

**PROPOSAL FOR RECONNAISSANCE SURVEY (G-4)
FOR MANGANESE ORE AND GRAPHITE IN
LARAMBHA-KANAITAL & PUDAPADAR-BHARATBAHAL BLOCK
(135 SQ. KM AREA)
DISTRICT- BALANGIR, ODISHA**

COMMODITY: MANGANESE AND GRAPHITE

**BY
MINERAL EXPLORATION CORPORATION LIMITED
DR. BABASAHAH AMBEDKAR BHAWAN
SEMINARY HILLS**

PLACE: NAGPUR

DATE: 28th February 2022

Summary of the Block for Reconnaissance Survey (G-4)

Features	Details
Block ID	Larambha-Kanaital & Pudapadar-Bharatbahal Block
Exploration Agency	Mineral Exploration Corporation Limited (MECL)
Commodity	Manganese and Graphite
Mineral Belt	Eastern Ghats Mobile Belt, Balangir District, Odisha
Budget & Time schedule to complete the project	193.51 lakhs & 18 months
Objectives	The present exploration programme (G-4) has been formulated on the basis of previous regional data available and the data collected by MECL team during the field visit to fulfil the following objectives: i) To carry out geological mapping on 1:12,500 scale and demarcate the rock types of manganese and graphite bearing formations with the structural features i.e. strike, dip, lineations / foliations etc. ii) To demarcate concealed graphite and manganese ore bodies by carrying out surface geophysical survey (Self Potential (S.P) and Magnetic) after completion of geological mapping. iii) To carry out trenching/pitting to expose manganese and graphite bodies under soil & lateritic cover. iv) To drill scout boreholes to prove the existence and establish persistence of manganese ore and graphite bodies over a promising strike length. v) To estimate reconnaissance (334) resource of manganese ore and graphite in the block as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 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	Work will be carried out by the proposed agency.
Name/Number of Geoscientists	
Expected Field days (Geology, Geophysics, Surveyor)	Geologist Party days: Field -180 days & HQ-60 days
	Geophysicist Party Days: Field -30 days & HQ-20 days
	Survey Party days: 30 days (for geophysics)
	Sampling Party days: 40 days

1. Location	The block proposed for exploration lies in the parts of Survey of India Toposheet No 64 P/01 and is bounded by latitude 20° 45' 35.29" to 20° 54' 7.53" and longitude 83° 9' 31.46" to 83° 15' 0.10" (Plate No I). The area is connected by fair weather road from the State High-Way No.-1 (Balangir-Patanagarh Road). The fair weather road crosses Suktel River through a ford north of Khuntapalli village and is open to traffic from January to June. During the peak of Monsoon, Larambha-Bharatbahal block can be approached from Balangir via Sarmuhan by an all weather pucca road. The intermittent villages are connected by fair weather jeepable unmetalled roads. The nearest railhead is Balangir.																																										
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Villages	Chuwaliudar, Brahmanipali, Baghamunda, Gunchadihi, Chandanjuri, Thelkuchppar, Dumerjharan, Taljuri, Ratakhadi, Jamjuri, Jubakhol, Dangapal, Laherjuri, Kanaital, Damakipali, Pandripani, Gudiyajur, Larambha, Ghasian, Pudapadar, Bijamagur, Gargachhappar, Tamiya, Bhatpali, Gahirpali, Kalangapali, Dharmahul, Ghumer, Dabkani, Ainatunga, Bagbahali, Bharatbahal, Champasar, Bhatpali, Uchbahal, Mudalsar, Bagbahal, Gandamel etc.																																										
Tehsil/Taluk	Balangir-Patnagarh-Loisinga																																										
District	Balangir																																										
State	Odisha																																										
2. Area (hectares/ square kilometres)																																											
Block Area	135 sq.km																																										
Forest Area	Mostly Non-Forest area.																																										
Government Land Area (Bilanam)	Data not available																																										
Charagaha	Data not available																																										

	Private Land Area	Data not available
3.	Accessibility	
	Nearest Rail Head	Balangir (280 km from Raipur and 310 Km from Bhubaneswar),
	Road	The intermittent villages in the area are connected by fair weather jeepable metalled / unmetalled roads. The nearest railhead is Balangir.
	Airport	Raipur (225 km)
4.	Hydrography	
	Local Surface Drainage Pattern (Channels)	The general slope of the country is towards southerly and the drainage is collected by southerly flowing nala ultimately draining into Suktel River. The area has got dendritic pattern of drainage. The block area is surrounded by Baraputa reserve forest on north-western part and other area mostly by Non-forest and Agricultural lands. Rain-fed south-easterly flowing Suktel River in the southern part of the block.
	Rivers/ Streams	Suktel River
5.	Climate	
	Mean Annual Rainfall	Average annual rainfall is 100 cm
	Temperature:	Minimum temperatures: 10°C (Dec-Feb), Maximum temperatures: up to 46°C (March-June)
6.	Topography	
	Toposheet Number	64P/01
	Morphology of the Area	The area is almost flat terrain and covered with agriculture land. The average height of the area is 250m above MSL.
7.	Availability of baseline geoscience data	
	Geological Map (1:50K/25K)	Regional Geological map available (part of the area), Geological Survey of India (1:25,000 scale)
	Geochemical Map	Not available.
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	Available.
8.	Justification for taking up Reconnaissance Survey/ Regional Exploration	1. The Govt. of India enacted the MMDR Amendment Act-2015 duly introducing the system of auction for allocation of Mineral Concessions. Manganese has been categorized in the Fourth Schedule which needs prospecting and exploration by the State Govt. before auctioning of blocks. 2. Considering the potentiality of the area for manganese and graphite based on the available historic exploration data of blocks explored by GSI & MECL in the surrounding area, MECL proposed G-4 stage

exploration work for manganese & graphite in Larambha-Bharatbahal Block in Balangir District of Odisha through NMET funding. Larambha-Bharatbahal Block may be the prospective manganese blocks identified for auction.

3. During the field season 1997-98, S. N. Behera and B. K. Acharya carried out prospecting for manganese in Dandapani, Tamiya and adjoining areas in Balangir District, Odisha and reported manganese occurrences nearby Larambha and Kanaital villages. They have carried out geological mapping at 1:25000 scale in the part of the block area. They have also collected 13 bedrock samples and analysed. Eleven out of 13 samples having Mn value more than 10% Mn. The analytical details are given below.

Sl. No.	1	2	3	4	5	6	7
Sample No.	LB-1	LB-6	KB-1	KB-2	KB-2A	KB-3	KB-5
Mn (%)	8.73	19.97	11.45	4.58	11.23	14.15	16.85

Sl. No.	8	9	10	11	12	13
Sample No.	KB-7	KB-8	KB-10	KB-12	KB-13	KB-14
Mn (%)	10.61	15.6	12.07	13.52	12.27	17.06

4. During the course of exploration of Rengali Graphite and Manganese Block, MECL team visited the area nearby Larambha, Kanaital and Pudapadar villages where manganese occurrences were reported by Behera and Acharya (F.S. 1997-98). Some pits and a few trenches are available in the area; however, the analytical data of these are not available. They collected 4 bedrock samples from manganese ore zones in Pudapadar area and analysed for Mn by hand held XRF. All the 4 samples having Mn value more than threshold i.e., 10% Mn. The analytical details are given below.

Sl. No.	1	2	3	4
Sample No.	PB-1	PB-2	PB-3	PB-4
Mn (%)	25.09	31.42	18.29	15.26

5. The proposed study area falls in the west and north-west of Kumiapali-Rengali-Antapali-Tabalbanji-Dungaripali-Khagsabahal-Biarpali-Babja Cluster of Manganese blocks, north of Tamiya Manganese block and east of Rengali Graphite and

Manganese Block.

6. There are 10 manganese blocks explored by MECL are in vicinity of the block. The details of the blocks are given below:

SL No.	Block Name	Area (Sq. Km)	At 18% Mn Cut-off		At 10% Mn Cut-off	
			Resource (MT)	Grade Mn %)	Resource (MT)	Grade (Mn %)
1	Tamiya (G-2)	0.81	0.633	23.04	1.314	18.19
2	Tamiya (G-4)	3.12	-	-	-	-
3	Rengali (G-2)	1.83	0.328	21.37	2.193	14.45
4	Rengali (G-4)	2.45	0.011	18.8	0.045	13.5
5	Babja (G-2)	0.20	0.356	23.6	1.157	19.49
6	Biarpalli (G-2)	1.32	1.937	22.45	3.358	18.63
7	Biarpalli (G-4)	2.06	-	-	0.047	11.14
8	Dunguripalli (G-3)	8.05	0.264	22.5	0.555	17.77
9	Kumiapali (G-4)	8.92	-	-	0.235	14.07
10	Antapali (G-4)	2.30	-		0.109	12.97
11	Rengali Graphite & Mn (G-4)	9.41	Exploration under progress			
Total		40.47	3.529	22.56	9.013	17.35

Considering the resource and grade of all these blocks, the cluster mining approach can be used in the area.

