

**DETAILED PROPOSAL FOR PRELIMINARY EXPLORATION (G-3 STAGE) FOR GRAPHITE & ASSOCIATED
MINERALS BARWAIYA-IRGU BLOCK, PALAMU & LATEHAR DISTRICT, JHARKHAND**

(2.70 Sq.Km Area)

COMMODITY: GRAPHITE

**SUBMITTED TO
NATIONAL MINERAL EXPLORATION DEVELOPMENT TRUST (NMEDT)**

**BY
M/s APC DRILLING & CONSTRUCTION PRIVATE LIMITED
NAMAKKAL
E-mail:apcdrilling @gmail.com**

JULY 2026

Summary of Preliminary Exploration (G3 Stage) for Graphite and Associated Minerals in Barwaiya-Irgu Block, Palamu & Latehar district, Jharkhand

GENERAL INFORMATION ABOUT THE BLOCK

	Features	Details
	Block ID	Barwaiya-Irgu Block
	Exploration Agency	APC Drilling & Construction Private Limited
	Previous Exploration Agency	Geological Survey of India (FS2022-23)
	Geological Report (Previous stage Geological Report)	Final report on Reconnaissance Survey of Graphite, Vanadium and associated minerals in Chama-Barwaiya area, of Latehar and Palamu districts, Jharkhand (G4 Stage), Toposheet No. 73A/05
	Commodity	Graphite and associated minerals
	Mineral Belt	Chhotanagpur Gneissic Complex
	Completion Period with entire Time schedule to complete the project	10 months.
	Objectives	The objectives of proposed G3 level exploration are as follows. ❖ Geological Mapping on 1:2000 scale to delineate the surface outcrops of Graphite ❖ Surface Sampling and chemical analysis ❖ Surface Geophysical Investigation (Self Potential and Magnetic) ❖ Trenching ❖ To drill 17 Nos. of boreholes to decipher depth persistence and strike continuity of Graphite mineralization. ❖ To estimate the in situ resource of Graphite for G3 stage of exploration and preparation of Geological Report (GR). ❖ To estimate in situ resource of Graphite reconnaissance category resources (333) of Graphite

		and associated minerals in the block as per UNFC norms & MEMC Rule- 2015 and Minerals (Evidence of Mineral Contents) Amendment Rule, 2021.																					
	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	The Geological Mapping, Geochemical studies, Geophysical Investigation, Pitting/ Trenching, Drilling, core logging, sampling and Geological Report writing will be carried out by APC Drilling & Construction Private Limited. Chemical Analyses and Petrographic Studies will be carried out through NABAL accredited outsourcing agencies.																					
	Name/ Number of Geoscientists	Geologists: 01 HQ Geologists: 01 Field																					
	Expected Field days & HQ (Geology, Surveyor)	Geologist: 100 days (Field) Geologist: 30 days (HQ) Surveyor: 45 days																					
1.	Location	Barwaiya-Irgu Block is located in Latehar and Palamau districts of Jharkhand. The block is located 30km SW of town Daltonganj and NE of Ranchi at 100 km distance.																					
	Latitude & Longitude	<table border="1"> <thead> <tr> <th>Block Corner points / Cardinal Points</th><th>Latitude</th><th>Longitude</th></tr> </thead> <tbody> <tr> <td>A</td><td>N23.93390</td><td>E84.36609</td></tr> <tr> <td>B</td><td>N23.93818</td><td>E84.37151</td></tr> <tr> <td>C</td><td>N23.93414</td><td>E84.37610</td></tr> <tr> <td>D</td><td>N23.94807</td><td>E84.39079</td></tr> <tr> <td>E</td><td>N23.94220</td><td>E84.39639</td></tr> <tr> <td>F</td><td>N23.92497</td><td>E84.37480</td></tr> </tbody> </table>	Block Corner points / Cardinal Points	Latitude	Longitude	A	N23.93390	E84.36609	B	N23.93818	E84.37151	C	N23.93414	E84.37610	D	N23.94807	E84.39079	E	N23.94220	E84.39639	F	N23.92497	E84.37480
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	Villages	Chama and Barwaiya Khurd																					
	Tehsil/ Taluk	Manika Tehsil																					
	District	Latehar and Palamau district																					
	State	Jharkhand																					
2	Area (hectares/ square kilometers)																						
	Block Area	2.70 Sq.km																					
	Forest Area	Nil																					

	Government Land Area	Nil
	Private Land Area	100 % Private Land
3.	Accessibility	The area under investigation is approachable from Matnag town located at a distance of 20 km to the SW. Matnag is connected to Daltonganj town by state highway. It is approachable from Ranchi via Chandwa and Latehar by NH-39.
	Nearest Rail Head	Chianki and Daltonganj are major railway stations nearby the study area.
	Road	Area approachable from Ranchi via Chandwa and Latehar by NH-39.
	Airport	The nearest airport is Ranchi.
4.	Hydrography	
	Rivers/ Streams	The area is mainly drained by the streams flowing southwesterly, joining Maila Nadi located to the south of the proposed area.
5.	Climate	The maximum temperature during March and June is about 42°C. The minimum temperature during the month December-January is 4°C.
	Mean Annual Rainfall	The average annual rainfall is 700-1200 mm
	Temperature	Winter: Minimum temperatures 4°C (December-January) Summer: Max. 42° C (April - June)
6	Topography	
	Toposheet Number	73A/5
	Morphology of the area	Physiographically, the study area is gently undulating with minimum elevation of 380MSL to maximum of 418 MSL.
7	Availability of baseline geoscience data	
	Geological Map (1:50K/ 25K)	Geological map on 1:50,000 scale (Source: NGDR/Bhukosh)

	Geochemical Map	Geochemical mapping in toposheet no. 73A/5 by Ahmad and Nagar, Geologist, GSI in FS 2017-18.
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		Map Not Available.
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	Interpretation of High Altitude Aeromagnetic Data, Palamau Area, Parts of Chattisgarh and Jharkhand States, F.S. 2005-2006 (Part of Block N-III, flown by NRSA during 1994-95), By Ch.V.V.S.Murthy, Geophysicist (Sr.), H.C.Gouda, Assistant Geophysicist, G.S.R.Umasankar, Assistant Geophysicist & R.K.Singh, Assistant Geophysicist. Maps not Available.
8 .	Justification for taking up Preliminary Exploration	Justification: Barwaiya–Irgu Block, Palamu & Latehar Districts, Jharkhand The Barwaiya–Irgu block forms part of the proven Palamu–Latehar graphite belt within the Chhotanagpur Gneissic Complex and has emerged as one of the most prospective sectors for graphite mineralisation based on more than nine decades of progressive exploration. Early reconnaissance by Dey (1929–30), Hukti Nath (1945–53) and Modak (1957–58) established the regional potential of Ledwakhari–Sohri–Arapur–Barwaiya sectors, while recent investigations by Ahmad & Nagar (2017–18), Rawat & Pandiya (2019–20) and Swain & Singh (2022–23) have specifically highlighted the Ejamar–Barwaiya–Chama–Irgu tract as a geochemically and structurally favourable zone for graphite occurrence. Earlier work by Rawat & Pandiya (2019–20) in adjacent blocks has recorded FC values up to ~37% and strike continuity of graphite schist bands up to 2 km, confirming regional persistence of graphite horizons into the Barwaiya–Irgu block. Large-scale mapping and systematic trenching carried out by Swain & Singh (2022–23) in Chama–Barwaiya have delineated multiple graphite-bearing bands in the Barwaiya Khurd and Chama–Irgu areas, with individual lenses extending up to 400 m in strike length and widths of 10–30 m. Fixed carbon values range from 1.01% to 34.78% in pit and trench samples and from 0.58% to 28.02% in bedrock samples, with nearly 70% of the samples showing more than 10% FC, indicating

		the presence of moderate- to high-grade graphite mineralisation at surface. The graphite mineralisation is hosted by high-grade graphite–sillimanite schist and graphite-bearing gneiss, closely associated with quartzite, calc-silicate and calc-granulite bands, which act as reliable lithological marker horizons. Structural studies reveal strong control of mineralisation, with lenticular and en-echelon bodies aligned along WNW–ESE to NW–SE and N–S trends, affected by three deformation phases (F1–F3). Such a structural regime is favourable for down-plunge continuity and local thickening of graphite lenses, which cannot be assessed without subsurface investigation. Geochemical results further enhance the strategic importance of the block. Vanadium values up to 2555 ppm in pit and trench samples and up to 1263 ppm in bedrock samples show a positive correlation with fixed carbon, indicating significant by-product potential. Enrichment of Co, Cr, Ni, Ba, Zr and magnetite in associated lithologies suggests a broader polymetallic signature linked with high-grade metamorphic processes. Despite encouraging surface results, the Barwaiya–Irgu area suffers from poor exposure due to soil cover, agriculture and weathering, making the true thickness, depth continuity and resource potential of graphite bodies impossible to assess at the surface. Previous workers have therefore explicitly recommended subsurface geophysical studies and follow-up drilling to evaluate the resources. Thus, Barwaiya–Irgu block amply satisfies the criteria for Preliminary Exploration (G3 stage). In view of the following: (i) proven regional continuity of graphite-bearing horizons, (ii) surface delineation of multiple graphite lenses with encouraging fixed carbon values,
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		(iii) strong structural control indicating potential for down-dip persistence, and (iv) significant vanadium and base-metal enrichment indicating associated mineral potential. Further APC visited and collected 5 Nos. of samples in the area, the sample results shown FC% between 8.08 and 16.11% The true lateral and depth continuity of subsurface Graphite mineralization can be established only through geophysical and drilling investigations. G3-stage exploration involving detailed Geological mapping, geophysical surveys followed by systematic drilling is essential to establish subsurface geometry, grade continuity, thickness variations and to generate first-order resource estimates for graphite and associated vanadium mineralisation in this strategically important sector of the Palamu–Latehar graphite belt.
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Detailed description

1.0.0 Background information

Anam Ahmad, Geologist and Poonam Nagar, Geologist, GSI, (2017-18), carried out Regional Geochemical mapping in toposheet no. 73A/5 in Latehar and Palamau districts, Jharkhand. Reported that the area hosts occurrences of mineral resources like coal and graphite. Graphite deposit is present near Ejamar and Barwaiya village, the western part of toposheet no. 73A/5. An abandoned graphite mine is there in the Barwaiya area. Graphite deposit belongs to graphite sillimanite schist.

GSI during the Field Season 2022-2023 carried out Reconnaissance Survey of Graphite, Vanadium and associated minerals in Chama-Barwaiya area, of Latehar and Palamu districts, Jharkhand (G4 Stage) in parts Survey of India Toposheet No 73A/5, carried out was carried out LSM on a 1:12,500 scale along with 100 cu.m. pitting and trenching covering an area of 100 sq.km. Observed that the potentiality of the graphite mineralization is confined to graphite bearing gneisses in the north central part of the block in the areas like Chama, Barwaiya khurd and Irgu. The graphite mineralization in the study area is flaky and mainly structurally controlled. General strike of the graphite bodies varying from WNW-ESE to NW SE with shallow to moderate dip in the southern direction.

Proximate analysis of graphitic BRS samples showing highly encouraging values for fixed carbon and vanadium. The values of fixed carbon in BRS samples ranges from 0.58 % to 28.02%, volatile content ranges from 1.06% to 7.99% and ash content ranges from 69.80 % to 95.78%. 70% of the BRS samples shows FC value between 10% to 28.02%. The chemical analysis of fixed carbon value in the trench samples ranges from 1.01% to 34.78%, volatile content from 0.81% to 9.70% and ash content from 63.14% to 94.83%.

On the basis of surficial mapping, trenching and chemical results of BRS and PTS samples, identified two probable zones of graphite mineralization (i) near Barwaiya Khurd village and (ii) around Chama and Irgu village. The mineralization observed discontinuously, to poor surface exposure, **geophysical surveys, followed by systematic drilling**, are strongly recommended to delineate depth continuity, grade variation and to assess the potential of associated vanadium and base-metal enrichment for by-product recovery.

Further APC Geologist visited the site for geological traverses and collection of samples. The sample analyses results are encouraging where in the FC % vary from 8.08 and 16.11%.

