GROUND WATER INFORMATION BOOKLET
BIRBHUM DISTRICT, WEST BENGAL

DISTRICT AT A GLANCE

Sl. No.	Items	Statistics
1.	GENERAL INFORMATION	
	i) Geographical Area (Sq. km.)	4545
	ii) Administrative Division (as on 2001)	
	• No. of Subdivision	3 nos.
	• No. of Block	19 nos.
	• No. of Municipalities	6 nos.
	• No. of inhabited villages	2256 nos.
	iii) Population (as on 2001 Census) (with density of population)	30,15,422 (664 per sq.km.)
	iv) Normal Annual Rainfall (mm)	1601
2.	GEOMORPHOLOGY	
	Major Physiographic Units	**Altitude:** more than 100 m amsl in the west to about 30 m amsl in the east. **Land slope:** 20-80 m/km in the western part, 10-20 m/km in the central part and less than 10 m/km in the eastern part of the district. **General Gradient:** NW-SE.
	Major Drainages	River Ajoy, Mayurakshi, Brahmani etc.
3.	LAND USE (Sq.km.) (as on 2004-05)	
	a) Forest Area	158.50
	b) Net Area Sown	3206.10
	c) Non-Agricultural Area	917.70
	d) Others	228.90
4.	MAJOR SOIL TYPES	Red sandy and loamy soil, lateritic soil, older and younger alluvial soils.
5.	AREA UNDER PRINCIPAL CROPS (Sq.km.) (As on 2004-05)	Total Cereals: 4173.0 Total Pulses: 157.0 Total Oilseeds: 425.0 Total Fibre: 6.0 Total Miscellaneous Crops: 133.0
6.	IRRIGATION BY DIFFERENT SOURCES (as on 2004-05) (Areas & No. of Structures)	
	Dug wells (data till 2000-01)	3.70 sq.km. area irrigated through 448 nos. of dug wells.
	Tube wells/ Bore wells (data till 2000-01)	446.45 sq. km. area irrigated through 17500 nos. of tube wells.
	Surface Flow (data till 2000-01)	182.96 sq. km. area irrigated through 7434 nos. of schemes.
	Surface Lift (data till 2000-01)	175.80 sq. km. area irrigated through 8760 nos. of schemes.
	Tanks/ Ponds	254.0 sq.km. area irrigated through 14681 nos. of tanks.
	Canals	1840.20 sq.km. area irrigated through Govt. Canals.
	Other Sources	549.50 sq.km. area irrigated through 16775 nos. of other sources.
	Gross Irrigated Area	3165.40 sq.km.
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.03.07)	78
	No. of Dug wells	55
	No. of Piezometers/ Tube wells	23
8.	PREDOMINANT GEOLOGICAL FORMATIONS	Metamorphics & gneissic complex of Archaean to Proterozoic age, Gondwana Super Group, Rajmahal Trap, Laterites and Quaternary Alluvium.

9.	HYDROGEOLOGY		
	➢ Major Water bearing formation	• Weathered mantle within 12 mbgl & fractures in Archaean granites, Gondwanas & Rajmahal traps in the depth span of 70 mbgl. • Shallow (within 50 mbgl) & deeper aquifers (within 400 mbgl) in Alluvium.	
	➢ Pre-monsoon depth to water level during 2006	In general 5-10 mbgl & as deep as 16.35 mbgl.	
	➢ Post-monsoon depth to water level during 2006	In general, within 5 mbgl, & as deep as 14.75 mbgl.	
	➢ Long term water level trend in 10 years (1997-2006) in m/yr	➢ During Pre-monsoon, rise of water level to the tune of 0.003-0.74 m & fall to the tune of 0.0095-0.399 m. ➢ During Post-monsoon, rise of water level to the tune of 0.0067-0.32 m & fall to the tune of 0.01-0.522 m.	
10.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.07)	Hard Rock	Alluvium
	No. of wells drilled	12	20
	Depth Range (m)	32-137	91-493
	Discharge (lps)	0.83-5.28	0.8-45.23
	Storativity (S)		$0.2X10^{-3} - 4.6X10^{-4}$
	Transmissivity (m^2/day)		700-2900
11.	GROUND WATER QUALITY		
	• Presence of Chemical constituents more than permissible limit	Sporadic occurrence of high fluoride (above 1.5 mg/l & as high as 17.9 mg/l) reported from 7 blocks of the district.	
	• Type of water	Mainly Calcium Bicarbonate type, at places Sodium Chloride type.	
12.	DYNAMIC GROUND WATER RESOURCES (2004) IN MCM		
	• Net Annual Ground Water Availability	1526.12	
	• Existing Ground Water Draft for All Uses	393.59	
	• Projected Demand for Domestic & Industrial Uses after 25 years	64.73	
	• Stage of Ground Water Development	25.79%	
13.	AWARENESS & TRAINING ACTIVITY		
	Mass Awareness Programme organised		
	• Date	14.02.03	17.03.04
	• Place	Suri	Rampurhat
	• No. of Participants	175	100
	Water Management Training Programme organised		
	• Date	14.02.03	
	• Place	Suri	
	• No. of Participants	150	
14.	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING		
	• Projects completed by CGWB (No. & Amount spent)	1 no. completed & amount Rs. 7.65 lakh spent.	
	• Projects under technical guidance of CGWB (No.)	Nil	
15.	GROUND WATER CONTROL & REGULATION		
	• No. of OE Blocks	Nil	
	• No. of Critical Blocks	Nil	
	• No. of Blocks Notified	Nil	
16.	MAJOR GROUND WATER PROBLEMS & ISSUES	• Water scarce hard rock & drought prone area • Areas with fluoride contaminated groundwater • Areas categorised as 'Semi-critical'	

GROUND WATER INFORMATION BOOKLET
BIRBHUM DISTRICT, WEST BENGAL

1.0 INTRODUCTION

ADMINISTRATIVE FRAMEWORK

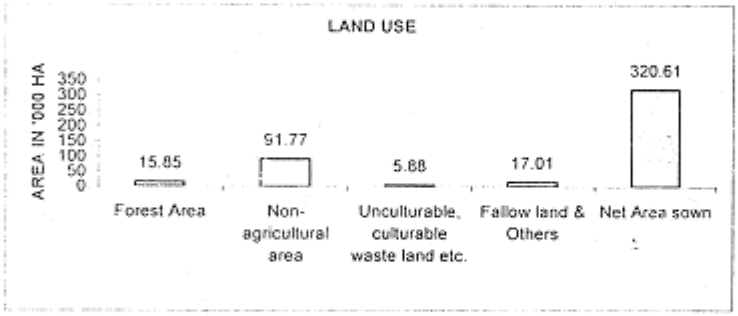
- **Geographical Area:** 4545 sq.km.

