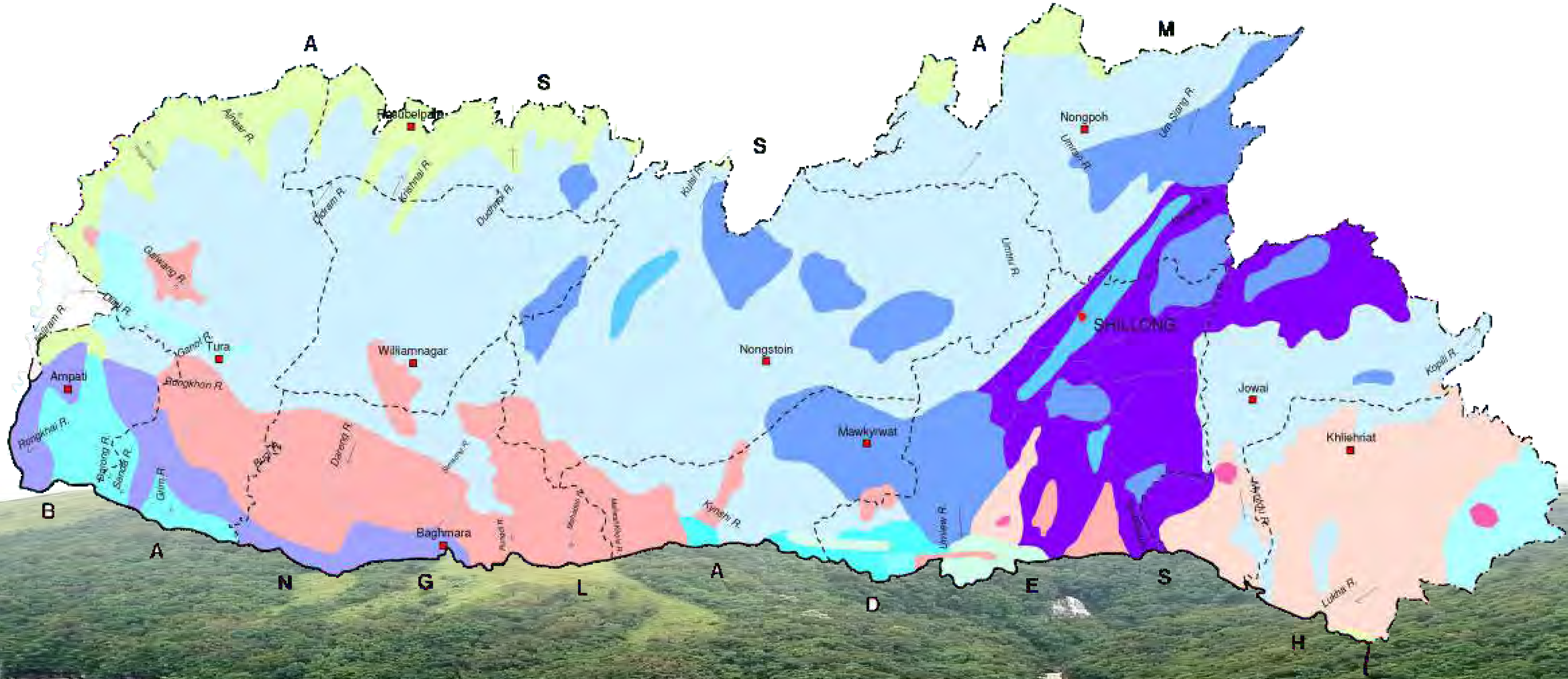
AQUIFER SYSTEMS
OF
MEGHALAYA



Compiled Under the Supervision of

Dr. S. C. Dhiman
Chairman

Govt. of India
Ministry of Water Resources
Central Ground Water Board
North Eastern Region, Guwahati

Compiled under the guidance of

Dr. S.C. Dhiman,
Chairman,
Central Ground Water Board

<u>Team Leader</u>

Utpal Gogoi, Suptd. Hydrogeologist, Central Ground Water Board, NER, Guwahati

<u>Principal Contributors</u>

Anu Radha Bhatia, Scientist 'C', Central Ground Water Board, SUO, Shillong
Dakhina Rabha, Scientist 'B', Central Ground Water Board, NER, Guwahati
J.K.Tondon, Draftsman, Central Ground Water Board, CHQ, Faridabad

<u>Contributors</u>

Sunil Kumar Suptd. Hydrogeologist, Cehntral Ground Water Board, NHR, Dharamshala
S.K. Sinha, Scientist 'D', Central Ground Water Board, CHQ, Faridabad
Dr Arijit Dey, Scientist 'D' & OSD to Hon'ble Minister of State, Ministry of Water Resources, Government of India, New Delhi
K.V.Kumar, Scientist 'D', Central Ground Water Board, CHQ, Faridabad
Biplab Ray, Scientist 'C', Central Ground Water Board, SUO, Shillong
Dr. M.A. Farooqui, Scientist 'B', Central Ground Water Board, SUO, Shillong
Vekhosa Kezo, Scientist 'C', Central Ground Water Board, SUO, Shillong
Gargee M.B. Sharma, Asstt. Hydrogeologist, Central Ground Water Board, CHQ, Faridabad
Sangita Bhattacharjee, Asstt. Hydrogeologist, Central Ground Water Board, SR, Bangalore
R. Dasgupta, Draftsman, Central Ground Water Board, SUO, Shillong
Hitendra Verma, Draftsman, Central Ground Water Board, CHQ, Faridabad
Nilesh Dhokia, Draftsman, Central Ground Water Board, CHQ, Faridabad

AQUIFER SYSTEMS
OF
MEGHALAYA

Compiled Under the Supervision of

Dr. S. C. Dhiman
Chairman

Govt. of India
Ministry of Water Resources
Central Ground Water Board
North Eastern Region, Guwahati

ध्रुव विजय सिंह
DHRUV VIJAI SINGH

सत्यमेव जयते

सचिव
भारत सरकार
जल संसाधन मंत्रालय
श्रम शक्ति भवन
रफी मार्ग, नई दिल्ली-110 001

SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
SHRAM SHAKTI BHAWAN
RAFI MARG, NEW DELHI-110 001

13TH September 2012

MESSAGE

Ground water utilization has increased significantly during the last two decades. The unplanned and indiscriminate use of this vital resource has resulted in declining water levels and water quality deterioration in certain areas. The apparent stress on ground water resources is more often a management issue, and this needs to be addressed in a holistic manner, for its long term sustainability, through an integrated approach. Aquifer mapping is an essential step towards the effective management of ground water resources.

The atlas entitled **"Aquifer Systems of Meghalaya"** is a step towards achieving the ultimate goal of aquifer wise management of ground water resources in Meghalaya State.

I congratulate Central Ground Water Board, Ministry of Water Resources for its efforts to bring out this document containing data and information pertaining to various aspects of ground water including aquifer disposition in the State. I am sure this atlas will be of immense use to planners, policy makers, researchers and users involved in ground water sector.

(Dhruv Vijai Singh)

डॉ. एस. सी. धीमान
Dr. S. C. Dhiman

अध्यक्ष
भारत सरकार
केन्द्रीय भूमि जल बोर्ड
जल संसाधन मंत्रालय
भूजल भवन एन.एच. 4 फरीदाबाद

Chairman
Government of India
Central Ground Water Board
Ministry of Water Resources
Bhujal Bhawan, NH-IV, Faridabad

Foreword

Availability of fresh water has always been a prime consideration in fostering the socio economic growth of the people. Rapid urbanization coupled with industrialization has resulted in increased demand of ground water at an alarming rate. Dependence on ground water is increasing continuously in order to supplement the domestic, agricultural and industrial requirements. In the last two decades there is a paradigm from development to management of Ground Water. The management of ground water is to be focussed on aquifers, which act as the repository of ground water.

To meet these challenges, it has become imperative to formulate aquifer management plan to establish the priorities for ground water use with community involvement at various levels of implementation. Central Ground Water Board over the years has generated enormous data on various aspects of ground water and has been utilised to prepare aquifer maps depicting their extent and characteristics and are compiled in the form of Atlas on "Aquifer Systems of Meghalaya".

This will provide a framework for prioritizing the aquifer level management strategies and build inventory of the aquifers for better understanding of the groundwater resources. An attempt has been made to present various aquifer systems in the form of maps by integrating all thematic information to formulate the aquifer wise ground water management plans.

The sincere efforts of the dedicated team of officers of Central Ground Water Board, North Eastern Region, Guwahati is highly appreciated. I am sure this atlas would be of immense use in formulating scientifically viable implementable strategies for efficient management of ground water resources ensuring sustainability.

(Dr. S.C. Dhiman)

Ph. 0129-2419075 Fax 0129-2412524 E-mail chmn-cgwb@nic.in

Preamble

Meghalaya is a hilly forested State in the north eastern part of India. Previously, a part of Assam, Meghalaya came into existence as an independent state on 21st January, 1972. The state covers an area of 22,429 sq.km. It is surrounded in the northwest, north, east and southeast by the state of Assam and to the south and southwest by Bangladesh. The hilly State is thinly populated with Schedule Tribes Khasi, Garo, Hajong, Pnar, Jaintia, War and Bhoi, forming a major chunk (86%) of the State's populace. The State presents a picturesque landscape of hills, plateau, ravines, rivulets, lakes, waterfalls and escarpments as well as the magnificent gorges exceeding 600 m. in depth. Shillong, the capital of the state also known as the “Scotland of the East” is located at an elevation of 1496 m. above mean sea level, in the central part of the East Khasi Hills district. The Shillong peak has the highest elevation in the State at 1965 m above mean sea level.

One of the world's wettest regions is found in Meghalaya. Mawsynram and Cherrapunji (Sohra) in the East Khasi Hills district are geographically considered as the rainiest places in the World. — Cherrapunji, which has an average annual precipitation of about 11,430 mm (450 inches) during monsoon season (from May to September) and Mawsynram, a village directly west of Cherrapunji, where rainfall of around 17,800 mm (700 inches) per year has been recorded. The area receives rainfall on an average for 160 days in a year, spread over 6 to 8 months from March to October.

Physiographically, Meghalaya represents a remanant of an ancient plateau of Pre-Cambrian Peninsular shield, block lifted to its present height and is referred as Meghalaya Plateau or as Shillong-Mikir massif. It is the detached northeastern extension of Indian Peninsular shield, part of which lies beneath the alluvium deposited by Ganga Brahmaputra system of rivers. The rivers of the State are rainfed and therefore their discharge dwindles during summer. Important rivers in Garo Hills region are Daring, Sanda, Bugi, Dareng and Simsang. In the central and eastern part of the plateau are Umkhri, Digaru, Umngot and Myntdu rivers. The surface water resource is tapped in a number of places by constructing dams across the rivers. The reservoirs, like the Umium and Kopili, so developed are not only used for irrigation and drinking water but also for generating electricity. Inspite of this, the area experiences shortage of water during the summer resulting in crisis for drinking water. This is mainly due to topographical and geomorphological conditions apart from alterations of the natural land surface by way of development, mining and urbanization. Moreover, the characteristic hilly and steep sloping terrain condition in the area with localized small valleys results in very high surface run-off during the monsoon.

Geologically, the State is occupied by unconsolidated, semi-consolidated and consolidated rock formations, ranging in age from Archaean to Recent. Hydrogeological units occurring in this hilly state of Meghalaya are heterogeneous and complex in nature. The rugged topography and lateral variation of geological horizons over short distance makes it difficult to select sites for construction of productive boreholes. The zones are not uniform in characteristics as the aquifer material, fracture density and distribution, and hydrogeological characteristics vary widely over short distances. Consequently, their water yielding capabilities vary considerably. The consolidated formations comprises the Archaean Gneissic Complex, acid and basic intrusives, quartzite and phyllite of Shillong Group of rocks, carbonate and non-carbonate sedimentary rocks. These rocks possess negligible primary porosity and the movement and occurrence of ground water is controlled by the nature of the aquifer material and the secondary porosity created by weathering and fractures. Groundwater occurs under unconfined condition in the weathered residuum and semi-confined conditions especially in the fractured rocks. In hard rock terrain, selection of site with the highest potential on the basis of geomorphology, relative relief, gentle gradient, thick top weathered mantle, fractured zone, solution cavities (in carbonate rocks), occurrence and location of intruded dykes for getting a productive borehole is a necessity and reduces chances of striking a dry hole. The unconsolidated alluvial formations and the semi-consolidated sedimentary (Tertiary) formations in the western fringes of Garo hills have the most productive aquifers of the state. The semi-consolidated formations are chiefly composed of sandstones, siltstone and shale inter bedded with the coal seams and limestones. The sedimentary deposits belonging to Gondwana and tertiary formations are also included under this category. The aquifers are formed by rock strata that are granular/porous, fissured/fractured or cavernous and groundwater occurs under confined, unconfined or perched conditions. Under favourable situations, these sedimentaries give rise to artesian conditions. The sandstones form potential aquifers locally. Ground water is found to occur under confined to unconfined aquifer conditions within 300m. In Meghalaya, ground water is generally extracted through dugwells and springs (or seepage wells in valley areas/topographic depressions) and bore wells. Apart from this, tubewells are in use in West Garo Hills district. Dugwells are generally shallow in depth varying from a meter to 6 mbgl. Bore wells are drilled up to 200 m bgl.

However, the majority of them are shallow and range from 40 to 80 m bgl. The exploration in Meghalaya was initiated for the first time in 1977 and till March 2012, about 90 numbers of exploratory wells have been drilled in Meghalaya. Down the Hole Hammer (DTH) rigs are employed in the consolidated formations of East /West Khasi, Ri-Bhoi and Jaintia Hills districts and Rotary drilling rigs are used in the unconsolidated and semi-consolidated formations of Garo hills. Though the targeted depth is 250m bgl, but in certain sites the total depth drilled is reduced due to miscellaneous constraints like encountering basement-rock, borehole caving, wear and tear of the rig etc.

The annual gross dynamic ground water recharge of Meghalaya has been estimated as 1.234 billion cubic meter (BCM). Annual allocation for domestic & industrial water requirement upto year 2025 is estimated as 0.096 BCM as per census 2001. 1.014 BCM of ground water potential may be utilized for irrigation. The level of ground water development in the state is 0.15%.

Meghalaya's economy is primarily agricultural engaging around 80 per cent of its total work force. The main agri-horticultural products of the State are rice, jute, potato, orange and other citrus fruits, bay leaf, betel, banana, plum, pears and pineapple. Meghalaya is mostly dependent on rain and surface water resources for irrigation purposes. Surface water is abundant but limited during non-rainy season.

The importance and contribution of ground water is felt in the recent years to cope up with development and scarcity situations, particularly to meet the drinking water needs. Of course, the physiography of the rugged terrain restricts development of groundwater, but areas with low gradients and valley areas are favourable areas for groundwater development. Construction of groundwater abstraction structures should be promoted in needy areas, especially areas which face scarcity of water during summer. Unutilised springs should be developed scientifically for providing safe drinking water. Also, conjunctive use of surface and ground water, as well as rain water harvesting should be encouraged in the State as this entails the planned and coordinated harnessing of ground and surface water resources to achieve optimal utilization of total resources of the State.

Springs play a major role of water requirement for the people in rural areas. The dependency of spring water for domestic and other purposes is worth mentioning. It is found that the location of the spring is mainly restricted to foothills and intermontane valleys. The spring water is of excellent quality and is suitable for drinking purposes as per BIS standard. As the people in rural areas are totally dependent on spring, there is an urgent need for scientific approach for proper development and management of this precious resource.

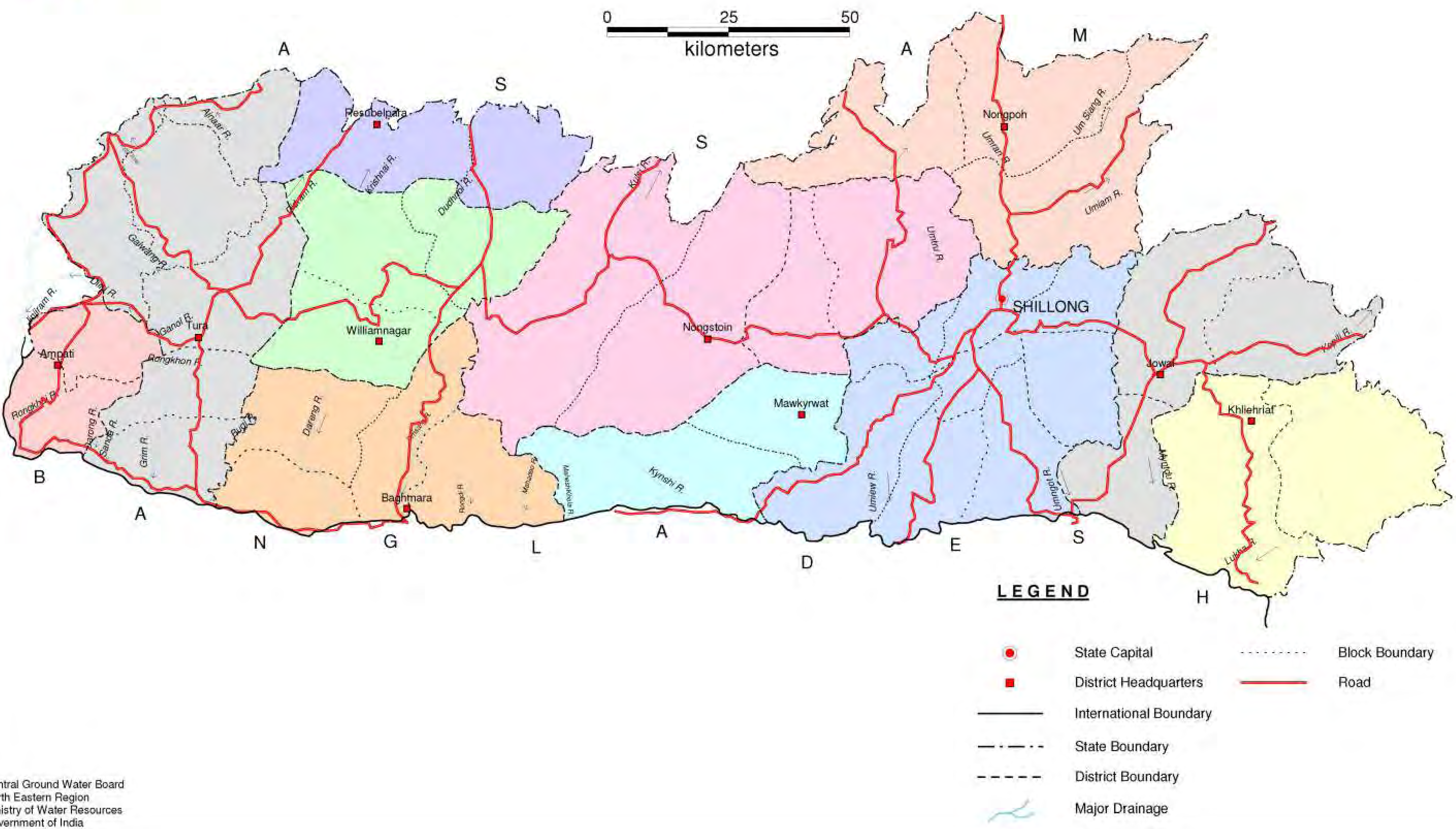
Groundwater is the largest accessible and yet underdeveloped resource in Meghalaya. The regional water shortages and water crises can only be met with a rational and sustainable use of this untapped freshwater reservoir. Such sustainable use requires understanding and knowledge as well as careful planning and management. Yet, information on this hidden resource is still weak in many places. Greater knowledge and the improvement of basic data through research are prerequisites for better management of groundwater systems.

Conservation & Rain Water Harvesting and management of springs is the key to protect the ground water resources of the State. There is a need to adopt traditional wisdom along with innovative techniques developed by CGWB for construction of conservation structures, implementation of efficient irrigation practices, maintenance of existing /springs, benching and terracing of hill slopes through public participation.

The objective of preparation of this document is to define the extent of principal and major aquifer systems of the State with their characterization on regional scale and depict aquifer wise ground water scenario along with major issues and challenges which need immediate attention for sustainable management of ground water resources. Further, creating a baseline data in GIS platform for initiating National Aquifer Mapping Programme and demarcating priority areas for aquifer wise management of ground water resources on scientific and sustainable basis. An attempt has been made to prioritize areas based on the sustainability and quality related ground water issues and presented in the atlas. Various ground water management strategies have also been suggested.

