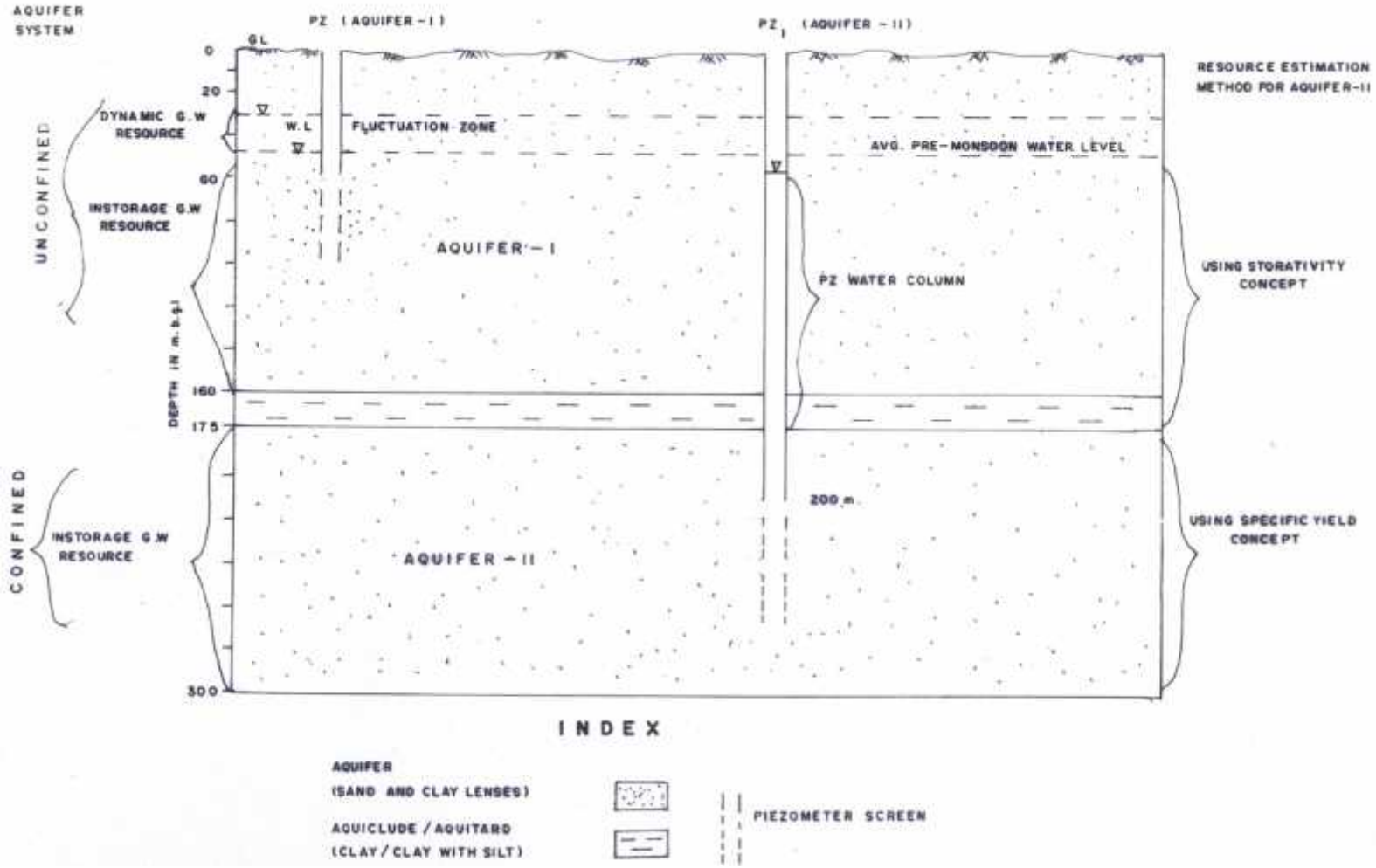
**Specific Yield Concept:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ii) | In-storage Ground Water resources (within the Aquifer thickness) | = | Thickness of the confined Aquifer (granular/ productive zone) down to the bottom layer of confined Aquifer or exploitable depth of 300 m | × | Sp. Yield of the Aquifer | × | Areal extent of the confined Aquifer group |

Preliminary assessment of the ground water resources in confined Aquifer does not imply that the assessed resource is available for exploitation. The objective of this exercise is to have an overview of the ground water regime in the particular confined Aquifer. It should be kept in mind that any significant ground water withdrawal from confined Aquifer may invoke serious environmental degradation problem. Therefore, in case the preliminary assessment reveals that ground water is being withdrawn in significant quantity for any confined Aquifer, that particular Aquifer should be identified for detailed assessment using numerical modelling approach.

***Total Availability of Ground Water Resources = Dynamic Resources + In-storage Resources.***

**Fig 9: Concept for Resource Estimation in Unconfined and Confined Aquifer System**



## Table 5: BLOCK WISE INSTORAGE GROUND WATER RESOURCES IN UNCONFINED AQUIFER –I (PATHANKOT DISTRICT)

| S. N. | Name of Assessment Unit | Type of rock formation | Areal extent (ha) | | | | Average Pre-monsoon Water Level (m bgl) | Depth to bottom of unconfined Aquifer I (m bgl) | Total Thickness of formation below Pre-monsoon Water Level (m) (9-8) | Thickness of the Granular Zone in unconfined Aquifer I below Pre-monsoon WL (m) | Average Specific Yield | In-Storage Ground Water Resources [(6)*(11)*(12)*] FRESH (ham) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total Geographical Area | Assessment Area | | | | | | | | |
| | | | | Total | Fresh Water | Brackish/Saline Water | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 1 | Bamial | Alluvium | 4780 | 4780 | 4780 | 0 | 5.10 | 75.0 | 69.90 | 27 | 0.072 | 9292 |
| 2 | Dhar Kalan | Alluvium | 39840 | 15823 | 15823 | 0 | 9.49 | 75.0 | 65.51 | 26 | 0.072 | 29621 |
| 3 | Narot Jaimal Singh | Alluvium | 17090 | 17090 | 17090 | 0 | 5.10 | 91.3 | 86.15 | 63 | 0.072 | 77520 |
| 4 | Pathankot | Alluvium | 35150 | 35150 | 35150 | 0 | 7.25 | 65.0 | 57.75 | 39 | 0.072 | 98701 |
| | **Dist. Total (ham)** | | **96860** | **72843** | **72843** | | | | | | | **215134** |
| | **Dist. Total (mcm)** | | | | | | | | | | | **2151.34** |

## Table 6: BLOCK WISE INSTORAGE GROUND WATER RESOURCES - CONFINED (AQUIFER II)
## (PATHANKOT DISTRICT) Type of Ground Water Assessment Unit (Block):

| Sr. No. | Name of Assessment Unit | Type of rock formation | Areal extent (ha) | | | | Top Aquifer II (m bgl) | Depth to bottom of Aquifer II (m bgl) | Total Thickness of confined Aquifer down to explored depth (m) (9-8) | Thickness of the Granular Zone in confined Aquifer down to explored depth (m) | Average value of Storat-ivity | In-Storage Ground Water Resources [(6)*(11)*(12)*] FRESH (ham) | In-Storage Ground Water Resources [(7)*(11)*(12)*] BRAKISH / SALINE (ham) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total Geographical Area | Assessment Area | | | | | | | | | |
| | | | | Total | Fresh Water | Brackish/Saline Water | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| | **Gurdaspur** | | | | | | | | | | | | |
| 1 | Bamial | Alluvium | 4780 | 4780 | 4780 | 0 | 0 | 0 | 0 | 0 | 0.000403 | 0 | 0 |
| 2 | Dhar Kalan | Alluvium | 39840 | 15823 | 15823 | 0 | 0 | 0 | 0 | 0 | 0.000403 | 0 | 0 |
| 3 | Narot Jaimal Singh | Alluvium | 17090 | 17090 | 17090 | 0 | 101 | 300 | 199 | 129 | 0.000403 | 888 | 0 |
| 4 | Pathankot | Alluviam/ Boulders | 35150 | 35150 | 35150 | 0 | 73 | 160 | 87 | 39 | 0.000119 | 163 | 0 |
| | **Dist.Total (ham)** | | **96860** | **72843** | **72843** | **0** | | | | | | **1052** | |
| | **Dist.Total (mcm)** | | | | | | | | | | | **10.52** | **0.00** |

## Table 7: BLOCK WISE TOTAL AVAILABLE GROUND WATER RESOURCES IN AQUIFERS UP TO 300m DEPTH

**Annexure I B-2**

**AVAILABILITY OF TOTAL FRESH GROUNDWATER RESOURCES IN PATHANKOT DISTRICT UPTO 300 METRE DEPTH**

| Sl.No | BLOCK | *Dynamic Groundwater Resources (2013) AQUIFER-I* | *In-storage Groundwater Resources AQUIFER-I* | Groundwater Resources AQUIFER-I [(3)+(4)] | In-storage Groundwater Resources AQUIFER-II | In-storage Groundwater Resources AQUIFER-III | Total Availabilty of Groundwater Resources [(5)+(6)+(7)] | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | ham | mcm |
| *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* |
| 1 | Bamial | *1698* | *9292* | 10991 | 0 | 0 | 10991 | **110** |
| 2 | Dhar Kalan | *5890* | *29621* | 35511 | 0 | 0 | 35511 | **355** |
| 3 | Narot Jaimal Singh | *5815* | *77520* | 83335 | 888 | 0 | 84224 | **842** |
| 4 | Pathankot | *18555* | *98701* | 117257 | 163 | 0 | 117420 | **1174** |
| **Dist.Total (ham)** | | ***31959*** | ***215134*** | ***247094*** | ***1052*** | ***0*** | ***248145.1*** | |
| **Dist.Total (mcm)** | | **320** | **2151** | **2471** | **11** | **0** | **2481** | |

**Table -8**

## BLOCK WISE INSTORAGE GROUND WATER RESOURCES IN UNCONFINED AQUIFER –I (GURDASPUR DISTRICT)

| Sr. No. | Name of Assessment Unit | Type of rock formation | Areal extent (ha) | | | | Average Pre-monsoon Water Level (m bgl) | Depth to bottom of Aquifer Group I (m bgl) | Total Thickness of formation below Pre-monsoon Water Level (m) (9-8) | Thickness of the Granular Zone in AQUIFER GROUP-I below Pre-monsoon WL (m) | Average Specific Yield | In-Storage Ground Water Resources [(6)*(11)*(12)*] FRESH (ham) | In-Storage Ground Water Resources [(7)*(11)*(12)*] BRAKISH/SALINE (ham) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total Geographical Area | Assessment Area | | | | | | | | | |
| | | | | Total | Fresh Water | Brackish/Saline Water | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| | **Gurdaspur** | | | | | | | | | | | | |
| 1 | Batala | Alluvium | 27830 | 27830 | 27830 | 0 | 8.60 | 69 | 60.40 | 47 | 0.072 | 94177 | 0 |
| 2 | Dera Baba Nanak | Alluvium | 29450 | 29450 | 29450 | 0 | 7.19 | 55 | 47.81 | 30 | 0.072 | 63612 | 0 |
| 3 | Dhariwal | Alluvium | 25680 | 25680 | 25680 | 0 | 8.20 | 45 | 36.80 | 23 | 0.072 | 42526 | 0 |
| 4 | Dina Nagar | Alluvium | 23630 | 23630 | 23630 | 0 | 4.39 | 127 | 122.61 | 74 | 0.072 | 125901 | 0 |
| 5 | Fatheh Garh Churian | Alluvium | 21330 | 21330 | 21330 | 0 | 8.05 | 57 | 48.95 | 32 | 0.072 | 49144 | 0 |
| 6 | Gurdaspur | Alluvium | 25130 | 25130 | 25130 | 0 | 4.83 | 115 | 110.17 | 83 | 0.072 | 150177 | 0 |
| 7 | Kahnuwan | Alluvium | 32370 | 32370 | 32370 | 0 | 10.49 | 96 | 85.51 | 56 | 0.072 | 130516 | 0 |
| 8 | Kalanour | Alluvium | 22640 | 22640 | 22640 | 0 | 6.35 | 54 | 47.65 | 35 | 0.072 | 57053 | 0 |
| 9 | Quadian | Alluvium | 18060 | 18060 | 18060 | 0 | 12.41 | 135 | 122.59 | 95 | 0.072 | 123530 | 0 |
| 10 | Sri Hargobindpur | Alluvium | 28330 | 28330 | 28330 | 0 | 14.94 | 103 | 88.06 | 77 | 0.072 | 157062 | 0 |
| | **Dist.Total (ham)** | | **254450** | **254450** | **254450** | **0** | | | | | | **993697** | **0** |
| | **Dist.Total (mcm)** | | | | | | | | | | | **9936.97** | **0.00** |

## Table-9 BLOCK WISE INSTORAGE GROUND WATER RESOURCES IN UNCONFINED AQUIFER –II, (GURDASPUR DISTRICT)

| Sr. No. | Name of Assessment Unit | Type of rock formation | Areal extent (ha) | | | | Top Aquifer II (m bgl) | Depth to bottom of Aquifer II (m bgl) | Total Thickness of confined Aquifer down to explored depth (m) (9-8) | Thickness of the Granular Zone in confined Aquifer down to explored depth (m) | Average value of Storativity | In-Storage Ground Water Resources [(6)*(11)*(12)*] FRESH (ham) | In-Storage Ground Water Resources [(7)*(11)*(12)*] BRAKISH / SALINE (ham) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total Geographical Area | Assessment Area | | | | | | | | | |
| | | | | Total | Fresh Water | Brackish /Saline Water | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| | **Gurdaspur** | | | | | | | | | | | | |
| 1 | Batala | Alluvium | 27830 | 27830 | 27830 | 0 | 81 | 176 | 95 | 67 | 0.0022 | 4028 | 0 |
| 2 | Dera Baba Nanak | Alluvium | 29450 | 29450 | 29450 | 0 | 67 | 165 | 98 | 75 | 0.0022 | 4771 | 0 |
| 3 | Dhariwal | Alluvium | 25680 | 25680 | 25680 | 0 | 66 | 133 | 67 | 48 | 0.0022 | 2663 | 0 |
| 4 | Dina Nagar | Alluvium | 23630 | 23630 | 23630 | 0 | 0 | 0 | 0 | 0 | 0.0022 | 0 | 0 |
| 5 | Fatheh Garh Churian | Alluvium | 21330 | 21330 | 21330 | 0 | 72 | 135 | 63 | 48 | 0.0022 | 2211 | 0 |
| 6 | Gurdaspur | Alluvium | 25130 | 25130 | 25130 | 0 | 126 | 180 | 54 | 44 | 0.0022 | 2388 | 0 |
| 7 | Kahnuwan | Alluvium | 32370 | 32370 | 32370 | 0 | 107 | 220 | 113 | 94 | 0.0022 | 6572 | 0 |
| 8 | Kalanour | Alluvium | 22640 | 22640 | 22640 | 0 | 74 | 158 | 84 | 68 | 0.0022 | 3325 | 0 |
| 9 | Quadian | Alluvium | 18060 | 18060 | 18060 | 0 | 145 | 238 | 93 | 62 | 0.0022 | 2419 | 0 |
| 10 | Sri Hargobindpur | Alluvium | 28330 | 28330 | 28330 | 0 | 116 | 202 | 86 | 74 | 0.0022 | 4528 | 0 |
| | **Dist.Total (ham)** | | **254450** | **254450** | **254450** | **0** | | | | | | **25959** | **0** |
| | **Dist.Total (mcm)** | | | | | | | | | | | **259.59** | **0.00** |

**Table-10**

**BLOCK WISE INSTORAGE GROUND WATER RESOURCES IN UNCONFINED AQUIFER –III, (GURDASPUR DISTRICT)**

| Sr. No. | Name of Assessment Unit | Type of rock formation | Areal extent (ha) | | | | Depth to Top Aquifer III (m bgl) | Depth to bottom of Aquifer III (m bgl) | Total Thickness of confined Aquifer down to explored depth (m) (9-8) | Thickness of the Granular Zone in confined Aquifer down to explored depth (m) | Average value of Storativity | In-Storage Ground Water Resources [(6)*(11)*(12)*] FRESH (ham) | In-Storage Ground Water Resources [(7)*(11)*(12)*] BRAKISH / SALINE (ham) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total Geographical Area | Assessment Area | | | | | | | | | |
| | | | | Total | Fresh Water | Brackish/ Saline Water | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| | **Gurdaspur** | | | | | | | | | | | | |
| 1 | Batala | Alluvium | 27830 | 27830 | 27830 | 0 | 192 | 300 | 108 | 86 | 0.0024 | 5636 | 0 |
| 2 | Dera Baba Nanak | Alluvium | 29450 | 29450 | 29450 | 0 | 196 | 255.58 | 59.58 | 42 | 0.0024 | 2913 | 0 |
| 3 | Dhariwal | Alluvium | 25680 | 25680 | 25680 | 0 | 0 | 0 | 0 | 0 | 0.0024 | 0 | 0 |
| 4 | Dina Nagar | Alluvium | 23630 | 23630 | 23630 | 0 | 0 | 0 | 0 | 0 | 0.0024 | 0 | 0 |
| 5 | Fatheh Garh Churian | Alluvium | 21330 | 21330 | 21330 | 0 | 0 | 0 | 0 | 0 | 0.0024 | 0 | 0 |
| 6 | Gurdaspur | Alluvium | 25130 | 25130 | 25130 | 0 | 193 | 300 | 107 | 78 | 0.0024 | 4616 | 0 |
| 7 | Kahnuwan | Alluvium | 32370 | 32370 | 32370 | 0 | 230 | 300 | 70 | 57 | 0.0024 | 4345 | 0 |
| 8 | Kalanour | Alluvium | 22640 | 22640 | 22640 | 0 | 190 | 300 | 110 | 86 | 0.0024 | 4585 | 0 |
| 9 | Quadian | Alluvium | 18060 | 18060 | 18060 | 0 | 252.5 | 300 | 47.5 | 42 | 0.0024 | 1786 | 0 |
| 10 | Sri Hargobindpur | Alluvium | 28330 | 28330 | 28330 | 0 | 218 | 300 | 82 | 55 | 0.0024 | 3669 | 0 |
| | **Dist.Total (ham)** | | **254450** | **254450** | **254450** | **0** | | | | | | **22096** | **0** |
| | **Dist.Total (mcm)** | | | | | | | | | | | **220.96** | **0.00** |

## Table-11 BLOCK WISE TOTAL AVAILABLE GROUND WATER RESOURCES IN AQUIFERS UP TO 300m DEPTH

**Annexure I B-2**

**AVAILABILITY OF TOTAL FRESH GROUNDWATER RESOURCES IN GURDASPUR DISTRICT UPTO 300 METRE DEPTH**

| Sl.No | BLOCK | *Dynamic Groundwater Resources (2013) AQUIFER-I* | *In-storage Groundwater Resources AQUIFER-I* | Groundwater Resources AQUIFER-I [(3)+(4)] | In-storage Groundwater Resources AQUIFER-II | In-storage Groundwater Resources AQUIFER-III | Total Availabilty of Groundwater Resources [(5)+(6)+(7)] | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | ham | mcm |
| *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* |
| 1 | Batala | *17609.37* | *94176.72* | 111786 | 4028 | 5636 | 121450 | **1215** |
| 2 | Dera Baba Nanak | *17690.55* | *63612.00* | 81303 | 4771 | 2913 | 88986 | **890** |
| 3 | Dhariwal | *19263.41* | *42526.08* | 61789 | 2663 | 0 | 64452 | **645** |
| 4 | Dina Nagar | *11138.76* | *125900.64* | 137039 | 0 | 0 | 137039 | **1370** |
| 5 | Fatheh Garh Churian | *18649.42* | *49144.32* | 67794 | 2211 | 0 | 70005 | **700** |
| 6 | Gurdaspur | *18808.43* | *150176.88* | 168985 | 2388 | 4616 | 175990 | **1760** |
| 7 | Kahnuwan | *20553.68* | *130515.84* | 151070 | 6572 | 4345 | 161987 | **1620** |
| 8 | Kalanour | *13360.30* | *57052.80* | 70413 | 3325 | 4585 | 78324 | **783** |
| 9 | Quadian | *11991.40* | *123530.40* | 135522 | 2419 | 1786 | 139727 | **1397** |
| 10 | Sri Hargobindpur | *15407.36* | *157061.52* | 172469 | 4528 | 3669 | 180667 | **1807** |
| **Dist.Total (ham)** | | ***164473*** | ***993697*** | ***1158170*** | ***25959*** | ***22096*** | ***1206224*** | |
| **Dist.Total (mcm)** | | **1645** | **9937** | **11582** | **260** | **221** | **12062** | |

## 5. GROUND WATER RELATED ISSUES

Gurdaspur is famous for its paddy cultivation and is also known as 'Rice Bowl' of Punjab. The quality of ground water in the district is potable for both the drinking and irrigation purposes therefore, the ground water is constantly being pumped for the irrigation due to its easy access through tube wells and they are the main source of irrigation.

This will lead to its major ground water issue which is deepening of ground water level as the recharge of the groundwater through rainfall and other sources are less than the overall extraction.

### 5.1 GROUND WATER IRRIGATION SCENARIO

As per the data available from minor irrigation census 2006-07, the number of shallow and deep, tube wells, lined, unlined water distribution system, land holdings of wells are given in Table 12,13 and 14

**Fig 10: Irrigation tube wells as per depth.**

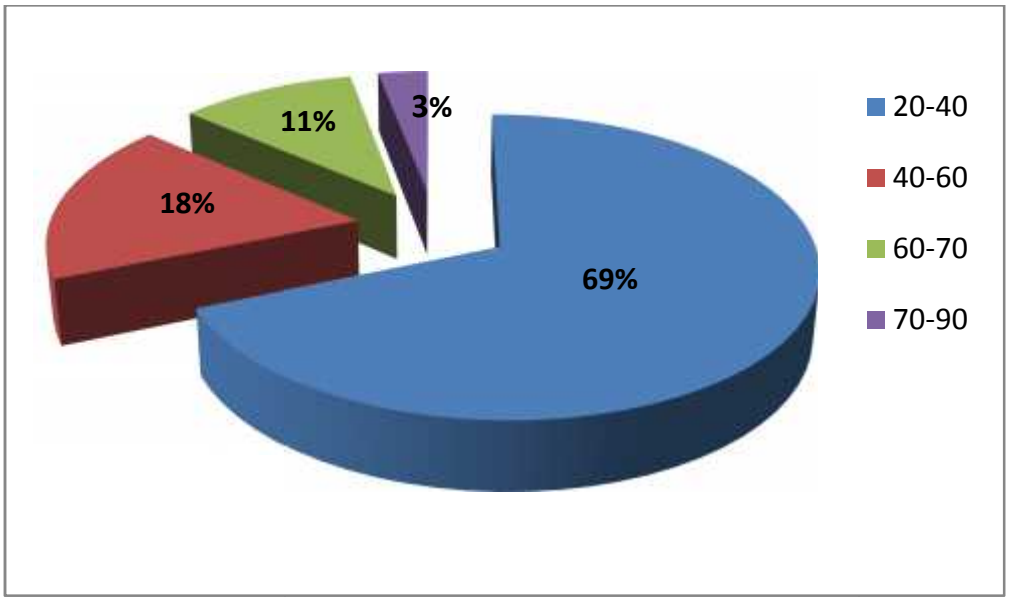


**Table 12-Distribution of Tube wells According to Owner's holding Size**

| No. of shallow tube wells by size class of individual owner | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sr.no | district | Marginal (0-1 ha) | Small (1-2 ha) | Semi-Medium (2-4 ha) | Medium (4-10ha) | Big (>=10 ha) | Total |
| **1** | **Gurdaspur** | **6319** | **17639** | **36473** | **19183** | **2747** | **82361** |

**Table13 -Distribution of Shallow Tube wells According to Depth of tube well**

| No. by the depth of shallow Tube well | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sr.no | district | (0-20 mts) | (20-40 mts) | (40-60 mts) | (60-70 mts) | (>70 mts) | Total |
| **1** | **Gurdaspur** | **2169** | **56933** | **14618** | **8830** | **2478** | **85028** |

**Table14- Type of Ground water distribution device**

| Open Water Channel | | |
|---|---|---|
| Lined/pucca | **Unlined/kutcha** | Total |
| **5979** | **78500** | **84479** |

## 6. AQUIFER MANAGEMENT PLAN

A summery outline of the artificial recharge plan for the entire district of each OE block is given at the beginning in tabular forms. This is followed by the salient features of each block along with the detailed structure-wise recharge plan and cost estimates. Details of the block wise, type of suitable recharge structures and volume of water assured for annual recharge for each block in rural area, urban area and artificial recharge in agricultural farm are given in table and design of recharge structures are annexed at annexure I, II. More than 5 meter Mean decadal water level with falling trend is considered for block wise artificial recharge calculation.

Another focus has been given to minimize the gross draft by enhancing ground water use efficiency in irrigation system after replacing the water distribution system from unlined/kutcha channel to Under Ground Pipeline System in the whole district.

## 6.1 SCOPE OF IMPLEMENTATION

This plan is focusing on the technical aspects of the ground water recharge through various means so that various implementing agencies may get the appropriate technical guidelines. The existing/ongoing schemes of the Central or State Govt. like MANERGA, IWSP, PMKSY (Prime Minister Krishi Sinchai Yojna), NABARD funded schemes, Urban Development schemes, departmentally funded projects etc. may be benefitted from the recharge plan by incorporating the input in the operational guidelines/ design and for locating the specific sites.

Agriculture University, Engineering Collages, Academic and Research Institutions, NGO may also take up the pilot or demonstrative projects in the blocks suitable to them to plan at local level as per local conditions.

## 6.2 POTENTIAL OF ENHANCING THE GROUND WATER USE EFFICIENCY

The micro level transformation in the ground water management have vast impact potential to counter extensive ground water depletion faced by the state of Punjab, particularly in overexploited blocks. There are around 84932 operated by farmers for irrigation through unlined/Kutcha (92.32%) open channel system in Gurdaspur district where water from the tubewell is discharge to the agricultural field. In this process huge quantity of ground water is wasted in soil moisture and evaporation losses.

Dynamic ground water resources (2013) indicate that Gross ground water draft for irrigation in Gurdaspur district is estimated at 2197.41MCM. It is expected that around 26.52 % of over draft can be brought down by switching over to underground/surface pipeline based distribution from the prevailing unlined open channels. Thereby gross draft will be reduced to the tune of 1784.77 MCM assuming there is no crop diversification by the farmers.

The benefit will lead to saving of precious ground water resources in overexploited blocks of Gurdaspur Districts. The measure if implemented will bring down the ground water overdraft from 127% to 100.48 %. The category of the blocks will also improve drastically resulting in boosting of agriculture and industrial development otherwise not sustainable in majority of the blocks in the state.

The tubewells also consume enormous electricity which is subsidized and government incurs significant revenue on this account. The measures therefore will result in saving of energy and money. Pollution impact will be reduced whenever diesel engines are used by the farmers. The environmental and ecological condition in the irrigated land will improve. Unwanted weed growth will also be controlled inside the farm land. This will also be useful in the waterlogged/ shallow water table areas as the seepage losses in these areas also aggravate the water logging. **Government should make/launch a mission mode program for installing the underground pipe lines instead of having *katcha* channel in the entire Punjab**. Heavy ground water overdraft can be reduced by these efforts. This will ensure **more crop per drop**.

