



# भूजल सूचना पुस्तिका

## वैशाली जिला, बिहार

### Ground Water Information Booklet Vaishali District, Bihar State



केन्द्रीय भूमिजल बोर्ड  
जल संसाधन मंत्रालय  
(भारत सरकार)  
मध्य-पूर्वी क्षेत्र  
पटना

Central Ground water Board  
Ministry of Water Resources  
(Govt. of India)  
Mid-Eastern Region  
Patna

सितंबर 2013

September 2013

<b>PREPARED By</b>	- <b>Shri S. Tarafdar, STA (HG)</b>
<b>UNDER SUPERVISION OF</b>	- <b>Shri A.K.Agrawal, Scientist'D'</b>
<b>CARTOGRAPHY</b>	- <b>Shri Lokendra Kumar, Draughtsman</b>
<b>UPDATED By</b>	- <b>Shri S.N. Dwivedi, Sc-C &amp; Dr.Fakhre Alam, STA(Hg)</b>

**Ground Water Information Booklet**  
**Vaishali District, Bihar State**  
**CONTENTS**

<b>SI.No</b>	<b>TITLES</b>	<b>PAGE NO.</b>
1.0	Introduction (Administration, Drainage, irrigation Practices, activity by CGWB)	4-5
2.0	Rainfall and Climate	5
3.0	Geomorphology and Soil types	5-6
4.0	Ground Water Scenario	7-10
	4.1 Hydrogeology	
	4.2 Ground Water Resources	
	4.3 Ground Water Quality	
	4.4 Status of Ground Water Development	
5.0	Ground Water Management Strategy	10-11
	5.1 Ground Water Development	
	5.2 Water Conservation and Artificial Recharge	
6.0	Ground Water related issue and problems	11
7.0	Mass Awareness and Training Activity	11
	7.1 Mass Awareness Programme(MAP) & Water Management Training Programme by CGWB	
	7.2 Participation in Exhibition, Mela, Fair	
	7.3 Presentation and lecture delivered in public forum/Radio/T.V etc.	
8.0	Area Notified by CGWB/SGWA	11
9.0	Recommendations	11-12

**FIGURES**

- 1.0 Index Map showing location of block' HQ, boundary, drainage, location of EW, Pz, GW observation wells of CGWB
- 2.0 Hydrogeological map (showing water bearing formations, yield potential, bore well statistics, high yield bore well, lineaments, EC contours and point value of Arsenic.
- 3.0 Pre monsoon depth to water level map May 2011
- 4.0 Post monsoon depth to water level map November 2011
- 5.0 Stage of Ground Water Development(as on 31<sup>st</sup> March 2009)

**TABLES**

- 1.0 Details of Exploratory well (EW), Vaishali district.
- 2.0 Block wise status of Ground Water Development of Vaishali district, Bihar.

**“Ground Water Information Booklet” Vaishali district, Bihar**

## **1.0 Introduction**

### **1.1 Administration**

Vaishali district has a proud place in ancient Indian history as founder of Jainism, Lord Mahavira was born here. It was a sub-division of erstwhile Muzaffarpur district which was upgraded into a full fledged district on 2<sup>nd</sup> October, 1972.

The district lies between north latitude 25°28'0" to 26° 5'0" and east longitude 85°5'00" to 85 °40'00". It covers a part the degree sheet number 72G of survey of India. The geographical area of the district is 2015.37 km<sup>2</sup>. It's district Headquarter is Hajipur. The district is bounded in the north by Muzaffarpur, in the south by Patna (the river Ganga forms a natural boundary), in the east by Samastipur, and in the west by Saran (the river Gandak forming a natural boundary) districts. There are 16 development blocks in the district. According to census 2011, population of the district is 3495249 and out of this 3262715 (Rural) and 232534 (Urban). There are three urban areas namely Hajipur, Lalganj and Mahnar. The administrative map of the district is given in Figure 1.

### **1.2 Basin/sub-basin, Drainage**

The Vaishali district constitutes a part of Ganga river basin. It has two sub-basins, namely Gandak sub-basin and Burhi Gandak sub-basin. The major part of the district falls under Burhi Gandak sub-basin. The Gandak is the main river flowing in the southeasterly direction and forming western boundary of the district. It discharges in the river Ganga near Hajipur. The river Gandak does not receive any important tributary in its course. There are two important distributary channels namely the Gandaki and the Baya rivers flowing parallel to the river Gandak and discharge into the river Ganga. The Baya runs through the central part of the district in north-south direction.