- **Location:** The district is located in the western part of the State and lies between latitude 24°35'0":23°32' 30"(N) and 88°01'40":87°05'25"(E). The district is bounded in the east and north-east by Murshidabad district, on the south and south-east by Barddhaman district of West Bengal and on the west by Sahebganj and Dumka districts of Jharkhand State. The district is located in the Ganga basin.

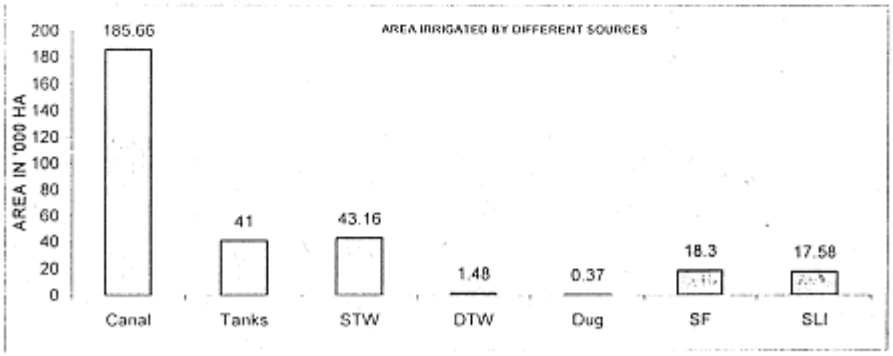
- **Administrative Division**
  - **No. of Subdivision:** 3 nos – Rampurhat, Sadar & Bolepur.
  - **No. of Blocks/ Taluk:** 19 nos.
  - **No. of Municipalities:** 6 nos.
  - **No. of inhabited villages:** 2256 (as per 2001 census).
  - **District Head Quarter:** Suri.
  - **Population with density of population:** 30,15,422 & 664 per sq.km. (as per 2001 census). Population of S.C. & S.T. is 889894 (29.18%) and 203127 (6.66%) respectively.

LAND USE, IRRIGATION PRACTICES & AGRICULTURE

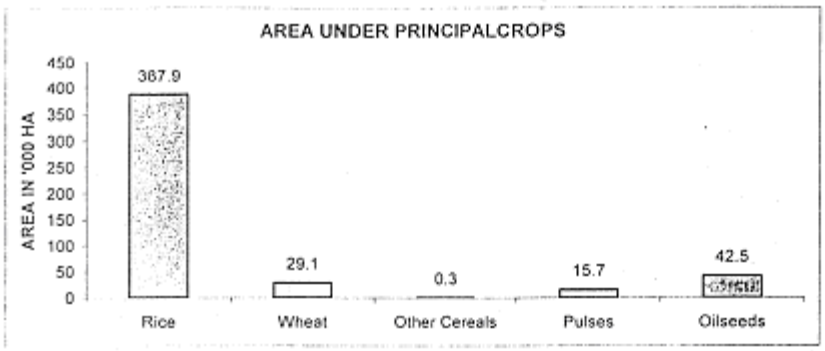
- **Land Use:**



- **Irrigation:** For agricultural productions, water is being provided either by major irrigation systems or by minor irrigation systems and it comes to about 98.73% of the cultivated area. The major irrigation systems are generally being operated through network of canal system of Mayurakshi River and about 58.13% of the total irrigated lands has been irrigated by canals in 2004-05.



• Agriculture



➢ STATUS OF SURVEY CARRIED OUT BY CGWB:

- Under the programme of Systematic Hydrogeological Surveys, entire district was covered in different phases during 1965-71.
- To understand the changes in quality and quantity of groundwater with time and space, the entire district has been covered in different phases by Reappraisal Hydrogeological Survey during 1989-90, 1990-91 and 2003-04.
- During 1976, the study on the feasibility of construction of tube wells was carried out in Mayurakshi Canal Command area.
- Part of the district has been covered under the programme of groundwater exploration and till now 32 nos of exploratory wells have been constructed.
- To have a close observation on the trend of water levels and also on the changes in the quality of groundwater with time and space water levels are being monitored four times in a year and water samples are being analyzed once in a year.
- A number of short term water supply investigations have been carried out.

2.0 CLIMATE

- **Normal Annual Rainfall:** 1601 mm with 1261 mm normal monsoon rainfall.
- **Average Maximum & Minimum Temperature:** 41^0C & 9^0C respectively.

- **Declared drought prone area of the district:** Murarai-I & Rajnagar blocks.

3.0 GEOMORPHOLOGY & SOIL TYPES

- **Physiography:** The altitude of the district, in general, varies from more than 100 m amsl in the west to about 30 m amsl in the east with land slope to the tune of 20-80 m/km in the western part, 10-20 m/km in the central part and less than 10 m/km in the eastern part of the district. The general gradient is from north-west to south-east.

- **Drainage:** The main rivers are Ajoy, Mayurakshi and Brahmani, flowing from west to east following the master slope of the land surface. Ajoy river flows along the southern boundary, Mayurakshi river through the central part and Brahmani river in the northern part of the district.

- **Soil:** The north-western, western and south-western parts of the district are covered by red sandy and red loamy soils. Lateritic soil covers maximum area in the central part of the district. Older alluvial soil covers southern and south-eastern part of the district. Younger alluvial soil occurs in small patches in south -eastern and northern part of the district.

