Annexure_20.1

आदेश द्वारा श्री अरूण कुमार पाण्डेय, भा.व.से. अपर प्रधान मुख्य वन संरक्षक
एवं सदस्य सचिव, छत्तीसगढ़ राज्य जैवविविधता बोर्ड,
अरण्य भवन, नॉर्थ ब्लॉक सेक्टर-19, नवा रायपुर अटल नगर, जिला-रायपुर
ईमेल– cgmsbdb@gmail.com फोन/फै.नं.– 0771-2512807

//आदेश//

आदेश क्रमांक/जै.वि.बो./17 रायपुर,दिनांक 21/08/2023

भारत सरकार, पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, नई दिल्ली के पत्र कमांक IA-J-11015/104/2021-IA-II (NCM), दिनांक 11.03.2022 द्वारा वन संरक्षण अधिनियम 1980 के अंतर्गत वन भूमि के गैर वानिकी उपयोग हेतु NMDC-CMDC Ltd.(NCL) संस्थान द्वारा प्रस्तुत प्रस्ताव Proposal for Diversion of Forest Land For Bailadila Iron Ore Deposit - 4 Mine के संबंध में जारी TOR के बिंदु कमांक 18 के पालन में आवेदक संस्थान द्वारा तैयार किए गए "Biodiversity Conservation Plan and Soil Water & Moisture Conservation Plan for Tree Fern Area" का परीक्षण बोर्ड के विशेषज्ञों के समक्ष संस्थान द्वारा दिए गए प्रस्तुतीकरण दिनांक 18.08.2023 में किया गया। प्लान के संबंध में विस्तृत चर्चा NMDC के अधिकारियों एवं प्लान तैयार करने वाली संस्थान से करने के पश्चात् प्रस्तावित संशोधन/सुधारों को प्रोजेक्ट में शामिल कराया जाकर प्लान को अनुमोदित किया गया। प्लान के संबंध में वनमंडलाधिकारी, दंतेवाड़ा एवं मुख्य वन संरक्षक, जगदलपुर वृत्त द्वारा पत्र कमांक/व.त.अ./1911 दिनांक 10.08.2023 के माध्यम से की गई अनुशंसाओं एवं बोर्ड के विशेषज्ञों द्वारा सुझावए गए संशोधनों को समाहित करते हुए संशोधित प्रोजेक्ट जिसकी कुल लागत राशि रू. 31.07 करोड़ है, का अनुमोदन निम्नानुसार किया जाता है –

1. प्लान में प्रावधानित कार्यों एवं कार्यवार व्यय का आंकलन निम्नानुसार है –

Sr.No	ITEM	Total (Rs. In Lacs)
1	Cost of Infrastructure development for nursery for Tree Fern and RET spp.	100.00
	Nursery Development for Tree Fern and RET species for plantation of 125 Ha. In Impact / Buffer area (Please Refer Chapter 5, point 5.11 of the Plan)	66.4126
2	**Conservation of Tree Fern (For details Please refer chapter 5 of the Plan)** In situ conservation & Protection of Tree fern and its associates falling in Project area Within ML area and along Galli nalla (75. 0 Ha)	100.00
	Ex situ conservation of Tree fern and. its associates falling outside Project area (Within 10 Km from periphery of ML area) (75 Ha.)	105.00
3	Budgetary provision for RET species (i) Nursery Development for RET species for plantation of 50 Ha. In Impact / Buffer area. (Please refer chapter 5 of the Plan)	40.659
	(ii) In-situ Conservation of RET species in PF/RF of (Within 10 Km from periphery of ML area) and its maintenance one plot of 10 Ha. Each year for 5 years (5 Plots = 50 Ha.)	100.00
	(iii) Maintenance of RET species in-situ plots (5years) (50 Ha.)	75.00
	(iv)Ex-situ Conservation of RET species and including maintenance for 5 years (Within 10 Km from periphery of ML area) (50 Ha)	150.00
4	Budgetary provision for Biodiversity Conservation & protection of Forest. (Watch and Ward for 15 years)	75.00
5	Biodiversity Park is proposed to develop at Dantewada district for Education purpose of Front-line staff, Miners, Educational Institutes, reaserchers and local People.	200. 00

Sr.No	ITEM	Total (Rs. In Lacs)
6	Budgetary provision for Research Monitoring and Evaluation of plan including cost of subject specialist/ experts/ expert NGO.	35.00
7	Development of Training and Interpretation center (A). Construction of center	100.00
	(B). Regular Training, Awareness program, Seminar, Lectures and Orientation program on Biodiversity Conservation	90.00
8	Budgetary provision for Training & Awareness for BMC Members at Village level in Buffer area.	90.0
9	(I) Budgetary provision for Grass and leaf fodder species in common land, /farmers land area in 24 affected villages in Impact / Buffer zone (total 120 Ha). Grass land development works may be carried out in nearby forest area by the department, as per the working plan provisions.	48.00
	(II) Additional budgetary provision for Maintenance of grass and leaf fodder plots 5 years	25.00
	(III) Budgetary provision for Additional 100 Ha grass and leaf fodder plot in adjoining forest area (10 Ha each from 6th year onward) including maintenance. (For introducing Systems of rotational grazing)	50.00
10	Plantation of Horticulture species and Ethno- botanical/ medicinal importance species in affected 24 villages and their maintenance for 3 years	120.00
11	Organizing study tour and exposure visit within country for Experts/ Scientists/ People/ Villagers/ Students etc.	50.00
12	**Monitoring of EX-SITU andIN-SITU Conservation activities:** A panel of Expert team shall monitor the EX-SITU and IN-SITU Conservation activities. The budget shall be deposited in Chhattisgarh Biodiversity Board's account.	40.00
13	(I) Budgetary provision for Providing and fixing of Bird nesting boxes (50 boxes in 4 locations and replicate after 2 years) i.e., 400 boxes, under the supervision of Avifauna Experts from the Board.	8.00
	(II) Budgetary provision for Monitoring activity after 2 years	2.00
14	Budgetary provision for Butterfly habitat development in 5 suitable areas	15.00
15	Estimated cost of Soil, Water and Moisture conservation in respect of Tree Fern area fall in ML area. Please refer Part B and Chapter IV	910.1382
16	Repair and Maintenance of SWM Conservation Structure After Every Third year till Plan Period	40.00
17	Provision for Chain link fencing 6feet height for the protection of tree fern area in Buffer Zone (10 Kms radius from ML area) and other area having sporadic occurrence of tree fern species.	190.00
Total		**2825.212**
10% Escalation		**282.5212**
Grand Total		**3107.733**

उक्त कार्यों के सम्पादन हेतु समय–सीमा एवं वर्षवार वित्तीय आंकलन संलग्न है। (**Annexure-1**)

2. RET (Rare Endangered &Thretened) प्रजाति के *Ex-situ* संरक्षण हेतु एवं साथ ही ट्री फर्न के Ex-situ संरक्षण हेतु प्रस्तावित नर्सरी में निम्नानुसार प्रजातियों के पौधे तैयार किया जाना सुनिश्चित किया जावे। (जिसे पश्चात्वर्ती स्थिति में विभिन्न उपयुक्त स्थानों में लगाया जा सकता है) (**Annexure-2**) क्षेत्र में पाई जाने वाली RET प्रजातियॉ, जो प्लान में शामिल हैं एवं साथ ही जैवविविधता बोर्ड के विशेषज्ञों द्वारा पूर्व में अध्ययन के दौरान चिन्हित की गई हैं, निम्नानुसार हैं –

S.N.	Botanical Name/Local Name	Family	S.N.	Botanical Name/Local Name	Family
1	*Acacia concinna (Shikakai)*	Fabaceae	19	*Droceraburmanii (Tropical sundew)*	*Droseraceae*
2	*Alocasia decipiens*Schott	Araceae	20	*Embeliabasaal*(Roem. & Schult.) A. DC./Babrang, Baibrang, Baya Birang	Primulaceae
3	*Aristolochia indica* L./ Iswari, Iswarmool, Eswaramooli	Aristolochiaceae	21	*Equisetum (Horse Tail or Snake grass)*	*Equisetaceae*
4	*Blepharispermum subsessile* DC./ Rasna	Asteraceae	22	*Gloriosa superba* L./ Languli, Kalihari	Colchicaceae
5	*Breynia retusa* (Dennst.) Alston	Phyllanthaceae	23	*Gymnemainodorum*	*Apocynaceae*
6	*Celastruspaniculatus*Willd./Malkangni, Angul	Celastraceae	24	*Gymnemasylvestre*R.Br./ Gudmar, Gurmar	Apocynaeae
7	*Cledodendrumserretum (Bag Flower)*	Lamiaceae	25	Gymnosporia bailadillana Narayan. & Mooney	Celastraceae
8	*Cochlospermumreligiosum*(L.) Alston/ Kumbi, Gabdi, Ganiar, Galgal, Galgala	Bixaceae	26	*Huberanthacerasoides*	*Annonaceae*
9	*Cosmostigmaracemosum*	*Apocynaceae*	27	*Litseaglutinosa*(Lour.) Robinson/ Garbijaur, Maida, Maidalakri	Lauraceae
10	*Curculigoorchioides (Kali Musli)*	Hypoxidaceae	28	*Mucuna pruriens* (L.) DC./ Kavach, Kiwach	Leguminosae
11	*Curcuma petiolata*Roxb./Jangli Haldi	Zingiberaceae	29	*Peucedanumnagpurense*(C.B. Clarke) Prain	Apiaceae
12	*Cyathea alata (Tree Fern Sps.)*	*Cyayheaceae*	30	*Plumbago zeylanica (Ceylon leadwort)*	*Plubaginaceae*
13	*Cyathea arborea (Tree fern Sps.)*	*Cyayheaceae*	31	*Pterocarpus marsupium* Roxb./Bijasal, Vijayasar	Leguminosae
14	*Dilleniaaurea*Sm./ Kalle	Dilleniaceae	32	Pueraria tuberosa (Willd.) DC./ Vidharikand, Vidari, Patal Kumbha	Leguminosae
15	*Dilleniapentagyna*Roxb./ Karmal, KallaKarmeta	Dilleniaceae	33	*Solanum erianthum*	*Solanaceae*
16	*Dioscoreahispida*Dennst./Baichadi, Karodi	Dioscoreaceae	34	*Strychnospotatorum (Cleaning Nut Tree)*	*Loganiaceae*
17	*Dracaena terniflora*Roxb.	Asparagaceae	35	*Symplocosracemosa*Roxb./Loadh, Loadhra	Symplocaceae
18	*Drimia indica* (Roxb.) Jessop/ Janglipiyaz, Kande, Koli-kanda,	Asparagaceae	36	*Utricularia sps.(Bladderworts)*	*Lentibulariaceae*

3. ट्री फर्न एरिया जिन क्षेत्रों में पाया जाता है, संबंधी जानकारी प्लान के पैरा 5.7 A & B में दी गयी है। सुनिश्चित किया जावे कि जिन नालों में ट्री फर्न पाये जा रहे है, उन समस्त की सुरक्षा मजबूत चैनलिंक फेसिंग के माध्यम से एवं भूजल संरक्षण कार्य वर्षवार व्यय के आंकलन के बिन्दु क्रमांक 15 एवं 17 में अनुमानित राशि क्रमशः 910.1382 लाख एवं 190.00 लाख से की जावे। अध्ययन क्षेत्र, (कोर जोन एवं बफर जोन जो कि माईनिंग लीज एरिया से 10 कि.मी. की परिधि में है) में आने वाले समस्त नालों जिनमें ट्री फर्न पाये जा रहे है कि समुचित सुरक्षा सुनिश्चित की जावे।

4. माईनिंग लीज एरिया के 10 Km की परिधि के अंतर्गत सीमा पर स्थित 24 ग्रामों में इको विकास के कार्य में प्राथमिकता पूर्वक घास एवं लैग्यूम प्रजातियों का रोपण उपलब्ध स्थलों में ग्रामवासियों की सहमति से इस प्रकार किया जावे कि मवेशियों के लिये चारे की आपूर्ति हो सके, जिससे कि वनक्षेत्र में अनयिमित चराई का भार न्यूनतम रहे। वन विभाग की योजनाओं में यदि घास भूमि विकास का कार्य समीप के वनक्षेत्रों में किये जा सकते है तो प्रावधानित राशि (**Annexure-I** बिन्दु कमांक 9**(I) , (II)** व **III** अनुसार) से यह कार्य किया जावे।

5. जिले में उचित स्थल का चयन कर जैवविविधता पार्क (Annexure-1 बिंदु क. 5 में प्रावधानित राशि से) तैयार किया जावे। माइनिंग लीज एरिया में पायी जाने वाली RET प्रजातियों के अतिरिक्त अन्य विशिष्ट प्रजातियों सहित हर्ब/शर्ब/क्लाइम्बर्स/ मेडिसिनल प्लांट आदि का प्रदर्शन क्षेत्र तैयार हो सके, जो कि शैक्षणिक संस्थानों अनुसंधानकर्ताओं एवं विषय विशेषज्ञों हेतु उपयोगी हो सकेगा।
6. प्रस्तावित कार्यो में भविष्य की परिस्थितियों में यदि विचलन किया जाना प्रस्तावित हो तो मुख्य वन संरक्षक की अनुमति से वनमंडलाधिकारी कार्य करने हेतु सक्षम होंगे।
7. जैवविविधता के संरक्षण एवं संवर्धन के लिए *In-situ* एवं *Ex-situ* संरक्षण कार्यो की सतत मॉनिटरिंग बोर्ड के अधिकारियों एवं विषय विशेषज्ञों द्वारा की जावेगी इस हेतु अनुमोदित तालिका (Annexure-1) के बिन्दु कमांक 12 में प्रावधानित राशि बोर्ड के खाते में जमा करते हुए अनुमोदित प्लान की शेष राशि प्रचलित नियम अनुसार यूजर एजेन्सी वन विभाग में जमा करायेंगे।
8. उक्त जैवविविधता संरक्षण योजना की लागत राशि रू. 31.07 करोड़ रू. वर्तमान दरों पर है। परियोजना में विलंब होने से समय लागत बढ़ेगी, जिसमें प्राईस इन्डेक्स के हिसाब से वृद्धि होगी। परियोजना के कियान्वयन के समय जो भी लागत आयेगी, वह प्रस्तावकों को वन विभाग में एकमुश्त जमा करानी होगी, जिससे मूल्य वृद्धि के प्रभाव को समाप्त किया जा सके। वन विभाग इस प्रकार जमा की गई राशि से जैवविविधता संरक्षण योजना में दर्शाए समय सारणी के अनुसार कियान्वयित करेगा।
9. अनुमोदित जैवविविधता संरक्षण प्लान में दर्शाए गए घटकों के संगत किए जाने वाले क्षेत्रीय कार्यवार/स्थलवार प्रोजेक्ट संबंधित वनमंडल अधिकारी द्वारा विभाग में तत्समय प्रचलित निर्देशों, व्यय नार्म्स आदि के अनुरूप तैयार कर सक्षमता अनुसार मकनीकी स्वीकृति जारी की जावेगी/प्राप्त की जावेगी। संबंधित मुख्य वन संरक्षक द्वारा प्रोजेक्ट की तकनीकी स्वीकृति/अनुशंसा के साथ प्रशासकीय स्वीकृति हेतु सदस्य सचिव, राज्य जैवविविधता बोर्ड को प्रेषित किया जावेगा। प्रशासकीय स्वीकृति आदेश जारी होने के पश्चात् कार्यों का कियान्वयन वनमंडलाधिकारी के द्वारा किया जावेगा, कार्यों का सतत् निरीक्षण मुख्य वन संरक्षक, जगदलपुर एवं बोर्ड के अधिकारियों/विशेषज्ञों द्वारा समय-समय पर किया जावेगा।

संलग्न – उपरोक्तानुसार।

(अरूण कुमार पाण्डेय)
सदस्य सचिव,
छत्तीसगढ़ राज्य जैवविविधता बोर्ड,
नवा रायपुर अटल नगर

पृ.क्रमांक/जै.वि.बो./1509 रायपुर,दिनांक 21/08/2023

प्रतिलिपि :–

1. अपर प्रधान मुख्य वन संरक्षक एवं नोडल अधिकारी (भू. प्रबंध) अटल नगर नवा रायपुर की ओर सूचनार्थ।
2. मुख्य वन संरक्षक, जगदलपुर वृत्त को पत्र कमांक 1911, दिनांक 10.08.2023 के संबंध में सूचनार्थ एवं आवश्यक कार्यवाही हेतु।
3. वनमंडलाधिकारी दंतेवाड़ा, वनमंडल दंतेवाड़ा
4. मुख्य कार्यपालन अधिकारी, NMDC- CMDC Ltd.(NCL)
5. संस्थान वी. द. फारेस्टर वेलफेयर सोसायटी, नया रायपुर

की ओर सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

सदस्य सचिव,
छत्तीसगढ़ राज्य जैवविविधता बोर्ड,
नवा रायपुर अटल नगर

Annexure - I

Approved Expenditure For Bio Diversity Conservation

In Iron Ore Mines Area NMDC CMDC Ltd. Deposit 4

(W.R. to the Project titled " Biodiversity Conservation Plan and Soil Water & Moisture Conservation Plan for Tree Fern Area" approved vide Member Secretary, Chhattisgarh State Biodiversity Board's Order No. 17, dated 21.08.2023)

Dantewada Forest Division

Sr. No	ITEM	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total (Rs. In Lacs)
1	Cost of Infrastructure development for nursery for tree fern and RET spp.	50.00	20.00	10.00	10.00	10.00	0	0	0	0	0	0	0	0	0	0	**100.00**
	Nursery Development for Tree Fern and RET species for plantation of 125 Ha. In Impact / Buffer area Please Refer Chapter 5, point 5.11	47.4375	12.9375	4.7438	1.2938	0	0	0	0	0	0	0	0	0	0	0	**66.4126**
2	**Conservation of Tree Fern (For details Please refer chapter 5)** In situ conservation & Protection of Tree fern and its associates falling in Project area Within ML area and along Galli nalla (75. 0 Ha)	10	10	10	10	10	5	5	5	5	5	5	5	5	5	5	**100**
	Ex situ conservation of Tree fern and. its associates falling outside Project area (Within 10 Km from periphery of ML area) (75 Ha.)	0	0	0	20	20	20	5	5	5	5	5	5	5	5	5	**105**

Member Secreatary,
Chhattisgarh State Biodiversity Board,
Naya Raipur.

Sr. No	ITEM	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total (Rs. In Lacs)
3	Budgetary provision for RET species (For details Please refer chapter 5) (i) Nursery Development for RET species for plantation of 50 Ha. In Impact / Buffer area. Please refer chapter 5	29.90	7.47	2.99	0.299	0	0	0	0	0	0	0	0	0	0	0	**40.659**
	(ii) In-situ Conservation of RET species in PF/RF of (Within 10 Km from periphery of ML area) and its maintenance one plot of 10 Ha. Each year for 5 years (5 Plots = 50 Ha.)	20.0 1 Plot (10Ha.)	20.0 1 Plot (10Ha.)	20.0 1 Plot (10Ha.)	20.0 1 Plot (10 Ha.)	20.0 1 Plot (10 Ha.)	0	0	0	0	0	0	0	0	0	0	**100.00**
	(iii) Maintenance of RET species in-situ plots (5years) (50 Ha.)	0	3.0 1 plot (10 ha)	6.0 2 plots (20Ha.)	9.0 3 plots (30Ha.)	12.0 4 Plots (40Ha.)	15.0 5 plots (50Ha.)	12.0 4 plots (40Ha.)	9.0 3 plots (30Ha.)	6.0 2 plots (20Ha.)	3.0 1 plot (10Ha.)	0	0	0	0	0	**75.00**
	(iv)Ex-situ Conservation of RET species and including maintenance for 5 years (Within 10 Km from periphery of ML area) (50 Ha)	0	0	0	30.0 10 Ha	30.0 10 Ha	30.0 10 Ha	30.0 10 Ha	30.0 10 Ha	0	0	0	0	0	0	0	**150.0**
4	Budgetary provision for Biodiversity Conservation & protection of Forest. (Watch and Ward for 15 years	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**75.00**

Member Secreatary,
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Sr. No	ITEM	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total (Rs. In Lacs)
5	Biodiversity Park is proposed to develop at Dantewada district for Education purpose of Front-line staff, Miners] Educational Institutes, reaserchers and local People.	150.0	50.0	0	0	0	0	0	0	0	0	0	0	0	0	0	**200. 0**
6	Budgetary provision for Research Monitoring and Evaluation of plan including cost of subject specialist/ experts/ expert NGO.	0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0	2.0	1.0	1.0	**35.00**
7	Development of Training and Interpretation center (A) Construction of center	100.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**100.00**
	(B) Regular Training, Awareness program, Seminar, Lectures and Orientation program on Biodiversity Conservation	0	10	10	10	10	5	5	5	5	5	5	5	5	5	5	**90.00**
8	Budgetary provision for Training & Awareness for BMC Members at Village level in Buffer area.	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	**90.0**
9	I) Budgetary provision for Grass and leaf fodder species in common land, /farmers land area in 24 affected villages in Impact / Buffer zone (total 120 Ha). Grass land development works may be carried our in nearby Forest area by the	10.0	10.0	10.0	10.0	8.0	0	0	0	0	0	0	0	0	0	0	**48.00**
		25 Ha (5	25 Ha (5	25 Ha (5	25 Ha (5	20 Ha (4											

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Sr. No	ITEM	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total (Rs. In Lacs)
	department, as per the working plan provisions.	village)	village)	village)	village)	village)											
	II) Additional budgetary provision for Maintenance of grass and leaf fodder plots 5 years	0	1.0 25 Ha	2.0 50 Ha	3.0 75 Ha	4.0 100 Ha	4.8 120 Ha	3.8 95 Ha	2.8 70 Ha	1.8 45 Ha	1.0 25 Ha	0.8 20 Ha	0	0	0	0	**25.00**
	(III) Budgetary provision for Additional 100 Ha grass and leaf fodder plot in adjoining forest area (10 Ha each from 6th year onward) including maintenance. (For Introducing System of rotational grazing)	0	0	0	0	0	5.0 10 Ha	5.0 10 Ha	5.0 10 Ha	5.0 10 Ha	5.0 10 Ha	5.0 10 Ha	5.0 10 Ha	5.0 10 Ha	5.0 10 Ha	5.0 10 Ha	**50.00**
10	Plantation of Horticulture species and Ethno-botanical/ medicinal importance species in affected 24 villages and their maintenance for 3 years	40.0	40.0	40.0	0	0	0	0	0	0	0	0	0	0	0	0	**120.0**
11	Organizing study tour and exposure visit within country for Experts/ Scientists/ People/ Villagers/ Students etc.	10.0	10.0	10.0	10.0	10.0	0	0	0	0	0	0	0	0	0	0	**50.00**

Member Secretary,
Chhattisgarh State Biodiversity Board,
Naya Raipur.

Sr. No	ITEM	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total (Rs. In Lacs)
12	**Monitoring of EX-SITU andIN-SITU Conservation activities:** A panel of Expert team shall monitor the EX-SITU and IN-SITU Conservation activities. The budget shall be deposited in Chhattisgarh Biodiversity Board`s account.	40.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**40.0**
13	(I) Budgetary provision for Providing and fixing of Bird nesting boxes (50 boxes in 4 locations and replicate after 2 years) i.e., 400 boxes, under the supervision of Avifauna Experts from the Board.	4.00 200 Boxes	0	4.0 200 Boxes	0	0	0	0	0	0	0	0	0	0	0	0	**8.00**
	(II) Budgetary provision for Monitoring activity after 2 years	0	0	1.00	0	1.00	0	0	0	0	0	0	0	0	0	0	**2.00**
14	Budgetary provision for Butterfly habitat development in 5 suitable areas.	9.0 3 areas	6.0 2 areas	0	0	0	0	0	0	0	0	0	0	0	0	0	**15.00**
15	Estimated cost of Soil, Water and Moisture conservation in respect of Tree Fern area fall in ML area. Please refer Part B and Chapter IV	**910.1382**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**910.1382**

Member Secretary,
Chhattisgarh State Biodiversity Board,
Naya Raipur.

Sr. No	ITEM	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total (Rs. In Lacs)
16	Repair and Maintenance of SWM Conservation Structure After Every Third year till Plan Period	0	0	0	10	0	0	10	0	0	10	0	0	10	0	0	**40.00**
17	Provision for Chain link fencing 6feet height for the protection of tree fern area in Buffer Zone (10 Kms radius from ML area) and other area having sporadic occurrence of tree fern species.	50.0	50.0	50.0	40.0	0	0	0	0	0	0	0	0	0	0	0	**190.0**
	Total	**1491.476**	**264.4075**	**194.7338**	**197.5928**	**149**	**98.8**	**89.8**	**75.8**	**41.8**	**48**	**33.8**	**33**	**43**	**32**	**32**	**2825.212**
	10% Escalation	**149.1476**	**26.44075**	**19.47338**	**19.75928**	**14.9**	**9.88**	**8.98**	**7.58**	**4.18**	**4.8**	**3.38**	**3.3**	**4.3**	**3.2**	**3.2**	**282.5212**
	Grand Total	**1640.623**	**290.8483**	**214.2072**	**217.3521**	**163.9**	**108.68**	**98.78**	**83.38**	**45.98**	**52.8**	**37.18**	**36.3**	**47.3**	**35.2**	**35.2**	**3107.733**

(Arun Kumar Panday)
Member Secretary
C.G. State Biodiversity Board,
Nava Raipur Atal Nagar

Annexure - II

LIST OF RARE, ENDANGERD AND THREATENED PLANTS SPEICESIN STUDY AREA (Core and Buffer zone)

For Ex-Situ Conservation

(W.R. to the plan " Proposal for Diversion of Forest Land For Bailadila Iron Ore Deposit - 4 Mine")

Sl. No.	Botanical Name/Local Name	Family
1	*Acacia concinna (Shikakai)*	Fabaceae
2	*Alocasia decipiens*Schott	Araceae
3	*Aristolochia indica* L./ Iswari, Iswarmool, Eswaramooli	Aristolochiaceae
4	*Blepharispermum subsessile* DC./ Rasna	Asteraceae
5	*Breynia retusa* (Dennst.) Alston	Phyllanthaceae
6	*Celastruspaniculatus*Willd./Malkangni, Angul	Celastraceae
7	*Cledodendrumserretum (Bag Flower)*	Lamiaceae
8	*Cochlospermumreligiosum*(L.) Alston/ Kumbi, Gabdi, Ganiar, Galgal, Galgala	Bixaceae
9	*Cosmostigmaracemosum*	*Apocynaceae*
10	*Curculigoorchioides (Kali Musli)*	Hypoxidaceae
11	*Curcuma petiolata*Roxb./Jangli Haldi	Zingiberaceae
12	*Cyathea alata (Tree Fern Sps.)*	*Cyayheaceae*
13	*Cyathea arborea (Tree fern Sps.)*	*Cyayheaceae*
14	*Dilleniaaurea*Sm./ Kalle	Dilleniaceae
15	*Dilleniapentagyna*Roxb./ Karmal, KallaKarmeta	Dilleniaceae
16	*Dioscoreahispida*Dennst./Baichadi, Karodi	Dioscoreaceae
17	*Dracaena terniflora*Roxb.	Asparagaceae
18	*Drimia indica* (Roxb.) Jessop/ Janglipiyaz, Kande, Koli-kanda,	Asparagaceae
19	*Droceraburmanii (Tropical sundew)*	*Droseraceae*
20	*Embeliabasaal*(Roem. & Schult.) A. DC./Babrang, Baibrang, Baya Birang	Primulaceae
21	*Equisetum (Horse Tail or Snake grass)*	*Equisetaceae*
22	*Gloriosa superba* L./ Languli, Kalihari	Colchicaceae
23	*Gymnemainodorum*	*Apocynaceae*
24	*Gymnemasylvestre*R.Br./ Gudmar, Gurmar	Apocynaeae
25	Gymnosporia bailadillana Narayan. & Mooney	Celastraceae
26	*Huberanthacerasoides*	*Annonaceae*
27	*Litseaglutinosa*(Lour.) Robinson/ Garbijaur, Maida, Maidalakri	Lauraceae

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Naya Raipur.

Sl. No.	Botanical Name/Local Name	Family
28	*Mucuna pruriens* (L.) DC./ Kavach, Kiwach	Leguminosae
29	*Peucedanumnagpurense*(C.B. Clarke) Prain	Apiaceae
30	*Plumbago zeylanica (Ceylon leadwort)*	*Plubaginaceae*
31	*Pterocarpus marsupium* Roxb./Bijasal, Vijayasar	Leguminosae
32	Pueraria tuberosa (Willd.) DC./ Vidharikand, Vidari, Patal Kumbha	Leguminosae
33	*Solanum erianthum*	*Solanaceae*
34	*Strychnospotatorum (Cleaning Nut Tree)*	*Loganiaceae*
35	*Symplocosracemosa*Roxb./Loadh, Loadhra	Symplocaceae
36	*Utricularia sps.(Bladderworts)*	*Lentibulariaceae*

सदस्य सचिव, छत्तीसगढ़ राज्य जैवविविधता बोर्ड के आदेश कमांक 17, दिनांक 21.08.2023 के बिंदु कमांक 02 से संबंधित कार्यों हेतु अनुमोदित।

(Arun Kumar Panday)
Member Secretary
C.G. State Biodiversity Board,
Nava Raipur Atal Nagar

Biodiversity Conservation Plan

and

Soil, Water & Moisture Conservation Plan

Specific to Tree Fern Area of

Bailadila Iron ore Deposit No.-4

Dist. Dantewada Chhattisgarh

(Project by NMDC-CMDC Limited (NCL))

Prepared by

We the Foresters Welfare Society

Chhattisgarh

Regd. no. 1222094229

From the desk of "We the Foresters Welfare Society".

NMDC-CMDC Ltd. (NCL) was incorporated on 1st July 2006 between NMDC and CMDC Ltd. as a Joint Venture Company. The objective of NCL is to develop, explore, raise and sell Iron Ore and any other minerals from the deposits allocated by GoI. NMDC-CMDC Ltd. (NCL) plans to opening up of green field projects and enhance capacity expansion of brown field projects. One of project identified under green field is Bailadila Iron Ore Deposit-4

Bailadila Iron Ore Deposit-4 Mine (M.L. Area = 646.596 Ha) **(Leaving Tree Fern area of 76.496 Ha.)** Tehsil Bacheli, District South Bastar Dantewada State

Our society, ***'We the Foresters Welfare Society'*** through its team of forestry experts and subject experts visited the entire forest area and gathered first-hand information on status of Flora and Fauna status of the forest areas as per the terms referred in TOR,

This composite plan has two parts

Part A. Bio Diversity Conservation plan

Part B. Soil, water and Moisture conservation plan focusing conservation of Tree Fern area.

The survey has taken special care to study the status of TREE FERN in the proposed area also considered the other ecological factors.

The plan is prepared consulting with the experts and technically capable people of subjects in reference.

The plan has been prepared after considering primary and secondary source of information and literature available specially regarding Tree Fern.

We thankfully acknowledge and pay our deep regards to Shri Sudheer Agrawal IFS Principal Chief Conservator of Forest (Wild life) and CWLW Chhattisgarh, Shri Kaushlendra Kumar IFS Additional Principal Chief Conservator of Forest (Wildlife) for their valuable guidance

We would like to express our gratitude towards Mr. Mohammad Shaheed IFS Chief Conservator of Forest Jagdalpur circle, Dr. Jadhav Sagar Ramchandra IFS Divisional Forest Officer Dantewada, for their valuable suggestions and directions. Extending special thanks to Mr. Ashish Nanda, M.Tech. Engineer in charge of Water Development Program (Narwa) in Dantewada Forest division who helped us in making Soil, Water and Moistures Conservation measures for Tree Fern area.

We would like to express our special gratitude and thanks to Shri. Padmanabh Naik CEO, NCL, Raipur. Shri. Amit Kumar Singh DGM (Mining)/ NCL. Shri. B. Mehta AGM (Mech)/ NCL. Shri. Ravi Mohan Agrawal AGM (Mining)/ NCL and Shri. B. Venkateshwarlu, CGM, Bacheli for extending timely and extensive support.

We also acknowledge and pay regards to Sub divisional officers and Range Forest officers of the Dantewada division and Field staff of NMDC-CMDC for their great field support.

Chandra Shekhar Tiwari IFS	***Narendra Kumar Pandey IFS***	***Dilip Kumar Verma SFS***
Retd. CCF (Wildlife)	***Retd. CCF***	***Forest Expert***
President	***Vice President***	***Secretary***

"We the Foresters welfare society"

Part A

Biodiversity Conservation Plan

for Tree Fern Area Bailadila Iron ore Deposit No.-4

M/s NMDC-CMDC Limited (NCL) Dist. Dantewada

Chhattisgarh

Part A
INDEX BIO DIVERSITY CONSERVATION PLAN
BAILADILA IRON ORE DEPOSIT NO.-4

CHAPTER 01
INTRODUCTION

NMDC-CMDC Ltd. (NCL) was incorporated on 1st July 2006 between NMDC and CMDC Ltd. as a Joint Venture Company having it's registered office at Green Villey City, Housing Board Colony, Boriyakala, Raipur, Chhattisgarh - 492 015. The objective of NCL is to develop, explore, raise and sell Iron Ore and any other minerals from the deposits allocated by GoI.

As per National Steel Policy-2017, Government of India has an ambitious plan for increasing the domestic steel production from present capacity of around 115 MTPA to 300 MTPA in next 10 to 15 years. This will necessitate production of 400-450 million tonnes of iron ore annually. Low per capita steel consumption in the country at approx. 77 kg vis-a-vis the world average of 233 kg also indicates the huge growth potential for the Indian steel industry. In view of the ambitious targets set by National Steel Policy, steel producers like Tata Steel, JSW Steel, JSPL etc. are already ramping up their steel production capacities. NMDC being India's largest iron ore producer has to take lead in ensuring high production to avoid iron ore imports leading to loss of precious foreign exchange.

To achieve the targets set by National Steel Policy-2017, Ministry of Steel, GoI has asked NMDC Ltd. to increase its Iron Ore Production capacities.