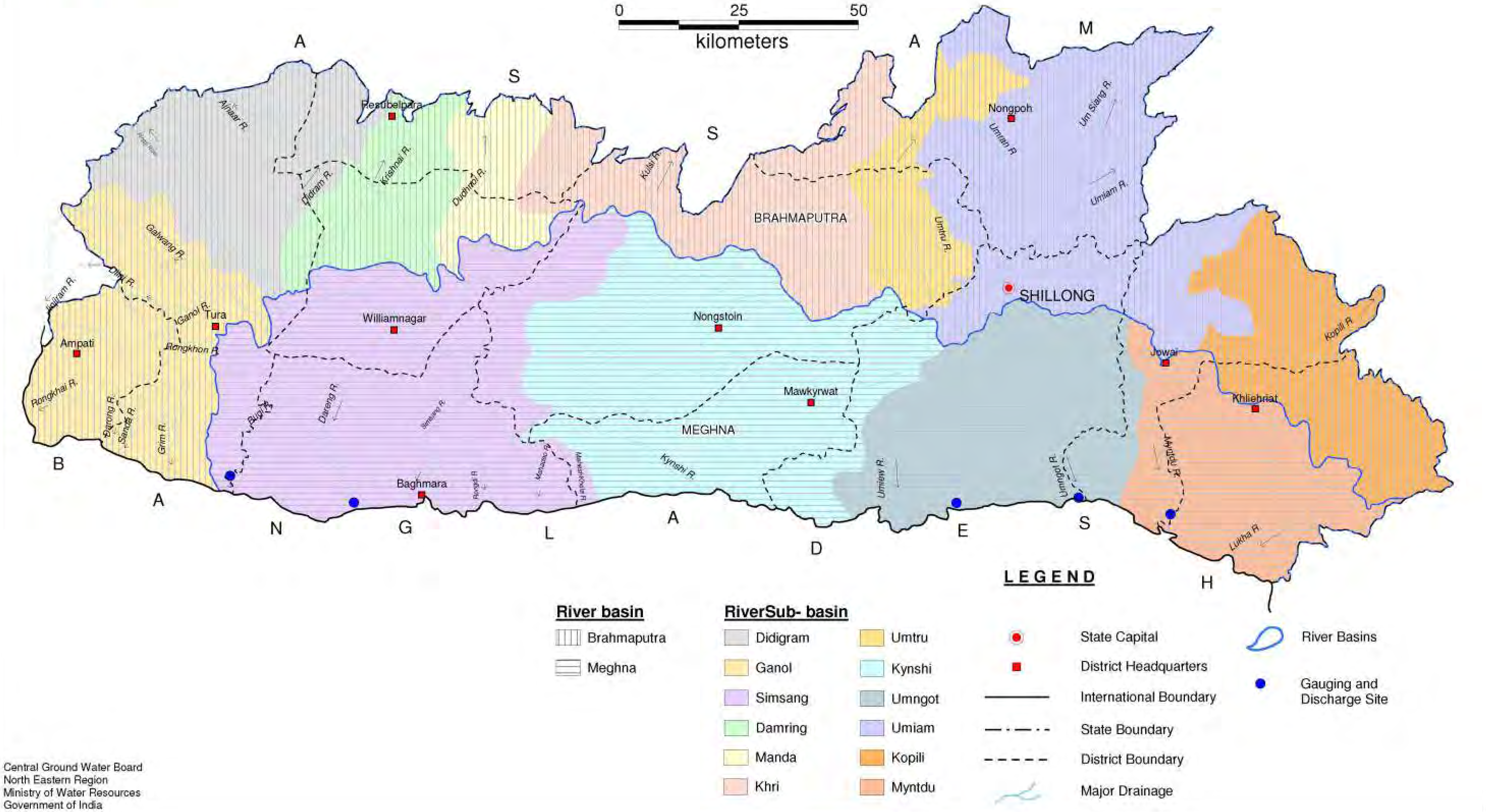
Th Atlas, “Aquifer Systems of Meghalaya”, has been prepared keeping in view that the information is of utility to all stakeholders -water experts as well as decision makers and the general public Simple presentation of maps and tables is used to explain aquifer wise ground water scenario in the State. Attempt has been made to represent the correlations of various thematic layers such as climate, topographic, and geologic setting on the occurrence, movement and quality of ground water. Water is a scarce and precious national resource to be planned, developed and conserved on an integrated and environmentally sound basis.

ADMINISTRATIVE DIVISIONS



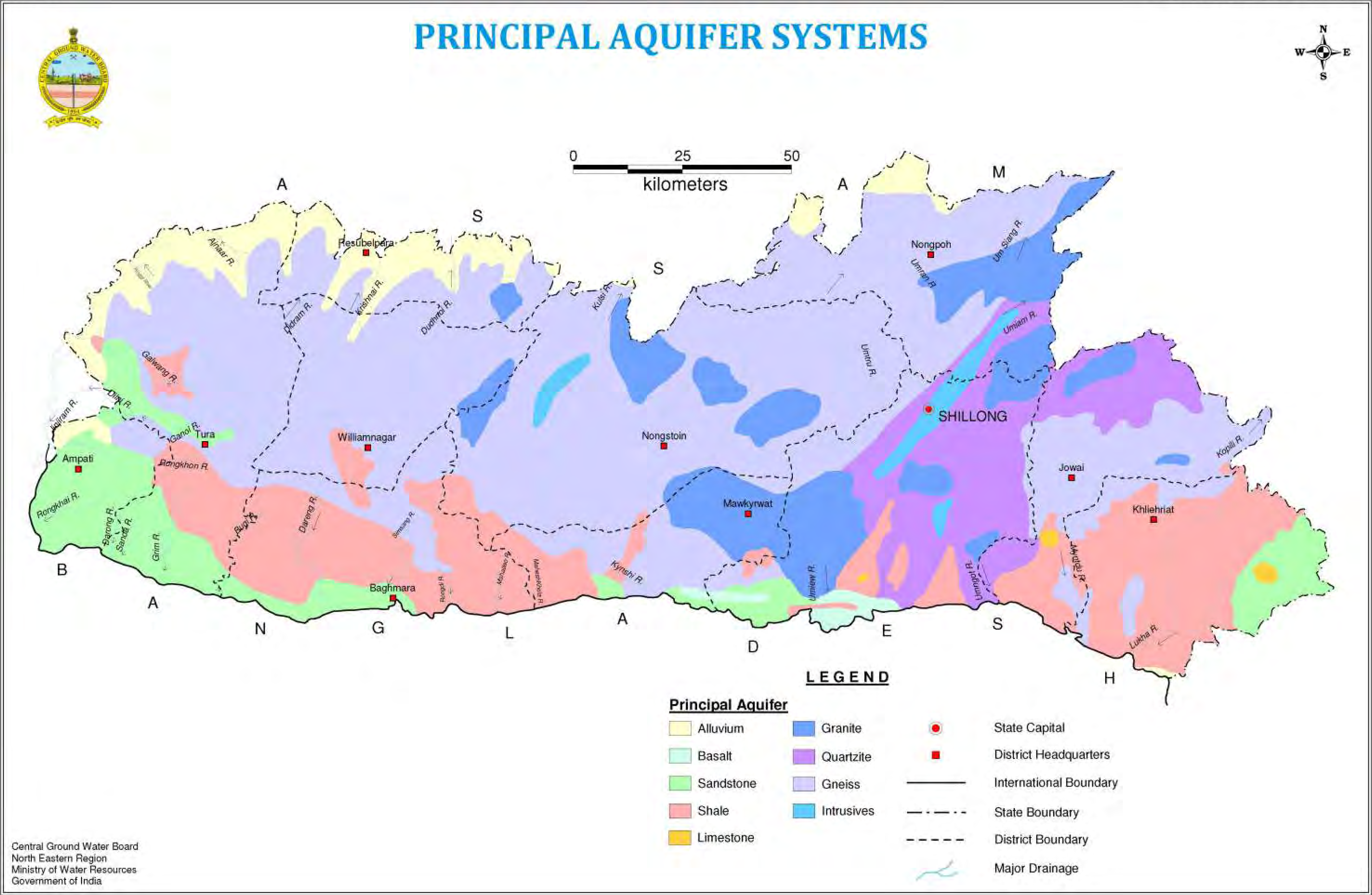
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

RIVER BASINS

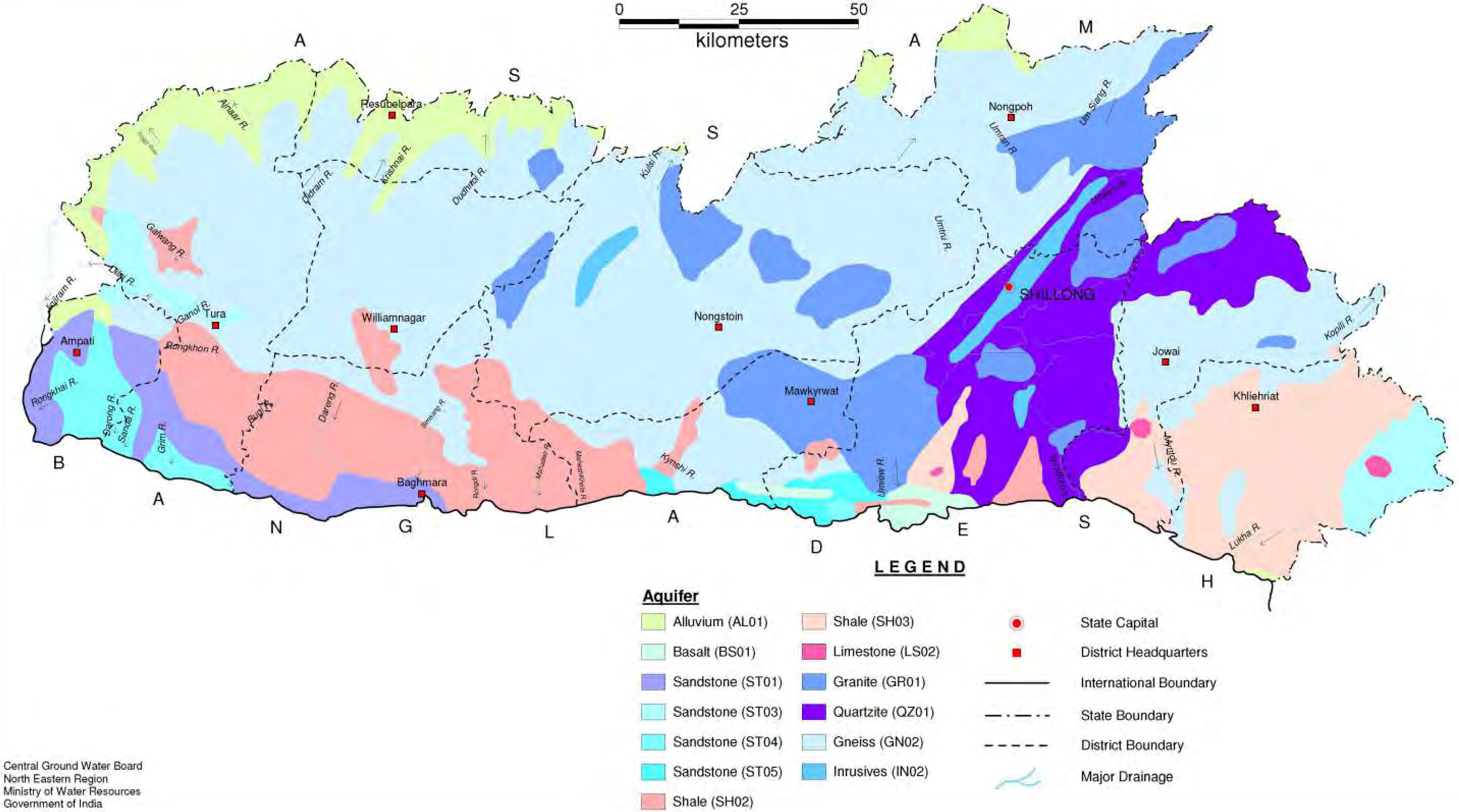


Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

PRINCIPAL AQUIFER SYSTEMS

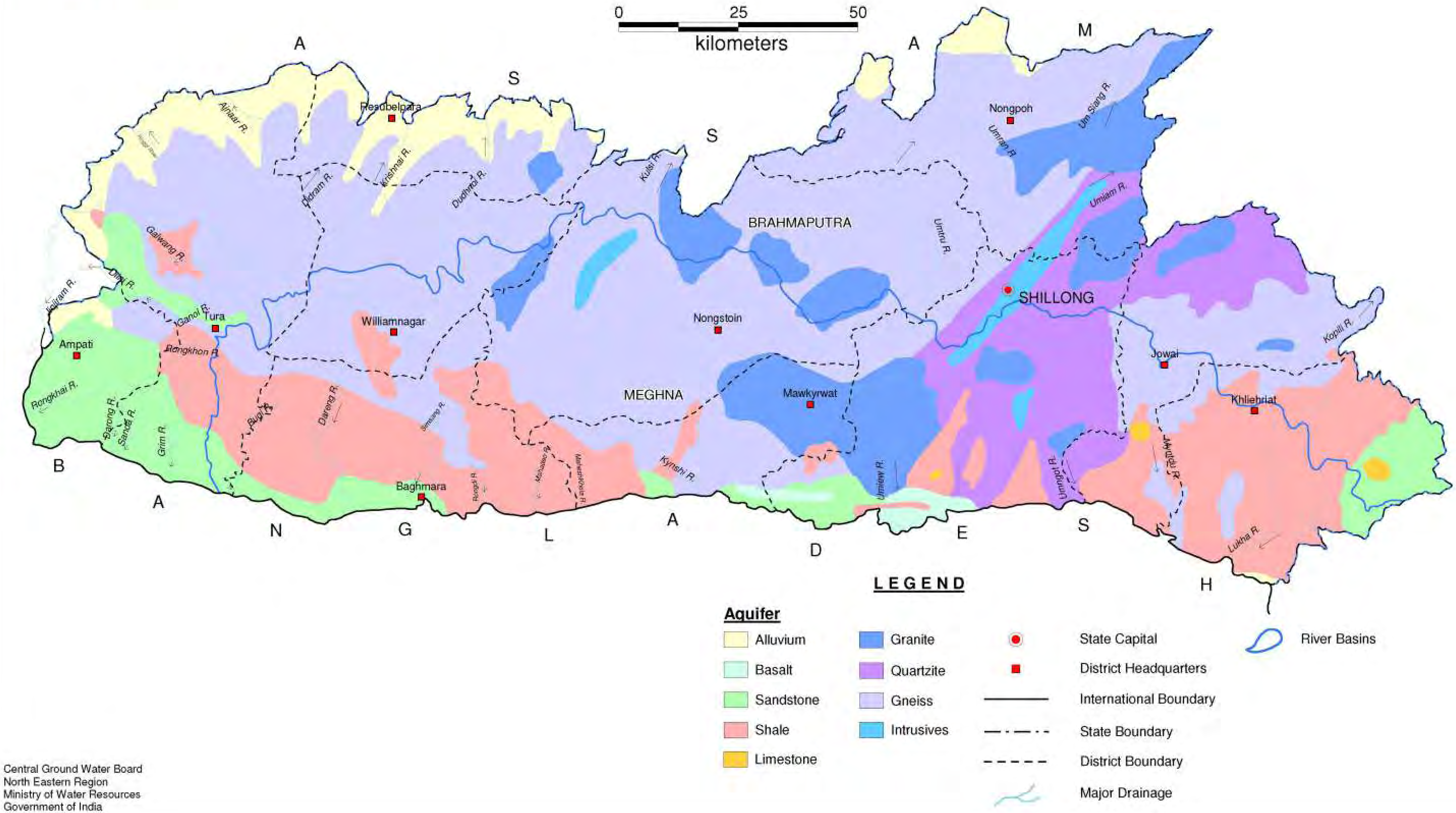


MAJOR AQUIFER SYSTEMS



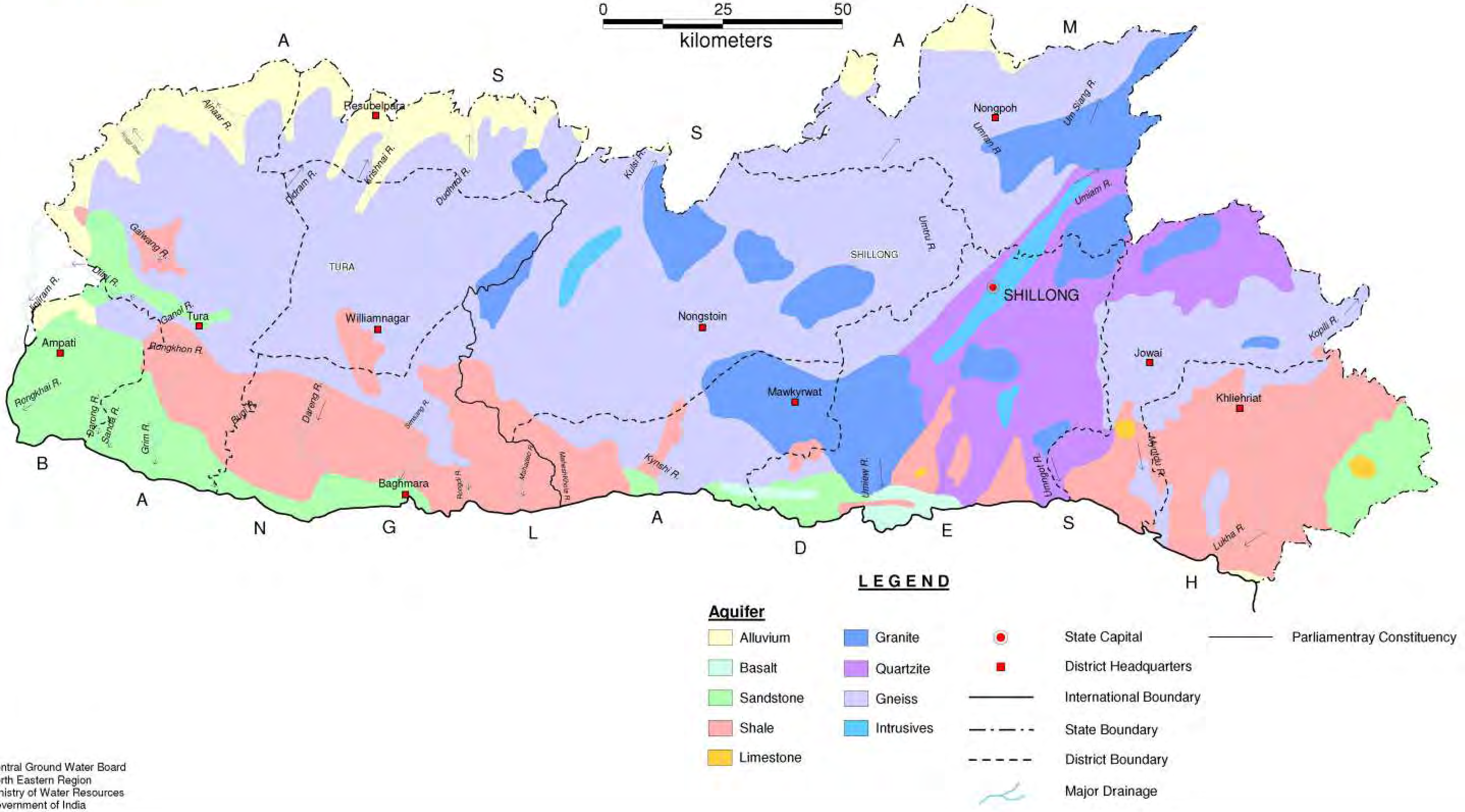
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

AQUIFERS - RIVER BASINWISE



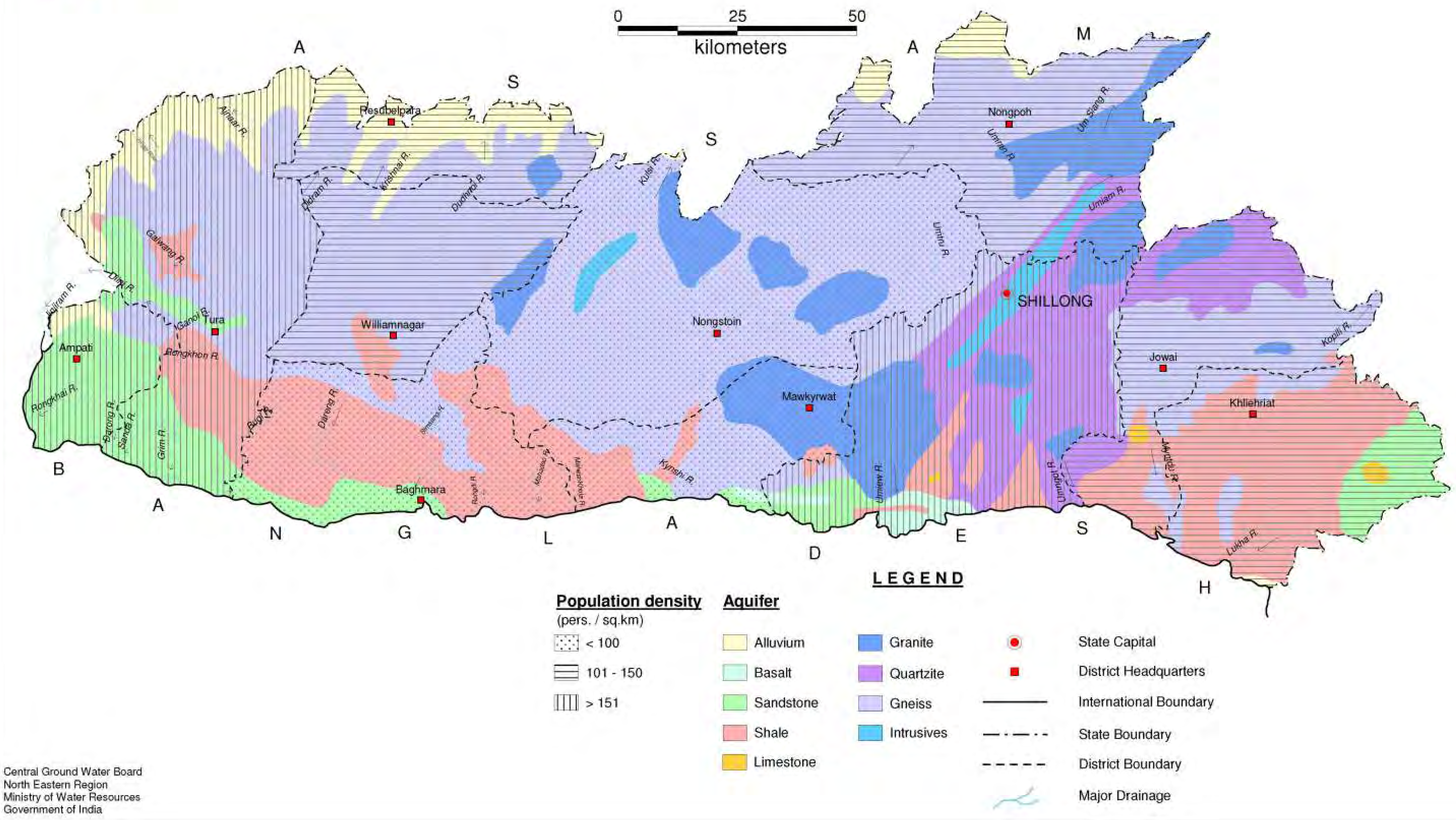
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

