GROUND WATER INFORMATION BOOKLET OF BARDHAMAN DISTRICT, WEST BENGAL

BARDHAMAN DISTRICT AT A GLANCE

Sl. No.	Items	Statistics
1.	**GENERAL INFORMATION**	
	i) Geographical Area (Sq. km.)	7024
	ii) Administrative Division (as on 2001)	
	• No. of Sub-division	6
	• No. of Blocks	31
	• No. of Municipal Corporation	2
	• No. of Municipalities	9
	• No. of inhabited villages	2438
	iii) Population (as on 2001 Census) (with density of population)	68,95514 (982- per sq.km.)
	iv) Normal Annual Rainfall (mm)	1442
2.	**GEOMORPHOLOGY**	
	Major Physiographic Units	(i) **Plateau area** (extensionof Chotonagpur area of Bihar) – the westernmost Asansol - Kulti sector. (ii) **Undulatory area-** Asansol - Durgapur sector (iii) **Flat alluvium terrain** –From Durgapur eastwards.
	Major Drainages	The Ganga/ Bhagirathi is the main river, with tributaries namely the Damodar, the Ajoy, the Barakar, and many other small streams, viz. Kunur, Banka, Khari, Brahmani, Behula, Ghea, Mundeswari, Kana, etc. form the main drainage system.
3.	**LAND USE (Sq.km.) (as on 2004-05)**	
	a) Forest Area	22.27
	b) Net Area Sown	466.63
4.	**MAJOR SOIL TYPES**	(a) **Gangetic soil,** which is found along the Ganga River (b) **Vindhyan soil,** between Ajoy and Damodar Rivers in the central and eastern parts. © **Red soils** occurring in the undulating and coal field areas in the western parts of the district.
5.	**AREA UNDER PRINCIPAL CROPS (Sq.km.) (As on 2004-05)**	Total Cereals: 6393.0 Total Pulses: 15.0 Total Oilseeds: 562.0 Total Fibre: 127.0 Total Miscellaneous Crops: 456.0

6.	**IRRIGATION BY DIFFERENT SOURCES (Areas & Nos. of Structures)**	
	Open wells	1.04 sq. km. area irrigated by 88 nos. of open wells
	Tube wells/ Bore wells	3170.63 sq. km irrigated by 51710 nos of shallow tube wells and 445.84 sq.km irrigated by 626 nos. of deep tube wells
	Surface Flow	243.55 sq. km irrigated by 1583 nos of surface flow
	Surface Lift (RLI)	313.08 sq. km irrigated by 4291 nos. of RLI.
	Total area irrigated by ground water	3617.51 sq. km
	Total area irrigated by surface water	556.63 sq. km
	Gross Irrigated Area	4174.14 sq.km.
7.	**NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.03.07):** No. of Dug wells: No. of Piezometers / Tube wells:	 94 42 52
8.	**PREDOMINANT GEOLOGICAL FORMATIONS**	(a) Up. Tertiary – Quaternary sequence of Alluvium, Laterite, etc. (b) Up. Palaeozoic- Mesozoic -Tertiary sequence of Gondwana Supergroup of Sedimentaries. (c) Archaean metamorphics, viz. granite gneiss,schist
9.	**HYDROGEOLOGY**	
	Major Water bearing formation	Quaternaries & Tertiaries
	Pre-monsoon depth to water level during 2006	0.74 to 19.95m bgl in open wells and 2.95 to 19.03m bgl in tube wells
	Post-monsoon depth to water level during 2006	0.22 to 11.63m bgl in open wells and 1.03 to 31.00m bgl in tube wells
	Long term water level trend in 10 years (1997-2006) in m/yr	Declining trend of water level to the tune of 0.01 to1.00 m/yr shown by 64.04% of wells and rising trend of 0.01 to 0.66 m/yr shown by 35.96% of wells.
10.	**GROUND WATER EXPLORATION BY CGWB (As on 31.03.07)**	
	No. of wells drilled	67
	Depth Range (m)	Maximum depth drilled- 350.50m
	Discharge (lps)	0.17-35.74 lps
	Transmissivity (m^2/day)	$3.0x10^{-4}$ – $188x10^{-4}$
	Storativity	30.77- 1700
11.	**GROUND WATER QUALITY**	
	Presence of Chemical constituents more than permissible limit	Sporadic high content of Total Hardness (TH), Arsenic and Iron
	Type of water	Ca-Mg-HCO_3 type
12.	**DYNAMIC GROUND WATER RESOURCES (2004) – in ham**	
	Annual Replenishable Ground Water Resources	303295
	Gross Annual Ground water: a) For irrigational use b) For domestic & Industrial use	131900 123679 8221
	Projected Demand for Domestic and	12187

	Industrial uses up to 2025	
	Stage of Ground Water Development (%)	43.49
15.	**AWARENESS AND TRAINING ACTIVITY**	
	Mass Awareness Programmes organized Date: Place: Nos. of participants:	 14-11-2000 Durgapur 200
	Water Management Training Programmes organized Date: Place: Nos. of participants:	 15-16 December,2005 Asansol 20
16.	**EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**	
	Projects completed by CGWB (No. & amount spent)	Nil
	Projects under technical guidance of CGWB (No.)	Nil
17.	**GROUND WATER CONTROL & REGULATION**	
	Nos. of Over-exploited Blocks	Nil
	Nos. of Critical Blocks	Nil
	Nos. of Blocks notified	Nil
18.	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Geogenic quality problem of arsenic & iron in some parts, 6 Blocks categorized as semi-critical, decline in water level in NW of district, risk to man-made activities such as mining, industrialization, etc affecting both quality & quantity.

