Ground Water Information Booklet
East Khasi Hills District, Meghalaya

Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Guwahati
July 2007

जल वर्ष 2007 Water Year 2007

स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE

GROUND WATER INFORMATION BOOKLET
EAST KHASI HILLS DISTRICT, MEGHALAYA

DISTRICT AT A GLANCE

Sl No.	ITEMS	STATISTICS
1.	GENERAL INFORMATION	
	i) Geographical area (sq. km.) ii) Administrative Divisions (As per 2001 census) Number of Blocks a) Mawphlang b) Mylliem c) Mawrynkeng d) Mawkynrew e) Mawsynram f) Shella Bholaganj g) Pynursla Number of Villages	2748 7 899
	iii) Population (as on 2001 census)	660923
	iv) Average Annual Rainfall (mm)	1600-12000, Mawsynram is the world wettest place with an average annual rainfall of about 12270 mm.
2.	GEOMORPHOLOGY	
	Major physiographic units	Denudational High & Low Hills, dissected plateau with deep gorges.
	Major Drainages	Umtrew, Umiam, UmKhen, Myntang, Umgnot
3.	LAND USE (sq km)	
	a) Forest Area:	1075.15
	b) Net Area Sown:	272.22
	c) Total Cropped area:	351.42
4.	MAJOR SOIL TYPES	a) Red loamy b) Lateritic c) Alluvial
5.	AREA UNDER PRINICIPAL CROPS (as on 2002, in sq. km)	Paddy -51.6 Maize -18.47 Cereals /other millets-4.59
6.	IRRIGATION BY DIFFERENT SOURCES Net & Gross Irrigated area (surface water in sq. km)	15.87
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (as	

	on 31.3.2007 National Hydrograph Network Station) No of dug wells No of Piezometers	 03 01
8.	PREDOMINANT GEOLOGICAL FORMATIONS	Archaean Gneissic Complex and Shillong Group of rocks.
9.	HYDROGEOLOGY	
	Major water bearing formation	Ground water occurs under phreatic/unconfined condition in the top weathered quartzite and in semi-confined condition in the interconnected secondary structural weakness/ features like joints, fractures etc of the underlying hard rocks
	(Pre-monsoon depth to water level during 2006)	Shillong (DW)-0.60m bgl Mawngap (DW)-5.10 mbgl Balat – 4.02 m bgl ----------
	(Post-monsoon depth to water level during 2006)	Shillong (DW)-0.14m bgl Mawngap (DW)-2.10 m bgl Balat (DW) –3.62 m bgl Mawsmai (Newly established peizometer)-94.40 m bgl
	Long term water level trend in 10 yrs(1986-2005) in m/yr	In 4 stations, max. falling trend (10 cm/yr) is observed at Balat in pre-monsoon period.
10.	GROUND WATER EXPLORATION BY CGWB (as on 31.3.2007)	
	No. of wells drilled (EW,OW,PZ, SH. Total)	EW-7 OW-3 Total 10
	Depth Range (m)	60-247.6
	Discharge (litres per second) Transmissivity(m^2 /day)	0.15 -18.55 In order of 7.46
11.	GROUND WATER QUALITY	Good and potable
	Presence of chemical constituents more than permissible limits (e.g. EC, F, As, Fe)	Sporadic occurrence of high concentration of Fe.
	Type of water	Good for drinking & irrigation purposes
12.	DYNAMIC GROUND WATER RESOURCES	

