

District Survey Report
Of
MINOR MINERALS IN
CHAMPHAI DISTRICT (Undivided)
MIZORAM



DIRECTORATE OF GEOLOGY & MINERAL RESOURCES
GOVERNMENT OF MIZORAM

CONTENTS

Page No.

1. Introduction.....	1
2. Location and Geographical Area.....	2
3. History.....	1-2
4. Population.....	2
4.1 Urban Population 2011.....	2
4.2 Rural Population 2011.....	3
5. Administration.....	3
6. Social Life.....	3-4
7. Economy.....	4-5
8. Education.....	5-6
9. Health.....	6
10. Topography.....	7-9
11. Climate.....	9-10
12. Season.....	10
12.1 The cold and winter season.....	10
12.2 Spring season.....	10
12.3 Summer season/Rainy season.....	11
12.4 Autumn season.....	11
13. Temperature.....	11
14. Rainfall.....	11-12
15. Relative Humidity.....	12
16. Wind.....	12-13

17. Land Use Land Cover.....	13-14
18. Soils.....	14
18.1 Entisols.....	14-15
18.2 Inceptisols.....	15
18.3 Ultisols.....	15-16
19. Drainage System.....	16
19.1 Tiau Drainage System.....	16
19.2 Tuipui Drainage System.....	17
19.3 Tuichang Drainage Sytem.....	17
19.4 Tuivawl Drainage System.....	17
19.5 Tuivai Draiang System.....	18
19.6 Tuiphal Drainage System.....	18
19.7 Tuisa Drainage System.....	18
20. Geology.....	19
20.1 Structure.....	19-20
20.2 Lithology.....	20-22
21. Process of Deposition of Sediments in the Rivers of the District.....	22-23
22. Minor Minerals in the District.....	23
22.1 River Sand.....	23-25
22.2 Stone.....	26
References.....	32

List of Maps

Map No.1: Villages and Road Network of Champhai District

Map No.2: Topography of Champhai District

Map No.3: Land Use Land Cover of Champhai District

Map No.4: Lithology of Champhai District

Map No.5: Drainage System of Champhai District

Map No.6: Sand extracted Area of Champhai District

Map No.7: Quarry Location of Champhai District

List of Figures

Figure 1 & 2: Sand Mining area

Figure 3 & 4: Quarry area

ANNEXURE: List of Stone Quarries within Champhai District.....27-31

DISTRICT SURVEY REPORT

DISTRICT CHAMPHAI

With reference to Gazette notification of 15th January 2016 of Ministry of Environment, Forest and Climate Change, the District Environment Impact Assessment Authority (DEIAA) and District Environment Assessment Committee (DEAC) are to be constituted by the Divisional Commissioner for prior environment clearance of Mining of Minor Minerals. The DEIAA and DEAC will scrutinize and recommend the prior environmental clearance of mining of minor minerals on the basis of District Survey Report. This is a model and guiding document which is a compendium of available mineral resources, geographical set up, environmental and ecological set up of the District and is based on data of various Department, Published Reports, Journals and Websites.

1. INTRODUCTION

Minor Minerals resource mapping of Champhai District of Mizoram is a part of environmental clearance for Mining Leases of minor minerals up to 5 hectares and 25 hectares in cluster mining to the District Environmental Impact Assessment Authority (DEIAA) headed by District Collector. For the purpose of assisting DEIAA, the District Level Expert Appraisal Committee (DEAC) for all District of Mizoram had also been constituted by Government of Mizoram (Notification No.B.11015/5/2015-FST Dated-23/08/2016) who will recommend the projects and its activities. As per the Hon'ble Supreme Court instructions and National Green Tribunal orders, Environmental Clearance for all mining is the prior requirement, and the Government of India delegated power for granting environmental clearance for Mining Leases.

In order to activate DEIAA and DEAC for all Districts, it is mandatory to have District survey reports on river sand and other mineral deposits for which mineral resource mapping is a must. And the Department had conducted field survey for potential stone and river sand deposits of Champhai District during November 2019 – January 2020. This report was prepared considering the Champhai District as Undivided District because this District is now split into three districts that is Champhai District, Khawzawl District and Saitual District.

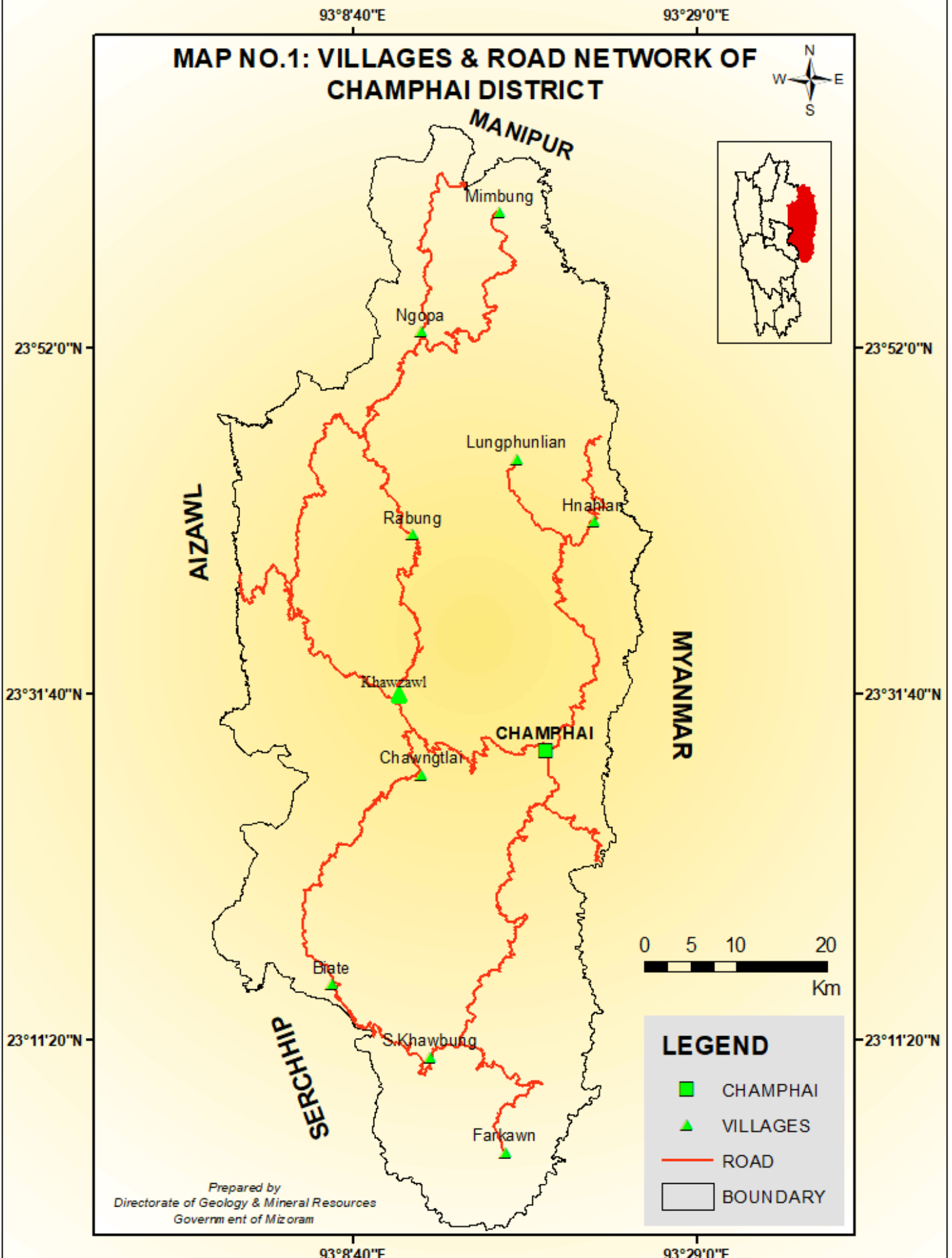
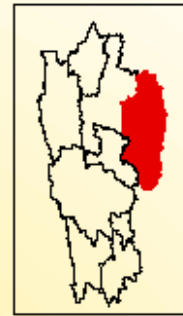
2. LOCATION AND GEOGRAPHICAL AREA

Champhai District is one of the eight district of Mizoram which is located in the North Eastern part of the state. It is one of the largest districts in the state and geographically important as it is situated between 93°00'32" to 93°26'18" E longitude and 23°00'04" to 24°05'03" N latitude near the India-Myanmar border and about 1678 meter above mean sea level. The District is bounded by Churachandpur District of Manipur State on the north, on the west by Aizawl and Serchhip Districts, and on the south and east by Myanmar. Champhai District is connected only by road with the State Head Quarter i.e. Aizawl. The district headquarter is at Champhai which is 194 kilometres from the state capital i.e. Aizawl. The total area of Champhai District is 3,185.83 square kilometres, which contribute 15.11 % of the total area of Mizoram.

3. HISTORY

History of Champhai District depicts the domination of various rulers in the region and its development as a District.

MAP NO.1: VILLAGES & ROAD NETWORK OF CHAMPHAI DISTRICT



The records of British government, who ruled the country in ancient times, state that Fenngo clan was the first group migrated from east to Mizoram State during 1500-1800 AD. The village where they settled gradually were named according to their clan name as Lawihmun, Chawnchhim etc. The ancient cultural heritage of the Mizo people can still be witnessed in several areas of Champhai District. Vanhnuailiana came to this District with his companions in 1864. He later became the chief of Lawihmun whereas his mother was made the chief of Chawnchhim. After the death of Vanhnuailiana in 1871, his wife Rolianpuii became the chief of Chawnchhim and ruled over it.

The first clan who occupied this region were Hmar clan. After their migration, it was captured by Ralte clan who were followed by Sailo clan. The end of Sailo period was marked by Lusei clan. A number of clans inhabited in the area of Champhai District. Numerous historical monuments also stand in this place including Mangkhaia lung, Chhura farep, Sikpui lung, Lungverh, Mura puk etc. Champhai was later ruled by the British rulers too.

Champhai District came into existence on 12th December 1997. The Office of the Deputy Commissioner, Champhai District was established on 22nd April 1998 and had Pu C.Hmingthanzuala, IAS as its first Deputy Commissioner.

4. POPULATION

According to 2011 census, Champhai District had population of 1,25,745 of which male and female were 63,388 and 62,357 respectively. In 2001 census, Champhai had a population of 1,08,392 of which males were 55,756 and remaining 52,636 were females. There was change of 16.01 per cent in the population compared to population as per 2001 census. In the previous census of India 2001, Champhai District recorded increase of 29.84 per cent to its population compared to 1991.

4.1 Urban Population 2011

Out of the total population of Champhai District as per 2011 census, 38.59 per cent lives in urban regions of the District. A total of 48,529 peoples lived in urban areas of which males were 24,278 and females were 24,251. Sex ratio in urban region of Champhai District was 999 as per 2011 census data. Similarly, child sex ratio in Champhai District was 976 in 2011 census. Child population (0-6) in urban region was 7,389 of which males and females were 3,739 and 3,650. This child population figure of Champhai District is 15.40 % of total urban population.

4.2 Rural Population 2011

As per 2011 census, 61.41 % population of the District lived in rural areas. The total population living in rural areas were 77,216 out of which male and female ratios are 39,110 and 38,106 respectively. Sex ratio was 974 females per 1000 males. Child population in the age 0-6 is 13,256 in rural areas of which males were 6,735 and females were 6,521. The child population comprises 17.22 % of total rural population of the District.

Christianity is the dominant religion in the District. Also few number of others religions which are in percentages, Christian – 98.17, Muslims – 0.56, Sikh – 0.01, Buddhist – 0.12, Jain – 0.04, Others – 0.15, and Not stated – 0.10.

