PROPOSAL FOR PRELIMINARY EXPLORATION (G-3 STAGE) FOR REE AND ASSOCIATED MINERALS IN UMPRI KHOLA BLOCK, (AREA 4.80 SQ.KM), DISTRICTS: KAMRUP (METRO), STATE: ASSAM

COMMODITY: REE AND ASSOCIATED MINERALS

BY

MINERAL EXPLORATION AND CONSULTANCY LIMITED

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SEMINARY HILLS

PLACE: NAGPUR

DATE: 12th NOVEMBER, 2024

Summary of the Block for Preliminary Exploration (G-3 Stage)
GENERAL INFORMATION ABOUT THE BLOCK

	Features	**Details**
	Block ID	Umpri Khola Block
	Exploration Agency	Mineral Exploration and Consultancy Limited (MECL)
	Commodity	REE & associated minerals
	Mineral Belt	Assam-Meghalaya Gneissic Complex
	Completion Period with entire Time schedule to complete the project	15 months
	Objectives	Based on the evaluation of geological data available, the present exploration program has been formulated to fulfill the following objectives: i. To carry out detail geological mapping on 1:4000 scale. ii. To collect surface bed rock samples for analyses of REE and other associated minerals. iii. To drill Systematic vertical boreholes in 400 m X 400 m grid within the already identified mineralized zones. iv. In case, analytical results of BRS samples outside the potential zones are found positive for pegmatites, inclined boreholes shall be drilled for 1st level of intersection. v. Study for diorite hosted Ni, Cr and PGE mineralization. vi. To estimate reconnaissance resources of REE bearing minerals as per UNFC norms and Minerals (Evidence of Mineral Contents) Amendment Rules, 2021 at G-3 level mineral exploration.
	Whether the work will be carried out by the proposed agency or through outsourcing and details thereof. Components to be outsourced and name of the outsource agency	Work will be carried out by the proposed agency
	Name/ Number of Geoscientists	Two
	Expected Field days (Geology) Geological Party Days	Geologist Party Days: 180 (Field) + 60 Days (HQ)

1.	**Location**	
	The coordinate of the cardinal points of Block boundary is given below.	

Corner Point	Geographic Coordinate System (D M S) Datum WGS-84		UTM Zone 46N (m) Datum WGS-84	
	Latitude	Longitude	Easting	Northing
A	26° 2' 3.856" N	91° 52' 44.983" E	387857.4085	2879975.4032
B	26° 2' 11.235" N	91° 52' 35.816" E	387604.5566	2880204.6028
C	26° 2' 51.388" N	91° 52' 24.380" E	387297.3775	2881442.7018
D	26° 3' 5.954" N	91° 54' 3.667" E	390060.4903	2881867.3005
E	26° 2' 13.987" N	91° 54' 12.534" E	390293.4647	2880266.4214
F	26° 1' 49.598" N	91° 52' 49.247" E	387972.1499	2879535.7322

	Villages	Umprikhola, Tanduk, Rohana
	Tehsil/ Taluk	Kamrup (Metro)
	District	Kamrup (Metro)
	State	Assam
2.	**Area (hectares/ square kilometers)**	
	Block Area	4.80 sq. km
	Forest Area	Data Not Available
	Government Land Area	Data Not Available
	Private Land Area	Data Not Available
3.	**Accessibility**	
	Nearest Rail Head	Guwahati (GHY) Railway station is located 25 km North west from the block.
	Road	The area is connected by the Guwahati-Shillong Road (NH 40). The Guwahai - Shillong (GS) road passes through the western side of the block. Within the study area, there are metalled and 'Kutcha' roads originating mostly from G.S. road. There is a network of foot-tracks in the area.
	Airport	Lokpriya Gopinath Bordoloi International Airport, Guwahati is located around 50 km west from the block.
4.	**Hydrography**	

	Local Surface Drainage Pattern (Channels)	Maximum portion of the area is very undulating in nature and characterized by ridges intervening with valleys and hills.
	Rivers/ Streams	The major parts of the area are drained by southerly streams and a river named Digaru along with their tributaries called Umpri & Umtrew confluence near the town Byrnihat. The important river of the area is Digaru which is flowing north-easterly and joining the Kalang River near Gobardhan Grant, which later joins Brahmaputra River.
5.	**Climate**	
	Mean Annual Rainfall	Generally average annual rainfall varies between 100mm – 200mm per year.
	Temperature	The area experiences warm and temperate climate. The rainy season starts from mid-May and continues till September. In the winter season i.e. from December to January, the climate is cold and the temperatures ranges between 90°C to 110°C. The climate of the area in general, is moderate. (Source: Department of Agriculture, Govt. of Meghalaya and Assam).
6.	**Topography**	
	Toposheet Number	Part of Toposheet Nos. 78N/16
	Morphology of the Area	Geomorphologically the entire area is occupied by undulating low hills.
7	**Availability of baseline geosciences data**	
	Geological Map (1:50K/ 25K)	1:12500 scale LSM map of G-4 Exploration
	Geochemical Map	Maps regarding NGCM work in the Toposheet for different elements are available.
	Geophysical Map	Geophysical Map is also available with the G-4 exploration report.
8.	**Justification for taking up Reconnaissance Survey / Regional Exploration**	A. The proposed Umpri Khola Block is located in the North Central part of the Shillong Plateau mostly comprises of granite gneiss belonging Assam-Meghalaya gneissic complex which has been intruded by younger granites and pegmatites. Geologically, younger granites and pegmatites are potential to host REE minerals.

		B. During the G-4 stage exploration of REE and associated mineralization in the Byrnihat area, three potential zones for further investigation has been identified within which Umpri Khola area, i.e., mineralized zone 3 (1.1 sq km area) has been targeted for present G-3 level of exploration. C. There is total 18 numbers of BRS samples, 2 pits, 3 trenches and 3 numbers of boreholes were drilled during the G-4 investigation within the presently proposed Umri khola block having area of 4.80 sq. km. It has been observed that the ΣREE value is varying from 24.49 ppm to 710.30 ppm where as there are six numbers of samples show ΣREE value more than 500 ppm. All the samples drawn from the pit and trenches also show ΣREE value more than 500 ppm with highest 1537.70 ppm in Pit No-2. The diorite intersected in the borehole MEGBRK-03 also indicate ΣREE value 1134.168 ppm. D. Mineral phases like allanite and monazite has been observed in stream sediments as well as in the petrographic study of granite, diorite. Bastnaesite is also observed under microscopic study of Diorite sample collected from zone-3. E. Hence the proposal for G-3 level exploration for REE has been formulated in the area mainly for REE and associated minerals but also for diorite hosted PGE, Ni and Cr mineralization in accordance to the recommendation of previous geoscientist.

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1.1.0 INTRODUCTION

1.1.1 Rare earth elements are characterized by high density, high melting point, high conductivity and high thermal conductance with distinctive electrical, metallurgical, catalytic, nuclear, magnetic and luminescent properties make them indispensable for a variety of emerging high end and critical technology applications which are relevant to India's energy security i.e., clean energy, defense, civilian application, environment and economic areas. REE demand is expected to continue its growth, especially for their use in low carbon technology. The ever-increasing demand for these REE necessitates a concerted effort to augment the resource position of our country.

1.1.2 The Rare earth elements (REE) are a collection of 17elements in the periodic table , namely scandium, yttrium and lanthanides (15 elements in the periodic table with atomic numbers 57 to 71 namely: lanthanum (La), cerium (Ce), praseodymium(Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb) and lutetium (Lu). In spite of its low atomic weight Yttrium (atomic no. 39) has properties more similar to the heavy lanthanides and is included with this group. Scandium (atomic no. 21) is found in a number of minerals although it may also occur with other rare earth elements (REE).

1.1.3 Although these elements tend to occur together, the lanthanide elements are divided into two groups. The light rare earth elements (LREE) are those with atomic numbers 57 through 62 (La, Ce, Pr, Nd, Pm, Sm) and the heavy rare earth elements (HREE) are those with atomic numbers from 63 to 71 (Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu) and Y, Sc. However, because of their geochemical properties, rare earth elements are typically dispersed and not often found concentrated as rare earth minerals in economically exploitable ore deposits.

1.1.4 Generally, the light rare earth elements (LREE) are more abundant in the earth's crust and easily extracted than heavy rare earth elements (HREE). It was the very scarcity of these minerals (previously called "earths") that led to the term "rare earth". The first such mineral discovered was gadolinite, a compound of cerium, yttrium, iron, silicon and other elements. This mineral was extracted from a mine in the village of Ytterby in Sweden; several of the rare earth elements bear names derived from this location.

1.1.5 In the other hand, critical minerals are those minerals that are essential for economic development and national security. The lack of availability of these minerals or concentration of extraction or processing in a few geographical locations may lead to supply chain vulnerabilities and even disruption of supplies. The future global economy will be underpinned by technologies that depend on minerals such as lithium, graphite, cobalt, titanium, and rare earth elements. These are essential for the advancement of many sectors, including high-tech electronics, telecommunications, transport, and defenses. They are also vital to power the global transition to a low carbon emissions economy, and the renewable energy technologies that will be required to meet the 'Net Zero' commitments of an increasing number of countries around the world. Hence, it has become imperative to identify and develop value chains for the minerals which are critical to our country.

1.1.6 Considering important parameters such as resource/ reserve position in the country, production, import dependency, use for future technology/ clean energy, requirement of fertilizer minerals in an agrarian economy, the Committee has identified a set of 30 critical minerals. These are Antimony, Beryllium, Bismuth, Cobalt, Copper, Gallium, Germanium, Graphite, Hafnium, Indium, Lithium, Molybdenum, Niobium, Nickel, PGE, Phosphorous, Potash, REE, Rhenium, Silicon, Strontium, Tantalum, Tellurium, Tin, Titanium, Tungsten, Vanadium, Zirconium, Selenium and Cadmium. (Critical Minerals for India, Report of the Committee on Identification of Critical Minerals, Ministry of Mines, June 2023)

1.1.7 A study, conducted by the Council on Energy Environment and Water, identified 12 minerals out of 49 that were evaluated as **'**most critical**'** for India's manufacturing sector by Vision 2030 which makes more thrust for exploration in Strategic Mineral, Precious Metals, Platinum Group of Elements by Government of India.

1.2.0 BACKGROUND

1.2.1 The Exploration for strategic, critical, rare metals, rare earths elements, PGE and precious metals is given top priority by Govt. of India after amendment of MMDR act. Moreover, emphasis has been given to explore the more numbers of blocks in North eastern states. Keeping this in view, the present proposal Preliminary Exploration (G-3 stage exploration) for REE and associated minerals in Umpri Khola Block, Districts: Kamrup (Metro), Assam is being put up for evaluation under NMET funding and execution.