Based on GSI investigation during the FS 2022-23 and supported by encouraging results of APC samples, the target area for Preliminary Exploration (G3 level) in Barwaiya-Irgu Block measures an area of 2.70 sq.km has been identified

2.0.0 Block Summary

Location and Accessibility

The Barwaiya-Irgu Block falls in Survey of India Toposheet No. 73A/05 and is bounded by the following co-ordinates.

Block Corner points / Cardinal Points	Latitude	Longitude
A	N23.93390	E84.36609
B	N23.93818	E84.37151
C	N23.93414	E84.37610
D	N23.94807	E84.39079
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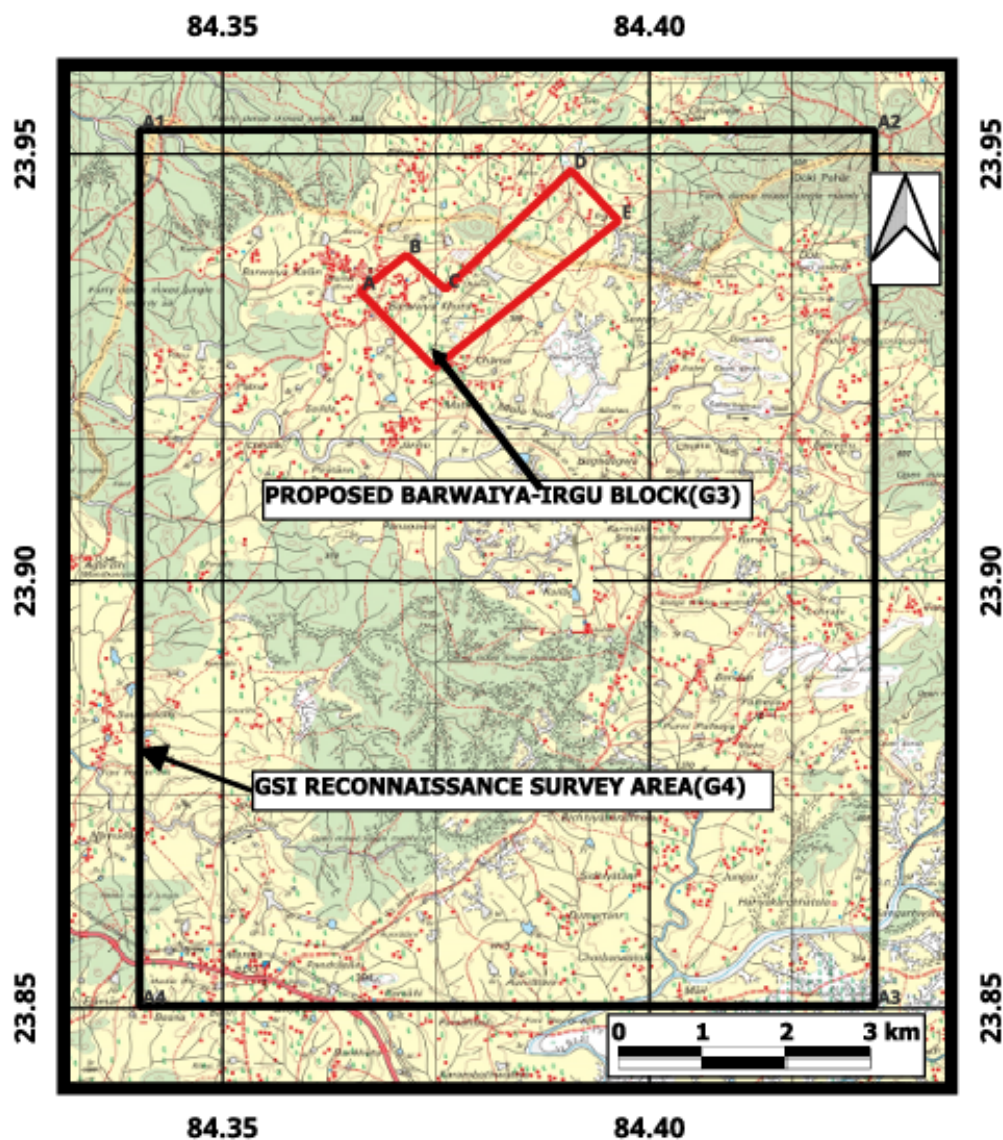


Figure-1: Location of proposed Barwaiya-Irgu Block on Toposheet No. 73A/05

Physiography

Physiographically, the study area is gently undulating and covered with agricultural land. The minimum elevation of the area is around 380 MSL to maximum of 418 MSL.

3.0.0 Previous Work

Exploration for graphite in Palamu–Latehar district commenced with the regional mapping work of **A.K. Dey (1929–30)** in the Arapur area (Topo 72D/4), who first reported graphite occurrences within Archaean schists and gneisses. This was followed by **Hukti Nath (1945–46)** in the Ledwakhar–Rabda sector (Topo 73A/1), who identified graphite-bearing schist lenses within gneissic terrain, and later during **1951–53** in the Sohri–Ekta belt (Topo 73A/5), where he delineated E–W trending graphite schist bands associated with quartz-sillimanite schist and calc-granulite and noted old workings. **G.K. Modak (1957–58)** compiled district-wide graphite occurrences in Palamu and recommended Ledwakhar, Sohri and Arapur as priority investigation zones. **B.N. Jha (1965–66)** carried out detailed prospecting in Bhang-Parasia and Sokra and confirmed workable graphite

lenses with 10–25% fixed carbon in Sokra. **Shashidhar Prasad (1968–69)** provided the first detailed appraisal of 15 graphite occurrences in Ledwakhar, Sohri-Ekta and Arapur, defining a narrow Bohita–Ghutuwa–Siuri-Ekta graphite belt. After a long gap, modern investigations resumed with **Anam Ahmad & Poonam Nagar (2017–18)** through regional geochemical mapping over Toposheet 73A/5, identifying Ejamar–Barwaiya as a geochemically favourable zone. This was followed by **Abhishek Rawat & Jyoti Pandiya (2019–20)**, who delineated 15 graphite schist bands and six potential graphite blocks in Parsahi–Satbarwa–Ranki Kalan. The most advanced work was carried out by **Madhusmita Swain & Shikha Singh (2022–23)** in Chama–Barwaiya, involving large-scale mapping, trenching, geochemistry and micro-analytical studies, which defined new promising graphite zones.

a. General Geology of the Graphite-Bearing in Palamu-Latehar districts, Jharkhand

The Palamu–Latehar graphite belt forms part of the high-grade metamorphic terrain of the **Chhotanagpur Gneissic Complex**, consisting of Archaean schists and gneisses of Dharwar affinity, intruded by granitic and basic bodies, and locally overlain by Lower Gondwana Talchir sediments. The terrain has undergone intense deformation and high-grade regional metamorphism up to granulite facies / sillimanite-almandine-orthoclase subfacies, followed by widespread feldspathization and granitization, which remobilised graphite locally.

b. Host Rocks, Nature of Occurrence, Structural Control and Fixed Carbon Content

Graphite mineralisation is **strata-bound** and hosted mainly by **graphite–sillimanite schist and graphite-bearing gneiss**, closely associated with quartzite, feldspathic quartzite, biotite schist, calc-silicate and calc-granulite bands. The graphite occurs as **flaky to fine disseminations** aligned along foliation planes and shows strong **structural control**, forming lenticular and en-echelon bodies trending E–W, WNW–ESE, NW–SE and N–S, with dips generally between 40° and 85°, often steep to sub-vertical.

Reported **Fixed Carbon (FC)** values show wide variation:

- Sokra (B.N. Jha, 1965–66): **10–25% FC**
- Parsahi–Satbarwa–Ranki Kalan (Rawat & Pandiya, 2019–20):
 - BRS: **7.66–37.06% FC**
 - Trench samples: **<1–37.28% FC**
- Chama–Barwaiya (Swain & Singh, 2022–23):
 - BRS: **0.58–28.02% FC** (average 14.53%, ~70% samples >10%)
 - PTS: **1.01–34.78% FC**

c. Associated Minerals

The most diagnostic indicator mineral for graphite is **sillimanite**, occurring as fibrous needles or felted masses in quartzofeldspathic schist, reflecting upper amphibolite to granulite facies metamorphism. **Garnet (almandine)** is an important proximity and grade indicator, particularly in high-grade zones. The definitive mineral assemblage is: **Quartz + K-feldspar + Sillimanite + Biotite/Muscovite + Graphite**. Calc-silicate minerals (diopside, calcic plagioclase) and calc-granulite bands occur consistently near graphite horizons and serve as powerful lithological markers. Geochemical studies have revealed significant enrichment of **vanadium (up to 5005 ppm)**, along with Co, Cr, Ni, Ba, Zr and magnetite in gabbro-anorthosite suites.

4.0.0 Brief regional geology and structural framework

Regional Geology

Archaean metasediments is the oldest geological formation in the area and these metasediments were intruded by basic intrusives. Geologically the area is made up of highly metamorphosed and felspathised pre Cambrian sediments intruded by late to post tectonic pegmatite and quartz veins. The meta morphites are represented by mica schist, quartzite, amphibolite, quartz garnet granulite, calc silicate rocks. These have been extensively granitised to form various types of granite gneisses and hornblende gneiss and even granite. Mica schist is often found as inclusions within the gneiss. The pegmatite and vein quartz are mainly intrusive in nature. The Lower Gondwana and Upper Gondwana sedimentary rocks are occurring in the northeastern part of the area. Stratigraphy of toposheet no. 73A/5, as per compiled Geological Map of GSI is given below:

Table :-1 Stratigraphy of toposheet no. 73A/5, as per compiled Geological Map of GSI

Supergroup	Formation	Lithology	Age
		Dolerite dyke	Cretaceous to Early palaeogene
Gondwana Supergroup	Suprapanchet Formation	Ferruginous sandstone/ grit, red clay and shale	Late Triassic
	Panchet Formation	Sandstone, red shale, mudstone	Early Triassic
	Raniganj Formation	Sandstone, siltstone with coal	Late Permian
	Barakar Formation	Sandstone, siltstone and shale with clay and fire clay.	Early Permian
	Talchir Formation	Conglomerate, shale, sandstone	Late Carboniferous to Early Permian
		Pegmatite veins .	Proterozoic
		Pegmatite/Quartz vein	
Chhotanagpur Gneissic complex		Granite/migmatite	Archaean to Proterozoic
		Hornblende gneiss	
		Granite gneiss, porphyroblastic granite gneiss	
		Garnetiferous biotite gneiss	
Unclassified Metamorphics		Crystalline limestone, impure marble, calcsilicate	Archaean to Palaeoproterozoic
		Quartzite	
		Graphite Schist	
		Hornblende schist, amphibolite	

Metamorphism

The rocks of the area have undergone a high-grade regional metamorphism in response to which argillaceous, arenaceous and calcareous rocks together with basic and ultra-basic rocks have undergone changes. The effects of regional metamorphism of these older rocks associated with the great masses of the granite gneiss are manifested in the form of complete recrystallisation and textural re-adjustment. Schistosity and gneissosity are predominantly developed in the metasediments and are often accompanied by concentration of alternating lamellae of quartzo feldspathic and micaceous minerals. In the study area presence of pyroxene, hornblende and garnet which are high-grade metamorphic minerals indicate that the area had experienced the upper amphibolite to granulite(opx,cpx)facies of metamorphism.

Geology of the area

The LSM reveals that the rock types were encountered belonging to broadly three groups; Unclassified Metamorphics, Chhotanagpur Granite Gneiss Complex and younger intrusives. Unclassified Metamorphics include calc silicates, amphibolite and hornblende schist and Chhotanagpur Gneissic Complex consist of biotite granite gneiss, granitic gneiss, hornblende gneiss. Younger intrusive consists of pink and grey granite, pegmatite, quartz, quartzo-feldspathic veins and gabbro. During the course of mapping, it has been observed that only few surface exposures of graphite mineralization is present in the area, whereas graphite-bearing small pits and changes in the colour of the soil suggested probability of presence of new graphite-bearing zones.

Based on the field study and identification of lithology and structural elements the following stratigraphy has been established.