### 6.3 Water Saving Potential from Crop Diversification-Change Paddy to Maize/Pulses:

As the requirement of water for paddy is much high therefore by changing paddy to maize/Pulses will help in saving of water. For estimating the water saving by crop diversification it is assumed that one mcm of water will be saved in case of maize or pulses planted in one sq km of land. In case of pulses even higher amount of ground water can be saved

**Table 15: Scope of Quantitative Impact on Stage of Development after applying various management strategies (District Gurdaspur)**

| Block | Net Ground Water ability (mcm) | Total Draft (mcm) | Present Stage of Draft (SOD) (%) As per 2013 | Reduction in draft by different water saving method | | | | SOD afterwards (%) | nge of paddy cultivation area (% of existing) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | eplace water urses by UG Pipes (mcm) | opt Artificial recharge (mcm) | ge Paddy to Maize (mcm) | Total (mcm) (2+3+4) | | |
| | | | 1 | 2 | 3 | 4 | 5 | | |
| BATALA | 176.1 | 265.1 | 151 | 66.3 | 3.27 | 19.5 | 89.07 | 100 | 12 |
| DINA NAGAR | 111.4 | 115.1 | 103 | 28.8 | 0.00 | 0.0 | 28.8 | 78 | - |
| FATEHGARH CHURIAN | 186.5 | 248.4 | 133 | 62.1 | 2.52 | 0.0 | 64.62 | 99 | - |
| GURDASPUR | 188.1 | 159.9 | 85 | 40.0 | 0.35 | 0.0 | 40.35 | 64 | - |
| KAHNUWAN | 205.5 | 255.0 | 124 | 63.8 | 4.59 | 0.0 | 68.39 | 91 | - |
| KALANAUR | 133.6 | 175.4 | 131 | 43.9 | 2.46 | 0.0 | 46.36 | 97 | - |
| QADIAN | 119.9 | 154.0 | 128 | 38.5 | 2.85 | 0.0 | 41.35 | 94 | |
| SRI HARGOBINDPUR | 154.1 | 178.1 | 116 | 44.5 | 3.33 | 0.0 | 47.83 | 85 | - |
| DERA BABA NANAK | 176.9 | 248.1 | 140 | 62.0 | 3.10 | 6.0 | 71.1 | 100 | 3 |
| DHARIWAL | 192.6 | 235.3 | 122 | 58.8 | 3.06 | 0.0 | 61.86 | 90 | - |
| Total | 1644.7 | 2034.4 | 124 | 508.6 | 25.52 | 19.5 | 553.62 | 91 | - |

**Table 16: Scope of Quantitative Impact on Stage of Development after applying various management strategies (District Pathankot)**

| Block | Net Ground Water ability (mcm) | Total Draft (mcm) | Present Stage of draft (SOD) (%) As per 2013 | Reduction in draft by different water saving method | | | | SOD afterwards (%) | nge of paddy cultivation area (% of existing) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | eplace water urses by UG Pipes (mcm) | opt Artificial recharge (mcm) | ge Paddy to Maize (mcm) | Total (mcm) (2+3+4) | | |
| | | | 1 | 2 | 3 | 4 | 5 | | |
| BAMYAL | 17.0 | 14.0 | 82 | 3.5 | - | - | 3.5 | 62 | - |
| DHAR KALAN | 58.9 | 11.2 | 19 | 2.8 | - | - | 2.8 | 14 | - |
| PATHANKOT | 185.6 | 124.2 | 67 | 31.0 | - | - | 31.0 | 50 | - |
| NAROT JAIMAL SINGH | 58.2 | 53.8 | 93 | 13.5 | - | - | 13.5 | 69 | - |
| **Total** | 319.6 | 203.2 | 64 | 50.8 | - | - | 50.8 | 48 | - |

# 7. BLOCK WISE AQUIFER MAPS AND MANAGEMENT PLAN

# (I) BATALA BLOCK (278.30 SQ KM)

## 1. Salient Information

| | |
|---|---|
| **Population (2011)** | Rural-140815<br>Urban-2002<br>Total-142817 |
| **Rainfall 2014** (Gurdaspur Distt.) | Average annual rainfall – 1047.70 mm |
| **Average Annual Rainfall** (Batala block) | 779 mm |
| **Agriculture and Irrigation** | Major Crops- Rice, Wheat<br>Other crops-Sugarcane, Potatoes, Pulses,<br>Net Area Sown- 197.59 sq.km<br>Total Irrigated Area-381.59 sq.km |

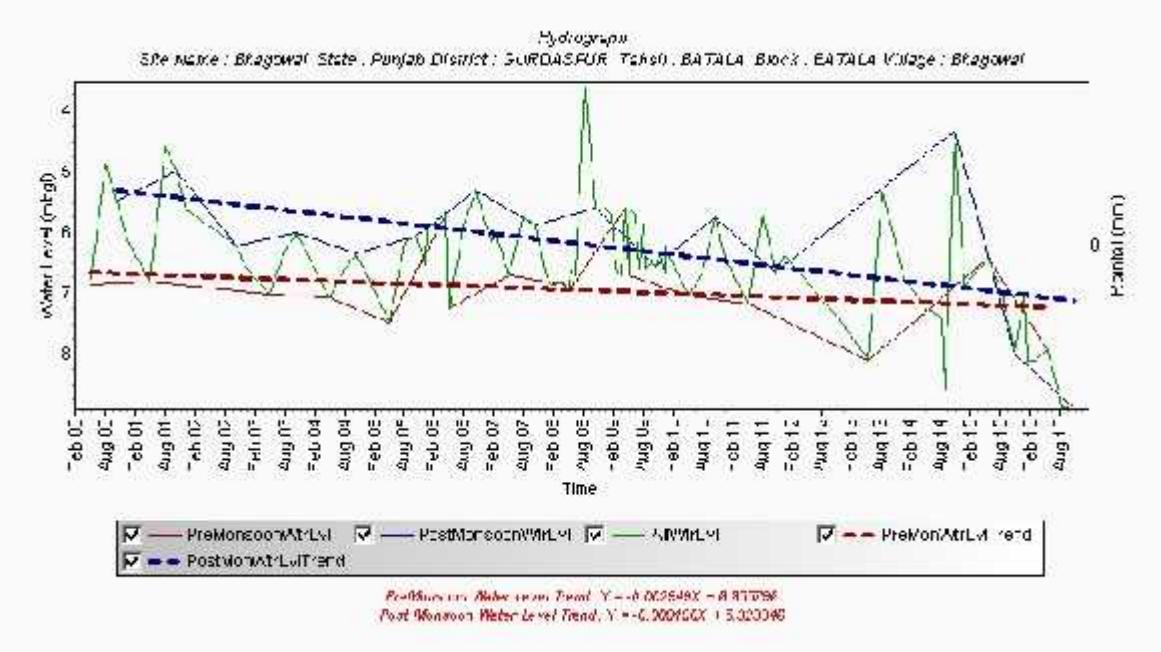
**Water Bodies & Canal Irrigation**

Water bodies available in the villages for storm water and untreated waste water of villagers, can be used for irrigation after treatment. The canal irrigation is also available in the Batala block.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (47m) is not very prominent in terms of thickness and geographic extent. Aquifer II (67 m) & III (86 m) are more prominent in thickness and geographic extent. Block is categorized as Over-Exploited as per Ground Water Assessment 2013 assessment.

**Ground water Extraction**: Information regarding the abstraction from Aquifer III is not available, but there are drinking water supply from Tubewells tapping combined Aquifer and separate Aquifer could not be assessed separately.

**Water level Behavior (2015)**: Pre Monsoon-~6.30-9.10 *(mbgl)*bgl &Post Monsoon-~4.32-9.40 *(mbgl)*



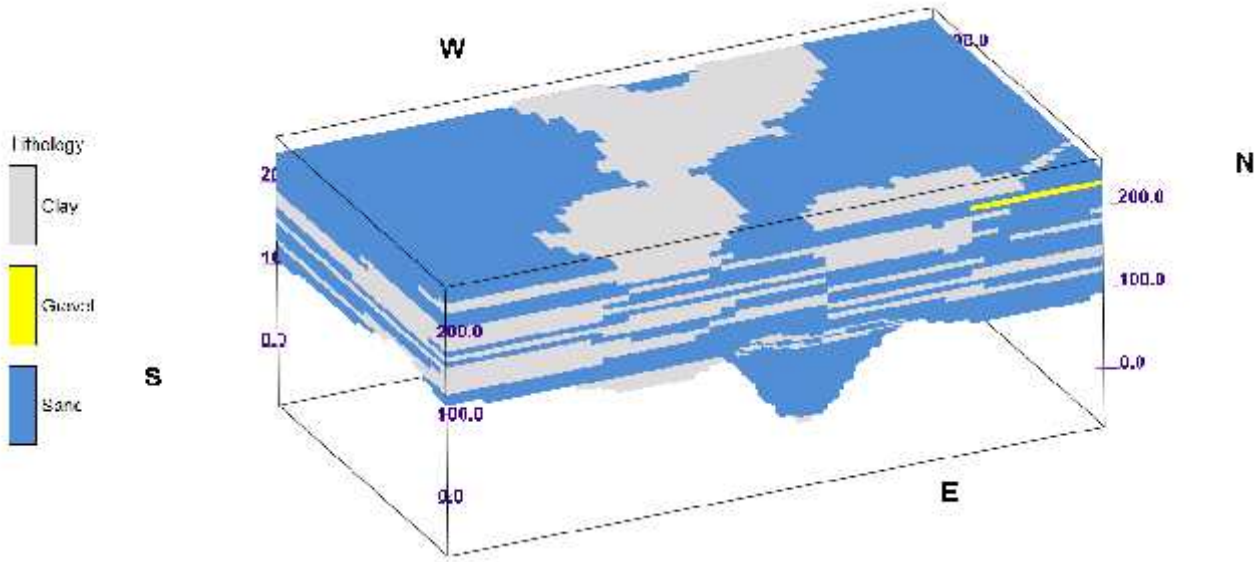

2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (9-69m) | Quaternary Alluvial deposits | Unconfined | 47 | *1450-7190* | 0.072 | $2.00*10^{-2}$ |
| Aquifer-II (81-176m) | | Unconfined to Confined | 67 | - | NA | - |
| Aquifer-III (192-300m) | | Unconfined to Confined | 86 | - | NA | - |

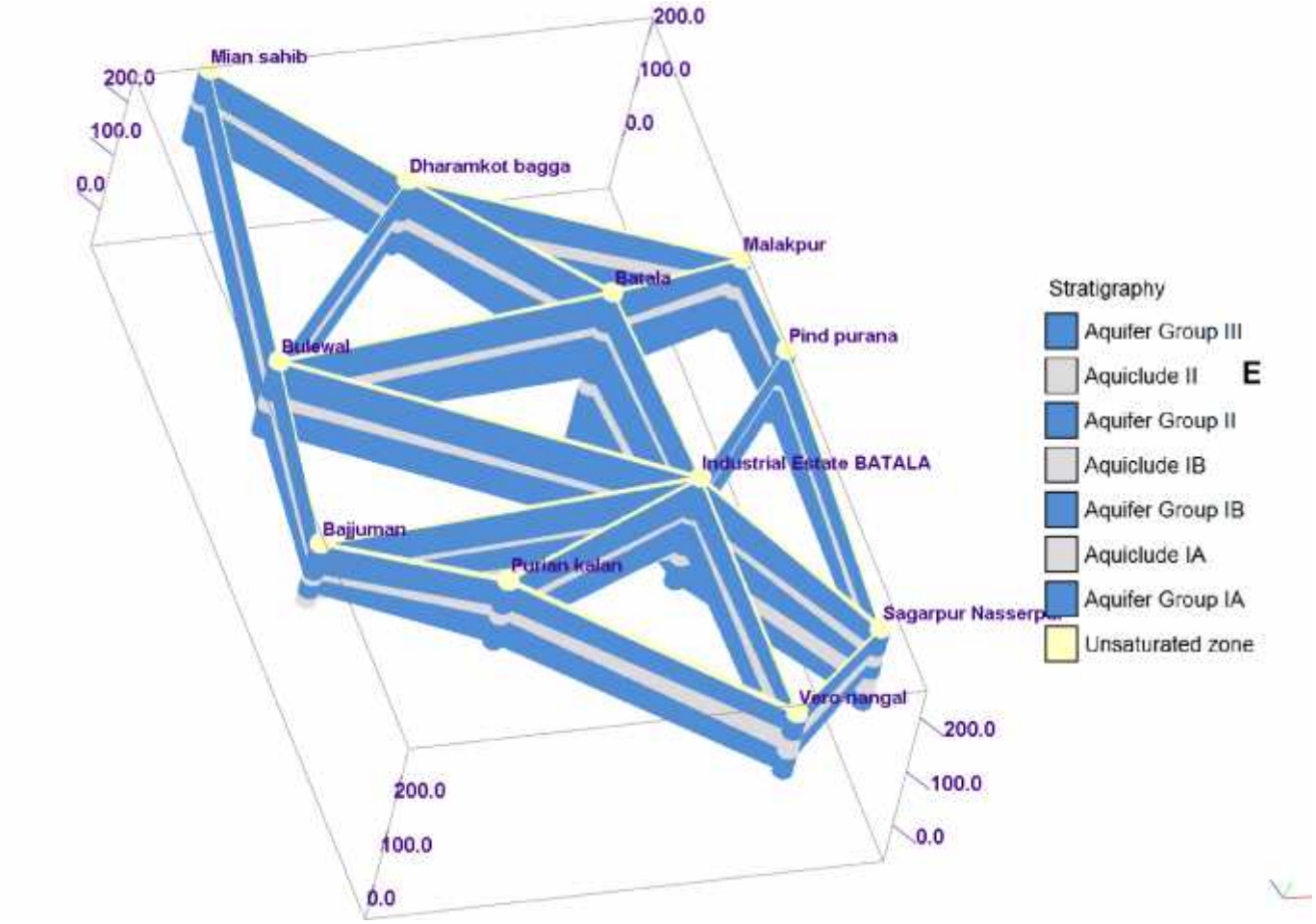
Aquifer comprises of freshwater only and the main Aquifer formation is sand.

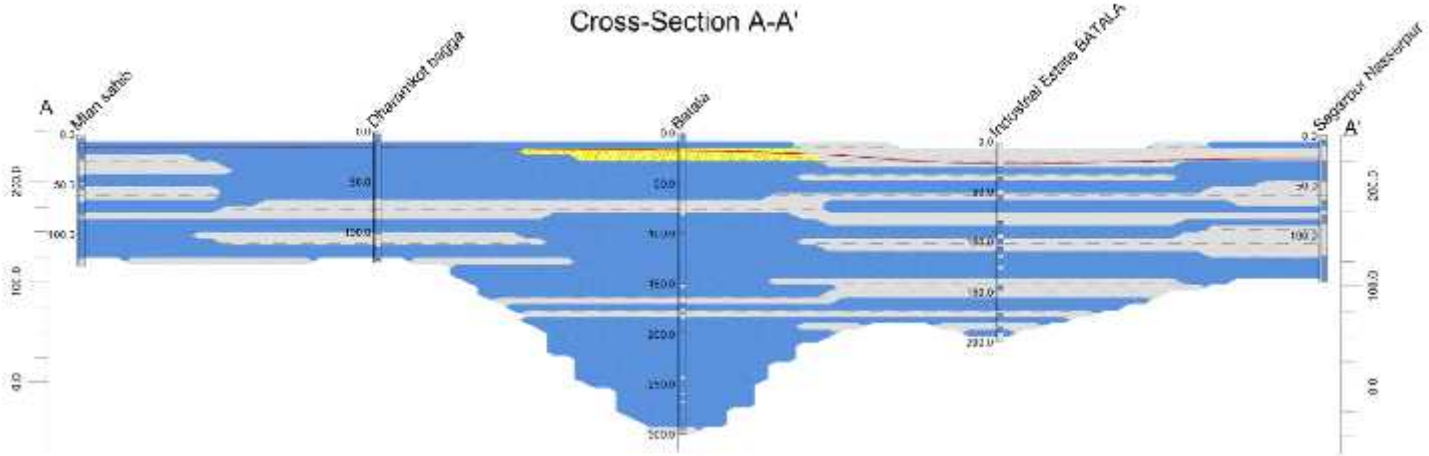
The non-Aquifer material comprise of clay.

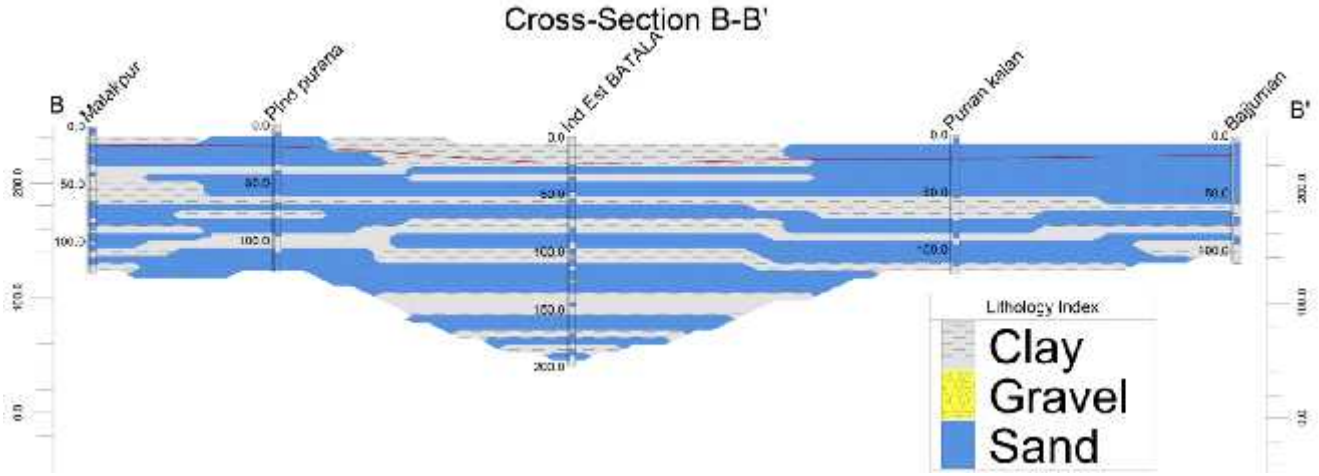
3D Lithology model



# 3D Lithology Fence






## 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquifer wise Water Resources available (in mcm) | Dynamic Aquifer I | *176.09* |
| | In-storage Aquifer I | *941.77* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | 40.28 |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | 56.36 |
| | Total | 1215 |
| Ground Water Extraction (in mcm) | Irrigation | 257.00 |
| | Domestic & Industrial | 11.00 |
| Provision for domestic & Industrial requirement up to 2025 (in mcm) | | 12.68 |
| Chemical Quality of ground water and contamination | | Suitable for drinking and irrigation purposes |
| Other issues | | Declining water level trend |

## 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone up to the average depth to water level (9 m). |

| | |
|---|---|
| Other interventions proposed | Artificial Recharge, Roof top Rainwater Harvesting, Farm recharge by constructing pits will save 3.215 mcm volume of water |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | Lining of underground pipelines (Kutcha channel) will save 70.43 mcm volume of water wastage |
| Change in cropping pattern | Proposed change in cropping pattern from Paddy to maize/soyabean<br>12 % of the total area needs to change the crop from paddy to maize/soyabean<br>Anticipated volume of water to be saved by maize/soyabean is 19.5 mcm |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

# (II) FATEHGARH CHURIAN BLOCK (213.30 SQ KM)

## 1. Salient Information

| | |
|---|---|
| **Population (2011)** | Rural- 117690<br>Urban--<br>Total- 117690 |
| **Rainfall 2014** (Gurdaspur Distt.) | Average annual rainfall - 1047.70 mm |
| **Average Annual Rainfall** (Fatehgarh Churian block) | 700 mm |
| **Agriculture and Irrigation** | Major Crops- Rice, Wheat<br>Other crops-Sugarcane, Potatoes, Pulses,<br>Net Area Sown- 175.54 sq.km<br>Total Irrigated Area- 335.54 sq.km |

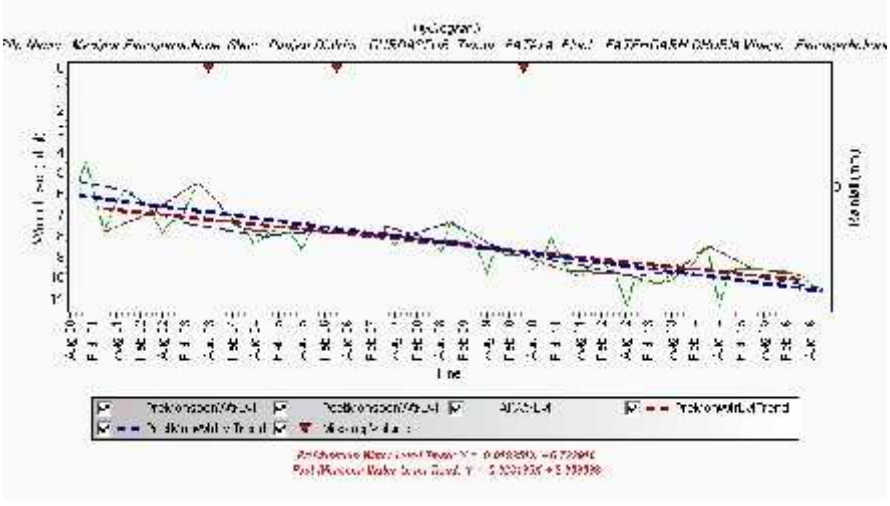
**Water Bodies & Canal Irrigation**

Water bodies available in the villages for storm water and untreated waste water of villagers, can be used for irrigation after treatment. The canal irrigation is also available in the Fatehgarh Churian block.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (32m) is not very prominent in terms of thickness and geographic extent. Aquifer II (48 m) is more prominent & Aquifer III (-na-) data is not available . Block is categorized as Over-Exploited as per Ground Water assessment 2013.

**Ground water Extraction**: Information regarding the abstraction from Aquifer III is not available, but there are drinking water supply from Tubewells tapping combined Aquifer and separate Aquifer could not be assessed separately.

**Water level Behavior (2015)**: Pre Monsoon *6.10-9.56 (mbgl)* & Post Monsoon-*~6.30-9.66 (mbgl)*



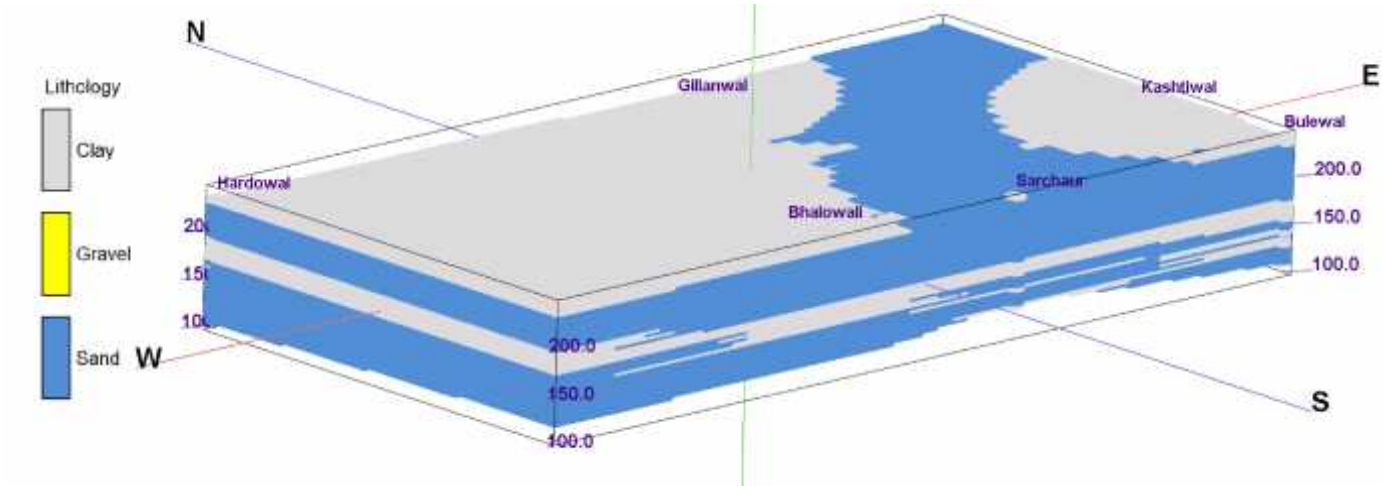
2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (8-57m) | Quaternary Alluvial deposits | Unconfined | 32 | *142-4300* | 0.072 | *$1.0*10^{-3}$ to $4.03*10^{-3}$* |
| Aquifer-II (72-135m) | | Unconfined to Confined | 48 | - | Not assessed | - |
| Aquifer-III (data not available) | | - | - | - | Not assessed | - |

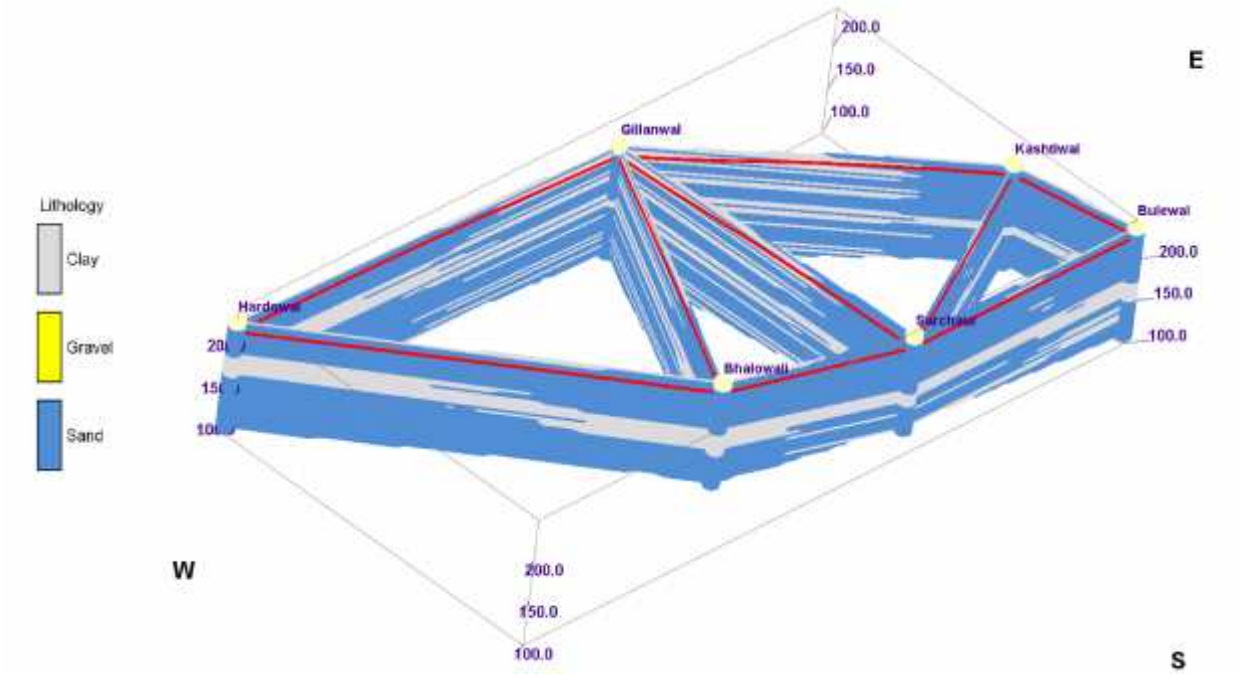
Aquifer comprises of freshwater only and the main Aquifer material is sand.

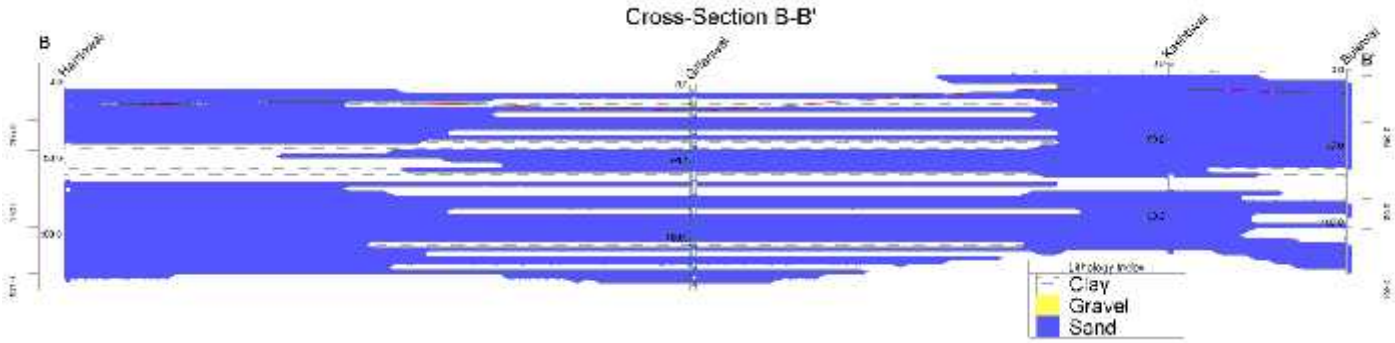
The non-Aquifer material comprise of clay.