### **1.3 Irrigation Practices**

A part of the district falls in the tail end command area of Tirhut Main Canal. The canal gets water from Gandak Barrage which is located at Valmikinagar, Bagaha district. The area under the canal command in Vaishali

district works out to be nearly 450 km<sup>2</sup>. The irrigation from canal has been carried out in an area of 1558 hectares. The irrigation from tube wells and other minor irrigation structures is 283 hectares.

### **1.3 Studies/ activities carried out by CGWB**

Geomorphological mapping in parts of Vaishali district was carried in 1985-86 by G.S.I., and ground water exploration by the state Ground water Department of Bihar.

The district was covered under reappraisal survey during 1991-1992 and under Ground Water Exploration 3 EW and 4 OW were constructed through departmental Rigs (Table-1) by CGWB. Seven Hydrograph Network Stations(HNS) are monitored as per its monitoring programme. Thirteen peizometers were drilled to a depth to a depth of 30 m for monitoring of water level, out of which, 7 peizometers are functional (figure -1).The water level of the peizometers are also monitored along with HNS as per the monitoring programme.

## **2.0 Rainfall and Climate**

The climate of the district is sub-tropical to sub-humid. The winter temperature ranges varies from 16° C to 4° C where as the summer temperature rises upto 40° C. The relative humidity is at its minimum during April and May and maximum during July and August. It ranges between 60 to 90%. The average annual rainfall in the district is 1168 mm. The district receives about 85% of the total rainfall from south-west monsoon. The south west monsoon extends from the middle of June to end of September. The district receives 50% of the rainfall during July and August month of the year.

## **3.0 Geomorphology and Soil**

### **3.1 Geomorphology**

The district comprises extensive plain formed by the alluvium brought by the Ganga, the Gandak and distributaries of Gandak. The morphology of the area has been shaped mainly by Gandak river which originates in the Himalayas in Nepal . Morphologically it can be classified into three broad categories.

- 1) Hazipur Surface: It is the oldest morpho-unit of the area comprising yellow-brown to brownish-grey compact clay.
- 2) Vaishali Surface: It overlies the Hazipur surface. This surface comprises ash-grey-silt/silt-clay/clayey-silt and has been found development on the eroded and very gently sloping Hazipur surface.
- 3) Diara Surface: It is the lowest and youngest geomorphic unit which emerges from river bed .The diara surface has come into existence after the main channel has migrated. They are the old river beds.

### **3.2 Soils**

Vaishali district is characterized by a wide variety of soils which can be broadly grouped into two categories according to U.S Survey Staff in 1975.

- 1) Entisols: They are younger alluvial soils locally known as Balsundari. They are deficient in nitrogen, phosphoric acid but generally rich in potash and lime. The Balsundari soils are generally a light friable loam with higher portion of sand and silt. The soil is most fertile and suitable for cultivation of high yielding crops like sugarcane and wheat.
- 2) Inceptisols: Calcareous alluvial soils occur mostly in the central part and locally known as Mathivari. The percentage of both phosphoric acid and potash are higher in this region. This soil is richer in lime content and kanker than Balsundari soil. This forms the typical paddy land of Bihar.

### **4.0 Ground Water Scenario**

#### **4.1 Hydrogeology**

Quaternary Alluvial deposit consisting of alternate layers of sand, silt, clay and gravel forms prolific unconfined and confined aquifer system. The unconfined aquifer system consists of sand layers with parting of thin clay layers upto a depth of 60-70 m. The clay layers at shallow depth are not regionally extensive as such the entire sequence behaves as unconfined aquifer system. The transmissivity of the aquifer varies from 1000 to 5000 m<sup>2</sup>/day. The specific yield varies between 8-12%. The movement of ground water is in south-east direction towards the river Ganga. The aquifer is highly potential. An yield of 50-100 m<sup>3</sup>/hr may be obtained from a well tapping 40 m thick aquifer for nominal drawdown (Figure 2).

Depth to ground water level during pre-monsoon (Figure-3) and post-monsoons (Figure-4) for the year 2011, has been prepared. A perusal of the depth to water level map of pre-monsoon period indicates that water level is ranges from 7.15 to 8.90 m bgl and in post-monsoon its ranges between 3.68 to 6.06 m bgl.