1.3.0 BLOCK LOCATION AND ACCESSIBILITY

1.3.1 Umpri Khola Block area falls in the parts of Survey of India Toposheet No. 78N/16 covering a total area of 4.80 sq. km in around villages of Tanduk, Umprikhola, Rohana

villages, Kamrup (Metro) District, State-Assam. The location map of the block area is given in **Plate-I.** The Co-ordinates of the corner points of the block area both geodetic and UTM are given in **Table No. -1**

Table- 1

Co-ordinates of the Corner points of the Umpri Khola Block, Kamrup (Metro), Assam

Corner Point	Geographic Coordinate System (D M S) Datum WGS-84		UTM Zone 46N (m) Datum WGS-84	
	Latitude	Longitude	Easting	Northing
A	26° 2' 3.856" N	91° 52' 44.983" E	387857.4085	2879975.4032
B	26° 2' 11.235" N	91° 52' 35.816" E	387604.5566	2880204.6028
C	26° 2' 51.388" N	91° 52' 24.380" E	387297.3775	2881442.7018
D	26° 3' 5.954" N	91° 54' 3.667" E	390060.4903	2881867.3005
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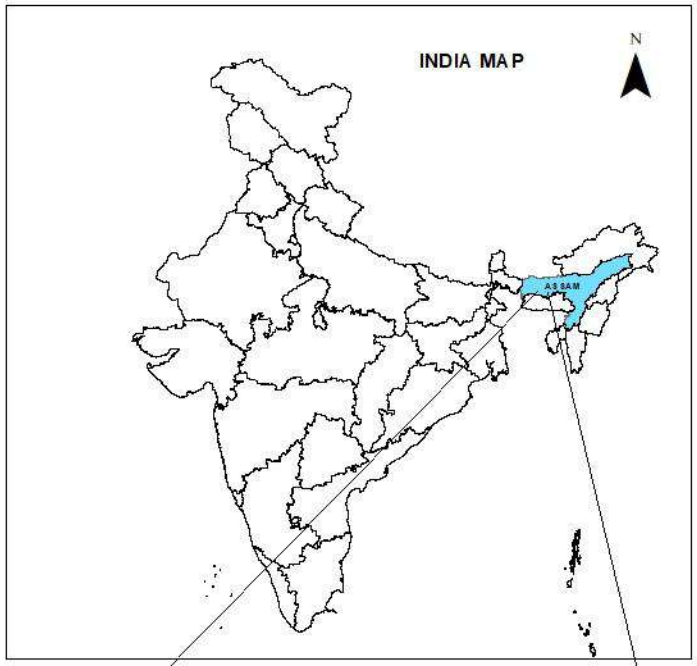
F	26° 1' 49.598" N	91° 52' 49.247" E	387972.1499	2879535.7322

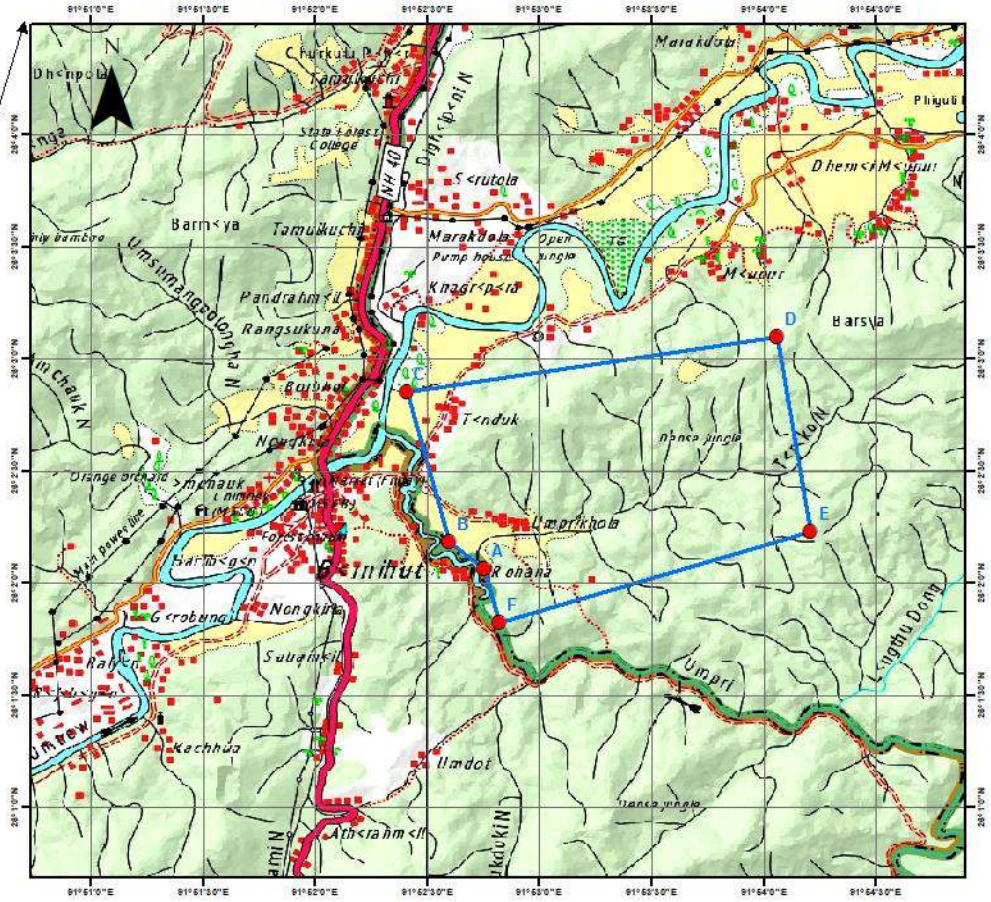
1.3.2 The area is connected by the Guwahati-Shillong Road (NH 40). The Guwahai - Shillong (GS) road passes through the western part of the block. Within the study area, there are metalled and 'Kutcha' roads originating mostly from G.S. road.

1.3.3 The nearest railway stations are Guwahati (GHY) and Kamakhya (KYQ), which are connected to this area by the Guwahati-Shillong Road (NH 40). The nearest airport is Lokpriya Gopinath Bordoloi International Airport. The State capital Dispur is located around 20 km NW from the block.

1.3.4 On the whole, the area is not easily accessible by vehicle as maximum portion of the block area is occupied by hills and forest cover.

LOCATION MAP OF PROPOSED UMPRI KHOLA BLOCK FOR REE (PART OF TOPOSHEET NO 78N/16, AREA- 4.80 sqkm), DISTRICT:KAMRUP METROPOLITAN, ASSAM





NOT TO SCALE

Legend

- Corner Points of Proposed Umprikhola block
- Proposed UmriKhola Block Boundary

Coordinates of Corner points of Proposed Umprikhola Block Boundary

Datum: WGS-84

Corner Points	DMS		UTM (m) Zone - 46 (NORTH)	
	Latitude	Longitude	Easting (m)	Northing (m)
A	26° 2' 3.856" N	91° 52' 44.983" E	387857.41	2879975.40
B	26° 2' 11.235" N	91° 52' 35.816" E	387604.56	2880204.60
C	26° 2' 51.388" N	91° 52' 24.380" E	387297.38	2881442.70
D	26° 3' 5.954" N	91° 54' 3.667" E	390060.49	2881867.30
E	26° 2' 13.987" N	91° 54' 12.534" E	390293.46	2880266.42
F	26° 1' 49.598" N	91° 52' 49.247" E	387972.15	2879535.73

1.4.0 PHYSIOGRAPHY, DRAINAGE AND CLIMATE:

1.4.1 The western and north western portion of the area which is less undulating, the remaining portion of the block area is very undulating in nature and characterized by ridges intervening with valleys and the block is completely covered with high hills and forest cover.

1.4.2 The major parts of the area are drained by southerly streams and a river named Digaru along with their tributaries called Umpri & Umtrew confluence near the town Byrnihat. The important river of the area is Digaru which is flowing north-easterly and joining the Kalang River near Gobardhan Grant, which later joins the main river Brahmaputra.

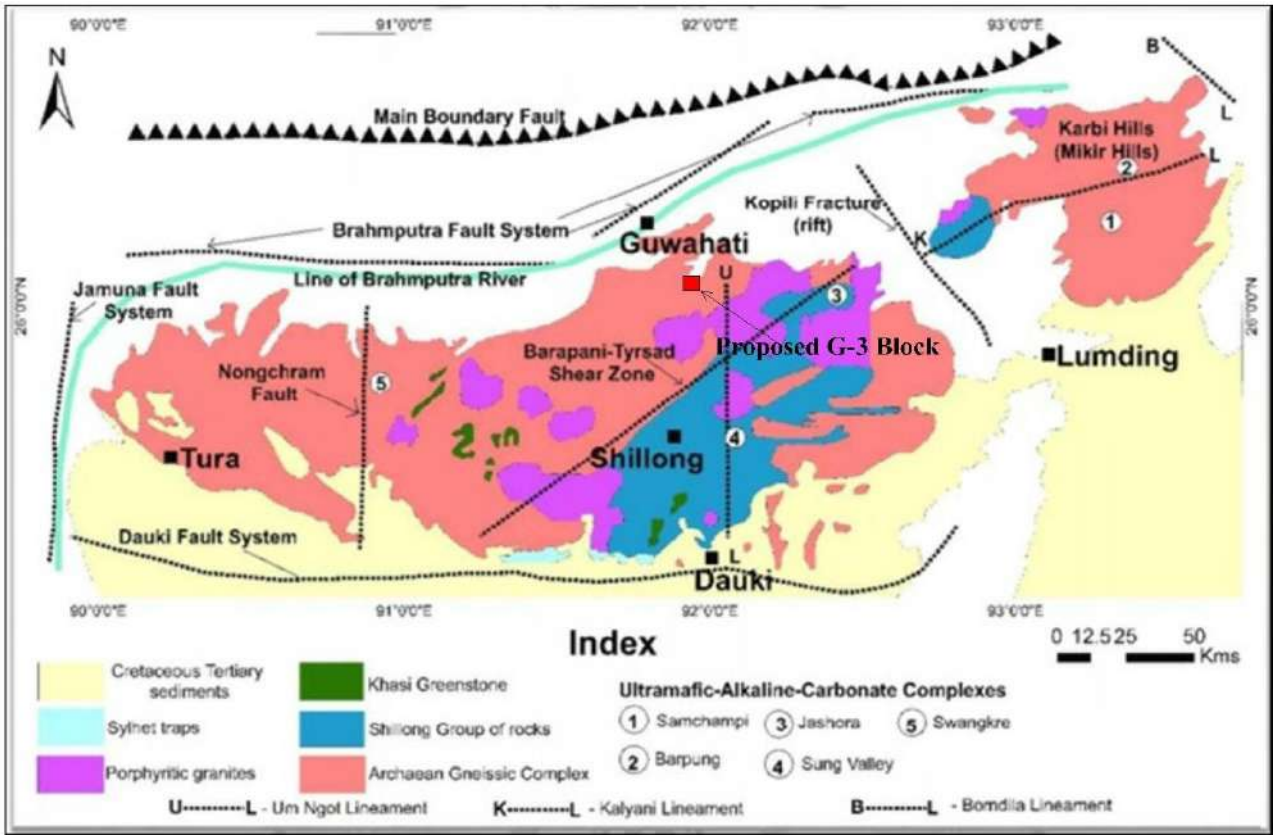
1.4.3 The area experiences warm and temperate climate. The average rainfall of the area is about 100–200 mm per year. The rainy season starts from mid-May and continues till September. In the winter season i.e. from December to January, the climate is cold and the temperatures ranges between 9^0C to11^0C. The climate of the area in general, is moderate. (Source: Department of Agriculture, Govt. of Meghalaya and Assam). The average annual temperature in area is 24.6 °C. The study area being close to Brahmaputra Valley remains warm and humid most of the year except in winter when temperature falls to 10°C or even less.