GROUND WATER INFORMATION BOOKLET OF BARDHAMAN DISTRICT, WEST BENGAL

1.0 INTRODUCTION

Location and area:

Bardhaman district is bounded by the latitudes $23^0$53' and $22^0$56' N and longitudes $88^0$25'and $86^0$48' E. The total geographical area of the district is 7024 sq. km. It has 6 Sub-Divisions consisting of 31 blocks, Total police station is 32.There are 2 nos. of Municipal Corporation, 9 Municipalities, 277 Gram Panchayats and 2513 villages. Bardhaman is the headquarters of this District and other important towns are Barakar, Rupnarainpur, Kulti, Burnpur, Asansol, Raniganj, Andal, Durgapur, Panagarh, Gushkara, Kalna, Katwa, Saktigarh and Memari.

Ground water basin:

This district falls in the lower part of the Ganga basin.

Drianage:

The Ganga/ Bhagirathi, with tributaries namely the Damodar, the Ajoy, the Barakar,and many other small streams, viz. Kunur, Banka, Khari, Brahmani, Behula, Ghea, Mundeswari, Kana, etc. form the main drainage system of the district.

Irrigation practices:

The cultivation is done mainly by the surface water (in 312.29 ha) by means of canal network system, tanks and river-lift irrigation system; however, Irrigation by ground water source is done in about 23.6 ha. Boro paddy are mostly grown.

Studies by C.G.W.B:

CGWB has completed **Systematic Hydrogeological Survey** and continuing Groundwater Management Studies. Apart from this, **Groundwater Exploration** has been carried out to delineate the aquifer geometry and to know the aquifer characteristics. Special attention has been given to identify the deeper aquifers and construction of tube wells adopting cement sealing techniques, especially in arsenic infested areas to cater the need for arsenic free water through state agencies . There are 5 arsenic infested Blocks in the district, viz. Purbasthali-I, Purbasthali-II, Kalna-II, Katwa-I and Katwa-II. Till March 2007, 2 tube wells at Adarshapalli (Katwa-I Bl;ock), 3 tube wells at Benakar (Purbasthali-II Block) and 3 tube wells at Purba Sahapur (Kalna-II Block) have been constructed by CGWB and all these tube wells yield arsenic free ground water. Depth range of the aquifers tapped by these wells is between 50 mbgl and 252 mbgl.

2.0 RAINFALL & CLIMATE

Rainfall:

The normal rainfall is of the tune of 1442mm. Annual Rainfall in the year 2004 is 1193 mm.

Climate:

The district is characterised by hot and humid climate. It receives adequate Rainfall from south west monsoon, which sets in the later half ofJune and withdraws by the middle of October. Pre- monsoon rains are received during March-April. Maximum and Minimum temperatures as recorded in 2004 are 44 and 08 degree Centigrade respectively.

3.0 GEOMORPHOLOGY & SOIL TYPES

Geomorphology:

Bardhaman district is divided in to three (3) geomorphic units:

(i) **Plateau area** (extension of Chotonagpur area of Bihar) – the westernmost Asansol - Kulti sector.

(ii) **Undulatory area**- Asansol - Durgapur sector

(iii) **Flat alluvium terrain** –From Durgapur eastwards.

Soil Types:

Depending upon the soil types the district is divided in three (3) separated zones-

(a) Gangetic soil, which is found along the Ganga River

(b) Vindhyan soil, between Ajoy and Damodar Rivers in the central and eastern parts.

(c) Red soils, occurring in the undulating and coal field areas in the western parts of the district.

4.0 GROUNDWATER SCENARIO

4.1 Geology:

(a) The extreme northwestern small part of this district, near Rupnarainpur in Salanpur Block, is occupied by the Archaean metamorphic rocks, viz. granite gneiss, hornblende schist, which are traversed by bands/patches of amphibolites, pegmatites and quartz veins. (b)The western part of about 2063 sq. km is covered by Up. Palaeozoic- Mesozoic-Tertiary sequence of Gondwana Supergroup of sedimentary rocks of fluviatile - lacustrine origin, deposited in intracratonic basins. The Lr. Gondwana Damuda Group of rocks of Permo-Carboniferous age contain valuable resources of coal seams. (c) The major central and the eastern parts of about 4965 sq. km of this district is covered by alluvium blanket comprising of Older Alluvium, Younger Alluvium, Laterite, sand, gravel, lithomargic clay, etc.of Up. Tertiary – Quaternary age.

4.2 Hydrogeology :

In the major part of the district, ground water occurs in thick unconsolidated Quatrnaries & Tertiaries deposited under fluviatile environment; the sand and/or gravel in different proportions of this formation constitute the main aquifers and they occur down to 295m bgl in the central and eastern part of the district. Deeper aquifers occur under semi-confined to confined condition.

