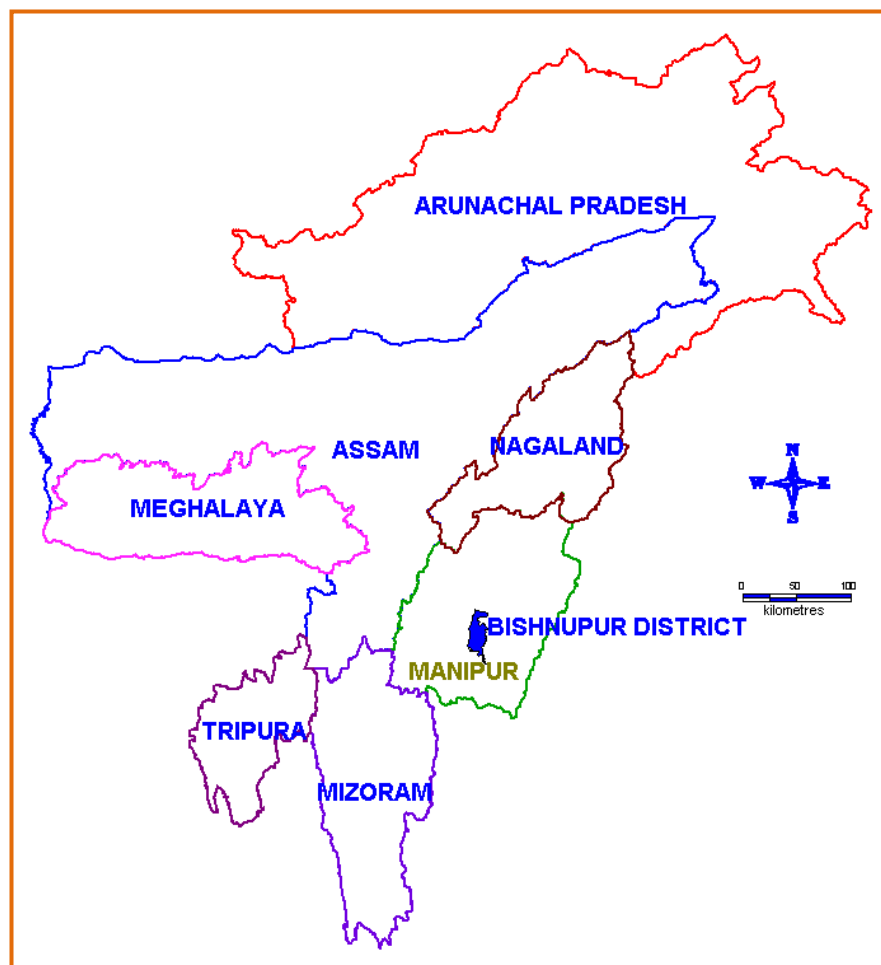




Ground Water Information Booklet

Bishnupur District, Manipur



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Guwahati
June 2009

Ground Water Information Booklet

Bishnupur District, Manipur

DISTRICT AT A GLANCE

Sl. No.	ITEMS	STATISTICS
1.	GENERAL INFORMATION	
	i) Geographical Area (in sq.km.)	496.00
	ii) Administrative Division (as on 2006) Number of Tehsil/CDBlock Number of Panchayat/Villages	2 25
	iii) Population (as on 2001 Census)	2,05,907
	iv) Average Annual Rainfall (mm)	1,414
2.	GEOMORPHOLOGY	
	i) Major Physiographic Units	i. Valley area, ii. Area under water (lakes), & iii. Hillocks with forests
	ii) Major Drainages	ii) Small tributaries like Thongjaorock, Nambol, khuga, Ningthoukhong, Sunusiphai, Iram, Yangoi rivers which are flowing towards Loktak lake (except Khuga)
3.	LAND USE (sq.km.)	
	i) Forest Area	15.00
	ii) Net Area Sown	386.71
	iii) Cultivable Area	423.66
4.	MAJOR SOIL TYPES	
		i. Younger & Older alluvial soil ii. Red gravelly sandy and loamy soil
5.	AREA UNDER PRINCIPAL CROPS in sq.km. (as on 2005)	177.20
6.	IRRIGATION BY DIFFERENT SOURCES (sq.km.)	
	i) Dug Wells	-
	ii) Tube /Bore Wells	0.33
	iii) Tanks/Ponds	-
	iv) Canals (SLI+SFI)	(6.48 + 34.90) =41.38
	v) Other Sources, MIS	41.71
	vi) Net Irrigated Area	51.44
	vii) Gross Irrigated Area	83.42
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (as on 31-03-2009)	Nil
8.	PREDOMINANT GEOLOGICAL FORMATIONS	Disang and the Barail Group of rock consisting of shale, siltstone & sandstone of Upper Cretaceous to Eocene age.
9.	HYDROGEOLOGY	

	i) Major water Bearing Formations ii) Pre-monsoon Depth to Water Level during 2004 iii) Post-monsoon Depth to Water Level during 2004 iv) Long term Water Level Trend in 10 yrs (1997 –2006) in m/yr	i. Unconsolidated alluvium rocks ii. 2.73 to 16.02 mbgl iii. 1.47 to 3.36 mbgl iv. No significance change								
10.	GROUND WATER EXPLORATION BY CGWB (as on 31-03-2009) i) No of Wells Drilled ii) Depth Range (m) iii) Discharge (lpm) iv) Transmissivity (m ² /day)	2 No of Exploratory Wells <table border="1"> <thead> <tr> <th>Kumbi</th> <th>Bishnupur</th> </tr> </thead> <tbody> <tr> <td>96.80</td> <td>45.70</td> </tr> <tr> <td>232.0</td> <td>100.0</td> </tr> <tr> <td>38.84</td> <td>4.30</td> </tr> </tbody> </table>	Kumbi	Bishnupur	96.80	45.70	232.0	100.0	38.84	4.30
Kumbi	Bishnupur									
96.80	45.70									
232.0	100.0									
38.84	4.30									
11.	GROUND WATER QUALITY i) Presence of Chemical Constituents more than Permissible Limit (e.g. EC, F, Fe, As) ii) Type of Water	Except Fe and As, other elements are within the permissible limit. Fe and As are more than permissible limit in the shallow aquifers Good and potable, Ca ⁺ - Mg ⁺ - HCO ₃ ⁻ type								
12.	DYANMIC GROUND WATER RESOURCES (2004) in mcm i) Annual Replenishable Ground Water Resources ii) Net Annual Ground Water Draft iii) Projected demand for Domestic and Industrial Use upto 2025 iv) Stage of Ground Water Development	80.60 72.54 6.02 20.28 0.04%								
13.	AWARENESS AND TRAINING ACTIVITY i) Mass Awareness Programmes Organized ii) Date iv) Place v) No of Participants	Nil								
14.	EFFORTS OF ARTIFICIAL RECHARGE AND RAINWATER HARVESTING i) Projects Completed by CGWB (No & amount spent) ii) Projects Under technical Guidance of CGWB (Numbers)	Nil								
15.	GROUND WATER CONTROL AND REGULATION i) Number of OE Blocks ii) Number of Critical Blocks iii) Number of Blocks Notified	Nil								
16.	MAJOR GROUND WATER PROBLEMS AND ISSUES	Higher concentration of Fe and As in ground water of the district is observed (at Keinouthonkhong)								

Ground Water Information Booklet

Bishnupur District, Manipur

1.0 Introduction

Bishnupur district is located in the south west of Manipur Central valley area between 24°10' & 24° 45' North Latitudes and 93° 45' & 93° 52' East Longitudes covering a total area of 496 sq. km. The average altitude is 822.18 m above MSL. The district is bounded on the North by Imphal West District, on the South by Churachandpur District, on the East by Imphal and Thoubal Districts. The original name of Bishnupur was Lumlangdong (now Lamangdong). Bishnupur is popularly known as the '**land of dancing deer**'.