Accordingly, NMDC has targeted to achieve Iron Ore production of 84 MTPA by 2025 and 100 MTPA by 2030. To achieve this, NMDC plans to opening up of green field projects and enhance capacity expansion of brown field projects. One of project identified under green field is Bailadila Iron Ore Deposit-4 of M/s NMDC-CMDC Limited (NCL) which is located north of Deposit-5 on the western flank of the Bailadila range of hills, lying at a distance of about 135 kms towards south-west of Jagdalpur in the state Chhattisgarh.

Ministry of Mines, GoI on 30.09.2019 has granted its prior approval for reservation of Bailadila Iron Ore Deposit-4 (Total Area 646.596 Ha), in favour of NMDC-CMDC Ltd. (NCL) for the purpose of Prospecting and Mining of Iron Ore. Further, Ministry of Mines, GoI on 18.02.2021 has issued amendment for the revised coordinates in the earlier issued Gazette Notification for reservation of Bailadila Iron Ore Deposit-4.

Mineral Resource Department (MRD), Government of Chhattisgarh (GoCG) on 26.06.2021 has issued a Letter of Intent (LOI) for grant of Mining Lease for the said area of Bailadila Iron Ore Deposit-4 for a period of five years.

Subsequently, MRD, GoCG on 07.08.2021 has issued an amendment in the Letter of Intent (LOI) prescribing the requirement of approved Mining Plan.

Further, MRD, GoCG on 04.05.2022 has issued an amendment in the Letter of Intent (LOI) mentioning period of the mining lease as 50 years.

The Mining Plan was approved from IBM vide letter no. Dantewada/Fe/Khanij-1292/2021/-Raipur dated 24-09-2021.

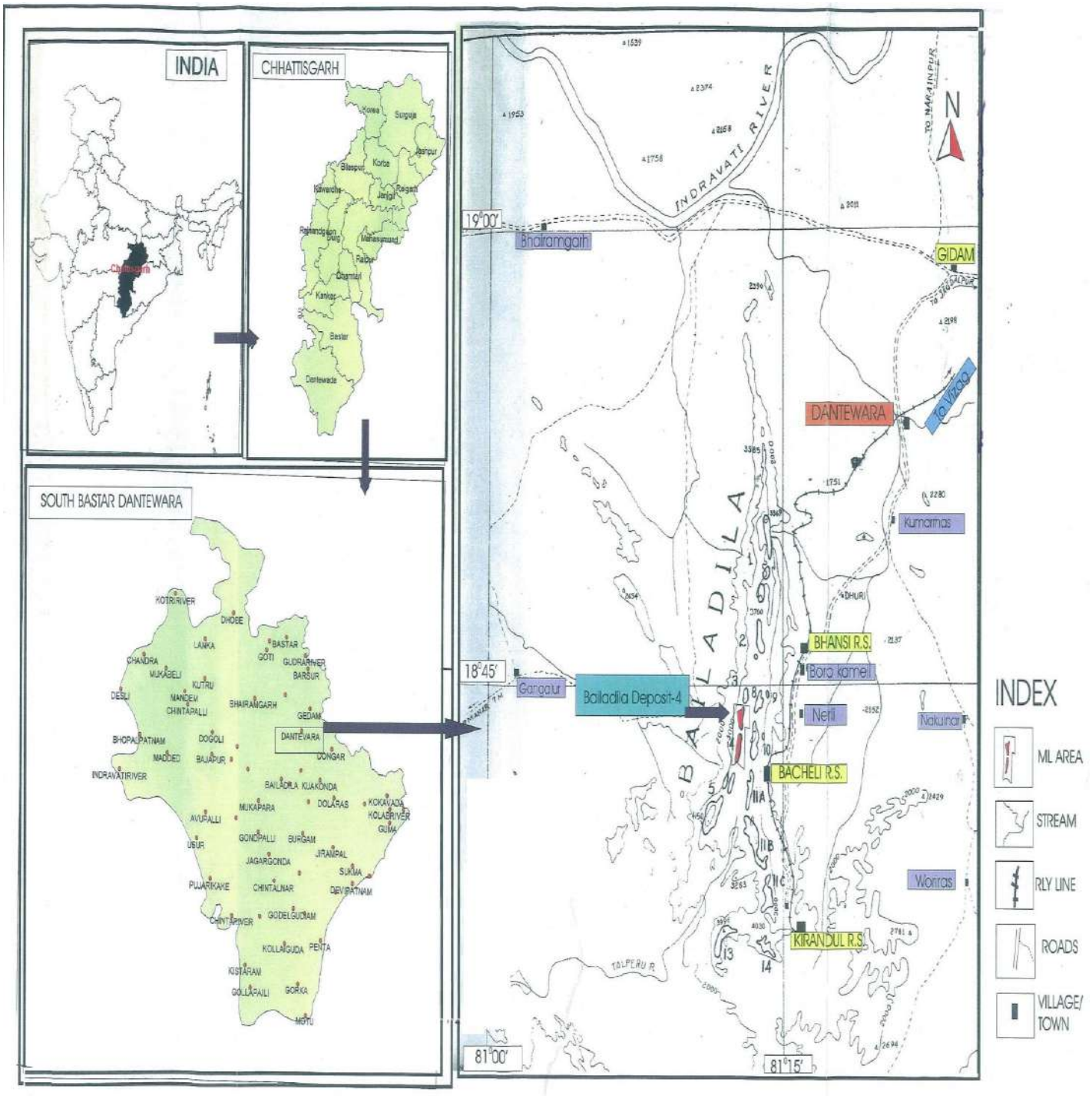
Form -1 and PFR was uploaded in Parivesh portal of MoEF&CC for obtaining Terms of Reference on 14/01/2022 for both proposals i.e. non coal mining (Proposal No: IA/CG/MIN/251288/2022, File No: IA-J-11015/104/2021-IA-II(NCM)) for the Mining Lease of Dep-4 and Industrial Projects-I sector (Proposal No: IA/CG/IND/251437/2022, File No: IA-J-11011/23/2022-IA-II(IND-I)) for the Beneficiation plant outside the Mining Lease of Deposit-4.

The EAC meeting for Bailadila Iron Ore Deposit-4 Mine was held on 17th February 2022 and TOR was issued vide No. IA-J-11015/104/2021-IA-II(NCM) dated 11.03.2022. (Annexure enclosed)

The EAC meeting for Beneficiation Plant outside the Mining Lease of Dep-4 mine was held on 10th February 2022 and TOR issued vide F. No. IA-J-11011/23/2022-IA-II(IND-I) dated 21.02.2022.

In addition to ML area, forest land falling outside Mining Lease is also required for development of infrastructure facilities such as downhill conveyor, screening plant, loading plant, approach road etc for development of Bailadila Deposit 4 project as a fully mechanized mine and standalone project. The total land required outside mining lease is 122.5428 Ha (Forest area of 100.077 Ha. and 22.4658 Ha. of revenue land) area located at outside the Mine Lease area of Bailadila Iron Ore Project, Deposit-4 at Village: Bhansi, Tehsil: Bacheli, District Dantewada, Chhattisgarh by M/s NMDC-CMDC Limited (NCL) which is falling in Bailadila Reserve Forest area and apart out the forest area.

MAP 1.1 LOCATION MAP OF BAILADILA IRON ORE DEPOSITE-4

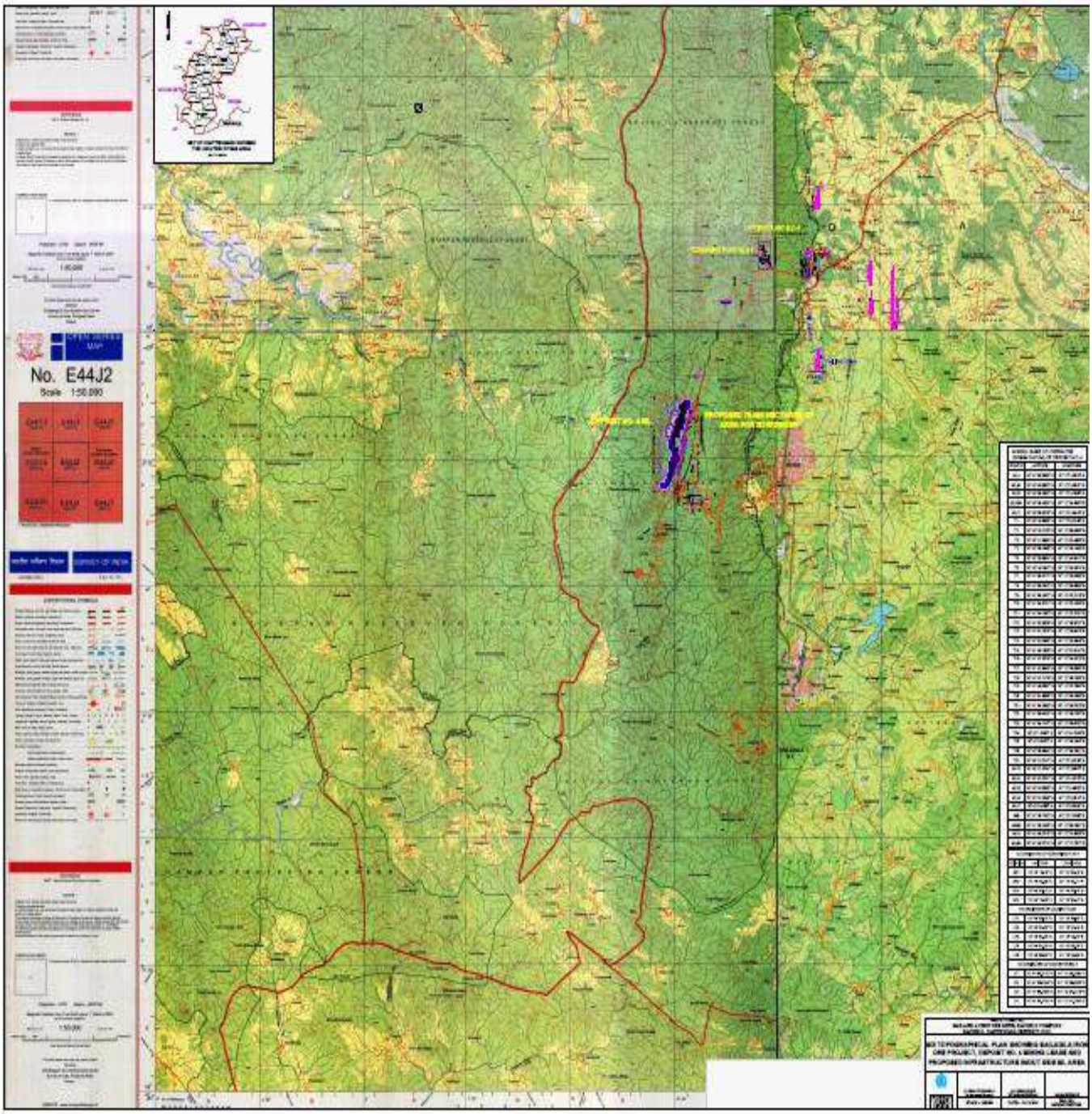


LOCATION MAP OF BAILADILA IRON ORE DEPOSIT NO.4

NMDC CMDC Ltd. (NCL) has conceptualized that Bailadila Deposit-4 will be developed as a standalone mining project, which will have all mineral processing facilities i.e., crushing plant, downhill conveyor, screening plant & loading plant exclusively for Deposit-4. The township, power distribution system, water supply and tailing disposal systems also will be independent and exclusive for Bailadila Deposit-4. The infrastructure plan prepared for indicative tentative location of the proposed OCSL plant and other infrastructural facilities are shown in **Map 1.1**

MAP 1.2 TOPO SHEET NO E44 J2

Topo Map showing the BIOP Dep-4 ML area along with infrastructure development



The area for which lease is sought lies within the Bailadila Range which is 40 km long. The deposit is situated on the north of Deposit 5 and in the south of Dep-3 and is characterized by rugged and undulating topography. The highest elevation is 1210 m above MSL and the lowest elevation is above 1020 above MSL. The ore body has a general NNE-SSW trend steep easterly slope. The north south trending range of hills comprise for the greater part of its length of two ridges with a valley in between. The Galli nalla is situated in the valley.

1.1 GENERAL DESCRIPTION OF THE DEPOSIT / ORE BODY:

The ore body occurs along the top of the ridge for 4.4 km in length and is characterized by narrow width, which varies from 250 mts. to a minimum of 80 mts. The ore body is divided into north and south blocks which are separated by unenriched BHQ. The deposit is bounded by a deep valley on western side and Galli nalla on eastern side. The eastern flank of the deposit is mostly covered by poor grade literates. Small cliffs composed of hard massive ore occur on the western side of the deposit. Western boundary is often marked by sharp contact against the BHQ. The deposit has a general synclinal structure. The ore body is however, disturbed by several faults which are oblique and transverse in nature. The ore body is also characterized by cross folding, because of which the width of the ore body at places is wider and narrower and at the bottom configureration also gets quite corrugated The scope of the work includes biodiversity survey and preparation of Biodiversity Conservation Plan for Bailadila Iron Ore project of Deposit-4, South Bastar Dantewada District, Chhattisgarh. Bailadila has two urban habitats namely Bacheli (29 km from Dantewada) and Kirandul (41 km from Dantewada). The range comprises of 14 iron ore deposits spread over the whole area, a major part of which comes under Reserve Forest. Bailadila lies in the Survey of India toposheet no. 65F/2 within latitude 18o32'32" &19o36'5" North and longitude 81o13' & 81o14'30".

1.2 DESCRIPTION OF FOREST:

The state of Chhattisgarh being placed in Deccan bio-geographical Area, which is an important part of rich and unique biological diversity. What is a more conspicuous is that the state is significantly rich in endemism with respect to many plants having medicinal importance.

Apart from the species diversity, the state is also endowed with rich genetic diversity. The variation in the genetic composition of individuals within or among floristic species is large.

The recorded forest area in the state is 59,772 km2 which is 44.21 of its geographical area. Reserved, Protected and Unclassed Forests constitute 43.13%, 40.21% and 16.65% of the total forest area respectively.

The forests of the state fall under two major forest types, i.e., Tropical Moist Deciduous Forest and the Tropical Dry Deciduous Forest (Champion and Seth, 1968). The state of Chhattisgarh is endowed with about 22 varied forest sub-types existing in the state.

The study area falls under Deccan bio-geographical area that houses an important partof the rich and unique biological diversity.

As per Champion and Seth (1968), Sal is one of the dominant tree species in the tropical moist

as well as dry deciduous forests in India and it has been considered as a deciduous species (Cooke, 1958; Kirtikar and Basu, 1975; Tiwari, 1995), semi-deciduous species (Bor, 1953), an evergreen species (Krishnaswamy and Mathauda, 1954; Singh and Singh, 1992; Borchert, 2000), and deciduous or brevi-deciduous (Joshi, 1980).

Major forest types in Chhattisgarh	
Forest types	**% of the total**
5A/C3 Southern Dry Mixed Deciduous Forest	27.37
3C/C2e (ii) Moist Peninsular Low-Level Sal Forest	16.64
3B/C2 Southern Moist Mixed Deciduous Forest	15.68
5B/C1c Dry Peninsular Sal Forest	15.27
5B/C2 Northern Dry Mixed Deciduous Forest	13.16
3B/C1c Slightly Moist Teak Forest	6.47
Relatively lesser forest types in Chhattisgarh	
5/E9 Dry Bamboo Brakes	1.49
3C/C2e (i) Moist Peninsular High-Level Sal Forest	1.48
Plantation/ TOF	1.01
5B/DS1 Dry Deciduous Scrub	0.98
5A/C1b Dry Teak Forest	0.43
3/E1 *Terminalia elliptica* Forest	0.02
(Source- FSI, 2019)	

1.3 CLASSIFICATION OF FOREST IN DANTEWADA DIVISION:

As per Champion and Seth the study area (Project area and Impact Zone) in Dantewada Forest Division can be termed as follows:

Northern Tropical Moist Deciduous Forest - Type 3C

(i) Tropical Moist Penninsular High level Sal Forest 3C/C2ei

(ii) Tropical Moist Penninsular Sal Forest 3C/C2

(iii) Tropical Moist Penninsular Valley Sal Forest 3C/C2eiii

Southern Tropical Dry Deciduous Mixed Forest - Type 3B

(i) Southern Moist Mixed Deciduous Forest 3B/C2

Bailadila Reserve Forest can prove to be a paradise for both plant and wildlife diversity. The Dantewada district of Chhattisgarh lies on the Gondwana Biodiversity Zone, which mostly comprises of the Tropical Forests. As this area is full of terrains, much of the forest remains unexplored and it is highly probable that this area contains some of the undocumented species. The forest area in the buffer zone comes under Reserve Forest and has following classes as per classification of FSI.

- Closed Forest/ Very Dense Forest- Where canopy cover is above 70%
- Dense Forest- Where canopy cover is between 40% - 70%
- Open Forest- Where canopy cover is between 10% - 40%
- Degraded Forest- Where canopy cover is below

The area has highly undulating topography with elevation varying from 400 to 1276 m above MSL. Bailadila hill ranges are a group of hills ranging about 40 km in length and 10 km width. The lower undulating plains vary in elevation from 300 to 400 m and occasionally rise to 600 m. The area experiences a mean annual rainfall of 1400 mm. With the moderately high rainfall, the densely forested ecosystem of the hills is quite characteristic to a mixed/ moist deciduous forest type. On the contrary, the area is reported to experience severe dry period during the post-monsoon and summer seasons. The Bailadila hills primarily forms part of the sub-basin watersheds of the Indravati River, which is one of the major tributaries of Godavari River. A relatively smaller portion of the area under Bailadila Hills towards SW is drained by Taliperu River that forms one of the tributaries of the Godavari River. Both the Indravati and Taliperu Rivers are located respectively north (draining NW and entire eastern slope) and south-west of the hill ranges. The drainage pattern of the area is radial, parallel, and sub-dendritic in nature. The SE slope of the hill is drained by Kirandul Nala that joins the Sankini River, which ultimately draining into the Dankini River at Dantewada. These drainages form part of the Indravati River. A relatively small stream called Madadi Nala originates at the extreme south of the hill and joins the Kirnadul Nala at its downstream near Kadampal. The SW slope of the hill ranges are drained by the Malinger Nala, which joins the Kolab River and further into the Taliperu River. Several natural water courses criss-cross the ridges and meet one of the above streams.

Moderate Dense and 1907.45 km2 (22.99%) under Open Forest with a total of 44613.15 km2 (53.79%) out of the total geographic area of 8298 km2, together with a scrub forest cover of 26.34 Sq.km

1.4 SCOPE OF THE WORK:

The scope of the work includes biodiversity survey and preparation of Biodiversity Conservation Plan for Bailadila Iron Ore project of Deposit-4, South Bastar Dantewada District, Chhattisgarh. Bailadila has two urban habitats namely Bacheli (29 km from Dantewada) and Kirandul (41 km from Dantewada). The range comprises of 14 iron ore deposits spread over the whole area, a major part of which comes under Reserve Forest.

The present study area covers both the core zone i.e. mining lease area (ML area)646.595ha of

Bailadila Iron Ore project known as Deposit-4 and buffer zone i.e. 10 Km radius all along the boundary of mining lease for preparation of Biodiversity Conservation Plan.
It needs spicily mention that the tree fern species namely *Cyathea arboreais* available within ML area of this deposit. The species is confined to both the sides of Galli nalla, which gets indirect sunlight with moist condition, and maintain a high level of humidity in all seasons.
The scope of the study was to

1. provide baseline data on biodiversity of various ecosystem analysis for inventory of flora & fauna that would serve as the basis for assessment of biological ecosystem quality of seasonal/perennial streams in and around the mining lease area of Bailadila Iron Ore Mine, deposit 04 (a proposed mining plan) Kirandul Complex, South Bastar Dantewada district, Chhattisgarh state.

2. The study was part of a broader ecological and biodiversity assessment of the deposit 04 mining area buffer area in connection with the identification of potential impacts of iron ore mining on the environment. The study consisted of a rapid semi-quantitative field sampling of flora species from the perennial/seasonal various ecosystem of the area. The main objective of the study was to analyse the abundance and richness of common mixed forest flora and pteridophytes species occur in patches among deposit 04.

3. The ecological condition, ecosystem health of pteridophytes population and the riparian habitat of the study area is largely influenced by land use land cover changes on account of iron ore mining
4. species is confined to both the sides of Galli nalla, which gets indirect sunlight with moist condition, and maintain a high level of humidity in all seasons.
5. therefore, it is pertinent to evaluate the assemblages and diversity of sensitive/indicator flora and fauna for biomonitoring of ecosystem as well as to prose the mitigation measures for the impacts arising out of mining on the ambient environment.

The present study area covers both the core zone i.e., mining lease area (ML area)646.595ha of Bailadila Iron Ore project known as Deposit-4 and buffer zone i.e., 10 Km radius all along the boundary of mining lease for preparation of Biodiversity Conservation Plan. It needs spicily mention that the tree fern species namely *Cyathea arborea* is available with in ML area of this deposit.

1.5 STUDY AREA:

The study area includes

- Core/Project area (ML area which includes Tree Fern area)
- Impact/Buffer Zone (10 Kms radius around the Core/Project area)

The study covers 10km radius around the core area. The iron ores of Bailadila range belong to the Bailadila series which are associated with slightly metamorphosed iron-ore bearing sedimentary rocks of Pre-Cambrian age. Iron ore occurs as separate ore bodies on the crest of the two sub-parallel hills running north-south. These hill ranges comprise shales, banded hematite, quartzite, and conglomerates containing pebbles of quartzite and shale.

1.6 GEOGRAPHY OF THE AREA:

The Bailadila Iron Ore Project Deposit no.4 is one of the deposits located in the southern part of the south Bastar, Dantewada District. Bailadila Iron Ore Mine Deposit 4 project is in Bailadila range of hills, lying at about 135 kms towards south-west of Jagdalpur in Chhattisgarh state. The deposit is 27 km southwest of Bacheli railway station.

The deposit-4 ML area i.e.646.596 Ha falls in Bailadila Reserve Forest compartment no.1826, 1832, 1833, 1834, 1841, 1842, 1885, 1886 and 100.077 Ha outside ML area falling in **compartment no.1811, 1826, 1822, 1825, 1824, 1823, 1834 of Bacheli Range Dantewada Forest Division**

1.7 FOREST & LAND SCAPE:

The region is administratively governed under Dantewada district & south Bastar Forest division predominantly covered by three different forest types viz., Southern Dry Mixed Deciduous Forest (5A/C3), Moist Peninsular Low-Level Sal Forest (3C/C2e (ii)) and Southern Moist Mixed Deciduous Forest (3B/C2). Although a vast area within the Forest Division falls under the category of non-forest, the mountain ridges where the iron ore mined is covered with dense forests of Southern Moist Mixed Deciduous type. The land use of area falling under Bacheli Range Forests as per the draft plan for conservation and management of wildlife in Dantewada Forest Division, prepared for NMDC, occupies mixed forests to the tune of 88.69%, followed by mining lease of 5.86%, plantation of 3.88%, etc., while the same falling under the mining lease and its 10 km buffer zone as per analysis done by IBRAD - Biodiversity Survey and Conservation Plan for Deposit 14 & 11C Mines occupies dense forest to the tune of 27.18%, open forest of 26.36%, degraded forest of 19.15%, forest blanks of 3.38%, that put together 76.06% followed by agriculture 8.35%, mining 1.03%, etc. According to ISFR, 2019, the estimated area under forest cover in South Bastar Dantewada district of Chhattisgarh state amounts to 250.63 km2 (3.02%) under Very Dense, 2305.07 km2 (27.78%) under

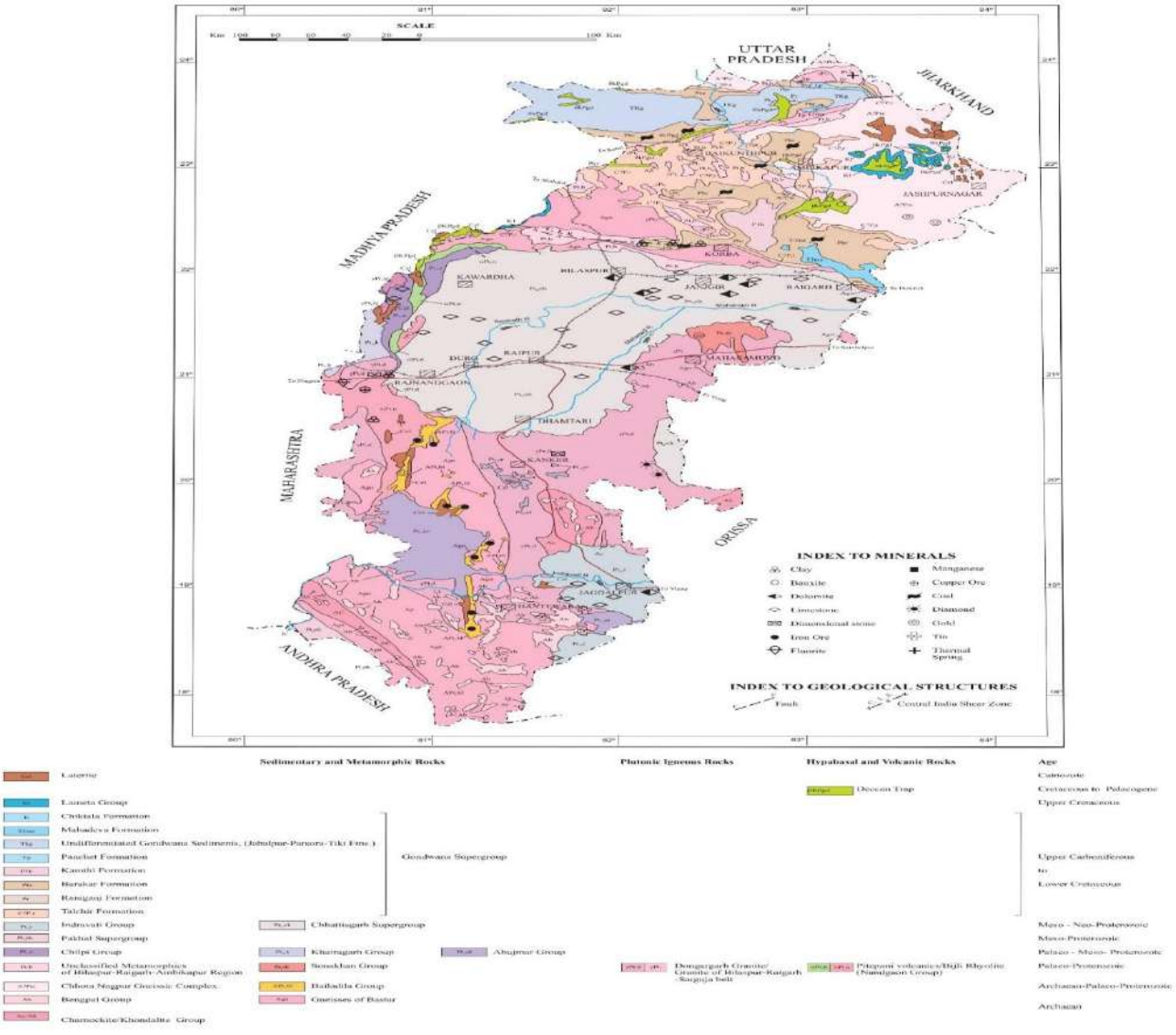
1.8 CLIMATE:

The climatic condition of the project area is semi-arid. The maximum temperature goes up to 400C during summer in the month of May and the minimum temperature goes down to 110C during winter in the month of December and January. The average humidity in the area ranges from 20 – 55%. The average rainfall recorded in the area is about 350 cm, about 85% of which is falling between July and September due to the Southwest monsoon. During monsoon and pre monsoon cyclone seasons, the wind velocities touch as high as 60-70km/h on Beaufort's scale.

1.9 GEOLOGY (geological map):

The iron ores of Bailadila range belong to the Bailadila series, which are associated with slightly metamorphosed iron-ore bearing sedimentary rocks of pre-Cambrian age. Iron ore occurs as separate ore bodies on the crest of the two sub parallel hills running north-south. These hill ranges comprise shale's, banded hematite, quartzite and conglomerates containing pebbles of quartzite's and shale.

MAP 1.3 GEOLOGICAL MAP OF CHHATTISGARH



1.10 OBJECTIVES OF PLAN:

The main objective of Biodiversity Conservation and Management Plan is sustainable use of natural resources which involves scientific management of natural wealth vis-a-vis developmental activities which is likely to affect these resources. The threats to natural terrestrial and aquatic ecosystems generally arise due to by anthropogenic activities that arise as a result of mining and associated activities of Bailadila Iron Reserve. Therefore, Biodiversity Conservation Plan is being developed for the conservation and management of the forest ecosystems in Bailadila an important forest area of Central India.

1.10.1 SPECIFIC OBJECTIVES OF THIS PLAN:

1 Understanding the Biodiversity of core as well as buffer area through primary and secondary sources to get basic information of existing status of flora and fauna within the study area.

2 Preparation of Biodiversity Conservation Plan basis on the findings in view of existing threat of anthropogenic pressure in the study area.

3 Preparing a management plan for *Cyathea arborea* (Indian Tree fern) that is an endangered species of India.

4 Record the existing traditional practices of use of the components of biodiversity by the ethnic communities within the study area.

5 Developing phase-wise biological reclamation strategy of the broken area to rehabilitate indigenous flora and fauna in the ML area.

6 Developing participatory initiative of local people for conservation and management of habitats in the buffer zone.

CHAPTER-II

METHODOLOGY FOLLOWED

2.1 RAPID ECOLOGICAL STUDY:

This ecosystem is a dynamic one with both rich floral and faunal biodiversity with respect to its diversity of species composition and visible successional stages. An ecosystem can be studied from different angles. This report has tried to explore various aspects of the study area to understand mostly the structural aspects of this forest ecosystem and associated ones. For this study sampling technique was followed as stated below. Field for this study was carried out during October 2022 and last week of November 2022.

2.2 FLORAL STATUS STUDY BY SAMPLE SURVEY:

Pteridophytes, the seedless vascular plants, had a very flourishing past in dominating the vegetation on the earth about 280-230 million years ago. Although they are now largely replaced by the seed-bearing vascular plants in the extant flora today, yet they constitute a prominent part of the present-day vegetation of the world. India with a highly variable climate has a rich diversity of its flora and Pteridophytic flora greatly contributes to its diversity. Pteridophytes also form an interesting and conscious part of our national flora with their distinctive ecological distributional pattern. On a very conservative estimate 500 species of ferns and100 species of fern-allies are on record from India. According to a census, the Pteridophytic flora of India comprises of 67 families, 191genera and more than 1,000 species (Dixit 1984) including 47endemic Indian ferns, less than 10% of those reported previously and 414 species of Pteridophytes (219 At risk, of which 160 critically endangered, 82 Nearthreatened and 113 Rare), constituting 41-43% of the total number of 950-1000 Pteridophytes of India. Shubhash (2000) recorded 34 families, 144 genera and more than 1100 species of ferns with about 235 endemic species from Indian region. The vascular flora of our country in general has about 15,000 species and as a constituent of Indian flora of vascular plants, the ferns and fern-allies form only five percent part as far as the number of species is concerned. But, due to their abundance in individuals as well as their conspicuousness in epiphytic vegetation and in the terrestrial vegetation along forest margins, road sides and forest floors, the contribution of fern and fern-allies to the vegetational pattern in India rank only next to the flowering plants.

2.3 ASSESSMENT OF FLORA:

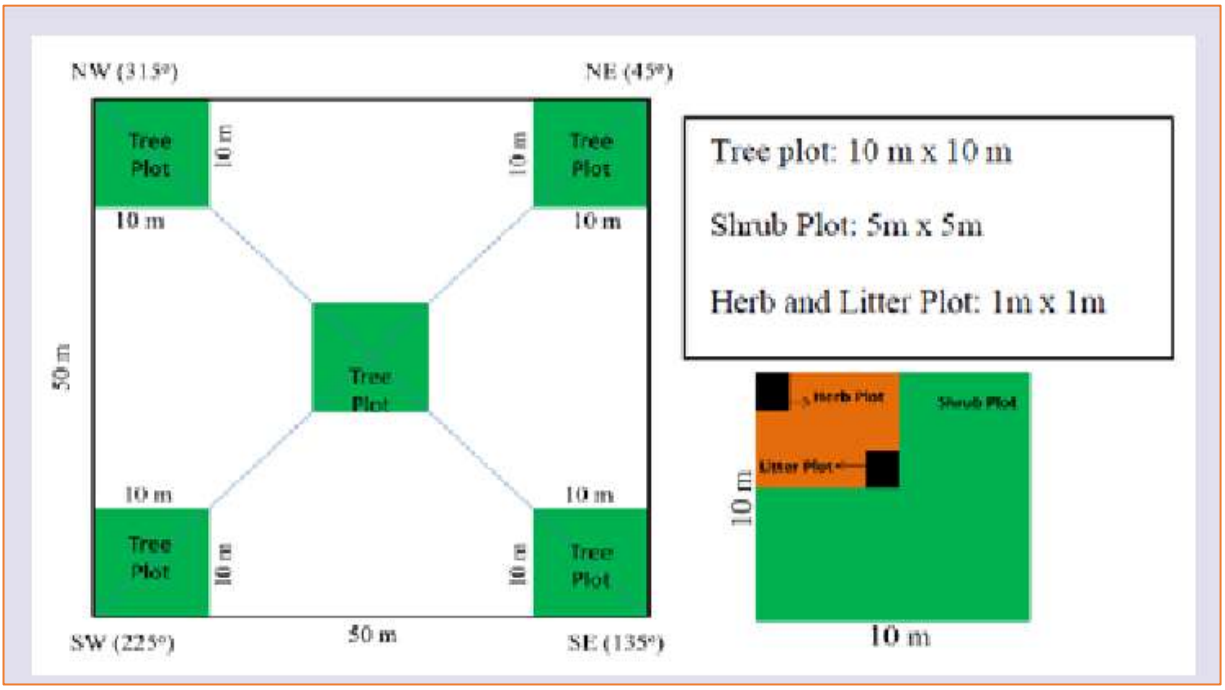
- Status of floral species was assessed in representative vegetation types existing in the study area.
- Quantitative data was collected using Quadrat / Traverse methods
- Status of tree, shrub, and annuals (grass and herb) was quantified using plot quadrats of Appropriate sizes.
- Plant species ascertained from the secondary sources was included in the report as Annexure along with field data to give near complete floral list of the study area.
- Biodiversity status assessment was done covering major floral components such as trees,shrubs, and herbs.
- Species of Economical, Ecological and Ethnobotanical importance was identified.
- Phyto-sociological studies was carried out to obtain information on species frequency, density, abundance, dominance, diversity index, importance value index.
- Quantity estimation of forest Flora and Fringe area flora was also done.
- Type of forest area and its conservation status was observed to best possible extent.
- Information on the dependency of local people on forest was also assessed.