5. ADMINISTRATION

The District administration is look after by the office of the Deputy Commissioner (DC) and various development programmes are implemented mainly by the office of the Deputy Commissioner, District Rural Development Agencies (DRDA) and actively assisted by Block Development Officers (BDO). The office of the Deputy Commissioner is headed by the Deputy Commissioner (DC) and he is assisted by Additional Deputy Commissioner, Sub Deputy Officer (Sadar), two assistant to Deputy Commissioner, Sub Divisional Magistrate. Judiciary is at the hands of Deputy Commissioner, Sub Divisional Officer (Sadar) and Sub Divisional Magistrate. All cases of civil criminal are within their purview except some cases of customary in nature are within the purview of the District Council Courts. The District is divided into four rural development blocks (Champhai, Ngopa, Khawbung and Khawzawl) for efficient implementation and monitoring of various developmental programmes of both the Central and the State Government. The following offices are function by the Rural Development Blocks. Below the Block level set up there are 105 numbers of Village council headed by Village council president. Also there are five Legislative Assembly constituencies in this District – 1. Champhai North 2. Champhai South, 3. East Tuipui 4. Lengteng and 5.Tuichang.

6. SOCIAL LIFE

The fabric of social life in Mizo society has undergone tremendous change over the years. Before the British moved into the hills, for all practical purposes the village and the clan formed units of Mizo society. The Mizo code of ethics or Dharma moved around “Tlawmngaihna”, an untranslatable term meaning on the part of everyone to be hospitable, kind, unselfish and helpful to others. “Tlawmngaihna” to Mizo stands for the

compelling moral force which finds expression in self-sacrifice for the service of the others. The Mizo have been enchanted to their new-found faith of Christianity with so much dedication and submission that their entire social life and thoughts have been transformed and guided by the Christian Church Organization and their sense of values has also undergone drastic change. The Mizo are a close-knit society with no class distinction and no discrimination on grounds of sex. Village exists like a big family. Birth of a child, marriage in the village and death of a person in the village or a community feast arranged by a member of the village are important occasions in which the whole village is involved.

With the passage of time, the process of modernization enveloped almost all aspects of life of the Mizo Society. It is a remarkable feature that the Mizo society retained the character of a closely related society even after modernity has reached the society, forming a close-knit society that are casteless and classless. The society is cohesive and in time of crisis they have the capacity to rise as one community to safeguard and protect their identity and their social and cultural life. The entire society is united together by a peculiar code of ethics “Tlawmngaihna” an untranslatable term meaning on the part of everyone to be hospitable kind, unselfish and helpful to others.

Mizoram has been marching ahead in its pursuit of economic development and there is no doubt that a lot has to be done for improving the living standards of the people of Mizoram.

7. ECONOMY

Today Mizoram economy is largely agrarian with more than 70% of the total workforce engaged in farming and cultivation. The climatic condition of the state is also favourable for growing various types of crops including maize, paddy, pulse, sugarcane, potato etc. The natural features and resources also offer opportunities for growing a variety of agricultural crops. These include chilly, ginger, turmeric, potato, tobacco, vegetables, banana, pineapples and other important crops.

Agriculture is the main source of occupation of the state. Pigs and fowls are reared by many farmers and exotic variety and breeds of pigs and fowls have been introduced and have become very popular among the villagers. The state has considerable cultivation of fruits like orange, Lemon, Kagzi lime, Passion fruits, Hatkora, Jamir, Pineapple and Papaya are main horticulture crops.

Mizoram is an industrially backward state. Major industries of the state are agro and forest based industries together with handloom, handicrafts, electronics, consumer goods industries and sericulture. Cotton industry and other small scale industries play an important role in the state economy. There has not been any significant industrial development due to lack of raw materials. But there is scope of Industrial development from forests products. The Government of Mizoram framed the industrial policy in 1989. Various steps have been taken to boost up the food processing industry in the state. The state of Mizoram has very little deposit of mines or minerals. Only hard rock of tertiary formation is available and is utilized as building materials and road construction. The thrust areas for industrial development are: • Bamboo • Food processing • Handloom and Handicrafts • Mines and Minerals • Tourism • Information Technology.

8. EDUCATION

Education is not only one of the most important socio-economic factors known to be significant in influencing individual's behaviour and attitudes, but is a fundamental indicator of a country's level of human capital development.

For administrative control and convenience, the School Education Department having District Education Offices in the District Capital, i.e. Champhai. The Department is having 2 (two) Sub-Divisional Education offices in Khawzawl and Champhai which are placed under the charge of Sub-Divisional Education Officers.

Average literacy rate of Champhai in 2011 were 95.91% compared to 91.15% of 2001. If things are looked out at gender wise, male and female literacy were 97.21% and 94.59% respectively. For 2001 census, same figures stood at 93.12% and 89.06% in Champhai District. Total literate in Champhai District were 1,00,802 of which male and female were 51,440 and 49,362 respectively. In 2001, Champhai District had total literate persons of 82,036 in its district.

Champhai District is clear that the level of education is fairly high and it holds the third literate District in the State. Even though there is generally high literacy rate in all the towns and villages.

In actual number 39,780 people are literate in urban region of which males and females are 20,060 and 19,720 respectively. Literacy rate in rural areas of the district is 95.41 % as per census data 2011. Gender wise, male and female literacy stood at 96.93 and 93.85 per cent respectively. In total, 61,022 people were literate of which males and females were 31,380 and 29,642 respectively. The list of educational institute exist in the district are as follows.

Sl. No.	Stage of Education	Total
1	Primary Schools	228
2	Middle Schools	203
3	High Schools	93
4	Higher Secondary Schools	16
5	Colleges	3

Source: Directorate of School Education

9. HEALTH

The Health & Family Welfare Department look after the District Hospital, PHCs and Sub-Centres within the District. The District hospitals (DHs) with bed strengths is 60 number of beds are an essential component of the District health system and function as a secondary level of health care which provides curative, preventive and promotive healthcare services to the people in the District. Champhai District is expected to have a district hospital linked with the public hospitals/health centres down below the district such as Sub-district/Sub divisional hospitals, Community Health Centres, Primary Health Centres and Sub-centres. Here is the list of health care facility centres in the district are as follows.

Sl. No.	Name of Hospitals/Health Centres	No. of Hospitals/Health Centres
1	Hospital	3
2	Sub-District Hospital	1
3	Community Health Centre	2
4	Primary Health Centre	11
5	Sub-Centre	60
6	Sub-Centre Clinic	27

Source: Directorate of Health & Family Welfare

10. TOPOGRAPHY

The area is characterized, apart from several minor ridge lines, by six main ridge lines and intervening valleys and less prominent ridges. On the western flank of the study area, runs Tuivawl River flowing for a distance of about 46.50 km. It flows along a relatively small valley and dissected terrain and has practically no large flood plain. On the eastern side of Tuivawl river runs a highly dissected ridge line, which starts from Chhawrtui tlang towards northwest till Sahmula tual tlang. This ridge line passes through Puilo, Kawlkulh and Tawitawkawn villages, whose total length is 42.30 km. This ridge line varies in height. It attains a height of 1257 metres at Kawlkulh village and 1147 metres at Tawitakawn. This ridge line attains a height of 1587 metres at Melkhat tlang, 1548 meters at Bualpui tlang, and at Sahmula tual the ridge line continues in the northern side from Meitei tlang (16220 metres) and continues towards Aiduzawl village (1553 metres) and Hmawngzawl village (1172 metres) and extends all the way to Kawnzawr tlang (1182 metres), Khumzawl tlang (1109 metres) and Phalte tlang (1178 meters). This ridge line is terminated by Tuiphal lui, whose total length is about 15.50 km.

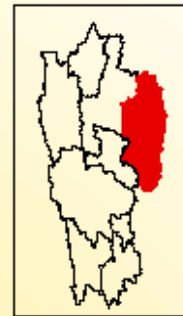
On the eastern side of these two main ridges, runs Tuiphal lui which originates near Khuanglam village in the east and flows through the central part of the district towards North West direction before it drains itself into Tuivai River. The total length of the Tuiphal lui within the District is about 36.20 km. On the northern side of Tuiphal lui, which is the central part of the District, another major ridge line starts from Behliang tlang (1681 meters) and Pamchung village (1180 metres) up to Pamchung tlang (1196 metres). The ridge is terminated by Tuiphal lui. The total length of this ridge is about 17.50 km. Another ridge runs in the northern side starting from Sialkal tlang towards eastern side and passes through Selam village (1665 metres) and ends at Takzang tlang (1272 metres). The total length of this ridge is about 13.76 kms. Just west of the ridge, another ridge line starts near Tuimai lui which joins with the Sialkal tlang, and extends through Lengteng tlang whose peak is called Neuzuarzo (2141 metres). This ridge is terminated by a small stream. It then continues towards northern direction for a short distance through Ngaikham tlang (1895 metres) before ending at the peak of Mutelen tlang (1432 metres).

On the north-western part of the District, another ridge line extends from Vanchungbung tlang (1190 metres) and passes through Tingahmun tlang (1258 metres), chawrahmun tlang (1266 metrs), Ngopa village (1249 metres), khawdungsei tlang (1200 metres) and Khawkawn village (1280 metres) before ending near Tuivai lui towards north before ultimately draining itself to Tuivai river in the northern boundary of the District. The length of the Tuivai lui is about 31.43 kms. To the east of the Tuitla lui, runs another ridge line which starts from Mimbung tlang whose peak is about 1627 metres

93°8'40"E

93°29'0"E

MAP NO.2: TOPOGRAPHY OF CHAMPHAI DISTRICT



23°52'0"N

23°52'0"N

AIZAWL

MYANMAR

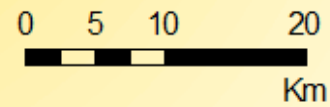
23°31'40"N

23°31'40"N

23°11'20"N

23°11'20"N

SERCHHIP



LEGEND

- CHAMPHAI
- VILLAGES
- ROAD
- High : 2139
Low : 246
- BOUNDARY

Prepared by
Directorate of Geology & Mineral Resources
Government of Mizoram

93°8'40"E

93°29'0"E

high. The ridge line terminates in the north eastern side of the District. The length of this ridge line is about 7.37 kms.

On the easternmost side of the District, run two ridges almost parallel to each other. These two ridges are separated by Tangkawng lui. One of them starts from Khuangphah tlang (1508 metres) and passes through Zopuichhip (1618 metres) and continues through Tangkawng mual until it is terminated by Tuisa lui. The total length of this ridge is about 14.80 kms. The other ridge starts from near Khuangphah village and passes through New Vaikhawtlang village (1185 metres) and extends all the way to Vaikhawtlang dung whose height varies from 1066 to 1172 metres. This ridge terminates near Vaikhawtlang village, after extending through a length of about 17.03 kms. These two ridges are sandwiched by Tuisa lui in the west and Tuimang lui in the east. Tuisa lui originates after five small streams join together near Bungzung tlang (1286 metres). It then flows towards the northern direction for about 62.38 kms. before emptying itself to Tuimang lui in the north. Tuimang lui, on the other hand, originates near Khuangphah village and flows towards northern direction, forming eastern boundary of the District for about 24.32 kms.

To the south of these two ridges, runs another ridge line named Diltlang dung, almost in northwest direction and joins another ridge extending in the north-south direction. The later bifurcates into two ridges at Bungzung tlang. The eastern side of this ridge passes through Hnahlan village and extends through Hnahlan tlangdung, while the western ridge straight runs in the north to south direction before terminated by Tuisa lui in the north. On the south of this ridge, flows Tuithoh lui originating near Khuanglam village. It flows in the south-east direction until it drains itself in the Tiau River in the east.

