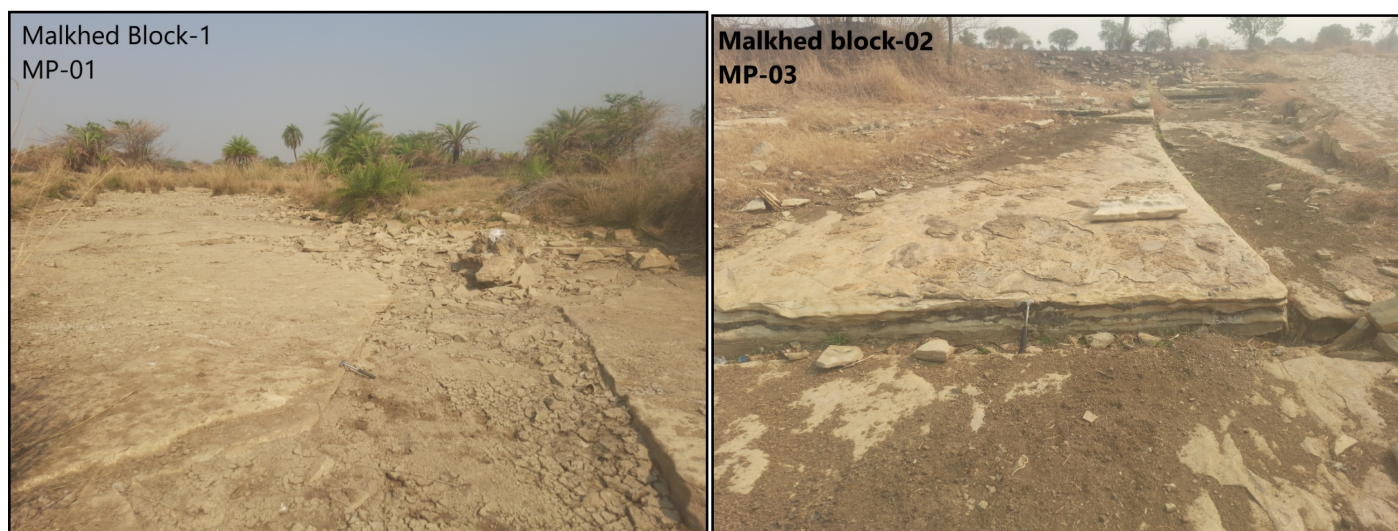


**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR
LIMESTONE IN MALKHED - 1 NORTH, MALKHED - 1 SOUTH, MALKHED - 2
NORTH AND MALKHED - 2 SOUTH BLOCKS**

**KALABURAGI DISTRICT, KARNATAKA
TEXT, ANNEXURES, AND PLATES**



MINERAL EXPLORATION AND CONSULTANCY LIMITED
(Formerly known as Mineral Exploration Corporation Limited)

A Government of India Enterprise
CORPORATE OFFICE, NAGPUR

JUNE-2025

**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR
LIMESTONE IN MALKHED - 1 NORTH, MALKHED - 1 SOUTH, MALKHED -
2 NORTH AND MALKHED -2 SOUTH BLOCKS, KARNATAKA**

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MALKHED – 2 NORTH AND MALKHED -2 SOUTH BLOCKS.**

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मालखेड -1 उत्तर, मालखेड -1 दक्षिण, मालखेड -2 उत्तर और मालखेड -2 दक्षिण ब्लॉक, सेडेम तालुक, जिला- कलबुर्गी, कर्नाटक में चूनापत्थर के लिए प्रारंभिक गवेषण (जी 3) पर भूवैज्ञानिक रिपोर्ट।

अध्याय 1

1.0.0 कार्यकारी सारांश

1.1.0 परिचय

- 1.1.1 चूनापत्थर, एक अवसादी चट्टान है, जो मुख्य रूप से समुद्री से लेकर स्थलीय तक विभिन्न प्रकार के निक्षेपण वातावरणों में कार्बोनेट खनिजों के रासायनिक/जैव रासायनिक अवक्षेपण से उत्पन्न हुआ है।
- 1.1.2 कैल्साइट के रूप में कैल्शियम कार्बोनेट (CaCO_3) चूनापत्थर का प्रमुख खनिज घटक है। इसमें कुछ मात्रा में मैग्नीशियम कार्बोनेट (MgCO_3) और/या डोलोमाइट ($\text{CaMg}(\text{CO}_3)_2$) भी होता है। गैर-कार्बोनेट खनिजों के रूप में मौजूद फेरुजिनस क्वार्ट्ज, क्ले, पाइराइट, हेमेटाइट, चर्ट आदि की परिवर्तनशील मात्रा चूनापत्थर की गुणवत्ता/ग्रेड को नियंत्रित करती है।
- 1.1.3 चूनापत्थर एक महत्वपूर्ण और बहुमुखी खनिज वस्तु है। आधुनिक समय में, चूनापत्थर का उपयोग मुख्य रूप से सीमेंट बनाने के लिए किया जाता है। लौह और इस्पात उद्योग में, चूनापत्थर का उपयोग ब्लास्ट फर्नेस और स्टील मेल्टिंग शॉप दोनों में फ्लक्स के रूप में किया जाता है। रासायनिक उद्योग में, चूनापत्थर का उपयोग ब्लीचिंग पाउडर, ट्रूथपेस्ट, कैल्शियम कार्बाइड आदि बनाने के लिए किया जाता है। इसका उपयोग चीनी उद्योग में शोधक के रूप में किया जाता है। चूनापत्थर का उपयोग कागज, उर्वरक और ढलाई आदि जैसे उद्योगों द्वारा भी किया जाता है।
- 1.1.4 यूएनएफसी (संयुक्तराष्ट्र फ्रेमवर्क वर्गीकरण) प्रणाली पर आधारित एनएमआई (राष्ट्रीय खनिज मालसूची) डेटा के अनुसार दि. 1.4.2015 (खनिज वर्ष पुस्तिका 2020) तक सभी श्रेणियों और ग्रेडों के चूनापत्थर के कुल भंडार / संसाधन 203,224 मिलियन टन अनुमानित किए गए हैं, जिनमें से 16,336 मिलियन टन (8%) को भंडार श्रेणी में रखा गया है और 1,86,889 मिलियन टन (92%) संसाधन श्रेणी में हैं। कर्नाटक कुल संसाधनों का 27% रखने वाला अग्रणी राज्य है, इसके बाद आंध्र प्रदेश और राजस्थान (12-12%), गुजरात (10%), मेघालय (9%), तेलंगाना (8%), छत्तीसगढ़ और मध्य प्रदेश (5-5%) और

शेष 12% अन्य राज्यों द्वारा हैं। ग्रेड के अनुसार, सीमेंट ग्रेड की हिस्सेदारी लगभग 70% है, इसके बाद अवर्गीकृत ग्रेड (12%) और बीएफ ग्रेड (7%) का स्थान है

- 1.1.5 राजस्थान चूनापत्थर के कुल उत्पादन में अग्रणी उत्पादक राज्य था (20%), उसके बाद मध्य प्रदेश (13%), आंध्र प्रदेश और छत्तीसगढ़ (12-12%), और कर्नाटक (10%), तमिलनाडु और तेलंगाना (7-7%), गुजरात (6%) और शेष 13% का योगदान असम, बिहार, हिमाचल प्रदेश, केंद्र शासित प्रदेश जम्मू और कश्मीर, झारखंड, केरल, महाराष्ट्र, मेघालय, ओडिशा और उत्तर प्रदेश द्वारा किया गया।

1.2.0 जांच शुरू करने हेतु आधार

- 1.2.1 वित्त वर्ष 2022-2023 के दौरान, एमईसीएल द्वारा दो बड़े चूनापत्थर ब्लॉक, मालखेड-1 और मालखेड-2 को गवेषित किया गया। कर्नाटक राज्य सरकार ने इन ब्लॉकों को नीलामी के लिए बहुत बड़ा माना और एमईसीएल से उन्हें विभाजित करने का अनुरोध किया। इसके बाद एमईसीएल ने उन्हें चार छोटे ब्लॉकों में विभाजित कर दिया, जिनमें से प्रत्येक का आकार लगभग 5 वर्ग किलोमीटर है। व्यक्तिगत ब्लॉक नीलामी के लिए एमईएमसी नियम की आवश्यकताओं को पूरा करने के लिए बोरहोल को भरने के साथ आगे के गवेषण की आवश्यकता है। एमईसीएल ने प्रारंभिक गवेषण (G-3) के लिए इन ब्लॉकों को उत्तर और दक्षिण खंडों में विभाजित करने के बाद गवेषण का प्रस्ताव रखा। उक्त प्रस्ताव पर 27 अगस्त, 2024 को आयोजित टीसीसी, एनएमईटी की 68वीं बैठक में चर्चा की गई, तत्पश्चात इसका तकनीकी मूल्यांकन किया गया और एफ.संख्या 23/502/2024-एनएमईटी/429 दिनांक 22 अक्टूबर, 2024 के तहत मालखेड-1 और 2 दोनों ब्लॉकों के लिए 10 महीने की समयावधि में 1,21,84,885/- रुपये की अनुमानित लागत के साथ अनुमोदित किया गया।

1.3.0 परियोजना और जांच एजेंसी का विवरण

- 1.3.1 मालखेड, कोंकणहल्ली गाँव, तालुका: सेदम, कलबुर्गी जिला, कर्नाटक में प्रारंभिक गवेषण (जी-3) का एक प्रमुख उद्देश्य, चार समीपवर्ती ब्लॉकों नामतः मालखेड-1 उत्तर, मालखेड-1 दक्षिण, मालखेड-2 उत्तर और मालखेड-2 दक्षिण ब्लॉकों में चूनापत्थर के विभिन्न ग्रेडों का सीमांकन करना और (333 और 334) के अंतर्गत संसाधनों का आकलन करना है।
- 1.3.2. ब्लॉक के लिए जांच एजेंसी मिनरल एक्सप्लोरेशन एंड कंसल्टेंसी लिमिटेड (एमईसीएल), नागपुर है।

1.4.0 जांच के उद्देश्य

गवेषण निम्नलिखित उद्देश्यों के साथ प्रस्तावित किया गया था:

- i) जी-3 गवेषण स्तर पर 11 इनफिलिंग बोरहोल्स की ड्रिलिंग द्वारा ब्लॉक क्षेत्र के भीतर चूनापत्थर की उपस्थिति का सीमांकन करना, जिससे जी-3 गवेषण स्तर के यूएनएफसी मानदंडों के अनुसार ब्लॉक क्षेत्र में ग्रेडवार चूनापत्थर अनुमानित संसाधनों का अनुमान लगाया जा सके।
- iii) खनिज (साक्ष्य और खनिज सामग्री) संशोधन नियम 2021, खनिज नीलामी नियम 2015 2021 तक संशोधित, एमएमडीआर संशोधन अधिनियम 2015 के अनुसार प्रारंभिक गवेषण (जी-3) करना ताकि राज्य सरकार (कर्नाटक) को ब्लॉक की नीलामी में सुविधा हो सके।

1.5.0 कार्य का विवरण

- 1.5.1 एनएमईटी से अनुमोदन आदेश: एफ. सं. 23/365502/2024-एनएमईटी/429 नई दिल्ली दिनांक 22 अक्टूबर, 2024 प्राप्त होने के बाद, एमईसीएल ने गवेषण गतिविधियां शुरू कर दी हैं और प्रस्तावित कार्य बनाम उपलब्धि का विवरण, प्रकृति और मात्रा नीचे तालिका संख्या: 1 में दी गई है। जहां भी आवश्यक हो, उक्त ब्लॉकों को क्रमशः मालखेड 1/एन, एम1/एस, एम2/एन तथा एम2/एस नाम दिया गया है।

तालिका संख्या: 1.1
कार्य की मात्रा - प्रस्तावित बनाम प्राप्त मालखेड - 1/एन, एम1/एस, एम2/एन और एम2/एस, कलबुर्गी जिला, कर्नाटक।

क्रम सं.	कार्य का विवरण एवं प्रकृति	इकाई	अनुमोदित	प्राप्ति	प्राप्ति	प्राप्ति	प्राप्ति	प्राप्त करना
			4 ब्लॉक संयुक्त	मालखेड 1 उत्तर	मालखेड 1 दक्षिण	मालखेड 2 उत्तर	मालखेड 2 दक्षिण	4 ब्लॉक संयुक्त
क	भूवैज्ञानिक कार्य और सर्वेक्षण							
1	सर्वेक्षण कार्य							
	i) बोर होल निर्धारण, निर्देशांक का निर्धारण और बोरहोल और कार्डिनल बिंदुओं के स्तर को कम करना।	नग	बोरहोल पॉइंट 11	3	3	3	2	11
			कोने के बिंदु 4	उत्तर और दक्षिण दोनों में 2 बिंदु समान हैं		उत्तर और दक्षिण दोनों में 2 बिंदु समान हैं		कोने के बिंदु 4
ख	गवेषणात्मक ड्रिलिंग							
1	300 मीटर तक ड्रिलिंग (सॉफ्ट रॉक)	मी.	600	150	150	150	100	600
2	ड्रिल कोर संरक्षण	मी.	500	138	137	135	90	500
ग	प्रयोगशाला अध्ययन							

1	रासायनिक विश्लेषण							
	i) प्राथमिक CaO, MgO, Al ₂ O ₃ , SiO ₂ , Fe ₂ O ₃ , Na ₂ O, SO ₃ , P ₂ O ₅ , K ₂ O, LOI XRF द्वारा	नग	500	141	145	122	93	501
	ii) बाह्य जाँच 10% (CaO, MgO, Al ₂ O ₃ , SiO ₂ , Fe ₂ O ₃ , Na ₂ O, SO ₃ , P ₂ O ₅ , K ₂ O और LOI) XRF द्वारा	नग	50	14	15	12	9	50
घ	रिपोर्ट तैयार करना (5 हार्ड कॉपी और एक सॉफ्ट कॉपी)	नग	2	1	1	1	1	
ड	गवेषण प्रस्ताव की तैयारी (5 हार्ड कॉपी एवं एक सॉफ्ट कॉपी)	नग	1	1	1	1	1	

1.6.0 ब्लॉक का स्थान

1.6.1 गवेषित मालखेड 1/एन, एम1/एस, एम2/एन और एम2/एस ब्लॉक पश्चिम की ओर सेदम तालुक के अधिकार क्षेत्र में आते हैं, जो लगभग 26 किलोमीटर की दूरी पर है। जिला मुख्यालय कलबुर्गी ब्लॉक से उत्तर-पश्चिम की ओर लगभग 45 किलोमीटर की दूरी पर है। निकटतम शहर चितापुर क्रमशः मालखेड-1 और 2 ब्लॉक से लगभग 16 किलोमीटर और 24 किलोमीटर की दूरी पर है। निकटतम रेलवे स्टेशन मालखेड रोड रेलवे स्टेशन है। ब्लॉक का स्थान **प्लेट नंबर I** में दिखाया गया है।

ये ब्लॉक भारतीय सर्वेक्षण टोपोशीट संख्या 56जी/04 के तहत आते हैं तथा **तालिका संख्या 1.2** में सूचीबद्ध निर्देशांकों से घिरे हुए हैं।

1.6.2 गवेषित मालखेड 1/एन, एम1/एस, एम2/एन और एम2/एस ब्लॉकों का गवेषण किया गया, जिनका संयुक्त क्षेत्रफल 18.02 वर्ग किलोमीटर है। केवल 4 मुख्य बिंदुओं के लिए डीजीपीएस सर्वेक्षण करने को मंजूरी दी गई, जिसके माध्यम से 18.02 के पूरे ब्लॉक को नीलामी के लिए 5 किलोमीटर से कम के ब्लॉक बनाने वाले 4 भागों में विभाजित किया गया है और इन 4 मुख्य बिंदुओं के निर्देशांक निम्नलिखित तालिका संख्या 2 में दिए गए हैं और अनुलग्नक संख्या II बी में दिए गए हैं।

तालिका संख्या: 1.2

चूनापत्थर (जी-3) के लिए कर्नाटक के कालाबुरगी जिले में मालखेड-1/एन, एम1/एस, एम2/एन और एम2/एस ब्लॉक में गवेष्टित 4 कार्नर बिंदुओं के निर्देशांक
तालुका: सेदम, जिला: कालाबुरगी, राज्य: कर्नाटक

सीमा बिंदु	अक्षांश	देशान्तर	यूटीएम (मीटर)		आर एल
			एक्स (एम ई)	वाई (एम एन)	
एमडब्ल्यूएन-4/एमडब्ल्यूएस-1	17 ° 10 ' 58.551"उ	77 ° 9 ' 44.983 " ई	730003.904	1901074.665	404.550
एमडब्ल्यूएन-3/एमडब्ल्यूएस-2	17° 10' 17.629"उ	77 ° 11 ' 3.207"पूर्व	732330.105	1899842.294	409.939
पुरुष-4/एमईएस-1	17 ° 10' 48.262"उ	77 ° 12' 6.033"पूर्व	734176.458	1900805.215	417.827
पुरुष-3/एमईएस-2	17 ° 9' 51.509"उ	77 ° 13' 18.083"पूर्व	736326.064	1899084.422	428.317

1.7.0 क्षेत्र की क्षेत्रीय भूवैज्ञानिक संरचना

1.7.1 भीमा बेसिन, भारत में एक प्रोटेरोज़ोइक अवसादीय बेसिन है, जो उत्तर-पूर्व-दक्षिण-पश्चिम (NE-SW) की ओर प्रवृत्त है और सिग्मोइडल (S-आकार) ज्यामिति प्रदर्शित करता है। यह कुडप्पा बेसिन के उत्तर-पश्चिम में और कलादगी बेसिन के उत्तर-पूर्व में स्थित है। यह बेसिन चूनापत्थर के अपने विशाल भंडार और गोगी के पास हाल ही में खोजे गए यूरेनियम की मौजूदगी के लिए प्रसिद्ध है। क्षेत्रीय भूवैज्ञानिक मानचित्र भीमा बेसिन (भाग) में गवेष्टित गए मालखेड 1/N, M1/S, M2/N और M2/S ब्लॉक प्लेट-II के रूप में दिखाए गए हैं।

1.8.0 ब्लॉक भूविज्ञान

1.8.1 ब्लॉकों में उजागर चट्टानें भीमा समूह के सेदम उप समूह के शाहाबाद संरचना से संबंधित हैं। एमईसीएल ने मालखेड-1/एन, एम1/एस, एम2/एन और एम2/एस ब्लॉकों का गवेषण एमईसीएल द्वारा पूर्व में गवेष्टित डिग्गाँव ब्लॉक से लगभग 5 किलोमीटर उत्तर की ओर की थी। क्षेत्रीय अवलोकनों और आस-पास की खदानों/क्षेत्रों से उपलब्ध डेटा/साहित्य के आधार पर मालखेड 1 ब्लॉक का सामान्य स्ट्रेटीग्राफिक अनुक्रम नीचे तालिका संख्या: 1.3 में दिया गया है।

तालिका संख्या: 1.3

ब्लॉक के अंदर और आसपास उजागर लिथो-इकाइयों का स्ट्रेटीग्राफिक अनुक्रम

युग	समूह	उप समूह	गठन	लिथो इकाइयाँ
कार्टनरी	-	-	हाल ही का	ऊपरी मिट्टी
ऊपरी प्रोटेरोज़ोइक	भीमा	सेदम	शाहाबाद चूनापत्थर	सिलिका/फ्लैगी चूनापत्थर विशाल ग्रे चूनापत्थर शाली चूनापत्थर
----- क्रमिक और संक्रमणकालीन संपर्क -----				
-	-	-	रबनपल्ली क्लास्टिक्स	फेरुजेनस शैल्स, कैल्शियम युक्त शैल्स, हरे, ग्लौकोनाइट, बारीक दाने वाले बलुआ पत्थर और सिल्टस्टोन

1.9.0 व्यवस्थित ड्रिलिंग द्वारा गवेषण

- 1.9.1 एमईसीएल ने 06.02.2025 को मालखेड-1 दक्षिण भाग में प्रारंभिक गवेषण (जी-3 स्तर) शुरू किया और 03.04.2025 को मालखेड-2 उत्तर भाग में पूरा किया। कुल 11 बोरहोल ड्रिल किए गए, जिनकी कुल ड्रिलिंग क्षमता 550 मीटर थी।
- 1.9.2 संपूर्ण कोर ड्रिलिंग वायर लाइन विधि द्वारा की गई है, जिसमें डायमंड बिट्स का उपयोग करके NQ बोरहोल आकार का उपयोग किया गया है। लिथोलॉजिकल रूप से चूनापत्थर बहुत कठोर और विशाल है, जिसमें कभी-कभी कुछ स्थानों पर मिट्टी का पतला मिश्रण पाया जाता है, इसलिए 95-100% कोर रिकवरी हुई। संसाधन आकलन में इन कारकों पर विचार किया जाता है।

1.10.0 नमूनाकरण और विश्लेषण

1.10.1 प्राथमिक और जाँच नमूने

सभी बोरहोल में काफी मोटाई पर चूनापत्थर की एकरूप प्रकृति को ध्यान में रखते हुए और जी-3 गवेषण के दौरान उत्पन्न लिथोलॉजिकल डेटा के अध्ययन के बाद चूनापत्थर के ग्रेड का मूल्यांकन करने में 1 मीटर की इष्टतम नमूना लंबाई उचित है। कुल 501 प्राथमिक नमूने तैयार किए गए हैं और 10 रेडिकल्स के लिए उनका विश्लेषण किया गया है, इसके अलावा 50 चेक नमूने तैयार किए गए हैं और बाहरी चेक विश्लेषण के लिए जेएनएआरडीसी को भेजे गए हैं।

1.11.0 चूनापत्थर क्षितिज का मूल्यांकन

1.11.1 ड्रिलिंग, भूवैज्ञानिक अध्ययन और प्रयोगशाला कार्य के माध्यम से एकत्रित गवेषण डेटा का उपयोग चूनापत्थर निक्षेप के आकार, आकार और संरचना को निर्धारित करने के लिए किया गया था। चूनापत्थर क्षेत्रों की पहचान कम से कम 1.0 मीटर लंबाई के नमूनों का विश्लेषण करके, कट-ऑफ मानों का उपयोग करके और उन्हें पास के बोरहोल और पूर्व गवेषण से क्षेत्रों के डेटा के साथ तुलना करके की गई थी। मूल्यांकित चूनापत्थर का वर्गीकरण यहाँ नीचे सारणीबद्ध किया गया है।

वर्ग	श्रेणी		
	CaO%	MgO%	SiO ₂
सीमेंट ग्रेड	≥ 44.00	3.50% (अधिकतम)	16.00% अधिकतम
मिश्रण योग्य ग्रेड	≥ 38 से ≤ 44.00	5.00 % (अधिकतम)	16.00 से 18.00%
श्रेयोल्ड ग्रेड	35.00% (न्यूनतम)	6.00 % (अधिकतम)	18.00% अधिकतम
लाभकारी-मिश्रणीय ग्रेड	≥ 38 से ≤ 44.00	5.00 % (अधिकतम)	+ 18.00%

1.12.0 संसाधन आकलन के लिए अपनाई गई पद्धति

1.12.0 संसाधन आकलन के लिए अपनाई गई पद्धति

1.12.1 चूनापत्थर के संसाधनों का अनुमान मुख्य विधि के रूप में भूवैज्ञानिक क्रॉस सेक्शन विधि और चेक विधि के रूप में पॉलीगॉन विधि द्वारा लगाया गया है। संसाधन आकलन के लिए उपरोक्त मान्यताओं को ध्यान में रखते हुए अपनाई गई कार्यप्रणाली इस प्रकार है:

1.12.2 संसाधनों का वर्गीकरण

यूएनएफसी के अनुसार संसाधनों को चूनापत्थर संसाधनों की अनुमानित और आवीक्षण श्रेणी (333 और 334) के अंतर्गत वर्गीकृत किया गया है। चूनापत्थर क्षेत्रों की गणना और वर्गीकरण भारतीय खान ब्यूरो, भारत सरकार द्वारा निर्धारित **अंतिम उपयोग ग्रेड** विनिर्देशों के आधार पर किया जाता है।

1.13.0 संसाधन

1.13.1 सीमेंट, मिश्रणयोग्य और लाभकारी-मिश्रणयोग्य/ग्रेड चूनापत्थर के कुल भूवैज्ञानिक सकल और शुद्ध स्व-स्थाने संसाधन को मोटे तौर पर अनुमानित और आवीक्षण (333 और 334) संसाधनों के तहत वर्गीकृत किया गया है, इनका विवरण निम्नलिखित तालिकाओं 1.4, 1.5, 1.6 और 1.7 में व्यक्तिगत रूप से ब्लॉकवार प्रस्तुत किया गया है।

मालखेड - 1 साउथ ब्लॉक

तालिका क्रमांक 1.4

मालखेड -1 साउथ ब्लॉक के सीमेंट, मिश्रण योग्य और लाभकारी-मिश्रण योग्य ग्रेड चूनापत्थर संसाधन का सारांश - क्रॉस सेक्शनल विधि (अनुमानित और आवीक्षण)

इकाई: मिलियन टन

ग्रेड श्रेणी	संसाधन श्रेणी	सकल भूगर्भीय संसाधन (मिलियन टन)	शुद्ध भूगर्भीय संसाधन (मिलियन टन)	CaO	MgO	Si O ₂
सीमेंट ग्रेड	333	497.74	398.19	49.41	0.43	10.82
	334	91.19	72.95	49.75	0.44	10.41
कुल आर ₁	333 और 334	588.93	471.14	49.50	0.43	10.71
मिश्रण योग्य ग्रेड कुल - आर ₂	333	6.52	5.22	46.03	0.39	16.73
	334	1.60	1.28	46.03	0.39	16.73
	कुल	8.12	6.50	46.03	0.39	16.73
लाभकारी-मिश्रणीय ग्रेड	333	66.56	53.25	43.95	0.48	19.88
	334	4.81	3.85	43.73	0.49	20.20
कुल - R ₃	कुल	71.37	57.10	43.93	0.48	19.90
कुल R ₁ +R ₂ +R ₃	सभी में	688.42	534.74	48.86	0.44	11.77

मालखेड - 1 नॉर्थ ब्लॉक

तालिका क्रमांक 1.5

मालखेड -1 उत्तर ब्लॉक के सीमेंट, मिश्रण योग्य और लाभकारी-मिश्रण योग्य ग्रेड चूनापत्थर संसाधन का सारांश - क्रॉस सेक्शनल विधि (अनुमानित और आवीक्षण)

इकाई: मिलियन टन

ग्रेड श्रेणी	संसाधन श्रेणी	सकल भूगर्भीय संसाधन (मिलियन टन)	शुद्ध भूगर्भीय संसाधन (मिलियन टन)	CaO	MgO	Si O ₂
सीमेंट ग्रेड	333	191.89	153.50	48.20	0.40	12.96
	334	35.64	28.51	47.89	0.40	13.66
कुल आर ₁	333 334	227.53	182.01	48.15	0.40	13.07
मिश्रण योग्य ग्रेड	333	8.26	6.61	45.79	0.53	16.89
	334	4.29	3.43	45.79	0.53	16.89
कुल - आर ₂	कुल	12.55	10.04	45.79	0.53	16.89
लाभकारी-मिश्रणीय ग्रेड	333	272.23	217.79	43.29	0.56	19.60
	334	69.60	55.68	42.73	0.57	21.12
कुल - R ₃	333 334	341.83	273.47	43.18	0.56	19.91
कुल R ₁ +R ₂ +R ₃	सभी में	581.91	465.52	45.18	0.50	17.17

मालखेड - 2 साउथ ब्लॉक

तालिका क्रमांक 1.6

सीमेंट, लाभकारी-मिश्रणीय चूनापत्थर संसाधन का सारांश
मालखेड -2 साउथ ब्लॉक - क्रॉस सेक्शनल विधि (अनुमानित और आवीक्षण)

इकाई: मिलियन टन

ग्रेड श्रेणी	संसाधन श्रेणी	सकल भूगर्भीय संसाधन (मिलियन टन)	शुद्ध भूगर्भीय संसाधन (मिलियन टन)	CaO	MgO	SiO ₂
सीमेंट	333	130.59	104.47	48.55	0.39	12.49
	334	56.58	45.26	48.17	0.37	13.33
कुल आर ₁	333 334	187.17	149.73	48.44	0.38	12.75
लाभकारी-मिश्रण योग्य ग्रेड	333	324.13	259.30	43.40	0.49	20.82
	334	109.28	87.44	43.58	0.51	20.88
कुल - R ₂	333 334	433.41	346.74	43.45	0.50	20.84
कुल R ₁ +R ₂	सभी में	620.58	496.47	44.95	0.46	18.40

मालखेड - 2 नॉर्थ ब्लॉक

तालिका क्रमांक 1.7

सीमेंट, लाभकारी-मिश्रणीय चूनापत्थर संसाधन का सारांश
मालखेड -2 उत्तर ब्लॉक - क्रॉस सेक्शनल विधि (अनुमानित और आवीक्षण)

इकाई: मिलियन टन

ग्रेड श्रेणी	संसाधन श्रेणी	सकल भूगर्भीय संसाधन (मिलियन टन)	शुद्ध भूगर्भीय संसाधन (मिलियन टन)	CaO	MgO	SiO ₂
सीमेंट	333	94.73	75.80	49.32	0.42	10.94
	334	14.28	11.42	49.83	0.46	10.50
कुल आर 1	333 334	109.01	87.22	49.39	0.43	10.88
लाभकारी- मिश्रण योग्य ग्रेड	333	221.32	177.05	43.32	0.41	20.37
	334	39.37	31.49	43.24	0.44	20.82
कुल - R ₃	333 334	260.69	208.54	43.31	0.42	20.44
कुल R₁+R₂	सभी में	369.70	295.76	45.10	0.42	17.62

1.14.0 अनुशंसाएँ

1.14.1 मालखेड-1 साउथ ब्लॉक: सीमेंट ग्रेड संसाधन अनुमान के कुल भूवैज्ञानिक शुद्ध स्व-स्थाने संसाधन 471.14 मिलियन टन हैं, जिसमें औसत ग्रेड CaO 49.50%, MgO 0.43% और SiO₂ 10.71 % है। ब्लेंडेबल ग्रेड के कुल भूवैज्ञानिक शुद्ध स्व-स्थाने संसाधन 6.50 मिलियन टन हैं, जिसमें CaO 46.03%, MgO 0.39% और SiO₂ 16.73 % है। हालांकि, लाभकारी-मिश्रण योग्य ग्रेड संसाधन 57.10 मिलियन टन हैं, जिसमें औसत ग्रेड CaO 43.93%, MgO 0.48% और SiO₂ 19.90 % है। **सभी ग्रेड संसाधनों का कुल शुद्ध भूवैज्ञानिक संसाधन 534.74 मिलियन टन है, जिसका औसत ग्रेड CaO% 48.86, MgO 0.44% और SiO₂ 11.77 % है।**

मालखेड-1 नॉर्थ ब्लॉक: सीमेंट ग्रेड संसाधन अनुमान के कुल भूवैज्ञानिक शुद्ध स्व-स्थाने संसाधन 182.01 मिलियन टन हैं, जिनका औसत ग्रेड CaO 48.15%, MgO 0.40% और SiO₂ 13.07 % है। ब्लेंडेबल ग्रेड के कुल भूवैज्ञानिक शुद्ध स्व-स्थाने संसाधन 10.04 मिलियन टन हैं, जिनमें CaO 45.79%, MgO 0.53% और SiO₂ 16.89 % है। हालांकि, लाभकारी-मिश्रण योग्य ग्रेड संसाधन 273.47 मिलियन टन हैं, जिनका औसत ग्रेड CaO 43.18%, MgO 0.56% और SiO₂ 19.91 % है। **सभी ग्रेड संसाधनों का कुल शुद्ध**

भूवैज्ञानिक संसाधन 465.52 मिलियन टन है, जिसका औसत ग्रेड CaO 45.18, MgO 0.50% और SiO_2 17.17 % है।

मालखेड - 2 साउथ ब्लॉक: सीमेंट ग्रेड संसाधन का कुल भूगर्भीय शुद्ध स्व-स्थाने संसाधन अनुमान 149.73 मिलियन टन है, जिसमें औसत ग्रेड CaO 48.44%, MgO 0.38% और SiO_2 12.75 % है। लाभकारी-मिश्रण योग्य ग्रेड संसाधन का कुल भूगर्भीय शुद्ध स्व-स्थाने संसाधन 346.74 मिलियन टन है, जिसमें औसत ग्रेड CaO 43.45%, MgO 0.50% और SiO_2 20.84 % है।

सभी ग्रेड संसाधनों का कुल शुद्ध भूवैज्ञानिक संसाधन 496.47 मिलियन टन है, जिसका औसत ग्रेड CaO 44.95, MgO 0.46% और SiO_2 18.40 % है।

मालखेड - 2 नॉर्थ ब्लॉक: सीमेंट ग्रेड संसाधन अनुमान के कुल भूवैज्ञानिक शुद्ध स्व-स्थाने संसाधन 87.22 मिलियन टन हैं, जिनमें औसत ग्रेड CaO 49.39%, MgO 0.43% और SiO_2 10.88 % है। लाभकारी-मिश्रण योग्य ग्रेड संसाधन के कुल भूवैज्ञानिक शुद्ध स्व-स्थाने संसाधन 208.54 मिलियन टन हैं, जिनमें औसत ग्रेड CaO 43.31%, MgO 0.42% और SiO_2 20.44 % है। **सभी ग्रेड संसाधनों के कुल शुद्ध भूवैज्ञानिक संसाधन 295.76 मिलियन टन हैं, जिनमें औसत ग्रेड CaO 45.10, MgO 0.42% और SiO_2 17.62 % है।**

- 1.14.2 गवेषण खनिज (खनिज सामग्री का साक्ष्य) नियम-2015, खनिज नीलामी नियम-2015, एमएमडीआर संशोधन अधिनियम-2015 और खनिज (खनिज सामग्री का साक्ष्य) संशोधन नियम 2021 के अनुसार किया जाता है।
- 1.14.3 गवेषण का यह स्तर कर्नाटक राज्य सरकार को खनन पट्टे के तहत ब्लॉक की नीलामी करने में सुविधा प्रदान करेगा।
- 1.14.4 अध्ययन क्षेत्र से पता चलता है कि भविष्य में होने वाली कोई भी खनन परियोजना स्थानीय लोगों के लिए रोजगार पैदा कर सकती है तथा आस-पास के क्षेत्रों में रहने वाले लोगों की सामाजिक-आर्थिक स्थिति में सुधार ला सकती है।

**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR
LIMESTONE IN MALKHED – 1 NORTH, MALKHED - 1 SOUTH, MALKHED –
2 NORTH AND MALKHED – 2 SOUTH BLOCKS, SEDEM TALUK, DISTRICT-
KALABURAGI, KARNATAKA.**

CHAPTER-1

1.0.0 EXECUTIVE SUMMARY

1.1.0 INTRODUCTION

- 1.1.1 Limestone, a sedimentary rock, originated mainly by chemical/biochemical precipitation of carbonate minerals in a variety of depositional environments, ranging from marine to terrestrial.
- 1.1.2 Calcium carbonate (Ca CO_3) in the form of calcite is the predominant mineral constituent of limestone. It also contains some amount of magnesium carbonate (Mg CO_3) and/or dolomite ($\text{Ca Mg (CO}_3)_2$). Variable amount of ferruginous quartz, clay, pyrite, haematite, chert etc., present as non-carbonate minerals, control the quality/grade of limestone.
- 1.1.3 Limestone is a crucial and versatile mineral commodity. In the modern time, limestone is primarily used to manufacture cement. In Iron & Steel Industry, limestone is used both in blast furnace and steel melting shop as a flux. In chemical industry, limestone is consumed to produce bleaching powder, toothpaste, calcium carbide etc. It is used as a purifier in the sugar industry. Limestone is also consumed by industries like paper, fertilizer and foundry etc.
- 1.1.4 The total reserves/resources of limestone of all categories and grades as per NMI (National Mineral Inventory) data based on UNFC (United Nations Framework Classification) system as on 1.4.2015 (Mineral Year Book 2020) have been estimated at 203,224 million tonnes, of which 16,336 million tonnes (8%) are placed under reserves category and 1,86,889 million tonnes (92%) are under resources category. Karnataka is the leading state having 27% of the total resources followed by Andhra Pradesh and Rajasthan (12% each), Gujarat (10%), Meghalaya (9%), Telangana (8%), Chhattisgarh and Madhya Pradesh (5% each) and remaining 12% by other states. Grade wise, Cement Grade has leading share of about 70% followed by Unclassified Grades (12%) and BF Grade (7%). Remaining (11%) are different Grades.
- 1.1.5 Rajasthan was the leading producing state accounting for (20%) of the total production of limestone, followed by Madhya Pradesh (13%), Andhra Pradesh

& Chhattisgarh (12% each), & Karnataka (10%), Tamil Nadu & Telangana (7% each), Gujarat (6%) and the remaining 13% was contributed by Assam, Bihar, Himachal Pradesh, UT of Jammu and Kashmir, Jharkhand, Kerala, Maharashtra, Meghalaya, Odisha and Uttar Pradesh.