2.3.1 THE DETAILS OF THE FLORAL BIODIVERSITY ASSESSMENT:-

Methodology Are Given Below**: -**

Random samples were taken to assess the ecological structure of the study area and get some simple idea of the ecological functions. The study area deposit 04 is basically a hill running in East-West direction. The whole core area where mining activity is in progress is almost completely denuded and rarely has any species. In some places where species available was recorded as per the findings of transact walk. Random sampling was done with the help of Satellite Imagery and toposheet of the area. Samples were studied both within mining sites (ML area) and in the buffer area i.e., 10 km radius of the ML area of the three mines namely 14ML, 14NMZ and a part of 11ML i.e., 11B. Each site studied is marked with geographical coordinates recorded in GPS handset (GARMIN-e Trex-30). Studies were done for understanding the phytosociology, inventorisation of faunal species as well as their habitat.

Quadrat sampling was done in the buffer zone only where there are both forest areas and non-forest areas. At the outset a species area curve was prepared in eastern side of the hill to find out the minimum size of the quadrat required for the study of three layers (considered as separate communities) such as tree, shrub, and herb (Cain, 1938). It was inferred that for tree layer the minimum size of the quadrat required for study was 500m2 (50m X 10m) for trees, (5m X 5m) 25m2 for shrubs and (1m X 1m) 1m2 for herbs. In each of the sample sites a quadrat of 500m2 was laid to study the tree community (Philip, 1959), Diversity Index, and Canopy Cover. In each of the tree quadrat four shrub quadrats were laid on alternate sides and similarly five herb quadrats were for study of herb layer. Each quadrat was given a code and marked by GPS reading. The sampling sites are as follows.



According to the forest working plan guidelines 1 X 1 metre area is covered and note the additional species according to the FSI and Working plan guidelines designed by The Braon – Balnquet (1932) .

2.4 PHYTOSOCIOLOGICAL STUDY METHODOLOGY:

Parameters like Importance Value Index (IVI), Canopy Cover were studied for the tree layer only both within core and buffer zone. Diversity Index and Dominance Index was calculated for the three layers.

2.4.1 IDENTIFICATION OF PLANT SPECIES:

Plant species were identified following standard flora prepared by Hooker (1872-1897)1, Vermaet al. (1985)2 and Kumar et al (2005)3. Names of the plant species were verified using Bennet (1987)4. The help of scientists of Botanical survey of India (BSI), Kolkata was taken.

2.4.2 CALCULATION OF IMPORTANCE VALUE INDEX (IVI) OF TREES:

This index utilizes 3 characteristics such as Relative frequency, Relative Density and Relative dominance.

- **Relative dominance** = (Total basal area of the species/Total basal area of all species) x 100
- **Relative density** = (Number of individuals of the species/Number of individuals of all species) x 100
- **Relative abundance** = Number of occurrences of the species/Number of occurrences of all species) x 100

(The above three values are added to get Importance Value Index (IVI).

2.4.3 METHODOLOGY OF CANOPY STATISTICS:

A geometric measurement was adopted to estimate Canopy Cover, by directly measuring the crown diameters at right angles, in a specified quadrat. The total canopy cover area (C) in a sample quadrat equals the sum of the canopy areas of all trees within the quadrat, $\Sigma\pi ri2$. Thus, the Canopy Cover Index (CC) is the ratio of C to A, where A = XY (X and Y denoting axes of the quadrat being measured). Open canopy is inferred when CC < 0.4. of these species is not very frequent in the core zone. Species like *Borassus flabellifer (Found in abundance in Buffer Zone), Azadirachta indica, Terminalia tomentosa, Eugenia jambolana, Ficus glomerata, Terminalia arjuna, Diospyros montana, and Mangifera indica* share the tree canopy layer in the non-forest area of the buffer zone. Diversity in the tree level in the non-forest areas is further enhanced by the availability of non-forest species like *Mangifera indica*, and *Acacia auriculiformis*, etc. Shrub species like *Lantana camara and Eupatorium odoratum, Parthenium* species are also available in this region which is the invasive species in Indian forests as well as non-forest areas. These invasive species are also very frequently available in the core area. Availability of these species in the buffer zone signifies that there is considerable anthropogenic intervention in the ecosystem which has resulted in alteration of species composition of the core as well as buffer zone which is like the studies on impact of invasive species on forests (Gordon, 1998; Sanders et al., 2003; Charles & Dukes, 2007; Capers et al., 2009; Devine & Fei, 2011; Priyanka & Joshi, 2013).

The diversity index in the tree level (2.10) is much more in the buffer zone in comparison to core zone (1.44). However, in our study, the species diversity index is lower than compared to other studies done at Eastern Ghats (Sahu et al., 2007; Reddy et al., 2008; Ganguli et al., 2016). Anthropogenic activity within forest area seems to be low in the tree layer as observed from the count of cut off stumps. Canopy cover in most places of the forest area in this zone is within 40-70% which is known to be dense forest as per the FSI classification.

Dominance index in the tree level of the buffer zone is only 0.27 which is much lower to 0.36 in comparison to core zone. This signifies that the tree layer in the buffer zone is shared by many species rather than a few ones which is a tendency towards mixed forest type rather than dominance of few tree species. Dominancy of single species is often attributed to niche diversification, disease, species competition and grazing (Whittaker & Levin, 1977; Harper, 1977). It is also observed that within the buffer zone there are few important species like *Bauhinia malabarica, Cedrela toona, Dalbergia paniculata, Croton oblongifolia, Shorea robusta,* and *Annona squoamosa* which are prominent forest species of central India.

The availability of some There may be less extraction of forest resources form the buffer zone due to its remoteness but long-term impact of human habitation and planting of domesticated species and exotic species like teak and Eucalyptus species certainly have a negative impact on the ecosystem. Therefore, initiative on the part of NMDC CMDC Ltd. (NCL) in developing positive attitude towards conserving the forest resources in the buffer zone is suggested. Habitat development, therefore, cannot confine within the efforts of plantation, water body creation or soil conservation only. It also will include developing participatory conservation approach taking the villagers of the buffer as well as fringe area in to confidence. There is a clear negative relationship between the diversity and dominance indices in both core and buffer zone. In the buffer zone this relationship is more evident because of its pristine nature.

TABLE 2.1 PHYTOSOCIOLOGICAL PARAMETERS OF CORE AND BUFFER ZONES OF DEPOSIT 04 AND AREA:

Sl. No.	Indices	Core Zone	Buffer Zone
1	**Canopy Cover (%)**	0%-10% (40% in one site)	10%-40% and 40%-70%
2	**Diversity Index**		
	a. Tree Level	1.44	2.10
	b. Shrub level	1.75	2.05
	c. Herb level	1.13	1.49
3	**Dominance Index**		
	a. Tree level	0.36	0.27
	b. Shrub level	0.42	0.13
	c. Herb level	0.52	0.22

2.4.4 SPECIES DIVERSITY ASSESMENT (ALPHA DIVERSITY):

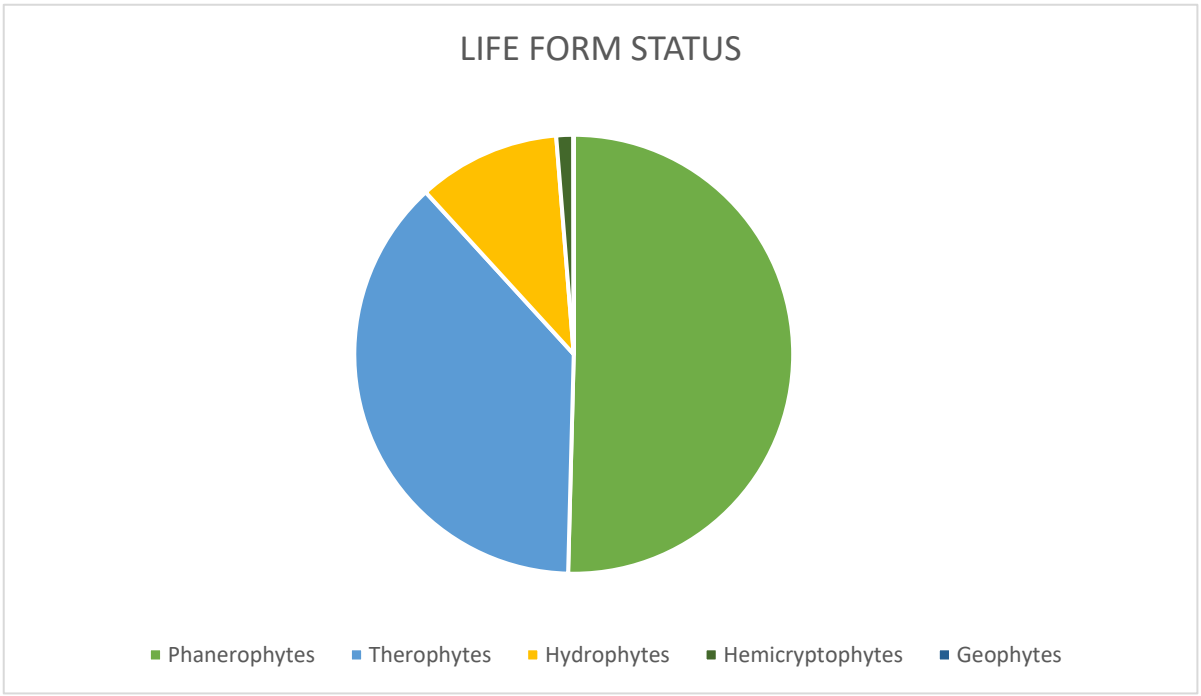
The index formula has been described below. its just a submission of methodology applied.

- Since Shannon and Wiener's H' is an index of information, it may be employed to measure diversity of any assemblage.
- The formulas are as follows:
- H' = -∑ pi ln pi, where pi = ni/N
- where ni = total number of individuals of a species N= total number of individuals of all the species
- The Simpsons Dominance Index (D) was also calculated. D = ∑n(n-1) / N(N-1)

2.4 .5 LIFE FORM STATUS STUDY METHODOLOGY:

The life form composition of the community is the manifestation of the adaptations of its component species to the climatic condition, and contributes to community architecture (Jamir et al., 2006). Life form spectrum is the sum of adaptations of plants to the climate. Following the system of Braun-Banquet's (1951) system the area possesses five major classes like

- Phanerophytes,
- Therophytes,
- Hydrophytes,
- Hemicryptophytes and Geophytes. Water bodies
- Grassland



2.5 INFORMATION FROM SECONDARY SOURCES:

Ethnobotanical information has been collected for this study from following sources also. These are (i) Old literature and (ii) Oral history. Herbarium specimen and field notes on herbarium sheets also proved to be a good source of ethnos-botanical information. In many cases the observation on plant is made by previous botanical explorers, and were noted on herbarium labels. This information was not published and remained unnoticed. Much useful information on plants associated with people of extent past has gone in written accounts of those items. Sometimes this information is scattered and exists in rather obsolete literature, such as, travel accounts, forest department reports, natural history, ethnologist, etc. In the present study all the tools mentioned above have been taken as source of information.

2.6 METHODS FOR MAPPING:

Uses already prepared 1: 50000 scale vegetation map & 1:15000 topographic map provided by forest division office Dantewada forest division. Map has been observed as per the compartment map description and history. Geo spatial coordinates & KMZ has obtained by GPS e Trex 30.

- Roadside plantation
- Grassland
- Water bodies

2.7 PRE-PROCESSING OF DATA:

The Digital Image Processing will be performed using ERDAS software tools and Garmin handled GPS that is used for ground truthing. IRS satellite imageries are geometrically corrected with respect to SOI toposheet. Satellite imageries were analyzed digitally by the method of supervised classification with necessary Ground truthing using the reference map as well as GS instrument. The hybrid method of digital interpretation and visual interpretation are used to classify the core zone to achieve accuracy levels.

2.8 FAUNAL STUDY:

- An ecological survey of the study area for understanding the fauna of the study area was conducted, particularly with reference to listing of species and assessment of the existing wild life has been studied by the forest working plan 2010-2021 and compiled time to time departmental studies in wild life recent census.
- An oral rapid interactive discussion & inquire survey with villagers and departmental officers of the forest departments is also been conducted during study.
- Forest dwellers are aware of the species found in their forest as they regularly visit forests for fuel wood and earn livelihood. The data recorded through interview gives an additional support of the presence of certain species in the study area. The faunal details are explained in details in **Chapter no. 6. Pl refers**.

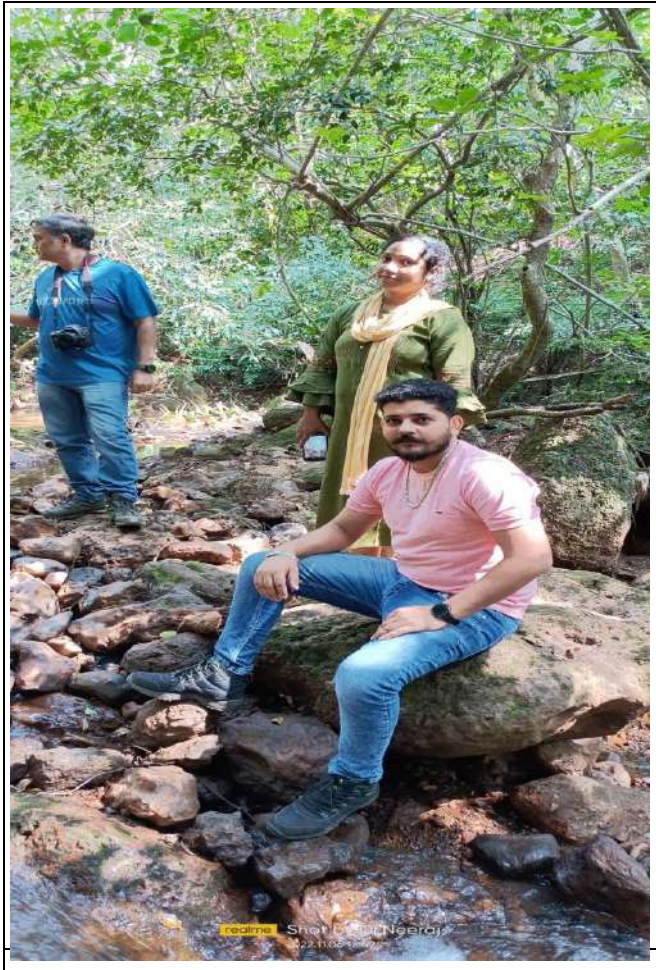
2.9 PROTOCOL OF WATER COLIFORM COUNT:

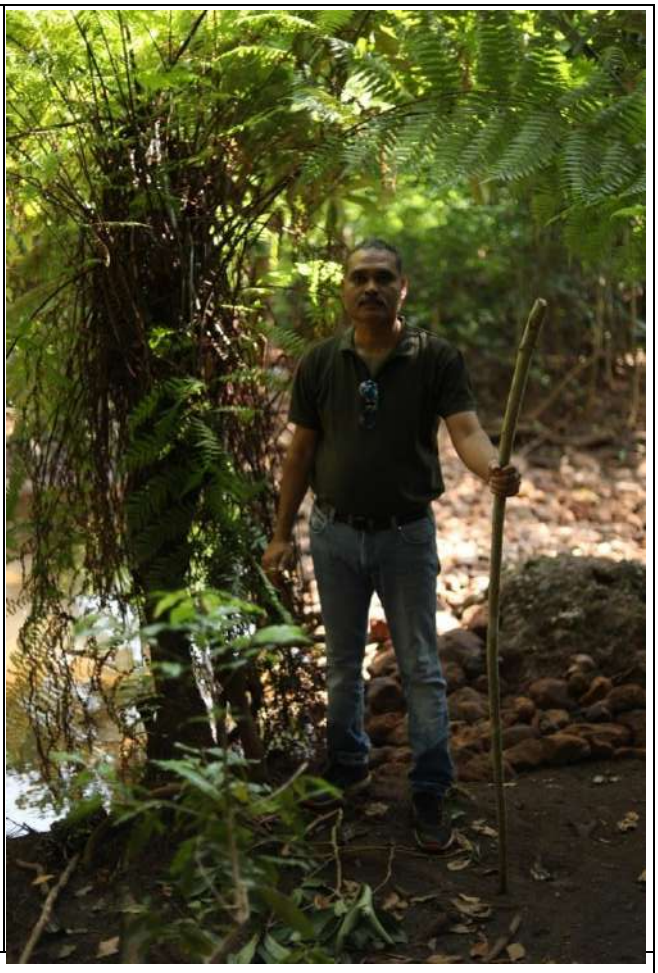
Lactose broth of two different strength – LB Single strength (X) and LB Double strength (2X) were used. For LB(X) 10 test-tubes and for LB (2X) 5 test-tubes were used and labeled. In LB(2X) test-tubes, 10 ml of sample water inoculated. In 5 test-tubes of LB(X), 1 ml of sample water inoculated and in another 5 test-tubes of LB(X), 0.1 ml of sample water inoculated. Then in all test-tubes, Durham's tubes putted and kept in incubation for 48 hours. After observing gas formation, numbers of positive test tubes were noted and the sequence then matched with the table provided by APHA, 2005. Thereby total coliform count determined by the table. For qualitative determination, bacterial inoculations from positive test-tubes were done on EMB Agar for another 24 hours of incubation.

2.10 SURVEY AND DATA COLLECTION TEAM:

SL. No	Member Name	Expertise
1	Mr. Chandra Shekhar Tiwari IFS Retd. CCF (Wild Life)	Botanist, Wild life and Forest management and Conservation
2	Mr. Dilip Kumar Verma, SFS Ex. Forest Officer	Forest Management, Environmentalist, Statistical Data Analyst
3	Dr. Neeraj Tiwari (Botany anf Forestry)	Ecology, Botany and Forestry
4	Ashutosh Mishra	Botany Plant Photography
5	Damini Bhuarya	Science Associate
6	Bindu Yadav	Field Associate for data collection
7	Pragati Trivedi	Botany and Ecologist

2.11 FIELD PHOTOGRAPHS OF DATA COLLECTION AND FIELD VISIT:






realme Shot by Dr.Neeraj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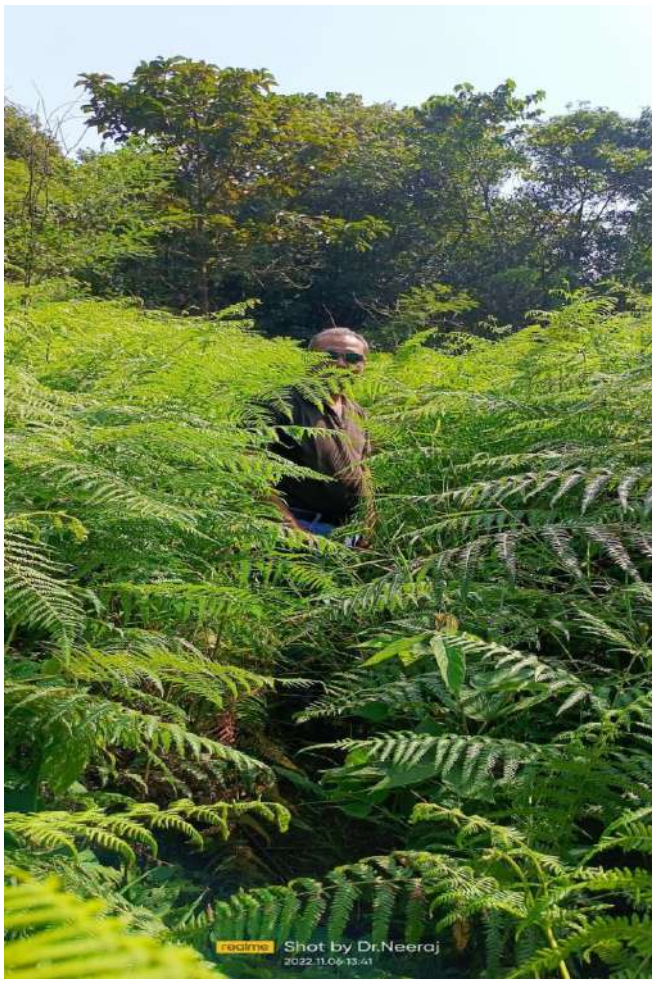
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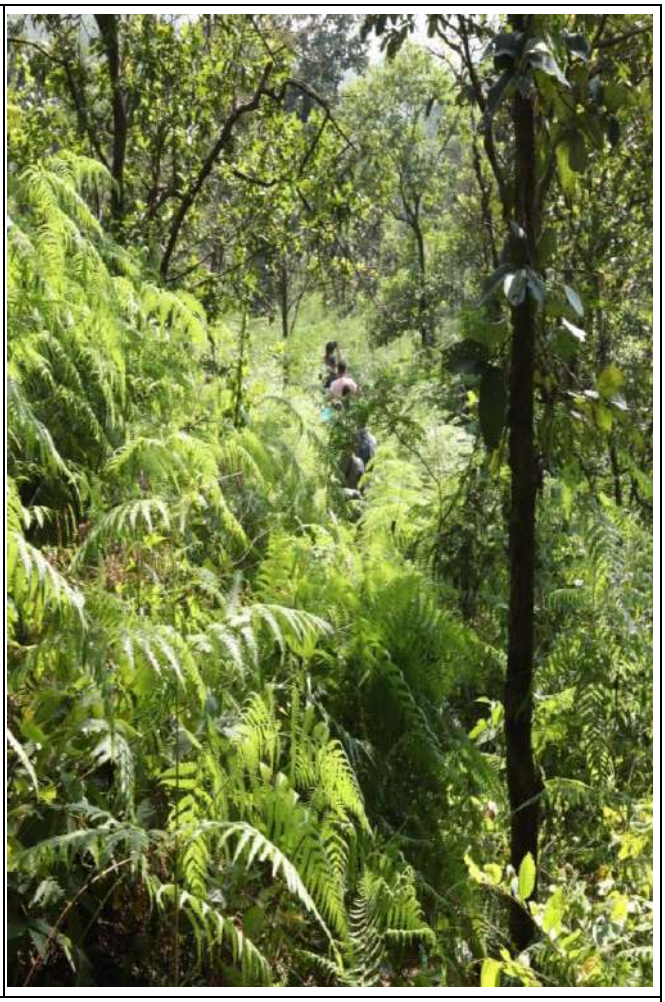

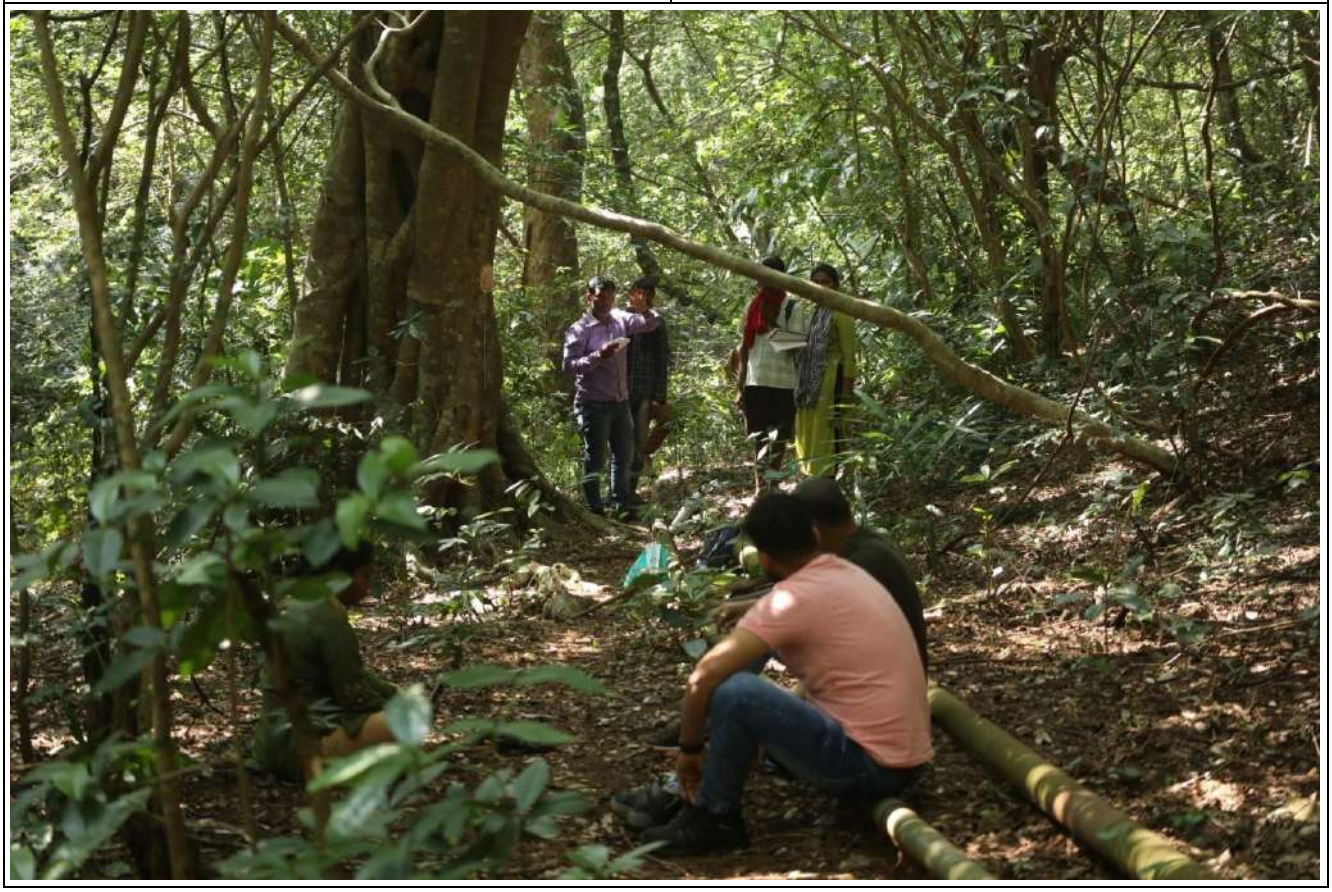


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realme Shot by Dr.Neeraj


ISUZU
D-MAX
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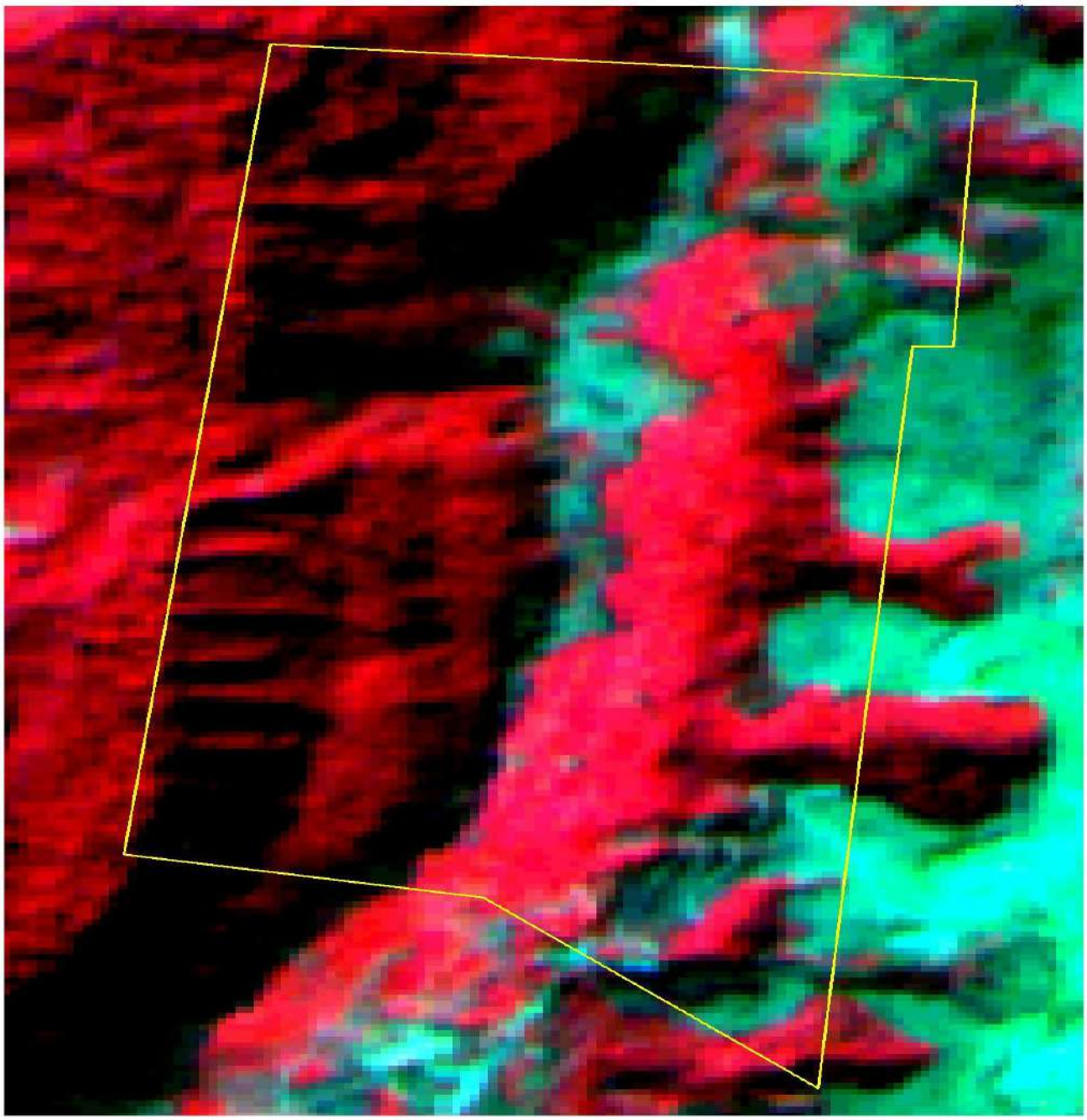
CHAPTER-III

TOPOGRAPHY AND LAND USE

3.1 TOPOGRAPHY IN CORE ZONE:

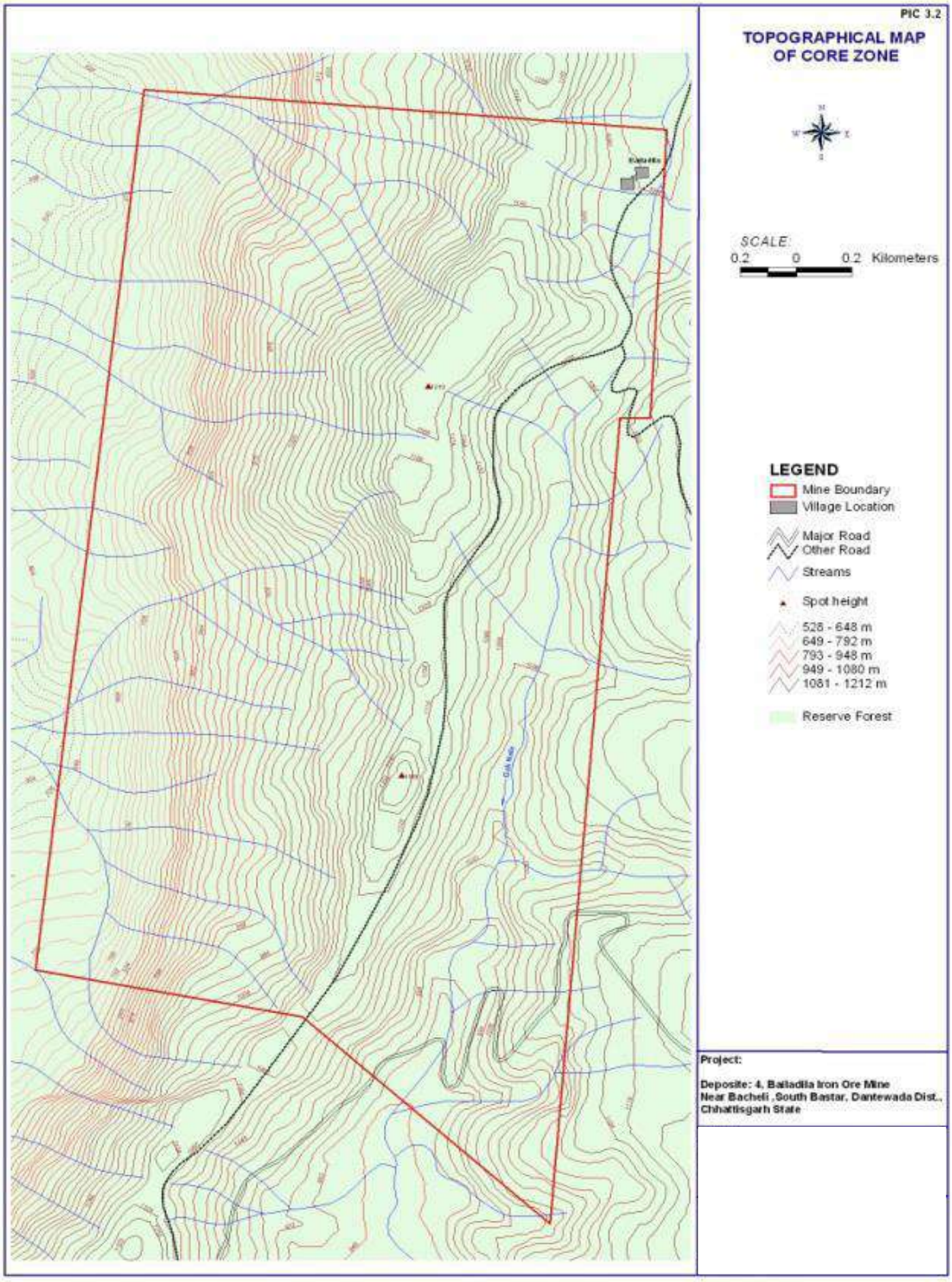
The core zone falls within the Bailadila Reserve Forest and on the Hilly Terrain. The elevation contours of the core zone range from 660m to 1200m AMSL. The 12m contour has been generated using toposheet and IRS P5 Cartosat1 Stereo data. A rivulet 'Galli Nalla is passing through the Core Zone from North to South.