1.5.0 FLORA & FAUNA:

1.5.1 The plant of betalnut (Areca catechu), Bamboo (Bambusoideae), Banana (Musa acuminata), are the main plants of the area of exploration. Coniferous and deciduous trees are the major flora observed in the area. Along the hill slopes and low-lying areas Paddy (Oryza sativa) is the main cultivation. The valley portion is occupied by various varieties of Elephant grass (Pennisetum purpureum) that grows upto 2-3 metres high during the rainy season. Wild jackal (Canis aureus) and various faunas like wild boar (Susscrofa), elephant (Loxodonta), several kinds of birds, leeches and poisonous snakes are seen in this area (Source: Forest and Environment Department, Govt. of Meghalaya and Assam).

1.6.0 REGIONAL GEOLOGYAND STRUCTURE

1.6.1 The proposed study area in toposheet No. 78N/16 lies in the Northern fringe of the Shillong Plateau. The study area is regionally located west of Um-Ngot lineament and bounded by Brahmaputra fault system in the North.



Regional Geological and tectonic framework of the Shillong Plateau (compiled by GSI from Evans, 1964); Desikachar, 1974; Mazumdar, 1976; Nandy, 1980; Acharyya et al., 1986; Gupta and Sen 1988; Golani, 1991; Das Gupta and Biswas, 2000)

1.6.2 The lithounits in and around the region belong to the Archean-Proterozoic Assam-Meghalaya Gneissic Complex (AMGC) which is unconformably overlain by metasedimentary rocks by Paleo-Meso Proterozoic Shillong Group, all intruded by Neo-Proterozoic-early Palaeozoic granite plutons. Extensive granitoid magmatism related to Grenvillian and Pan-African orogeny is common in AMGC. These granites occur as plutons and intruded the entire Precambrian regime of the Meghalaya Plateau and the Mikir Hills which includes the small exposures occurring as inselbergs. Different rocks viz. cordierite metapelite, granite gneiss, amphibolite, diorite etc. of AMGC are exposed in and around Byrnihat. The porphyritic granite known as 'Nongpoh Pluton' intruding into the AMGC, occurs in the southern part of the studied area. At the contact of granite, the gneisses are migmatised. All the rock types were traversed by numerous veins and veinlets of quartz, pegmatite and aplite, which are most probably late stage fluids of granitic pluton. Among these, quartz veins are very important since they invariably carry "Basemetal sulphide" mineral with them (Bandopadhyay, 1983; Bhattacharya et al., 2000).

1.6.3 The Assam Meghalaya Gneissic Complex is considered as the tectonically detached and uplifted part of the Indian Peninsular Shield separated by the "Garo-Rajmahal Gap" (Evans 1964) from the Chhotanagpur Gneissic Complex. The main structural trend in the Assam Meghalaya Plateau is NE-SW, which is persistent all over the area and variation of this trend is apparent at places near the contact of granite pluton intrusions. The NE extension of the Assam Meghalaya Plateau is known as Mikir Hills. The Mikir Hills are separated from the Meghalaya plateau by the alluvium tract of the Kopili River and the NE-SW Kopili Fault (Nandy, et al., 1986).

1.6.4 The regional Stratigraphic Succession around the area as established by GSI is furnished below

Table:2

Regional Stratigraphy of Meghalaya (GSI, Misc. Pub. No.30 Part IV Vol 2(ii) Meghalaya, 2009).

Age	Group Name	Formation	Lithology
HOLOCENE	**Newer Alluvium**	Unclassified	Sand, silt and clay
PLEISTOCENE	**Older Alluvium**	Unclassified	Sand, clay, pebble, gravel and boulder deposit
----------Unconformity----------			
MIO-PLIOCENE		Dupitila Formation	Mottled clay, feldspathic sandstone and conglomerate
----------Unconformity----------			
OLIGOMIOCENE	**Garo Group**	Chengapara Formation (700m) Baghmara Formation (530m) Simsang Formation (1150m)	Coarse sandstone, siltstone, clay and marl Coarse feldspathic sandstone pebble, conglomerate, clay, silty clay with fossiliferous limestone horizon at the top Siltstone and fine sandstone and alternations of siltstone-mudstone
EOCENEOLIGOCENE	**Barail Group**	----------	Coarse sandstone, shale, carbonaceous shale with streaks and minor lenses of coal
PALAEOCENEEOCENE	**Jaintia Group**	Kopili Formation (50m)	Shale, Sandstone, marl
		Shella Formation (600m)	Upper Sylhet Limestone (Prang Limestone) Upper Sylhet Sandstone (Narpuh Sandstone) Middle Sylhet Limestone (Umlatdoh Limestone) Middle Sylhet Sandstone (Lakadong sandstone) Lower Sylhet Limestone (Lakadong Limestone) Lower Sylhet Sandstone (Therria Sandstone)
		Langpar Formation (100m)	Calcareous shale, sandstone and limestone

Age	Group Name	Formation	Lithology
UPPER CRETACEOUS	**Khasi Group**	Mahadek Formation(150m) Conglomerate (25m) Jadukata Formation(140m)	Arkosic sandstone (often Glauconitic and Uraniferous) Conglomerate Conglomerate/sandstone
----------Unconformity----------			
CRETACEOUS	**Alkaline-Ultramafic-Carbonatite Complex of Sung**	----------	Pyroxenite-Serpentinite with abundant development of melilite pyroxene rock, ijolite, syenite and carbonatite
----------Unconformity----------			
CRETACEOUS	**Sylhet Trap (600m)**	----------	Basalt, alkali basalt, rhyolite and acid tuff
----------Unconformity----------			
CARBONIFEROUS TO PERMIAN	**Lower Gondwana**	Karharbari Formation	Very coarse to coarse grained sandstone with conglomerate lense, siltstone, shale, carbonaceous shale and coal
		Talchir Formation	Basal tillite with sandstone bands, siltstone and shale
----------Unconformity----------			
NEO PROTEROZOIC TO EARLY PALAEOZOIC		Granite plutons: Kyrdem Granite Pluton Nongpoh Granite Mylliem Granite South Khasi Granite	Porphyritic coarse granite, pegmatite, aplite/quartz vein traversed by epidiorite, dolerite and basal dykes
----------Intrusive contact----------			
PROTEROZOIC	**Khasi basic-Ultrabasic intrusive (Khasi greenstone)**	----------	Epidiorite, dolerite, amphibolite and pyroxenite dykes and sills.
PALAEO-MESOPROTEROZOIC	**Shillong Group**	----------	Quartzite, phyllite, quartz sericite schist, Conglomerate.
----------Unconformity----------			
ARCHAEAN (?)-PROTEROZOIC	Meghalaya Gneissic Complex		Biotite gneiss, biotite hornblende gneiss, granite gneiss, mica schist, sillimanite quartz schist, biotite-granulite-amphibolite, pyroxene granulite, gabbro and diorite.

1.7.0 GEOLOGY AND STRUCTUREOF THE BLOCK AREA

1.7.1 The rock types of the area include granite gneiss, foliated granitoids, coordirite metapelites, diorite and pegmatites/quartz veins.

1.7.2 The rocks like cordierite metapelite and foliated granitoid are intimately related with granite gneiss. Paucity of continuous exposure and extreme weathering of rock are the two main factors that limit to correlate direct field relationship to ascertain their stratigraphic position. On the other hand, diorite has an intrusive relation with the granite gneiss and pegmatite vein/ quartzo-feldspathic vein/ quartz vein cuts across all the lithounits.

1.7.3 It is assumed that the cordierite metapelites (paragneiss) were supracrustal metasediments and older than the granite gneiss (orthogneiss). Thus, the cordierite metapelite occurs as enclave within the granite gneiss. The foliated granitoid occurs as an intrusive body within the gneissic rock. The stratigraphy of the study area is mentioned below.

Table No 3.

Stratigraphic Succession within the block

Pegmatite/ quartzo-feldspathic vein

|

Diorite

|

Foliated granitoid

|

Granite gneiss

|

Cordierite metapelite

|

Basement (unseen)

1.7.4 **Description of Lithounits in and around the proposed block as described in the G-4 investigation by GSI**

Pegmatite/ quartzo-feldspathic vein: There are mainly four types of veins, which intruded the major lithounits of the study area. Those veins were categorized on the basis of their mineral content.

Quartzo-feldspathic vein: It is coarse grained, light colored and composed of only quartz and feldspar. Best exposure of quartzo-feldspathic vein is present near Umprikhola village.

Quartz vein: It is coarse grained, light colored and composed of only quartz.

Pegmatite vein: Pegmatite bodies are mostly concordant with the general foliation (E-W to NE-SW trend) of the area. At places, the pegmatite vein cuts across the gneissic

foliation. They are mainly found within the granite gneiss. In most of the cases, these are deformed pegmatite, as they show pinch and swell structure and other deformation signature of the last deformational episode. The rock is composed of quartz and alkali feldspar. The quartz is pink in color. The feldspar is kaolinized at places. Some black dots are also present in the quartz and feldspar. Those black dots might be the REE bearing mineral phases, which contribute the high value of REE in the rock.

Quartz-magnetite vein: 1cm-1m wide and 1m-10m long quartz-magnetite veins were observed within cordierite metapelite of Umdot, Tandu and Tamulkuchi during G-4 investigation. These are both concordant and discordant to the gneissic foliation. At places, these veins are sulfide bearing.

Diorite: It is coarse grained, hard, massive, compact rock with a melanocratic look. Plagioclase, hornblende, quartz and biotite are the main constituents. Diorites are intrusive into gneissic rock. Diorites occur in isolated bodies, aligned along E-W direction. Best outcrops were observed at lower Amchauk and Umprikhola during G-4 exploration. Within a single outcrop the mafic percentage varies. The percentage of biotite decreases and the percentage of amphibole increases from West to East. Diorite is also present in some core sample of borehole no. MEGBRK 3 & 10. Diorite body was intruded by quartzo-feldspathic veins of different dimension.

Granite gneiss: It is the dominant lithounit of the study area. It is grey colored, fine to medium grained with alternate dark colored and light-colored band. The mineral constituents are quartz, alkali feldspar and plagioclase with varying amount of biotite, hornblende and magnetite. Original igneous textures are completely obliterated by metamorphism and deformation. Based on the distribution of mafic minerals, the protolith of the granite gneiss has been identified as biotite granite. Modal abundance of magic minerals is usually low (<10 modal%). The gneissic banding is a few millimeters to a few inches in thickness.