4.0 GEOLOGY:

The crystalline metamorphic rocks of Archaean to Proterozoic age occupy the southwestern part of the district The Gondwana Supergroup, overlying this basement, is represented by thick piles of pelitic and psamitic sedimentary rocks containing coal seams belonging to Barakar, Barren Measure, Raniganj and Dubrajpur Formations ranging from Permian to Jurassic in age. Patchy occurrences of Gondwana formation are exposed mainly along the Ajoy river in Khyrasol-Dubrajpur-Ilambazar tract and Md. Bazar area. The Gondwana is overlain by Rajmahal trap (basalt) occurring in the northern and north-western part of the district. The north and also the central part of the rest of the area is occupied by laterite and lateritic soil. Hard clay impregnated with caliche nodules of Rampurhat formation occupy the area in the north-east and also in the east and is overlain by alternating layers of sand, silt and clays of Kandi formation of Quaternary age.

5.0 GROUND WATER SCENERIO

5.1 HYDROGEOLOGY:

In the western part of the district, underlain by Archaeans, Rajmahal Traps and Gondwanas, groundwater occurs under water table condition in the weathered zones (6 to 12m thick) and under semi-confined to confined conditions in the zone of secondary porosities, in general within 55 mbgl, and at places also down to 70 mbgl. Groundwater is generally being developed through open wells in the weathered zone and the available discharges can only meet the domestic needs but is not sufficient enough for any large scale development of groundwater. However, groundwater from the zone of secondary porosities is being developed through bore wells and yield to the tune of 60-150 lpm, which, at places, goes as high as 330 lpm. There is scope for development of ground water through bore wells.

The thickness of alluvium increases from west to east from < 20 to about 80 mbgl in the western part of the district and it increases to huge thickness towards east. Major portion of the Older Alluvium cover areas in uplands, which are sometimes overlain by laterite. Recent Alluvium occupies extreme eastern parts of the district, along its border with Murshidabad district, and also comprises the area along the major river channels.

In the area, underlain by Alluvium, groundwater occurs under unconfined conditions in the shallow aquifers. At deeper depths, it occurs under semi-confined to confined conditions and the cumulative thickness of this aquifer within a depth span of 50-200 m depth has been found to be as high as 61 m in the area around Illambazar and decreases gradually towards east and is as low as 9 m around Bolpur . However in the eastern part around Bolpur, potential granular zone consisting of fine to coarse grained, occur below the depth of 200 mbgl and the cumulative thickness of the aquifer in the depth span of 200 to 400 mbgl ranges between 27 and 68 m.

The aquifer characteristics and yield potentialities, observed from the ground water exploration carried out in the district by CGWB and other organizations, reveal that

- From Murarai to Mayureswar II and Sainthia blocks, average yield of shallow tube wells of about 10 to 50 m depth varies from 13.60 to 22.7 m^3/hr at reasonable draw down. T varies from 250 to 400 m^2/day and Storage Coefficient (S) being $0.5x10^{-1}$.
- In Illambazar and Dubrajpur blocks, within a depth of 200 m bgl, yields of tube wells range from 102.19 m^3/hr to 276.75 m^3/hr with a reasonable draw down of 4.5 to 8.5m.
- Yields from tube wells tapping the aquifers in the depth ranges of 200 to 400 mbgl in Bolpur block range from 85 m^3/hr to 178.87 m^3/hr.with draw down in the range of 8 to 24 m.

In general, coefficient of Transmissibility of deeper aquifers ranges from 700 –2900 m^2/day from west to eastern part of the district and the Storativity values varies from 0.2×10^{-3} to 4.6×10^{-4}.

It has been observed that there are some auto-flowing shallow tube wells of 25-40 m depth along the drainage courses in parts of Nanoor, Sainthia, Nalhati and Murarai blocks. Ground water exploration in the district reveals that auto flowing condition also prevails in the aquifer zones between 222-342 mbgl at Ahmedpur in Sainthia block and 203-490 mbgl at Mustal in Labpur block with free flow to the tune of 4.25 lps for the piezometric head at 0.90 magl and 6.94 lps for the piezometric head at 3.27 magl respectively.

During pre-monsoon period in major part of the area, depth to water level is in the range of 5.0 to 10.0 mbgl. During post-monsoon period in major part of the hard rock terrain depth to water level is found to be in the range of near ground level to 5.0mbgl and in the alluvial terrain, particularly in the northern part of the district, it is found to be mainly in the range 5.0 to 10.0mbgl while in the southern part it was mainly in the

range of 2.0 to 5.0mbgl. Seasonal water level fluctuation between pre-monsoon and post-monsoon periods is found to be mainly in the range of 2.0 to 4.0 m, while along Ajoy river it is as high as more than 4.0 m. In Birbhum district the value of water table ranges from 102.25 m amsl in the western part to 13.40 m amsl in the eastern part of the district. Broadly the groundwater flow direction is easterly to south easterly.

Long-term water level trend analysis from some hydrograph stations, separately for pre-monsoon and post-monsoon periods, show declining trend of water level to the tune of 0.0095-0.399 m/yr and 0.01-0.52 m/yr respectively over a period of 1997-2006.

5.2 GROUND WATER RESOURCES:

The dynamic ground water resources of Birbhum district has been estimated jointly by CGWB and SWID, Govt. of West Bengal, following the norms laid down by GEC 1997 methodology and projected as on 31.03.04.

The reconciled figures are as under:

- Total Ground Water Resources: **166715 ham**
- Net Annual Ground Water Availability: **152612 ham**
- Existing Ground Water Draft for All Uses: **39359 ham**
  - For Irrigation : 34887 ham
  - For domestic & industrial water supply: 4472 ham
- Stage of Ground Water Development: **25.79%**
- Allocation for domestic & industrial water: **6473 ham**
  supply requirement upto 25 yrs.
- Net Ground Water Availability for future irrigation development: **111252 ham**
- Categorization of blocks: All blocks are categorized under 'Safe',except 4 blocks, namely, Nanoor, Nalhati-II, Murarai-II & Rampurhat-II are under 'Semi-critical' category.