	(as on March 2004) in mcm	
	Annual Replenishable Ground Water Resources	169.73
	Net Annual Ground Water Draft	0.3
	Projected Demand for Domestic and Industrial Uses upto 2025	23.82
	Stage of Ground Water Development	0.2 %
13.	AWARENESS AND TRAINING ACTIVITY Mass Awareness Programmes organized	Date: 26th March, 2004 Place: Auxillium Convent School, Shillong No. of participants:200 ---------- Date: 30th March, 2005 Place: Shillong Club, Shillong No. of participants :100
	Water Management Training Programme organized	Date: 24th & 25th March,2004 Place: PHED conference Hall, Shillong No. of participants:13 ---------- Date: 28th & 29th March, 2005 Place: PHED conference Hall, Shillong No. of participants:16
14.	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	
	Project Completed by CGWB (No. & amount spent)	6 no., Rs 20.32 lakh under Central Sector Scheme executed by WAPCOS.
	Project under technical guidance of CGWB (nos.)	10 RWH structures in rural Govt. schools executed by NGO through GRHC,
15.	GROUND WATER CONTROL & REGULATION	
	Number of OE Block	Nil
	Number of Critical Block	Nil
	Number of Blocks notified	Nil

16.	MAJOR GROUND WATER PROBLEMS AND ISSUES	As per findings of CGWB, a few pockets of the district are having high concentration of Fe (value ranging from 1.52 to 8.4 ppm). This high content of Fe in water gives a bitter astringent taste. Groundwater constitutes an important part of rural water supply scheme. Due to lack of proper and effective water treatment plant in East Khasi Hills, contaminant & pollutant water is a major concern. The surface and ground water are being polluted due to adoption of most common practice of dumping municipal waste along the streams in absence of solid waste disposal management system in the district and the matter has been pointed out in presence of the district authorities during the MAP organized by CGWB.

1.0 Introduction:

East Khasi Hills is one of the seven districts of Meghalaya covering an area of 2748 sq. km. Shillong is the district headquarter of East Khasi Hills which is also the capital of Meghalaya. As per 2001 census the total population of the district is about 660923 with a male population of 333553 and female population of about 327370. The district has a density of population of about 241 persons per square km and a sex ratio of about 981 females per thousand males. The district has been divided into seven blocks as shown below-

Name of Block	Inhabited villages	Area (sq km)
a) Mawphlang	166	290
b) Mylliem	98	204
c) Mawrynkeng	62	293
d) Mawkynrew	70	355
e) Mawsynram	155	523
f) Shella Bholaganj	204	578
g) Pynursla	144	505

The district is a classic example of watershed where in the north, the rivers flow toward the Brahmaputra Riverto and in the south, the rivers flow towards the Bangladesh plateau. The important rivers in the northern part are Umtrew, Umiam and Umkhen and in the southern part, rivers like Myntang and Umgnot are draining the district. The drainage pattern is structurally controlled and parallel to sub-parallel in nature.

Central Ground Water Board has carried out many water supply investigations and regional hydrogeological surveys in East Khasi hills district. In 1998, a study was taken up to review the drinking water scenario in Shillong Urban Agglomerate. During 2000, the Board carried out development and augmentation possibilities of groundwater prospect in Shillong Urban Agglomerate. Ground water investigation was carried out in North Eastern Indira Gandhi Regional Institute of Health & Medical Science (NEIGRIHMS). During Annual Action Plan of 2004-05 and 2005-06, exploration activity was carried out in the district. Ground Water Management study in East Khasi Hills was carried out in the year 2004-05.

2.0 Rainfall & Climate:

The district has the unique distinction of having the wettest place on earth i.e. Mawsynram with an average annual rainfall of about 12,270 mm. This is followed by 2nd wettest place called Cherrapunjee with an average annual rainfall of 11,600 mm. Southwest monsoon originating from the Bay of Bengal and the Arabian Sea directly influences this high rainfall.

The high altitude areas of the district experience temperate humid climate and low altitude areas experience tropical to sub-tropical humid climate. The whole year can be divided into four seasons namely summer, rainy, autumn and winter. The temperature varies from 1.7^0 C to 24^0 C.

3.0 Geomorphology & Soil Type:

Geomorphologically, the East Khasi hills is an undulatory one. It comprises of denudational high and low hills with deep gorges. The district represents a remnant of ancient plateau of Indian Peninsular Shield which is deeply dissected suggesting several geotectonic and structural deformities that the plateau has undergone. In the southern border areas, there are fringes of alluvial plains that are localized in nature.