Table -2: Stratigraphy of the study area

Later intrusives	Dolerite
	Pegmatite/ Quartz vein
	Gabbro
	Graphite bearing gneiss
Chhotanagpur Granite Gneiss Complex	Undeformed Granite
	Sheared Granite
	Granite Gneiss / Biotite granite gneiss
	Hornblende gneiss +/- biotite
Unclassified Metamorphics	Calc-silicate
	Amphibolite / Hornblende schist

Description of Lithounits

Amphibolite :These rocks are melanocratic and dark greyish in colour, very hard, compact and medium to coarse grained with Hornblende and plagioclase feldspars are the main constituents. The trend of the body is almost NE-SW direction.

Calc silicate: Megascopically, the calc-silicate rocks are very hard, compact, banded and medium grained, showing granulitic texture. The colour of these rocks varies from almost white to pale greenish grey depending on the proportion of the lime silicates.

Hornblende gneiss: The gneissosity is well defined in the rock by an alternate hornblende rich layer and quartzo-feldspathic layer. It is characterised by quartz and feldspars as the main constituents with hornblende and biotite as the accessories. General strike of the gneissosity in the area varying from NW-SE to NE-SW direction with a moderate dip towards both west and east direction.

Graphite gneiss: In the area the graphite is present with quartz and feldspars in the form of gneisses. Host rock of the graphite mineralization in the study area is granite gneiss of CGGC. Graphite gneiss is mostly exposed in the opencast mining at Barwaiya village, in few old pits near Barwaiya and nearby areas, Chama and Irgu village in the study area. A small exposure of 7m length and 2m wide is found in the southern part of Barwaiya Khurd village. Mineralization in the area is mainly flaky nature and structurally controlled. The general foliation in graphite gneiss is S 90°E- N90°W with a southerly dip near the mines and western pit of the mines to S70°E-N70°W with southerly dip near Irgu village.

Granite and granite gneiss: Granite gneisses are the most dominant rock type encountered in the area. Megascopically, the granite and granite gneiss are compact, medium to coarse grained and greyish white to grey in colour and show development of alternate bands and layers of felsic and mafic minerals in gneissic variety. The granite gneiss is traversed by large no. of quartzo-feldspathic, pegmatitic, quartz vein and younger granite.

Massive granite:Undeformed younger granitic intrusions were also observed within granite gneiss and other lithounits. Two varieties of granite are identified one is rich in K feldspar and the other is plagioclase rich.

Gabbro: The north central and north eastern part of the block is occupied by gabbro- anorthositic suit of rocks. These are dark green colour, coarse grained and have high density. Mineralogically they form pyroxenes, amphiboles as alteration products of pyroxenes and feldspars. Hard, compact, dark coloured, coarse to medium grained are the typical characteristics of the rock. Two varieties of gabbros i.e. magnetic and non-magnetic have been found in the area. In the north eastern part, magnetic nature of the gabbro has been observed and here inside these gabbroic anorthosites found having magnetite mineralisation in two old pits at Leorahi and Doki village.

Pegmatite/Quartz vein: The pegmatite veins are intruded subparallel or parallel to the gneissosity of gneiss and schistosity of the metasediments. Sometimes they occur as clusters, veins, dykes, flat lenses and show irregular distribution. Quartz veins are emplaced mostly along foliation of gneissic rocks. In the south eastern part of the area near village Jungur, the quartz veins form reef like bodies of considerable width, Quartz veins of smaller dimensions are quite common in other parts of the area.

Dolerite :Dolerite is characterised by presence of feldspars and altered pyroxenes as the dominant constituents with accessory of quartz at places. Spheroidal weathering is well observed in west of Sewan village.

Structure:

The study area is a part of CGGC and the rocks underwent at least three phases of deformational episodes. The primary structure represented by bedding in calc silicates, while the secondary linear structures like lineation, foliations, folds, joints, fractures, shear planes were well identified in the area implying multiphase deformational history.

Primary structure: In a quarry section in south of Sadhwadih, calc silicate rocks preserve bedding which is defined by alternate grey and greyish white bands. It shows parallelism with the regional foliation of the host granite gneisses. The trend of bedding varies from N70°W S70°E with steep to sub-vertical dips.

Secondary structure: lineation, foliations, folds, joints, fractures, shear planes.

Foliations: The regional strike of the rock in this area is ENE-WSW, which is defined by pervasive foliation. As the rocks in this area are intensively folded and metamorphosed, foliation is well developed. Gneissosity in Biotite gneiss is represented by alternate light (Felsic) and dark coloured (Mafic) layers. Throughout the area mylonitic foliation (Sm) showing parallelism with the S1 surfaces, is also dominant along certain linear zones. The mylonitic foliation has steep to moderate northerly dips. The mylonitic foliation occurs in all the Graphite deposits viz. Jagantola, Lougur, Bharweli, Tirodi and Sukli-Sitapathore (Banerjee et.al. 1995).

Folds: Three phases of folding have been identified in the study area. Near Bicchiyabandhtola village, indication of three phases of folding has been preserved in the outcrop of granite gneiss. First phase of folding is represented by the tight isoclinal fold and the rootless fold. Plunge of axial plane of this F1 fold is 70° towards East. In Bichhiyabandhtola village, plunge of F2 fold is measured to be 55° towards NW direction. Likewise, the plunge of F3 fold which is showing broad warp type of feature is 55° towards NE direction.

Foliation: The most commonly occurring mesoscopic secondary planar structure in the study area include foliation planes that are observed within the granite gneisses and foliated granite. Up to three sets of foliation planes can be identified in the study area among which NW-SE trending foliation is most dominant in the area. General foliations observed in the area are (i) ENE-WSW to E-W dip varying from 20° to 75° in southern direction (ii) NW-SE dip varying from 10° to 80° in either direction and (iii) NE-SW dip varying from 45° to 80° in south eastern direction.

Fracture / Joint: Two sets of fractures and joints are observed in most of places in the study area. Trend of both the sets are NE-SW and NW-SE with sub-vertical to vertical di.

Mineralogy of the ore zones and ore textures:

Field observations as well as petrographic study of the graphite bearing gneisses suggest that the mineralization of graphite in the present study area originating from hydrothermal fluids is likely and the transporting carbon as CO and CH₄, formed the mineralization which is hosted by shear zones. The carbon-rich

fluid may be migrated along the permeable directions i.e. along foliation planes and fractures and resulted in the graphite mineralization.

4.0.4 Geophysical Exploration :

The high-altitude aeromagnetic surveys were conducted for GSI by NRSA under the national programme of the aeromagnetic survey. Item No. 2005 2006/ASGE/AMS/ZS/2005/013 states the objective of ground evaluation of aeromagnetic data over the Palamau area, Jharkhand to assess the iron ore (magnetite) potential. Two magnetic domains have been identified in the area viz. 'A' & 'B' over strong and weak magnetic intensity zones respectively. The magnetic domain 'A' falls over Chhotanagpur Gneissic Complex (CGC) and 'B' falls over the basement depressions, which are occupied by Gondwana sediments of Damodar Valley Coalfields. The GSI investigation area showing magnetic high with closely spaced contours observed near Manika which falls in domain 'A' represents the rock types included in CGC with patches of Unclassified Metamorphics. The contour interval is 10nT on a scale of 1:250,000.

During FS 2020-21 by Ambeshwar Nath Pathak, Bhaktu Chandrashekar and Nikhil Kumar, Geophysicists carried out geophysical mapping in Toposheets 63P/16, 64M/14, 72D/4&8 and 73A/5 covering parts of Garhwa, Palamu, districts of Jharkhand. A broad high anomaly zone trending nearly in EW direction in almost all parts of 73A/5 may represent the basic/ultrabasic nature with enrichment magnetic material of shallow lower crust in this part. The high-pass filtered magnetic (TF) anomaly map shows magnetic highs and lows around Satbarwa, Manika and Sardamdag area in TS no.73A/5 suggesting some structure showing magnetic behaviour.

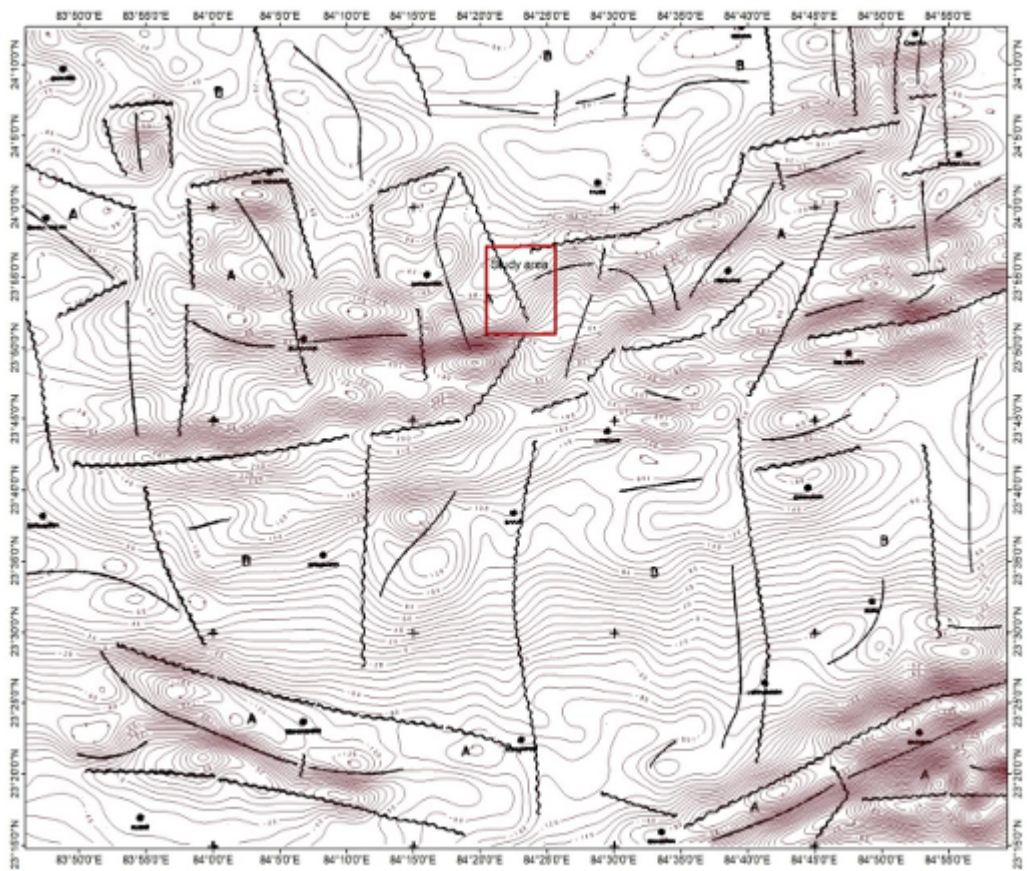


Fig-2:-Total intensity magnetic map (IGRF corrected) Jharkhand and Chattisgarh (FS 2005 06)

Details of geochemical mapping:

Anam Ahmad, Geologist and Poonam Nagar, Geologist, GSI, (2017-18) carried out Geochemical Mapping in toposheet no. 73A/5 in Latehar and Palamau districts, Jharkhand. The area hosts occurrences of mineral resources like coal and graphite. Graphite deposit is present near Ejamar and Barwaiya village, the western part of toposheet no. 73A/5. An abandoned graphite mine is there in the Barwaiya area. Graphite deposit belongs to graphite sillimanite schist. CaO values are high in the western and northern part of toposheet 73A/5 and it is due to the presence of limestone. A higher concentration of MgO is plotted over the area with graphite sillimanite schist, biotite gneiss and amphibolite in toposheet 73A/5. Cobalt and vanadium respectively having moderate values in the central part of the toposheet which covers the study area of FS 2022-23 with block boundary.