5.3 GROUND WATER QUALITY:

The analysis of water samples indicates that the value of Sodium Adsorption Ration, in general, ranges from 0.08 to 3.17 falling in the category of C_2S_1 and C_3S_1 indicating low sodium and low salinity hazard. The percent sodium concentration indicate that the values are generally with in 50 mgt/lit and that of Sp. Conductance is within 1500 μ/cm at 25^0C and therefore the groundwater can be grouped as 'excellent to good' and 'good to permissible' in irrigation sector. Ground water in the district is, in general, of Calcium Bicarbonate type, but Sodium Chloride type of water is found to occur around Nalhati & Tejhati. At Suri, a mixed type of ground water is found.

In drinking water supply schemes, high concentration of iron and fluoride in groundwater is a serious problem. High conc. of iron has got sporadic occurrence and in water supply schemes it is being managed with the help of Iron Elimination Plants.

Groundwater in 7 blocks, namely, Khyrasol, Rajnagar, Sainthia, Suri-II, Mayureswar-I, Nalhati-I and Rampurhat-I, is affected sporadically by high concentration of fluoride in groundwater i.e. more than the permissible limit (>1.5 mg/l) in the following depth ranges in different types of hydrogeological formations:

- In fractured granite within 50.0 to 80.0m depth.
- In Gondwana sediments with in 30m depth.
- In basalts within 50.0 to 80.0m depth.
- In alluvium within 50.0 to 60.0m depth.

In Khyorasol and Rampurhat-I blocks concentration of fluoride in groundwater has been reported to be as high as 15.9 mg/lit and 17.9 mg/lit respectively.

During survey (2001) carried out by PHED, it was observed that in Birbhum district about 52,563 population spreading over 78 habitations are affected by fluoride contaminated groundwater.

5.4 STATUS OF GROUND WATER DEVELOPMENT (BLOCKWISE)

Block	Occurrence of Aquifers & its potentiality (as per data available with CGWB)	Feasibility of GW Abstraction Structures	Ground Water Resourse Available & Status of GW Development (as on March'04)	Remarks
Murarai-I	Multiple aquifer system occurs, in general, in the depth span of 17-115 mbgl, beyond this depth basaltic rock occurs. T of the aquifers is about 700 m^2/d.	Low duty tube wells (about 30 m3/hr) are generally feasible. Tube well tapping granular zones within 115 mbgl may yield about 40 m^3/hr at 20.74 m. drawdown.	Net GW Availability: 3760 ham. Irrigation draft (projected upto 2004): 849 ham No. of Irrigation well (as per Census 2001): STW: 449, Dug well: 1 Category of block: **Safe**.	In the block, aquifers are not very potential. Hence, development may be done in planned manner.
Murarai-II	Potential aquifers, in general, occur in the depth span of 30-50 mbgl and 120-150 mbgl with T about 1650 m^2/d. Depth of the basement increases from west to east. In the eastern part of the block it is generally more than 150 mbgl.	Medium (about 90 m3/hr) to heavy-duty tube wells (>150 m3/hr) are feasible. Successfully constructed tube wells yield about 180 m^3/hr at 6.36 m. drawdown	Net GW Availability: 7171 ham. Irrigation draft (projected upto 2004): 1818 ham. No. of Irrigation well (as per Census 2001): STW: 900, DTW: 7 & Dug well: 1. Category of block: **Semi-critical.**	Since the block is under 'Semi-critical' category, ground water development may be done with special attention for augmentation of ground water & regular monitoring of water level.
Nalhati-I	In the western most part, at places, basaltic rock is exposed and water-bearing fractures encounter within 60 mbgl. In the eastern part, multiple aquifers occur within 50 mbgl and in the depth span of 63-120 mbgl. Basement encounters at shallow depth (around 51 mbgl) in the western side & at deeper depth in the eastern part. T & S of the aquifers are to the tune of 850-2900 m^2/d and $1.2x10^{-3}$ to $2x10^{-3}$ respectively.	In the areas where trap is exposed, dug wells within 10-15 mbgl/ bore wells, tapping fractures in the depth span of 10-13, 18-30 and 44-56 mbgl yielding 10 m3/hr are feasible. Medium to heavy-duty tube wells are feasible in the alluvial part. Tube well tapping granular zones between 60-185 mbgl may yield 200-222 m^3/hr at a drawdown of 3.40 – 6.2 m.	Net GW Availability: 4205 ham. Irrigation draft (projected upto 2004): 1892 ham. No. of Irrigation well (as per Census 2001): STW: 965, DTW: 5 & Dug well: 1. Category of block: **Safe**.	Ground water with high fluoride concentration is reported from the dug & bore wells, tapping weathered residuum & fractures in Rajmahal trap, in the depth span of 50-80 mbgl. Hence it is suggested that measures for defluoridation may be undertaken before utilisation of water for drinking purpose.
Nalhati-II	Multiple aquifers encountered within 185 mbgl of the drilling depth of 223 mbgl.		Net GW Availability: 4187 ham. Irrigation draft (projected upto 2004): 2165 ham. No. of Irrigation well (as per Census 2001): STW: 1114, DTW: 5. Category of block: **Semi-critical.**	Since the block is under 'Semi-critical' category, ground water development may be done with special attention for augmentation of ground water & regular monitoring of water level.
Rampurhat-I	At places in the western most part, basaltic rock is exposed and towards eastern part the same is encountered at depth. In the western part, at places, water-bearing fractures encounter within 60 mbgl. In the eastern part, multiple aquifers encountered within 150 mbgl.	In the alluvial part where the thickness of it is reasonably good, medium to heavy-duty tube wells are feasible. Tube well tapping granular zones within 150 mbgl may yield 220 m^3/hr at a drawdown of 9.80 m. In the areas where trap is the	Net GW Availability: 8312 ham. Irrigation draft (projected upto 2004): 773 ham. No. of Irrigation well (as per Census 2001): STW: 356, DTW: 5 & dug well: 5. Category of block: **Safe**.	Ground water with high fluoride concentration is reported from the dug & bore wells, tapping weathered residuum & fractures in Rajmahal trap, as well as from the tube wells tapping shallow aquifers, in the depth span of 50-80 mbgl. Hence it is suggested that measures for defluoridation may be