Exploratory drillings down to depth range of 127 to 300.15 m by CGWB at Lalganj, Hazipur and Garoul confirm presence of highly potential and thick sand & gravel layers. The zones tapped at Kohnara ranges from 86 to 248 for a total drilled depth of 300 m and the zones tapped at Lalgang ranges from 141 to 220 meter for a total drilled depth of 240 m. Due to impervious clay layers at greater depth the aquifers are semi-confined to confined in nature. The storativity value of the deeper confined aquifer is  $0.13 \times 10^{-7}$  and transmissivity value ranges between 621 and 5163 m<sup>2</sup>/day. The piezometric head has been found to rest within 5 mbgl. A high discharge of more than 200 m<sup>3</sup>/hr may be obtained from a well drilled to 300 m tapping sufficient thickness of confined aquifer.

#### **4.2 Ground Water Resources:**

Annually replenishable dynamic ground water resource of the unconfined aquifer has been estimated as on 31<sup>st</sup> march 2009 for all the blocks following GEC-1997 norm. The net annual replenishable ground water resource of the district is 71952 ham. The gross draft for all uses, (irrigation, domestic and industrial water supply) as on 31<sup>st</sup> March 2009, is 40288 ham. The allocation for

domestic and industrial requirement supply up to next 25 years is 8730 ham. The stage of ground water development of the district is 56%. Except the Rajapakar Block, all the fifteen blocks of district fall under safe category. The ground water can be further exploited for irrigation and other uses. Maximum ground water development is in Rajapakar block (74.7%), while minimum in Vaishali block (35.4%). Details of ground water resources of all blocks are given below

**Assessment of Dynamic Ground Water Resources of the Bihar state  
Vaishali district (as on 31<sup>st</sup> March 2009)**

(in hectare meter)

Sl. No	Assessment Unit/District	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 (10+11)	Allocation for Domestic and Industrial Requirement Supply upto year 2025	Net Ground Water Availability for future irrigation developme nt (9-10-13)	Stage of Ground Water Development (12/9)*100 (%)
1	2	9	10	11	12	13	14	15
1	Bhagwanpur	3350	1997	284	2281	440	914	68.1
2	Biddupur	7840	2298	363	2661	562	4980	33.9
3	Chehrala	2292	1376	176	1552	273	642	67.7
4	Goroul	2807	857	136	993	211	1739	35.4
5	Hazipur	3363	2136	237	2373	367	860	70.6
6	Jandaha	5237	3068	620	3688	983	1187	70.4
7	Lalganj	4672	2831	363	3194	563	1278	68.4
8	Mahnar	4863	2326	485	2811	561	1976	57.8
9	Mahua	4352	1360	413	1773	401	2591	40.7
10	Patepur	4764	2675	382	3057	592	1497	64.2
11	Patehi Belsar	8623	5211	495	5706	766	2646	66.2
12	Premraj	2107	929	130	1059	202	976	50.3
13	Raghapur	6966	2520	328	2848	509	3937	40.9
14	Rajapakar	2601	1731	210	1941	326	544	74.7
15	Sahdai	2632	1386	174	1560	269	976	59.3
16	Vaishali	5485	2029	256	2285	397	3059	41.7
	<b>Total</b>	<b>71952</b>	<b>34729</b>	<b>5558</b>	<b>40288</b>	<b>8730</b>	<b>29802</b>	<b>56.0</b>

**4.2 Chemical quality of ground water:**



The chemical analysis of ground water of unconfined aquifer of May 2006 indicates that the water is potable and can be used for industrial and irrigation purposes. The ground water of the district is basic in nature and bicarbonate type. The range of concentration of major constituents is given below:

<b>Chemical Parameters</b>	<b>Range</b>
1. PH	7.48 – 8.78
2. Specific conductance	550 – 2500 micromhos/cm at 25oC
3. Calcium	18 – 70 milligram/litre
4. Magnesium	6 - 101 milligram/litre
5. Bicarbonate	154 -592 milligram/litre
6. Chloride	18 - 426 milligram/litre
7. Total hardness as CaCo3	190 - 270 milligram/litre
8. Na	32 - 265 milligram/litre
9. K	1.9 – 6.2 milligram/litre

However, in some villages in Biddupur block geogenic contamination of ground water with arsenic in phreatic aquifer has been reported by PHED, Govt. of Bihar. The Arsenic concentration has been reported to be above permissible limit of more than 0.05 milligram/litre. In two tolas namely Miyatoli and Babantola of Kalyanpur village, Biddupur block, arsenic concentration of 85% and 79% of the total samples collected shows arsenic level above permissible limit observed by PHED during blanket testing in the field using field test kit. A few ground water samples from affected wells were rechecked in CGWB laboratory. The results of the analysis are given below. In none of the samples the As concentration has exceeded the permissible limit of 0.05 milligram/litre.