7. There are 1.330 mt graphite resource with an average grade of 4.71% FC at 2% FC cut-off has been estimated in Tamiya (G-2), Rengali (G-2), Babja (G-2) and Biarpalli (G-2) blocks which are east of Larambha-Bharatbahal Block. The details of the block wise resources are given below.

S. No	Block	Resource (MT)	FC %
1	Tamiya (G-2) Block	0.610	5.56
2	Rengali (G-2) Block	0.308	4.41
3	Babja (G-2) Block	0.111	3.61
4	Biarpalli (G-2) Block	0.302	3.71
	TOTAL	1.330	4.71

8. The Rengali graphite block, which is west of Larambha-Bharatbahal Block, is under exploration for graphite.

9. Since the graphite mineralisation is also reported in the area, the

		block may be explored for graphite also and will be a value addition. 10. Since most of the block area is covered with soil, geophysical survey (Self potential, (SP and magnetic survey) in the block will facilitate to demarcate the geophysical anomaly/mineralized zones of manganese/graphite, which will help in the formulation of G-4/G-2 level exploration programme. 11. The exploration will be helpful in estimation of Reconnaissance (334) Resources and will help in planning G3/G2 level of exploration programme which in turn will lead to estimation of indicated/inferred (333/332) category resources and will facilitate the State Govt. Odisha for auctioning of blocks.
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LARAMBHA-KANAITAL & PUDAPADAR-BHARATBAHAL BLOCK,
DISTRICT-BALANGIR, ODISHA**

1.0.0 INTRODUCTION

1.1.0 Preamble:

- 1.1.1 Manganese is one of the most common elements in the Earth's crust and is widely distributed across the planet's surface. It is very hard, brittle, gray-white transition metal that is found in variety of minerals, but never as free element in nature; is it often found in minerals in combination with iron. Manganese ore is the basic source to provide manganese as indispensable input in making of iron and all types of steels. So far there is no technology which can substitute manganese in steel making. Manganese combines the twin benefits of relatively low price with outstanding technical usage.
- 1.1.2 In order to sustain the current level of production of Mn ores and to meet the future demands, the exploration of Manganese ore is the need of the hour.
- 1.1.3 In India the Manganese Ore deposits mainly occurs as metamorphosed bedded sedimentary deposits associated with Gondite Series (Archaean) of Madhya Pradesh (Balaghat, Chhindwara & Jabua districts), Maharashtra (Bhandara & Nagpur districts), Gujarat (Panchmahal district), Odisha (Sundargarh district) and Kodurite Series (Archaean) of Odisha (Ganjam & Koraput districts) and Andhra Pradesh (Srikakulam & Vishakhapatnam districts).
- 1.1.4 The total reserves/resources of manganese ore in the country as on 1.04.2015 have been placed at 495.87 million tonnes as per NMI database, based on UNFC system (Mineral Year Book-2019). Out of these, 93.47 million tonnes are categorised as reserves and the balance 402.40 million tonnes are in the remaining resource category. Grade-wise, Ferromanganese grade accounts for 7%, Medium grade 11%, BF grade 28% and the remaining 54% are of Mixed, Low, Others, Unclassified, and Not-known grades including 0.17 million tonnes of battery/chemical grade. The overall grade of the manganese ore reserve in the country is in the range of 30-35% Mn (IBM Mineral Year Book 2019).
- 1.1.5 The total state-wise distribution of the manganese resources in the country indicates that Odisha tops with 44% share followed by Karnataka 22%, Madhya Pradesh 12%,

Maharashtra & Goa 7% each, Andhra Pradesh 4% and Jharkhand 2% each. Rajasthan, Gujarat, Telangana and West Bengal together shared the remaining about 2% resources.

- 1.1.6 The Govt. of India enacted the MMDR Amendment Act, 2015 duly introducing the system of auction for allocation of Mineral Concessions. Manganese has been categorized in the Fourth Schedule which needs prospecting and exploration by the State Govt. before auctioning of blocks
- 1.1.7 MECL looked up for the area for investigation of manganese and graphite around already explored Manganese blocks in Balangir district and received consent from Directorate of Mines, Government of Odisha to take up exploration work for manganese and graphite in Larambha-Kanaital & Pudapadar-Bharatbahal Block in Balangir District of Odisha through NMET funding.
- 1.1.8 Subsequently, after receipt of consent from Directorate of Mines, Govt. of Odisha, MECL prepared a proposal for reconnaissance survey (G-4) for manganese and graphite in Larambha-Kanaital & Pudapadar-Bharatbahal Block, district -Balangir, Odisha and submitted to NMET for taking up for discussion in the upcoming TCC.

1.2.0 Background:

- 1.2.1 The proposed study area falls in the west and north-west of Kumiapali-Rengali-Antapali-Tabalbanji-Dungaripali-Khagsabahal-Biarpali-Babja Cluster of Manganese blocks, north of Tamiya Manganese block and east of Rengali Graphite and Manganese Block. During the exploration of Rengali Graphite and Manganese Block, MECL team visited the area nearby Larambha, Kanaital and Pudapadar villages where manganese occurrences were reported by S. N. Behera and B. K. Acharya during the field season 1997-98. Some pits and a few trenches are available in the area; however, the analytical data of these are not available. S. N. Behera and B. K. Acharya have collected 13 bedrock samples and analysed. Eleven out of 13 samples having Mn value more than threshold i.e., 10% Mn. The analytical details are given below.

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- 1.2.2 MECL team also collected 4 bedrock samples from manganese ore zones in Pudapadar area and analysed for Mn by hand held XRF. All the 4 samples having Mn value more than threshold i.e., 10% Mn. The analytical details are given below.

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Mn (%)	25.09	31.42	18.29	15.26

1.2.3 The Tamiya (G-2), Rengali (G-2), Babja (G-2), Biarpalli (G-2) and Rengali graphite (G-4) blocks are explored for graphite also. Since the graphite mineralisation is also reported in the proposed area, the block may be explored for graphite also. Hence, considering the previous study, field visit by MECL team and vicinity of adjoining manganese and graphite bearing area, MECL propose to carry out the exploration for manganese along with graphite in the block.

1.3.0 Location & Accessibility of the Area

The block proposed for exploration lies in the parts of Survey of India Toposheet No 64 P/01 and is bounded by latitude 20° 45' 35.29" to 20° 54' 7.53" and longitude 83° 9' 31.46" to 83° 15' 0.10" (Plate No I).

The coordinate of cardinal points of block boundary are as follows:

Cardinal Point	WGS-84	
	Latitude	Longitude
A	20° 54' 7.53" N	83° 9' 31.46" E
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The area is connected by fair weather road from the State High-Way No.-1 (Balangir-Patanagarh Road). The fair weather road crosses Suktel River through a ford north of Khuntapalli village and is open to traffic from January to June. During the peak of Monsoon, Larambha-Kanaital & Pudpadar-Bharatbahal Block can be approached from Balangir via Sarmuhan by an all weather pucca road. The intermittent villages are connected by fair weather jeepable unmetalled roads. The nearest railhead is Balangir.

1.4.0 Physiography, Drainage and Vegetation

- 1.4.1 The area comprises of wide spread plain land, folded ridges, hillocks and mounds. The maximum height of the ridge is 372m and minimum height of the valley is 194m above MSL. Rain-fed easterly flowing Suktel River with network of streams drains the area. The drainage is sub-parallel to sub-dendritic controlled by ridges and lineaments. Thick alluvium accumulated due to the Suktel River has helped extreme cultivation in the area.
- 1.4.2 The area has a sub-tropical climate with torrential rainfall between June and September. The temperature ranges between 10⁰ C in winter and 46⁰ C in summer season and the average annual rainfall is around 100 cm. This part of Odisha is very hot in summer with occasional extreme hotness in comparison to other parts of the state.
- 1.4.3 The areas under exploration are sparse to densely vegetated. The floral assemblage includes Sal (*Shorea robusta*), Shishu (*Dalbergia latifolia*), Neem (*Nekua indica*), Tamarind (*Tamarindus indica*), Jackfruit (*Autocarpus intergrifolia*), Kendu (*Diaspyros melanxylon*), Mango, Amla, Harida, Bahada, Boula, Simili, Berries and Bel etc. Wild animals are scarcely observed in this area. The faunal assemblages include bears, rabbits, snakes, wild boars, jackals, peacocks, wild hens and host of birds.