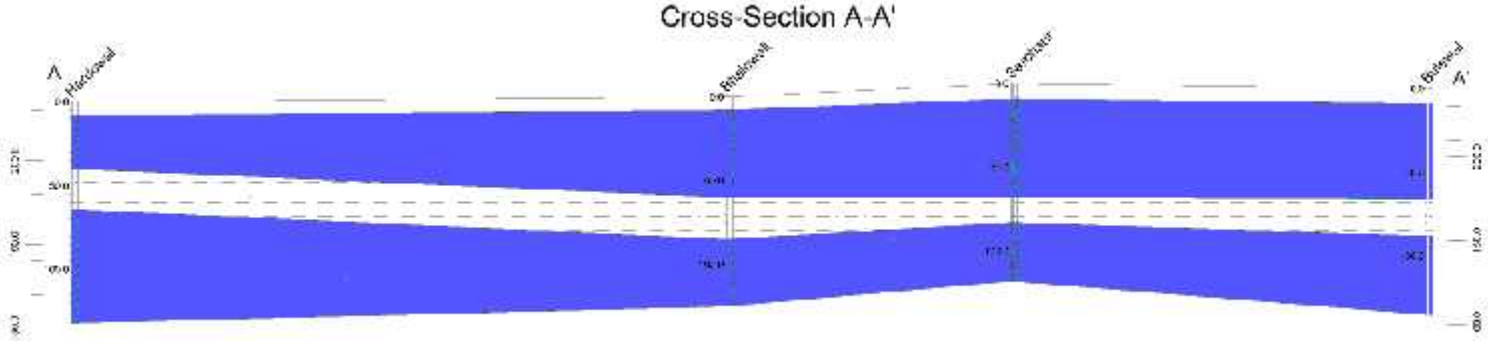
## 3D Lithology model



# 3D Lithology Fence



## 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Ground Water Resources (in mcm) | Dynamic Aquifer I | *186.49* |
| | In-storage Aquifer I | *491.44* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | 22.11 |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | - |
| | Total | 700 |
| Ground Water Extraction (in mcm) | Irrigation | 248.39 |
| | Domestic & Industrial | 3.23 |
| Future Demand for domestic & Industrial sector (2025) (in mcm) | | 3.79 |
| Chemical Quality of ground water | | Potable for drinking and irrigation |
| Other issues | | declining water level trend |

## 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone up to the average depth to water level (8 m). |
| Other interventions proposed | Artificial Recharge, Roof top Rainwater Harvesting, Farm recharge by constructing pits will save 2.549 mcm volume of water |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | Lining of underground pipelines (Kutcha channel) will save 67.90 mcm volume of water wastage |
| Change in cropping pattern | Changing of cropping pattern is not required in the block |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

# (III) KAHNUWAN BLOCK (323.70 SQ KM)

## 1. Salient Information

| | |
|---|---|
| **Population (2011)** | Rural-134576<br>Urban- -<br>Total- 134576 |
| **Rainfall 2014** (Gurdaspur Distt.) | Average annual rainfall - 1047.70 mm |
| **Average Annual Rainfall** (Kahnuwan block) | 624 mm |
| **Agriculture and Irrigation** | Major Crops- Rice, Wheat<br>Other crops- Sugarcane, Potatoes, Pulses,<br>Net Area Sown- 239.19 sq.km<br>Total Irrigated Area- 446.19 sq.km |

**Water Bodies & Canal Irrigation**

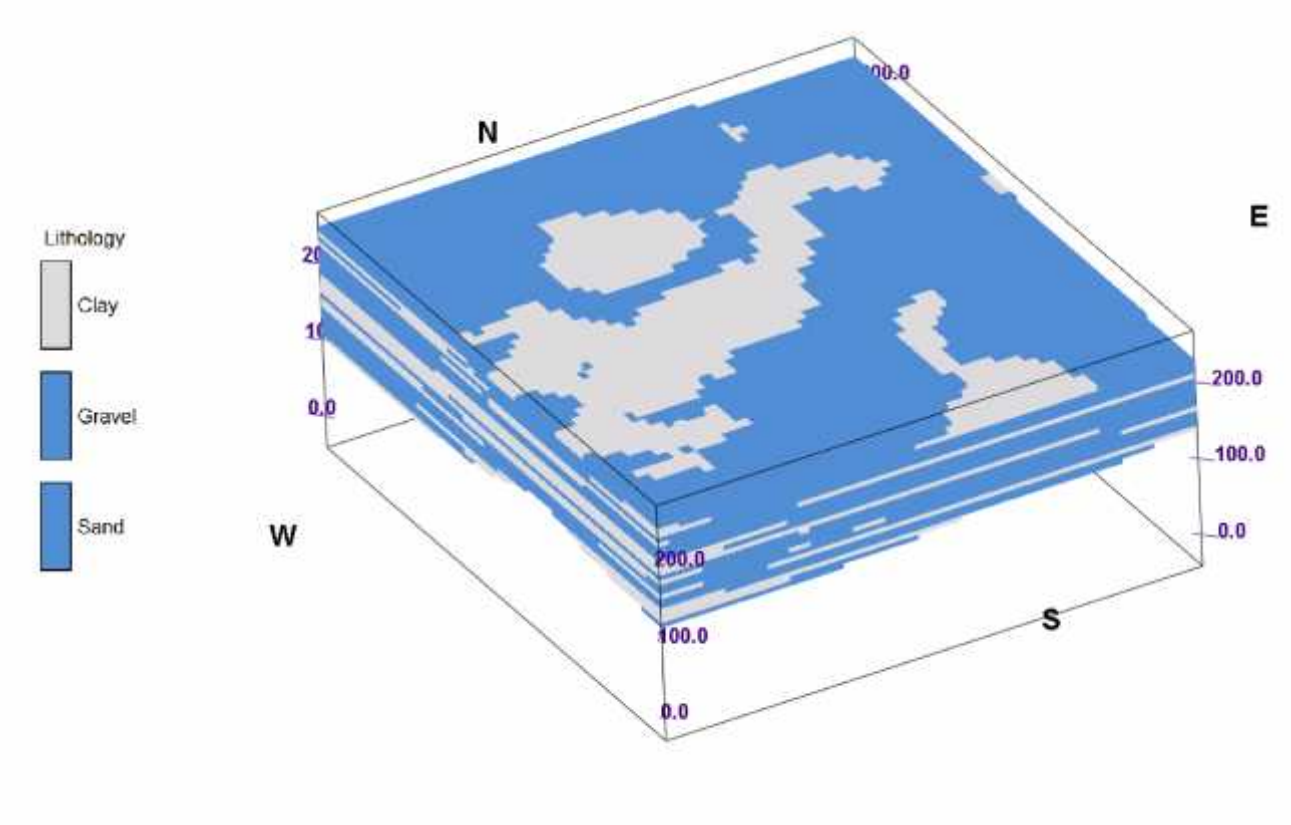
Water bodies are available in the villages for the storm water and untreated water of villagers, that can be used for irrigation after treatment. The canal irrigation is available in the Kahnuwan block.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (56 m) is not very prominent in terms of thickness and geographic extent as compared to Aquifer II (94 m) & III (57) m. Block is categorized as Over-Exploited as per Ground Water Assessment 2013.

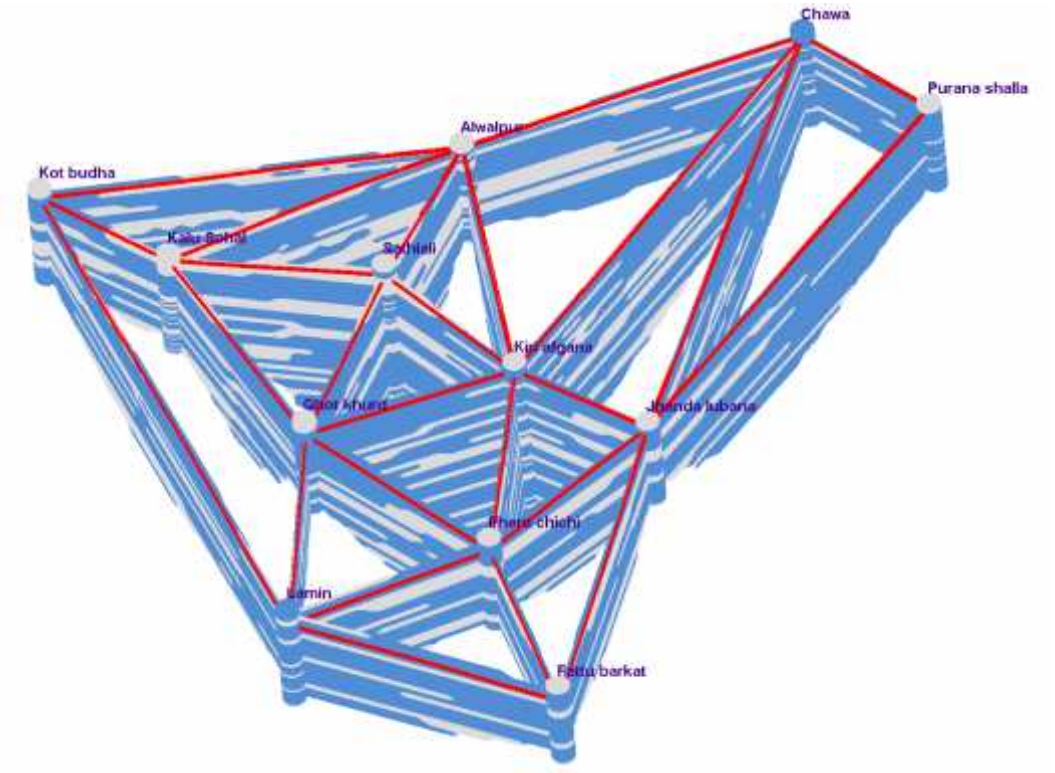
**Ground water Extraction**: Information regarding the abstraction from Aquifer II & III is not available, but there are drinking water supply tapping combined Aquifer and Aquifer could not be assessed separately.

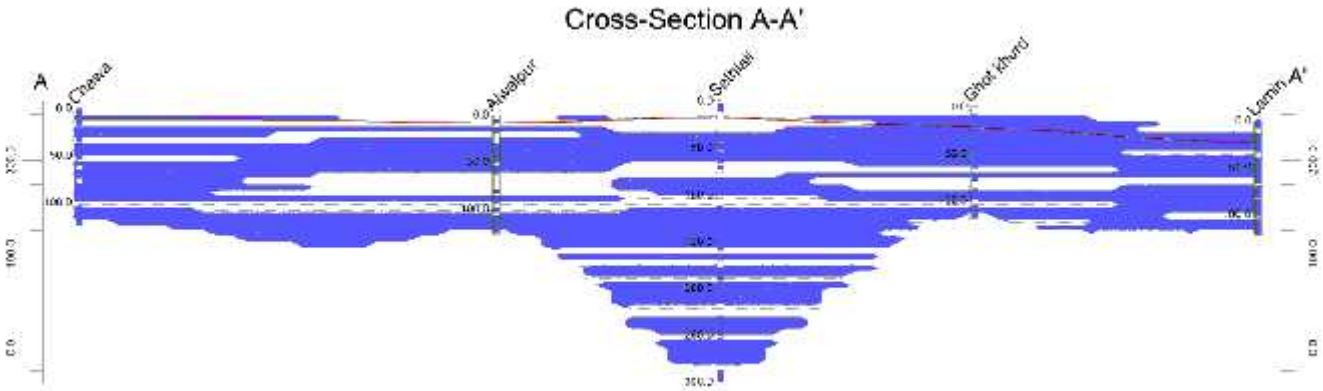
**Water level Behavior (2015)**: Pre Monsoon *3.04-7.60 (mbgl)* &Post Monsoon-*~3.70-8.00(mbgl)*

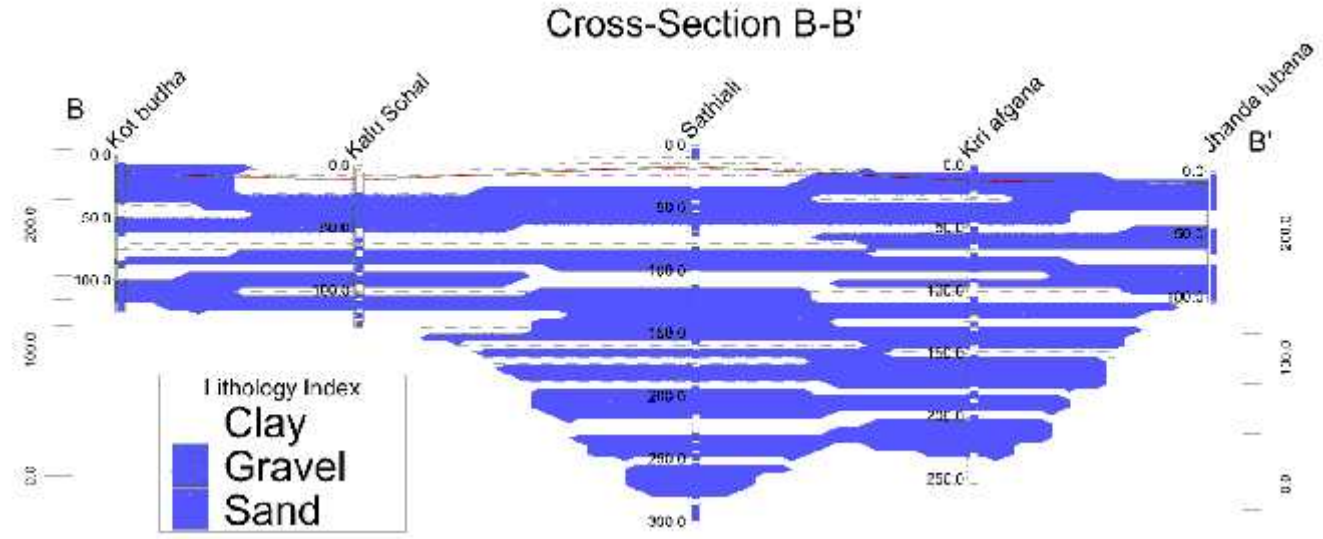
3D Lithology model




3D Lithology Fence




Cross-Section A-A'
A
Chawa
Atualpur
Sathiali
Ghot Khurd
Lamin
A'


Cross-Section B-B'
B
Kot budha
Kalu Sohal
Sathiali
Kiri afgana
Jhanda lubana
B'
Lithology Index
Clay
Gravel
Sand

2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (11- 96m) | Quaternary Alluvial deposits | Unconfined | 56 | *142-4300* | 0.072 | *$1.0*10^{-3}$ to $4.03*10^{-3}$* |
| Aquifer-II (107-220m) | | Unconfined to Confined | 113 | - | NA | - |
| Aquifer-III (230-300m) | | Unconfined to Confined | 70 | - | NA | - |

Aquifer comprises of freshwater only and the main Aquifer material is sand.

The non-Aquifer material comprise of clay.

### 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquifer wise Resources available(in mcm) | Dynamic Aquifer I | *206* |
| | In-storage Aquifer I | *1305* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | 65.72 |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | 43.45 |
| | Total | 1620 |
| Ground Water Extraction (in mcm) | Irrigation | 255.02 |
| | Domestic & Industrial | 3.03 |
| Provision for domestic & Industrial requirement upto2025 (in mcm) | | 3.71 |
| Chemical Quality of ground water & contamination | | Potable for drinking and irrigation purposes |
| Other issues | | declining water level trend |

### 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone upto the average depth to water level (11 m). |
| Other interventions proposed | Artificial Recharge, Roof top Rainwater Harvesting, Farm recharge by constructing pits will save 4.586 mcm volume of water |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | Lining of underground pipelines (Kutcha channel) will save 69.79 mcm volume of water wastage |
| Change in cropping pattern | Changing of cropping pattern is not required in the block |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

## 6. KALANOUR BLOCK (206.20 SQ KM)

### 1. Salient unformation

**Population (2011)** Rural- 81650
Urban- -
Total- 81650

**Rainfall 2014** (Gurdaspur Distt.) Average annual rainfall - 1047.70 mm

**Average Annual Rainfall** (Kalanour block) 795 mm

**Agriculture and Irrigation** Major Crops- Rice, Wheat
Other crops- Sugarcane, Potatoes, Pulses,
Net Area Sown- 160.08 sq.km
Total Irrigated Area- 312.08 sq.km

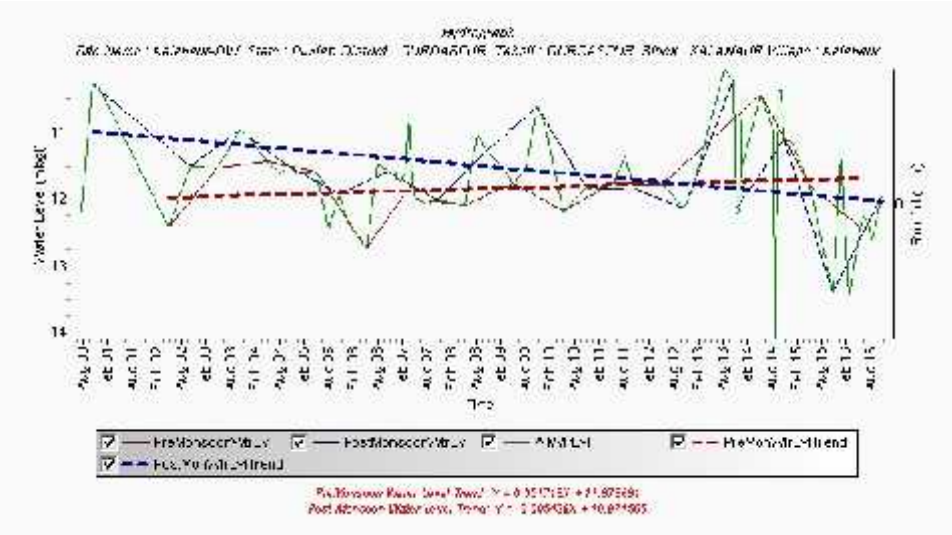
**Water Bodies & Canal Irrigation**

Water bodies are available in the villages for the storm water and untreated water of villagers, that can be used for irrigation after treatment. The canal irrigation is available in the Kalanour block.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (48 m) is not very prominent in terms of thickness and geographic extent as compared to Aquifer II (68 m) & Aquifer III is (86 m) Block is categorized as Over-Exploited as per Ground Water assessment 2013.

**Ground water Extraction**: Information regarding the abstraction from Aquifer III is not available, but there are drinking water supply from tube wells tapping combined Aquifer and separate Aquifer could not be assessed separately.

**Water level Behavior (2015)**: Pre Monsoon 3.04- 11.79 *(mbgl) &*Post Monsoon- ~ 3.80 – 11.09 *(mbgl)*



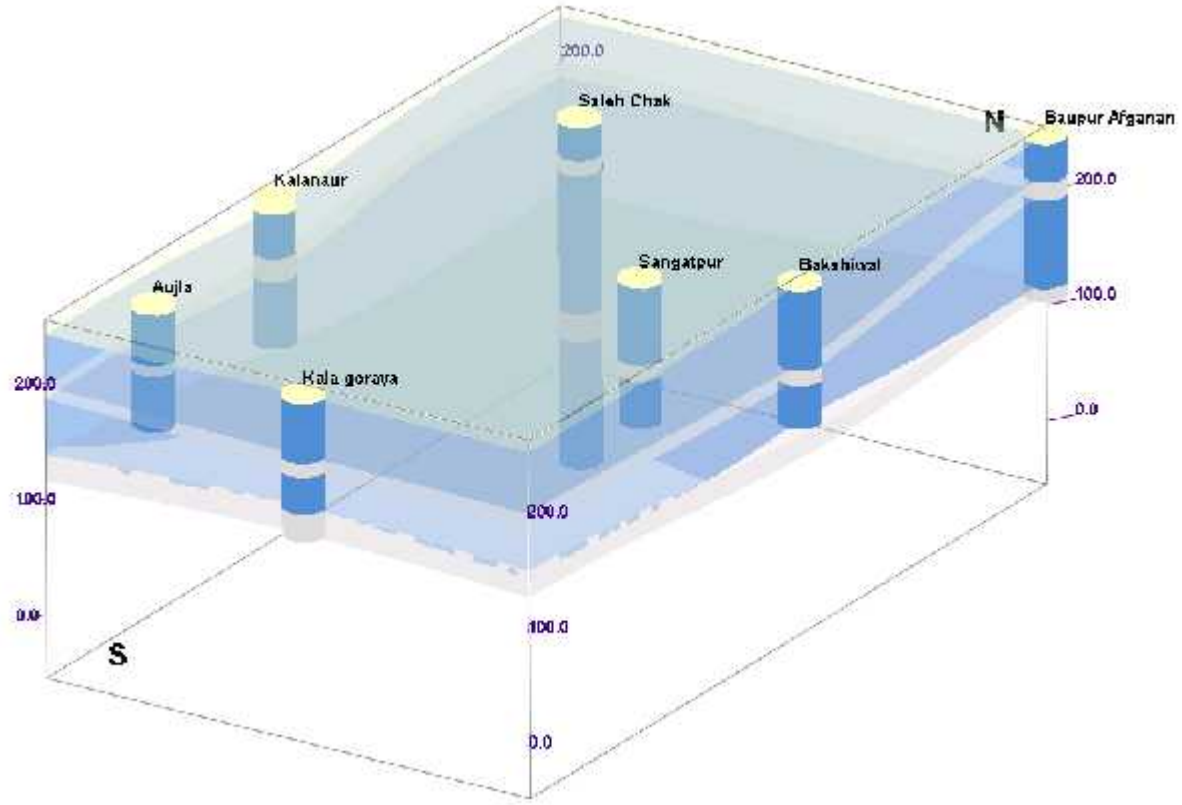
2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (6-54m) | Quaternary Alluvial deposits | Unconfined | 79 | *142-4300* | 0.072 | $1.0*10^{-3}$ *to* $4.03*10^{-3}$ |
| Aquifer-II (74-158m) | | Unconfined to Confined | 68 | - | NA | - |
| Aquifer-III (190-300m) | | Unconfined to Confined | 86 | - | NA | - |

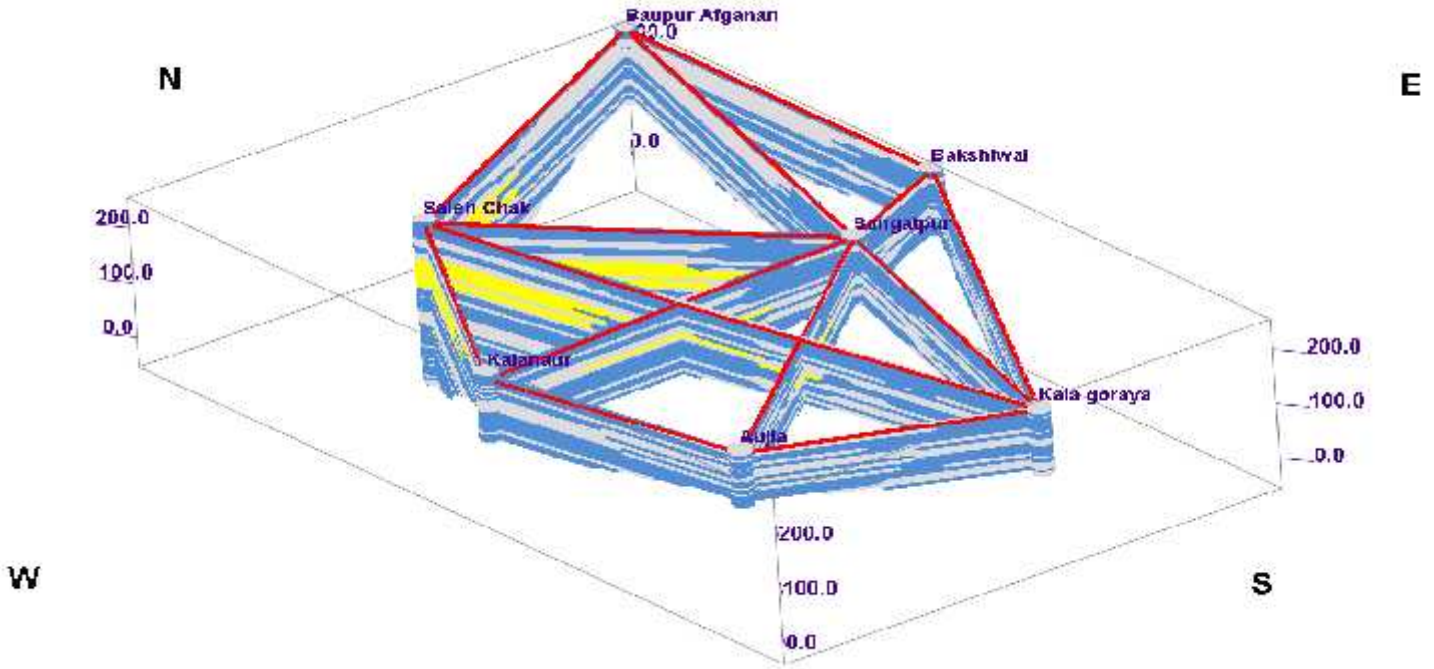
Aquifer comprises of freshwater only and the main Aquifer material is sand.

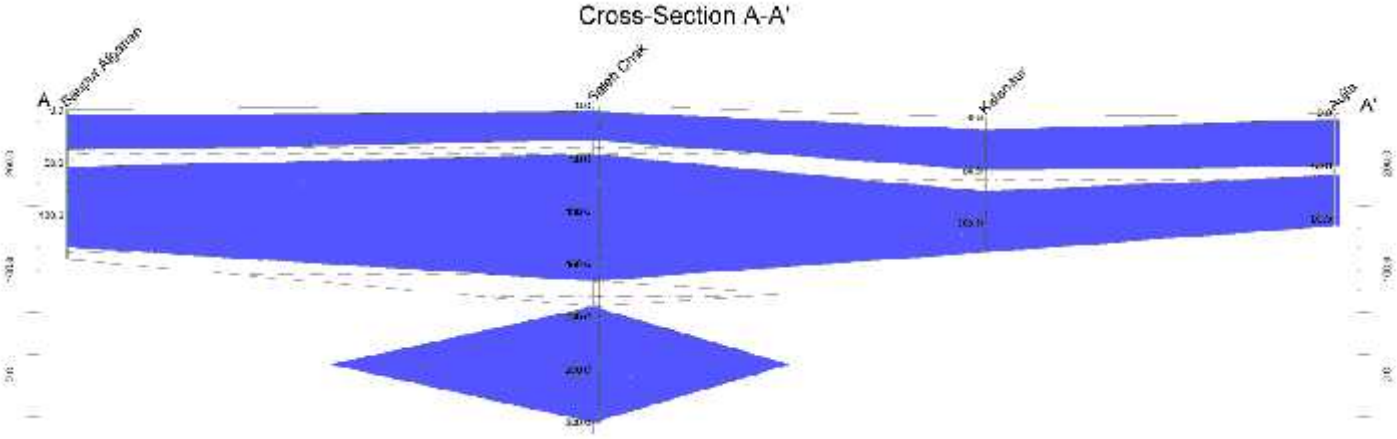
The non-Aquifer material comprise of clay.

