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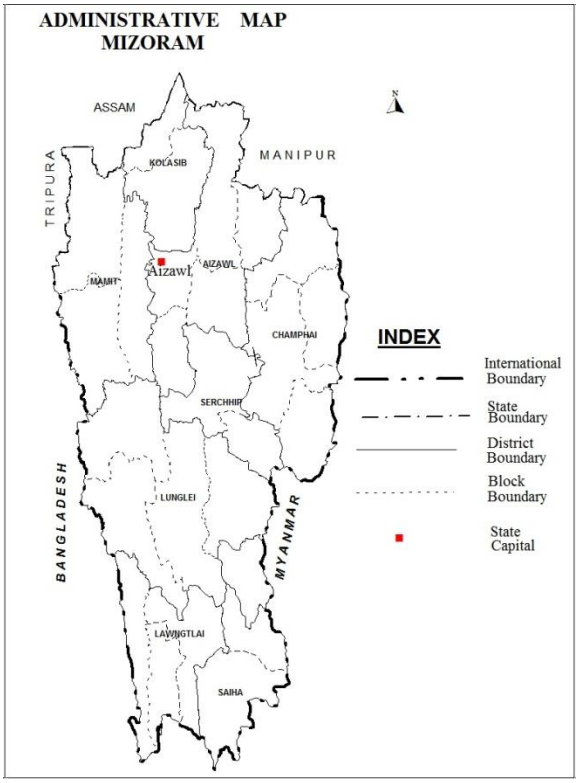
GOVERNMENT OF INDIA
MINISTRY OF JAL SHAKTI
DEPARTMENT OF WATER RESOURCES, RIVER DEVELOPMENT & GANGA REJUVENATION
CENTRAL GROUND WATER BOARD



DYNAMIC GROUND WATER RESOURCES MIZORAM
(As on March 2020)

NORTH EASTERN REGION, GUWAHATI

September 2021

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PREFACE

Mizoram is located in the northeastern part of India and is one of the most sparsely populated states of the country. More than three-fourths of the land area of Mizoram is forested. Agriculture is the dominant economic activity of the state, engaging more than two-thirds of the workforce. Geologically, the Mizo Hills form a part of the Rakhine (Arakan) Mountains, a series of compact parallel ridges with a north-south axis formed of sandstone, limestone, and shales-all Cenozoic rocks. The ridges, separated by narrow river valleys, rise to about 2100 meters.

Development of groundwater in the state is practically negligible. Rainfall is abundant in the state but there is cute shortage of water during the summer as majority of the rain is lost as surface run-off. Development of groundwater resources will help in the overall sustainable development of the State and its people and bring about agricultural revolution in this tribal state.

For a scientific planning of development of dynamic ground water resource potential, estimation of ground water resource has been done based on the latest methodology as recommended by Ground Water Resource Estimation Committee-2015(GEC-2015) and duly approved by Govt. of India. The report on dynamic Ground water resource potential has been assessed based on the field data generated by Central Ground Water Board and statistical information collected from other State Departments. The annual ground water recharge, net ground water availability and existing gross draft on irrigation and domestic uses, etc., have been estimated for the state. The report also highlights on the net annual ground water availability for future use.

The total annual ground water recharge in the state of Mizoram is 0.22 BCM. The Annual Extractable Ground Water Resources of the state is 1.19 BCM after deducting the natural discharge. Present Ground Water Extraction is 0.007 BCM all of which is on account of annual domestic extraction. The annual allocation for Domestic and Industrial uses up to 2025 has been made as 0.009 BCM based upon the population data projected up to year 2025. The over-all stage of ground water development of the state is a meager 4.0%.

I strongly believe that the report with its technical data will help in understanding present ground water scenario in Mizoram State and prove valuable to policy makers, technical experts, professionals and user agencies for management of ground water development in the state in planned manner.

(Biplab Ray)
Regional Director (i/c)

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Estimation of ground water resources of Mizoram involved contribution from different agencies such as CGWB, Govt. of India, PHED, MIRSAC, WR, Agriculture Department and Directorate of Economics and Statistics Planning (Statistics) Department of Govt. of Mizoram. PHED, Govt. of Mizoram made available most of the basic data required for the computations. The computation of resource estimation is done through INGRES software and preparation of the report is done by Ms.Anenuo Pienyu, Scientist-B.

1. INTRODUCTION

Perching on the high hills of North Eastern corner, Mizoram is a storehouse of natural beauty with its endless variety of landscape, hilly terrain, meandering streams deep gorges, rich wealth of flora and fauna. Flanked by Bangladesh on the west and Myanmar on the east and south, Mizoram occupies a long international boundary of 722 Kms (404 kms with Myanmar and 318 kms with Bangladesh). It has common boundary with Assam (123 kms), Tripura (277 kms) and Manipur (95 kms). The state lies between North latitudes $21^0 58'$ and $24^0 35'$ and East longitudes $92^0 15'$ and $93^0 29'$. The total geographic area of the state is 21081sq.km with the population of 10,91,014 (2011 Census). The state has been divided into 8 districts and 26 blocks.

1.a Background for re-estimating the ground water resources of the state.

The previous assessment of groundwater resources of Mizoram was carried during 2016-17. The ground water resource of the state has been re-estimated by Central Ground Water Board, North Eastern Region based on GEC 2015 methodology for the assessment year 2019-20. Census figures for population as per 2011 Census and data for the year 2019-20 provided by Government of Mizoram have been used to update and revise the assessment of groundwater resources of Mizoram.

During the year 2016-17, the annual groundwater recharge of the state was 0.21 BCM and the annual extractable ground water recharge was 0.19 BCM after deducting the natural discharge. The groundwater extraction estimated in 2016-17 was 0.007 BCM and the overall stage of groundwater was 3.82 %.

1.b Constitution of state level committee for ground water resources estimation.

Government of Mizoram has constituted a state level committee under the Chairmanship of the Commissioner & Secretary, Public Health Engineering Department (PHED) for ground water resource estimation with the following committee members.

i)	Commissioner & Secretary, PHED	-Chairman
ii)	Regional Director, CGWB, NER	-Member Secretary

iii) Engineer in Chief, PHED - Member

iv) Chief Engineer, Zone-I, PHED -Member

v) Chief Engineer, Zone-II, PHED -Member

vi) Chief Engineer, Hqtrs & WR, PHED -Member

vii) Chief Engineer, Irrigation & WRD -Member

viii) Director, Agriculture Department -Member

ix) Director, Industries Department -Member

x) General Manager, NABARD -Member

xi) Chief Scientific Officer, Directorate of Science & Technology – Co-opted Member

2. HYDROGEOLGICAL CONDITION OF MIZORAM

2.a Description of rock types with area coverage

Geologically the area is underlain by repetition of arenaceous and argillaceous sediments. The arenaceous and argillaceous group of rocks occurs in relatively higher and lower grounds respectively. These have deformed into a series of anticlinal and synclinal folds trending NNW-SSE to NNE-SSW with plunging direction is either towards north or south.

The state is occupied mainly by the rocks of the Tertiary formation ranging in age from Oligocene to Miocene to Recent. The general stratigraphic succession of the state is as follows:

AGE	SERIES		LITHOLOGY
RECENT	Alluvium		Clay, sands with pebbles conglomerate and gravels.
---------- Unconformity ----------			
MIOCENE	Tipam		Sandstone medium to coarse grained, ferruginous, friable with clay, shale mottled.
	Surma	Bokabil	Shale with siltstone, sandstone and mudstone in alternation.
		Bhuban	Sandstone fine grained, compact, Massive to well bedded with laminated siltstone, shale
----------Unconformity ----------			
OLIGECENE	Barail		Shale, siltstone with sand of sandstone fine grained.
Base not exposed			

The Barails form the lower most rock units comprising siltstone and bands of soft and hard fine grained sandstone with strings of carbonaceous material. The Barail formation occurs in the north eastern part of the state mostly covering Champhai district. The Surma is divided into two formations, Bhuban and Bokabil. The Bhuban is made up of grey sandstone and shale. Lower Bhuban is more arenaceous while the middle formation is more argillaceous and the Upper Bhuban is a combination of both and is soft in nature. The Bhutan formation occupies the major part of the state all along the length of the state. The Bokabil is predominantly argillaceous. The Bokabil formation mostly occurs along the western part of the state. The Tipam sandstone is of semi consolidated in nature comprising medium to coarse grained sandstone with

subordinate shale. The Tipam formation occurs in limited extent in the north western part of the state. The alluvial deposits comprising silt, clay and sands occur in the valley fill area with very limited thickness.