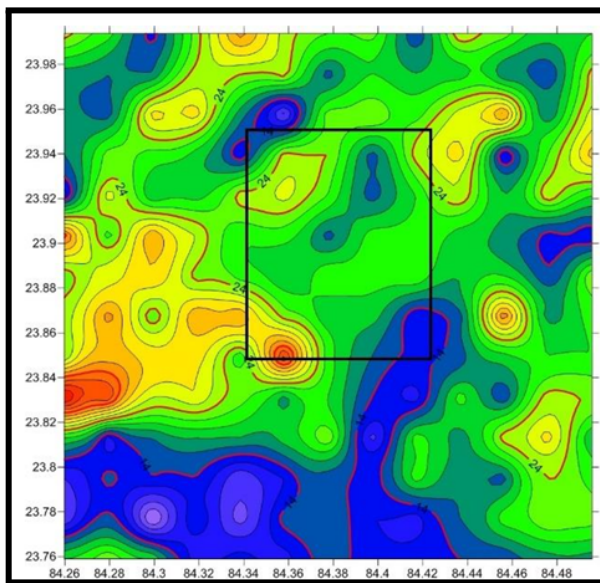


Figure-3:Geochemical elemental map of Co in toposheet on. 73A/5

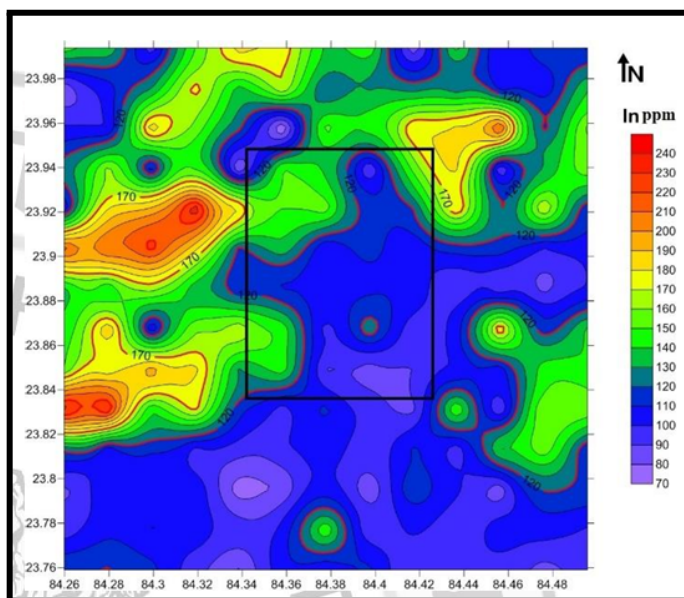


Figure-4: Geochemical elemental map of & in toposheet on. 73A/5

5.0.0 Scope for proposed exploration.

The proposed Preliminary Exploration (G3 Stage) for Graphite and associated Minerals in Barwaiya-Irgu Block, comprises of Detailed Geological mapping of 2.70 Sq.km area on 1:2000 scale, systematic collection of BRS / Channel samples and trenching, Surface Geophysical Survey, Trenching and subsurface exploration by drilling of 17 Nos. of inclined boreholes involving about 850 m of drilling. Out of 17 boreholes, 13 boreholes will be put to intersect the graphite mineralisation at first level (30m) and remaining boreholes will be put to intersect the mineralised zone at the second level (50m) and associated survey, chemical analysis, Petrological analysis and estimation of resources under G3 category and Geological Report preparation.

Objectives

The objective of the proposed Exploration is to carry out G-3 level exploration work in the block has been formulated in accordance with the previous work carried out by GSI during 2022-23 and also as per Mineral (Evidence of Mineral Contents) (MEMC) Rule-2015 & Mineral (Auction) Rules-2015 to fulfill the following objectives:

- ❖ To carry out detailed geological mapping on 1:2000 scale and demarcate the rock types of Graphite bearing formations with the structural features i.e. strike, dip, lineations / foliations etc.
- ❖ To demarcate subsurface Graphite ore body on the basis of surface geophysical survey after completion of geological mapping
- ❖ Surface Sampling (Grab/Bedrock samples) & chemical analysis
- ❖ To carry out surface Geophysical Investigation by Self Potential (S.P)(100 line spacing) and Magnetic (100 m line spacing and 20m station spacing)
- ❖ Trenching work
- ❖ To drill boreholes to prove depth continuity up to 30 m vertical depth in 1st Level and 50 m vertical depth in 2nd Level
- ❖ To estimate Graphite ore resources (333) in the block as per UNFC norms & Amendment Act 2021 of Mineral (Evidence of Mineral Contents) Rules- 2015.

6.0.0 Planned Methodology

The exploration scheme is proposed in accordance with the objective set for Preliminary Exploration (G-3) in the block, in accordance with Minerals (Evidence of Mineral Contents) Rule-2015 and Amendment 2021. Accordingly, the following scheme of exploration is formulated.

6.0.1 Topographical Surveying

Topographical survey will be carried out in the block area, with contouring at 3m interval. All the surface features including geological outcrop & Pits/ Trench will be picked up and marked on a map on 1:2000 scale. The Blocks boundary shall be surveyed by DGPS in WGS-84 datum for demarcation of block boundary/corner points. RL's and co-ordinates of survey and Borehole points will be determined with reference to the Survey of India Bench Mark as available.

6.0.3 Geological Mapping (1:2,000 Scale)

The detailed geological mappings on 1:2000 scale will be carried out in the entire block by taking geological traverses in the block, to demarcate the surface manifestations and lateral disposition of the mineralized zones along with the structural features i.e. strike, dip, lineation / foliations etc to have structural control of the area. The contacts of different formations, identification of different rock formation, structural features, etc., will be carried out in detail. The geological map on 1:2000 scale will be generated based on the detail geological mapping of the block and interpretation of G-3 level exploration data along

6.0.5 Bed Rock Sampling

During the course of Geochemical mapping, grab, the bed rock / channel along with soil samples will be collected from the surface exposures to examine the grade of ore. A total of 25 no of primary samples will be subjected to proximate analyses for graphite mineralizations.

6.0.3 Surface Geophysical Survey :

Surface Geophysical Survey:

- 27 Lime Km of Self Potential (S.P)(100 line spacing)
- Magnetic (100 m line spacing and 20m station spacing)

6.0.6 Trenching

Trenching will be carried out on the surface up to a depth of 2 m after removal of soil/weathered column in the area. Trenching shall be carried out in the potential zones identified and samples will be collected from pit wall/floor sections, based on the observations of geological mapping and the results of geochemical sampling and Geophysical Investigation. A provision of pitting in mineralized zones (Trenching (1 x5 x2 m) 100 cubic meters is proposed from 10 No. of pits with provision of collection of 50 Nos. of trench samples.

6.0.7 Exploratory Drilling:

Based on the outcome of geological mapping & Geophysical survey, analytical results of surface, grab samples and to verify the strike and depth continuity of Graphite mineralization, the detailed drilling at close spaced grid at 100 m is proposed for the known mineralised area to bring the deposit to G-3 level. Tentatively, a total of 17 of exploratory Inclined boreholes involving 850 m of exploratory drilling (Diamond core drilling) have been earmarked for G-3 level of exploration. The azimuth and angle of inclination of the proposed boreholes will be decided by the field geologist once the attitude (strike & dip) of mineralized zones (host rock) is deciphered after geological mapping and trenching/pitting. The boreholes have been planned in such a manner that it is presumed to intersect the Graphite ore bands at deeper levels. It is expected that the Graphite ore band will extend both laterally & vertically along the dip direction.

6.0.8 Drill Core Logging and Sampling

The borehole cores would be logged systematically. Viz. details of the litho units, colour, structural feature, texture, mineralization, core recovery and Graphite ore type would be recorded.

6.0.9 Core Sampling

The mineralized part of the drill core from each borehole will be sampled as the primary sample. The individual sample will be split into two equal halves and one part will be preserved in the core box for future reference and will be stored in core library, after completion of the project. The whole samples shall be splitted through coning and quartering in field. One part will be sent to the NABL accredited Laboratory for analysis, second part will be preserved in the camp as duplicate sample, third part will be utilized for preparing composite sample for individual ore band and the fourth part will be kept as either check sample or sample to be used for any other specific purpose. The length of each sample will be kept 1m within the ore zone depending upon the width of particular type of Graphite ore and its physical character. The length of each sample will be kept 0.50 m-1.0m depending upon the width of particular types of Graphite ore and its physical character. Around 380 core samples will be generated from 17 boreholes. The primary core samples will be analyzed Proximate analyses.

6.0.10 Check Samples: External Check samples will be 10% of the total primary samples(46No. of samples) will be sent to NABL accredited Labs for analysis Proximate analyses

6.1.2 Petrographic & Mineragraphic Studies

Thin and polished section studies on drill cores as well as out-crop samples would be done for ascertaining the petrographic and mineragraphic characteristics. These samples would be drawn from ore zones and host rocks. A provision of 10 specimens (5 specimens from core samples and 5 specimens from outcrop samples) for petrographic and 10 specimens (5 specimens from core samples and 5 specimens from outcrop samples) for mineragraphic studies has been kept in G-3 level.

6.1.3 Bulk Density Determination

A provision of 5 nos pits in Graphite ore zone is kept for assessment of bulk density of Graphite. The dimension of the pit will be 1 m x 1 m x 1 m.

7.0.0 Nature Quantum and Target

The Quantum of work proposed in the block is given below:

Sl. No.	Description and Nature of Work	Unit	Target
A	GEOLOGICAL WORK AND SURVEYING		
1	Geological Mapping (1:2000 scale)	Sq. km	2.70
2	Topographic Survey (Contour interval 3m) at 1:2000 scale	Sq. km	2.70

3	Bore Hole Fixation and determination of co-ordinates & Reduced Level (RL) of the boreholes	Nos.	14
4	Boundary survey by DGPS	Nos.	6
5	Bedrock samples		25
6	TRENCHING- Trenching (1x5x2)10 Nos.	Cum.	100
B	SURFACE GEOPHYSICAL SURVEY		
7	Self Potential (S.P)(100 line spacing)	Line km	27
8	Magnetic (100 m line spacing and 20m station spacing)	Station	1350
C	EXPLORATORY DRILLING		
9	Drilling (Hard Rock)	m	560
10	Drill Core Preservation	Per m	300
D	Sampling & Chemical Analysis		
11	Primary samples to be analyzed Proximate Analysis of Graphite: Fixed Carbon (FC), Ash (A), Moisture (M) and Volatile Matter (VM)		455
i)	Bedrock samples	Nos .	25
ii)	Trench samples	Nos .	50
iii)	Borehole Core samples	Nos .	380
iv)	Check samples (10% external)	Nos .	46
12	Spectroscopic Studies		
	ICP-AES/ICPMS (sequential technique) for 34 elements i.e. 16 other elements viz. Li, Ga, In, Be, Ge, Mo, Ni, Cr, Ta, W, Ba, Co, Rb, Sr, Zr, Nb ;16 REE viz. La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, a Yb, Lu, Sc, Y; 02 Actinides viz. U, Th.	Nos .	10
13	Petrological Studies		
	i) Preparation of thin section	Nos.	10
	ii) Study of Thin Section plus photo micrographs	Nos.	10
	iii)Preparation of polished section	Nos.	10
14	Bulk Density	Nos.	5
15	Whole Rock Analysis (SiO ₂ , Fe ₂ O ₃ , MnO ₂ , Al ₂ O ₃ ,MgO, CaO, BaO, K ₂ O, P ₂ O ₅ , TiO ₂ , V ₂ O ₅ , LOI, S,V)	Nos.	10
E	Geological Report Preparation -As per MEMC Rules-2015	Nos.	1

8.0.0 Time Schedule and Cost Estimates

Time Schedule: The total duration of the project proposed is 11 months.