1.5.0 Previous Work

- 1.5.1 B.C. Roy (1940) first reported the manganese ore deposits in Balangir district. He observed that: (i) the manganese ore deposits occupy summits and plains (ii) the manganese ore bodies have definite strike and dip (iii) the manganese ore comprises mainly of pyrolusite and psilomelane as ore minerals with chert, limonite and wad, (iv) the ore bands are associated with calc-granulites and garnetiferous gneisses.
- 1.5.2 Later on, Jhingran (1947) investigated and Krishnaswamy (1950) estimated the ore reserve to the tune of 650 thousand tonnes up to 1.5 m depth. Later on, host of workers from Geological Survey of India have carried out field work from 1962-65 and onwards. Finally, investigation aided by drilling was taken up in 1994-95. The average grade of ores from Balangir district range from 19-39% Mn, 10-28% Fe, 4-46% SiO₂ and 0.12-0.48% P.
- 1.5.3 A.G. Jhingran (1947) envisaged that the Dunguripalli manganese ore deposit (T. S. No. 64 P/5) was of considerable magnitude. Shri S. Krishnaswamy (1950) observed numerous occurrences of Mn ore mainly as lenses and pockets in calc-silicates, being parallel to regional foliation trend and assessed a reserve of 6,60,000 tonnes up to a depth of 15 m in T.S. P/1 & 5. M.W. Tak (1964-65), P. Bose (1965-66) and D. Mitra (1964-65) had

mapped on 1:63,360 scale in Toposheet No. 64 P/5 & 9, 64 P/5, and 64 P/1 & 5 respectively.

- 1.5.4 M.W. Tak carried out mapping in the northern part of the present area and found that Mn mineralisation is associated with calc-gneiss, diopside granulite and highly weathered khondalite. P. Bose (1967) observed numerous lensoidal and pocket type deposits within khondalite and partly in calc-silicate rocks. D. Mitra observed the occurrences of Mn ore within khondalite suite of rocks. He envisaged that the presence of quartz-garnet-rhodonite association in deposits indicate probably a gonditic rock and closeness of calc-silicate within ore deposits suggest a calc-magnesian association common in sedimentary environment.
- 1.5.5 Patel, N.K. et al. (1983) of D.M.G., Orissa carried out systematic mapping of 60 sq. km on 1: 25,000 scale in Babja-Dumerijharam area and 2.5 sq. km detailed mapping on 1: 2000 scale in Bijapatti east of Belpali-Bhaludungri area. He computed the total probable reserve of all grades to be 95,677 tonnes up to a depth of 3m. They observed that Mn ores occurs at the contact of khondalite and calc-granulites in the form of discontinuous bands and pockets of irregular dimensions. Twelve numbers of Mn ore occurrences were reported in the area such as: near southeast of Banipali, NW of Dandapani, NW of Dumerijharam, NE of Gerdi and SE of Thakurpalli. Besides, disintegrated manganese float ores were reported near Barkani, Babja and Uchhabpalli. They had done 410 cu. m of trenching and pitting and 249 nos. of channel and grab sampling.
- 1.5.6 Jena, S.K. et al. (1993-94) carried out large scale mapping on 1:25,000 scale in Gadashankar-Dandapani area of Balangir district between latitude 20° 44' to 20° 55'N and longitude 83° 15' to 83° 21'E and delineated four major ore zones.
- 1.5.7 Patel, M.C. (1996) initiated preliminary exploration work by drilling in 1994-95 F.S. Mishra U.S. and Hussain, A. (1997) carried out E-1stage (G-3 of UNFC, Ref: letter No 2692/K-1(Vol-II)/TC/ODS/2017 dated 07/11/2017 of GSI) exploration work over four blocks, viz., Biarpalli, Khagsabahal. Tabalbanji and Dunguripalli (north) blocks aided by detailed mapping and drilling in Toposheet No. 64 P/5 & 6.
- 1.5.8 Behera, S.N. (1996-97) carried out large scale mapping of an area of 115 sq.km on 1:25,000 scale in Babja (20°50'00"-83°20'36"E) - Thelkuchhapur (20°50'15"N-83°46'00"E), Dandapani, Tamiya and adjoining areas under P-II stage investigation to study manganese occurrences viz-a-viz their nature & grade and to identify potential blocks for detailed exploration.
- 1.5.9 During F.S.P. 1997-98, N. Behera and B. K. Acharya, carried out prospecting for manganese in Dandapani, Tamiya and adjoining areas in Balangir District, Odisha and

reported manganese occurrences in and around Larambha and Kanaital villages. They have collected 13 bedrock samples and analysed. Eleven out of 13 samples having Mn value more than threshold i.e., 10% Mn.

1.6.0 Regional Geology

- 1.6.1 The exploration area lies in the northern part of the Eastern Ghats Super Group of rocks belonging to the meta-sedimentary sequence of Precambrian khondalite. The sequence of para-metamorphic is made up of pelitic, psammitic and calcareous formations, which are represented by khondalite, quartzite and calc-silicate rocks. These have been intruded by granites. All the hill ranges in this area are composed of either khondalite or garnetiferous quartzite or both. Calc-silicate bands adjoining to the ore horizons form denudational hillocks or mounds and are 1 to 2m thick. Granite gneiss occupies the valleys. The whole sequence has been metamorphosed to granulite facies. Structurally the area exhibits a complex picture.
- 1.6.2 On the basis of contact relationship, presence of xenoliths/caught up patches of one particular unit within the other & structural and stratigraphical relationship, the tentative stratigraphic succession of the area (After GSI) may be given as follows:

Age	Formation	Lithology
Quaternary	-	Alluvium, soil and latsol
Tertiary	-	Laterite
Precambrian (Eastern Ghat Supergroup)	-	Aplite, Pegmatite and Quartz veins
	Granitoids	Equigranular, non-garnetiferous granite gneiss, garnetiferous granite gneiss and granulite, leptinitic gneiss Migmatite
	Charnockite Suite	Hypersthene bearing gneisses and granulites (mostly acid to intermediate charnockitic type)
	Khondalite Suite	Pyroxene granulite, quartzite, Khondalite with manganiferous horizons Calc-silicate rocks with manganese ore
Base Not Seen		

1.6.3 Description of various rock formations in the Area

The rock types exposed in the area are calc-silicate, quartzite (Mn bearing), granite gneiss, amphibolite and quartz and pegmatite vein. From the disposition of individual members of khondalite it is difficult to ascertain the stratigraphy, as the units have been subjected to different cycles of sedimentation as well as deformation. Description of different litho units is given below.

Calc-silicate rocks: The calc-silicate rocks occur as bands and lenses within khondalite and also with Mn-ore bearing silicate-carbonate rock in the form of denudational hillocks and mounds and are intricately folded and exhibit rib and furrow weathering structure and crude layering. Their trend generally confirms the regional foliation direction and the contact of these rocks with khondalite and granite is sharp. The calc-silicate bands are 100m to 1km in length and 20 to 50 m in width. The calc-silicate rock is usually a dark grey to greenish, fine to medium grained, hard and massive to foliated. It contains green diopside, hornblende, plagioclase (andesine), garnet (grossularite), scapolite, sphene and quartz. Accessories include zircon, calcite, apatite and epidote.

Khondalite (quartz- feldspar- garnet- sillimanite + graphite schist/gneiss): It occurs typically in bouldery outcrops (highly weathered) on narrow, steep hill ranges and low lying mounds and in valley interbanded with quartzite and calc-silicate rocks. This is coarse grained, brownish yellow to reddish grey coloured, foliated and highly weathered rock. Due to varying degree of weathering its colour changes to pinkish/purplish at places, when highly kaolinised, it becomes very light. It is highly sheared and mylonitised at places. The rock is manganiferous and secondary manganese minerals occur along the foliation, fracture and joints planes. The rock is intimately associated with quartzite and both grade into each other along as well as across the foliation. They are highly migmatized and the quartzofeldspathic neosome bands that have traversed the rock along the regional foliation plane of the rocks.

Quartzite: The quartzites is medium to coarse grained, white to buff coloured, granular to faintly schistose in nature and are invariably garnetiferous. Pegmatite and quartz veins traverse the rock along foliation planes. Quartzite grades laterally to khondalite. It is predominantly made up of large xenoblastic grains of quartz with pale pink garnet and clusters of sillimanite. Quartzite is highly brecciated in a number of places such as in Dandapani block. Brecciated quartzite, in general contains ore bodies. Manganese mineralisation is noticed within brecciated and feldspathised quartzite at places. Manganiferous quartzite is exposed in Dandapani and Dunguripalli (south) blocks.

Granulite: It is coarse grained black massive rock and occurs as small lenticular inclusions parallel to foliation within granite gneiss and at places occur in boulder form along small ridges in association with khondalite and quartzite. It is mainly a plagioclase (andesine-labradorite)-pyroxene rock with subordinate amount of amphibole, biotite, garnet, perthite and quartz and accessories include sphene, ilmenite, zircon and apatite.

Migmatite: Migmatite occupy the low lying areas in the east of Bijapati and around Dunguripalli. It exhibits gneissose structure and the palaeosome includes hypersthene, diopside and biotite and the neosome comprises of K-feldspar and plagioclase.

Granite Gneiss: This is medium to coarse grained rock occupying low-lying areas with migmatite, consisting mainly of quartz, plagioclase, K-feldspar, biotite, garnet, epidote and few opaques. The whole sequence has been metamorphosed to granulite facies. The alkali-feldspar gneiss is fine to coarse grained and contains porphyroblasts of microcline and perthite within quartz-feldspar-garnet aggregates.