The Tiau River in the east forms the eastern and southern boundary of the District as well as the international boundary of India with Myanmar. The Tiau River originates to the north-east of Khuangphah village and flow southwards direction. The total length of the river within the district is about 155.34 km. Another important river within the District is the Tuipui River which originates near Khankawn, located within Champhai town area. It flows eastward for a short distance before making a left-turn near Zotlang village and then flows through champhai plain in the northward direction, until Keilungliah lui joins it near Zote village. It then flows in the north-west direction before changing course in the southward direction near Tualpui village. It flows in the central part of the District and ultimately drains itself in the Tiau River in the south.

To the west of Tuipui River, runs another major ridge line towards north starting from Chawngtlai village (1420 metres). It extends through Khawzawl village (1303 meters) and ends at Darngawn tlang (1449 metres). The length of this ridge is about 20 km. In the south western part of the study area, run two ridges almost parallel to each other.

These two ridges are separated by Lungva Lui. One of these two ridges, named Tlangpui tlangdung starts near Tlangpui village (1392 metres), and continues towards north. It passes through Vaisam tlang (1463 metres), Tlangpuite village (1309 metres), Lungtan village (1307 metres) and terminates near Saichal tlang. The total length of this ridge is about 20.30 km. The other ridge named Khawhai tlangdung, starts from Tinghmun tlang (1474 metres) and continues towards north. This ridge passes through Sialhawk village (1408 metres), Leithum tlang (1388 metres), Khawhai tlang (1592 metres) and Khawhai village (1568 metres). The length of this ridge is about 18.87 metres. In the southern part of the study area, runs another ridge line starts near Khuangthing village and runs towards north. It passes through Bunghmun tlang (1247 metres), Zawlsei village and Khawbung village. To the east of this ridge extends another ridge line from Samthang tlang (1740 metres), Lianchhiari Lunglen tlang (1694 metres), Dungtlang (1708 metres), Sakei buksuk tlang (1558 metres), Puruar tlang (1521 metres) before ending at Khuang Mual (1143 metres). This ridge is terminated by a small stream (Thangai lui). The total length of this ridge is about 19.12 km. In addition to the aforesaid ridges, there are also several minor ridge lines located in various parts of the District.

The Tuichang River, which forms an important major river within the District originates near Darngawn village and flows in the north-west direction before flowing in the southward direction near Mangpui tlang in the central part of the District. It flows through the central part of the District before forming the south-western boundary of the District.

Some areas like Tan tlang and its surrounding, Hlumte tlang, Ralvawng tlang, Sahmula tual (Mawmrang tlang), Vanchungbung tlang and Sur tlang are characterised by many spectacular scarps. These scarps are generally very steep, and made up of hard rock units. It has been observed that these scraps are mainly confined to the southern and northern part of the District, while the central and western part are lacking in these scarps. The spurs are mainly running in east – west directions. The spurs on the eastern side of the main ridge are relatively long and gentle than the spurs on the western side.

11. CLIMATE

Climate is the aggregate of all atmospheric or meteorological influences such as moisture, wind pressure, temperature and evaporation. Climate is one of the most important factors of the geographical environment to which man is subjected and man's activities like agriculture, forestry, supply of water, industry, etc.

The climate of Mizoram is controlled by its location, physiographic, pressure regime in the North West India and Bay of Bengal, warm and moist maritime tropical air masses

from the Bay of Bengal, Local Mountain and valley winds. Overall its climate is tropical monsoon type. As the Champhai District lies in the Eastern part of the state, it enjoys a moderate climate owing to its temperate sub alpine climate. It falls under the direct influence of the South West Monsoon. As such the area receives an adequate amount of rainfall which is responsible for a humid temperate sub alpine climate characterized by long winter and short summer with heavy rainfall. In general the climate of the District is temperate sub alpine and humid type.

The District has a pleasant climate. It is generally cool in summer and not very cold in winter. In winter the temperatures varies from 8 degree Celsius to 24 degree Celsius and in summer, it is between 18 degree Celsius and 32 degree Celsius. Relative humidity is highest during the south-west monsoon and heavy precipitation is usually received during the months from May up to September every year. The hottest period starts from the month of March up to August every year. During the rainy season, it is usually heavily clouded. There is an increase of cloudiness from March onwards. A clear and cool weather starts appearing from the month of September up to January the next year.

12. SEASON

Based on the variation in temperature, rainfall, humidity and other general weather conditions, four different types of seasons are observed for the District. They are as follows

12.1 The cold or winter season

Winter season starts from the month of December to first half of February. This is the coldest season of the year. During this period rainfall is much less as compared to other seasons, and whatever amount of rainfall received is originated from North East Monsoon, generally known as the retreating monsoon. This season is very pleasant with clear blue sky in the absence of covering and all the people of Mizoram are in festive mood since the most celebrated festival 'Christmas' occurs during this season.

12.2 Spring season

Spring season is the shortest season of the year. It starts from the second half of the February to the first half of March. Temperature is mild during this period and the sky is clear and the Mizo people accustomed to build new houses during this season as there are no weather disturbances during the period.

12.3 Summer season/Rainy season

Summer season or Rainy season is the longest season covering about seven months starting from the second half of March till the first half of October. The early part of this season i.e. from second half of March till First half of May is characterized by bright sunshine and clear sky with little or no cloud till it is disrupted by the coming of Monsoon showers. The warmest months, i.e. June and July, prevails during this period and maximum insolation is received during the early part of this season.

12.4 Autumn season

Autumn season covers for a period generally starting from the second part of October to November. The season is very pleasant and the summer rain already diminished. This is the season the Mizos are longing for since they have no undone jobs in their jhum fields, just waiting for the ripening of their paddies. People are in festive moods. During this time one of Mizo festivals called 'Mim Kut' was used to be celebrated. But now what we called 'Thal favang Kut' takes the name instead and is celebrated with joy.

13. TEMPERATURE

Temperature of Champhai District does not fluctuate much. The average maximum and minimum temperature of the District is 34.50°C and 5.72°C, respectively. On an average July and August was recorded to be the warmest months with mean maximum temperature 27.5°C and mean minimum temperature 20.4°C. The temperature starts falling from November and it falls far low during December and January. January was recorded to be the coldest month of the year with mean maximum temperature 27.1°C and minimum temperature 6.1°C.

14. RAINFALL

Champhai District receives adequate amount of rainfall during the monsoon season as it comes under the direct influence of South West Monsoon and it received 1626.20 mm average rainfall during 2018. The rainfall data collected from four different rain gauge stations such as Champhai, Khawzawl, Vaphai and Ngopa are displayed in the table below which shows that the heavy rainfall starts from the second part of May to the first part of October. In the last five years, the highest rainfall was recorded for the month July of 2015 (449.70 mm). Intensive rainfall occurs in certain pockets of Champhai District. Often hailstorm occurs during April and May.

Sl. No.	MONTH	AVERAGE RAINFALL (in mm)				
		2014	2015	2016	2017	2018
1	January	0.00	8.37	1.10	0.00	4.10
2	February	25.30	4.15	17.70	7.00	2.10
3	March	22.05	29.1	37.40	123.20	17.30
4	April	23.77	253.02	80.00	296.40	59.70
5	May	287.02	103.20	290.10	215.00	133.00
6	June	287.05	177.50	314.50	347.20	442.80
7	July	228.55	449.70	285.20	337.00	286.20
8	August	268.77	426.00	315.70	235.50	287.20
9	September	295.15	238.90	266.15	294.30	207.70
10	October	80.00	168.05	151.40	224.40	164.00
11	November	3.55	4.57	48.90	36.80	0.00
12	December	0.00	2.32	0.00	57.20	22.10
	ANNUAL TOTAL	1521.21	1864.88	1808.15	2174.00	1626.20
	ANNUAL AVERAGE	126.77	155.41	150.68	181.17	135.51

Sources: Directorate of Economics & Statistics, India Meteorological Department.

15. RELATIVE HUMIDITY

Relative humidity is the ratio of moisture content in the air to the moisture holding capacity of the same air and it is directly related to the rate of evaporation. Of the various components of atmosphere, moisture constitutes from nearly zero to about 4 per cent by volume. Humidity plays a very important role in the heat budget as well as day to day weather changes.

16. WIND

The monsoon wind is the most important wind that prevails in Mizoram. During summer, the sub-tropical high pressure belt and the thermal equator are displaced northward in response to the changing pattern of solar heating of the earth. From the ocean, particularly from the north Indian Ocean or Bay of Bengal, they move towards the land mass and blow over the Asian continent. This south-west monsoon reaches Mizoram during second half of May and prevails up to the first half of October. The

summer monsoon is characterized by highly variable weather with frequent spells of drought and heavy rains. Besides this, winter monsoon also prevails which is a gentle drift of air in which the winds generally blow from the north east. This retreating monsoon cause sporadic rainfall especially in Mizoram and other north eastern states producing sometimes heavy cyclonic rains.

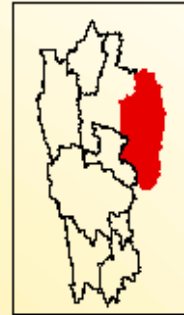
As evidence from the earlier records, Mizoram state is vulnerable to impact of tropical cyclone which develop in North Indian Ocean (Bay of Bengal), and the cyclones of the Post Monsoon season (October to December) are more intense than those of Pre Monsoon season (April & May). Cyclones are associated with strong winds, torrential rains and storm. Though the impact has not yet been devastating, it has often led to loss of properties and even lives. The impact of cyclone has often led to damages to houses, power line cut-off, blockage of road, damages to crops and plantations, loss of live stocks, etc. Generally these winds come from the north western part of the state as the winds originate from the Bay of Bengal.

17. LAND USE LAND COVERS

The Land use land cover analysis of the entire District has been attempted in order to map the various land use land cover types such as Thick forest, Open forest, Jhum land, Barren land, Water bodies and Settlements (Built-up) by visual interpretation methods. This classification was carried out using LANDSAT 8 Remote sensing data acquired on 11th March 2018. Generally, land cover is constrained by environmental factors such as soil characteristics, climate, topography and vegetation. Land use used as a key and finite resource for most human activities including agriculture, industry, forestry, energy, production, settlement, recreation and water catchments and storage. The various classes of land use land cover were classified based on field verification.

From the study of land use land cover it is found that Thick forest covers about 2305.63 square kilometres which is 67.17 % of the total area, Open forest covers about 672.46 square kilometres which is 19.59 % of the total area, Jhum land covers about 152.34 square kilometres which is 4.43 % of the total area, Settlements (Built-up) covers about 287.76 square kilometres which is 8.38 % of the total area, Barren land covers about 13.65 square kilometres which is 0.39% of the total area and Water body covers about 0.37 square kilometres which is 0.010 % of the total area.