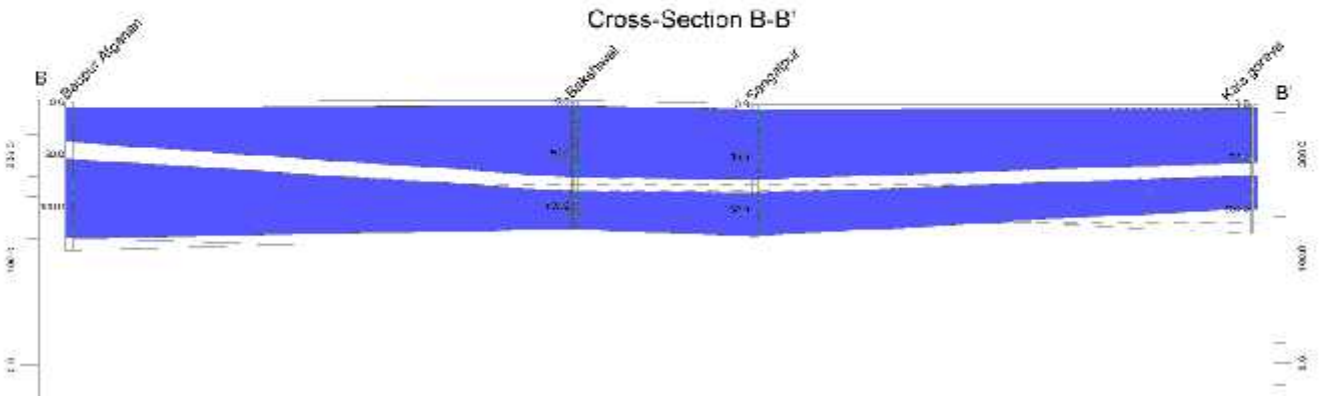
3D Lithology model



3D Lithology Fence






## 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquifer wise Water Resources available (in mcm) | Dynamic Aquifer I | *133.60* |
| | In-storage Aquifer I | *570.53* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | 33.25 |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | 45.85 |
| | Total | 783 |
| Ground Water Extraction (in mcm) | Irrigation | 173.54 |
| | Domestic & Industrial | 1.86 |
| Provision for domestic & Industrial sector (2025) (in mcm) | | 2.27 |
| Chemical Quality of ground water | | Potable for drinking and irrigation |
| Other issues | | declining water level trend |

## 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone up to the average depth to water level (6 m). |
| Other interventions proposed | Artificial Recharge, Roof top Rainwater Harvesting, Farm recharge by constructing pits will save 2.462 mcm volume of water |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | Lining of underground pipelines (Kutcha channel) will save 48.06 mcm volume of water wastage |
| Change in cropping pattern | Changing of cropping pattern is not required in the block |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

# 7. QUADIAN BLOCK (180.86 SQ KM)

## 1. Salient Features

**Population (2011)** Rural-96436
Urban- 1733
Total- 98169

**Rainfall 2014** (Gurdaspur Distt.) Average annual rainfall – 1047.70 mm

**Average Annual Rainfall** (Quadian block) 894 mm

**Agriculture and Irrigation** Major Crops- Rice, Wheat
Other crops- Sugarcane, Potatoes, Pulses,
Net Area Sown- 159.62 sq.km
Total Irrigated Area- 320.62 sq.km

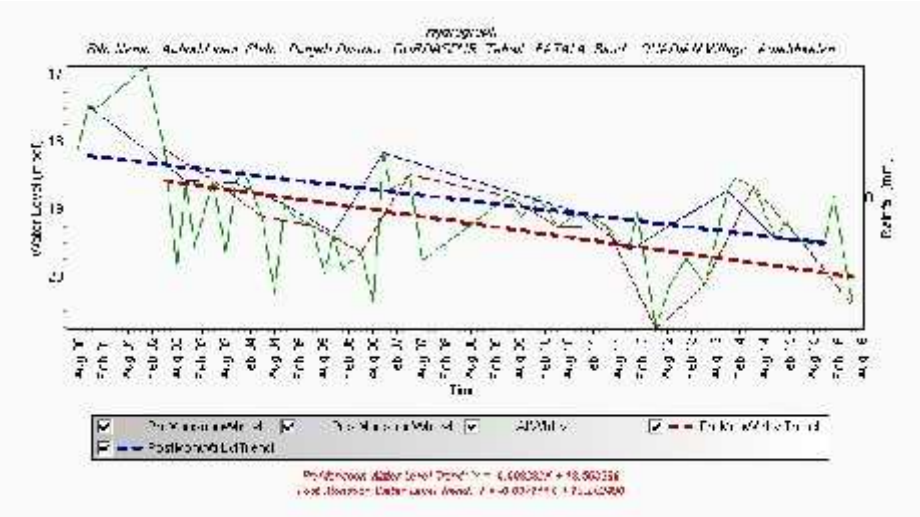
**Water Bodies & Canal Irrigation**

Water bodies are available in the villages for the storm water and untreated water of villagers, that can be used for irrigation after treatment. The canal irrigation is available in the Quadian block.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (95 m) is very prominent in terms of thickness and geographic extent. Aquifer II (62 m) is less in thickness & Aquifer III is (42 m). Block is categorized as Critical as per Ground Water assessment 2013.

**Ground water Extraction**: Information regarding the abstraction from Aquifer III is not available, but there are drinking water supply tapping from Tubewell combined Aquifer and separate Aquifer could not be assessed separately.

**Water level Behavior (2015)** : Pre Monsoon *9.00-19.51 (mbgl)* &Post Monsoon- *~ 6.80-15.10 (mbgl)*



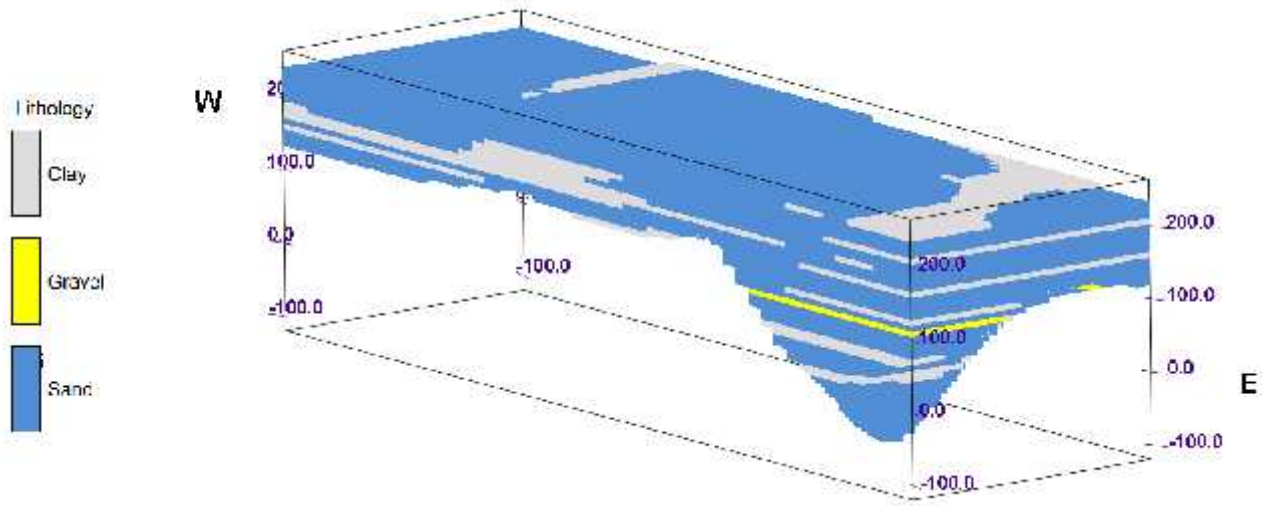
2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (12-135m) | Quaternary Alluvial deposits | Unconfined | 95 | *142-4300* | 0.072 | *$1.0*10^{-3}$ to $4.03*10^{-3}$* |
| Aquifer-II (145-238m) | | Unconfined to Confined | 62 | - | NA | - |
| Aquifer-III (253-300m) | | Unconfined to Confined | 42 | - | NA | - |

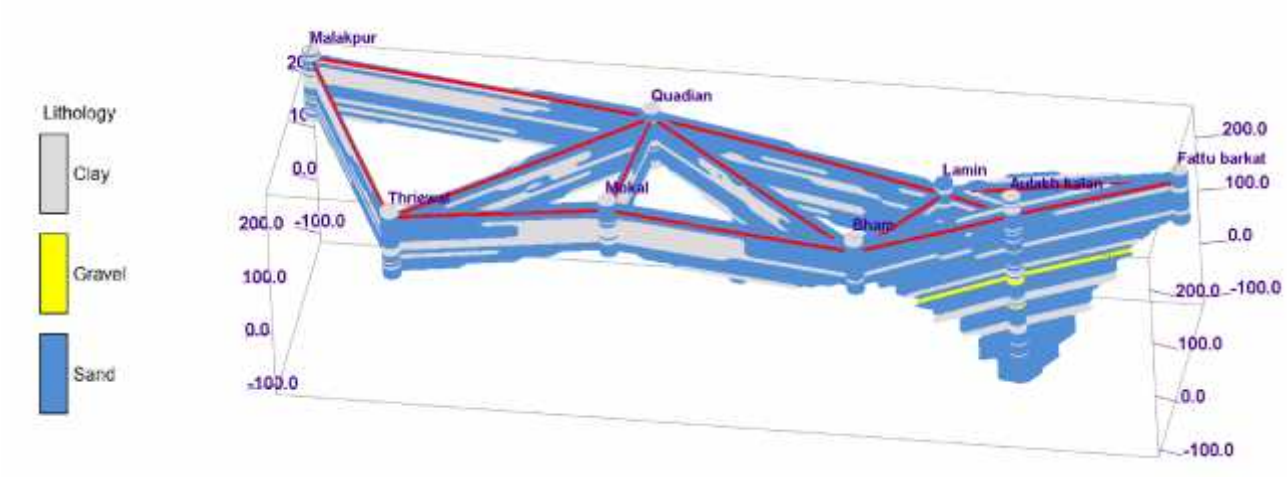
Aquifer comprises of freshwater only and the main Aquifer formation is sand.

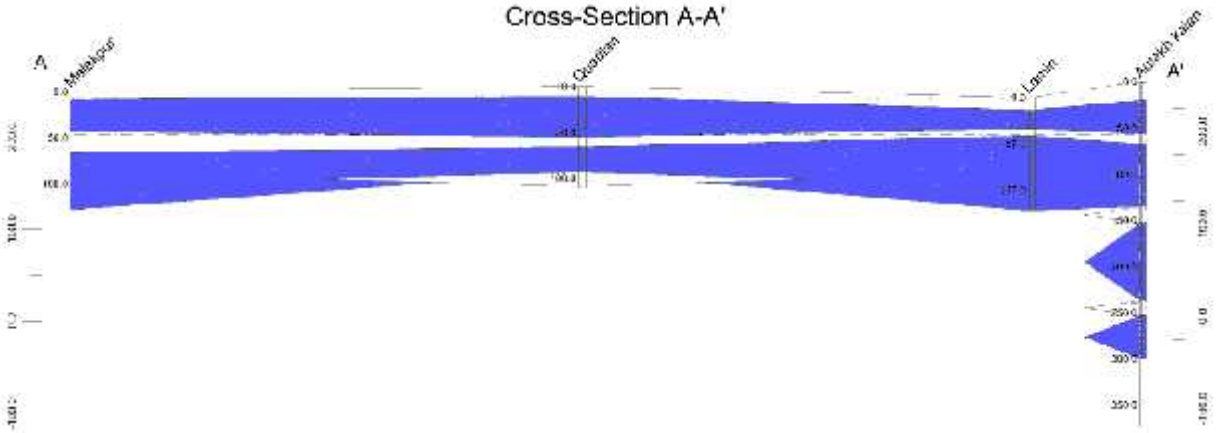
The non-Aquifer material comprise of clay.

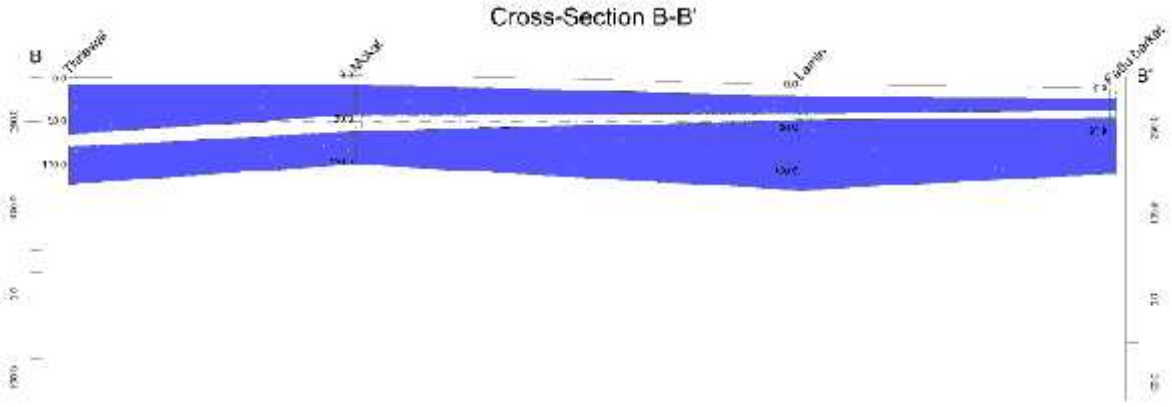
3D Lithology model



# 3D Lithology Fence



## 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquifer wise Water Resource available (in mcm) | Dynamic Aquifer I | *119.91* |
| | In-storage Aquifer I | *1235.30* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | 24.19 |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | 17.86 |
| | Total | 1397 |
| Ground Water Extraction (in mcm) | Irrigation | 151.58 |
| | Domestic & Industrial | 2.41 |
| provision for domestic & Industrial requirement up to 2025 (in mcm) | | 2.91 |
| Chemical Quality of ground water & contamination | | suitable for drinking and irrigation purposes |
| Other issues | | declining water level trend |

## 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone upto the average depth to water level (12m). |
| Other interventions proposed | Artificial Recharge, Roof top Rainwater Harvesting, Farm recharge by constructing pits will save 2.849 mcm volume of water |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | Lining of underground pipelines (Kutcha channel) will save 41.98 mcm volume of water wastage |
| Change in cropping pattern | Changing of cropping pattern is not required in the block |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

## 8. SRI HARGOBINDPUR BLOCK (326.40 SQ KM)

### 1. Salient Information

**Population (2011)** Rural- 116271
Urban- -
Total- 116271

**Rainfall 2014 (**Gurdaspur Distt.) Average annual rainfall – 1047.70 mm

**Average Annual Rainfall** (Sri Hargobindpur block) 816 mm

**Agriculture and Irrigation** Major Crops- Rice, Wheat
Other crops- Sugarcane, Potatoes, Pulses,
Net Area Sown- 195.85 sq.km
Total Irrigated Area- 393.85 sq.km

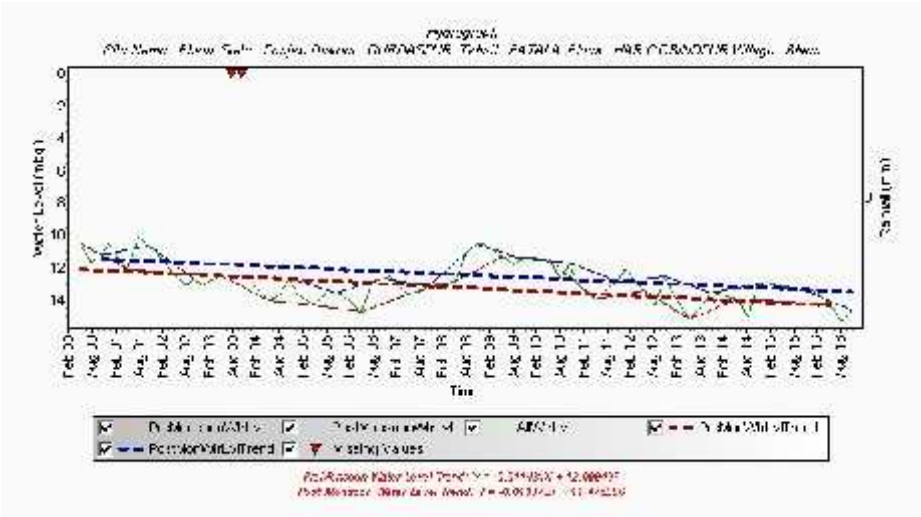
**Water Bodies & Canal Irrigation**

Water bodies are available in the villages for the storm water and untreated water of villagers, that can be used for irrigation after treatment. The canal irrigation is available in the Sri Hargobindpur block.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (77 m) is very prominent in terms of thickness and geographic extent. Aquifer II (74 m) is very prominent in terms of thickness & Aquifer III is (55 m) Block is categorized as Over-Exploited as per Ground Water assessment 2013

**Ground water Extraction**: Information regarding the abstraction from Aquifer III is not available, but there are drinking water supply from tubewells tapping combined Aquifer and separate Aquifer could not be assessed separately.

**Water level Behavior (2015)**: Pre Monsoon *4.50-15.65 (mbgl)* &Post Monsoon- *~ 4.50-15.65 (mbgl)*



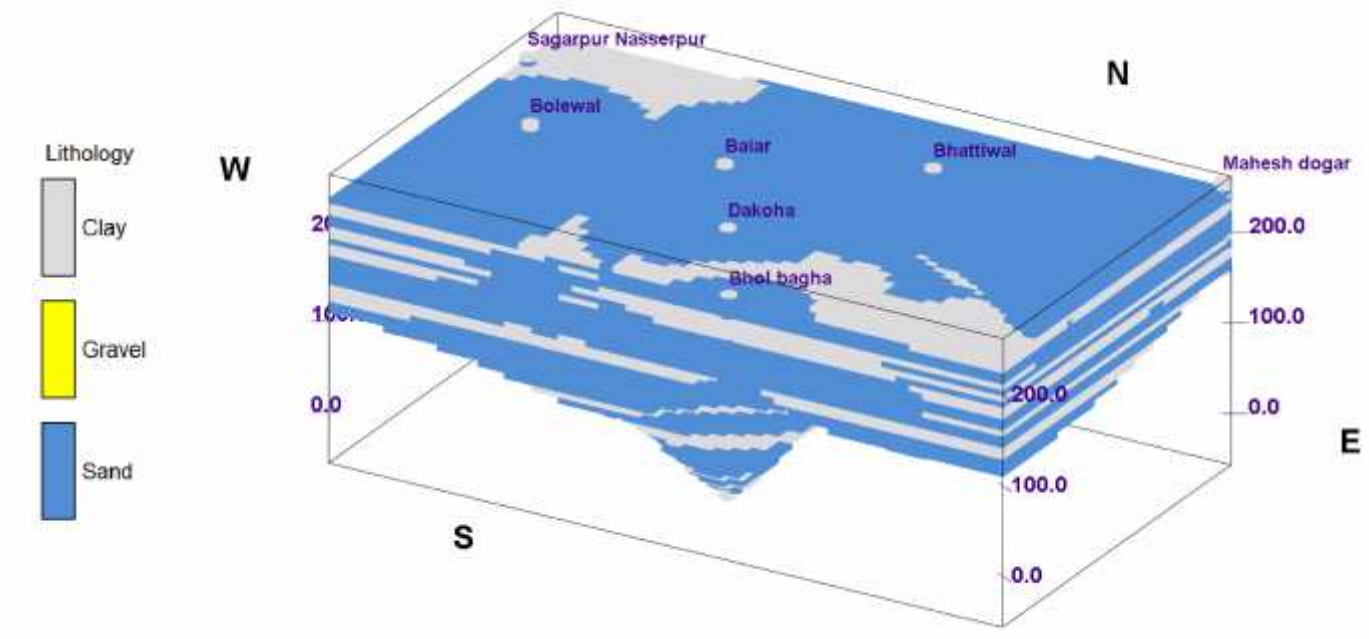
2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (15-103m) | Quaternary Alluvial deposits | Unconfined | 77 | *142-4300* | 0.072 | *$1.0*10^{-3}$ to $4.03*10^{-3}$* |
| Aquifer-II (116-202m) | | Unconfined to Confined | 74 | - | NA | - |
| Aquifer-III (218-300m) | | Unconfined to Confined | 55 | - | NA | - |

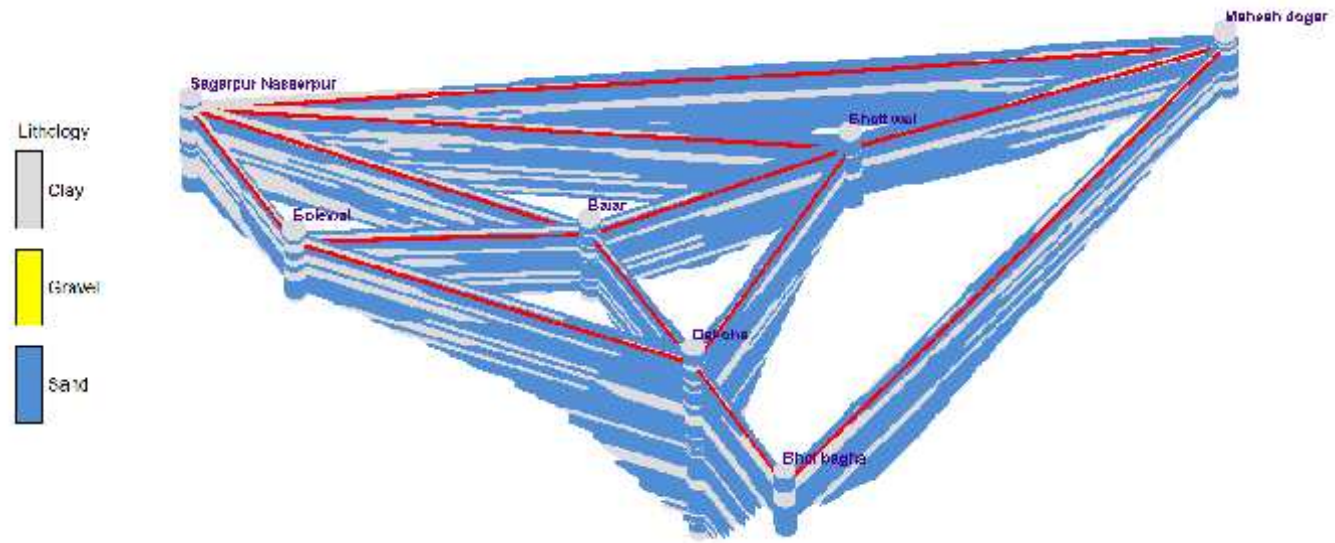
Aquifer comprises of freshwater only and the main Aquifer material is sand.

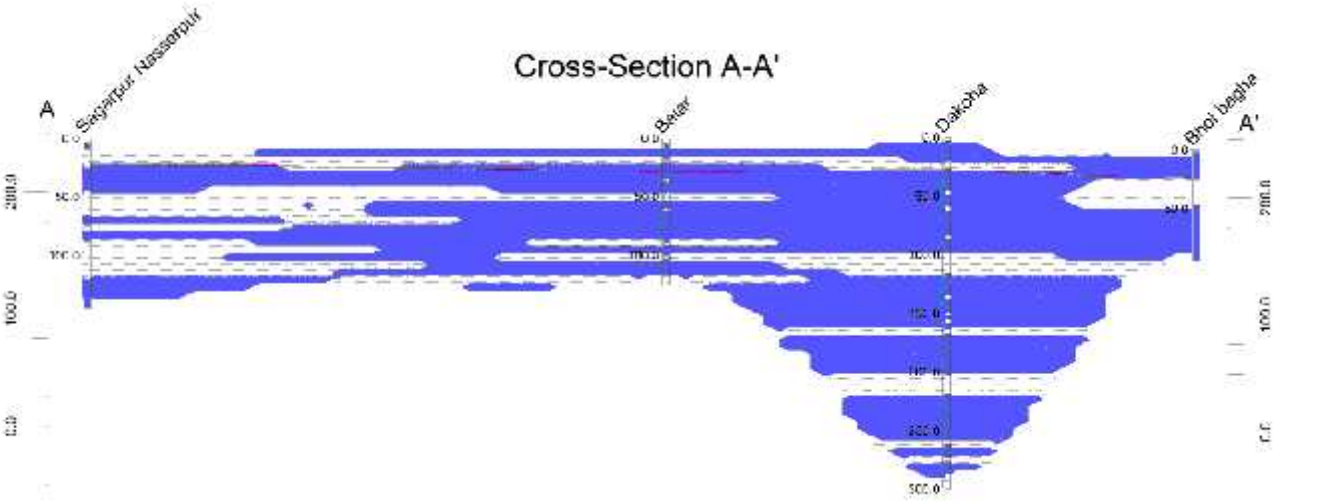
The non-Aquifer material comprise of clay.

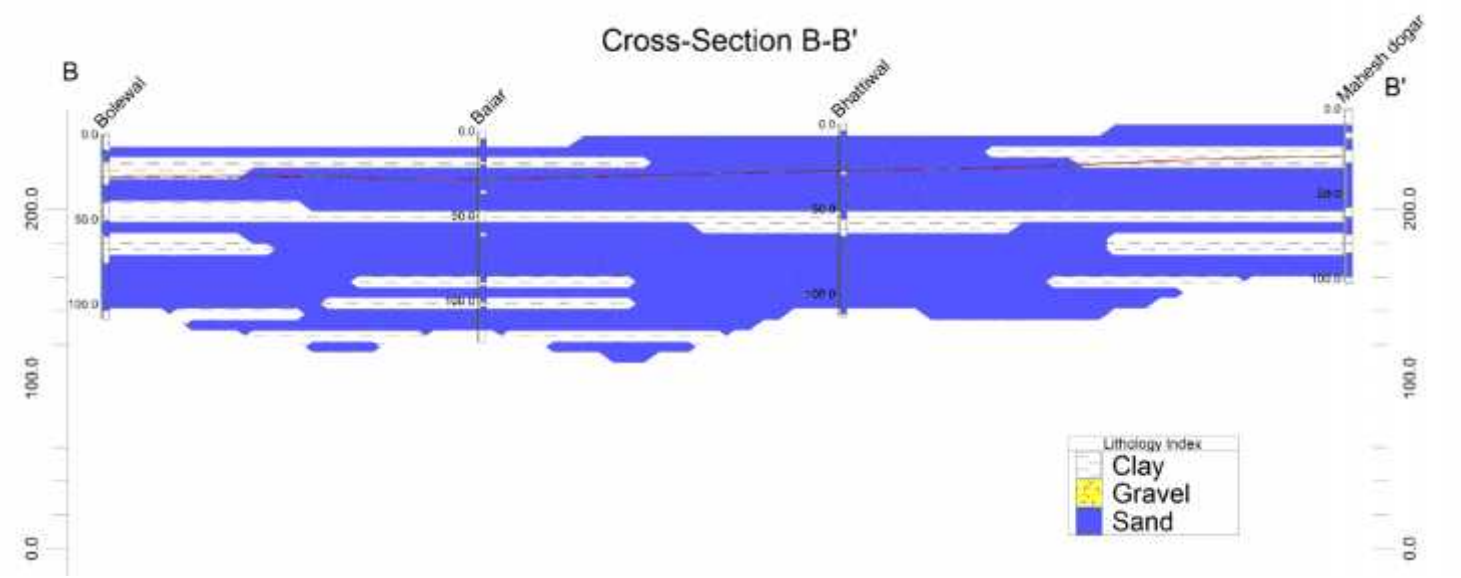
3D Lithology model



# 3D Lithology Fence




Cross-Section B-B'
B
B'
Bolewal
Bajar
Bhattiwal
Mahesh dogar
200.0
100.0
0.0
Lithology Index
Clay
Gravel
Sand

### 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquiferwise Water Resource available(in mcm) | Dynamic Aquifer I | *154.07* |
| | In-storage Aquifer I | *1570.62* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | 45.28 |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | 36.69 |
| | Total | 1807 |
| Ground Water Extraction (in mcm) | Irrigation | 174.74 |
| | Domestic & Industrial | 3.37 |
| Provision for domestic & Industrial requirement upto 2025 (in mcm) | | 3.98 |
| Chemical Quality of ground water & contamination | | Suitable for drinking and irrigation purposes |
| Other issues | | declining water level trend |

### 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone upto the average depth to water level (15m). |
| Other interventions proposed | Artificial Recharge, Roof top Rainwater Harvesting, Farm recharge by constructing pits will save 3.346 mcm volume of water |

### 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | Lining of underground pipelines (Kutcha channel) will save 48.39 mcm volume of water wastage |
| Change in cropping pattern | Changing of cropping pattern is not required in the block |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

## 9. DERA BABA NANAK BLOCK (294.50 SQ KM)

### 1. Salient information

**Population (2011)** Rural- 115015
Urban- 4001
Total- 119016

**Rainfall 2014** (Gurdaspur Distt.) Average annual rainfall – 1047.70 mm

**Average Annual Rainfall** (Dera Baba Nanak block) 706 mm

**Agriculture and Irrigation** Major Crops- Rice, Wheat
Other crops- Sugarcane, Potatoes, Pulses,
Net Area Sown- 252.71 sq.km
Total Irrigated Area- 488.71 sq.km

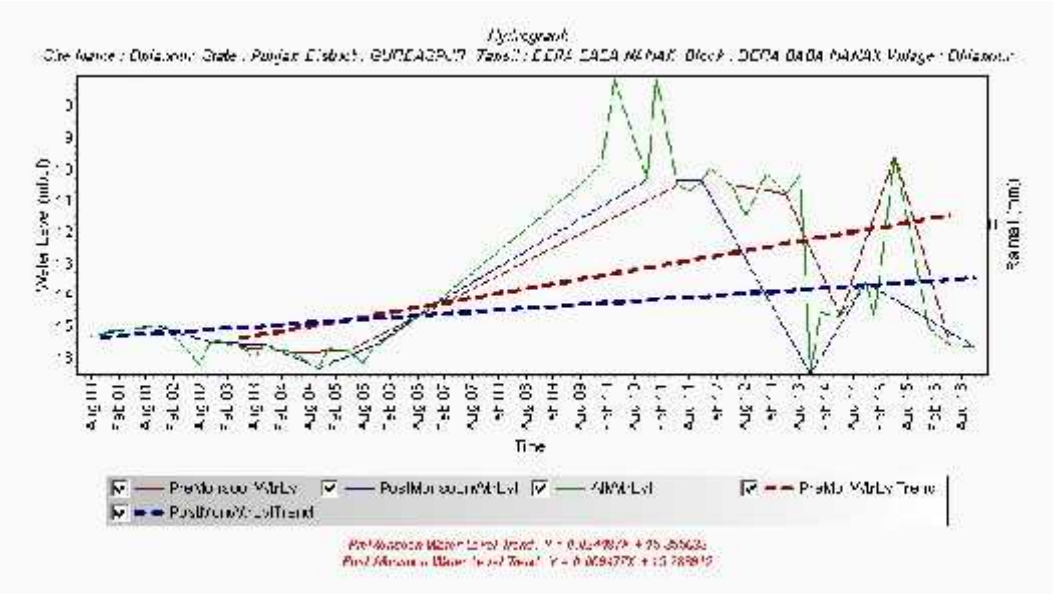
**Water Bodies & Canal Irrigation**

Water bodies available in the villages for storm water and untreated waste water of villagers, that can be used for irrigation after treatment. The canal irrigation is also available in the Dera Baba Nanak block.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (30 m) is not very prominent in terms of thickness and geographic extent. Aquifer II (75 m) is prominent in thickness & Aquifer III is (42 m). Block is categorized as Over-Exploited as per ground water assessment 2013.