Pegmatite and quartz veins: Pegmatite and quartz veins traverse the rocks at a number of places close to manganese mineralisation in all the rock types both along and across the foliation. At places pegmatite contains few crystals of beryl which are of less significance.

Laterite: Laterite is developed mainly over khondalite and granite gneiss and is very common in areas close to manganese mineralised zones as in Dunguripalli (south) Block. Extensive development of laterite over laterite has been developed in northeast of Rengali.

1.6.4 Regional Structure

The entire area covered by large scale/detailed mapping exhibits a complex structural fabric as the whole sequence has been subjected to multiple cycles of deformation. As a result, the existing structural elements are completely altered rendering it difficult to decipher the complete structural geometry. However, the secondary planar structural elements like, foliation and gneissosity and joints are well preserved in the rock types of the area. The different structural features as observed are described below:

Primary structures: The primary structures have been mostly obliterated due to granulite facies metamorphism. However, relict bedding is observed along the contact between khondalite, quartzite and calc-silicates. Interbanding of different litho units within the Khondalite Group is seen clearly in many outcrops.

Secondary structures: The secondary planar structures such as foliation, gneissosity, schistosity, joint and cleavages are well preserved in rocks. S₁ is defined by compositional banding, preferred orientation of prismatic, acicular and flaky minerals in the rock.

i) **Foliations:** Foliation (S₁) is most pervasive and trends in NNW-SSE to NE-SW direction with moderate to steep easterly to south-easterly dip. Planar arrangement of minerals like garnet, biotite, sillimanite, graphite, quartz and feldspar mark the foliation plane in khondalite, quartzite, calc-silicate rocks and granite.

- ii) Joints:** Altogether, two sets of joints are observed in the surrounding area. These are E-W dipping 70° to 80° to south and N 65° E-S 65° W dipping 60° - 80° to southeast.
- iii) Lineations:** Two types of lineations are noted in the area:
 - (a) slickenside lineation: This is observed in manganiferous quartzite and calc-silicate rocks.
 - (b) Mineral lineation: The mineral lineation is defined by minerals like sillimanite, biotite and garnet.
- iv) Folding:** The area exhibits at least three generations of folding. The first generation of folds (F1) is tight isoclinal, intrafolial, upright and reclined in nature. The F1 folds are developed conspicuously in calc-silicate rocks and to a lesser extent in quartzite. The axial planes of F1 folds have a general trend in NNW-SSE direction. The second generation of folds (F2) is moderate to steeply plunging, open and broad type on NE-SW axis and third generation fold (F3) is characterised by upright, open to broad warps with E-W trend.
- v) Faults and Shear:** Faulting and shearing are evidenced by brecciation, silicification, vug filling, slickensides and mylonitisation in quartzite and khondalite. Quartzite and khondalites are intensely silicified and brecciated resembling chert breccia in the vicinity of manganese ore bands in a number of places such as west of Bijapali village in Dunguripalli south block. Shifting and missing of ore bands are due to local fault and pinching and swelling nature of ore bodies in the area.

1.6.5 Metamorphism

High grade metamorphism under granulite facies conditions characterise the Eastern Ghats Super Group of rocks. The mineral assemblages of khondalite (quartz-feldspar-garnet-sillimanite+graphite), granulite (plagioclase-hypersthene-diopside) and calc-silicate (diopside-plagioclase-calcite-quartz-scapolite) indicate pyroxene granulite sub-facies under granulite facies of Eskola.

1.6.6 Mineralization (Surface manifestation)

On the surface the Mn ore mineralization presents a rugged bouldery outlook. In general, oxide minerals show granoblastic to granulitic fabric. Gravity filling, stalactitic, botryoidal, box work and colloform structures are commonly observed within the ore. The ore is in general steel grey to dull grey in colour and is soft or powdery in nature. Pyrolusite, psilomelane and cryptomelane are seen replacing each other. Silica in rhodonite is seen replaced by the manganese oxides.

Manganese ore bodies occur as bands, lenses, pockets, veins, tabular bodies and disseminations within the khondalite group of rocks. The ore is more enriched at the central part. The lensoidal/discontinuous ore bodies are arranged in an en-echelon

pattern. These are lateritic and have been weathered to a considerable depth along with the enclosing rocks.

The ore bodies are conformably interstratified with and enclosed in different stratigraphic levels with calc-granulite at its contact with khondalite. Detailed mapping and available subsurface data suggest that the ore is concentrated along the fold axes of minor and mesoscopic folds. Intense brecciation, shearing, fracture form the important loci for mineralisation and the granitic intrusion have influenced the depth persistence of the ore. The lensoidal discontinuous ores owe their origin to the flowage or drag folds. Hence it may be concluded that manganese ores are both lithologically and structurally controlled.

Graphite mineralisation is restricted to Khondalite suite and its migmatised equivalents. The graphite is crystalline and flaky and occurs in disseminated state with varying proportion especially in quartz-feldspar-garnet-sillimanite-graphite schist. Workable concentration results through the process of remobilisation and epigenetic enrichment in migmatised khondalite. The deposits are in the form of bands, en-echelon veins and lenses usually disposed conformably to the foliation planes of the host rocks and at places, in shear zones and hinge zones of folds suggesting both lithological and structural controls of localisation. The lensoidal bodies have limited extension both along and across the strike. The graphite deposits occur invariably at shallow depth, within 30m from the surface, just below the soil and laterite cover. The ore zone is often intercalated with grey clay partings.

1.7.0 Scope of Proposed Exploration

- 1.7.1 The proposed Reconnaissance Survey (G-4 stage) program comprises Geological mapping (1:12,500 scale), Trenching, Geophysical Survey, Drilling of scout boreholes involving about 500m with associated survey, chemical analysis & physical analysis and geological report preparation.

1.8.0 Observation and Recommendations of previous work

- 1.8.1 During F.S.P. 1997-98, N. Behera and B. K. Acharya, carried out prospecting for manganese in Dandapani, Tamiya and adjoining areas in Balangir District, Odisha and reported manganese occurrences nearby Larambha, Kanaital and Pudapadar villages. MECL team visited the area and found some pits and a few trenches are available in the area; however, the analytical data of these are not available. S. N. Behera and B. K. Acharya have collected 13 bedrock samples and analysed. Eleven out of 13 samples

having Mn value more than threshold i.e., 10% Mn. They have recommended for further sampling in the area.

2.0.0 Previous Work / Background information

2.0.1 The background information and previous works have been described in para 1.2.0 and 1.5.0 respectively. On the basis of previous data available, field visit by MECL team and vicinity of adjoining manganese bearing area, the block has been proposed for G-4 level of exploration for manganese along with graphite in the block.

3.0.0 Block description

The proposed block details are given in para 1.3.0.

4.0.0 Objective of the proposed Reconnaissance Survey (G4):

4.0.1 The present exploration programme (G4) has been formulated on the basis of previous regional data available and the data collected by MECL team during the field visit to fulfil the following objectives:

4.1.0 Objective of the proposed Reconnaissance Survey (G4):

- i) To carry out geological mapping on 1:12,500 scale and demarcate the rock types of manganese and graphite bearing formations with the structural features i.e. strike, dip, lineations / foliations etc.
- ii) To demarcate concealed graphite and manganese ore bodies by carrying out surface geophysical survey (Self Potential (S.P) and Magnetic) after completion of geological mapping.
- iii) To carry out trenching/pitting to expose manganese and graphite bodies under soil & lateritic cover.
- iv) To drill scout boreholes to prove the existence and establish persistence of manganese ore and graphite bodies over a promising strike length.
- v) To estimate reconnaissance (334) resource of manganese ore and graphite in the block as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.

5.0.0 Planned Methodology

5.1.0 In accordance to the objective set for reconnaissance survey (G-4) of the block, the exploration programme is proposed. The Exploration shall be carried out as per

Minerals (Evidence of Mineral Contents) Rule-2015. 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.

5.2.0 Surveying:

- 5.2.1 The prospect area would be tied up with the triangulation network and the surface features will be picked up and marked on a map on 1:12,500 scale. The reduced levels and co-ordinates of boreholes, pits and trenches would be determined.

5.3.0 Geological Mapping

- 5.3.1 Large scale geological mapping on 1:12,500 scale will be carried out in the entire block by taking geological traverses. The contacts of different formations, identification of different lithological units, structural features, etc., will be carried out in detail. The geophysical survey data could help in updating of map. The geological map on 1:12,500 scale will be generated based on the detail geological mapping of the block and interpretation of exploration data.

5.4.0 Geochemical Sampling

5.4.1 Surface sampling (Bed Rock /Channel):

During the course of Geochemical Sampling the bed rock / channel samples shall be collected from the outcrops along with soil and stream sediment samples. A total of 100 no of primary, 5 no of internal check and 10 no of external check channel samples will be analyzed for manganese mineralization i.e. Mn, SiO₂, P₂O₅ Fe₂O₃, MnO₂ and Acid Insolubles. Similarly, 100 no of primary, 5 no of internal check and 10 no of external check channel samples will be analyzed for graphite mineralization i.e. Fixed Carbon (FC: Non-carbonate), Ash (A), Moisture (M) and Volatile Matter (VM).