		only hydrogeological formation, bore wells, tapping fractures in the depth span of 10-13, 18-30 and 44-56 mbgl yielding 10 m3/hr are feasible.		undertaken before utilisation of water for drinking purpose. In case, the fluoride is found above permissible limit in the tube wells tapping shallow aquifers, the occurrence of deeper aquifers, if any, may be explored.
Rampurhat-II	Multiple aquifers encountered in the depth span of 60-95 mbgl and 106-162 mbgl. Though at places basement touches at 125.65 mbgl (Tarapith), but at most of the places basement encounters beyond this depth.	Medium to low duty tube wells are feasible. Tube well tapping granular zones in the depth span of 77-88, 119-123, 128-141, 156-162 mbgl yields about 90 m^3/hr. However at some places yield of tube wells may be as low as 40 m^3/hr.	Net GW Availability: 7518 ham. Irrigation draft (projected upto 2004): 1784 ham. No. of Irrigation well (as per Census 2001): STW: 944, DTW: 2 & dug well: 1. Category of block: **Semi-critical.**	Since the block is under 'Semi-critical' category, ground water development may be done with special attention for augmentation of ground water & regular monitoring of water level.
Md. Bazar	Ground water occurs in the weathered residuum within 12 mbgl & fractures encountered at shallow depth (within 30 mbgl) in the exploratory bore hole drilled down to 74 mbgl.	Dug wells & bore wells or dug-cum-bore wells are feasible in the area. Bore well tapping fractures in the depth span of 23-28 mbgl yields 7.2. m^3/hr.	Net GW Availability: 7072 ham. Irrigation draft (projected upto 2004): 353 ham. No. of Irrigation well (as per Census 2001): STW: 184, & dug well: 36. Category of block: **Safe.**	Since the aquifers are not potential. Hence, development may be done in planned manner.
Mayureswar-I	Multiple aquifers encounter in the depth span of 15-75 mbgl and 170-192 mbgl. Basement encounters at shallow depth, around 63.44 mbgl near Mollarpur in the western side, but it is at deeper depth in the eastern part.	Medium to heavy-duty tube wells are feasible. Tube well tapping granular zones in the depth span of 32-35, 41-53 and 56-69 mbgl yields about 249.70 m^3/hr at a drawdown of 6.02 m.	Net GW Availability: 8508 ham. Irrigation draft (projected upto 2004): 1286 ham. No. of Irrigation well (as per Census 2001): STW: 944, DTW: 2 & Dug well: 1. Category of block: **Safe.**	Ground water with high fluoride concentration is reported from the tube wells tapping shallow aquifers, generally down to the depth of 60 mbgl. Hence it is suggested that the occurrence of deeper fluoride free aquifers may be identified & tapped in the tube wells.
Mayureswar-II	Multiple aquifers encounter in the depth span of 29-44, 93-102 and 179-194 mbgl.	Medium to heavy-duty tube well is feasible. Tube wells tapping granular zones in the depth span of 29-44 mbgl may yield about 180 m^3/hr.	Net GW Availability: 8031 ham. Irrigation draft (projected upto 2004): 2286 ham. No. of Irrigation well (as per Census 2001): STW: 1230, DTW: 1 & Dug well: 1. Category of block: **Safe.**	Large scale ground water development may be done.
Sainthia	Multiple aquifers, in the depth span of 53-168, 222-342 mbgl, occur up to the explored depth of 350 mbgl & the thickness of the aquifers increases towards east. T is recorded to be about 7200 m^2/day & S to be $9.1x10^{-2}$. The deeper aquifers are under auto-flowing condition & auto flow, to the tune of 4.25 lps for the head of 0.90 magl, has been observed in the tube well tapping granular zones between 222 to 342 mbgl at Ahmedpur. In	In general, medium-duty tube wells are feasible. Tube well tapping granular zones in the depth span of 53 to 168 mbgl or 222 to 342 mbgl may yield around 72 to 80 m^3/hr with drawdown in the range of 5.10 to 6.82 m. At places, yield from deep tube wells has been reported to be as high as 200 m^3/hr with about 6 m drawdown.	Net GW Availability: 15066 ham. Irrigation draft (projected upto 2004): 3193 ham. No. of Irrigation well (as per Census 2001): STW: 1635, DTW: 8. Category of block: **Safe.**	Ground water with high fluoride concentration is reported from the tube wells tapping shallow aquifers, generally down to the depth of 60 mbgl. Hence it is suggested that the occurrence of deeper fluoride free aquifers may be identified & tapped in the tube wells.