**Ground water Extraction**: Information regarding the abstraction from Aquifer III is not available, but there are drinking water supply from tubewelss tapping combined Aquifer and separate Aquifer could not be assessed separately.

**Water level Behavior (2015)**: Pre Monsoon 2.00-10.00 (mbgl)



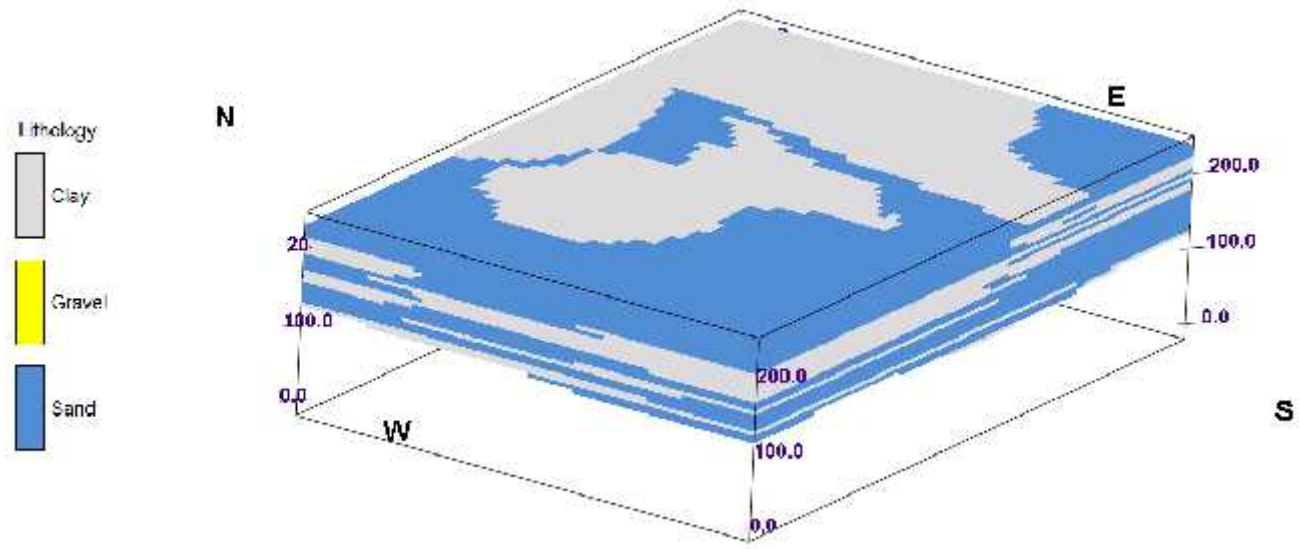
2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (7-55 m) | Quaternary Alluvial deposits | Unconfined | 30 | *142-4300* | 0.072 | $1.0*10^{-3}$ *to* $4.03*10^{-3}$ |
| Aquifer-II (57-165 m) | | Unconfined to Confined | 75 | - | NA | - |
| Aquifer-III (196-256m) | | Unconfined to Confined | 42 | - | NA | - |

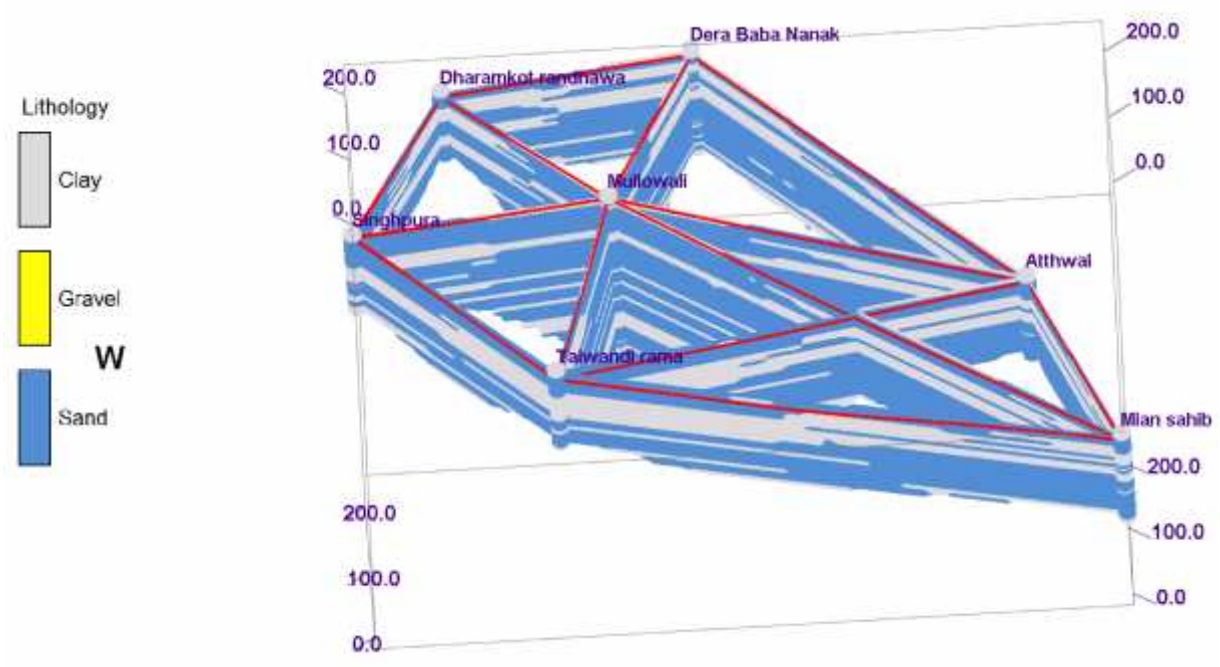
Aquifer comprises of freshwater only and the main Aquifer matirial is sand.

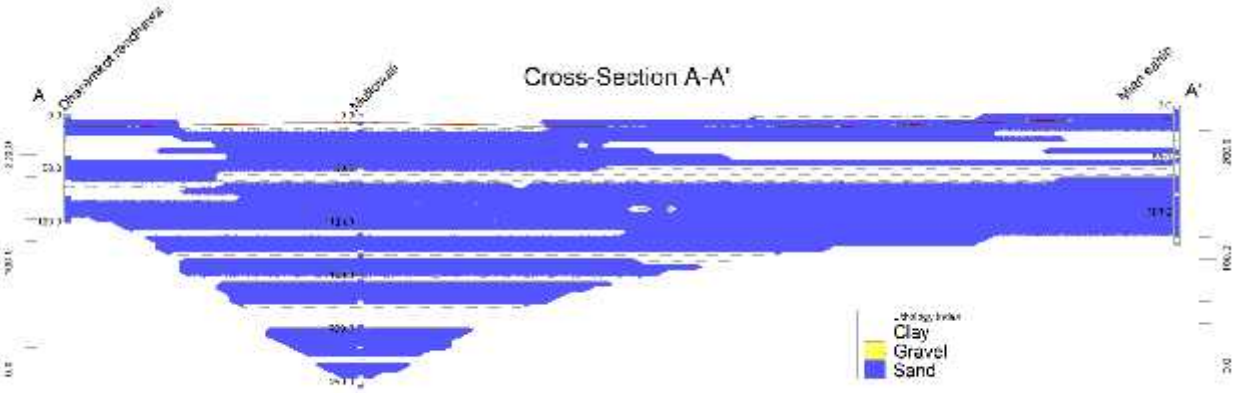
The non-Aquifer material comprise of clay.

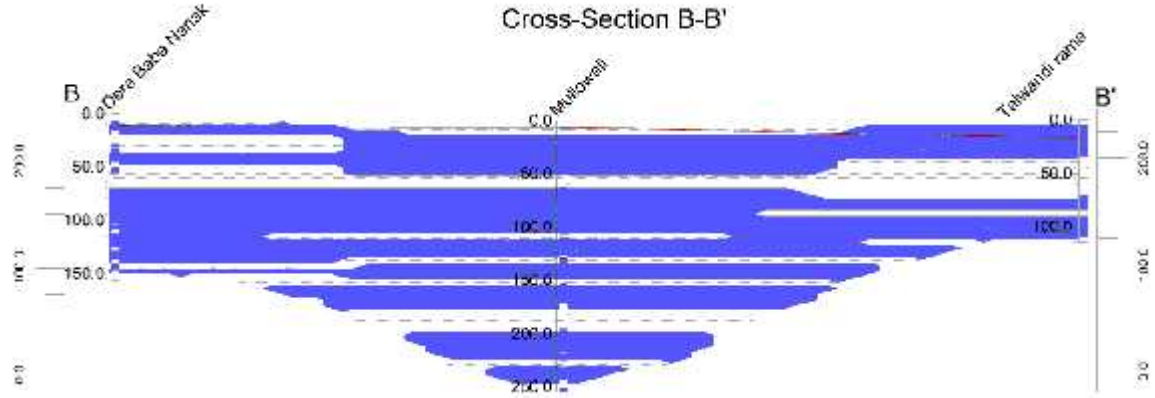
3D Lithology model



# 3D Lithology Fence



## 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquifer wise Water Resource available (in mcm) | Dynamic Aquifer I | *176.91* |
| | In-storage Aquifer I | *636.12* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | 47.71 |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | 29.13 |
| | Total | 890 |
| Ground Water Extraction (in mcm) | Irrigation | 244.68 |
| | Domestic & Industrial | 3.38 |
| Provision for domestic & Industrial sector requirement up to 2025 (in mcm) | | 4.05 |
| Chemical Quality of ground water | | Suiatable for drinking and irrigation |
| Other issues | | declining water level trend |

## 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone upto the average depth to water level (7m). |
| Other interventions proposed | Artificial Recharge, Roof top Rainwater Harvesting, Farm recharge by constructing pits will save 3.098 mcm volume of water |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | Lining of underground pipelines (Kutcha channel) will save 67.77 mcm volume of water wastage |
| Change in cropping pattern | Proposed change in cropping pattern from Paddy to maize/soyabean<br>3 % of the total area needs to change the crop from paddy to maize/soyabean<br>Anticipated volume of water to be saved by maize/soyabean is 6 mcm |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

# DHARIWAL BLOCK (256.80 SQ KM)

## 1. Salient information

**Population (2011)** Rural- 138380
Urban- 7721
Total- 146101

**Rainfall 2014** (Gurdaspur Distt.) Average annual rainfall – 1047.70 mm

**Average Annual Rainfall** (Dhariwal block) 819 mm

**Agriculture and Irrigation** Major Crops- Rice, Wheat
Other crops- Sugarcane, Potatoes, Pulses,
Net Area Sown- 174.30 sq.km
Total Irrigated Area- 330.30 sq.km

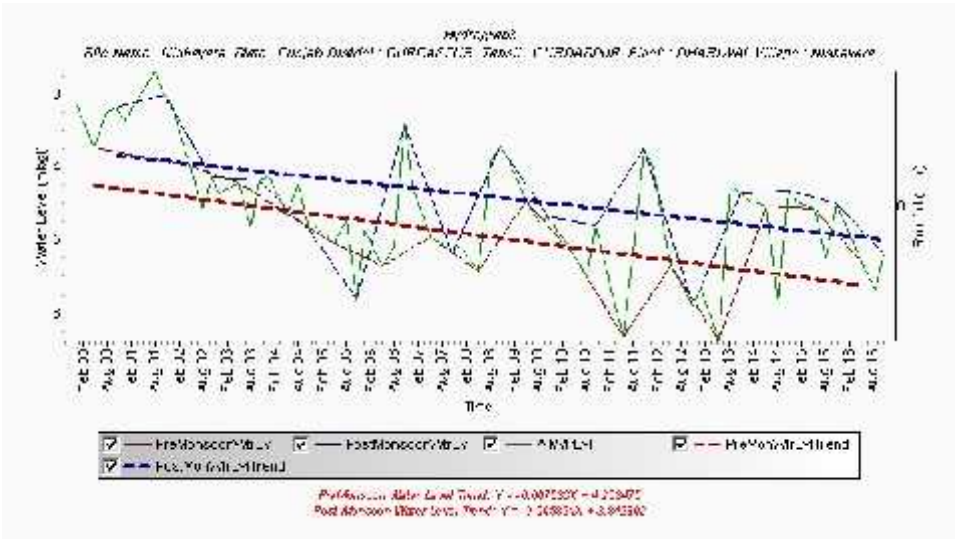
**Water Bodies & Canal Irrigation**

Water bodies available in the villages for storm water and untreated waste water of villagers, can be used for irrigation after treatment. The canal irrigation is also available in the Dhariwal block.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (23 m) is not very prominent in terms of thickness and geographic extent. Aquifer II (48 m) is more in thickness & Aquifer III is not assessed due to non availability of data. Block is categorized as Over-Exploited as per ground water assessment 2013.

**Ground water Extraction**: Information regarding the abstraction from Aquifer III is not available, but there are drinking water supply tapping combined Aquifer and separate Aquifer could not be assessed separately.

**Water level Behavior (2015)**: Pre Monsoon *4.30-11.80 (mbgl)* &Post Monsoon-~ *2.90-26.90 (mbgl)*



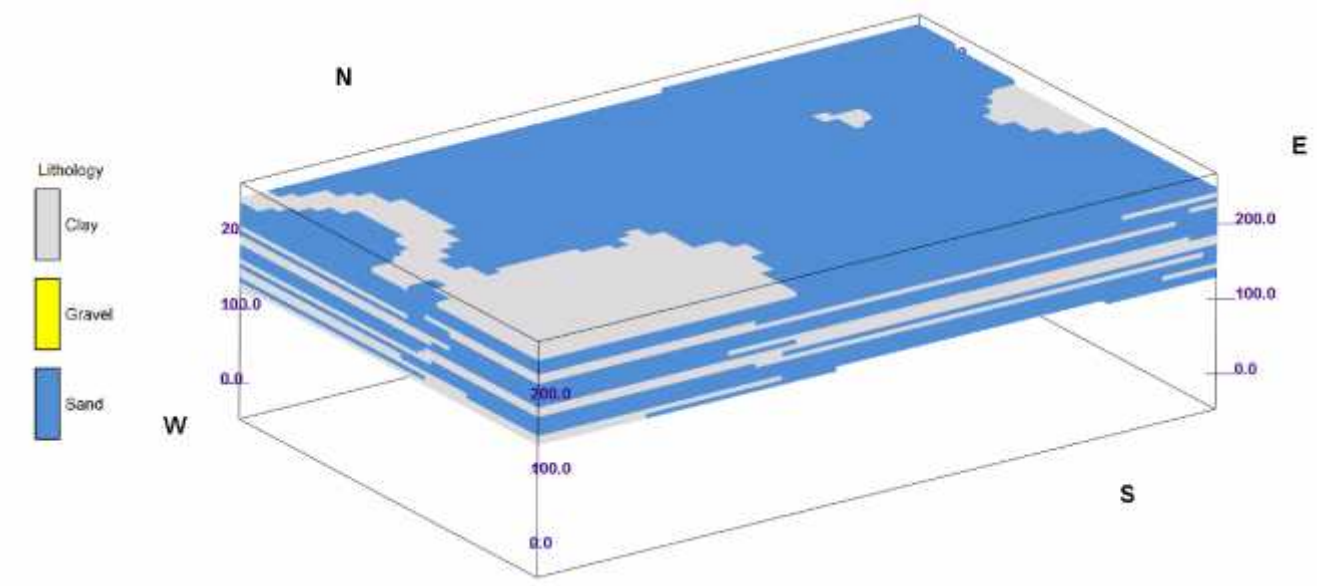
2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (8-45m) | Quaternary Alluvial deposits | Unconfined | 23 | *142-4300* | 0.072 | *$1.0*10^{-3}$ to $4.03*10^{-3}$* |
| Aquifer-II (66-133m) | | Unconfined to Confined | 48 | - | NA | - |
| Aquifer-III (225-300m) | | Unconfined to Confined | NA | - | NA | - |

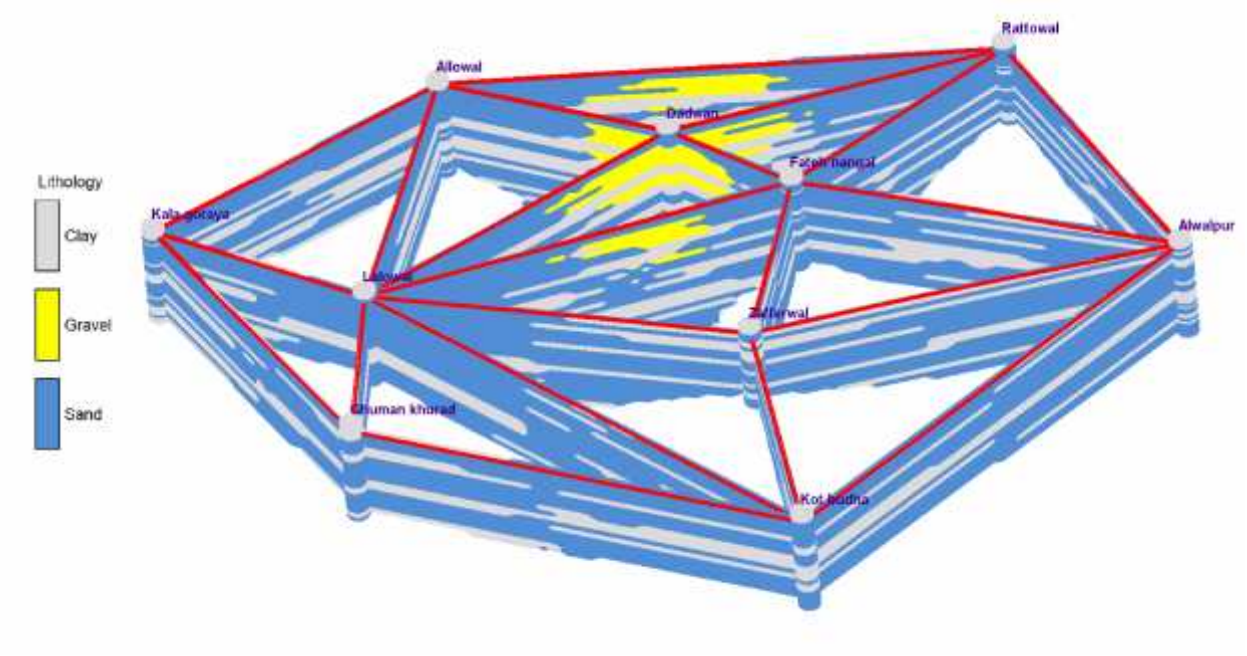
Aquifer comprises of freshwater only and the main Aquifer formation is sand.

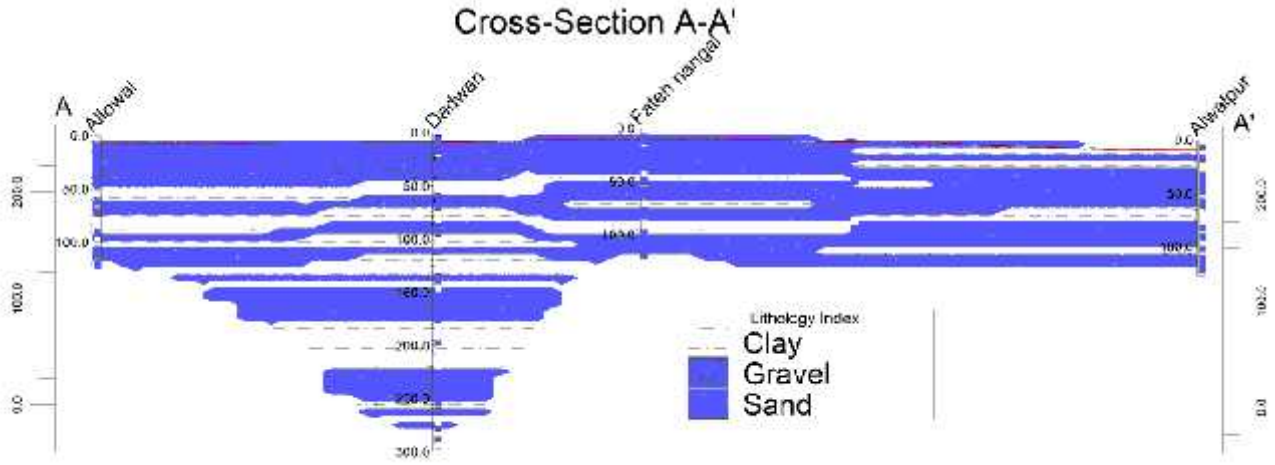
The non-Aquifer material comprise of clay.

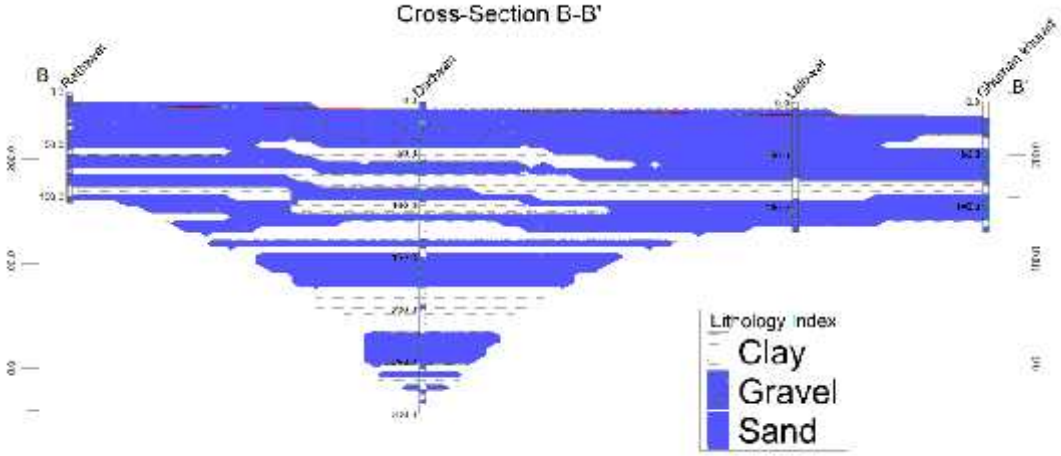
3D Lithology model



# 3D Lithology Fence



## 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquifer wise Water Resource available (in mcm) | Dynamic Aquifer I | *192.63* |
| | In-storage Aquifer I | *425.26* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | 26.63 |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | - |
| | Total | 645 |
| Ground Water Extraction (in mcm) | Irrigation | 232.14 |
| | Domestic & Industrial | 3.13 |
| Provision for domestic & Industrial sector requirement up to2025 (in mcm) | | 3.80 |
| Chemical Quality of ground water & Contamination | | Suitable for drinking and irrigation purposes |
| Other issues | | declining water level trend |

## 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone upto the average depth to water level (8 m). |
| Other interventions proposed | Artificial Recharge, Roof top Rainwater Harvesting, Farm recharge by constructing pits will save 3.112 mcm volume of water |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | Lining of underground pipelines (Kutcha channel) will save 64.29 mcm volume of water wastage |
| Change in cropping pattern | Changing of cropping pattern is not required in the block |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

# 10. GURDASPUR BLOCK (256.80 SQ KM)

## 1. Salient Information

**Population (2011)** Rural- 138380
Urban- 7721
Total- 146101

**Rainfall 2014** (Gurdaspur Distt.) Average annual rainfall – 1047.70 mm

**Average Annual Rainfall** (Gurdaspur block) 819 mm

**Agriculture and Irrigation** Major Crops- Rice, Wheat
Other crops- Sugarcane, Potatoes, Pulses,

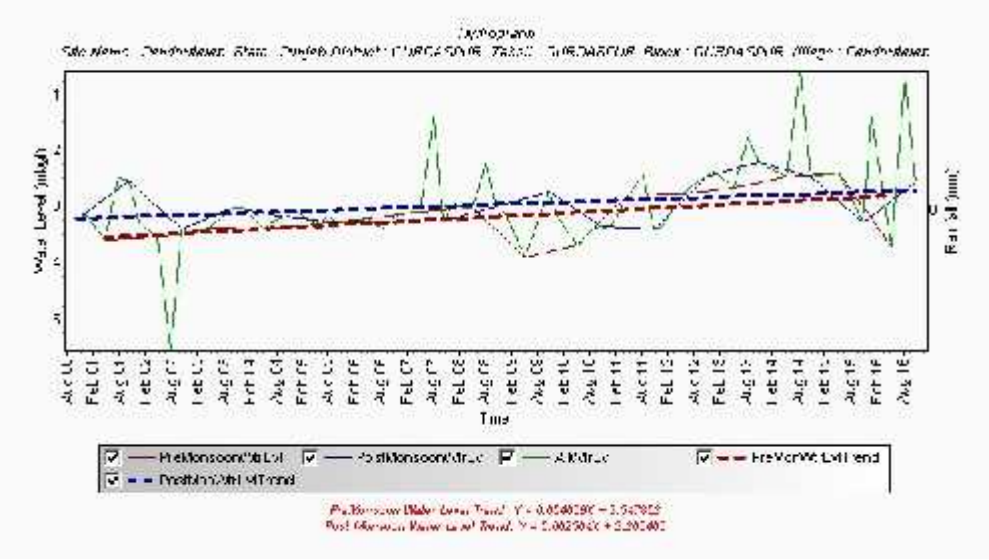
**Water Bodies & Canal Irrigation**

Water bodies available in the villages for storm water and untreated waste water of villagers, that can be used for irrigation after treatment. The canal irrigation is also available in the Gurdaspur block.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (110 m) is very prominent in terms of thickness and geographic extent. Aquifer II (54 m) is not more in thickness & Aquifer III (107 m) is also very prominent in terms of thickness and geographic extent. Block is categorized as Semi- Critical as per ground water assessment 2013.

**Ground water Extraction**: Information regarding the abstraction from Aquifer II & III is available, but there are drinking water supply tapping combined Aquifer and separate Aquifers are assessed separately.

