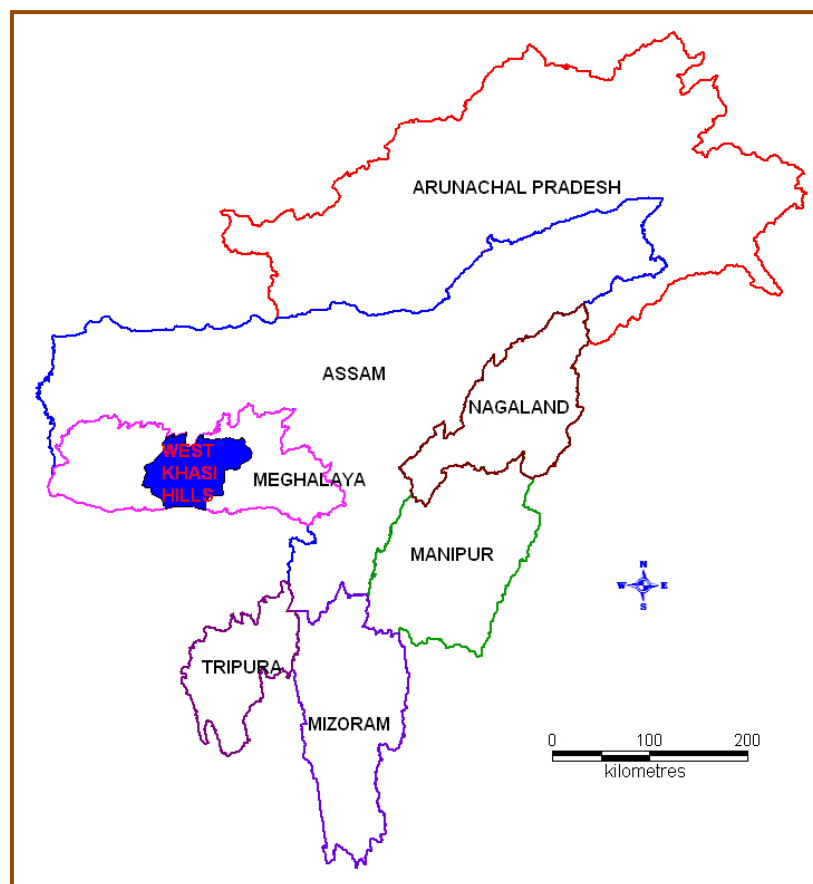




Ground Water Information Booklet West Khasi Hills District, Meghalaya



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Guwahati
November 2008

**GROUND WATER INFORMATION BOOKLET
WEST KHASI HILLS DISTRICT, MEGHALAYA**

DISTRICT AT A GLANCE

Sl. No.	ITEMS	STATISTICS
1.	GENERAL INFORMATION	
	a) Geographical area (sq. km.)	5,247
	b) Administrative Divisions (as per Statistical Handbook, 2007)	
	I) Blocks	6
	a) Mawshynrut	
	b) Nongstoin	
	c) Mairang	
	d) Ranikor	
	e) Mawkrywat	
	f) Mawthadraishan	
	II) Number of Villages	943
	III) Sub-division	2
	IV) Town	2
	c) Population (as per 2001 census)	2,96,049
	d) Average Annual Rainfall (mm) Source: Dept. of Agriculture, Meghalaya	1,900 – 7,000
2.	GEOMORPHOLOGY	Denudational low hills and highly dissected plateau in the south with minor valleys
	Major physiographic units	The district is hilly with deep gorges and narrow valleys.
	Major Drainages	Kynshi, Wahkri, Rilang, Rwiang, Umngi Rivers
3.	LAND USE (sq. km.) 2003-04	
	a) Forest area	2,085
	b) Net area sown	206.83
	c) Total Cropped area	264.33
4.	MAJORS SOIL TYPES	Red Gravelly Soil and Red Loamy Soil
5.	AREA UNDER PRINCIPAL CROPS	Rice, Maize, Millets, Oilseeds and pulses.
6.	IRRIGATION BY DIFFERENT SOURCES	Mainly by surface water.
	Surface water command area (sq. km.)	7.29
7.	NUMBERS OF GROUND WATER MONITORING WELLS of CGWB	
	No of dug well	01