PARLIAMENTARY CONSTITUENCIES



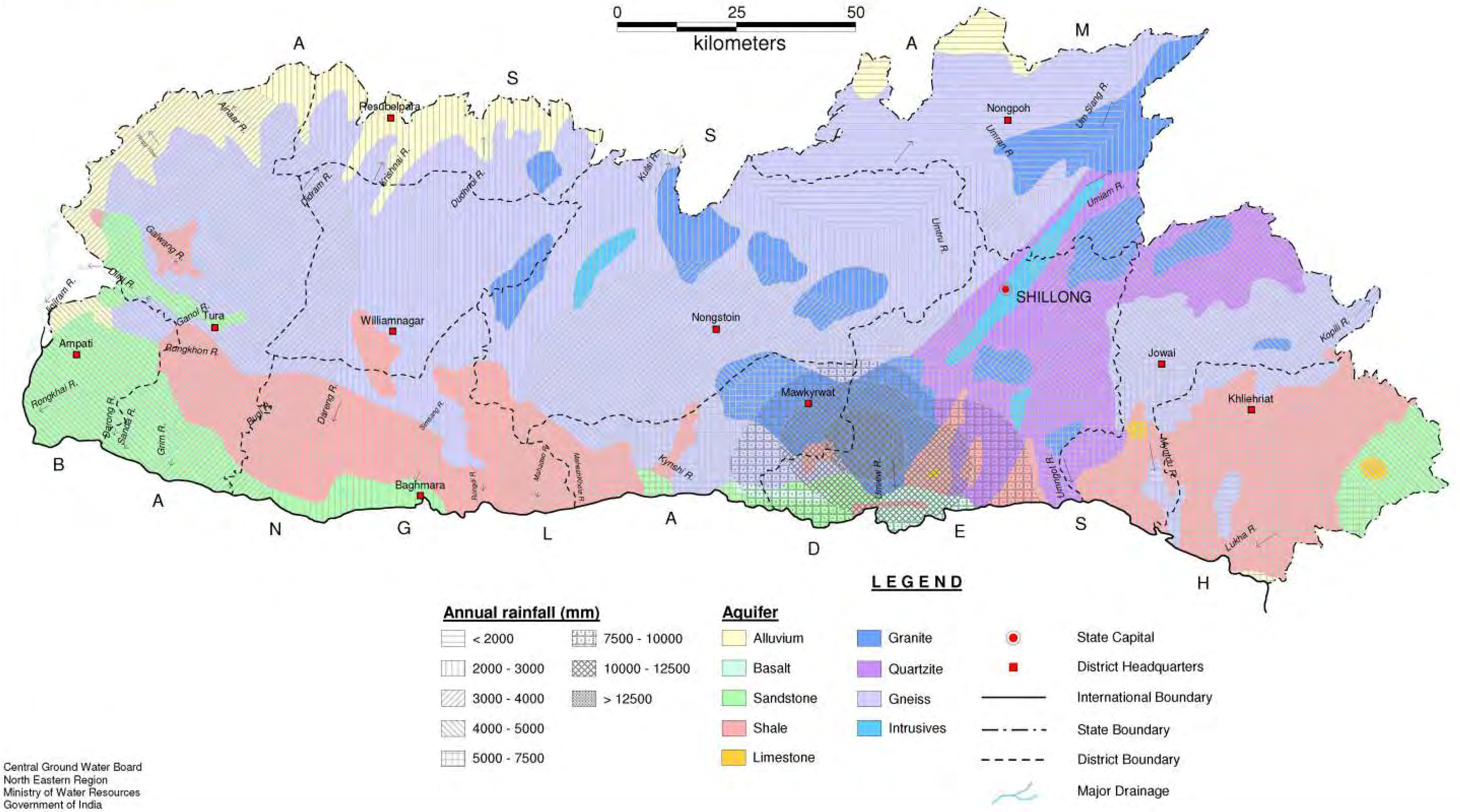
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

POPULATION DENSITY



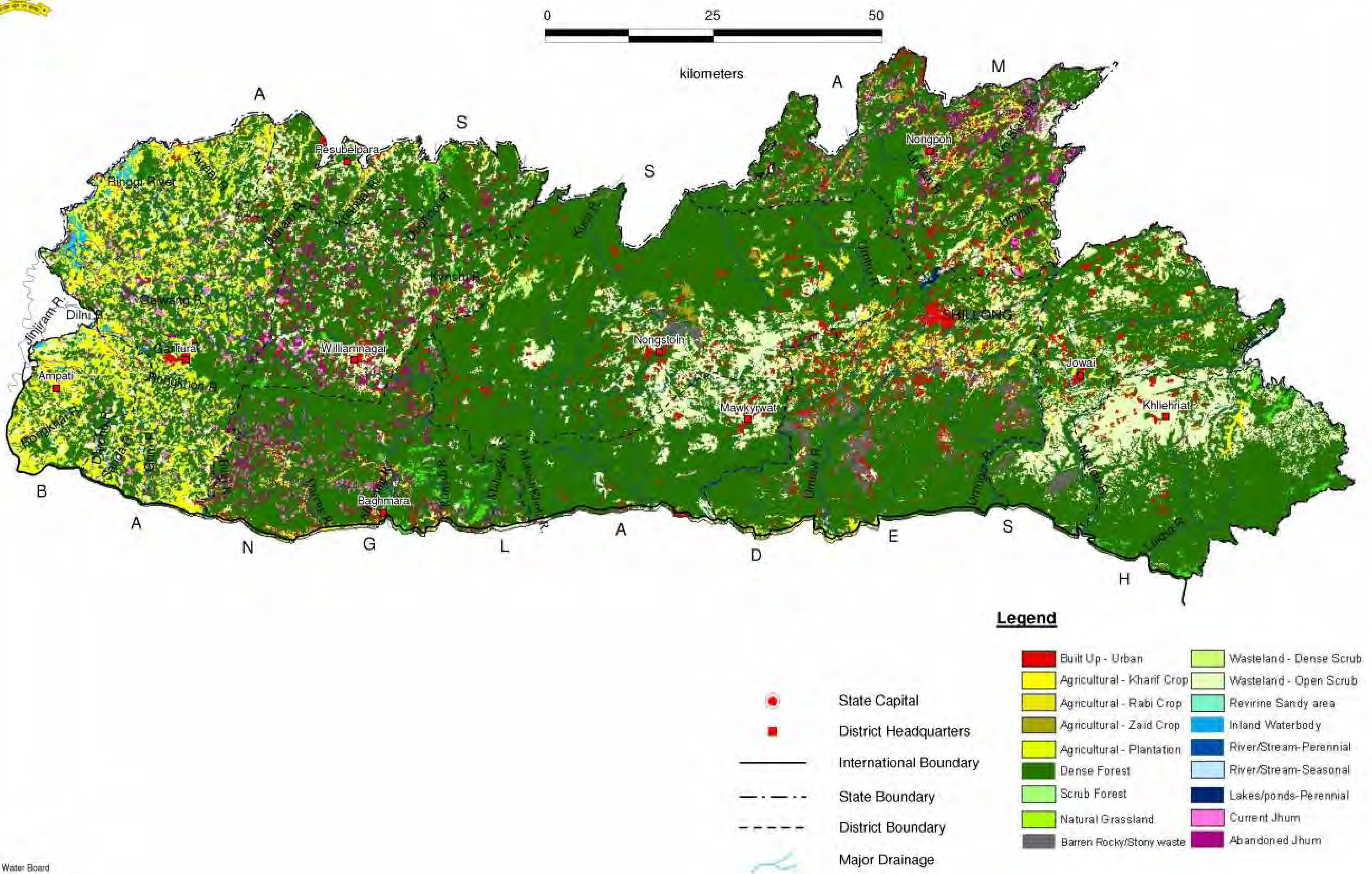
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

ANNUAL RAINFALL DISTRIBUTION



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

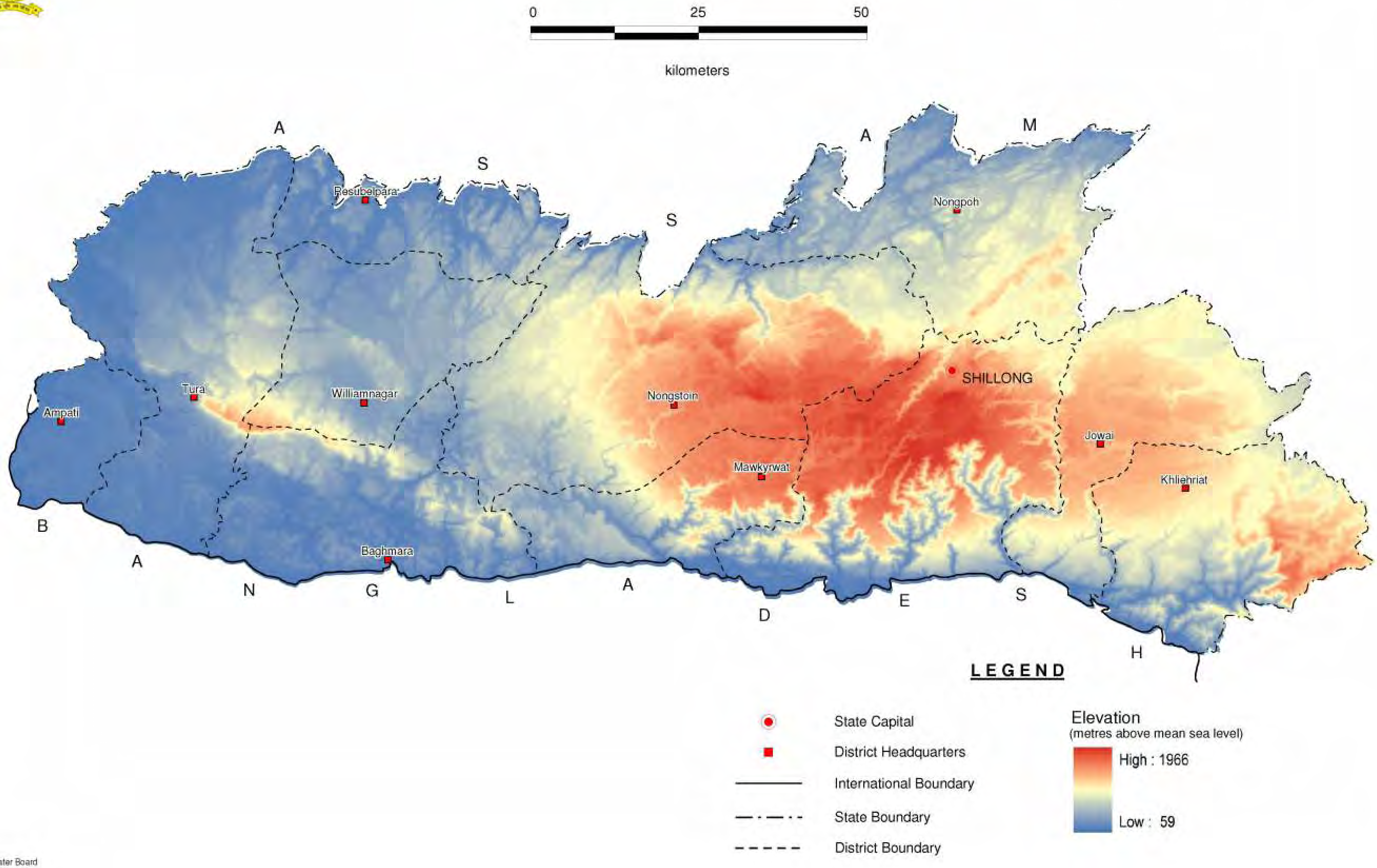
LAND USE LAND COVER



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

(Based on IRS P6L3 imagery of 2005-06, Papared by North Eastern Space Application Centre, DOS, Umiam, Meghalaya)

DIGITAL ELEVATION MODEL

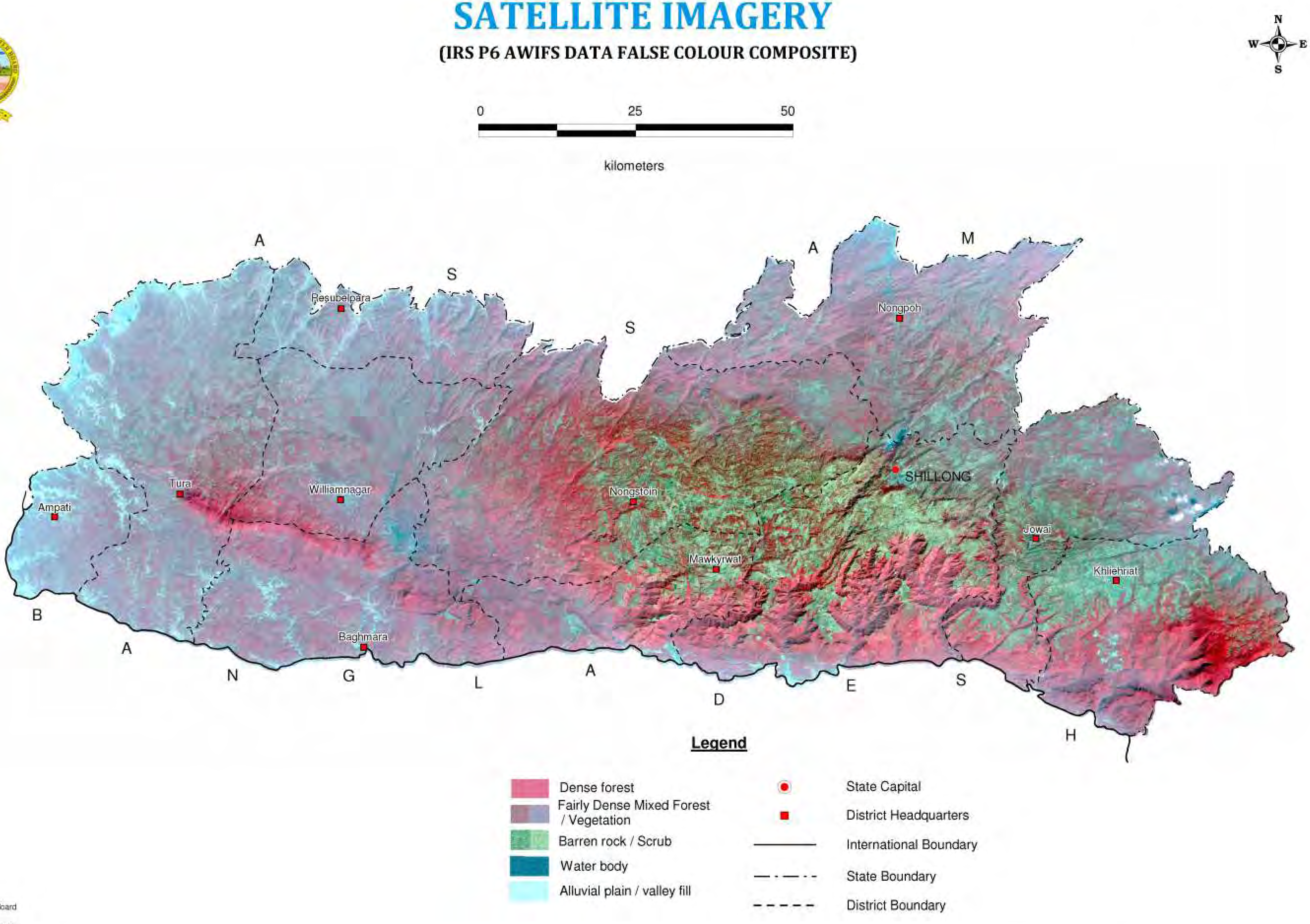


Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

Courtesy: North Eastern Space Application Centre, DOS, Umiam, Meghalaya, ASTER data)

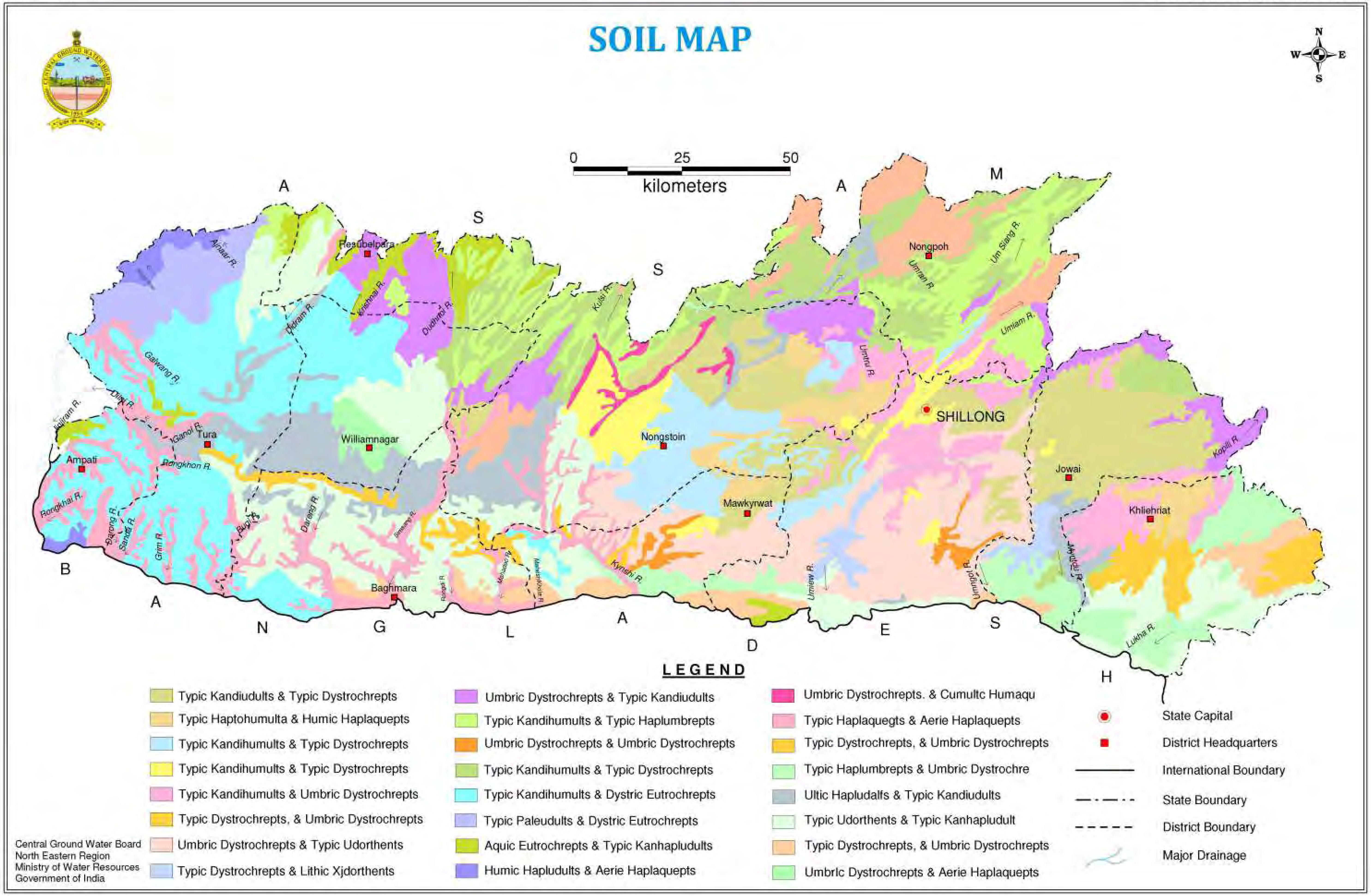
SATELLITE IMAGERY

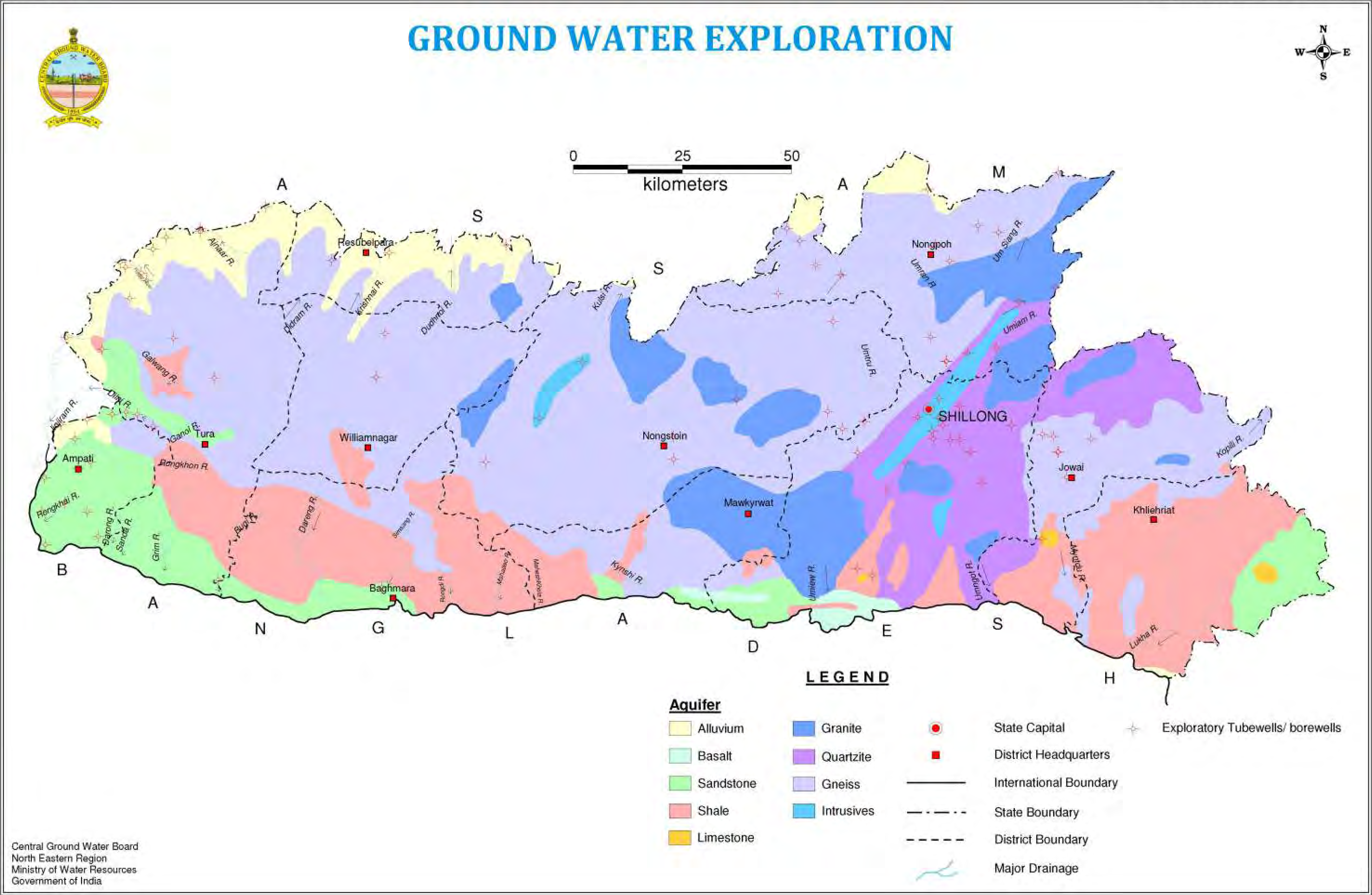
(IRS P6 AWIFS DATA FALSE COLOUR COMPOSITE)