<b>Location</b>	<b>Source</b>	<b>Concentration milligram/litre</b>
1. Kalyanpur	H/P	0.033
2. Kalyanpur	H/P	0.033
3. Kalyanpur	D/W	0.012
4. Kalyanpur-Babantola	H/P	0.033
5. Kalyanpur-Babantola	H/P	0.033
6. Kalyanpur-Miyatola	H/P	0.047

#### **4.3 Status of Ground Water Development- Block wise**

In Vaishali district the stage of ground water development is 56% (Figure-5). The existing gross ground water draft for irrigation is maximum in Patehi Belsar Block (5211 ham) and minimum in Goroul Block(857 ham) out of the total existing ground water draft for the entire district for irrigation (34729 ham).The maximum water use for domestic and industrial purposes is in Jandaha block (620 ham).

## **5.0 Ground Water Management Strategy**

### **5.1 Ground Water Development**

A perusal of Table 2 indicates that most of the blocks in low ground water development category. The ground water draft for irrigation is very low in Chehra Kalan, Garoul, Paterhi Belsar, Desari and Rajapakar blocks, hence development of ground water for irrigation and other usages viz, soft drinks, mineral water plants, can be taken up on large scale. This will increase the per-capita income of the local people. The development of ground water can be done both by shallow and deep tube wells.

Additional number of ground water structures like heavy duty tube well (discharge 150-200m<sup>3</sup>/hr, medium duty tubewell (discharge 100 m<sup>3</sup>/hr) and shallow tube well(discharge 50 m<sup>3</sup>/hr) should be recommended for proper development of available ground water resources in the above mentioned blocks of Vaishali district for irrigation.

After study of the lithologs of wells drilled by CGWB and the State Agencies it has been observed that the impervious clay layer becomes thick in the south and south eastern part of the districts. A high discharge tube well should have greater depth than those in the northern part of the district In the western part aquifer geometry suggests that at depth of 40 m nearly 10 to 15 m thick water bearing formation is encountered. But in the southern sector, most promising range of depth for tapping aquifer should be kept between 60 to 75 meters.

### **5.2 Water Conservation and Artificial Recharge**

Water conservation like contour bunds, tanks and ponds should be recommended in the low ground water development blocks with consideration of local topography, slope, depth to water level and public participation. In urban area there is concentration of demand of water leading to over abstraction of ground water Artificial recharge may be recommended.

## **6.0 Ground water related issue and problems:**

**Water-Logging and Flooding:** The district has several small patches of area which remain submerged for longer periods. The district has 9036 hectares of land which remains permanently waterlogged. As the district is bounded on two sides by two major rivers, flooding is a major problem in the district.

**Arsenic affected areas:** Ground water quality in some blocks is a matter of concern as geogenic contamination of Arsenic in ground water above permissible limit of 0.05 mg/litre has been observed. A few villages from Biddupur block have been reported as arsenic affected(source :PHED, Bihar).

## **7.0 Mass Awareness and Training Activity:**

### **7.1 Mass Awareness Programme:**

No mass awareness and training activities have been carried out in this district.

### **8.0 Area notified by CGWA/SGWA**

All blocks of Vaishali district under safe category for ground water development point of view. So far no block has been notified by the Authorities.

## **9.0 Recommendation**

- (1) In arsenic affected area deep drilling should be carried out to delineate arsenic free aquifer and to provide arsenic free water for drinking purpose.
- (2) The net annual replenishable ground water resource of the district is 71952 ham. The gross draft for all uses, (irrigation, domestic and industrial water supply) as on 31<sup>st</sup> March 2009, is 40288 ham. The allocation for domestic and industrial requirement supply up to next 25 years is 8730 ham. The stage of ground water development of the district is 56%.
- (3) The waterlogged areas can be developed as pisciculture centers.

- (4) Additional number of ground water structures should be recommended for proper development of available ground water resources in the low ground water development blocks of Vaishali district.
- (5) Flooding in the district can be minimized by removing the blockade and choking (drainage congestion) of the drainage courses of distributaries of river Gandak.