2.b Hydrometeorology

Climate

The state of Mizoram enjoys sub-tropical humid climate. It is generally cool in summer and not very cold in winter. During winter the temperature varies from 11ºC to 24ºC and in summer it varies between 20ºC to 29ºC.

Rainfall Distribution

Mizoram experiences the phenomenal influence of the South West Tropical monsoon which persists from May to October, with occasional winter showers. The average annual rainfall of the state is recorded to be 2794 mm with little variation within the state. The average monsoon rainfall is 1761 mm (63%) and non-monsoon rainfall is 1033 mm (37 %).

Relative humidity

The Relative humidity is high throughout the year but it reaches more than 85 percent during the months of January, March, April, May, June, July, October, November and December.

2.c Description of Hydrogeological Units

Hydrogeologically the various rock types found in Mizoram can be grouped into two categories i.e. semi-consolidated formations and unconsolidated formations.

The unconsolidated formations with limited alluvial thickness are restricted along streams and rivers. Semi-consolidated formations are developed secondary porosity due to tectonic disturbances. As the state is entirely occupied by hills with slopes mostly more than 20%, most of the rainwater flows out as surface runoff. In this type of terrain, the scope for ground water storage is limited to mostly secondary porosity and structural control in the higher elevation aquifers. Ground water is confined only to valley filled areas. These aquifers are the main source

for springs. Ground water stored in the hill slopes emanates in the form of springs, which are being used as a source for water supply.

Ground water exploration carried out by CGWB indicates that yield potential of deep tubewells within the depth range of 200 m tapping Tertiary sandstone ranges from 120 to 330 liters per minute for drawdown of 13 to 20 m. The transmissivity ranges from 11 to 46 m^2/day. Specific Capacity and Storativity of the Exploratory Well constructed at Bungthum and Zawlnuam in Lakichera valley is 25.61 lpm/mdd and $4.28x10^{-4}$ respectively.

SPRINGS

During field investigation it was found that only springs are easily accessible source for water. A large number of springs are noticed which are found in all places and altitude.

2.d Ground Water Level Conditions

Central Ground Water Board is not monitoring the depth to water level in the state due to non availability of representative dug wells. Ground water management studies carried out in state indicates depth to water levels are highly varies from hilly areas to plain areas.

2.e Ground Water Quality

The chemical analysis of water samples collected from springs indicates that the water is slightly alkaline with pH values ranging from 6.9-8.3. In general Electrical Conductivity of the ground water varies from 31-249 Micromhos/cm at 25^o C. The carbonate is nil and the concentration of bicarbonate ranges from 12-158 ppm. The range of concentrations of calcium and magnesium varies between 4 and 22 ppm respectively. The concentration of iron ranges from 0.02 to 0.3 ppm. In general ground water is fresh and potable and is suitable for domestic, irrigation and industrial purposes.

2. GROUND WATER RESOURCES ESTIMATION METHODOLOGY-GEC'2015

Brief Description

The present methodology used for resources assessment is known as Ground Water Resource Estimation Methodology – 2015 (GEC'2015). The revised methodology GEC 2015 recommends aquifer wise ground water resource assessment. Ground water resources have two components – Replenishable ground water resources or Dynamic ground water resources and In-storage resources or Static resources.GEC 2015 recommends estimation of Replenishable and in-storage ground water resources for both unconfined and confined aquifers. In GEC'2015, two approaches are recommended – water level fluctuation method and norms of rainfall infiltration method. The water level fluctuation method is based on the concept of storage change due to difference between various input and output components. Input refers to recharge from rainfall and other sources and subsurface inflow into the unit of assessment. Output refers to ground water draft, ground water evaporation, transpiration, base flow to streams and subsurface outflow from the unit. Since the data on subsurface inflow/ outflow are not readily available, it is advantageous to adopt the unit for ground water assessment as basin/ sub basin/ watershed, as the inflow / outflow across these boundaries may be taken as negligible.

Thus the ground water resources assessment unit is in general watershed particularly in hard rock areas. In case of alluvial areas, administrative block can also be the assessment unit. In each assessment unit, hilly areas having slope more than 20% are deleted from the total area to get the area suitable for recharge. Further, areas where the quality of ground water is beyond the usable limits should be identified and handled separately. The remaining area after deleting the hilly area and separating the area with poor ground water quality is to be delineated into command and non-command areas. Ground water assessment in command and non-command areas are done separately for monsoon and non-monsoon seasons.

3.1 Ground water Recharge

Monsoon season

Recharge from rainfall is estimated by using the following relationship -

Rrf = RFIF * A* (R – a)/1000

Where,

Rrf= Rainfall recharge in ham

A = Area in Hectares

RFIF = Rainfall Infiltration Factor

R = Rainfall in mm

a = Minimum threshold value above which rainfall induces ground water recharge in mm

The threshold limit of minimum and maximum rainfall event which can induce recharge to the aquifer is to be considered while estimating ground water recharge using rainfall infiltration factor method. The minimum threshold limit is in accordance with the relation shown in above equation and the maximum threshold limit is based on the premise that after a certain limit, the rate of storm rain is too high to contribute to infiltration and they will only contribute to surface runoff. It is suggested that 10% of Normal annual rainfall may be taken as minimum rainfall threshold and 3000 mm as maximum rainfall limit.

The resources assessment during monsoon season is estimated as the sum total of the change in storage and gross draft. The change in storage is computed by multiplying water level fluctuation between pre and post monsoon periods with the area of assessment and specific yield. Monsoon recharge can be expressed as –

$$R_{RF} = h \times Sy \times A - R_{OS} \pm VF \pm LF + GE + T + E + B$$

Where,

h = rise in water level in the monsoon season, A = area for computation of recharge,

Sy = specific yield, D_{G} = gross ground water draft, R_{OS}= Other sources of ground water recharge during monsoon season include R_c, R_{sw}, R_t, R_{gw}, R_{wc} which are recharge from seepage from canals, surface water irrigation, tanks and ponds, ground water irrigation, water conservation structures respectively; LF = Recharge through Lateral flow/ Through flow across assessment unit boundary in the monsoon season for the i^{th} particular year, VF – Vertical inter aquifer flow in the monsoon season for the i^{th} particular year, T- Transpiration in the monsoon season for the i^{th} particular year, E- Evaporation in the monsoon season for the i^{th} particular year, GE = Ground water extraction in monsoon season for the i^{th} particular year, B = Base flow the monsoon season for the i^{th} particular year

B = Base flow the monsoon season for the i^{th} particular year

The monsoon ground water recharge has two components – rainfall recharge and recharge from other sources. Mathematically it can be represented as –

$R(Normal) = R_{RF}\,(normal) + R_{OS}$

Where,

R_{rf} is the normal monsoon rainfall recharge. R_{OS} is the other sources of ground water recharge during monsoon season include R_c, R_{sw}, R_t, R_{gw}, R_{wc} which are recharge from seepage from canals, surface water irrigation, tanks and ponds, ground water irrigation, water conservation structures respectively

The rainfall recharge during monsoon season computed by Water Level Fluctuation (WLF) method is compared with recharge figures from Rainfall Infiltration Factor (RIF) method. In case the difference between the two sets of data are more than 20%, then RIF figure is considered, otherwise monsoon recharge from WLF is adopted. While adopting the rainfall recharge figures, weightage is to be given to WLF method over adhoc norms method of RIF. Hence, wherever the difference between RIF & WLF is more than 20%, data have to be scrutinized and corrected accordingly.

Non-Monsoon season

During non-Monsoon season, rainfall recharge is computed by using Rainfall Infiltration Factor (RIF) method. Recharge from other sources is then added to get total non-Monsoon recharge. In case of areas receiving less than 10% of the annual rainfall during non-monsoon season, the rainfall recharge is ignored.

Total annual ground water recharge

The total annual ground water recharge of the area is the sum-total of monsoon and non-monsoon recharge. An allowance is kept for natural discharge in the non-monsoon season by deducting 5% of total annual ground water recharge, if WLF method is employed to compute rainfall recharge during monsoon season and 10% of total annual ground water recharge if RIF method is employed. The balance ground water available accounts for existing ground water

withdrawal for various uses and potential for future development. This quantity is termed as Annual Extractable Ground Water Resources.