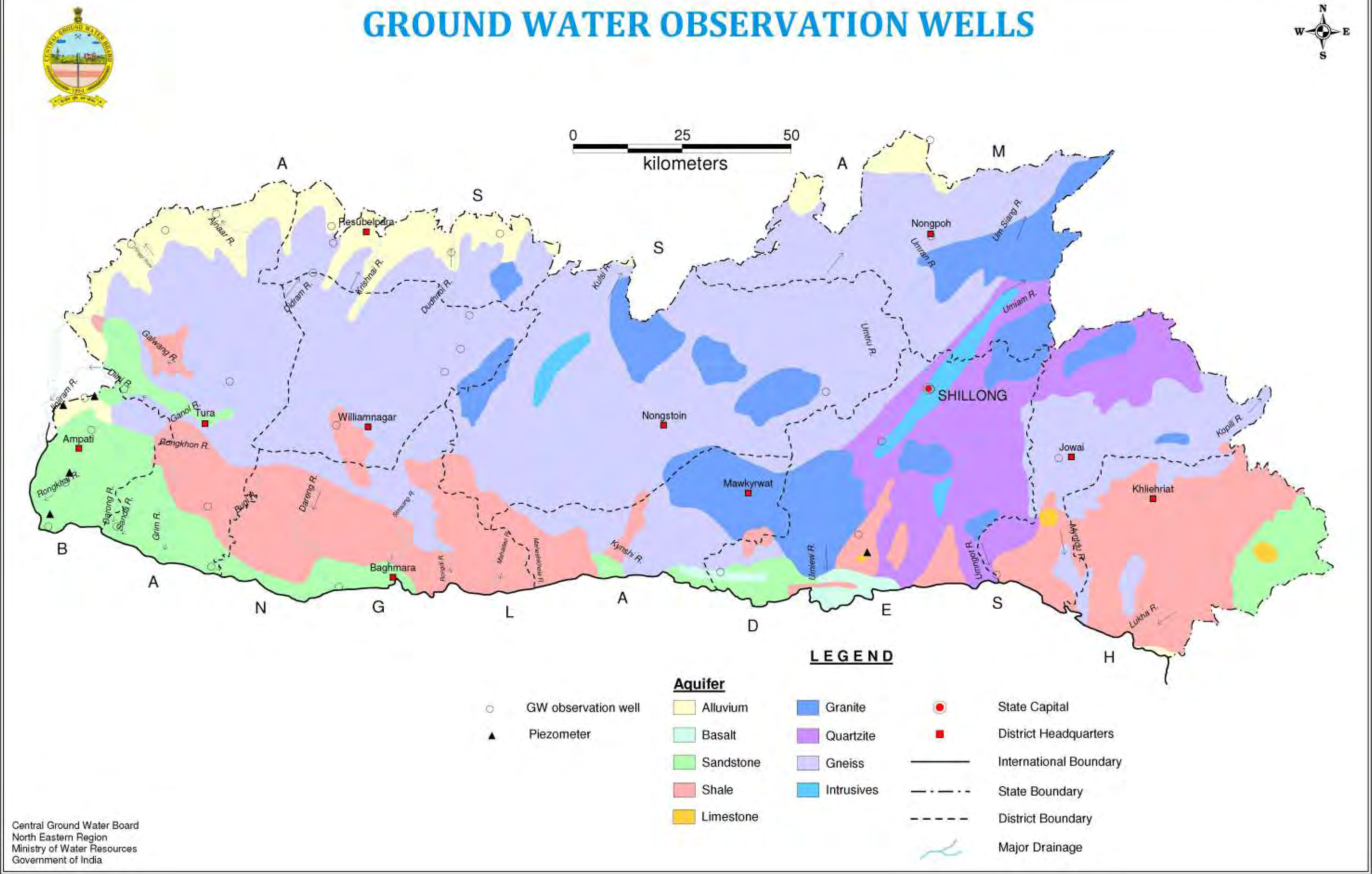
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

Courtesy: North Eastern Space Application Centre, DOS, Umiam, Meghalaya)


SOIL MAP
N
W
E
S
0
25
50
kilometers
A
S
S
A
M
B
A
N
G
L
A
D
E
S
H
Resubelpara
Nongpoh
SHILLONG
Williamnagar
Tura
Ampati
Nongstoin
Mawkyrwat
Jowai
Khliehriat
Baghmara
Ganol R.
Rongkhon R.
Rongkhai R.
Galwang R.
Kulsi R.
Umiam R.
Um Siang R.
Umtru R.
Kopili R.
Kynshi R.
Umiew R.
Umngot R.
Myntdu R.
Lukha R.
Bugi R.
Darang R.
Simsang R.
Dudhnoi R.
Krishnai R.
Didram R.
Ajnaar R.
Jinjiram R.
Dinai R.
Darong R.
Sanda R.
Gnim R.
Umram R.
LEGEND
Typic Kandiudults & Typic Dystrochrepts
Typic Haptohumulta & Humic Haplaquepts
Typic Kandihumults & Typic Dystrochrepts
Typic Kandihumults & Typic Dystrochrepts
Typic Kandihumults & Umbric Dystrochrepts
Typic Dystrochrepts, & Umbric Dystrochrepts
Umbric Dystrochrepts & Typic Udorthents
Typic Dystrochrepts & Lithic Xjdorthents
Umbric Dystrochrepts & Typic Kandiudults
Typic Kandihumults & Typic Haplumbrepts
Umbric Dystrochrepts & Umbric Dystrochrepts
Typic Kandihumults & Typic Dystrochrepts
Typic Kandihumults & Dystric Eutrochrepts
Typic Paleudults & Dystric Eutrochrepts
Aquic Eutrochrepts & Typic Kanhapludults
Humic Hapludults & Aerie Haplaquepts
Umbric Dystrochrepts. & Cumultc Humaqu
Typic Haplaquegts & Aerie Haplaquepts
Typic Dystrochrepts, & Umbric Dystrochrepts
Typic Haplumbrepts & Umbric Dystrochre
Ultic Hapludalfs & Typic Kandiudults
Typic Udorthents & Typic Kanhapludult
Typic Dystrochrepts, & Umbric Dystrochrepts
Umbrlc Dystrochrepts & Aerie Haplaquepts
State Capital
District Headquarters
International Boundary
State Boundary
District Boundary
Major Drainage
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India


GROUND WATER EXPLORATION
N
W
E
S
0
25
50
kilometers
A
S
S
A
M
B
A
N
G
L
A
D
E
S
H
Resubelpara
Nongpoh
Williamnagar
Tura
Ampati
Nongstoin
Mawkyrwat
SHILLONG
Jowai
Khliehriat
Baghmara
Ajnaar R.
Krishnai R.
Didram R.
Dudhnoi R.
Kulsi R.
Umtru R.
Umran R.
Um Siang R.
Umiam R.
Galwang R.
Dilni R.
Jinjiram R.
Ganol R.
Rongkhon R.
Rongkhai R.
Darong R.
Sanda R.
Grim R.
Bugi R.
Dareng R.
Simsang R.
Kynshi R.
Umiew R.
Umngot R.
Myntdu R.
Lukha R.
Kopili R.
LEGEND
Aquifer
Alluvium
Basalt
Sandstone
Shale
Limestone
Granite
Quartzite
Gneiss
Intrusives
State Capital
District Headquarters
International Boundary
State Boundary
District Boundary
Major Drainage
Exploratory Tubewells/ borewells
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

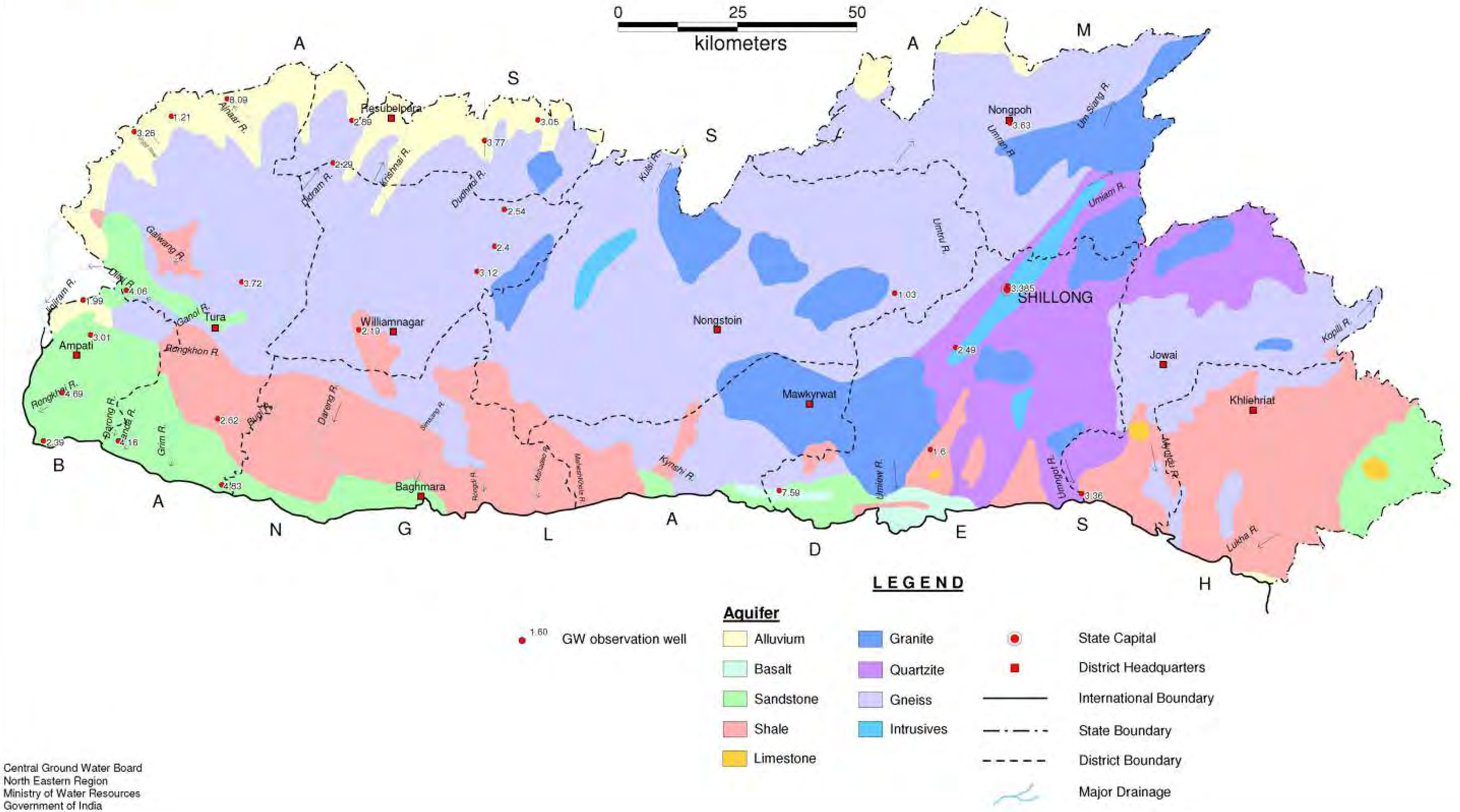
GROUND WATER OBSERVATION WELLS



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

DEPTH TO WATER LEVEL

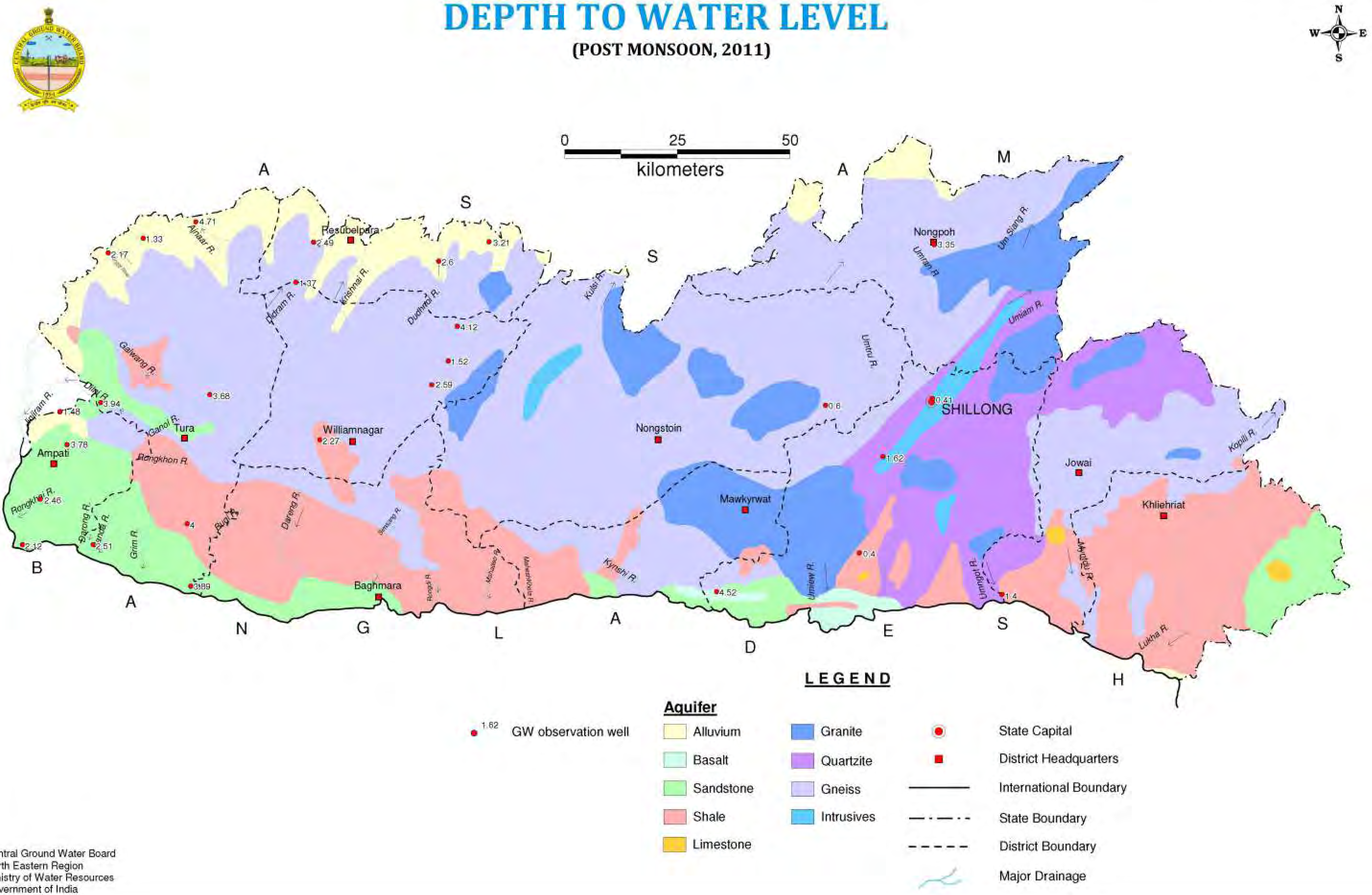
(PRE MONSOON, 2011)



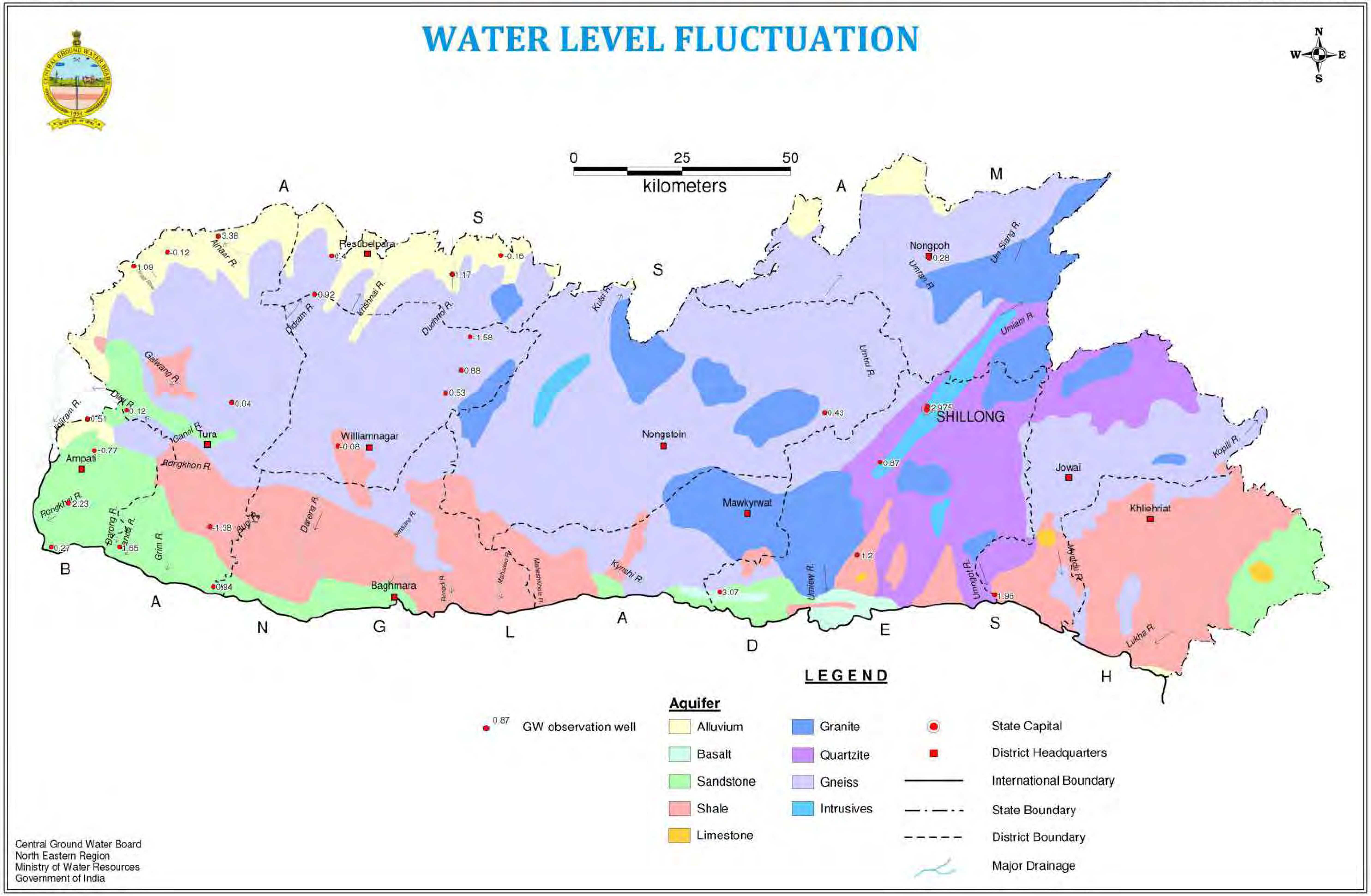
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

DEPTH TO WATER LEVEL

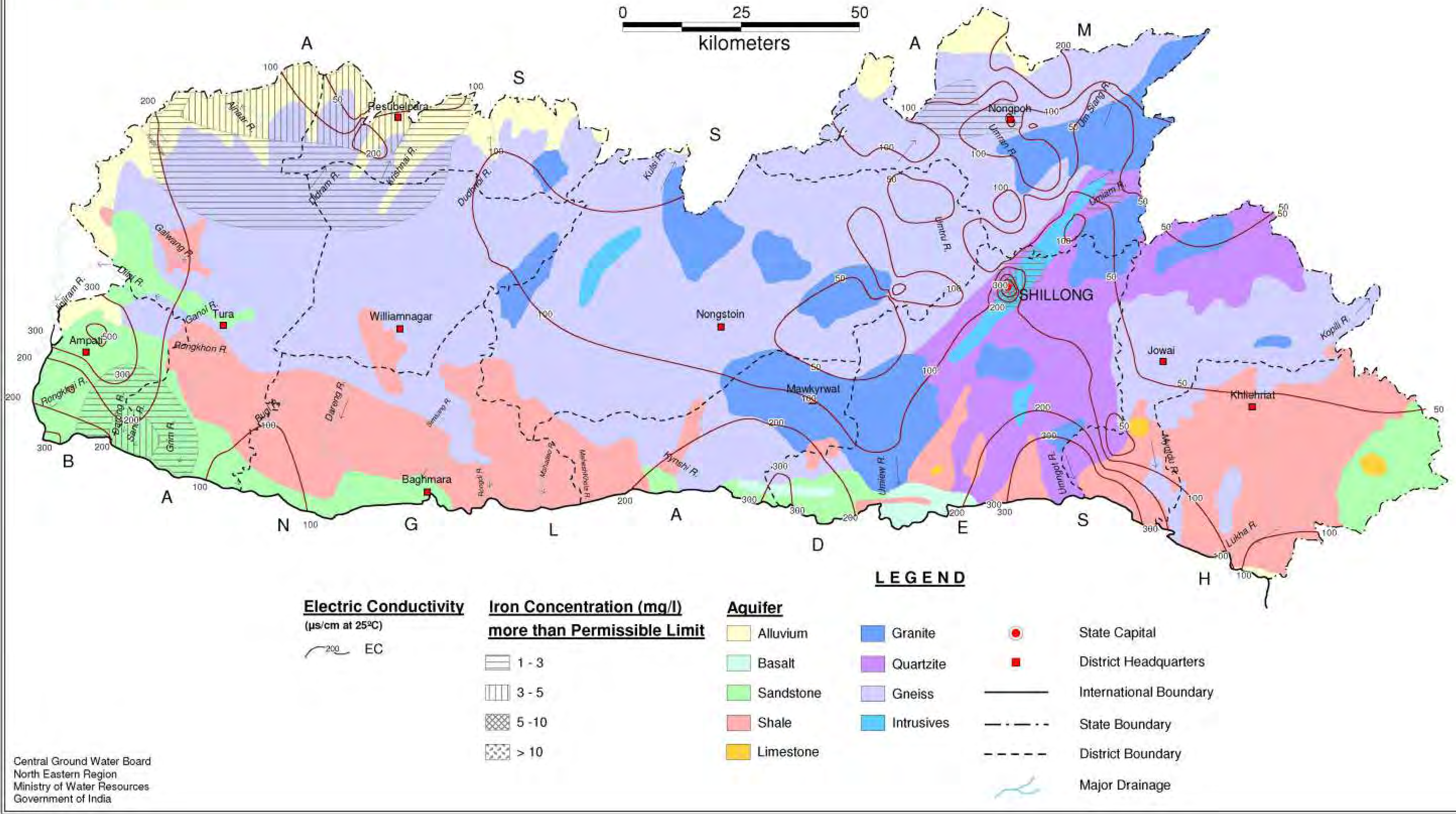
(POST MONSOON, 2011)