1.2 .0 BASIS FOR TAKING UP INVESTIGATION

1.2.1 During FY 2022-2023, MECL explored two large limestone blocks, Malkhed-1 and Malkhed-2. The State Government of Karnataka deemed these blocks too large for auction and requested MECL to divide them. MECL subsequently divided them into four smaller blocks, each around 5 sq km. Further exploration with infilling boreholes is needed to meet MEMC Rule requirements for individual block auctions. MECL proposed exploring these blocks after dividing them into North and South sections for preliminary exploration (G-3).

The said proposal was discussed in the 68th meeting of TCC, NMET held on 27th August 2024, subsequently it was technically evaluated and approved vide F. No.23/502/2024-NMET/429 dated 22nd October 2024 with an estimated cost of Rs.1,21,84,885/- in the time schedule of 10 months together for both Malkhed - 1 & 2 blocks.

1.3.0 DETAILS OF PROJECT AND INVESTIGATING AGENCY

1.3.1 One of the prime objectives of the preliminary exploration (G-3) is to demarcate the various grades of limestone and estimation of resources under (333 & 334) in the following four contiguous blocks namely Malkhed -1 North, Malkhed -1 South, Malkhed – 2 North and Malkhed - 2 South Blocks. in Malkhed, Konkanahalli Villages, Taluka: Sedam, Kalaburagi District, Karnataka.

1.3.2. The investigating agency for the block is Mineral Exploration and Consultancy Limited (MECL), Nagpur

1.4.0 OBJECTIVES OF INVESTIGATION

The exploration was proposed with following objectives:

- ii) To demarcate the limestone occurrences within the block area by drilling of 11 infilling boreholes at G-3 level of exploration to estimate the grade wise limestone inferred resources in the block area as per UNFC norms of G-3 level of exploration.

iii) To carry out preliminary exploration (G-3) as per the Minerals (Evidence and Mineral Contents) Amendment Rules 2021, Mineral Auction Rule 2015 Amended up to 2021, MMDR Amendment Act 2015 in turn to facilitate the State Government (Karnataka) for auctioning of the block.

1.5.0 DETAILS OF THE WORK

1.5.1 Following the receipt of approval vide Order No. F. No. 23/365502/2024-NMET/429, dated 22nd October 2024, from the National Mineral Exploration Trust (NMET), Mineral Exploration & Consultancy Ltd. (MECL) has undertaken exploration activities in the designated areas. The details regarding the nature, scope, and quantum of work as proposed versus the actual achievements are presented in **Table No. 1** below. Henceforth, for reference purposes, the respective exploration blocks shall be referred to as **Malkhed 1/N, M1/S, M2/N, and M2/S**, wherever applicable.

. Table No: 1.1

Quantum of Work - Proposed Vs Achieved Malkhed – 1/ N, M1/S, M2/N and M2/S in Kalaburagi Dist. Karnataka.

Sl. No.	Description and Nature of Work	Unit	Approved 4 Blocks combined	Achieved Malkhed 1 North	Achieved Malkhed 1 South	Achieved Malkhed 2 North	Achieved Malkhed 2 South	Achieved 4 Blocks combined
A	GEOLOGICAL WORK AND SURVEYING							
1	Survey Work							
	i) Bore Hole Fixation, determination of coordinates & Reduced Levels of the boreholes and cardinal points.	Nos.	Borehole Points 11	3	3	3	2	11
			Corner Points 4	2 points common to both North & South		2 points common to both North & South		Corner Points 4
B	EXPLORATORY DRILLING							
1	Drilling up to 300m (Soft Rock)	m	600	150	150	150	100	600
2	Drill Core Preservation	m	500	138	137	135	90	500
C	LABORATORY STUDIES							
Sl. No.	Description and Nature of Work	Unit	Approved 4 Blocks combined	Achieved Malkhed 1 North	Achieved Malkhed 1 South	Achieved Malkhed 2 North	Achieved Malkhed 2 South	Achieved 4 Blocks combined
1	Chemical Analysis							
	i) Primary CaO, MgO, Al ₂ O ₃ , SiO ₂ , Fe ₂ O ₃ , Na ₂ O, SO ₃ , P ₂ O ₅ , K ₂ O, LOI by XRF	Nos.	500	141	145	122	93	501

	ii) External Check 10% (CaO, MgO, Al ₂ O ₃ , SiO ₂ , Fe ₂ O ₃ , Na ₂ O, SO ₃ , P ₂ O ₅ K ₂ O and LOI.) by XRF	Nos.	50	14	15	12	9	50
D	Report Preparation (5 Hard copies with a soft copy)	Nos.	2	1	1	1	1	
E	Preparation of Exploration Proposal (5 Hard copies with a soft copy)	Nos.	1	1	1	1	1	

1.6.0 LOCATION OF THE BLOCK

1.6.1 The explored Malkhed 1/N, M1/S, M2/N and M2/S blocks falls in the jurisdiction of Sedam Taluk towards west at a distance of ~26kms. The district head quarter Kalaburagi is at a distance ~45km towards north-west from the block. The nearest town Chitapur is at a distance of ~16 kms and 24 kms from Malkhed-1 and 2 blocks respectively. The nearest railway station is Malkhed Road railway station. Location of the Block is shown in **Plate No. I**.

The Blocks fall in the Survey of India Toposheet No.56G/04 and is bounded by the co-ordinates as listed in the **Table no: 1.2**

1.6.2 The explored Malkhed 1/N, M1/S, M2/N and M2/S blocks having an area of 18.01 sq. kms combined. It was approved to do DGPS Survey for 4 cardinal points only through which the entire block of 18.01 is divided into 4 parts forming less than 5 km block to auction and the co-ordinates of these 4 cardinal points are given in the following Table No 2 and given in Annexure No II B.

Table No: 1.2
Co-ordinates of 4 corner points of explored in Malkhed - 1/ N, M1/S, M2/N and M2/S
blocks in Kalaburagi Dist. Karnataka. (G-3) for Limestone, Taluka: Sedam,
District: Kalaburagi, State: Karnataka

Boundary Points	Latitude	Longitude	UTM (m)		RI
			X (m E)	Y (m N)	
MWN-4/MWS-1	17° 10' 58.551"N	77° 9' 44.983"E	730003.904	1901074.665	404.550
MWN-3/MWS-2	17° 10' 17.629"N	77° 11' 3.207"E	732330.105	1899842.294	409.939
MEN-4/MES-1	17° 10' 48.262"N	77° 12' 6.033"E	734176.458	1900805.215	417.827
MEN-3/MES-2	17° 9' 51.509"N	77° 13' 18.083"E	736326.064	1899084.422	428.317

1.7.0 REGIONAL GEOLOGICAL SETUP OF THE AREA

1.7.1 The Bhima basin, a Proterozoic sedimentary basin in India, is trending northeast-southwest (NE-SW) and exhibits a sigmoidal (S-shaped) geometry. It is situated northwest of the Cuddapah basin and northeast of the Kaladgi basin. The basin is well known for its huge reserves of limestone and the newly discovered Uranium occurrence near Gogi. Regional Geological Map Bhima Basin (Part) of the explored Malkhed 1/N, M1/S, M2/N and M2/S blocks are shown as Plate -II.

1.8.0 BLOCK GEOLOGY

1.8.1 The rocks exposed in the blocks belong to the Shahabad formation of Sedam sub group of Bhima Group. MECL had explored Malkhed -1/N, M1/S, M2/N and M2/S blocks at a distance of around 5 kms north of previously explored Diggaon Block by MECL. The general stratigraphic succession of the Malkhed 1 Block based on field observations and available data/literature from nearby mine/areas is given below in Table No: 1.3.

Table No: 1.3
Stratigraphic Sequence of Litho-units exposed in and around the Block

Age	Group	Sub Group	Formation	Litho Units
Quaternary	-	-	Recent	Top soil
Upper Proterozoic	Bhima	Sedam	Shahabad Limestone	Siliceous/flaggy limestone Massive grey limestone Shaly limestone
----- Gradational and transitional contact -----				
-	-	-	Rabanpalli Clastics	Ferruginous Shales, calcareous shales, Green, Glauconite, fine grained Sandstones and Siltstones

1.9.0 EXPLORATION BY SYTEMATIC DRILLING

1.9.1 MECL commenced preliminary exploration (G-3 level) in Malkhed -1 South part on 06.02.2025 and completed on 03.04.2025 in Malkhed -2 North part. Totally 11 boreholes drilled with cumulative meterage of 550 meters of drilling.

1.9.2 The entire core drilling has been carried out by wire line method with NQ borehole size using diamond bits. Lithologically the limestone is very hard and massive with occasional thin intercalation of clays encountered in few places, hence resulted 95-100% core recovery. These factors are considered in resource estimation.

1.10.0 SAMPLING AND ANALYSIS

1.10.1 PRIMARY AND CHECK SAMPLES

Considering the uniform nature of the limestone over considerable thickness in all the boreholes and after study of lithological data generated during G-3 exploration optimum sample length of 1m is justifiable in evaluating grade of limestone. Totally 501 Primary samples have been prepared and analysed for 10 radicals, in addition to this 50 nos. of check samples were prepared and sent to JNARDC for external check analysis.

1.11.0 EVALUATION OF LIMESTONE HORIZONS

1.11.1 Exploration data, gathered through drilling, geological studies, and lab work, was used to determine the shape, size, and structure of limestone deposits. Limestone zones were identified by analyzing samples of at least 1.0 meter in length, using cut-off values and comparing them with data from nearby boreholes and previously explored areas. The classification of evaluated limestone are tabulated here under.

Category	Range		
	CaO%	MgO%	SiO ₂
Cement Grade	≥ 44.00	3.50% (Max)	16.00% Max
Blendable Grade	≥ 38 to ≤ 44.00	5.00 % (Max)	16.00 to 18.00%
Threshold Grade	35.00% (Min)	6.00 % (Max)	18.00% Max
Beneficiable-Blendable Grade	≥ 38 to ≤ 44.00	5.00 % (Max)	+ 18.00%

1.12.0 METHODOLOGY ADOPTED FOR RESOURCE ESTIMATION

1.12.0 METHODOLOGY ADOPTED FOR RESOURCE ESTIMATION

1.12.1 The resources of limestone have been estimated by Geological Cross Section method as principal method and Polygon method as check method. The methodology adopted, keeping the above assumptions in view, for resource estimation is as follows:

1.12.2 CATEGORISATION OF RESOURCES

Resources have been categorized under inferred and reconnaissance category of limestone resources (333 and 334) as per UNFC. Limestone zones are computed and categorized based on **End Use Grade** specifications prescribed by Indian Bureau of Mines, Government of India.

1.13.0 RESOURCE

1.13.1 The total geological gross and net in-situ resource of Cement, Blendable and Beneficiable-Blendable/grade limestone are broadly categorized under inferred and reconnaissance (333 & 334) resources, the details of the same are furnished block wise individually in the following tables 1.4, 1.5, 1.6 and 1.7.

Malkhed – 1 South Block

Table No 1.4

Summary of Cement, Blendable and Beneficiable-Blendable Grade Limestone Resource of Malkhed -1 South Block – Cross sectional method (Inferred and Reconnaissance)

Unit: Million tonnes

Grade Category	Resource Category	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO	MgO	Si O ₂
Cement Grade	333	497.74	398.19	49.41	0.43	10.82
	334	91.19	72.95	49.75	0.44	10.41
Total R ₁	333 & 334	588.93	471.14	49.50	0.43	10.71
Blendable Grade Total - R ₂	333	6.52	5.22	46.03	0.39	16.73
	334	1.60	1.28	46.03	0.39	16.73
	Total	8.12	6.50	46.03	0.39	16.73
Beneficiable-Blendable Grade	333	66.56	53.25	43.95	0.48	19.88
	334	4.81	3.85	43.73	0.49	20.20
Total - R ₃	Total	71.37	57.10	43.93	0.48	19.90
Total R ₁ +R ₂ +R ₃	In All	688.42	534.74	48.86	0.44	11.77

Malkhed – 1 North Block

Table No 1.5

Summary of Cement, Blendable and Beneficiable-Blendable Grade Limestone Resource of Malkhed -1 North Block – Cross sectional method (Inferred and Reconnaissance)

Unit: million tonnes

Grade Category	Resource Category	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO	MgO	Si O ₂
Cement Grade	333	191.89	153.50	48.20	0.40	12.96
	334	35.64	28.51	47.89	0.40	13.66
Total R ₁	333 334	227.53	182.01	48.15	0.40	13.07
Blendable Grade	333	8.26	6.61	45.79	0.53	16.89
	334	4.29	3.43	45.79	0.53	16.89
Total - R ₂	Total	12.55	10.04	45.79	0.53	16.89
Beneficiable-Blendable Grade	333	272.23	217.79	43.29	0.56	19.60
	334	69.60	55.68	42.73	0.57	21.12
Total - R ₃	333 334	341.83	273.47	43.18	0.56	19.91
Total R₁+R₂+R₃	In All	581.91	465.52	45.18	0.50	17.17

Malkhed – 2 South Block

Table No 1.6

Summary of Cement, Beneficiable-Blendable Limestone Resource of Malkhed -2 South Block – Cross sectional method (Inferred and Reconnaissance)

Unit: million tonnes

Grade Category	Resource Category	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO%	MgO%	Si O ₂ %
Cement	333	130.59	104.47	48.55	0.39	12.49
	334	56.58	45.26	48.17	0.37	13.33
Total R ₁	333 334	187.17	149.73	48.44	0.38	12.75
Beneficiable-Blendable Grade	333	324.13	259.30	43.40	0.49	20.82
	334	109.28	87.44	43.58	0.51	20.88
Total – R ₂	333 334	433.41	346.74	43.45	0.50	20.84
Total R₁+R₂	In All	620.58	496.47	44.95	0.46	18.40

Malkhed – 2 North Block

Table No 1.7

Summary of Cement, Beneficiable-Blendable Limestone Resource of
Malkhed -2 North Block – Cross sectional method (Inferred and Reconnaissance)

Unit: million tonnes

Grade Category	Resource Category	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO%	MgO%	Si O ₂ %
Cement	333	94.73	75.80	49.32	0.42	10.94
	334	14.28	11.42	49.83	0.46	10.50
Total R ₁	333 334	109.01	87.22	49.39	0.43	10.88
Beneficiable-Blendable Grade	333	221.32	177.05	43.32	0.41	20.37
	334	39.37	31.49	43.24	0.44	20.82
Total - R ₃	333 334	260.69	208.54	43.31	0.42	20.44
Total R₁+R₂	In All	369.70	295.76	45.10	0.42	17.62

1.14.0 RECOMMENDATIONS

1.14.1 Malkhed - 1 South Block: Total Geological Net In-situ Resources of Cement Grade resource estimate is 471.14 million tonnes with an average grade of CaO 49.50%, MgO 0.43% and SiO₂ 10.71%. Total Geological Net In-situ Resources of Blendable grade is 6.50 million tonnes CaO 46.03%, MgO 0.39% and SiO₂ 16.73%. However, the Beneficiable-Blendable grade resource are 57.10 million tonnes with an average grade of CaO 43.93%, MgO 0.48% and SiO₂ 19.90% have also been established. **The total net geological resources of all grade resources are 534.74 million tons with an average grade of Cao% 48.86, MgO 0.44% and SiO₂ 11.77%.**

Malkhed - 1 North Block: Total Geological Net In-situ Resources of Cement Grade resource estimate is 182.01 million tonnes with an average grade of CaO 48.15%, MgO 0.40% and SiO₂ 13.07%. Total Geological Net In-situ Resources of Blendable grade is 10.04 million tonnes CaO 45.79%, MgO 0.53% and SiO₂ 16.89%. However, the Beneficiable-Blendable grade resource are 273.47 million tonnes with an average grade of CaO 43.18%, MgO 0.56% and SiO₂ 19.91% have also been established. **The total net geological resources of all grade resources are 465.52 million tons with an average grade of Cao% 45.18, MgO 0.50% and SiO₂ 17.17%.**

Malkhed - 2 South Block: Total Geological Net In-situ Resources of Cement Grade resource estimate is 149.73 million tonnes with an average grade of CaO

48.44%, MgO 0.38% and SiO₂ 12.75%. Total Geological Net In-situ Resources of Beneficiable-Blendable grade resource are 346.74 million tonnes with an average grade of CaO 43.45%, MgO 0.50% and SiO₂ 20.84% have also been established.

The total net geological resources of all grade resources are 496.47 million tons with an average grade of Cao% 44.95, MgO 0.46% and SiO₂ 18.40%.

Malkhed - 2 North Block: Total Geological Net In-situ Resources of Cement Grade resource estimate is 87.22 million tonnes with an average grade of CaO 49.39%, MgO 0.43% and SiO₂ 10.88%. Total Geological Net In-situ Resources of Beneficiable-Blendable grade resource are 208.54 million tonnes with an average grade of CaO 43.31%, MgO 0.42% and SiO₂ 20.44% have also been established.

The total net geological resources of all grade resources are 295.76 million tons with an average grade of Cao% 45.10, MgO 0.42% and SiO₂ 17.62%.

- 1.14.2 The exploration is carried out as per Mineral (Evidence of Mineral Contents) Rule-2015, Mineral Auction Rule-2015, MMDR Amendment Act - 2015 and in accordance with the Minerals (Evidence of Mineral Contents) Amendments Rules 2021.
- 1.14.3 This level of exploration will facilitate the State government of Karnataka for auctioning of block under Mining Lease.
- 1.14.4 The study area suggests that any future mining project may generate employment for the local people and will increase socio-economic status of the people residing in the nearby areas.

CHAPTER – 2

2.0.0 DETAILS OF THE QUALIFIED PERSON(S) / EXPLORATION AGENCY

2.1.0 INVESTIGATING AGENCY

MINERAL EXPLORATION& CONSULTANCY LIMITED

(A Govt. of India Enterprise Miniratna PSE)

Dr. Babasaheb Ambedkar Bhavan, High Land Drive Road,

Seminary Hills, Nagpur-440006

2.2.0 PERSONAL INVOLVED WITH PRELIMINARY EXPLORATION (G3) FOR LIMESTONE IN MALKHED - 1 NORTH, MALKHED - 1 SOUTH, MALKHED - 2 NORTH, AND MALKHED – 2 SOUTH BLOCKS, DISTRICT-KALABURAGI, KARNATAKA.

- A : OVERALL GUIDANCE
: Shri P. Ravindran GM (Exploration)
- B : OVERALL PLANNING and CO-ORDINATION
: Shri P. Ravindran GM (Exploration)
: Shri. Dr. Kuppusamy E, Sr Manager (Geology)
- C : OVERALL SUPERVISION
: Dr. Kuppusamy E, Sr. Manager (Geology)
- D PROJECT MANAGEMENT
: Shri. Anil Tiwari, Project Manager
: Dr. Kuppusamy E, Sr. Manager (Geology)
: Shri, Kamlesh Kumar ADO (Drilling Engineer)
- E : PHYSICAL EXECUTION OF WORK
: Dr. Kuppusamy E, Sr. Manager (Geology)
: Shri. Kamalesh Kumar, ADO (Drilling Engineer)
: Mr. Nagraju Vaddi Sr. Tech. (Sampling)
- F : SAMPLE PROCESSING, MECL, NAGPUR
: Shri. Sathish Kumar Inaparthi Sr. Tech. Sampling
: Mrs. Shika Sharam Sr. Tech. (Sampling)
- G : CHEMICAL LABORATORY, MECL, NAGPUR
: Shri. Rohit Sharma, Manager (Chemical)
: Dr. Dipti Rahangdale, Manager (Chemical)

- H : PETROLOGICAL LABORATORY, MECL, NAGPUR
: Shri. Sayantan Pal, Manager (Geology)
- I : INFORMATION TECHNOLOGY CENTRE
: Shri. N.C.S. Reddy, Console Operator
: Shri Shivananda S., Sr. Computer Operator
- J : DATA PROCESSING and DOCUMENTATION
: Dr. Kuppusamy E, Sr. Manager (Geology)
: Shri. Jagdish Thakaral, Sr. MSO
: Shri. Durgesh Devarshi STA (Map)

CHAPTER - 3

3.0.0 TITLE OF THE REPORT & OWNERSHIP

Title: Geological Report on Preliminary Exploration (G3) for Limestone in Malkhed - 1 North, Malkhed - 1 South, Malkhed - 2 North and Malkhed - 2 South Blocs in Kalaburagi district, Karnataka.

Ownership: Department of Geology and Mining, Government of Karnataka

3.1.0 DETAILS ABOUT PERIOD OF PROSPECTING

The exploratory drilling in the block commenced on 06.02.2025 in Malkhed -1 South block. Totally 11 boreholes were drilled with the cumulative meterage of 550m and borehole core sampling etc. were completed simultaneously. The analytical / laboratory studies were also carried out simultaneously in laboratories of MECL and other NABL accredited laboratories.

3.2.0 DETAILS OF EXPLORATION AGENCY, QUALIFICATION, AND EXPERIENCE OF ASSOCIATED TECHNICAL PERSONS ENGAGED IN EXPLORATION

3.2.1 Exploration Agency: Mineral Exploration and Consultancy Limited

(Formerly Mineral Exploration Corporation Limited)

A Govt. of India Enterprise-A Miniratna-ICPSE

3.3.2 Qualification: M.Sc. / M. Sc. Tech. (Geology)

3.3.3 Experience: Experience: Since 1972 Exploration agency

: Mineral Exploration and Consultancy Limited

3.3.4 Address of the Prospector: Dr. Babasaheb Ambedkar Bhavan, High Land Drive
Road, Seminary Hills, Nagpur, Pin- 440006

3.3.5 Email: cmd@gov.in; gm-exploration@mecl.gov.in

3.3.6 Phone No: 0712-2510289; 0712-2511829

CHAPTER - 4

4.0.0 DETAILS OF THE AREA

4.1.0 LOCATION OF THE BLOCK

4.1.1 The explored Malkhed - 1 North, Malkhed - 1 South, Malkhed - 2 North and Malkhed - 2 South Blocs are located in Sedam Taluk, Kalaburagi District. The Malkhed -1 North & South and Malkhed -2 North & South blocks can be approached at a distance of around 14 kms and 26 kms respectively towards west from the nearest Sedam Taluk headquarters. The explored block fall in the jurisdiction of Malkhed Village, Sedam Taluk, Kalaburagi District. The district head quarter Kalaburagi is at a distance 45kms towards northwest from the block. And the nearest rail head is Malkhed Road ~3kms. Towards south. The location of the Block is shown in **Plate No: I**.

4.1.2 A village road running from Bhimnagar Village to Malkhed -1 South is passing through the block from south to north in the western end of the block. In addition to this, one more is running south to north and is located at about 350m east of the Bhimnagar-Malkhed road.

The explored Malkhed - 1 North, Malkhed - 1 South, Malkhed - 2 North and Malkhed - 2 South block covers an area of 18.01 sq.km combined. It was approved to do DGPS Survey for 4 cardinal points only through which the entire block of 18.01 is divided into 4 parts forming less than 5 km block to auction and the co-ordinates of these 4 cardinal points are given in the following Table No 4.1.

Table No: 4.1
Co-ordinates of 4 corner points of explored in Malkhed – 1/N, M1/S, M2/N and M2/S Blocks (G-3) for Limestone. Taluka: Sedam, District: Kalaburagi, State: Karnataka

Boundary Points	Latitude	Longitude	UTM (m)		RI
			X (m E)	Y (m N)	
MWN-4/MWS-1	17° 10' 58.551"N	77° 9' 44.983"E	730003.904	1901074.665	404.550
MWN-3/MWS-2	17° 10' 17.629"N	77° 11' 3.207"E	732330.105	1899842.294	409.939
MEN-4/MES-1	17° 10' 48.262"N	77° 12' 6.033"E	734176.458	1900805.215	417.827
MEN-3/MES-2	17° 9' 51.509"N	77° 13' 18.083"E	736326.064	1899084.422	428.317

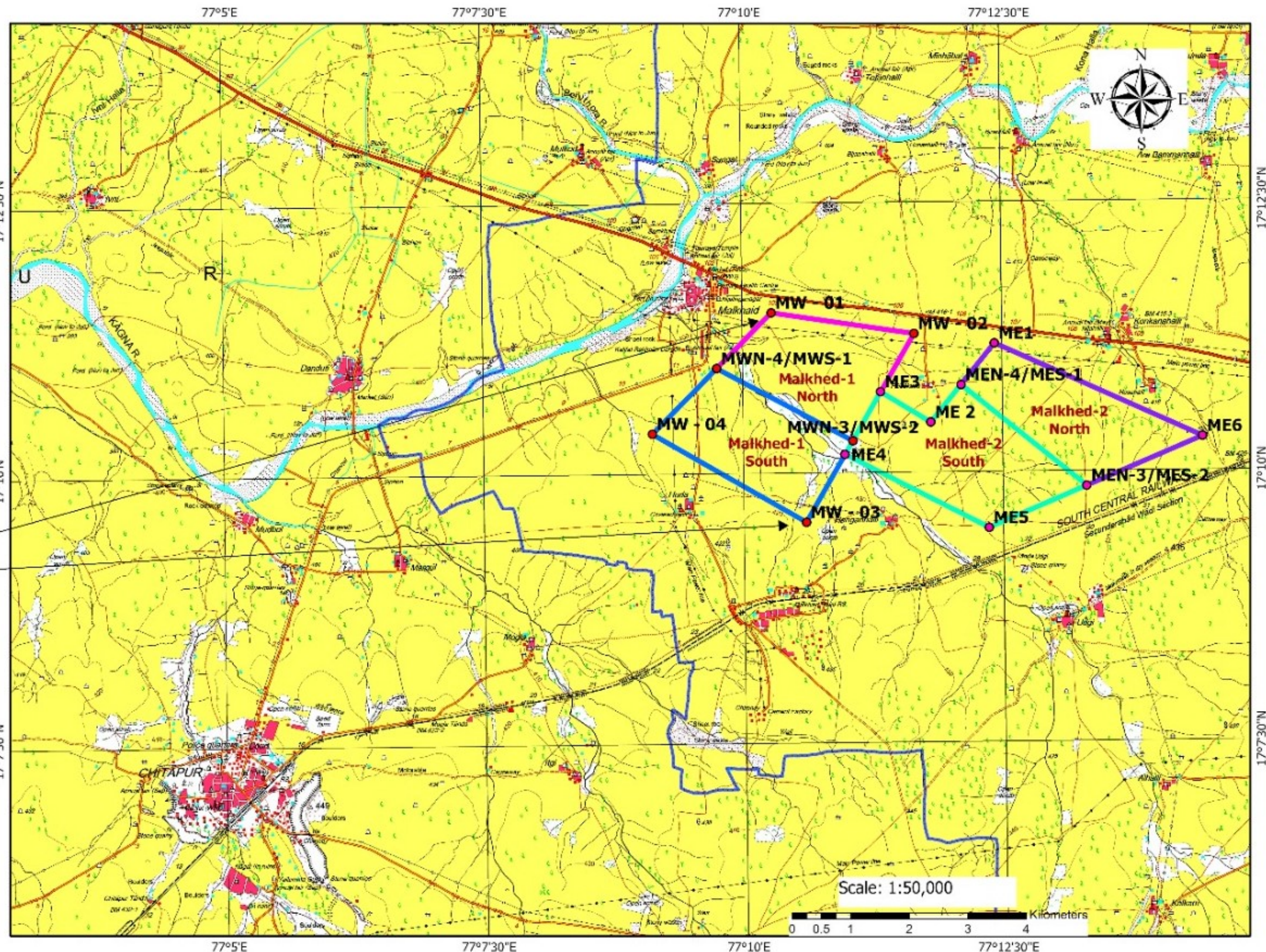
All the coordinates of corner points of Malkhed – 1/N, M1/S, M2/N and M2/ Blocks are given Annexure No IIB

4.2.0 DETAILS OF THE AREA WITH LAND USE

4.2.1 Cadastral details of the area with land use, area under forest with type of forest. In case the cadastral details are not available an indicative data of breakup of government, private and forest land.: Data not available.