**Water level Behavior (2015)**: Pre Monsoon *4.30-11.80 (mbgl) &*Post Monsoon-~ *2.90-26.90 (mbgl)*



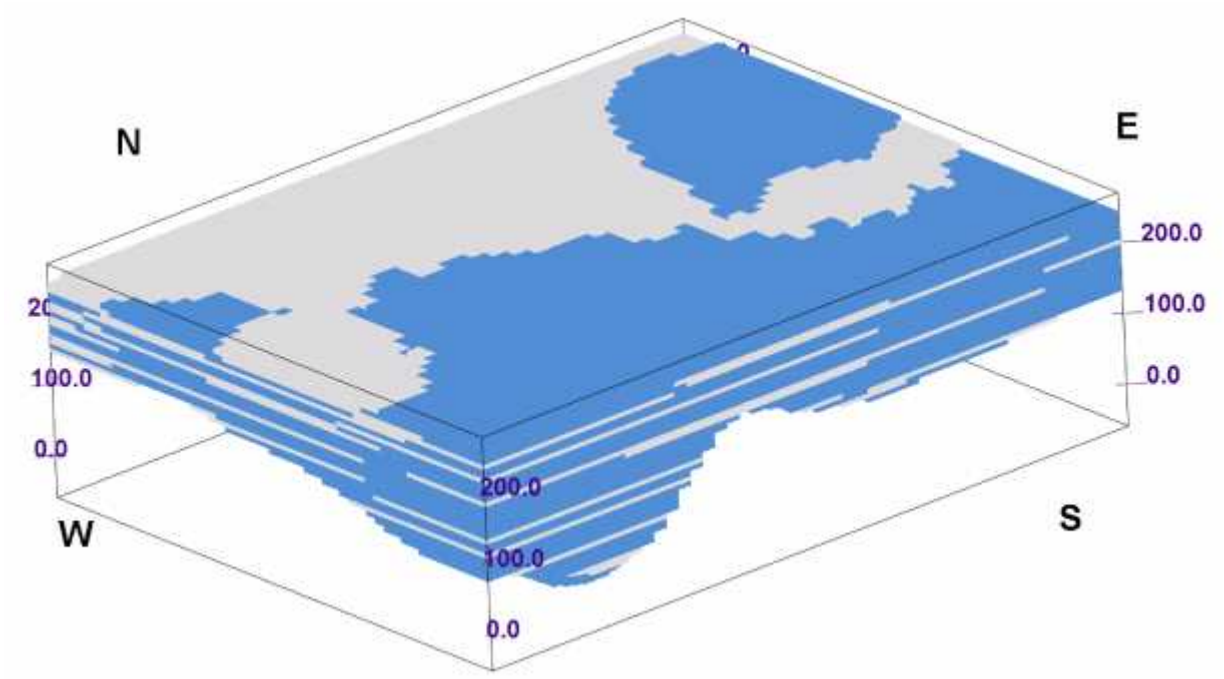
2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (5-115m) | Quaternary Alluvial deposits | Unconfined | 110 | *142-4300* | 0.072 | $1.0*10^{-3}$ *to* $4.03*10^{-3}$ |
| Aquifer-II (126-180m) | | Unconfined to Confined | 54 | - | NA | - |
| Aquifer-III (193-300m) | | Unconfined to Confined | 107 | - | NA | - |

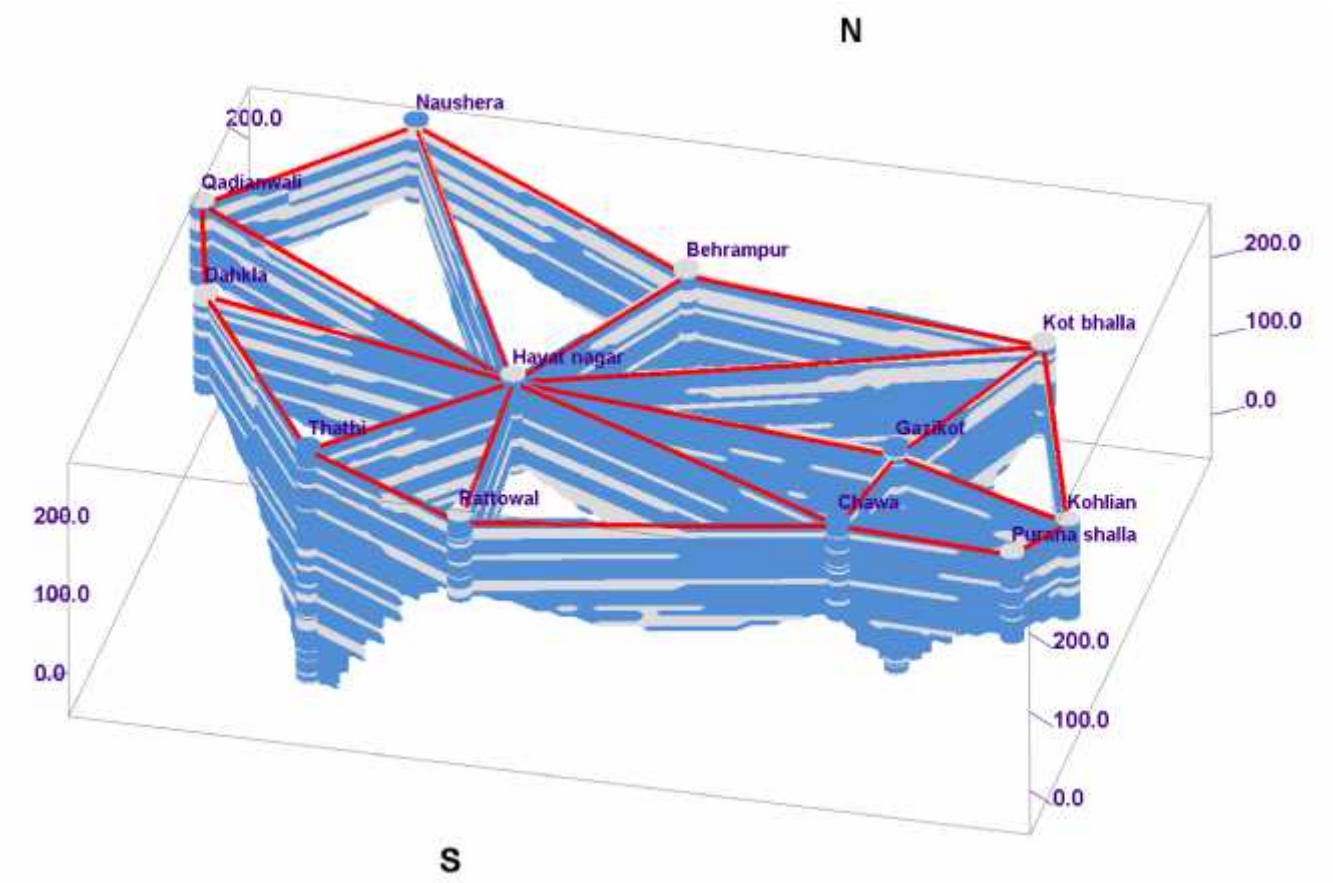
Aquifer comprises of freshwater only and the main Aquifer material is sand.

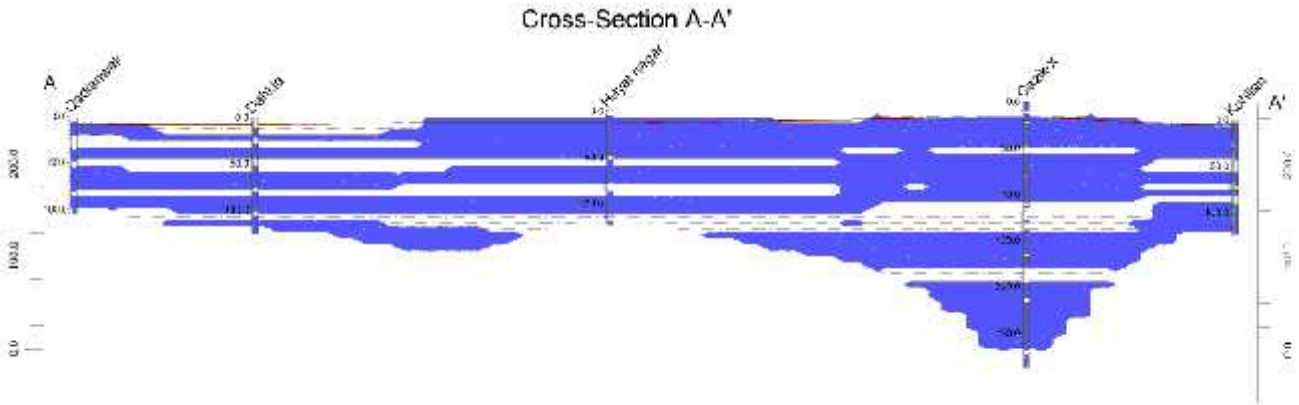
The non-Aquifer material comprise of clay.

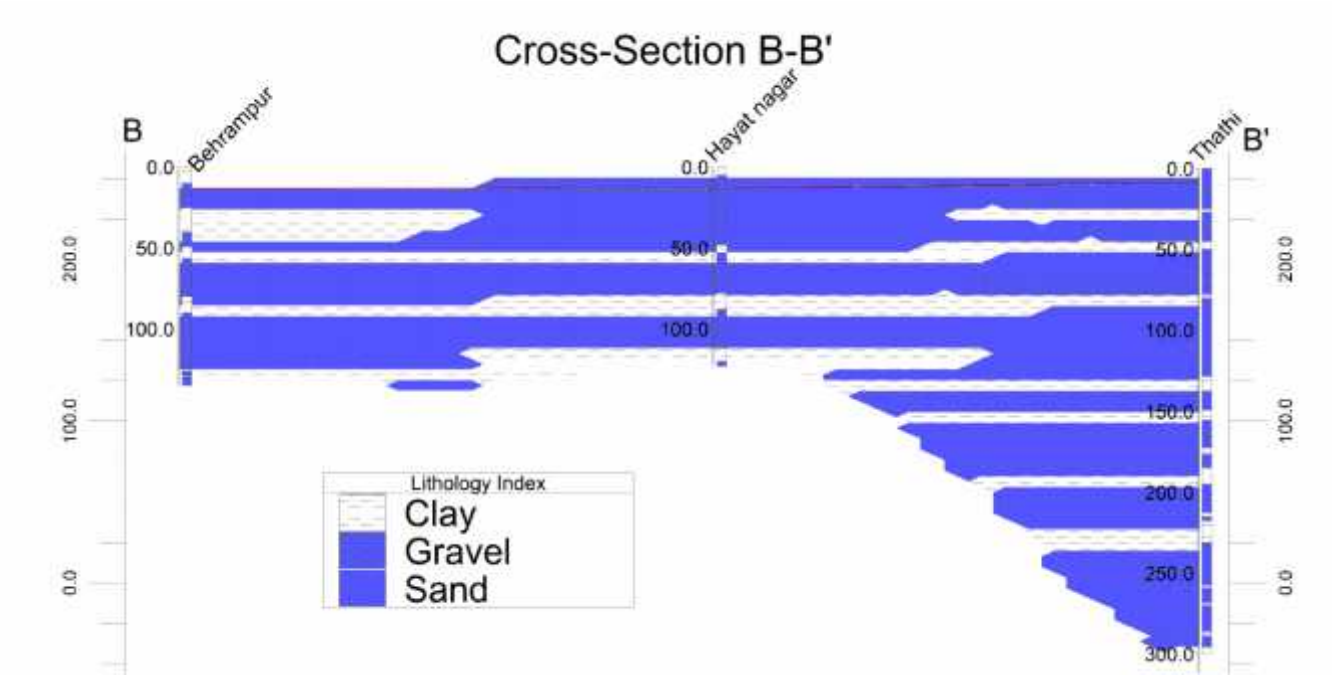
3D Lithology model



3D Lithology Fence






### 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquifer wise Water Resource available (in mcm) | Dynamic Aquifer I | *188.08* |
| | In-storage Aquifer I | *1501.77* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | 23.88 |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | 46.16 |
| | Total | 1760 |
| Ground Water Extraction (in mcm) | Irrigation | 149.18 |
| | Domestic & Industrial | 10.69 |
| Provision for domestic & Industrial requirement up to 2025 (in mcm) | | 12.54 |
| Chemical Quality of ground water & contamination | | Suitable for drinking and irrigation purposes |
| Other issues | | declining water level trend |

## 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone upto the average depth to water level (5 m). |
| Other interventions proposed | Artificial Recharge, Roof top Rainwater Harvesting, Farm recharge by constructing pits will save 0.35 mcm volume of water |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | Lining of underground pipelines (Kutcha channel) will save 40.00 mcm volume of water wastage |
| Change in cropping pattern | Changing of cropping pattern is not required in the block |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

# 11. DINANAGAR BLOCK (236.30 SQ KM)

## 1. Salient Information

**Population (2011)** Rural- 106323
Urban- -
Total- 106323

**Rainfall 2014** (Gurdaspur Distt.) Average annual rainfall – 1047.70 mm

**Average Annual Rainfall** (Dinanagar block) 947 mm

**Agriculture and Irrigation** Major Crops- Rice, Wheat
Other crops- Sugarcane, Potatoes, Pulses,
Net Area Sown- 147.22 sq.km
Total Irrigated Area- 267.22 sq.km

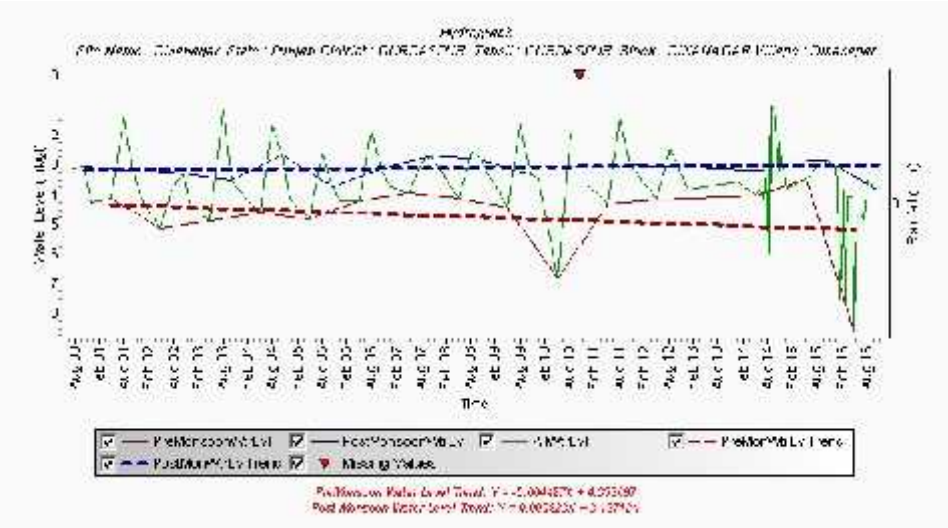
**Water Bodies & Canal Irrigation**

Water bodies available in the villages for storm water and untreated waste water of villagers, that can be used for irrigation after treatment. The canal irrigation is also available in the Dinanagar block.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (122 m) is very prominent in terms of thickness and geographic extent. Aquifer II & Aquifer III is not assess due to non availability of data. Block is categorized as **Safe** as per ground water assessment 2013.

**Ground water Extraction**: Information regarding the abstraction from Aquifer II & III is not available.

**Water level Behavior (2015)**: Pre Monsoon *3.47-6.80 (mbgl)* &Post Monsoon-~ *2.23-5.56(mbgl)*



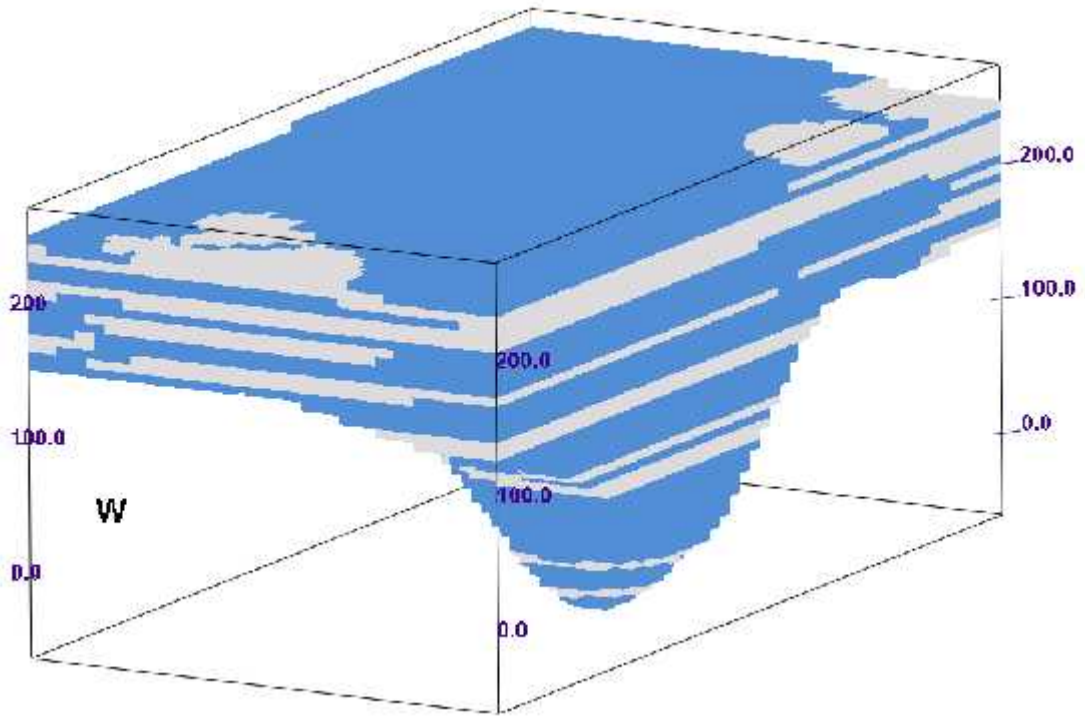
2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (4-127m) | Quaternary Alluvial deposits | Unconfined | 122 | *142-4300* | 0.072 | *$1.0*10^{-3}$ to $4.03*10^{-3}$* |
| Aquifer-II | | Unconfined to Confined | NA | - | NA | - |
| Aquifer-III | | Unconfined to Confined | NA | - | NA | - |

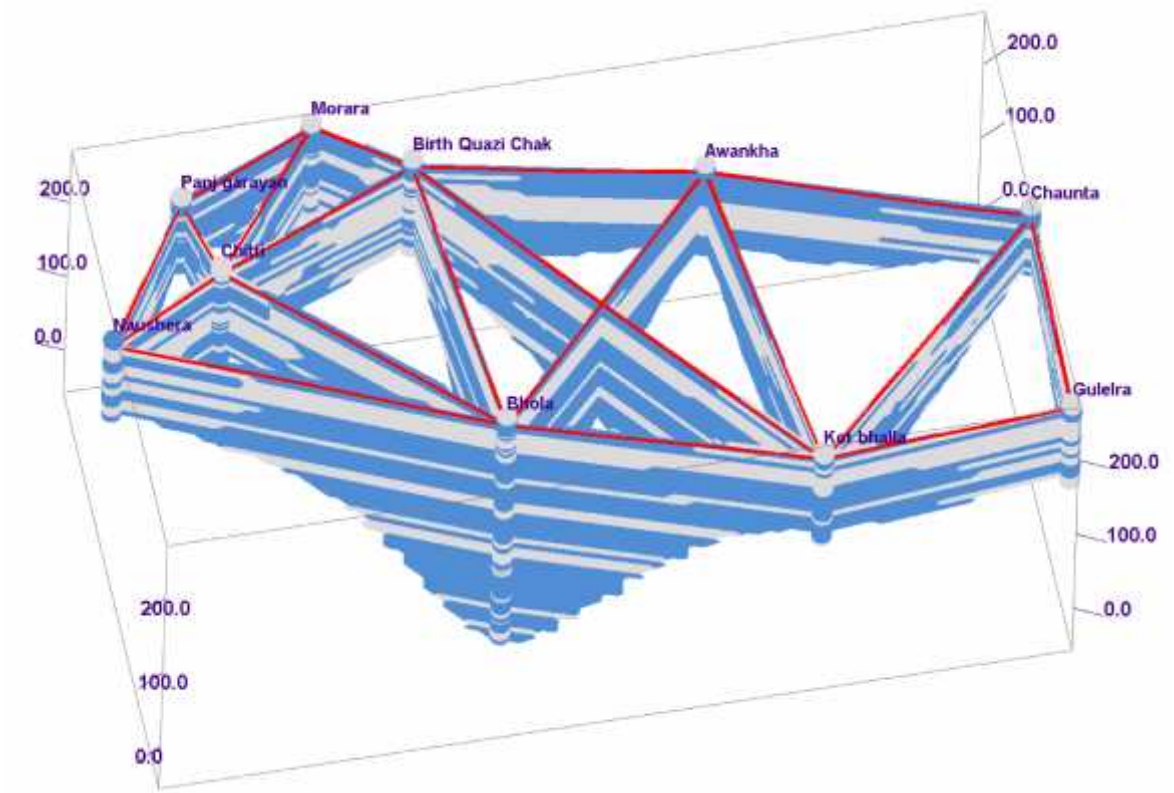
Aquifer comprises of freshwater only and the main Aquifer material is sand.

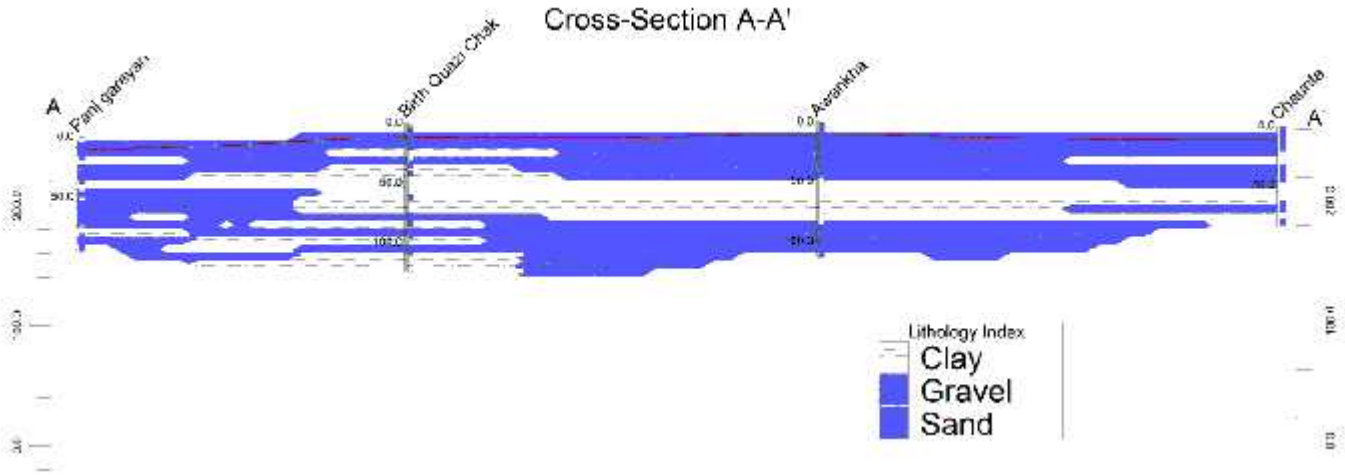
The non-Aquifer material comprise of clay.

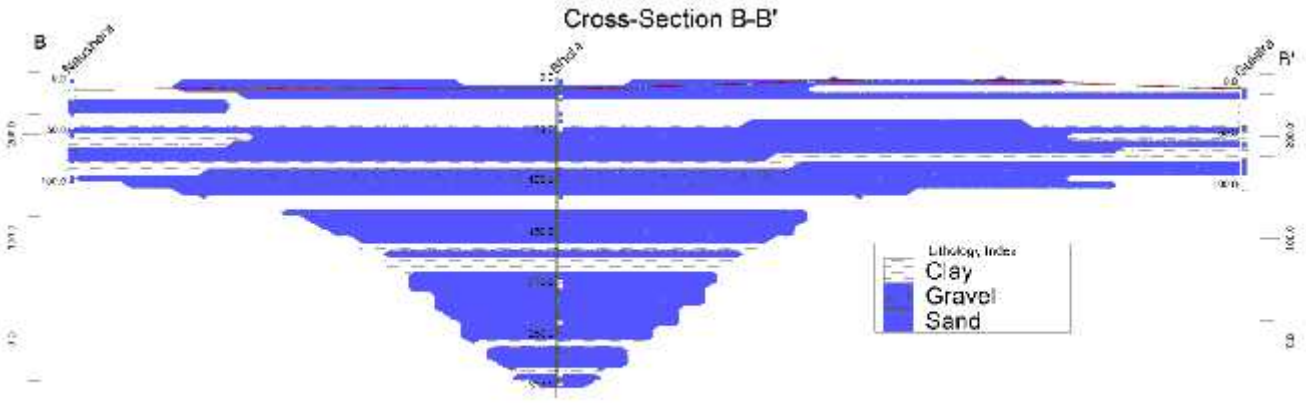
3D Lithology model



# 3D Lithology Fence






## 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquifer wise Water Resource available ( mcm) | Dynamic Aquifer I | *192.63* |
| | In-storage Aquifer I | *425.26* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | 26.63 |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | - |
| | Total | 645 |
| Ground Water Extraction (in mcm) | Irrigation | 232.14 |
| | Domestic & Industrial | 3.13 |
| Provision for domestic & Industrial requirement up to2025 (in mcm) | | 3.80 |
| Chemical Quality of ground water & Contamination | | Suitable for drinking and irrigation purposes |
| Other issues | | declining water level trend |

## 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone up to the average depth to water level (8 m). |
| Other interventions proposed | Artificial Recharge, Roof top Rainwater Harvesting, Farm recharge by constructing pits will save 3.112 mcm volume of water |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | Lining of underground pipelines (Kutcha channel) will save 64.29 mcm volume of water wastage |
| Change in cropping pattern | Changing of cropping pattern is not required in the block |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

## 12.BAMYAL BLOCK (47.8 SQ KM)

1. **Salient Information**

| | |
|---|---|
| **Population (2011)** | Rural- 16400<br>Urban- -<br>Total- 16400 |
| **Rainfall 2014** (Pathankot Distt.) | Average annual rainfall – 1047.70 mm |
| **Average Annual Rainfall** (Bamyal block) | 1158 mm |
| **Agriculture and Irrigation** | Major Crops- Rice, Wheat<br>Other crops- Sugarcane, Potatoes, Pulses,<br>Net Area Sown- 34.02 sq.km<br>Total Irrigated Area- 34.34 sq.km |

**Water Bodies & Canal Irrigation**

Water bodies are not available in the villages for the storm water and untreated waste water of villagers, that can be used for irrigation after treatment.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (70 m) is very prominent in terms of thickness and geographic extent. Aquifer II & Aquifer III is not assessed due to non availability of data. Block is categorized as **Safe** as per ground water assessment2013.

**Ground water Extraction**: Information regarding the abstraction from Aquifer II & III is not available.

**Water level Behavior (2015)**: Pre Monsoon *4.30-4.92 (mbgl) &*Post Monsoon-~ *4.60-4.90 (mbgl)*

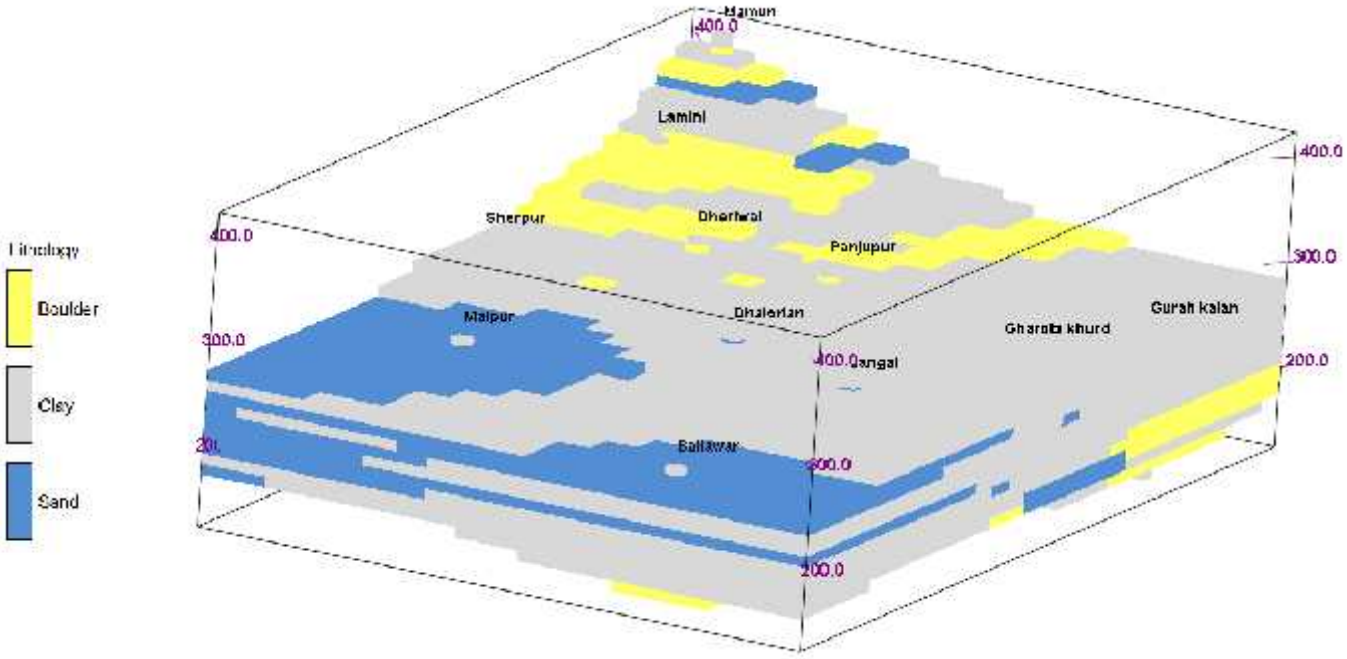
2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

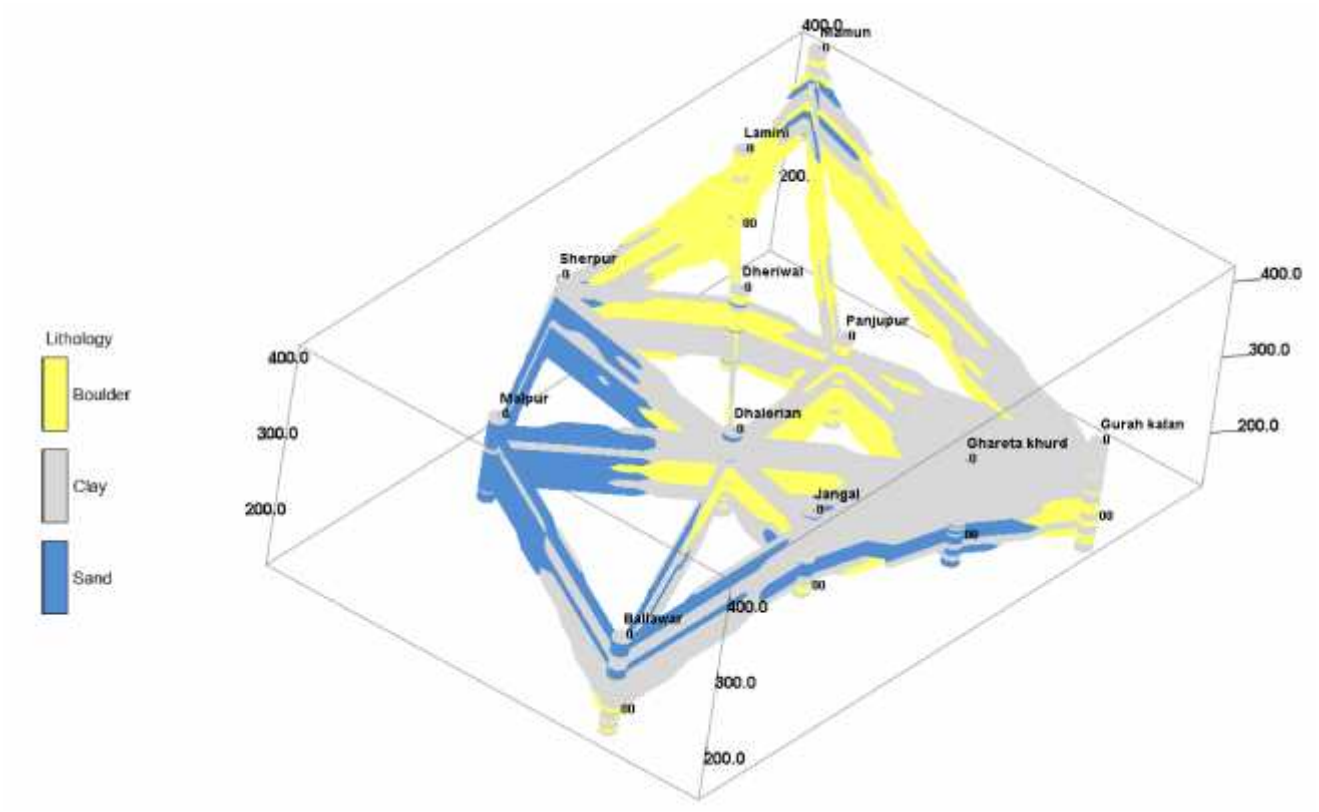
| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (5-75m) | Quaternary Alluvial deposits | Unconfined | 70 | *142-4300* | 0.072 | *$1.0*10^{-3}$ to $4.03*10^{-3}$* |
| Aquifer-II | | Unconfined to Confined | NA | - | NA | - |
| Aquifer-III | | Unconfined to Confined | NA | - | NA | - |

Aquifer comprises of freshwater only and the main Aquifer material is sand.