Annual Extractable Ground Water Resources (AEGR) = Annual Ground Water Recharge – Natural discharge during non-monsoon season

Norms for estimation of recharge

GEC'2015 methodology has recommended norms for various parameters being used in ground water recharge estimation. These norms vary depending upon water bearing formations and agroclimatic conditions. While norms for specific yield and recharge from rainfall values are to be adopted within the guidelines of GEC'2015, in case of other parameters like seepage from canals, return flow from irrigation, recharge from tanks & ponds, water conservation structures, results of specific case studies may replace the adhoc norms.

3.2 Ground Water Extraction

The gross yearly ground water extraction is to be calculated for Irrigation, Domestic and Industrial uses. The gross ground water extraction would include the ground water extraction from all existing ground water structures during monsoon as well as during non-monsoon period. While the number of ground water structures should preferably be based on latest well census, the average unit draft from different types of structures should be based on specific studies or ad-hoc norms given in GEC2015 report.

3.3 Stage of ground water Extraction & Categorization of units

The stage of Ground water Development is defined by,

$$\text{Stage of Ground water Extraction (\%)} = \frac{\text{Existing Gross Ground water extraction for all uses}}{\text{AEGR}} \times 100$$

Validation of Stage of Ground Water Extraction

The assessment based on the stage of ground water extraction has inherent uncertainties. It is desirable to validate the 'Stage of Ground Water Extraction' with long term trend of ground water levels.

If the ground water resource assessment and the trend of long term water levels contradict each other, this anomalous situation requires a review of the ground water resource computation, as well as the reliability of water level data. The mismatch conditions are enumerated below.

SOGWE	Ground Water Level Trend	Remarks
≤70%	Significant decline in trend in both pre-monsoon and post-monsoon	Not acceptable and needs reassessment
>100%	No significant decline in both pre-monsoon and post-monsoon long term trend	Not acceptable and needs reassessment

Categorization of Assessment Units

As emphasized in the National Water Policy, 2012, a convergence of Quantity and Quality of ground water resources is required while assessing the ground water status in an assessment unit. Therefore, it is recommended to separate estimation of resources where water quality is beyond permissible limits for the parameter salinity.

Categorization of Assessment Units Based on Quantity: The categorization based on status of ground water quantity is defined by Stage of Ground Water Extractionas given below:

Stage of Ground Water Extraction	**Category**
≤70%	Safe
>70%and ≤90%	Semi-Critical
>90%and ≤100%	Critical
> 100%	Over Exploited

Categorization of Assessment Units Based on Quality

The committee recommends that each assessment unit, in addition to the quantity based categorization (safe, semi-critical, critical and over-exploited) should bear a quality hazard identifier. Such quality hazards are to be based on available ground water monitoring data of State Ground Water Departments and/or Central Ground Water Board. If any of the three quality hazards in terms of Arsenic, Fluoride and Salinity are encountered in the assessment sub unit in mappable units, the assessment sub unit may be tagged with the particular quality hazard.

3.4 Allocation of ground water resource for utilization

The net annual ground water availability is to be apportioned between domestic, industrial and irrigation uses. Among these, as per the National Water Policy, 2002, requirement for domestic water supply is to be accorded priority. The requirement for domestic and industrial water supply is to be kept based on population as projected to the year 2025. The water available for irrigation use is obtained by deducting the allocation for domestic and industrial use, from the net annual ground water availability.

3.5 Poor quality ground water

Computation of ground water recharge in poor quality ground water is to be done on the same line as described above. However, in saline areas, there may be practical difficulty due to non availability of data, as there will usually be no observation wells in such areas. Recharge assessment in such cases may be done based on rainfall infiltration factor method.

3.6 Apportioning of ground water assessment from watershed to development unit

Where the assessment unit is a watershed, the ground water assessment is converted in terms of an administrative unit such as block/ taluka/ mandal. This is done by converting the volumetric resource into depth unit and then multiplying this depth with the corresponding area of the block.

3.7 *Additional Potential Recharge*

In shallow water table areas, particularly in discharge areas, rejected recharge would be considerable and water level fluctuation are subdued resulting in under-estimation of recharge component. In the area where the ground water level is less than 5m below ground level or in waterlogged areas, ground water resources have to be estimated upto 5m bgl only based on the following equation -

Potential ground water recharge = (5-D) X A X Sp. Yield

Where,

D = Depth to water table below ground surface in pre-monsoon season in shallow aquifers;

A = Area of shallow water table zone.

The potential recharge from flood plain is estimated based on the same norms as for ponds, tanks and lakes.

Potential Resource Due to Spring Discharge: Spring discharge constitutes an additional source of ground water in hilly areas which emerges at the places where ground water level cuts the surface topography. The spring discharge is equal to the ground water recharge minus the outflow through evaporation and evapotranspiration and vertical and lateral sub-surface flow.

4. PROCEDURE FOLLOWED IN THE PRESENT ASSESSMENT INCLUDING ASSUMPTIONS

- **Data source for each of the data element and how the data was used in the computation (Constraints in the data base if any).**

The major source for various data elements are:

a. The assessment made for ground water resources for the year 2004, 2008-09, 2010-11 2012-13 & 2016-17.

b. Hilly Area demarcation (having slope more than 20%) by MIRSAC.

c. Statistical hand book of Mizoram.

d. Data collected during 2019-20.

c. Report on hydrogeological surveys in parts of Aizawl and Champai districts.

d. District Ground Water Management Studies in parts of Aizawl (erstwhile north and west) districts of Mizoram.

a. Report on pilot project studies under technology mission on drinking water and related water management in central and eastern parts of erstwhile Aizawl district of Mizoram.

f. Basic Data Report of Exploratory well drilled at Bungthuam, Aizawl district of Mizoram.

- **Constraints in the data base**

a. Non availability of representative depth to water level data- CGWB does not have National Hydrograph Network Stations for monitoring the water levels in the state of Mizoram.

b. Irrigation data – season-wise and crop-wise coverage.

- **Changes if any applied in the original methodology proposed by GEC along with justifications.**

a) No changes have been applied in the original methodology proposed by GEC in the case of computation of resource, draft etc.

b) **Change of methodology applied for Categorization of blocks** – Categorization was done based on stage of development only, instead of stage of groundwater extraction and validation.

c) Since there is no monitoring well in the state, long term trends couldn't utilized for validation purpose.

- **Various norms used in the computation:**

a.	Hilly area	**:** more than 20% slope
b.	Command area threshold limit	**:** 100 hectares.
c.	Rainfall infiltration factor	**:** 0.04 (4%).
d.	Recharge from Ground water irrigation	**:** Nil.
e.	Recharge from surface water irrigation (Since entire falls under Non-command)	**:** Nil
f.	Recharge from Ponds and Tanks	**:** Negligible
g.	Recharge from Check dams and Nallas	**:** Negligible.
h.	Percapita requirement of water for domestic use.	**:** 60 liters/day
i.	Unaccounted Natural Discharge	**:** 10%
j.	Ground Water Draft- STW (Domestic)	**:** 0.05 ham (source PHE, Mizoram)
k.	Ground Water Draft (Irrigation)	**:** Nil
l.	Ground Water Draft (Industry)	**:** Nil
m.	Water level trend	**:**NA (No monitoring stations)

- **Any documented field studies**

No documented field studies were carried out.

5. COMPUTATION OF GROUND WATER RESOURCE ESTIMATION IN MIZORAM

a. Salient features of the dynamic ground water resources assessments including the type assessment units, total number of assessment units in the state, base-year of collection of data, year of projection of data.

The ground water assessment year is 2019-20. The smallest administrative unit, i.e. the block, has been taken as the unit of computation. This is mainly because of the lack of data especially on population, number of ground water structures, draft and other important parameters on watershed basis. The following sub-units have been considered for computation of the ground water resource as per the methodology recommended by GEC2015.

- **Hilly Area and Recharge Worthy Areas:**

Hilly areas are those with more than 20% slope. The state of Mizoram has about 15% of hilly area. Block-wise data on areas having slope more than 20% and less than 20% is collected from Mizoram Remote Sensing Application Centre (MIRSAC), Govt. of Mizoram, Aizawl. In the earlier studies the recharge worthy areas has been calculated from the toposheet of Mizoram available on 1:50000 scale. For the parts for which the toposheet was not available, the recharge worthy areas have been calculated taking into account the area suitable for Wet Rice Cultivation (W.R.C.Statistics) as furnished in the Agricultural abstract of the Department of Agriculture and Minor Irrigation of the Government of Mizoram.