MAP 3.1 SATELLITE IMAGE OF CORE ZONE

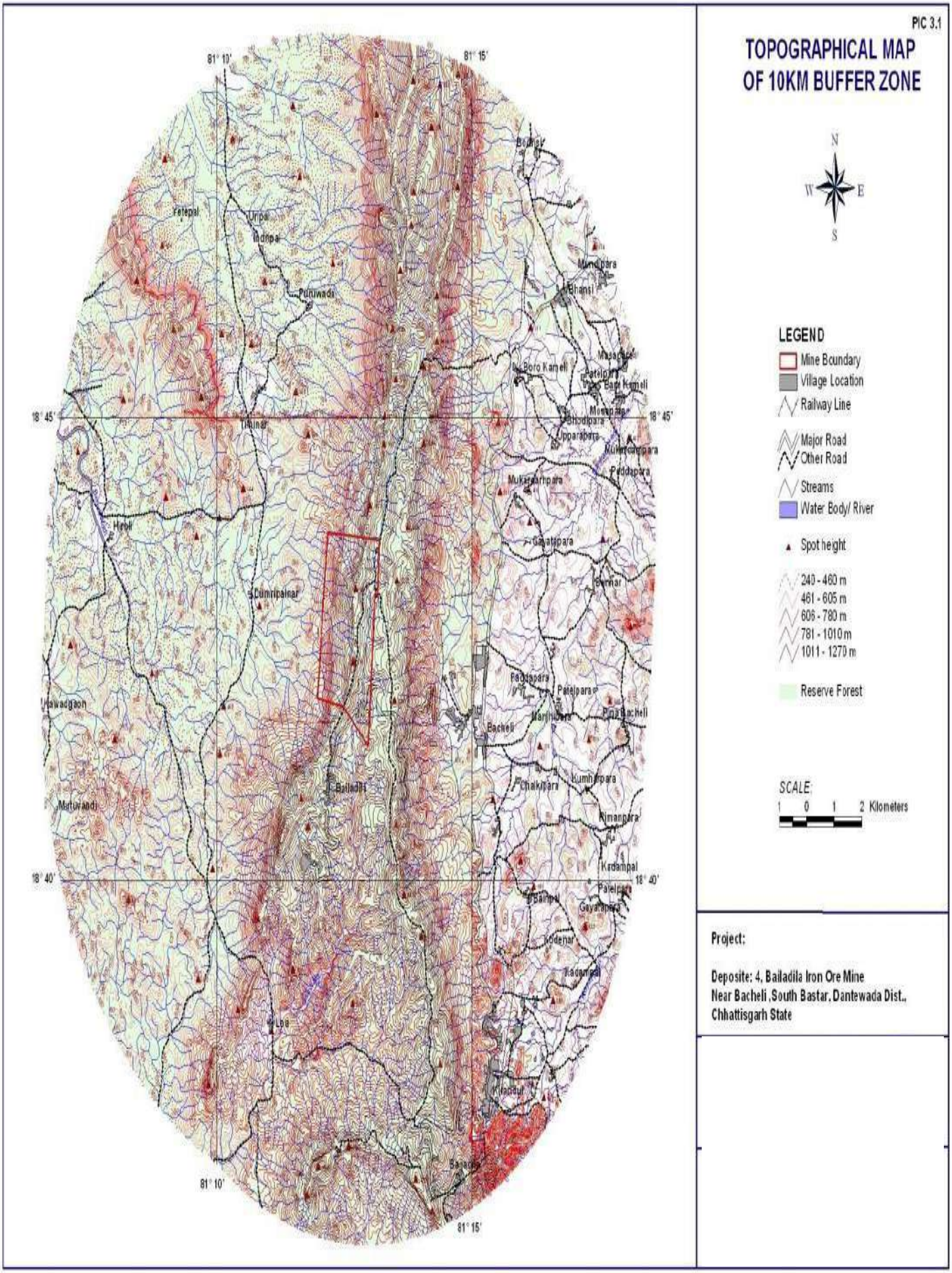


Satellite: IRS Resourcesat2 Sensor: Liss 4fmx Path/ Row: 102-059 C Date of Pass: 08 Jan 2012

MAP 3.2 TOPOGRAPHICAL MAP OF CORE ZONE



MAP 3.3 TOPOGRAPHICAL MAP OF 10KM BUFFER ZONE



3.2 TOPOGRAPHY OF BUFFER ZONE:

The 10km buffer zone from the core zone boundary i.e. mine lease area of Deposit 4 of Bailadila Iron Ore Mine is a mixed terrain. The Central Part (North to South- Vertically) of the Buffer zone is hilly terrain falling within the Bailadila Reserve Forest. The elevation contours ranges from 240m to 1270m from AMSL, whereas the Bailadila RF block of the buffer zone has the elevation contours from 660 to 1270 AMSL. About 80% of the buffer zone falls in Forest area namely Bailadila Reserve Forest and Bijapur Reserve Forest. BerudiNadi, KoyarNadi, Sankahi Nadi, Bacheli Nalla and Galli Nalla are the rivulets/ streams passing through the buffer zone and then fall in 1st to 5th order streams. The topography of the buffer zone is shown in below Topograph.

3.3 SOURCE OF INFORMATION:

Survey of India toposheets 65F/1, 65F/2, 65F/5 and 65F/6 has been used for the study of the topography.

3.4 LAND USE LAND COVER ANALYSIS:

The Digital Image Processing has been performed using ERDAS Imagine software tools and Garmin 30 eTrex GPS has been used for Ground truthing. The IRS P VI LISS III data has been geometrically corrected with respect to Survey of India toposheets. To carry out the geo-referencing, ground control points (GCPs) were identified on the maps and raw satellite data. The coefficients for two co-ordinate transformation equations were computed based on polynomial regression between GCPs on map and satellite data. Alternate GCPs were generated till the Root Mean Square (RMS) error was less than 0.5 pixel and then both the images were co-registered. Similarly, IRS Resourcesat-2 L4fmx data (of Core Zone) has been geo-referenced. The topography of the buffer zone has been studied using the Survey of India Toposheets considering the elevations and the drainage pattern including drainage orders.

3.5 LAND USE LAND COVER CLASSIFICATION:

This IRS PVI LISS III data has been used for the Land Use Land Cover Analysis of Buffer Zone and Core Zone. The satellite image is analyzed digitally by the method of Supervised classification with necessary Ground truthing using the reference map as well as GPS instrument. Then the hybrid method of Digital Interpretation and visual interpretation has been used to classify the Core Zone to achieve accuracy levels. The topography of the buffer zone has been studied using the Survey of India Toposheets considering the elevations and the drainage pattern including drainage orders

3.6 LAND USE / LAND COVER CLASSIFICATION FOR CORE ZONE:

The classified data of the Mine core zone is depicted in figure- 3.2. The extents of various Land Use/Land Cover classes pertaining to the study area are given in table.

So far there has been no excavation in this mine and the unexplored areas are categorized in to regular land use land cover classes. The Core Zone i.e., mine lease area of 646.6 Ha is falls within the Bailadila Reserve Forest. Hence the land use in the core zone remains within the Forest classes and it varies within the Dense Forest (0.4-0.7 canopy), Open Forest (0.1 – 0.4 canopy), Degraded Forest (0.01- 0.1 canopy) and Forest Blanks (0 -0.01 canopy). No major standing water bodyor human settlement is found within the core zone. During mining operation there will be loss of about 74.76% of dense and open forest which about 483.76Ha out of 646.80Ha.

Land Use Land Cover Class	Area In Ha	Area in %
Dense Forest (0.4 - 0.7)	222.10	34.34
Open Forest (0.1 - 0.4)	261.46	40.42
Degraded Forest (0.01 - 0.1)	81.57	12.61
Forest Blanks (Less than 0.01)	81.67	12.63
Total Area	**646.80**	**100.00**

3.7 LAND USE / LAND COVER DETAILS FOR BUFFER ZONE:

Digital image processing was carried out to delineate various land use / land cover categories in 10km buffer Zone viz. Forest with various density classes, build up area, crop areas, land with or without scrub, water bodies by assigning necessary training sets, which were identified based on tone, texture, size, shape pattern and location information. Necessary care has been taken to identify proper land use class, where there is conflict between signatures of various classes. The interpreted map was verified on ground at limited points and final land use / land cover map was prepared.

3.8 LAND USE /LAND COVER CLASSIFICATIONS FOR BUFFER ZONE

The Core zone and major part of the buffer zone are in the Bailadila Reserve Forest in the Bacheli Range of Dantewada Division. The buffer zone i.e., the area covered with 10km distance from the core zone boundary has been also studied. Approximately 80% of the buffer zone covered with in Reserve Forests. The division is located on the Eastern Ghats. The Moist deciduous forests in the foot hills are gradually replaced by deciduous forests and semi-evergreen forests with the increase in altitude. Distribution of forests is largely influenced by the altitudinal variation. Based on Champion & Seth, this area is classified in to four groups namely: South Indian Moist Deciduous Forest mainly comprising of teak, Moist Deciduous Forest without teak, Mixed Forest, and subtropical wet hill forests comprising of Bamboo also.

It is also worth mentioning here that in some parts of the Dantewadasal forest give way to rich teak forest. In the study site has Moist Deciduous Forest without teak, Mixed Forest, and subtropical wet hill forests.

Approximately 6% of land is cultivated land. Most of the cultivated land belongs to single crop lands (dry crops) or agriculture fallows. The area is characterized by metallic yellow and brown soil, ranging from loam to loamy sands with poor retentivity for moisture. Hence these require irrigation for Kharif in the absence of rains. The soils are generally poor in nitrogen, moderate in phosphorus, moderate to high in potash and rich forest humus. The major crop is paddy, followed by Jowar, Kodar, Kutki, Maize and soil seeds.

Due to lack of irrigation facilities above 11% of the total area (more than 50% of the non- forest area) covered with waste lands like Dense Scrubs, Land with or without scrubs and Barren. Iron Ore Mining activities are observed in about 1.5% of the buffer zone directly. Some more area is also being used for the mining activities like Dumps, Tailing Ponds, Railway sliding etc. Few stone quarries also seen in the buffer zone.

Land Use Land Cover Class	Area In Ha	Area in %
Dense Forest	6562.95	15.96
Open Forest	13057.70	31.75
Degraded Forest	8084.37	19.66
Forest Blanks	4142.81	10.07
Agriculture- Single Crop	2192.55	5.33
Agriculture- Fallow	641.14	1.56
Barron Land	587.36	1.43
Dense Scrubs	677.49	1.65
Land with or without scrub	3451.72	8.39
Mining	606.81	1.47
Mining Dumps	60.80	0.15
Railway Sliding	91.55	0.22
Stone Quarry	65.76	0.16
Tailing Pond/ Reservoir	239.27	0.58
Built up	484.52	1.18
Water Body	181.88	0.44
Total Area	**41128.67**	**100.00**

The land use land cover map of 10km Buffer Zone is shown in figure3.3 and 10km Buffer zone statistics shown in Table 3.1. The values are presented in pie chart 3.1. Data shows that in the buffer zone almost 77.44% is within forest area of which 29.73% is either degraded forest or forest blank. Therefore, study of possible impacts on forest habitats within buffer zone has been given more emphasis.

3.9 VARIOUS LAND USE CLASSES IDENTIFIED:

The buffer zone can be broadly identified into forest areas, built-up areas, agriculture areas and other land with or without Scrub. The definitions of various land use classes are given below. For forest classification, the classes following at AP Forest Department has been adopted.

a. Forest Cover:

All the areas declared as reserve forest areas are shown in this class. The forests can be classified based on density into following classes:

Closed Forest: Forests with tree canopy coverage above 70% (above 0.7)

Dense Forest: Forests with tree canopy coverage between 40%-70% (0.4 -0.7)

Open Forest: Forests with tree canopy coverage between 10%-40% (0.1 to 0.4)

Degraded Forest: Forests with tree canopy coverage between 5%- 10%. (0.01- 0.1)

Forest Blanks: Forests with tree canopy coverage less than 1%. Forest encroachments and illegal agriculture also will be shown in this class.

b. Agriculture Area

Double Crop Land: The areas where farmers practice cultivation for two seasons (Rabi and kharif) in a year.

Single Crop Land: The areas where farmers practice cultivation for single season in a year. Fallow: The areas not cultivated in current year/ years.

c. Plantations: The private areas with horticulture/ other plantations. Waste Lands

d. Dense Scrubs: The areas covered with Dense Scrubs and mixed jungle andwhich are out of forest boundaries.

e. Areas with/without Scrub: Generally waste lands- non agriculture, non-forest areas covered with or without scrubs.

f. Barren lands: Land without any usage and without scrubs and sometimes they are rocky exposed areas.

g. Built-up Area: The villages/colonies/Industries will be shown in this class.

h. Mining Areas The areas, where the mining activity is being carried out/ hasbeen done are shown in this class.

i. Industrial Area The industrial establishments will be shown in this class.

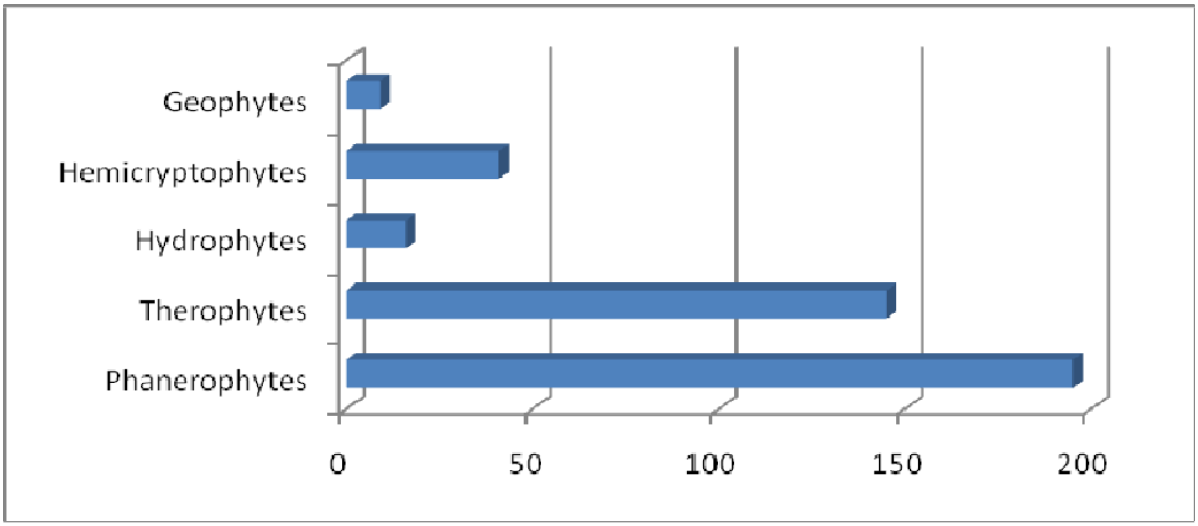
j. Water Bodies: The oceans, rivers, streams, lakes, tanks, reservoirs, canals etc it. will be identified in this class.

CHAPTER-IV

FLORA DIVERSITY STATUS IN CORE AND BUFFER AREA

4.1 FLORAL STUDY:

Life-form refers rather to the vegetative form of the plant body which is assumed by many ecologists to be a result of morphological adjustments to the environment. Those organisms which show the same general morphological features (woody lianas, stem succulents, annuals, tap-rooted perennials with a basal rosette of leaves and the renewal bud at the soil surface, tall broad-leaf deciduous trees, etc.) belong to the same life-form whatever their systematic position in the plant families. It is inherent in the so-called "biological" concept of life-form that there is a fundamental harmony or analogy between the members of such structural groups and the environment in which they prevail Presence of large percentage of phanerophytes (trees and shrubs) and therophytes (annuals and herbaceous vegetation indicates semiarid to tropical vegetation structure



(DIFFERENT LIFE FORM STATUS)

Groups	No.	Percentage
Phanerophytes	195	47.90
Therophytes	145	35.80
Hydrophytes	16	3.95
Hemicryptophytes	41	10.13
Geophytes	09	2.22
Total	**405**	**100.00**

4.2 FLORA WITH IN STUDY AREA:

A. PTERIDOPHYTES

SL. No.	PLANT NAME	FAMILY	ECOLOGY
1.	*Azolla pinnata*	*Azollaceae*	*Aquatic*
2.	*Adiantum philippense*	*Adiantacece*	*Swamp & aquatic*
3.	*Adiantum flabellulatum*	*Adiantacece*	*Terrestrial*
4.	*Dryopteris cochleate*	*Dryopteridaceae*	*Swamp & aquatic*
5.	*Equisetum palustre*	*Equisetaceae*	*Swamp & aquatic*
6.	*Ophioglossum nudicaule*	*Ophioglossaceae*	*Swamp & aquatic*
7.	*Ophioglossum costatum*	*Ophioglossaceae*	*Swamp & aquatic*
8.	*Pteris confuse*	*Pteridaceae*	*Terrestrial*
9.	*Pteris vittate*	*Pteridaceae*	*Terrestrial*
10.	*Lygodium*	*Lygodiaceae*	*Terrestrial*
11.	*Isoetes*	*Isoetaceae*	*Terrestrial*
12.	*Marsilea. Minutta*	*Marsileaceae*	*Terrestrial*
13.	*Selaginella miniatospora*	*Seleginaceae*	*Terrestrial*
14.	*Selaginella repanda*	*Seleginaceae*	*Terrestrial*
15.	*Cyathea spp.*	*Cyatheacea*	*Terrestrial*

B. ANGIOSPERMS TREE SPECIES

SL. No.	PLANT NAME	FAMILY	ECOLOGY
1.	*Acacia auriculiformis*	*Fabaceae*	*Xerophyte*
2	*Adina cordifolia*	*Rubiaceae*	*Mesophyte*
3	*Aegle marmelos*	*Rutaceae*	*Mesophyte*
4	*Albizzia procera*	*Fabaceae*	*Mesophyte*
5	*Bauhinia acuminate*	*Fabaceae*	*Mesophyte*
6	*Boswellia serreta*	*Burseraceae*	*Mesophyte*
7	*Buchanania lanzan*	*Anacardiaceae*	*Mesophyte*
8	*Butea monosperma*	*Fabaceae*	*Mesophyte*
9	*Cassia fistula*	*Fabaceae*	*Mesophyte*
10	*Cedrela toona*	*Meliaceae*	*Mesophyte*
11	*Cliestanthus collinus*	*Euphorbiaceae*	*Mesophyte*
12	*Dillenia pentagyna*	*Dilleniaceae*	*Mesophyte*
13	*Diospyros melanoxylon*	*Ebenaceae*	*Mesophyte*
14	*Emblica officinalis*	*Euphorbiaceae*	*Mesophyte*
15	*Ixora pavetta*	*Rubiaceae*	*Mesophyte*

C. ANGIOSPERMS SHRUB SPECIES

SL. No	PLANT NAME	FAMILY	ECOLOGY
1	*Asparagus racemosus*	*Liliaceae*	*Mesophyte*
2	*Bauhinia vahlii*	*Fabaceae*	*Mesophyte*
3	*Caesalpinia bonducella*	*Caesalpiniaceae*	*Mesophyte*
4	*Calotropis procera*	*Asclepiadaceae*	*Mesophyte*
5	*Capparis spinosa*	*Capparidaceae*	*Mesophyte*
6	*Casiareavaracca*	*Samydaceae*	*Mesophyte*
7	*Coccinia grandis*	*Apocynaceae*	*Mesophyte*
8	*Cryptolepis buchanani*	*Apocynaceae*	*Mesophyte*
9	*Dioscorea bulbifera*	*Dioscoreaceae*	*Mesophyte*
10	*Dioscorea alata*	*Dioscoreaceae*	*Mesophyte*
11	*Gardenia gummifera*	*Rubiaceae*	*Mesophyte*
12	*Gymnema sylvestre*	*Asclepiadaceae*	*Mesophyte*
13	*Hemidesmus indicus*	*Asclepiadaceae*	*Mesophyte*
14	*Icnocarpus frutescens*	*Apocynaceae*	*Mesophyte*
15	*Phoenix acualis*	*Arecaceae*	*Mesophyte*
16	*Randia uliginosa*	*Rubiaceae*	*Mesophyte*
17	*Rivea hypocrateriformis*	*Convolvulaceae*	*Mesophyte*
18	*Smilax macrophylla*	*Liliaceae*	*Mesophyte*
19	*Streblus asper*	*Moraceae*	*Mesophyte*
20	*Tephrosia purpurea*	*Papilionaceae*	*Mesophyte*
21	*Thespesia lampas*	*Malvaceae*	*Mesophyte*
22	*Trema orientales*	*Urticaceae*	*Mesophyte*
23	*Vangueria spinosa*	*Rubiaceae*	*Mesophyte*
24	*Vitex negundo*	*Verbenaceae*	*Mesophyte*
25	*Woodfordia floribunda*	*Lythraceae*	*Mesophyte*

D. ANGIOSPERMS HERBS SPECIES

SL.No	PLANT NAME	FAMILY	ECOLOGY
1	*Aerva lanata*	*Amaranthaceae*	*Mesophyte*
2	*Ageratum conyzoides*	*Asteraceae*	*Mesophyte*
3	*Alternanthera sessilis*	*Amaranthaceae*	*Mesophyte*
4	*Alysicarpus monilifer*	*Fabaceae*	*Mesophyte*
5	*Amaranthus spinosus*	*Amaranthaceae*	*Mesophyte*
6	*Aristida adscenscionis*	*Poaceae*	*Mesophyte*
7	*Asparagus racemosus*	*Asperagaceae*	*Mesophyte*
8	*Atylosia scarabaeoides*	*Papilionaceae*	*Mesophyte*
9	*Bonnaya brachiate*	*Scrophulariaceae*	*Mesophyte*
10	*Botrychium daucifolium*	*Ophioglossaceae*	*Mesophyte*
11	*Cassia occidentalis*	*Caesalpiniaceae*	*Mesophyte*
12	*Cassia tora*	*Fabaceae*	*Mesophyte*
13	*Celosia argentea*	*Amaranthaceae*	*Mesophyte*
14	*Curculigo orchioides*	*Amaryllidaceae*	*Mesophyte*
15	*Cynodon dactylon*	*Poaceae*	*Mesophyte*
16	*Cyperus rotundus*	*Cyperaceae*	*Mesophyte*
17	*Dactyloctenium aegypticum*	*Poaceae*	*Mesophyte*
18	*Desmodium triflorum*	*Papilionaceae*	*Mesophyte*
19	*Digitaria sanguinalis*	*Poaceae*	*Mesophyte*
20	*Eichhornia crassipes*	*Pontederiaceae*	*Mesophyte*
21	*Elephantopus scaber*	*Asteraceae*	*Mesophyte*
22	*Eragrostis tenella*	*Poaceae*	*Mesophyte*
23	*Eragrostis unioloides*	*Poaceae*	*Mesophyte*
24	*Euphorbia hirta*	*Euphorbiaceae*	*Mesophyte*
25	*Euphorbia microphylla*	*Euphorbiaceae*	*Mesophyte*
26	*Evolvulusalsenoides*	*Convolvulaceae*	*Mesophyte*
27	*Evolvulus nummularius*	*Convolvulaceae*	*Mesophyte*
28	*Fimbristylis japonicum*	*Cyperaceae*	*Mesophyte*
29	*Flemingia chapper*	*Fabaceae*	*Mesophyte*

30	*Gymnema sylvestre*	*Asclepiadaceae*	*Mesophyte*
31	*Habenaria diphylla*	*Orchidaceae*	*Mesophyte*
32	*Hemidesmus indicus*	*Asclepiadaceae*	*Mesophyte*
33	*Indigofera pulchella*	*Fabaceae*	*Mesophyte*
34	*Ionidium suffruticosum*	*Violaceae*	*Mesophyte*
35	*Leea spp.*	*Leeaceae*	*Mesophyte*
36	*Panicum repens L.*	*Poaceae*	*Mesophyte*
37	*Parthenium hysterophorus*	*Asteraceae*	*Mesophyte*
38	*Paspalidium flavidum*	*Poaceae*	*Mesophyte*
39	*Perotis indica (P. latifolia)*	*Poaceae*	*Mesophyte*
40	*Phagmatiskarka*	*Poaceae*	*Mesophyte*
41	*Phyllanthus amarus*	*Euphorbiaceae*	*Mesophyte*
42	*Phyllanthus niruri*	*Euphorbiaceae*	*Mesophyte*
43	*Rivea hypocretariformis*	*Convolvulaceae*	*Mesophyte*
44	*Rungia parviflora*	*Acanthaceae*	*Mesophyte*
45	*Scoparia dulcis*	*Scrophulariaceae*	*Mesophyte*
46	*Setaria glauca*	*Poaceae*	*Mesophyte*
47	*Sida cordifolia*	*Malvaceae*	*Mesophyte*
48	*Solanum zylanicum*	*Solanaceae*	*Mesophyte*
49	*Spermacocehispida*	*Rubiaceae*	*Mesophyte*
50	*Stephania harnandifolia*	*Menispermaceae*	*Mesophyte*
51	*Thysanolaena*	*maxima Poaceae*	*Mesophyte*
52	*Trichosanthes spp.*	*Cucurbitaceae*	*Mesophyte*
53	*Tridax procumbens*	*Asteraceae*	*Mesophyte*
54	*Triumfetta rhomboidei*	*Tiliaceae*	*Mesophyte*
55	*Urena lobata*	*Malvaceae*	*Mesophyte*
56	*Vernonia cinerea*	*Asteraceae*	*Mesophyte*
57	*Vetiveria zizanioides*	*Poaceae*	*Mesophyte*
58	*Viscum articulatum*	*Loranthaceae*	*Mesophyte*
59	*Zornia diphylla*	*Papilionaceae*	*Mesophyte*

E. ANGIOSPERMS EPIPHYTES

SL. No.	PLANT NAME	FAMILY	ECOLOGY
1	*Cuscuta roxburghii*	*Convolvulaceae*	*Mesophyte*
2	*Viscum articulatum*	*Viscaceae*	*Mesophyte*
3	*Vanda roxburghii*	*Loranthaceae*	*Mesophyte*

F. LIST OF RARE, ENDANGERD AND THREATENED PLANTS SPEICES IN STUDY AREA (Core and Buffer zone)

Sl. No.	Botanical Name/Local Name	Family
1	*Acacia concinna (Shikakai)*	Fabaceae
2	*Alocasia decipiens* Schott	Araceae
3	*Aristolochia indica* L./ Iswari, Iswarmool, Eswaramooli	Aristolochiaceae
4	*Blepharispermum subsessile* DC./ Rasna	Asteraceae
5	*Breynia retusa* (Dennst.) Alston	Phyllanthaceae
6	*Celastrus paniculatus* Willd./ Malkangni, Angul	Celastraceae
7	*Cledodendrum serretum (Bag Flower)*	Lamiaceae
8	*Cochlospermum religiosum* (L.) Alston/ Kumbi, Gabdi, Ganiar, Galgal, Galgala	Bixaceae
9	*Cosmostigma racemosum*	*Apocynaceae*
10	*Curculigo orchioides (Kali Musli)*	Hypoxidaceae
11	*Curcuma petiolata* Roxb./ Jangli Haldi	Zingiberaceae
12	*Cyathea alata (Tree Fern Sps.)*	*Cyayheaceae*
13	*Cyathea arborea (Tree fern Sps.)*	*Cyayheaceae*
14	*Dillenia aurea* Sm./ Kalle	Dilleniaceae
15	*Dillenia pentagyna* Roxb./ Karmal, KallaKarmeta	Dilleniaceae
16	*Dioscorea hispida* Dennst./ Baichadi, Karodi	Dioscoreaceae
17	*Dracaena terniflora* Roxb.	Asparagaceae
18	*Drimia indica* (Roxb.) Jessop/ Janglipiyaz, Kande, Koli-kanda,	Asparagaceae
19	*Drocera burmanii (Tropical sundew)*	*Droseraceae*
20	*Embelia basaal* (Roem. & Schult.) A. DC./ Babrang, Baibrang, Baya Birang	Primulaceae
21	*Equisetum (Horse Tail or Snake grass)*	*Equisetaceae*
22	*Gloriosa superba* L./ Languli, Kalihari	Colchicaceae

23	*Gymnema inodorum*	*Apocynaceae*
24	*Gymnema sylvestre* R.Br./ Gudmar, Gurmar	Apocynaeae
25	Gymnosporia bailadillana Narayan. & Mooney	Celastraceae
26	*Huberantha cerasoides*	*Annonaceae*
27	*Litsea glutinosa* (Lour.) Robinson/ Garbijaur, Maida, Maidalakri	Lauraceae
28	*Mucuna pruriens* (L.) DC./ Kavach, Kiwach	Leguminosae
29	*Peucedanum nagpurense* (C.B. Clarke) Prain	Apiaceae
30	*Plumbago zeylanica (Ceylon leadwort)*	*Plubaginaceae*
31	*Pterocarpus marsupium* Roxb./ Bijasal, Vijayasar	Leguminosae
32	*Pueraria tuberosa* (Willd.) DC./ Vidharikand, Vidari, Patal Kumbha	Leguminosae
33	*Solanum erianthum*	*Solanaceae*
34	*Strychnos potatorum (Cleaning Nut Tree)*	*Loganiaceae*
35	*Symplocos racemosa* Roxb./ Loadh, Loadhra	Symplocaceae
36	*Utricularia sps.(Bladderworts)*	*Lentibulariaceae*

Remarks: A list of Rare and threatened Plants in Chhattisgarh in Enclosed as Annexure.

4.3 FREQUENCY, DENSITY AND DOMINANCE / BASAL AREA

TABLE 4.1 FREQUENCY, DENSITY AND DOMINANCE / BASAL AREA

SL. No.	Name of species	Total no. of individuals (in all the quadrats laid)	Frequency (%)	Density (individuals /ha)	Basal area(cm2 /ha)	IVI (Index)
1	*Acacia auriculiformis*	6.00	33.33	2.00	197.02	5.24
2	Amla (*Emblica officinalis*)	3.00	33.33	1.00	60.31	4.31
3	Bel (*Aegle marmelos*)	17.00	50.00	5.67	732.56	10.51
4	Ber (*Ziziphus jujuba*)	1.00	16.67	0.33	41.78	2.09
5	Bhira (*Chloroxylon swietenia*)	2.00	16.67	0.67	32.70	2.26
6	*Cassia fistula*	1.00	16.67	0.33	6.11	2.00

7	*Cyathea arborea*	1.00	16.67	0.33	57.87	2.13
8	Dhawda (*Anogeissus latifolia*)	358.00	100.00	119.33	14662.77	117.42
9	Jamun (*Syzygium cumini*)	4.00	16.67	1.33	4294.36	13.23
10	Kadam (*Anthocephalus chinensis*)	1.00	16.67	0.33	438.02	3.07
11	Karala (*Clitoria ternatea*)	1.00	16.67	0.33	10.45	2.01
12	Tendu (*Diospyros melanoxylon*)	1.00	16.67	0.33	176.59	2.42
13	Kumbhi (*Careya arborea*)	3.00	16.67	1.00	57.78	2.52
14	Kusum (*Schleichera oleosa*)	1.00	16.67	0.33	47.27	2.10
15	Neem (Azadiracta indica)	2.00	16.67	0.67	6.88	2.20
16	Mahaneem (*Melia azedarach*)	5.00	16.67	1.67	225.78	3.33
17	Pipul (*Ficus religiosa*)	1.00	16.67	0.33	27.13	2.05
18	Piyar (*Buchanania lanzan*)	15.00	66.67	5.00	3314.87	18.31
19	Saja (*Terminalia tomentosa*)	15.00	50.00	5.00	5478.50	21.90
20	Shikakai (*Acacia concinna*)	1.00	16.67	0.33	8.68	2.00
21	Sihari (*Bauhinia vahlii*)	1.00	16.67	0.33	10.50	2.01
22	Sonarli (Cassia fistula)	2.00	16.67	0.67	1009.62	4.68
23	Swetinia (*Swietenia mahagoni*)	2.00	16.67	0.67	142.82	2.53
24	Tangan (*Leucaena leucocephala*)	10.00	33.33	3.33	2224.28	11.05
25	Others	14.00	66.67	4.67	1494.39	13.60
	Total	**468**	**716.72**	**155.98**	**34759.04**	**254.97**

TABLE 4.2 LOCATION OF SAMPLE PLOT IN CORE AREA

SL. No.	COMPARTMENT	LOCATION (GPS BEARING)	HABITAT DESCRIPTION
1.	1885	18º41'51.7" N 81º12'19.5" E Alt-1085 m	Forest with closed canopy, dominated species- *Anogeissus latifolia, Terminalia tomentosa, Syzygium cumini, Bougain villea* etc
2	1885	18º 41' 51. 2" N 81º 12'21.2" E Alt-1077m	Closed forest with dominated species like *Anogeissus latifolia, T. tomentosa, Syzygium cumini, Emblica officinalis*
3	1885	18º41'48.9" N 81º12'18.1" E Alt – 1079 m	Closed forest with about 80% canopy, dominated by species like *Anogeissus latifolia, Terminalia tomentosa, Syzygium cumini, Aegle marmelos* etc.
4	1885	18º 41' 53.1" N 81º 12' 20.5" E Alt – 1090 m	Open forest in the hill top on the side of a forest road *Terminalia tomentosa, Emblica officinalis* and lot of grasses were noticed, a deer trap was in this point.
5	1885	18º 41' 57.0" N 81º 12' 23.5" E Alt – 1086 m	Open forest with lot of climbers like *Bauhinia vahlii* and invasive species like *Lantana camara* and *Eupatorium odoratum*; *Anogeissus latifolia* is the major species of this site.
6	1885	18º41'53.0" N 81º12'20.1" E Alt – 1098 m	Open grass land with scattered trees, tree species like *Anogeissus latifolia, Terminalia tomentosa, Buchnania lanzan* etc. is noticed.
7	1834	18°41´48.8´´ N 81°12´36.2´´ E Altitude 952.5m	The land is besides a security camp with almost 60% canopy cover, tree species like *Anogeissus latifolia, Terminalia tomentosa, Syzygium cumini, Cleistanthus collinus, Eucalyptus sp* etc. were found.
8	1834	18º41.47.3' N 081º 12.39 'E Altitude 1062m	An almost open land with lot of *Lantana camara* and *Eupatorium* and tree species like *Madhuca indica* and *Diospyros melanoxylonis* observed.