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

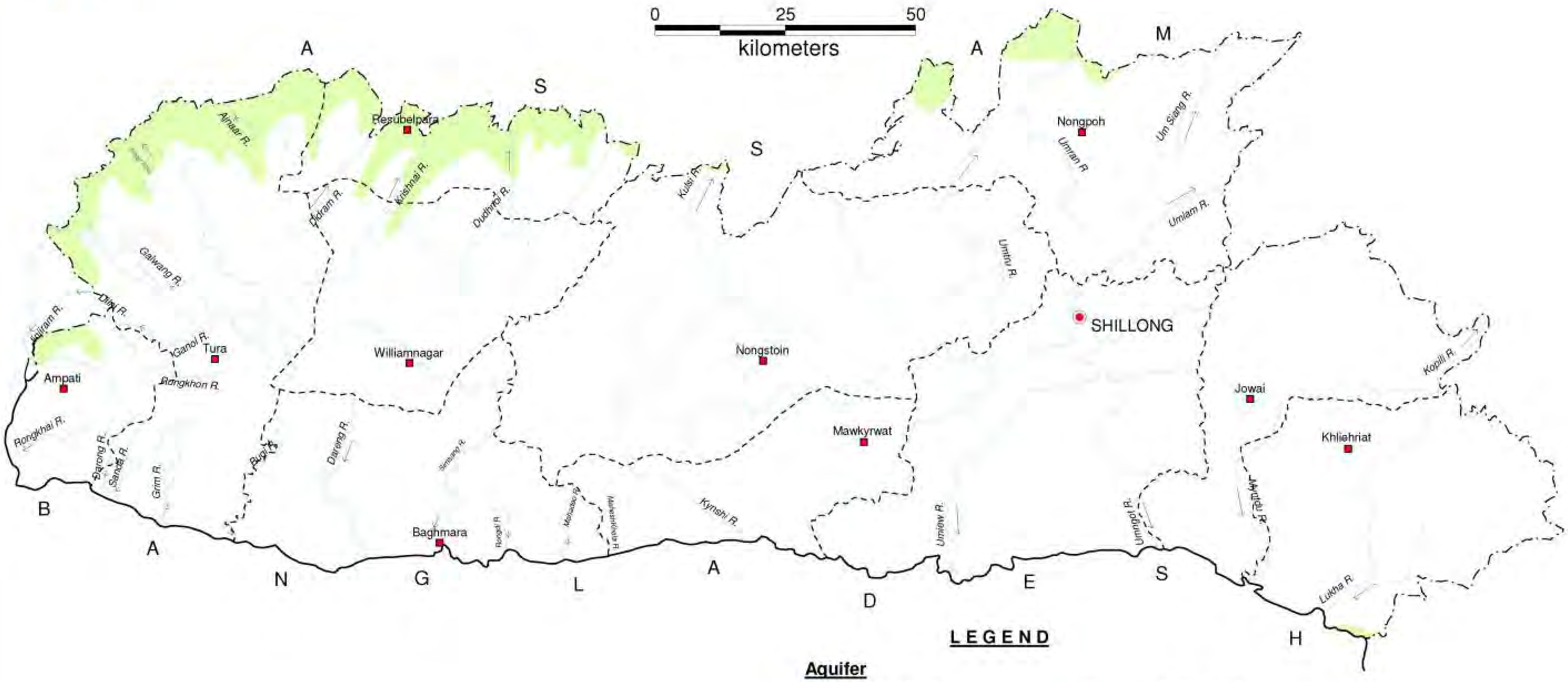

WATER LEVEL FLUCTUATION
N
W
E
S
0
25
50
kilometers
A
S
S
A
M
B
A
N
G
L
A
D
E
S
H
Resubelpara
Nongpoh
SHILLONG
Tura
Ampati
Williamnagar
Nongstoin
Mawkyrwat
Jowai
Khliehriat
Baghmara
3.38
-0.12
1.09
0.4
-0.16
1.17
0.92
-1.58
0.88
0.53
0.04
0.12
0.51
-0.77
-0.08
2.23
0.27
1.65
-1.38
0.94
3.07
1.2
1.96
0.87
0.43
2.975
0.28
Ajnaar R.
Krishnai R.
Didram R.
Dudhnoi R.
Kulsi R.
Umtru R.
Umiam R.
Um Siang R.
Umran R.
Kopili R.
Galwang R.
Dilni R.
Jinjiram R.
Ganol R.
Rongkhon R.
Rongkhai R.
Darang R.
Grim R.
Dareng R.
Simsang R.
Kynshi R.
Umiew R.
Umngot R.
Myntdu R.
Lukha R.
Mahadeo R.
Maheshkola R.
LEGEND
Aquifer
0.87 GW observation well
Alluvium
Basalt
Sandstone
Shale
Limestone
Granite
Quartzite
Gneiss
Intrusives
State Capital
District Headquarters
International Boundary
State Boundary
District Boundary
Major Drainage
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

GROUND WATER QUALITY



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

ALLUVIUM - AQUIFER SYSTEM



LEGEND

Aquifer

Alluvium (AL01)

State Capital

District Headquarters

International Boundary

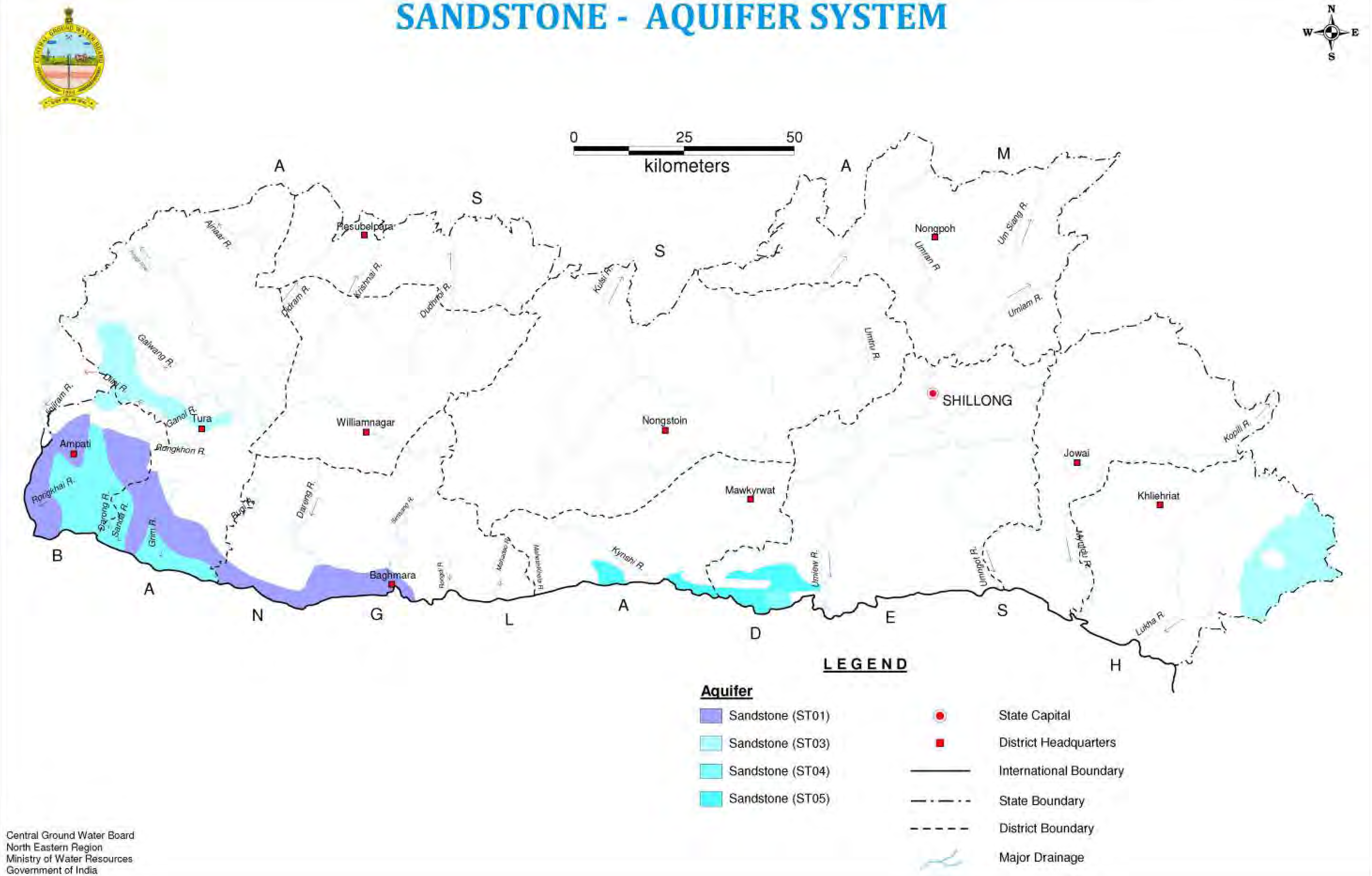
State Boundary

District Boundary

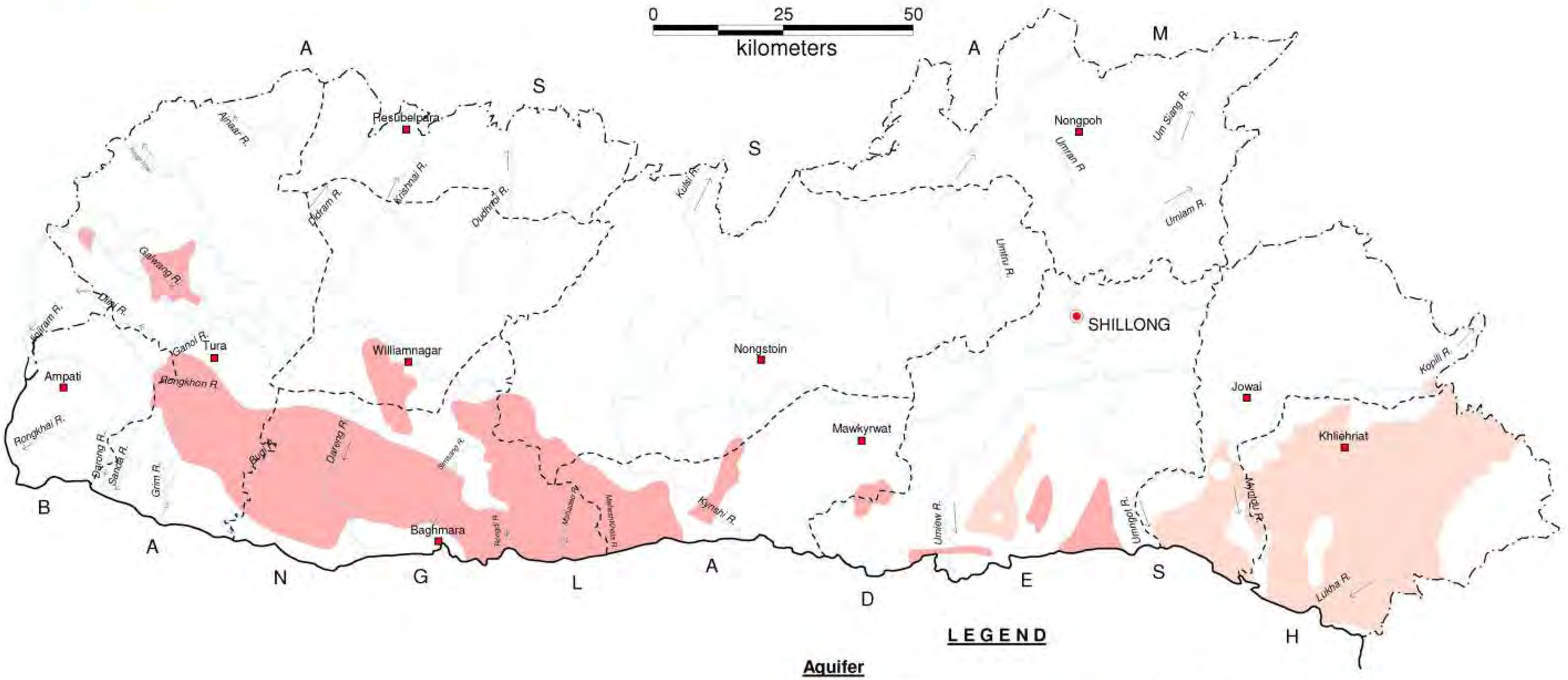
Major Drainage

Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

SANDSTONE - AQUIFER SYSTEM



SHALE - AQUIFER SYSTEM



LEGEND

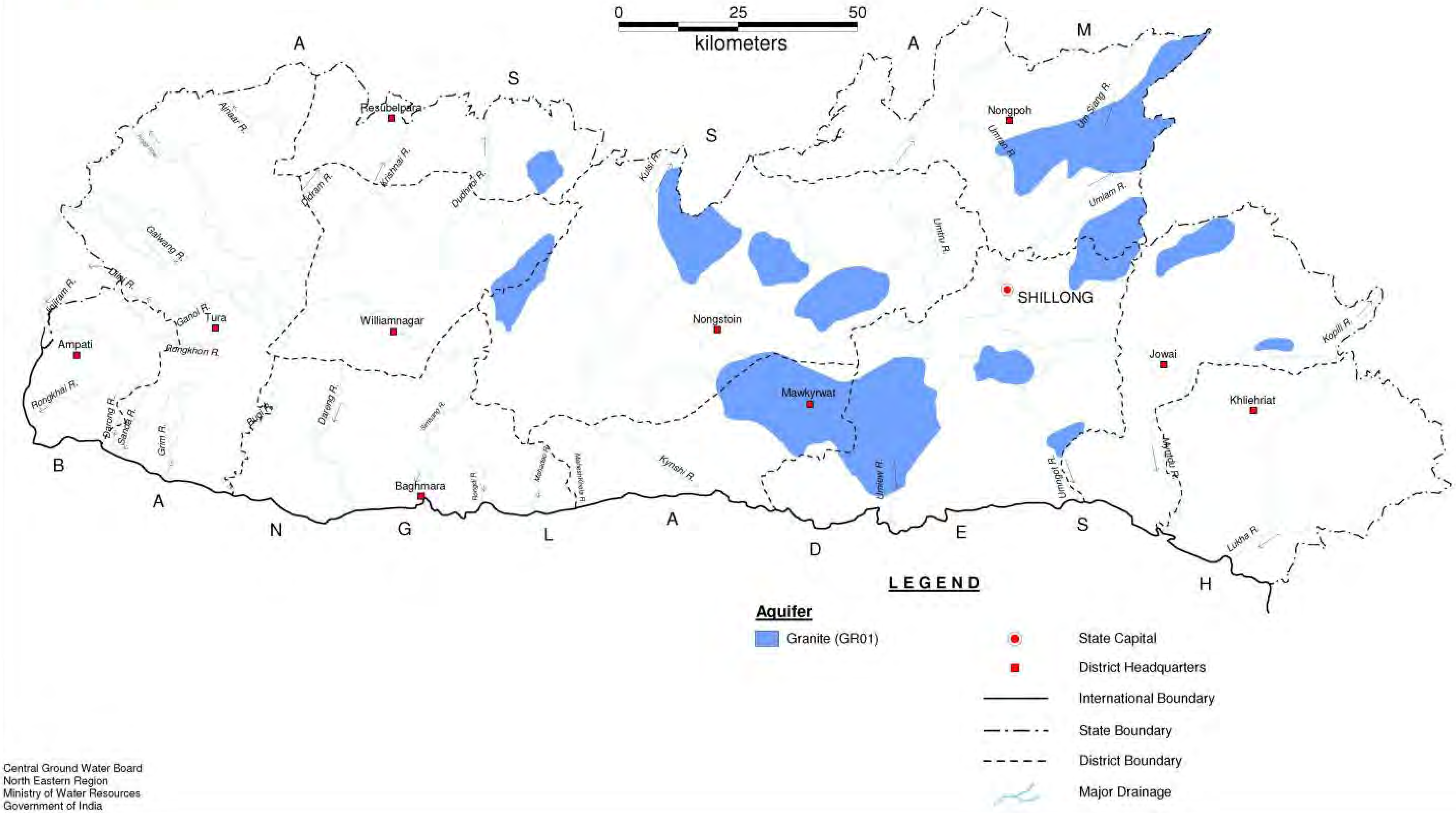
Aquifer

- Shale (SH02)
- Shale (SH03)

- State Capital
- District Headquarters
- International Boundary
- State Boundary
- District Boundary
- Major Drainage

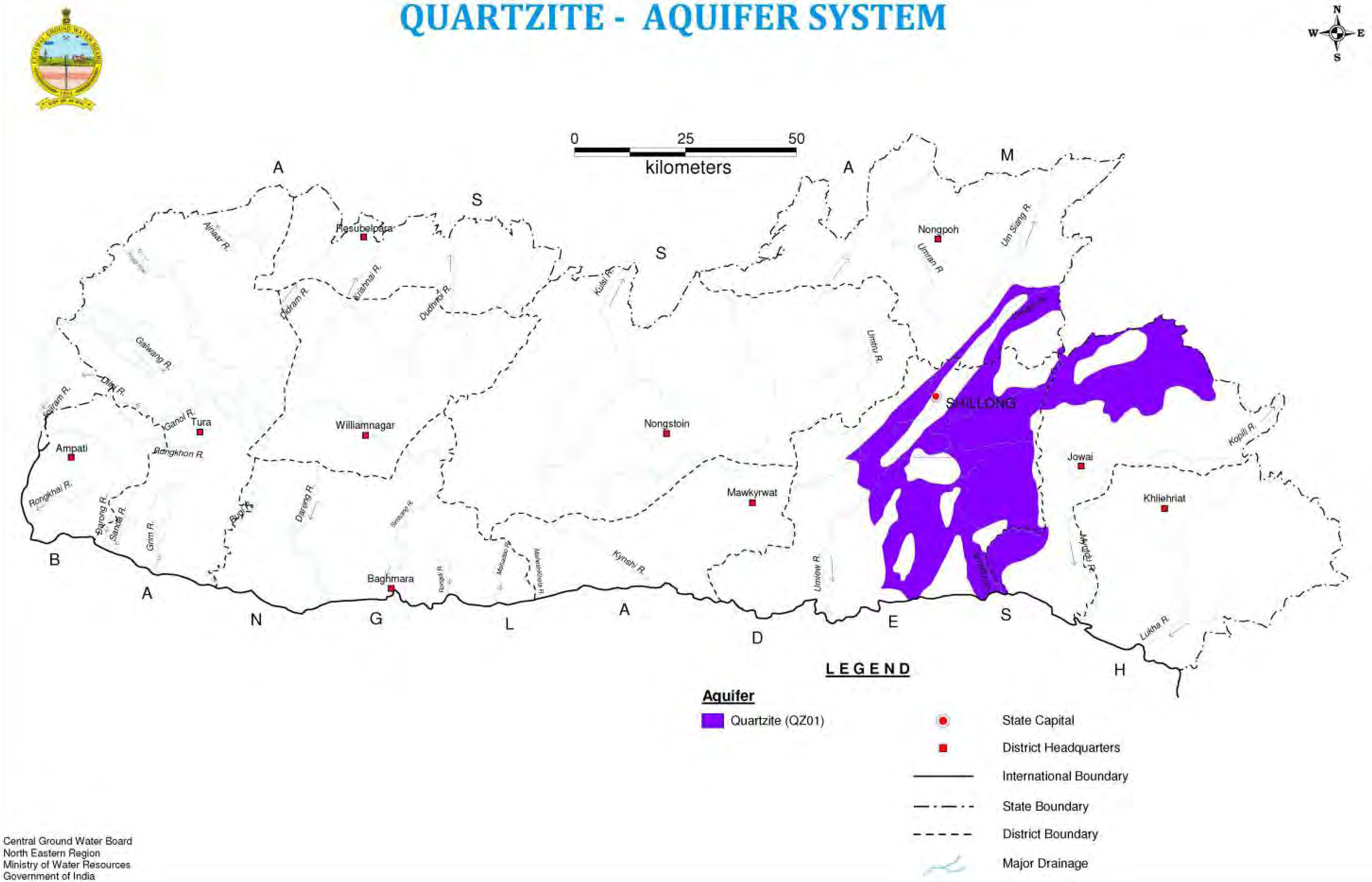
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