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	the block, there is much ground water development through shallow tube wells, tapping ground water from the aquifers occurring under unconfined condition with T & S values to the tune of 250 to 400 m^2/d & $0.5x10^{-1}$ respectively.	In the block, there is much ground water development through shallow tube wells yielding 13.6 to 15 m^3/hr.		
Suri – I & II	In general, ground water occurs in the weathered residuum occurring in the depth span of 6 to 12 mbgl & fractures in the granite gneiss down to the depth of about 65 mbgl. In eastern most part of the block, the hard rock is overlain by laterite-capped alluvium, thickness of which has been reported to be 112 m at Purandarpur.	Dug wells & bore wells or dug-cum-bore wells are feasible in the area. In the eastern most part of the block, low duty tube wells tapping both alluvium as well as weathered part of hard rock are feasible. General yield from open wells within 12m depth is around 4.5 m^3/d. Bore wells of about 70 m depth yield to the tune of 3 to 19m^3/hr.	Net GW Availability: 5506 & 1723 ham in Suti-I & II respectively. Irrigation draft (projected upto 2004): 247 & 595 ham in Suti-I & II respectively. No. of Irrigation well (as per Census 2001): STW: 126 & 323, Dug well: 37 & 1 in Suti-I & II respectively. Category of both the blocks: **Safe.**	Ground water with high fluoride concentration is reported from the dug & bore wells, tapping weathered residuum & fractures in granitic rock, as well as from the tube wells tapping shallow aquifers, in the depth span of 50-80 mbgl. Hence it is suggested that measures for defluoridation may be undertaken before utilisation of water for drinking purpose. In case, the fluoride is found above permissible limit in the tube wells tapping shallow aquifers, the occurrence of deeper aquifers, if any, may be explored.
Rajnagar	Ground water occurs in the weathered residuum in the depth span of 6 to 12 mbgl & fractures in the granite gneiss down to the depth of about 60 mbgl.	Dug wells & bore wells or dug-cum-bore wells are feasible in the area. General yield from open wells within 12m depth is around 4.5 m^3/d. Bore wells of about 60 m depth yield around 5 m^3/hr.	Net GW Availability: 2246 ham. Irrigation draft (projected upto 2004): 72 ham. No. of Irrigation well (as per Census 2001): STW: 4, Dug well: 161. Category of block: **Safe.**	Ground water with high fluoride concentration is reported from the dug & bore wells, tapping weathered residuum & fractures in granitic rock. Hence it is suggested that measures for defluoridation may be undertaken before utilisation of water for drinking purpose.
Khayrasol	Ground water occurs in the weathered residuum in the depth span of 6 to 12 mbgl & fractures in the granite gneiss down to the depth of about 60mbgl.	Dug wells & bore wells or dug-cum-bore wells are feasible in the area. General yield from open wells within 12 m depth is around 4.5 m^3/d. Bore wells of about 60 m depth yield to the tune of 5 –8 m^3/hr.	Net GW Availability: 4488 ham. Irrigation draft (projected upto 2004): 1201 ham. No. of Irrigation well (as per Census 2001): STW: 630, Dug well: 104. Category of block: **Safe.**	Ground water with high fluoride concentration is reported from the dug & bore wells, tapping weathered residuum & fractures in granitic rock. Hence it is suggested that measures for defluoridation may be undertaken before utilisation of water for drinking purpose.
Dubrajpur	Potential aquifers occur within 140 mbgl & thickness of aquifers increases towards east.	Medium to heavy-duty tube wells are feasible. Tube well tapping granular zones in the depth span of 30 to 135 mbgl may yield to the tune of 130 to 270 m^3/hr with drawdown in the range of 4.57 to 7.32m. Shallow tube wells in the area yield about 13.5 m^3/hr.	Net GW Availability: 12978 ham. Irrigation draft (projected upto 2004): 1724 ham. No. of Irrigation well (as per Census 2001): STW: 638, DTW: 23, Dug well: 48. Category of block: **Safe.**	The aquifers are potential & the block is under Safe category, Hence, large scale ground water development may be undertaken in planned manner.

Illambazar	Potential aquifers occur within 290 m bgl depth. The aquifers available in the depth range of 290 to 350 mbgl are less potential & tube wells tapping aquifers in the depth span of 304 to 310 mbgl & 330 to 342 mbgl yielded 56.70 m^3/hr at a drawdown of 7.87 m.	Medium to heavy-duty tube wells are feasible. Tube well tapping granular zones down to 290 mbgl depth may yield to the tune of 102 to 276 m^3/hr with drawdown in the range of 4.57 to 8.54 m.	Net GW Availability: 9938 ham. Irrigation draft (projected upto 2004): 4026 ham. No. of Irrigation well (as per Census 2001): STW: 1661, DTW: 42. Category of block: **Safe.**	The aquifers are potential & the block is under Safe category, Hence, large scale ground water development may be undertaken in planned manner.
Bolepur	Potential aquifers occur within 396 mbgl in Older Alluvium & Tertiary sediments. In Santiniketan area the value of co-efficient of transmissivity has been determined to be 250 m^2/day.	Medium duty tube wells are feasible. In general, tube well tapping granular zones down to 396 mbgl may yield to the tune of 48 to 96 m^3/hr with drawdown ranging from 6.0 to 08.43 m.	Net GW Availability: 15461 ham. Irrigation draft (projected upto 2004): 2840 ham. No. of Irrigation well (as per Census 2001): STW: 1490, DTW: 4, Dug well: 15. Category of block: **Safe.**	
Nanoor	Aquifers encountered, in general, in the depth span of 40-138, 247-261 & 315-336 mbgl within the drilled depth of 345 mbgl show less potentiality. Tube well tapping granular zones in the depth span of 40-138, 247-261 may yield low to as high as 45 m^3/hr with high drawdown to the tune of 14.56 to 21.75 m. The discharge of deeper aquifers in the depth span of 315-336 mbgl is as low as 3 lps. T & S are about 180 m^2/d and $0.7x10^{-3}$ to $3.6x10^{-5}$ respectively. In the area, there is much ground water development through shallow tube wells of 30-45 m deep. At places, autoflow condition persists with free flow 2 to 10 m^3/hr & piezometric head 0.26 to 3.76 magl.	Low duty tube wells are feasible.	Net GW Availability: 13711 ham. Irrigation draft (projected upto 2004): 4195 ham. No. of Irrigation well (as per Census 2001): STW: 2280. Category of block: **Semi-critical.**	Since the block is under 'Semi-critical' category, ground water development may be done with special attention for augmentation of ground water & regular monitoring of water level.
Labpur	Potential aquifers encountered in the depth span of 138-490 mbgl within the drilled depth of 508 mbgl. Tube well tapping granular zones in the depth span of 204-490 mbgl yields about 163 m^3/hr with 13.13 m drawdown T is about 150 m^2/d. The well at Mustal is under autoflowing condition with free flow of about 25 m^3/hr & piezometric head 3.27 magl.	Medium duty tube wells are feasible.	Net GW Availability: 12732 ham. Irrigation draft (projected upto 2004): 3590ham. No. of Irrigation well (as per Census 2001): STW: 1805, DTW: 11, Dug well: 36. Category of block: **Safe.**	The aquifers are potential & the block is under Safe category, Hence, large scale ground water development may be undertaken in planned manner.