Preliminary Exploration (G-3) for Graphite and associated minerals in Barwaiya-Irgu Block, Palamu & Latehar district, Jharkhand														
Sl.		Months												
No.	Activities	1	2	3	4		5	6	7		8	9	10	11
1	Camp Setting													
2	Geological Mapping & Sampling (Bed Rock /Pit/Grab)													
3	Survey Work(1 Party) (Topography + BH Survey)													
4	Surface Geophysical Survey													
5	Trenching													
6	Drilling													
7	Geological Work(1 Geologist)													
8	Sampling Work -BRS/Pit/Core Samples													
9	Camp Winding													
10	Laboratory Studies													
11	Geological Work/ Report Writing													
12	Peer Review and Report Submission													

9.0.0 Cost Estimates:

Tentative cost has been estimated based on the Schedule of Charges (SoC) of projects funded by National Exploration Trust (NMET). The total cost estimate of Rs. 269.13 Lakhs(Including GST) is being proposed for completion of exploratory work up to G-3 level. Activity wise break-ups of the same are furnished below

Activity wise break up of cost of the project

Sl.No.	Item	Total Cost
1	Geological Work	3102630
2	Surface Geophysical study	4422780
3	Trenching	412500
4	Laboratory Studies	1978307
5	Drilling	11679500
	Sub total	21595717
6	Report	750000
7	Peer Review	30000
8	Proposal Preparation	431914.34

	Total	22807631
9	GST (18%)	4105374
10	Total cost including 18% GST	26913005

10.0.0 Justifications

- GSI during the Field Season 2022-2023 carried out Reconnaissance Survey of Graphite, Vanadium and associated minerals in Chama-Barwaiya area, of Latehar and Palamu districts, Jharkhand (G4 Stage) in parts Survey of India Toposheet No 73A/5, carried out was carried out LSM on a 1:12,500 scale along with 100 cu.m. pitting and trenching covering an area of 100 sq.km. Observed that the potentiality of the graphite mineralization is confined to graphite bearing gneisses in the north central part of the block in the areas like Chama, Barwaiya khurd and Irgu. The graphite mineralization in the study area is flaky and mainly structurally controlled. General strike of the graphite bodies varying from WNW-ESE to NW SE with shallow to moderate dip in the southern direction.
- Proximate analysis of graphitic BRS samples showing highly encouraging values for fixed carbon and vanadium. The values of fixed carbon in BRS samples ranges from 0.58 % to 28.02%, volatile content ranges from 1.06% to 7.99% and ash content ranges from 69.80 % to 95.78%. 70% of the BRS samples shows FC value between 10% to 28.02%. The chemical analysis of fixed carbon value in the trench samples ranges from 1.01% to 34.78%, volatile content from 0.81% to 9.70% and ash content from 63.14% to 94.83%.
- On the basis of surficial mapping, trenching and chemical results of BRS and PTS samples, identified two probable zones of graphite mineralization (i) near Barwaiya Khurd village and (ii) around Chama and Irgu village. The mineralization observed discontinuously, to poor surface exposure, **geophysical surveys, followed by systematic drilling**, are strongly recommended to delineate depth continuity, grade variation and to assess the potential of associated vanadium and base-metal enrichment for by-product recovery.
- Further APC visited the site for collection of samples in the area, the sample results are given below

Sample No.	Latitude	Longitude	FC %
JH/LT/BA/S-1	23.9371	84.37583	16.11
JH/LT/BA/S-2	23.93842	84.38099	8.93
JH/LT/BA/S-3	23.92329	84.38591	8.08
JH/LT/BA/S-4	23.93241	84.37207	11.07
JH/LT/BA/S-5	23.93131	84.3729	13.6

- Based on GSI investigation during the FS 2022-23 and APC field samples encouraging analyses results, an target area for Preliminary Exploration (G3 level) in Barwaiya-Irgu Block measures an area of 2.70 sq.km has been identified

Reference:

1. Final report on Reconnaissance Survey of Graphite, Vanadium and associated minerals in Chama-Barwaiya area, of Latehar and Palamu districts, Jharkhand (G4 Stage).
2. REPORT ON THE GRAPHITE INVESTIGATION IN THE PALAMAU DISTRICT, BIHAR (Progress Report for the Field Season 1968-69)
3. FINAL REPORT ON REGIONAL GEOCHEMICAL MAPPING IN TOPOSHEET NO. 73A/5 IN LATEHAR AND PALAMAU DISTRICTS, JHARKHAND(field season 2017-18) ANAM AHMAD & POONAM NAGAR, Geologist, GSI

List of Plates:

1. Location Plan of Proposed Barwaiya-Irgu Block_on Topoisheet No. 73A/05 (1:25000) (**ANNEXURE-1**)
2. Location of Proposed Barwaiya-Irgu Block on Regional Geological Map (1:25000) (**ANNEXURE-2**)
3. Location of Proposed Barwaiya-Irgu Block on GSI LSM Geological Map (1:25000) (**ANNEXURE-3**)
4. Location of Proposed Barwaiya-Irgu Block onGSI outcrop Geological Map (1:25000) (**ANNEXURE-4**)