GRANITE - AQUIFER SYSTEM



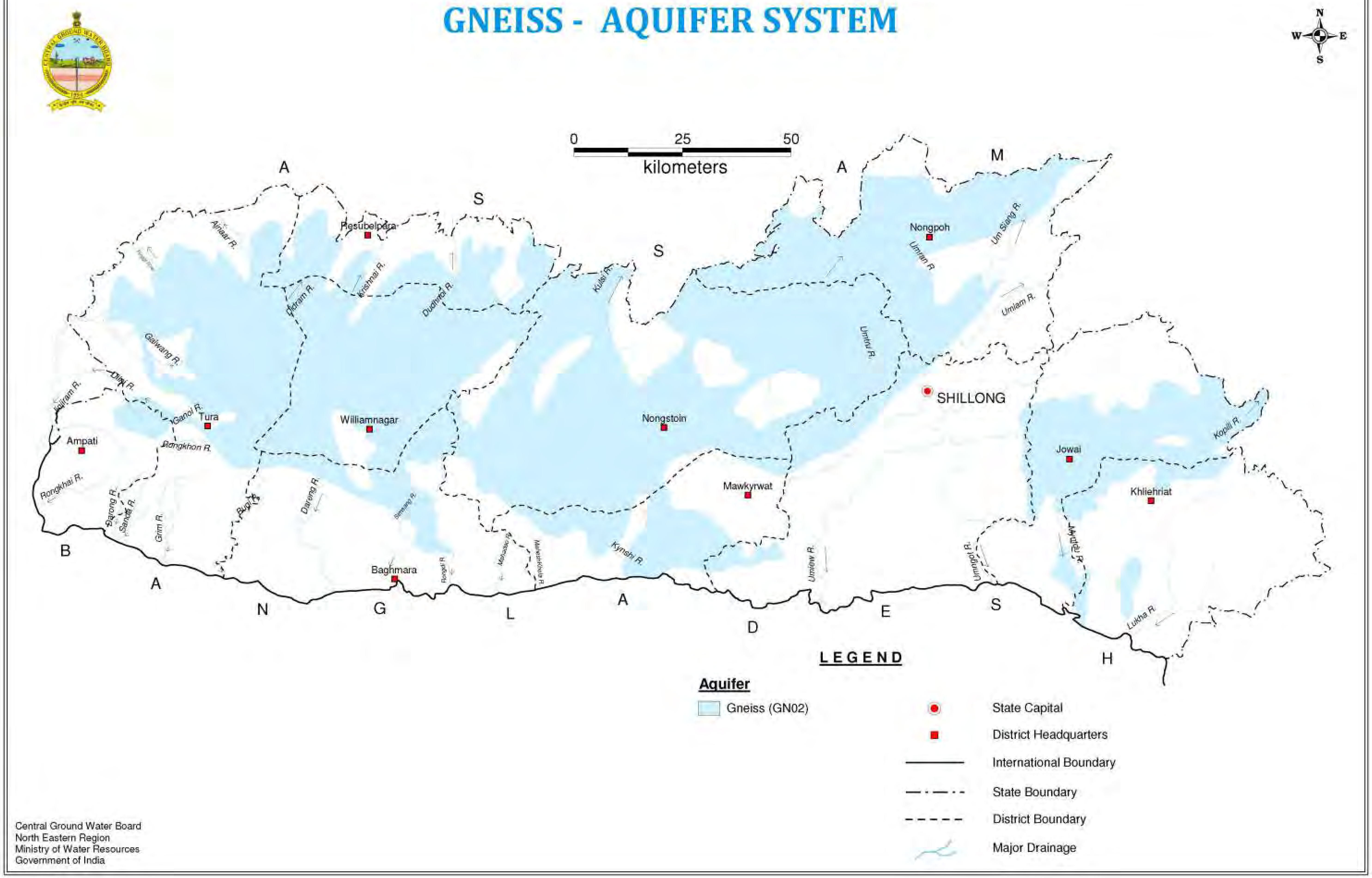
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

QUARTZITE - AQUIFER SYSTEM

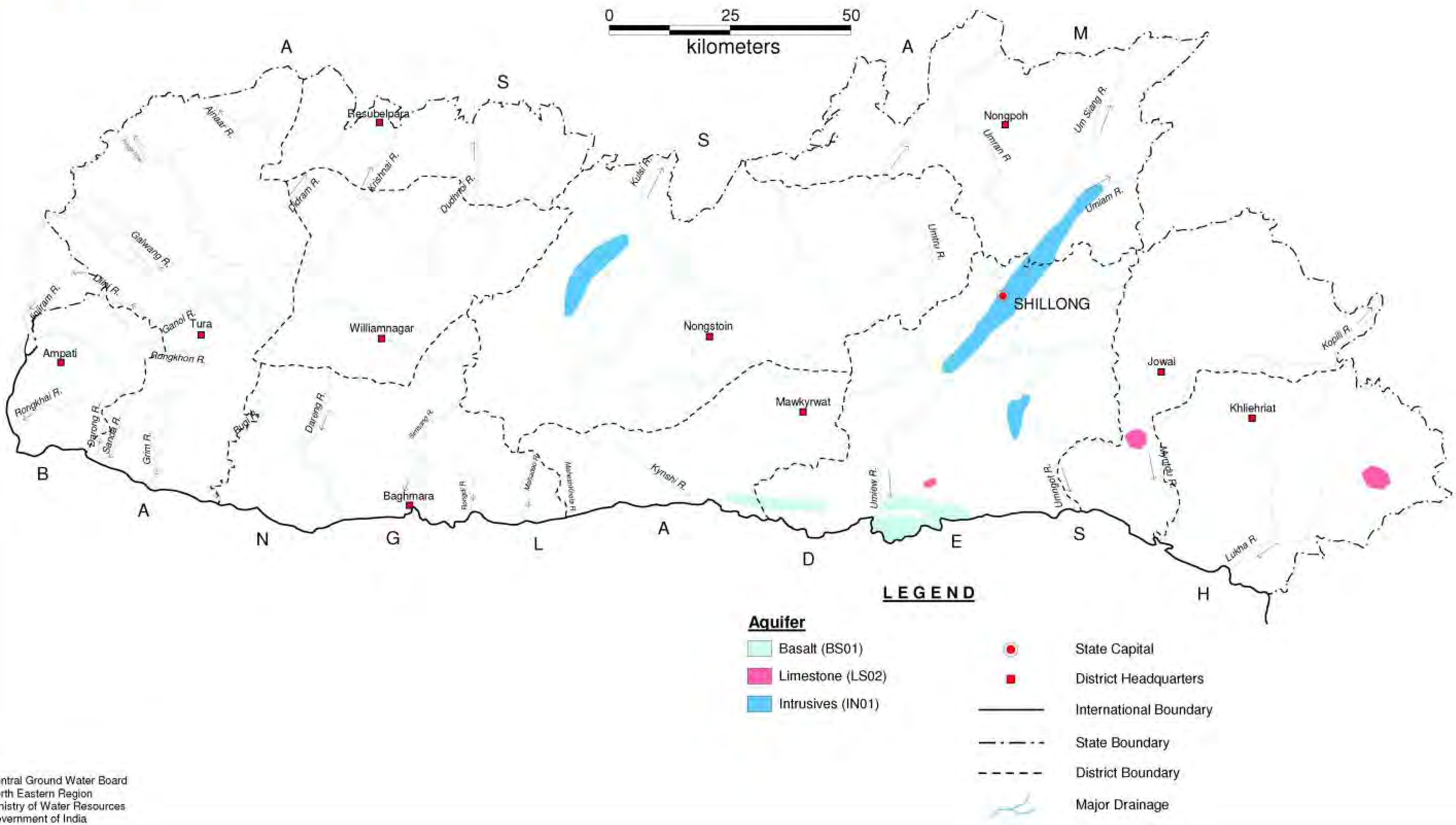


Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

GNEISS - AQUIFER SYSTEM

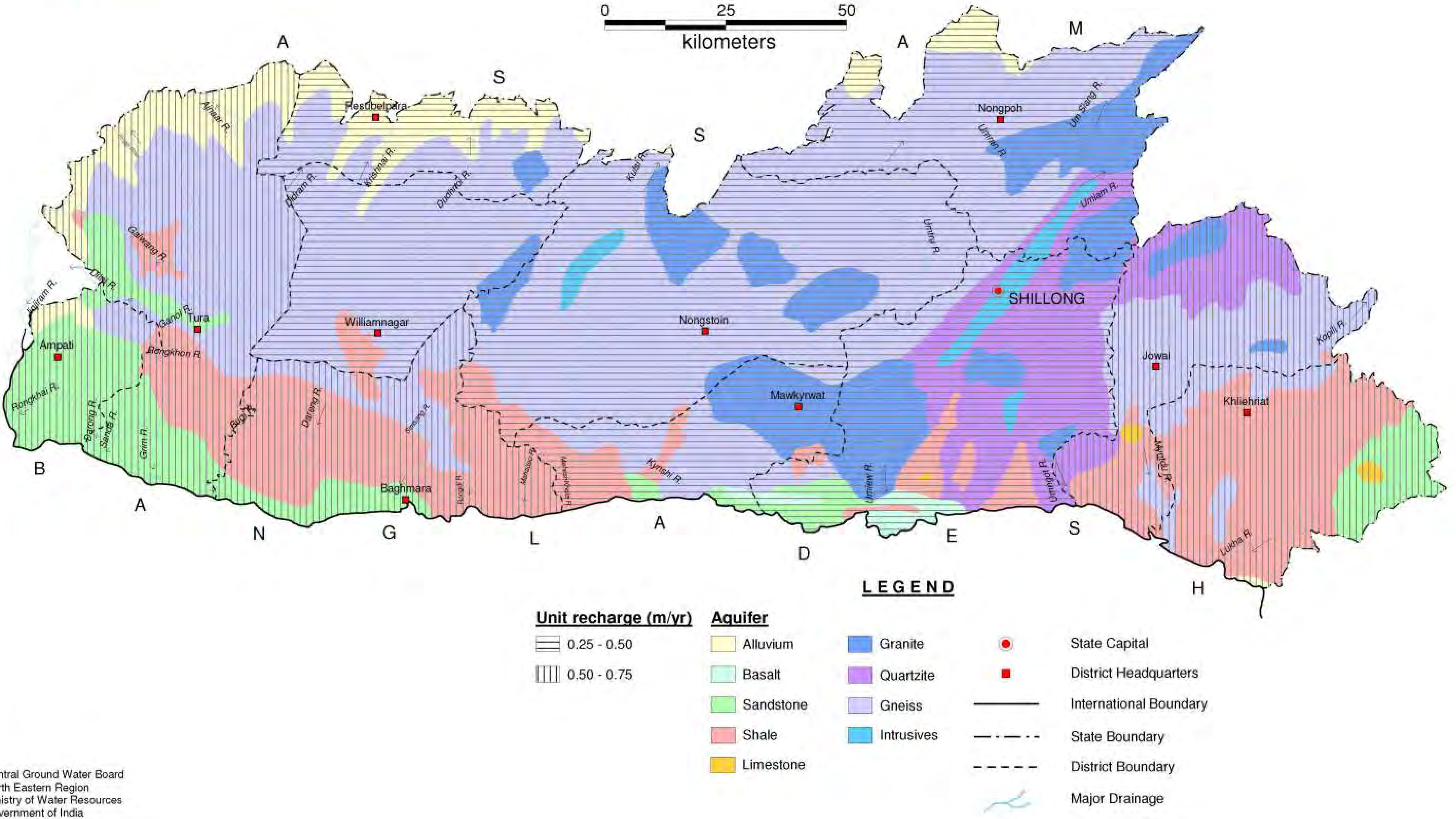


BASALT, LIMESTONE, INTRUSIVES - AQUIFER SYSTEM



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

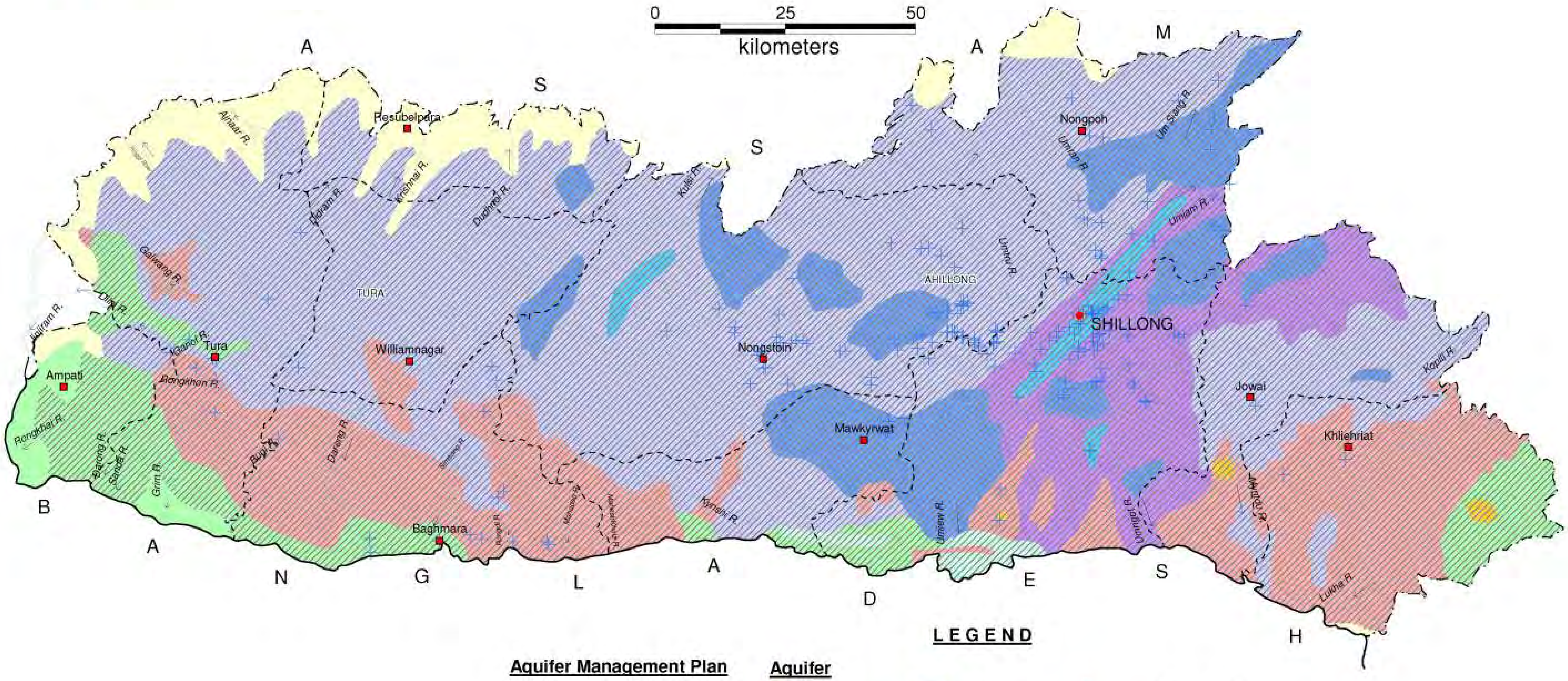
ANNUAL REPLENISHABLE RECHARGE



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

SPRING MANAGEMENT - PRIORITY AREA

(AQUIFER MANAGEMENT PLAN)



LEGEND

Aquifer Management Plan

- Priority Area for Spring Management

Aquifer

- Alluvium
- Basalt
- Sandstone
- Shale
- Limestone
- Granite
- Quartzite
- Gneiss
- Intrusives
- Spring

- State Capital
- District Headquarters
- International Boundary
- State Boundary
- District Boundary
- Major Drainage

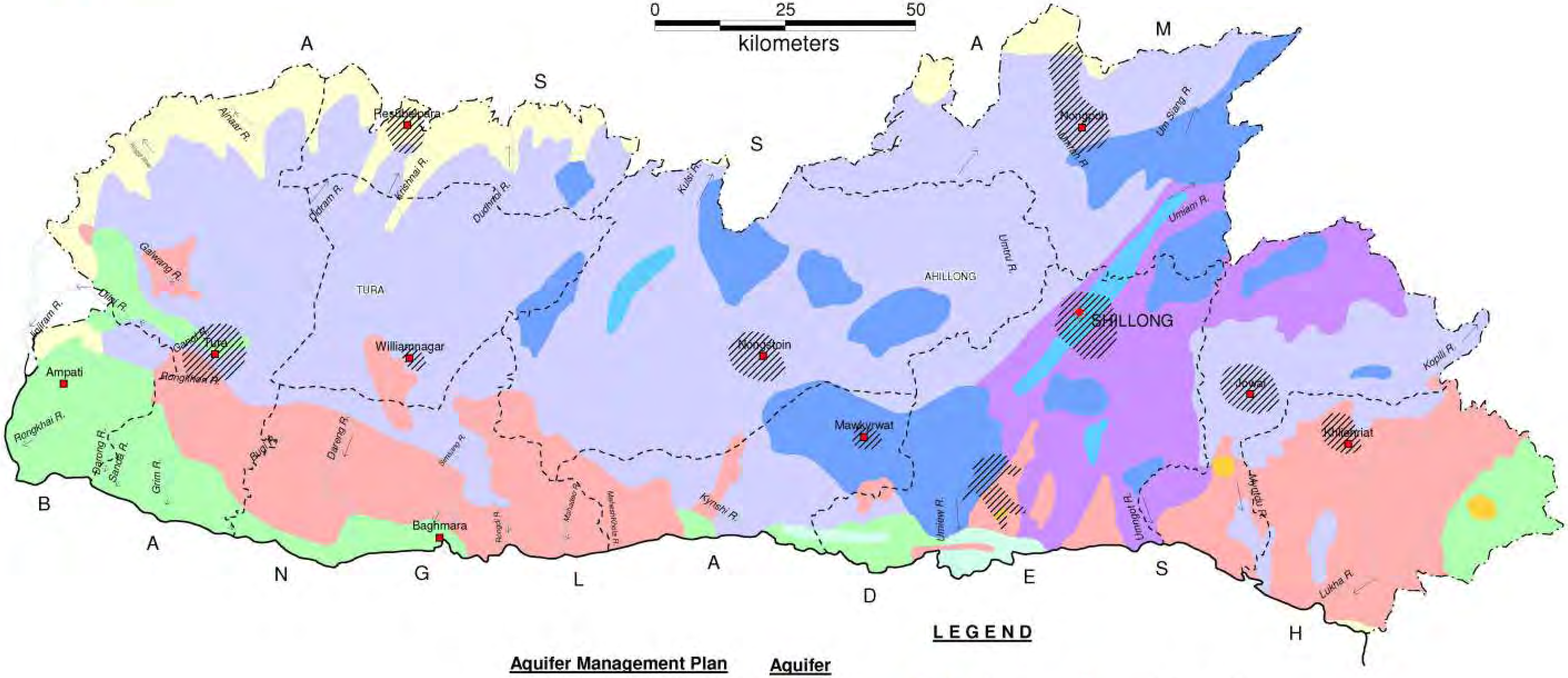
Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

WATER CONSERVATION AND RAIN WATER HARVESTING - PRIORITY AREA

(AQUIFER MANAGEMENT PLAN)

N W E S

0 25 50
kilometers



LEGEND

Aquifer Management Plan

- Priority Area for Water Conservation and Rain Water Harvesting

Aquifer

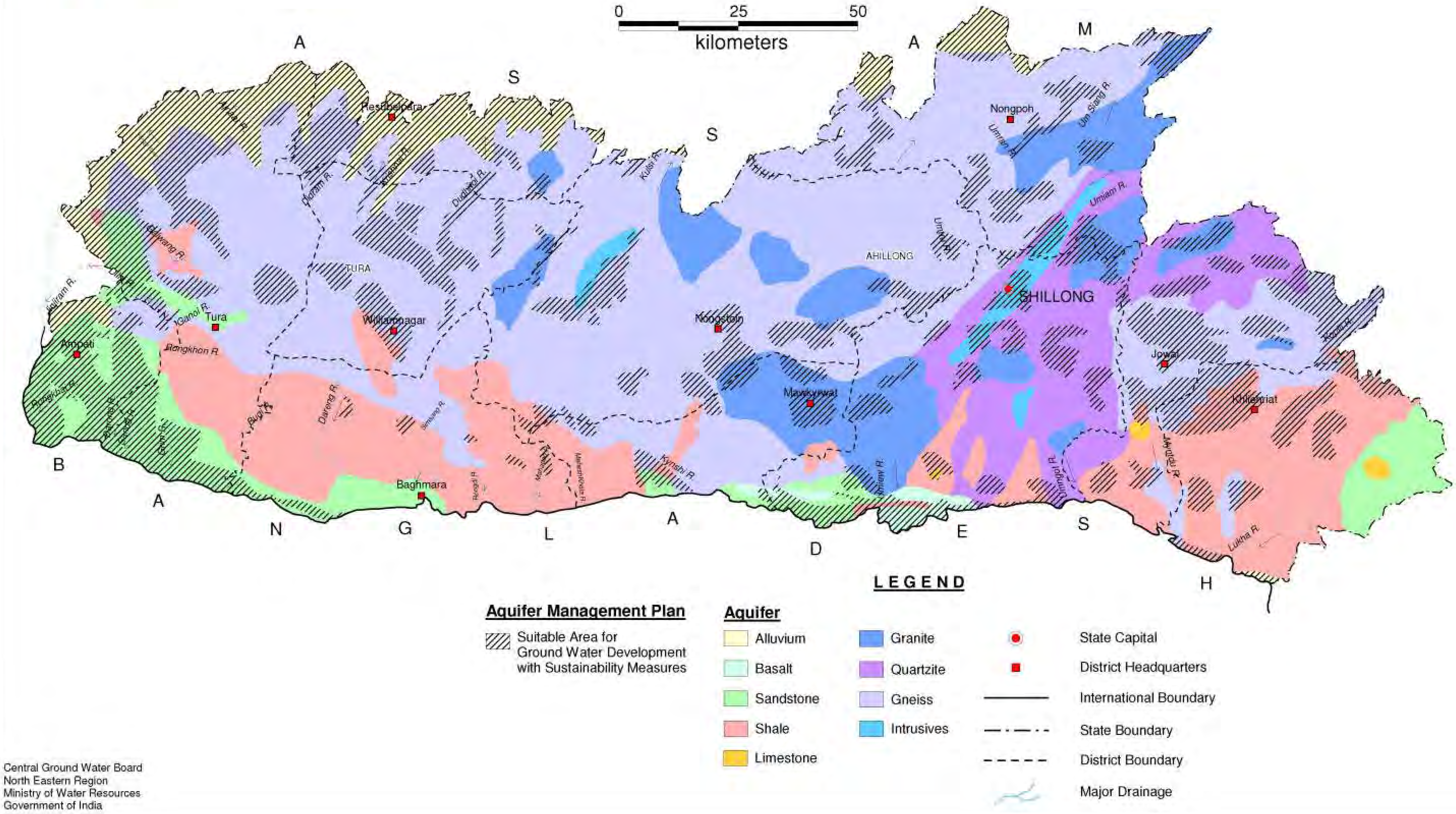
- Alluvium
- Basalt
- Sandstone
- Shale
- Limestone
- Granite
- Quartzite
- Gneiss
- Intrusives