Groundwater in the western Up. Palaeozoic- Mesozoic-Tertiary sequence of Gondwana Supergroup of sedimentaries occurs under both unconfined and confined conditions down to 150.35m bgl.

Groundwater in the the extreme northwestern small part of Salanpur Block occupied by the archaean metamorphics occurs down to a depth of about 82m bgl under both unconfined and confined conditions down to 150.35m bgl. It mainly occurs under unconfined condition in the dug well zone and under semi-confined to confined condition in the deeper horizons.

Depth to water level in premonsoon period (2006) varies from 1.43 to 19.03 mbgl whereas that to post monsoonn it is from 1.03 to 31.00 mbgl.

Aquifer characteristics : Tube wells in the central & eastern part constructed tapping both semi-confined and confined aquifers are characterized generally medium duty (50-150 m^3 /hr) to heavy duty (>150 m^3 /hr) yield with nominal drawdown of 4-5m.Transmissivity(T) values ranges from 30.77-1700 m^2 /day and the storativity ranges from $2.0x10^{-4}$ to $188x\ 10^{-4}$. The aquifers of Gondwana sedimentaries and archaean metamorphics show T values ranging from 40 to 50 m^2 /day and Storativity value is about $14x10^{-4}$.

4.3 Groundwater Resources

The dynamic ground water resources of Bardhaman 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 :	333868 ham
Net Annual Ground Water Availability :	303295 ham
Existing Ground Water Draft for All Uses :	131900 ham
(a) Irrigation:	123679 ham
(b) Domestic & industrial water supply :	8221 ham
Stage of Ground Water Development :	43.49 %
Allocation for domestic & industrial water supply requirement up to 25 yrs. :	12187 ham
Net Ground Water Availability for future irrigation development :	161807 ham
Categorisation of blocks :	25 blocks are categorized 'safe', 6 blocks are Semi-Critical.

4.4 Groundwater Quality :

The chemical quality of groundwater in the area is, in general, Ca-Mg-HCO_3 . type. Electrical Conductivity EC) is generally well below 2000 µS/cm at 25^{0}C; values more than 2000 mg/l have been found occasionally in the blocks of Andal (up to 2300 µS/cm), Jamalpur(up to 2720 µS/cm), Jamuria(up to 2400µS/cm)and Ranigaunj (up to 3000 µS/cm).The chloride content in groundwater is low(11-386 mg/l). The water is mainly mildly alkaline in nature with pH values ranging between 7.90and 8.20.Total Hardness (TH) as $CaCO_3$ rnges from 60-830 mg/l. higher concentration of TH has been encountered in the western Blocks, viz. Andal, Andal, Barabani, Ranigang, Jamuria etc.. Generally, iron content ranges from B.D.L. (below detection limit) to 1.00mg/l; but more than 1.00 mg/l has been encountered in some places in the Blocks of Kalna-II (maximum 3.91mg/l), Khandakosh (maximum 2.53mg/l) & Katwa-II (maximum 2.00 mg/l). Arsenic concentration more than the permissible limit of 0.01mg/l has been encountered in the Blocks of Purbasthali-I, Purbasthali-II, Katwa-I, Katwa-II and Kalna-II; in Purbasthali-I and Purbasthali-II Blocks, maximum arsenic content reported in ground water is 0.10 mg/l and that in Kalna-II, it has been reported up to 0.15 mg/l. Thus, the chemical quality of groundwater in both shallow and deeper aquifers is good except in 5 Blocks where sporadic occurrences of arsenic contamination more than the permissible limit of 0.01 mg/l in groundwater has been noticed in shallow aquifers in the Blocks of Purbasthali-I, Purbasthali-II, Katwa-I, Katwa-II and Kal;na-II.

Table-4.1: **Status of Groudwater Development** (Blockwise):