	No of Piezometers	Nil
8.	PREDOMINANT GEOLOGICAL FORMATIONS	Granitic, Gneissic and schistose rocks with sedimentary rocks like sandstone and limestone.
9.	HYDROGEOLOGY	
	Major water bearing formation	The major water bearing formation is the fractured, fissured and jointed granitic, gneissic rock. Weathered zones of these formations are potential water bearing zones. The sandstone and limestone also hold good amount of ground water.
	(Pre-monsoon depth to water level during 2007)	Mairang: 0.83 m bgl
	(Post-monsoon depth to water level during 2007)	Mairang: 0.83 m bgl
	Long term water level trend in 10 years (1987 – 2006) in m/yr	Rise in water level trend (0-5) m
10.	GROUND WATER EXPLORATION BY CGWB (As on 31.3.2008)	10 8 exploratory wells proposed during 2008-09
	No. of wells drilled (EW, OW, PZ, SH. Total)	EW-09 SH-01
	Depth Range (m bgl)	31.5 to 80.0
	Discharge (m ³ /hr)	1.5 to 10
11.	GROUND WATER QUALITY	Good and potable
	Presence of chemical constituents more than permissible limits	Sporadic occurrence of high concentration of Iron
	Type of water	Good for drinking and irrigation purposes.
12.	DYNAMIC GROUND WATER RESOURCES (as on March 2004) (ham)	
	Annual Replenishable Ground Water Resources	5,945
	Net Annual Ground water draft	15
	Projected demand for domestic and industrial uses upto 2025	1,293
	Stage of Ground Water Development	0.29%, 'Safe' Category
13.	AWARENESS AND TRAINING ACTIVITY	
	Mass Awareness Programme Organized	Nil
	Water Management Training Programme Organized	Nil
14.	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	----

	Project Completed by CGWB (No. & amount spend)	Nil
	Project under technical guidance of CGWB (nos.)	Nil
	Others	Mazzarello Orphanage cum Vocational Training Center, Nongkroh, Rambrai has implemented multipurpose rain water harvesting ponds for ground water augmentation.
15.	GROUND WATER CONTROL & REGULATION	Nil
	Number of OE Block	
	Number of Critical Block	
	Number of Blocks notified	
16.	MAJOR GROUND WATER PROBLEMS AND ISSUES	The major ground water related problem of the district is its management and utilization in the steep slopes resulting in limited natural recharge areas. This has created some water deficient areas in the district. The approach and accessibility to the hamlets and villages is a difficult task, which are the major impediments in developing the ground water resources. As some pockets are affected with higher concentration of Iron in water, so the water supply agencies should take precautionary measures to provide Iron free water for potable purpose.

GROUND WATER INFORMATION BOOKLET
WEST KHASI HILLS DISTRICT, MEGHALAYA

1.0 Introduction

West Khasi Hills district is the largest district of Meghalaya covering 23% of the total area of the state. The total geographical area is 5,247 sq. km. The district was carved out from Khasi hills on 28.10.1976. The district headquarters is Nongstoin which covers an area of 76 sq. km. It lies between Latitude 25°10' and 25°51' N and Longitude 90°44' and 91°49' E. As per 2001 census, the population in this hilly and tribal district is 2,96,049 with male population of 1,50,419 and female population of 1,45,630. It is bounded by East Khasi Hills district and Ri-Bhoi district on the eastern part. The East Garo Hills and South Garo Hills districts lie in the western side. In the north, lies Assam and in the south, it is Bangladesh. The density of population of the district is 56 persons per square km with a sex ratio of 968. The percentage of literacy as per 2001 census is 65.1% having a male literacy of 66.5% and female literacy of 63.7%. The main occupation of the population in the district is agriculture. The land utilization of the district is presented in the **Table 1.1**.