In the present study, recharge worthy area is considered as 314941 ha.

- **Poor Water Quality Area:**

There is no such reported area in the state of Mizoram, hence they have not been considered.

- **Command And Non-Command Area:**

In Mizoram there is no command area as per the GEC2015 Methodology since no Irrigation Project is having command area over the threshold limit of 100 hectares. The entire state has thus been considered as non-command area.

- **Type of assessment unit:** Administrative.

- **Total number of assessment units in the state:** 26 blocks

b. Assessment sub-unit wise method adopted for computing rainfall recharge during monsoon season (WLF/RIF).

Rainfall Infiltration Factor (RIF) method adopted for computing rainfall recharge during monsoon season in the absence of availability of water level data.

c. The total resources of the state, existing development, balance available for future development, stage of development, categorization of assessment units and other relevant salient features of the resources assessment in the state.

The total resources of the state	: 0.19 BCM
Gross ground water draft (annual)	: 0.007 BCM
Balance available for future development	: 0.19 BCM
Stage of development	: 4.0 %
Categorization of assessment units	: Safe (All units)
Ground water recharge in Poor quality zone	: Nil

d. Spatial variation of the Ground water recharge and development scenario in the state.

Annual Extractable ground water resources in the state are of the order of 0.19 BCM. Maximum annual extractable ground water resource of 0.05 BCM is found in Mamit district while the minimum of 0.007 BCM is in Saiha district. The stage of ground water extraction is the maximum in Aizawl district with 14.0 % while the lowest is found in Kolasib district with 1.0 %.

e. Comparison with the earlier ground water resources estimate and reasons for significant departure from earlier estimates.

A comparison is made between the previous estimate as on March 2017 and present estimate based on GEC'15 as on 2020, and presented in tabular statement given below.

Table showing comparison of Ground Water Resource estimates between 2016-17 and 2019-20

Sl. No.	ITEM	Year, 2016-17	Year, 2019-20	COMPARISON
	Estimation	Manual	INGRES	
1	Total Annual Ground Water Recharge (BCM)	0.21	0.22	+0.01
2	Annual Extractable Ground Water Resources (BCM)	0.19	0.19	+0.00
3	Irrigation Draft (BCM)	0.0	0.0	+0.00
4	Domestic Draft (BCM)	0.007	0.007	+0.00
5	Stage of GW Extraction (%)	3.82	4.0	+0.18
6	Provision for Domestic, Industrial & Other uses (BCM)	0.011	0.008	-0.003
7	GW availability for future development	0.18	0.19	+0.01
9	No. of O.E. Units	0	0	+0.00
10	No. of Dark/ Critical units	0	0	+0.00

The comparison depicts that there is an increase in total annual ground water recharge by 0.01 BCM in the 2020 estimate. Stage of GW Extraction has increased from 3.82 % in 2017 to 4.0 % 2020.

f. Ground water recharge in poor ground water quality zone.

There is no poor ground water quality area in the state.

g. Additional annual potential recharges.

Govt. of Mizoram has provided with block-wise number of springs and accordingly annual potential recharge from those springs were estimated. It was considered that during

monsoon season discharge of a spring ranges from 2.0 - 168.0 litre per second and during non-monsoon season the discharge ranges from 1.0 - 84.0 litre per second.

6. AUTOMATION OF ESTIMATION OF DYNAMIC GROUND WATER RESOURCES USING GEC-2015 THROUGH IN-GRES

The computation of the resource estimation of Mizoram for the year 2019-20 is done through IN-GRES software (India Ground Water Resource Estimation System).IN-GRES is the common portal to input, estimate, analyze, and access static and dynamic groundwater resources. India GEC system will take Data Input through Excel as well as through Forms, compute various Ground water components (recharge, draft, flux, etc.), classify assessment unit into appropriate categories, develop visibility dashboards for each of the components. System allows user to view the data in both MIS as well as GIS view. User can also download the reports in formats like CGWB, etc.

India GEC system is divided into 3 modules – Input, Computation and Output.

i. Input module – Input Module refers to the Data Entry module at an Assessment Unit level. Data Input is done via 2 methods i.e.

a. Excel based input – In this, the user needs to download District level data sheet template where he/she can fill the data at an Assessment Unit level. User now needs to upload their fully filled excel sheet into the system.

b. Form based input – In this, the user is shown a form and he/she can fill/edit the data in data sheet in an online mode. Once user is done with editing online, he/she can Submit the data file.

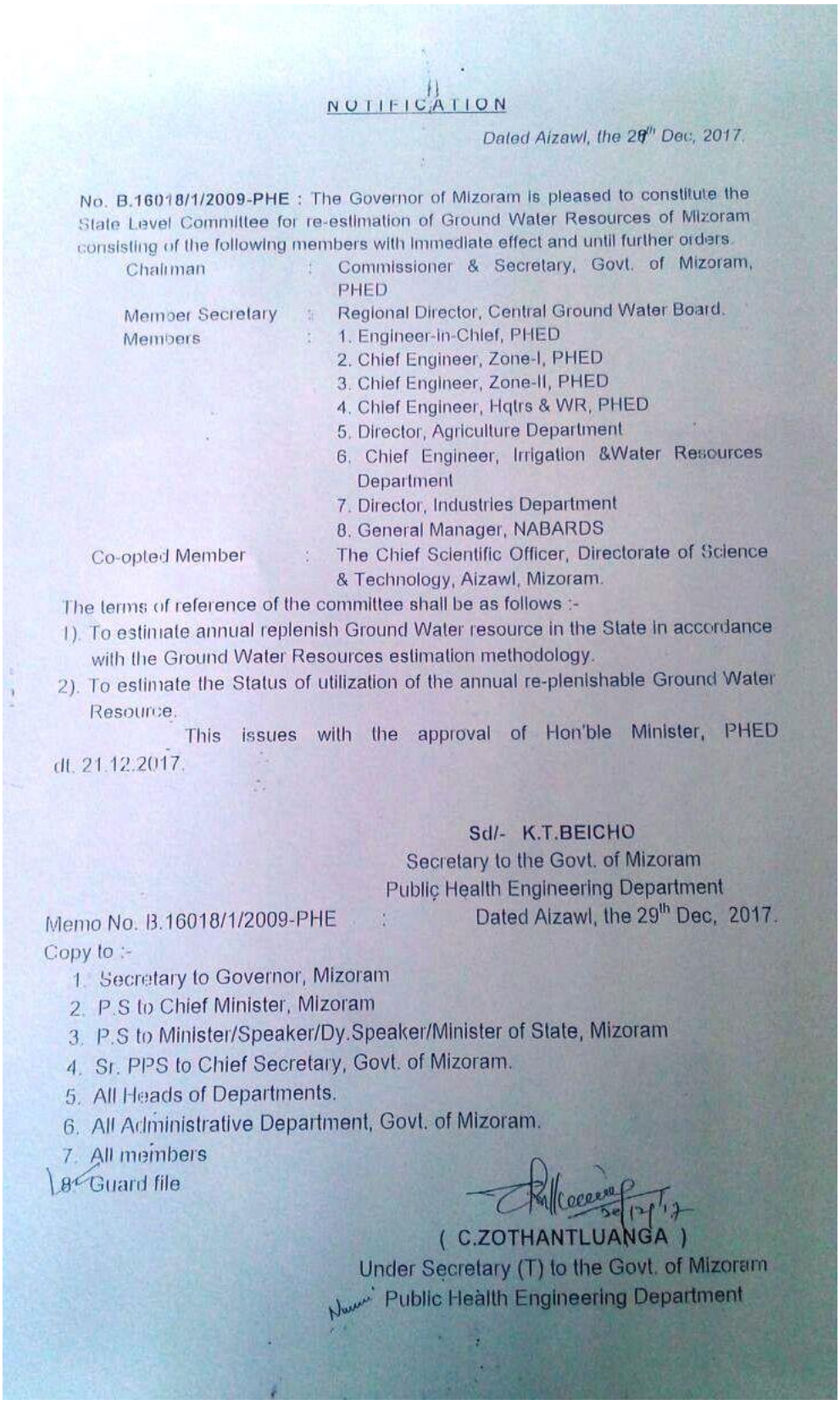
ii. Computation module – Computation Module refers to the ground water calculations for an assessment unit. These computations are based on GEC 2015 methodology and are used to calculate Annual Extractable Ground Water Resource, Total Current Annual Ground Water Extraction (utilization) and the percentage of ground water utilization with respect to recharge (stage of Ground Water Extraction) for an assessment unit. Based on these percentages an assessment unit is categorized into SAFE, SEMI-CRITICAL, CRITICAL AND OVEREXPLOITED categories.

iii. Output module Once categorized the data is shown in two views:

a. MIS Dashboard – MIS dashboard shows the results of the assessment for the entire India, and also State wise in tabular form. The MIS dashboard shows all type of recharges, extractions, inflows and outflows computed for both monsoon and non-monsoon periods of the year and then reflect the overall stage of extraction at the selected Geo-Zoom Level.

b. GIS Dashboard – GIS dashboard shows the data in Web Geo-Server format, implemented in interactive GIS platform allowing user to all GEC related information in the map itself. GIS view represents the data on India map and color codes each District/Assessment unit based on the categorization.