The rock shows pervasive foliation by stretching of grains which locally produces a linear abric. Alkali feldspar is perthitic in nature and constitutes the dominant feldspar species. Fine biotite flakes occur parallel to the foliation. Zircon, apatite and sphene are abundant phase within the matrix and the grains shows elongated idioblastic shape.

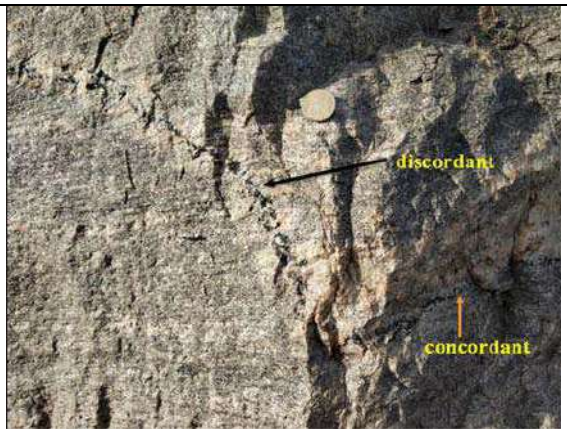
Cordierite metapelite: It is purplish grey colored, medium to coarse grained rock. It shows compositional banding of mafic and quartzo-feldspathic units with a few millimeters to a few inches in thickness. It consists of an assemblage: quartz-microcline-plagioclase-biotite-cordierite-garnet-magnetite. The outcrop of cordierite metapelite is well exposed at Umdot. At some places like Tandu village and Garobungi, the rock has more concentration of garnet than cordierite. At some places like Rohana village, the garnet is absent. Proportions of the minerals vary considerably from one part of the gneiss to another. Cordierite is much more abundant in the quartzo-feldspathic part and the garnet occur in the biotite rich part. Gradation from scattered

grains to cluster of garnet was noticed at Tandu. Lenses of microcline-quartz pegmatite and magnetite-quartz veins are intimately associated with the gneiss; some are concordant, others cut across the foliation and banding of the gneiss. Throughout the area, the rock is migmatised. The degree of migmatisation varies with location with its highest at Umdot.

The migmatitic structure in the studied area varies between metatexites and daitexites. Metatexites are mainly preserved in the form of stromatic type, which is characterized by a banding defined by the alternation of leucocratic and melanocratic layers. The melanocratic part is fine-grained and comprises more than 60% of the rock. It is composed mainly of biotite, cordierite, sillimanite, and garnet. The leucocratic parts are medium-grained and occur principally as small lenses or layers. The modal composition of the leucocratic layers is typically 40% quartz, 30% K-feldspar, 20% plagioclase, 10% mafic and, thus, broadly leucogranodioritic. The most common aluminous mineral in the metatexite migmatites is cordierite. Diatexite migmatite is medium to fine-grained with high proportion of leucosome, between 40 and 60% of the rock, and contains many centimeter-size lenses of melanosome, mostly composed of biotite and cordierite, oriented parallel to the general foliation. The most common aluminous mineral is cordierite; because the mineral assemblages are similar to those in the metatexite migmatites, the diatexite is believed to have formed at similar metamorphic conditions. The diatexites comprise mainly of schollen type, where palaeo some occur as raft-like fragments, partially dissolved in the neo some showing distinct border. At places, Ophthalmitic structure is also preserved. The neo some is distributed or rather dispersed, within the palaeo some in the shape of eyes.

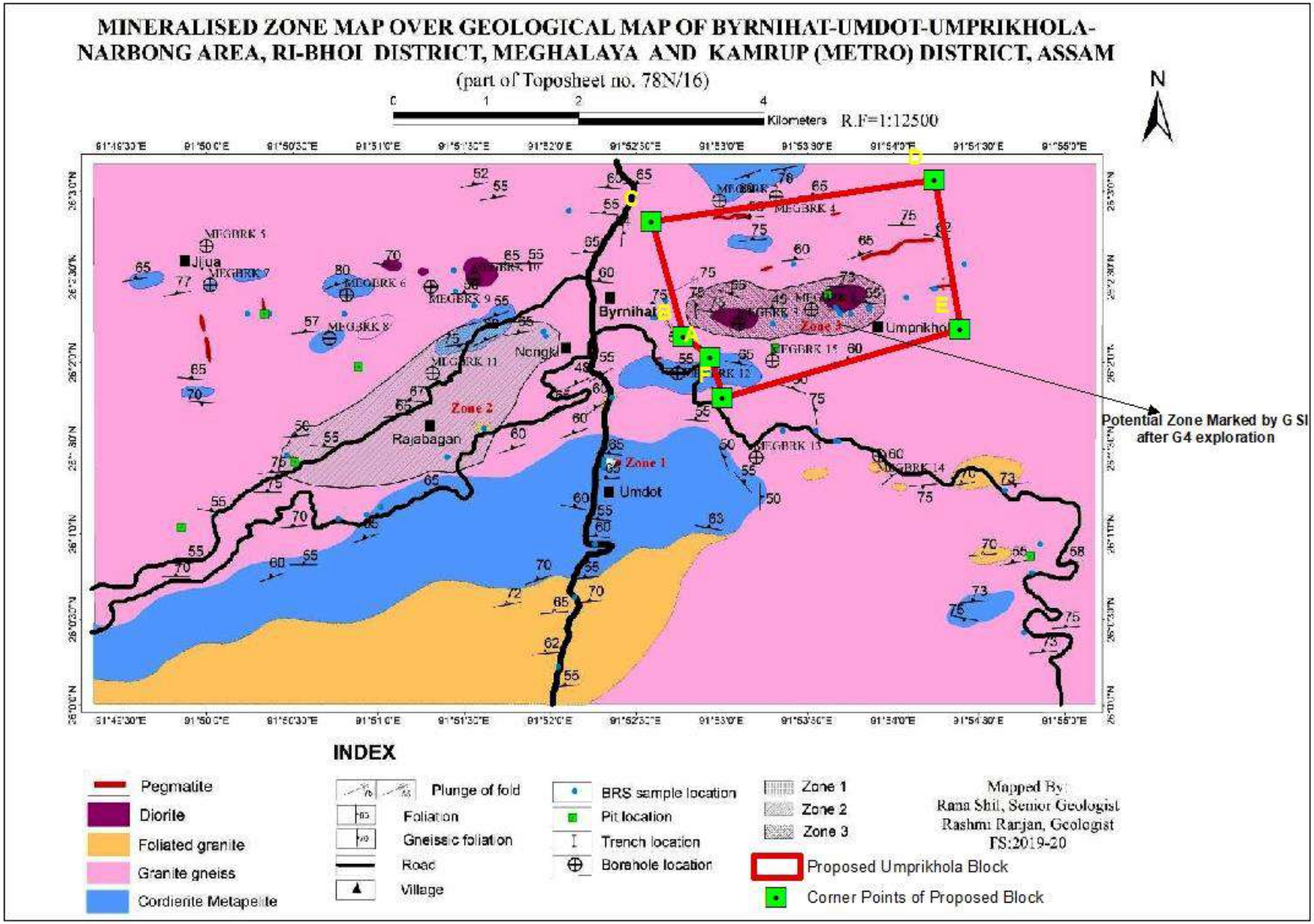
Photographs of various Rock types in and around the study area (Source: GSI Report)

	
Field photohraph of quartzo-feldspathic vein. Quartz vein is overlain by feldspar vein Location: north of Umprikhola.	Field photohraphof quartz vein Location: Umprikhola.

	
Pegmatite vein intruded within the gneissic rock. Location: Rajabagan	Both concordant and discordant quartz-magnetite vein intruded within cordierite metapelite. Location: Umdot.
	
Field photograph of diorite. Location: North of Umprikhola.	Field photograph of diorite body. Location: North of Umprikhola.
	
Core of diorite. Location: Umprikhola.	3 2 cm. wide quartzo-feldspathic vein intrudes the diorite body. Location: Umprikhola.

	
Field photograph of foliated granitoid. Location: Atharamail.	Field photograph of granite gneiss. Location: North of Umdot.
	
Field photograph of cordierite metapelite. Location:Umdot.	Gradation from scattered grains to cluster of garnet. Rock type: cordierite metapelite. Location: Tandu
	
Magnetite-quartz vein cuts across the gneissic banding of cordierite metapelite. Location: Umdot.	The light-colored layers (leucosome) and dark layers occur parallel. The thinnest leucosome layer is at the top and the thickest leucosome is at the bottom. Location: Umdot.

	
Schollen (raft) structure. Palaeosome occur as raft-like fragments partially dissolved in the neosome showing distinct border. Rock type: cordierite metapelite. Location: West of Umprikhola.	Ophthalmitic structure. The neosome is distributed or rather dispersed, within the palaeosome in the shape of eyes. Rock type: cordierite metapelite. Location: Umdot.


MINERALISED ZONE MAP OVER GEOLOGICAL MAP OF BYRNIHAT-UMDOT-UMPRIKHOLA-NARBONG AREA, RI-BHOI DISTRICT, MEGHALAYA AND KAMRUP (METRO) DISTRICT, ASSAM
(part of Toposheet no. 78N/16)
0 1 2 4
Kilometers R.F=1:12500
N
Byrnihat
Umprikhola
Nongkl
Rajabagan
Umdot
Zone 1
Zone 2
Zone 3
Potential Zone Marked by G SI after G4 exploration
INDEX
Pegmatite
Diorite
Foliated granite
Granite gneiss
Cordierite Metapelite
Plunge of fold
Foliation
Gneissic foliation
Road
Village
BRS sample location
Pit location
Trench location
Borehole location
Zone 1
Zone 2
Zone 3
Proposed Umprikhola Block
Corner Points of Proposed Block
Mapped By:
Rana Shil, Senior Geologist
Rashmi Ranjan, Geologist
FS:2019-20

1.8.0 PREVIOUS WORK - OBSERVATION AND RECOMMENDATIONS

1.8.1 AMGC is composed pre-dominantly of gneisses with lenticular bands of amphibolite, biotitegranulite, biotite schist and isolated occurrences of granites and hornblende-diorite, all belonging to the Archaean Gneissic Complex. Gogoi (1964-65) mapped the area around Umpyrtha and tried to differentiate rock types within the gneisses. The porphyritic granite, known as Nongpoh Pluton, which intrudes the gneissic complex, occurs in the southern part of the studied area. Mazumdar et.al.,1968 mapped the southern part of the area and established the relationship of the Nongpoh Pluton with the gneisses.