Table 1.1: Land utilization statistics of West Khasi Hills (2003-04)

Land Classification	Area (sq. km.)
Geographical area	5,247
Reporting area	5,171
Forest area	2,085
Non-Agricultural area	204.5
Barren Uncultivable area	504.3
Land under Misc. Tree, Crops, Groves etc	405.8
Cultivable Waste Land	1,061.4
Current Fallows	224.1
Fallow Land other than Current Fallow	478.9
Net Area Sown	206.8
Area Sown more than once	57.5
Total area cropped	264.3

The district has a forest area of 2,085 sq. km. that is about 40% of the total area. The net area sown is 206.8 sq. km. and the total cropped area is 264.3 sq. km. Thus, in West Khasi Hills

district, fallow land covers about 13%, net area sown is about 4%, and the total cropped area is about 5%.

The principal crops grown in the district are rice, maize, millets, oilseeds and pulses. Horticulture products include orange, pineapple and banana. Vegetables like potato, sweet potato, ginger, garlic etc are grown.

Geomorphologically, the district represents denudational hills of old gneissic and schistose rocks except in the southern parts where highly dissected plateau are observed. Few narrow elongated intermontane valleys are seen along major lineaments.

The drainage system of the district is controlled by topography. The east-west trending central upland acts as water divide dissecting the district into two drainage basins. In the north, lies the Brahmaputra basin and in the south, lies the Meghna basin. The northern system drains out into the mighty Brahmaputra River in the adjoining Assam state and the major drainage system in the south merges into the Bangladesh plains. Kynshi is the major river that originates in the southern slope of Marpna peak near Mawmaram village. This river is joined by number of tributaries on its westerly course ultimately draining into Bangladesh. Another River Khri rises near Kyllang rock flowing northward into Assam plains. Other important Rivers of the district are Umngi, Wahblei, Riangdo, Rilang, Tyrsung, Ryndi, Rwiang etc. The drainage pattern of the district is angular to sub-angular and is found to be structurally controlled.

There is no existing hydel/thermal project in the district, but some are in the execution stage like the 240 MW Nongjiri and 450 MW Kynshi project.

In the district, there is no major or medium irrigation project. There are only minor irrigation schemes in Mairang Block and hence the agricultural development in the area is dependent on it. The existing irrigation schemes are based only on surface water. Majority of the project are flow irrigation project in nature as the district is hilly. **Table 1.2** presents the salient features of some of the minor irrigation schemes in Mairang Block.

Table 1.2: Salient Features of Minor Irrigation Projects in Mairang

Name of the project	Block	Year of Completion	Command Area (sq. km.)
Kynshi LIP	Mairang	1976-1977	2.56
Mawnai-Mawkshu FIP	-do-	1991-92	0.31
Tienglam FIP	-do-	1993-1994	0.14
Pdem FIP	-do-	1996-1997	1.31
Bynther FIP	-do-	1996-1997	0.42
Kynrud FIP	-do-	1997-1998	0.93
Patharsyngkhaw FIP	-do-	2000-2001	0.75
Phudumjer FIP	-do-	2000-2001	0.31
Madan Umthied FIP	-do-	2004-2005	0.32
Ladpnarrim FIP	-do-	2005-2006	0.24
Total			7.29

(Source: Irrigation Department, Government of Meghalaya)

Central Ground Water Board has carried out Water Supply Investigations, Ground Water Exploration and District Ground Water Management Studies in the district. Under Technology Mission on drinking water in villages, water management feasibility studies in West Khasi Hills were prepared by CGWB along with PHED during 1986. During the Annual Action Plan for 2001-02, District Ground Water Management Studies were carried out in the district. Further, a part of the district i.e. Mairang Block was covered as part of District Ground Water Management Studies in the year 2006-07. Ground water exploration was initiated in the district for the first time during the AAP of 1996-97 with the drilling of one exploratory well in Sohiong. And till date about 10 wells were drilled in the district. During the current AAP of 2008-09, ground Water Exploration has been earmarked for West Khasi Hills district in association with PHED.

2.0 Rainfall & Climate

The Climate of the district varies in latitudinal and longitudinal directions and is influenced mainly by physiography. There are four seasons in the district namely summer, monsoon or rainy, autumn and winter. The summer season extends from the end of March to Mid May, which is characterized by relatively high temperature, occasional thunderstorm with high wind velocities. The rainy season commences with the onset of southwest monsoon in April

and lasts up to October. This is followed by short autumn from mid October to November. This season indicates the slow retreating of monsoon with clear and sunny sky. The winter season extends from December to the end of March. This is the coldest season of the year with sharp decline in the temperature. During winter, some high altitude areas of the state experiences very cold nights. Winter is basically dry with reducing diurnal range of temperature.