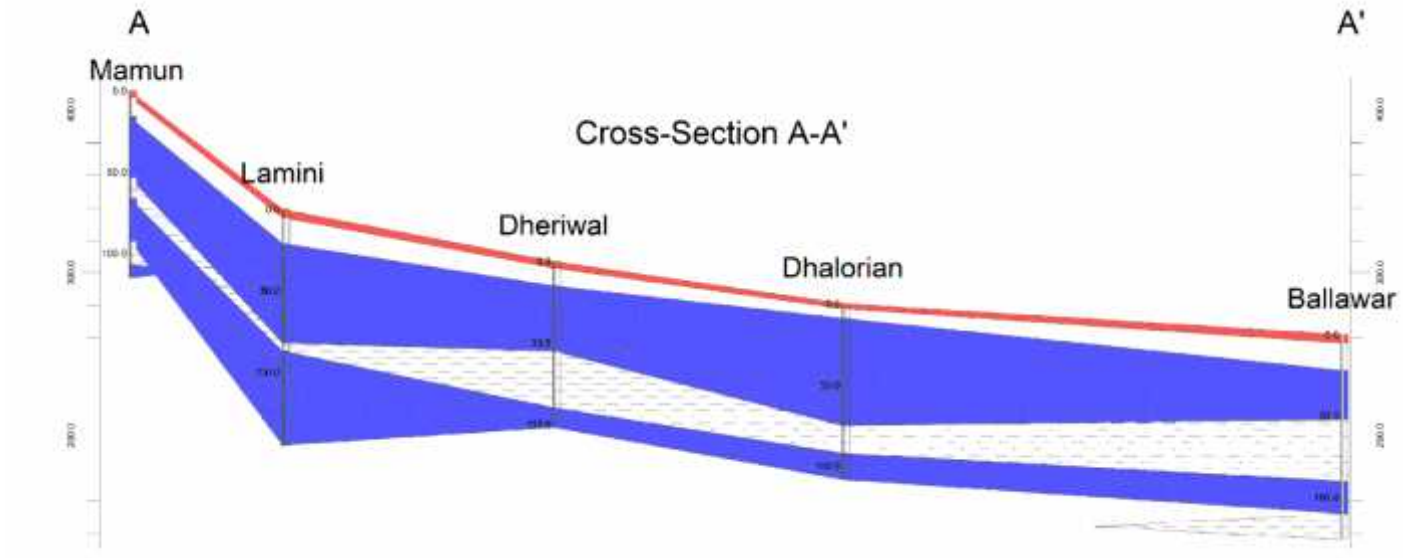
The non-Aquifer material comprise of clay.

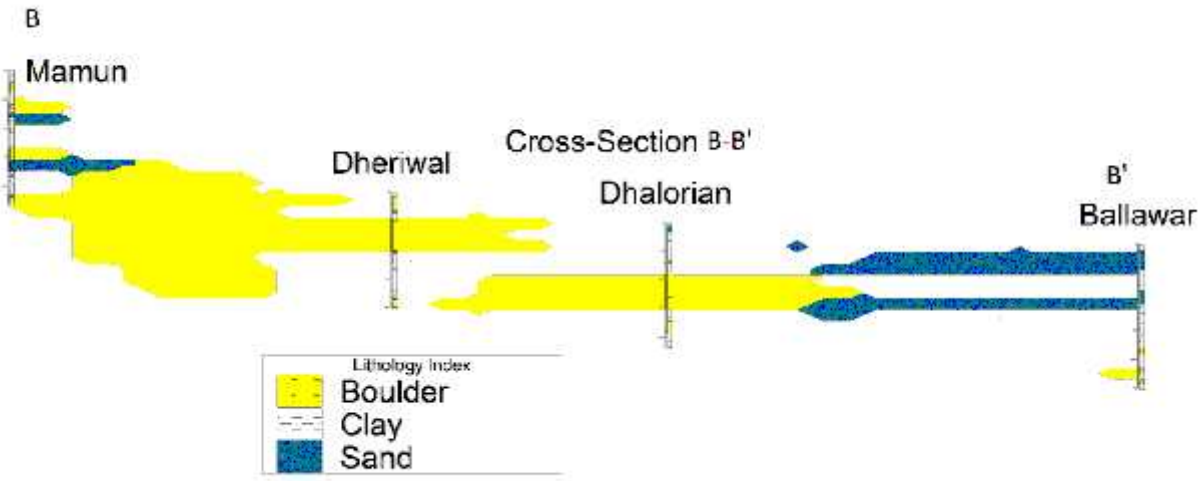
3D Lithology model






3D Lithology Fence




B
Mamun
Dheriwal
Cross-Section B-B'
Dhalorian
B'
Ballawar
Lithology Index
Boulder
Clay
Sand

## 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquifer wise Water Resource available (mcm) | Dynamic Aquifer I | *16.98* |
| | In-storage Aquifer I | *92.92* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | - |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | - |
| | Total | 109.90 |
| Ground Water Extraction (in mcm) | Irrigation | 13.02 |
| | Domestic & Industrial | 0.99 |
| Provision for domestic & Industrial requirement up to 2025 (in mcm) | | 1.22 |
| Chemical Quality of ground water & contamination | | Suitable for drinking and irrigation purposes |
| Other issues | | declining water level trend |

## 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone up to the average depth to water level (5 m). |
| Other interventions proposed | - |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | - |
| Change in cropping pattern | Changing of cropping pattern is not required in the block |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

## 13. NAROT JAIMAL SINGH BLOCK (170.90 SQ KM)

1. **Salient Information**

| | |
|---|---|
| **Population (2011)** | Rural- 85614<br>Urban- -<br>Total- 85614 |
| **Rainfall 2014** (Pathankot Distt.) | Average annual rainfall – 1047.70 mm |

**Average Annual Rainfall** (Narot Jaimal Singh block) 1103 mm

| | |
|---|---|
| **Agriculture and Irrigation** | Major Crops- Rice, Wheat<br>Other crops- Sugarcane, Potatoes, Pulses,<br>Net Area Sown- 97 sq.km<br>Total Irrigated Area- 137.65 sq.km |

**Water Bodies & Canal Irrigation**

Water bodies available in the villages for storm water and untreated waste water of villagers, can be used for irrigation after treatment.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (86m) is very prominent in terms of thickness and geographic extent. Aquifer II & Aquifer III is not assessed due to non availability of data. Block is categorized as **Safe** as per ground water assessment 2013.

**Ground water Extraction**: Information regarding the abstraction from Aquifer II & III is not available.

**Water level Behavior (2015)**: Pre Monsoon *4.80 (mbgl)* &Post Monsoon-~ *4.70(mbgl)*

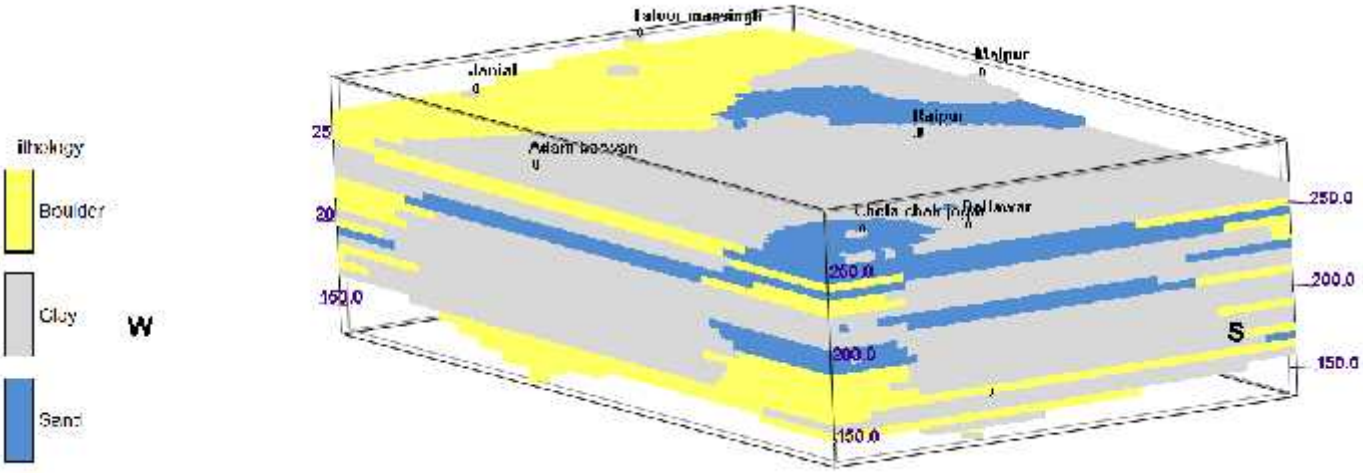
2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (5-91m) | Quaternary Alluvial deposits | Unconfined | 86 | *142-4300* | 0.072 | *$1.0*10^{-3}$ to $4.03*10^{-3}$* |
| Aquifer-II (101-300m) | | Unconfined to Confined | 129 | *142-4300* | NA | *$1.0*10^{-3}$ to $4.03*10^{-3}$* |
| Aquifer-III | | Unconfined to Confined | NA | - | NA | - |

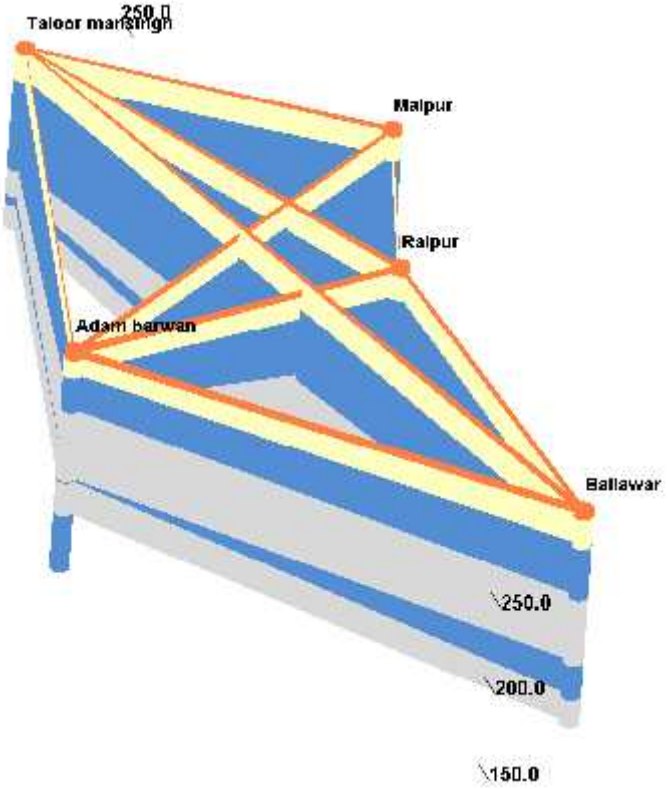
Aquifer comprises of freshwater only and the main Aquifer material is sand.

The non-Aquifer material comprise of clay.

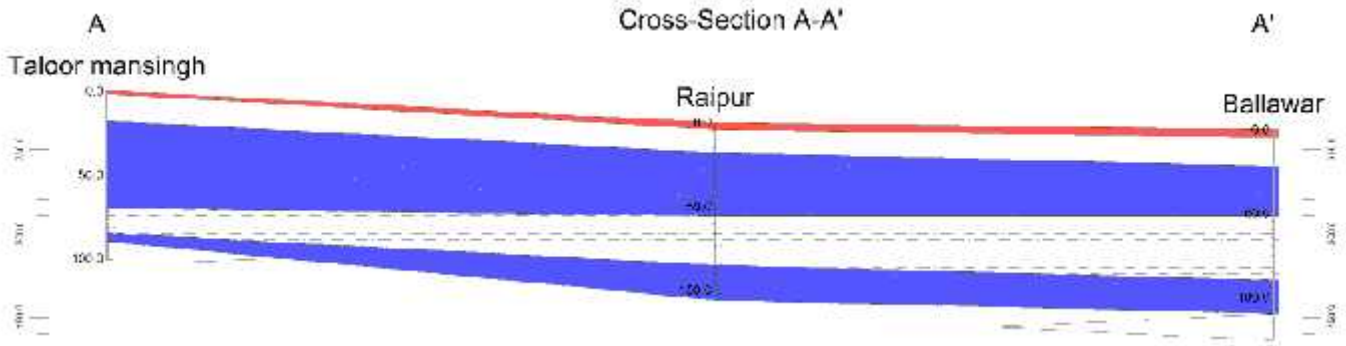
3D Lithology model

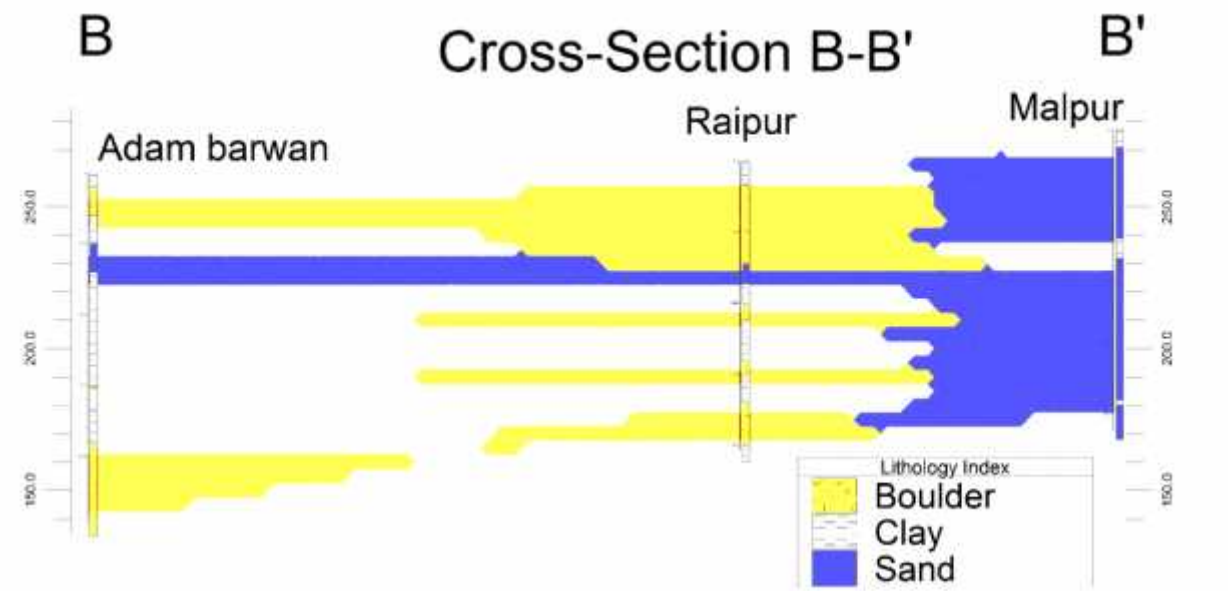


3D Lithology Fence

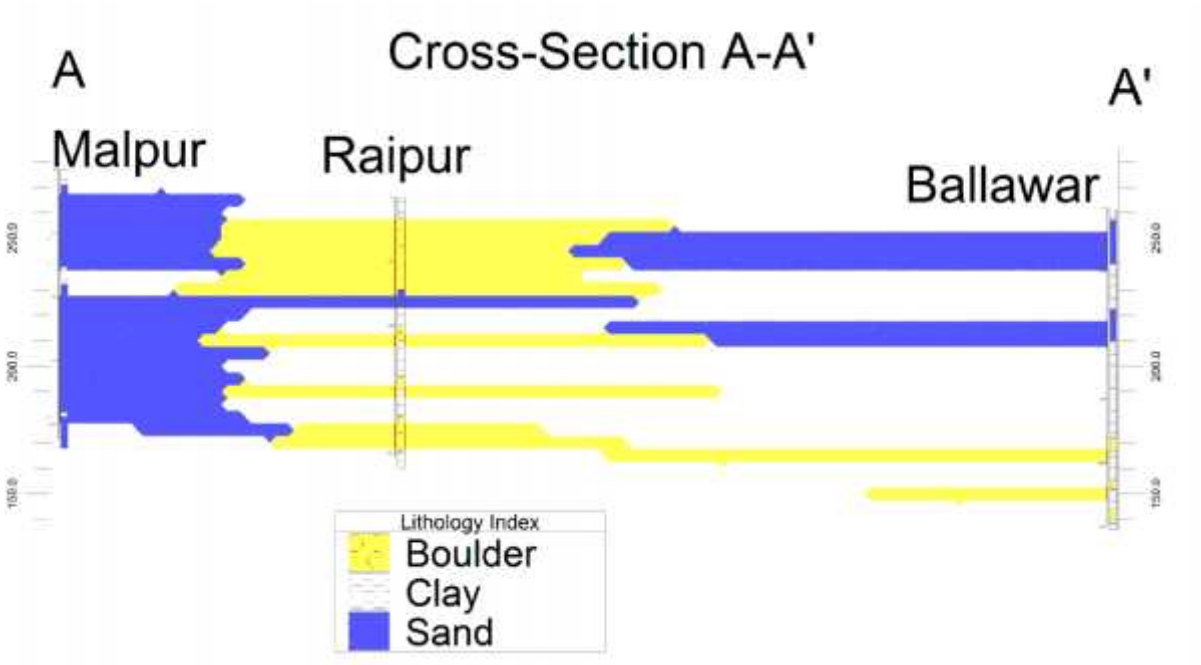



Lithological Section






Stratigraphical Section



## 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquifer wise Water Resource available (mcm) | Dynamic Aquifer I | *58.15* |
| | In-storage Aquifer I | *775.20* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | 8.88 |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | - |
| | Total | 842 |
| Ground Water Extraction (in mcm) | Irrigation | 51.28 |
| | Domestic & Industrial | 2.52 |
| Provision for domestic & Industrial requirement up to 2025 (in mcm) | | 3.10 |
| Chemical Quality of ground water & contamination | | Suitable for drinking and irrigation purposes |
| Other issues | | declining water level trend |

## 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone upto the average depth to water level (5 m). |
| Other interventions proposed | - |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | - |
| Change in cropping pattern | Changing of cropping pattern is not required in the block |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

## 14. PATHANKOT BLOCK (351.50 SQ KM)

### 1. Salient Information

**Population (2011)** Rural- 216223
Urban- 143593
Total- 72630

**Rainfall 2014** (Pathankot Distt.) Average annual rainfall – 1047.70 mm

**Average Annual Rainfall** (Pathankot block) 1121 mm

**Agriculture and Irrigation** Major Crops- Rice, Wheat
Other crops- Sugarcane, Potatoes, Pulses,
Net Area Sown- 68.30 sq.km
Total Irrigated Area- 68.86 sq.km

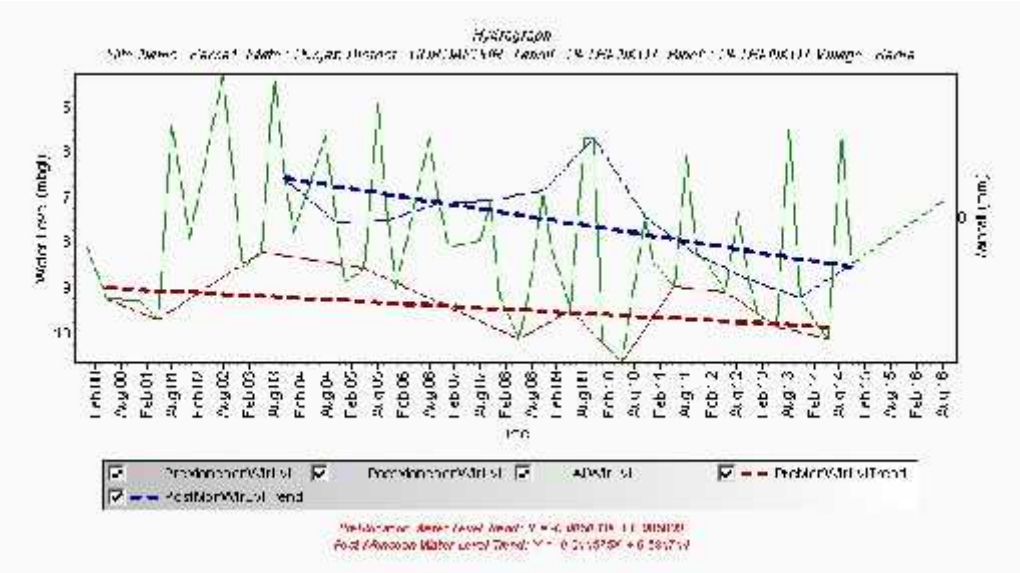
**Water Bodies & Canal Irrigation**

Water bodies available in the villages for storm water and untreated waste water of villagers, that can be used for irrigation after treatment.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I & II (39 m) is very prominent in terms of thickness and geographic extent. Aquifer III is not assessed due to non availability of data. Block is categorized as **Safe** as per ground water assessment 2013.

**Ground water Extraction**: Information regarding the abstraction from Aquifer III is not available.

**Water level Behavior (2015)**: Pre Monsoon *1.91-9.54 (mbgl)* &Post Monsoon-~ *2.52-8.48 (mbgl)*



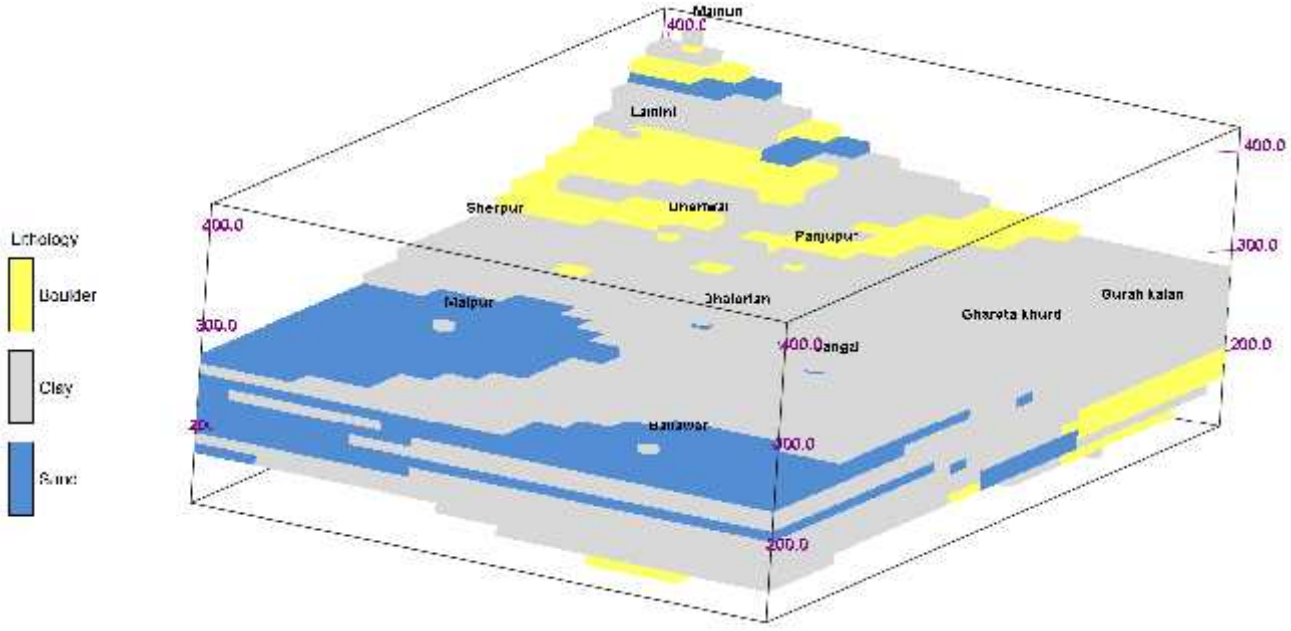
2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (7-65m) | Quaternary Alluvial deposits | Unconfined | 39 | *142-4300* | 0.072 | $1.0*10^{-3}$ *to* $4.03*10^{-3}$ |
| Aquifer-II (73 – 160m) | | Unconfined to Confined | 39 | - | NA | - |
| Aquifer-III | | Unconfined to Confined | NA | - | NA | - |

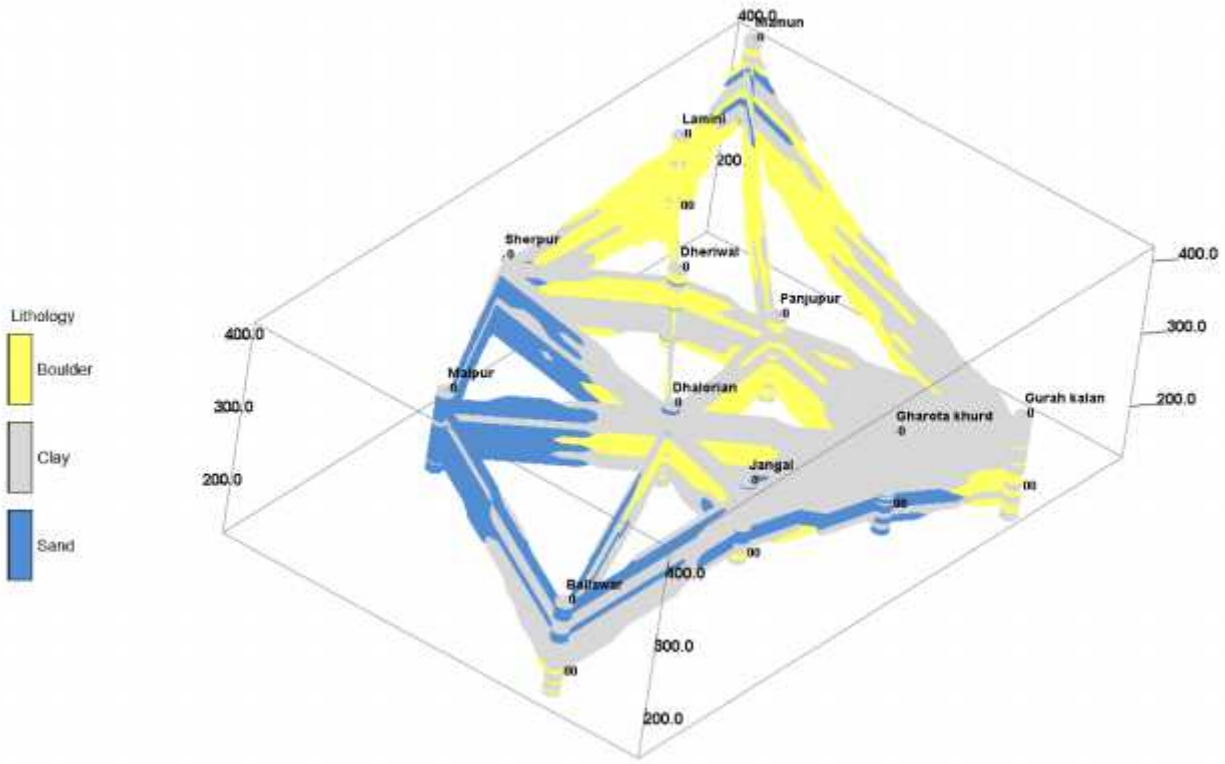
Aquifer comprises of freshwater only and the main Aquifer matierial is sand.