Block	Occurrence of Aquifers & its potentiality (as per data available with CGWB)	Feasibility of GW Abstraction Structures	Ground Water Resourse Available, Irrigational draft Stage of GW development(as on March'04) & existing Structures (as per Census 2000-2001)	Remarks
1. Bhatar	Multiple aquifer system occurs in general in the depth span of 28.0-58.0 mbgl, 105.50-123.50 mbgl, 181.0-295.0 mbgl; Transmissibility (T) of the aquifers ranges up to 1700 m^2/day. Storativity (S) ranges within $3x10^{-4}$ to $2x10^{-4}$	Heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 17407 ham Irrigation has been done through 3125 nos of shallow tube wells (STW) & 2 nos. of deep tube wells (DTW) & the irrigation draft has been projected is 6826 ham. Stage of development (SOD) is 41.26%	Semi-Critical Block
2. & 3. Burdwan I + II	in general in the depth span of 8.53 - 12.19, 27 - 36.57 mbgl, 40.53 –46.02 mbgl, 49.68 – 58.21 mbgl, 62.17 - 65.22 mbgl, 105.76 – 126.18 mbgl and 174.04 –179.22 mbgl; T of the aquifers ranges within 30.77 – 1700 m^2/day and S) ranges within $2x10^{-4}$ to $188x10^{-4}$.	Heavy duty (>150 m^3/hr) tube wells and medium duty (50- 150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 20568 ham. Irrigation has been done through 3823 nos of STW & 5 nos. of DTW & the irrigation draft has been projected is 8702 ham. SOD is 44.47%	Safe category
4. Galsi - I	generally in the depth span of 28.0 – 34.0 mbgl, 40.0 – 54.0 mbgl, 90.0 – 120.0 mbgl, 186.0 – 192.0 mbgl and 232.0 – 238.0 mbgl; T of the aquifers ranges within 30.77 – 186.50 m^2/day and S ranges within $4x10^{-4}$ - $188x10^{-4}$.	Medium duty (50- 150 m^3/hr) and heavy duty (>150 m^3/hr) tube wells tube wells are generally feasible.	Net GW Availability is 14469 ham. Irrigation has been done through 2771 nos of STW & 4 nos of DTW & the irrigation draft is 6103 ham. SOD is 43.72%	Safe Block
5. Galsi - I I	in the depth span of 27.00- 33.00 mbgl, 40.00 – 52.00 mbgl, 66.00 – 92.00 mbgl and 106.00-112.00 mbgl; T of the potential aquifers is ranges within 30.77 – 31.81 m^2/day and S is $4x10^{-4}$	Medium duty (50- 150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 4075.09ham Irrigation has been done through 1290 nos of STW and 3 nos of DTW & the irrigation draft has been projected upto 2004 as 2866.27 ham. SOD is 75.89%	Safe category
6. Kalna-I	in the depth span of 33.53 – 121.95 mbgl;T of the aquifers ranges within 31.81 – 1700 m^2/day and S is $2x10^{-4}$ to $3x10^{-4}$	Heavy duty (> 150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 8983 ham. Irrigation has been done through 1361 nos of STW and 48 nos of DTW & the irrigation draft projected upto 2004 is 4036 ham. SOD is 48.17%	Safe Block
7. Kalna-II	in the depth span of 33.53 – 121.95 mbgl;T of the aquifers ranges within 31.81 – 1700 m^2/day and S is $2x10^{-4}$ to $3x10^{-4}$	Heavy duty (> 150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 9043 ham. Irrigation has been done through 1725 nos of STW and 49 nos of DTW & the draft is 4848 ham. SOD is 56.22%	Safe Block; Arsenic contaminated aquifer down to a depth of 90m bgl
8. Katwa-I	in the depth span of 15.25 – 91.50 mbgl, 94.55 – 106.75 mbgl, 109.80 – 115.90 mbgl, 185.5 – 209.5 mbgl and 212.5 –221.5 mbgl; T of the aquifers is 31.81 - 1700 m^2/day and S is $2x10^{-4}$ to $3x10^{-4}$	Heavy duty (> 150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 8827 ham Irrigation has been done through 2 nos of dug wells (DW), 1319 nos. of STW and 32 nos. of DTW & the irrigation draft projected upto 2004 is 3585 ham. SOD is 43.36%	Safe Block; Arsenic contaminated aquifer within a depth of 90m bgl

9. Katwa-II	in the depth span of 15.25 – 91.50 mbgl, 94.55 – 106.75 mbgl, 109.80 – 115.90 mbgl, 185.5 – 209.5 mbgl and 212.5 –221.5 mbgl; T of the aquifers is 31.81 - 1700 m^2/day and S is $2x10^{-4}$ to $3x10^{-4}$.	Heavy duty (> 150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 8336 ham Irrigation has been done through 3 nos of DW, 1587 nos. of STW, 50 nos of DTW ; the irrigation draft projected upto 2004 is 4573 ham. SOD is 57.21%	Safe category; Arsenic contaminated aquifer within a depth of 90m bgl
10. Khandaghosh	Multiple aquifer system occurs, in general, in the depth span of 27-33 mbgl, 40-52 mbgl, 66-92 mbgl, 106-112 mbgl; T of the aquifers ranges 30.77-31.81 m^2/day, S is $4.0x10^{-4}$.	Medium duty (50-150 m^3/hr), and Heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 18288 ham Irrigation has been done through 3015 nos of STW & 23 nos of DTW & the irrigation draft has been projected upto 2004 as 7061 ham. SOD is 40.11%	Safe Block
11. Mangalkote	in general, in the depth span of 29.0 - 50.0 mbgl, T of the aquifers is 1128 m^2/day and S is about $2.8x10^{-4}$.	Medium duty (50-150 m^3/hr), and Heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 16885 ham Irrigation has been done through 2845 nos of STW, 13 nos of DTW & the irrigation draft projected is 6467 ham. SOD is 40.56%	SemiCritical Block
12. Memari-I	in general, in the depth span of 21.36-39.65 mbgl, 67.10-111.32 mbgl, T of the aquifers ranges within 31.81- 1700 m^2/day & S is within $2x10^{-4}$ - $3x10^{-4}$.	Medium duty (50-150 m^3/hr), and Heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 10096 ham Irrigation has been done through 1207 nos of STW, 8 nos of DTW & the irrigation draft has been projected upto 2004 is 2800 ham. , SOD is 31.32%	Safe Block,
13. Memari-II	in general, in the depth span of 12.19-18.29 mbgl and 21.34-115.82 mbgl, T of the aquifers ranges within 31.81-1700 m^2/day and S is within $2x10^{-4}$ - $3x10^{-4}$.	Heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 12466 ham Irrigation has been done through 1646 nos of STW, 22 nos of DTW (as per Census 2001) & the irrigation draft has been projected upto 2004 as 4068 ham. SOD is 34.75%	Semi-Critical Block
14. Monteswar	Multiple aquifer system occurs in general up to a depth of 125 mbgl, T of the aquifers T of the aquifers ranges within 31.81-1700 m^2/day and S is within $2x10^{-4}$ - $3x10^{-4}$.	Heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 14417 ham. Irrigation has been done through 3566 nos of STW, 46 nos of DTW (as per Census 2001) & the irrigation draft has been projected upto 2004 as 8776 ham. SOD is 63.24%	SemiCritical Block
15. Purbasthali-I	Multiple aquifer system occurs in general up to a depth of 150 mbgl, T of the aquifers ranges within 31.81-1700 m^2/day and S is within $2x10^{-4}$ - $3x10^{-4}$.	Heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 8534 ham Irrigation has been done through 1633 nos of STW and 57 nos. of DTW (as per Census 2001) & the irrigation draft has been projected upto 2004 as 4829 ham. SOD is 59.89%	Safe category; Arsenic contaminated aquifer within a depth of 90m bgl
16. Purbasthali-II	in general, in the depth span of 36-48 mbgl, 72-90 mbgl, 111.5-129.5 mbgl and 136-145 mbgl, T of the aquifers ranges within 31.81-1700 m^2/day and S is within $2x10^{-4}$ - $3x10^{-4}$.	Heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 10374 ham Irrigation has been done through nos of STW, nos of DTW (as per Census 2001) & the irrigation draft has been projected upto 2004 as 8787 ham. SOD is 87.53%	SemiCritical Block; Arsenic contaminated aquifer within a depth of 90m bgl
17. Raina-I	Multiple aquifer system occurs up to depth of 200 mbgl, T of the aquifers ranges up to 1700 m^2/day and S is	Medium duty (50-150 m^3/hr), and Heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 11459 ham Irrigation has been done through 2319 nos of STW, 55 nos. of DTW & the irrigation draft has	Safe Block