As per 2001 census, the total population of the district is 2,05,907. The density of population is 364 persons per square km. The district is the home of large number of different communities.

The district experiences fair cold climate during winter and hot in summers. The maximum temperature is 33⁰C during May to September and the minimum dips down to 4⁰C in the month of January. However, the temperature of the district as a whole is moderate and there is no extreme climate in the district. Irregular rain starts in the month of April with occasional and irregular light showers and continues up to the end of May. This rain occurs due to the influence of Northeastern wind. Normal monsoon rain begins from the early part of June and heavy rains occur in the district till the month of September. About 80% rainfall is due to South West monsoon.

The district is primarily an agrarian as majority of the population depend their livelihood on agriculture and other allied activities. As major portion of the district is plain, wet cultivation is the main method of cultivation. The principal agriculture crops are paddy, maize, potato, pea, mustard, chilly, cabbage, etc. Sugarcane is the main cash crop of the district.

Physiographically the district may be divided into three main parts i.e. (i). valley or alluvial plain area, (ii) area under water or wetland / lakes and (iii) area covered under hillocks and forest. Alluvial plains cover majority of the district area with a flat gentle regional slope towards Loktak Lake.

A considerable area of the district is covered by the lakes like Loktak, Ngakrapat, Awangsoi, Laisoi, Zingpat, Loukoipat, and Ikokpat etc. Loktakpat, which is the largest in Land Lake not only in Manipur but also in the North-Eastern India, covers an area of about 247 sq. km. during the rainy season with an average depth of about 10-15 metres. Keibul Lamjao, the National park is situated on the southeastern side of the Loktak Lake and it has an area of 40 sq. km. The sonapat, Utrapat, Samusang, Kharungpat and Ikokpat are also worth-mentioning lakes in Bishnupur district.

Hillocks and forests, having an area of about 34.12 acres, constitute rest of the district. Some of the worth mentioning hillocks are Lotpaching, Loukoiching, Sendra, Khongjaingambaching, Thangaching etc.

Locally originated small tributaries control the drainage of the district. There is no large-scale river in the district. Some of the small rivers, which are flowing in the district, are Thongjaorock, Sunusiphai, Nambol, Yangoimacha, Yangoiachouba, Khuga, and Iram etc.

Except Khuga River, all other river starts from the hill located in the west of the Tiddim Road and flows towards east falling into Loktak Lake.

Geologically the district is occupied by the shale, siltstone and sandstone of the Disang Group and the Barail Group of Upper Cretaceous to Eocene age. It follows the strike of the general N 10° folding direction of the Indo-Burmese range. The valley fill of Plio-Quaternary age consisting of clay, sand and gravel deposited in a fluvio lacustrine environment. In the western edge of the valley, there are small alluvial fans in Bishnupur and in north of Leimakhong River. In Bishnupur, condensed series show a progradation of gravel beds into lacustrine black sandy clay. At the bottom, lacustrine laminated sand and clay overlies the fresh Disang shale.

Ground water in the district occurs under both the confined and unconfined conditions.

The piezometric head of existing tube wells varies from 1.00 metres above ground level to 22.35 metres below ground level. The water level fluctuates up to 12.66 m. The high fluctuation is because of clayey and silty nature of the aquifers. Water level rises in the months of May and June during pre-monsoon and falls during the month of February-March during the post-monsoon period. The water level reaches its minimum during March-end. Rainfall starts from the month of April end and hence, water level is found to rise during April-May.

The study area is mostly occupied by semi-consolidated formations which cover almost the entire area comprising shale, siltstone, sandstone and conglomerate. These formations belong to Disang, Barail, Surma and Tipam group of rocks. In the western part of the study area, unconsolidated alluvium of Quaternary age occurs in the valleys and topographical lows. Ground water is restricted to weathered residuum of semi-consolidated rocks and intergranular pore spaces of alluvial deposits.

Hydrogeologically the entire district has been grouped into two main units, viz. (i) unconsolidated formation, and (ii) semi-consolidated formation. Unconsolidated alluvium of Quaternary age occurs in the valleys and topographical lows. Ground water is restricted to weathered residuum of semi-consolidated rocks and intergranular pore spaces of alluvial deposits. Further subdivisions like Older and Younger alluvium have been made on the basis of (a) geomorphology including landuse (b) lithology and soil characteristics (c) hydrogeological properties like yield characteristics etc.

The ground water movement is essentially towards the wetland area from the peripheral higher elevation of the district and finally it results to the west to east hydrologic gradient. There are variations in the hydraulic gradient in the areas especially in between Disang and Barail parts of the valley. As per the exploration data of C.G.W.B, there is more or less single horizon of aquifer existing from Bishnupur to Kongwai within 44 m depths with thin clay intercalations.

The main sources of water for irrigation are rivers, ponds, lakes, tanks, wells etc. And various means of distribution are canals and pumping sets through which water are drawn from the sources. The Loktak lift irrigation also supplies water to a considerable area of land in the district.

Occurrence of potential aquifers and its yield potential, prospects for ground water development in the district are mainly confined to the alluvial deposit surrounding the Loktak Lake. The eastern and northern region are feasible for the development of ground water through shallow to moderately deep tube wells down to 75 m tapping about 10 to 30 m of cumulative thickness of granular horizon capable of yielding 20 to 40 m³/hr for draw down upto 12 m.

The potential aquifer is found in the southern part of the valley bordering Iril River from Sugnu to Kumbhi adjoining some parts of Churachandpur valley. The terrace zones running from Bishnupur to Sekmai in north which mainly comprise pebbles, boulders with clay matrix.

Other than arsenic (As) and iron (Fe) concentration in the ground water, most of the chemical constituents are within the permissible limits for both the drinking and irrigational uses. In some parts of the district, fluoride contents show beyond permissible limit.

The estimated gross annual dynamic groundwater resource is 80.60 mcm while net ground water resource is 72.54 mcm. The stage of ground water development is 0.04 %. Future provision for domestic and industrial use is 6.02 mcm and for irrigation use, it is 66.52 mcm.

2.0 Rainfall and Climate

Bishnupur district receives monsoon rainfall mainly from June to September every year. Rain starts in the month of April with occasional and irregular light showers and continues up to the end of May. This rain occurs due to the influence of Northeastern wind. Normal monsoon begins from the early part of June and heavy rains occur in the district till the month of September. About 80% rainfall is due to south west monsoon.