MAP NO.3: LAND USE LAND COVER OF CHAMPHAI DISTRICT



23°52'0"N

23°52'0"N

23°31'40"N

23°31'40"N

23°11'20"N

23°11'20"N

AIZAWL

MYANMAR

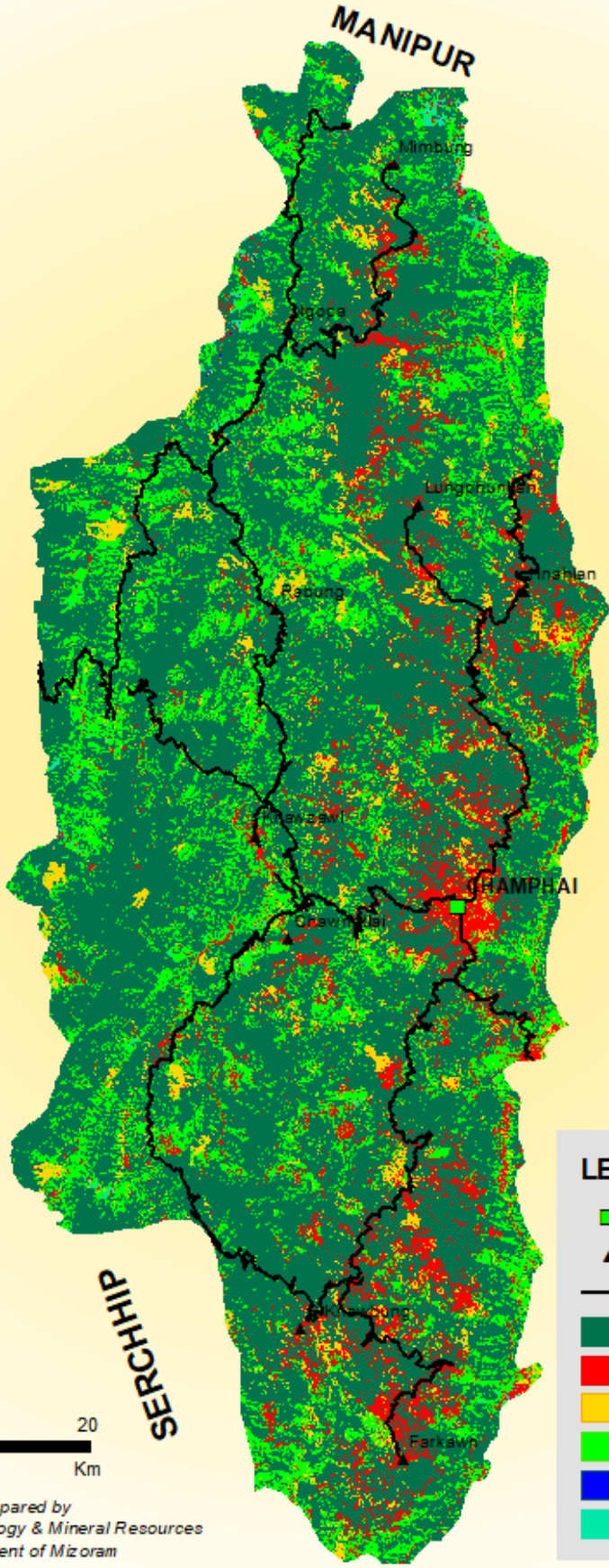
SERCHHIP

93°8'40"E

93°29'0"E

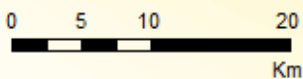
93°8'40"E

93°29'0"E



LEGEND

- CHAMPHAI
- ▲ VILLAGES
- MAJOR ROAD
- THICK FOREST
- SETTLEMENTS
- JHUM LAND
- OPEN FOREST
- WATER BODY
- BARREN LAND



Prepared by
 Directorate of Geology & Mineral Resources
 Government of Mizoram

Table of Land Use Land Cover

SL. NO.	CLASS	AREA COVER (in Sq. Km)	AREA COVER IN PERCENTAGE
1	THICK FOREST	2305.63	67.1756
2	SETTLEMENTS	287.763	8.38411
3	JHUM LAND	152.347	4.4387
4	OPEN FOREST	672.469	19.5927
5	WATER BODY	0.3726	0.010856
6	BARREN LAND	13.6593	0.39797

Source: LANDSAT 8 Imagery

18. SOILS

The soils in Mizoram are generally sandy. Derived soil with red loamy texture is also found with high level of lateritic. The soil acidity is high. They are usually low in Potash and Phosphorous. But in an un-eroded soil, the content of Nitrogen is quite high mainly due to the accumulation of the organic matters. The soils in the valleys are heavier, as they are brought down by rain water from high altitudes.

Classifications of soils of the district have been done according to Sanker K and Nandy (1976) have classified the soils of Mizoram into three orders of soil taxonomy, viz., 1) Entisols, 2) Inceptisols and 3) Ultisols.

18.1 ENTISOLS

These soils have little or no evidence of profile development. They occur on steep, actively eroding slopes and ridges, or on flood plains that receive new deposits of alluvium at frequent intervals. In the order of entisols, the following soils have been identified at the family level classification.

a) *Mixed Hyperthermic, Typic Udipsammets* - which occurs in narrow valleys especially on river courses in a very limited area.

b) *Loamy Skeletal, Mixed Hyperthermic, Lythic Udorthents* - occur only in ridge tops which have been severely eroded due to indiscriminate felling of forests. The soils have been coherent strata with 50 cm. Exposed rock sequences are seen at few places.

c) *Loamy Skeletal, Mixed Hyperthermic, Typic Udorthents* - these soils have been encountered in erosional areas on ridge tops and terraces. These are found as dominant units on ridges which are under scrubs. The soils are having 40-60 per cent of coarse gravels. These soils can support good vegetation if properly managed.

18.2 INCEPTISOLS

This order of soils occur widely in sub-humid region. The common horizon sequence is an ochric epipedon over a cambic horizon. Freely drained inceptisols are classified as Ochrepts. The following families of sub-group typic Dystrochrepts have been identified in Mizoram.

a) *Fine Loamy, Mixed Hyperthermic, Typic Dystrochrepts* - commonly occurring on the steep slopes, in narrow valleys and on terraces. They are generally covered with dense scrubs or grasses. The soils are fine loamy in texture. They have few rock fragments also.

b) *Fine Loamy, Mixed Hyperthermic, Typic Dystrochrepts* - found on the concave part of the slopes (in narrow patches) of hill top ridges. Generally, these soils are deep with 40-50 cm thick solum, below which weathered soft rocks are found. They are well suited for forest species.

18.3 ULTISOLS

Ultisols are commonly found on the foot slopes. The soils have horizons which are rich in translocated silicate clays. The main sub-orders of these soils are Aquults, Humults and Udults.

a) *Aquults* - only one family of this sub-order, i.e., mixed hyperthermic, fine loamy, typic palcquults have been found to exist in Mizoram. It is found in the flat lands.

b) *Humults* - only one family of this sub-order have been identified. These soils are rich in humus and support generally rain forests.

c) *Udults* - Udults order of soils are fairly widespread in Mizoram. They are fairly drained, poor in humus associated with humid climate with high rainfall.

To summarise, in hilly terrain, the slopes are steep to very steep consisting mostly of Hapludults, Paleudults and Palehumults. These soils are highly leached, poor in bases, rich in iron and low in pH value. They have wider occurrence as compared to other soil types.

The soils on the top of ridges are mostly shallow or underlain by weathered rock and have thin depth. They have poor moisture supply and are capable of supporting only scrubs or low trees.

In narrow valleys, the soils are young and sandy. The extent is very much limited and are importance for land use. The soils in flat are poorly drained and have high ground water table. The soils of Mizoram as a whole, are well drained except in flat lands, and are capable of providing substantial oxygen supply for plant growth. The soils of the region also have capability to retain soil moisture and maintain its supply throughout the growing season of the normal crop. They have a low inherent fertility in the form of poor supply of bases and mineral reserve. This implies the necessity of inputs.

19. DRAINAGE SYSTEM

Champhai District is drained by both the north flowing rivers like Tuisa, Tuivai and Tuivawl rivers and the south flowing river like Tiau, Tuipui and Tuichang Rivers. Besides these, there are a good number of streams and rivulets of various patterns and length. Most of these streams and rivulets are ephemeral in nature. Since the drainage system for a particular area is governed mainly by the natural drainage course and topography, therefore the drainage system of Champhai District has been studied with the help of satellite imageries and the survey of India topographical maps. And it is found that most of the drainage patterns of the study area as a whole are dendritic to sub-dendritic patterns and the topography is young and the soils are highly erosional in character. The District capital Champhai lies in the east-central part of the District and serves a good trade center.

The drainage system of Champhai District as a whole is said to be dendritic to Sub dendritic in nature and the streams are youthful stage with deep courses. The topography is young and its soils do not show much diversity. They are highly erosional in character. The main drainage lines or rivers of the district are discussed one by one below

19.1 Tiau Drainage System

Tiau River drains the eastern fringe of Mizoram (India) and Myanmar for a distance of about 83 Km. The River rises from the north eastern part of the district near Khuangphah village and it flows in the southward direction. Tiau River system is the second largest drainage system within the district covering an area of 725.25 Sq.Km. i.e. 22.77% of the geographical area of the District. It's important tributaries are Tuithoh Lui, Sihmit Lui, Iva Lui and Tlawva Lui. The drainage system as a whole is elongated in north to south direction showing angulated; dendritic to sub-dendritic drainage patterns. Among these tributaries Tuithoh Lui, Iva Lui and Tlawva Lui have created narrow fluvial flood plains making the area suitable for Agricultural and Agro-Horticultural development for the local inhabitants.

19.2 Tuipui Drainage System

Tuipui River is the most important river of the District since it has created a vast fluvial flood plain which may be called 'Rice bowl of Champhai District' at a height of 1,300m above Mean Sea Level (MSL); that too within the periphery of the Champhai town. It originates near Champhai township and first it flows eastwards and then northwards and finally flows southwards till it confluences to Tiau River in the southern most part of the District. This drainage system covers the largest area among the seven watersheds of the District covering an area of 815.58 Sq.Km. i.e. 25.60% of the geographical area of the District.

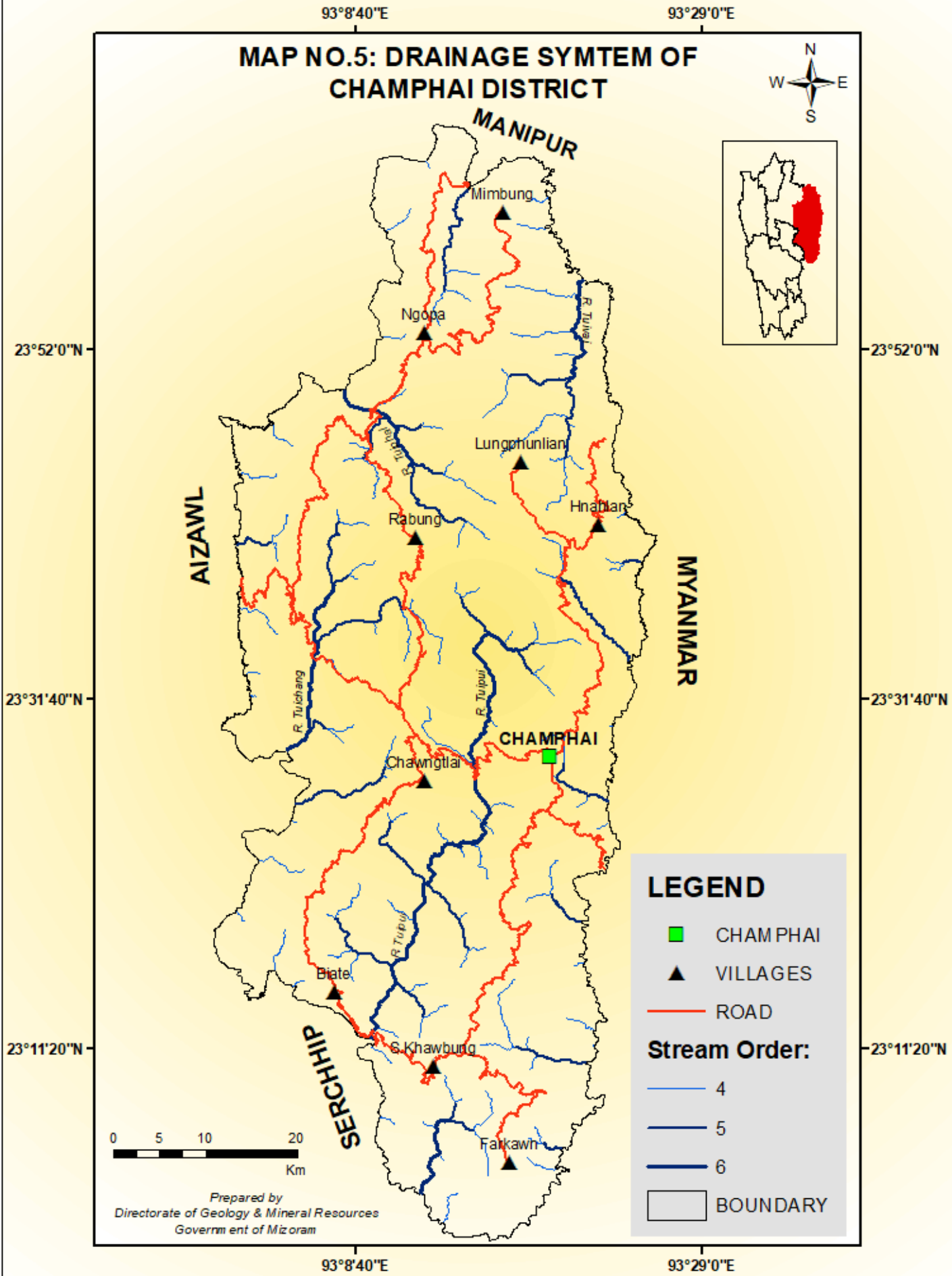
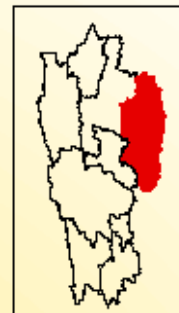
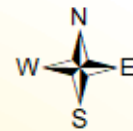
19.3 Tuichang Drainage System