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1. Bhatar	Multiple aquifer system occurs in general in the depth span of 28.0-58.0 mbgl, 105.50-123.50 mbgl, 181.0-295.0 mbgl; Transmissibility (T) of the aquifers ranges up to 1700 m^2/day. Storativity (S) ranges within $3x10^{-4}$ to $2x10^{-4}$	Heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 17407 ham Irrigation has been done through 3125 nos of shallow tube wells (STW) & 2 nos. of deep tube wells (DTW) & the irrigation draft has been projected is 6826 ham. Stage of development (SOD) is 41.26%	Semi-Critical Block
2. & 3. Burdwan I + II	in general in the depth span of 8.53 - 12.19, 27 - 36.57 mbgl, 40.53 –46.02 mbgl, 49.68 – 58.21 mbgl, 62.17 - 65.22 mbgl, 105.76 – 126.18 mbgl and 174.04 –179.22 mbgl; T of the aquifers ranges within 30.77 – 1700 m^2/day and S) ranges within $2x10^{-4}$ to $188x10^{-4}$.	Heavy duty (>150 m^3/hr) tube wells and medium duty (50- 150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 20568 ham. Irrigation has been done through 3823 nos of STW & 5 nos. of DTW & the irrigation draft has been projected is 8702 ham. SOD is 44.47%	Safe category
4. Galsi - I	generally in the depth span of 28.0 – 34.0 mbgl, 40.0 – 54.0 mbgl, 90.0 – 120.0 mbgl, 186.0 – 192.0 mbgl and 232.0 – 238.0 mbgl; T of the aquifers ranges within 30.77 – 186.50 m^2/day and S ranges within $4x10^{-4}$ - $188x10^{-4}$.	Medium duty (50- 150 m^3/hr) and heavy duty (>150 m^3/hr) tube wells tube wells are generally feasible.	Net GW Availability is 14469 ham. Irrigation has been done through 2771 nos of STW & 4 nos of DTW & the irrigation draft is 6103 ham. SOD is 43.72%	Safe Block
5. Galsi - I I	in the depth span of 27.00- 33.00 mbgl, 40.00 – 52.00 mbgl, 66.00 – 92.00 mbgl and 106.00-112.00 mbgl; T of the potential aquifers is ranges within 30.77 – 31.81 m^2/day and S is $4x10^{-4}$	Medium duty (50- 150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 4075.09ham Irrigation has been done through 1290 nos of STW and 3 nos of DTW & the irrigation draft has been projected upto 2004 as 2866.27 ham. SOD is 75.89%	Safe category
6. Kalna-I	in the depth span of 33.53 – 121.95 mbgl;T of the aquifers ranges within 31.81 – 1700 m^2/day and S is $2x10^{-4}$ to $3x10^{-4}$	Heavy duty (> 150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 8983 ham. Irrigation has been done through 1361 nos of STW and 48 nos of DTW & the irrigation draft projected upto 2004 is 4036 ham. SOD is 48.17%	Safe Block
7. Kalna-II	in the depth span of 33.53 – 121.95 mbgl;T of the aquifers ranges within 31.81 – 1700 m^2/day and S is $2x10^{-4}$ to $3x10^{-4}$	Heavy duty (> 150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 9043 ham. Irrigation has been done through 1725 nos of STW and 49 nos of DTW & the draft is 4848 ham. SOD is 56.22%	Safe Block; Arsenic contaminated aquifer down to a depth of 90m bgl
8. Katwa-I	in the depth span of 15.25 – 91.50 mbgl, 94.55 – 106.75 mbgl, 109.80 – 115.90 mbgl, 185.5 – 209.5 mbgl and 212.5 –221.5 mbgl; T of the aquifers is 31.81 - 1700 m^2/day and S is $2x10^{-4}$ to $3x10^{-4}$	Heavy duty (> 150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 8827 ham Irrigation has been done through 2 nos of dug wells (DW), 1319 nos. of STW and 32 nos. of DTW & the irrigation draft projected upto 2004 is 3585 ham. SOD is 43.36%	Safe Block; Arsenic contaminated aquifer within a depth of 90m bgl