5.5.0 Geophysical Survey

- 5.5.1 The proposed area consists of a sequence of para-metamorphics made up of pelitic, psammitic and calcareous formation, which were represented by khondalite, quartzite and calc-Silicate rocks. The rock types in the area are khondalite, granite gneiss, granulite, quartzite, calc-silicate, quartz vein. Graphite as well as manganese mineralisation is restricted to Khondalite Suite and its migmatized equivalents.

- 5.5.2 The Physical properties of Graphite are given in table:

S.No	Property	Value
1	Bulk Density (g/cm ³)	1.3-1.95
2	Porosity (%)	0.7-53
3	Modulus of Elasticity (GPa)	8-15
4	Compressive strength (MPa)	20-200
5	Thermal conductivity (W/m.K)	25-470
6	Electrical resistivity (Ω.m)	5x10 ⁻⁶ -30x10 ⁻⁶

5.5.3 Physical properties of Manganese ore and expected host rocks are given in table below.

Ore/ rock	Chemical composition	Mn content	Density (g/cc)	Magnetic Susceptibility. 0-CGS
Pyrolusite	MnO ₂	63%	4.70-5.00	Paramagnetic
Psilomelane	MnOMn ₂ OH ₂ O		3.70-4.70	
Braunite	Mn ₂ O ₃ Mn ₆ O ₂	64.3%	4.75-4.82	
Rhodonite	MnSiO ₃	41.8%	3.40-3.6	Paramagnetic
Rhodochrosite	MnCO ₃	47.8%	3.40-3.60	100
Jacobsite	MnFe ₂ O ₄		4.95	200-300
Quartz	SiO ₂		2.6-2.8	.00063
Mica	K(Mg,Fe) ₃ AlSi ₃ O ₁₀ (F,OH) ₂ / KAl ₂ (F,OH) ₂		2.15	

5.5.4 Based on the above physical properties of the graphite in typical geological settings the variation in Resistivity, Conductivity and Self potential are very high. Density of the Graphite deposit varies significantly in order of magnitude.

5.5.5 In addition to above the resistivity contrast between Manganese ore and host rocks is also remarkable, based on the above physical properties of the manganese ores and its host rocks in typical geological settings.

5.5.6 On the basis of above properties, Integrated Geophysical Surveys i.e., Self Potential (S.P) and Magnetic have been planned to carry out in the potential area marked by geological mapping. A total of 20.00 L.km of Self Potential (S.P) and Magnetic Surveys will be covered in the block. The Approximate time period to conduct the survey will be around 3 months.

5.6.0 Trenching:

5.6.1 During the exploration, trenching work will be carried out by cutting trenches of 1m width and 2 m depth directly on the fresh outcrop/rock exposures across the Mn ore/graphite bearing formation involving 150 cubic meter excavation.

5.7.0 Channel Sampling:

5.7.1 During the exploration, trenching work will be carried out by cutting trenches of 1m width and 2 m depth directly on the fresh outcrop/rock exposures across the Mn ore/graphite body involving 300 cubic meter excavation. The channel of 5cm x 2cm dimension will be cut on the floor of the trenches to collect the channel samples. The length of each channel sample will be kept as 1.00m uniformly in the same type of lithology, whereas, the length of the sample may be adjusted with variation/change in

lithology. The representative powdered samples of (-) 200 # size will be obtained by stage wise grinding of the chips collected from the channels and by reducing the weight of sample by repeated coning and quartering. A final finished sample of 500 gram (-200 mesh) will thus be prepared. One part around 100gm sample will be sent to chemical laboratory for analysis, second part will be preserved in the camp as duplicate sample, the 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. Thus total 200 no of primary channel samples will be generated. 5% of primary channel samples (10 no samples) will be analyzed as internal check samples. Around 10% of primary samples (20 no samples) will be analyzed as external check samples from any NABL accredited External Laboratory. A total of 75 no of primary, 4 no of internal check and 8 no of external check channel samples will be analyzed for manganese mineralization i.e. Mn, SiO₂, P₂O₅, Fe₂O₃, MnO₂ and Acid Insolubles. Similarly, 75 no of primary, 4 no of internal check and 8 no of external check channel samples will be analyzed for graphite mineralization i.e. Fixed Carbon (FC: Non-carbonate), Ash (A), Moisture (M) and Volatile Matter (VM).

5.8.0 Exploratory Drilling:

- 5.8.1 Based on the outcome of geological mapping, analytical results of surface channel samples and delineation of graphite and manganese ore zones, approximately **500.00 m** of drilling in 8 scout boreholes will be carried out for intersection of mineralised zones in the block.

5.9.0 Core Logging

- 5.9.1 The borehole cores would be logged systematically. Viz. details of the litho units, colour, structural feature, texture, mineralization, besides the recovery, rock quality designation (RQD) and graphite and manganese ore type would be recorded.

5.10.0 Core Sampling

- 5.9.1 The mineralized (graphite & manganese) part of drill core will be sampled as Primary sample. The length of each sample will be kept 1.00 m within the ore zone depending upon the thickness of particular type of manganese ore & graphite and its physical character. The primary core samples for manganese mineralisation will be analysed for 6 radicals' i.e. Mn, SiO₂, P₂O₅, Fe₂O₃, MnO₂ and Acid insolubles. The primary core samples for graphite mineralisation will be analysed for Fixed Carbon (FC: Non-carbonate), Ash, Moisture and Volatile Matter (VM) (Proximate Analysis for 4 parameters). The cores of rocks 3 m immediate on footwall and 3 m immediate on hanging wall of mineralized zones would be sampled at 1.0 m interval, as far as possible, depending upon the intensity of mineralization, change in lithology and core recovery etc.

- a) Around 1380 no of core samples (120 no Primary & 18 no Check samples) shall be generated from the mineralized zones to be intersected in the boreholes of Larambha-Kanaital & Pudapadar-Bharatbahal Block. A total of 120 no of primary core samples for manganese mineralization (Mn, SiO₂, P₂O₅ Fe₂O₃, MnO₂ and Acid Insolubles) and 120 no of primary core samples will be analyzed for graphite mineralization (FC: Non-carbonate, Ash, Moisture and VM).
- b) Around 5% (6 no samples each for Manganese and Graphite) samples will be analyzed in Chemical Laboratory of MECL as Internal check samples and 10% of Primary samples (12 no samples each for Manganese and Graphite) will be sent to NABL External Labs for analysis of manganese mineralization (Mn, SiO₂, P₂O₅ Fe₂O₃, MnO₂ and Acid Insolubles) and/or for graphite mineralization graphite mineralization (FC: Non-carbonate, Ash, Moisture and VM) as external check samples.

5.10.0 Whole Rock Analysis:

- 5.10.1 Whole Rock analysis for SiO₂, Al₂O₃, Fe₂O₃, TiO₂, MnO, CaO, Na₂O, K₂O+H₂O, MgO, P₂O₅, CO₂, & S radicals will be carried out on 15 Nos samples to check the rock types, their variation in chemical composition.

5.11.0 Petrological and Mineragraphic Studies

- 5.11.1 Thin and polished section studies on drill cores 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 15 specimens for petrographic and 15 specimens for mineragraphic studies has been kept in the block.

5.12.0 Quantum of work:

- 5.12.1 The quantum of work proposed by MECL in Rengali Graphite Block (G-4 Stage of Exploration) is given in Table 5.1.

Table: 5.1 Proposed Quantum of Exploratory Work in Larambha-Kanaital & Pudapadar-Bharatbahal Block, District-Balangir, Odisha.

Sl. No.	Item of Work	Unit	Proposed Quantum of work
1	Geological Mapping (on 1:12,500 Scale)	Sq. Km.	135.00
2	Geophysical Work		
	i) Self Potential (S.P) and Magnetic Survey	Line Km	20.00
3	Trenching (1m x 2m x75m)	Cu. m	150
4	Core Drilling (8 Scout Boreholes)	m.	500.00