Tuichang River system is the third largest drainage system within the District covering an area of 559.89 Sq.Km. i.e. 17.57% of the geographical area of the District. It originates from Darngawn tlang near Khawzawl township at a height of 1,449m above Mean Sea Level (MSL). The river does not create much fluvial flood plain and yet it serves as a fishing ground for the nearby villages. Its main tributaries include Tuimarul Lui, Tuisen Lui, Phaisen Lui, Nghalrawh Lui, Tuikau Lui and Kharzawl Lui are the important ones. The drainage system as a whole is elongated in north to south direction showing angulated; dendritic to sub-dendritic drainage patterns.

19.4 Tuivawl Drainage System

Tuivawl River originates from Rullam tlang at a height of 1,590m above Mean Sea Level (MSL) near Rullam village in Serchhip district and flows northward till it confluences to Tuivai river in the north. It formed a district boundary with Aizawl district in the western side of the district up to a considerable length. Tuivawl river system is the least drainage system in area-wise within the district covering an area of 196.44 Sq.Km. i.e. 6.17% of the geographical area of the district. Tuivawl river does not create much fluvial flood plain along its course except a few narrow valley fills. The river is of 6th in stream order and it is utilized for fishing ground for the nearby villages. Its main tributaries within the district are Serlui, Saichal Lui, Tuingam Lui and Chhirdem Lui. The drainage system as a whole is elongated in north to south direction showing angulated; dendritic to sub-dendritic drainage patterns.

MAP NO.5: DRAINAGE SYMTEM OF CHAMPHAI DISTRICT



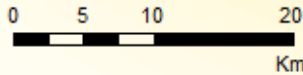
LEGEND

- CHAMPHAI
- ▲ VILLAGES
- ROAD

Stream Order:

- 4
- 5
- 6

BOUNDARY



Prepared by
 Directorate of Geology & Mineral Resources
 Government of Mizoram

19.5 Tuivai Drainage System

Tuivai River originates from Manipur state in the north east of Mizoram and it forms a state boundary line between the two states for a considerable length and then after entering Mizoram it forms again district boundary line between Aizawl and Champhai District. Again this river made a U-turn towards north and then again it form state boundary line with Manipur and after that it flows westwards and then northwards till it confluences to Tuiruang (Barak) river in the north. Tuiruang river flows towards north forming state boundary line again till it enters into Manipur state. Tuivai drainage system covers only a few part of its drainage area in Champhai District covering an area of 247.94 Sq.Km. i.e. 7.78% of the geographical area of the district. Tuila Lui is the only important tributary of Tuivai in the district which flows northwards creating some fluvial flood plains along its course. Other tributaries of less importance are Tuikhur Lui, Tuisik Lui and Leisang Lui. These tributaries highlighted dendritic to sub-dendritic drainage patterns.

19.6 Tuiphal Drainage System

Tuiphal River is an important river from an agricultural point of view since it has created a vast fluvial flood plain along its course. It originates from Zirtan zotlang at a height of 1,894m above Mean Sea Level (MSL) near Khuanglam village in the Sialkal hill ranges. It flows in north-west direction till it meets with Tuivai river. Tuiphal river system covers an area of 270.71 Sq.Km. i.e. 8.5% of the geographical area of the district. Its important tributaries are Tuimai Lui, Tuiluai Lui, Phalte Lui and Tuithil Lui. These tributaries highlighted dendritic to sub-dendritic drainage patterns.

19.7 Tuisa Drainage System

Tuisa River originates from Tlangsam tlang near Tualcheng village in the Sialkal hill ranges at a height of 1,750m above Mean Sea Level (MSL). It is a north flowing river and Tuisa River created quite a number of fluvial flood plains along its courses and hence this drainage system has an importance from agricultural and horticultural point of view. Tuisa River system is covering an area of 370.02 Sq. km. i.e. 11.61% of the geographical area of the district. Its main tributaries are Dimphai Lui, Leiva Lui, Tangkawng Lui, Tuingo Lui, Tuikual Lui, Tuimang Lui, Tuiching Lui and Bak Lui. These tributaries highlighted dendritic to sub-dendritic drainage patterns. The total length of perennial streams and non-perennial streams are 1,865.13 Km. and 13,265.14 Km.

20. GEOLOGY

The study area occupies the North Eastern part of the state and presents a monotonous sequence of argillaceous and arenaceous rocks. The formations are folded into almost N-S trending anticlines and synclines and affected by longitudinal, oblique and transverse faults of varying magnitudes. While the Geological Survey of India (1974 & 2003) classified the rocks of the eastern part of the area around Champhai and its surroundings into Barail Group, the Oil and Natural Gas Commission (1975, 1978 & 1984), on the other hand, do not agree with their views. However, an attempt has been made to classify in details. Therefore, the formations are tentatively classified on the basis of lithological assemblage and sedimentary structures, incorporating the scheme of classification of both the parties.

20.1 STRUCTURE

The structural elements noticed in the area are both primary and secondary in nature. The beds generally trend N-S to roughly NNW-SSE and dip on either side from 15° to 65° with local variations at the vicinity of faults.

Primary Structures

The rocks of the area exhibit various types of primary sedimentary structures which are useful in understanding the environment of deposition. The sediments show prominent primary bedding. Laminated bedding is common in some cases. Bedding is the most common sedimentary structure observed in the rocks of the study area. The thickness of bedding varies from few centimeters to more than a metre. Flaser and lenticular bedding are common structures observed in sandstone unit. Cross bedding is also observed in certain sandstone units. Both planar and trough type cross bedding are noticed within the fine grained sandstone unit. Ripple marks are another important primary structures observed in the rocks. They are preserved at many places especially where the fine sediments dominated. The morphology of the ripples varies widely. Linguoid, rhomboidal and parallel crested ripples occur in close association at number of places. In thickly bedded sandstones, ripple drift lamination, both in-phase is common. These structures indicate shallow marine to deltaic environment of deposition for the sediments.

Secondary Structures

The thick sedimentary sequence of the area has been folded into a number of anticlines and corresponding synclines. The general strike of bedding is N 30° E – S 30° W which swerves to N 30° W to S 30° E in the north-central part of the mapped area. The general trend of the area in the eastern part of the district around Ngur, Vapar, Murlen and their

surrounding areas slightly changes to NNW to SSE. The axial trace of the synclines follows the prominent river valleys and their corresponding axial traces of anticlines passes through the ridges (sometimes along the flanks of the ridges). Generally, the anticlines are having sharp crests while the corresponding synclines are relatively having broader troughs. At certain places, the strike of the beds is obliterated because of faulting. The joints are generally tight and widely spaced except in the shale bands where they are closely spaced.

The lineaments are mapped using the Digital Elevation Model, Satellite imagery and ground checks. The area has been affected by a number of faults of varying magnitude. They are mostly transverse/oblique in disposition. Major oblique faults are Ngur lui Tuipui-Pumpet lui Fault, which divides Zote and Ngur villages; saikah-Lungverh lui Fault located within Champhai town area; Tuimai lui-Thangpui lui Fault located in between Murlen and Khuanglam villages; Tuiphal lui Fault located in between Pawlrang and Ngopa villages; Vaikah lui Fault located near Khawdungsei village in the northern part of the district; Tuichang Fault near Khualen village; Tlawva lui-Keiphaw lui fault located near Farkawn village in the southern part of the district Chhingzawl lui-Tuiaw lui-Tuipui-Raifan lui Fault and Hmunte lui Fault in the south western side, and Tualte lui-Thlikva lui Fault near Vangtlang and Zawngtetui tlang villages. The faults are delineated with the help of Satellite Imagery, SOI topographical maps on the basis of field criteria like shifting of axial plane, course of the rivers, etc. and subsequent ground check. The general trend of the oblique faults is roughly NNW-SSE. In some cases, the throw of the fault could not be measured or estimated due to the absence of any marker horizon. Presence of other minor faults is indicated in the area by reversal of dips.

As the area is a part of a linear belt of folds which comprises not only Mizoram but also its adjoining areas, the area bears tectonic marks of folding and faulting. The dislocation and the deformation of strata gave rise to linear structural features in the area. The prominent directions are NNW-SSE and E-W, and the less prominent ones are in almost all direction e.g. NNW-SSW. The lineaments are varying in lengths. The total length of lineaments (including faults and inferred faults) is 104.96 kms.