4.3.0 MINERAL(S) UNDER INVESTIGATION

4.3.1 Mineral (s) under investigation or granted under license or lease. Limestone



- Legend**
- Boundary Points
 - Malkhed-1 N & S Block
 - Malkhed-2 N & S Block
 - Block Boundary
 - Malkhed-1 North Block
 - Malkhed-1 South Block
 - Malkhed-2 North Block
 - Malkhed-2 South Block

Text Figure No: 1 Location Map of Malkhed-1 North, Malkhed-1 South, Malkhed-2 North and Malkhed-2 South Blocks

CHAPTER - 5

5.0.0 PHYSIOGRAPHY AND ENVIRONMENT

5.1.0 RELIEF OF THE AREA WITH MINIMUM AND MAXIMUM ELEVATION, DRAINAGE PATTERN, NATURAL WATER COURSES, RSERVOIRS ETC.

- 5.1.1 The area is flat with gentle slope towards east. The entire area is covered by black cotton soil. The elevation of the area ranges from 416m MSL to 400m MSL above mean sea level in Malkhed 1 block. The elevation of the area ranges from 428m MSL to 408m MSL above mean sea level in Malkhed 2 block the general slope of the topography in the blocks are from East to West.



Photo-1: A Panoramic view of Malkhed - 1 Block.



Photo -2: A Panoramic view of Malkhed - 2 Block.

5.2.0 ROADS, RAILWAY TRACK, ELECTRIC TRANSMISSION LINE, TELEPHONE LINE ETC

- 5.2.1 The explored block fall in the jurisdiction of Malkhed village, Sedam Taluk and Kalaburagi District. The district head quarter Kalaburagi is at a distance 45 km towards north-west from the block.
- 5.2.2 Malkhed road is the nearest railway station at a distance of around `3 kms and Chittapur railway station is around 10 kms from the explored block. Nearest airport is at Kalaguragi at a distance of 30 kms. The nearest port is Marmagoa, Goa State situated at around 480 kms from the explored block.

5.2.3 No electrical Transmission lines are seen within the block. However, the surrounding villages having electric transmission for domestic purposes.

5.3.0 HOST POPULATION (LOCAL TRIBES), HUMAN SETTLEMENTS WITHIN AND NEARBY THE AREA

5.3.1 The initial provisional data released by Census India 2011, shows the density of Kalaburagi District for 2011 had population of 25,66,326 of which male and female were 13,017,55 and 12,64,571 respectively.

5.3.2 Malkhed - 1 North, Malkhed - 1 South, Malkhed - 2 North and Malkhed - 2 South blocks fall in Sedam Taluka of Kalaburagi District. Villages falling in the block are Malkhed, Hanganhalli and Huda.

5.3.2 The Sedam Taluka of Kalaburagi District has a population of 218,572 out of which 108,598 are male and 109,574 females. literacy rate combined is 57.53% (Male 57.90% & Female 41.13%), out of total population 61,748 (28.25%) belong to SC community and 4,983 (2.28%) belong to ST community.

5.4.0 SOCIO DEMOGRAPHIC PROFILE OF THE AREA AND NEARBY

5.4.1 Sedam Taluka has a population of 218,572 as per 2011 census data out of which 108,598 are male and 109,574 females of sex ratio is 1000 females per 991 males.

5.4.2 Professionally there are workers, agricultural farmers and labourers in Sedam Taluka. Out of total population 99,705 were engaged in work activities. 77.30% of workers describe their work as Main work (Employment or Earning more than 6 months) while 22.70% were involved in marginal activity providing livelihood for less than 6 months. Of 99,705 workers engaged in Main work, 21817 were cultivators (owner or co-owner).

5.5.0 HISTORICAL SITES AND ARCHAEOLOGICAL MONUMENTS, PLACES OF WORSHIP, PUBLIC UTILITIES ETC. WITHIN OR NEARBY

5.5.1 Malkhed Fort & Budh Vihar are at 4kms, Khwaja Bande Nawaz Dargah & Haft Gumbaz at 5kms from the block

5.6.0 FOREST, SANCTUARIES, NATIONAL PARK AND WILD LIFE SANCTUARY

5.6.1 No Forest, Sanctuaries, National Park and Wild Life Sanctuaries within the 10 kms from the explored block.

5.7.0 FLORA AND FAUNA

- 5.7.1 The area is characterised by scanty vegetation and dry crop cultivation. Chilli, maize, groundnut, gingili and pulses are the common dry crops cultivated by rotation. Study area is fertile. Mostly cashew, black gram is cultivated in the study area.
- 5.7.2 The area has no rare endangered species of flora. The species of fauna found in the area are rat, squirrel, lizard and house crow and reptiles.
- 5.7.3 Total block area is under cultivation i.e. agricultural activities.

5.8.0 WATER BODIES SUCH AS RIVER, NALA, STREAM, RESERVOIR ETC

- 5.8.1 The blocks are drained by west flowing Kagina river forms the main drainage in the area. There are no perennial rivers in the block area, however a seasonal nala flows across the central part of the block. The drainage pattern of the area is dendritic in nature.

5.9.0 CLIMATE CONDITIONS

- 5.9.1 The climate of the area is tropical monsoon type. The temperature during winter month seldom goes to 10° C, while in the peak summer it rises up to 45° C. The average rain fall is 770-880 mm and the relative humidity varies from 26% in summer to 62% in winter.

5.10.0 OTHER PHYSIOGRAPHIC, SOCIAL AND ENVIRONMENT FACTOR

- 5.10.1 The block area is generally flat with moderately sloping down terrain from east to west. Generally, the area is covered by soil cover, agriculture lands with scanty limestone exposures along seasonal water way. The main source of the income is agriculture. The block area is surrounded by cement manufacturing industries and some of them are as follows:

- Orient Cement Plant, Itgi, Chittapur
- Ultratech Cement Plant, Malkhed
- Vasavadatta Cement plant, Sedam
- Jaypee Cement Corporation Ltd. Plant, Shahabad
- ACC, Cement, Wadi
- Shree Cement, Kalaburagi

Cement Industries mainly contributes to the economic growth and development in the region of Kalaburagi District.

- 5.10.2 No major environment factors such as Sanctuaries, Forest areas are within the buffer zone of 10 kms. However. Chincholi Wild life Sanctuary is around 70 kms from the explored block towards north-east.

CHAPTER - 6

6.0.0 INFRASTRUCTURE AND ENVIRONMENT

6.1.0 LOCAL INFRASTRUCTURE DETAILS

- 6.1.1 The Malkhed -1 North & South and Malkhed -2 North & South blocks can be approached at a distance of around 14 kms and 26 kms respectively towards west from the nearest Sedam Taluk headquarters. The explored block fall in the jurisdiction of Malkhed Village, Sedam Taluk, Kalaburagi District. The district head quarter Kalaburagi is at a distance 45 kms towards northwest from the block. The Kalaburagi Airport is nearest and 30 km from the block on Kalaburagi-Sedam state highway No.10.
- 6.1.2 Banking, Government medical facility, Postal, Police facilities are available at Malked village, and as well as in Sedam Taluka which is 26 km from the explored block and educational and other major facilities are available at Sedam Taluk.
- 6.1.3 Chittapur double electric line on South Central Railway line is nearest railway station at a distance of around 10km from the explored block. Nearest airport is at Kalaburgiat a distance of 30km. nearest port is Marmagoa, Goa State situated at around 480km from the explored block.

6.2.0 HOST POULATION AND HISTORICAL SITES

- 6.2.1 The explored block falls in SedamTaluka, Kalaburagi District of Karnataka State. As per the Census India 2011, Kalaburagi District has total population of 26,66,326 of which 13,01,755 are males and 12,64,571 are females.
- 6.2.2 The sex-ratio of Kalaburagi District is 971 females per 100 males.
- The literacy rate of Kalaburagi District is 64.85% out of which 74.38% males are literate and 55.09% females are literate. The total area of Kalaburagi District is 10,954 sq.km with population density of 234 per sq.km.

6.3.0 FORESTS, SANCTUARIES, NATIONAL PARK AND ENVIRONMENT SETTING OF THE AREA

- 6.3.1 Chincholi Wild life Sanctuary ia around 70 kms from the explored block towards north-east.

CHAPTER - 7

7.0.0 GEOLOGY OF THE AREA

7.1.0 REGIONAL GEOLOGY

- 7.1.1 Bhima basin is the smallest of all Proterozoic basins of India. They do not actually come in contact with the Kaladgi Group and are believed to be younger. They are in close resemblance to the Kurnool Group of the Cuddapah Super group. The Bhima Basin is covered by latitude N 16°20' to 17°35' and longitude N 76°15' to 77°40'E. The Bhima Basin is trending N-S for about 160 km with varying width and the maximum being 40 km. The Northern and North-Western extensions are concealed under Deccan Traps. The Southern and Eastern margins of the basin mark the unconformable contact with granitic gneisses of Dharwar Craton. It extends over an area of 5200 Sq.km. and is situated to the North-West of Cuddapah Basin and North-East of Kaladgi Basin.
- 7.1.2 Bold (1842 – 1845) was first to record the Talikote flaggy limestone and Muddebihal red sandstone. Bruce Foote (1876) had divided the Bhima Group (mainly of limestone) into lower clastic represented by sandstone and shale and upper mainly of limestone and shale. Further, Mahadevan (1947), Janardhana Rao et.al (1973), Mathur (1977), Mudholkar and Kale (1982) and Mishra et.al (1987) classify Bhima Group. However, Kale, Phansalkar et.al (1991) classify Bhima Group into Rabanapalli (clastic) formation and Shahabad (limestone) formations.
- 7.1.3 The Stratigraphic Column of the Bhima Group (after GSI) is furnished as below:

Table No:7.1
The Stratigraphic Column of the Bhima Group (after GSI)

Group	Sub-Group	Formation	Member	Thickness(m)
Deccan Trap	-		Basic flows	
Bhima Group (upper Proterozoic) (93-273 m.y)		Harwal-Gogi	Fossil shale member ortho-quartzite chert + pebble conglomerate.	5-10
	Andola Sub-group in Pulsating basin environment (31-68 m.y)	Katamdevar-halli		10-40 16-18
		Halkal		
	----- Paraconformity -----			
			Flaggy dark grey and argillaceous limestone.	4-6
			Massive dark grey and bluish grey Limestone.	8-20
		Shahabad	Variegated and siliceous/cherty Limestone.	20-80
	Sedam Sub-group with quiescent basin regime (62-2.5 m.y)		Blackish, light grey to bluish grey limestone.	10-15
			Slabby and flaggy Limestone.	4-8
			Purple shale.	2-40
		Green/yellow shale.	5-15	
		Rabanapalli	Siltstone.	3-4
			Quartzite/Inter-calated sandstone.	5-15
		Conglomerate / grit.	1-2	
----- Un conformity -----				
Basement Crystallines			Younger granite peninsular gneisses.	-

7.1.4 Revised litho stratigraphy of the Bhima Group is furnished below:

Table No: 7.2
Revised litho stratigraphy of the Bhima Group
(after Kale, Phansalkar et.al 1991)

Formation	Maximum Thickness(m)	Member	Main Lithological components
2. Shahabad Limestone	< 75		<ul style="list-style-type: none"> • Grey, argillaceous micritic limestone. • Dark, bluish grey, massive limestone. • Variegated, siliceous and cherty limestone. • Blue- grey, black-micritic limestone. • Flaggy (Partly impure argillaceous and cherty) limestone.
----- Gradational and transitional contact -----			
1. Rabanpalli Clastics	< 70	Ekmai shale member	Ferruginous shale, with calcareous shales at top.
		Kasturpalli-Glauconitic member	Green, glauconite, fine grained sandstone and siltstone.
		Kundrapalli quartz arenite member	Quartzitic sandstone (medium to fine grained).
		Adki Hill conglomerate member	Polymictic conglomerates and arkosic, gritty sandstones.

7.1.5 The total absence of fossils rules out the sediments of Bhima Group transgresses into the Cambrian. Thus envisaged the upper age limit is not less than 600 million years.

7.1.6 Regional Geological map of Bhima Basin (Part) is enclosed as Plate No. II on 1: 50,000 Scale.

7.2.0 REGIONAL STRUCTURE

7.2.1 PRIMARY SEDIMENTARY STRUCTURES

The preservation of primary sedimentary structure is relatively poor. In terms of primary sedimentary structure, bedding planes and laminations are common within limestone-shale unit. Bedding planes are usually marked by variation in colour, composition and grain size.

7.2.2 SECONDARY/ DIAGENETIC STRUCTURE

Stylolites are diagenetic structures usually follow the bedding plane and are filled by ferruginous clayey material. Within the massive limestone, dolomitic limestone and shaly limestone and thin veins of re-crystallized calcite are present. Solution cavities

and vugs filling are found well within the dolomitic limestone and shaly limestone. Sedimentary deformation structures are present at places in shaly limestone.

7.2.3 The general trend of all formations is NE–SW. The rectilinear East - West (E-W) to North West (NW) - South East (SE) trending boundaries are faulted while the N-S and NNE-SSW linear trends show unconformable relation with the underlying gneisses.

7.2.4 Sediments of Bhima Group are structurally least disturbed and preserve their horizontal bedded character since the time of deposition. Deformation is observed only in the vicinity of faults. The faults encountered have continued into the basement and have controlled the basin configuration.

7.3.0 REGIONAL MINERALISATION

7.3.1 The basin is well known for its huge resources of limestone and the newly discovered Uranium occurrence near Gogi (1998-2000) by AMD. Regional Geological map of Bhima basin is provided as Text Figure No: 2 & Plate No. II.

7.4.0 BLOCK GEOLOGY

7.4.0 GEOLOGY OF THE AREA

7.4.1 The rock types exposed in the block belong to the Shahabad Formation of Sedam subgroup of Bhima Group. The stratigraphic sequence of the litho units exposed in and around the block based on field observations and available data/literature from nearby mine/areas is given in Table No: 7.3. The Topographical & Geological Map of the Malkhed - 1 North and Malkhed - 1 South Block is enclosed as Plate No. III A in 1: 4000 Scale and Malkhed - 2 North and Malkhed - 2 South Block is enclosed as Plate No. III B in 1: 4000 Scale.

Table No: 7.3

Stratigraphic Sequence of Litho-units exposed in and around the Block

Age	Group	Sub Group	Formation	Litho Units
Quaternary	-	-	Recent	Top soil
Upper Proterozoic	Bhima	Sedam	Shahabad Limestone	Siliceous/flaggy limestone. Massive grey limestone Shaly limestone.
----- Gradational and transitional contact -----				
-	-	-	Rabanpalli Clastics	Ferruginous Shale, calcareous shale, Green, Glauconite, fine grained Sandstone and Siltstone

7.4.1 DESCRIPTION OF ROCK TYPES IN THE BLOCK

7.4.1 Almost entire area of the block is concealed under quaternary sediments i.e. soil cover. Scanty scattered limestone outcrops are seen at places along the seasonal water way of the block. Since most of the area is concealed under soil cover the strike and dip of the limestone beds are observed in two or three places within the block. Mining activities are currently ongoing in the eastern part of the Bhima Basin wherein limestone is being excavated for manufacturing of cement. The lithological description of litho units from top to bottom as obtained from drilled boreholes as well as from nearby mines is given below:

7.4.2 Top Soil and Over burden

The top soil is black in colour, fine to silty, friable when dry and sticky when wet. The top soil covers almost the entire block. The thickness of the soil as intersected in boreholes varies from 1.00 m to about 7.00 m at places.

The overburden of siliceous clay intersected from 6.00m to 37.30m in the borehole MKML/11 in malkhed-2 North Block only.

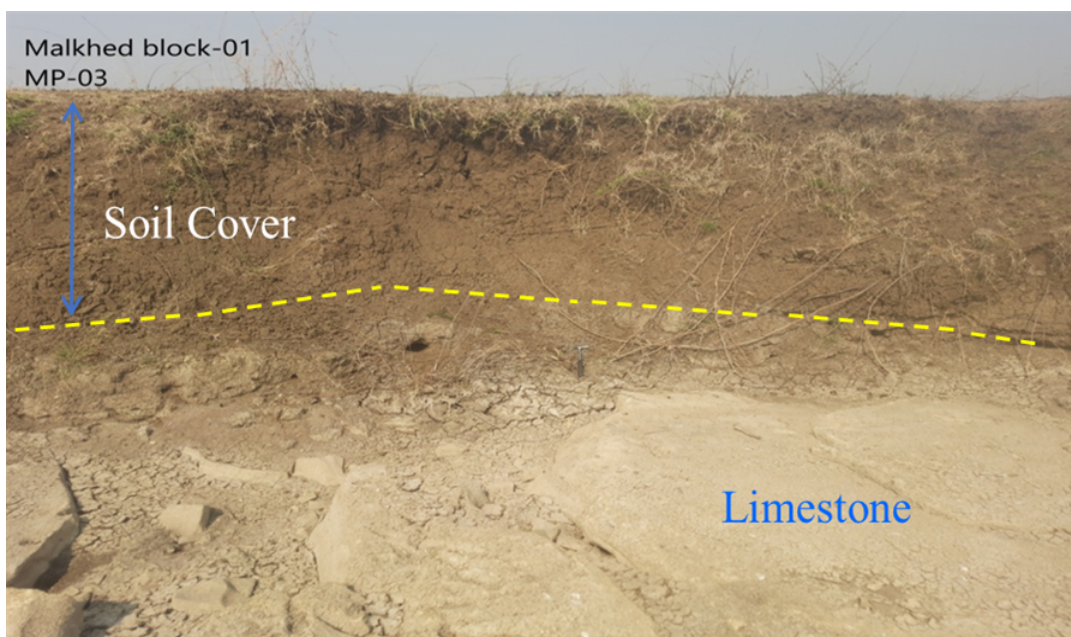


Photo-3: Limestone with Overburden (Soil cover) in Malkhed-1 South Block

7.4.3 Shahabad Limestone

Massive limestone is dark grey to light grey in colour, micritic, fine grained and compact. Stylolitic structures are often noticed. This Formation has a cumulative thickness from 1.00m to 50 m in the borehole MKML-02 drilled in Malkhed-1 South Block. However, the limestone continued up to 128.40m in the borehole

KML-08 which was drilled during the first phase of drilling in April 2023 in Malkhed -1 Block, the massive grey limestone is of Cement Grade to high grade encountered with intermittent partitions of beneficiable-blendable, blendable and threshold grade limestone zones. Over all the blendable, beneficiable-blendable and threshold limestone are + 38% CaO with +18.00 % SiO₂ and it is dark grey to light grey in colour, micritic, fine grained and compact.

7.4.4 **Ekmai shale**

These are ferruginous shale with calcareous top and has been intersected in the borehole in KML-08 at 145.00m, during the first phase of drilling in April 2023 in Malkhed -1 Block.

7.5.0 **STRUCTURAL FEATURES OBSERVED IN THE BLOCK**

7.5.1 **STRUCTURE OF THE BLOCK**

The rock formations of the Block are horizontally disposed and mostly concealed under top soil. At places, limestone beds dip 1° to 2° due N to NW.

7.6.0 **PETROGRAPHIC STUDIES**

7.6.1 Petrographic studies are not approved to conduct in the NMET approval.

7.7.0 **MINERALISATION IN THE BLOCK**

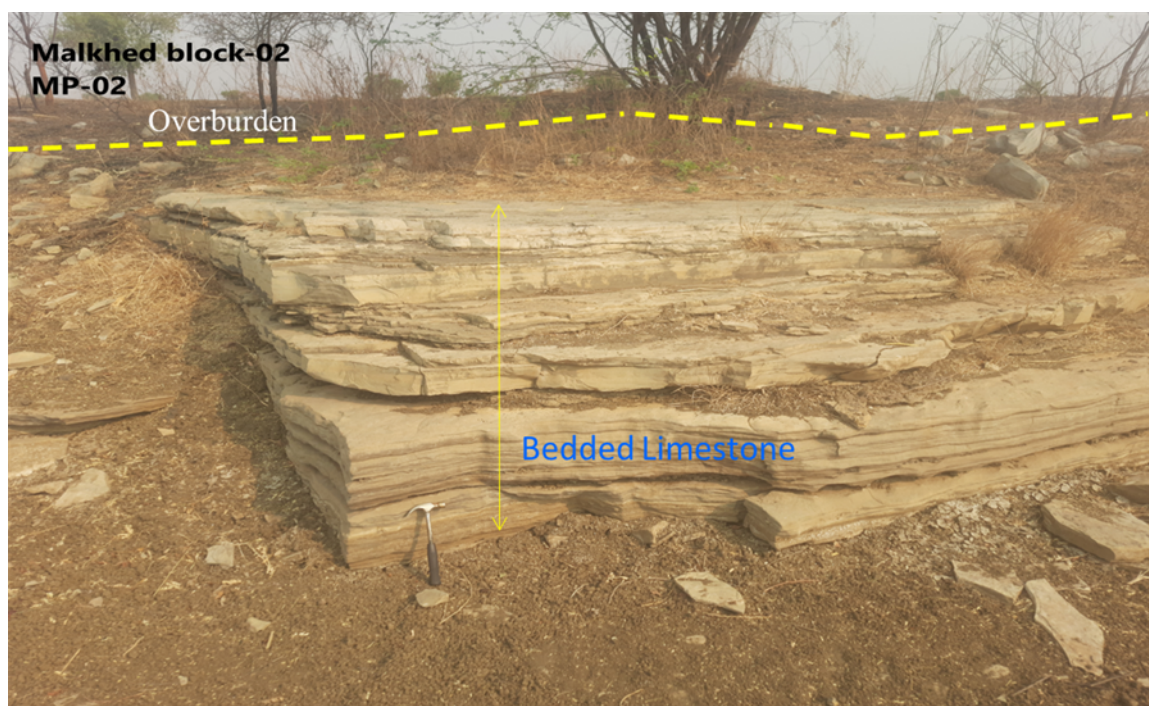


Photo-4: Limestone with Overburden (Soil cover) in Malkhed – South Block

7.7.1 Massive limestone is dark grey to light grey in colour, micritic, fine grained and compact. Stylolitic structures are often noticed. The intersection of soil cover, overburden (Sandy clay & Siliceous clay) and limestone are tabulated block wise.

Block	Borehole	Top Soil Cover		OB & Rej. (Sandy clay & Siliceous clay)		Limestone (m)	
		From	To	From	To	From	To
Malkhed-1 South	MKML-01	00.00	2.00	-	-	2.00	50.00
	MKML-02	00.00	1.00	-	-	1.00	50.00
	MKML-05	00.00	2.40	-	-	2.40	50.00
Malkhed-1 North	MKML-03	00.00	3.60	-	-	3.60	50.00
	MKML-04	00.00	2.00	-	-	2.00	50.00
	MKML-06	00.00	2.60	-	-	2.60	50.00
Malkhed-2 South	MKML-07	00.00	5.00	-	-	5.00	50.00
	MKML-08	00.00	2.40	-	-	2.40	50.00
Malkhed-2 North	MKML-09	00.00	4.00	-	-	4.00	50.00
	MKML-10	00.00	1.00	1.00	7.00	7.00	8.00
				8.00	10.00	10.00	18.00
				18.00	19.00	19.00	50.00
	MKML-11	0.00	2.00	2.00	39.30	39.30	41.30
				41.30	45.00	45.00	45.40
				45.40	45.90	45.00	45.40
				47.00	50.00	45.90	47.00

The massive grey limestone is of Cement Grade to high grade zones with intermittent partitions of beneficiable-blendable and blendable grade limestone zones. The limestone is dark grey to light grey in colour, micritic, fine grained and compact.

7.7.2 MINERAGRAPHIC STUDIES

Mineragraphic studies are not approved to conduct in the NMET approval.

7.7.3 PHOTOMICROGRAPHIC STUDIES

Photomicrographic studies are not approved to conduct in the NMET approval.

CHAPTER - 8

8.0.0 PREVIOUS WORK

8.1.0 DETAILS OF PREVIOUS EXPLORATION CARRIED OUT BY OTHER AGENCIES/PARTIES

- 8.1.1 The entire Bhima basin was mapped by GSI and exploration at different stages was carried out in a scattered manner. The Geological Map of Bhima Basin (Part) of Kalaburagi and Bijapur Districts of Karnataka and Ranga Reddy district Andhra Pradesh in Parts of Degree Sheets 56 C, D, G and H on Scale 1:150,000, Published by GSI (2007) is attached as **Plate No. IIA and IIB for Malkhed - 1 North, Malkhed - 1 South, Malkhed - 2 North, Malkhed 2 South blocks respectively.**
- 8.1.2 Directorate of Mining & Geology (DMG), Karnataka explored the adjoining area in detail in the year 1976 with the purpose of proving cement grade limestone in the area. The exploration could establish the occurrence of large reserves of cement grade limestone in the area. The results of investigation are given in the report entitled “Limestone Deposits immediately to the East of Chittapur, Kalaburagi District of Karnataka”. The said work was targeted for feasibility to setup cement industry.
- 8.1.3 Jayaprakash (1974-75) from GSI carried out preliminary investigation for Flux grade Limestone around Wadi, Kalaburagi District, Karnataka. The area is occupied by Shahabad limestone formation of Bhima group, chip samples were collected from vertical faces of the quarries existing in the area. Chemical analysis shows that the MgO content is always very low. A few beds of grey to dark grey soft limestone are of blast furnace grade and the rest are of cement grade. Flaggy to slab by variegated limestones are always siliceous in composition with the insoluble around 15%.
- 8.1.4 During the field season 1976-77, GSI carried out preliminary investigation for Flux grade Limestone near Wadi, Kalaburagi District, Karnataka. An area of about 16.75 sq. km. on 1:7,910 scale using the village maps as base map was covered by mapping. A total of 150 samples were collected and analysed. The formations met with include Rabanapalli shale and flaggy limestone, stylolitic limestone and variegated limestone units of Shahabad Limestone Formation. All those formations are remarkably horizontal and undisturbed. Generally, stylolitic limestone contains CaO 48% and above and insoluble around 10%. Hence it is categorized as Blast Furnace Grade. The other two units can be utilized in cement manufacture if suitably blended with high grade limestone. An inferred reserve of 96 million tonnes of Blast

Furnace grade limestone has been estimated over an area of 4.00 sq.km to a depth of 12 m. Drilling can be taken up to explore the depth-wise persistence and lateral extension of the B.F. grade limestone.

- 8.1.5 Jayaprakash (1977-78), GSI carried out preliminary investigation for Flux grade and Cement grade Limestone in Bhima Basin, Kalaburagi District, Karnataka. Preliminary investigation for flux grade and cement grade limestone in parts of Bhima Basin, Kalaburagi District, Karnataka was taken up over an area of 50.5 sq.km on 1:10,000 scale using tape and compass and a total of 125 samples were collected, around Wadi and Chittapur. The limestone met with in this area has been classified as fissile limestone, stylolitic limestone and variegated limestone. Stylolitic limestone is of Flux grade (Blast Furnace grade) and occupies over an area of 8.5 sq.km. Total inferred reserve of B.F. grade limestone has been calculated as 153 million tonnes for the area under investigation.
- 8.1.6 East of Chittapur and North Diggaon village, MECL has carried out exploration during 2018-19 at G3 level and established 530.80 MT with average grade 45.45% CaO, 1.00% MgO, 11.59% SiO₂ in Diggaon Block and 385.35 MT with average grade 45.66% CaO, 0.55% MgO, 12.98% SiO₂ in Udagi Block of net in-situ resource of Cement grade Limestone.
- 8.1.7 GSI had carried out G-2 exploration in Bommanalli Limestone Block and estimated a resource of B.F Grade 244.27 MMT in Avg 49.83% CaO, 9.92% SiO₂, 1.16% Al₂O₃, Cement Cement Grade 18.921 MMT in Avg 47.42% CaO, 14.41% SiO₂, 0.91% Al₂O₃, 154.246 MMT in Avg 41.80% CaO, 23.37% SiO₂, 2.12% Al₂O₃ and 46.488 MMT in Avg 39.12% CaO, 27.17% SiO₂, 1.65% Al₂O₃.
- 8.1.8 GSI had carried out G-2 exploration in Chittapur South Limestone Block and estimated a resource of Cement Cement Grade 89.04 MMT in Avg. 46.39% CaO, 15.65% SiO₂, 0.98% Al₂O₃, Beneficiable Cement Grade 228.16 MMT in Avg 39.08% CaO, 27.03% SiO₂, 1.66% Al₂O₃.
- 8.1.9 GSI had carried out G-4 level exploration in Chittapura SW Block and Sulahalli Limestone Block, estimated a resource of 438.00 MMT of Cement Grade Limestone and 466.00 MMT of Cement Grade Limestone respectively.
- 8.1.10 Mining activities are currently ongoing in surrounding areas and limestone being excavated for manufacturing cement.

8.2.0 PREVIOUS WORK DONE BY MECL

- 8.2.1 MECL has carried out G-3 level of exploration in Diggaon and Udagi blocks and recently carried G3 level exploration in Malkhed-1 and 2 blocks in February-April 2023 & Kiranagi-1 & 2 blocks in May to June-2023.
- 8.2.2 East of Chittapur and north of Diggaon village, MECL has carried out exploration during 2018-19 at G3 level and established 530.80 MT with an average grade of 45.45% CaO, 1.00% MgO, 11.59% SiO₂ in Diggaon Block and 385.35 MT with average grade 45.66% CaO, 0.55% MgO, 12.98% SiO₂ in Udagi Block of net in-situ resource of Cement grade limestone. Presently these blocks are under auction.
- 8.2.3 In the recent exploration carried out in Malkhed-1 block, MECL estimated a total Geological Net in-situ Resource of Cement Grade of 686.26 million tonnes with an average grade of CaO 49.09%, MgO 0.42% and SiO₂ 11.49%. Total Geological Net In-situ Resource of Blendable grade is 25.00 million tonnes CaO 45.87%, MgO 0.48% and SiO₂ 16.84%. However, the Blendable/Beneficiable grade resource is 346.89 million tonnes with an average grade of CaO 43.26%, MgO 0.52% and SiO₂ 20.68% have also been established. The occurrence of limestone is confirmed up to 130m by a stratigraphic borehole (KML-08) which was drilled up to 150m (Closed in Ekmai Shale at 150.00m)
- 8.2.4 In the recent exploration carried out by MECL in Malkhed-2 block, estimated a total Geological Net in-situ Resource of Cement grade resource of 264.02 million tonnes with an average grade of CaO 48.31%, MgO 0.38% and SiO₂ 13.17%. However, the Blendable/Beneficiable grade resource is 606.70 million tonnes with an average grade of CaO 43.51%, MgO 0.48% and SiO₂ 20.58% have also been established.
- 8.2.5 In Kiranagi-1 block, MECL estimated a total Geological Net in-situ Resource of Cement Grade resource estimate is 281.43 million tonnes with an average grade of CaO 49.13%, MgO 0.54% & SiO₂ 9.96%. Total Geological Net in-situ Resource of Blendable grade is 50.78 million tonnes CaO 43.88%, MgO 0.67% & SiO₂ 17.11%, Blendable/Beneficiable grade resource is 3.27 million tonnes with an average grade of CaO 42.28%, MgO 0.45% & SiO₂ 20.26% and Threshold grade resource is 97.27 million tonnes with an average grade of CaO 40.60%, MgO 0.58% and SiO₂ 23.45% have also been established.
- 8.2.6 In Kiranagi-2 block, MECL estimated a total Geological Net in-situ Resource of Cement grade resource estimate is 18.32 million tonnes with an average grade of CaO 47.26%, MgO 0.45% and SiO₂ 13.87%. and Threshold grade resource is 494.89

million tonnes with an average grade of CaO 39.13%, MgO 0.57% and SiO₂ 27.16% have also been established.

- 8.2.7 In Naddisinur-1 block MECL estimated a total Net in-situ Resource of Cement Grade resource is 495.63 million tonnes with an average grade of CaO 49.77%, MgO 0.62% and SiO₂ 9.40%. have been established. Out of which 460.77 million tonnes are inferred (333) and 34.86 million tonnes are reconnaissance (334) categories. The total inferred category resource is 92.97% of total estimated resource of 495.63 million tonnes. Hence the total of 495.63 million tonnes of resource is considered as inferred category to auction under mining lease.
- 8.2.8 In Naddisinur-2 block MECL estimated a total Net in-situ Resources of;
- (i) Cement Grade resource is 56.08 million tonnes with an average grade of CaO 47.78%, MgO 0.40% and SiO₂ 13.27%. have been established. Out of which 45.69 million tonnes are inferred and 10.39 million tonnes are reconnaissance categories.
 - (ii) Blendable Grade resource is 5.56 million tonnes with an average grade of CaO 46.02%, MgO 0.60% and SiO₂ 17.44% have been established. Out of which 4.38 million tonnes are inferred and 1.18 million tonnes are reconnaissance categories.
 - (iii) Blendable-Beneficiable Grade resource is 299.35 million tonnes with an average grade of CaO 41.10%, MgO 0.60% and SiO₂ 23.66%. have been established. Out of which 225.72 million tonnes are inferred and 73.73 million tonnes are reconnaissance categories.
 - (iv) Threshold Grade resource is 82.90 million tonnes with an average grade of CaO 39.68%, MgO 0.61% and SiO₂ 26.09%. have been established. Out of which 78.66 million tonnes are inferred and 4.14 million tonnes are reconnaissance categories.