In general, the district has a mildly tropical climate in the northern and southern foothills, whereas central upland portion experiences temperate climate and the places of medium altitude of the northern, southern and western part of the district experiences sub-tropical climate.

The district receives a fairly high rainfall throughout the year. Most of the precipitation occurs during the rainy season i.e. between April and October due to SW monsoon. The average rainfall in some of the selected stations of the district is presented in **Table 1.3**.

Table1.3: Average Rainfall (Mm) of Selected Stations in West Khasi Hills

Station	Rainfall (mm)	Total Years
Mairang	1,918	5
Nongstoin	3,633	17
Riangdo	3,140	17
Ranikor	7,116	5

3.0 Geomorphology & Soil Type

Geomorphologically, the district is an undulatory one, with the E-W trending Khasi hill ranges of Central Upland zone. The average altitude of the Central Upland is about 1,400 m AMSL. Other northern, southern and western parts have a general altitude of 150 to 900 m Above Mean Sea Level. This further controls the drainage system as it divides the state into two watersheds namely the Brahmaputra system in the North and Meghna /Surma system in the South. The West Khasi Hills district also represents the remnant of ancient plateau of Indian Peninsular shield that is deeply dissected suggesting several geotectonic and structural deformities that the plateau has undergone.

Broadly, the district can be differentiated into the following geomorphic units.

- **Denudational Low and High Hills:** It occupies the major part of the state comprising of hard rocks like granite and gneiss. It is moderately dissected by fractures and joints forming a good number of narrow intermontane valleys.
- **Dissected Plateau:** It is found in the south portion of district comprising of soft and friable rocks like shale, sandstone and quartzite.
- **Deep Gorges:** It is exposed in the southern parts comprising of Tertiary rocks like sandstone, shale and limestone.

The district shows different types of soil as the provenance differs widely. Red Gravelly and Red Loamy Soil are the common soil types. The soils are acidic in nature and comparatively rich in organic matter and nitrogen but poor in phosphorous.

Some of the important mineral resources of the district are Sillimanite, Coal, Uranium and Limestone.

4.0 Ground Water Scenario

4.1 Hydrogeology

Hydrogeologically, the district can be divided into two units, namely consolidated and semi consolidated formations.

4.1.1 Consolidated Formation

Consolidated formations are like the Archaean Gneissic Complex, acid / basic intrusive, and the Pre-Cambrian quartzite and phyllites of Shillong Group of rocks. These formations lack primary porosity and the movement and occurrence of ground water is controlled by physiography, zone of weathering and interconnected zones of weakness or secondary porosity like joints, faults etc. Groundwater occurs under unconfined condition in the weathered residuum and semi confined conditions in secondary pore spaces like fractures, fissures etc.

At hydrogeological feasible situations, well drilled down to a depth of about 80 -150 m below ground level may yield a moderate discharge of 5-15 m³/hr in Archaean and Pre-Cambrian Group of rocks whereas the acid and basic counterparts have a discharge of 5-10 m³/hr. Water level is found to occur between 2 and 15 m bgl. The valley areas are found to be favourable for the construction of dug wells and bore wells in other steep areas.

4.1.2. Semi-consolidated Formations

It includes limestone, sandstone, and shale inter bedded with the coal seams. Aquifers developed in limestone can be granular/porous, fissured/fractured and conduit/cavernous and that can be confined, unconfined or perched. Sandstone with limited porosity yields water through secondary fissures like joints. Shale in many cases acts as aquiclude. The aquifers are thick and discontinuous in nature. Ground water is found to occur under confined to semi-confined conditions with low yield of 5-15 m³/hr. Water level is found to rest between 2 and 4 m bgl. The areas which are favorable for construction of shallow as well as deep tube well are the synclinal and intermontane valleys.