Sl. No.	Item of Work	Unit	Proposed Quantum of work
5	Sample Preparation & Chemical Analysis		
A.	Primary samples for Manganese (Bedrock/Channel Samples)		
	i) Primary samples for 6 radicals i.e. Mn, SiO ₂ , P ₂ O ₅ , Fe ₂ O ₃ , MnO ₂ and Insolubles	Nos.	100
	ii) Internal Check samples (5% of Primary samples) for 6 radicals	Nos.	5
	iii) External Check sample (10% of Primary samples) for 6 radicals	Nos.	10
B.	Primary samples for Graphite (Bedrock/Channel Samples)		
	i) Proximate Analysis of Primary samples for Graphite for 4 parameters i.e. Fixed Carbon (FC), Ash (A), Moisture (M) and Volatile Matter (VM)	Nos.	100
	ii) Internal Check samples (5% of Primary samples) for Graphite for 4 parameters	Nos.	5
	iii) External Check sample (10 % of Primary samples) for Graphite for 4 parameters	Nos.	10
C.	Primary samples for Graphite (Trennch/Channel Samples)		
	i) Primary samples for 6 radicals i.e. Mn, SiO ₂ , P ₂ O ₅ , Fe ₂ O ₃ , MnO ₂ and Insolubles	Nos.	75
	ii) Internal Check samples (5% of Primary samples) for 6 radicals	Nos.	4
	iii) External Check sample (10% of Primary samples) for 6 radicals	Nos.	8
D.	Primary samples for Graphite (Trennch/Channel Samples)		
	i) Proximate Analysis of Primary samples for Graphite for 4 parameters i.e. Fixed Carbon (FC), Ash (A), Moisture (M) and Volatile Matter (VM)	Nos.	75
	ii) Internal Check samples (5% of Primary samples) for Graphite for 4 parameters	Nos.	4
	iii) External Check sample (10 % of Primary samples) for Graphite for 4 parameters	Nos.	8
E.	Primary samples for Graphite (Core)		
	i) Primary samples for 6 radicals i.e. Mn, SiO ₂ , P ₂ O ₅ , Fe ₂ O ₃ , MnO ₂ and Insolubles	Nos.	120
	ii) Internal Check samples (5% of Primary samples) for 6 radicals	Nos.	6
	iii) External Check sample (10% of Primary samples) for 6 radicals	Nos.	12
F.	Primary samples for Graphite (Core)		
	i) Proximate Analysis of Primary samples for Graphite for 4 parameters i.e. Fixed Carbon (FC), Ash (A), Moisture (M) and Volatile Matter (VM)	Nos.	120
	ii) Internal Check samples (5% of Primary samples) for Graphite for 4 parameters	Nos.	6

Sl. No.	Item of Work	Unit	Proposed Quantum of work
	iii) External Check sample (10 % of Primary samples) for Graphite for 4 parameters	Nos.	12
6	Whole Rock Analysis For SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , TiO ₂ , MnO, CaO, Na ₂ O, K ₂ O+H ₂ O, MgO, P ₂ O ₅ , CO ₂ , & S.	Nos	15
7	Petrographic Studies	Nos	15
8	Mineragraphic Studies	Nos	15
9	Report Preparation (Digital format)	Nos.	1

6.0.0 Manpower Deployment

6.0.1 Manpower deployment List may be provided later.

7.0.0 Break-up of Expenditure

7.1.0 The proposed exploration programme is planned for reconnaissance survey (G-4). The work activities like camp setting, survey and associated geological work, geophysical studies, drilling & laboratory work will be completed within 12 months' time. Report writing (including peer review) will take another 4 months' time with overlapping of one month's laboratory studies. Thus the total duration of the project shall be 15 months from the date of commencement of the project. The bar chart showing activities wise time schedule is placed at Table-7.1.

7.2.0 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 and the total estimated cost is **Rs. 193.51 Lakh**. The summary of tentative cost estimates for Reconnaissance Survey is given in **Table No.-VA** and details of tentative cost estimates are given in **Table No.-VA**. Tentative Time schedule/action plan for proposed Reconnaissance Survey (G-4) for manganese and graphite is given in **Table No. VB**.

Table No-VA**Summary of Tentative Cost Estimates for Reconnaissance Survey (G-4 Level) Exploration**

Sl. No.	Item	Total
1	Geological Work	29,51,240
2	Pitting & Trenching	4,95,000
3	Geophysical Work	21,03,487
4	Drilling	74,64,630
5	Laboratory Studies	23,18,355
	Sub total	1,53,32,712
6	Report	7,50,000
7	Peer Review	10,000
8	Proposal Prepration	3,06,654.24
	Total	1,63,99,366
9	GST (18%)	29,51,885.92
Total cost including 18% GST		1,93,51,252
SAY, in Lakhs		193.51

8.0.0 Justification:

- 8.0.1 The Govt. of India enacted the MMDR Amendment Act-2015 duly introducing the system of auction for allocation of Mineral Concessions. Manganese has been categorized in the Fourth Schedule which needs prospecting and exploration by the State Govt. before auctioning of blocks.
- 8.0.2 Considering the potentiality of the area for manganese and graphite based on the available historic exploration data of blocks explored by GSI & MECL in the surrounding area, MECL proposed G-4 stage exploration work for manganese & graphite in Larambha-Kanaital & Pudpadar-Bharatbahal Block in Balangir District of Odisha through NMET funding. Larambha-Kanaital & Pudpadar-Bharatbahal Block may be the prospective manganese blocks identified for auction.
- 8.0.3 During the field season 1997-98, S. N. Behera and B. K. Acharya carried out prospecting for manganese in Dandapani, Tamiya and adjoining areas in Balangir District, Odisha and reported manganese occurrences nearby Larambha and Kanaital villages. They have carried out geological mapping at 1:25000 scale in the part of the block area. They have also collected 13 bedrock samples and analysed. Eleven out of 13 samples having Mn value more than 10% Mn. The analytical details are given below.

Sl. No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Sample No.	LB-1	LB-6	KB-1	KB-2	KB-2A	KB-3	KB-5	KB-7	KB-8	KB-10	KB-12	KB-13	KB-14
Mn (%)	8.73	19.97	11.45	4.58	11.23	14.15	16.85	10.61	15.6	12.07	13.52	12.27	17.06

8.0.4 During the course of exploration of Rengali Graphite and Manganese Block, MECL team visited the area nearby Larambha, Kanaital and Pudapadar villages where manganese occurrences were reported by Behera and Acharya (F.S. 1997-98). Some pits and a few trenches are available in the area; however, the analytical data of these are not available. They collected 4 bedrock samples from manganese ore zones in Pudapadar area and analysed for Mn by hand held XRF. All the 4 samples having Mn value more than threshold i.e., 10% Mn. The analytical details are given below.

Sl. No.	1	2	3	4
Sample No.	PB-1	PB-2	PB-3	PB-4
Mn (%)	25.09	31.42	18.29	15.26

8.0.5 The proposed study area falls in the west and north-west of Kumiapali-Rengali-Antapali-Tabalbanji-Dungaripali-Khagsabahal-Biarpali-Babja Cluster of Manganese blocks, north of Tamiya Manganese block and east of Rengali Graphite and Manganese Block.

8.0.6 There are 10 manganese blocks explored by MECL are in vicinity of the block. The details of the blocks are given below.

SL No.	Block Name	Area (Sq. Km)	At 18% Mn Cut-off		At 10% Mn Cut-off	
			Resource (MT)	Grade Mn %)	Resource (MT)	Grade (Mn %)
1	Tamiya (G-2)	0.81	0.633	23.04	1.314	18.19
2	Tamiya (G-4)	3.12	-	-	-	-
3	Rengali (G-2)	1.83	0.328	21.37	2.193	14.45
4	Rengali (G-4)	2.45	0.011	18.8	0.045	13.5
5	Babja (G-2)	0.20	0.356	23.6	1.157	19.49
6	Biarpalli (G-2)	1.32	1.937	22.45	3.358	18.63
7	Biarpalli (G-4)	2.06	-	-	0.047	11.14
8	Dunguripalli (G-3)	8.05	0.264	22.5	0.555	17.77
9	Kumiapali (G-4)	8.92	-	-	0.235	14.07
10	Antapali (G-4)	2.30	-		0.109	12.97
11	Rengali Graphite & Mn (G-4)	9.41	Exploration under progress			
Total		40.47	3.529	22.56	9.013	17.35

Considering the resource and grade of all these blocks, the cluster mining approach can be used in the area.

- 8.0.7 There are 1.330 mt graphite resource with an average grade of 4.71% FC at 2% FC cut-off has been estimated in Tamiya (G-2), Rengali (G-2), Babja (G-2) and Biarpalli (G-2) blocks which are east of Larambha-Kanaital & Pudapadar-Bharatbahal Block. The details of the block wise resources are given below.