The district experiences fair cold climate during winter and hot climate during summer season. May to September is the hottest months and December and January are

Table-1 Monthly Rainfall (in mm) in Bishnupur district as per rainfall data from Imphal station

Year / Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1997	7.2	25.3	101.5	62.6	144.1	148.7	278.5	148.4	317.8	8.70	9.00	69.4	1321.2
1998	47.1	30.0	165.3	81.00	191.3	296.5	164.2	300.2	65.4	53.5	49.9	0.00	1444.4
1999	1.00	0.00	48.9	15.00	284.6	181.9	292.7	267.6	125.1	165.7	6.50	12.8	1401.8
2000	27.9	11.8	109.8	167.7	255.7	206.7	122.0	116.3	204.5	201.7	13.00	0.00	1437.1
2001	12.2	46.0	94.3	127.3	188.0	218.7	238.4	202.3	163.7	123.4	45.30	17.1	1401.0
2002	36.3	1.5	12.5	79.7	197.3	136.8	412.2	360.8	145.4	231.1	65.7	7.5	1686.8
2003	53.6	11.8	30.2	143.4	139.6	279.7	372.3	187.3	87.4	122.4	4.1	74.9	1506.7
2004	4.8	TR	27.1	459.6	153.8	225.4	256.5	154.8	159.2	153.7	6.6	2.8	1604.3
2005	TR	36.8	126.9	77.1	129.3	116.2	36.4	213.0	251.6	194.7	16.2	31.3	1229.5

2006	0.00	37.4	0.4	84.0	215.6	184.8	188.3	98.7	114.0	3.30	32.0	22.7	981.2
2007	0.0	39.2	39.6	385.1	256.7	220.6	141.0	89.8	172.0	145.8	58.1	0.2	1548.1

Source: IMD, Imphal Airport Station

the coldest months. The maximum temperature is 33⁰C during May to September and the minimum dips down to 4⁰C in the month of January. In winter, slight and thin snowfalls are observed in colder years. However, the temperature of the district as a whole is moderate and there is no extreme climate in the district.

3.0 Geomorphology and Soil Types

3.1 Geomorphic Features and Landforms

Bishnupur district may be divided into three main physiographic divisions i.e. (i). valley or alluvial plain area, (ii) area under water or wetland / lakes and (iii) area covered under hillocks and forest. The plain area covers the major portion of the area in the district; secondly, the lakes cover a considerable area in the district. Alluvial plains are characterized by a flat gentle regional slope towards Loktak Lake.

The lakes like Loktak, Ngakrapat, Awangsoi, Laisoi, Zingpat, Loukoipat, and Ikokpat etc cover a considerable area of the district. Loktakpat, which is the largest in Land Lake not only in Manipur but also in the North-Eastern India, covers an area of about 247 sq. km during the rainy season with an average depth of about 10-15 metres. Keibul Lamjao, the National park is situated on the southeastern side of the Loktak Lake and it has an area of 40 sq. km. Sonapat, Utrapat, Samusang, Kharungpat and Ikokpat are also worth-mentioning lakes in Bishnupur district.

The hillocks and forests, having an area of about 34.12 acres, constitute the third part of the district. Some of the worth mentioning hillocks are Lotpaching, Loukoiching, Sendra, Khongjaingambaching, Thangaching etc.

3.2 Drainage and Morphometric Features

The drainage of the entire area is controlled by locally originated small tributaries of the district. There is no large-scale river in the district. Some of the small rivers, which are flowing in the district, are Thongjaorock, Sunusiphai, Nambol, Yangoimacha, Yangoiachouba, Khuga, and Iram etc. Except Khuga River, all other rivers start from the hill located at the west of the Tiddim Road and flow towards east falling into Loktak Lake, discharging maximum quantity of water during the monsoon months (May – September). These tributaries frequently inundate the land along their banks by experiencing havocs of flood in every year.

3.3 Soil

The nature of the soil in the district is transported type of soils. The transported soils are of two types. i.e. alluvial and organic . The area covered by plains and hillocks are mainly characterized by alluvial soils. These soils have general clayey warm texture and grey to pale brown colour. They contain a good proportion of potash and phosphate, a fair quantity of nitrogen and organic matter and are less acidic. The organic soils covered the low-lying areas surrounding the lakes. With dark grey colour and claye loam texture, these peaty soils have high acidity, abundance of organic matter, a good amount of nitrogen and phosphorous but

poor in potash. The hill soils are more or less rich in organic carbon (1 to 3%) in the topsoil, but poor in available phosphorous and potash. They are acidic in nature.

Alluvial sediments belonging to Quaternary ages occupy the plain areas. Based on sedimentation, soil characteristics and geomorphic features, the sediments can be divided into two subdivisions, viz. older and younger alluvium. The older alluvium by virtue of its relative maturity is composed of somewhat oxidized sediments comprising yellow and the reddish brown colour sand, silt and clay in contrast to the light colour, less compact younger alluvium sediment. The older alluvium always occupies the higher grounds than the adjacent younger alluvium but takes the proper stratigraphic position underlying the younger alluvium sediments in the plain areas

4.0 Ground Water Scenario

4.1 Hydrogeology

Hydrogeologically the entire district has been defined by semi-consolidated to unconsolidated formations of Quaternary age. These are shale, siltstone, sandstone and conglomerate, which belong to Disang and Barail group of rocks. Ground water is restricted to weathered residuum of semi-consolidated rocks and intergranular pore spaces of alluvial deposits. Further subdivisions like Older and Younger alluvium have been made on the basis of geomorphology including landuse, lithology, soil characteristics and hydrogeological properties like yield characteristics etc.

There are small alluvial fans in Bishnupur and north of Leimakhong River. In Bishnupur, condensed series show a progradation of gravel beds into lacustrine black sandy clay. At the bottom, lacustrine laminated sand and clay overlies the fresh Disang shale.

The ground water movement is essentially towards the lower topographic wetland area from the peripheral higher elevation of the district and finally results to the west to east hydrologic gradient. The nature is radial from peripheral higher elevations to the lower levels of the area since there are variations in the hydraulic gradient in the areas especially in between Disang and Barail parts of the valley. As per the exploration data of C.G.W.B, there are more or less single horizon of aquifer exists from Bishnupur to Kongwai within 44 m depths with thin clay intercalations.

AQUIFERS

As per the hydrogeological data of CGWB, in some parts of the district, it reveals that the aquifer thickness ranges from 10 to 20 mbgl. Piezometric head varies from 2.50 to 4.30 mbgl. The transmissivity and hydraulic conductivity ranges between 4.30 and 89 m²/day and 0.67 to 16 m/day. The discharge of tube wells established is about 10-30 m³/hr at 10-15 m drawdown. In fact there is great variation in both vertical and lateral lithology, even over small distances. Sand and gravel layers have largely undefined boundaries.

The thickness of older alluvium in the area reveals to be more than 50 m by some deep tube wells constructed by CGWB. The potential aquifer is found in the southern part of the area bordering Iril River from Sugnu to Kumbhi touching some parts of Churachandpur valley. The terrace zones running from Bishnupur to Sekmai in north which are mainly comprises pebbles, boulders with clay matrix.

OCCURRENCE

Ground water is found to occur under water table conditions in the shallow dug well horizons with depth to water table varying from 1 m above ground level to 20 m below ground level. Ground water in deeper layers is found to occur under semi-confined to confined conditions.

It also occurs under semi-confined to confined conditions in the deeper aquifer tapped by medium duty deep tube wells. In younger alluvium, ground water occurs under unconfined conditions and is extracted by means of open wells and small diameter tube wells for both domestic and irrigation purposes.