CHAPTER - 9

9.0.0 GEO PHYSICAL EXPLORATION

Geophysical/Geochemical survey was not carried out by MECL and it was also not proposed to the NMET for the approval.

CHAPTER - 10

10.0.0 EXPLORATION UNDERTAKEN DURING CURRENT INVESTIGATION

10.1.0 OBJECTIVES OF INVESTIGATION

The exploration was proposed with following objectives:

- i) To confirm the continuity of limestone occurrences within the block area by drilling of 11 infilling boreholes at G-3 level of exploration to estimate the grade wise limestone inferred resources in the block area as per UNFC norms of G-3 level of exploration.
- ii) To carry out preliminary exploration (G-3) as per the Minerals (Evidence and Mineral Contents) Amendment Rules 2021, Mineral Auction Rule 2015 Amended up to 2021, MMDR Amendment Act 2015 in turn to facilitate the State Government (Karnataka) for auctioning of the block.

10.2.0 EXPLORATION ACTIVITIES TAKEN UP

After the receipt of approval Order: F. No.23/365502/2024-NMET/429 New Delhi dated 22nd October 2024 from NMET, MECL has carried out exploration activities in Malkhed -1/N, M1/S, M2/N and M2/S Blocks. The details, nature and quantum of work proposed Vs achievement is given below:

Table No: 10.1
Quantum of Work - Proposed Vs Achieved Malkhed – 1/ N, M1/S, M2/N and M2/S Blocks,
Kalaburagi Dist. Karnataka State.

Sl. No.	Description and Nature of Work	Unit	Approved	Achieved	Achieved	Achieved	Achieved	Achieve
			4 Blocks combined	Malkhed 1 North	Malkhed 1 South	Malkhed 2 North	Malkhed 2 South	4 Blocks combined
A	SURVEYING							
1	Borehole Survey Work		Borehole Points 11	3	3	3	2	11
2	Corner Points Survey		Corner Points 4	2 points common to both North & South		2 points common to both North & South		Corner Points 4
B	EXPLORATORY DRILLING							
1	Drilling up to 300m (Soft Rock)	m	600	150	150	150	100	600
C	LABORATORY STUDIES							
1	Chemical Analysis							
	i) Primary Sampling	Nos.	500	141	145	122	93	501
	ii) Check Sampling External	Nos.	50	14	15	12	9	50*

* Sent to JNARDC lab for external check analysis

Exploratory drilling commenced with borehole no. MKML-01 on 06.02.2025 in Malkhed -1 South Block and was completed with the closure of borehole no. MKML-11 on 03.04.2025 in Malkhed – 2 North Block. The allied field-works including surveying, drilling and borehole core sampling etc. were completed simultaneously. The analytical / laboratory studies were also carried out simultaneously in laboratories of MECL and other NABL accredited laboratories, JNARDDC, Nagpur.

10.2.1 Topographical Survey:

In the first phase of exploration during 2023, block boundaries of Malkhed-1 and 2 blocks are surveyed with the help of DGPS (TRIMBLE make) and topographical survey by total station in WGS-84 datum by the input data provided by DMG, Karnataka. Triangulation network has been laid in the explored area of 8.49 sq.km and 9.52 sq. km for Malkhed-1 and Malkhed-2 blocks respectively. Surface Contouring done at 2m contour intervals along with survey of surface features for Malkhed 1 North & South (on scale 1:5,000) and Malkhed - 2 North, South (on scale 1:4,000) blocks. During current exploration boreholes are fixed on the ground. RL's and co-ordinates of survey and exploration points are determined by DGPS survey. The RL and co-ordinates of boreholes and corner points have been determined and furnished as **Annexure IA and IB** respectively.

10.2.2 Geological Mapping

In 2023 during first phase of exploration Geological mapping on 1:4,000 scale was carried out area of 8.49 and 9.52sq. km. for Malkhed-1 and Malkhed-2 blocks respectively. Since then, no change of surface features and topography of the for Malkhed-1 and Malkhed-2 blocks. The entire block area is covered with soil/alluvium, and the same is marked in the Topographical and Geological Map enclosed as **Plate No. III A and III B** on 1: 4000 and 1: 4000 Scale for Malkhed-1 and Malkhed-2 blocks respectively.

10.2.3 Exploratory Drilling

Geological logging of borehole cores was properly done along-with all the structural, lithological and mineralogical observations. (Annexure-IIA and IIB). limestone bands have been encountered in all of the 11 boreholes.

Borehole co-ordinates along with RL have been determined for all the boreholes with the help of WGS-84 Datum. The drilling commenced on 06.02.2025 with MKML/01 and concluded with MKML/11 on 03.04.2025. The details of section wise boreholes

drilled by is Tabulated below Table No 10.2 and the details of section wise boreholes drilled by MECL during I Phase of exploration is tabulated below Table No 10.3.

Table No: 10.2

Details of section-wise boreholes drilled in Malkhed – 1 South, Malkhed-1 North, Malkhed-2 South and Malkhed-2 North Blocks, Kalaburagi Dist. Karnataka State.

Sl. No.	Borehole No.	Section Line	Vertical (°)	Total Depth (m)	RL (m)	Block
1	MKML/01	S4 – S4'	90°	50.00	411.49	Malkhed-1 South
2	MKML/02	S4 – S4'	90°	50.00	403.73	Malkhed-1 South
3	MKML/05	S2 – S2'	90°	50.00	407.052	Malkhed-1 South
4	MKML/03	S4 – S4'	90°	50.00	401.409	Malkhed-1 North
5	MKML/04	S2 – S2'	90°	50.00	401.62	Malkhed-1 North
6	MKML/06	S2 – S2'	90°	50.00	411.22	Malkhed-1 North
7	MKML/07	S5 – S5'	90°	50.00	419.56	Malkhed-2 South
8	MKML/08	S5 – S5'	90°	50.00	419.05	Malkhed-2 South
9	MKML/09	S3 – S3'	90°	50.00	422.13	Malkhed-2 North
10	MKML/10	S1 – S1'	90°	50.00	421.37	Malkhed-2 North
11	MKML/11	S3 – S3'	90°	50.00	424.97	Malkhed-2 North

Table No: 10.3

Details of section-wise boreholes drilled in Malkhed - 1 and Malkhed - 2 Blocks drilled in the I Phase exploration (Feb-May2023), Kalaburagi Dist. Karnataka State.

Sl. No.	Borehole No.	Section Line	Vertical (°)	Total Depth (m)	RL (m)	Block
1	KML/09	S5 – S5'	90°	50.00	411.579	Malkhed-1 South
2	KML/08	S3 – S3'	90°	150.00	402.502	Malkhed-1 South
3	KML/07	S3 – S3'	90°	50.00	413.204	Malkhed-1 South
4	KML/10	S3 – S3'	90°	50.00	44.459	Malkhed-1 North
5	KML/06	S1 – S1'	90°	50.00	409.219	Malkhed-1 North
6	KML/02	S7 – S7'	90°	50.00	410.55	Malkhed-2 South
7	KML/01	S6 – S6'	90°	50.00	414.76	Malkhed-2 South
8	KML/04	S4 – S4'	90°	50.00	421.62	Malkhed-2 South
9	KML/05	S4 – S4'	90°	50.00	422.21	Malkhed-2 North
10	KML/03	S2 – S2'	90°	50.00	423.81	Malkhed-2 North

10.2.4.1 The limestone formation of the block is horizontally disposed with strike of N to NE and dips 1° to 2° due N to NW. Hence the parallel cross section lines are prepared along N 4°-S 4°E direction in Malkhed - 1 and Malkhed – 2 blocks.

Malkhed – 1 North and South Blocks.

In total there are 5 geological cross sections are prepared along N 4°-S 4°E direction in Malkhed – 1 North and Malkhed – 1 South blocks. Both the current phase boreholes (MKML-01,02,03,4,05,06) and I phase boreholes (KML-06,07,08,09 & 10) all together 11 boreholes are considered for the preparation geological cross section. All the 11 boreholes intersected limestone zones, out of this one stratigraphic borehole KML-08 was drilled in the first phase of exploration. The limestone in KML-08 is continued up to 130 meters followed by ferruginous shale and ekmai shale.

The intersected limestone is of Cement Grade to high grade encountered with intermittent partitions of blendable and beneficiable-blendable grade limestone zones. A total of four limestone zones are intersected in Malkhed -1 North and South blocks. Zone-wise borehole wise intersection of various grades limestone zones, are tabulated here under in Table No: 10.4 and 10.5.

Malkhed -1 South Block

Table No: 10.4

Details of section wise borehole wise intersections of Cement grade limestone zones in Malkhed – 1 South Block District- Kalaburagi, Karnataka State.

Borehole Number	From (m)	To (m)	Thick (m)	Zone	Block
MKML-01	2.00	50.00	48.00	I (Cement Grade)	M 1 South
MKML-02	1.00	50.00	49.00	I (Cement Grade)	M 1 South
MKML-05	2.40	20.00	17.60	I (Cement Grade)	M 1 South
<i>KML-07</i>	<i>1.00</i>	<i>33.00</i>	<i>32.00</i>	<i>I (Cement Grade)</i>	<i>M 1 South</i>
<i>KML-08</i>	<i>3.00</i>	<i>39.00</i>	<i>36.00</i>	<i>I (Cement Grade)</i>	<i>M 1 South</i>
<i>KML-09</i>	<i>1.74</i>	<i>50.00</i>	<i>48.26</i>	<i>I (Cement Grade)</i>	<i>M 1 South</i>
<i>KML-07</i>	<i>39.00</i>	<i>41.00</i>	<i>2.00</i>	<i>II (Cement Grade)</i>	<i>M 1 South</i>
<i>KML-08</i>	<i>48.00</i>	<i>56.00</i>	<i>8.00</i>	<i>II (Cement Grade)</i>	<i>M 1 South</i>
<i>KML-07</i>	<i>44.00</i>	<i>50.00</i>	<i>6.00</i>	<i>III (Cement Grade)</i>	<i>M 1 South</i>
<i>KML-08</i>	<i>74.00</i>	<i>86.00</i>	<i>12.00</i>	<i>III (Cement Grade)</i>	<i>M 1 South</i>
<i>KML-08</i>	<i>95.00</i>	<i>130.00</i>	<i>35.00</i>	<i>IV (Cement Grade)</i>	<i>M 1 South</i>

Boreholes KML 07,08 and 09 are old boreholes drilled in 2023-24 (First phase).

Cement grade limestone:

- The thickness of Zone-I varies from a minimum 17.60 m (MKML-05) to maximum 49.00 m (MKML-02).
- The minimum thickness of Zone-II is 2.00 m in KML-07 and maximum is 8.00 m in KML-08.

iii. The minimum thickness of Zone-III is 6.00 m MKML-07 and maximum is 12.00 m in KML-08.

iv. The thickness of Zone-IV is 35m and it intersected only in KML-08.

Table No: 10.5

Details of Section wise Borehole wise intersection of blendable, beneficiable-blendable grade limestone zones in Malkhed -1 South Block District- Kalaburagi, Karnataka State.

Borehole Number	From (m)	To (m)	Thick (m)	Zone	Block
KML-07	41.00	44.00	3.00	II Blendable Grade	M 1 South
MKML-05	20.00	50.00	30.00	I Beneficiable- Blendable Gr	M 1 South
KML-07	33.00	39.00	6.00	I Beneficiable- Blendable Gr.	M 1 South
KML-08	39.00	48.00	9.00	I Beneficiable- Blendable GrI	M 1 South
KML-08	56.00	74.00	18.00	II Beneficiable- Blendable Gr	M 1 South
KML-08	86.00	95.00	9.00	III Beneficiable- Blendable GI	M 1 South

Boreholes KML 07 and 08 are old boreholes drilled in 2023-24 (First phase).

Blendable grade limestone:

i. The thickness of Blendable grade limestone is 3.00 m and intersected in KML-07 only. It is classified as Zone II.

Beneficiable-blendable grade limestone:

ii. The thickness of Zone-I varies from a minimum 6.00 m (KML-07) to maximum 30.00 m (MKML-05).

iii. The thickness of Zone-II is 18 m and intersected in KML-08 only.

iv. The thickness of Zone - III is 9.00 m and intersected in KML-8 only.

Malkhed – 1 North Block

Table No: 10.6

Details of section wise borehole wise intersections of Cement grade limestone zones in Malkhed-1 North Block District- Kalaburagi, Karnataka State.

Borehole Number	From (m)	To (m)	Thick (m)	Zone	Block
MKML-03	3.60	28.00	24.40	I (Cement Grade)	M 1 North
MKML-04	2.00	15.00	13.00	I (Cement Grade)	M 1 North
MKML-06	2.60	9.00	6.40	I (Cement Grade)	M 1 North
KML-06	2.30	5.00	2.70	I (Cement Grade)	M 1 North
KML-10	3.00	17.00	14.00	I (Cement Grade)	M 1 North
MKML-06	18.00	22.00	4.00	II (Cement Grade)	M 1 North
KML-06	13.00	17.00	4.00	II (Cement Grade)	M 1 North
MKML-06	47.00	50.00	3.00	III (Cement Grade)	M 1 North
KML-06	36.00	41.00	5.00	III (Cement Grade)	M 1 North

Boreholes KML 06 and 10 are old boreholes drilled in 2023-24 (First phase)

Cement grade limestone:

- The thickness of Zone-I varies from a minimum 2.70 m (KML-06) to maximum 24.40 m (MKML-03).
- The thickness of Zone-II is 4.00 m in both MKML-06 and KML-06.
- The minimum thickness of Zone-III is 3.00 m in MKML-06 and maximum is 5.00 m in KML-06.

Table No: 10.7

Details of Section wise Borehole wise intersection of blendable, beneficiable-blendable grade limestone zones in Malkhed -1 North Blocks District- Kalaburagi, Karnataka State.

Borehole Number	From (m)	To (m)	Thick (m)	Zone	Block
KML-06	17.00	21.00	4.00	II Blendable Grade	M 1 North
MKML-03	28.00	50.00	22.00	I Beneficiable- Blendable Gr.	M 1 North
MKML-04	15.00	50.00	35.00	I Beneficiable- Blendable Gr.	M 1 North
MKML-06	9.00	18.00	9.00	I Beneficiable- Blendable Gr.	M 1 North
KML-06	5.00	13.00	8.00	I Beneficiable- Blendable Gr.	M 1 North
KML-10	17.00	27.50	10.50	I Beneficiable- Blendable Gr.	M 1 North
MKML-06	22.00	47.00	25.00	II Beneficiable- Blendable Gr.	M 1 North
KML-06	21.00	36.00	15.00	II Beneficiable- Blendable Gr.	M 1 North
KML-10	31.50	50.00	18.50	II Beneficiable- Blendable Gr.	M 1 North
KML-06	41.00	50.00	9.00	III Beneficiable- Blendable Gr.	M 1 North

Boreholes KML 06 and 10 are old boreholes drilled in 2023-24 (First phase).

Blendable grade limestone:

- The thickness of Blendable grade limestone is 4.00 m and intersected in KML-06 only. It is classified as Zone II.

Beneficiable-blendable grade limestone:

- The thickness of Zone-I varies from a minimum 8.00 m (KML-06) to maximum 35.00 m (MKML-04).
- The thickness of Zone-II varies from a minimum 15.00 m (KML-06) to maximum 25.00 m (MKML-06).
- The thickness of Zone - III is 9.00 m and intersected in KML-06 only

Malkhed – 2 North and South Blocks.

In total there are 7 geological cross sections are prepared along N 4°-S 4°E direction in Malkhed – 2 North and Malkhed - 2 South blocks. Both the current phase boreholes (MKML-07,08,09,10 & 11) and I phase boreholes (KML-06,07,08,09 &

10) all together 10 boreholes are considered for the preparation geological cross section. The intersected limestone is of Cement Grade to high grade encountered with intermittent partitions of beneficiable-blendable, and blendable grade limestone zones. A total of three limestone zones are intersected in Malkhed -2 block. Zone wise borehole wise intersection of various grades limestone zones, are tabulated here under in Table No: 10.8 10.9 10.10 and 10.11.

Malkhed – 2 South Block

Table No: 10.8

Details of section wise borehole wise intersections of Cement grade limestone zones Malkhed -2 South Block District- Kalaburagi, Karnataka State.

Borehole Number	From (m)	To (m)	Thick (m)	Zone	Block
<i>KML-01</i>	<i>3.00</i>	<i>20.00</i>	<i>17.00</i>	<i>I (Cement Grade)</i>	<i>M 2 South</i>
<i>KML-02</i>	<i>1.00</i>	<i>4.00</i>	<i>3.00</i>	<i>I (Cement Grade)</i>	<i>M 2 South</i>
MKML-07	22.00	26.00	4.00	II (Cement Grade)	M 2 South
MKML-08	10.00	16.00	6.00	II (Cement Grade)	M 2 South
<i>KML-01</i>	<i>29.00</i>	<i>35.00</i>	<i>6.00</i>	<i>II (Cement Grade)</i>	<i>M 2 South</i>
<i>KML-02</i>	<i>38.00</i>	<i>42.00</i>	<i>4.00</i>	<i>II (Cement Grade)</i>	<i>M 2 South</i>
<i>KML-04</i>	<i>18.00</i>	<i>23.00</i>	<i>5.00</i>	<i>II (Cement Grade)</i>	<i>M 2 South</i>
MKML-07	42.00	50.00	8.00	III (Cement Grade)	M 2 South
MKML-08	35.00	39.00	4.00	III (Cement Grade)	M 2 South
<i>KML-04</i>	<i>40.00</i>	<i>50.00</i>	<i>10.00</i>	<i>III (Cement Grade)</i>	<i>M 2 South</i>

Boreholes KML 01,02 and 04 are old boreholes drilled in 2023-24 (First phase).

Cement grade limestone:

- The minimum thickness of Zone-I is 3.00 in KML-02 and maximum is 17.00 m (KML-01).
- The thickness of Zone-II varies from a minimum 4.00 m (MKML-07 and KML-02) to maximum 6.00 m (MKML-08 and KML-01).
- The thickness of Zone-III varies from a minimum 4.00 m (MKML-08) to maximum 10.00 m (KML-04).

Table No: 10.9
Details of Section wise Borehole wise intersection of blendable, beneficiable-blendable grade limestone zones in Malkhed -2 South Block District-Kalaburagi, Karnataka State.

Borehole Number	From (m)	To (m)	Thick (m)	Zone	Block
MKML-07	5.00	22.00	17.00	I Beneficiable-Blendable Grade	M 2 South
MKML-08	2.40	10.00	7.60	I Beneficiable-Blendable Grade	M 2 South
KML-01	20.00	29.00	9.00	I Beneficiable-Blendable Grade	M 2 South
KML-02	4.00	38.00	34.00	I Beneficiable-Blendable Grade	M 2 South
KML-04	4.00	18.00	14.00	I Beneficiable-Blendable Grade	M 2 South
MKML-07	26.00	42.00	16.00	II Beneficiable-Blendable Grade	M 2 South
MKML-08	16.00	35.00	19.00	II Beneficiable-Blendable Grade	M 2 South
KML-01	35.00	50.00	15.00	II Beneficiable-Blendable Grade	M 2 South
KML-02	42.00	50.00	8.00	II Beneficiable-Blendable Grade	M 2 South
KML-04	23.00	40.00	17.00	II Beneficiable-Blendable Grade	M 2 South
MKML-08	39.00	50.00	11.00	III Beneficiable-Blendable Grade	M 2 South

Boreholes KML 01,02 and 04 are old boreholes drilled in 2023-24 (First phase).

Beneficiable-blendable grade limestone:

- The thickness of Zone-I varies from a minimum 7.60 m (MKML-08) to maximum 34.00 m (KML-02).
- The thickness of Zone-II varies from a minimum 8.00 m (KML-02) to maximum 19.00 m (MKML-08).
- The thickness of Zone-III is 11.00 m and it intersected in MKML-08 only.

Malkhed – 2 North Block

Table No: 10.10
Details of section wise borehole wise intersections of Cement grade limestone zones Malkhed -2 North Block District-Kalaburagi, Karnataka State.

Borehole Number	From (m)	To (m)	Thick (m)	Zone	Block
MKML-09	4.00	5.00	1.00	I (Cement Grade)	M 2 North
KML-03	3.00	5.00	2.00	I (Cement Grade)	M 2 North
MKML-09	21.00	25.00	4.00	II (Cement Grade)	M 2 North
MKML-10	15.00	18.00	3.00	II (Cement Grade)	M 2 North
MKML-11	39.30	41.30	2.00	II (Cement Grade)	M 2 North
KML-03	18.00	23.00	5.00	II (Cement Grade)	M 2 North
KML-05	23.00	28.00	5.00	II (Cement Grade)	M 2 North
MKML-09	41.00	50.00	9.00	III (Cement Grade)	M 2 North
MKML-10*	37.00	50.00	13.00	III (Cement Grade)	M 2 North
KML-03	39.00	50.00	11.00	III (Cement Grade)	M 2 North
KML-05	44.00	50.00	6.00	III (Cement Grade)	M 2 North

*** 40.60-41.00 & 43.20-44.20 Void. No sample for 1.40 m thick.**

Boreholes KML 01,02,03,04 and 05 are old boreholes drilled in 2023-24 (First phase).

Cement grade limestone:

- The minimum thickness of Zone-I is 1.00 in MKML-09 and maximum is 2.00 m (KML-03).
- The thickness of Zone-II varies from a minimum 2.00 m (MKML-11) to maximum 5.00 m (KML-03 and KML-05).
- The thickness of Zone-III varies from a minimum 6.00 m (KML-05) to maximum 13.00 m (MKML-10).

Table No: 10.11

Details of Section wise Borehole wise intersection of blendable, beneficiable-blendable grade limestone zones in Malkhed -2 North Block District-Kalaburagi, Karnataka State.

Borehole Number	From (m)	To (m)	Thick (m)	Zone	Block
MKML-09	5.00	21.00	16.00	I Beneficiable-Blendable Grade	M 2 North
MKML-10	7.00	8.00	1.00	Ia Beneficiable-Blendable Grade	M 2 North
	10.00	15.00	5.00	Ib Beneficiable-Blendable Grade	M 2 North
KML-03	5.00	18.00	13.00	I Beneficiable-Blendable Grade	M 2 North
KML-05	4.00	23.00	19.00	I Beneficiable-Blendable Grade	M 2 North
MKML-09	25.00	41.00	16.00	II Beneficiable-Blendable Grade	M 2 North
MKML-10	19.00	37.00	18.00	II Beneficiable-Blendable Grade	M 2 North
MKML-11	45.00	45.40	0.40	Ila Beneficiable-Blendable Grade	M 2 North
	45.90	47.00	1.10	Ilb Beneficiable-Blendable Grade	M 2 North
KML-03	23.00	39.00	16.00	II Beneficiable-Blendable Grade	M 2 North
KML-05	28.00	44.00	16.00	II Beneficiable-Blendable Grade	M 2 North
KML-07	26.00	42.00	16.00	II Beneficiable-Blendable Grade	Influence in M2 North

Boreholes KML 03, 05 and 07 are old boreholes drilled in 2023-24 (First phase).

Beneficiable-blendable grade limestone:

- The thickness of Zone-I varies from a minimum 1.00 m (MKML-10) to maximum 19.00 m (KML-05).
- The thickness of Zone-II varies from a minimum 0.40 m (KML-11) to maximum 18.00 m (MKML-10).
- The thickness of Zone-III is 16.00 m KML- 03, 05 and 07.

10.2.4.2 The associated sampling and chemical analysis of 501 primary samples were completed simultaneously and geological report has been submitted.

CHAPTER - 11

11.0.0 LOCATION DATA POINTS

11.1.0 ACCURACY AND QUALITY OF SURVEY USED TO LOCATE BLOCK BOUNDARY AND DRILL HOLES

11.1.1 The entire survey work has been carried out with the help of DGPS (Make-Trimble GNSS System, Model-R8s). With the help of DGPS, coordinates of surface features i.e., roads, village boundaries, water bodies, base station co-ordinates of boreholes 11 nos. and co-ordinates of corner points 4 nos. of block boundary cardinal points with R.L. has been determined (Annexure IA and IB) and accordingly the topographical map is presented for Malkhed-1 North & South (Plate-III A) and Malkhed-2 North & South (Plate- III B). Contour interval in topographical map is taken as 2 m. The topographic survey was done in PPK (Post Precision Kinematics) mode. Positional (horizontal) accuracy of the survey is 10mm while the elevation accuracy is 20mm in PPK mode.

11.1.2 TECHNICAL SPECIFICATION OF DGPS

MAKE	TRIMBLE DGPS
MODEL	R8-S
YEAR	2017

a) MEASUREMENT ACCURACY:

Static Mode

Horizontal – 10 mm +0.1 ppm or better.

Vertical – 20 mm +0.4 ppm or better.

b) BASE LINE ACCURACY:

a. Accuracy Horizontal shall not be more than 4 mm for 10 km baseline with occupation line of 10 minutes or less.

b. Accuracy vertical shall not be more than 7.5 mm for 10 km baseline for with occupation of 10 minutes or less.

c) FAST STATIC:

c. Horizontal – 3mm +0.5 ppm

d. Vertical – 5 mm +0.5 ppm

▪ GNSS RECEIVER:

▪ Trimble R8s Multiple frequency GNSS Receiver has internal on-board memory via SD card or internal memory.

▪ Trimble R8s has 440 channels (GPS + GLONASS +GAGAN) and should be capable of tracking.

- GPS: LIC/A, L2C, L1C, L2E, L5
- GLONASS: LIC/A, L2C/A, L1P, L2P, & L3
- Beidou : B 1 complete with (phase 2) & B2
- SBAS: LIC/A, L5
- Galileo: E1, E5A, E5B
- Systems: EGNOS, QZSS, SBAS, WAAS, GAGAN (takes correction from GAGAN) etc.
- **SOFTWARE & COMMUNICATION:** Fully functional and Trimble business center office post processing software.
- **CONTROLLER:**
- Trimble TSC 3 windows-based controller for base and 02 nos. Rovers

11.1.3 The survey of boreholes drilled in the block has also been carried out by the DGPS (Make-Trimble GNSS System, Model-R8s). The base station has been utilised for the fixing of the 11 boreholes position on the ground as well as for reduced levels of the boreholes. The coordinate of base station is given in Table-11.1. DGPS report for the block has been attached as Annexure XVII/1-28

Table No. 11.1
Co-ordinates of the base station for DGPS survey of Malkhed -1 North, Malkhed-1 South, Malkhed-2 North and Malkhed-2 South blocks,
Kalaburagi District, Karnataka.

Sl. No.	Point Name	UTM (m)		RL (m)
		Northing	Easting	
1	BASE 1	1899870.354	729717.660	412.405

11.2.0 QUALITY AND ADEQUACY OF TOPOGRAPHIC CONTROL

11.2.1 Block boundary co-ordinates, the surface features, contour points were surveyed by DGPS). The topographic survey was done in PPK (Post Precision Kinematics) mode. Positional (horizontal) accuracy of the survey is 10mm while the elevation accuracy is 20mm in PPK mode. The detailed topographical map has been prepared for Malkhed -1 North & South blocks on 1:4,000 scale and Malkhed-2 North & South blocks on 1:4,000 scale with 2m Contour Interval.

CHAPTER – 12

12.0.0 SAMPLING TECHNIQUES

12.1.0 NATURE AND QUALITY OF SAMPLING AND MEASURES TAKEN TO ENSURE SAMPLE REPRESENTATIVITY

12.1.1 The sampling and analyses have been carried out for the entire mineralized zones/length encountered in bed rocks and boreholes drilled on visual identification basis. The primary samples have been marked in the mineralized zones based on type and concentration of mineralisation/lithology and in general the sample length has been kept as 1.0 m which varies in some instances because of variation in lithology and type and concentration of mineralisation. The mineralized core has been split into two equal halves in such a way that the concentrations of ore minerals are uniform in both the equal halves. One half of the core sample has been crushed to (-) 200 mesh size. By progressive coning and quartering and repeatedly mixing the sample has been reduced to 600 g. A representative sample of 200 g has been collected and analyzed for CaO, MgO, Al₂O₃, SiO₂, Fe₂O₃, Na₂O, SO₃, P₂O₅, K₂O and LOI at Chemical Laboratory of MECL, Nagpur.

12.1.2 A total of 501 nos. of primary samples out of which 68 nos. BRS, 102nos. borehole core samples and 50 nos. external check samples were generated. All the primary samples are analysed in MECL laboratory and external check samples are sent to external lab for analysis.

Samples	Malkhed-1 North	Malkhed-1 South	Malkhed-2 North	Malkhed-2 South	Total
Primary	141	145	122	93	501
External Check	14	15	12	9	50

12.2.0 NATURE, QUALITY AND APPROPRIATENESS OF THE SAMPLE PREPARATION TECHNIQUE

12.2.1 The details of sampling procedure for primary samples are described in Para 12.1.0. Quality of the sample preparation is maintained by proper cleaning, maintenance of the equipment and proper crushing, sieving and coning and quartering of samples. For sample preparation proper technique and expertise has been used.

12.3.0 QUALITY CONTROL PROCEDURES ADOPTED

- 12.3.1 The primary core samples have been collected from entire mineralized zones/length intersected in the boreholes drilled and the samples have been prepared at centralized mechanized sampling unit. The standard sampling procedure in supervision of qualified sampling technician has been adopted to control the quality of samples. Similarly, internal check and external check samples have also been prepared under the supervision of qualified sampling technician following the standard sampling procedure.

12.4.0 MEASURES TAKEN TO ENSURE THE SAMPLING IS REPRESENTATIVE OF THE IN-SITU MATERIAL COLLECTED

- 12.4.1 All the primary samples have been marked and prepared from mineralised cores. During the preparation of primary samples, the mineralised cores have been studied meticulously and samples have been marked properly. These mineralised cores are subjected for preparation of primary samples as per the sampling procedure for primary samples are described in Para 12.1.0. The proper marking of primary samples from drilled cores and following standard procedure for sample preparation shows the representative samples have been collected from the in-situ materials.

12.5.0 WHETHER SAMPLE SIZES ARE APPROPRIATE TO THE GRAINSIZE OF THE MATERIAL BEING SAMPLED

- 12.5.1 The primary samples have been prepared (-) 200 mesh size and all the other samples have been prepared from primary samples. As per the previous studies in the area, (-) 200 mesh size is appropriate for the analysis of limestone mineralization in the block area.

CHAPTER - 13

13.0.0 DRILLING TECHNIQUES AND DRILL SAMPLING EMPLOYED

13.1.0 DRILLING TYPES AND DETAILS

13.1.1 During the present investigation, MECL has drilled 11 nos. of boreholes with a cumulative meterage of 550m and other associated geological analytical works in the Malkhed-1/N, M1/S, M2/N and M2/S blocks. The details of boreholes are given in Annexure-I B and summary of borehole is given in Table-No: 10.1.

13.1.2 The Drilling operation in the block was performed by skid mounted Kores RD60 Drilling Rig. All the boreholes in the block were drilled in NQ size with double tube barrel wire line, wet core drilling method. Initially 0.00m to 6.00m HW casing was set in each borehole by using HW casing short piece. After setting HW casing, drilling advanced in NQ size till to the total depth of each borehole.

Drilling was done by NQ Diamond bit, (Hyden, Sandwik) till closure of the borehole. RD60 (MEC 345) rig were deployed in the block.

13.1.3 The quality of drilling was ensured during the operation. After closure, all the boreholes have been properly plugged and sealed with cement pillars.

13.2.0 DEVIATION SURVEY IN DRILLING

13.2.1 All the exploratory boreholes drilled in the block are vertical and drilled up to 50m depth in each of boreholes MKML-01,02,03,04,05,06,07,08,09,10 and 11. Since the depth is shallow and no deviation occurred hence deviation survey was not performed for the boreholes.

13.3.0 WHETHER CORE AND CHIP SAMPLE RECOVERIES HAVE BEEN PROPERLY RECORDED AND RESULTS ASSAYED

13.3.1 The core samples have been recorded properly and the detailed run wise litholog and summarized concise litholog for boreholes are given in Annexure-IIA and Annexure-IIB respectively. The logging of run wise core as well as the cuttings from boreholes have helped in discerning the physical characters like colour, shape, size and nature of the mineralisation as well as texture, structural features and identification of different litho units.