Appendix – I :Government order on constitution of Committee Mizoram



NOTIFICATION

Dated Aizawl, the 28th Dec, 2017.

No. B.16018/1/2009-PHE : The Governor of Mizoram is pleased to constitute the State Level Committee for re-estimation of Ground Water Resources of Mizoram consisting of the following members with immediate effect and until further orders.

Chairman	:	Commissioner & Secretary, Govt. of Mizoram, PHED
Member Secretary	:	Regional Director, Central Ground Water Board.
Members	:	1. Engineer-in-Chief, PHED
		2. Chief Engineer, Zone-I, PHED
		3. Chief Engineer, Zone-II, PHED
		4. Chief Engineer, Hqtrs & WR, PHED
		5. Director, Agriculture Department
		6. Chief Engineer, Irrigation &Water Resources Department
		7. Director, Industries Department
		8. General Manager, NABARDS
Co-opted Member	:	The Chief Scientific Officer, Directorate of Science & Technology, Aizawl, Mizoram.

The terms of reference of the committee shall be as follows :-

1). To estimate annual replenish Ground Water resource in the State in accordance with the Ground Water Resources estimation methodology.

2). To estimate the Status of utilization of the annual re-plenishable Ground Water Resource.

This issues with the approval of Hon'ble Minister, PHED dt. 21.12.2017.

Sd/- K.T.BEICHO
Secretary to the Govt. of Mizoram
Public Health Engineering Department

Memo No. B.16018/1/2009-PHE : Dated Aizawl, the 29th Dec, 2017.

Copy to :-

1. Secretary to Governor, Mizoram
2. P.S to Chief Minister, Mizoram
3. P.S to Minister/Speaker/Dy.Speaker/Minister of State, Mizoram
4. Sr. PPS to Chief Secretary, Govt. of Mizoram.
5. All Heads of Departments.
6. All Administrative Department, Govt. of Mizoram.
7. All members
8. Guard file

(C.ZOTHANTLUANGA)
Under Secretary (T) to the Govt. of Mizoram
Public Health Engineering Department

Appendix – II :Minutes of the first meeting of the State Level Committee Mizoram

MINUTES OF THE FIRST MEETING OF THE STATE LEVEL COMMITTEE HELD ON 19th MARCH, 2021 THROUGH GOOGLE MEET FOR ASSESSMENT OF THE DYNAMIC GROUND WATER RESOURCES (as on March 2020) FOR THE STATE OF MIZORAM

The meeting of the State Level Committee (SLC) for Assessment of Dynamic Ground Water Resources of Mizoram was held on 19.03.2021 through Google Meet under the Chairmanship of Er. C. Lalremsiama, Engineer- In -Chief, PHE Department, Govt. of Mizoram.

The list of Members attended the meetings are:

1. Shri Biplab Ray, Regional Director (i/c), CGWB, NER, Guwahati& Member Secretary
2. Shri T Chakraborty, Officer – In-Charge, CGWB, SUO, Shillong
3. Er. F. Lianluanga, Chief Engineer, Zone II,PHE Department, Govt. of Mizoram
4. Dr. S. S. Singh, Scientist C, Central Ground Water Board, GOI
5. Er. Lalropuia, SE(Monitoring) & State Nodal Officer (GWRE), PHED, Govt. of Mizoram
6. Er. S K Das, SE, Irrigation & Water Resources Department, Govt. of Mizoram
7. Er. Malsawma Hauhnar, Sr. EE, I& WRD, Govt. of Mizoram
8. Mr Lalruatkima, Hydrogeologist, PHED, Govt. Of Mizoram
9. Dr. F Labiak mawia, Asstt. Hydrogeologist,PHED, Govt. Of Mizoram

The Chairman, SLC, Govt.of Mizoram welcomed the committeemembers. Shri B Ray, H O O, CGWB, NER, Guwahatigive a brief on dynamic ground water resource estimation for Mizoram for 2019-20.

Shri T Chakraborty, OIC, CGWB, SUO, Shillong started the presentation with introducing the INGRES software; he said that dynamic groundwater resources in Mizoram are estimated jointly by CGWB and the State Govt. Departments. Healso informed that earlier this dynamic groundwater resource estimation work was done manually throughout the country. Later it was observed that some minor computational error might haveoccurred in calculating the resource, as the process of dynamic groundwater resource estimation is a complicated and lengthy. So to overcome this human error,Ministry of Jal Shakti in collaboration with IIT Hyderabad developed the software INGRES (INDIA GROUNDWATER RESOURCE ESTIATION SOFTWARE). First, he has presented the excel sheets containing data received from the State Govt. Departments that are uploaded in the software. Then he logged into INGRES and shown the dynamic groundwater resources estimated and lastly a comparison sheet showing difference between dynamic ground water resources for 2016-17 and 2019-20 has been presented before the committee members. Healso mentioned that the manual calculation has also been done and it matches with the result of INGRES.

After thorough deliberation by various members of the committee, the Dynamic Groundwater Resource Estimation of Mizoram using INGES was finally approved by the committee.

19/03/2021

(BIPLAB RAY)
Regional Director (ic) &
Member Secretary, State Level Committee for
Dynamic Ground Resources Assessment

Annexure I
General Description of Administrative Unit/Assessment Unit of Mizoram (As on March 2020)

S.No.	District	Assessment Unit/Block	Total Geographical Area						Rainfall	Ground Water Recharge
			Recharge Worthy Area				Hilly Area	Total		
			C	NC	PQ	Total				
1	AIZAWL	AIBAWK	0	131	0	131	54933	55064	2352	10
2	AIZAWL	DARLAWN	0	7623	0	7623	97420	105043	2352	574
3	AIZAWL	PHULLEN	0	3343	0	3343	52547	55890	2352	252
4	AIZAWL	THINGSULTHLIAH	0	4161	0	4161	68939	73100	2352	313
5	AIZAWL	TLANGNUAM	0	6476	0	6476	62027	68503	2352	488
6	CHAMPHAI	CHAMPHAI	0	8096	0	8096	50984	59080	1863	491
7	CHAMPHAI	KHAWBUNG	0	5495	0	5495	61040	66535	1863	333
8	CHAMPHAI	KHAWZAWL	0	9486	0	9486	103801	113287	1863	576
9	CHAMPHAI	NGOPA	0	5596	0	5596	74002	79598	1863	340
10	KOLASIB	BILKHAWTHLIR	0	18978	0	18978	32128	51106	2199	1335
11	KOLASIB	NORTH THINGDAWL	0	20537	0	20537	66557	87094	2199	1445
12	LAWNGTLAI	BUNGTLANG SOUTH	0	14659	0	14659	35542	50201	1949	914
13	LAWNGTLAI	CHAWNGTE	0	24542	0	24542	45406	69948	1949	1530
14	LAWNGTLAI	LAWNGTLAI	0	11093	0	11093	77200	88293	1949	692
15	LAWNGTLAI	SANGAU	0	1781	0	1781	45477	47258	1949	111
16	LUNGLEI	HNAHTHIAL	0	5275	0	5275	89322	94597	2299	388
17	LUNGLEI	LUNGLEI	0	9850	0	9850	99043	108893	2299	725
18	LUNGLEI	LUNGSEN	0	34645	0	34645	102595	137240	2299	2548
19	LUNGLEI	WEST BUNGHMUN	0	24717	0	24717	90253	114970	2299	1818
20	MAMIT	REIEK	0	11650	0	11650	71977	83627	2447	912
21	MAMIT	WEST PHAILENG	0	20459	0	20459	79119	99578	2447	1602
22	MAMIT	ZAWLNUAM	0	39522	0	39522	77673	117195	2447	3094
23	SAIHA	SAIHA	0	2266	0	2266	40882	43148	2371	172
24	SAIHA	TUIPANG	0	8394	0	8394	88358	96752	2371	637
25	SERCHHIP	E LUNGDAR	0	3846	0	3846	40595	44441	1743	215
26	SERCHHIP	SERCHHIP	0	12320	0	12320	85339	97659	1743	687
		Total	0	314941	0	314941	1793159	2108100	2200	22201