- State Capital
- District Headquarters
- International Boundary
- State Boundary
- District Boundary
- Major Drainage

Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

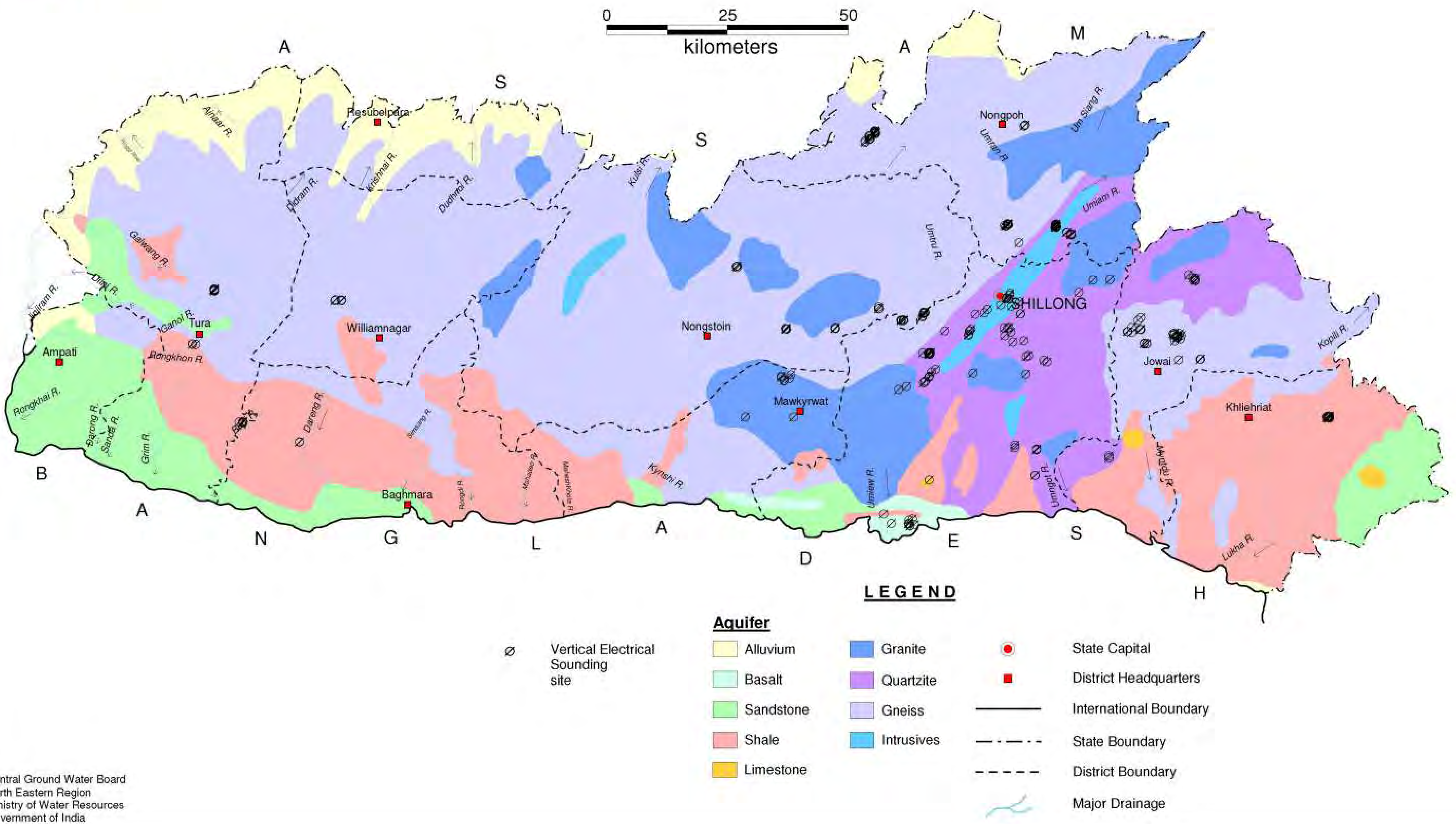
AREA FOR GROUND WATER DEVELOPMENT

(AQUIFER MANAGEMENT PLAN)



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

SURFACE GEOPHYSICAL SURVEYS



Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Government of India

Way Forward

Water is one of the most important natural resources and is vital to all aspects of human life. Water resources development is an essential component of growth, socioeconomic development and overall welfare of the masses. Population increase is resulting into growing and per capita demand for water is also growing. With climate change affecting the rainfall pattern all over the globe, water scarcity is increasing. It is very important that water infrastructure is developed and strengthened to achieve water security and sustainable development. There is a very high density of drainage network system in Meghalaya, but most of the rivers and streams have water only during the rainy season and many streams dry up or their flow dwindles during the summer leading to water scarcity. Groundwater is the largest accessible and yet underdeveloped resource in the entire State. The regional water shortages and water crises can only be met with a rational and sustainable use of this untapped freshwater reservoir. The importance and contribution of ground water is felt in the recent years to cope up with development and scarcity situations, particularly to meet the drinking water needs.

The compilation of information in this Atlas, “Aquifer Systems of Meghalaya”, provides valuable information on the areal and vertical extents of major aquifers and their characteristics. This will serve as the foundation for the National Aquifer Mapping Programme being contemplated during the XII and XIII Plan period, which aims at detailed mapping of the aquifers on 1:50,000 or larger scales . Further, to achieve the objectives of the National Aquifer Mapping Program proposed during 12th five year Plan, the following road map is envisaged:-

- The aquifer maps presented in the atlas on the 1:250,000 scale will form the base of the detailed aquifer mapping to be taken up on 1:50,000 scale.
- Outline the issues, approach and activities for initiating the national aquifer mapping programme for detailed understanding of aquifer systems and planning ground water development and management strategies.
- Defininig priority areas on the basis of water management issues of the state.
- Defining depth of drilling up to which data is to be collected.
- Data gap identification, collation, integration of existing data from various sources and generation of additional data required for the refinement of aquifer disposition, its geometry and characteristics.
- Demarcation of vulnerable areas in terms of ground water depletion and contamination from natural or anthropogenic sources and assessment of the vulnerability.
- Taking up special hydrogeological / Hydrochemical / Geophysical studies and wells construction details in identified area with data gap.
- Planning of cost-effective scientific investigations suited to various terrain conditions aimed at filling the data gaps.
- In the hilly areas studies may be taken using non-conventional techniques such as remote sensing with limited field checks. The mapping of the springs and their springsheds along with their perenniality and discharges can be taken up for improvement of discharges and sustainability.
- Preparation of ground water development and aquifer management plan.
- Demarcation of Aquifer for remediation, Areas needing regulation and area for springsheds development.
- Strategies for ensuring long-term sustainability of ground water resources in identified aquifers by adopting the supply side and demand side management by developing aquifer wise ground water management plans in an integrated water management approach.

The data collected through these studies need to be integrated in GIS format and fed in to numerical models to simulate present and future scenario for suggesting optimal water utilization strategies. The model output need to be shared with stakeholders for participatory management of the ground water resources at village level and reorientation of the water utilization pattern of the area. Finally, the aquifer mapping programme aims at developing a user friendly web based Aquifer Information and Management System which will enable the stakeholders to execute the aquifer management and water security plans at the local level. This will facilitate management of ground water resources in a scientific way even by the community itself.

Save Water

Every Drop Counts

In Hindi

Central Ground Water Board
North Eastern Region,
Tarun Nagar, Bye Lane 1,
Guwahati - 781005
Assam
Ph: +91-361-2134452 Fax: +91-361-2455497
Email: rdner-cgwb@nic.in

Central Ground Water Board
North Eastern Region,
Tarun Nagar, Bye Lane 1,
Guwahati - 781005
Assam
Ph: +91-361-2134452 Fax: +91-361-2455497
Email: rdner-cgwb@nic.in

Contents

Table 1: Administrative Divisions of Meghalaya

Sl No	District name	Area (Sq km)	District Headquarters	Number of Development Blocks	Number of towns
1	**East Khasi Hills**	2748	Shillong	8	2
2	**West Khasi Hills**	3906	Nongstoin	4	1
3	**South West Khasi Hills**	1341	Mawkyrwat	1	1
	East Jaintia Hills	2040	Khliehriat	2	1
4	**West Jaintia Hills**	1779	Jowai	3	1
6	**Ri-Bhoi**	2448	Nongpoh	3	1
7	**East Garo Hills**	1443	Williamnagar	3	1
8	**North Garo Hills**	1160	Resubelpara	2	1
9	**West Garo Hills**	2781	Tura	8	1
10	**South West Garo Hills**	896	Ampati	2	1
11	**South Garo Hills**	1887	Baghmara	4	1
Total		**22429**		**40**	**12**

Table 2 a : River Basins of Meghalaya

Sl No	Basin	Place of origin of main river	Catchment area	
			Total	In Meghalaya
1	**Brahmaputra**	Mansarovar, Himalayas, South West Tibet	651335	11598.2
2	**Meghna**	Manipur Hills	1520000	10830.8
Total				**22429**

Table 2 b : Major River Basins

Sl No	Basin	Sub-basin	Area	Number of Gauge and Discharge sites
1	**Brahmaputra**	Ganol	1830.2	0
		Didiram (Jinari)	1584	0
		Damring (Krishnai)	880	0
		Manda (Dudhnai)	540	0
		Khri (Kulsi)	1673	0
		Umtrew (Digaru)	779	0
		Umiam (Barapani)	2855	0
		Kopili	1457	0
2	**Meghna**	Simsang (Someswari)	3675.8	2
		Kynshi (Jadukata)	3444	0
		Umngot (Piyaingang)	2135	2
		Myntdu (Hari)	1576	1
Total			**22429**	**5**

Area in Sq km

Table 3 : District wise Distribution of Principal Aquifer Systems

District Name	Alluvium		Basalt		Sandstone		Shale		Limestone		Granite		Quartzite		Gneiss		Intrusive		Total area
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	
East Khasi Hills			133	4.84	134	4.86	275	10.01	4	0.13	607	22.08	1126	40.98	331	12.06	139	5.05	2748
West Khasi Hills	5	0.14					110	2.82			544	13.92			3175	81.28	72	1.84	3906
South West Khasi Hills			15	1.12	60	4.46	311	23.21			421	31.41			534	39.81			1341
East Jaintia Hills	29	1.40			352	17.24	1389	68.07	21	1.01					250	12.28			2040
West Jaintia Hills							220	12.36	13	0.73	105	5.90	536	30.15	905	50.87			1779
Ri-Bhoi	20	0.82									550	22.46	127	5.20	1686	68.88	65	2.65	2448
East Garo Hills							76	5.27			54	3.74			1313	90.99			1443
North Garo Hills	539	46.48									48	4.14			573	49.39			1160
West Garo Hills	494	17.76			343	12.32	578	20.79							1366	49.12			2781
South West Garo Hills	71	7.97			681	75.96	47	5.22							97	10.85			896
South Garo Hills					220	11.65	1290	68.38							377	19.97			1887
Total	1159	5.17	148	0.66	1788	7.97	4296	19.16	37	0.16	2328	10.38	1790	7.98	10608	47.29	275	1.23	22429

Area in Sq Km and % in respect to the total area of the District

Table 4 : Major Aquifer Systems of Meghalaya

Sl No	Principal Aquifer Code	Principal Aquifer Name	Major aquifer Code	Major Aquifer Name	Area Covered	%
1	AL	Alluvium	AL01	Fluvial Alluvium (Sand/ gravel/Clay)	1142	5.1
3	BS	Basalt	BS01	Basic rocks/Basalt	147	0.7
5	ST	Sandstone	ST01	Sandstone with conglomerate	707	3.2
6			ST03	Sandstone with coal beds	344	1.5
7			ST04	Sandstone with Clay, siltstone	432	1.9
8			ST05	Sandstone/Conglomerate	165	0.7
9	SH	Shale	SH02	Shale with sandstone	2585	11.5
10			SH03	Shale, sandstone and limestone	1697	7.6
12	LS	Limestone	LS02	Limestone/Dolomite	37	0.2
14	GR	Granite	GR01	Acidic Rocks (Granite,Syenite etc.)	2311	10.3
17	QZ	Quartzite	QZ01	Quartzite	1804	8
22	GN	Gneiss	GN02	Gneiss	10781	48.1
	IN	Intrusive	IN01	Ultra Basics (dolerite dykes and sills)	278	1.2

Area in Sq km

Table 5 : Aquifer distribution - River Basinwise

Name of Basin	Total Area	Alluvium	Basalt	Sandstone	Shale	Limestone	Granite	Quartzite	Gneiss	Intrusive
Brahmaputra	11598	1131		1114	754	20	1180	841	6422	136
Meghna	10831	11	147	534	3528	17	1131	963	4359	142
Total	**22429**	**1142**	**147**	**1648**	**4282**	**37**	**2311**	**1804**	**10781**	**278**

Area in Sq km

Table 6: Aquifer wise area of Parliamentary Constituencies

Sl No	Parliamentary Constituency	Area	Alluvium	Basalt	Sandstone	Shale	Limestone	Granite	Quartzite	Gneiss	Intrusive
1	**Shillong**	14262	53.5	146.7	532.3	2255.1	36.9	2209.1	1803.8	6946.9	277.7
2	**Tura**	8167	1088.4	-	1115.4	2027.1	-	101.6	-	3834.5	-
Total area		**22429.0**	**1141.9**	**146.7**	**1647.7**	**4282.2**	**36.9**	**2310.7**	**1803.8**	**10781.4**	**277.7**

Area in Sq km

Table 7 : Population Census of Meghalaya

Sl No	District Name	Males	Females	Total	Density/sq. Km	Decennial growth rate	Sex ratio
1	East Khasi Hills	410360	413699	824059	300	24.68	1008
2	West Khasi Hills	194628	190973	385601	73	30.25	981
3	South West Khasi Hills						
4	Jaintia Hills	195641	197211	392852	104	31.34	1008
5	East Jaintia Hills						
6	Ri-Bhoi	132445	125935	258380	105	34.02	951
7	East Garo Hills	161372	156246	317618	122	25.84	968
8	North Garo Hills						
9	West Garo Hills	324900	318023	642923	175	26.73	979
10	South West Garo Hills						
11	South Garo Hills	73322	69252	142574	75	29.33	944
Total		1492668	1471339	2964007	132	27.82	986

Table 8: Soil Types of Meghalaya

S. No.	Soil Taxonomy	Description
1	Typic Kandiudults & Typic Dystrochrepts	Deep, excessively drained, fine soils on moderately sloping side-slopes of hills having loamy surface with moderate erosion hazard; associated with Moderately deep, excessively drained, coarse loamy soils on gently sloping hill tops with very severe erosion hazard.
2	Typic Haptohumulta & Humic Haplaquepts	Deep, excessively drained, fine soils on gently sloping side-slopes of hills having loamy surface with moderate erosion hazard; associated with deep, poorly drained, fine-loamy soils on very gently sloping valleys with very slight erosion hazard.
3	Typic Kandihumults & Typic Dystrochrepts	Deep, excessively drained, fine soils on moderately sloping side-slopes of hills having loamy surface with moderate erosion hazard and slight stoniness; associated with moderately deep, excessively drained, loamy-skeletal soils on gently sloping hill tops.
4	Typic Kandihumults & Typic Dystrochrepts	Deep, excessively drained, fine soils on moderately steep side-slopes of hills having loamy surface with moderate erosion hazard and strong stoniness; associated with moderately deep, excessively drained, loamy-skeletal soils on very gently sloping hill slopes.
5	Typic Kandihumults. & Typic Dystrochrepts	Deep, excessively drained, fine soils on moderately sloping side-slopes of hills having loamy surface with moderate erosion hazard; associated with moderately deep, excessively drained, fine-loamy soils on gently sloping hill tops with very severe erosion hazard.
6	Umbric Dystrochrepts & Umbric Dystrochrepts	Moderately shallow, excessively drained, fine-loamy soils on moderately steep side slopes of hills having loamy surface with severe erosion hazard and strong stoniness; associated with moderately shallow, excessively drained, loamy-skeletal soils on gentle slopes.
7	Umbric Dystrochrepts & Typic Udorthents	Moderately deep, excessively drained, coarse-loamy soils on very steeply sloping hill escarpment having sandy surface with very severe erosion hazard and strong stoniness; associated with deep, excessively drained, coarse-loamy soils on steeply sloping hills.
8	Typic Dystrochrepts & Lithic Udorthents	Moderately deep, excessively drained, loamy skeletal soils on moderately steep side-slopes of hills having sandy surface with very severe erosion, hazard and strong stoniness; associated with shallow, excessively drained, loamy-skeletal soils on moderate slopes.
9	Umbric Dystrochrepts & Typic Kandihumults	Deep, excessively drained, fine-loamy soils on moderately sloping side-slopes of hills having loamy surface with moderate erosion hazard; associated with deep, excessively drained , fine soils on moderately sloping side-slopes of hills with moderate erosion hazard.
10	Typic Kandihumults & Typic Haplumbrepts	Deep, excessively drained, fine soils on moderately steep side-slopes of hills having loamy surface with moderate erosion hazard; associated with deep, somewhat excessively drained, fine-loamy soils on moderately steep side-slopes of hills with slight erosion hazard.
11	Typic Kandihumults & Umbric Dystrochrepts	Deep, excessively drained, fine soils on moderately steep side-slopes of hills having clayey surface with slight erosion hazard; associated with moderately deep, excessively drained, loamy-skeletal soils on moderately steep side-slopes of hills with severe erosion hazard.
12	Typic Kandthumults & Typic Dystrochrepts	Deep, excessively drained, fine soils on moderately steep side-slopes of hills having loamy surface with moderate erosion hazard; associated with moderately deep, excessively drained, fine-loamy soils on gently sloping hill tops with very severe erosion hazard.
13	Tupic Kandihumults & Dystric Eutrochrepts	Deep, somewhat excessively drained, fine soils on gently sloping side-slopes of hills having loamy surface with moderate erosion hazard; associated with moderately deep, excessively drained fine soils on moderately steep side slopes of hills with moderate erosion hazard.
14	Typic Paleudults & Dystric Eutrochrept	Deep, somewhat excessively drained, fine soils on moderately sloping side-slopes of hills having loamy surface with moderate erosion hazard; associated with deep excessively drained, fine soils on moderately sloping side-slopes of hills with moderate erosion hazard.
15	Aquic Eutrochrepts & Typic Kandihumults	Deep, moderately well drained, fine soils on very gently sloping upland having loamy surface with slight erosion and slight flood hazards; associated with: Deep, well drained, fine soils on moderately sloping side slopes of hills with moderate erosion hazard.
16	Humic Hapludults & Aerie Haplaquepts	Deep, well drained, fine soils on very gently sloping plains having loamy surface with slight erosion hazard; associated with: Deep, imperfectly drained, fine soils on nearly level plains with slight erosion and slight flood hazards.
17	Umbric Dystrochrepts. & Cumultc Humaquepts	Deep, well drained, fine-loamy soils on gently sloping valleys having loamy surface with slight erosion hazard and ground water table between two to five metres of the surface; associated with deep, poorly drained fine soils on nearly level valley bottoms.
18	Typic Haplaquegts & Aerie Haplaquepts	Deep, very poorly drained, fine soils on nearly level valley having clayey surface with very slight erosion ground water table between one to two metres of the surface and moderate flood hazards; associated with deep, poorly drained fine soils on nearly level valley bottoms.
19	Typic Dystrochrepts, & Umbric Dystrochrepts	Moderately deep, excessively drained, fine-loamy soils on steeply sloping side-slopes of hills having loamy surface with very severe erosion hazard and strong stoniness; associated with deep, excessively drained, fine soils on moderately sloping hill tops.
20	Typic Haplumbrepts & Umbric Dystrochrepts	Deep, excessively drained, loamy-skeletal soils on steeply sloping side-slopes of hills having loamy surface with severe erosion hazard and strong stoniness; associated with deep, excessively drained, coarse-loamy, soils on steeply sloping sideslopes of hills.
21	Ultic Hapludalfs & Typic Kandiudults	Moderately deep, excessively drained, fine-loamy soils on steeply sloping side-slopes of hills having loamy surface with severe erosion hazard and moderate stoniness; associated with deep, excessively drained fine soils on steeply sloping side-slopes of hills.
22	Typic Udorthents & Typic Kanhapludults	Moderately deep, excessively drained coarse loamy soils on moderately steep side-slopes of hills having loamy surface with moderate erosion hazard and slight stoniness; associated with moderately deep, excessively drained, fine soils on moderately sloping hills.
23	Pachic Haplumbrepts & Typic Udorthents	Moderately deep, excessively drained loamy-skeletal soils on moderately steep side-slopes of hills having loamy surface with very severe erosion hazard and strong stoniness; associated with moderately shallow, excessively drained, coarse loamy soils on slopes of hills.
24	Umbric Dyatrochrepts & Aerie Haplaquepts	Deep, well drained, fine-loamy soils on gently sloping valleys having loamy surface with moderate erosion hazard; associated with deep, imperfectly drained, fine-loamy soils on very gently sloping valleys with slight erosion hazard.