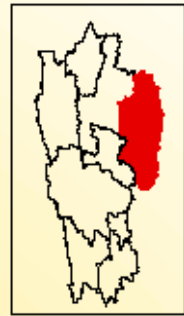
20.2 LITHOLOGY

The lithology of the Champhai area is represented by sandstone, siltstone, shale and their intermixtures in different proportions. Additionally, loose clay, gravel, sand and silt form the unconsolidated sediments of the area. Sandstone are fine to very fine grained, ash to bluish grey in colour, compact and hard, thinly bedded; rarely yellowish brown; medium grained, and friable. Few thick beds of sandstones are found in some areas. Shale and Siltstone are dark grey and grey in colour and usually splintery. A few thickly bedded sandstone bands are noticed at certain places. These beds are important source

MAP NO.4: LITHOLOGY OF CHAMPHAI DISTRICT

93°8'40"E

93°29'0"E



23°52'0"N

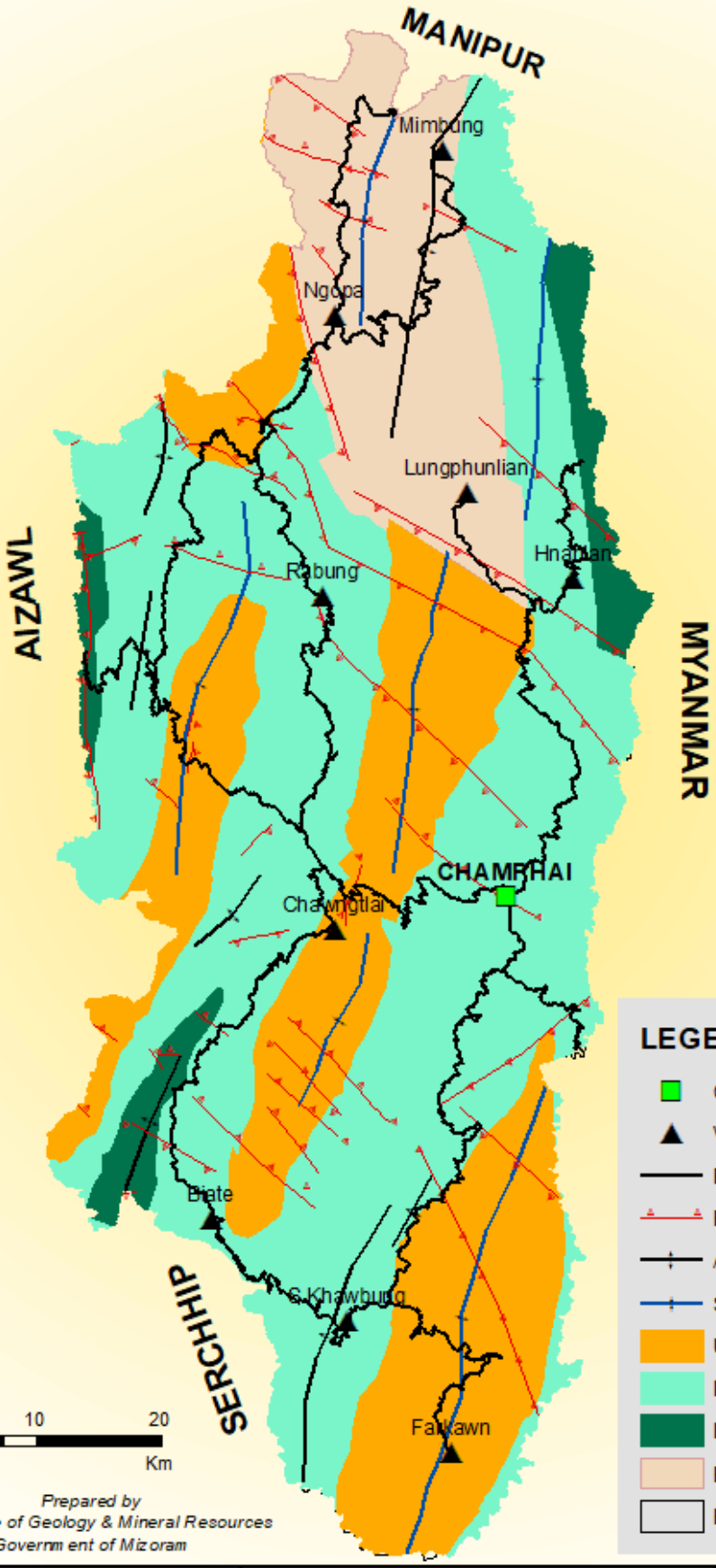
23°52'0"N

23°31'40"N

23°31'40"N

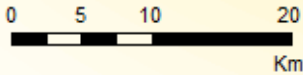
23°11'20"N

23°11'20"N



LEGEND

- CHAMPHAI
- ▲ VILLAGES
- ROAD
- ▲— FAULT
- +— ANTICLINE
- +— SYNCLINE
- UPPER BHUBAN
- MIDDLE BHUBAN
- LOWER BHUBAN
- BARAIL
- BOUNDARY



Prepared by
 Directorate of Geology & Mineral Resources
 Government of Mizoram

93°8'40"E

93°29'0"E

of buildings and road construction materials in the area, and they form the main ridges of the area.

The lithology of the low-lying areas such as Tuivawl, Tiau, parts of Tuiphal, Tuisa, Tuila and parts of Tuichang synclines, is mainly represented by shale-siltstone and little mudstone. Geomorphically, this unit occurs as subdued hills giving rise to hummocky topography.

The lithological mapping was traced from the map prepared by ONGC and validated in the field in a limited area, and is divided into four litho classes, viz., Upper Bhuban, Middle Bhuban, Lower Bhuban and Barail. In addition to these, recent alluvium deposits are observed and mapped, and have been classified into four classes, viz., Gravel, Sand & Silt, and Clayey Sand. Sandstone, the harder rock formation is found mainly along the ridgeline owing to this resistance to erosion, and it covers an area of 1538.50 Sq.km., which is 48.29% of the total area. Siltstone and Shale are put together as they are almost inseparable, and this unit covers a total area 1556.63 of sq.km., which is 48.86%. Gravel, Sand and Silt are found along the major rivers, Tuichang, Tuivai, Tuivawl, Tuisa lui, Tiau, Tuiphal and Tuipui rivers, covers and area of 1.52 sq.km. which is 0.33% of the total area. Clayey Sand deposits are found scattered all over the area along small streams with an area of 80.18 Sq.km., which is 2.52% of the study area.

There are two divergent views regarding the classification of the Champhai sediments into rock stratigraphic unit. The workers of Geological Survey of India (1974 & 2003) hold the view that the rock succession around Champhai can be equated with Barail Group on the basis of heavy mineral content and lithological contracts it bears with the overlying Surma Group of central Mizoram. They further made an informal classification of the rock succession as belonging to member one and member two of Champhai Formation of Barail Group of Oligocene age. The geologists of the Oil & Natural Gas Commission (ONGC), such as Ganju (1975), Shrivastava *et al.* (1979) and Jokhan Ram (1984), on the other hand, did not find any supporting evidence prior to the classification of the Champhai sediments into the Barail Group. They maintained that the rock exposures around Champhai are lithologically identical with Middle Bhuban, and are mainly argillaceous. According to them, the Champhai sediments belong to the informally classified rock stratigraphic unit named Dulte Formation of Surma Group. Therefore, they are of the opinion that these rocks are a part of Bhuban Sub-Group of Surma Group belonging to Miocene age. Since the basis of classification employed by both the parties being lithological, no specific conclusion could be drawn in this regard.

Recently, Tiwari and Mehrotra (2003) have reported several definite plant fossils from Champhai rock succession. Their collection includes some leaf and fruit/seed impressions from the fossiliferous sandstone-shale horizon located along the Champhai-

Aizawl road section. The specimen collected by them was identified as *Podocarpus oligocenicus* Aswathi *et. al.* (1992), *Leguminocarpon mizoramensis* Nov., *Vernoniapalaeoarborea*, Antal & Aswathi (1994) and *Dictylophyllum mizoramensis* sp. Nov. These plant remains indicate deltaic to fluvial environment of deposition for the enclosing sediments. On correlating these floral assemblage with their counterparts recovered from other parts of India and the world, the sediments containing them are assigned to Oligocene age. As such, we favour the views of Geological Survey of India as far as litho-stratigraphic nomenclature of rocks within and around Champhai is concerned.

21. PROCESS OF DEPOSITION OF SEDIMENTS IN THE RIVER OF THE DISTRICT

Sediments are the small pieces of material that come from rocks or other living things like bones, shells, leaves, stems that are broken down into small parts. The four main processes that responsible for generation of sediments are –mechanical breakdown of rocks due to weathering, Erosion by precipitation, transportation by fluvial action of drainage networks, and finally deposition on the river bank as the velocity of the transporting medium decreases called sedimentation.

Generally the deposition of sediment is very high in this hilly terrain due to heavy rainfall during monsoon season, highly jointed rocks and the lithology is mostly sandstones, siltstones and shale with high proportion of organic matter.

The passage of numbers of rivers in the district is initially through sandy, silty and clayey rich terrain, where erosion of country rocks and transportation may be high but may result in the sand/gravel formation. As the area is tectonically active which accelerate the weathering processes that produces bulk quantity of sand/gravel and associated aggregates along the river bed. Thus, geology plays a major role. They coupled with mineral composition sandstone; comprises essentially greyish and buff fine to medium grained hard compact sandstone with silt and clay within the sandstone. Climatic conditions, water-load and velocity of river and rainfall have a vital role in the entire process of transportation and deposition of sand/gravel and associated aggregates. Here too, abrasion is the most important action which involves wearing away of the bank and the bedrock by stream water with the help of sand grains (floating, dragging pebbles and gravels and all such small particles) that are being carried in it. The floating, dragging and rolling depends upon the size and shape of the grains.

Energy, environment and time are the three factors which determine the process of deposition by streams. Thus, when energy decreases to transport the load (by reduction in velocity or volume of water), a part of material can no longer be transported and

hence deposited. Similarly, the factor of environment influences the deposition through configuration or shape of the channel. Uneven surface of the channel check the velocity and hence cause deposition. As a river goes around a bend most of the water is pushed towards the outside causing increased erosion. The river is now eroding sideways into its banks rather than downwards into its bed, a process called lateral erosion.

Based on grain size analysis, the paleo-depositional history indicative of mixed environment where both marine and fluvial influences are present. And the grain size ranges from fine to medium grain.

22. MINOR MINERALS IN THE DISTRICT

There are no major minerals of economic importance reported so far in the district. Only minor minerals such as River sand, Granular Sub Base (GSB), Gravels, Boulders, etc. are found in this district.

22.1 RIVER SAND

In the state of Mizoram, river sediments are deposited alongside of the rivers and the occurrences are of limited extent and are extracted by manually or by small scale methods. With increasing trend of population and infrastructure development in the district, demand of sand for construction works is very high. River sands are the preferred source of building materials but sustainable source of supply is critical. Mining of sand/gravel is being done since long time therefore no specific method of exploration is required as the sand/gravel, deposited all along the bed is very well exposed on surface. Moreover, the excavated minerals are accumulated/replenished every year during rainy season by flow of water depending on intensity of rains on the upstream side.

The process of sand deposition is highly dependent upon the rainfall received in the catchment areas of the rivers and their tributaries and the velocity of the river as it is a dynamic process. Thus it is difficult to predict what quantity of sand may be deposited by the river. If there is less rainfall in the particular year, less water in the river resulting to less erosion and minimal deposition of sand in the river. Besides, the rivers in the state are located in the narrow valleys and the bed rocks are mostly exposed along the course of the stream/rivers. Thus deposition took place only in limited spaces and sand mining activities neither harm the river beds nor the ground water conditions. But it is, suggested that Environmental Clearances may be issued to the eligible people/applicants who are ready to following the Sand Mining Procedure of the state,



Fig.1: Granular Sub Base deposited at Tuipui River



Fig.2: River Sand extracted from Tuichang River

without harming the environment, so that revenue from the minor mineral can be realized properly by the state.

Geographical location of sand mining areas and the estimated volume of sand along the various rivers within the district are as follows.