Annexure II
Assessment of Dynamic Ground Water Resources of Mizoram (As on March 2020) in Ham

Sl. No.	District	Assessment Unit/Block	Monsoon Season		Non-Monsoon Season			Total Natural Discharges	Annual Extractable Ground Water Resource	Current Annual Ground Water Extraction				Annual GW Allocation for Domestic use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction(%)
			Recharge from rainfall	Recharge from other Sources	Recharge from rainfall	Recharge from other Sources	Total Annual Ground Water Recharge			Irrigation	Industrial	Domestic	Total			
1		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Aizawl	AIBAWK	7.81	0	2.05	0	9.86	0.98	8.88	0	0	5.94	5.94	6.83	2.04	66.89
2	Aizawl	DARLAWN	454.33	0	119.53	0	573.86	57.38	516.48	0	0	19.44	19.44	22.39	494.08	3.76
3	Aizawl	PHULLEN	199.24	0	52.42	0	251.66	25.16	226.5	0	0	13.12	13.12	15.11	211.38	5.79
4	Aizawl	THINGSULTHLIAH	248.00	0	65.24	0	313.24	31.32	281.92	0	0	16.84	16.84	19.4	262.52	5.97
5	Aizawl	TLANGNUAM	385.97	0	101.54	0	487.51	48.75	438.76	0	0	143.75	143.75	165.59	273.17	32.76
6	CHAMPHAI	CHAMPHAI	413.22	0	78.05	0	491.27	49.12	442.15	0	0	29.18	29.18	32.06	410.1	6.60
7	CHAMPHAI	KHAWBUNG	280.46	0	52.97	0	333.43	33.35	300.08	0	0	1.48	1.48	1.62	298.45	0.49
8	CHAMPHAI	KHAWZAWL	484.17	0	91.45	0	575.62	57.57	518.05	0	0	7.22	7.22	7.93	510.12	1.39
9	CHAMPHAI	NGOPA	285.62	0	53.95	0	339.57	33.96	305.61	0	0	7.52	7.52	8.27	297.35	2.46
10	KOLASIB	BILKHAWTHLIR	1093.13	0	242.16	0	1335.29	133.53	1201.76	0	0	22.12	22.1	25.77	1175.99	1.84

													2			
11	KOLASIB	NORTH THINGDAWL	1182.93	0	262.05	0	1444.98	144.5	1300.48	0	0	9.11	9.111	10.62	1289.86	0.70
12	LAWNGTLAI	BUNGTLANG SOUTH	832.63	0	81.5	0	914.13	91.41	822.72	0	0	4.41	4.41	5.42	817.3	0.54
13	LAWNGTLAI	CHAWNGTE	1393.99	0	136.45	0	1530.44	153.04	1377.4	0	0	29.82	29.82	36.65	1340.75	2.16
14	LAWNGTLAI	LAWNGTLAI	630.08	0	61.6799999999999	0	691.76	69.18	622.58	0	0	58.73	58.73	72.18	550.4	9.43
15	LAWNGTLAI	SANGAU	101.16	0	9.900000000000001	0	111.06	11.11	99.95	0	0	7.66	7.66	9.42	90.53	7.66
16	LUNGLEI	HNAHTHIAL	354.9	0	33.13	0	388.03	38.8	349.23	0	0	60.33	60.333	64.75	284.49	17.28
17	LUNGLEI	LUNGLEI	662.71	0	61.86	0	724.57	72.46	652.11	0	0	62.19	62.19	66.74	585.37	9.54
18	LUNGLEI	LUNGSEN	2330.92	0	217.57	0	2548.49	254.85	2293.64	0	0	48.4	48.4	51.95	2241.69	2.11
19	LUNGLEI	WEST BUNGHMUN	1662.96	0	155.22	0	1818.18	181.82	1636.36	0	0	27	27	28.97	1607.39	1.65
20	MAMIT	REIEK	710.18	0	201.78	0	911.96	91.2	820.76	0	0	28.08	28.08	35.1	785.67	3.42
21	MAMIT	WEST PHAILENG	1247.18	0	354.35	0	1601.53	160.16	1441.37	0	0	34.74	34.742	43.42	1397.95	2.41
22	MAMIT	ZAWLNUAM	2409.26	0	684.52	0	3093.78	309.38	2784.4	0	0	35.72	35.72	44.64	2739.76	1.28
23	SAIHA	SAIHA	153.91	0	18.04	0	171.95	17.19	154.76	0	0	29.32	29.32	32.87	121.89	18.95
24	SAIHA	TUIPANG	570.12	0	66.8200000000001	0	636.94	63.69	573.25	0	0	11.4	11.4	12.78	560.46	1.99

25	SERCHHIP	E LUNGDAR	186.92	0	27.69	0	214.61	21.46	193.15	0	0	27.77	27.77	31.03	162.12	14.38
26	SERCHHIP	SERCHHIP	598.75	0	88.7	0	687.45	68.75	618.7	0	0	20.88	20.88	23.33	595.37	3.37
		Total (Ham)		0		0	22201	2220	19981	0	0	762	762	875	19106	4.0
		Total (BCM)	0.189	0	0.033	0	0.222	0.022	0.2	0	0	0.0076	0.008	0.009	0.191	4.0

Annexure III
District Wise Comparison of Ground Water Resource

S.No.	District	Total Annual Ground Water Recharge			Annual Extractable Ground Water Recharge			Total Current Annual Ground Water Extraction			Stage of Ground Water Extraction (%)		
		2019-2020	2016-2017	Diff	2019-2020	2016-2017	Diff	2019-2020	2016-2017	Diff	2019-2020	2016-2017	Diff
1	AIZAWL	1636	1554	-82	1473	1399	-74	199	193	-6	14	14	0
2	CHAMPHAI	1740	1527	-213	1566	1374	-192	45	44	-2	3	3	0
3	KOLASIB	2780	1981	-799	2502	1783	-719	31	30	-2	1	2	0
4	LAWNGTLAI	3247	3979	732	2923	3581	659	101	95	-6	3	3	0
5	LUNGLEI	5479	5727	247	4931	5154	223	198	193	-5	4	4	0
6	MAMIT	5607	4705	-903	5047	4234	-812	99	92	-6	2	2	0
7	SAIHA	809	818	9	728	736	8	41	39	-2	6	5	0
8	SERCHHIP	902	991	89	812	892	80	49	47	-2	6	5	0
	total(Ham)	22201	21281	-920	19981	19907	-74	762	732	-30	4	4	

Annexure IV
Categorization of Blocks/Mandals/Talukas (2019-20)

S.No.	District	Assessment Unit/Block	Assessment type	Total No. Of assessed Units	Categorisation									
					Safe		Semi Critical		Critical		Over-exploited		Saline	
					Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
1	AIZAWL	AIBAWK	Block	1	1	100	-	-	-	-	-	-	-	-
2	AIZAWL	DARLAWN	Block	1	1	100	-	-	-	-	-	-	-	-
3	AIZAWL	PHULLEN	Block	1	1	100	-	-	-	-	-	-	-	-
4	AIZAWL	THINGSULTHLIAH	Block	1	1	100	-	-	-	-	-	-	-	-