13.3.2 Core recovery with reference to the lithologies are properly recorded and represented in Annexure-IIA.

13.3.3 The mineralised zones /length recorded during the geological core logging have been sampled for limestone analysis consisting 10 radicals i.e., CaO, MgO, Al₂O₃, SiO₂, Fe₂O₃, Na₂O, SO₃, P₂O₅, K₂O and LOI at Chemical Laboratory of MECL, Nagpur.

The primary sample had been marked in the mineralized zones intersected in the borehole based on visual inspection/lithology and in general the sample length has been kept as 1.00m which varied in some instances because of variation in lithology and type and concentration of mineralisation. The details of analysis of primary core samples are given in Annexure-III A.

13.4.0 MEASURES TAKEN TO MAXIMIZE SAMPLE RECOVERY AND ENSURE REPRESENTATIVE NATURE OF THE SAMPLES

13.4.1 The drilling has been done by NQ size diamond drill bit with single barrel wire line, wet core drilling method. Initially 0.00m to 6.00m HW casing was set in each borehole by using HW casing short piece. After setting HW casing, drilling advanced in NQ size till. NW casing was set in the drilled ranging from 10m to 25m depending on the formation of the boreholes. The polymer was used as drilling fluid to flush out the cuttings and stabilize the borehole wall. The drilling fluid also works as a coolant to avoid burning of drill bits. Proper core recovery of more than 90% was maintained in limestone by using double tube core barrel, however in case of weathered, loose and fractured zone and in solution cavities, the core recovery was low. Whenever core recovery is less, the grade of the recovered portion has been extrapolated over the non-recovered section. However, all the precautions like modulated water pressure, proper liner, optimum head pressure and the hands of an expert drilling technician had been taken to maintain the quality of drilling.

13.5.0 WHETHER THE RELATIONSHIP EXISTS BETWEEN SAMPLE RECOVERY AND GRADE

13.5.1 No such definite relation exists between sample recovery and grade.

13.6.0 CORE LOGGING

13.6.1 The core recovered by drilling was logged systematically in detail describing lithological units with mineralisation details that can be observed by visual inspection. The details of lithology, grain size, colour, texture, structural features, presence of intercalations and cavities have been recorded. Wherever the recovery is less than 100%, extrapolations of drilled depth were done on proportionate basis considering the physical characteristics of individual units recovered. All the cores were kept and preserved properly in the GI core boxes of specifications given by NMET following “Book pattern”. The detailed run wise litholog and summarized litholog for boreholes are given in Annexure- IIA and Annexure- IIB respectively.

Core Photographs:



Photo -5: MKML-01 (17.00 to 22.00m) (FULL CORE)



Photo - 6 MKML-01 (17.00 to 22.00m) (Half cut core)



Photo -7: MKML-07 (20.00-25.00) FULL CORE



Photo – 8: MKML-07 (20.00-25.00) HALF CUT CORE



Photo - 9: MKML-09 (45.00-50.00) FULL CORE



Photo - 10: MKML-09 (45.00-50.00) HALF CUT CORE

CHAPTER - 14

14.0.0 SUB SAMPLING TECHNIQUES AND SAMPLE PREPARATIONS

14.1.0 WHETHER CUT OR DRAWN AND WHETHER QUARTER, HALF OR ALL CORE TAKEN

- 14.1.1 The core sampling and chemical analysis of core samples have been carried out for entire mineralized zones/length intersected in the boreholes drilled. Samples were marked in limestone zones marked on the basis of visual inspection. The mineralized core has been split into two equal halves by core splitter in such a way that the concentrations of ore minerals are uniform in both the equal halves. The whole quantity of half portion of the sample was crushed to (-) 200 mesh and about 600g representative sample of was drawn by coning and quartering method of gradual size reduction with the help of crusher and pulverizer. Two sample pouches weighing samples 200g each were drawn, one of which was analysed for limestone analysis of 10 radicals CaO, MgO, Al₂O₃, SiO₂, Fe₂O₃, Na₂O, SO₃, P₂O₅, K₂O and LOI at Chemical Laboratory of MECL, Nagpur and external check samples were sent to Jawaharlal Nehru Aluminium Research Development and Design Centre, (JNARDDC) Nagpur (A NABL accredited Laboratory). The remaining 200g fraction was kept for future purpose including composite sample analysis etc.

14.2.0 NATURE, QUALITY AND APPROPRIATENESS OF THE SAMPLE PREPARATION TECHNIQUE

- 14.2.1 Quality of the sample preparation is maintained by proper cleaning, maintenance of the equipment and proper crushing, sieving and coning and quartering of samples. For sample preparation, proper technique and expertise has been used.

14.3.0 QUALITY CONTROL PROCEDURES ADOPTED

- 14.3.1 The primary core samples have been collected from entire mineralized zones/length intersected in the boreholes drilled and the samples have been prepared at centralized mechanized sampling unit. The standard sampling procedure in supervision of qualified sampling technician has been adopted to control the quality of samples. Similarly external check samples have also been prepared under the supervision of qualified sampling technician following the standard sampling procedure and analysed at NABL accredited external lab.

14.4.0 MEASURES TAKEN TO ENSURE THE SAMPLING IS REPRESENTATIVE OF THE INSITU MATERIAL COLLECTED

- 14.4.1 All the primary samples have been marked and prepared from mineralised cores. During the preparation of primary samples, the mineralised cores have been studied meticulously and samples have been marked properly. These mineralised cores are subjected for preparation of primary samples as per the sampling procedure for primary samples are described in Para 14.1.0. The proper marking of primary samples from drilled cores and following standard procedure for sample preparation shows the representative samples have been collected from the in-situ materials.

14.5.0 WHETHER SAMPLE SIZES ARE APPROPRIATE TO THE GRAIN SIZE OF THE MATERIAL BEING SAMPLED

- 14.5.1 The primary samples have been prepared (-) 200 mesh size and all the other samples have been prepared from primary samples. As per the previous studies in the area, (-) 200 mesh size is appropriate for the analysis of limestone etc. mineralization in the block area.

CHAPTER - 15

15.0.0 QUALITY OF ASSAY DATA AND LABORATORY TESTS

15.1.0 THE NATURE, QUALITY AND APPROPRIATENESS OF THE ASSAYING AND LABORATORY PROCEDURES

15.1.1 The primary samples from limestone mineralization have been analyzed for 10 radicals i.e., CaO, MgO, Al₂O₃, SiO₂, Fe₂O₃, Na₂O, SO₃, P₂O₅, K₂O and LOI by XRF Chemical Laboratory of MECL, Nagpur and external check samples for same 10 radicals have been analysed at Jawaharlal Nehru Aluminium Research Development and Design Centre, (JNARDDC) Nagpur a NABL accredited Laboratory.

15.2.0 STANDARD OPERATING PROCEDURE (SoP) FOR THE ANALYSIS BY JNARDDC, NAGPUR

CHEMICAL ANALYSIS

- 1. Pellet Method (using XRF)**
- 2. XRF (model Axiosm Ax, (Panalytical make)**
- 3. CRM used- NCSDC-16006**

Procedure for Preparation of Pellets by Hydraulic Press:

For XRF measurement a sample must be homogenized, pulverized to -100 mesh and pressed into pellet.

- (i) Weigh accurately 5 gms of sample and used 10 gms of boric acid as a binder
- (ii) Press the sample at a pressure of around 20-22 tons on a hydraulic press (Pellet Making Machine) with a diameter of 40 mm
- (iii) Calibrate the XRF equipment using known standards for elements present in limestone (Calcium, Magnesium etc)
- (iv) Ensure the instrument is set up correctly according to standard guidelines
- (v) Place the prepared pellet into the sample holder
- (vi) Ensure the sample cup is positioned correctly in the instrument for carrying out analysis
- (vii) Start the XRF analysis using software and initiate the analysis process automatically
- (viii) Allow the XRF instrument to scan the sample. It will emit X-rays onto the sample, causing the atoms to emit fluorescence

(ix) Record the results in a report, including elemental concentrations and any relevant information about the analysis conditions

(x) Intermediate check also performed using bead with inbuilt software

LOSS ON IGNITION

WCL procedure for determination of LOI:

Weighed quantity of sample (duly dried at 110°C) is placed in platinum crucible and heated to 1000°C for about an hour. Sample is again weighed after it is cooled. Difference in weight expressed in percentage as LOI.

15.3.0 STANDARD OPERATING PROCEDURE (SoP) FOR THE ANALYSIS BY MECL LAB, NAGPUR

15.3.1 SOP OF ANALYSIS BY XRF

Sample Particle Size:

The Sample is ground to a particle size <75µm, but <50µm is ideal.

Sample preparation: Pellets preparation

The process of making pressed pellets for XRF analysis includes grinding the sample to fine particle size and pressing the sample at pressure of between 15 to 35 ton.

Instrumentation:

1. X-ray irradiates the sample.
2. Sample emits secondary X-ray characteristic of a particular element.
3. Analyzing sample rotates to accurately diffract each wavelength and satisfy Bragg's Law.
4. Detector measures position and intensity of XRF peaks

Photograph of WD-XRF instrument (Rigaku, Japan) at Chemical Lab, MECL, Nagpur have been represented in photo 11.



Photo - 11: Photographs showing WD-XRF instrument (Rigaku, Japan) at Chemical Lab, MECL, Nagpur

15.3.2 STANDARD OPERATING PROCEDURE (SoP) FOR THE DETERMINATION OF LOSS ON IGNITION (L.O.I.) AT MECL LAB

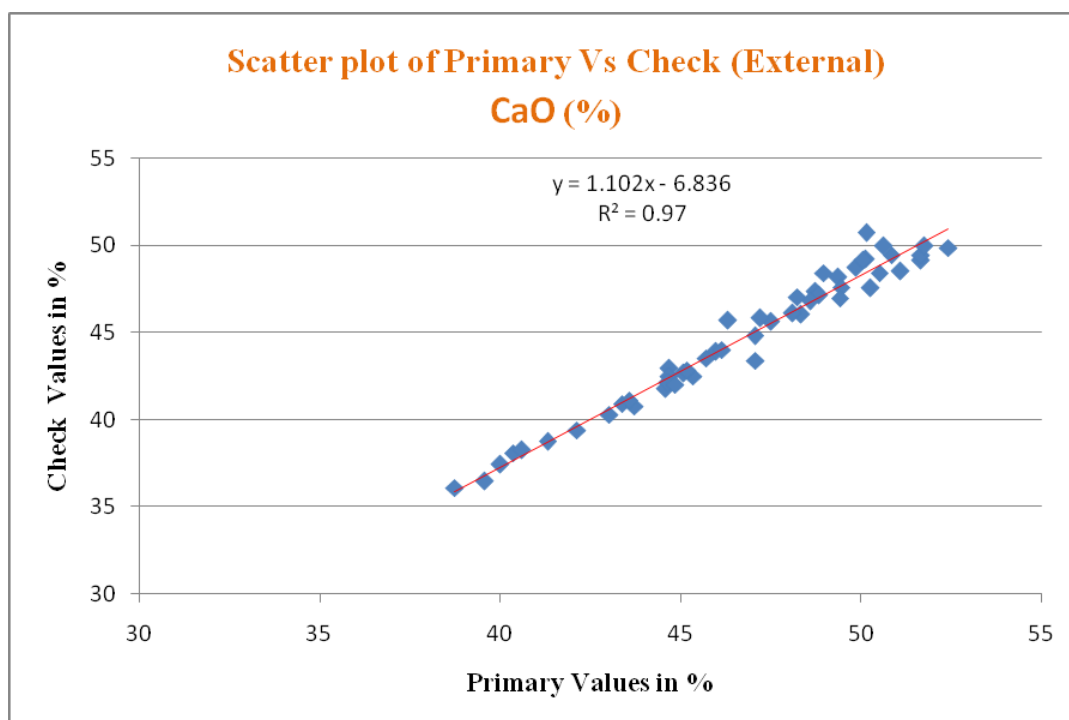
Procedure

1. Weigh 1 g of dry sample in silica or platinum crucible.
2. Place this crucible in muffle furnace at a temperature below 300°C. Raise the temperature of the furnace to 1000°C. Keep this at this temperature for about 30 minutes.
3. Cool the crucible in desiccators and weigh the crucible.
4. Find the loss in weight.
5. % Loss on Ignition (LOI) = $\left(\frac{\text{Loss in weight}}{\text{Sample Weight}} \right) \times 100$

15.4.0 NATURE OF QUALITY CONTROL PROCEDURES ADOPTED

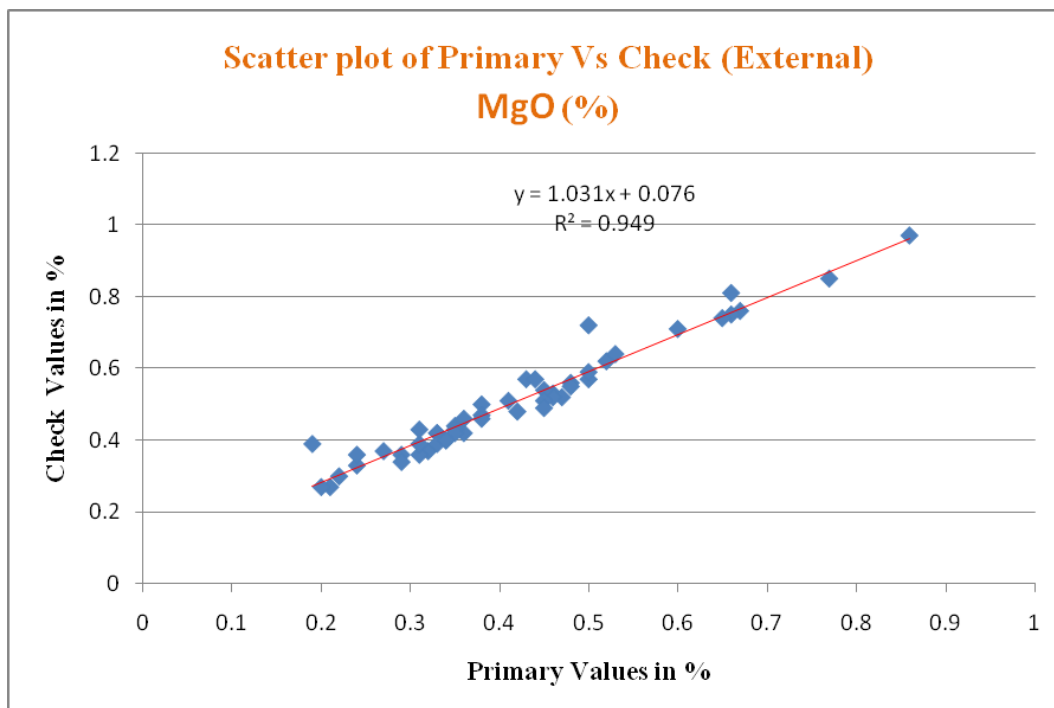
In order to ensure the accuracy of the analyzed samples, **NCSDC-16006** has been used as certified reference material. The Certified Reference Material (CRM) was processed under similar conditions as samples and run after every 20 samples.

- 15.4.1 A total 50 nos. of external check samples have been analysed by JNARDDC laboratory, Nagpur for 10 radicals, however 3 radicals i.e. CaO, MgO and SiO₂ analysis have been statically compare to check the reliability of chemical analysis and the results are given in Annexure VA. Statistical comparison has been furnished below in the following tables and corresponding figures.



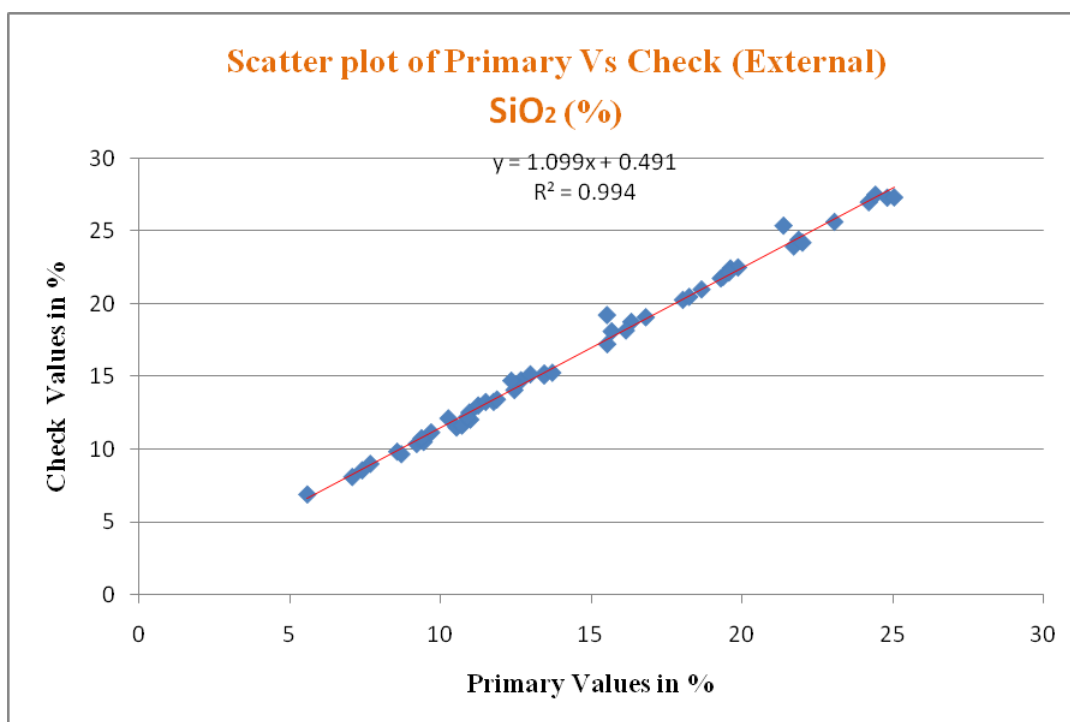
COMPARISON OF PRIMARY Vs EXTERNAL CHECK ANALYSIS

COMPARISON INDEX	CaO %	
	Primary	Check
No. of Sample Pairs	50	
Arithmetic Mean	46.741	44.71
Standard Deviation	3.569	3.996
Std. Error of Mean	0.505	0.565
Variance	12.737	15.97
Mean of Deviation	2.03	
Standard Deviation (Error)	0.784	
Correlation Coefficient	0.985	
Mean Absolute Error	2.055	
Mean Relative Random Error	4.396%	
Paired T value	18.317	
F - test value	0.798	



COMPARISON OF PRIMARY Vs EXTERNAL CHECK ANALYSIS

COMPARISON INDEX	MgO %	
	Primary	Check
No. of Sample Pairs	50	
Arithmetic Mean	0.416	0.505
Standard Deviation	0.145	0.153
Std. Error of Mean	0.021	0.022
Variance	0.021	0.024
Mean of Deviation	-0.089	
Standard Deviation (Error)	0.035	
Correlation Coefficient	0.975	
Mean Absolute Error	0.089	
Mean Relative Random Error	21.394%	
Paired T value	-18.159	
F - test value	0.894	



COMPARISON OF PRIMARY Vs EXTERNAL CHECK ANALYSIS

COMPARISON INDEX	Primary	SiO ₂ % Check
No. of Sample Pairs	50	
Arithmetic Mean	14.834	16.809
Standard Deviation	5.323	5.87
Std. Error of Mean	0.753	0.83
Variance	28.33	34.456
Mean of Deviation		-1.974
Standard Deviation (Error)		0.681
Correlation Coefficient		0.997
Mean Absolute Error		1.974
Mean Relative Random Error		13.308%
Paired T value		-20.486
F - test value		0.822

15.4.3 It has been observed that

- i) The scatter plots clearly show scatter of values along a band closely following the bisector.
- ii) The arithmetic means of principal and check assays show an excellent agreement for all the radicals.

iii) The correlation coefficient, which is an index assays showing value for CaO% 0.970, MgO% 0.949 and SiO₂% 0.994 which implies excellent/agreement for the dataset of primary and check analysis of radicals.

15.5.0 SECURITY AND CHAIN OF CONTROL OF SAMPLES SHOULD BE CLEARLY MENTIONED

15.5.1 The samples have been prepared at centralized mechanized sampling unit with proper labelling and tag and sent to chemical laboratory in supervision of qualified sampling technician. At the sampling unit, standard procedure has been followed and all the precautionary measures have been taken to avoid the contamination. The sampling unit is separate from the chemical laboratory, so there is no chance of contamination.

CHAPTER - 16

16.0.0 MOISTURE

16.1.0 All the analysis of borehole core samples has been carried out with natural moisture.

CHAPTER - 17

17.0.0 BULK DENSITY/SPECIFIC GRAVITY

17.1.0 BULK DENSITY

Bulk density study was not approved by NMET. However, a total of 10 of samples are conducted for bulk density studies in first phase of exploration in 2023. hence, we considered the first phase study results for resource estimation and the results are tabulated hereunder.

Sr. No.	Sample No.	BH. No.	From(m)	To (m)	Bulk Density
1	KML-01/ S1	KML-01	44.30	44.36	2.67
2	KML-01/ S2	KML-01	46.00	46.08	2.72
3	KML-03/ S3	KML-03	24.95	25.02	2.67
4	KML-04/ S4	KML-04	37.20	37.26	2.71
5	KML-03/ S5	KML-05	27.25	27.31	2.67
6	KML-05/ S6	KML-06	15.85	15.91	2.71
7	KML-06/ S7	KML-07	19.05	19.11	2.66
8	KML-06/ S8	KML-08	5.40	5.46	2.67
9	KML-09/ S9	KML-09	18.84	18.90	2.71
10	KML-10/ S10	KML-10	3.90	3.96	2.72

The average bulk density of the limestone zones in the block is determined as 2.69, which has been utilised for the resource estimation.

CHAPTER – 18

18.0.0 BENEFICIATION STUDIES

18.1.0 The present exploration has no provision for beneficiation studies.

CHAPTER – 19

19.0.0 RESOURCE ESTIMATION TECHNIQUE

19.1.0 GENERAL

19.1.1 The limestone resource of the block has been estimated by “**Geological cross-section Method**” and **Polygonal** methods. Certain axiomatic assumptions are inherently involved in estimation of overall grade and resource of the deposit, which are given below:

1. The rule of gradual change or law of linear function has been applied (Constantine C. Popoff, 1966) along with the rule of nearest points for application of influence of half way between successive boreholes.
2. The boreholes which did not intersect any mineralisation have been considered as negative boreholes and completely eliminated from resource estimation.
3. The thickness and grade of each mineralized zone intersected in the borehole have been considered as it is for the entire influence area of the borehole.

19.1.2 Grades and Resource have been assessed on the basis of end-use grade classification given by IBM’s National Mineral Inventory (NMI) in following three categories i) Threshold grade (≥ 34 to $< 38\%$ CaO) in addition to ii) Blendable grade (≥ 38 to $< 44\%$ CaO, $< 5\%$ MgO and $< 18\%$ SiO₂) and iii) Cement grade ($\geq 44\%$ CaO, $< 3.5\%$ MgO and $< 16\%$ SiO₂). In addition to this limestone having $+38\%$ CaO with $+18\%$ SiO₂ is classified as beneficiable-blendable grade.

19.1.3 Further Resource have been estimated and categorized as per UNFC and placed as Inferred Resource (333) and Reconnaissance Resource (334) categories by cross sectional method also has been calculated by polygonal method also.

19.2.0 ASSUMPTIONS FOR RESOURCE ESTIMATION

19.2.1 Resource was computed by “Cross-sectional method” as well as by “Polygonal method”. Certain axiomatic assumptions are inherently involved in estimating overall grade and resource of a deposit, are given below.

19.2.2 For limestone grade categorization into cement, blendable and threshold grade, CaO has been considered strictly. For other radicals like in case of MgO and CaO, slight variation on higher side is also considered.

19.2.3 Resource estimated for Cement grade limestone CaO $\geq 44\%$, 3.5% MgO (Max) and 16% SiO₂ (Max), Blendable Grade CaO $\geq 38\%$ to $< 44\%$, 5.00% MgO (Max) and 18% SiO₂ (Max) and Threshold grade limestone is CaO $\geq 34\%$ to $< 38\%$ and 6.00% MgO (Max) are considered for the assessment of limestone resource. Apart from these

zones has +38% CaO with +18.00 SiO₂ is categorised separately termed as beneficiable-blendable grade is estimated.

- 19.2.4 The zones of different grades have been demarcated from the values of primary sample analysis as per cut-off limits by End Use Grade specifications by IBM for CaO, MgO and SiO₂. The minimum cumulative thickness of 1.00m of all grades has been considered for resource calculation in both methods.
- 19.2.5 The exploration scheme had been formulated for G-3 level of exploration, it has been observed after the completion of exploration program by drilling of 6 nos. of boreholes which are falling in five parallel cross section lines S1-S1', S2-S2', S3-S3', S4-S4' and S5-S5' in Malkhed -1 North and South blocks, have been drawn along N 4°-W/ S 4°-E direction. A total no of 5 nos. of boreholes which are falling in seven parallel cross section lines S1-S1', S2-S2', S3-S3', S4-S4', S5-S5', S6-S6' and S7-S7' in Malkhed -2 North and South blocks,
- 19.2.6 The Limestone body is bedded and continuous within the block. For resource estimation by cross-section method, resources are categorized under Inferred Resource (333) and Reconnaissance Resource (334) of UNFC (as per MEMC 2015 and 2021) Rules.
- 19.2.7 The grade classification and categorisation marked in the cross sections are suitable indexed and enclosed as Plate No IVA for Malkhed -1 North & South and Plate No IVB for Malkhed - 2 North & South blocks. Along strike and dip the influence of maximum 400 m from control point towards the lease boundary has been categorized in Inferred Category (333). Beyond this limit the resource are categorized under Reconnaissance category (334) up to block boundary
- 19.2.8 The average bulk density of limestone has been taken as 2.69 as determined by Calliper's method from 10 limestone samples in MECL Laboratory, Nagpur. This value is taken for computation of resource for cement, blendable, beneficiable-blendable and threshold grades of limestone.
- 19.2.9 A deduction of 20% from Gross in-situ resource has been made to arrive at Net-in-situ resource by geological cross-section and, polygon method for unseen geological factors i.e. nature of core, recovery factor, cavities/caverns and other structural features.
- 19.2.10 Cross sectional resource is calculated for Cement grade for thickness of limestone zone of respective grades encountered in each borehole is enclosed as Annexure VII,

VIII for Malkhed 1 South and North blocks respectively and IX, X for Malkhed 02 South and North blocks respectively. However, the inferred, reconnaissance resources estimated block-wise separately and suitably annexed accordingly.

19.2.11 Polygonal resource is calculated for Cement grade for thickness of limestone zone of respective grades encountered in each borehole is enclosed as Annexure XI and XII for Malkhed-1 (South & North) and Annexure XIII and XIV for Malkhed-2 (South & North) blocks.

19.2.12 Annexures pertaining to resource statements are listed hereunder for ready reference.

19.3.0 PARAMETERS FOR RESOURCE ESTIMATION

19.3.0 SAMPLING PROCEDURE

The primary samples have been collected as per the litho-contact and sample length of one meter has been taken, however due to lithological variations in very few places the sample length was also taken less than 1.00m, but resource has not been calculated for the zones which are less than 1.00m. Samples from bore hole cores were crushed to (-) 200 mesh size, cone and quartered, thoroughly mixed and representative samples of 200g were prepared and sent to laboratory for analysis of 10 radicals i.e. CaO, MgO, Al₂O₃, SiO₂, Fe₂O₃, Na₂O, SO₃, P₂O₅, K₂O and LOI at Chemical Laboratory of MECL, Nagpur and results were obtained to delineate the ore zones.

19.3.1 CHEMICAL ANALYSIS

A total of 501 nos. of samples, all together in Malkhed-1 North, Malkhed -1 South, Malkhed-2 North and Malkhed – 2 South blocks block analyzed for boreholes drilled by MECL Lab, Nagpur and the results are enclosed as Annexure No III. A total of 50 nos. of external check samples have been sent for analysis at JNARDDC Lab and the results are enclosed as Annexure-VI.

Considering the open cast potentiality of the block, the minimum workable thickness / minimum stopping width of 1.00 m and minimum non ore parting of 1.00 m is considered for resource estimation.

The limestone is grey and greyish white with massive hard-core nature. The maximum average CaO% is 51.25 which is intersected in MKML-07, between 42.00m to 50.00m (Zone III). Over all three zones are interested in the explored boreholes drilled up to 50m. however in first phase of drilling one stratigraphy borehole was drilled up to 150 m where in the Iv zone intersected from 95.00 to 130m followed by ekmai shales.

19.4.0 OVERBURDEN

19.4.1 Overburden of limestone includes top layer of soil and subsequent sticky clay/sandstone which lies immediately above Limestone in Malkhed 1 and 2 blocks.

The range of overburden thickness (m) in this block is given below:

Top Soil Cover		Over Burden of Sandy Clay and Siliceous Clay underneath Top Soil	
Minimum (m)	Maximum (m)	Minimum (m)	Maximum (m)
1.00 (MKML-02 & KML-10)	5.00 MKML-07	6.00 MKML-10	37.30 MKML-11

19.5.0 METHODOLOGY

19.5.1 The resource of limestone has been estimated by geological cross section method.

The methodology is adopted, keeping the above assumptions in view resource estimation are described further.

19.6.0 METHODOLOGY ADOPTED IN CROSS-SECTION METHOD OF RESOURCE ESTIMATION (PRINCIPAL METHOD)

19.6.1 A total no of 6 boreholes which are falling in five parallel cross section lines S1-S1', S2-S2', S3-S3', S4-S4' and S5-S5' in Malkhed -1 North and South blocks, have been drawn along N 4°-W/ S 4°-E direction from East to West throughout the block which is marked on Plate No. IVA. A total no of 5 nos. of boreholes which are falling in seven parallel cross section lines S1-S1', S2-S2', S3-S3', S4-S4', S5-S5', S6-S6' and S7-S7' in Malkhed -2 North and South blocks, have been drawn along N 4°-W/ S 4°-E direction from East to West throughout the block which is marked on Plate No. IVB.

19.6.2 The limestone intersected in all the drilled boreholes. and continuous within the block. Efforts were made to pass these sections through drilled borehole locations wherever possible. The boreholes which have not fallen on section lines are projected on to the nearest section line. Since the beds are generally horizontal with very low dip of 1° to 2° due N to NW direction and boreholes drilled are all vertical hence true thickness will be the same as thickness intersected in the exploratory boreholes. Geological cross sections are generated by GDM software. Cross sectional area on each section has been measured with the help of Auto CAD map

2018 software and recorded systematically. Strike influence between two section lines and boreholes has been taken up-to half way distance. However, the influence is up to block boundary has been taken in section S1-S1' and S5-S5' up to 400m in 333 category beyond 400m is 334 category. Each of these areas has been multiplied with sectional influence / strike influence of the section lines to give volume. The volume is then multiplied with average specific gravity, to estimate geological in-situ gross resources.

$$R = S_v (X) T (X) \text{ Avg Specific Gravity}$$

Where in,

R = Resource / Tonnage

S_v = Sectional area of limestone

T = Influence between successive section lines

Sp. gr. = Specific gravity of limestone

Methodology adopted for determining area of influence is tabulated in the following Table No 19.2.

Table No. 19.1
Section-wise area influence for estimation of resource
by cross sectional method

Block	BH No	Cross Section Line	Influence (m)
Malkhed -1 South Block	MKML-05	S2-S2'	681.25
	KML-08	S3-S3'	707.00
	KML-07	S3-S3'	800.00
	MKML-02	S4-S4'	732.50
	MKML-01	S4-S4'	732.50
	KML-09	S5-S5'	1132.50
Malkhed -1 North Block	KML-06	S2-S2'	959.53
	MKML-04	S3-S3'	800.00
	MKML-06	S3-S3'	800.00
	KML-10	S4-S4'	800.00
	MKML-03	S4-S4'	460.00
Malkhed -2 South Block	KML-04	S4-S4'	884.95
	MKML-07	S5-S5'	725.48
	MKML-08	S5-S5'	800.00
	KML-01	S6-S6'	860.00
	KML-02	S7-S7'	860.00
Malkhed -2 North Block	MKML-10	S1-S1'	912.673
	KML-03	S1-S1'	800.00
	MKML-09	S3-S3'	988.72
	MKML-11	S3-S3'	800.00
	KML-05	S4-S4'	800.00
	KML-07	S5-S5'	236.00

19.7.0 POLYGON METHOD (CHECK METHOD):

19.7.1 The main objective of this method is to demarcate the area of influence of the limestone intersected by a particular borehole. The influence area has been obtained by constructing polygons by drawing perpendicular bisector of triangles, rectangles that connect the adjoining boreholes. The area of the influence of zones has been ascertained by Auto-Cad software. The area of non-development of respective zones is shown on the resource plan. The height of polygons is the cumulative thickness of limestone horizon/bands encountered by the corresponding borehole. The entire limestone body in block is divided into number of polygons.