4.4 FLORA FOUND IN SAMPLE SURVEY IN BUFFER ZONE:

Buffer zone comes within 10km radius of the mine-lease area deposit 04 and it is within Bailadila Reserve Forest and within Dantewada Taluk, Dantewada district of Chhattisgarh. Buffer zone is mostly covered with undulated hilly terrain within 180m-1200m altitude. More than one third of the Buffer zone is within Bailadila RF, Bijapur RF and Palnar PF. But within 10km radius there is no notified Wildlife Sanctuary and National Park. Talperu and Malenger Nadi are passing through the Buffer Zone. There are few nallahs and stream within the buffer area. Number of herb and shrub species is comparatively much less in the buffer zone than the core zone taking the area in to account. The season of study being winter number herbaceous species in general and grasses are ephemerals in these habitat conditions and therefore not possible to identify.

TABLE 4.3 RESULT OF SAMPLE SURVEY FOR FLORA IN BUFFER AREA

SL. No.	Name of species	Total no. of individuals (in all the quadrats laid)	Frequency (%)	Density (individuals /ha)	Basal area (cm2/ha)	IVI
1	*Acacia auriculiformis*	1	8.33	0.17	3.515	2.69
2	Amla (*Emblica officinalis*)	4	25.00	0.67	20.95667	8.38
3	Arjun (*Terminalia arjuna*)	1	8.33	0.17	1302.083	4.11
4	Saja (*Terminalia tomentosa*)	35	33.33	5.83	3249.317	23.72
5	*Bauhinia vahlii*	2	8.33	0.33	818.1417	3.89
6	Bel (*Aegle marmelos*)	45	8.33	7.50	800.9	16.94
7	Bhira (*Chloroxylon swietenia*)	28	8.33	4.67	213.97	11.13
8	Dhawda (*Anogeissus latifolia*)	104	25.00	17.33	1120.497	39.98
9	Jaggi dumur (Ficus racemosa)	5	8.33	0.83	9346.065	14.14
10	Jamun (*Syzygium cumini*)	11	33.33	1.83	1385.293	14.38

11	Kanchan (*Bauhinia purpurea*)	2	8.33	0.33	604.9667	3.65
12	Tendu *(Diospyros melanoxylon*)	4	16.67	0.67	21478	29.51
13	*Madhuca Latifolia*	1	8.33	0.17	6.25	2.69
14	Mango (*Mangifera indica*)	5	16.67	0.83	2453.703	8.97
15	Mahua (*Madhuca indica*)	14	25.00	2.33	26312.09	40.22
16	Piyar (*Buchanania lanzan*)	16	8.33	2.67	180.9467	7.44
17	Sonarli *(Cassia fistula)*	4	8.33	0.67	22.595	3.62
18	Tangan (*Ricinus communis*)	7	16.67	1.17	245.6417	7.16
19	Wild jujuba (*Ziziphus jujuba*)	6	8.33	1.00	15436.11	21.11
	Total	**295**	**283.3**	**49.17**	**85001.04**	**263.73**

TABLE 4.4 LOCATION OF SAMPLE PLOT IN BUFFER AREA

S. No.	Latitude, Longitude, Altitude	Compartment	DESCRIPTION of species
1	18° 41' 55.800" N 81° 12' 38.100" E Alt – 962m	1834	On the bank of Galli nalla, it is moist and with lot of humus. This humid habitat is dominated by Cyathea arborea (India tree fern) one of the rare species of this region.
2	18° 41' 56.800" N 81° 12' 38.500" E Alt – 976m	1834	Patch of Cyathea sp (Tree fern).
3	18° 41' 31.100" N 81° 11' 55.800" E Alt- 1025m	1884	Diospyros melanoxylon, Terminalia tomentosa and Emblica officinalis.
4	18° 41' 24.400" N 81° 12' 7.700" E Alt – 1080m	1884	Bamboo plantation has been done in the slope of a hill with lot of Phoenix acaulis.

5	18° 41' 30.400" N 81° 11' 51.800" E Alt – 960m	1884	Embelica officinalis, Syzygium cumini, Dillenia pentagyna etc.
6	18° 45' 28.800" N 81° 14' 42.300" E Alt – 522m	1825	Few trees of Ficus sp., Diospyros melanoxylon, Madhuca indica etc. and lot of Eupatorium odoratum in it.
7	18° 46' 5.700" N 81° 16' 40.600" E Alt – 491m	1754P	Lot of Lantana camara, Eupatorium odoratum, Cleistanthus collinus etc.
8	18° 45' 53.600" N 81° 16' 54.300" E Alt – 482m	1754P	It has few Salfi trees and almost no tree cover.
9	18° 45' 11.600" N 81° 16' 59.900" E Alt – 473m	900m Away from1753P	Degraded forestland with its slope towards north. Few Madhuca indica and Diospyros melanoxylon trees dispersed here and there.
10	18° 43' 51.800" N 81° 15' 50.300" E Alt – 557m	1837	It has lot of saplings of D. melanoxylon and invasives like Lantana camara and Eupatorium odoratum.
11	18° 41' 1.000" N 81° 15' 28.400" E Alt – 603m	1845	The land is totally degraded with saplings of Diospyros melanoxylon.
12	18° 40' 20.100" N 81° 15' 58.700" E Alt – 559m	1850	Tree cover has almost come down drastically.
13	18° 39' 29.700" N 81° 16' 5.600" E Alt – 609m	1852	Hardly about 20% canopy cover. Trees of species like Diospyros melanoxylon and Madhuca indica..
14	18° 39' 13.300" N 81° 16' 1.300" E Alt – 536m	1853	Eupatorium odoratum and Lantana camara gradually colonizing the area.
15	18° 45' 43.300" N 81° 15' 39.300" E Alt 1074 m	1825	Lot of wild mango trees (Mangifera indica), Madhuca latifolia

16	18° 42' 51.000" N 81° 12' 52.000" E Alt 960 m	1834	A closed forest is with species like Madhuca indica and Diospyros melanoxylon dominating the habitat.
17	18° 41' 50.000" N 81° 12' 26.000" E Alt - 1106 m	1834	Tree species like Mangifera indica, Madhuca latifolia dominate the area.
18	18° 41' 55.800" N 81° 12' 38.100" E Alt – 962m	1834	Bank of Galli nalla, This humid habitat is dominated by Cyathea arborea (India tree fern) one of the rare species of this region. Shade is provided by tree species like T. tomentosa and Syzygium cumini.
19	18° 41' 56.800" N 81° 12' 38.500" E Alt – 976m	1834	Patch of Cyathea sp (Tree fern)
20	18° 41' 31.100" N 81° 11' 55.800" E Alt- 1025m	1884	Open forest area with lot of Diospyros melanoxylon, Terminalia tomentosa and Emblica officinalis.
21	18° 41' 24.400" N 81° 12' 7.700" E Alt – 1080m	1884	Bamboo plantation area in an open forest land
22	18° 41' 30.400" N 81° 11' 51.800" E Alt – 960m	1884	Embelica officinalis, Syzygium cumini, Dillenia pentagyna etc.
23	18° 45' 28.800" N 81° 14' 42.300" E Alt – 522m	1825	Very few trees of Ficus sp., Diospyros melanoxylon, Madhuca indica etc. and lot of Eupatorium odoratum
24	18° 46' 5.700" N 81° 16' 40.600" E Alt – 491m	1754Ꝑ	Invasive species like Lantana camara, Eupatorium odoratum, Cleistanthus collinus etc.
25	18° 45' 53.600" N 81° 16' 54.300" E Alt – 482m	1754Ꝑ	It has few Salfi trees and almost no tree cover.

4.5 CANOPY STATUS TABLE IN STUDY AREA:

SL. No.	Indices	Core Zone	Buffer Zone
1.	**Canopy Cover (%)**	**0%-10% (40% only in one site)**	**10%-40% and 40%-90%**
2	**Diversity Index**		
	Tree Level	1.38	2.38
	Shrub level	1.79	2.13
	Herb level	1.53	1.89
3.	**Dominance Index**		
	Tree level	0.47	0.29
	Shrub level	0.54	0.29
	Herb level	0.47	0.31

Dominance index in the tree level of the buffer zone is only 0.31 which is much lower to 0.47 in comparison to core zone.

X Axis denotes Fauna levels and Y Axis denotes Canopy cover (%)

(Reference table above)

The diversity index of vegetation (Table-4.3) in the tree level (2.18) is much more in the buffer zone in comparison to core zone (1.38). Anthropogenic activity within forest area seems to be low in the tree layer as observed from the count of cut off stumps. Canopy cover in most places of the forest area in this zone is within 40-70%, which is known to be dense forest as per the FSI classification. This signifies that the tree layer in the buffer zone is shared by many species rather than a few ones which is a tendency towards mixed forest type rather than dominance of few tree species. It is also observed that within the buffer zone there are few important species like *Adina cordifolia, Bauhinia acuminata, Shorea robusta* which are considered to be prominent forest species of central India. The availability of some of these species is not very frequent in the core zone. Species like *Caryota urens, Terminalia tomentosa, Syzigiumcumini, Ficus carica, Terminalia arjuna, Diospyros melanoxylon and Mangifera indica* are the tree canopy layer in the non-forest area of the buffer zone. Diversity in the tree level in the non forest areas is further enhanced by the availability of non-forest species like *Mangifera indica, Madhuca indica etc. Shrub species like Lantana camara and Eupatorium odoratum* are also available in this region, which is considered to be the invasive species in Indian forests as well as non-forest areas. These invasive species are also very frequently available in the core area. Availability of these species in the buffer zone signifies that there is considerable anthropogenic intervention in the ecosystem which has resulted in alteration of species composition of the core as well as buffer zone.

Extraction of forest resources form the buffer zone might be less due to its remoteness but long-term impact of human habitation and plantation of domesticated species and exotic species like Tectona grandis (teak) and Eucalyptus sp certainly have a negative impact on the ecosystem. This is why initiative on the part of NMDC CMDC Ltd. (NCL) in developing positive attitude towards conserving the forest resources in the buffer zone is suggested. Habitat development, therefore, cannot confine within the efforts of plantation, water body creation or soil conservation only. It also will include developing participatory conservation approach taking the villagers of the buffer as well as fringe area in to confidence. There is a clear negative relationship between the diversity and dominance indices in both core and buffer zone. In the buffer zone this relationship is more evident because of its pristine nature.

4.6 LIFE FORM SUTDY:

Definition and characteristic properties of life form study has already been defined in the starting of the chapter as “Life Form Status”. On the basis of morphological symptoms, the phyto diversity has been identified and taxonomic nomenclature is also opted as per international code of conduct. The forest type, occurrence of particular associates of the forest types and ecological expectations has also been submitted in assessment of phyto diversity.

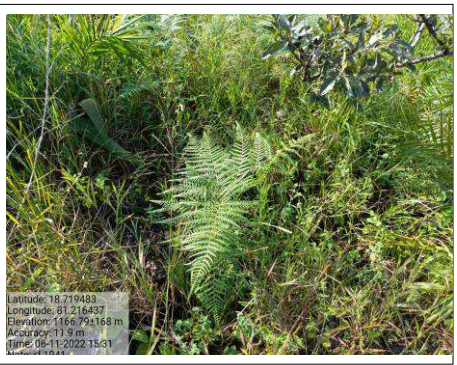
4.6.1 TAXONOMIC IDENTIFICATION OF PHYTODIVERSITY:

Plant species were identified following standard flora by Hooker (1872-1897), Verma et al. (1985) and Kumar et al., (2005). Names of the plant species were verified using Bennet (1987). The help of scientists of Botanical survey of India (BSI), Kolkata was taken. The local Forest Department has prepared their working plan and identified vegetation in various levels like ecological factors, occurrence of vegetation and associates of the forest types, economically important plants, medicinal and aromatic plants, high value vulnerable, threatened, rare, extinct and endangered plants for their planning and management of conservation, protection and regeneration. Result of this survey is a compiled working plan, which can define all minute results and status of life forms found in the particular area.

Photographs of Floral species found in study area

Selaginella repanda

Cyathea alata



Cyathea arborea

Acacia auriculiformis

Adina cordifolia

Aegle marmelos

Albizia procera

Bauhinia acuminata

Boswellia serrata

Azola pinnata

Adiantum phillippense

Equisetum palustre

Lygodium

Ophioglossum nudicaule

Ophioglossum costatum

Dryopteris willichiana

Pteris vittata

Pteris confusa

Isoetes, bilaspurensis

Marsilea minutta

Selaginella miniatospora

Cedrela toona

Cliestanthus collinus

Dillenia pentagyna

Diospyros melanoxylon

Emblica officinales

Ixora coccinea

Asparagus racemosus

Bauhinia vahlii

Caesalpinia bonducella

Calotropis procera

Capparis spinosa

Casia reavaracca

Coccinia grandis

Cryptolepis buchanani

Dioscorea bulbifera

Flacourtia ramontchi

Gardenia gummifera

Gymnema sylvestre

Hemidesmus indicus

Icnocarpus frutescens

Jatropha gossypifolia

Phoenix acaulis

Randia uliginosa

Ricinus communis

Rivea hypocrateriformis

Smilax macrophylla

Streblus asper

Tephrosia purpurea

Thespesia lampas

Trema orientales

Vangueria spinosa

Vitex negundo

Woodfordia floribunda

Aerva lanata

Ageratum conyzoides

Alternanthera sessilis

Alysicarpus monilifer

Amaranthus spinosus

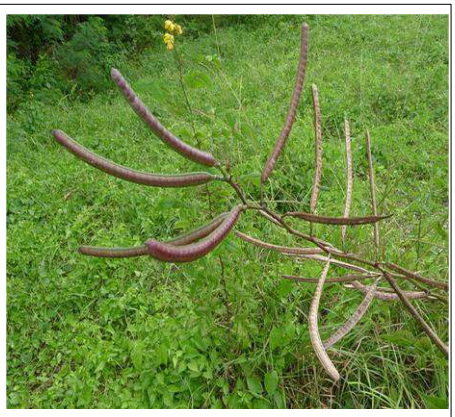
Aristida adscenscionis

Asparagus racemosus

Atylosia scarabaeoides

Bonnaya brachiata

Botrychium daucifolium (fern)



Cassia occidentalis

Cassia tora

Celosia argentea

Curculigo orchioides

Cynodon dactylon

Cyperus rotundus

Dactyloctenium aegyptium

Desmodium triflorum

Digitaria sanguinalis

Dioscorea alata

Eichhornia crassipes

Elephantopus scaber

Eragrostis tenella

Eragrostis unioloides

Euphorbia hirta

Euphorbia microphylla

Evolvulus alsinoides

Evolvulus nummularius

Fimbristylis japonicum

Flemingia chapper

Habenaria diphylla

Indigofera pulchella

Ionidium suffruticosum

Panicum repens L.

Parthenium hysterophorus

Paspalidium flavidum

Perotis indica

Phragmaties karka

Phyllanthus amarus

Phyllanthus niruri

Rivea hypocrateriformis

Rungia parviflora

Scoparia dulcis

Setaria glauca

Sida cordifolia

Solanum zylanicum

Spermacoce hispida

Stephania harnandifolia

Thysanolaena

Tridax procumbens

Triumfetta rhomboidea

Urena lobata

Vernonia cinerea

Vetiveria zizanoides

Viscum articulatum

Zornia diphylla

Gymnema sylvestre

Cuscutarox burghii

Viscum articulatum

Vanda roxburghii

Buchanania lanzan

Butea monosperma

Cassia fistula

4.6.2 ASSESMENT RESULT OF PHYTODIVERSITY:

Status of Phyto diversity NMDC-CMDC Ltd. (NCL) Bailadila Reserve Forest can be a good habitat for both plant and wildlife diversity. The Dantewada district of Chhattisgarh lies on the Gondwana Biodiversity Zone, which mostly comprises of the Tropical Forests. As this area is full of terrains, much of the forest remains unexplored and it is highly probable that this area contains some of the undocumented species. The forest area in the buffer zone comes under Reserve Forest and has following classes as per classification of Forest Survey of India.

(i) Closed Forest/Very Dense Forest—Where canopy cover is above 70%

(ii) Dense Forest—Where canopy cover is between 40%-70%

(iii) Open Forest—Where canopy cover is between 10%-40%

(iv) Degraded Forest—Where canopy cover is below 10% The vegetation occurring in the area belongs to Southern tropical dry deciduous forests (Class-5A) which intermingles with Class-5B (Northern tropical dry deciduous type) according to Champion and Seth Classification of forest types of India 1968. According to the classification of Legris and Pascal (1982) the area falls under Deciduous climax forests and this type of forests does not have the potentiality of secondary moist deciduous forests. The most characteristic tree of this type is ***Anogeissus latifolia*** while ***Terminalia tomentosa*** is a very typical associate. ***Diospyros melanoxylon*** is also common. ***Boswellia serrata*** and ***Lagersatroemia parviflora*** are very wide spread and conspicuous in this category of forests. Bamboo is generally of poor quality. Grass is conspicuous till it is grazed or burnt in forest fire. Woody climbers are few like ***Bauhinia vahlii***. This type of forest, being especially prevalent in the drier localities occurs throughout the study area. But the rain fall being around 3000mm annually it can hardly be classified under dry forest type. Therefore, some patches can be classified under Tropical Moist Deciduous Forest with types as 3B/C1 and 3B/C2. In this type of forests, trees are comparatively tall. It has a leafless period during dry season which may or may not begin with the cold weather.

The boundaries of biogeographic provinces i.e., Eastern Plateau (6B2) and Eastern Highlands (6C2) are not very sharp and they inter-grade into each other. Interestingly the recent physiographic map adopted by the Forest Survey of India also classifies this region into three zones viz., North Deccan, East Deccan, and South Deccan by apparently giving more weightage to the political boundary between Maharashtra and Chhattisgarh. The entire area forms the South-Western and Westernmost part of historical Dandakaranya region. This region extends up to North-Eastern Ghats. The top canopy remains leafless between February-May. The under storey is well defined and the forest floor is full of vegetal growth. Portions of moist deciduous forests were clear felled and converted into plantations of different species such as Teak ***(Tectona grandis),*** Eucalyptus sps, etc. But none of these species being indigenous to this

region and planted without any ecological impact study could not successfully establish themselves. In some of the plantation area invasive species like ***Lanatana camara and/or Eupatorium odoratum*** has invaded. The adjacent areas to drainage nallas show rich vegetation whereas the hill top shows barren condition with clear signs of laterization. In the hill top soil formation process is poor and simultaneously there is rapid washing out of top soil. In the hilly areas of Bailadila, availability of iron ore and vegetation change with altitude. According to Mooney (1942a), vegetation at the study area is divided into three zones and has been sub-divided to different associations depending upon various sites in the hill range as,

(i) The outer slope of the Hill Range up to an altitude above 914m above sea level—Northern portion of the hill "vegetation is of Hill type with dense bamboo" with evergreen species like Sataparni (*Alstonia scholaris*), Garari (*Cleistanthus collinus*), and *Bauhinia vahlli*. In the southern half of the hill species like Haldu (*Adina cordifolia*), and Mahua (*Madhuca indica*) are available in low quantity. Bijasal (*Pterocarpus marsupium*) with good girth size is found in this side.

(ii) The crest of the Hill Range and the adjoining slope—this comes within 914m to 1224m above MSL. This region has high rock content and laterite with low soil content. Trees are stunted, sparse and dense grass (*Physalanona sp*) noticed. Tree species are Saja (*Terminalia alata*), Tendu (Diospyros melanoxylon), Awnla (*Emblica officinalis*), Achar bui, Harra (*Terminalia chebula*), and Sal (*Shorea robusta*), etc. Mooney (1942b) has described this grass dominated region as sub-climax or pro-climax type as a result of shifting cultivation that was in practice even few years back while non been found Shorea robusta in deposit 04 core area.

(iii) The Central valley—the central valley does not come under the study site but is in the buffer area—has species like Saja (*Terminalia alata*), Bijasal (*Pterocarpus marsupium*), Kusum (*Schleichera oleosa*), Semal (*Bombax ceiba*), Kala-Siris (*Albizzia lebbbek*), and Kadamba (*Anthocephalus cadamba*), etc. Bamboo is conspicuously low in this region. Here are few types of forests dominated by species as stated below provided undisturbed: Saja Forest, Dhaora (*Anogeisus latifolia*) forest, Garari (*Cleistanthus collinus*) forest, Bhirra (*Chloroxylon swietenia*) forest, Khair (*Acacia catechu*) forest, Jamun (*Syzygium cumini*) forest, Anjan (*Hardwickia binata*) forest, and Mixed Forest with miscellaneous species.

4.7 FLORAL ASSOCIATION OF THE STUDY AREA:

Below listed flora species are associates and sub-associates of Sal Forest. Shorea robusta (Sal Tree) has disappeared from the studied core area of the ML area, and major tree species have been denoted and described here as remaining member associates of Sal associated forest type.

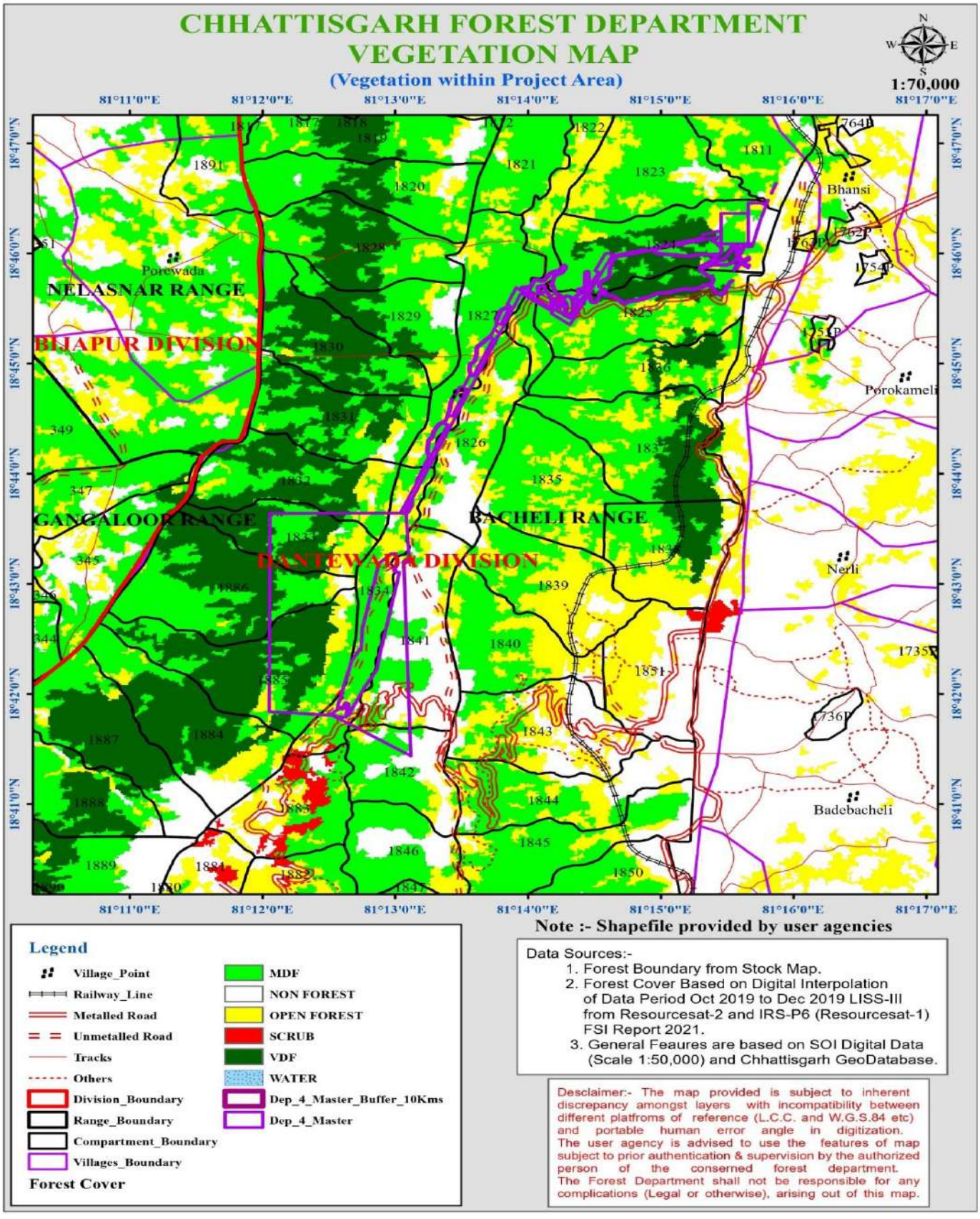
- **Acacia catechu (Khair)** The coarse gravelly soil supports the xerophytic growth of Khair. The forests are generally open. Quality of the crop and natural reproduction is generally poor.
- ***Anogeissus latifolia (Dhaora)*** The most common constituent of the mixed deciduous forests, often growing gregariously. Avoids swampy and badly drained grounds and requires good drainage. It produces abundant natural regeneration but most of it gets severely damaged and killed in areas with low density due to severe annual forest fires.
- ***Chloroxylon swietenia (Bhirra)*** Commonly found in areas where the soil is shallow, arid, and sandy.
- ***Cleistanthus collinus (Garai)*** Patches of practically pure Garai forest are sometimes seen in the mixed forests in which there are very few associates in the over wood. The reasons for its occurrence in a gregarious form are not quite understood. This sub-type forms an important future reserve for poles and fuel. Density is generally full.
- ***Syzygium cumini (Jumun)*** Commonly found in the open forests of the area and some of the outer forest of deposit area in bailadila range. It exhibits xerophytic characters and is narrow leaved. Its seedlings die back annually for some years in their early stages.
- ***Terminalia alata (Saja)*** It alone thrives in such places where the soil is moist but somewhat heavy owing to the presence of fine clay, where the drainage is hampered and the species are that are susceptible to bad soil aeration disappear.
- ***Hardwickia binata (Anjan)*** It is scattered in the southern portion of. This has probabl deposit area spread from the adjoining area of buffer and core zone where it is commonly seen. The areas under this sub-type are not much of any economic importance.

4.8 ECOLOGICAL STATUS:

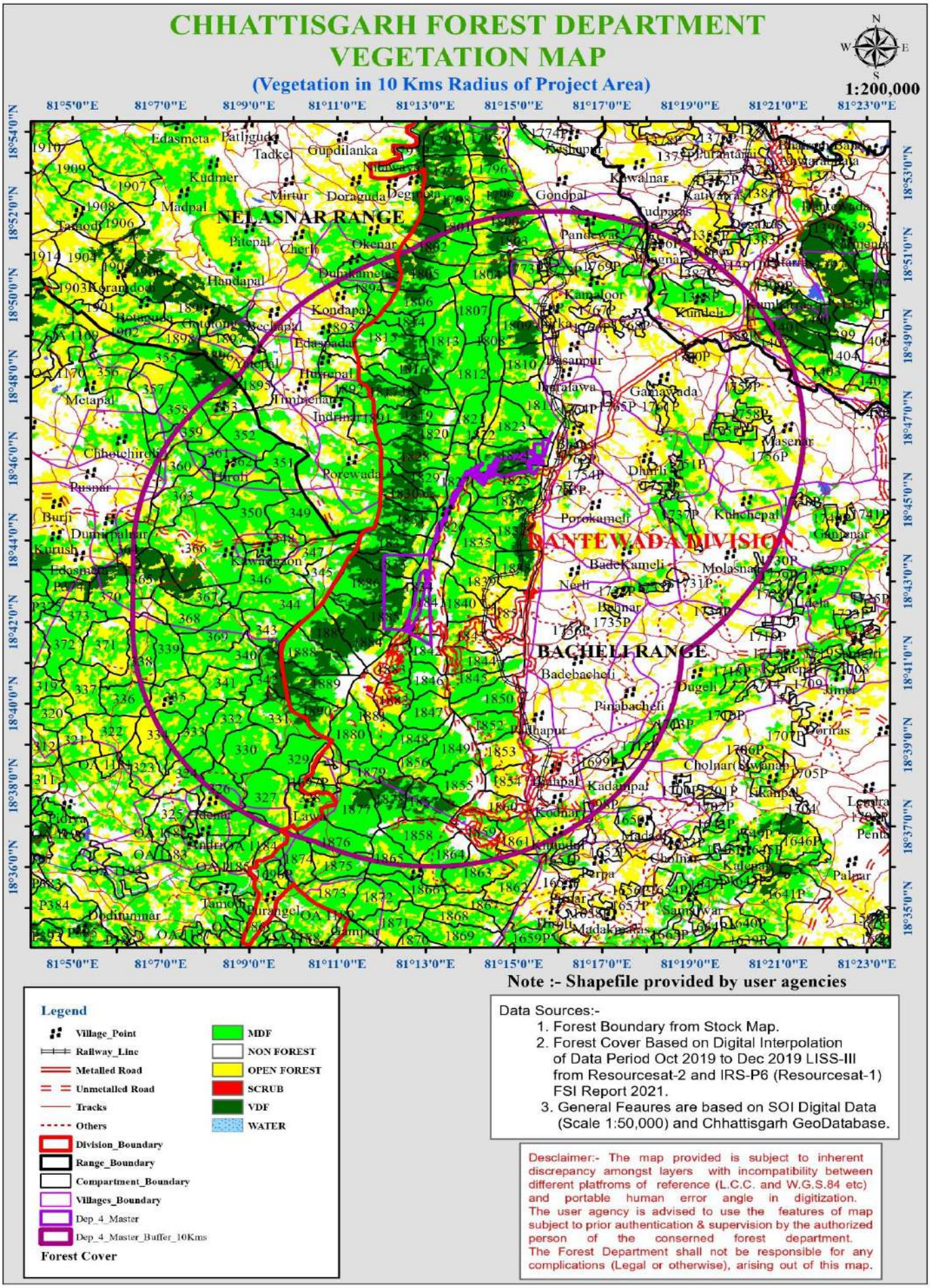
Life-form refers rather to the vegetative form of the plant body which is assumed by many ecologists to be a result of morphological adjustments to the environment. Those organisms which show the same general morphological features (woody lianas, stem succulents, annuals, tap-rooted perennials with a basal rosette of leaves and the renewal bud at the soil surface, tall broad-leaf deciduous trees, etc.) belong to the same life-form whatever their systematic position in the plant families. It is inherent in the so-called ‘‘biological” concept of life-form that there is a fundamental harmony or analogy between the members of such structural groups and the

environment in which they prevail. Presence of large percentage of phanerophytes (trees and shrubs) and therophytes (annuals and herbaceous vegetation) indicates semiarid to tropical vegetation structure. The life form status of the study area is given in diagram;

MAP 4.1 VEGETATION WITHIN PROJECT AREA



MAP 4.2 VEGETATION IN 10 KMS RADIUS OF PROJECT AREA



CHAPTER V

THE TREE FERNS AND IT'S CONSERVATION

5.1 AVAILABILITY IN THE STUDY AREA:

After extensive survey during the study in the buffer area of proposed mine at Deposit-4, it has been noticed that now this species (Cyathea) is confined to only on the bank of the stream *Galli nalla*. This habitat though not exclusive one extends for about 3.5km along *Galli nalla* in both of its sides starting from Deposit-4 to Rajabangla. Galli *nalla* being close to the present mining site (Deposit-5) also receives silt from the ores and waste dumps. Probably due to habitat destruction *Cyathea sp.* is not available in other similar habitat conditions within thestudy area.

The *in-situ availability* of *Cyathea arborea* species is confined to the following locations-

1	18º41'55.8" N 81º12'38.1" E	On the bank of *Galli nalla*, it is moist and with lot of humus. This humid habitat is dominated by *Cyathea arborea* (India tree fern) one of the rare species of this region. Shade is provided by tree species like *T. tomentosa* and *Syzyzium cumini.*
2	18º 41' 56.8" N 81º 12' 38.5" E	showing complete patch of *Cyathea arborea* (Tree fern) .

In view of habitat destruction / over exploitation and its threatened state, it is paramount importance to conserve this taxon. Conservation sites are being proposed for rehabilitation of the species *Cyathea arborea* where suitable habitat conditions for the speciespersist. All these sites have perennial streams providing hot and humid environment persisting throughout the year. The sites also have rich humus compost which retains water but does not become water logged. The sites proposed for conservation of the species are alsoat present least disturbed by humans. As buffer zone (within 10 km radius) of both the mining complexes overlap with each other, the sites mentioned below becomes common conservation sites for *Cyathea* sp.

5.1.1 LOCATION OF SPECIAL TREE FERN AREA: It has been observed that there is tree fern area of 76.496 Ha within Mining Lease area which are not to be diverted for mining purpose and special conservation measures are to be taken.