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6.1 GROUND WATER MANAGEMENT STRATEGY & RECOMMENDATION:

6.2 Ground Water Development

In Birbhum district, about half of the district area falls under hard rock terrain and the remaining area is underlain by alluvium. Block wise strategy for ground water development has been furnished in item no. 5.4. Hence, a general strategy, as applicable, in the district is summarized below:

- In hard rock terrain, constituted by hard crystalline rocks/ Gondwana sedimentaries/ Rajmahal Traps, the following ground water abstraction structures are feasible:
  - Large dia dug wells within 12 mbgl can only meet the domestic needs.
  - Borewells/ dug-cum-bore wells within 70 mbgl, may yield to the tune of 60-150 lpm and at places as high as 330 lpm. Sites to be selected through hydrogeological survey and geophysical survey.
  - Considering limited potentialities, attempts are to be made to augment the groundwater resources, especially for the weathered zones. It can be done by rainwater harvesting and considering the terrain conditions
  - Special care is to be taken on the concentration of fluoride in groundwater for drinking purpose, as at some places in Khyrasol, Rajnagar, Sainthia & Suri-II blocks, fluoride concentration is above the permissible limit and fluoride contaminated water can be used only after proper de-fluoridation. The water conserved in ponds, especially in fluoride affected areas, can be used for drinking purpose after treatment

- In alluvial terrain, thickness of alluvium gradually increases from west to east. In the transitional area the thickness of alluvium is limited within the depth range of 50 to 70 m, and it is very thick in within the depth of 400 m in the eastern part of the district. Here, ground water may be developed through different abstraction structures, considering the availability of potential and potable aquifers, thickness of potable aquifers, stage of ground water development, etc.

  - Shallow tube wells are generally constructed within the depth ranges of about 10 to 50 m bgl. Average yield of tube wells at reasonable draw down varies from 18 to 22.7 m^3/ hr.
  - In general, medium to heavy duty tube wells within 200 m bgl are feasible in the eastern part of the district, average yield of which is to the tune of 102.19 m^3/hr to 276.75 m^3/hr with a reasonable draw down of 4.5 to 8.5m.
  - In the alluvial part of the district, four blocks namely Nalhati-II, Nanoor, Murarai-II and Rampurhat-II are in 'Semi-Critical' category. These blocks need special attention for augmenting the groundwater resources
  - Fluoride contaminated groundwater has been reported from the tube wells within 60 m depth in the blocks of Nalhati-I, Rampurhat-I and Mayureswar-I. The deeper aquifers, beyond 60 mbgl, may be exploited for drinking purpose.

6.3 Water Conservation & Artificial Recharge

Rain Water Harvesting is need of the day. Normal annual rainfall in the district is 1601mm and normal monsoon rainfall is 1261mm i.e. sufficient rainfall is available for rainwater harvesting.

- **Conservation of Rainwater:**

In the areas along the western boundary and also in the southwestern part of the district where different types of hard rocks are the hydrogeological formations, generally potentialities of these formations are poor and as such dug wells are the main feasible ground water abstraction structure. With the onset of summer these areas generally face acute drinking water crisis. In this area where the scope of groundwater development is limited, rainwater conservation is the best option to mitigate the crisis of drinking water problem. Conservation of rainwater can be done from the water that can be available from both the rooftops and also from the lands.

- The water that can be available from roofs can be stored giving considerations to all types of losses in cemented tanks or in PVC tanks. Before conserving, the water should be sand filtered.
- The rainwater that can be available from any land surface can be stored in any ponds and in this case sites as well as designs of ponds are to be finalized considering local hydrogeological as well as terrain conditions.
- In addition to these, the surface water which flows through streams/ nallahs can be conserved with the help of check dams, giving due considerations to the surrounding farmers' lands, local hydrogeological conditions and terrain conditions.
- In undulating terrain gully plugs can be feasible on cultivated lands to conserve limited quantity of water and there by soil moisture can be increased which will be beneficial for crop production.

In alluvial areas also, where hydrogeological conditions are feasible, rainwater conservation can be done by any of the techniques mentioned above, giving due considerations to the facts mentioned above.

- **Artificial Recharge to Groundwater:**

Feasibility of artificial recharge to groundwater is site specific. The guiding factors for selecting sites and type of structure for artificial recharge to ground water are as follows:

- Non- committed rainwater is to be utilized for artificial recharge to groundwater.
- Hydrogeological conditions should be feasible to get recharged by rainwater.
- As far as possible any site should be selected on plain terrain & the recharged water are not drained out in natural conditions through streams/ nallahs before development of the recharged water.
- Any structure is to be constructed on such a terrain where there is ample scope of development of groundwater and while designing the structures, the need of the people of downstream side is to be given due consideration.
- Post-monsoon water level should be more than 3 mbgl.

In Birbhum district the feasible structure for artificial recharge to ground water are as follows:

- In the district where depth to water level during post monsoon period is more than 3 mbgl and can be as high as 15 mbgl, the following structures are feasible for artificial recharge to groundwater:
  - Percolation tanks are feasible as with the depletion of post-monsoon water levels, water from the percolation tanks will start to percolate into the groundwater.
  - Check dams are feasible supported by properly designed recharge well. In case the check dams are on sloppy streambed, these are to be supported by Gabion structures on upstream side to control the velocity of water and accumulation of silt. The height of check dam is to be finalised based on levelling survey, in order to protect the private land from submergence.
  - Dry dug wells after cleaning can be used for artificial recharge to groundwater. However before recharging the water is to be sand filtered.
  - During monsoon period many ponds over flow and this surplus water can be used, considering feasible hydrogeological conditions, with the help of any of the mentioned structures for artificial recharge to groundwater. In addition to these structures, defunct tube wells can also be used for recharging the groundwater.
  - Sub-surface dykes below the streams/nallahs, flowing over plain terrain and ephemeral in nature, are feasible.

In Semi-critical blocks (namely Nalhati-II, Nanoor, Murarai-II and Rampurhat-II), pre-monsoon and post-monsoon depth to water level ranges from 5 to more than 15 mbgl and the blocks are covered by alluvium. Considering the status of ground water development, its impact on ground water level and hydrogeological condition, rain water harvesting for artificial recharge to ground water for augmentation of ground water resources in these blocks is most essential.