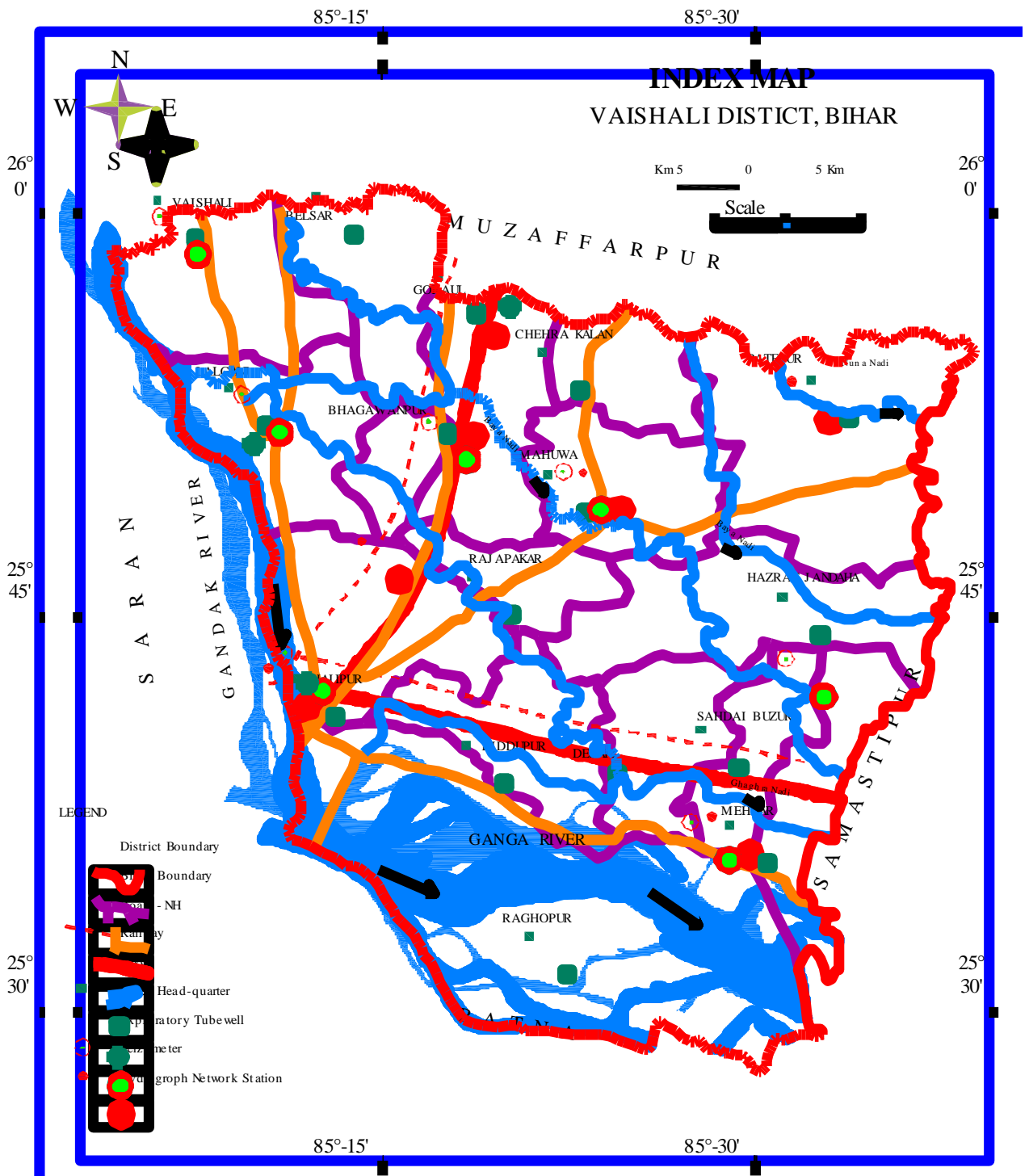


Figure 1. Index Map of Vaishali District, Bihar

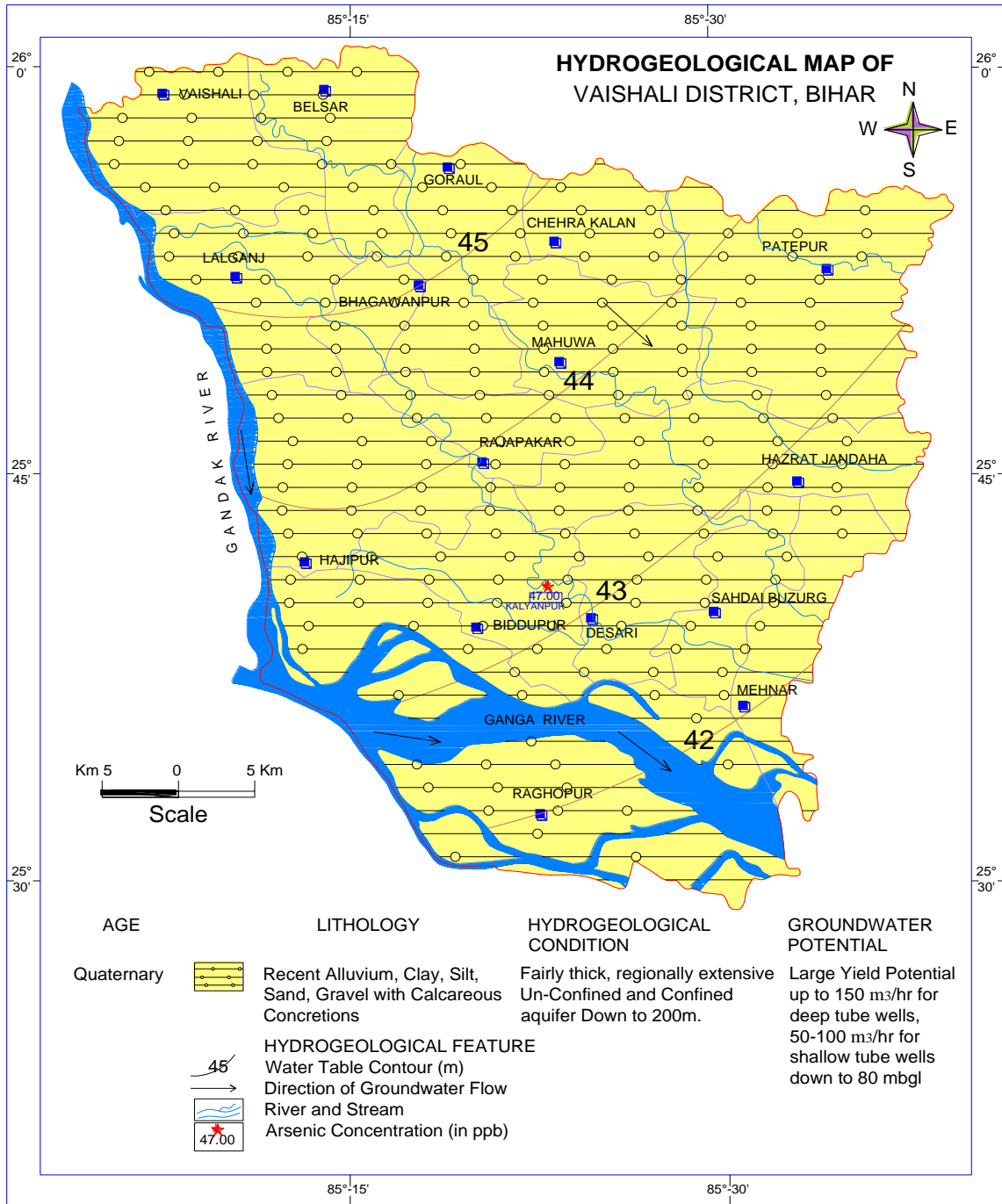