5	AIZAWL	TLANGNUAM	Block	1	1	100	-	-	-	-	-	-	-	-
6	CHAMPHAI	CHAMPHAI	Block	1	1	100	-	-	-	-	-	-	-	-
7	CHAMPHAI	KHAWBUNG	Block	1	1	100	-	-	-	-	-	-	-	-
8	CHAMPHAI	KHAWZAWL	Block	1	1	100	-	-	-	-	-	-	-	-
9	CHAMPHAI	NGOPA	Block	1	1	100	-	-	-	-	-	-	-	-
10	KOLASIB	BILKHAWTHLIR	Block	1	1	100	-	-	-	-	-	-	-	-
11	KOLASIB	NORTH THINGDAWL	Block	1	1	100	-	-	-	-	-	-	-	-
12	LAWNGTLAI	BUNGTLANG SOUTH	Block	1	1	100	-	-	-	-	-	-	-	-
13	LAWNGTLAI	CHAWNGTE	Block	1	1	100								
14	LAWNGTLAI	LAWNGTLAI	Block	1	1	100	-	-	-	-	-	-	-	-
15	LAWNGTLAI	SANGAU	Block	1	1	100	-	-	-	-	-	-	-	-
16	LUNGLEI	HNAHTHIAL	Block	1	1	100	-	-	-	-	-	-	-	-
17	LUNGLEI	LUNGLEI	Block	1	1	100	-	-	-	-	-	-	-	-
18	LUNGLEI	LUNGSEN	Block	1	1	100	-	-	-	-	-	-	-	-
19	LUNGLEI	WEST BUNGHMUN	Block	1	1	100	-	-	-	-	-	-	-	-
20	MAMIT	REIEK	Block	1	1	100	-	-	-	-	-	-	-	-
21	MAMIT	WEST PHAILENG	Block	1	1	100	-	-	-	-	-	-	-	-
22	MAMIT	ZAWLNUAM	Block	1	1	100	-	-	-	-	-	-	-	-
23	SAIHA	SAIHA	Block	1	1	100	-	-	-	-	-	-	-	-
24	SAIHA	TUIPANG	Block	1	1	100	-	-	-	-	-	-	-	-
25	SERCHHIP	E LUNGDAR	Block	1	1	100	-	-	-	-	-	-	-	-
26	SERCHHIP	SERCHHIP	Block	1	1	100	-	-	-	-	-	-	-	-

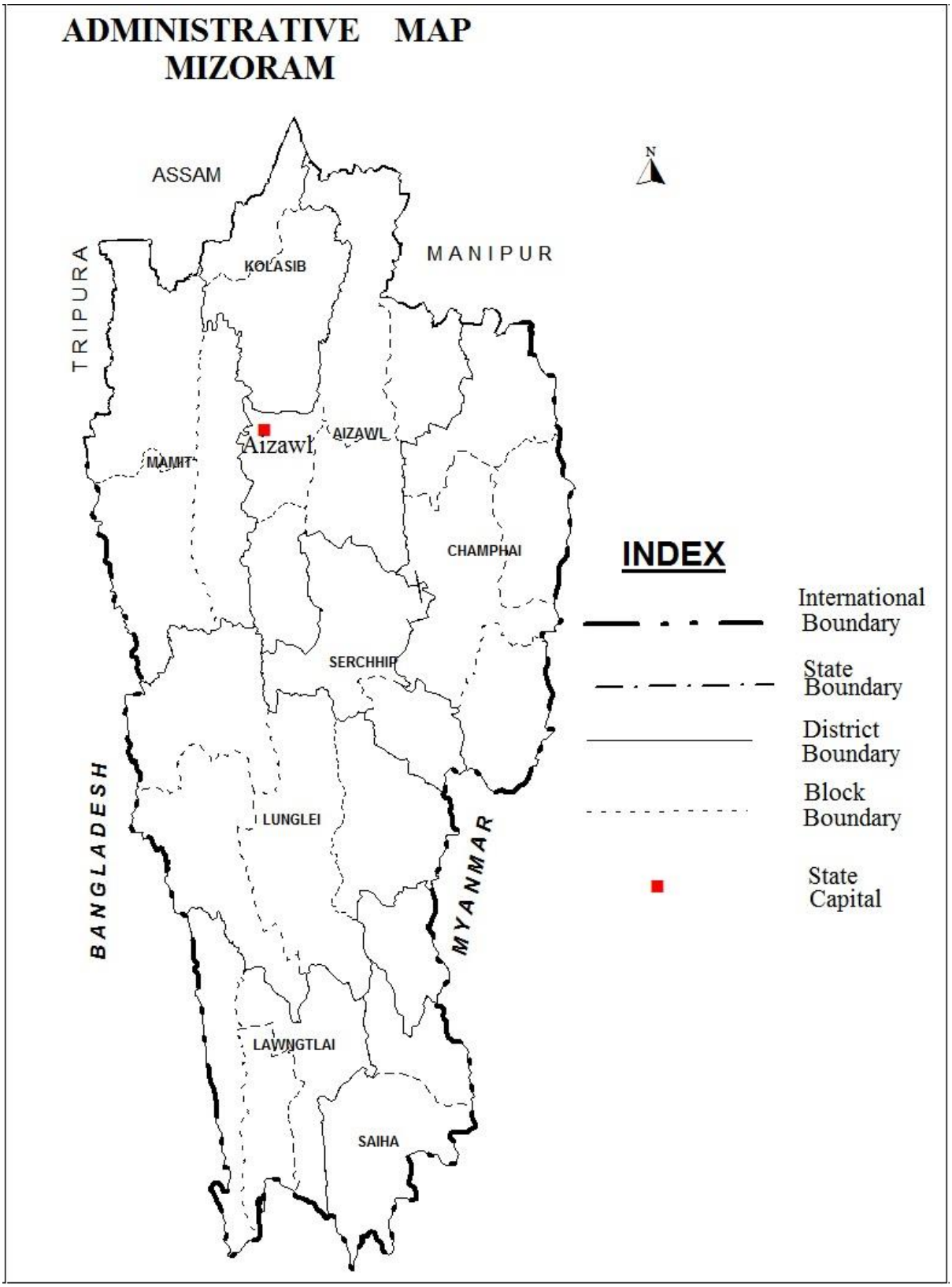
Annexure V-A
District Wise Categorisation (2019-20)

S.No.	District	Total Geographical Area in 1000 sq km	Recharge Worthy Area in 1000 sq km	Safe		Semi Critical		Critical		Over exploited		Saline	
				Recharge Worthy Area in 1000 sq km	%	Recharge Worthy Area in 1000 sq km	%	Recharge Worthy Area in 1000 sq km	%	Recharge Worthy Area in 1000 sq km	%	Recharge Worthy Area in 1000 sq km	%
1	AIZAWL	4	0	0	100	-	-	-	-	-	-	-	-
2	CHAMPHAI	3	0	0	100	-	-	-	-	-	-	-	-
3	KOLASIB	1	0	0	100	-	-	-	-	-	-	-	-
4	LAWNGTLAI	3	1	1	100	-	-	-	-	-	-	-	-
5	LUNGLEI	5	1	1	100	-	-	-	-	-	-	-	-
6	MAMIT	3	1	1	100	-	-	-	-	-	-	-	-
7	SAIHA	1	0	0	100	-	-	-	-	-	-	-	-
8	SERCHHIP	1	0	0	100	-	-	-	-	-	-	-	-
	Total States	21	3	3	100	-	-	-	-	-	-	-	-
	Grand Total	21	3	3	100	-	-	-	-	-	-	-	-