Soil type of an area is dependent on factors like geology, relief, climate and vegetation. Red Loamy soil is a product of weathering of rocks like granites, gneisses etc which are relatively rich in clay forming minerals. This soil type are rich in organic matter, nitrogen and acidic in nature. They are found exposed in the central part of the district. Laterite soil is a weathering product of rocks like quartzite, schist, conglomerate etc, which are found exposed in the northern area of East Khasi Hills. The soils are rich in iron and aluminium. Alluvial soils are found exposed in the southern part of the district that are rich in potash but poor in phosphate content. They are acidic in nature.

4.0 Ground Water Scenario:

4.1 Hydrogeology:

The district of East Khasi Hills is covered mainly by crystalline rocks with Tertiary sedimentary rocks. The secondary porosity in consolidated formation e.g. fractures; joints, etc developed due to major, minor tectonic movements, prolonged physicochemical weathering, form the conduits as well as reservoirs of ground water. The weathered mantle varies from 10 to 30 m bgl. Ground water occurs under water table condition in the top weathered quartzite and in semi-confined condition in the fractured and jointed rocks.

In the shallow aquifer, the depth to water level ranges from less than 2 m bgl to 6 m bgl. In the deeper aquifer, the depth to water level ranges generally beyond 2m bgl with yield ranging from 5-10 m^3/hr. The bore wells tapping the deeper aquifer are encountered with two sets of fractures within a depth range of 120 m. Other set of fracture may extend deep beyond 120 m bgl.

Ground water development in the district is mainly through dug /open well tapping the water in the weathered zone and bore wells are constructed to tap ground water from the fractures/joints in the hard rocks.

In the district of East Khasi Hills, the Board has constructed a total of 10 numbers of exploratory wells so far. The depth of the exploratory well ranges from 60 to 247.6 m below ground level, tapping aquifer thickness of 15-135 m. The static water level of the exploratory wells ranges from 1.95 to 49 m below ground level. The yield of the wells varied from 5-10 m^3/hr.Transmissivity (T) is in the order of 7.46 m^2 /day.

Spring plays a major role to cater water requirement of the people through out the year. Most of the springs are gravity springs. It is observed that discharge of most of the springs lie within the range of 5000-25000 lpd in pre- & post monsoon period. It has also been observed that the high yielding springs are closely related to rainfall. So the development of springs having a discharge more than 5000 lpd will help in mitigating the water requirement of the people in the area to a great extent.

4.2 Ground Water Resources:

For assessing the dynamic ground water resources, two approaches for estimation of rainfall recharge are recommended as per GEC'97–Water Level Fluctuation Method and Rainfall Infiltration Factor Method. As the data on depth to ground water level is not sufficient, the Rainfall Infiltration Factor Method is used for calculating the resource estimation of the district. Moreover, hilly area having slope of more than 20% are not taken into consideration as they are not worthy of recharge. Area with poor water quality is not considered, as there is no such report. The remaining area after deleting the hilly area (more than 20%) is delineated into command and non – command area and assessment is done for both monsoon and non-monsoon seasons.

Rainfall Infiltration Factor Method:

Recharge from rainfall (Rrf) = RIF *A* NMR

Where RIF= rainfall infiltration factor which has been taken as per norms recommended by GEC 97 for different geological formations.

A= area of computation for recharge.

NMR= normal monsoon rainfall

In calculation of Recharge from sources other than rainfall, ground water irrigation, recharge from ponds and tanks, check dams, nalla bunds is taken as nil in East Khasi Hills district and only surface water irrigation is taken into account. The total annual recharge is obtained as the sum of recharge from rainfall and the recharge from sources other than rainfall.

Ground Water Resource Potential of East Khasi Hills (as on March 2004) in ha m is as follows.