Figure 2. Hydrogeological Map of Vaishali district, Bihar

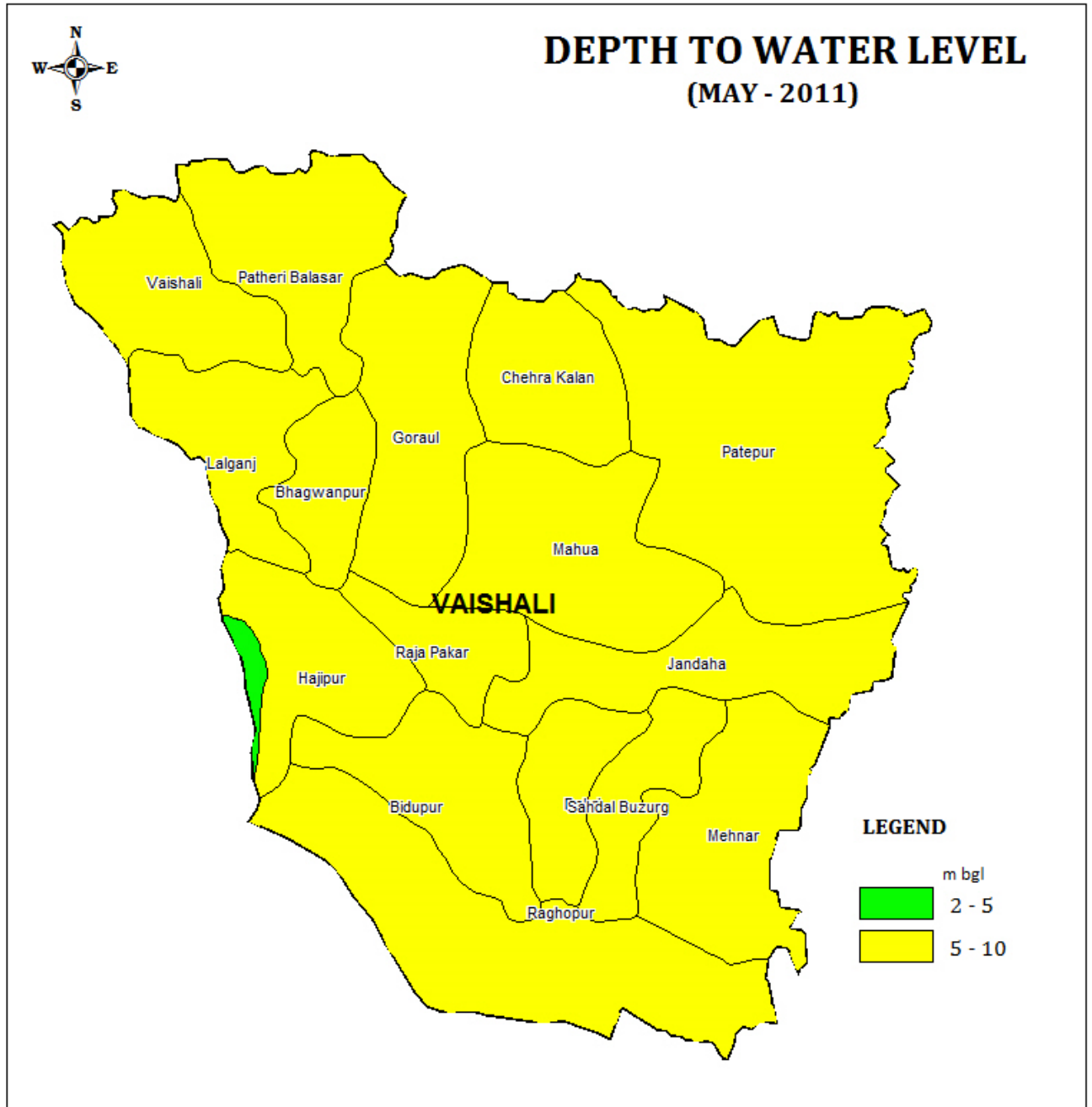


Figure 3. Depth to