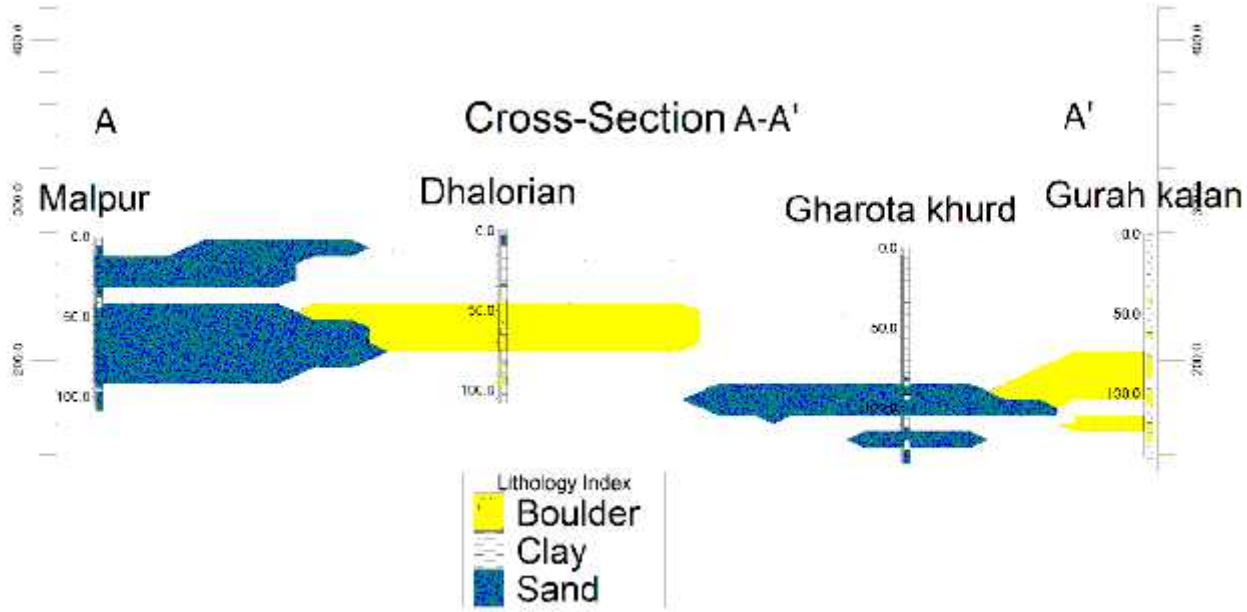
The non-Aquifer material comprise of clay.

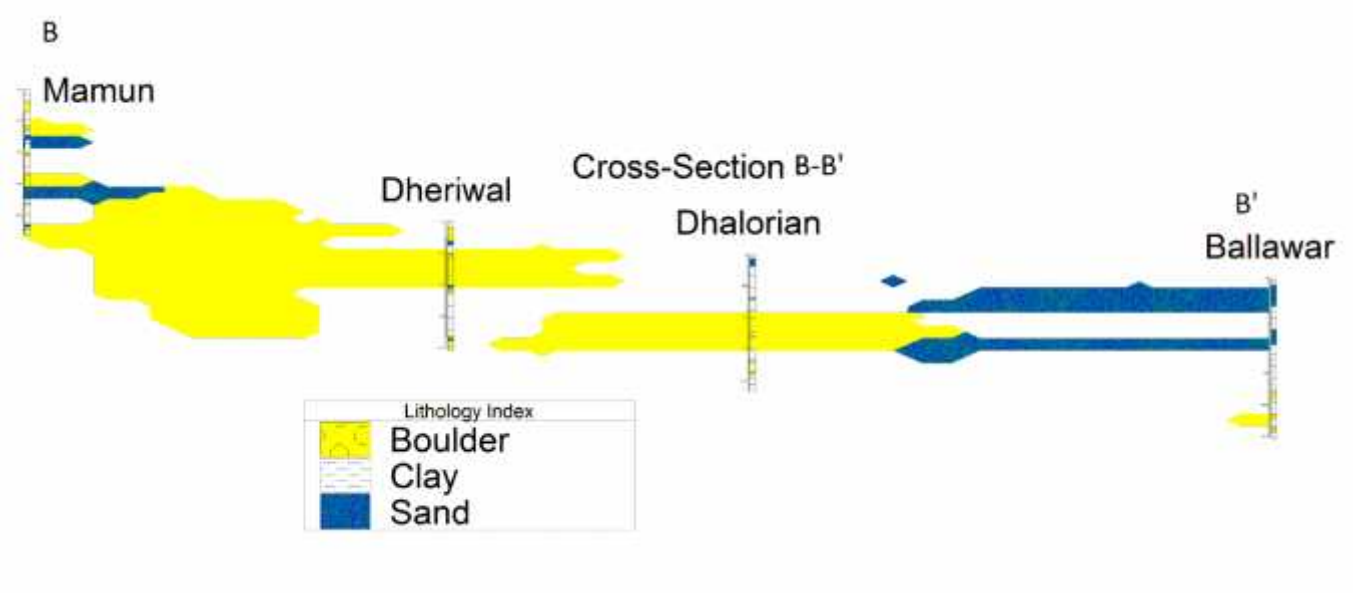
## 3D Lithology model

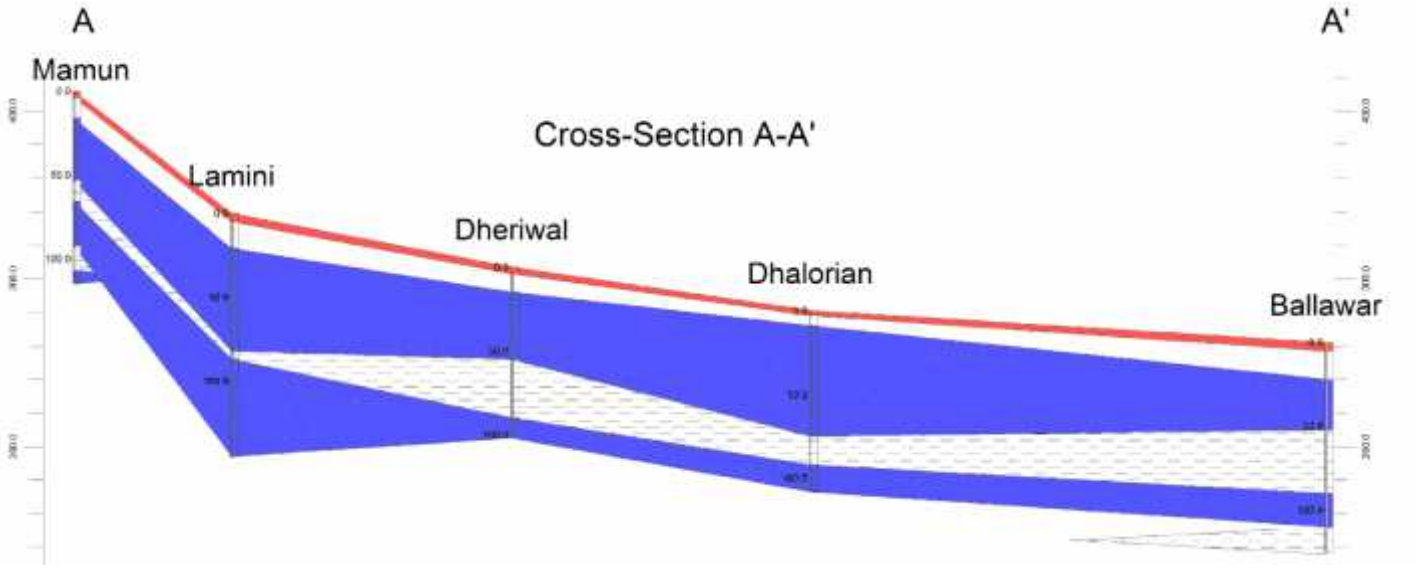


3D Lithology Fence




B
Mamun
Dheriwal
Cross-Section B-B'
Dhalorian
B'
Ballawar
Lithology Index
Boulder
Clay
Sand


A
A'
Mamun
Cross-Section A-A'
Lamini
Dheriwal
Dhalorian
Ballawar

## 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquifer wise Water Resource available ( mcm) | Dynamic Aquifer I | *185.55* |
| | In-storage Aquifer I | *987* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | 1.63 |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | - |
| | Total | 1174 |
| Ground Water Extraction (in mcm) | Irrigation | 111.90 |
| | Domestic & Industrial | 12.29 |
| Provision for domestic & Industrial sector requirement up to 2025 (in mcm) | | 14.41 |
| Chemical Quality of ground water & contamination | | Suitable for drinking and irrigation purposes |
| Other issues | | declining water level trend |

## 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone up to the average depth to water level (7 m). |
| Other interventions proposed | - |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | - |
| Change in cropping pattern | Changing of cropping pattern is not required in the block |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |

## 15. DHAR KALAN BLOCK (398.40 SQ KM)

### 1. Salient Information

**Population (2011)** Rural- 73329
Urban- 10663
Total- 62666

**Rainfall 2014** (Pathankot Distt.) Average annual rainfall – 1047.70 mm

**Average Annual Rainfall** (Pathankot block) 1276 mm

**Agriculture and Irrigation** Major Crops- Rice, Wheat
Other crops- Sugarcane, Potatoes, Pulses,
Net Area Sown- 98.47 sq.km
Total Irrigated Area- 99.15 sq.km

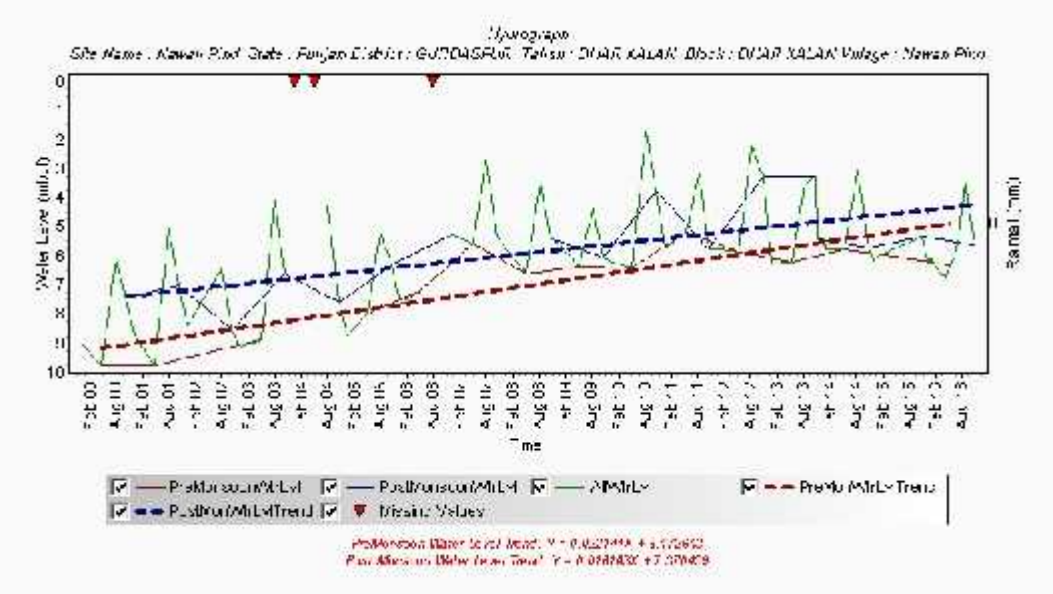
**Water Bodies & Canal Irrigation**

Water bodies available in the villages for the storm water and untreated waste water of villagers, that can be used for irrigation after treatment.

**Ground Water Resource Availability**: Ground Water Resources available in the different group of Aquifers. Aquifer I (122 m) is very prominent in terms of thickness and geographic extent. Aquifer II & Aquifer III is not assessed due to non availability of data. Block is categorized as **Safe** as per ground water assessment 2013.

**Ground water Extraction**: Information regarding the abstraction from Aquifer II & III is not available.

**Water level Behavior (2015)**: Post Monsoon-~ *2.90-26.90 (mbgl)*



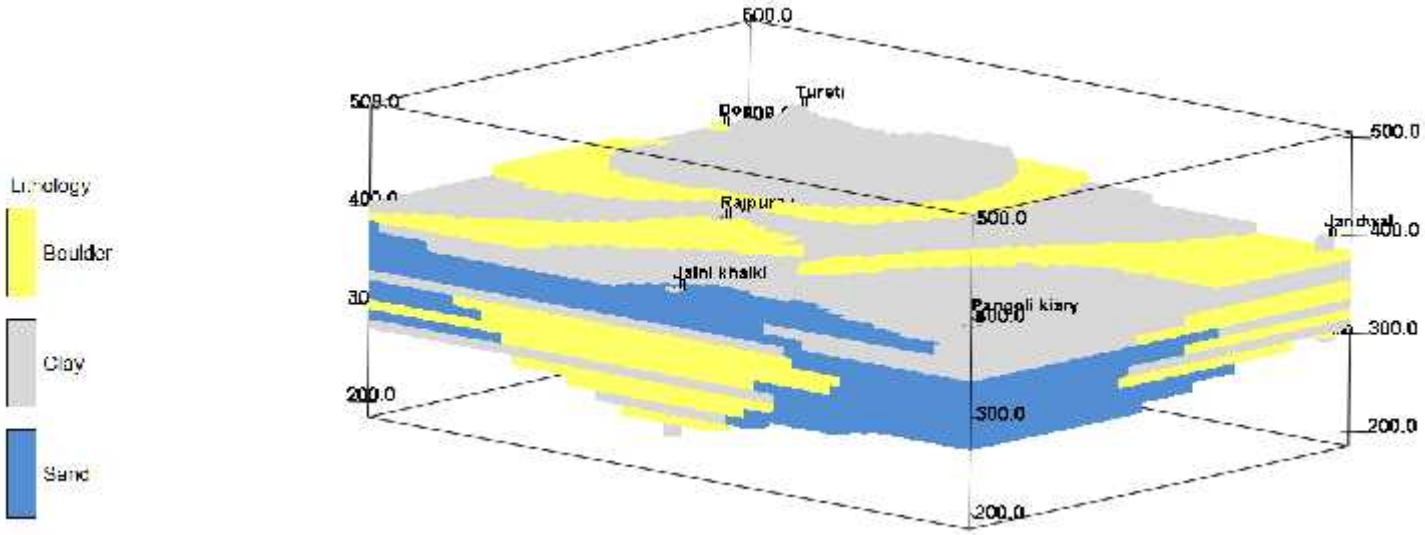
2. **Aquifer Disposition:** Multiple Aquifer System (3 Aquifer System)

| Aquifer | Geology | Type of Aquifer | Thickness of Granular Zones (m) | Transmissivity ($m^2$/day) | Specific Yield % | Storativity |
|---|---|---|---|---|---|---|
| Aquifer-I (9-75m) | Quaternary Alluvial deposits | Unconfined | 26 | *142-4300* | 0.072 | *$1.0*10^{-3}$ to $4.03*10^{-3}$* |
| Aquifer-II | | Unconfined to Confined | NA | - | NA | - |
| Aquifer-III | | Unconfined to Confined | NA | - | NA | - |

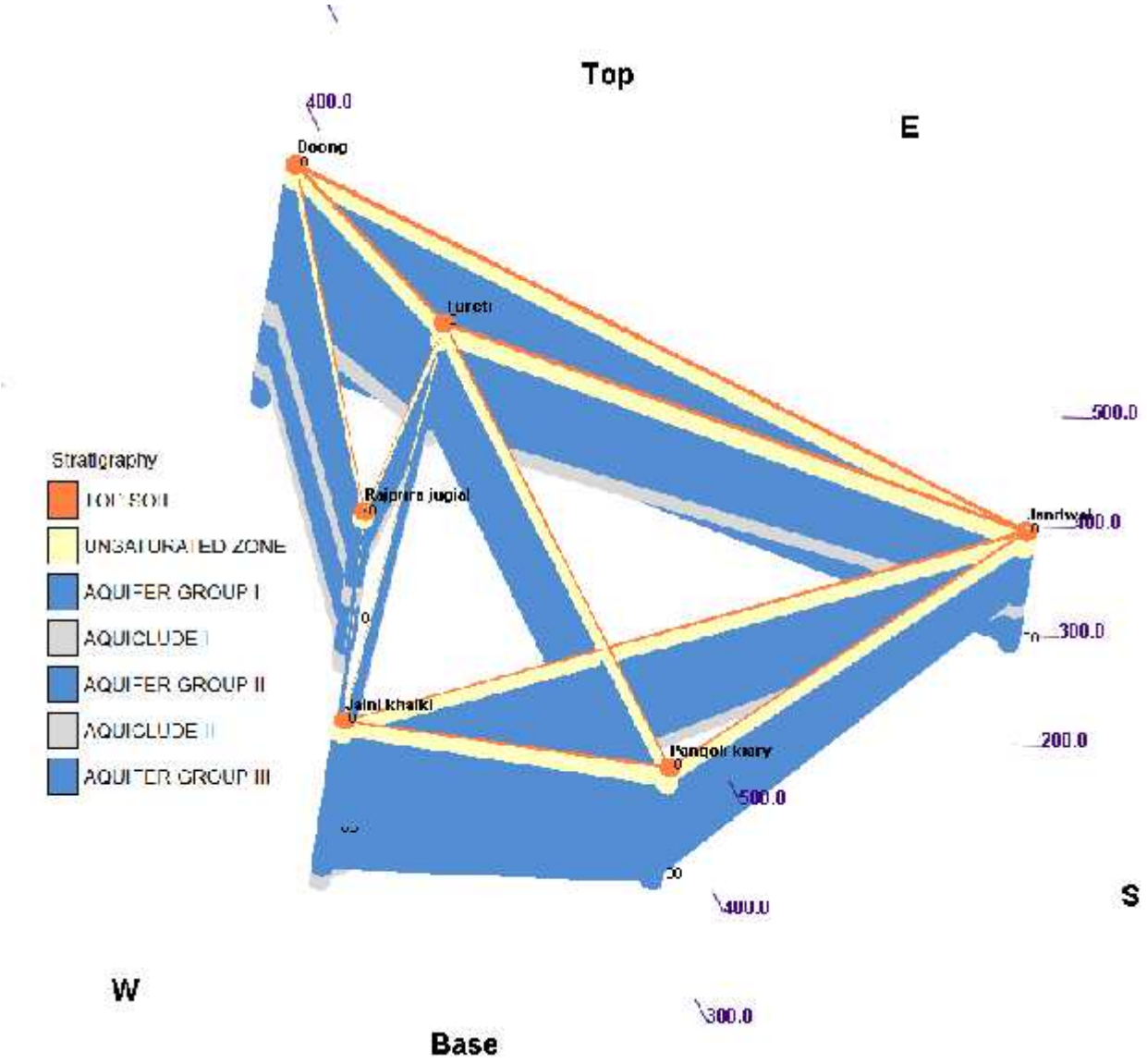
Aquifer comprises of freshwater only and the main Aquifer material is sand.

The non-Aquifer material comprise of clay.

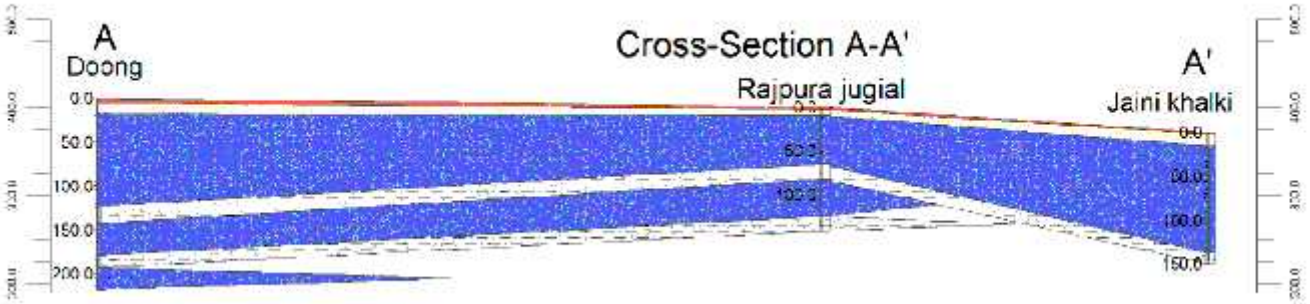
3D Lithology model

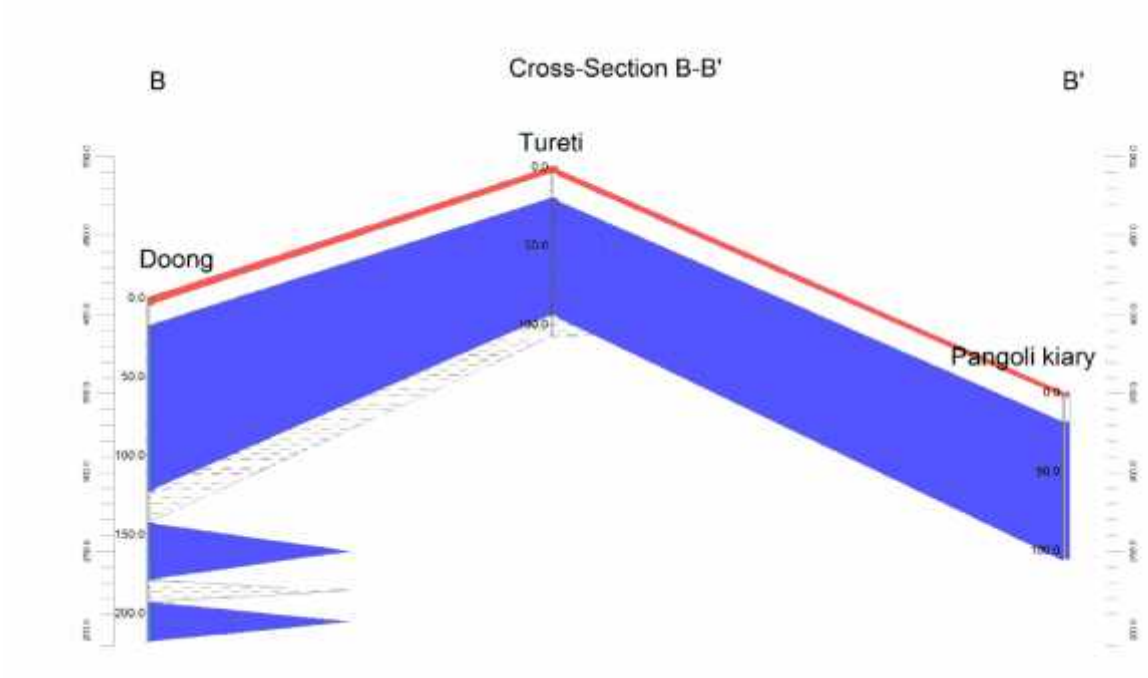


3D Lithology Fence

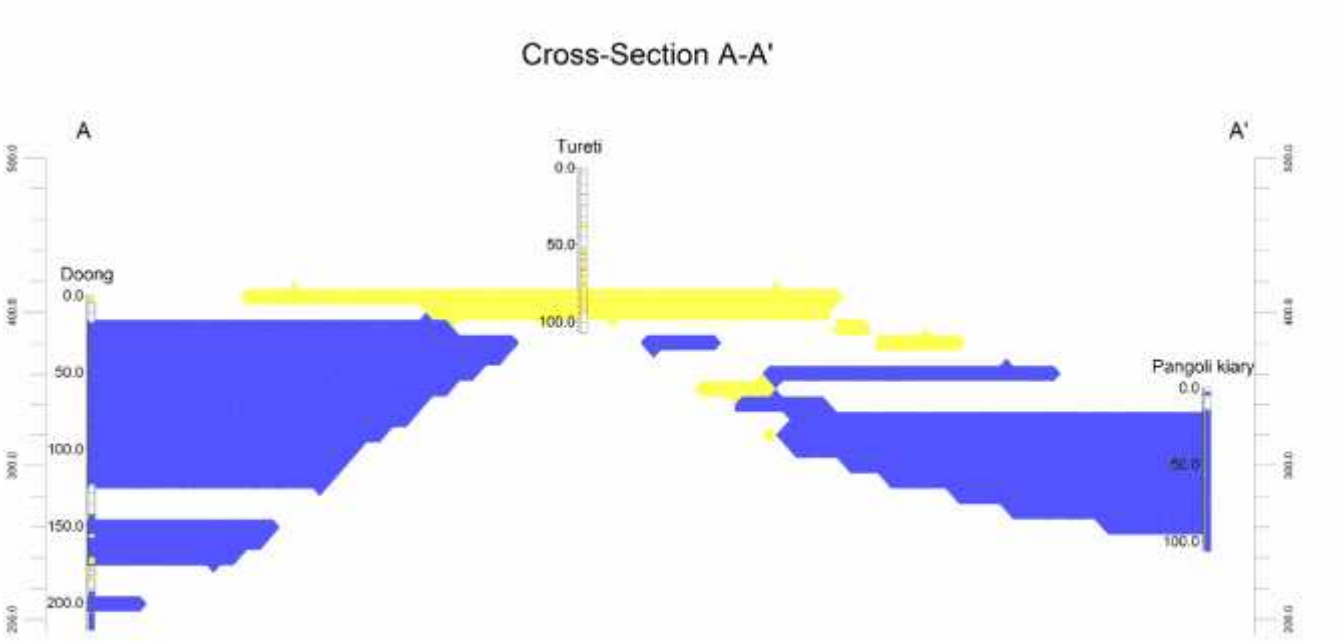


# Stratigraphical Section



# Lithological Section



## 3. Ground Water Resource, Extraction, Contamination and Other Issues

| | | |
|---|---|---|
| Aquifer wise Water Resource available ( mcm) | Dynamic Aquifer I | *58.90* |
| | In-storage Aquifer I | *296.21* |
| | Dynamic Aquifer II | - |
| | In-storage Aquifer II | - |
| | Dynamic Aquifer III | - |
| | In-storage Aquifer III | - |
| | Total | 355 |
| Ground Water Extraction (in mcm) | Irrigation | 8.78 |
| | Domestic & Industrial | 2.46 |
| Provision for domestic & Industrial requirement up to 2025 (in mcm) | | 3.0 |
| Chemical Quality of ground water & contamination | | Suitable for drinking and irrigation purposes |
| Other issues | | declining water level trend |

## 4. Ground Water Resource Enhancement

| | |
|---|---|
| Aquifer wise space available for recharge and proposed interventions | Volume of unsaturated zone upto the average depth to water level (9 m). |
| Other interventions proposed | - |

## 5. Demand Side Interventions

| | |
|---|---|
| Advanced Irrigation Practices | - |
| Change in cropping pattern | Changing of cropping pattern is not required in the block |
| Alternate water sources | Tanks, ponds and canals |
| Regulation and Control | - |
| Other interventions proposed, if any | - |