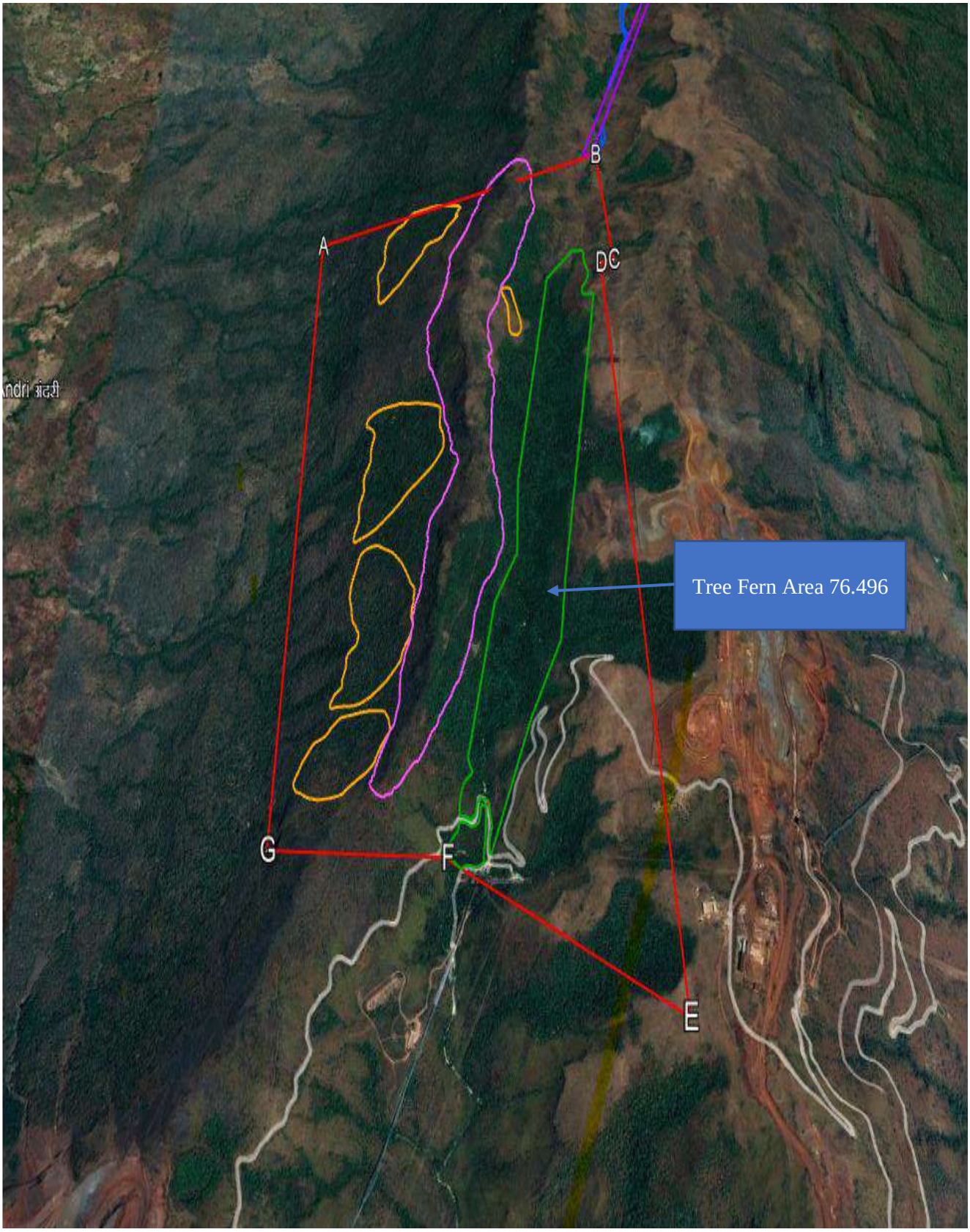
The Location is given table below showing Latitude and Longitude of the special Tree fern area

TREE FERN AREA:76.496 HA

Point id	Longitude	Latitude
Portion A		
A 1	81^0 12’ 37.71 “E	18^0 41’ 48.08“N
A 2	81^0 12’ 37.92“E	18^0 41’ 47.78“N
A 3	81^0 12’ 36.71“E	18^0 41’ 47.27“N
A 4	81^0 12’ 35.34“E	18^0 41’ 47.52“N
A 5	81^0 12’ 34.56“E	18^0 41’ 47.42“N
A 6	81^0 12’ 34.15“E	18^0 41’ 47.10“N
A 7	81^0 12’ 32.79“E	18^0 41’ 47.95“N
A 8	81^0 12’ 31.98“E	18^0 41’ 48.46“N
A 9	81^0 12’ 30.79“E	18^0 41’ 48.55“N
A 10	81^0 12’ 31.15“E	18^0 41’ 48.75“N
A 11	81^0 12’ 31.20“E	18^0 41’ 49.36“N
A 12	81^0 12’ 31.64“E	18^0 41’ 49.43“N
A 13	81^0 12’ 31.91“E	18^0 41’ 49.50“N
A 14	81^0 12’ 33.35“E	18^0 41’ 51.08“N
A 15	81^0 12’ 33.58“E	18^0 41’ 51.14“N
A 16	81^0 12’ 33.71“E	18^0 41’ 51.58“N
A 17	81^0 12’ 33.81“E	18^0 41’ 52.07“N
A 18	81^0 12’ 33.81“E	18^0 41’ 52.11“N
A 19	81^0 12’ 33.87“E	18^0 41’ 52.13“N
A 20	81^0 12’ 34.34“E	18^0 41’ 52.24“N
A 21	81^0 12’ 34.86“E	18^0 41’ 52.24“N
A 22	81^0 12’ 35.85“E	18^0 41’ 51.80“N
A 23	81^0 12’ 36.97“E	18^0 41’ 52.30“N
A 24	81^0 12’ 37.27“E	18^0 41’ 53.18“N
A 25	81^0 12’ 37.38“E	18^0 41’ 54.02“N
A 26	81^0 12’ 37.43“E	18^0 41’ 54.41“N
A 27	81^0 12’ 38.23“E	18^0 41’ 54.37“N
A 28	81^0 12’ 38.16“E	18^0 41’ 52.04“N
Portion B		
B 1	81^0 12’ 37.21“E	18^0 41’ 55.22“N
B 2	81^0 12’ 36.76“E	18^0 41’ 54.37“N
B 3	81^0 12’ 36.49“E	18^0 41’ 53.16“N
B 4	81^0 12’ 36.01“E	18^0 41’ 52.73“N
B 5	81^0 12’ 35.65“E	18^0 41’ 52.58“N
B 6	81^0 12’ 35.01“E	18^0 41’ 52.85“N
B 7	81^0 12’ 34.35“E	18^0 41’ 52.82“N

B 8	81^0 12’ 33.89“E	18^0 41’ 52.81“N
B 9	81^0 12’ 33.91“E	18^0 41’ 53.23“N
B 10	81^0 12’ 33.94“E	18^0 41’ 53.90“N
B 11	81^0 12’ 34.07“E	18^0 41’ 54.78“N
B 12	81^0 12’ 34.34“E	18^0 41’ 55.55“N
B 13	81^0 12’ 34.50“E	18^0 41’ 55.99“N
B 14	81^0 12’ 34.74“E	18^0 41’ 56.43“N
B 15	81^0 12’ 35.13“E	18^0 41’ 56.94“N
B 16	81^0 12’ 35.47“E	18^0 41’ 57.25“N
B 17	81^0 12’ 35.83“E	18^0 41’ 57.57“N
B 18	81^0 12’ 36.09“E	18^0 41’ 57.80“N
B 19	81^0 12’ 35.34“E	18^0 41’ 59.36“N
B 20	81^0 12’ 40.34“E	18^0 41’ 18.22“N
B 21	81^0 12’ 44.53“E	18^0 41’ 25.48“N
B 22	81^0 12’ 45.15“E	18^0 41’ 36.23“N
B 23	81^0 12’ 52.50“E	18^0 41’ 11.05“N
B 24	81^0 12’ 58.94“E	18^0 41’ 16.25“N
B 25	81^0 12’ 00.26“E	18^0 41’ 16.36“N
B 26	81^0 12’ 00.33“E	18^0 41’ 15.71“N
B 27	81^0 12’ 00.35“E	18^0 41’ 14.83“N
B 28	81^0 12’ 00.36“E	18^0 41’ 13.94“N
B 29	81^0 12’ 00.76“E	18^0 41’ 12.54“N
B 30	81^0 12’ 0094“E	18^0 41’ 11.84“N
B 31	81^0 12’ 00.96“E	18^0 41’ 11.01“N
B 32	81^0 12’ 00.82“E	18^0 41’ 10.25“N
B 33	81^0 12’ 00.56“E	18^0 41’ 09.60“N
B 34	81^0 12’ 00.09“E	18^0 41’ 08.79“N
B 35	81^0 12’ 59.56“E	18^0 41’ 08.31“N
B 36	81^0 12’ 59.33“E	18^0 41’ 07.60“N
B 37	81^0 12’ 59.43“E	18^0 41’ 06.92“N
B 38	81^0 12’ 59.84“E	18^0 41’ 06.45“N
B 39	81^0 12’ 00.84“E	18^0 41’ 06.45“N
B 40	81^0 12’ 01.37“E	18^0 41’ 06.37“N
B 41	81^0 12’ 01.68“E	18^0 41’ 06.27“N
B 42	81^0 12’ 56.92“E	18^0 41’ 41.66“N
B 43	81^0 12’ 52.85“E	18^0 41’ 20.56“N
B 44	81^0 12’ 51.67“E	18^0 41’ 13.08“N
B 45	81^0 12’ 46.02“E	18^0 41’ 03.85“N
B 46	81^0 12’ 38.96“E	18^0 41’ 48.55“N
B 47	81^0 12’ 38.72“E	18^0 41’ 48.55“N
B 48	81^0 12’ 38.68“E	18^0 41’ 48.60“N
B 49	81^0 12’ 38.65“E	18^0 41’ 49.62“N
B 50	81^0 12’ 38.84“E	18^0 41’ 50.65“N
B 51	81^0 12’ 39.18“E	18^0 41’ 51.87“N
B 52	81^0 12’ 39.00“E	18^0 41’ 52.71“N
B 53	81^0 12’ 38.84“E	18^0 41’ 53.58“N
B 54	81^0 12’ 38.71“E	18^0 41’ 54.70“N
B 55	81^0 12’ 38.57“E	18^0 41’ 54.86“N

MAP 5.1 GOOGLE IMAGINARY OF TREE FERN AREA

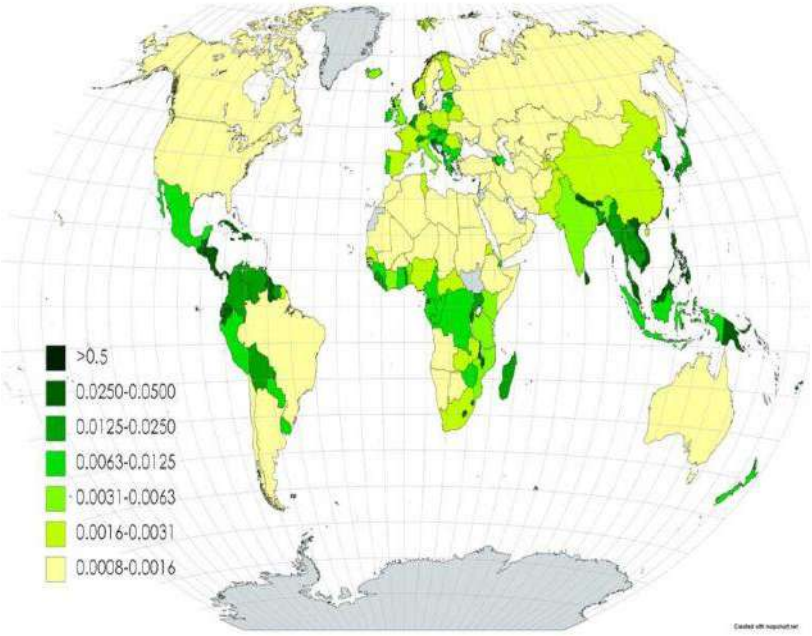


Source KML File

Remarks: Forest department should identify more Tree fern areas along Galli nalla and take appropriate measure to conserve Tree fern.

5.2 PTERIDOPHYTES:

Pteridophyta (pteron = feather, phyton = plants) are the most primitive vascular plants and are also known as ‘vascular cryptogams. The earliest references on Indian Pteridophytes are in Sanskrit classics related to Ayurveda. In Charak and Shushrut Samhitas Mayur Sikha (Actiniopteris) , Hansraj and Hanspadi (Adiantum spp.) were mentioned with medicinal properties. In Buddhist literature it is believed that the species of Moonworts (Botrychium spp.) has certain magical values and the plants of Botrychium are kept near the statue of Buddha to keep the devil powers away. About 9% world Pteridophytes occurs in India or only in 2.5% landmass of the world. In India Pteridophytes are distributed in all the phytogeographical zones of India ranging from sea level to alpine Himalayas where they grow as Hydrophytes, Mesophytes, Lithophyte, Epiphyte, Hemiepiphyte, Climbers etc.



They can be found in all ground habitats such as Ravine, Forest floor, on slopes, Grassland, on Rocks and crevices, on open walls and stone boulders and at certain places they form gregarious Thickets. As epiphytes different species of Pteridophytes also distributed on different part of tree as on base of tree, bole, branches, forking etc.

After Ayurvedic literature systematic documentation of the Indian Pteridophytes started after European voyages and settlement of Portuguese, Dutch, Danish, Spanish and French colonies and Missionary establishment in the Malabar Coast. In Hortus Indicus Malabaricus (1678-1693) Hendrik van Rheede documented and illustrated 20 Pteridophytes from Malabar Coast. The other pre-Linnean botanists who collected or documented Indian Pteridophytes are James Petiver, Johannes Burman, Nicolaas Laurens Burman, John Ray etc. Soon after the establishment of British East Indian Company the Botanical research in India is accelerated. Officers of British East India company surveyed all the parts of India, made collections of millions of plants, housed in Calcutta Garden, distributed duplicates to the various renowned herbaria of the west, prepared their illustrations, identified and published various Floras by expert botanists. Though based on the collections of East India Company, many species of

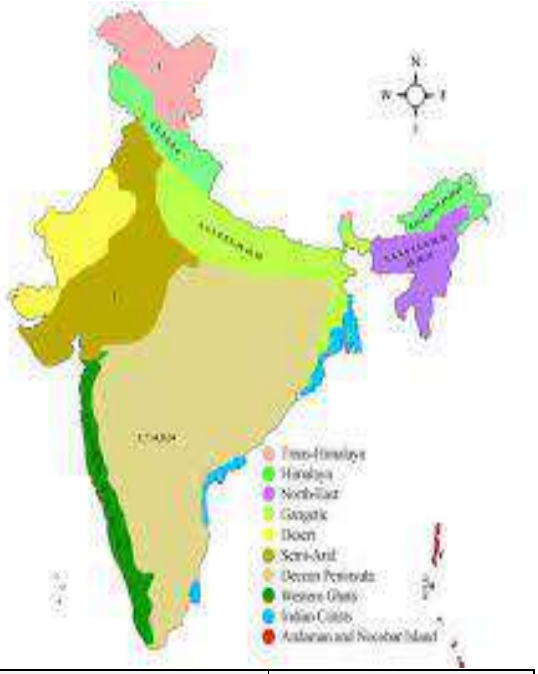
Indian Pteridophytes were described in the various taxonomic works from Europe by Linnaeus, Swartz, Kunze, W. J. Hooker, J. G. Baker, Presl, Sprengel, Spring, Lamark, Milde, N. L. Burman, Hieronymous, Kümmerle, Willdenow, T.Moore, Zenker, Taschner, Lowe, Dryander, Roth etc. Sir W. J. Hooker in his Species Filicum vol. I-V (1846-1864) documented almost all then known Indian Pteridophytes and many of them were new to sciences.

Indian Pteridophytes were also documented and described in India by Wallich, Griffith, Roxburgh etc. in many reports and floras. In Calcutta Journal of Natural History (1844) Griffith and Roxburgh listed all the Indian Cryptogams collected by Roxburgh and his collectors. The first comprehensive account of Indian Pteridophytes were presented by Col. R. H. Beddome with full illustrations and description in the form of Ferns of Southern India (1863-1865), Ferns of British Indian vol. 1(1865-1866), Ferns of British Indian vol. 2(1866-1870), Supplement to the Ferns of British India (1876) and Handbook to the Ferns of British India, Ceylon and Malay Peninsula (1883) with Supplement (1891). In the meantime, C. B. Clarke also documented The Ferns of Northern India (1980) and subsequently, Ferns of North Western Himalayas (1899-1904) were documented by C.W. HHope, Fernsof Shimla (1888,1889) by H. F. Blanford, and Ferns of Bombay (1924) by Blatter and Almeida. Similarly, the Pteridophytes of Bihar and Orissa were documented by Haines in his monumental book The Botany of Bihar and Orissa (1924) and Ferns of Mussoorie and Dehradun (1942), Kashmir (1945) and Pahalgam (1951) were documented by R. R. Stewart.

5.3 DISTRIBUTION OF FERN SPECIES:

Ferns, which include about 12,000 species worldwide (Hassler, 2004–2021), are one of the oldest and the most species-rich groups of vascular plants (Mabberley, 2008; Qian et al., 2021a). Fern propagules are spores, which are small (usually <0.1 mm in equatorial axis and polar axis; Adsersen, 1995), and are capable of dispersing thousands of kilometers by wind (Wolf et al., 2001). Ferns are generally distributed broadly, and fern distributions are thought to be more in equilibrium with climate than most other groups of vascular plants (Qian, 2009). Fern species richness exhibits marked variation among areas across the globe (Weigand et al., 2020), which is thought to be driven by environmental factors (Kreft et al., 2010; Khine et al., 2019).

Therefore, ferns are an ideal group of vascular plants for the study of geographic and ecological patterns and drivers of plant diversity at global and regional scales. Fern count numbers taken from Hassler, Michael (2004 – 2020): (World Plants. Synonymic Checklist and Distribution of the World Flora. Version 11.1; last update Dec. 8, 2020.)



COUNTRY	FERN COUNT	LAND AREA (KM2)	FERNS/KM2
India	1029	2,973,190	0.000346

In India, according to Botanical survey of India, Ferns and Fern-allies are second largest group of plants in Indian flora and represented by 33 families 130 genera and 1267species among them ca. 70 species are endemic to India. In Chhattisgarh tree ferns are occur in northern and southern hill area and middle hill ranges eg; Korba,Sarguja and Bastar. A microclimate has been found of tree ferns in Bacheli NMDC-CMDC Ltd. (NCL) area.

5.4 ECOLOGICAL SIGNIFICANCE OF TREE FERNS:

Ferns and their allies are in a major division of the Plant Kingdom called Pteridophyta, and comprise much of the fossil records and occupies among the oldest species of the planet. Literatures reported evidences of fossil showing tree fern evolved some 350 million years ago, in Carboniferous period, the period also known as the age of ferns. Ferns existing today have been there for more than 300 million years, and their evolution through various forms has been phenomenal, while most of them have also been extinct (Fernandez, 2011). Due to availability of favorable climatic conditions and suitable habitats for growth, the pteridophytes are widely distributed in Indian continent, even becoming abundant and conspicuous at some parts. However, they need proper microclimatic conditions for their survival and any disturbance in these conditions may lead to their extinction. Each fern species has its own preferences for temperature, humidity, soil type, moisture, etc. and in many cases are very specific indicators for the conditions they need (Shaikh & Dongare, 2009). Though some studies have been done

taking different habits and habitats of pteridophytes into account, in-depth ecological studies have not been done on the Indian pteridophytes. The pteridophytes grow in different habitats like moist or dry rocks and boulders, on tree trunks, as hydrophytes in lakes, ponds, etc., on forest floors and edges, along perennial streams and deep ravines, grasslands, tea and coffee estates, inside dark Georges, etc. Ecologically various members of ferns and fern allies inhabiting a region can be classified into different categories depending upon their growth habits and various habitats they occupy.

In an ecological views Ferns are an important component of tropical and temperate forests and play a significant role in ecosystem processes in the canopy and forest floor habitats (Hill & Silander 2001). Ferns are vascular, spore bearing plants and include ferns and fern-allies. They were the first vascular plants to grow on the surface of earth and began their life period from leafless and rootless individuals (with photosynthetic stem and rhizoids performing the function of roots) in the Silurian and Devonian periods. The pteridophytes are a paraphyletic group of seed plants and consist of four groups: Lycopods, Equisetum, Psilotaceae and Ferns (Qiu & Palmer, 1999). They played an important role in establishing the early land flora as they emerged shortly after the evolution of land plants and are much larger than bryophytes (Kenrick & Crane, 1997). Pteridophytes grow luxuriantly in moist tropical forests and temperate forests and their occurrence in different eco-geographically threatened regions from sea level to the highest mountains are of much interest (Dixit, 2000). Each fern species has its own preferences for temperature, humidity, soil type, moisture, etc. and in many cases are very specific indicators for the conditions they need (Shaikh & Dongare, 2009).

5.5 CYATHEA TREE FERN:

Scaly tree ferns, Cyatheaceae, are group of mostly tree forming ferns with fossil evidences marking their origin in the Middle Jurassic age (Ho et al., 2016). Among Pteridophyte, Cyatheaceae stands as one of the interesting and second largest living fern group due to its striking morphology, its ability to escape extinction during the evolution of the earth and wide geographical distribution along with local endemism (Tryon and Gastony, 1975). The Genus, Cyathea belongs to the family Cyatheaceae which comprise the world’s tallest tree ferns, some

of them even reaching 20 m in height (Tryon and Tryon 1982) and includes ca.600 species (Korall et al., 2006). The distribution of genus has been reported from sea level to higher elevation up to 4200 m above sea level (Tryon, 1976). Many taxonomic studies, classifications and data have been reported on the family Cyatheaceae in the last 50 years that recognise one (Cyathea) to many (e.g. Alsophila, Calochlaena, Cibotium, Culcita, Cyathea, Dicksonia) genus. In the last decade, phylogenetic studies of restriction site data and morphology led to the recognition of three or four evolutionary lineages within Cyatheaceae, i.e. Alsophila, Cyathea, Gymnosphaera and Sphaeropteris (Korall et al. 2007), of which, according to the Red List Category of International Union for Conservation of Nature, 8 species are Endangered (EN), 9 are Vulnerable (VU), 6 are Near Threatened (NT), 90 are Least Concern (LC) and 24 species are Data Deficient (DD) in the world (IUCN 2020). Tree fern provides all four ecosystem services: provisioning, regulating, supporting and cultural services. As for the provisioning services, which are the materials obtained from the tree fern for direct use by humans; its leaves and trunks are used. Young fronds of tree fern provide food, fodder, and fiber. They are being used as food especially as pickles (Achar) while the matured ones as fodder for the livestock. The following points is importantly out lined the significance of tree ferns in forest ecosystem.

5.5.1 TAXONOMY OF CYATHEA LEPTOSPORANGIATE FERNS:

In ‘A classification of extant ferns’ Smith et al. (2006) recognise four classes of ferns: Psilopsida; Equisetopsida; Marattiopsida; Polypodiopsida, which include 11 orders, and 37 families with ca. 9000 species. Cyatheaceae are placed within the class of ferns known as Polypodiopsida (or the Leptosporangiate Ferns) which contains most of the fern diversity. In Leptosporangiate Ferns the sporangia develop from a single daughter epidermal cell and the mature sporangial walls are only one cell thick. Conversely, in the eusporangiate ferns (Psilopsida, Equisetopsida and Marattiaceae), as well as the epidermal daughter cell, a group of adjacent cells become involved in the formation of the sporangium (Sporne, 1966). With ca. 9000 extant species (eusporangiate ferns have ca. 300 species) in 267 genera, leptosporangiate ferns are, after angiosperms, the most diverse lineage of vascular plants.

(Schuettpelz & Pryer, 2007). Along with the Podypodiales and Salviniales, the Cyatheales are one of the main lineages within the "Core Leptosporangiates". It is thought that these lineages began to diverge around 220mya – 211 mya. The Polypodiales, which are an incredibly diverse group, are thought to be the sister clade to Cyatheales (Pryer et al. 2004).

5.5.2 MORPHOLOGY:

Cyatheales have arborescent trunk-like stems, but other members of the order have a creeping and non-arborescent form. Tree ferns exhibit a range of morphological variations and sizes: from a few centimeters up to 20 meters. This is a well-supported monophyletic group – however, the tree ferns lack any obvious distinguishing feature or synapomorphy (Schuettpelz & Pryer, 2007). Furthermore, the arborescent growth form seen in tree ferns is not unique – it can also be seen in Blechnaceae (Korall et al. 2006). There are two morphological synapomorphies which can assist in identifying a tree fern. All tree ferns have pneumathodes along the stipe and/or rachis, and the presence of radial symmetry in the shoots. However, the presence of pneumathodes may unite the clade, but it is also found in other leptopsporangiate ferns, and may represent the ancestral (plesiomorphic) condition of this group. Radial symmetry of the shoots is a common feature of most tree ferns; however, the character does not have a common origin within the clade (homoplastic), with reversals to dorsiventral shoots seen in Loxomataceae and Metaxyaceae (Korall et al. 2006). The Cyatheaceae are mostly terrestrial, some epiphytic. The stems are mostly arborescent (tree ferns), the trunks often with marcescent (persisting) leaves or leaf bases; shoot apices and petiole bases are covered with large scales or hairs, the stem anatomy a polycyclic dictyostele. The leaves are usu. large (up to 5 m long), blades 1-3-pinnate (rarely simple), petioles with obvious, usually discontinuous pneumathodes (tissue with air spaces) in two lines; blade veins free, simple to forked, rarely anastomosing. Sori are abaxial, round, superficial or terminal on veins and marginal or submarginal, the receptacle raised, paraphyses present, exindusiate or insudiate Indusium, when present, saucer-like, cup-like, bivalvate, or globose and completely surrounding sporangia. Sporangia maturing gradately, the annulus oblique. Spores are tetrahedral, trilete, variously ornamented. Gametophytes are green, cordate

5.5.3 LIFE CYCLE OF CYATHEA:

The life cycle of the tree fern Cyathea has two different stages; sporophyte, which releases spores, and gametophyte, which releases gametes. Gametophyte plants are haploid, sporophyte plants diploid. This type of life cycle is called alternation of generations. Like all ferns, tree ferns reproduce by means of spores. The mature tree fern releases spores that are dispersed by wind. When conditions - especially temperatures and moisture levels -are suitable, spores develop into small structures termed gametophytes. The gametophytes then give rise to both sperm and egg. Once the sperm-bearing structure on a gametophyte has fertilized the egg - by means of the sperm swimming to the egg - the gametophyte begins to grow into a tiny tree fern that will, if conditions allow, develop into a mature tree fern. Meiosis is a type of cell division that produces gametes -cells that contain half the number of chromosomes than the parent cell. In ferns, these cells are the spores. The typical big fern plant, what it does is, by meiosis, produces spores, and the spores have half the number of chromosomes of the big parent plant. Spores are small reproductive structures that are released from the sporangium. So, a spore is the product of meiosis. In ferns, it is tiny. If you think of a ruler and think how big a centimeter is and divide that by 10, then you have got a millimeter, and then divide that by 10 again and then halve it. That is about the size of the spore. Released spores grow into a gametophyte – very small heart-shaped structures.

Spores are released into the wind. If those spores happen to land somewhere suitable, they will grow into what is called a gametophyte, and that is a whole separate individual plant. It is very tiny, maybe the size of your fingernail, and it’s just like a little, thin, small green plate. What that does is it will produce the sex cells – the eggs and the sperm. Gametophytes contain both female (archegonium) and male (antheridium) sex organs. They mature at different times in order to increase the chances of cross-fertilization and genetic variation. The prothallus is the fern gametophyte. It is a green, photosynthetic structure that is one cell thick, usually heart or kidney shaped, 3–10 mm long and 2–8 mm broad. It is very difficult to find in the bush as it is so tiny. It does not have roots, stems, or leaves, but it does have rhizoids that anchor it to the soil and help with absorption. The underside of the prothallus is where the gametes are produced from the male and female sex organs. The prothallus has both male and female sex organs. he archegonium is the female sex organ. These are flask-shaped structures that produce an egg, which is reached by the sperm swimming down the neck. the antheridium is the male sex organ. These are small spherical structures that produce flagellate sperm. Fertilisation occurs when the fern’s egg and sperm combine to form a zygote. Ferns require water to enable the movement of the sperm to reach the egg. A zygote is a combination of genetic material from both the egg and sperm and contains a complete set of DNA to form a new fern plant.

The sperm need to swim through water in order to get to the eggs. The eggs are housed or maintained in the gametophyte, and that dependence on water is why ferns are so often linked to wet habitats. If the sperm do manage to get to an egg, fertilization occurs, and that is where the two – the sperm and egg – come together. That doubles the number of chromosomes and that gives rise to a whole new typical fern plant again, and the cycle repeats. The zygote develops from the prothallus (fern gametophyte). It grows using mitosis and develops into a young fern plant.

5.6 POPULATION STRUCTURE OF TREE FERNS IN DEPOSITE 04 STUDY AREA:

Information on population structure of any species indicates its history of past distribution and its environment, which is very useful in forecast of the future trend of its population (Tamrat 1994, Demel 1997). The population structure and regeneration pattern of all three species of Cyathea showed their future potential in the Galli Nalla. Stream area is the main habitat of the tree ferns, mainly Cyathea arborea and C. alata has a well-established permanent habitat in core zone of the study area. Although the determined buffer zone of 10 km has found several scattered patches. From the origin of the Galli nalla, regeneration pattern of Cyathea tree ferns. The population structure of Cyathea species followed four general class distribution patterns (reverse J-shape, bell-shape, irregular-shape, and J-shape) at different sites of the deposit 04. At other sites, the different patterns of distribution of species showed the occurrence of irregular-, bell-, and J-shaped density distribution patterns at sites. In compartment 1826, 1822, 1825, 1824, 1823 showed irregular- (irregular density distribution between different size classes) and J-shaped patterns (higher density of individuals in higher diameter classes) respectively. In contrast C. henryi showed irregular- and bell-shaped patterns at sites 3 and 4 respectively of compartment 1825, 1824, 1823. The population structure of C. gigantea showed irregular-shaped pattern at all respective sites. All the patterns of distribution of individuals (except reverse J-shape) between the different forest sites indicated that there was an urgent need for protecting the respective species in their occurring environment. Reverse J-shaped distribution pattern indicates stable population structure, naturally replacing senesced individuals with seedlings and saplings (Condit et al. 1998, Obiri et al. 2002).

5.7 PRESENCE / OCCURRENCE OF TREE FERN SPECIES IN PROJECT AREA (ML AREA) ALONG GALLI NALLA AND IN OTHER FOREST AREAS OUTSIDE PROJECT AREA:

During observation it was found that the important species like Tree Fern (Cyathea species) are found in project area (ML area) along Galli nalla and further observation done that Tree Fern (Cyathea species) are found in other forest areas also which are not part of Project area (ML area).

Following are the details of forest area (Compartment wise) where Tree Fern (Cyathea species) is found during observation

a. **Within Project area (Core area) along Galli Nalla** – Compartment Nos. RF 1834, RF 1841 and RF 1842
b. **Outside Project area (Within 10 Km radius of the periphery of ML area)**- RF 1846, RF 1882, RF 1883, RF 1865, RF 1859, RF 1860, RF 1834, RF 1827, RF 1881, RF 1880, RF 1821, RF1822, RF 1812, RF 1807, RF 1823, RF1824 and RF 1825.

These very facts were verified from Forest Range records as secondary data.

5.7.1 DATA COLLECTION AND ANALYSIS OF PRESENCE / OCCURRENCE OF TREE FERN SPECIES:

The team of experts have done data collection in respect of Presence/ Occurrence of Tree Fern species in in Project area (ML area) along Galli Nalla and outside project area in other forest areas outside Project area.

a. Recorded data for Tree Fern Within Project area along Galli Nalla in Compartment Nos. RF 1834, RF 1841 and RF 1842 – **368**
b. Recorded data for Tree Fern Outside Project area in RF 1846, RF 1882, RF 1883 – **295**.

Girth and Height of these Tree Fern are taken and recorded.

5.7.2 ANALYSIS:

Based on available data, following are the results of the analysis which are given in following tables

TABLE 5.1 NUMBER OF TREE FERN SPECIES WITHIN AND OUTSIDE PROJECT AREA (FOUND DURING FIELD DATA COLLECTION)

Sr. No.	Tree Fern in Project area along Galli nalla		Tree Fern in Impact zone area (Outside)	
	Compartments	No. of Tree Fern	Compartments	No. of Tree Fern
1	RF 1834, RF 1841, RF 1842	368	RF 1883, RF 1882, RF 1846	295

Sr. No.	Compartment No.	Tree Fern Girth wise (In Cms.)						Total
		Up to 20	21-30	31-40	41-50	51-60	Above 60	
1	RF 1834, RF 1841, RF 1842	81	159	87	29	9	3	**368**
2	RF 1883, RF 1882, RF 1846	78	131	64	9	9	4	**295**

Sr. No.	Compartment No.	Tree Fern Height wise (In Cms.)					Total
		31-100	101-200	201-300	301-400	Above 400	
1	RF 1834, RF 1841, RF 1842	223	87	32	18	8	**368**
2	RF 1883, RF 1882, RF 1846	153	111	20	9	2	**295**

5.7.3 REGENERATION STATUS OF TREE FERN:

During field visit, it was found that due to conducive environment in area where tree fern are flourishing, the regeneration are seen around many established tree ferns.

TABLE 5.2 STATUS OF TREE FERN REGENERATION IN STUDIED COMPARTMENTS

Sr. No.	Compartment no.	No. of tree fern regeneration (Average height 12-30 Cms)	
		Established Tree fern around which regeneration seen	Total regeneration
1	RF 1834, RF 1841, RF 1842	64	401
2	RF 1883, RF 1882, RF 1846	47	253
Total		**111**	**654**

5.7.4 INFERENCE BASED ON OBSERVATION:

The Tree fern species are found not only in project area along Galli Nalla but also it was observed in other forest compartments beyond project area.

It was also observed that regeneration status in Tree Fern area is quite satisfactory.

TABLE 5.3 THE BELOW TABLE SHOWS CYATHEA AND THEIR PTERIDOPHYTE ASSOCIATES IN THE GALLI NALLA.