YIELD POTENTIAL OF AQUIFERS

Based on the hydrogeological conditions, occurrence of potential aquifer horizons and their yield potential, prospects for ground water development in the district mainly confined to the alluvial deposit plain areas surrounding the Loktak Lake. The eastern and northern region are feasible for the development of ground water through shallow to moderately deep tube wells down to 90 m tapping about 10 to 30 m of cumulative thickness of granular horizon capable of yielding 10 to 40 m³/hr for draw down upto 15 m.

Table 2 Summarized Hydrogeological data of EW of CGWB

Sl. No	Location	Depth Drilled (m)	Depth of Construction	Tapped Aquifer thickness (m)	S.W.L (mbgl)	Discharge (lpm)	Draw Down (m)	T (m ² /day)	Remarks
1	Kumbi	96.80	93.00	27.00	2.86	232.00	10.67	38.84	-
2	Bishnupur	45.70	44.00	12.00	3.91	100.00	18.00	4.30	-

4.2 Ground Water Regime and Depth to Water Analysis

District Ground Water Development and Management Studies were carried out in the Manipur Valley during the AAP 2004-05. The following well information and water level data of 2 monitoring stations were incorporated by the study for the computation of depth to water level and water table of Bishnupur district.

Depth to water level recorded during DGWM studies in the district ranges from 12.73 to 16.02 mbgl during pre-monsoon (2004) and it varies from 1.47 to 3.36 mbgl during post-monsoon (2004) period in the district. It is observed that the annual water level fluctuation in November 2004 with respect to April 2004 is 1.79.

Table 3 Depth to Water level and Water Table DGWMS stations in Bishnupur district, Manipur

Location	Well Type	MSL (m)	Drill Depth (m)	MP (m,agl)	DTW Apr' 04 (mbgl)	Water table Apr'04 (mbgl)	DTW Nov' 04 (mbgl)	Water table Nov'04 (mbgl)	Aquifer Parameter	Basin
Keinou Thonkhong	TW	778.341	61.00	0.41	16.02	762.32	3.36	774.98	Fine Sand	Manipur River Basin
Maibam Lokpa Hill	TW	778.644	50.3	0.42	2.73	772.11	1.47	777.17	Gravel and shale	

The formations encountered in the area comprise of clay, clayey sand down to 90 m followed by shale. Granular horizon was found to encounter from 65 to 75 m. Gas emanation were observed below 150 m. Tube well constructed down to 100 m through 100 mm dia pipes tapping aquifer horizons below 65-75 m, could not be tested due to the pressure of natural gas.

As per the reappraisal studies of CGWB, the area comprises five shallow tube wells, thirty seven shallow to medium depth tube well, fourteen medium to deep wells and two deep tube wells with different depth ranges of (0-20), (20-50, (50-100) and (100-150) mbgl respectively.

4.3 Water Level Trend Analysis

Depth to water table varies from 1.00 m above ground level to 22.35 mbgl in the area. Water level fluctuation varies from 1.81 to 12.66 m.

The following Ground Water Monitoring Stations of CGWB are regularly monitored prior to 1991, but at present these are not monitored due to problems.

Table 4 Details of GWM Stations in Bishnupur District, Manipur

Location	Well No	Well Type	Latitude	Longitude	M.P. (magl)	R.L of G.L. (mamsl)	Geology	Basin
Maibam	83H2D4	Dug Well	24°40'30"	93°48'15"	0.80	749.150	Alluvium	Imphal
Kongwai	83H3C3	Tube Well	24°26'24"	93°43'50"	0.50	780.950	Sandstone	Imphal
Kumbhi	83H3D4	Tube Well	24°29'00"	93°47'00"	0.67	777.860	Sandstone	Imphal

4.4 Ground Water Resources

Methodology adopted for ground water resource estimation of Bishnupur district of Manipur is as per GEC 1997 Report, i.e. Ground Water Level Fluctuation and Rainfall infiltration factor Method.

The estimated gross annual dynamic groundwater resource is 80.60 mcm while net ground water resources are 72.54 mcm. The stage of development is 0.04 %. Natural

discharge during non-monsoon season is 8.06 mcm. Future provision for domestic and industrial use is 6.02 mcm and for Irrigation use, it is 66.52 mcm.

Assessment unit can be categorized into 4 categories as safe, semi-critical, critical, and over-exploited. In bishnupur district, stage of ground water development is 0.04 %, which is under the 'SAFE' category. Long-term water level trend does not show any major change.

Ground Water Resource Estimation

Total Ground Water resources of the District	= 80.60 mcm
Net Ground Water Availability	= 72.54 mcm
Gross Ground Water Draft	= 0.03 mcm
Stage of Ground Water Development	= 0.04 %
Future provision for Domestic & Industrial Use	= 6.02 mcm
Future Provision for Irrigation Use	= 66.52 mcm

4.5 Ground Water Quality

The quality of ground water is measure of its chemical, physical, microbiological and radiological properties with respect to its purposed use. In recent year, arsenic in ground water has been reported from some parts of Imphal valley, which mostly fall in the vast riverine tracts of Imphal River. Central Ground Water Board, North Eastern Region, Guwahati based on study claimed that some parts of the district are found to be affected. However, clinical manifestation of *arsenicosis* is not seen till date among the people living in the area.

Ground water in Bishnupur district has high concentration of some harmful elements. High Iron contents in ground water of the district are found. Keeping in view this updated picture of chemical quality scenario of ground water in the district, it is advisable to test the potability of ground water before using it for drinking purposes. A long term environmental planning is also essential to blunt the danger from such pollution problems.

General chemical quality analysis of ground water samples were carried out by Standard Quantitative Methods and Advanced Instrumental Analysis Techniques. Physical parameters, such as pH, EC, TDS and temperature were determined at the time of sample collection in the field itself. The general hydrochemical behavior of contaminants and water quality standards were properly followed in the determination of chemical quality data of ground water sample in the area. It is not possible to consider all of them at a time. Some of the more important contaminants of ground water, which have direct bearing on human health and environment, are highlighted for the purpose of study.

In order to study the quality of ground water suitability for domestic, irrigation and industrial purposes, ground water samples were collected from dug wells, deep tube wells and hand pumps during the Reappraisal Study in Manipur valley by CGWB in the year 2004-05. The water samples were analysed in the Chemical Laboratory of CGWB, NER, Guwahati.

4.5.1 Water Quality of Aquifers

The water sample analysis results showed that the value of EC ranges from 675 to 682 $\mu\text{mhos/cm}$ at 25°C and that of pH varies from 8.0 to 8.2. The concentrations of TDS is found to be 340 to 342 ppm, Ca ranges from 20 to 26 ppm, Mg ranges from 12 to 22 ppm, HCO_3 varies from 323 to 350 ppm, and that of Cl is from 7.1 to 10.2 ppm. The concentration of F is found to be from 0.7 to 0.81 ppm. Different constituents are within the permissible limit.

The concentrations of Fe and As are found to be 5.3 ppm and 0.265 ppm respectively from the tube well of Keinou Thongkhong which is greater than the permissible limits of BIS and WHO.

4.5.2 Comparison of Ground Water Quality w.r.t. Previous Study

The area has not attracted much attention of hydro-chemist and chemist for detailed systematic study of quality and quantity of ground water. Study undertaken by Central Ground Water Board reveals that in the majority of cases, pH, EC and all other parameters are well within permissible limits. The ground water in the area is dominated by calcium-magnesium- bicarbonate (Ca-Mg-HCO_3) type.