	within $2.5x10^{-4}$ - $3.0x10^{-4}$.		been projected upto 2004 as 6273 ham. SOD is 57.06%	
18. Raina-II	Multiple aquifer system occurs up to depth of 125 mbgl, T of the aquifers ranges within 30.77-186.50 m^2/day and S is within $4.3x10^{-4}$ - $188x10^{-4}$.	Medium duty (50-150 ^{3}/hr)tube wells are generally feasible	Net GW Availability is 11573 ham Irrigation has been done through 2243 nos of STW, 30 nos of DTW (as per Census 2001) & the irrigation draft has been projected upto 2004 as 5544 ham. SOD is 44.65%	Safe category
19. Ausgram-I	in general, in the depth span of 22.00-25.00 mbgl, 31.00-46.00 mbgl, 74.00-89.00 mbgl and 178.00- 190.00 mbgl mbgl, T of the aquifers ranges within 88.0- 475 m^2/day and S ranges within $18x10^{-2}$ - $1.03x10^{-3}$.	Medium duty (50-150 ^{3}/hr) and heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 8471 ham Irrigation has been done through 18 nos of DW, 1646 nos. of STW and 2 nos of DTW & the irrigation draft has been projected upto 2004 as 3623 ham. SOD is 27.68%	Safe category
20. Ausgram-II	in general, in the depth span of 44.00-56.00 mbgl, 57-66 mbgl, 110-118 mbgl, 226-232 mbgl, 241-253 mbgl and 282-294 mbgl, T of the aquifers is about 41.00 –186.5 m^2/day.	Medium duty (50-150 ^{3}/hr) tube wells are generally feasible.	Net GW Availability is 14287 ham Irrigation has been done through 8 nos of DW, 1595 nos. of STW and 12 nos of DTW & the irrigation draft projected upto 2004 is 3734 ham. SOD is 27.68 %	Safe category
21. Jamalpur	Multiple aquifer system occurs up to depth of 125 mbgl, T of the aquifers ranges within 30.77-1700 m^2/day and S is within $2.5x10^{-4}$ - $188x10^{-4}$.	Medium duty (50-150 ^{3}/hr) and heavy duty (>150 m^3/hr) tube wells are generally feasible	Net GW Availability is 12732 ham Irrigation has been done through 2969 nos of STW, 25 nos of DTW (as per Census 2001) & the irrigation draft has been projected upto 2004 to the tune of 7007 ham. SOD is 58.12%	Safe category
22. Kanksa	in general, in the depth span of 13-29 mbgl, 35-63 mbgl, 118-136 mbgl, 150-160 mbgl and 170-203 mbgl; T of the aquifers ranges up to 186.50 m^2/d and S is within $4.3x10^{-4}$ - $188x10^{-4}$	Low duty (<50 m^3/hr), and medium duty (100 - 150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 13080 ham Irrigation has been done through 7 nos of DW, 825 nos of STW and 3 nos of DTW (as per Census 2001) & the irrigation draft has been projected as 1860 ham. SOD is 16.04%	Safe category
23. Ketugram-I	Multiple aquifer system occurs up to depth of 150 mbgl; T of the aquifers ranges within 31.81-1700 m^2/ day and S is within $2.5x10^{-4}$ -$3.0x10^{-4}$	Heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 11995 ham Irrigation has been done through 2830 nos of STW and 15 nos of DTW (as per Census 2001) & the irrigation draft has been projected upto 2004 as 6479 ham. SOD is 55.96%	Semi-Critical category
24. Ketugram-II	in general, in the depth span of 35.00-47.00 mbgl, 50.00-68.00 mbgl, 122.00-134.00 mbgl and 150.00-156.00 mbgl, T of the aquifers rangas up to 1700 m^2/ day and S is about $2.5x10^{-4}$	Heavy duty (>150 m^3/hr) tube wells are generally feasible.	Net GW Availability is 7461 ham Irrigation has been done through 1684 nos of STW and 26 nos. of DTW & the irrigation draft has been projected upto 2004 as 4241 ham. SOD is 59.20%	Safe category
25. & 26. Andal - Pandaveswar	in general, in the depth span of 3.00-20.98 mbgl, 44.98-59.42 mbgl, 66.43-69.45 mbgl, 76.40-82.84 mbgl, 96.14-100.00 mbgl and 146.37-150.39 mbgl,	Low duty (<50 m^3/hr) tube wells are generally feasible.	Net GW Availability is 3911 ham Irrigation has been done through 26 nos of STW, & the irrigation draft has been projected to the tune of 56 ham.	Safe Block.