The zone wise borehole wise resource estimation by Polygon method for Cement Grade Blendable Grade and Beneficial-Blendable Grades of this block are calculated.

The grade assigned to the polygon blocks is same as the weighted average grade of the corresponding boreholes. The area of non-development of particular grade in borehole has been deducted.

The formula of resource estimation is as follows:

$$R = P_A \times Th \times \text{Bulk Density}$$

Where, P_A = Area of Polygon

R = Resource/ Tonnage

Th = Thickness of Limestone

19.7.2 The resources are estimated grade wise, zone wise, borehole wise, polygon wise and presented as **Annexure Nos. XI, XII, XIII and XIV**. Polygon maps for Cement grade limestone is provided as Plate No VI A, B, C and D for Malkhed-1 South & North blocks and Plate No VII A, B and C for Malkhed-2 South & North blocks.

19.8.0 COMPUTATION OF AVERAGE GRADE

19.8.1 All calculations for grade estimation are made by weighted average method. The sample interval was uniformly maintained at 1.00m interval with the exception of minor variations or structural implications the weighted average method of calculation is made by the following formula:

$$1 \text{ Weighted Avg. Gr.} = \frac{1.0 \times 48.60 + 1.0 \times 50.58 + 1.0 \times 51.01 + 1.0 \times 52.40 + 1.0 \times 51.79 + 1.0 \times 51.98 + 1.0 \times 51.54 + 1.0 \times 52.09}{1.00 + 1.00 + 0.50 + 1.00 + 1.00} = 51.25\%$$

Where 'V' = Volume of limestone (CaO%) in individual borehole 'G' = Grade of the respective limestone zone in the borehole

Table No. 19.2

Borehole zone wise intersection of Cement Grade Limestone Zones in boreholes drilled by MECL in Malkhed 1 South and Malkhed 1 North Block, Sedam Taluk, Kalaburagi District, Karnataka State.

Malkhed -1 South block							Malkhed -1 North block						
Borehole Number	From (m)	To (m)	Thick (m)	CaO %	MgO %	SiO ₂ %	Borehole Number	From (m)	To (m)	Thick (m)	CaO %	MgO %	SiO ₂ %
Zone I							Zone I						
MKML-01	2.00	50.00	48.00	50.15	0.47	10.65	MKML-03	3.60	28.00	24.40	48.94	0.39	11.16
MKML-02	1.00	50.00	49.00	48.78	0.46	10.82	MKML-04	2.00	15.00	13.00	48.36	0.38	12.16
MKML-05	2.40	20.00	17.60	48.92	0.32	11.61	MKML-06	2.60	9.00	6.40	47.47	0.33	14.36
KML-07	1.00	33.00	32.00	49.11	0.37	11.44	KML-06	2.30	5.00	2.70	47.54	0.37	14.17
KML-08	3.00	39.00	36.00	49.70	0.40	11.18	KML-10	3.00	17.00	14.00	48.61	0.38	13.28
KML-09	1.74	50.00	48.26	49.89	0.47	9.91							
Zone II							Zone II						
KML-07	39.00	41.00	2.00	48.04	0.31	13.91	MKML-06	18.00	22.00	4.00	46.33	0.52	14.91
KML-08	48.00	56.00	8.00	46.56	0.45	15.66	KML-06	13.00	17.00	4.00	46.76	0.47	15.32
							KML-10	27.50	31.50	4.00	46.26	0.45	14.79
Zone III							Zone III						
KML-07	44.00	50.00	6.00	49.24	0.31	11.60	MKML-06	47.00	50.00	3.00	49.84	0.38	10.05
KML-08	74.00	86.00	12.00	46.80	0.43	15.24	KML-06	36.00	41.00	5.00	48.05	0.40	13.56
Zone IV							Zone IV						
KML-08	95.00	130.00	35.00	50.03	0.42	8.84							

Boreholes KML: 01,02,03,04 and 05 are old boreholes drilled in 2023-24 (First phase).

Table No. 19.3
Borehole zone wise intersection of Blendable and Beneficial-Blendable Grade Limestone Zones in boreholes drilled by MECL, Malkhed 1 South and Malkhed 1 North, Sedam Taluk, Kalaburagi, Karnataka State.

Malkhed -1 South block							Malkhed -1 North block						
Borehole Number	From (m)	To (m)	Thick (m)	CaO %	MgO %	SiO ₂ %	Borehole Number	From (m)	To (m)	Thick (m)	CaO %	MgO %	SiO ₂ %
Blendable Grade - Zone II							Blendable Grade - Zone II						
<i>KML-07</i>	<i>41.00</i>	<i>44.00</i>	<i>3.00</i>	<i>46.03</i>	<i>0.39</i>	<i>16.73</i>	<i>17.00</i>	<i>21.00</i>	<i>17.00</i>	<i>4.00</i>	<i>45.79</i>	<i>0.53</i>	<i>16.89</i>
Beneficial-Blendable Grade - Zone I							Beneficial-Blendable Grade - Zone I						
MKML-05	20.00	50.00	30.00	42.84	0.58	20.89	MKML-03	28.00	50.00	22.00	43.63	0.63	19.52
<i>KML-07</i>	<i>33.00</i>	<i>39.00</i>	<i>6.00</i>	<i>44.18</i>	<i>0.44</i>	<i>19.85</i>	MKML-04	15.00	50.00	35.00	41.87	0.69	21.44
<i>KML-08</i>	<i>39.00</i>	<i>48.00</i>	<i>9.00</i>	<i>45.04</i>	<i>0.46</i>	<i>19.29</i>	MKML-06	9.00	18.00	9.00	43.49	0.48	20.51
							<i>KML-06</i>	<i>5.00</i>	<i>13.00</i>	<i>8.00</i>	<i>44.26</i>	<i>0.50</i>	<i>20.21</i>
							<i>KML-10</i>	<i>17.00</i>	<i>27.50</i>	<i>10.50</i>	<i>43.79</i>	<i>0.48</i>	<i>9.58</i>
Beneficial-Blendable Grade - Zone II							Beneficial-Blendable Grade - Zone II						
<i>KML-08</i>	<i>56.00</i>	<i>74.00</i>	<i>18.00</i>	<i>42.87</i>	<i>0.51</i>	<i>21.11</i>	MKML-06	22.00	47.00	25.00	40.81	0.69	22.82
							<i>KML-06</i>	<i>21.00</i>	<i>36.00</i>	<i>15.00</i>	<i>41.70</i>	<i>0.60</i>	<i>22.84</i>
							<i>KML-10</i>	<i>31.50</i>	<i>50.00</i>	<i>18.50</i>	<i>42.47</i>	<i>0.55</i>	<i>21.04</i>
Beneficial-Blendable Grade - Zone III							Beneficial-Blendable Grade - Zone III						
<i>KML-08</i>	<i>86.00</i>	<i>95.00</i>	<i>9.00</i>	<i>44.07</i>	<i>0.49</i>	<i>19.24</i>	<i>41.00</i>	<i>50.00</i>	<i>9.00</i>	<i>43.36</i>	<i>0.54</i>	<i>20.44</i>	<i>41.00</i>

Boreholes KML: 01,02,03,04 and 05 are old boreholes drilled in 2023-24 (First phase).

Table No. 19.4
Borehole zone wise intersection of Cement Grade Limestone Zones in boreholes drilled by MECL,
Malkhed 2 South and Malkhed 2 North Block, Sedam Taluk, Kalaburagi District, Karnataka State.

Malkhed -2 South block							Malkhed -2 North block						
Borehole Number	From (m)	To (m)	Thick (m)	CaO %	MgO %	SiO ₂ %	Borehole Number	From (m)	To (m)	Thick (m)	CaO %	MgO %	SiO ₂ %
Zone I							Zone I						
KML-01	3.00	20.00	17.00	48.28	0.41	12.90	MKML-09	4.00	5.00	1.00	47.06	0.31	15.52
KML-02	1.00	4.00	3.00	48.32	0.32	14.09	KML-03	3.00	5.00	2.00	46.73	0.36	15.93
Zone II							Zone II						
MKML-07	22.00	26.00	4.00	49.28	0.34	10.42	MKML-09	21.00	25.00	4.00	49.87	0.34	10.77
MKML-08	10.00	16.00	6.00	46.63	0.40	14.38	MKML-10	15.00	18.00	3.00	47.32	0.25	12.31
KML-01	29.00	35.00	6.00	47.54	0.45	14.28	MKML-11	39.30	41.30	2.00	47.85	0.18	11.84
KML-02	38.00	42.00	4.00	47.26	0.47	14.64	KML-03	18.00	23.00	5.00	48.89	0.37	12.65
KML-04	18.00	23.00	5.00	48.60	0.31	12.71	KML-05	23.00	28.00	5.00	48.35	0.39	13.27
Zone III							Zone III						
MKML-07	42.00	50.00	8.00	51.25	0.52	8.18	MKML-09	41.00	50.00	9.00	50.54	0.52	8.06
MKML-08	35.00	39.00	4.00	49.52	0.35	11.39	MKML -10*	37.00	50.00	13.00	50.77	0.20	8.71
KML-04	40.00	50.00	10.00	50.16	0.51	9.06	KML-03	39.00	50.00	11.00	50.76	0.55	8.66
							KML-05	44.00	50.00	6.00	48.93	0.46	11.55
							* 40.60-41.00 & 43.20-44.20 Void No sample for 1.40 m thick						

Boreholes KML: 01,02,03,04 and 05 are old boreholes drilled in 2023-24 (First phase).

Table No. 19.5
Borehole zone wise intersection of Blendable and Beneficiable-Blendable Grade Limestone Zones in boreholes drilled by MECL, Malkhed 2 South and Malkhed 2 North, Sedam Taluk, Kalaburagi District, Karnataka State.

Malkhed -1 South block							Malkhed -2 North block						
Borehole Number	From (m)	To (m)	Thick (m)	CaO %	MgO %	SiO ₂ %	Borehole Number	From (m)	To (m)	Thick (m)	CaO %	MgO %	SiO ₂ %
Beneficiable-Blendable Grade - Zone I							Beneficiable-Blendable Grade - Zone I						
MKML-07	5.00	22.00	17.00	41.52	0.49	22.65	MKML-09	5.00	21.00	16.00	41.78	0.46	22.51
MKML-08	2.40	10.00	7.60	43.78	0.45	21.50	MKML-10	7.00	8.00	1.00	42.13	0.29	21.38
KML-01	20.00	29.00	9.00	43.89	0.54	20.36		10.00	15.00	5.00	39.39	0.351	24.30
KML-02	4.00	38.00	34.00	43.77	0.53	21.36	KML-03	5.00	18.00	13.00	43.21	0.45	21.33
KML-04	4.00	18.00	14.00	42.37	0.47	21.93	KML-05	4.00	23.00	19.00	42.18	0.47	21.77
Beneficiable-Blendable Grade - Zone II							Beneficiable-Blendable Grade - Zone II						
MKML-07	26.00	42.00	16.00	43.45	0.47	20.32	MKML-09	25.00	41.00	16.00	43.84	0.43	19.94
MKML-08	16.00	35.00	19.00	41.64	0.58	22.21	MKML-10	19.00	37.00	18.00	42.08	0.23	22.38
KML-01	35.00	50.00	15.00	42.56	0.63	21.35	MKML-11	45.00	45.40	0.40	41.10	0.30	23.03
KML-02	42.00	50.00	8.00	44.35	0.51	19.39		45.90	47.00	1.10	43.01	0.29	22.01
KML-04	23.00	40.00	17.00	44.79	0.38	19.48	KML-03	23.00	39.00	16.00	44.21	0.41	19.75
							KML-05	28.00	44.00	16.00	43.69	0.45	19.26
Beneficiable-Blendable Grade - Zone III							Beneficiable-Blendable Grade - Zone III						
MKML-08	39.00	50.00	11.00	43.74	0.42	19.81	-	-	-	-	-	-	-

As mentioned earlier, Limestone is classified into different grades on the basis of three major constituents viz. CaO, MgO and SiO₂. The Other major chemical constituents of limestone are Al₂O₃, Fe₂O₃ and LOI. The Cement grade limestone Zones-I, II, III and IV intersected in the boreholes in Malkhed-1 South, North, Malkhed-2 South & North blocks.

Table No: 19.6
Range of Major constituents in Cement Grade Zone-I, II, III IV
in Malkhed-1 South, North, Malkhed-2 South & North blocks.

Block	Zone	CaO%		MgO%		SiO ₂ %	
		Min	Max	Min	Max	Min	Max
Malkhed - South	I	43.57	52.85	0.23	1.40	5.74	20.14*
	II	45.85	50.03	0.29	0.51	10.01	17.88*
	III	43.22	51.42	0.24	0.63	8.17	19.55*
	IV	46.04	51.78	0.27	0.83	5.91	15.58*
Malkhed - North	I	43.51	51.58	0.26	0.63	8.50	21.76*
	II	45.25	50.21	0.35	0.60	10.17	16.65*
	III	49.31	50.83	0.33	0.46	8.70	11.18
Malkhed - South	I	44.90	51.31	0.32	0.58	8.75	17.85*
	II	45.93	51.29	0.28	0.53	6.95	17.12*
	III	45.42	52.40	0.31	0.62	6.40	14.92
Malkhed - North	I	45.72	47.74	0.31	0.39	14.40	17.47
	II	44.44	51.86	0.21	0.71	6.13	17.25*
	III	43.74	52.32	0.18	0.68	5.58	15.56

* Middle of high-grade zones, hence weighted average of Cement Grade quality achieved.

Deleterious Constituents

The most deleterious constituent of cement is MgO. It affects the soundness of setting time of cement. It mostly adds through limestone. The Indian cement manufacturers consider 4% as the safe limit. The average MgO % estimated for Cement grade Zones is 0.46.

Another harmful impurity in limestone for cement making is sulphur. The SO₃%content in limestone should not exceed 1.75%, because it forms sulpho-

aluminate which has marked swelling property. The average SO_3 content in Primary samples analyzed is 0.093% which is well-within the limit.

Minor Constituents

Besides above broad chemical specifications, Cement grade limestone bound to have some limitations in the content of minor elements and constituents. Although these minor constituents do not have direct significance in assessing the suitability of a limestone, however, their presence beyond certain limits is undesirable as these may affect the manufacturing process or the quality of cement adversely.

Phosphorus: Content of P_2O_5 should not exceed 1% as excess phosphorus which inhibits clinker minerals formation and reduces the strength of cement appreciably.

Average P_2O_5 content is 0.28% which is within the permissible limit.

19.9.0 CATEGORISATION OF RESOURCE

- 19.9.1 Resource have been categorised under Inferred (333) and Reconnaissance (334) category of resource as per UNFC. The assumptions and parameters ns are already discussed earlier in this chapter under 19.2.0 and 19.6.
- 19.9.2 Limestone zones are computed are categorised based on **end use grade** specifications prescribed by Indian Bureau of Mines.
- 19.9.3 The average grades for 3 radicals CaO , MgO and SiO_2 have been calculated. Thus, average grade of the block is calculated for all grades of limestone.

CHAPTER - 20

20.0.0 REPORTING OF RESOURCE

20.1.0 RESOURCE ESTIMATION

The Resource of limestone have been estimated grade wise, borehole wise and section wise in cross section method. Resource of limestone have been estimated for different intersected zones/grade wise, borehole wise as per specifications and basic assumptions enumerated earlier. The resources of limestone grades have been estimated borehole wise for limestone intersected in the boreholes as per specifications by cross section method. The category wise, zone-wise and grade wise estimated resources are tabulated in corresponding Annexures VII, VIII, IX and X for cross sectional resources and Annexure XI, XII, XIII and XIV for Polygonal resources.

20.1.1 The total gross in-situ resource of limestone is broadly categorized under inferred and reconnaissance resource categories. The details of the same are furnished in the following tables for Malkhed -1 South, M1/N, M2/S and m2/N blocks separately.

i. Malkhed -1 South Block

Table No 20.1
Summary of Cement Grade Limestone Resource of
Malkhed -1 South Block Cross sectional method – (Inferred and Reconnaissance)
Unit: million tonnes

Grade Category	Resource Category	Zone	Gross Geological Resources (Mil. tons)	Net Geological Resources (Mil. tons)	CaO%	MgO%	Si O ₂ %
Cement	Inferred (333)	Zone I	407.56	326.05	49.52	0.43	10.72
		Zone II	15.07	12.05	47.16	0.39	14.95
		Zone III	28.15	22.52	47.97	0.37	13.49
		Zone IV	46.96	37.57	50.03	0.42	8.84
	Total (333)	I II III IV	497.74	398.19	49.41	0.42	10.83
	Reconnaissance (334)	Zone I	86.93	69.55	49.79	0.45	10.32
		Zone II	1.06	0.85	48.04	0.31	13.91
		Zone III	3.19	2.55	49.24	0.31	11.60
		Zone IV	-	-	-	-	-
	Total (334)	I II III	91.19	72.95	49.75	0.44	10.41
Total R₁	Total (333 334)	I II III IV	588.93	471.14	49.50	0.43	10.71

Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Cement Grade limestone for Malkhed-1 South is furnished as Annexure No VII-A1 and VII-A2 respectively.

Table No 20.2
Summary of Blendable and Beneficiable-Blendable Grade Limestone Resource of Malkhed -1 South Block – Cross sectional method (Inferred and Reconnaissance)
Unit: million tonnes

Grade Category	Resource Category	Zone	Gross Geol. Resources (Mil. tons)	Net Geol. Resources (Mil. tons)	CaO	MgO	Si O ₂
Blendable Grade	333	Zone II	6.52	5.22	46.03	0.39	16.73
	334	Zone II	1.60	1.28	46.03	0.39	16.73
Total - R₂	Total	Zone II	8.12	6.50	46.03	0.39	16.73
Beneficiable-Blendable Grade	333	Zone I	26.20	20.96	44.60	0.45	19.58
	333	Zone II	17.94	14.35	42.87	0.51	21.11
	333	Zone III	22.42	17.94	44.07	0.49	19.24
	Total 333	I II & III	66.56	53.25	43.95	0.48	19.88
	334	Zone I	4.81	3.85	43.73	0.49	20.20
	Total 334	I II & III	4.81	3.85	43.73	0.49	20.20
Total - R₃	Total	I II III IV	71.37	57.10	43.93	0.48	19.90
Total R₂+R₃	Total	I II III	79.49	63.60	44.15	0.47	19.58

Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Blendable Grade limestone for Malkhed-1 South is furnished as Annexure No VII-B1 and VII-B2 respectively. Section-wise, borehole-wise Inferred and Reconnaissance resources of Beneficiable-Blendable Grade limestone for Malkhed-1 South is furnished as Annexure No VII-B3 and VII-B4 respectively.

ii. Malkhed -1 North Block

Table No: 20.3
Summary of Cement Grade Limestone Resource of
Malkhed -1 North Block – Cross sectional method (Inferred and Reconnaissance)
Unit: million tonnes

Grade Category	Resource Category	Zone	Gross Geological Resources (Mil. tons)	Net Geological Resources (Mil. tons)	CaO%	MgO%	Si O ₂ %
Cement	Inferred (333)	Zone I	122.91	98.33	48.39	0.37	13.01
		Zone II	31.03	24.82	46.41	0.47	14.96
		Zone III	22.33	17.86	48.35	0.40	12.81
		Zone IV	15.62	12.49	50.03	0.42	8.84
	Total	I II III IV	191.89	153.50	48.20	0.40	12.96
	Reconnaissance (334)	Zone I	23.19	18.55	48.25	0.38	13.23
		Zone II	7.09	5.67	46.56	0.46	15.11
		Zone III	5.36	4.29	48.05	0.40	13.56
		I II III	35.64	28.51	47.89	0.40	13.66
	Total	I II III IV	227.53	182.01	48.15	0.40	13.07

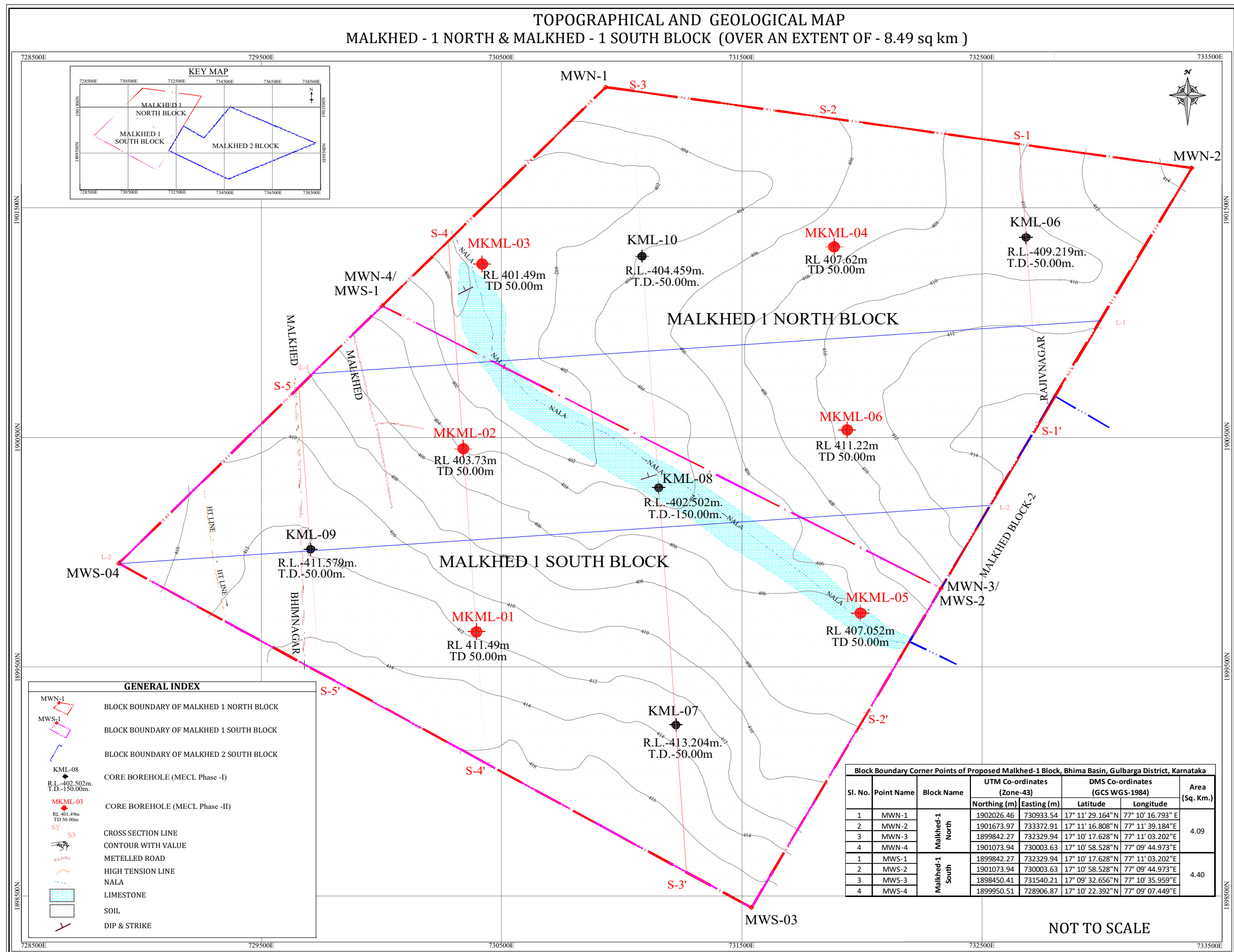
Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Cement Grade limestone for Malkhed-1 North is furnished as Annexure No VIII-A1 and VIII-A2 respectively.

Table No: 20.4
Summary of Blendable and Beneficiable-Blendable Grade Limestone Resource of
Malkhed -1 North Block – Cross sectional method (Inferred and Reconnaissance)
Unit: million tonnes

Grade Category	Resource Category	Zone	Gross Geological Resources (Mil. tons)	Net Geological Resources (Mil. tons)	CaO	MgO	Si O ₂
Blendable Grade	333	Zone II	8.26	6.61	45.79	0.53	16.89
	334	Zone II	4.29	3.43	45.79	0.53	16.89
Total - R ₂	Total	Zone II	12.55	10.04	45.79	0.53	16.89
Beneficiable-Blendable Grade	333	Zone I	171.94	137.55	43.79	0.56	18.53
	333	Zone II	79.13	63.31	42.17	0.57	21.74
	333	Zone III	21.16	16.93	43.45	0.53	20.29
	Total	I II III	272.23	217.79	43.29	0.56	19.60
	334	Zone I	30.92	24.73	43.19	0.57	20.46
	334	Zone II	29.03	23.22	42.04	0.58	22.04
	334	Zone III	9.65	7.72	43.36	0.54	20.44
	Total	I II III	69.60	55.68	42.73	0.57	21.12
Total - R ₃	Total	I II III	341.83	273.47	43.18	0.56	19.91
Total R ₂ +R ₃	Total	I II III	354.38	283.51	43.27	0.56	19.80

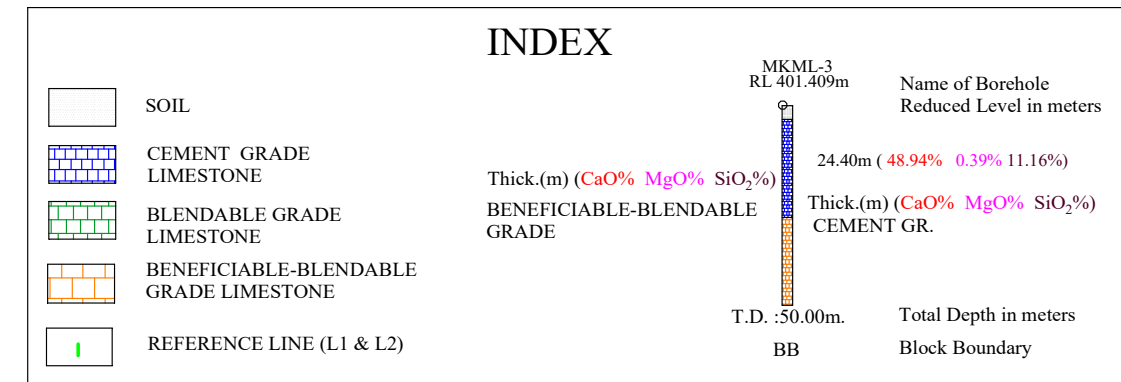
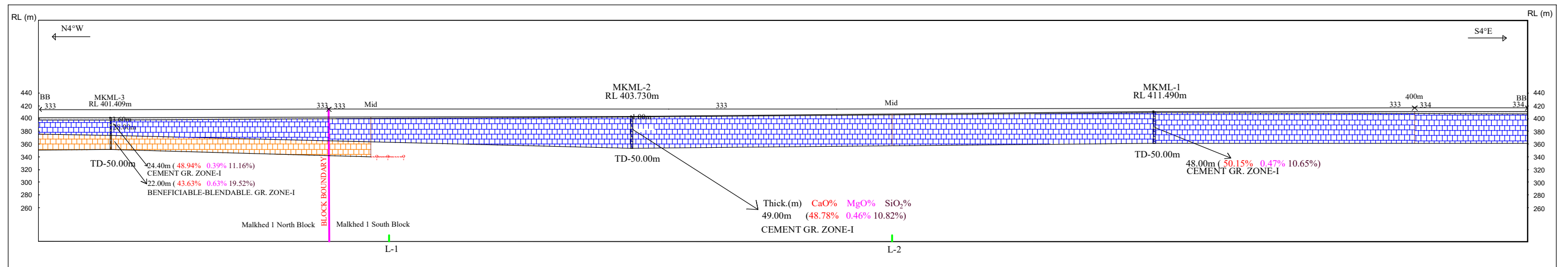
Section-wise, borehole-wise, zone-wise Inferred and Inferred resources of Blendable Grade limestone for Malkhed-1 North is furnished as Annexure No VIII-B1 and VIII-B2 respectively.