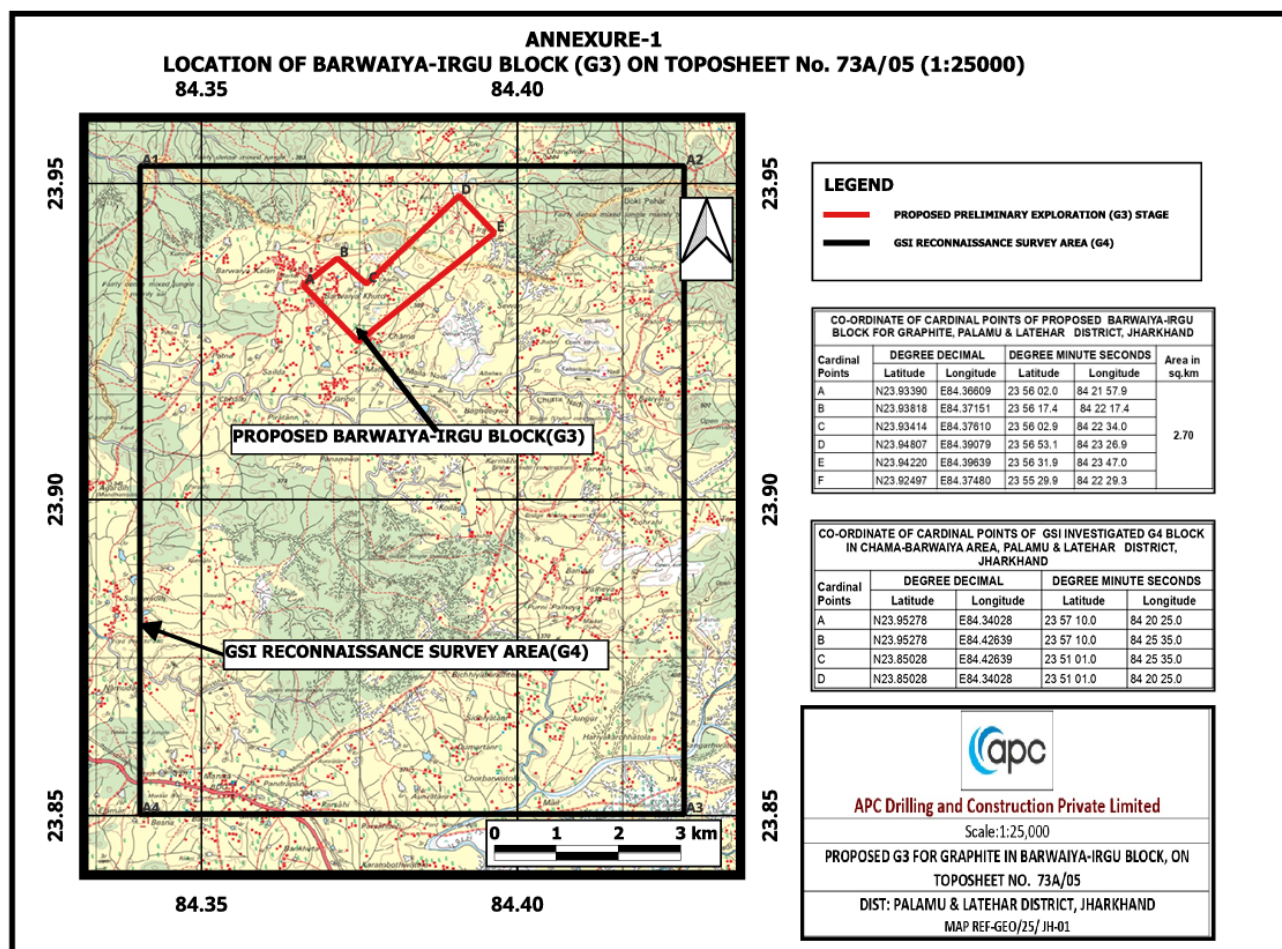


Figure-5:Location Plan of Proposed Barwaiya-Irgu Block on Topoisheet No. 73 A/05

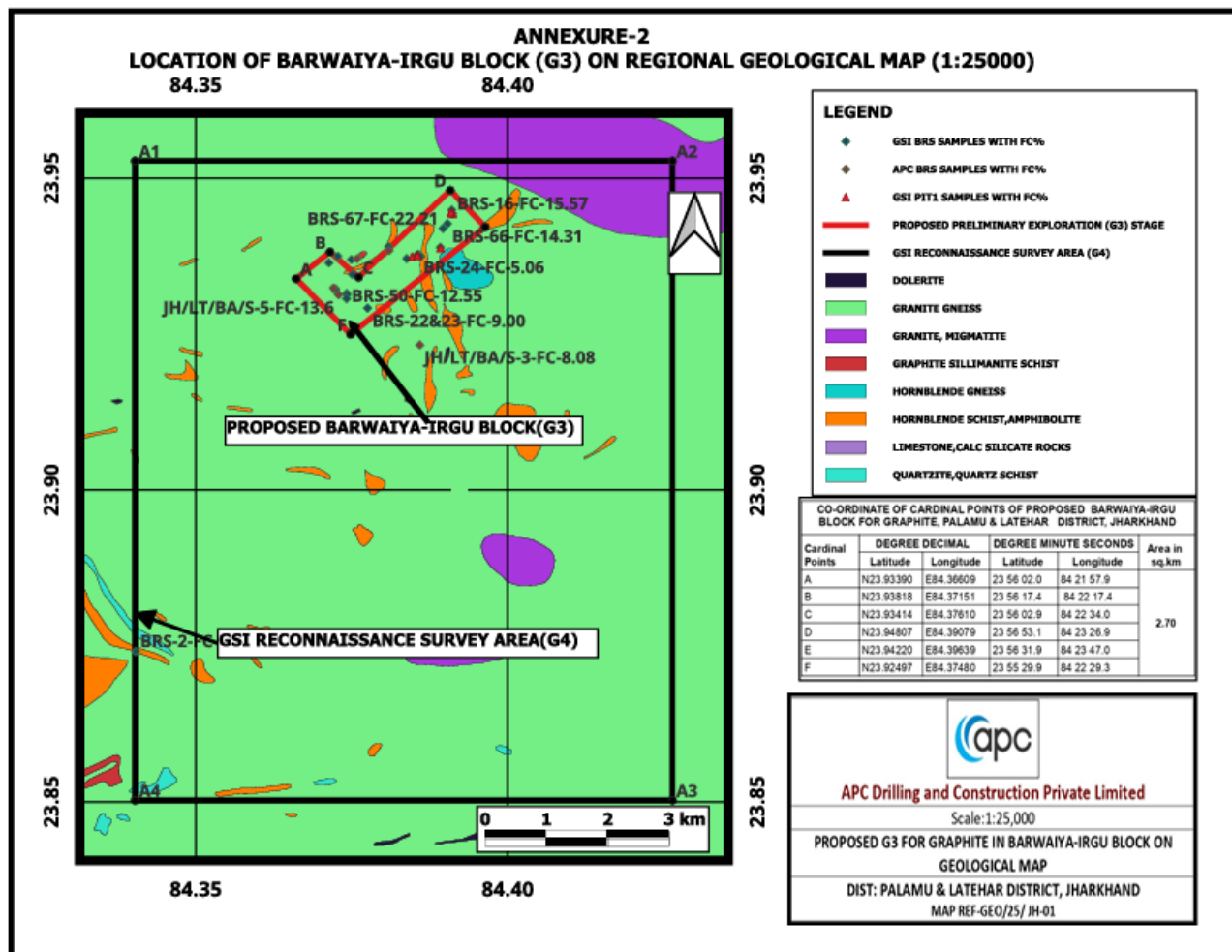


Figure-6: Location of Proposed Barwaiya-Irgu Block on Regional Geological Map

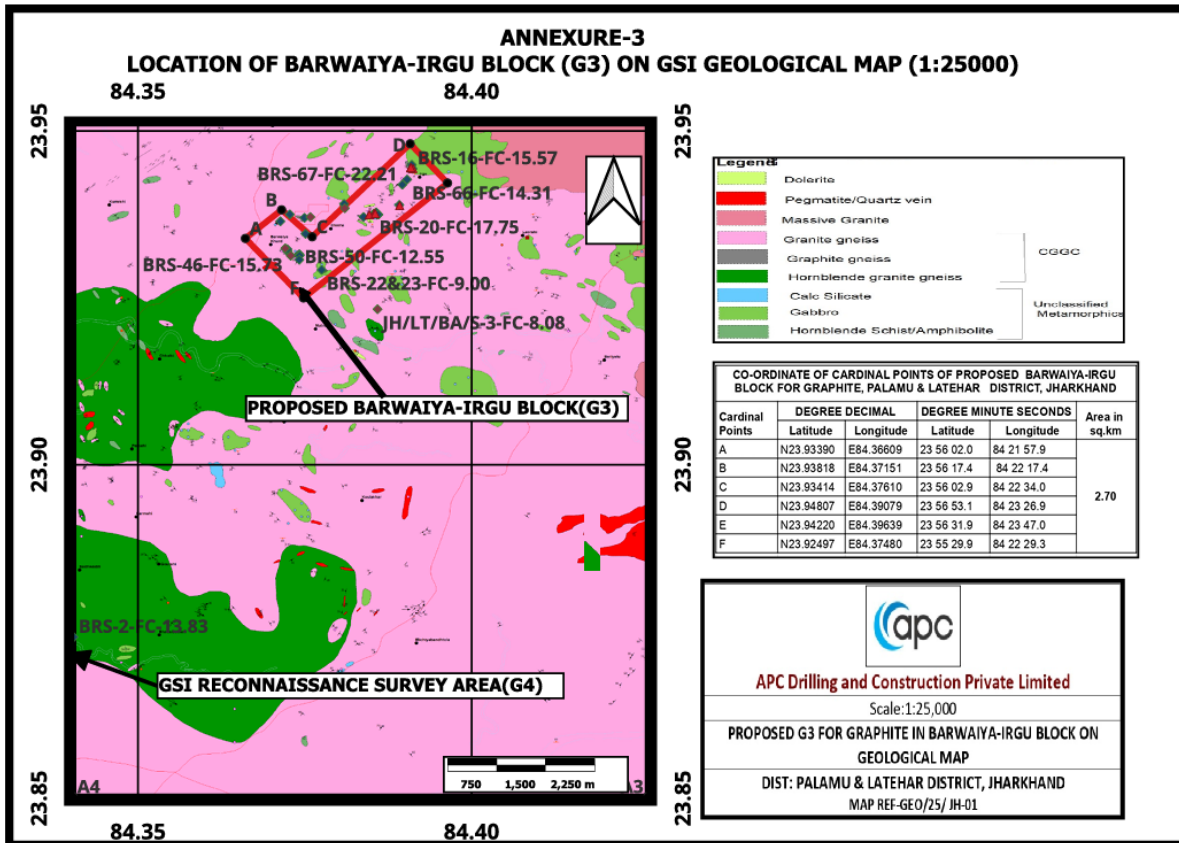


Figure-7: Location of Barwaiya-Irgu Block on GSI Geological Map

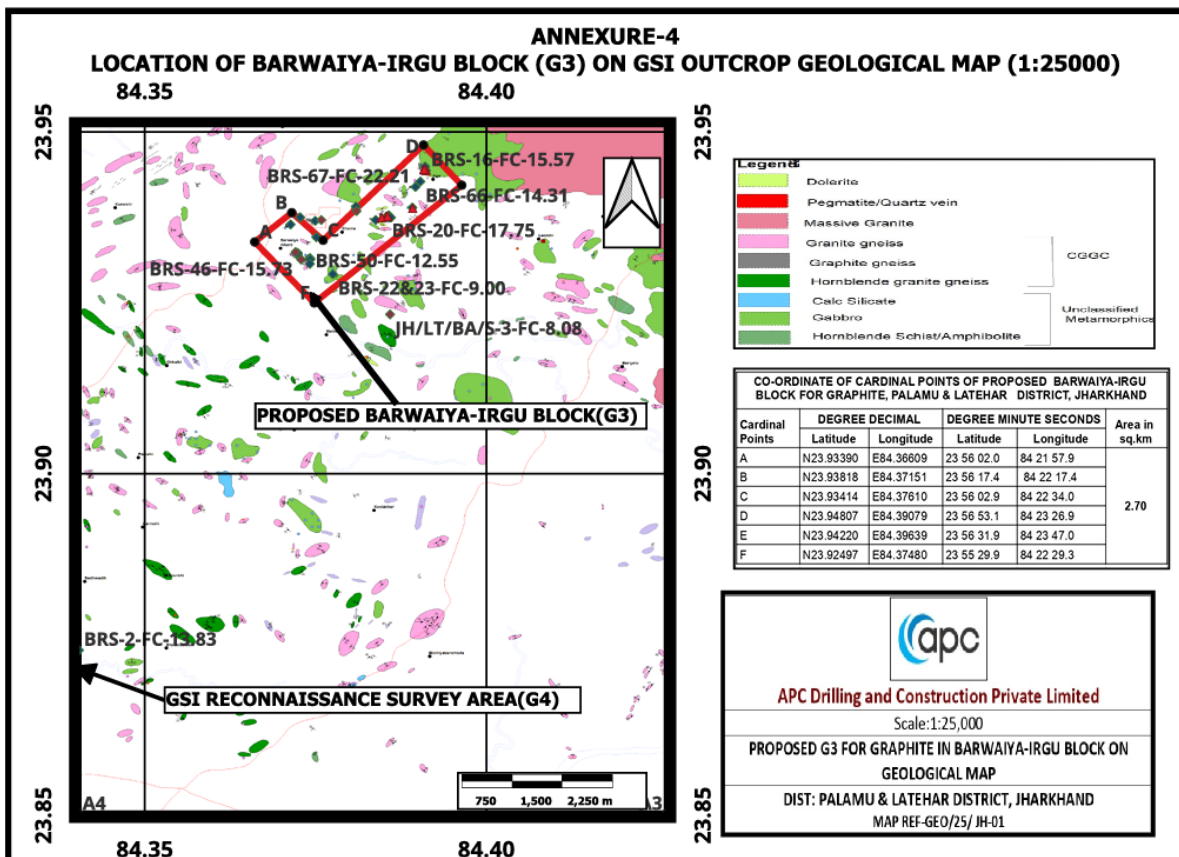


Figure-8: Location of Barwaiya-Irgu Block on GSI outcrop Geological Map

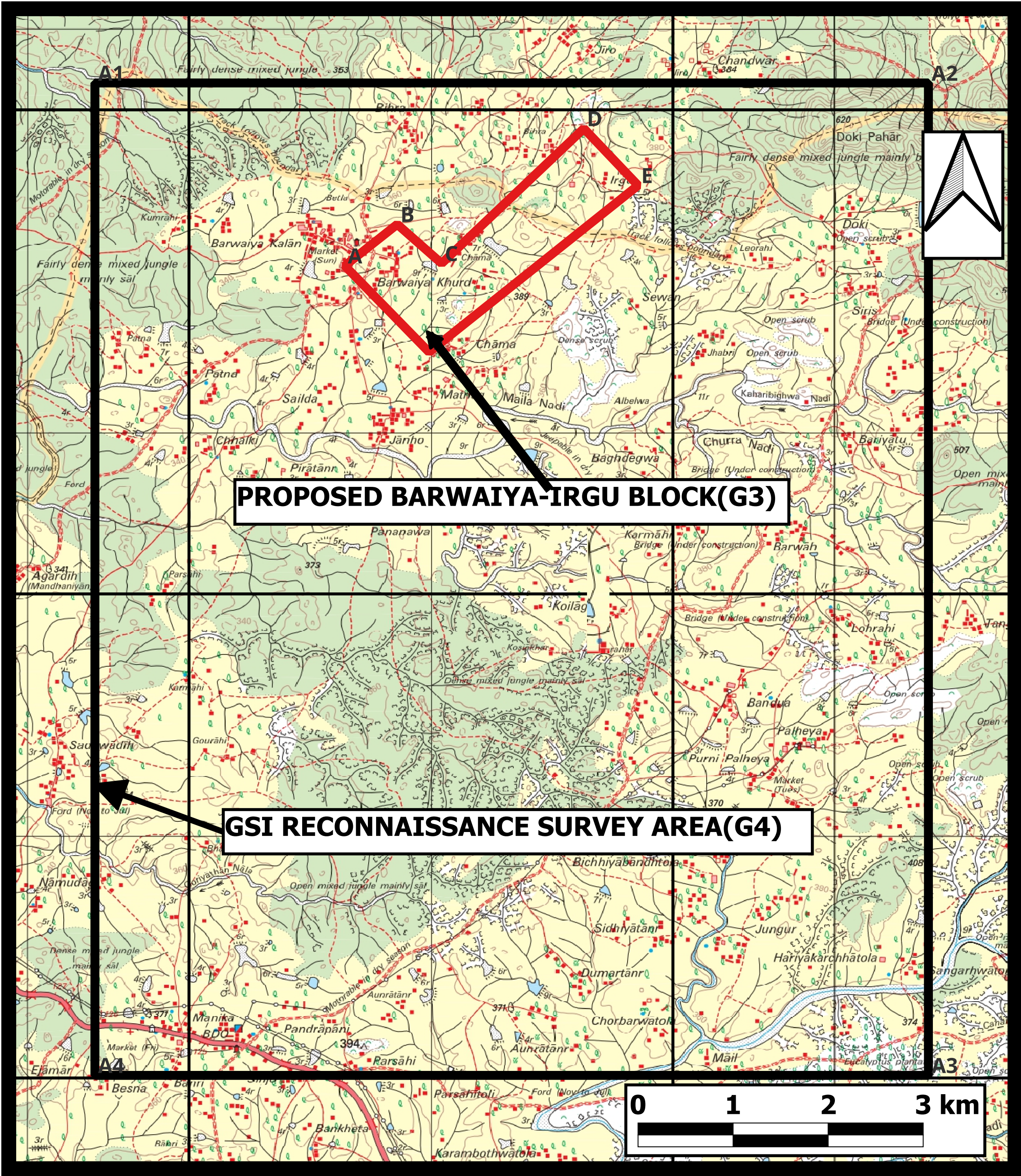
Detailed estimated cost of the project is given in table below:

Preliminary Exploration (G-3) for Graphite and associated minerals in Barwaiya-Irgu Block, Districts: Palamu & Latehar Districts, Jharkhand [Block area- 2.70 sq. km; Schedule timeline- 11 months; BH-13 Nos in 1st level-Depth 45m and 4 Boreholes in 2nd level-Depth of 70m Total Drilling meterage- 560 m; Review- After 4 & 7 months]							
SL No.	Item of Work	Unit	Rates as per NMET SoC		Estimated Cost of the Proposal		Remarks
			SoC-Item -SI No.	Rates as per SoC	Qty.	Amount (Rs)	
A	GEOLOGICAL WORK & TOPOGRAPHICAL SURVEY (1:2000 scale)						
i	Detailed Geological Mapping	day	1.1	18300	2.70	49410	
	Charges for one Geologist- Field	day	1.2.1a	14500	100	1450000	
ii	Charges for one Geologist - HQ	day	1.2.1a	10500	30	315000	
iii	2 labours / Party(As per rates of Central Labour Commissioner)	day	5.8	556	200	111200	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
iv	Sampling Party days-1 Samplers Labour charge not included	day	1.2.1b	7850	60	471000	
v	4 labours/ party (As per rates of Central Labour Commissioner)	day	5.8	556	240	133440	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
	Survey						
vi	Topographical Survey, boundary survey	day	1.6.1a	10500	45	472500	Topographical Survey on 1:2000 (2 m contour interval)
viii	4 labours for surveyor	day	5.8	556	180	100080	
	Sub Total- A					3102630	
B	Surface Geophysical Survey						
i	Self Potential (S.P)(100 line spacing)	L.km	3.3a	62140	27	1677780	
	Magnetic (100 m line spacing and 20m station spacing)	Station	3.2a	1800	1350	2430000	
iii	Geophysicist HQ	days	3.18	10500	30	315000	
	Sub Total- B					4422780	
C	PITTING / TRENCHING						
i	Trenching (1 x5 x2 m)10 No. of Trench	Cu m	2.1.2	4125	100	412500	