4.2 Ground Water Resources

The dynamic groundwater resources have been assessed based on Ground Water Resources Estimation Methodology of 1997 (GEC 97). In this methodology, two approaches are recommended – water level fluctuation method and rainfall infiltration method. As the data of ground water level is insufficient, the rainfall infiltration 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. Hence, the remaining area is delineated into command and non-command area and assessment is done for both monsoon and non-monsoon seasons. As per the Rainfall Infiltration Factor method, recharge from rainfall is given by the following formula.

$$(R_f) = RIF * A * NMR$$

Where RIF = Rainfall Infiltration Factor

A = Area of computation for recharge.

NMR = Normal Monsoon Rainfall

Recharges from sources other than rainfall, ground water irrigation, recharge from ponds and tanks, check dams, nalla, bunds are taken as **nil** for the district and only surface water irrigation is taken into account. The total annual recharge is obtained as the arithmetic sum of recharge from rainfall and the recharge from sources other than rainfall. Thus, Ground Water Resource Potential (as on March 2004) in ham is as follows (Table 4.1 and 4.2).

Table: 4.1 Net Ground Water Availability (ham)

Annual Replenishable GW resources				Total annual ground water recharge	Natural discharge during non-monsoon season	Net ground water availability
Monsoon season		Non-monsoon season				
Rainfall recharge	Recharge from other source	Recharge from rainfall	Recharge from other source			
4,026	212	1,659	48	5,945	595	5,350

Table 4.2: Categorization of Ground Water Resources (ham)

Net ground water availability	Annual GW draft			Domestic and industrial uses up to 2025	Ground water availability for future irrigation	Stage of ground water development (%)	Categorization
	Irrigation	Domestic and industrial uses	Total				
5,350	0	15	15	1,293	4,057	0.29	SAFE

As per the computed ground water resource, the stage of ground water development is yet to be picked up in the district. The stage of Ground Water development in the district is only 0.29% and is considered a **SAFE** one. Thus, there is abundant scope for utilization of available ground water resources in the district.

4.3 Ground water quality

In order to study the chemical quality of ground water, representative water samples were collected from selected dug wells and springs (**Table 4.3**). The parameters analyzed in the Chemical Laboratory of CGWB, NER, Guwahati are pH, EC, TDS, CO₃, Cl, SO₄, F, Ca, Mg, TH and Fe.

It was observed that ground water is alkaline rather than acidic. Overall, the chemical constituent present in the ground water is within permissible limit and is good for drinking, irrigation and industrial purposes. Some sporadic occurrence of higher concentration of Iron is reported from some localities.

Table 4.3: Chemical Analysis of Ground Water of West Khasi Hills District

Location	Type	Date of collection	pH	EC	TDS	HCO ₃	Cl	SO ₄	F	Ca	Mg	TH	Fe
Kynrud	Spring	14/6/06	6.4	86	56	31	11	1.0	0.1	8.0	2.4	30	0.18
Mawkarah	-do-	-do-	6.58	128	83	37	6.1	11	0.6	12	2.4	40	0.3
Mawphaniew	-do-	-do-	6.6	110	72	18	14	BDL	0.0	4.0	1.2	15	0.08
Nongkhlaw	DW	-do-	6.6	55	36	18	3.5	-do-	0.0	6.0	1.2	20	0.5
Mawshut	Spring	17/6/06	6.5	116	75	12	18	-do-	0.0	8.0	2.4	30	0.09
Mawlong	-do-	15/6/06	6.68	52	34	24	3.5	-do-	0.3	4.0	1.2	10	0.05
Nongbri	-do-	15/6/06	6.62	41	27	12	7.1	-do-	BDL	6.0	2.4	25	0.03
Laitshed	-do-	17/6/06	6.64	31	20	12	7.1	-do-	-do-	2.0	1.2	10	0.20
Laidom	-do-	-do-	6.74	93	60	24	11	5.0	0.18	8.0	2.4	25	0.93
Mawkhap	-do-	-do-	6.82	128	83	43	11	9.0	0.30	10	3.6	40	0.14
Mawpat	DW	21/6/06	6.95	28	18	18	3.5	BDL	0.21	4.0	1.2	15	0.09
Maranglang	Spring	1989	7.7	53	---	31	7.0	---	---	4.0	1.0	15.0	---
Nongmowlein	-do-	-do-	8.2	21	---	18	14	---	---	6.0	2.0	25	0.10
Rongthang	-do-	-do-	7.7	24	---	18	11	---	---	6.0	1.0	20	0.30
Pohjaud	-do-	-do-	7.7	31	---	18	11	---	---	4.0	2.0	20	0.40
Mawthapdaw	-do-	-do-	8.0	21	---	18	11	---	---	4.0	1.0	15	0.05
Mawsaw	-do-	-do-	8.1	19	---	49	7	---	---	6.0	4.0	30	0.40
Nongbothalong	-do-	-do-	7.8	21	---	24	11	---	---	4.0	4.0	25	0.05