Comparison of ground water quality with respect to previous study reveals that there is no major change in the chemical quality of water for the last ten years. But recently arsenic has been reported from Keinou Thongkhong as per studies of CGWB undertaken in 2004-05. Presence of arsenic contents (0.265 ppm) in the hand pumps is beyond the permissible limit of Indian Water Standard for drinking purposes.

4.6 Status of Ground Water Development

4.6.1 Present Ground Water Development

Ground water is used for drinking and irrigation purposes in the district. As there is no major industry in this district, ground water utilization for the same may be considered as negligible. Development of ground water in Bishnupur district is discussed below.

i) Urban and Rural Water Supply Schemes

In Bishnupur district, out of 496 sq. km. of total geographical area, 458.98 sq. km area is rural and only 37.02 sq.km area is under urban area. The present water demand for the small towns in the district is estimated to be 30.09 MLD and it has been extended with water supply facility at the rural standard (i.e. at the rate of 40 litre per capita per day). Upgradation of water supply schemes of the towns at par urban standard of supply i.e. 70 lpcpd (litres per capita per day) are taken up in phases since the Ninth Five Year Plan (1997 - 2002).

ii) Rural Water Supply

Rural Water Supply facilities are provided to the people in rural areas under Centrally Sponsored Minimum Need Programme (MNP) and Accelerated Rural Water Supply Programme (ARWSP). Majority of the habitations in the district were fully provided with drinking water facilities.

4.6.2 Ground Water for Irrigation

The main sources of water for irrigation are rivers, ponds, lakes, tanks, wells etc. And various means of distribution are canals and pumping sets through which water is drawn from the sources. The Loktak lift irrigation also supplied water to a considerable area of land in the district.

Table 5 MIS, Type, Irrigation, Potential & Utilization, Lifting Devices and Use

Structure	Frequency	Irrigation (in ha)		Lifting devices		
		Potential	Utilisation	Diesel	Electrica l	Others
STW	3	33	29	2	-	1
Surface Lift Irrigation	4	648	388	4	0	0
Surface Flow Irrigation	12	3490	2154	0	12	0

Source: 2nd Census, MIS of Manipur

Depending upon agro climatic conditions and rainfall distribution in the district, rice is the main crop, which is cultivated during two seasons i.e. autumn paddy (march to June) and winter paddy (June to November). The distributions of minor irrigation schemes for irrigation in the district are given below.

Table 6 Distribution of Minor Irrigation Schemes in the district

Structure	Frequency	Irrigation (in ha)			No. of Villages
		Potential	Utilisation	Share	
MIS	19	4171	2571	14.08	16

Source: 2nd Census, MIS of Manipur

5.0 Ground Water Management Strategy

5.1 Ground Water Development

Ground water is mostly exploited through open wells, occurs under sub-artesian conditions in the deeper aquifers. Through tube wells, the ground water is targeted to explore at the valley areas with the yields ranging from 0.6 to 4.0 cu.m/hr and annual recharge of 80.60 mcm has been estimated. Considering the clayey nature of formation in the top aquifer, development of this resource is not considered promising on a large scale for irrigation water supply. However, it can be exploited for local water supply through open wells, dug-cum-bore wells and tube wells.

Ground water development prospects in the district exist in the valley alluvial areas where ring wells and shallow tube wells are the feasible structures. Apart from this, ground water sources in the area can be augmented through spring development in the hill districts.

5.2 Water Conservation and Artificial Recharge

Development of rain water harvesting for the drinking water supply is also one of the appropriate measures for solving the scarcity of potable water as it involves relatively low cost, less time for implementation and provides almost entirely safe drinking water which does not require costly purification and treatment processes.

In most of the rural areas, hamlets are small and therefore, it can provide a small catchments area. Considering social and economic background, two types of rainwater harvesting structures may be designed.

Method of constructing ground water abstraction structure, type, design, depth of wells, number and spacing between two wells depend on size of aquifer material, depth range & hydraulic parameters of aquifer zones, which differ from place to place. As per earlier reports and present study, following design criteria is recommended.

5.2.1 Shallow Domestic Wells

Shallow domestic wells are feasible in the district by tapping upto 20 to 30 mbgl. The shallow aquifer zones are mainly concentrated in the southern part of the valley bordering Iril River from Sugnu to Kumbhi adjoining Churachandpur valley. The terrace zones running from Bishnupur to Sekmai in north which comprises pebbles, boulders with clay matrix.

5.2.2 Deep Tube Well for Irrigation Purpose

Deep tube wells are feasible in the district. Occurrence of potential aquifer horizons and their yield potential, prospects for ground water development in the district are mainly confined to the alluvial plain areas surrounding the Loktak Lake. The eastern and northern region are feasible for the development of ground water through moderately deep tube wells down to 75 m bgl tapping about 10 to 30 m of cumulative thickness of granular horizon capable of yielding 20 to 40 m³/hr for draw down upto 12 m.

Diameter of casing pipe, when used as housing pipe, needs to be decided based on the anticipated discharge. Housing pipe should be large enough to accommodate the pump. Based on the static water level, maximum draw down and seasonal fluctuation, length of housing pipe should range from 25 to 30 mbgl. For avoiding corrosion and clogging of well screen, the entrance velocity should be less than 2 cm/sec.

6.0 Ground Water Related Issues and Problems

Prior to 1991, the chemical quality of ground water in the area showed suitable for drinking and domestic purposes. But recent studies of ground water in valley parts showed concentration of some chemical constituents especially iron and arsenic more than the permissible limits of BIS (1991) and WHO (1996).

Recently, the North Eastern Regional Institute of Water and Land management (NERIWALM) and Central Pollution Control Board, Delhi have reported the sporadic presence of arsenic in ground water. The chemical quality of ground water in the district

shows an unusual high concentration of some harmful chemical elements such as, iron and arsenic as per the Reappraisal Hydrogeological Studies undertaken by Dr.S.S.Singh, Asstt. Hydrogeologist, C.G.W.B, NER, Guwahati during the AAP 2004-2005. High concentration of iron and arsenic is an important highlight for Bishnupur districts.

The concentration of iron is relatively high and almost above permissible limits in the district. Maximum amount of iron is observed as 5.3 mg/l at Keinou Thongkhong. Concentration of arsenic is found to be detected as 0.2654 mg/l at Keinou Thongkhong.

Keeping in view this updated picture of chemical quality scenario of ground water in the area, it is advisable to test the potability of ground water before using it for drinking purpose. A long term environmental planning is also essential to blunt the danger from such pollutants.

7.0 Awareness and Training Activity

7.1 Mass Awareness Programme and Water Management Programme by CGWB.

No such programme and activity has been carried out in the district.

7.2 Participation in Exhibition, Mela, Fair etc.

No such Exhibition, Mela, Fair etc were organized and participated by CGWB.

7.3 Presentation and Lecture delivered in Public forum / Radio / T.V / Institution of repute / Grassroots associations / NGO/ Academic institutions etc.

CGWB is not involved in such programme in the district

8.0 Areas Notified by CGWA/SGWA

Nil.

9.0 Recommendations

Based on the hydrogeological conditions, future development of ground water is mainly confined to the alluvial plain area and low-lying lands surrounding the Loktak Lake. The eastern and northern region are feasible for the development of ground water through shallow to moderately deep tube wells down to the depth of 75 m tapping about 10 to 30 m of cumulative thickness of granular horizon capable of yielding 20 to 40 m³/hr for draw down up to 12 m.