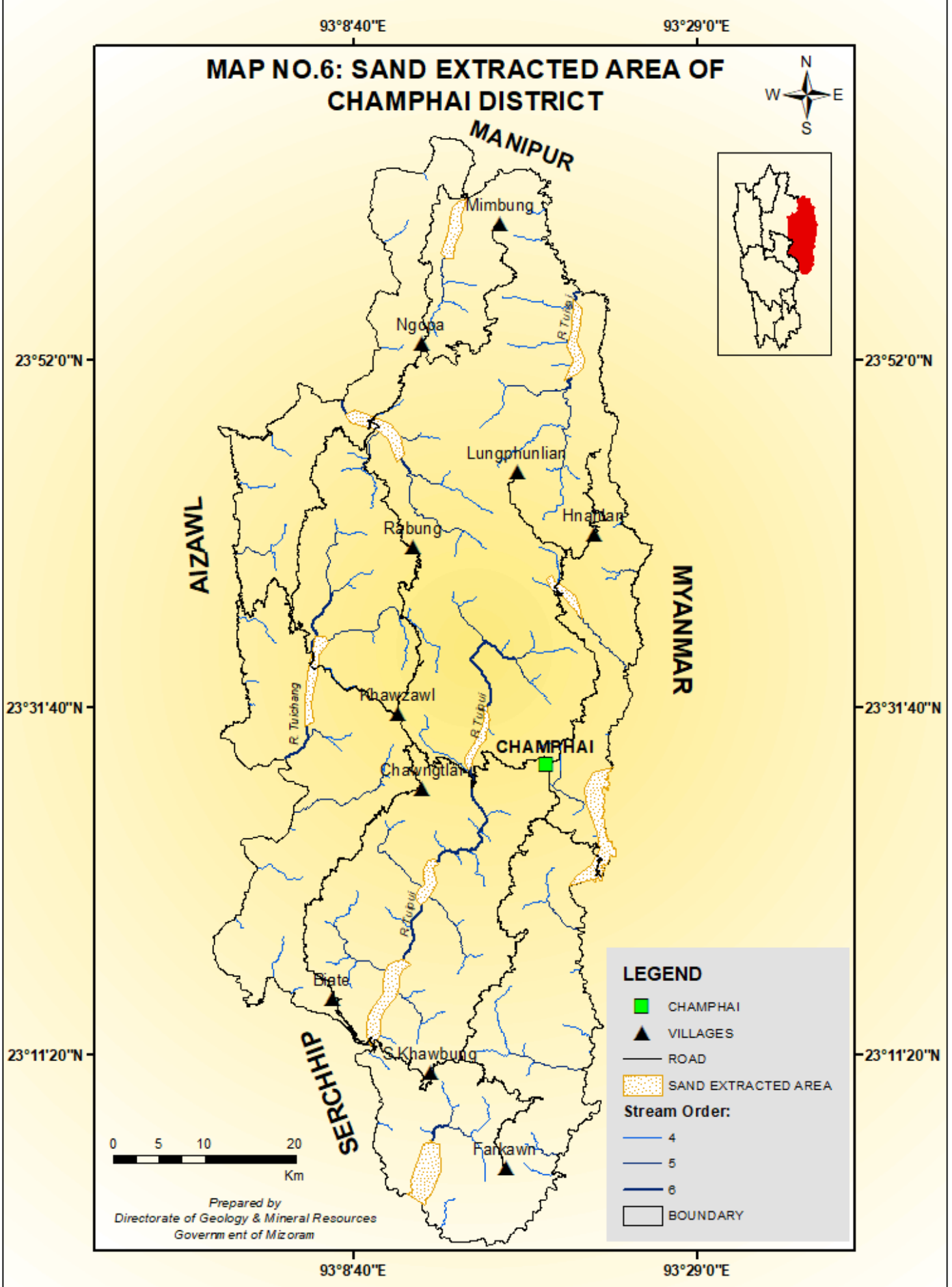
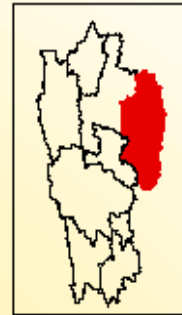
Sl. No.	Name of River	Area	Location of sand mining	Length in Km within the District	Estimated deposit(in metric tonne)
1	Tiau River	B2	Zotekai	155.34	20280.00
		B2	Tlangsam		
		B2	Zokhawthar		
		B2	Bulfekzawl		
		B2	Farkawn		
		B2	Thekte		
		B2	Thekpui		
		B2	Sesih		
		B2	Hnahlan		
2	Tuipui River	B2	Khawzawl	59.58	5500.00
		B2	Khuangthing		
3	Tuichang River	B2	Khawzawl	29.91	700.00
		B2	Vankalkai		
4	Tuithoh River	B2	Tuithoh	13.29	15.00

In order to strengthen the economic status of the local people of Champhai District, Directorate of Geology and Mineral Resources, Government of Mizoram allotted a limited permit to the various stakeholders to carry out the mining in small scale at selected sites. This results in generation of revenue for the Government of Mizoram as well as generates some employment for the local people who are engaged as daily wages worker in the mining site. Following are the data of impounded revenue collected by the Department of Geology and Mineral Resources for the year 2009 - 2019.

YEARLY DATA OF IMPOUNDED REVENUE FROM SAND (2009-2019) WITHIN CHAMPHAI DISTRICT

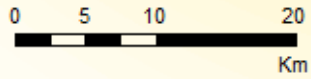
Sl. No.	YEAR	AMOUNT IN RUPEES
1	2009 - 2010	5,19,625.00
2	2010 - 2011	14,91,285.00
3	2011 - 2012	5,52,375.00
4	2012 - 2013	13,58,468.00
5	2013 - 2014	6,30,208.00
6	2014 - 2015	1,31,000.00
7	2015 - 2016	1,78,850.00
8	2016 - 2017	1,87,900.00
9	2017 - 2018	2,26,200.00
10	2018 - 2019	3,33,550.00
	TOTAL	56,09,461.00

MAP NO.6: SAND EXTRACTED AREA OF CHAMPHAI DISTRICT



LEGEND

- CHAMPHAI
- ▲ VILLAGES
- ROAD
- SAND EXTRACTED AREA
- Stream Order:**
 - 4
 - 5
 - 6
- BOUNDARY



Prepared by
Directorate of Geology & Mineral Resources
Government of Mizoram

22.2 STONE

Stone Mine is carried out at different region in the District depend on the accessibility and availability of the rocks. In Champhai District, the lease area comprises of private land only. The process of mining is usually carried out by manual method of opencast mining with the help of tools such as drills, jack hummer, air compressors, hand shovel, picks, excavators etc. Drilling and blasting is also involved in certain permitted areas. At first Topsoil is removed before the mining operations. Excavators (JCB/Hitachi) are usually used for the removal of overburden. Power is not required for the mining operations. The excavation of mineral/stone is carried out by excavators such as JCB. In certain areas the mineral is fractured and easily exploitable by rock breakers and excavators. The hard strata are usually excavated after drilling and blasting.

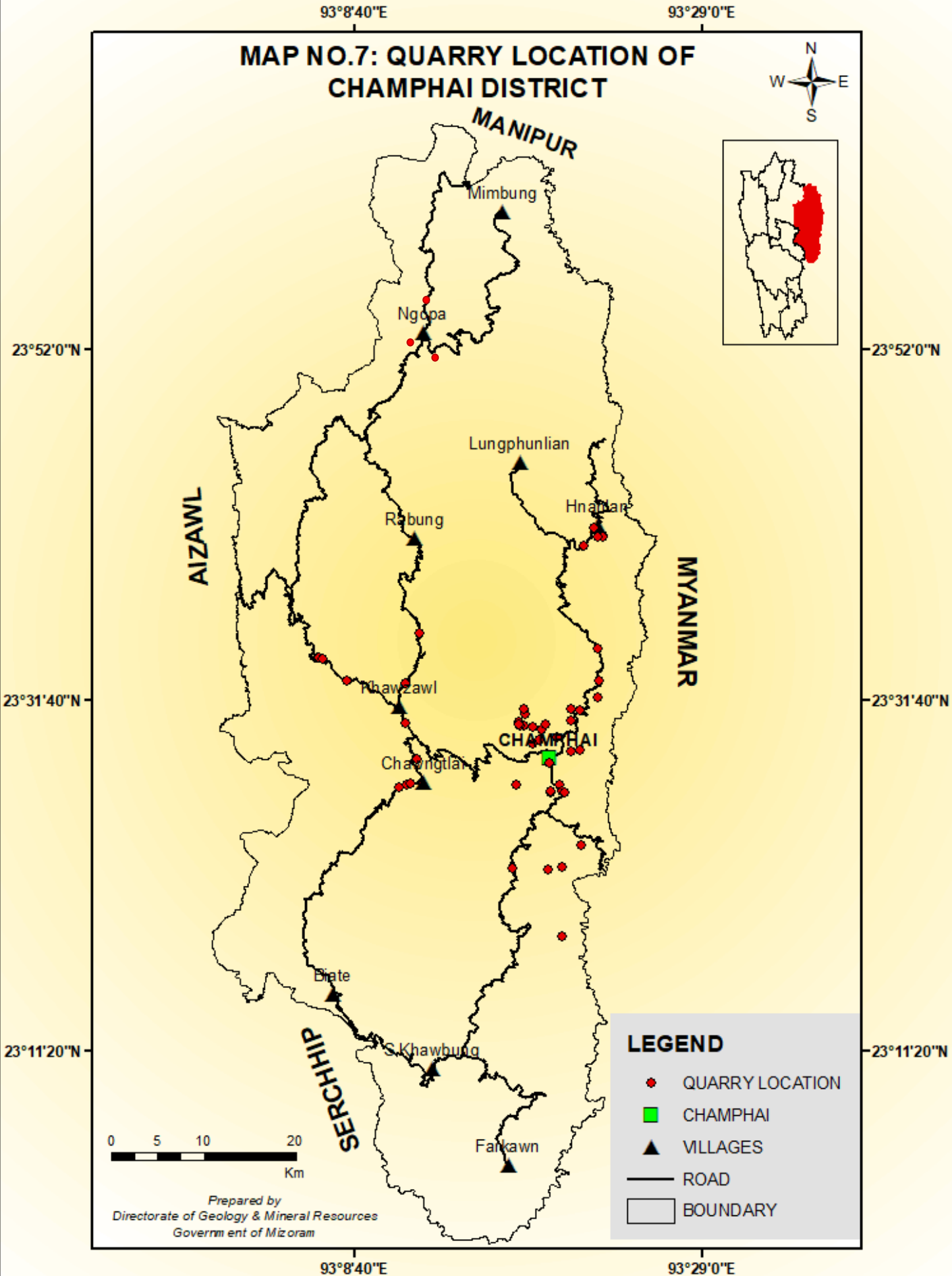
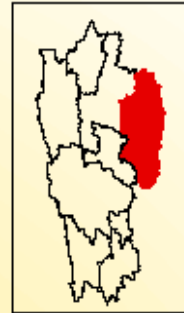
Road of Stone Quarry Mines are generally constructed by the owner of Lands or contribution from the permit holders. Loading of stones are done by excavator or labours and send to the crushing unit or to the place where they want to use for different purposes. Pick-Up/407 Trucks/Tippers of vehicles are used for transportation of mineral from mine site.

The cost of the Stone is directly dependent on the size of the material mined. First Stone bench will be opened by removal of Soil/OB than Stone will be mined out either by labour or with the help of JCB/Hitachi. Selection of quarry sites area generally done based on the quality of rock types, which are mainly used for construction of buildings, road, etc. As of now from 2009 the revenue collected for mineral/stone mining from various check gates within the district are as follows in the table below.

YEARLY DATA OF IMPOUNDED REVENUE FROM QUARRY (2009-2019) WITHIN CHAMPHAI DISTRICT

Sl. No.	YEAR	AMOUNT IN RUPEES
1	2009 - 2010	87,411.00
2	2010 - 2011	2,05,558.00
3	2011 - 2012	2,69,050.00
4	2012 - 2013	3,45,080.00
5	2013 - 2014	6,59,704.00
6	2014 - 2015	3,50,386.00
7	2015 - 2016	5,75,200.00
8	2016 - 2017	2,33,750.00
9	2017 - 2018	6,43,620.00
10	2018 - 2019	4,78,000.00
	TOTAL	38,47,759.00

MAP NO.7: QUARRY LOCATION OF CHAMPHAI DISTRICT



LEGEND

- QUARRY LOCATION
- CHAMPHAI
- ▲ VILLAGES
- ROAD
- BOUNDARY

Prepared by
Directorate of Geology & Mineral Resources
Government of Mizoram

Following are the list of authorised persons who are given the permit to carry out the mining within the district.