	T of the aquifers ranges within 40-50 m^2/day and S is $14x10^{-4}$.		SOD is 15.10%	
27. Barabani	in general, in the depth span of 7.00-8.00 mbgl, 18.00-33.00 mbgl, 46.00-88.00 mbgl and 126.00-135.00 mbgl, T of the aquifers ranges within 40 -50 m^2/day and S is $14x10^{-4}$.	Low duty (<50 m^3/hr) tube wells are generally feasible.	Net GW Availability is 2888 ham Irrigation has been done through 5 nos of DW, & the irrigation draft projected upto 2004 is 2 ham. SOD is 6.52%	Safe category I
28. Durgapur - Faridpur	in general, in the depth span of 12.00-38.00 mbgl, 31.00-55.00 mbgl and 70.00-88.00 mbgl, T of the aquifers ranges within 40 -50 m^2/day and S is $14x10^{-4}$	Low duty (<50 m^3/hr) tube wells are generally feasible.	Net GW Availability is 5268 ham Irrigation has been done through 117 nos of STW, & the irrigation draft has been projected up to 2004 to the tune of 254 ham. SOD is 8.03%	Safe category
29 Jamuria	Multiple aquifer system occurs up to a depth of 100 mbgl; T of the aquifers ranges within 40 -50 m^2/day and S is $14x10^{-4}$	Low duty (<50 m^3/hr) tube wells are generally feasible.	Net GW Availability is 3004 ham Irrigation has been done through 19 nos of DW, 2 nos. of STW & the irrigation draft has been projected to the tune of 13 ham. SOD is 13.90%	Safe category
30. Raniganj	generally in depth ranges within 0-13.9 mbgl, 18.0-28.66 mbgl, 29.51-66.00 mbgl, 70.00-72.00 mbgl, 75.00-76.00 mbgl and 80.00-81.00 mbgl; T of the aquifers ranges within 40 -50 m^2/day and S is $14x10^{-4}$	Low duty (<50 m^3/hr) tube wells are generally feasible.	Net GW Availability is 1932 ham Irrigation has been done through 5 nos of STW & the irrigation draft has been projected to the tune of 11 ham. SOD is 12.83%	Safe category
31. Salanpur	generally in depth ranges within 2.0-32.00 mbgl and 34.00-82.00 mbgl, T of the aquifers ranges within 40 -50 m^2/day and S is $14x10^{-4}$.	Low duty (<50 m^3/hr) tube wells are generally feasible.	Net GW Availability is 1736 ham Irrigation has been done through 1 no of DW, & the irrigation draft has been projected up to 2004 to the tune of 0.444 ham. SOD is 15.26%	Safe category

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 Groundwater Development : At present groundwater development in this district is controlled mainly by the shallow tube wells along with some deep tube wells and a few open wells. As per the Groundwater Estimation Committee,1997, the total groundwater resources calculated based on the data of shallow wells tapping the unconfined aquifers, is about 333868 ham. Existing ground water draft for all uses is 131900 ham and the stage of ground water development is 43.49%. Thus, uninterrupted development of ground water is possible in Bardhaman District excepting in 6 nos of Semi-Critical Blocks, where along with it's development close monitoring of water level and it's estimation, etc. should have to be taken care of.

5.2 Water Conservation & Artificial Recharge: No structure has been constructed by CGWB so far in this district.

6.0 GROUNDWATER RELATED ISSUES & PROBLEMS

(i) **Groundwater quality problem (Geogenic)** : arsenic contaminated (above permissible limit of 0.01mg/l) groundwater has been reported sporadically in 5 blocks, viz. Purbasthali-I &II, Katwa-I & II and Kalna-II. No. of affected population of 371000 are residing in risk zone of 266 villages of about 867.51 sq. km. This arsenic contamination is restricted within 80-90m depth. Also, sporadic occurrences of high concentration of iron above permissible limit in ground water have been reported at Asansol and Hirapur areas.

(ii) **Categorisation of Blocks**: Six Blocks have already been categorized as Semi-Critical Blocks.

(iii) **Decline in water level**: deep water level within a range of 15-20m bgl recorded in Mangolkot, Bhatar and Purbasthali-II Blocks. The northwestern corner of the district, underlain by hard rocks, viz. granites, shallow bore wells/open wells go dry and the saturated thickness of aquifers becomes neglisible for abstraction of water by pump. From the long term monitoring of water level as envisaged from the study of piezometers of CGWB, declining trend has been observed both in pre-monsoon and post-monsoon in some parts of district especially at Bhatar, Kusumgram, Ramjibanpur, Madhyamgram, and Ketugram; rising trend of water level has been encountered at Simlon.