Water Level Map of pre-monsoon 2011

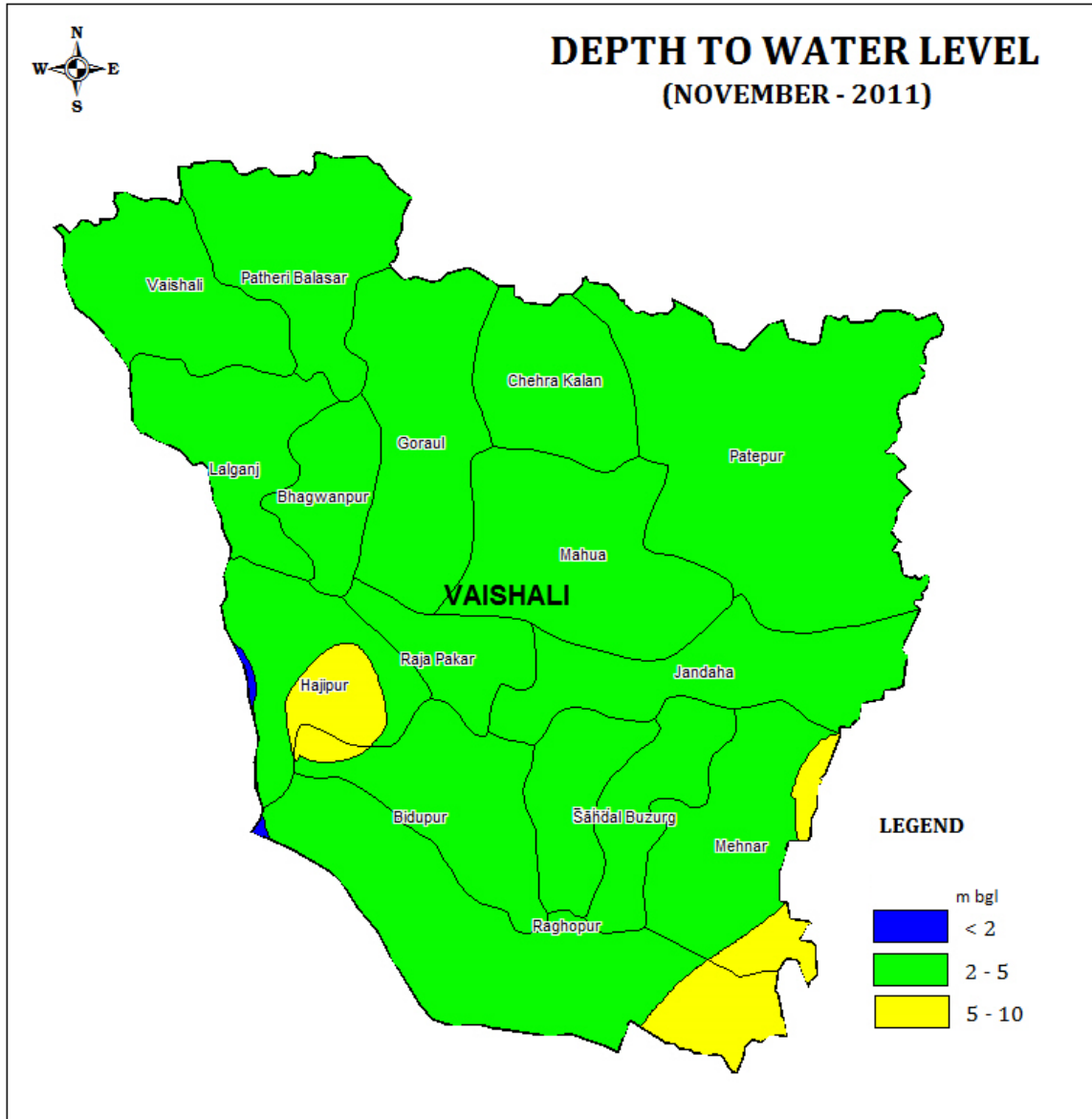


Figure 4. Depth to Water Level Map of pre-monsoon 2011