S. No	Block	Resource (MT)	FC %
1	Tamiya (G-2) Block	0.610	5.56
2	Rengali (G-2) Block	0.308	4.41
3	Babja (G-2) Block	0.111	3.61
4	Biarpalli (G-2) Block	0.302	3.71
	TOTAL	1.330	4.71

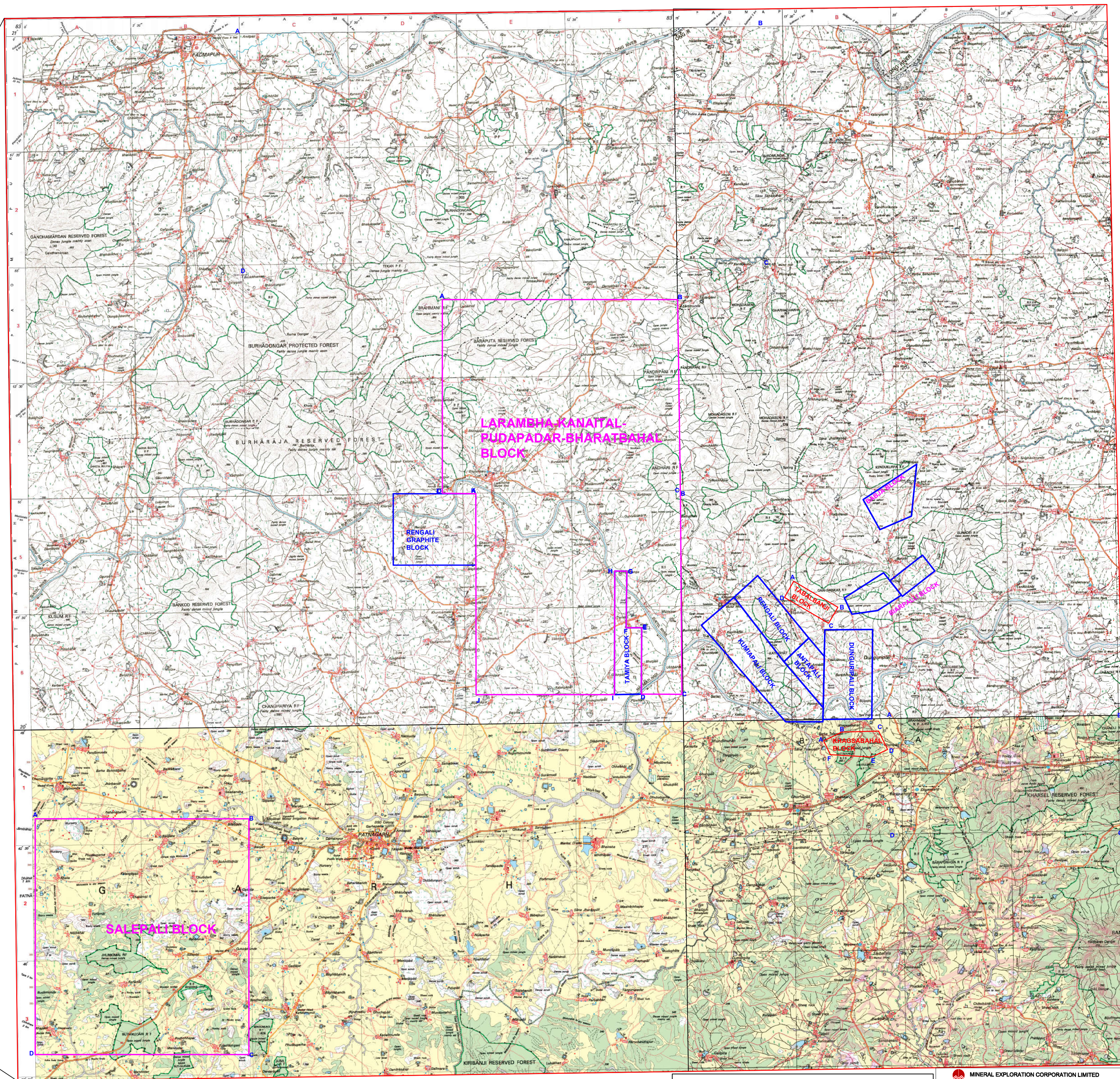
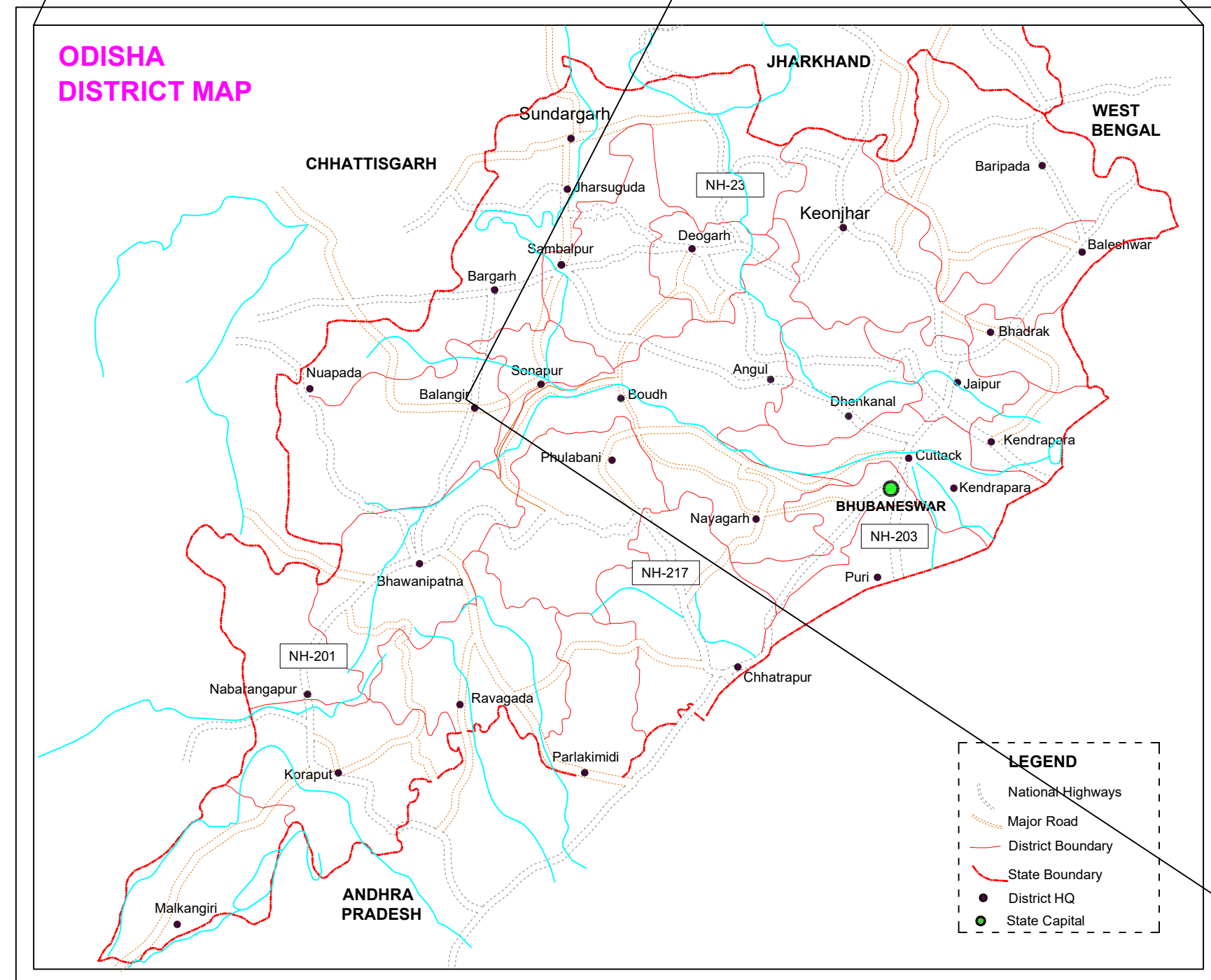
- 8.0.8 The Rengali graphite block, which is west of Larambha-Bharatbahal Block, is under exploration for graphite.
- 8.0.9 Since the graphite mineralisation is also reported in the area, the block may be explored for graphite also and will be a value addition.
- 8.0.10 Since most of the block area is covered with soil, geophysical survey (Self potential, (SP and magnetic survey) in the block will facilitate to demarcate the geophysical anomaly/mineralized zones of manganese/graphite, which will help in the formulation of G-4/G-2 level exploration programme.
- 8.0.11 The exploration will be helpful in estimation of Reconnaissance (334) Resources and will help in planning G3/G2 level of exploration programme which in turn will lead to estimation of indicated/inferred (333/332) category resources and will facilitate the State Govt. Odisha for auctioning of blocks.