Rainfall recharge during monsoon season	Recharge from other source during monsoon season	Recharge from rainfall during non-monsoon	Recharge from other source during non-monsoon season	Total annual ground water recharge	Natural discharge during non-monsoon season	Net annual ground water availability
11159	100	5691	23	16973	1697	15276

And the stage of Ground water development for the district is as follows:-

Net Ground water availability	Existing gross ground water draft for irrigation	Existing gross ground water draft for domestic and industrial purpose	Existing gross ground water draft for all uses	Allocation for domestic and industrial uses upto 2025	Net annual ground water availability for future irrigation development	Stage of ground water development (%)
15276	Nil	30	30	2382	12894	0.20

4.3 Ground water quality:

A summarized table is presented below from the available chemical analysis from various dug wells, springs, bore and tube wells in the East Khasi Hills district –(concentration is in mg/l except for specific conductance which is expressed as micro mhos/cm at 25°c)

Constituents	Springs	Shallow aquifer	Deeper aquifer
pH	4.8-7.2	5.2-7.1	5.7-6.4
Specific conductance	20-170	51-260	51-214
Carbonate	Nil	Nil	Nil
Bi-carbonate	6.1-24	6.1-134	18-104
Chloride	3.5-35	7.1-35	7.1-11
Fluoride	*BDL-0.21	0.07-0.35	0.08-0.47
Calcium	2-30	4-40	2-22
Magnesium	1.2-4.9	2.4-4.7	1.2-8.5
Total Hardness	10-80	15-115	10-90
Iron	BDL-0.24	BDL-1.52	BDL-8.4

*BDL- below detectable limit

According to Bureau of Indian Standards (BIS:IS:10500, 1991), the chemical constituents present in the ground water of the district is all within the desirable limit set for drinking and irrigation water standards except for Fe for drinking purpose.

Thus the water of the district is generally good and fit for drinking as well as irrigation point of view. In pockets where high concentration of Fe is detected, the water can be treated by adopting iron removal procedures for domestic use.

4.4 Status of Ground Water development:

In the district of East Khasi Hills, the Board has drilled a total of 10 numbers of wells so far. The depth of the exploratory well ranges from 60 to 247.6 m below ground level, tapping aquifer thickness of 15-135 m. The static water level of the exploratory wells ranges from 1.95 to 49 m below ground level. The yield of the wells varies from 5-10 m^3/hr.

5.0 Ground Water Management Strategy:

5.1 Ground Water Development:

As the district is characterized by undulatory terrain, the scope for development of ground water lies in low lying depression, and valley fills which hold good prospects for ground water development. In these areas, ring wells, shallow tube wells, deep tube wells are feasible.

Ground water manifests itself at the surface as springs. This plays an important role in rural water supply scheme in the district and a proper and scientific approach is required to augment the existing water supply scenario in the district. The discharge of the spring increases in the month of May and June, which is generally after the heavy rainfall that the district receives. Efforts should also be taken to safeguard the water of the spring from any sort of contamination.

5.2 Water Conservation & Artificial Recharge:

An amount of Rs 20.32 lakhs was expended under Central Sector Scheme to construct 6 structures in Shillong, the district headquarter of East Khasi Hills for implementing the roof top rain water harvesting. The implementing agency was WAPCOS who constructed 3 roof top rain water harvesting structures in schools and 3 in State Government Departments.

The details of the rooftop rainwater harvesting structures is as shown below-

Location	Roof Area (m^2)	Gutter length (m)	Drop pipe (m)	Conveyance pipe (m)	Carrying pipe (m)	Water harvested (m^3)
State Guest House	186.2	53.4	12.0	85.0	40.0	357
Circuit House	137.6	42.4	10.0	60.0	60.0	264.19
State Central library	1103.2	162.6	42.0	90.0	45.0	2118.4
Auxillium Convent	520.5	123.0	15.0	60.0	45.0	999.36
Pine Mount School	973.3	176.1	24.0	140.0	40.0	1868.73
All Saints High school	613.4	106.0	15.0	120.0	48.0	1177.73

All the beneficiaries were using the rainwater for gardening, washing, cleaning etc except for drinking. These structures are of great help to them for meeting their water requirement during rainy season.