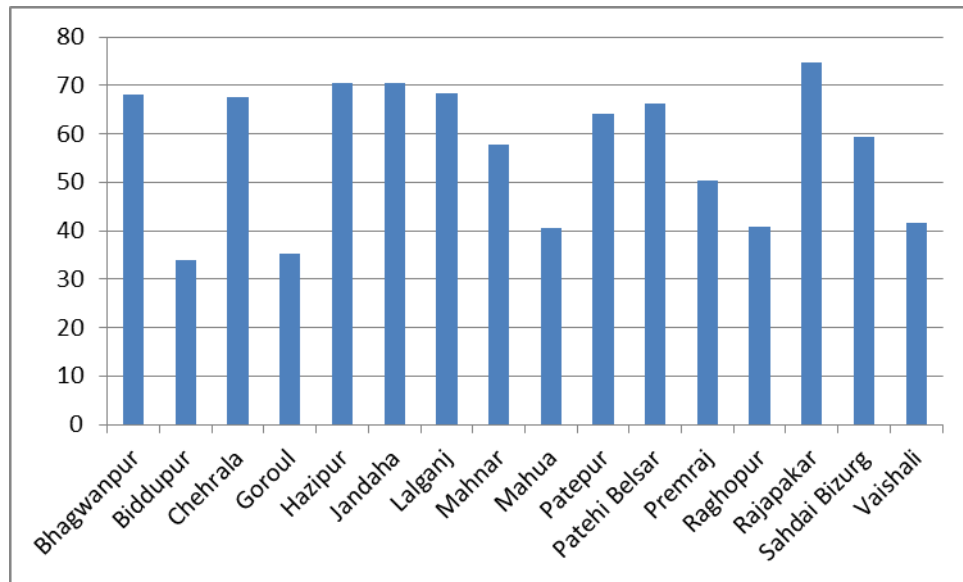


Figure 5. Blockwise Stage of Ground Water Development of Vaishali district, Bihar