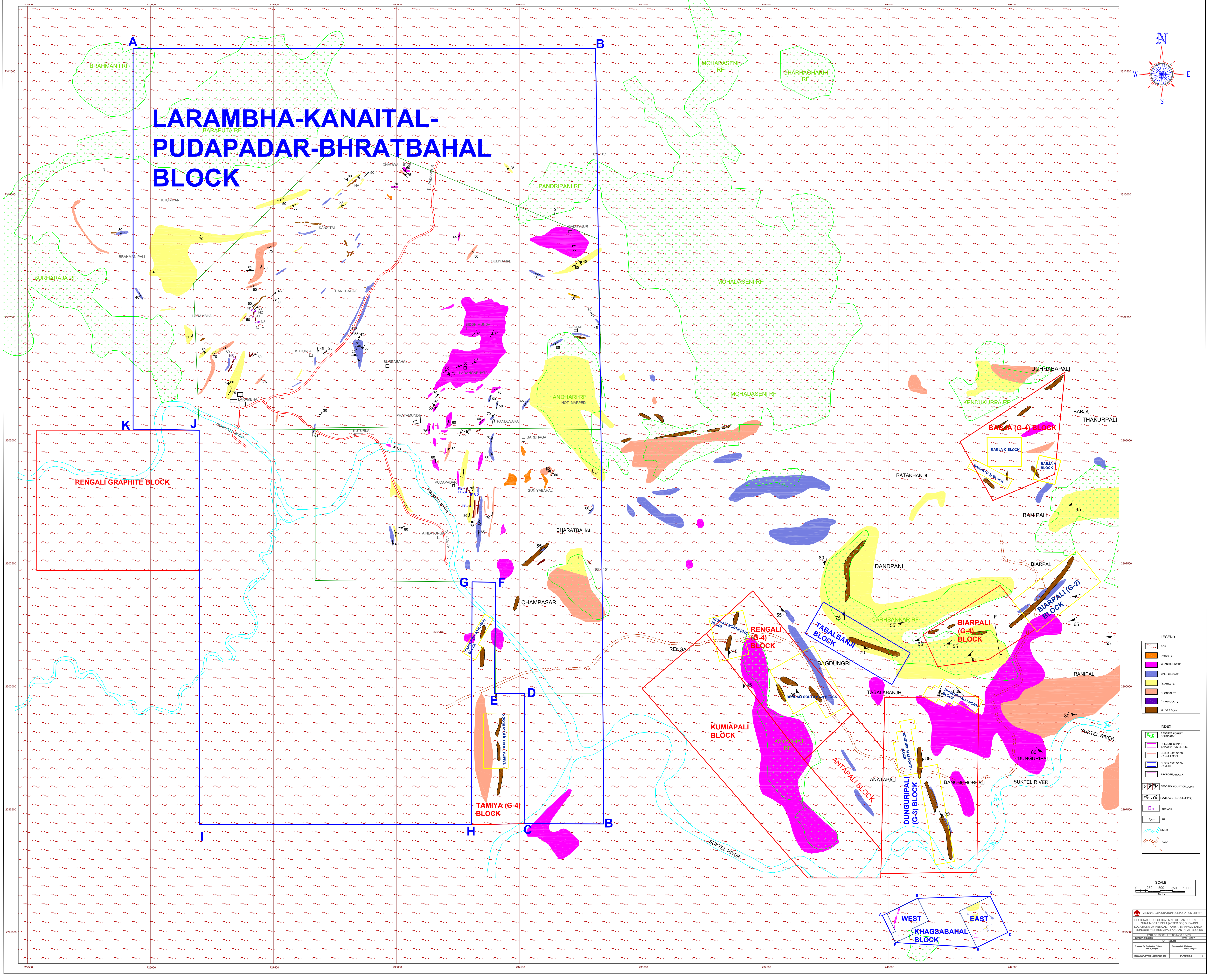
9.0.0 References:

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List of Plates:

1. Plate-I: Block Location Map of Larambha-Kanaital & Pudapadar-Bharatbahal Block in Toposheet no. 64P/01, Balangir District, Odisha State.
2. Plate-II: Regional Geological Map of the area (Scale 1: 1,25,000).





Estimated cost for Reconnaissance survey (G4) for manganese ore and graphite in Larambha-Kanaital & Pudapadar-Bharatbahal blocks, District: Balangir, Odisha. [Block area- 135 sq. km; Nos. of Borehole- 8; Borehole depth range- 60m; Schedule timeline- 18 months]							
S. No.	Item of Work	Unit	Rates as per NMET SoC 2020-21		Estimated Cost of the Proposal		Remarks
			SoC-Item -SI No.	Rates as per SoC	Qty.	Amount (Rs)	
A	GEOLOGICAL WORK (1:12,500 scale)						
i	Charges for one Geologist- Field	day	1.2	11,000	180	19,80,000	
ii	Charges for one Geologist per- HQ	day	1.2	9,000	60	5,40,000	
iii	2 labours/ party (Rs 437/day/labour) (As per rates of Central Labour Commissioner)	day	5.7	437	360	1,57,320	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
iv	Core Sampling -1 Samplers Labour charge not included	day	1.5.2	5,100	40	2,04,000	
v	4 labours/ party (Rs 437/day/labour) (As per rates of Central Labour Commissioner)	day	5.7	437	160	69,920	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
	Sub Total- A					29,51,240	
B	GEOPHYSICAL SURVEY						
i	SP and Magnetic Survey (8-20 L Km)	Line Km	3.3b	12,92,047	1	12,92,047	will be decided after review
ii	Charges for one Geophysicist per day at field	day	3.18	11,000	30	3,30,000	
iii	Charges for one Geophysicist per day at HQ	day	3.18	9,000	20	1,80,000	
iv	Surveyor Work	days	1.6.1a	8,300	30	2,49,000	
v	4 labours/ party (Rs 437/day/labour) (As per rates of Central Labour Commissioner)	day	5.7	437	120	52,440	
	Sub Total- B					21,03,487	
C	PITTING AND TRENCHING						
i	Trenching (1m x 2mx 150 m)	Cu m	2.1.1	3300	150	4,95,000	
	Sub Total- C					4,95,000	
D	DRILLING						
i	Drilling upto 300m (Hard Rock) (1 rigs)	m	2.2.1.4a	11,500	500	57,50,000	
ii	Borehole deviation Survey	m	2.2.6	330	500	1,65,000	
iii	Land / Crop Compansation	per BH	5.6	20,000	8	1,60,000	Amount will be reimburse as per actuals or max. Rs. 20000 per BH with certification from local authorities
iv	Construction of concrete Pillar (12"x12"x30")	per borehole	2.2.7a	2,000	8	16,000	
v	Transportation of Drill Rig & Truck associated per drill	Km	2.2.8	36	1,400	50,400	Certification in this regard is required to be provided
vi	Monthly Accomodation Charges for drilling Camp (up to 2 Rigs)	month	2.2.9	50,000	6	3,00,000	
vii	Drilling Camp Setting Cost	Nos	2.2.9a	2,50,000	1	2,50,000	
viii	Drilling Camp Winding up Cost	Nos	2.2.9b	2,50,000	1	2,50,000	
ix	Approach Road Making (Flat Terrain)	Km	2.2.10a	22,020	4	88,080	Road Making will be considered as per the requirement and Road Making Charges will be reimbursed for max. 4 km.
x	Bore Hole Fixation and determination of co-ordinates & Reduced Level of the boreholes and corner points of block by DGPS	Nos	1.6.2	19,200	9	1,72,800	
xi	One complete borehole plus mineralised cores of all the remaining Bhs	m	5.3	1,590	165	2,62,350	This amount will be reimbursed after successful delivery of the cores to concerned libraries/authorities
	Sub Total- D					74,64,630	
E	LABORATORY STUDIES						
1	Chemical Analysis						
i	Primary & Check samples for Maganese						
	a. Primary Samples for 6 radical (Mn, SiO ₂ , P ₂ O ₅ , Fe ₂ O ₃ , MnO ₂ and Insolubles)	Nos	4.1.7a + 7b	2,841	300	8,52,300	

S. No.	Item of Work	Unit	Rates as per NMET SoC 2020-21		Estimated Cost of the Proposal		Remarks
			SoC-Item -SI No.	Rates as per SoC	Qty.	Amount (Rs)	
	b-Internal (5%) Check samples for 6 radical (Mn, SiO2, P2O5, Fe2O3, MnO2 and Insolubles)	Nos	4.1.7a + 7b	2,841	15	42,615	
	c-External(10%) Check samples from NABL Lab for 6 radical (Mn, SiO2, P2O5, Fe2O3, MnO2 and Insolubles)	Nos	4.1.7a + 7b	2,841	30	85,230	
ii	Primary & Check samples for Graphite						
	a. Proximate Analysis for Graphite (Ash, Moisture, V.M. and F.C.) for Primary Samples	Nos	4.1.16	3,000	300	9,00,000	
	b Proximate Analysis for Graphite (Ash, Moisture, V.M. and F.C.) for Internal (5%) Check Samples	Nos	4.1.16	3,000	15	45,000	
	c Proximate Analysis for Graphite (Ash, Moisture, V.M. and F.C.) for External (10%) Check Samples NABL Lab	Nos	4.1.16	3,000	30	90,000	
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 polished 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	15	4,200	
vi	Whole Rock Analysis (Major oxide and 8 additional trace elements)	Nos	4.1.15a & b	7,568	15	1,13,520	
	Sub Total- E					23,18,355	
F	Total A to E					1,53,32,712	
G	Geological Report Preparation		5.2	For the projects having cost exceeding Rs. 150 lakhs and less than Rs. 300 lakhs - A minimum of Rs. 7.5 lakhs or 3% of the value of work whichever is more		7,50,000	Reimbursement will be made after submission of the final Geological Report in Hard Copies (5 Nos) and the soft copy to NMET.
H	Peer review Charges		As per EC decision			10,000	
I	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. 3.8 Lakhs whichever is lower		3,06,654.24	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.
K	Total Estimated Cost without GST					1,63,99,366.24	
J	Provision for GST (18% of I)					29,51,885.92	GST will be reimburse as per actual and as per notified prescribed rate
K	Total Estimated Cost with GST					1,93,51,252.16	or Say Rs. 193.51 Lakh
Note:							
1	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 Certifiате regarding non outsourcing of any component/project is required.						

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