1.8.2 Bandyopadhyay et al.,1983, mapped 300 sq km area in the Survey of India Toposheet Nos.78O/9, 78O/13 and 78 N/l6 on the scale of 1: 63,360 and encountered lithounits like Archaean metamorphics and porphyritic granite known as Nongpoh Pluton. According to the author, the Archaean Gneissic Complex is an admixture of a number of rock types most of which appear to grade into one another. Dominant rock types are leucogranite gneiss and biotite granite gneiss of the Archaean Gneissic Complex associated with nonporphyritic granites, diorites, mica schist, biotite granulite and amphibolite occuring as lenses. Bandyopadhyay et al. divided the granite into two contrasted types: (1) nonporphyritic granite, which is intimately associated with the gneisses and (2) porphyritic granite known as Nongpoh Pluton, which is found to be intrusive into the Gneissic complex. The leucogranite gneiss and biotite granite gneiss almost have identical mineralogical composition except for the abundance of biotite flakes in latter. The amphibolite occurring mostly as small disconnected lensoid bodies within the gneisses show sharp contact with them. It was reported that the Gneissic Complex represents an older suite of psammitic to psammopelitic sedimentary assemblage which were intruded by basic bodies and later metamorphosed to upper amphibolite facies conditions to form present gneissic complex. All these rock types are traversed by numerous veins and veinlets of quartz, pegmatite and aplite. Minor dissemination of sulphide mineralisation in the greisen zone (magnetite, tourmaline, dark mica) adjoining the granitic Pluton near Nongpoh had been located. From the economical point of view, 0.4% to 0.62% Cu values were reported within quartz vein in PWD quarry section.

1.8.3 Systematic geological mapping of an area of 520 sq.km. was carried out in parts of Ri-Bhoi and West Khasi Hills districts falling under toposheets 83B/4, 83C/1, 78N/16, 78O/10, 78O/13 and 78O/14 by Bhattacharya et al., 2000 during F.S: 1995-96. Two isolated patches were mapped separately, one around Umden-Umlaper (parts of toposheets 83 B/4. 83 O 1. 78 N/16. 78 O/13 and 78 O/14; henceforth referred to as Sector I) and

another around Kyrdemkulai -Bhalta (parts of toposheets 78O/10, 78O/13 and 78O/14, henceforth referred to as Sector II). The area comprises mainly of Precambrian Gneissic Rocks, Shillong Group of rocks and granitoids which are intrusive into the former. According to them, Gneisses are granitic to granodioritic in composition and over this gneissic basement rock, Shillong Group of metasedimentaries occupy as cover sequence, which is represented by quartz-mica-schist and quartzite. Granitoids are intrusive of which porphyritic granite is older than non-porphyritic, medium/fine grained granite.

1.8.4 Four phases of deformations are discernible in the area of which first one gives intrafolial folds and second one is steeply plunging. S2 is the major structural plane; orientation of which is rotated by third deformation in nearly E-W direction. Third folds are regional antiforms and synforms. The last deformation shows nearly upright folds in N-S axis, coupled with ductile shear zones. Gneisses attained upto amphibolite facies of metamorphism where as Shillong Group shows that of greenschist facies. Metamorphism in gneisses might have preceded that of Shillong Group. From the economical point of view, Granitoids are used as road metals as well as dimensional stones. Sulphide mineralisation with pyrite, chalcopyrite was reported within non-porphyritic granite (south of Umdokha) and also in diorite (near 17 km, on bank of Umtrew). Sulphides occur as specks and are locally disseminated.

1.8.5 Angami et al., 2012 had carried out Regional Geochemical Mapping on Toposheet no. 78N/16, in Kamrup, Darrang and Nagaon district, Assam and Ri-Bhoi district, Meghalaya on 1:50000 scale. Though there are no such significant values of base metal, Sn (upto 20 ppm.), W (upto 5.6 ppm.), REE, the author concluded high anomalous zones of Cu, Zn and Cr around Digaru area in alluvium, and Pb anomaly around Digaru river flood plain between Sonapur and Belguri TG and along the Bardong Nala basin. Even the author has recommended investigation for Ni depending on 42-78 ppm. value around Kumarkuchi Tea Garden, NW of Norbong, West of Dahel colony. 40-85 ppm, Pb values was recorded in the south of Sonapur and around Markong area. High values of REE (total REE: 102.8 - 1311.4 ppm.) was reported around Jabaikona.

1.8.6 Khonglah et al., 2017 carried out field work on genesis of ion-adsorption type REE Mineralisation in parts of Nongpoh Granitoid, Ri-Bhoi district, Meghalaya, on 1:25000 scale to study REE enrichment in the in-situ soil horizon formed above Nongpoh granitoids and also above adjoining gneissic rocks. Porphyritic granitoid forms the dominant lithology of the Nongpoh pluton with subordinate diorite-granodiorite-monzonite-vaugnerite. Potential REE bearing phases like allanite and sphene were locally

identified in the field along certain domains of porphyritic granitoid around Nongpoh and Umta, within pegmatite in south of Nongpoh. Chemical analyses of bed rock samples are having total REE in range of 158.39ppm in diorite of Umran to 1498.87ppm in porphyritic monzongranite compare to the range of 15.38ppm in soil sample developed on gneisses around Myrdon to a maximum range of 1521.18ppm in soil of porphyritic granite. Similar values of bedrocks and soil therefore reflects the area around Nongpoh region, suggest no noteworthy enrichment. The authors had summarized that, the soil samples developed over porphyritic granitoids are having higher total REE of 183.64 to 1521.18 ppm, relative to the surrounding soil formed over gneisses in range from 15.38 to 553.22ppm, which are again reflection of similar REE values in their respective bedrock.

1.8.7 Majhi et al., 2016 carried out mapping in and around Kumarkuchi and Chagaligaon, Kamrup (Metro) district, Assam for W, Sn and REE. Total REE: 2096.32ppm was found within biotite gneiss at Kumarkuchi (26°07'41.5"; 91°55' 13.9"). Total REE value was higher in case of porphyritic granite (max.1672.45 ppm) compared to other non porphyritic variants (max.1530.6 ppm). It was recommended not to go for further investigation for REE in porphyritic granite but the biotite gneiss of Chagaligaon has a good possibility for REE mineralisation (carbonate phase).

1.8.8 The area (78N/16) was covered by NGPM during FS: 2015-16 by Chakraborty et al. They reported a significant high intensity magnetic (TF) anomaly associated with high Bouguer gravity anomaly of the order -54 mGal around 1.5 Km northwest of Byrnihat, Ri-Bhoi district of Meghalaya. Bipolar magnetic nature also was noticed in this zone. This high gravity anomaly may possibly be due to the combined effect of high-density rock and heavy mineral concentration in pegmatite/quartz veins. Magnetite in association with other magnetic rich body is possibly responsible for higher magnetic anomaly within quartz vein. The source anomalies were well reflected in residual gravity map, upward magnetic continuation map and analytical signal map of magnetic. A major N-S trending magnetic discontinuity passing through Byrnihat was noticed in the southern part of TS No. 78N/16. Authors recommended for further investigation of the area with integrated approach of geological, geochemical and geophysical methods.

1.8.9 On basis of above-mentioned recommendation, reconnaissance survey (G-4 stage) was carried out for REE and associated mineralization in and around Byrnihat area, Ri-Bhoi district, Meghalaya and Kamrup (Metro) district, Assam (part of toposheet no. 78N/16) during the field season: 2019-20. The objective was to delineate the possible REE mineralized zones in the contact of Nongpoh granite and gneiss of AMGC and to assess

the basemetal and associated mineralization in pegmatite/ quartz veins. The investigation includes large scale mapping (1:12500 scale) of 50 sq. km area along with collection of 100 bed rock samples, 25 petrochemical samples, 25 petrological samples, 40 nos. of stream sediment samples and 10 nos. of samples for XRD. Besides this, 50 cu.m. pitting and trenching and 398 m drilling in 15 nos. of boreholes were also carried out.

1.8.10 The area forms in part of Assam Meghalaya Gneissic Complex (AMGC). Different rock units of the studied area are cordierite metapelite, granite gneiss, foliated granitoid and diorite, which were intruded by pegmatite and quartzo-feldspathic veins of different dimensions. Cordierite metapelite is purplish grey colored, medium to coarse grained and composed of quartz, feldspar, biotite, muscovite, cordierite and garnet. Granite gneiss is grey colored, fine to medium grained and composed of quartz, feldspar, biotite, hornblende etc. Foliated granitoid is grey colored, medium to coarse grained and composed of quartz (35-40%), alkali feldspar (25-30%), plagioclase (20-25 %) and mafic minerals (15- 20%) like biotite and hornblende etc. It is peraluminous in nature. Diorite is medium to coarse-grained; dark colored and composed of plagioclase feldspar, biotite, hornblende and clinopyroxene, which are randomly oriented. The general trend of the regional fabric varies from N50^{o}E to S70^{o}E dipping 50-70^{o} towards North or South. Different sulfide minerals like pyrite, chalcopyrite, bornite etc. were identified in quartz-magnetite veins (2cm to 0.5m wide and 1m to 20m long), intruded within cordierite metapelite.

1.8.11 Gravity, magnetic, IP & SP survey were carried out in three different blocks (Block A, Block B and Block C) within the studied area. The lithological boundaries of some major lithounits are well reflected in the form of low and high magnetic variations arising due to magnetization contrasts. Magnetic survey brought out the lithlogical contact between the Granite gneiss/ Cordierite metapelite with quartz vein and pegmatite veins in Block-A, which is well collaborated with the steep gravity gradient having a broad circular low anomaly zone varying in the order of -48.2 to -46.2 mGal trending in East-West direction. In the Block-B, several isolated alternative low and high intensity magnetic anomalies were delineated with anomaly variations between “-600nT and 350nT” trending in the NW-SE and NE-SW direction between the traverses L5 and L9 between the stations N500 and N700, N1000 and N1300 in the eastern part of studied area. This magnetic anomaly is well corroborated with high residual gravity anomaly. In Block-C, the high magnetic anomaly varies between “200nT and 600nT” trending in NE-SW direction in the eastern part and NW-SE direction in the central part of the area. It is well corroborated with the

high gravity zone varying from -45.1 mGal and -42.4 mGal between the traverses L9 and L14 over the granite gneiss and cordierite metapelite.

1.8.12 IP/ Resistivity survey was conducted by deploying current electrode spacing of 1000m and potential electrode spacing of 20m for gradient array and dipole-dipole (n=1,2,3,4,5 and a =20m) array. IP/ Resistivity survey delineated high chargeability and high resistivity zone over the traverses L6, L7 and L12 in the blocks A, B and C respectively. The high chargeability zone is well corroborated with highs of magnetic and gravity and may be structurally favorable zone for possible occurrence of mineralization at depth below the quartz/pegmatite vein.

1.8.13 The Bed Rock Sample (BRS) includes fresh rock sample, weathered rock sample as well as soil sample to target the REE and base metal. BRS samples were collected from those parts of the rock, where the fluid activity and sulphide mineralization were prominent. From the analytical result of BRS, it is

1.8.14 found that the calculated total REE (La-Lu +Y+Sc) value varies from 40 to 19563 ppm. 1.95 % total REE value was recorded in pegmatite (not mappable) intruded within cordierite metapelite in Umdot area.