	Sub Total- C					412500	
D	DRILLING						
i	Drilling upto 300m (Hard Rock)	m	2.2.1.1d	10000	850	8500000	BH-14 Nos; 1st level;45 m and BH-4 Nox. 2nd level-70m depth/total Drilling meterage- 850 m)
ii	Land / Crop Compensation	per BH	5.6	30000	17	510000	
iii	Construction of concrete Pillar (12"x12"x30") (14 BH Pillar +6 Boundary Pillar)	per borehole	2.2.7	2000	23	46000	(17 BH Pillar +6 Boundary Pillar)
iv	Miscellaneous charges -Transportation of Drill Rig, Accomodation of Drill Camp, Camo setting & winding,Construction of Approach Road and	Lumps um	2.2.9	-	-	1500000	if Drilling cost >50 lakhs & < 1 Cr, 20% of the Drilling cost with Maximum of 15.0 Lakhs
v	Drill Core Preservation (One complete borehole plus mineralised cores of all the remaining BHs)	Per meter	X	1590	450	715500	1 complete BH + mineralised zone
vi	Bore Hole Fixation and determination of co- ordinates & Reduced Level of the boreholes by DGPS	Nos	1.3.2	24000	17	408000	12
	Sub Total- D					11679500	
E	LABORATORY STUDIES						
1	Chemical Analysis						
	Primary & Check samples for Graphite BRS/Pit/Chip/Channel/BH samples)						
	a. Primary Samples for Proximate Analysis of Graphite: Fixed Carbon (FC), Ash (A), Moisture (M) and Volatile Matter (VM)	Nos	4.1.18	3614	455	1644370	BH-380 BRS-25, Trench-50
	b.Check samples from NABL Lab for Proximate Analysis of Graphite: Fixed Carbon (FC), Ash (A), Moisture (M) and Volatile Matter(VM)	Nos	4.1.18	3614	46	164437	
	d.ICP-AES/ICPMS (sequential technique) for 34 elements i.e. 16 other elements viz. Li, Ga, In, Be, Ge, Mo, Ni, Cr, Ta, W, Ba, Co, Rb, Sr, Zr, Nb ;16 REE viz. La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Sc, Y; 02 Actinides viz. U, Th.	Nos	4.1.15	7400	10	74000	Per BH 1 samples
2	Physical & Petrological Studies						
i	Preparation of thin section	Nos	4.3.1	500	10	5000	
ii	Study of Thin Section plus photo micrographs	Nos	4.3.4	2800	10	28000	

ANNEXURE-1
LOCATION OF BARWAIYA-IRGU BLOCK (G3) ON TOPOSHEET No. 73A/05 (1:25000)
84.35 84.40

23.95
23.90
23.85



84.35 84.40

23.95
23.90
23.85

LEGEND

- PROPOSED PRELIMINARY EXPLORATION (G3) STAGE
- GSI RECONNAISSANCE SURVEY AREA (G4)

CO-ORDINATE OF CARDINAL POINTS OF PROPOSED BARWAIYA-IRGU BLOCK FOR GRAPHITE, PALAMU & LATEHAR DISTRICT, JHARKHAND

Cardinal Points	DEGREE DECIMAL		DEGREE MINUTE SECONDS		Area in sq.km
	Latitude	Longitude	Latitude	Longitude	
A	N23.93390	E84.36609	23 56 02.0	84 21 57.9	2.70
B	N23.93818	E84.37151	23 56 17.4	84 22 17.4	
C	N23.93414	E84.37610	23 56 02.9	84 22 34.0	
D	N23.94807	E84.39079	23 56 53.1	84 23 26.9	
E	N23.94220	E84.39639	23 56 31.9	84 23 47.0	
F	N23.92497	E84.37480	23 55 29.9	84 22 29.3	

CO-ORDINATE OF CARDINAL POINTS OF GSI INVESTIGATED G4 BLOCK IN CHAMA-BARWAIYA AREA, PALAMU & LATEHAR DISTRICT, JHARKHAND

Cardinal Points	DEGREE DECIMAL		DEGREE MINUTE SECONDS	
	Latitude	Longitude	Latitude	Longitude
A	N23.95278	E84.34028	23 57 10.0	84 20 25.0
B	N23.95278	E84.42639	23 57 10.0	84 25 35.0
C	N23.85028	E84.42639	23 51 01.0	84 25 35.0
D	N23.85028	E84.34028	23 51 01.0	84 20 25.0



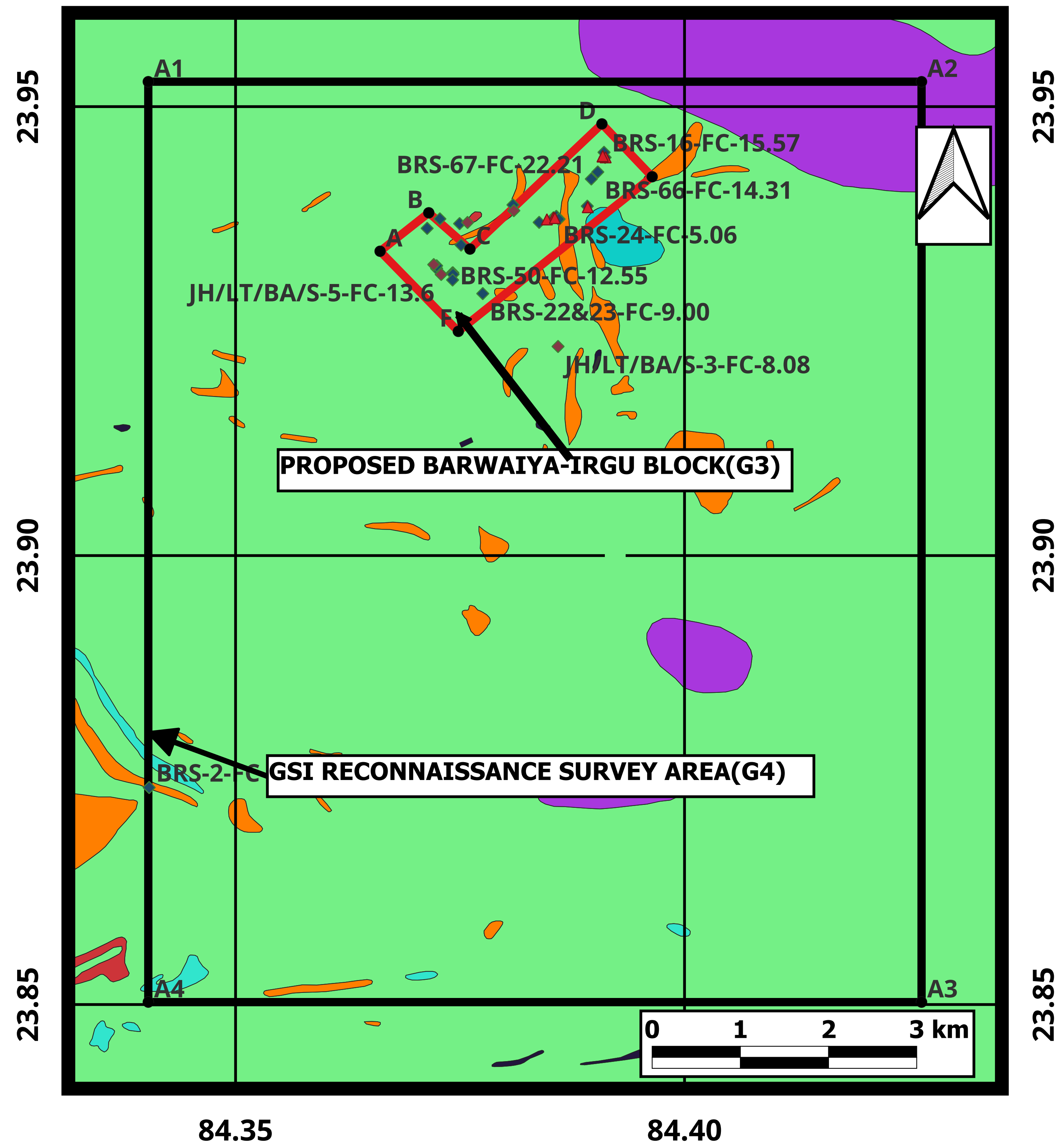
APC Drilling and Construction Private Limited

Scale:1:25,000

PROPOSED G3 FOR GRAPHITE IN BARWAIYA-IRGU BLOCK, ON
TOPOSHEET NO. 73A/05

DIST: PALAMU & LATEHAR DISTRICT, JHARKHAND
MAP REF-GEO/25/ JH-01

ANNEXURE-2
LOCATION OF BARWAIYA-IRGU BLOCK (G3) ON REGIONAL GEOLOGICAL MAP (1:25000)
84.35 84.40



LEGEND

- ◆ GSI BRS SAMPLES WITH FC%
- ◆ APC BRS SAMPLES WITH FC%
- ▲ GSI PIT1 SAMPLES WITH FC%
- PROPOSED PRELIMINARY EXPLORATION (G3) STAGE
- GSI RECONNAISSANCE SURVEY AREA (G4)
- DOLERITE
- GRANITE GNEISS
- GRANITE, MIGMATITE
- GRAPHITE SILLIMANITE SCHIST
- HORNBLLENDE GNEISS
- HORNBLLENDE SCHIST, AMPHIBOLITE
- LIMESTONE, CALC SILICATE ROCKS
- QUARTZITE, QUARTZ SCHIST

CO-ORDINATE OF CARDINAL POINTS OF PROPOSED BARWAIYA-IRGU BLOCK FOR GRAPHITE, PALAMU & LATEHAR DISTRICT, JHARKHAND

Cardinal Points	DEGREE DECIMAL		DEGREE MINUTE SECONDS		Area in sq.km
	Latitude	Longitude	Latitude	Longitude	
A	N23.93390	E84.36609	23 56 02.0	84 21 57.9	2.70
B	N23.93818	E84.37151	23 56 17.4	84 22 17.4	
C	N23.93414	E84.37610	23 56 02.9	84 22 34.0	
D	N23.94807	E84.39079	23 56 53.1	84 23 26.9	
E	N23.94220	E84.39639	23 56 31.9	84 23 47.0	
F	N23.92497	E84.37480	23 55 29.9	84 22 29.3	