Sl. No.	LIST OF MINING PERMITS WITHIN CHAMPHAI DISTRICT (Undivided)			
	Name	Address	Location	Permit No.
1	K. Zakunga	Tlamsam, Champhai	Hlawmchin dum, Dum hnar	005/5/05-13 of 2005
2	H.Khawlmawia	Champhai Zotlang	Farlui kawr, Bellei panna kawng	005/5/05-35 of 2007
3	Vanlalthara	Champhai, Venglai	Ui tlak kawr, Ngur ram	005/5/10-55 of 2010
4	R. Vanlalhluna	Chawngtlai	Theiria hmun pheii,	005/5/12-91 of 2012
5	Anthony Ngurliana	Champhai Vengthlang	Phaichhak Kawtchhuah Hla hnuai	005/5/13-96 of 2013
6	Biblechhiara	Ruantlang	Ruantlang Hmunhlui	005/5/14- 112 of 2014
7	Lalchhandami Pachuau	Upper Republic, Aizawl	Farlui, Ruantlang	005/5/15- 122 of 2015
8	H. Hmingthanzauva	Champhai electric Veng	Vengthar, Zote Road	005/5/16- 127 of 2016
9	J. Zadinga	Champhai Vengsang	Tamdar tlang hnuai, Zote kawng	005/1/16- 131 of 2016
10	C. Lalchhawna	Hmunhmeltha, Champhai	Paihte Riah hmun, Champhai	005/5/17- 136 of 2017
11	Vanlalsiama	Kahrawt	Paihte Riah hmun, Champhai	005/5/17- 139 of 2017
12	Biakvela	Champhai Zote	Champhai Zote Ram	005/5/17- 152 of 2017
13	C. Lallianhnuna	Champhai Venglai	Pialtlep hmun, Zotlang	005/5/17- 159 of 2017
14	K. Lalrosanga	Neihdawn, Champhai	Neihdawn, Dilkawr	005/5/17- 135 of 2017
15	Lalruatpuii	Khawzawl	Chhumliam kawn, Champhai	005/5/17- 160 of 2017
16	P.C. Lalchhuanawmi	Champhai	Vengthar Kawngnuai	005/5/18- 170 of 2018
17	Peter Zakuala	Champhai	Zamadar Tlang, Champhai	005/5/18- 168 of 2018

18	Rorelsaka	Khawzawl	Hmawnglian kawr kam	005/5/17-140 of 2017
19	Thangmuansanga	Ruantlang	Bellei mual, Ruantlang	005/5/17-142 of 2017
20	David Lalramsanga	Champhai	Zote kawngkawi, Vengthar champhai	005/5/18-173 of 2018
21	P. Khawlliana	Hmunhmeltha, Champhai	Milu Puk ram, champhai	005/5/18-177 of 2018
22	Lalchhuangi	Champhai	Thlithawpui Liam (Keite Kham)	005/5/18-172 of 2018
23	Tailiana	Champhai	Vawmbal ram,	005/5/18-175 of 2018
24	Hrangchalliana	Champhai	Laiawk kawngli, Ruantlang	005/5/17-157 of 2017
25	Lalrammawia Ralte	Champhai Vengthlang	Sabual tlang chung, Hmunhmeltha	005/5/17-158 of 2017
26	KT Vanlalchuana	Champhai	Vai sehsen ram, Champhai Dist.	005/5/18-167 of 2018
27	K. Lalhmingthanga	Hmunhmeltha, Champhai	Hmunhmeltha	005/5/17-153 of 2017
28	C. Lalliansanga	Khawzawl Vengsang	Chalkawr, Champhai District	005/5/17-161 of 2017
29	Vanlalthlamuanpuia	Champhai Vengsang	Chhungte-khawkawr	005/5/18-162 of 2018
30	Ramrohluna	Hmunhmeltha, Champhai	Tuikhurlui / Milu puk	005/5/18-163 of 2018
31	C. Thangzuala	Champhai	Bellei Mual.	005/5/19-195 of 2019
32	Lalruatkima	Champhai	Buangtui lui	005/5/19-196 of 2019
33	Zirkunga	Hmunhmeltha, Champhai	Buang lui kam, Champhai	005/5/19-178 of 2019
34	Lalbiakmawii	Zotlang, Champhai	Melpui mual, Ruantlang	005/5/19-179 of 2019
35	F. Zohunthara	Champhai vengthlang	Bethel vengthar tlang hnuai, CPI	005/5/19-183 of 2019
36	Suithanmanga	Champhai venglai	Chhungte, Tuivar kawr, CPI	005/5/19-181 of 2019

37	Sairengpuia	Ngur, Champhai	Ngur hmar hmun ram, Champhai	005/5/17-144 of 2017
38	Zonunmawia	Hmunhmeltha, Champhai	Kei kai, Hmunhmeltha	005/5/19-184 of 2019
39	Lalramzauva	Kahrawt, Champhai	Hospital hnuai, PHE veng, Zotui	005/5/19-187 of 2019
40	H. Lalhmingliana	Zote, Champhai	Dilkawn ram, Champhai Dist.	005/5/19-193 of 2019
41	Sairengpuia Sailo	Champhai	Ngur ram hmar hmun	005/5/19-197 of 2019
42	Lalthanmawia	Champhai	Zote hmun hlui ram	005/5/19-198 of 2019
43	Lianhnuna	Hmunhmeltha, Champhai	Savawm kaw hnuai, Champhai	005/5/19-200 of 2019
44	Zoramnghaka	Hmunhmeltha, Champhai	Nikang ram, Hmunhmeltha	005/5/19-203 of 2019
45	R. Zirkunga	Hmunhmeltha, Champhai	Lungpui chawlhhmun	005/5/19-205 of 2019
46	Vanlalnghaka	Hmunhmeltha, Champhai	Nikang ram, Hmunhmeltha	005/5/19-191 of 2019
47	Robert L.Rammuanpuia	Champhai Zote	Ngur Kawn kawng hnuai	005/5/20-215 of 2020
48	Thangliana	Zokhawthar	Hruaikawn leh zokhawthar ramri inkar	005/5/19-212 of 2019
49	Laltawna	Dilkawn	Dilkawn ram, Champhai Dist.	005/5/19-194 of 2019
50	F. Rohmingmawia	Mualkawi, Champhai	Hmawngsih Ram. Pu Thangluta leh Pu Zairema chul	005/5/19-206 of 2019
51	Rawngbawlliana	Hruaikawn	Satel buk kawng, Hruaikawn ram	005/5/19-180 of 2019
52	T.C. Laltlanthanga	Farkawn	Farkawn, Sihpui Ram	005/5/19-185 of 2019
53	Hrangkungi	Mualkawi, Champhai	Mualkawi, Sihpui ram	005/5/18-165 of 2018
54	Robert Liana	Zokhawthar	Phunchawng phai Luichhuak chhak, Damli Kam	005/5/19-201 of 2019
55	David Laldinpuia Colney	New Hruaikawn	Khuaikham tlangdung, khawlam hnaih	005/5/19-214 of 2019

56	F. Rohmingmawia	Mualkawi, Champhai	Hmawngsih ram, Thanghuta leh Zairema chul	005/5/19-213 of 2019
57	Emmanuel Muanpuia	Champhai venglai	Ngur ram, Uitlak kawr, Champhai	005/5/19-190 of 2019
58	Ngolam Vungi	Sesih	Khuai hnuai, Sesih, CPI	005/5/19-182 of 2019
59	CT Mawia Constr.	Champhai	Teikhang ram, Bengchheng lui, Khawzawl	005/5/18-165 of 2018
60	Vanlaltawna	Hruaikawn	Tuichhin ram, New Hruaikawn	005/5/18-164 of 2018
61	K. Robuanga	Champhai Dist	Ar lei kham	005/5/19-210 of 2019
62	Hrangchhuana	Hnahlan	Nekgan Ocean	005/5/19-202 of 2019
63	Lalhruaitluanga	Khuangleng	Bakhik Zau	005/5/19-211 of 2019
64	Laithanga	Farkawn	Sihpui ruam, Farkawn-Khankawn Rd.	005/5/16-129 of 2016
65	C. Lallawmkima	Khawzawl, Hermon	Chawngtlai ram, Falkawn chhak,	005/5/16-128 of 2016
66	PC Laltanpuia	Khawzawl	Phaisen hnar, zuchhip ram leh Muallungthu ram kal kawng	005/5/19-207 of 2019
67	R. Zadingliana	Khawzawl	Khawzawl lungvar tuikhur kam	005/5/17-146 of 2017
68	K. Lalrinliana	Khawzawl	Khawzawl singzawl road pengpui	005/5/17-138 of 2017
69	Hrangliani	Khawzawl	Aizawl, Khawzawl	005/5/18-174 of 2018
70	K. Lalthuama	Khawzawl Zaingen Veng	Zaingen Lunghlum ram, Khawzawl	005/5/15-121 of 2015
71	H. Lalremsanga	Chawngtlai	Chawngtlai Phairuam ram	005/5/19-186 of 2019
72	H. Sanga	Chanmary	Saihum Tumpui	005/5/18-171 of 2018
73	Lalhriatzuala Sailo	Khawhai	PHC Tank chhak, Khawhai	005/5/19-189 of 2019

74	Lalramthara	Chalrang	Pialtlep kawn, chalrang	005/5/18-176 of 2018
75	Hmingsangzuala	Champhai	Khawzawl to E.Lungdar Rd. Km 6	005/5/18-169 of 2018
76	Biaktluanga	Chawngtlai	Falkawn, Chawngtlai	005/5/19-188 of 2019
77	C. Saphlengliana	Ngopa	Mausin ram, Ngopa	005/5/19-208 of 2019
78	C. Lalthansanga	Ngopa	Vakawlchuan	005/5/19-204 of 2019
79	Zosiamliana	Ngopa	Tuithil hnar Mausin	005/5/19-199 of 2019
80	KC Lalhmingmawia	Bualpui	Sahlam Quarry, Hliappui	005/5/19-209 of 2019



Fig.3: Quarry near Zote Village



Fig.4: Making Block for Construction at Tuichang River

References

1. District Irrigation Plan, Champhai District, Department of Agriculture, Government of Mizoram
2. October 2013, Champai District, Ground Water Information Booklet, Mizoram, North Eastern Region, Central Ground Water Board
3. Micro, Small & Medium Enterprises, Brief Industrial Profile of Champhai District (mizoram), Ministry of Msme, Government of India
4. 2017, Champhai District, District Disaster Management Plan
5. <http://www.north-east-india.com/mizoram/lakes-of-mizoram.html>
6. <https://champhai.nic.in/about-district/>
7. K. C. Kabra (2008). *Economic Growth of Mizoram: Role of Business & Industry*. Concept Publishing Company.
8. Woodthorpe, RG. *The Lushai Expedition*. Hardpress. pp. 277–278. ISBN 9781290939966
9. <https://tourism.mizoram.gov.in/dist/8>
10. 2018, Statistical Handbook of Mizoram, Directorate of Economics & Statistics
11. <https://kvkchamphaidistrict.mizoram.gov.in/page/general-information-of-champhai-district>
12. Grain-size analysis of Tipam sandstones near Buhchang village, Kolasib district, Mizoram - C. Zoramthara^{1*}, V.Z. Ralte² and Lalramdina² *1Department of Geology, Government Zirtiri Residential Science College, Aizawl, 796001, India, 2Department of Geology, Mizoram University, Aizawl 796004, India*
13. KUMAR SHIVA AND VERMA RAHUL. Geochemical Analysis of Bhuban Formation of Surma. Department of Geology, Mizoram University, Aizawl