4.4 Status of Ground Water Exploration and Development

As a part of ground water exploration programme of CGWB, the Board had drilled ten exploratory wells in the district. The depth of the exploratory well ranges from 31.5 to 80 m below ground level. The static water level ranges from 0.9 to 1.7 m below ground level. The discharge of the wells varies from 1.5 to 10 m³/hr. However, the ground water development is yet to be picked up in the district

5.0 Ground Water Management Strategy

5.1 Ground Water Development

As the district is underlain by consolidated and semi-consolidated formations, the fractures and joints act as a good repository for the development of ground water. Lineaments studies through Remote Sensing and Electrical Resistivity Surveys can be of great help in this field. Structures like ring wells, shallow as well as deep tube wells are the feasible ground water structures.

All the minor irrigation schemes in the district are dependent upon the surface water resources. As per ground water resource estimation by CGWB, the stage of ground water

development is only 0.29 % and there is enough scope for future development of ground water resource in the district. Ground water development is being done through dug well and bore well in the intermontane valley. This is mainly used for domestic purposes such as washing and drinking. Springs can also play a major role in ground water development in the district. The development of spring as a source of water is seen mainly along the foothills or fracture zones. This plays a pivotal role in rural water supply scheme. But a proper and scientific approach is required to improve the existing water supply scenario in the district.

6.0: Ground Water Related Issues and Problems

West Khasi Hills district is basically a hilly one. Steep slopes and rugged terrain offers limited scope for recharge and development of ground water. Moreover, approachability is a big constraint for an assured water supply in the hamlets/ villages situated on hilltops or steep slopes.

7.0: Recommendation

Development of ground water in the district is still in nascent stage. Thus, there is ample scope for future development of ground water in the district. It is being done through dug well and bore well in the intermontane valley and linear ridges. The intermontane valleys are the most favorable places for ground water development. Structures like ring/dug well, shallow and deep bore well are feasible ground water abstraction structures. Hydrogeological studies have indicated that lineament, joint, fracture and fault are the main controlling factors for the occurrence and distribution of ground water. These structures can be targeted for ground water development. Thus, the potential fractured zones must be confirmed by Geophysical Survey and lineaments studies by Remote Sensing Studies.

Spring plays a major role in feeding water requirement of the people in rural areas. It is found that the location of the spring is mainly restricted to foothills and intermontane valleys. As the people in the rural areas are totally dependent on spring, there is an urgent need for scientific approach for proper development and management of it. It may be recommended that the development of springs having high discharge will help in mitigating the water requirement of the people to a large extent.

The chemical quality of ground water indicates that groundwater in the area is good for domestic, irrigation and industrial uses. Chemical analysis shows that the spring water is of

excellent quality and is suitable for drinking purposes as per BIS standard. However, some sporadic occurrence of high concentration of Iron in ground water has been reported in some pockets in the district. So, the water supply agencies should take precautionary measures to provide Iron free water for potable purpose.

Although, the district receives heavy rainfall, people face acute scarcity of water in the steep and hilly portion. This is because of higher gradient resulting in surface run off. In these areas, roof top rainwater harvesting may be adopted effectively to meet the demand of the people residing on hilltops. Rainwater can be collected from the rooftops made of PVC or concrete through bamboo or pipe. This water can be used for domestic uses including drinking purposes after treatment.

In the foothills where most of the precipitations get wasted as surface runoff, the area can be effectively utilized for augmentation of ground water by constructing structures such as gully plugging, check weirs and check dams. In doing so, the water level on the upstream can be raised to a considerable extent.

Mass Awareness Programme to the users and stakeholders on water consumption and protection of water quality will help in managing the precious resource in scientific ways for optimum benefits.