Table 9 a.: District wise Number of Exploratory Wells

Sl No	District Name	Area (sq. km)	Depth Range (m bgl)	Discharge Range (lps)	As on March 2011			
					EW	OW	PZ	Total
1	East Khasi Hills	2748	59.45-247.6	0.15-7.46	15	1		16
2	West Khasi Hills	3906	24.5-161.3	0.4-2.7	10	1		11
3	South West Khasi Hills	1341						
4	East Jaintia Hills	2040						
5	West Jaintia Hills	1779	74.2-159.53	0.1-4.8	7			7
6	Ri-Bhoi	2448	135-204.6	0.70-18.6	17	2		19
7	East Garo Hills	1443	14.25-214.7	0.01-12.0	2			2
8	North Garo Hills	1160	14.25-214.8	0.01-12.1	3			3
9	West Garo Hills	2781	28.4-300.15	0.4-61.7	16	2		18
10	South West Garo Hills	896	28.4-300.16	0.4-61.8	11	4		15
11	South Garo Hills	1887	22.37-142	2-14.4	3			3
Total		**22429**			**84**	**10**	**NA**	**94**

lps : litre/ second, mbgl : meters below ground level EW : Exploratory Well , OW: Observation Well , Pz : Peizometer

Table 9 b: District wise and Aquifer wise distribution of Exploratory Wells

Sl No	District Name	Alluvium	Basalt	Sandstone	Shale	Limestone	Granite	Quartzite	Gneiss	Intrusive	Total
1	East Khasi Hills				1	1		11		3	16
2	West Khasi Hills						1		9	1	**11**
3	South West Khasi Hills										
4	East Jaintia Hills										
5	West Jaintia Hills					1			6		**7**
6	Ri-Bhoi	1					1	2	15		**19**
7	East Garo Hills						1		1		**2**
8	North Garo Hills	2									**5**
9	West Garo Hills	12		3					3		**18**
10	South West Garo Hills	4		11							**15**
11	South Garo Hills			3							**3**
Total		**19**		**17**	**1**	**2**	**3**	**13**	**35**	**4**	**94**

Table 10 : District wise and Aquifer wise distribution of GW Observation Wells (Dugwells/Piezometer)

District Name	Alluvium		Basalt		Sandstone		Shale		Limestone		Granite		Quartzite		Gneiss		Intrusive		Total Number of DW	Total Number of Pz	Total No of Observation Wells (DW & Pz)
	DW	Pz	DW	Pz	DW	Pz	DW	Pz	DW	Pz	DW	Pz	DW	Pz	DW	Pz	DW	Pz			
East Khasi Hills	0	0	NA	NA	0	0	0	0	0	1	0	0	1	0	3	0	0	0	4	1	**5**
West Khasi Hills **South West Khasi Hills**	0	0	0	0	0	0	0	0	NA	NA	0	0	NA	NA	1	0	0	0	1	0	**1**
East Jaintia Hills **West Jaintia Hills**	1	0	NA	NA	1	0	0	0	0	0	0	0	0	0	0	0	NA	NA	2	0	**2**
Ri-Bhoi	1	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	1	0	0	0	2	0	**2**
East Garo Hills **North Garo Hills**	6	0	NA	NA	NA	NA	0	0	NA	NA	0	0	NA	NA	3	0	NA	NA	9	0	**9**
West Garo Hills **South West Garo Hills**	9	0	NA	NA	2	4	0	0	NA	NA	NA	NA	NA	NA	1	0	NA	NA	12	4	**16**
South Garo Hills	NA	NA	NA	NA	1	0	0	0	NA	NA	NA	NA	NA	NA	0	0	NA	NA	1		**1**
Total	**17**				**4**	**4**				**1**			**1**		**9**				**31**	**5**	**36**

DW : Dugwell , Pz : Peizometer

Table 11 a: Depth to Water Level, Pre Monsoon, 2011

District Name	Alluvium		Basalt		Sandstone		Shale		Limestone		Granite		Quartzite		Gneiss		Intrusive	
	Min	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*
East Khasi Hills													3.38		1.6	7.59		
West Khasi Hills															1.03			
South West Khasi Hills																		
East Jaintia Hills	3.36																	
West Jaintia Hills																		
Ri-Bhoi															3.63			
East Garo Hills	2.11	3.77													2.29	2.54		
North Garo Hills																		
West Garo Hills	1.21	8.09			2.62	4.06									3.72			
South West Garo Hills																		
South Garo Hills																		

Table 11 b: Depth to Water Level, Post Monsoon, 2011

District Name	Alluvium		Basalt		Sandstone		Shale		Limestone		Granite		Quartzite		Gneiss		Intrusive	
	Min	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*
East Khasi Hills													0.41		0.4	4.52		
West Khasi Hills															0.6			
South West Khasi Hills																		
East Jaintia Hills	1.4																	
West Jaintia Hills																		
Ri-Bhoi															3.35			
East Garo Hills	2.27	3.21													1.37	4.12		
North Garo Hills																		
West Garo Hills	1.48	4.71		4											3.68			
South West Garo Hills																		
South Garo Hills																		

All Figures in m bgl

Table 12: Area affected by Salinity , Fluoride , Nitrate, Arsenic and Iron in Ground Water in different Districts of Meghalaya

Sl No	Parameters	Name of districts (in parts)
1	**EC > 3000 µS/cm**	Nil
2	**Fluoride (>1.5mg/litre)**	Nil
3	**Nitrate (>45 mg/litre)**	Nil
4	**Arsenic(>50 ppb)**	Nil
5	**Iron (>1ppm)**	East Khasi Hills , Ri-Bhoi, North Garo Hills, East Garo Hills, West Garo Hills, South West Garo Hills

Table 13 : District wise Distribution and Characteristics of Alluvium Aquifer System

District Name	*Major Aquifer (Area in sq km)*	*Aquifer Properties*							
	Younger Alluvium	**Aquifer System**	**Type of Aquifer**	**Thickness**	**Zones encountered**	**DTW (Decadal Avg)**	**Transmissivity**	**Yield**	**Specific Yield**
	AL01			**m**	**m bgl**	**m bgl**	**m^2/day**	**m^3/day**	**%**
West Khasi Hills	5	Multiple	Unconfined, Semi confined	5-10	20-50	5 - 10	10 -30	50-100	0.01-0.03
South West Khasi Hills									
East Jaintia Hills	29	Multiple	Unconfined, Semi confined	5-10	20-80	5-10	20-50	50-100	0.01-0.03
West Jaintia Hills									
Ri-Bhoi	20	Multiple	Unconfined, Semi confined	5-10	20-80	5-10	20-50	50-100	
East Garo Hills		Multiple	Unconfined, Semi confined	20-30	20-100	5-10	20-150	100-1000	0.01-0.03
North Garo Hills	539								
West Garo Hills	494	Multiple	Semi confined to confined	20-45	20--200	5-10	14-800	120-2400	0.01-0.03
South West Garo Hills	71								
Total Area	**1142**								

DTW : Depth to Water Level , m bgl : meters below ground level

Table : 14 District wise Distribution and Characteristics of Sandstone Aquifer System

District Name	**Major Aquifers (Area in sq. km)**				***Aquifer Properties***							
	Sandstone with conglom-erate	**Sandstone with shale/ coal beds**	**Sandstone with Clay, siltstone**	**Sandstone/ Conglomerate**	**Aquifer System**	**Type of Aquifer**	**Aquifer Thickness**	**DTW (Decadal Avg)**	**Fractures encountered**	**Transmissivity**	**Yield**	**Specific Yield**
	ST01	**ST03**	**ST04**	**ST05**			**m**	**m bgl**	**m bgl**	**m2/day**	**m3/day**	**%**
East Khasi Hills			24	110	Not explored							
South West Khasi Hills				60	Not explored							
East Jaintia Hills		352			Multiple	Semicon-fined to Con-fined	15-20	5-10	20-65	0.9-3.0	7-12	0.001-0.015
West Garo Hills	197		146		Multiple	Semicon-fined to Con-fined	15-25	5-10	20-150	90-1400	100-2000	0.001-0.015
South West Garo Hills	357		324									
South Garo Hills	220		408		Multiple	Semicon-fined to Con-fined	10-20	5-10	20-100	2-10	100-200	0.001-0.015
Total Area	**707**	**344**	**432**	**165**								

DTW : Depth to Water Level , m bgl : meters below ground level

Table : 15 District wise Distribution and Characteristics of Shale Aquifer System

District Name	*Major Aquifer (Area in Sq km)*		*Aquifer Properties*								
	Shale with sandstone	Shale, Limestone and Sandstone	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	Fractures encountered	DTW (Decadal Avg)	Transmissivity	Yield	Specific Yield
	SH02	SH03			m	m bgl	m bgl	m2/day	m3/day	%
East Khasi Hills	160	115	Single	Unconfined to Semi-confined	5-15	20-80	5-10	0.9-2.0	50-150	0.001-0.002
West Khasi Hills	110		Not explored							
South West Khasi Hills	311									
East Jaintia Hills		1389	Not explored							
West Jaintia Hills		220								
East Garo Hills	76		Not explored							
West Garo Hills	578		Single	Unconfined to Semi-confined	10 - 20	20-100	5-10	5-11	40-120	0.001-0.002
South West Garo Hills	47									
South Garo Hills	1291		Not explored							
Total Area	**2573**	1697								

DTW : Depth to Water Level , m bgl : meters below ground level

Table : 16 District wise Distribution and Characteristics of Granite Aquifer System

District Name	*Major Aquifers (Area in sq km)*	*Aquifer Properties*							
	Acidic Rocks (Granite,Syenite etc.)	**Aquifer System**	**Type of Aquifer**	**Thickness of Weathered Zone**	**Fractures Encountered**	**DTW (Decadal Avg)**	**Transmissivity**	**Yield**	**Specific yield**
	GR01			**m**	**m bgl**	**m bgl**	**m2/day**	**m3/day**	**%**
East Khasi Hills	606	Not explored							
West Khasi Hills	945	Single	Unconfined Semi-confined	5-20	30-60	5-10	1-10	30-100	0.001-0.005
South West Khasi Hills	421								
West Jaintia Hills	105	Not Explored							
Ri-Bhoi	550	Single	Unconfined Semi-confined	5-15	20-150	5-10	4-12	70-600	0.001-0.005
North Garo Hills	48	Single	Unconfined Semi-confined	5-11	20-61	5-11	2-13	30-101	0.001-0.006
Total Area	**2311**								

DTW : Depth to Water Level , m bgl : meters below ground level

Table : 17 District wise Distribution and Characteristics of Quartzite Aquifer System

District Name	*Major Aquifers (Area in sq km)*	*Aquifer Properties*							
	Quartzite	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	Fractures Encountered	DTW (Decadal Avg)	Transmissivity	Yield	Specific yield
	QZ01			m	m bgl	m bgl	m2/day	m3/day	%
East Khasi Hills	1126	Single	Unconfined Semi-confined	5-15	20-100	5-10	5-15	100-180	0.001-0.003
West Jaintia Hills	536	Single	Unconfined Semi-confined	5-16	20-121	5-11	0.1-2.6	9-133	0.001-0.004
Ri-Bhoi	127	Single	Semi-confined to confined Semi-confined	10-15	45-200	5-10	4-12	800-1400	0.001-0.003
Total Area	**1804**								

Table : 18 District wise Distribution and Characteristics of Gneiss Aquifer System

District Name	*Major Aquifers (Area in Sq km)*	*Aquifer Properties*							
	Gneiss	**Aquifer System**	**Type of Aquifer**	**Thickness of Weathered Zone**	**DTW (Decadal Avg)**	**Fractures encountered**	**Transmissivity**	**Yield**	**Specific Yield**
	GN02			**m**	**m bgl**	**m bgl**	**m2/day**	**m3/day**	**%**
East Khasi Hills	331	Not explored							
West Khasi Hills	3175	Single	Unconfined, Semi-confined	5 - 10	5-10	20-80	2-10	36-120	0.001-0.005
South West Khasi Hills	534	Single	Unconfined, Semi-confined	5 - 10	5-10	20-80	2-10	36-120	0.001-0.005
East Jaintia Hills	250	Single	Unconfined, Semi-confined	5 - 10	5-10	20-60	0.4-29	36-120	0.001-0.005
West Jaintia Hills	905	Single	Unconfined, Semi-confined	5 - 10	5-10	20-60	0.4-29	36-120	0.001-0.005
Ri-Bhoi	1686	Single	Unconfined, Semi-confined	5-15	5-10	20-180	3-29	48-1000	0.001-0.005
East Garo Hills	1313	Single	Unconfined, Semi-confined	5-10	5-10	15-30	0.2-5	30-100	0.001-0.005
North Garo Hills	573	Single	Unconfined, Semi-confined	5-10	5-10	15-30	0.2-5	30-100	0.001-0.005
West Garo Hills	1366	Single	Unconfined, Semi-confined	5 - 10	5-10	20-50	1.5-3	50-100	0.001-0.005
South West Garo Hills	97	Single	Unconfined, Semi-confined	5 - 10	5-10	20-50	1.5-3	50-100	0.001-0.005
South Garo Hills	377	Not explored							
Total Area	**10607.6**								

DTW : Depth to Water Level , m bgl : meters below ground level

Table : 19 a District wise Distribution and Characteristics of Basalt Aquifer System

District Name	*Major Aquifers (Area in Sq km)*	*Aquifer Properties*							
	Basalt	**Aquifer System**	**Type of Aquifer**	**Thickness of Weathered Zone**	**DTW (Decadal Avg)**	**Fractures encountered**	**Transmissivity**	**Yield**	**Specific Yield**
	BS01			**m**	**m bgl**	**m bgl**	**m2/day**	**m3/day**	**%**
East Khasi Hills	133	Not explored							
South West Khasi Hills	15								
Total Area	**147**								

Table : 19 b District wise Distribution and Characteristics of Limestone Aquifer System

District Name	*Major Aquifers (Area in Sq km)*	*Aquifer Properties*							
	Limestone/Dolomite	**Aquifer System**	**Type of Aquifer**	**Thickness of Weathered Zone**	**DTW (Decadal Avg)**	**Fractures encountered**	**Transmissivity**	**Yield**	**Specific Yield**
	LS02			**m**	**m bgl**	**m bgl**	**m2/day**	**m3/day**	**%**
East Khasi Hills	4	Single	Unconfined,Semi-confined	5-15	5-10	20-100	10-30	5-50	0.005-0.03
East Jaintia Hills	26	Single	Unconfined,Semi-confined	5-15	5-10	20-100	50-290	30-410	0.005-0.03
West Jaintia Hills	30								
Total Area	**37**								

Table : 19 c District wise Distribution and Characteristics of Intrusives Aquifer System

District Name	*Major Aquifers (Area in Sq km)*	*Aquifer Properties*							
	Basalt	**Aquifer System**	**Type of Aquifer**	**Thickness of Weathered Zone**	**DTW (Decadal Avg)**	**Fractures encountered**	**Transmissivity**	**Yield**	**Specific Yield**
	BS01			**m**	**m bgl**	**m bgl**	**m2/day**	**m3/day**	**%**
East Khasi Hills	139	Single	Unconfined,Semi-confined	5-10	5-10	20-100	4-90	50-100	0.001-0.005
West Khasi Hills	65	Single	Unconfined, Semi-confined	5 - 10	5-10	20-80	2-20	30-60	0.001-0.005
Ri-Bhoi	65	Not explored							
Total Area	**278**								

DTW : Depth to Water Level , m bgl : meters below ground level

Table : 20 District wise and Aquifer wise Annual Replenishable Recharge (m/yr)

<table>
<tr><th>Sl No</th><th>District Name</th><th>Alluvium</th><th>Basalt</th><th>Sandstone</th><th>Shale</th><th>Limestone</th><th>Granite</th><th>Quartzite</th><th>Gneiss</th><th>Intrusive</th></tr>
<tr><td>1</td><td>East Khasi Hills</td><td></td><td>0.21</td><td>0.35</td><td>0.23</td><td>0.31</td><td>0.25</td><td>0.24</td><td>0.26</td><td>0.24</td></tr>
<tr><td>2</td><td>West Khasi Hills</td><td rowspan="2">0.6</td><td rowspan="2">0.23</td><td rowspan="2">0.38</td><td rowspan="2">0.23</td><td rowspan="2"></td><td rowspan="2">0.42</td><td rowspan="2"></td><td rowspan="2">0.36</td><td rowspan="2">0.28</td></tr>
<tr><td>3</td><td>South West Khasi Hills</td></tr>
<tr><td>4</td><td>East Jaintia Hills</td><td rowspan="2">0.72</td><td rowspan="2"></td><td rowspan="2">0.68</td><td rowspan="2">0.32</td><td rowspan="2">0.56</td><td rowspan="2">0.42</td><td rowspan="2">0.34</td><td rowspan="2">0.41</td><td rowspan="2"></td></tr>
<tr><td>5</td><td>West Jaintia Hills</td></tr>
<tr><td>6</td><td>Ri-Bhoi</td><td>0.61</td><td></td><td></td><td></td><td></td><td>0.33</td><td>0.31</td><td>0.32</td><td>0.27</td></tr>
<tr><td>7</td><td>East Garo Hills</td><td rowspan="2">0.55</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">0.22</td><td rowspan="2"></td><td rowspan="2">0.25</td><td rowspan="2"></td><td rowspan="2">0.26</td><td rowspan="2"></td></tr>
<tr><td>8</td><td>North Garo Hills</td></tr>
<tr><td>9</td><td>West Garo Hills</td><td rowspan="2">0.59</td><td rowspan="2"></td><td rowspan="2">0.57</td><td rowspan="2">0.28</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">0.39</td><td rowspan="2"></td></tr>
<tr><td>10</td><td>South West Garo Hills</td></tr>
<tr><td>11</td><td>South Garo Hills</td><td></td><td></td><td>0.67</td><td>0.32</td><td></td><td></td><td></td><td>0.41</td><td></td></tr>
</table>

Table 21: District wise Ground Water Management Plan for Spring Management

District Name	District Area	Alluvium		Basalt		Sandstone		Shale		Limestone		Granite		Quartzite		Gneiss		Intrusive		Total area
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	**Area**	**%**	
East Khasi Hills	2748			133	4.84	134	4.86	275	10.01	4	0.13	607	22.08	1126	40.98	331	12.06	139	5.05	2748
West Khasi Hills	3906							110	2.82			544	13.92			3175	81.28	72	1.84	3901
South West Khasi Hills	1341			15	1.12	60	4.46	311	23.21			421	31.41			534	39.81			1341
East Jaintia Hills	2040					352	17.24	1389	68.07	21	1.01					250	12.28			2011
West Jaintia Hills	1779							220	12.36	13	0.73	105	5.90	536	30.15	905	50.87			1779
Ri-Bhoi	2448											550	22.46	127	5.20	1686	68.88	65	2.65	2428
East Garo Hills	1443							76	5.27			54	3.74			1313	90.99			1443
North Garo Hills	1160											48	4.14			573	49.39			621
West Garo Hills	2781					250	8.99	578	20.79							1366	49.12			2195
South West Garo Hills	896					502	55.98	47	5.22							97	10.85			646
South Garo Hills	1887					220	11.65	1290	68.38							377	19.97			1887
Total	22429			**148**	**0.66**	**1517**	**6.76**	**4296**	**19.16**	**37**	**0.16**	**2328**	**10.38**	**1790**	**7.98**	**10608**	**47.29**	**275**	**1.23**	20999

Area in Sq Km and % in respect to the total area of the District

Table 22: Area Delineated for Water Conservation and Harvesting

<table>
<tr><th>Sl No</th><th>District Name</th><th>Alluvium</th><th>Basalt</th><th>Sandstone</th><th>Shale</th><th>Limestone</th><th>Granite</th><th>Quartzite</th><th>Gneiss</th><th>Intrusive</th><th>Total Area</th></tr>
<tr><td>1</td><td>East Khasi Hills</td><td></td><td></td><td></td><td>39</td><td>4</td><td>37</td><td>67</td><td>3</td><td>51</td><td>199</td></tr>
<tr><td>2</td><td>West Khasi Hills</td><td>6</td><td></td><td></td><td>16</td><td></td><td>19</td><td></td><td>78</td><td></td><td rowspan="2">97</td></tr>
<tr><td>3</td><td>South West Khasi Hills</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>East Jaintia Hills</td><td></td><td></td><td></td><td>45</td><td></td><td></td><td></td><td>84</td><td></td><td rowspan="2">129</td></tr>
<tr><td>5</td><td>West Jaintia Hills</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>Ri-Bhoi</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>East Garo Hills</td><td>44</td><td></td><td></td><td></td><td></td><td></td><td></td><td>21</td><td></td><td rowspan="2">65</td></tr>
<tr><td>8</td><td>North Garo Hills</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>9</td><td>West Garo Hills</td><td></td><td></td><td>26</td><td>30</td><td></td><td></td><td></td><td>55</td><td></td><td rowspan="2">111</td></tr>
<tr><td>10</td><td>South West Garo Hills</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>11</td><td>South Garo Hills</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Grand Total</td><td>44</td><td></td><td>26</td><td>113</td><td>4</td><td>56</td><td>67</td><td>241</td><td>51</td><td>601</td></tr>
</table>

Area in Sq. km

Table 23: Area Suitable for Ground Water Development

Sl No	District Name	Alluvium	Basalt	Sandstone	Shale	Limestone	Granite	Quartzite	Gneiss	Intrusive	Total Area
1	**East Khasi Hills**		74	80	62	3	111	227	30	58	**644**
2	**West Khasi Hills**	6			16		46		422	22	**511**
3	**South West Khasi Hills**		3	18	20		111		51		**203**
4	**East Jaintia Hills**	11			354	1			105		**471**
5	**West Jaintia Hills**				60	2	39	107	450		**658**
6	**Ri-Bhoi**	20					129		279	26	**454**
7	**East Garo Hills**	22			17		12		393		**443**
8	**North Garo Hills**	490					10		191		**691**
9	**West Garo Hills**	530		398	17				411		**1355**
10	**South West Garo Hills**	56		426					24		**505**
11	**South Garo Hills**			37	36						**73**
Total		**1134**	**77**	**958**	**580**	**6**	**457**	**333**	**2356**	**105**	**6007**

Area in Sq. km