Section-wise, borehole-wise Inferred and Reconnaissance resources of Beneficiable-Blendable Grade limestone for Malkhed-1 North is furnished as Annexure No VIII-B3 and VIII-B4 respectively



Text Figure No: 3 Topographical Geological Map of Malkhed-1 North, Malkhed-1 South Blocks

GEOLOGICAL CROSS-SECTION ALONG SECTION LINE S4-S4'
MALKHED - 1 NORTH & MALKHED - 1 SOUTH BLOCKS
(OVER AN EXTENT OF - 8.50 sq km)



NOT TO SCALE

Text Figure No: 4 Geological Cross section of Malkhed-1 North and Malkhed-1 South Blocks along S4-S4'

GRAPHIC LITHOLOGS OF BOREHOLES DRILLED BY MECL IN MALKHED 1 SOUTH BLOCK, (G-3) KALABURAGI DISTRICT, KARNATAKA

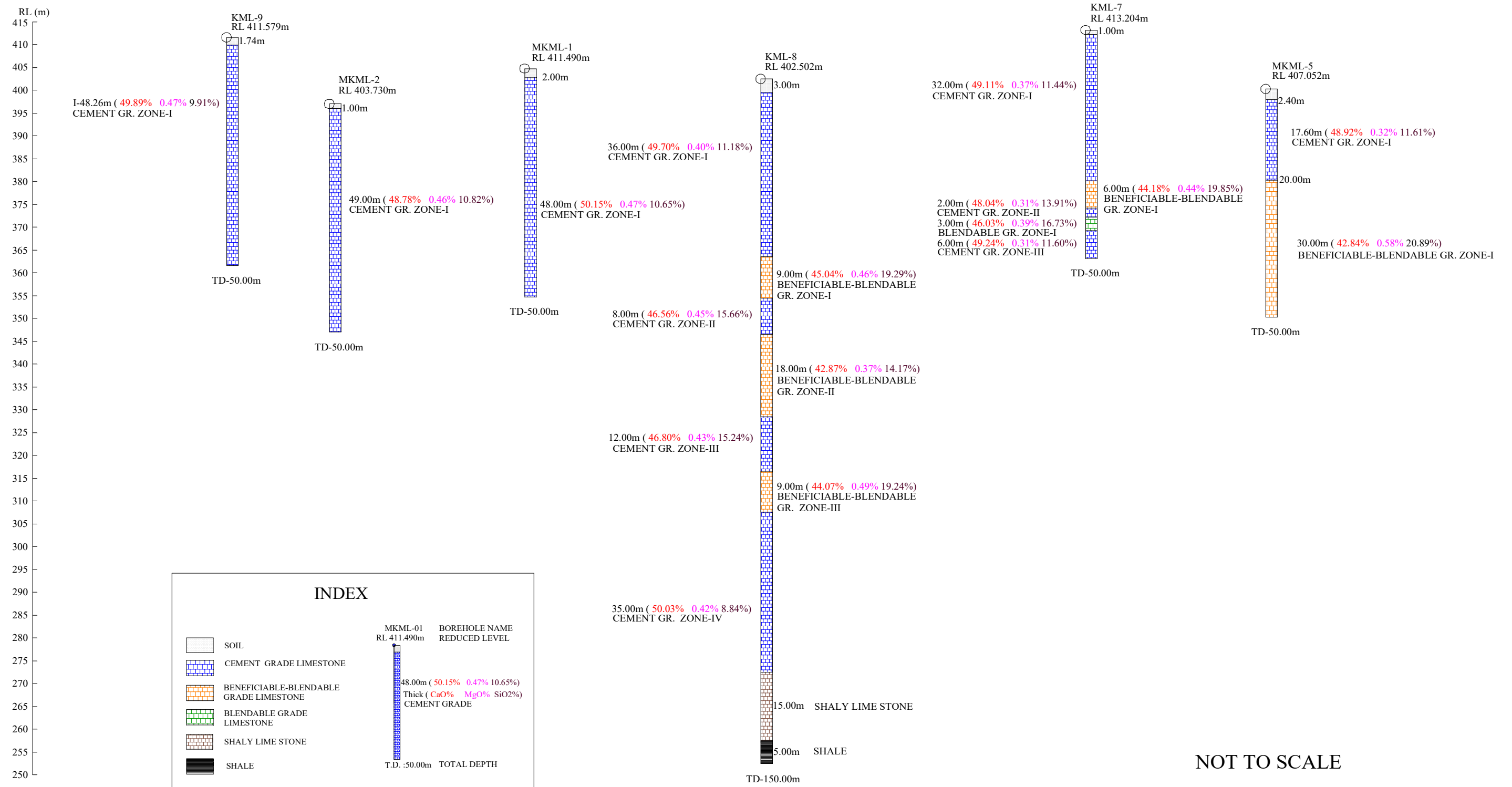
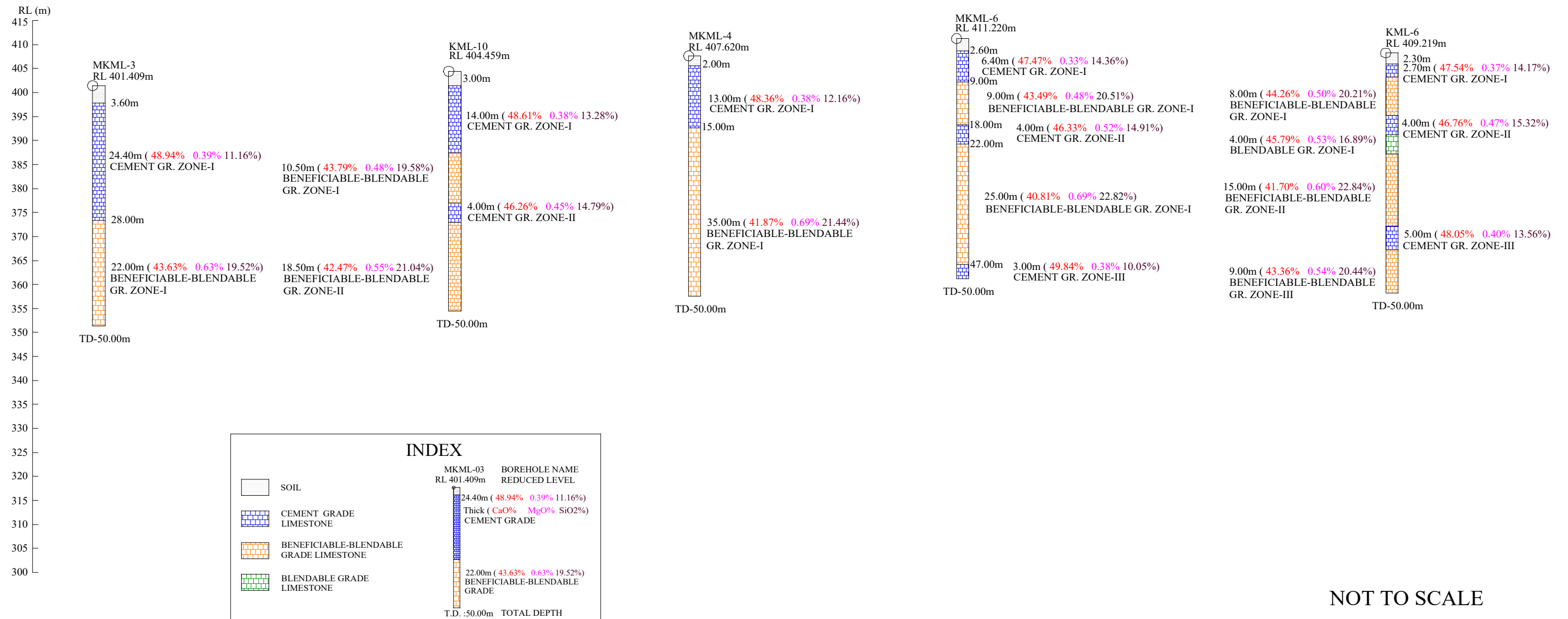


Figure No:5 Graphic Lithologs of boreholes drilled in Malkhed-1 South Block

GRAPHIC LITHOLOGS OF BOREHOLES DRILLED BY MECL IN MALKHED 1 NORTH BLOCK, (G-3) KALABURAGI DISTRICT, KARNATAKA



Text Figure No:6 Graphic Lithologs of boreholes drilled in Malkhed-1 North Block

iii. Malkhed -2 South Block

Table No: 20.5

**Summary of Cement Grade Limestone Resource of
Malkhed -2 South Block – Cross sectional method (Inferred and Reconnaissance)
Unit: million tonnes**

Grade Category	Resource Category	Zone	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO%	MgO%	Si O ₂ %
Cement	Inferred (333)	Zone I	37.11	29.69	48.29	0.39	13.1
		Zone II	49.41	39.53	47.75	0.39	13.40
		Zone III	44.07	35.26	49.65	0.39	10.97
	Total (333)	I II III IV	130.59	104.47	48.55	0.39	12.49
	Reconnaissance (334)	Zone I	25.90	20.72	48.29	0.38	13.30
		Zone II	17.53	14.02	47.64	0.41	13.96
		Zone III	13.15	10.52	48.66	0.31	12.54
	Total (334)	I II III	56.58	45.26	48.17	0.37	13.33
Total R₁	(333 334)	I II III	187.17	149.73	48.44	0.38	12.75

Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Cement Grade limestone for Malkhed-2 South is furnished as Annexure No IX-A1 and IX-A2 respectively.

Table No: 20.6

**Summary of Beneficiable-Blendable Grade Limestone Resource of
Malkhed -2 South Block – Cross sectional method (Inferred and Reconnaissance)
Unit: million tonnes**

Grade Category	Resource Category	Zone	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO%	MgO%	Si O ₂ %
Beneficiable-Blendable Grade	333	Zone I	150.88	120.70	43.09	0.50	21.62
	333	Zone II	147.77	118.21	43.69	0.50	20.18
	333	Zone III	25.48	20.39	43.74	0.42	19.81
	Total (333)	I II & III	324.13	259.30	43.40	0.49	20.82
	334	Zone I	59.70	47.76	43.54	0.52	21.32
	334	Zone II	45.93	36.76	43.61	0.51	20.40
	334	Zone III	3.63	2.91	43.74	0.42	19.81
	Total (334)	I II III	109.28	87.44	43.58	0.51	20.88
Total - R₃	(333 334)	I, II III	433.41	346.74	43.46	0.50	20.84

Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Beneficiable-Blendable Grade limestone for Malkhed-1 South is furnished as Annexure No IX-B1 and IX-B2 respectively. **Malkhed -2 North Block**

iv. Malkhed -2 North Block

Table No 20.7
Summary of Cement Grade Limestone Resource of
Malkhed -2 North Block – Cross sectional method (Inferred and Reconnaissance)
Unit: million tonnes

Grade Category	Resource Category	Zone	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO%	MgO%	Si O ₂ %
Cement	333	Zone I	3.63	2.91	46.86	0.34	15.78
	333	Zone II	32.11	25.69	48.64	0.36	12.53
	333	Zone III	58.99	47.20	49.83	0.46	9.78
	Total	I II III	94.73	75.80	49.32	0.42	10.94
	334	Zone I	0.02	0.02	46.73	0.36	15.93
	334	Zone II	6.54	5.23	48.87	0.37	12.39
	334	Zone III	7.71	6.17	50.66	0.53	8.89
	Total	I II III	14.27	11.42	49.83	0.46	10.50
Total - R1	Total (333 334)	I II III	109.00	87.22	49.39	0.43	10.88

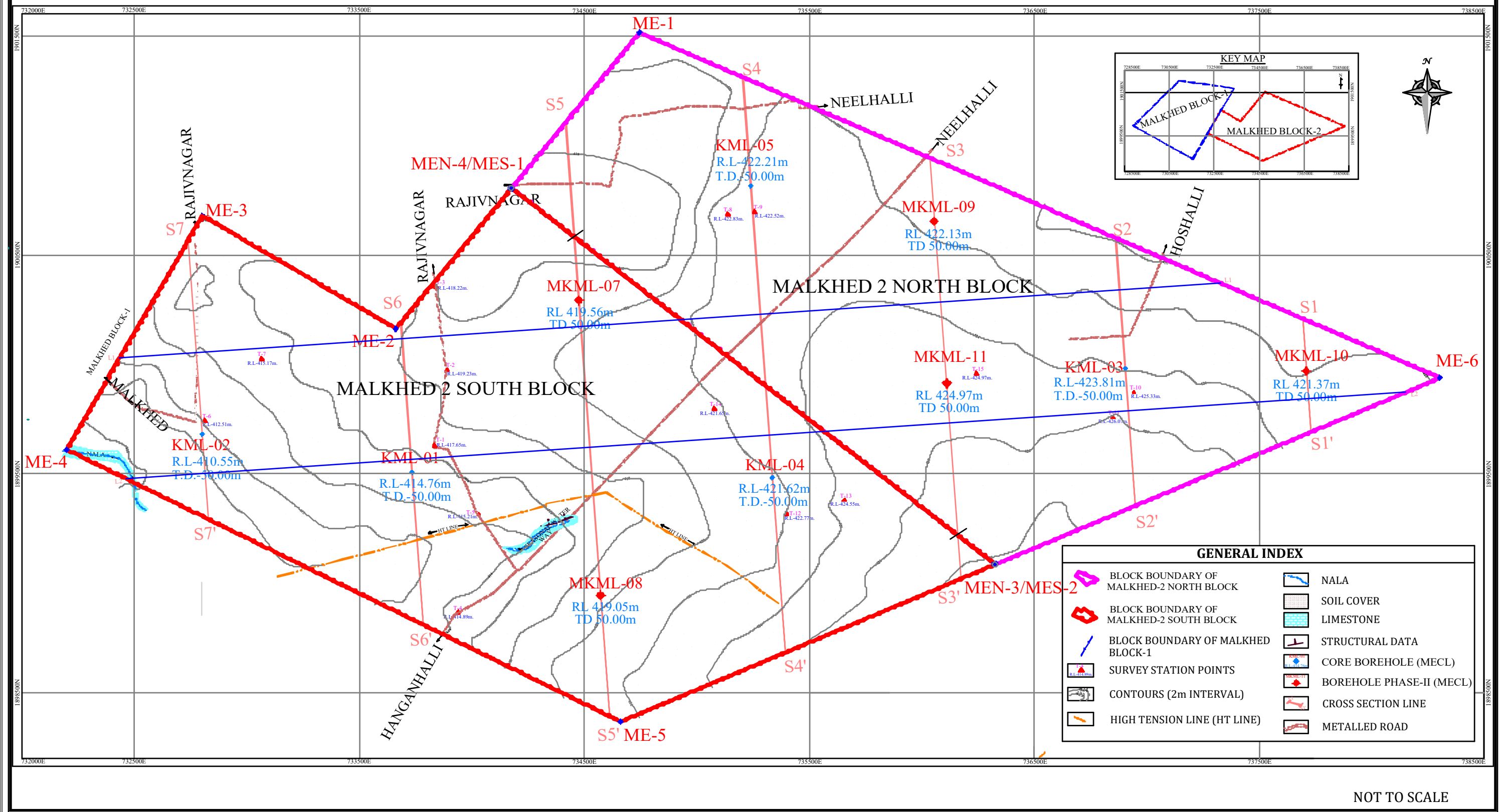
Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Cement Grade limestone for Malkhed-2 North is furnished as Annexure No X-A1 and X-A2 respectively.

Table No 20.8
Summary of Beneficiable-Blendable Grade Limestone Resource of
Malkhed -2 North Block – Cross sectional method (Inferred and Reconnaissance)
Unit: million tonnes

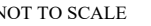
Grade Category	Resource Category	Zone	Gross Geol. Resources (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO%	MgO%	Si O ₂ %
Beneficiable-Blendable Grade	333	Zone I	97.09	77.67	43.09	0.44	20.64
	333	Zone II	124.22	99.38	43.50	0.39	20.16
	333	Zone III	-	-	-	-	-
	Total	I II III	221.31	177.05	43.32	0.41	20.37
	334	Zone I	19.88	15.90	42.50	0.47	21.80
	334	Zone II	19.49	15.59	44.00	0.41	19.82
	334	Zone III	-	-	-	-	-
	Total	I II III	39.37	31.49	43.24	0.44	20.82
Total - R₃	Total	I II III	260.70	208.54	43.31	0.42	20.44

Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Beneficiable-Blendable Grade limestone for Malkhed-2 North is furnished as Annexure No X-B1 and X-B2 respectively.

TOPOGRAPHICAL AND GEOLOGICAL MAP MALKHED - 2 NORTH & SOUTH BLOCK (OVER AN EXTENT OF - 9.52 sq km)

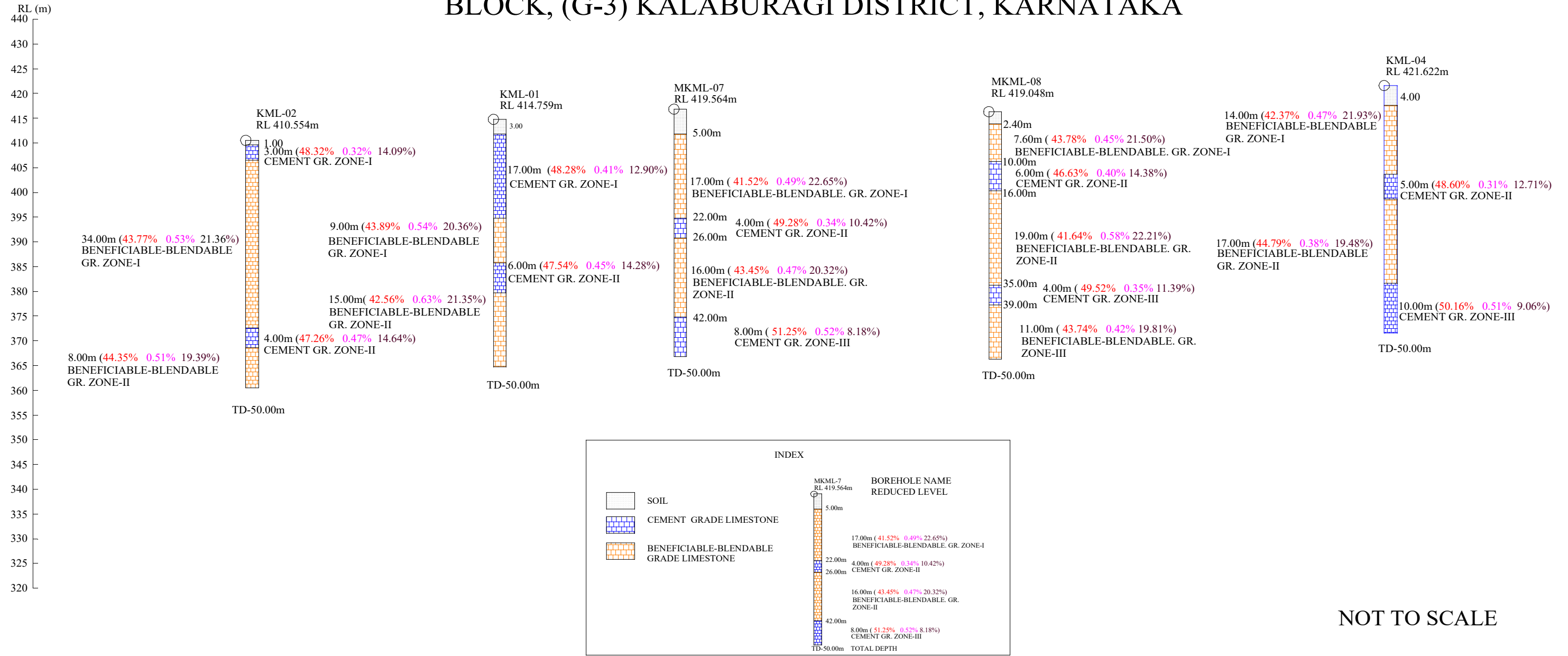


Text Figure No: 7 Topographical Geological Map of Malkhed-2 North, Malkhed-1 South Blocks



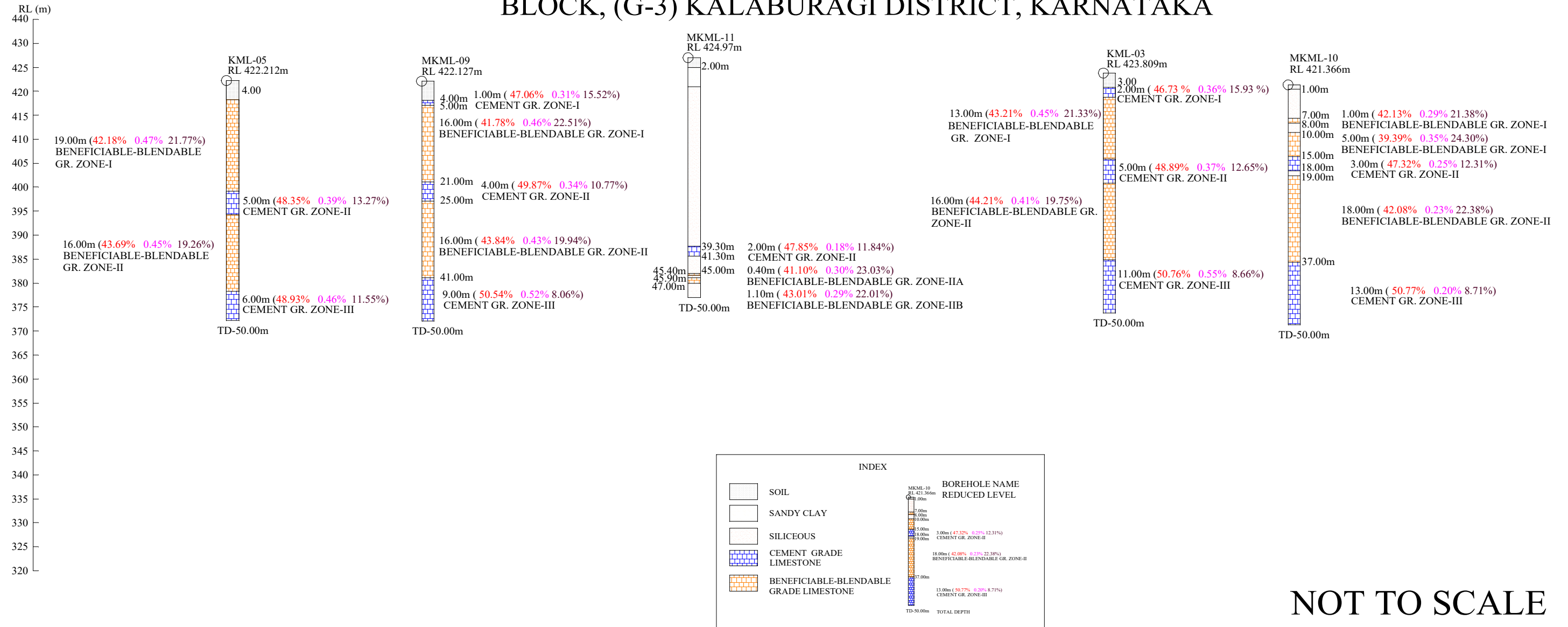
Text Figure No: 8 Geological Cross section of Malkhed-2 North, Malkhed-2 South Blocks along S3-S3' & S5-S5'

GRAPHIC LITHOLOGS OF BOREHOLES DRILLED BY MECL IN MALKHED 2 SOUTH BLOCK, (G-3) KALABURAGI DISTRICT, KARNATAKA



Text Figure No: 9 Graphic Lithologs of boreholes drilled in Malkhed-2 South Block

GRAPHIC LITHOLOGS OF BOREHOLES DRILLED BY MECL IN MALKHED 2 NORTH BLOCK, (G-3) KALABURAGI DISTRICT, KARNATAKA



Text Figure No: 10 Graphic Lithologs of boreholes drilled in Malkhed-2 North Block

20.2.0 POLYGON METHOD

20.2.1 The main objective of this method is to demarcate the area of influence of the limestone intersected by a particular borehole and the same is discussed earlier under chapter 19.7.0 of this report.

20.2.2 The grade assigned to the polygon blocks is same as the weighted average grade of the corresponding boreholes. The area of non-development of particular grade in borehole has been deducted. Block-wise, polygon-wise, borehole-wise polygonal area is tabulated hereunder.

Block	Polygon No	Borehole No	Polygonal Area (m ²)	Remarks
Malkhed – 1 South	P5 S	MKML-01	744619.59	Current exploration
	P1 S	MKML-02	733076.02	
	P3 S	MKML-05	494069.31	
	P6 S	<i>KML-07</i>	1050698.64	1 st Phase exploration
	P2 S	<i>KML-08</i>	554723.13	
	P4 S	<i>KML-09</i>	829916.04	
Malkhed – 1 North	P1 N	MKML-03	437987.57	Current exploration
	P3 N	MKML-04	773114.27	
	P5 N	MKML-06	1058015.44	
	P4 N	<i>KML-06</i>	849630.20	1 st Phase exploration
	P2 N	<i>KML-10</i>	979769.83	
Malkhed – 2 South	P1 S	MKML-07	839683.12	Current exploration
	P5 S	MKML-08	1041149.27	1 st Phase exploration
	P4 S	KML-01	1128793.09	
	P3 S	KML-02	1075393.93	
	P2 S	KML-04	1109312.28	
Malkhed – 2 South	P2 N	MKML-09	603977.40	Current exploration
	P5 N	MKML-10	434999.34	
	P3 N	MKML-11	997867.92	
	P4 N	<i>KML-03</i>	913108.02	1 st Phase exploration
	P1 N	<i>KML-05</i>	130650.68	

20.2.3 Polygon Maps of Malkhed-1 North and South blocks for Cement Grade limestone zones are furnished for Zone I, II, III and IV as Plate No VI-A, VI-B, VI-C & VI-D respectively.

20.2.4 Polygon Maps of Malkhed-2 North and South blocks for Cement Grade limestone zones are furnished for Zone I, II and III as Plate No VII-A, VII-B and VI-C respectively.

20.2.5 The Polygone-wise zone-wise borehole-wise resource estimation by Polygon method for Cement Grade Blendable Grade and Beneficiable-Blendable Grades of this block are calculated and tabulated here under.

i. Malkhed -1 South Block

Table No 20.9

**Summary of Cement Grade, Blendable and Beneficiable-Blendable
Grade Limestone Resource of Malkhed -1 South Block - Polygonal Method**
Unit: million tonnes

Grade	Zone	Gross Geol. Resources (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO%	MgO%	Si O ₂ %
Cement	I	468.07	374.45	49.49	0.43	10.78
	II	17.59	14.07	47.04	0.41	15.10
	III	34.86	27.89	47.99	0.37	13.47
	IV	46.52	37.21	50.03	0.42	8.84
	Total	567.04	453.63	49.37	0.43	10.92
Blendable	Zone II	8.48	6.78	46.03	0.39	16.73
Beneficiable- Blendable	Zone I	70.26	56.21	43.58	0.52	20.33
	Zone II	26.86	21.49	42.87	0.51	21.11
	Zone III	13.43	10.74	44.07	0.49	19.24
	Total	110.55	88.44	43.47	0.52	20.39
All Grades Combined	Total	686.07	548.85	48.38	0.44	12.52

Polygon-wise, borehole-wise, zone-wise resources of Cement Grade limestone for Malkhed-1 South estimated by Polygonal method is furnished as Annexure No XI-A/1. Polygon -wise, borehole-wise, zone-wise resources of Blendable Grade limestone for Malkhed-1 South is furnished as Annexure No XI-B/1. Polygon -wise, borehole-wise resources of Beneficiable-Blendable Grade limestone for Malkhed-1 South is furnished as Annexure No XI-C/1.

ii. Malkhed -1 North Block

Table No: 20.10

**Summary of Cement Grade, Blendable and Beneficiable-Blendable
Grade Limestone Resource of Malkhed -1 North Block - Polygonal Method**
Unit: million tonnes

Grade	Zone	Gross Geol. Resources (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO%	MgO%	Si O ₂ %
Cement	I	117.07	93.65	48.40	0.38	12.71
	II	31.07	24.85	46.43	0.48	14.99
	III	19.97	15.97	48.82	0.39	12.06
	IV	0.00	0.00	0.00	0.00	0.00
	Total	168.10	134.48	48.09	0.40	13.06
Blendable	Zone II	9.14	7.31	45.79	0.53	16.89
Beneficiable- Blendable	Zone I	170.28	136.22	42.95	0.59	20.57
	Zone II	154.19	123.35	41.53	0.63	22.26
	Zone III	20.57	16.46	43.36	0.54	20.44
	Total	345.04	276.03	42.34	0.60	21.32
All Grades Combined	Total	522.29	417.82	44.25	0.54	18.58

Polygon-wise, borehole-wise resources of Cement Grade limestone for Malkhed-1 North estimated by Polygonal method is furnished as Annexure No XII-A/1-2.

Polygon -wise, borehole-wise resources of Blendable Grade limestone for Malkhed-1 North is furnished as Annexure No XII-B/1. Polygon -wise, borehole-wise resources of Beneficiable-Blendable Grade limestone for Malkhed-1 North is furnished as Annexure No XII-C/1.

iii. Malkhed -2 South Block

Table No: 20.11
Summary of Cement Grade, and Beneficiable-Blendable
Grade Limestone Resource of Malkhed -2 South Block - Polygonal Method
Unit: million tonnes

Grade	Zone	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO%	MgO%	Si O ₂ %
Cement	I	60.30	48.24	48.29	0.39	13.07
	II	70.55	56.44	47.72	0.40	13.54
	III	61.84	49.47	50.49	0.49	9.06
	Total	192.68	154.15	48.79	0.43	11.96
Beneficiable-Blendable	I	227.14	181.71	43.15	0.51	21.58
	II	208.77	167.02	43.22	0.52	20.72
	III	30.81	24.65	43.74	0.42	19.81
	Total	466.72	373.38	43.22	0.50	21.08
All Grades Combined	Total	659.41	527.53	44.85	0.48	18.41

Polygon-wise, borehole-wise resources of Cement Grade limestone for Malkhed-2 South estimated by Polygonal method is furnished as Annexure No XIII-A/1-2.

Polygon -wise, borehole-wise resources of Beneficiable-Blendable Grade limestone for Malkhed-2 South is furnished as Annexure No XIII-B/1-2.

iv. **Malkhed -2 North Block**

Table No: 20.12
Summary of Cement Grade, Blendable and Beneficiable-Blendable
Grade Limestone Resource of Malkhed -2 North Block - Polygonal Method
Unit: million tonnes

Grade	Zone	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO%	MgO%	Si O ₂ %
Cement	I	6.54	5.23	46.81	0.35	15.83
	II	29.42	23.53	48.70	0.32	12.08
	III	58.96	47.17	50.65	0.45	8.63
	Total	94.92	75.93	49.78	0.40	10.19
Blendable	Zone II	-	-	-	-	-
Beneficiable-Blendable	Zone I	80.27	64.21	41.98	0.44	22.27
	Zone II	96.01	76.81	43.54	0.37	20.46
	Zone III	-	-	-	-	-
	Total	176.28	141.02	42.83	0.40	21.28
All Grades Combined	Total	271.20	216.95	45.26	0.40	17.40

Polygon-wise, borehole-wise resources of Cement Grade limestone for Malkhed-2 South estimated by Polygonal method is furnished as Annexure No XIV-A/1-2.

Polygon -wise, borehole-wise resources of Beneficiable-Blendable Grade limestone for Malkhed-2 South is furnished as Annexure No XIV-B/1-2.

20.3.0 RELIABILITY OF RESOURCE

20.3.1 The Limestone resource estimated at different end use cut off by the cross-section method and polygonal method were compared to ascertain the confidence level of estimation. The resources are estimated grade wise, borehole wise, section wise by both cross sectional and polygonal methods and presented as Annexure Nos VII to X and XI to XIV respectively.

20.3.2 In Malkhed - 1 South block, the difference in Resource by two methods comes to 2.75%. The resource calculated by cross sectional method are bit lower side due to irregular shape of the block. Hence the cross-sectional method is more reliable than polygon method. The comparison of resource is given in the Table 20.13.

Table No: 20.13
Comparison of Net in-situ Resource estimated by
Cross sectional and Polygonal method for Malkhed-1 South Block

Method of estimation	Net in-situ Resource (mT)
Cross sectional method	534.74
Polygonal method	548.85
Difference	14.71 (2.75%)

20.3.3 In Malkhed - 1 Norh block, the difference in Resource by two methods comes to 10.24%. The resource calculated by polygonal method are bit lower side due to irregular shape of the block. Hence the cross-sectional method is more reliable than polygon method. The comparison of resource is given in the Table 20.14.

Table No: 20.14
Comparison of Net in-situ Resource estimated by
Cross sectional and Polygonal method for Malkhed-1 North Block

Method of estimation	Net in-situ Resource (mT)
Cross sectional method	465.52
Polygonal method	417.82
Difference	47.69 (10.24%)

20.3.4 In Malkhed - 2 South block, the difference in Resource by two methods comes to 6.25%. The resource calculated by polygonal method are bit lower side due to irregular shape of the block. Hence the cross-sectional method is more reliable than polygon method. The comparison of resource is given in the Table 20.15.

Table No: 20.15
Comparison of Net in-situ Resource estimated by
Cross sectional and Polygonal method for Malkhed-2 South Block

Method of estimation	Net in-situ Resource (mT)
Cross sectional method	496.47
Polygonal method	527.53
Difference	31.39 (6.25%)

20.3.5 In Malkhed - 2 Norh block, the difference in Resource by two methods comes to 26.64%. The resource calculated by polygonal method are bit lower side due to irregular shape of the block. Hence the cross-sectional method is more reliable than polygon method. The comparison of resource is given in the Table 20.14.

Table No: 20.16
Comparison of Net in-situ Resource estimated by
Cross sectional and Polygonal method for Malkhed-2 North Block

Method of estimation	Net in-situ Resource (mT)
Cross sectional method	295.76
Polygonal method	216.95
Difference	78.81 (26.64%)

CHAPTER – 21

21.0.0 SUMMARY AND RECOMMENDATIONS

21.1.0 SUMMARY

- 21.1.1 The Malkhed -1 North, Malkhed - South, Malkhed – 2 North and Malkhed – 2 South block for Preliminary Exploration (G-3 stage) for limestone which lies in the Bhima Basin of Kalaburagi District, Karnataka State. It falls in parts of the Survey of India Toposheet No. 56G/4 in Sedam Taluka of Kalaburagi District, Karnataka State.
- 21.1.2 Major portion of the explored block are soil cover and the exposures of limestone are noticed only in few places along the seasonal water way. The general stratigraphic succession of the Malkhed -1 North & Malkhed – South in 1: 4000 scale and Malkhed - 2 North & Malkhed - 2 South Block on 1: 4000 scale geological mapping done by MECL during the first phase of exploration in 2023 along-with current exploration and available data and literature.
- 21.1.3 The total absence of fossils rules out the sediments of Bhima Group transgresses into the Cambrian. Thus envisaged the upper age limit is not less than 600 million years.
- 21.1.4 The rock types exposed in the block belong to the Shahabad Formation of Sedam subgroup of Bhima Group. Almost entire area of the block is concealed under quaternary sediments i.e. soil cover. Scanty scattered limestone outcrops are seen at places along the seasonal water way of the block.
- 21.1.5 The limestone formation of the block is horizontally disposed with strike of N to NE and dips 1° to 2° due N to NW. Hence the parallel cross section lines are prepared along N 4°-S 4°E direction in Malkhed - 1 and Malkhed – 2 blocks.

Malkhed – 1 North and South Blocks.

In total there are 5 geological cross sections are prepared along N 4°-S 4°E direction in Malkhed – 1 North and Malkhed – 1 South blocks. Both the current phase boreholes (MKML-01,02,03,4,05,06) and I phase boreholes (KML-06,07,08,09 & 10) all together 11 boreholes are considered for the preparation geological cross section. All the 11 boreholes intersected limestone zones, out of this one stratigraphic borehole KML-08 was drilled in the first phase of exploration. The limestone in KML-08 is continued up to 130 meters followed by ferruginous shale and ekmai shale.

The intersected limestone is of Cement Grade to high grade encountered with intermittent partitions of beneficiable-blendable, blendable and threshold grade limestone zones. A total of four limestone zones are intersected in Malkhed -1 block. Zone-wise borehole wise intersection of various grades limestone zones, are discussed under Chapter 10.

Malkhed – 2 North and South Blocks.

In total there are 7 geological cross sections are prepared along N 4°-S 4°E direction in Malkhed – 2 North and Malkhed - 2 South blocks. Both the current phase boreholes (MKML-07,08,09,10 & 11) and I phase boreholes (KML-06,07,08,09 & 10) all together 10 boreholes are considered for the preparation geological cross section. The intersected limestone is of Cement Grade to high grade encountered with intermittent partitions of beneficiable-blendable, and blendable grade limestone zones. A total of three limestone zones are intersected in Malkhed -2 block. Zone wise borehole wise intersection of various grades limestone zones, are discussed under Chapter 10.