APC Drilling and Construction Private Limited

Scale:1:25,000

PROPOSED G3 FOR GRAPHITE IN BARWAIYA-IRGU BLOCK ON
GEOLOGICAL MAP

DIST: PALAMU & LATEHAR DISTRICT, JHARKHAND
MAP REF-GEO/25/ JH-01

ANNEXURE-3

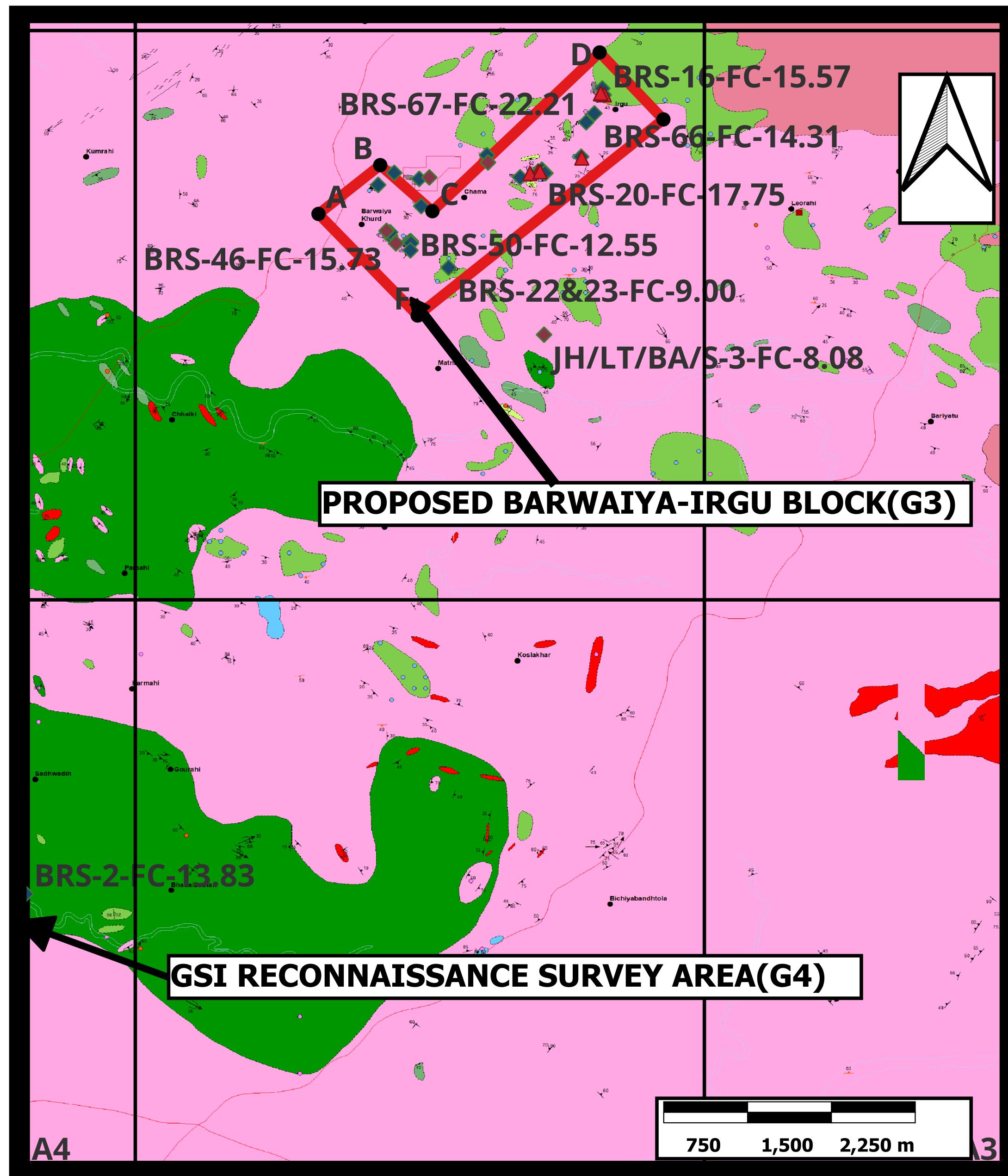
LOCATION OF BARWAIYA-IRGU BLOCK (G3) ON GSI GEOLOGICAL MAP (1:25000)

84.35

84.40

23.95

23.95



23.90

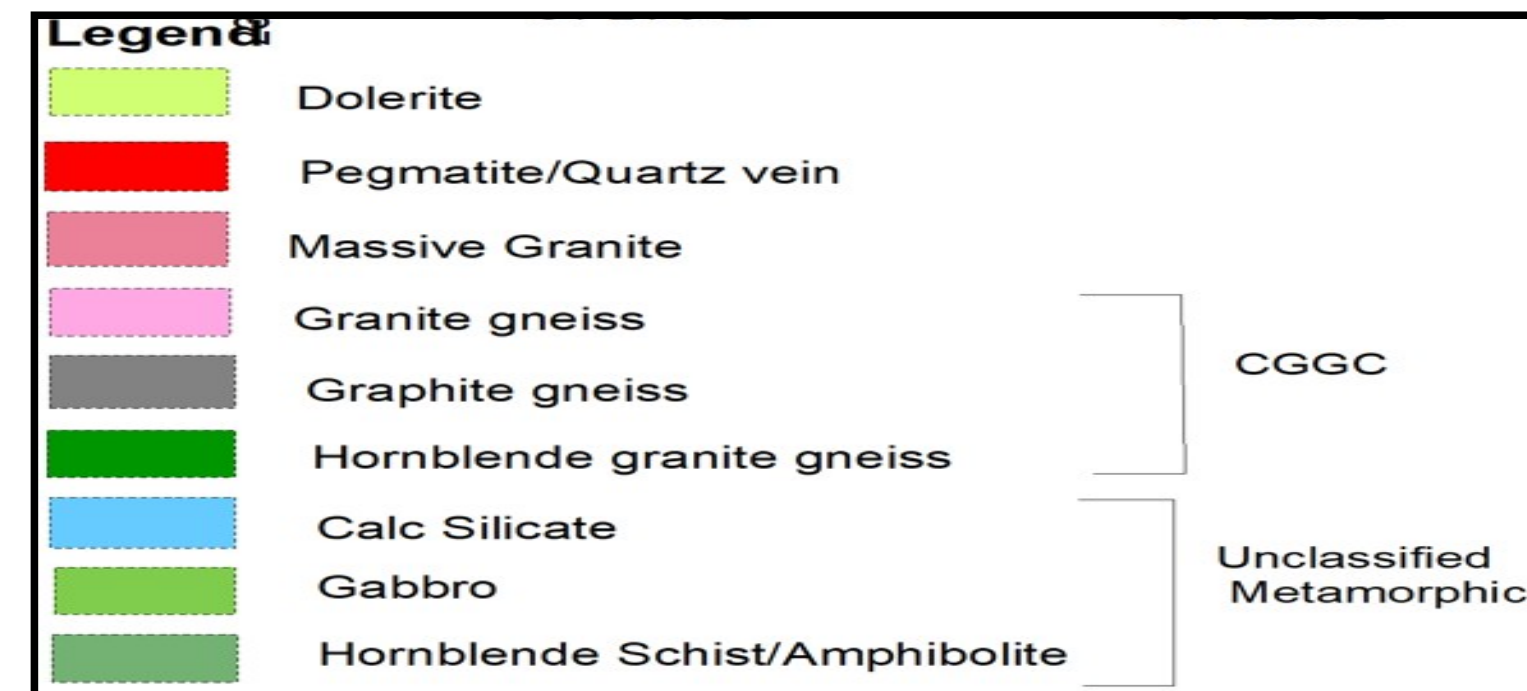
23.90

23.85

84.35

84.40

23.85



CO-ORDINATE OF CARDINAL POINTS OF PROPOSED BARWAIYA-IRGU BLOCK FOR GRAPHITE, PALAMU & LATEHAR DISTRICT, JHARKHAND					
Cardinal Points	DEGREE DECIMAL		DEGREE MINUTE SECONDS		Area in sq.km
	Latitude	Longitude	Latitude	Longitude	
A	N23.93390	E84.36609	23 56 02.0	84 21 57.9	2.70
B	N23.93818	E84.37151	23 56 17.4	84 22 17.4	
C	N23.93414	E84.37610	23 56 02.9	84 22 34.0	
D	N23.94807	E84.39079	23 56 53.1	84 23 26.9	
E	N23.94220	E84.39639	23 56 31.9	84 23 47.0	
F	N23.92497	E84.37480	23 55 29.9	84 22 29.3	



APC Drilling and Construction Private Limited

Scale:1:25,000

PROPOSED G3 FOR GRAPHITE IN BARWAIYA-IRGU BLOCK ON GEOLOGICAL MAP

DIST: PALAMU & LATEHAR DISTRICT, JHARKHAND

MAP REF-GEO/25/ JH-01

ANNEXURE-4

LOCATION OF BARWAIYA-IRGU BLOCK (G3) ON GSI OUTCROP GEOLOGICAL MAP (1:25000)

23.95

23.90

23.85

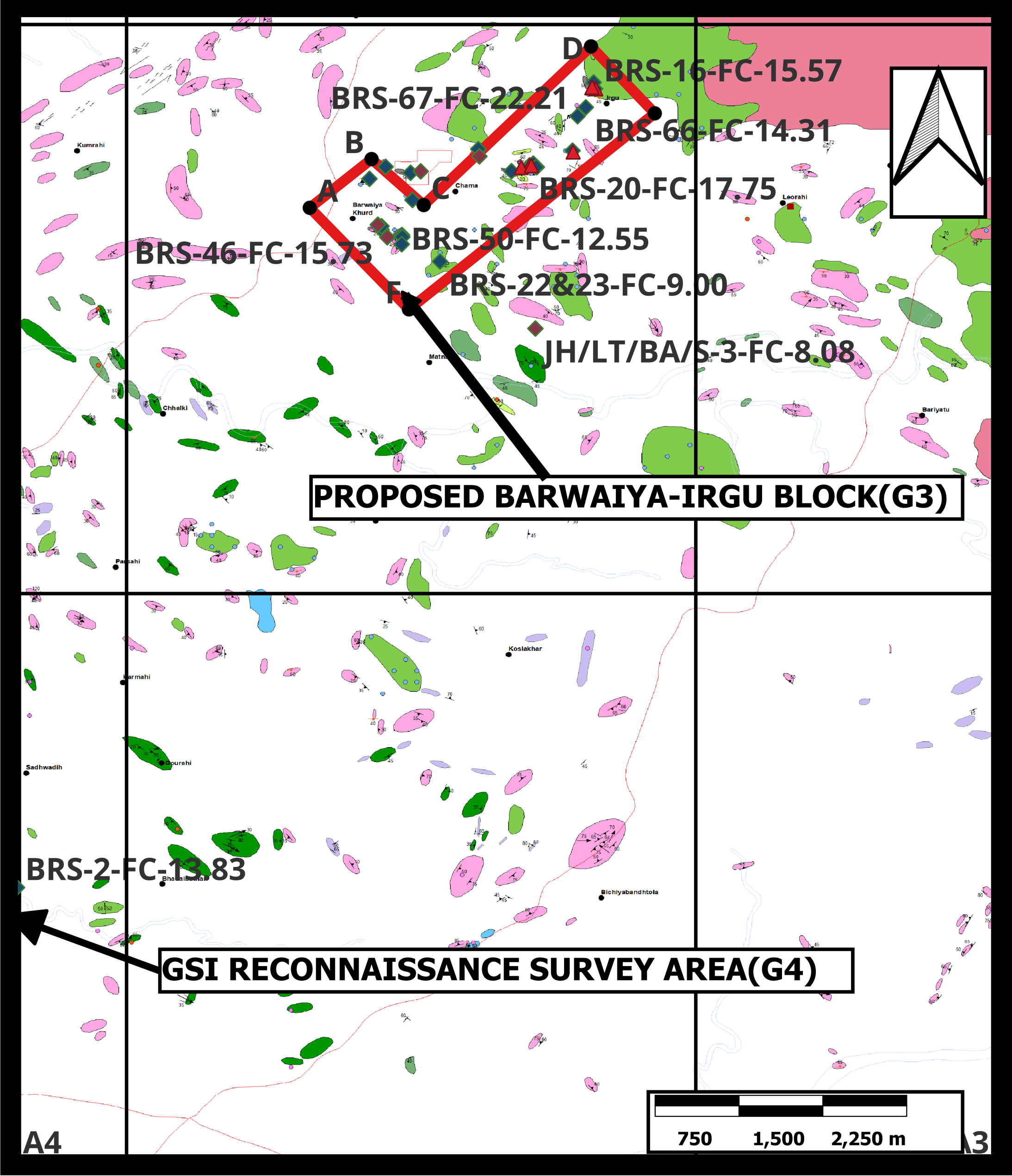
84.35

84.40

23.95

23.90

23.85



CO-ORDINATE OF CARDINAL POINTS OF PROPOSED BARWAIYA-IRGU BLOCK FOR GRAPHITE, PALAMU & LATEHAR DISTRICT, JHARKHAND					
Cardinal Points	DEGREE DECIMAL		DEGREE MINUTE SECONDS		Area in sq.km
	Latitude	Longitude	Latitude	Longitude	
A	N23.93390	E84.36609	23 56 02.0	84 21 57.9	2.70
B	N23.93818	E84.37151	23 56 17.4	84 22 17.4	
C	N23.93414	E84.37610	23 56 02.9	84 22 34.0	
D	N23.94807	E84.39079	23 56 53.1	84 23 26.9	
E	N23.94220	E84.39639	23 56 31.9	84 23 47.0	
F	N23.92497	E84.37480	23 55 29.9	84 22 29.3	



APC Drilling and Construction Private Limited

Scale:1:25,000

PROPOSED G3 FOR GRAPHITE IN BARWAIYA-IRGU BLOCK ON GEOLOGICAL MAP

DIST: PALAMU & LATEHAR DISTRICT, JHARKHAND

MAP REF-GEO/25/ JH-01