The potential aquifer is found in the southern part of the valley bordering Iril River from Sugnu to Kumbhi adjoining Churachandpur valley. The terrace zones running from Bishnupur to Sekmai in north comprise pebbles, boulders with clay matrix.

Most of the chemical constituents are within the permissible limits for both the drinking and irrigational uses except high concentration of arsenic and iron in ground water.

Ground water development prospects in the area may be carried out successfully by constructing ring wells and shallow tube wells are also feasible structures. Apart from this, ground water sources in the district may be augmented through spring development.

Based on the static water level, maximum draw down and seasonal fluctuation, length of housing pipe should range from 25 to 30 mbgl. For avoiding corrosion and clogging of well screen, the entrance velocity should be less than 2 cm/sec.

FIG.2 MAP SHOWING DRAINAGE SUB-BASINS OF BISHNUPUR DISTRICT, MANIPUR

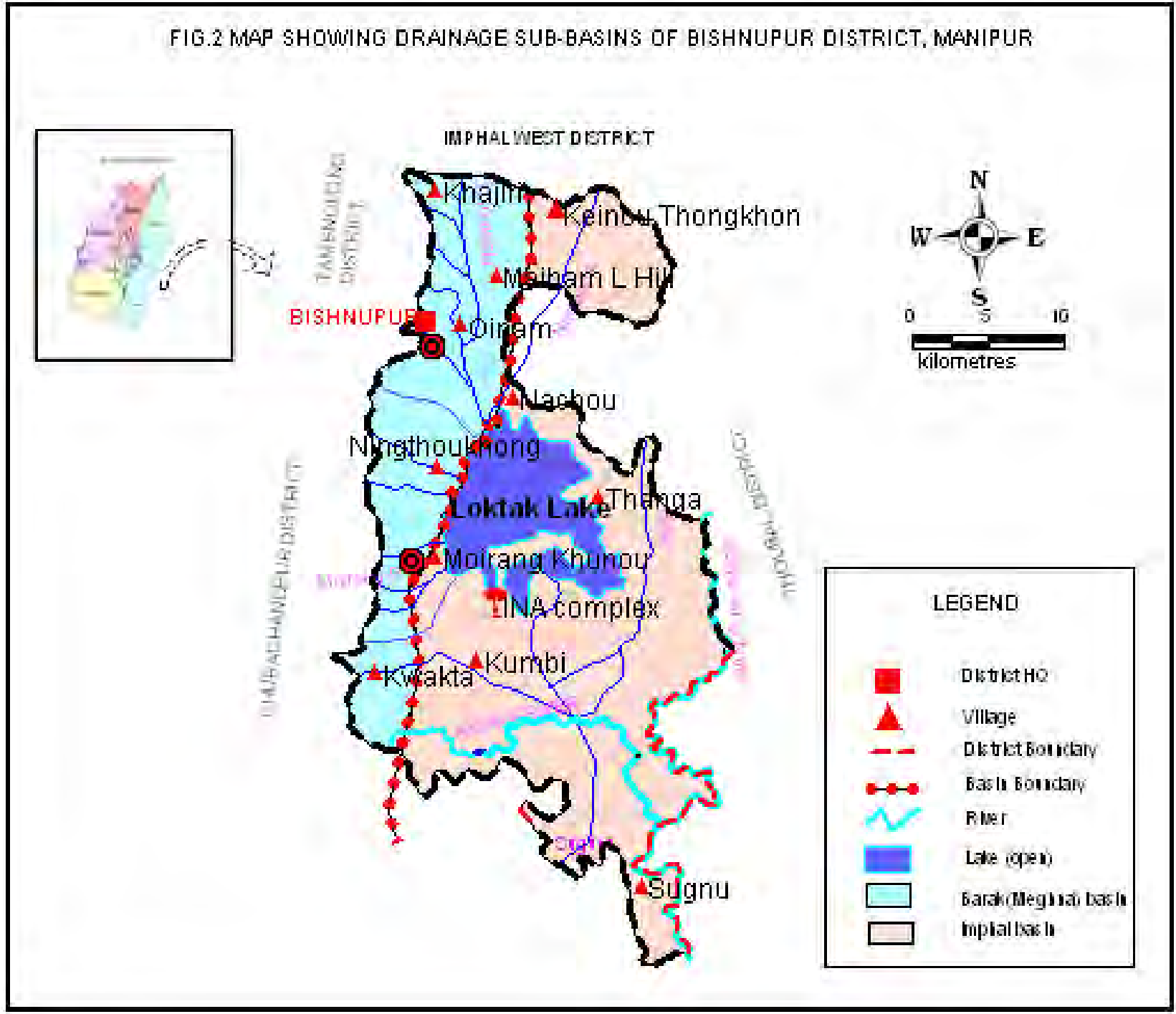


FIG.5. IRON AND ARSENIC CONCENTRATION IN THE GROUND WATER IN BISHNUPUR DISTRICT, MANIPUR

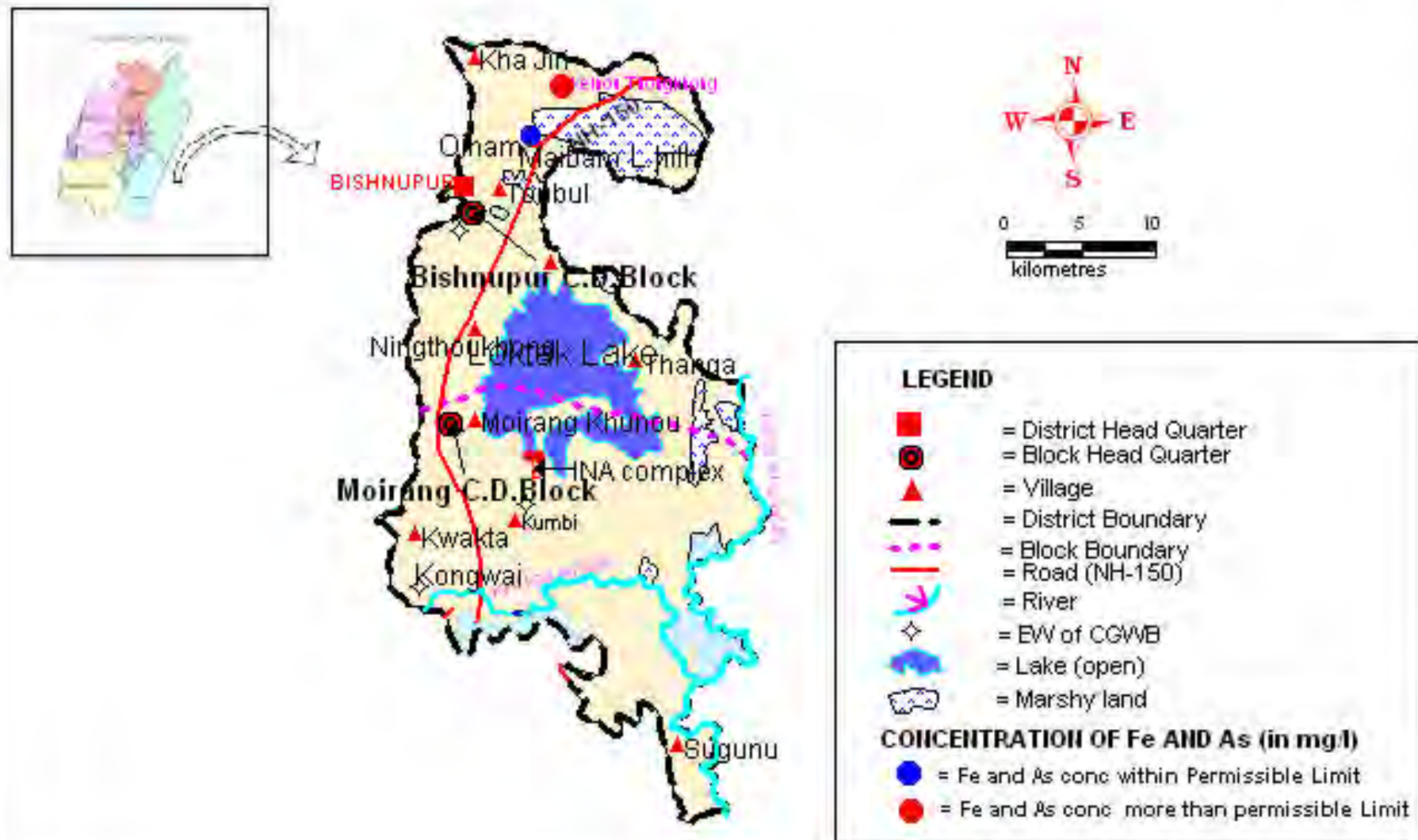


FIG.3. SOIL AND GEOHYDROMORPHOLOGICAL SETUP OF BISHNUPUR DISTRICT, MANIPUR

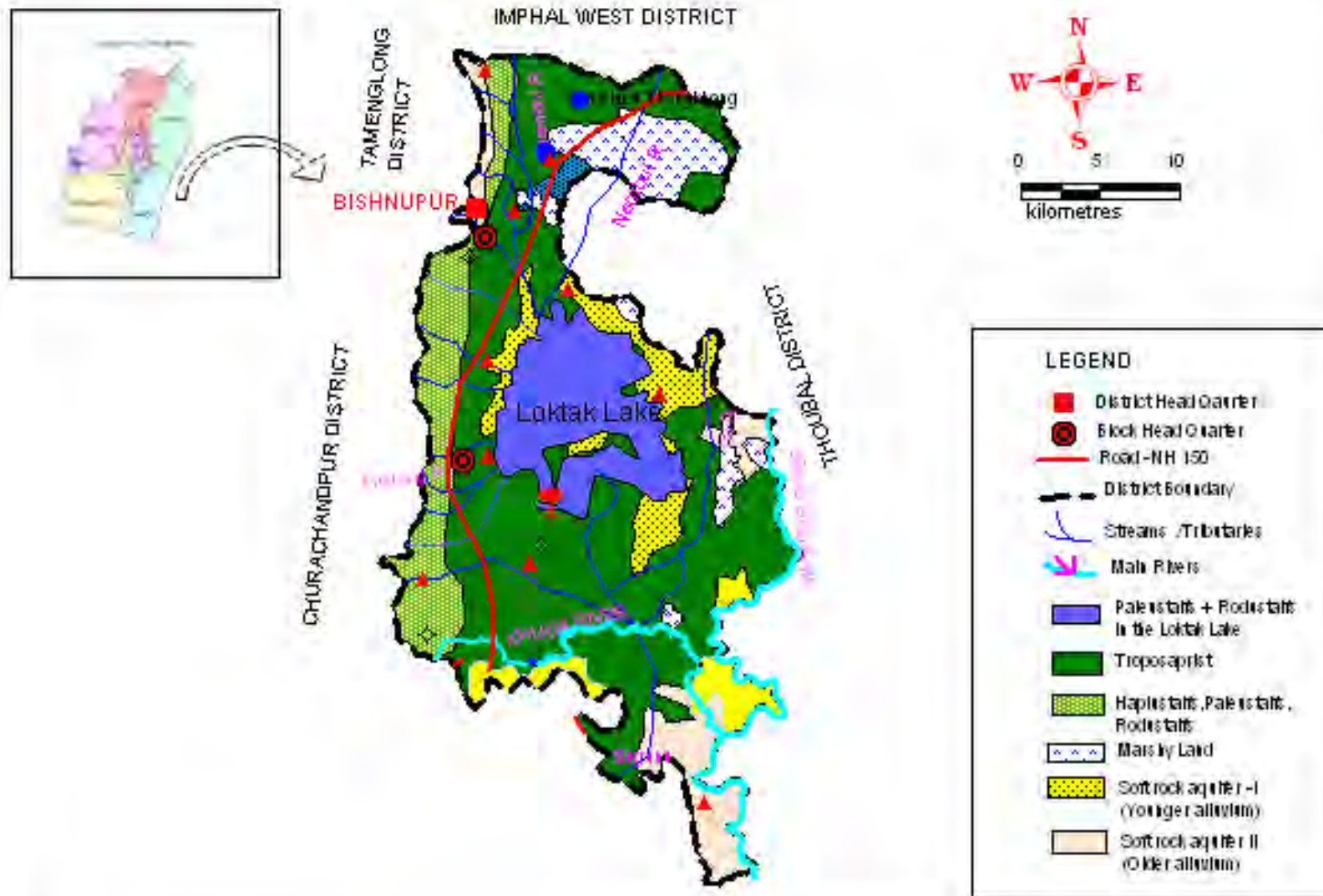