1.8.15 The PCS samples were collected from the fresh exposures of major lithounits (cordierite metapelite, granite gneiss, foliated granitoid, diorite etc.) of the area to know the geochemical characteristics of the rock. From the analytical result of PCS, it is found that the calculated total REE value varies from 68 to 2166 ppm. The high value of total REE was noticed in foliated granitoid. The presence of REE phases like monazite, allanite etc. within foliated granitoid could be contributing factor for the REE enrichment compared to other lithologies.

1.8.16 Stream sediment samples (SSS) were collected from 2nd order and 3rd order streams of the study area. From the analytical result of SSS, it is found that the calculated total REE value varies from 130 to 1777 ppm. After panning and bromoform separation of few collected stream sediment samples, the nonmagnetic fractions of the heavy minerals were studied under binocular microscope and different heavy minerals like zircon, monazite, allanite, sphene, apatite, garnet etc. were identified. REE phases like monazite and allanite may attribute to the higher value of total REE in case of stream sediment. Pitting and trenching were carried out at different locations of the studied area, to expose the subsurface lithology. Pit-Trench Sample (PTS) consists of both soil and weathered rock sample. From the analytical result of PTS, it is found that the calculated total REE value varies from 303 to 1537 ppm. Core logging was carried out based on different soil

horizons (A, B & C) and core samples were collected from each horizon. From the analytical result of Core Sample (CS), it is found that, the calculated xtotal REE value varies from 162 to 1200 ppm.

1.8.17 The G4 stage exploration reveals that the REE content is very less in cordierite metapelite whereas it is medium in granite gneiss and medium to high in foliated granitoid. So, it is recommended not to target cordierite metapelite for REE exploration. The foliated granitoid unit could be targeted for REE. 0.24% Ba; 0.14% Cr; 0.1% Sr and 1134 ppm. ∑REE were found within diorite of Umprikhola (mineralized zone- 3). The diorite bodies could be mapped properly and explored for Ni, Cr and PGE. An area in and around Nongki, Kachhua and Rajabagan (mineralized zone-2) was identified as potential area for REE (based on ∑REE values like 2166 ppm in foliated granitoid and 1064 ppm. in granite gneiss near Nongki area; 1548 ppm in stream sediment sample of Rajabagan area and 1777 ppm in stream sediment sample of Kachhua area). More sampling is recommended for foliated granitoid, granite gneiss and it´s weathered part in and around Nongki. Two sporadic values of Zn (508 & 445 ppm) were recorded from sulfide bearing cordierite metapelite of Tandu. More sampling could be carried out in sulfide rich zone of cordierite metapelite. 1.95 % total REE was recorded in pegmatite (not mappable) intruded within cordierite metapelite in Umdot area (mineralized zone-1). This type of veins might be potential for REE and RM. More emphasis should be given to demarcate younger pegmatite veins, intruded within cordierite metapelite for REE exploration in future.

1.9.0 MINERAL POTENTIALITY OF THE BLOCK AND JUSTIFICATION FOR TAKING UP THE EXPLORATION

A. The proposed Umpri Khola Block is located in the North Central part of the Shillong Plateau mostly comprises of granite gneiss belonging Assam-Meghalaya gneissic complex which has been intruded by younger granites and pegmatites. Geologically, younger granites and pegmatites are potential to host REE minerals.

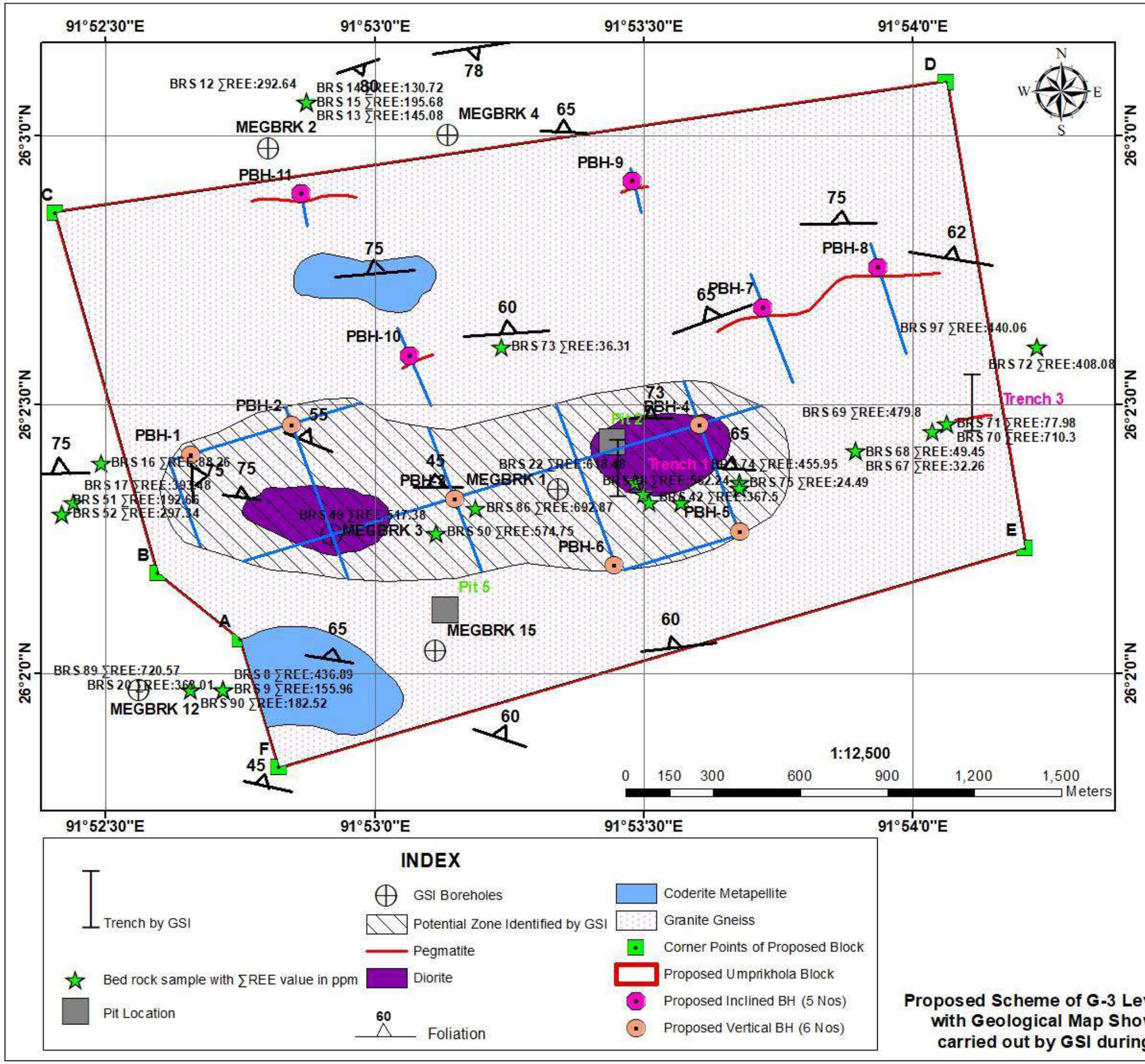
B. During the G-4 stage exploration of REE and associated mineralization in the Byrnihat area, three potential zones for further investigation has been identified within which Umpri Khola area, i.e., mineralized zone 3 (1.1 sq km area) has been targeted for present G-3 level of exploration.

C. There is total 18 numbers of BRS samples, 2 pits, 3 trenches and 3 numbers of boreholes were drilled during the G-4 investigation within the presently proposed Umri khola block having area of 4.80 sq. km. It has been observed that the ΣREE value is varying from 24.49 ppm to 710.30 ppm where as there are six numbers of

samples show ΣREE value more than 500 ppm. All the samples drawn from the pit and trenches also show ΣREE value more than 500 ppm with highest 1537.70 ppm in Pit No-2. The diorite intersected in the borehole MEGBRK-03 also indicate ΣREE value 1134.168 ppm.

D. Mineral phases like allanite and monazite has been observed in stream sediments as well as in the petrographic study of granite, diorite. Bastnaesite is also observed under microscopic study of Diorite sample collected from zone-3.

E. Hence the proposal for G-3 level exploration for REE has been formulated in the area mainly for REE and associated minerals but also for diorite hosted PGE, Ni and Cr mineralization in accordance to the recommendation of previous geoscientist.



Pit No	Sample Length	Lithology	∑ REE in ppm
Pit-2	1.125	Brown soil	1109.9
	1.125	Grey soil	1537.7
	1.125	Grey soil with rock fragments	751.1
Pit-5	1.125	Dark brown soil	552.6
	1.125	Brown soil	616.3
	1.125	Brown soil with pebbles of quartz	498.2

Trench No	Sample Length	Lithology	∑ REE in ppm
Trench-1	1	Granite Gneiss	570.7
	1	Granite Gneiss	657.2
	1	Granite Gneiss	623.6
	1	Contact of Granite gneiss & diorite	1013.4
	1	Diorite	638.4
	1	Diorite	562.1
	1	Diorite	673
Trench-3	1	Brown soil with granite gneiss clast	553.8
	1	Brown soil with granite gneiss clast	538.7
	1	Brown soil with granite gneiss clast	452.6
	1	Granite gneiss with quartz vein	424.2
	1	Granite Gneiss	557.3
	1	Granite Gneiss	579.8
	1	Granite Gneiss	452.7

Borehole No.	Details of sample	Total REE (ppm)
MEGBRK-01	C-upper	581.636
	C-lower	640.989
	Clay	693.123
	B-horizon	422.015
	C-horizon	412.781
	Granite gneiss	316.528
MEGBRK-03	B-upper	408.182
	B-lower	442.56
	C-upper	320.91
	C-lower	680.375
	B-horizon	299.172
	C-horizon	530.559
	Diorite	1134.168
MEGBRK-15	C-upper	385.046
	C-lower	412.006
	A-horizon	421.638
	B-horizon	498.687
	C-horizon	384.851

Proposed Scheme of G-3 Level of Exploration in Umprikhola block with Geological Map Showing BRS,Pit,Trench and Boreholes carried out by GSI during G4 level Exploration (FS 2019-20)

1.10.0 SCOPE FOR PROPOSED EXPLORATION.

The proposed Preliminary Exploration of G-4 stage for REE mineralization will comprise of Detail Geological mapping (1:4000 scale), Topographic Survey, Surface Sampling (Bedrock), Drilling, chemical analysis, physical analysis and geological report preparation. The Exploration shall be carried out as per Minerals (Evidence of Mineral Contents) Amendment Rules, 2021. Accordingly, the following scheme of exploration is formulated in order to achieve the objectives. The details of different activities to be carried out are presented in subsequent paragraphs

1.10.1 GEOLOGICAL MAPPING

Detail geological mapping will be done in the entire 4.80 sq. km area on 1:4000 scale. Rock types, their contact, structural features will be mapped. Surface manifestations of the mineralisation available along with their surface disposition will be marked on map.

1.10.2 TOPOGRAPHIC SURVEY

The Umprikhola Block under G-3 exploration shall be surveyed by Total Station to generate Topographical map at 1:4000 scale which will be used as base map for other works. The contours shall be drawn at 4m interval. The corner points of the block boundary shall be surveyed by DGPS instrument and the coordinated and Rl of the boreholes shall also be determined by DGPS instrument only.