Sl. No.	PLANT NAME	FAMILY
1	*Azolla pinnata*	*Azollaceae*
2	*Adiantum philippense*	*Adiantacece*
3	*Adiantum flabellulatum*	*Adiantacece*
4	*Dryopteris cochleate*	*Dryopteridaceae*
5	*Dryopteris cochleate*	*Dryopteridaceae*
6	*Equisetum palustre*	*Equisetaceae*
7	*Ophioglossum nudicaule*	*Ophioglossaceae*

8	*Ophioglossum costatum*	*Ophioglossaceae*
9	*Pteris confuse*	*Pteridaceae*
10	*Pteris vitta*	*Pteridaceae*
11	*Lygodium*	*Lygodiaceae*
12	*Isoetes, bilaspurensis*	*Isoetaceae*
13	*Marsilea. Minutta*	*Marsileaceae*
14	*Selaginella miniatospora*	*Seleginaceae*
15	*Selaginella repanda*	*Seleginaceae*
16	*Cyathea arborea*	*Cytheaceae*
17	*Cythea alata*	*Cytheaceae*

5.8 MAJOR THREATS ON TREE FERNS:

The family Cyatheaceae is listed in Appendix II of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1975 in order to protect these epibiotic tree ferns from being sold randomly and overexploited. It is also listed in threatened category of IUCN Red Data Book in 1998. Cyathea is one of the interesting genera among Pteridophytes due to its magnificent prehistoric existence and appearance and survival ability through evolutionary processes since millions of years ago. Like every living organism, these threatened Pteridophytes provide several services to the humans and the ecosystem where it exists, yet very little is known about the ecology, social and economic values and potential threats that have been pushing these genera towards endangerment. They have unique ecological niches and are highly sensitive to changes in microhabitat nearby its vicinity (Harper, 1977). In order to achieve effective conservation of tree fern, collaborative actions from conservationists, local communities, civil societies, and government authorities are very important. Various anthropogenic activities like deforestation for agricultural land expansion, logging, urbanization, and roads/trails building activities have resulted in tremendous pressure on the natural habitat of tree fern species. Corrective measures for conservation of these threatened tree ferns are suggested below:

1) There is an urgent need to educate and increase awareness of the local people about the conservation of Cyathea spp.
2) On a priority basis, continuous monitoring and dynamic protection measures should be carried out to protect the present population of Cyathea spp.
3) An artificial introduction of immature individuals of the species in suitable ecological habitats or secondary forest is necessary to restore the populations.

5.9 ACTION PLAN OF CONSERVATION & PROTECTION OF TREE FERN and RET SPECIES

The conservation of Tree Fern and RET species are basically based on three main principles

- **Protection**
- **Conservation and**
- **Development**
- Enhancing the scientific understanding and knowledge on tree fern and RET species for the development of database and research avenues related to tree fern
- Conservation of tree fern and its associated species along with their habitats (In-situ Conservation)
- Linking conservation of tree ferns with the livelihoods through wise use of tree ferns.
- Promotion of knowledge and awareness on importance of tree fern and its conservation
- Building capacity of the concerned stakeholders for the conservation of tree ferns and RET associated species and their habitats
- Need to establishment of separate fully equipped nursery for the tree fern and RET species in the buffer zone.

5.9.1 PROTECTION:

There may be biotic interferences in the Tree Fern and other area as this area is adjoining to the mines area so protection aspect becomes very crucial to keep the naturality of the Tree Fern area. As tree fern is endangered according to the CITES list this habitat of treefern has to be protected by conservation of this species. As there will be anthropogenic pressure on the area during mining activities or in the initial stage of construction, it has to be ensured that no harvesting of the species is done for ornamental or other purposes.

5.9.1.1 MEASURES:

1. Notify the area between Mine pits and Galli Nalla as **NO GO area (Buffer area for mines)** where movement of any kind shall be restricted. No mining activity of any type shall be allowed in this area.

2. **Provision of Protection Fencing:**

   a. Chain link fencing (height 6 ft. and gap in chain link 2inch x2 inch.) to be provided in the NO GO area belonging to Tree Fern and nearby area. As per field observation, the Tree Fern area, which fall within ML area is majorly confined along both sides of Galli Nalla and its tributary. So Chain link fencing to be fixed at suitable distance (Not less than 200 Mts from the Galli Nalla) on either side of Galli Nalla to protect the nalla and its tributaries towards Western and Eastern side of Nalla. Chain link fencing shall be done by the forest department.

b. The forest area having Tree Fern (Compartments given in Chapter 5 ,point no. 5.7 (a,b)) and forest area other than these compartments where sporadic occurrence of Tree fern species are seen , all those areas are to be protected with Chain link fencing just to restrict the movement of any kind.

3. Protection of local native species shall be done in 7.5 Metres all along the Chain link fencing towards Mining area i.e. Western side of Galli nalla towards mine site, special care shall be taken for associate species of Cyathea Sps (List of some species are given in table no. 5.3) and species belonging to the local conditions (Choice of associates of Sal) . Identification and listing of such species can be made by the Forest department.
4. Round the year 4 no. Watch and Ward to be deployed for at least 15 years period. They shall be responsible for the safety and security of the Tree Fern areas and the buffer area (10 Km periphery from the mines area).

5.9.2 CONSERVATION (IN-SITU AND EX-SITU):

IN-SITU measures

- **Assisted Natural Regeneration (ANR):** Assisted Natural Regeneration is a simple, low-cost species restoration method that can effectively convert degraded vegetationto more productive one. The method aims to accelerate, rather than replace, natural successional processes by removing or reducing barriers to natural forest regenerationsuch as soil degradation, competition with weedy species, and recurring disturbances(e.g., fire, grazing, and wood harvesting). The process of assisted natural regeneration(ANR) will be adopted in the present habitat for tree fern conservation.

  Area proposed for IN-SITU conservation of TREE FERN – 75 Ha. (Within ML area along Galli Nalla) and EX-SITU conservation 75 Ha. (Buffer zone 10 Kms from ML area)

  Area proposed for IN-SITU conservation of RET Species – 50 Ha. (Outside ML area within 10 Km radius from ML area) **In-situ Conservationof RET species in PF/RF of study area and its maintenance one plot of 10 Ha. Each year for 5 years (5 Plots= 50 Ha.)**

EX-SITU

Propagation: *Cyathea* is a plant which does not bear seeds. The only mode of propagation here is spore. However, micropropagation protocols of several species of *Cyathea* has been developed by different workers where spores have been used as explants.

- **NURSERY TECHNIQUE AND DEVELOPMENT AS EX-SITU CONSERVATION**

Tree ferns are usually adopted temperate, tropical & subtropical climatic condition. For the better conservation in challenging region a separate nursery must be developed by proper study of tree fern species and their vernacular natural microclimate and habitat. Deposit 04 area is comprising with a peculiar microclimate and favorable environmental conditions for the tree ferns species. Large area is flourish with the Cythea alata and C. arborea tree fern species in both the bank of Galli nalla Although human interference and continuous environmental disturbance in these habitat areas. Conservation of the tree ferns a nursery must be developed by the modern recommended international protocol.

There are so many different species of Cyathea tree ferns that each must be approached individually to fully understand its characteristics and cultural needs. Some are giant tree-like plants, while others rarely grow above one inch in height. Most like shady conditions, but a few grow best in nearly full sun. Some like dry soil, while most need to be kept constantly moist. Most of the popular varieties of ferns for the garden should be planted in a part-shade location, in soil that is rich and which is both moist and well-drained. Spacing should depend on the type of ferns some are mat-forming, and will quickly spread to blanket an area, while others are self-contained and can be used as specimen plants among mixed plantings.

The only rule of thumb for growing ferns is to keep them moist—most varieties, that is. Many ferns are so easy to grow that they can become a nuisance, spreading where you do not want them unless you supervise them. Watch for slug damage through the season. Fronds can be left in place to protect the crowns over winter but should be cleaned away in the spring. For the ideal tree fern growing nursery the following need-based acknowledgement is very important;

Light:

Most ferns prefer a shady location, but they don't do well in deep shade. The dabbled shade provided by tree branches provide the best conditions. Think about how they grow in the forest and try and find similar conditions in your yard. Wild ferns are found more commonly on sloping sites where the ground water is not static. However, such sites are infrequently available in gardens, and level sites are perfectly satisfactory providing the other environmental factors described above are met. South-facing sites must be fully shaded.

Soil:

Nearly all ferns prefer a soil that is moist and well-draining. Most do best in slightly acidic to neutral soil, from 4.0 to 6.0 in pH, but some, such as the maidenhair fern (Adiantum), requires a more alkaline soil. Providing that soil pH does not stray too far from neutral pH7, many ferns will be happy, but a pH slightly on the acid side of 7 (e.g. pH 6.5) is the best for general fern

cultivation. However, there are exceptions. Some ferns prefer a higher pH, e.g. those that normally grow in limestone areas. See our leaflet ‘Ferns for different soil conditions. A moist but not water-logged soil is best for most ferns. Wild ferns often grow in situations where the ground water is on the move.

Water:

Water ferns regularly during periods without rain, and do not let the soil get totally dry. A two-inch-thick layer of mulch will help keep the roots cool and damp. When grown indoors, water the plant slightly every day.

Temperature And Humidity:

Most ferns like a humid environment, but their temperature tolerance is quite broad. There is a fern for almost every climate, provided soil and humidity needs are met.

Fertilizer:

Although not essential, you can use a slow-release fertilizer mixed into the soil in early spring. Ferns are sensitive to fertilizer, so don't overfeed. Common organic cow dung, soil mixed and coco pit mixed soil with rich calcium and magnesium soil is best for the tree ferns,

Potting And Repotting:

When using ferns as nursery plant, choose tropical species. Rather than standard potting soil, ferns will grow best in a richer medium, such as a fern-specific commercial mix or compost mixed with peat moss and sand. Repotting is necessary when the plant begins to crowd its container, which may lead to smaller fronds.

PROPAGATING METHODOLOGIES:

(i) FERNS FROM SPORES:

To collect Tree fern spores, wait until they darken and start to fall off the fronds, signaling they are ripe. An easy way to do this is to cut off a frond when its spores are beginning to darken in color. Leave the frond in an open paper bag or on top of a piece of paper (indoors, where the spores will not get blown away) and wait for the spores to fall. You want to be sure they are fully mature and fall off on their own.

A. Fill a flat or another container with sterile, moistened potting mix designed for ferns. Shake the spores off the paper or bag directly on top of the mix and press gently, so the spores make good contact with the soil.

B. Mist the surface of the potting mix, to moisten the spores and keep them in place. Cover the container with plastic and place it in a tray filled with one to two inches of water. Move to a warm spot, with indirect sunlight.

C. Keep replacing the water in the tray until you see signs of growth. This can take 6 to 12 weeks, so be patient and do not let the soil dry out.

D. The first thing you will see will be small heart-shaped shoots called prothalli. These can be gently lifted out of the container and moved into individual pots filled with damp, sterile fern potting mix. Leave the transplants uncovered, but keep them moist. Once the prothalli begin developing fronds, they can be slowly hardened off and transplanted outdoors nursery bad.

Isolation of spores from leaf

(ii) FROM STOLONS: A second way to propagate ferns is by planting the stolon's—long, fuzzy string-like structures growing from your fern. These are stolon's or runners, and you can propagate ferns by layering them on the soil. Pin the stolen to the nearby soil with a U-shaped landscape staple or a small rock. Keep moist and in a few weeks the stolon should root and send up new growth. When that happens, cut the stolen from the mother plant. This new plant can now be dug up and transplanted to a new location.

(iii) PROPAGATING FERNS BY DIVISION: When fern fronds begin to get smaller, or if you notice a bare center in a clump, it is time to divide them. Some ferns form visible crowns, and while others grow as mats of fibrous roots like the macho fern. To divide, dig up the entire clump and cut six-inch squares of the most robust growth. Each piece should have at least one growing tip where fronds are sprouting. Replant the pieces at the same depth as the original plant, then water them in thoroughly.

Most ferns have no serious problem, other than slugs that may feed on the fronds. Fight them with commercial slug bait or diatomaceous earth spread over the ground around the plants. Ferns that get too much sun, or are growing in subpar soil, will be weak and won't spread as vigorously.

MICROPROPAGATION OF TREE FERN:

- Micropropagation protocol of several species of *Cyathea* has been developed by different workers is available where spores have been used as explants. It is fastest and most economic method of *in vitro* propagation for regeneration in laboratory condition.
- Vascular cryptogams, especially ferns have not been very favourable material for tissue culture because its vascular system is made up of highly differentiated tissues that are unlikely to proliferate into cell masses capable of growth *in vitro* and lack ofsecondary activities (Burr, 1976).
- Plant tissue culture has been used for off-site conservation and micropropagation, butin comparison to higher plants very little work is reported on ferns.
- Although many species of ferns have been successfully propagated by tissue culture techniques (George, 1996), only a few studies on the genus *Cyathea* were reported and none on *C. arborea*. The reported work for tree ferns is *Cyathea spinulosa* by Shukla and Khare in 2014 at CIMAP and NBRI, Lucknow, India.
- These studies also have not concentrated on efficient organogenesis and successful acclimatization of in vitro-raised plantlets. The process being technical one outsourcing will be done for engaging a tissue culture laboratory for micropropagation.

5.10 NURSERY OF THE ENDAMIC ASSOCIATES PLANT SPECIES AND RET SPECIES:

Nursery is a place where plants are raised for eventual planting out. It comprises of nursery beds, paths irrigated channels etc. It is a place where plants are propagated and grown to usable size. Nursery has vital importance in forestry and biodiversity conservation as it is one of the primary needs for plantation. The planting materials for forest plantations are raised from seeds and vegetative parts therefore, role of mother plants is primarily important. Species are selected based on its genetic traits and other factors like availability and adaptation in the growing environment.

5.10.1 IMPORTANCE OF THE NURSERY:

It occupies an important place in artificial regeneration. The following objects for which nursery is generally made, clearly bring out its importance.

1. Plantations of local or endemic species that do not seed every year will be raised annually, by sowing all available seeds in nursery to raise seedlings to be planted out various years.

2. Slow growing species will be raised in nursery and planted out, only when the seedlings are not liable to be damaged by weeds.

3. Plantations of some species, when raised by direct sowing are not so successful when raised by transplanting their seedlings. Therefore, seedlings from nursery will be planted in respective plantation sites.

4. Causalities in plantations must be replaced either for the year of planting or in the next year. Sowing done in the gaps is liable to be unsuccessful as a result of suppression from weeds and cannot catch up the growth as from, original sowing. Therefore, replacement of causalities is always done by planting nursery grown plants or stumps and so nursery is very essential for causality replacement also.

5.10.2 PHYSICAL RESOURCES REQUIRED FOR NURSERY:

These physical resources required in a nursery are enlisted below,

1. Land is the basic and fundamental physical resource for plant nursery.
2. Soil sample testing should be done to avoid problematic and unmanageable soils. Soil should bewell drained, porous, and light to medium in texture. Soil pH should be 6.5 – 7.5. Low lyingland should not be selected.

3. Required land with sufficient and assured supply of irrigation is the most important basic resource.
4. Skilled as well as unskilled man power is necessary for grafting, budding, weeding, irrigation, spraying, dusting, training, pruning, etc.
5. Provision for electricity is required for water pumps, spraying, dusting, and other operations.
6. Separate planting of mother plants is necessary. Different varieties of mother plants will be planted in different plots.
7. Propagation structures for hardening of plant.
8. Small shade net houses are required for hardening of nursery plants.

5.11 PROPOPSED EXPENDITURE ON NURSERY DEVELOPMENT FOR PLANTATION OF RET SPECIES AND TREE FERN SPECIES AS EX-SITU CONSERVATION:

Biodiversity conservation require Ex-Situ conservation of species of great importance. Major concerns are the development of Centralized Nursery for preparation of plants for

- RET species
- Tree Fern species and its associates

This would require a centralized nursery outside the ML and Impact / buffer zone area.
It is proposed to develop a well-equipped nursery which shall be in approximately 5 Ha. (Shall be made available by Forest Department in Dantewada Forest Division).

Details of Plantation: After due observation, thorough survey and considering gaps, crop density etc. (within forest area), it is found that approximately 50% area shall be available for various types of plantations. In that case the gap filling of plants can be taken up in more areas in order to cover the entire buffer area. Here 50 Ha, area for RET plantation is an indicative estimated area.

Hence nursery shall be prepared in accordance with the requirement. Standard number of plants required for 1 Ha. plantation is 1000 with spacing of 3X3mtr when 100% area is available for plantation. Here we are considering 100% plantation area so number of plants required for 1 Ha. plantation would be 1000 only.

Estimated Expenditure: Given below the cost of nursery development for REET species, Tree Fern species and its associates.

TABLE 5.4 STATEMENT EXPENDITURE OF NURSERY DEVELOPMENT FOR RET SPECIES

SL. No.	FY	Work description	Proposed area of Plantation	No. of plants	Special Rate per plant (In Rs.)	Amount (in Rs.)
1	1st year	Preparation and growing plants	50 Ha	57500 plants (@ 575 plants per Ha. Including 15% casuality replacement)	52.00	29,90,000
2	2nd year	Maintenance of plants	50 Ha	57500	13.00	7,47,000
3	3rd Year	Preparation and growing plants for causality replacement (10% casuality)	50 Ha	5750	52.00	2,99,000
4	4th year	Maintenance of plants	50 Ha	5750	13.00	29,900
	Total					**40,65,900**
				Round Off		**40.66 Lacs**

TABLE 5.5 STATEMENT EXPENDITURE OF NURSERY DEVELOPMENT FOR TREE FERN SPECIES AND ITS ASSOCIATES

SL. No.	FY	Work description	Proposed area of Plantation	No. of plants	Special Rate per plant (In Rs.)	Amount (in Rs.)
1	1st year	Preparation and growing plants	75 Ha	43125 plants (@ 575 plants per Ha. Including 15% casuality replacement)	110.00	47,43,750
2	2nd year	Maintenance of plants	75 Ha	43125	30.00	12,93,750
3	3rd Year	Preparation and growing plants for causality replacement (10% casuality)	75 Ha	4312	110.00	4,74,375
4	4th year	Maintenance of plants	75 Ha	4312	30.00	1,29,375
	Total					**66,41,250**
				Round Off		**66.41 Lacs**

Total Expenditure = 207.07 lacs

1. For REET species = Rs. **40.66 Lacs**
2. **For Tree Fern and its associated species = Rs. 66.41 Lacs**
3. Capital expenditure (Infrastructure development cost for nursery of Tree fern and REET spp.) **= Rs.100.00 lacs**

Important note for Selection of area for Nursery development:

The Dantewada Forest Division shall identify separate nursery area for the purpose propagating Tree Ferna and RET species in around 6 Ha. area.

5.11.1 PLANTING SEEDLING:

Care should be taken for planting of tree fern seedling. The area should contain well drained soil with bright indirect sunlight, suitable humidity and availability of humus in substratum. The prepared Tree Fern plants in nursery will have to be planted in all the areas along Galli Nalla and in forest area (Within 10 Kms radius from ML area) where Tree Ferns are found.

5.12 RESTORATION OF FOREST THROUGH EX-SITU:

Restoration of forest in the vicinity of the tree fern habitat will have to be taken care as the proposed mining activity will be very close to this fragilehabitat. Conservation of tree fern can only be ensured if restoration of forest around the area is done.

Area proposed for EX-SITU conservation of TREE FERN – 75 Ha. (Within ML area along Galli Nalla)

Area proposed for EX-SITU conservation of TREE FERN – 75 Ha. (Outside the ML area in 10 Kms radius from ML area)

Area proposed for EX-SITU conservation of RET species – 50 Ha. (Outside the ML area in 10 Kms radius from ML area)

Monitoring of EX-SITU and IN-SITU Conservation activities for Tree Fern and RET species:

5.13 SOIL, WATER AND MOISTURE CONSERVATION:

During initial process of mining activity care has to be taken so asto protect the habitat of tree fern from eroded soil components. *Galli nalla* being a natural drainage will carry rain water being drained from its catchment. During the process of mining there will be every chance of such erosion which is to be arrested at any cost as this is the only habitat of *Cyathea arborea*.

Detailed report regarding the Soil, Water and Moisture Conservation specific to the Tree Ferna area within ML area along Galli Nalla is enclosed as Part B of this plan .

To achieve the goal in an effective and sustainable manner, following five objectives were identified.

5.14 DEVELOPMENT FOR TREE FERNS:

This plant is not a seed bearing one and therefore regeneration process is complicated. The plant from sori present underneath the leaves produces spores. The reproductive biology of the species indicate it may be a good colonizer but fertilization success is solely dependent onthe prolonged availability of water at the time of maturity of sexes in the gametophyte germinatingfrom spores. Besides other factors essential climatic factors that determine its regeneration and propagation are (1) Suitable humidity throughout the year (2)Availability of humus in the substratum and (3) Availability of indirect but bright sunlight.

NMDC CMDC Ltd. (NCL) and Forest department will take following steps for conservationand propagation of the species.

Firstly, it is proposed that necessary steps on the part of NCL will be taken for *in situ* conservation of the species in its lone habitat within the buffer area providing protection to theplant and keeping the present habitat (18^0 35´40.5´´N 81^0 13´ 23.3´´E Alt – 742m) condition intact. A unique nursery development activities are to be taken by the stake holders.

5.15 PATHOLOGICAL MANAGEMENT:

While the tree fern doesn't have any major issues with diseases or pests, it can occasionally get mites or mealybugs. The first treatment recommendation is to spray the infestation with strong streams of water; if that doesn't work, treat the plant with neem oil or an insecticide until all signs of infestation have gone. Some types of pests such as slugs, snails, and caterpillars may eat some ferns such as aspleniums, and may damage young croziers of other ferns. Ferns, especially aspleniums, are also susceptible to vine weevil attack. Biological controls e.g. nematodes that attack the pests, are available and are more environmentally friendly than chemical pesticides. Mulching with substances that slugs and snails find it difficult to move across, e.g. bark or sharp gravel, can also be helpful.

Distraction techniques e.g. beer traps, citrus or mango peel can attract the slugs away from precious ferns. Iron phosphate slug bait is probably safer and more effective than metaldehyde. Ferns may also be damaged by the leaf-mining caterpillars of the Fern Smut moths. These tiny larvae cause brown patches on the fronds, and use the developing spore cases as shelters, heaping them into mounds. Remove and burn any affected fronds at the first sign of disease, as the alternative insecticide remedy, a neonicotinoid, may well harm your bee population.

Special care for conservation of Tree Fern: Secondly sporophytes plantlets available in its present habitat should not be used forplantation in other sites as it may hamper the process of natural regeneration. Utmost care has to be taken so that the natural regeneration process in its present site of availability isnot hampered.

5.16 SOIL AND WATER MONITORING: -

Monitoring of water quality of the nullah, at least at the interval of six month, is required on following parameters.

- Physical characters: pH, conductivity, TDS and temperature. These parameters should be measured at the site.
- Chemical characters: Alkalinity test- Methyl orange, phenolpthalin and total, Phosphate- ortho (Disolved) phosphate and total phosphate.
- Nitrogen: Nitrate, nitrite and Ammonia
- Iron
- Silica
- Sulphur
- Molybdenum

Study of these parameters of water are required because these will have direct impact to the root zone and survival of the fern.

5.17 AWARENESS TRAINING:

Training / Awareness among Front line Forest filed Staff, Villagers and miners will have to be carried out so that they can identify the species and take necessary measures to protect the species.

Provisions

- Development of Training and Interpretation Center at suitable place within Dantewada Forest Division where regular lectures/ Seminar/ Training program/ Orientation sessions can be organized.
- Biodiversity park is proposed to develop at Dantewada district .
- Organizing study tour and exposure visit within country for Experts/ Scientists/ People/ Villagers/ Students etc.
- Provision for Biodiversity Conservation and management Plan (BCMP) (Faunal Component) for 5 years i.e., provision for field experts.

5.18 VILLAGE DEVELOPMENT PROGRAM:

There are 24 villages in buffer zone (10 Kms from ML area) where following program can be taken up

- Grass and leaf fodder species in common land, /farmers land area in 24 affected villages in Impact / Buffer zone (total 120 Ha). Grass land plan and rotational grazing shall be prepared by forest department, Budgetary provision for Additional 100 Ha grass and leaf fodder plot in adjoining forest area (10 Ha each from 6th year onward) including maintenance. Grass land plan and rotational grazing plan shall be prepared by forest department.
- Plantation of Horticulture species and Ethno- botanical/ medicinal importance species in affected 24 villages and their maintenance for 3 years

There are certain livelihood support activities which can be taken up from CSR fund. The activities can be

1. Organic Vegetable and fruit farming Program in 24 villages
2. Village level Fish Farming in adjacent 24 villages
3. Apiculture - Honeybee Farming in 24 villages for 35 villagers each

5.19 FOR BIRDS AND BUTTERFLIES CONSERVATION:

- Distribution and fixing of artificial Nest boxes and its monitoring for the success of the program.
- Provision for Development of Butterfly habitat development in 5 areas(mine lease and near human habitations).

5.20 CONTINUOUS ENGAGEMENT OF SUBJECT EXPERTS / RESEARCHERS:

Provision for Research Monitoring and Evaluation of plan including cost of subject specialist/ experts/ expert NGO.

5.21 MONITORING OF EX-SITU AND IN-SITU FOR TREE FERN AND RET SPECIES CONSERVATION ACTIVITIES:

A panel of Expert team shall monitor the EX-SITU and IN-SITU **for Tree Fern and RET species Conservation** activities which are being carried out and a periodical report shall be generated for the review of the program. Corrective measures. If any , suggested by the panel shall be liable for forest department to implement immediately. The budget shall be deposited in Chhattisgarh Biodiversity Board's account.

CHAPTER VI
STATUS OF FAUNA

The State of Chhattisgarh falls under the Deccan Biogeographical Zone (Rodgers et al 2002) and its forests, 11% are under the Protected Area network. During the study period around 103 species belong to 6 Faunal Groups recorded from the Core and Buffer Areas of proposed Iron Ore Mine study sites, butterflies; Odonates and Damselfly, Amphibians; Reptiles; Birds (reported in core zone and in Buffer zone) Mammals. The list are given below.

An ecological survey of the study area for understanding the fauna of the study area was conducted, particularly with reference to listing of species and assessment of the existing baseline ecological conditions in the study area through Interviewing Local Villagers.

The study was conducted during winter season October in the year 2022. The study for fauna was conducted before sunrise to late night (11:00 am to 7:00pm).

The adults of Odonata, Lepidoptera and Hymenoptera were observed in the field with aspirator, manually and aerial sweeping nets. Mollusca, Amphibians and Reptiles were observed with the help associates hand manually the random field observation was also made on different groups of the fauna of the study area.

The Reptiles, Aves and Mammals were identified by using Binocular (10mm X 25mm) and their presence was recorded by observation. The presence of some Mammals species is also ascertained based on interview with wildlife and forest officials and their records, NMDC CMDC Ltd. staff and villagers residing in study

The most important of which are deterioration and loss of habitat. Controlling poaching will improve bird habitat and keystone species of the birds should be introduced for forage of the frugivores.

DETAILS OF FAUNA RECORDED AT NMDC CMDC Ltd. DEPOSIT 4 IRON ORE MINE (CORE AND BUFFER AREA)			
6.1 MOLLUSCA			
SL. No.	**FAUNA SPECIES**	**CORE**	**BUFFER**
1.	*Bellamya bengalensis form typica (Ghongha)*	+	+
2.	*Bellamya crassa (Ghongha)*	+	+
3.	*Bellamya dissimilis (Ghongha)*	+	+
4.	*Bithynia (Digoniostoma) cerameopoma (Ghongha)*	+	+

5.	*Bithynia (Digoniostoma) pulchella (Ghongha)*	+	+
6.	*Melanoides tuberculata (Snail)*	+	+
7.	*Tarebia lineata (Snail)*	+	+
8.	*Lymnaea (Pseudosuccinea) acuminata (Snail)*	+	+
9.	*Lamellidens corrianus (Fresh Water Mussel)*	+	+
10.	*Lamellidens marginalis (Fresh Water Mussel)*	+	+
11.	*Corbicula striatella (Asian Fresh Water Clam)*	+	+
12.	*Gittenedouardia orbus (Mollusca)*	+	+
13.	*Ariophanta laidlayana (Land Snail)*	+	+
14.	*Hemiplecta basileus (Ghongha)*	+	+
15.	*Macrochlamys indica (Land Snail)*	+	+
6.2 CRUSTACEAN (CRAB)			
1	Brachytelphusa jaquemonti	+	+
6.3 ODONATA (DAMSEL & DRAGON FLIES)			
S.No	**FAUNA SPECIES**	**CORE**	**BUFFER**
1	Ceriagrion coromandelianum	+	+
2	Ischnura aurora	+	+
3	Pseudagrion rubriceps	+	+
4	Ictinogomphus rapax	+	+
5	Anax immaculifrons	+	+
6	Acisoma panorpoides	+	+
7	Brachythemis contaminata	+	+
8	Crocothemis servilia	+	+
9	Diplacodes trivalis	+	+

10	Orthetrum glaucum	+	+
11	Orthetrum pruinosum	+	+
12	Orthetrum sabina	+	+
13	Orthetrum triangulare	+	+
14	Palpopleura sexmaculata	+	+
15	Pantala flavescen	+	+
16	Tramea virgina	+	+
17	Trithemis aurora	+	+
18	Trithemis festiva	+	+
19	Trithemis pallidinervis	+	+

6.4 LEPIDOPTERA (BUTTERFLIES)			
S.No	**FAUNA SPECIES**	**CORE**	**BUFFER**
1	Graphium Agamemnon	+	+
2	Papilio polytes	+	+
3	Papilio demoleus	+	+
4	Atrophaneura aristolochiae	+	+
5	Eurema hecabe	+	+
6	Catopsilia Pomona	+	+
7	Catopsilia pyranthe	+	+
8	otis danae	+	+
9	Marianne	+	+
10	Ixias pyrene	+	+
11	Pieris brassicae	+	+
12	Pieris canidia	+	+
13	Cepora Nerissa	+	+

14	Delias eucharis	+	+
15	Belenois aurota	+	+
16	Castalius rosimon	+	+
17	Catochrysops Strabo	+	+
18	Maha	+	+
19	Tirumala limniace	+	+
20	Danaus genutia	+	+
21	Danaus chrysippus	+	+
22	Euploea core	+	+
23	Polyura athamas	+	+
24	Melanitis leda	+	+
25	Acraea violae	+	+
26	Hyperbius	+	+
27	Phalanta phalantha	+	+
28	Moduza Procris	+	+
29	Athyma perius	+	+
30	Euthalia nais	+	+
31	Tanaecia lepidea	+	+
32	Cyrestis thyodamas	+	+
33	Ariadne Ariadne	+	+
34	Junonia orrithiya	+	+
35	Junonia hierta	+	+
36	Junonia iphita	+	+
37	Junonia atlites	+	+
38	Junonia almanac	+	+

39	Junonia lemonias	+	+
40	Hypolimnas misippus	+	+
41	Kallima inachu	+	+

6.5 HYMENOPTERA (BEES AND WASP)			
S.No	**FAUNA SPECIES**	**CORE**	**BUFFER**
1	Apis (Megapis) dorsata dorsata	+	+
2	Ropalidia brevita	+	+
3	Delta pyriforme pyriforme	+	+
6.6 PISCES (FISHES)			
1	Channa gachua	+	+
2	Danio dangila	+	+
3	Danio rerio	+	+
4	Garra mullya	+	+
5	Pethia conchonius	+	+
6	Puntius amphibius	+	+
7	Rasbora daniconius	+	+
8	Schistura dayi	+	+
6.7 AMPHIBIANS (Toad and Frogs)			
1	Duttaphrynus melanostictus	+	+
2	Euphlyctis cyanophlyctis	+	+
3	Fejervarya syhadrensis	+	+
4	Fejervarya orissaensis	+	+
5	Calotes versicolor	+	+
6	Echis carinatus	+	+
7	Hemidactylus brooki	+	+

8	Lycodon aulicu	+	+
9	Lygosoma punctata	+	+
10	Mabuya macularia	+	+
11	Naza naza	+	+
12	Psammophilus dorsalis	+	+

6.8 MAMMALS (COMPLETELY RECORDED BASED ON INTERACTIONS)				
SL. No.	**FAUNA SPECIES**	**COMMON NAME**	**CORE**	**BUFFER**
1	Bandicota bengalensis	Field Rat, Chooha	+	+
2	Boselaphus tragocamelus	Blue Bull, Neel gay	+	+
3	Canis aureus	Jackal, Siyar	–	+
4	Funambulus pennantii	Palm Squirrel, Gilhari	+	+
5	Harpestes edwardsii	Common Mongoose, Newla	–	+
6	Hystrix indica	Indian Porcupine, Sahi	–	+
7	Lepus nigricollis	Black-naped hare	+	+
8	Macaca mulatta	Rhesus Macaque, Bandar	–	+
9	Melursus ursinus	Sloth bear, Bhalu	–	+
10	Muntiacus muntjac	Barking deer, Bhedhaki	–	+
11	Pteropus giganteus	Indian flying fox	–	+
12	Ratufa indica	Giant Squirrel	–	+
13	Semnopithecus entellus	Sacred Langur	–	+
14	Sus scrofa	Indian wildboar, Jungli suar	–	+
15	Vulpes bengalensis	Indian fox, Lomdi	+	+
6.9 REPTILES (LIZARDS, SKINKS AND SNAKES)				
1	Calotes versicolor	Chameleon, Girgit	–	+
2	Echis carinatus	Saw-scaled viper	–	+
3	Hemidactylus brooki	Spotted house gecko	–	+
4	Lycodon aulicu	Non-poisonous snake, Dhaman	–	+
5	Lygosoma punctata	Spotted Supple Skink	–	+

6	Mabuya macularia	Bronze grass skink	–	+
7	Naza naza	Cobra, Nag	–	+
8	Psammophilus dorsalis	Rock agama	–	+
9	Ptyas mucosa	Indian Rat Snake	+	+
10	Bungarus caeruleus	Indian Krait	+	+

6.10 AVES (BIRDS)

S.No	FAUNA SPECIES	COMMON NAME	CORE	BUFFER
1	Accipiter badius	Little banded goshawk, Shikra	–	+
2	Actitis hypoleucos	Common Sandpiper	–	+
3	Ardeola grayii	Pond Heron, Bhura bagula	–	+
4	Acridotheres tristis	Common Myna, myna	+	+
5	Alcedo atthis	Common King fisher, Chhota kilkila	+	+
6	Bubulcus ibis	Cattle Egret, Gay bagula	+	+
7	Centropus sinensis	Crow-pheasant, Mahoka	–	+
8	Chloropsis cochinchinensis	Gold mantled chloropsis, Harit Kanchan	–	+
9	Columba livia	Blue Rock pigeon, Kabutar	+	+
10	Coracius benghalensis	Blue Jay, Neelkanth	–	+
11	Corvus splendens	House Crow, Kowa	+	+
12	Cypsiurus balasiensis	Asian Plam	–	+
13	Coturnix pectoralis	Stubble quail	+	+
14	Dendrocopos canicapillus	Grey- capped pygmy Woodpecker	–	+
15	Dendrocopos nanus	Indian pygmy Woodpecker	–	+
16	Dendrocitta vagabunda	Indian Tree Pie, Mahalat	–	+
17	Dinopium benghalense	Golden backed Wood pecker, Kathfodwa	–	+
18	Dicrurus adsimilis	King crow, Bhujang kotewal	+	+
19	Dryocopus Javensis	White-bellied Woodpecker	+	+
20	Egretta garzetta	Little Egret, Chhota bagula	–	+
21	Falco tinnunculus	European Kestrel, Koiyarut	–	+

22	Gallus gallus	Red Junglefowl	–	+
23	Halcyon smyrensis	White breasted Kingfisher, Kilkila	–	+
24	Hemicircus canente	Heart-spotted Woodpecker	–	+
25	Hierococcyx varius	Common Hawk-Cuckoo	–	+
26	Lanius cristatus	Brown Shrike	–	+
27	Lanius schach tricolor	Rufous backed Shrike, Kala latora	–	+
28	Megalaima asiatica	Berbet	–	+
29	Megalaima haemacephala	Crimson breasted Barbet, Chhota basant	–	+
30	Megalaima lineata	Lineated Barbet	–	+
31	Merops leschenaulti	Chestnut-headed Bee-eater	–	+
32	Merops orientalis	Green Bee-eater, Patringa	–	+
33	Mesophoyx intermedia	Smaller egret	–	+
34	Milvus migrans	Common Pariah Kite, Cheel	+	+
35	Nyctyornis athertoni	Blue-bearded bee-eater	–	+
36	Nettapus coromandelianus	Cotton teal	+	+
37	Oriolus tenuirostris	Slender-billed oriole	–	+
38	Oriolus xanthornus	Black headed oriole, Pitak	–	+
39	Pavo cristatus	Common Pea fowl, Mayur	–	+
40	Phaenico phaeus tristis	Large Green-billed Malkoha	–	+
41	Phalacrocorax niger	Little Cormorant	–	+
42	Pitta brachyura	Indian Pitta	–	+
43	Pseudibis papillosa	Black Ibis, Kala bagla	–	+
44	Psittacula cyanocephala	Blossom headed Parakeet	–	+
45	Passer domesticus	House sparrow	+	+
46	Perdicula asiatica	Jungle Bush Quail	+	+
47	Ploceus philippinus	Baya Weaver	+	+
48	Pycnonotus cafer	Red-vented Bulbul	+	+
49	Spilornis cheela	Crested Serpent Eagle	–	+
50	Spizaetus cirrhatus	Crested Hawk Eagle, Shahbaz	–	+

51	Streptopelia chinensis	Spotted Dove, Phakhta	–	+
52	Terpsiphone paradisi	Asian Paradise Flycatcher	+	+
53	Upupa epops	Common Hoopoe	+	+
54	Vanellus cinereus	Grey- headed lapwing	–	+
55	Vanellus indicus	Red wattled Lapwing, Titova	–	+
56	Vanellus malabaricus	Yellow Wattled Lapwing, ardee	–	+

Description: Where (+) indicates Presence and (-) indicates Absence of the species in thestudy area.