FIG.4b. POST-MONSOON DEPTH TO WATER TABLE MAP FOR DGWMS WELL IN BISHNUPUR DISTRICT MANIPUR

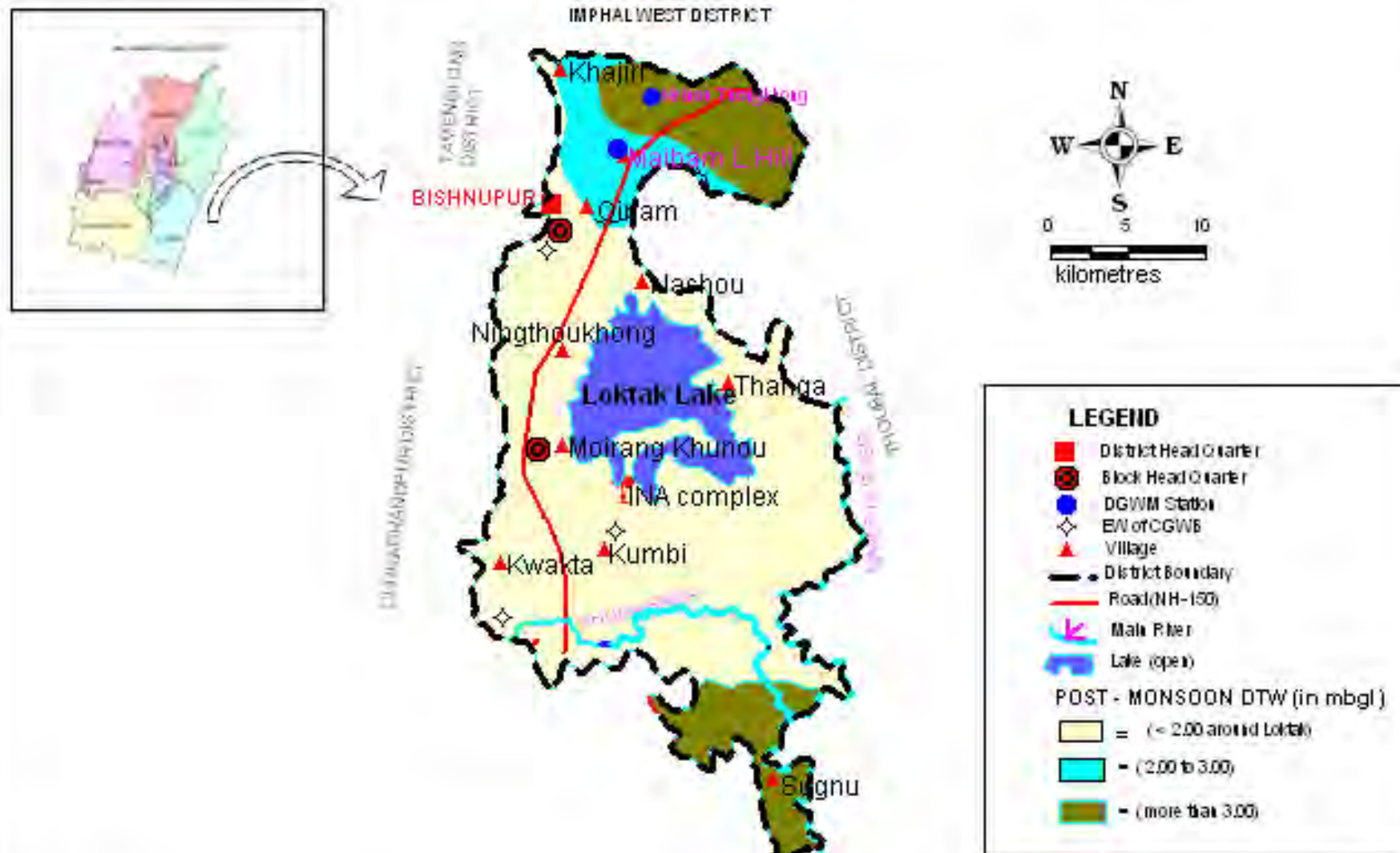


FIG.4a. PRE-MONSOON DEPTH TO WATER TABLE MAP FOR DGWMS WELLS IN BISHNUPUR DISTRICT, MANIPUR

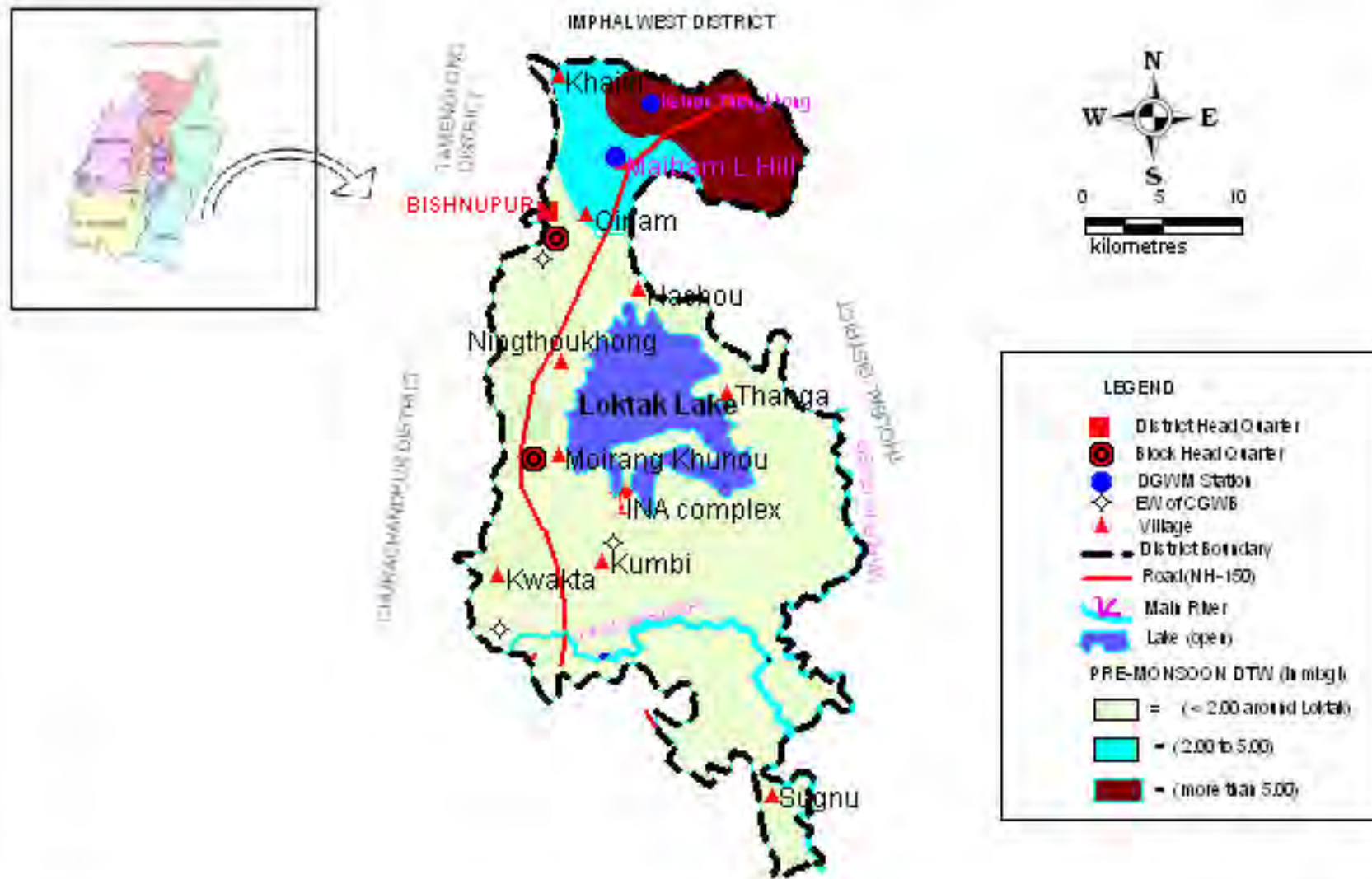
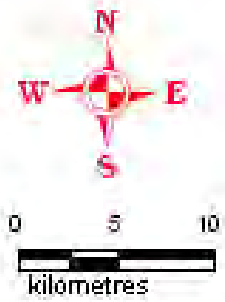
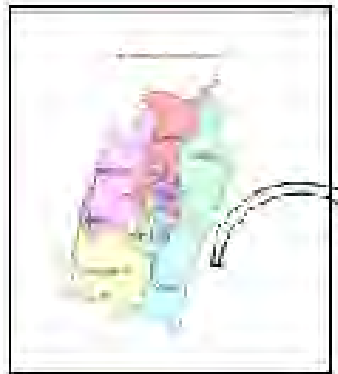


FIG.1 MAP SHOWING ADMINISTRATIVE SET UP OF BISHNUPUR DISTRICT, MANIPUR



LEGEND

- = District HQ
- = Block HQ
- ▲ = Village
- = District Boundary
- - - = Block Boundary
- = Road
- = River
- ◇ = EW of CGWB
- = DGWMS well
- = Lake (open)
- = Marshy land

FIG.1 MAP SHOWING ADMINISTRATIVE SET UP OF BISHNUPUR DISTRICT, MANIPUR