(iv) **Risk to disasters** : a) ground water gets contaminated with mine seepage water in the coal mine area and the effluents from the nearby industrial units, and it becomes unsuitable for domestic consumption. As a result, high concentrations of and SO_4^{2-} and Ca^{2+} have been reported in ground water in the vicinity of coal mines.(b)The water level recedes very much during summer months in the vicinity of active mine establishments of coal belts resulting in the drying up of majority of open wells. The presence of both open cast and under ground coal mines have a pronounced effect on the ground water regime and modifies the ground water flow pattern to a large extent. © Bio-chemical Oxygen Demand (BOD) is high in case of

surface water and very high in mine-seepage water and very often exceeds the permissible limit. Chemical Oxygen Demand (COD)-value, concentration of phenolic compounds, oil and grease in mine seepage water in some of the collieries also exceeds the permissible limit. At places, copper and cyanides are present in excess in some mine-seepage water and surface water respectively.

7.0 MASS AWARENESS & TRAINING ACTIVITY

7.1 Mass Awareness Program (MAP): One no. of Mass Awareness Programme was conducted in this district and the details are given below:

Sl.No	Place/ Block	Participants	Theme	Date
1.	Durgapur/ Durgapur-Faridpur	200	Industrial pollution of ground water in Durgapur and it's surrounding	14-11-2000

7.2 Ground Water Management & Training Programme (WMTP): One no.of Ground Water Management & Training Programme was conducted in this district and the details ar as follows:

Sl.No	Place/ Block	Participants	Theme	Date
1.	Asansol/Asansol	20	Rain Water Harvesting	15-16 December 2005

7.3 Water Resources Day :

Sl.No	Place/ Block	Date	Objective
1.	Bardhaman/ Bardhaman	1990-1991	To aware the people about the scope for development of ground water resourcess

8.0 AREA NOTIFIED BY CGWB/ SGWA: Nil

9.0 RECOMMENDATIONS:

1. Ground water resources (as on March 2004) of the district is 333868 ham and the stage of GW developnent is43.49% and the net ground water availability for further irrigation is 161807 ham. As such there is still scope for further development in Bardhaman district. Out of 31 Blocks, 6 Blocks have been categorized as 'Semi-Critical', viz. Purbasthali-II, Mangalkot, Memari-II, Ketugram-I, Bhatar and Monteswar; in these 6 Blocks, development of ground water should be done taking cautious approach with close monitoring of water level in shallow and deep piezometers.

2. In the Quaternaries and Tertiaries occurring in the east ground water development may be done by means of open wells, shallow tube wells and deep tube wells at suitable sites. In the Archaeans and Gondwanas, it may be done by means of large diameter open wells in topographic 'lows' and should be away from active coal mines; also, in

hard formation this may be done by means of shallow and deep bore wells depending upon the availability of depth of potential fractures.

3. Sporadic occurrence of toxic arsenic contaminated ground water has been reported in shallow aquifers within 80-90m depth in the alluvium terrain. Tube wells should be properly designed adopting cement sealing techniques to avoid mixing of arsenic-contaminated ground water of this depth with the potable water of deeper aquifers. Contaminated ground water can be used only after proper treatment by arsenic/iron, etc. removal units and the same may be periodically monitored.

4. Sub-surface outflow of ground water in coal mines (about 108 MCM/yr) reduces the ground water development to a large extent in the surrounding area on the one hand and poses serious problem in the mines on the other. This area still holds a good scope for large-scale development of ground water by open wells and shallow and deep bore wells provided the mine seepage component can be minimized by adopting suitable methods.

5. The huge amount of ground water pumped out from the active coal mines, abandoned mine shafts and pits can be developed for water supply, only after proper treatment to make it free from bacteria and other pollutants. If the water is withdrawn within the limits of replenishment, hazards like mine fire and collapsing/subsidence of land, etc, which are normally apprehended in the underground workings following the withdrawal of ground water, can possibly be averted. If mine water from different collieries is locally used, it will reduce pressure on general supply of water, which in turn can be optimally used in urban areas.

6. There is excellent scope for conjunctive use of suface water and ground water in the district. The chronic crisis of supply of water in Raniganj coalfield area can be minimized by utilizing surface water from Damodar River and the shortfall in supply in the tail-end area near Panagarh, Galsi, etc., may be compensated by means of ground water through shallow and deep tube wells. The surface water in the perennial streamlets and nalas of the coalfield area may be stored by constructing small bunds across them and the water may be used for domestic purposes after treatment.

7. Artificial recharge to ground water can be done only under feasible hydrogeological conditions specially in Critical/ Semi-Critical Blocks where water level is declining. Roof top rainwater conservation and the same from surface run off in ponds and lakes will definitely help to mitigate the crisis of domestic water supply in coalfield and it's adjoining area in lean period. Roof top rainwater can be conserved either in cement tanks or in PVC tanks; for artificial recharge to ground water the preferable structures are percolation tank, check dam, dry dug well and gully plugging on undulating land, etc with or without recharge shafts.The entire rainwater is going waste, a portion of which can be easily stored for future domestic use. Artificial recharge to ground water in coal field area will contribute a good quantity of water to percolate in to the mines in addition to the existing natural seepage of ground water in it.This extra input of water in to the mines will be difficult to control and will cause flooding and submergence of mines, which may be devastating.