The construction of rain water harvesting tank of capacity of 40,000 liters and two low cost toilets in each Govt rural school have been completed in collaboration of local Non Government Organization namely Bethany Society, Shillong in the district of East Khasi Hills, coordinated by Global Rainwater Harvesting Collective, Tilonia, Rajasthan. Central Ground Water Board has also prepared Roof Top Rain Water Harvesting Scheme at Raj Bhawan, Shillong.

As the East Khasi Hills district is basically a hilly one, most of the rainfall flows away as surface runoff due to undulating topography. Due to limited ground water recharge, the springs and wells do not yield sufficient water in summer months. Hence, roof top rainwater harvesting technique is a viable option. These structures can be implemented in areas where human settlement exist and in areas with steep gradient (say more than 20%) which are usually not worthy of ground water recharge

6.0 Ground Water Related Issues & Problems:

In a few pockets of the district, high concentration of Fe (value ranging from 1.52 to 8.4 ppm) is found giving a bitter astringent taste.

Groundwater constitutes an important role in rural water supply scheme. Due to lack of proper and effective water treatment plant in East Khasi Hills, contaminant & pollutant water is a major concern. The surface

and ground water are being polluted due to adoption of most common practice of dumping municipal waste along the streams in absence of solid waste disposal management system in the district. The matter has been pointed out in presence of the district authorities during the MAP organized by CGWB.

7.0 Awareness & Training Activity:

7.1Mass Awareness Programme(MAP)& Water Management Training Programme (WMTP) by CGWB:

A Mass Awareness Programme was conducted on Ground Water Management & Rain Water Harvesting on 26th march 2004 at Auxillium Convent School. Shillong. About 200 people from different walks of life participated making the programme a huge success.

A Mass Awareness Programme was conducted on 30th March 2005 at Shillong Club, Shillong on Ground Water Management & Rainwater Harvesting.

Two days long Water Management Training Programme was organized on 24th & 25th March 2004 at PHED conference hall, Shillong. A total of 13 Trainees participated from different State, Central and Non-Governmental Organizations.

During 2004-05, two days long Water Management Training Programme was conducted on 28th & 29th March '05 at PHED conference hall, Shillong. A total of 16 Trainees participated in the training programme.

All MAP and WMTP organized by CGWB were covered by local News Papers and electronic media.

7.2 Presentation & lectures Delivered in Public Forum/Institution of Repute, etc:

Fresh Water Year was celebrated in the district in the year 2003 in collaboration with Central Water Commission. Central Ground Water Board has participated during the workshop on "The impact of Air and water pollution as the quality of life and solution thereof" organized by the State Development Reforms Commission, Government of Meghalaya. A technical topic on "Ground Water Pollution" was presented by the Board and was associated in the celebration of World Water Day at Shillong (during 2005 & 2007). Government of Meghalaya has prepared a draft Model Bill to regulate and control the development and management of ground water in Meghalaya during March, 2007, and a representative from CGWB is a member of the committee on the Model Bill. Government of Meghalaya has proposed to constitute Water Harvesting Authority /Mission in the state to look after

various activities in connection with implementation of rainwater harvesting schemes in the state.

8.0 Recommendations:

Judicious planning for Ground Water Resource Development should be preceded by intensive hydrogeological and geophysical survey aided by remote sensing studies.

Energisation of the wells should be stepped up to ensure optimal utilization of the ground water resources creating additional irrigational potential.

The farmers should be educated through agricultural extension services, Mass Awareness and Water Management Training Programme to adopt suitable cropping pattern,irrigation method, conservation of ground water for optimal utilization of available ground water resources.

The springs having a discharge more than 5000 lpd should be developed fully in mitigating the water requirement of the people in the area.

Roof top rain water harvesting technique may be encouraged to augment ground water resource potential wherein water table is deeper particularly in recharge zone.

The municipal solid waste disposal management system should be developed to avoid the surface and ground water contamination due to adoption of most common practice of dumping municipal waste along the streams/here & there.

****