1.10.3 SURFACE SAMPLING

During the course of geological mapping, around 50 nos of bed rock samples shall be collected from granite, pegmatite and diorite by means of chipping from a representative area.

1.10.4 Drilling

Previously G-4 stage of exploration already indicated potential zone with an area of 1.1 sq. km. The historical boreholes also indicate the soil thickness of 15-20 m in the Umprikhola area. Hence the subsurface rock and soil profile samples can only be taken through drilling of boreholes.

Hence, the potential area shall be covered by systematic drilling of vertical boreholes with average 50 m depth at 400 m X 400 m grid interval. Hence a total 300 m in 6 vertical boreholes will be drilled in the area.

Moreover, Based on Geological mapping and BRS sampling, if the intruded pegmatites found fertile, further 5 Nos of systematic inclined boreholes with average depth of 60 m

shall be drilled for the 1st level intersection of pegmatite bodies. Hence, 300 m drilling shall be carried out in 5 inclined boreholes.

Hence a total 11 boreholes with 600 m of drilling shall be carried out to explore 4.80 sq km area of proposed Umprikhola block in G-3 stage.

1.10.5 BOREHOLE SAMPLING

Sampling is the key component to establish the mineralization on any block. In case of proposed block, all the intersected hard rock, i.e., granite, pegmatite and diorite shall be sampled keeping the sample length 1.00 m. Further, soil sampling shall be carried out for 50% of the boreholes, i.e., in 6 Nos of boreholes. Horizon wise soil sampling shall be carried out. The entire length of a particular soil horizon shall be mixed and prepare one sample for chemical analysis. And thus around 350 Nos of samples (325 Nos of hard rock sample and 25 nos of soil samples) shall be generated. Sampling work shall be carried out as per the standard practice of sampling followed for REE investigation.

1.10.6 LABORATORY STUDY

1.10.6.1 CHEMICAL ANALYSIS

A total around 400 Nos of samples shall be generated (50 BRS and 350 Nos of Borehole Core Samples) for REE and shall be analysed for 34 elements, i.e., REE and associated trace elements through ICPMS.

10% of the primary samples, i.e., 40 Nos samples shall be subjected as external check samples and analysed for the same elements by ICPMS.

Due to presence of Diorite in the block, as well as in accordance with the recommendation of G-4 stage investigation, around 25 nos of samples shall be subjected to Ni and Cr analysis by AAS method and PGE analysis by ICP-MS Ni-S fire assay technique

1.10.6.2 PHYSICAL ANALYSIS

PETROGRAPHIC, MINERAGRAPHIC AND EPMA STUDY

15 Nos of samples of different lithology with suspected REE minerals shall be subjected to complete petrographic and mineragraphic study. Few samples shall also be subjected for EPMA study.

XRD STUDY

15 nos. of samples from mineralized zones shall be subjected for XRD studies for mineral phase identification.

The summarized details of the proposed Nature and Quantum of work has been furnished below in Table-4

Table No 4
Summarized Details of the proposed Nature and Quantum of work

Sl. No.	Item of Work	Unit	Target
1	**Geological Mapping** (on 1:4000 Scale)	sq.km	4.80
2	**Geochemical Sampling**		
	Surface Samples (BRS Chip Sampling)	Nos	50
3	**Surveying**		
	a) Topographic Survey by Total Station	Cu.m	90
	b) Determination of Coordinate of Corner points of Block boundary (6 Nos) and boreholes (11 Nos) by DGPS instrument	Nos	17
4	**Drilling**		
	a) Drilling (core) (6 vertical BH with 300 m and 5 Inclined Bh with 300 m)	m	600
	b) Geological Logging	m	600
	c) Borehole core samples	Nos	350
5	**Laboratory Studies**		
	a)REE associated Trace Elements (34 Element)by ICPMS Surface samples-50 BRS Bh Core Samples : 350 nos	Nos	400
	b) External Check Samples	Nos	40
	c) Ni and Cr by AAS method	Nos	25
	d) PGE by ICP-MS Ni-S fire assay technique	Nos	25
6	**Physical Study**		
	a) Petrological Study	Nos	15
	b) Mineragraphic Study	Nos	15
	c) XRD Study	Nos	15
	d) EPMA Study	Hours	15
7	**Report Preparation (5 Hard copies with a soft copy)**	Nos.	1

1.11.0 BREAK-UP OF EXPENDITURE

1.11.1 Tentative Cost has been estimated based on Schedule of Charges (SoC) of projects funded by National Mineral Exploration Trust (NMET) w.e.f. 01/04/2020. The total estimated cost is **Rs. 561.41 Lakhs.** The summary of tentative cost estimates for Preliminary Exploration (G-3 Level) is given below in Table No-5**.** Detailed cost sheet for Preliminary Exploration (G-3) for REE & associated minerals is given as Annexure No. **I**

Table No: 5

Summary of Cost Estimates for Preliminary (G-3 Level) Exploration in Umprikhola Block, Kamrup Metro, Assam

Sl. No.	Item	Total Estimated Cost (Rs.)
1	Geological Work	9,255,360.00
2	Topographical Survey	3,184,644.00
3	Drilling	29,098,267.50
4	**Sub total**	**41,538,271.50**
5	Laboratory Studies	4,138,480.00
6	**Sub total**	**45,676,751.50**
7	Report	1,370,302.55
8	Peer Review	30,000.00
9	Proposal Preparation	500,000.00
10	**Total**	**47,577,054.05**
11	GST (18%)	8,563,869.73
Total cost including 18% GST		**56,140,923.77**
SAY, in Lakhs		**561.41**

1.12.0 TIME SCHEDULE

1.12.0 The proposed exploration programme envisages geological mapping, geochemical sampling, exploratory mining, drilling, sample preparation and laboratory studies, which will be completed within 12 months, geological report preparation will consume 3 months. Therefore, a total of 15 months is planned for completion of the entire program.

Enclosed Plates:

i. Location map of Proposed Umprikhola Block, District: Kamrup (Metro), Assam

ii. Geological Map of Proposed Umprikhola Block, District: Kamrup (Metro), Assam

iii. Proposed Scheme of G-3 Exploration Umprikhola Block, District: Kamrup (Metro), Assam

TIME SCHEDULE FOR PRELIMINARY EXPLORATION (G3 STAGE) OF REE AND ASSOCIATED MINERALS IN UMPRI KHOLA BLOCK, KAMRUP (METRO), STATE-ASSAM.

		1	2	3	4	5	6	7	8		9	10	11	12	13	14	15
1	Camp Setting																
2	Geological Mapping																
3	Topographic Survey/DGPS survey /BH Fixation																
4	Core Dilling																
5	Camp Winding									Review							
6	Laboratory Studies																
7	Geologist Party days, HQ																
8	Geological Report Writing																
9	Peer Review																

*** Commencement of project will be reckoned from the day the exploration acreage is available along with all statutory clearances**

*** Time loss on account of monsoon/agricultural activity/forest clearance/local law and order problems will be addition to above time line**

ANNEXURE-I

COST ESTIMATE OF PRELIMINARY EXPLORATION (G3 STAGE) OF REE AND ASSOCIATED MINERALS IN UMPRI KHOLA BLOCK, KAMRUP (METRO), STATE-ASSAM.

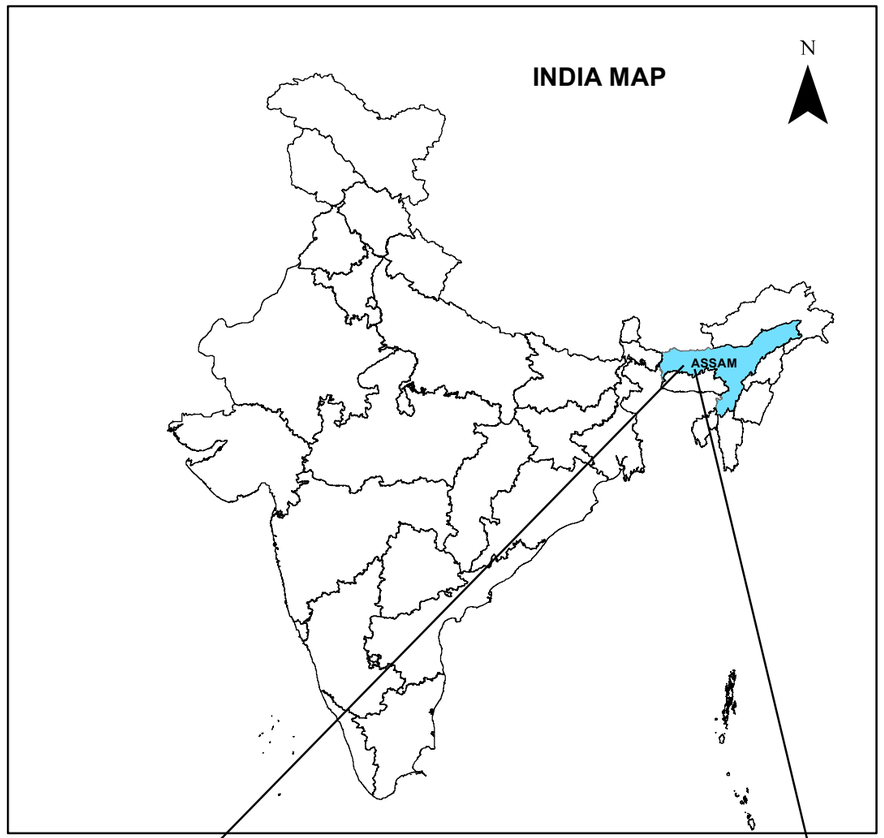
Total Area - 4.80 sq km; Boreholes: 11 Nos, Average Depth: 50 m Completion Time -15 Months, Review after 8th Month