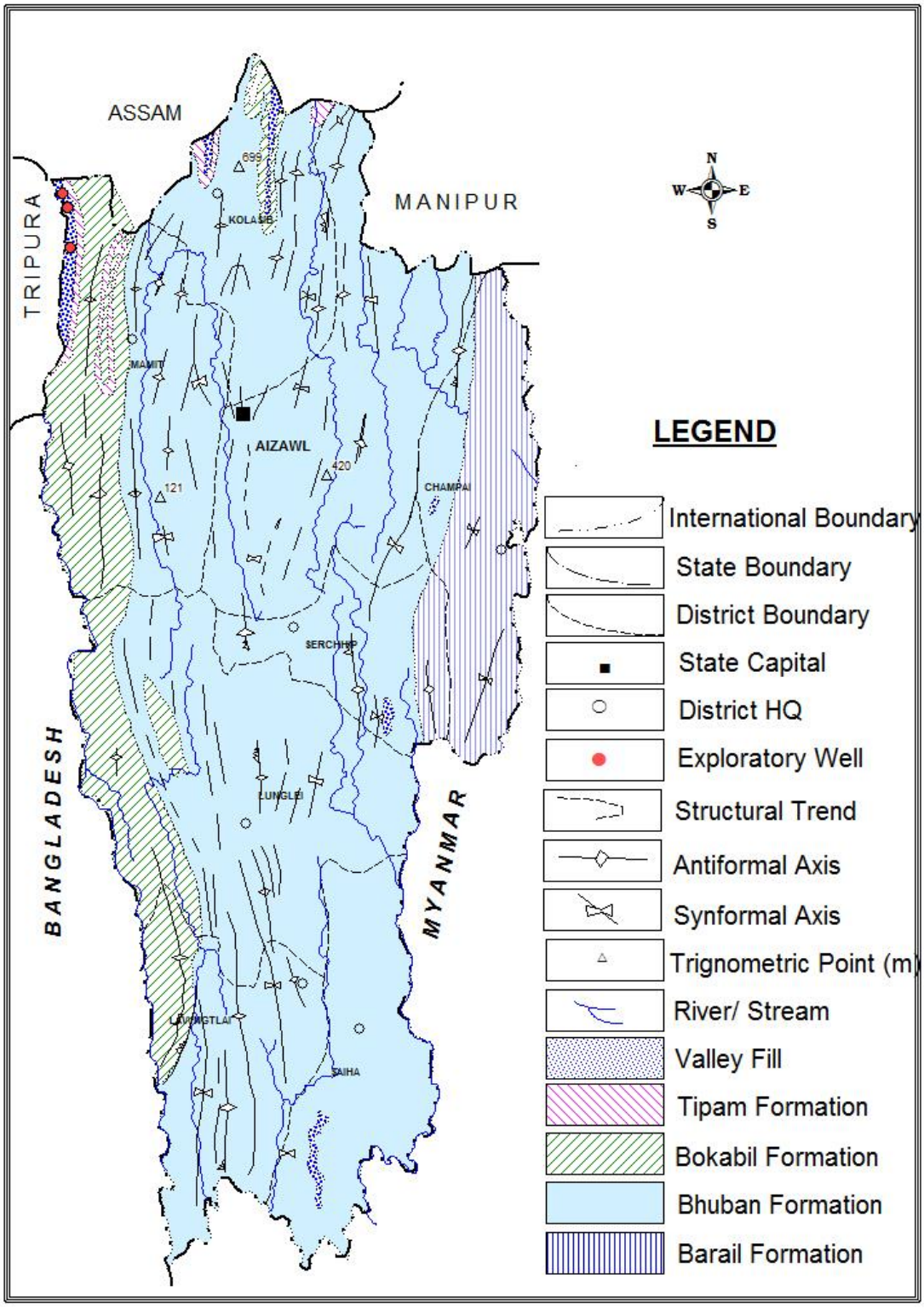
Annexure V-B
District Wise Categorisation (2019-20)

S.No.	District	Annual extractable groud water resource in mcm	Safe		Semi Critical		Critical		Over exploited		Saline	
			Annual extractable groud water resource in mcm	%	Annual extractable groud water resource in mcm	%	Annual extractable groud water resource in mcm	%	Annual extractable groud water resource in mcm	%	Annual extractable groud water resource in mcm	%
1	AIZAWL	15	15	100	-	-	-	-	-	-	-	-
2	CHAMPHAI	16	16	100	-	-	-	-	-	-	-	-
3	KOLASIB	25	25	100	-	-	-	-	-	-	-	-

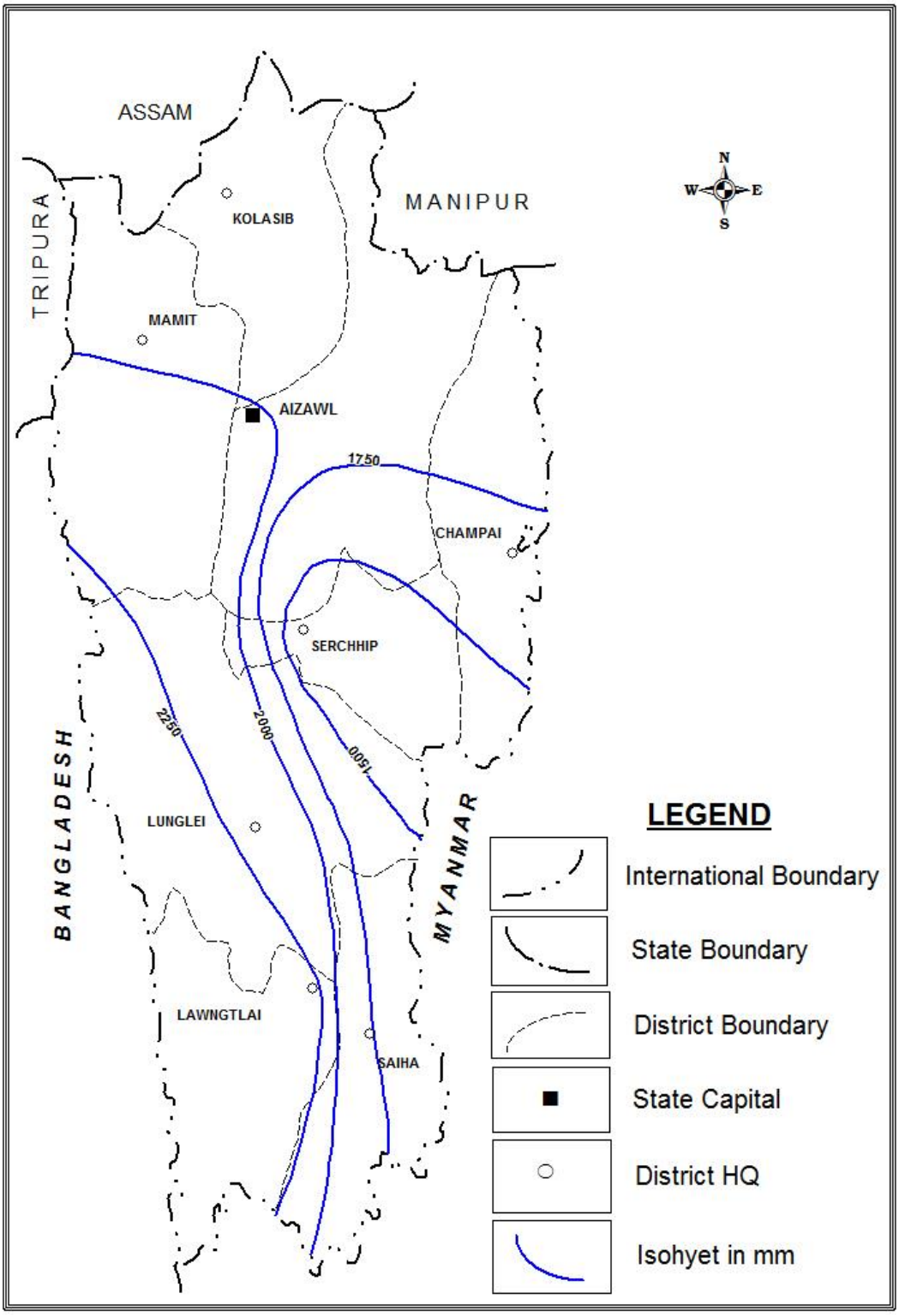
4	LAWNGTLAI	29	29	100	-	-	-	-	-	-	-	-
5	LUNGLEI	49	49	100	-	-	-	-	-	-	-	-
6	MAMIT	50	50	100	-	-	-	-	-	-	-	-
7	SAIHA	7	7	100	-	-	-	-	-	-	-	-
8	SERCHHIP	8	8	100	-	-	-	-	-	-	-	-
	Total States	200	200	100	-	-	-	-	-	-	-	-
	Grand Total	200	200	100	-	-	-	-	-	-	-	-


ADMINISTRATIVE MAP
MIZORAM
ASSAM
MANIPUR
TRIPURA
BANGLADESH
MYANMAR
KOLASIB
AIZAWL
Aizawl
MAMIT
CHAMPHAI
SERCHHIP
LUNGLEI
LAWNGTLAI
SAIHA
N
INDEX
International Boundary
State Boundary
District Boundary
Block Boundary
State Capital

HYDROGEOLOGICAL MAP OF MIZORAM



ISOHYETAL MAP OF MIZORAM



CATEGORISATION OF GROUND WATER DEVELOPMENT MIZORAM-2019-20