- 21.1.5 A total of 501 nos. of samples, all together in Malkhed-1 North, Malkhed -1 South, Malkhed-2 North and Malkhed - 2 South blocks block analyzed for boreholes drilled by MECL Lab, Nagpur and the results are enclosed as Annexure No III. A total of 50 nos. of external check samples have been analysed for analysis at JNARDDC Lab and the results are enclosed as Annexure-VI.

Considering the open cast potentiality of the block, the minimum workable thickness / minimum stopping width of 1.00 m and minimum non ore parting of 1.00 m is considered for resource estimation.

The limestone is grey and greyish white with massive hard-core nature. The maximum average CaO% is 51.25 which is intersected in MKML-07, between 42.00m to 50.00m (Zone III). Over all three zones are interested in the explored boreholes drilled up to 50m. however in first phase of drilling one stratigraphy borehole was drilled up to 150 m where in the fourth (IV) zone intersected from 95.00 to 130m followed by shally lime stone and shale.

21.1.12 RESOURCE

The block-wise resources are estimated are broadly categorized under inferred (333) and reconnaissance resource (334) the details of the same is furnished in the following tables.

i. Malkhed – 1 South Block

Table No: 21.1

Summary of Cement, Blendable and Beneficiable-Blendable Grade Limestone Resource of Malkhed -1 South Block – Cross sectional method (Inferred and Reconnaissance)

Unit: million tonnes

Grade Category	Resource Category	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO	MgO	Si O ₂
Cement Grade	333	497.74	398.19	49.41	0.43	10.82
	334	91.19	72.95	49.75	0.44	10.41
Total R₁	333 & 334	588.93	471.14	49.50	0.43	10.71
Blendable Grade Total - R₂	333	6.52	5.22	46.03	0.39	16.73
	334	1.60	1.28	46.03	0.39	16.73
	Total	8.12	6.50	46.03	0.39	16.73
Beneficiable-Blendable Grade	333	66.56	53.25	43.95	0.48	19.88
	334	4.81	3.85	43.73	0.49	20.20
Total - R₃	Total	71.37	57.10	43.93	0.48	19.90
Total R₁+R₂+R₃	In All	688.42	534.74	48.86	0.44	11.77

Section-wise, borehole-wise Inferred and Reconnaissance resources of Cement Grade limestone for Malkhed-1 South is furnished as Annexure No VII-A1 and VII-A2 respectively.

Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Blendable Grade limestone for Malkhed-1 South is furnished as Annexure No VII-B1 and VII-B2 respectively. Section-wise, borehole-wise Inferred and Reconnaissance resources of Beneficiable-Blendable Grade limestone for Malkhed-1 South is furnished as Annexure No VII-B3 and VII-B4 respectively.

ii. Malkhed – 1 North Block

Table No: 21.2

Summary of Cement, Blendable and Beneficiable-Blendable Grade Limestone Resource of Malkhed -1 North Block – Cross sectional method (Inferred and Reconnaissance)

Unit: million tonnes

Grade Category	Resource Category	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO	MgO	Si O ₂
Cement Grade	333	191.89	153.50	48.20	0.40	12.96
	334	35.64	28.51	47.89	0.40	13.66
Total R₁	333 334	227.53	182.01	48.15	0.40	13.07
Blendable Grade	333	8.26	6.61	45.79	0.53	16.89
	334	4.29	3.43	45.79	0.53	16.89
Total - R₂	Total	12.55	10.04	45.79	0.53	16.89
Beneficiable-Blendable Grade	333	272.23	217.79	43.29	0.56	19.60
	334	69.60	55.68	42.73	0.57	21.12
Total - R₃	333 334	341.83	273.47	43.18	0.56	19.91
Total R₁+R₂+R₃	In All	581.91	465.52	45.18	0.50	17.17

Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Cement Grade limestone for Malkhed-1 South is furnished as Annexure No VIII-A1 and VIII-A2 respectively.

Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Blendable Grade limestone for Malkhed-1 North is furnished as Annexure No VIII-B1 and VIII-B2 respectively.

Section-wise, borehole-wise Inferred and Reconnaissance resources of Beneficiable-Blendable Grade limestone for Malkhed-1 North is furnished as Annexure No VIII-B3 and VIII-B4 respectively

iii. Malkhed – 2 South Block

Table No: 21.3

Summary of Cement, Beneficiable-Blendable Limestone Resource of
Malkhed -2 South Block – Cross sectional method (Inferred and Reconnaissance)

Unit: million tonnes

Grade Category	Resource Category	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO%	MgO %	Si O ₂ %
Cement Grade	333	130.59	104.47	48.55	0.39	12.49
	334	56.58	45.26	48.17	0.37	13.33
Total R₁	333 334	187.17	149.73	48.44	0.38	12.75
Beneficiable - Blendable Grade	333	324.13	259.30	43.40	0.49	20.82
	334	109.28	87.44	43.58	0.51	20.88
Total – R₂	333 334	433.41	346.74	43.45	0.50	20.84
Total R₁+R₂	In All	620.58	496.47	44.95	0.46	18.40

Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Cement Grade limestone for Malkhed-2 South is furnished as Annexure No IX-A1 and IX-A2 respectively.

Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Beneficiable-Blendable Grade limestone for Malkhed-2 South is furnished as Annexure No IX-B1 and IX-B2 respectively.

iv. Malkhed – 2 North Block

Table No: 21.4

Summary of Cement, Beneficiable-Blendable Limestone Resource of
Malkhed -2 North Block – Cross sectional method (Inferred and Reconnaissance)

Unit: million tonnes

Grade Category	Resource Category	Gross Geol. Res. (Mil. tons)	Net Geol. Res. (Mil. tons)	CaO%	MgO%	Si O ₂ %
Cement	333	94.73	75.80	49.32	0.42	10.94
	334	14.28	11.42	49.83	0.46	10.50
Total R₁	333 334	109.01	87.22	49.39	0.43	10.88
Beneficiable-Blendable Grade	333	221.32	177.05	43.32	0.41	20.37
	334	39.37	31.49	43.24	0.44	20.82
Total – R₂	333 334	260.69	208.54	43.31	0.42	20.44
Total R₁+R₂	In All	369.70	295.76	45.10	0.42	17.62

Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Cement Grade limestone for Malkhed-2 North is furnished as Annexure No X-A1 and X-A2 respectively.

Section-wise, borehole-wise, zone-wise Inferred and Reconnaissance resources of Beneficiable-Blendable Grade limestone for Malkhed-2 North is furnished as Annexure No X-B1 and X-B2 respectively.

21.2.0 RECOMMENDATIONS

21.2.1 Malkhed - 1 South Block: Total Geological Net In-situ Resources of Cement Grade resource estimate is 471.14 million tonnes with an average grade of CaO 49.50%, MgO 0.43% and SiO₂ 10.71%. Total Geological Net In-situ Resources of Blendable grade is 6.50 million tonnes CaO 46.03%, MgO 0.39% and SiO₂ 16.73%. However, the Beneficiable-Blendable grade resource are 57.10 million tonnes with an average grade of CaO 43.93%, MgO 0.48% and SiO₂ 19.90% have also been established. **The total net geological resources of all grade resources are 534.74 million tons with an average grade of Cao% 48.86, MgO 0.44% and SiO₂ 11.77%.**

Malkhed - 1 North Block: Total Geological Net In-situ Resources of Cement Grade resource estimate is 182.01 million tonnes with an average grade of CaO 48.15%, MgO 0.40% and SiO₂ 13.07%. Total Geological Net In-situ Resources of Blendable grade is 10.04 million tonnes CaO 45.79%, MgO 0.53% and SiO₂ 16.89%. However, the Beneficiable-Blendable grade resource are 273.47 million tonnes with an average grade of CaO 43.18%, MgO 0.56% and SiO₂ 19.91% have also been established. **The total net geological resources of all grade resources are 465.52 million tons with an average grade of Cao% 45.18, MgO 0.50% and SiO₂ 17.17%.**

Malkhed - 2 South Block: Total Geological Net In-situ Resources of Cement Grade resource estimate is 149.73 million tonnes with an average grade of CaO 48.44%, MgO 0.38% and SiO₂ 12.75%. Total Geological Net In-situ Resources of Beneficiable-Blendable grade resource are 346.74 million tonnes with an average grade of CaO 43.45%, MgO 0.50% and SiO₂ 20.84% have also been established.

The total net geological resources of all grade resources are 496.47 million tons with an average grade of Cao% 44.95, MgO 0.46% and SiO₂ 18.40%.

Malkhed - 2 North Block: Total Geological Net In-situ Resources of Cement Grade resource estimate is 87.22 million tonnes with an average grade of CaO 49.39%, MgO

0.43% and SiO₂ 10.88%. Total Geological Net In-situ Resources of Beneficiable-Blendable grade resource are 208.54 million tonnes with an average grade of CaO 43.31%, MgO 0.42% and SiO₂ 20.44% have also been established. **The total net geological resources of all grade resources are 295.76 million tons with an average grade of Cao% 45.10, MgO 0.42% and SiO₂ 17.62%.**

21.2.2 The exploration is carried out as per Mineral (Evidence of Mineral Contents) Rule-2015, Mineral Auction Rule-2015, MMDR Amendment Act - 2015 and in accordance with the Minerals (Evidence of Mineral Contents) Amendments Rules 2021.

21.2.3 This level of exploration will facilitate the State Government of Karnataka for auctioning of these four blocks under Mining Lease.

21.2.4 The study area suggests that any future mining project may generate employment for the local people and will increase socio-economic status of the people residing in the nearby areas.

CHAPTER - 22

22.0.0 PLATES AND MAPS

- 22.1.0 Location Map Malkhed -1 North & South and Malkhed -2 North & South blocks, Sedam Taluk, Kalaburagi district, Karnataka State on 1: 50,000 Scale is given as Plate No, I.
- 22.2.0 Regional Geological Map Bhima Basin Part (GSI) - Malkhed -1 North & South and Malkhed -2 North & South blocks, Sedam Taluk, Kalaburagi district, Karnataka State on 1:50,000 scale is given as Plate No, II
- 22.3.0 Topographical and Geological map of Malkhed - 1 North & Malkhed - 1 South Block, Sedam Taluk, Kalaburagi District, Karnataka on 1:4,000 scale is given as Plate No. III A.
- 22.4.0 Topographical and Geological Map of Malkhed - 2 North & Malkhed - 2 South Block, Sedam Taluk, Kalaburagi District, Karnataka on 1:4,000 scale is given as Plate No. III B.
- 22.5.0 Geological Cross Sections of Malkhed -1 North and South Block (S_1-S_1' , S_2-S_2' , S_3-S_3' , S_4-S_4' , and S_5-S_5') on 1:2000 scale is given as Plate No. IVA.
- 22.6.0 Geological Cross Sections of Malkhed -2 North and South Block (S_1-S_1' , S_2-S_2' , S_3-S_3' , S_4-S_4' , S_5-S_5' , S_6-S_6' and S_7-S_7') on 1:2000 scale is given as Plate No. IVB.
- 22.7.0 Graphic Lithologs of boreholes drilled by MECL in Malkhed – 1 North Block on 1:800 scale is given as Plate No. V A1.
- 22.8.0 Graphic Lithologs of boreholes drilled by MECL in Malkhed – 1 South Block on 1:800 scale is given as Plate No. V A2.
- 22.9.0 Graphic Lithologs of boreholes drilled by MECL in Malkhed – 2 South Block on 1:800 scale is given as Plate No, V B1.
- 22.10.0 Graphic Lithologs of boreholes drilled by MECL in Malkhed – 2 North Block on 1:800 scale is given as Plate No V B2
- 22.11.0. Polygon Map of Cement Grade Limestone Zone I in Malkhed 1 North and South Block on 1: 10,000 scale is given as Plate No.VI A
- 22.12.0. Polygon Map of Cement Grade Limestone Zone II in Malkhed 1 North and South Block on 1: 10,000 scale is given as Plate No.VI B.
- 22.13.0. Polygon Map of Cement Grade Limestone Zone III in Malkhed 1 North and South Block on 1: 10,000 scale is given as Plate No.VI C

- 22.14.0. Polygon Map of Cement Grade Limestone Zone I in Malkhed 1 North and South Block on 1: 10,000 scale is given as Plate No. VI D
- 22.15.0 Polygon Map of Cement Grade Limestone Zone I in Malkhed 2 North and South Block on 1: 10,000 scale is given as Plate No. VII A
- 22.16.0 Polygon Map of Cement Grade Limestone Zone II in Malkhed 2 North and South Block on 1: 10,000 scale is given as Plate No. VII B
- 22.17.0 Polygon Map of Cement Grade Limestone Zone III in Malkhed 2 North and South Block on 1: 10,000 scale is given as Plate No. VII C

CHAPTER - 23

23.0.0 ANNEXURE / ENCLOSURES TO THE REPORT

23.1.0 The report includes all the relevant annexure and maps/, plans, sections and photographs etc. List of annexures, tables, maps/plans/sections, photographs, text figures etc are provided before the start of the text and part of the Geological Report.

CHAPTER - 24

24.0.0 ANY OTHER INFORMATION

24.0.0 ANY OTHER INFORMATION

24.1.0 UTILISATION ASPECTS AND MINEABILITY (AS PER NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS)

24.1.1 The specifications of limestone for various industrial used are as follows

1. CEMENT INDUSTRY SPECIFICATION

Table No. 24.1
Cement Industry Specification for Limestone

CaO	: 44% (min.) to 46%
MgO	: 3.50% (max.)
Silica	: 16% (max.)
Al ₂ O ₃	: 2 (max.)
Fe ₂ O ₃	: 2% (max.)
SO ₃	: 1.75% (max.)

i. Malkhed – 1 South Block

a) Lime Saturation Factor:

$$\text{Lime Saturation Factor (LSF)} = \frac{\text{CaO}}{2.8 (\text{SiO}_2) + 1.2 (\text{Al}_2\text{O}_3) + 0.65 (\text{Fe}_2\text{O}_3)} = 0.66 \text{ to } 1.02$$

Malkhed-1 South Block

$$\text{Lime Saturation Factor Cement Grade (LSF)} = \frac{49.35}{(2.8 \times 10.92) + (1.2 \times 0.96) + (0.65 \times 0.49)} = 1.54$$

The LSF in Malkhed -1 South Block is 1.54, hence it is suitable for Cement Industry

b) Silica Modulus:

$$\text{Silica Modulus} = \frac{\text{SiO}_2}{\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.2 \text{ to } 4.0$$

$$\text{Silica Modulus} = \frac{10.92}{0.96 + 0.49} = 7.56$$

The Silica modulus value in Malkhed-1 South Block is 7.56

c) Hydraulic Modulus:

$$\text{Hydraulic Modulus} = \frac{\text{CaO} + \text{MgO}}{\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.7 \text{ to } 2.4$$

$$\text{Hydraulic Modulus} = \frac{49.35+0.43}{10.92+0.96+0.49} = 4.03$$

Cement Grade

The Hydraulic modulus is 4.03

d) Alumina Modulus:

$$\text{Aluminus Modulus} = \frac{\text{Al}_2\text{O}_3}{\text{Fe}_2\text{O}_3} = 0.65 \text{ (min.)}$$

Alumina/Iron Ratio (AM)

$$\text{Aluminus Modulus} = \frac{0.96}{0.49} = 1.97$$

Cement Grade

The Alumina modulus value in Malkhed-1 South Block is 1.97

ii. Malkhed – 1 North Block

a) Lime Saturation Factor:

$$\text{Lime Saturation Factor (LSF)} = \frac{\text{CaO}}{2.8 (\text{SiO}_2) + 1.2 (\text{Al}_2\text{O}_3) + 0.65 (\text{Fe}_2\text{O}_3)} = 0.66 \text{ to } 1.02$$

$$\text{Malkhed-1 South Block Lime Saturation Factor} = \frac{48.23}{(2.8 \times 12.80) + (1.2 \times 0.94) + (0.65 \times 0.48)} = 1.29$$

Cement Grade (LSF)

The LSF in Malkhed -1 North Block is 1.29, hence it is suitable for Cement Industry

b) Silica Modulus:

$$\text{Silica Modulus} = \frac{\text{SiO}_2}{\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.2 \text{ to } 4.0$$

$$\text{Silica Modulus} = \frac{12.80}{0.94 + 0.48} = 8.97$$

Cement Grade

The Silica modulus value in Malkhed-1 North Block is 8.97

c) Hydraulic Modulus:

$$\text{Hydraulic Modulus} = \frac{\text{CaO} + \text{MgO}}{\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.7 \text{ to } 2.4$$

$$\text{Hydraulic Modulus} = \frac{48.23 + 0.39}{12.80 + 0.94 + 0.48} = 3.42$$

The Hydraulic modulus value in Malkhed-1 North Block is 3.42

d) Alumina Modulus:

$$\text{Aluminus Modulus} = \frac{\text{Al}_2\text{O}_3}{\text{Fe}_2\text{O}_3} = 0.65 \text{ (min.)}$$

Alumina/Iron Ratio (AM)

$$\text{Aluminus Modulus} = \frac{\text{Cement Grade}}{0.48} = 1.96$$

The Alumina modulus value in Malkhed-1 North Block is 1.96

iii. Malkhed – 2 South Block

a) Lime Saturation Factor:

$$\text{Lime Saturation Factor (LSF)} = \frac{\text{CaO}}{2.8 (\text{SiO}_2) + 1.2 (\text{Al}_2\text{O}_3) + 0.65 (\text{Fe}_2\text{O}_3)} = 0.66 \text{ to } 1.02$$

$$\begin{array}{l} \text{Malkhed-2 South Block} \\ \text{Lime Saturation Factor} = \frac{50.44}{(2.8 \times 9.16) + (1.2 \times 0.95) + (0.65 \times 0.50)} = 1.39 \\ \text{Cement Grade (LSF)} \end{array}$$

The LSF in Malkhed -2 South Block is 1.39, hence it is suitable for Cement Industry

b) Silica Modulus:

$$\text{Silica Modulus} = \frac{\text{SiO}_2}{\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.2 \text{ to } 4.0$$

$$\text{Silica Modulus} = \frac{9.16}{0.95 + 0.50} = 7.42$$

The Silica modulus value in Malkhed-2 South Block is 7.42

c) Hydraulic Modulus:

$$\text{Hydraulic Modulus} = \frac{\text{CaO} + \text{MgO}}{\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.7 \text{ to } 2.4$$

$$\begin{array}{l} \text{Hydraulic Modulus} = \frac{50.44 + 0.48}{9.16 + 0.95 + 0.50} = 3.64 \\ \text{Cement Grade} \end{array}$$

The Hydraulic modulus value in Malkhed-2 South Block is 3.64

d) Alumina Modulus:

$$\begin{array}{l} \text{Aluminus Modulus} = \frac{\text{Al}_2\text{O}_3}{\text{Fe}_2\text{O}_3} = 0.65 \text{ (min.)} \\ \text{Alumina/Iron Ratio (AM)} \end{array}$$

$$\text{Aluminus Modulus} = \frac{0.95}{0.50} = 1.85$$

The Alumina modulus value in Malkhed-2 South Block is 1.85

iv. Malkhed – 2 North Block

a) Lime Saturation Factor:

$$\text{Lime Saturation Factor (LSF)} = \frac{\text{CaO}}{2.8 (\text{SiO}_2) + 1.2 (\text{Al}_2\text{O}_3) + 0.65 (\text{Fe}_2\text{O}_3)} = 0.66 \text{ to } 1.02$$

$$\begin{array}{lcl} \text{Malkhed-2 South Block} & & \\ \text{Lime Saturation Factor} & = & \frac{49.68}{(2.8 \times 10.34) + (1.2 \times 0.95) + (0.65 \times 0.53)} = 1.63 \\ \text{Cement Grade (LSF)} & & \end{array}$$

The LSF in Malkhed -2 North Block is 1.63, hence it is suitable for Cement Industry

b) Silica Modulus:

$$\text{Silica Modulus} = \frac{\text{SiO}_2}{\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.2 \text{ to } 4.0$$

$$\text{Silica Modulus} = \frac{10.34}{0.95 + 0.53} = 7.01$$

The Silica modulus value in Malkhed-2 North Block is 7.42

c) Hydraulic Modulus:

$$\text{Hydraulic Modulus} = \frac{\text{CaO} + \text{MgO}}{\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.7 \text{ to } 2.4$$

$$\begin{array}{lcl} \text{Hydraulic Modulus} & = & \frac{49.68 + 0.38}{10.34 + 0.95 + 0.53} = 4.88 \\ \text{Cement Grade} & & \end{array}$$

The Hydraulic modulus value in Malkhed-2 North Block is 4.88

d) Alumina Modulus:

$$\begin{array}{lcl} \text{Aluminus Modulus} & = & \frac{\text{Al}_2\text{O}_3}{\text{Fe}_2\text{O}_3} = 0.65 \text{ (min.)} \\ \text{Alumina/Iron Ratio (AM)} & & \end{array}$$

$$\begin{array}{lcl} \text{Aluminus Modulus} & = & \frac{0.95}{0.53} = 1.81 \\ \text{Cement Grade} & & \end{array}$$

The Alumina modulus value in Malkhed-2 North Block is 1.81

2. B. I. S. (BUREAU OF INDIAN STANDARDS) SPECIFICATION

Table 24.2

B. I. S. (Bureau of Indian Standards) Specification for Limestone

CaO (Min)	:	42%
MgO (Max.)	:	2.5%
SiO ₂ (Max.)	:	15%
P ₂ O ₅ (Max.)	:	1.5 %
FeS ₂ (Max.)	:	2%

3. IRON AND STEEL INDUSTRY :

Table No. 24.3

Iron and Steel Industry for Specification for Limestone

Elements	BF Grade	SMS Grade	LD Grade
CaO	42% (Min.)	48% (Min.)	52% (Min.)
MgO	4% (Max.)	3% (Max.)	2% (Max.)
SiO ₂	9% (Max.)	4% (Max.)	1% (Max.)
SiO ₂ + Al ₂ O ₃	11.5% (Max.)	-	-
Total Insoluble	12%	-	-
Acid Insoluble	-	6.5% (Max.)	-

4. CHEMICAL INDUSTRY SPECIFICATION

BIS Specifications (1S:3204-1978, Reaffirmed-2003)

Table No. 24.4

Chemical Industry Specification for Limestone

Characteristics	Requirement in percent by mass for			
	Calcium carbide	Bleaching Powder	Caustic soda	Sugar
CaO (Min.)	54.0	54.0	53.0	50.0
MgO (Max.)	0.8	2.0	1.0	1.0
SiO ₂ (Max.)	1.0	0.75	-	2.0
Fe ₂ O ₃ (Max.)	0.25	0.15	-	-
Mn ₂ O ₃ (Min.)	-	0.06	-	-
CO ₂ (Min.)	42.00	42.00	42.00	41.00
Loss on Ignition (LOI)	46.00	46.00	46.00	44.00
S (Max.)	0.10	-	-	-
P (Max.)	0.01	-	-	-
Al ₂ O ₃ + Fe ₂ O ₃ (Max.)	0.50	-	-	1.5
SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃ (Max.)	-	-	3.0	-

5. FERTILIZER INDUSTRY SPECIFICATION

CaCO₃+ MgCO₃: 85% (Min)
SiO₂ : 5% (Max.)

6. GLASS INDUSTRY SPECIFICATION

CaCO₃ : 94.5 %
CaCO₃ + MgCO₃ : 97.5 %
Fe₂O₃ : 0.20 % (Max.)

BIS Specifications (1S:997-1973, Reaffirmed-1998)

CaO : 53.0 %

SiO ₂	:	2.5 %
Fe ₂ O ₃	:	0.10 %
CaO + MgO	:	54.50 %

7. FOUNDRY INDUSTRY SPECIFICATION

BIS Specifications (1S:4149-1978, Re-affirmed-2008)

Table N.: 24.5

Foundry Industry Specification for Limestone

Characteristics	Grade-1	Grade-2	Grade-3
CaO (Min.)	52 %	50 %	45 %
SiO ₂ (Max)	1.5 %	3 %	5 %
R ₂ O ₃ (Al ₂ O ₃ + Fe ₂ O ₃) Max.	1 %	1 %	2 %
MgO	2 %	3 %	5 %
Insoluble matter	0.5	1	2
Sulphur and Phosphorus	Traces	Traces	Traces

8. CEMENT, IRON AND STEEL AND CHEMICAL INDUSTRY SPECIFICATION

Table No. 24.6

Cement, Iron and Steel and Chemical Industry Specification for Limestone

Constituents	Cement Industry (Specification)	Iron and Steel Industry (Specification)			Chemical Industry BIS Specifications (1S:3204-1978, Reaffirmed-2003)			
		<i>BF Grade</i>	<i>SMS- OH Grade</i>	<i>SMS- LD</i>	Requirement in percent by mass for			
CaO (Min.)	44% (Min.) to 48% (Max.)	42% (Min.)	48% (Min.)	52% (Min.)	54.0	54.0	53.0	50.0
MgO (Max.)	3.50% (Max.)	4%	3%	2%	0.8	2.0	1.0	1.0
SiO ₂ (Max.)	16 % (Max.)	9%	4%	1%	1.0	0.75	-	2.0
Fe ₂ O ₃ (Max.)	2% (Max.)				0.25	0.15	-	-
Mn ₂ O ₃ (Min.)	--	--	--	--	-	0.06	-	-
CO ₂ (Min.)	--	--	--	--	42.00	42.00	42.00	41.00
Loss on Ignition	--	--	--	--	46.00	46.00	46.00	44.00
S (Max.)	--	--	--	--	0.10	-	-	-
P (Max.)	--				0.01	-	-	-
Al ₂ O ₃ + Fe ₂ O ₃ (Max.)	2%				0.50	-	-	1.5
SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃ (Max.)	--	11.5% (Max.)			-	-	3.0	-
<u>Acid Insoluble</u>			<u>6.5%</u> (Max.)					

CHAPTER - 25

25.0.0 CERTIFICATE FROM THE QUALIFIED PERSON WITH NAME, DATE AND SIGNATURE

This is to certify that geological report has been prepared in respect of Preliminary Exploration Report (G-3 stage) for Limestone in Malkhed-1 North, Malkhed-1 South, Malkhed-2 North and Malkhed - 2 South Blocks, District-Kalaburagi, Karnataka State. The report was prepared by Mineral Exploration and Consultancy Limited (MECL) on behalf of the National Mineral exploration Trust (NMET). The report adheres to the Minerals (Evidence of Mineral Contents) Rules, 2015, as specified under the Mineral Auction Rules, 2015 and amended up to 2021.

NAME: SHRI SHRIKANT SHARMA

DESIGNATION: HOD EXPLORATION

DATE:

**LIST OF PERSONNEL ASSOCIATED WITH PRELIMINARY EXPLORATION (G-3 STAGE)
FOR LIMESTONE IN MALKHED-1 NORTH, MALKHED-1 SOUTH, MALKHED-2 NORTH,
MALKHED -2 SOUTH BLOCKS, DISTRICT: KALABURAGI, KARNATAKA**

1	Overall guidance	: Shri P. Ravindran, GM (Exploration)
2	Overall Planning, Co-ordination & Supervision	: Shri P. Ravindran, GM (Exploration)
		: Dr Kuppusamy E, Sr. Manager (Geology)
3	Project Management	: Shri Anil Tiwari, Project Manager : Dr Kuppusamy E, Sr. Manager (Geology) : Shri Kamalesh Kumar Shankar ADO (Dilling Engineer)
4	Physical Execution of work	
	a) Geology	: Dr. Kuppusamy E Senior Manager (Geology)
	b) Core Sample Splitting	: Mr. Nagraju Vaddi Sr. Tech. (Sampling)
	c) Drilling	: Shri Kamalesh Kumar ADO (Dilling Engineer)
5	Sample Processing	: Shri Satish Kumar Inaparthi, Sr. Tech. Sampling : Mrs. Shika Sharma, Sr. Tech. Sampling
6	Chemical Laboratory	: Shri P. Ravindran, GM (Exploration)/Lab. in-charge
		: Shri Rohit Sharma, Manager (Chemistry)
		: Dr Deepti Rahangdale, Manager (Chemistry)
		: Shri Pijush Kanti Mohanti, Asstt. Manager (Chemistry)
7	Documentation	: Dr. Kuppusamy E, Sr. Manager (Geology)
		: Mr. S.K. Sathpathy Manager (Geology)
		: Ms. Moumita Ghosh, Sr. Geologist
		: Shri Shivanand, Sr. Computer Operator
8	Reprography and Printing	: Shri Durgesh Devarshee Senior Technical Assistant (S & D)

REFERENCES

1. A.V. Jayaprakash, F.S.1974-75, Preliminary investigation for Flux Grade and Cement Grade Limestone around Wadi, Kalaburagi District, Karnataka. (GSI)
2. A.V. Jayaprakash, F.S.1977-78, Preliminary investigation for Flux Grade and Cement Grade Limestone in Bhima Basin, Kalaburagi District, Karnataka. (GSI).
3. Directorate of Mining & Geology (DMG), Karnataka explored the adjoining area in detail in the year 1976 with the purpose of proving cement grade limestone in the area. The results of investigation are given in the report entitled “Limestone Deposits immediately to the East of Chittapur, Kalaburagi District of Karnataka.”
4. District Profile document from district website
5. Geological Report on Preliminary Exploration (G3) for Limestone in Diggaon Block, Sedam Taluka, Kalaburagi District, Karnataka by MECL.
6. Geological Report on Preliminary Exploration (G3) for Limestone in Udagi Block, Sedam Taluka, Kalaburagi District, Karnataka by MECL.
7. MSTC E commerce Website
8. N.R. Pattabhiramaiah, D.S. Malkai, 1978, Preliminary Report on the Feasibility of Establishing a Cement Factory in Malkhaid, Sedam Taluk, Kalaburagi District.
9. Reassessment of Basin Evolution Premise of Bhima Basin in Light of High Resolution Aeromagnetic Data by M. Sridhar, Atomic Minerals Directorate for Exploration and Research, Hyderabad, Telangana, India.
10. Stratigraphy of Bhima Group by Vivek S. Kale, A.V. Mudholkar, V.G. Phansalkar and V.V. Peshwa, Department of Geology, university of Poona: Paper published in Journal of The Paleontological Society of India Vol, 35,1990 Pages 91-103.
11. The Bhima Basin Geological Map by GSI and in Kalaburagi and Bijapur Districts of Karnataka and Ranga Reddy district Andhra Pradesh in Parts of Degree Sheets 56 C, D, G, and Scale 1:150,000, 2007, published by GSI.
12. The F.S. 1976-77, GSI carried out preliminary investigation for Flux grade Limestone near Wadi, Kalaburagi district Karnataka.
13. The G-2 level of exploration by GSI in Bommanalli Limestone Block.
14. The G4 level of exploration by GSI in Chitapur SW Block and Sulahalli Limestone Block
15. The G3 level of exploration by MECL in Malkhed-1 & 2, Kiranagi-1 & 2 blocks in Kalaburagi District, Karnataka.

ABBREVIATIONS USED

SL. No.	Abbreviation	Full form
1	MECL	Mineral Exploration and Consultancy Limited
2	GSI	Geological Survey of India
3	CGWB	Central Ground Water Board
4	CPSE	Central Public Sector Enterprises
5	NMET	National Mineral Exploration Trust
6	TCC	Technical cum Cost Committee
7	EC	Executive Committee
8	DMG, KA	Directorate of Mines and Geology, Karnataka
9	UNFC	United Nation Framework Classification
10	NMI	National Mineral Inventory
11	DGCO	Directorate General Camp Office
12	NABL	National Accreditation Board for Testing and Calibration Laboratories
13	JNARDDC	Jawaharlal Nehru Aluminium Research Development and Design Centre
14	F.S.P.	Field Season Programme
15	MEMC	Minerals (Evidence of Mineral Contents)
16	MMDR	Mines & Minerals (Development and Regulation)
17	NH	National Highway
18	WGS-84	World Geodetic System-84
19	UTM	Universal Transverse Mercator
20	RL	Reduced Level
21	Cu.m	Cubic Meter
22	DGPS	Differential Global Positioning System
23	DMS	Degree Minute Second
24	M / m	Meter
25	mt	Million Tonne
26	Sq. km/sq.km	Square Kilometer
27	M. Sc.	Master of Science
28	M. Sc. Tech	Master of Science Technology
29	NDDP	Net District Domestic Product
30	mRL	Reduced Level in metre
31	R.F.	Reserve Forest
32	XRF	X-ray Fluorescence
33	ML	Mining Lease
34	CRM	Certified Reference Material
35	MMT	Million Metric Tonnes
36	GGR	Gross Geological Resource
37	NGR	Net Geological Resource
37	Geol. Res. (Mil. tons)	Geological Resources (Million tons)