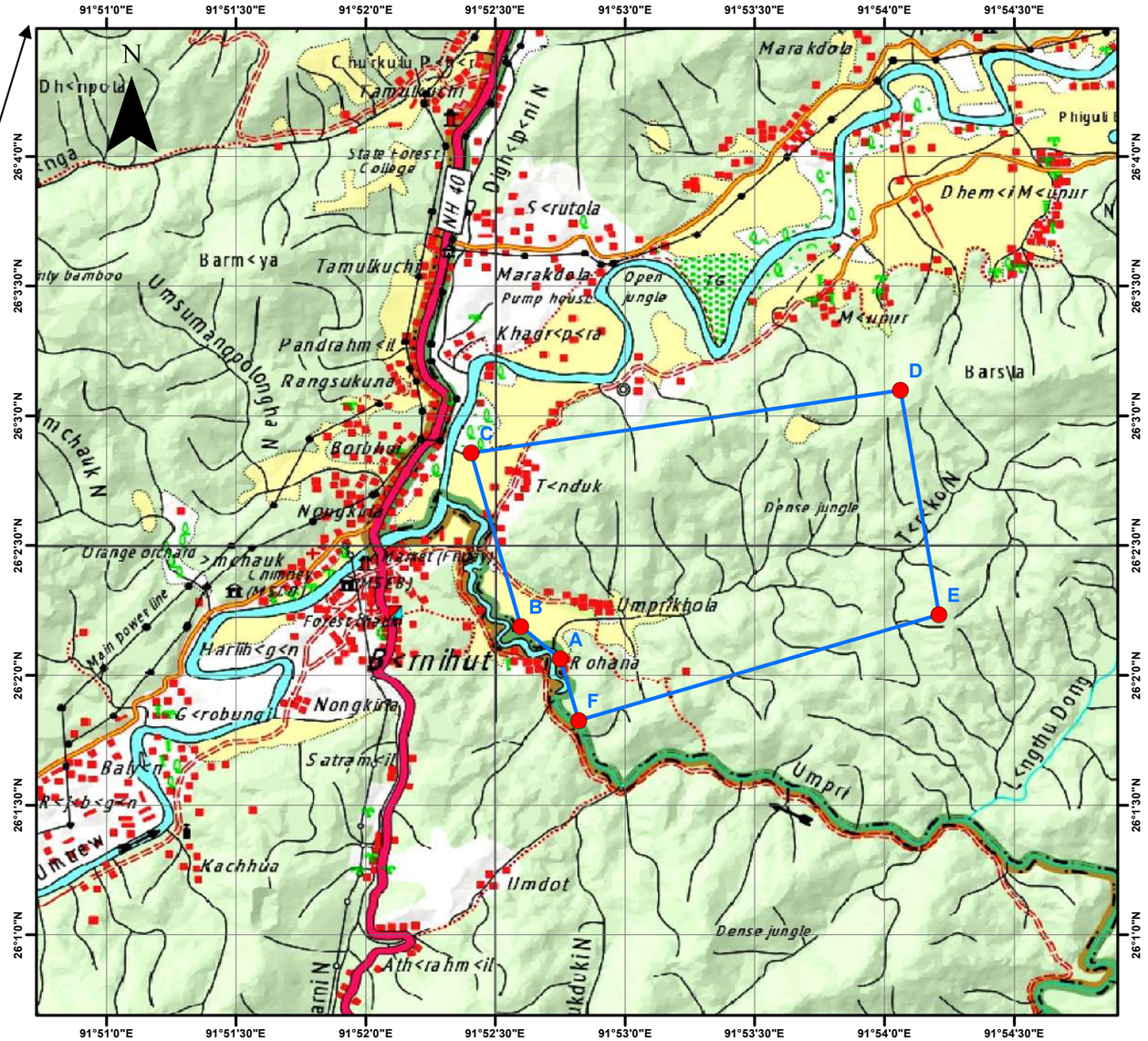
ANNEXURE-I

S.N	Item of Work	Unit	Rates as per NMET SoC 2020-21			Estimated Cost of the		Remarks
			SoC-Item -Sl No.	Rates as per SoC	Rates as per SoC North Eastern States and Hilly Terrain of Himalaya (3.35 times than the normal SoC rate)	Qty.	Total Amount (Rs)	
A	**GEOLOGICAL WORK**							
a	Charges for Geologist at HQ for data processing	day	1.3	9,000	-	60	540,000	
b	Charges for Geologist at field for detail mapping at 1:4000 scale, Surface sampling, Pitting and Scout Drilling	day	1.2	11,000	36,850	180	6,633,000	Hilly Tearrain with Forest area
c	Labour Charges for Geologist at Field	day	5.7	526	1,762	360	634,356	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
d	Charges for Sampler for BRS and BH Core Samples	one sampler per day	1.5.2	5,100	17,085	60	1,025,100	
e	Labour Charges for Sampling Work; Base rate - Rs. 526/ per day	day	5.7	526	1,762	240	422,904	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
	Sub-Total A						**9,255,360**	
B	**Topographical Surveying**							
a	Charges for Surveyor for Topographical Survey by total Station	Day	1.6.1a	8,300	27,805	60	1,668,300	
b	Labour Charges (4 labour for one Surveyor)	Day	5.7	526	1,762	240	422,904	
c	Demarcation of Lease boundary and BH Fixation by DGPS	Per point of observation	1.6.2	19,200	64,320	17	1,093,440	6 Corner Points and 11 Nos of Boreholes
	Sub-Total B						**3,184,644**	
C	**DRILLING**							
1	Core Drilling up to depth of 300m - Hard Rock	m	2.2.1.4a	11,500	38,525	600	23,115,000	
2	Land / Crop Compensation (in case the BH falls in agricultural Land)	per BH	5.6	20,000	67,000	11	737,000	
3	Construction of concrete Pillar (12"x12"x30")	per borehole	2.2.7a	2,000	6,700	11	73,700	
4	Transportation of Drill Rig & Truck associated per drill	Km	2.2.8	36	121	3,800	458,280	Approx3800 km to & fro from Nagpur/ Rig
5	Monthly Accomodation Charges for drilling Camp (up to 2 Rigs)	month	2.2.9	50,000	167,500	3	502,500	
6	Drilling Camp Setting Cost	Nos	2.2.9a	250,000	837,500	1	837,500	
7	Drilling Camp Winding up Cost	Nos	2.2.9b	250,000	837,500	1	837,500	
8	Road Making (Hilly Terrain)	Km	2.2.10b	32,200	107,870	5	539,350	
9	Drill Core Preservation	Per m	5.3	1,590	5,327	375	1,997,438	
	Sub-Total C						**29,098,268**	
D	**Sub Total A to C**						**41,538,272**	
E	**LABORATORY STUDIES**							
1	**Chemical Analysis**							
	Primary Samples Surface + BH Core Samples)							
i)	**Primary samples**							
	REE associated Trace Elements (34 Element)by ICPMS	Nos	4.1.14	7,731		400	3,092,400	Surface samples-50 BRS Bh Core Samples : 350 nos
ii)	**External check samples (10%)**							
	REE associated Trace Elements (34 Element)by ICPMS	Nos	4.1.14	7,731		40	309,240	
iii)	Ni and Cr by AAS method	Nos	4.1.7a	2,506		25	62,650	
iv)	PGE by ICP-MS Ni-S fire assay technique	Nos	4.1.5d	11,800		25	295,000	
2	**Physical & Petrological Stusies**							
i)	Preparation of thin section	Nos	4.3.1	2,353		15	35,295	
ii)	Complete petrographic study report	Nos	4.3.4	4,232		15	63,480	
iii)	Preparation of polish section	Nos	4.3.2	1,549		15	23,235	
iv)	Complete mineragraphic study report	Nos	4.3.4	4,232		15	63,480	
v)	Digital Photographs	Nos	4.3.7	280		20	5,600	
vi)	EPMA Study	Hour	4.4.1	8,540		15	128,100	
vii)	XRD Study	Nos	4.5.1	4,000		15	60,000	
	Sub-Total -E						**4,138,480**	
F	**Total D+E**						**45,676,752**	
I	**Geological Report Preparation**	**5 Hard copies with a soft copy**	**5.2**	For the projects having cost exceding Rs 300 Lakh, A minimum of Rs 9 Lakh or 3% of the work whichever more and Rs 10000/- per each additional copy			**1,370,303**	EA has to submit the final Geological Report in Hard Copies (5 Nos) and the soft copy to NMET.
J	**Peer review Charges**		**As per EC decision**				**30,000**	
K	**Preparation of Exploration Proposal (5 Hard copies with a soft copy)**	**5 Hard copies with a soft copy**	**5.1**	**2% of the Cost or Rs. 5.00 Lakhs whichever is lower**			**500,000**	EA has to submit the Hard Copies and the soft copy of the final proposal along with Maps and Plan as suggested by the TCC-NMET in its meeting while clearing the proposal.
L	**Total Estimated Cost without GST**						**47,577,054**	
M	**Provision for GST (18% of L)**	**%**					**8,563,870**	GST will be reimburse as per actual and as per notified prescribed rate
N	**Total Estimated Cost with GST**						**56,140,924**	
						or Say Rs. , In Lakhs:	***561.41***	
Note:								
$	Trenching/Pitting dimensions are tentative may vary depending upon the geology and field conditions							
#	2nd level of work shall be carried out after review of 1st level work i.e. Geological mapping, geochemical sampling and analysis							

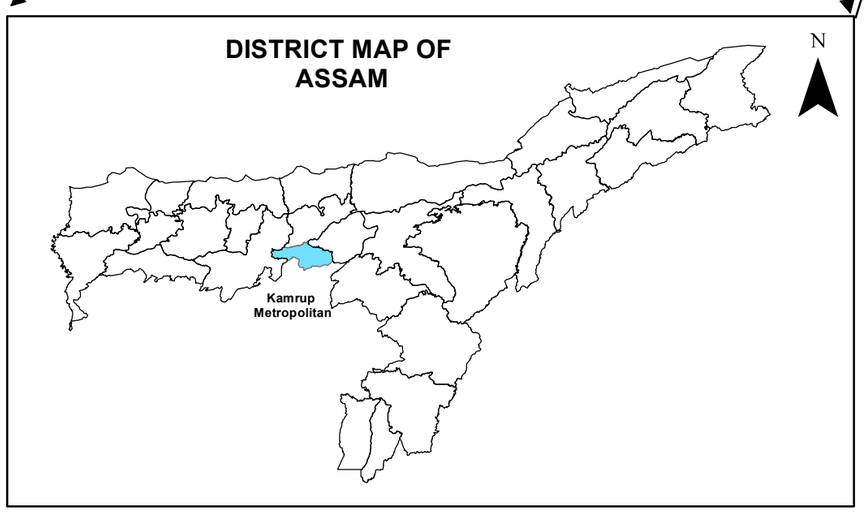
Note - If any part of the project is outsourced, the amount will be reimbursed as per the Paragraph 3 of NMET SoC and Item no. 6 of NMET SoC. In case of execusion of the project by NEA on its own, a Certifiate regarding non outsourcing of any component/project is required.

LOCATION MAP OF PROPOSED UMPRI KHOLA BLOCK FOR REE (PART OF TOPOSHEET NO 78N/16, AREA- 4.80 sqkm), DISTRICT:KAMRUP METROPOLITAN, ASSAM





NOT TO SCALE



Legend

- Corner Points of Proposed Umprikhola block
- Proposed UmriKhola Block Boundary

Coordinates of Corner points of Proposed Umprikhola Block Boundary

Datum: WGS-84

Corner Points	DMS		UTM (m) Zone- 46 (NORTH)	
	Latitude	Longitude	Easting (m)	Northing (m)
A	26° 2' 3.856" N	91° 52' 44.983" E	387857.41	2879975.40
B	26° 2' 11.235" N	91° 52' 35.816" E	387604.56	2880204.60
C	26° 2' 51.388" N	91° 52' 24.380" E	387297.38	2881442.70
D	26° 3' 5.954" N	91° 54' 3.667" E	390060.49	2881867.30
E	26° 2' 13.987" N	91° 54' 12.534" E	390293.46	2880266.42
F	26° 1' 49.598" N	91° 52' 49.247" E	387972.15	2879535.73

MECL