Scheme on Rain Water Harvesting for Artificial Recharge to Groundwater at Visva Bharati University, Santiniketan:

Recently under Central Sector Scheme one scheme on roof top rain water harvesting for artificial recharge to groundwater at Visva Bharati University, Santiniketan has been completed. The aim of the scheme was to recharge the aquifer below laterite by the water available from the roof of the **Central Library**. Details are as follows:

- Roof area: 873m^2
- Average annual rain fall: 1294mm
- Average monsoon rainfall: 1096mm.
- Quantity of water available from the roof: 956.80m^3
- Quantity of water available for recharge: 724m^3

Types of structures constructed— Four No. of gravity head inverted recharge shafts of depth ranging from 11.27-14.60 m, were constructed.

It has been observed that an increment of water level in the dug wells is to the tune of 0.23 m due to recharge during one monsoon.

7.0 GROUND WATER RELATED ISSUES & PROBLEMS

- Water scarce area:

In the western part of the district, the areas, underlain by Archaeans, Rajmahal Traps and Gondwanas, suffer from water scarcity owing to poor potentiality of the formations. In the areas, groundwater occurs under water table

condition in the weathered zones (6 to 12m thick) as well as under semi-confined to confined conditions in the zone of secondary porosities, wherever available below the zone of weathering and in general within 55 – 70 mbgl. From the weathered zone groundwater is generally being developed through open wells and the available discharges can only meet the domestic needs, but is not sufficient enough for any large scale development of groundwater and during summer the dug wells generally go dry. Groundwater from the zone of secondary porosities is being developed through bored wells, yielding to the tune of 60-150 lpm and at places as high as 330 lpm. Moreover, two blocks, Murarai-I & Rajnagar, have been declared under drought prone area by the Agriculture Department, Govt. of West Bengal. As such, the water scarce and drought prone areas need special attention from the point of view of groundwater management.

- Areas with fluoride contaminated groundwater:

In Birbhum district, about 52,563 population spreading over 78 habitations in 7 blocks, namely, Khoyrasol, Nalhati-I, Rajnagar, Rampurhat-I, Siuri-II, Mayureswar-I and Saithia, are affected by fluoride contaminated groundwater. In these blocks, concentration of fluoride above permissible limit, ranging from 1.52 mg/l to 17.9 mg/l, are reported from the aquifers mainly within 80 mbgl.

- Areas categorised as 'Semi-critical':

Four blocks of the district, namely, Nalhati-II, Nanoor, Murarai-II and Rampurhat-II, have been categorised as "Semi-critical", considering the ground water development wrt the ground water resources in the blocks.

8.0 AWARENESS & TRAINING ACTIVITY

8.1 Mass Awareness Programme (MAP) & Water Management Training Programme (WMTP) by CGWB

- **Mass Awareness Programme (MAP)**

Sl.No.	Place	Period	Theme	No. of Participants
1.	Suri	2002-03	Ground water pollution of Birbhum district & its remedial measures	175
2.	Rampurhat	2003-04	Ground water condition in Birbhum district with respect to presence of Fluoride -- and its remedial measure.	100

- **Water Management Training Programme (WMTP)**

Sl.No.	Place	Period	Theme	No. of Participants
1.	Suri	2002-03	Water Management training on rain water harvesting in Birbhum district	150

9.0 AREAS NOTIFIED BY CGWA/ SGWA

No area of Birbhum district has been notified by CGWA/ SGWA.

10.0 HIGH FLUORIDE IN GROUND WATER AND SUGGESTIONS FOR REMEDIAL MEASURES IN FLUORIDE AFFECTED BLOCKS OF BIRBHUM DISTRICT

Sporadic occurrence of high fluoride (>1.5 mg/l) in ground water has been reported from the blocks of Khyrasol, Rajnagar, Sainthia, Suri-Ii, Mayureswar-I, Nalhati-I and Rampurhat-I of Birbhum district. During survey (2001) carried out by PHED it was observed that in Birbhum district about 52,563 population spreading over 78 habitations are at risk zone by fluoride contaminated groundwater. In Khyorasol and Rampurhat-I blocks concentration of fluoride in groundwater has been reported to be as high as 15.9 mg/lit and 17.9 mg/lit respectively.

Considering the gravity of the problem created by fluoride contaminated groundwater, Govt. of West Bengal, constituted a Committee on fluoride in drinking water comprising representatives from different departments and organizations. As per the recommendations of the Committee rapid assessment of fluoride concentration in groundwater in all the affected districts and its adjoining blocks were done. Against the total number of 1905 collected samples fluoride concentration with more than 1.5mg/lit has been analysed only from 15 No of samples i.e. this problem is restricted to very limited number of areas.

Table-:11 Status of maximum concentration of fluoride in groundwater in Fluoride affected blocks of Birbhum district

Block	No. of samples tested	No. of samples having F		Max. Conc. (mg/lit)	Formation
		1><1.5 (mg/l)	>1.5 (mg/l)		
Khoyrasol	114	5	5	15.9	Gondwana sandstones
Nalhati-I	127	2	1	1.52	Basalt
Rajnagar	54	9	1	2.03	Granite
Rampurhat-I	126	3	5	17.9	Basalt
Siuri-II	59	1	1	2.56	Granite
Mayureswar-I	115	1	1	1.54	Alluvium
Saithia	142	91	1	1.52	Alluvium

According to the Committee fluoride concentration in groundwater with more than 1.5 mg/lit has been noted in the following depth ranges in different types of hydrogeological formations:

- In fractured granite, basalts & alluvium within 50.0 to 80.0m depth.
- In Gondwana Formation with in 30m depth.

Remedial Measures:

The fluoride concentration in ground water above permissible limit is, in general, noticed in the aquifers down to the maximum depth of 80 mbgl. The potable aquifers, beyond this depth, separated from the upper contaminated aquifers by clay layers, may be identified and tapped by adopting proper cement sealing technique against the clay layer to prevent vertical percolation for alluvium formation.

In order to remove excess fluoride, the following defluoridation technology may be adopted:

- Nalgonda technique (based on addition of lime and alum)
- Prasanti technique (based on absorption using activated alumina)
- Reverse Osmosis
- Ion Exchange

Based on the above techniques, the following types of defluoridation plants may be utilized:

- Community defluoridation plants,
- Hand pump attached defluoridation plants,
- Domestic defluoridation system.