6.11 THE LIST OF THE FAUNA FOUND IN DANTEWADA FOREST DIVISION IS GIVEN BELOW AS SECONDARY DATA:

(Based on Divisional Working Plan record)

(A) Wild Animals			
SL. No.	**Local Name**	**English Name**	**Scientific Name**
1	Bandar	Rhesus Macaque (Red faced monkey)	Macaca mullata (Zimmermann)
2	Bandar	Common Langur	Presbytis entellus (Dufrense)
3	Barasingha	Swamp Deer	Cervus duvaceli (Cuvier)
4	Bhendiya	wolf	Canis Lupus pallipes
5	Bhalu	Sloth Bear	Melursus ursinus (Shaw)
6	Chital	Spotted Deer	Axis axis (Evxleban)
7	Chuchunder	Grey musk shrew	Suncus murinus (Linnacus)
8	Chuha (Musa)	Field Rat	Bendicota bengalensis
9	Gaur	Indian Bison	Bos gaurus (H.Smith)
10	Gilheri	Three striped squirrel	Funambulus pennanti (Wroughton)
11	Gilheri	Malabar squirrel	Soiurns species
12	Gilheri	Flyings squirrel	Manis crassicaudata
13	Chowsingha (Jangli-Bakri)	Four horned antelope	Tetracerus quadricornis (Blainville)
14	Jangli-Billi	Jangle Cat	Felis chaus (Guldensteadt)
15	Jangli-Kutta	Indian Wild Dog	Coun alpinus (Pallas)
16	Khargosh	Indian Hare	Lepus nigricollis (F.Cuvier)
17	Koliha(Siyar)	Jackal	Canis aureus (Linnacus)

18	Kotari	Barking Deer	Muticus muntjac
19	Lakhar bagha	Striped Hyaena	Hyaena hyaena (Linnacus)
20	Lomri	Indian Fox	Vulpes bengalensis (Shaw)
21	Newala	Common mongoose	Herpestes edwardsi (Geeftrey)
22	Otter	The common otter	
23	Nilgai	Blue Bull	Boselaphus tragocamelus
24	Sahi	Indian percupine	Hystrix indica (Kerr)
25	Sambhar	Sambhar	Cervus unicolour (Keer)
26	Suar	Indian wild boar	Sus scrofa (Linnaeus)
27	Tendwa(Gulbagh)	Panther	Panthera pardus (Linnaeus)

(B) Snake			
SL.No.	**Local Name**	**English Name**	**Scientfic Name**
1	Cobra	Cobra	Naja naja (Linnaeus)
2	Ajgar	Python	Python molurus
3	Chuhamar Sarp	Rattle Snake	Ptyas mucosus (Linnaeus)
4	Russel Viper	Viper	Vipera russeli (Shaw)
5	Krait	Krait	Bungamus caeruleus(Schncider)
6	Deo Sarp	Deo Sarp	Bungamus
7	Pani Sarp	Pani Sarp	Natrix piscator (Schneider)

(C) Lizard			
SL.No.	**Local Name**	**English Name**	**Scientfic Name**
1	Monitor Lizard	Monitor Lizard	Varanus monitor (Linnaeus)

(D) Crocodile			
SL.No.	**Local Name**	**English Name**	**Scientific Name**
1	Magar	Crocodile	Crocodilus crocodilus
2	Ghadiyal	Ghadiyal	Gavialis gangeticus

(E)Fishes		
SL. No	**Comman Name**	**Scientific Name**
1	Catla	Catla catla (Ham.)
2	Chanda	Chanda ranga (Ham.)
3	Magur	Clarias batrachus (Ham.)
4	Singh	Heteropneustes fossilies (Bloch)
5	Rohu	Labio rohit
6	Mahasir	Walago sffu
7	Kotri	Forfor gundius

(F) Birds			
SL.No.	**Local Name**	**English Name**	**Scientfic Name**
1	Bater, lowwa	Iangle Bush Quail	Perdicula asiatica (Latham)
2	Bater	Grey Quail	Coturnix coturnix (Linnaeus)
3	Baya	Baya weaver bird	Poceus philippinus (Linnaeus)
4	Bhangraj	Racket-Tailed Drenge	Dicrurus adsimilis (bechatein)
5	Bulbul	Red vented bulbul	Pyconotus cafer (Linnaeus)
6	Cheel	Common pariah kite	Milvus migrans (Beddaert)
7	Chhota Kilkila	Small blueking fisher	Alcedo atthis (Linnaeus)
8	Dudharaj	Paradise flycatcher	Tirpsiphone paradisi (Linnaeus)
9	Gai-Bagula	Cattle-Egret	Bulbulcus ibis (Linnaeus)
10	Gauriyya	House sparrow	Passer domesticus (Linnaeus)
11	Ghughu	Indian great horned owl	Bubo bubo (Linnaeus)
12	Gidh	Bengal vulture	Gyps Bengalensis (Gmelin)
13	Giria	Cotton teal	Nettapus coromadelianus (Gmelin)
14	Harial	Common green Pigeon	Treron phoenicoptera (Latham)
15	Hoppoe	Hoppoe	Upera epops
16	Jangli Kowwa	Indian Jangle Crow	Corvus macrothyches (Walgler)
17	Jangli Murgi	Grey Jangle Fowl	Gallus Sonneratii (Temminck)

18	Jangli Murgi	Red Jangle fowl	Gallus Gallus (Linnaeus)
19	Kabutar	Blue-rock Pigeon	Columba livia (Gmelin)
20	Kali Mayna	Bastar Hill Myna	Grecula religiosa (Linnaeus)
21	Katphora	Rufous wood peeker	Micro Ptirnus brachyurua
22	Katphora	Indian Golden backed peeker	Dinopium Javanense
23	Katphora	Lisser Golden backed peeker	Dinopium-benghalense
24	Katphora	Great Black wood peeker	Dryocopus Javensis
25	Kowwa	House crow	Carvus splondens (Vicillot)
26	Koel	Koel	Eudynamys scolopaceae (Linnaeus)
27	Mor, Mayur	Common Peafowl	Pave Cristatus (Linnaeus)
28	Myna	Indian myna	Acridotheres tristis (Linnaeus)
29	Nakta	Comb Duck	Sarkidicrnis melanotos Pennaeus)
30	Nilkanth	Blue Jay (Roller)	Coracias benghalensis
31	Nilkanth-Basant	Blue throated barbet	Megalaima asiatica
32	Pan-dubki	Lesser Whistling Teak	Dendrocygna Javanica (Horsfield)
33	Sarus	Sarus Crane	Grus antigone (Linnaeus)
34	Teetar Kala	Painted Partiridge	Francolinus Pictus (Jardine &Selby)
35	Teetar Safed	Grey Partridge	Francolinus Pondiceriunus(Gmelin)
36	Tota	Large Indian Parakeet	Psitta-cula eupatria (Linnaeus)
37	Ullo	Barn Owl	Tyto alba (Scopoli)
38	Ullo	Brown fish Owl	Bubo Zeylenensis (Gmelin)

CHAPTER – VII

OTHER ECOLOGICAL OBSERVATIONS

7.1 HABITAT STRUCTURE:

In the buffer area of BailadilaIron Ore Mine, Bacheli complex it has been tried to understand the wildlife habitat through and detailed study of Phyto diversity as well as faunal diversity. Wildlife requires places to hide in order to feel safe from people, predators, and inclement weather. Use things like indigenous vegetation, shrubs, thickets and brush piles or even dead trees. Wildlife needs a sheltered place to raise their offspring. The most important features of a wildlife habitat is its canopy cover, availability of fodder, prey, water etc. In general, good habitat conditions for wildlife can be created while managing canopy cover through plantation of indigenous species or other management practices. Information presented here will help in planning for an integrated land management program that optimizes timber growth, plantation of fodder species for herbivores and thus planning to create wildlife habitats and corridors. When considering improvements for wildlife habitat during land management operations, it has been emphasized to be aware of the habitat requirements of wildlife. Wildlife has four basic needs: food, cover, water, and space. The quantity and quality of these components determine the carrying capacity of the land – the maximum number of animals that can be supported in good condition throughout the year. Carrying capacity changes by season and by year as a direct result of changes in farm and forest habitat. With proper planning, forest management can be conducted in such a fashion as to improve habitat conditions for certain species of wildlife. In a truly integrated forest and wildlife management operation, the goal of maximum timber production is compromised in favor of producing quality habitat for wildlife. A reasonable compromise between maximum timber production and quality habitat ensures sustained profits from forest products as well as suitable habitat for wildlife. As forests are altered to grow timber products, wildlife habitats are also changed. Forest management operations that affect habitats include harvesting, site preparation, forest regeneration practices, and intermediate stand treatments. Each of these forestry practices will affect habitats by altering certain characteristics of the forest. Some of the habitat characteristics that influence wildlife are edge, habitat diversity, interspersion, and plant succession. Forest stand arrangement also influences the quality of wildlife habitat. Stand arrangement refers to how the forest stands are in relation to each other. For quality wildlife habitat, forest stands providing habitat components must be available within the home ranges of the wildlife species being managed. Proper arrangement of food, water and cover can often determine the use and value of these habitat components to wildlife. Poor arrangement of habitat components fails to make the best use of a particular site

for wildlife. Size and arrangement of forest stands largely determine the quantity and quality of edge and total forest diversity that is created. A mixture of pasture land, woodland, and non-forested land creates more diversity and edge than does a large block of one timber type.

7.2 AQUATIC HABITAT:

Aquatic habitat is an important part of buffer zone. Besides the small seasonal and perennial streams there are water bodies like Check dams on Galli nalla, Tailing Pond 1 and 2 of Deposit-5 etc. Water bodies of the whole study area have 22 aquatic plant species in different water bodies. These include species of Nymphaeaceae, Cyperaceae, Poaceae, Marsileaceae etc. Nymphoidescristatum as feed for young Labeorohita (Rohufish, a popular and palatable carp fish species), were evaluated in terms of growth, conversion efficiency, specific activity of digestive enzymes by Patraet. al (2002)15. Marsileaminutais used by local people as a leafy vegetable of high value and is also cultivated in water bodies. Pistiastratiotesis considered as an invasive water plant. There are 8 fish species belonging to the families Channidae, Cyprinidae and Nemacheilidae

7.3 STUDY OF PHYTOPLANKTONS:

Both phytoplankton and zooplankton were studied in 7 sites of the study area. Water bodies of the study area have 11 genera of phytoplankton available. This phytoplankton provides food to the aquatic animal species specially fishes. These species cycle most important elements like C, N, P, Si, O, S, Fe and are major part of the chemical-biological processes in an aquatic system. In addition to the biochemical cycles some physical processes like flow of energy has a great influence on the system, which means that light penetration, formation of thermocline and evaporation etc. They are the primary producers of aquatic ecosystems. Genera belonging to the group Chlorophyceae are most important primary producers as they are green algae having lots of chl-a and chl-b. This group has larger diversity with 6 genera confirming the fact that the water bodies are less polluted and good in primary production in aquatic systems. The other two groups like Cyanophyceae (blue green algae) and Bacillariophyceae (brown algae) are represented respectively by 03 and 02 genera. Though they are not as good as Chlorophyceae in carbohydrate production, they contribute much towards many other ecological processes of aquatic ecosystems.

7.4 STUDY OF ZOOPLANKTONS:

Besides phytoplankton there are zooplanktons belonging to 13 genera of which Daphnia sp., Moina sp. and Bosmina sp. genera are prominent. Zooplankton are microscopic animals that eat other plankton. They are primary consumers and they feed mainly on phytoplankton. Their

main ecological role is to provide sustenance for secondary consumers such as small fish, thus they are an essential part of most aquatic food chains. All the seven water bodies studied different species of zooplanktons but a point at 4 km away from Malinger Pump House Latitude - 18º 36'19.5" N Longitude – 81º 15'42.1" E (Altitude – 680 m) has the maximum number of genera i.e. 13. The diversity index of all the studied sites have been studied which varies from 0.69 to 2.63.

7.5 MICROBIAL STUDY:

Water samples collected from Kadampal lake (Latitude - 18^0 39' 31.2'' N Longitude – 81^0 17' 34.6'' E and Altitude – 590 mtrs) which is away from the mining area and within buffer zone. Villagers of nearby villages depend on this water body for various purposes starting from house hold use to bathing, using for cattle etc. It was tested for non-fastidious microorganisms (non-fastidious microorganism is often used in the field of microbiology to describe microorganisms that does not require any special nutrient medium to grow. Water samples collected from this sites show an MPN (Most Probable Number) index greater than 2. The water contains harmful bacteria belonging to the genera and species like E. coli, Enterobacter sp., Shigella sp., Streptococcus sp., Staphylococcus sp. and Actinomycetes sp.. Therefore this water is highly unpotable and, harmful for human consumption as the ratio value is more than 1.5. Samples collected from all the rest 6 locations are safe for use so far as microbiological quality is concerned. But mineral content needs to be assured before human consumption.

7.6 ETHNOBOTANICAL STUDY:

This is the study related to use of different plant species by local people mostly for food, medicine, and other traditional uses. Method of procuring ethnobotanical information: The procedure of gathering data, in general, was some as mentioned by Jain (1963a6, 1964a7, 1965a8, 1967a9). It included either interviews of the informants or witness of the uses during the period of work in the field. Information on plants associated with food, medicine, material culture and worship. The conservation aspects of the community, natural history, ethnology has been done by rapid ethnobotanical appraisal (REA) as suggested by Martin (199510). REA is a method by which quick assessment of ecological knowledge and resource use can be studied and assessed. This technique is adopted from various disciplines to form a collaborative approach. Informants were requested to accompany the study team during field visit, to detect the plants. Alternatively, a particular plant was picked up and queries made as to how it was useful for them. The reply was either description of the uses in details in all respects or a reply in negative. When discussion on one plant was over, a second plant was taken up, and so on, where possible both a man and women were engaged, as the women were supposed to know the foods, vegetables, medicine etc. and the men the materials in wood working, housing as well as medicine

7.7 SPECIES OF ECONOMIC IMPORTANCE:

The forest has good number of NTFP (Non-Timber Forest Product species) which are of economic importance to the people. During the study 22 such species could be identified which are economically important to the people within the study area. Some of these species are also important to the Forest Department as they fetch good amount of money as these are nationalized items. These products (Tendu leaf, Sal seed) are sold to the Govt. recognized agencies only. These species also need to be preserved in in situ condition.

CHAPTER-VIII
ECOLOGICAL RESTORATION & DEVELOPMENT PLAN

8.1 HABITAT DEVELOPMENT PLAN:

This area being within Reserve Forest all such works are to be conducted within the prescriptions of Forest Working Plan and in consultation with the Forest Department of Chhattisgarh. The conservation plan is made for Grass and Fodder Land Development near villages, In-Situ and Ex-Situ conservation of RET species and utmost importantconservati0on is to develop Tree Fern area in Ex-Situ and In-Situ.

Development of habitat by *ex situ* conservation through plantation, soil conservation, grass land development and development of water bodies. The existing canopy covers in these sites are less than 10% and therefore are ideal places for undertaking plantation work as a part of Biodiversity Management Plan keeping the natural tree cover intact. The degraded forest areas suggested here would be protected and maintained by the leases under the supervision of Forest Department during the plan period of 15 years.

Plantation will be carried out in the species-specific suitable forest areas with species as suggested.

It will be ensured that there is at least 70% survival rate at the end of the 3rd year. Within few years these plantations may develop as natural habitats though not natural forests and satisfy usufructuary need of villagers to certain extent.

8.1.1 MANAGEMENT OF OVERBURDEN DUMPS:

Opencast mining of iron ore deposits involves the removal of overlying soil and rock debris and their storage in overburden dumps. In this Deposit there is very thin layer of topsoil in the lease-hold area. Total generation of overburden for the said mining activities period as stated in the approved mining plan is 26,40,962 tones. It will have three waste dumps. As it is suggested in the approved mining plan of Deposit-4 of Bailadila approximately 0.277 million tons of waste will be generated in first year only. In the second year there will be no generation of waste but from the third year onwards generation of waste will increase gradually. First dump will be in the eastern flank of the non- mineralized zone. The second and third one will come up gradually. Both these waste dumps are proposed to be situated in the western flank of the mineral deposit. It needs to be mentioned here that Galli nalla is situated in the western side of the mineralized zone of Deposit-4. Utmost care will be taken to check any flow of waste materials to the Galli

nalla as this will be highly polluted and the lone habitat of Cyathea species found on both the sides of the nalla will be lost. This site is also being proposed as the in-situ conservation site of the species. Therefore, suitable storm water management and drainage network will be there to facilitate proper flow of precipitate run-off. In order to check erosion of waste materials, OB dump management will be done with some mechanical works like slope management, making parapet walls, making terraces etc. Stabilization of waste dumps will be full proof only after proper vegetation of the slopes as well as the top. Simple plantation of trees will not serve the purpose and therefore initial process of organic matter deposition will be carried out with plantation and seed sowing of grass species indigenous to the region.

Some species like Dalbergia sissoo (Sissum) and Leucena leucocephala (Subabool) will perform well in the slopes in the initial phase and other species like *Azadirachta indica* (Neem) and Prosopis juliflora will follow. 1st, 2nd and 4th species being leguminous will add N2 to soil. But monocots belonging to Poaceae are also recommended for seed dispersal along with the tree species stated above. Monocots have fibrous roots and act as good soil binders. Therefore, species belonging to Saccharum and Cymbopogon genera will be tried. A local species namely Thysalolaena maxima which is one of the pioneer species of this region can be propagated on the slopes of the OB Dumps for accelerating natural succession. Previously disrupted or damaged ecosystems like OB Dumps must begin with a chain of ecological succession

That ultimately leads to a more biodiversity and steady-state ecosystem. Since uncolonized land like that of waste dumps have thin, poor-quality soils with few nutrients, pioneer species die creating plant litter after some time, making new soil for secondary succession, and nutrients. *Thysalolaena maxima*is an indigenous species and may prove suitable for such an initiation process of secondary succession. This species prefers moist and well-drained soil with full sun light to 50% shade. This is beautiful plant that looks like bamboo but is actually a perennial grass. It is very tight clumping which makes it a good screener or feature plant. Chauliya has done an integrated study on biological stabilization of the dump slope. The study indicated that biological reclamation will be considered for long term stability of dump. The grasses have good soil binding capacity and help to control soil erosion and improve dump stability. Native grasses like Broom grass (*Thysalolaena maxima),* Bamboo (*Dendrocalmus strictus*) and Kashi (*Saccharum spontaneum*) are the important constituents of grass species which can stabilize the dump slopes. Field observation of root development of these grass species has indicated that the roots can proliferate up to 0.5 m depth on a Iron mine overburden dump after three years of vegetation. From the numerical modelling it has been analyzed that roots of these grasses which significantly enhance the factor of safety of dump slope from 1.2 to 1.4 have a positive role in maintaining long term stability. Some other species like *Cyperus rotundus* (Cyperaceae),

Alternanthera sessilis (Amaranthaceae), *Evolvulus nummularis* (Leguminosae), *Tephrosia purpurea*(Leguminosae), *Mimosa pudica* (Leguminosae) within which few Leguminous species are there will also be propagated to stabilize the soil. Ecological monitoring will also be done to see whether these species including *Thysalolaena maxima* and *Saccharum spontaneum* as suggested are able to accommodate themselveson the dumps.

Biological reclamation measures to be followed are as follows-

i) Planting soil binding species like grasses, agave on the slopes.

ii) Planting leguminous species in the terrace to improve nitrogen content of soil.

iii) The work plan formulated for plantation of the dumping sites through 'Integrated Biological and Biotechnological Approach' would be based upon the following parameters. Help of Tropical Forest Research Institute (TFRI) Jabalpur can be requested as they have carried out many experiments on this aspect and have a good number of publications.:

a) Evaluation of rock material for their physical and chemical properties to assess the nutrient status to support vegetation.

b) Formulation of appropriate blends of organic waste and soil to enhance the nutrient status of rhizosphere.

c) Isolation and screening of specialized strains of mycorrhizal fungi, rhizobium, azotobacter and phosphate solubilizers (bio-fertilizers inoculums) suitable for the mined-out sites.

d) Mass culture of plant specific biofertilizer and mycorrhizal fungi to be procured from different institutions/organizations, which are engaged in the phyto-remediation activity of degraded areas.

e) Plantation at quarry sites/areas using identified blend and biofertilizer inoculum.

In the later stage (after two years of soil work etc.) when the grasses, leguminous species and other shrubs establish themselves properly planting local species as stated below will be done on the terrace and the table of species suggested for plantation on the waste dump is given below (Table-8.1).

TABLE 8.1 SPECIES SUGGESTED FOR PLANTATION ON THE WASTE DUMPS.

Sl No	Tree species	Utility
1.	*Acacia nilotica*	Fuel, timber, fodder
2.	*Albizia lebbeck*	Fodder, fuel
3.	*Annona squamosa*	Fuel, fruit
4.	*Bauhinia variegate*	Fodder, fuel
5.	*Sesbania suevalensis*	Fuel, timber
6.	*Cassia fistula*	Fuel, timber
7.	*Dalbergia sissoo*	Timber, fuel
8.	*Ficus benghalnensis*	Fruits and shelters
9.	*F. religiosa*	Fodder
10.	*Pongamia Pinnata*	Shelter
11.	*Leuceana leucocephala*	Fodder, fuel
12.	*Morus indica*	Timber, fuel
13.	*Prosopis sp*	Fodder, fuel, timber
14.	*Syzygium cumini*	Timber, fuel, fruit
15.	*Tamarindus indica*	Fodder, fuel, timber
16.	*Terminalia tomentosa*	Fuel, timber
17.	*Zizyphus sp.*	Fodder, fuel, fruit

Most of the above species have high growth rate and are drought resistant. For arresting dust tree species with broad leaves, closely arranged leaves, compact branching, wax coated leaves, can efficiently arrest dust. Leaf surfaces arrest dust 10/20 times more than the usual earth surface.

The above list contains plants as suggestions for revegetation. Selection and choice of the species should be done by the Forest Department checking the occurrence of native species among these plants.

8.1.2 MANAGEMENT OF SOIL EROSION IN THE BUFFER ZONE:

Construction of check dams and gully plugs will be taken up to arrest soil erosion. Terracing of dumps and plantation on the dump slopes to stabilize them will be effective in reducing soil erosion. A few mining majors used geo-textiles16 to arrest erosion on their dumps but scientists and others see more scope for soil bioengineering as more than 50 million tons of rejection is produced every year. The mining companies have tried coir-based geo-textiles as a cheaper and

more easily available option than lateritic material to cover the clay dumps. This is thin, bio-degradable, and permeable material made up of coir, cotton, jute, interwoven with nylon filaments and reduces the impact of erosion by rain on OB dumps.

Bailidila Iron Ore Mines Bacheli Complex is also using geo textile for rehabilitation of waste dumps. In the buffer area 10 km radius of ML area is highly undulated. It is observed that 68.19% of the area has different slope classes (Very steep 6.65% with more than 45% of slope, steep within 25-45% is in 25.16% of area, Moderate slope i.e. within 12-25% in 17.84% area, Gentle slope and plain area with 0-12% slope in 50.35% area). The core zone has the following slope classes very steep is in 24.78% area, steep which is in 54.40%, moderate in 10.45% area and 10.36% area. Soil and moisture conservation works will be carried out in 50 identified sites in slopes of deep gullies by check dams (boulder check dams) at a short interval and shall be erected to arrest silt and encourage water conservation. Coir-based geo-textiles will be used in large gullies instead of lateritic materials to cover the clay dumps so that plantation works can be done easily. Biological stabilization of check dams can be done with the species stated below. Conservation of soil with Fimbristylissp. – This species is considered as emergent one which can grow in water and land also. Their extensive rhizomes grow rapidly to bind the soil together and absorb nutrient, changing the habitat. Fimbristylissp is found to grow in soil of the slopes. *Thysanolaena maxima* or Tiger Grass seeds has been under-used as a landscape plant, until recent years. It is easily mistaken for a Bamboo as they share a lot of the same traits. Tiger Grass is made up of numerous long slender canes, which are topped with drooping, green, bi-lobed leaves. The leaves only grow out of the very top of the canes, which gives the plant a mushroom like appearance. When mature, Tiger Grass will start to produce purple flowers, which resemble the tassels on corn. The canes don't produce side shoots, so plants maintain a neat and tidy appearance, unlike some bamboo species. It is a beautiful plant that looks like bamboo but is a perennial grass. It is very tight clumping which makes it a good screener or feature plant.

8.1.3 SAFETY BARRIER AND GREEN BELT AROUND MINE AND OTHER BUILT-UP AREA:

The main objective of the green belt is to provide a barrier between the source of pollution and the surrounding areas. The green belt helps to capture the fugitive emission and to attenuate the noise generated apart from improving the aesthetics. Development of green belt and other forms of greenery shall also prevent soil erosion and washing away of topsoil besides helping in stabilizing the functional ecosystem and further to make the climate more conducive and to restore water balance. The wind rose diagram of this area shows that maximum wind flow occurs towards north-east and south-east direction. Therefore, in this direction at least 15m width plantation will be done to arrest suspended particulate matter (spm) and other pollutants.

Indigenous species suggested for arresting air pollutants like PM2.5 (fine particulate matter), PM10 (coarse particulate matter), SO2and NOx pollution are ***Alstonia scholaris***, ***Annona squamosa***, Cassia fistula, Bauhinia purpurea, Cassia siamea, Dalbergia sissoo, Ficus benghalensis, Ficus religiosa, ***Peltophorum ferrugineum***, ***Syzygium cumini***, ***Butea monosperma***, Tamarindus indica, Melia azedarach, Terminalia tomentosa etc. The plantation species have been considered based on the following:

- Adapted to the Geo-climatic conditions of the area;
- Mix of round, spreading, oblong and conical canopies;
- Different heights ranging from 4 m to 20 m; and
- Species, which are evergreen trees.

8.1.4 BIOLOGICAL RECLAMATION AFTER BACK FILLING IN THE MINED-OUT PITS:(If required)

Backfilling of the mined-out area will be done only after 21st year of beginning of operation. Top soil will be kept in a separate place and preserved to be used after 21st year of production when back filling work will start for restoring the mined-out land. Topsoil (within 0-30cm) kept aside will be used on the back filled broken area and plantation work will be carried out. This is evident that the biological nature of the top soil will not be retained but the physical nature i.e., ratio of sand, silt and clay or the mechanical organization will be retained which will be conducive for growth of plants. Process of natural succession will be more comfortable with the texture of top soil rather than back filled soil with completely inert materials and unsuitable soil texture.

During terrace plantation and slope plantation is also suggested with the species like Sesal (Agave americana), ***Dendrocalamus strictus*** (kanta bamboo) to stabilize the slope. Grass species like Broom grass ***(Thysalolaena maxima)*** and Kashi ***(Saccharum spontaneum)*** will be tried for soil binding. On the terrace, species like Albizzia lebbeck (siris), ***Acacia nilotica*** (babool), Acacia catechu (khair), Emblica officinalis (amla), Pongamia pinnata (Karanji) etc will be planted. Species suggested in table-8.1 are to be planted after stabilisation of the soil to a certain extent.

8.2 SOIL & MOISTURE CONSERVATION:

Soil conservation is linked to water use as soil properties influence the movement and storage of water. Soil texture and soil structure, strongly influence the way water behaves in a soil. Moreover, these properties affect the movement of water into the soil, drainage, and water storage in the soil profile.

The preferred soil conservation practices are:

- Developing vegetation belts and plantation of species which are good soil binders.
- Construction of check dams (boulder check dams) and terracing.
- Using geo-textiles for controlling soil erosion.

8.3 WETLAND CONSERVATION:

Site selection and demarcation for construction of water body.

- Excavation and preparation of pit for holding rain water according to predetermined dimensions (water body perimeter, water body depth, water body surface area and volume).
- Slope preparation for collection of flowing water
- Creation of a thick vegetation belt along the bank. Forested catchments supply a high proportion of the water for domestic, agricultural, industrial and ecological needs. It is in maintaining high water quality that forests make their most significant contribution to the supply of water. Through the stabilization of soils, forests minimize erosion. Furthermore, by trapping sediments and pollutants from other up-slope land uses and activities, forests can protect water bodies and watercourses. Other benefits of forests to water are multiple, by intercepting precipitation, evaporating moisture from vegetative surfaces, transpiring soil moisture, capturing fog water and maintaining soil infiltration, forests influence the amount of water available. By maintaining or improving soil infiltration and soil water-storage capacity. For Sustainable management of water bodies:
- Vegetation should be established along the down slope field edge to filter sediment, pollutants and runoffs entering water body.
- Plantation of deep-rooted native plants along the bank of water body to reduce soil erosion and loss of valuable land.
- Regular monitoring of water quality parameters such as DO, BOD, turbidity etc. Check the nutrient level (nutrient and phosphorus) to prevent eutrophication.

CHAPTER-IX
SUMMARY AND FINANCIAL OUTLAY OF BIODIVERSITY CONSERVATION PLAN

Bailadila Iron Ore Deposit No.- 4,Bacheli, District Dantewada in the state of Chhattisgarh of NMDC-CMDC Ltd. (NCL) is situated in Bacheli range of Dantewada Forest Division.

The project and Impact area is having biodiversity status in complex composition. On the one hand the area is having forest of Sal and its associates and on the other hand some part of the ML area is a typical Tree fern area which is of prime importance as far as conservation is concerned. This study and plan has considered many ecological aspects for conservation of Biodiversity.

The prominent feature of this conservation plan is summarized as below: -

I. **Ecological Balance:** Maintenance of ecological balance through protection, conservation and development of wherever likely to be disturbed due to Mining project activities.

II. **Key considerations:** Conservation, protection and development of natural habitats in Impact zone

III. **Conservation:** Protection, conservation and Rehabilitation of critical species (endemic and threatened species of this region), if any with provisions for in-situ or ex-situ conservation of critical/ important plant/ animal species.

IV. **Mitigation and development:** Mitigation and control of project induced biotic and/or abiotic pressures/influences that may affect the natural habitats, Habitat enhancement in project Impact zone by taking up forestation and soil conservation measures

V. **People's Awareness:** Creating all round awareness regarding conservation and ensuring people's participation in the conservation efforts and minimizing human - animal conflict.

All the remedial measures for Bio diversity conservation (Including tree fern) in the Project area and Impact Zone have been discussed in chapter-5 and 8

The proposed activities, which are to be executed by **State Forest Department**, are as follows.

1. **Nursery Development for Tree Fern species for plantation of 75 Ha. In Impact / Buffer area.** (For details, please refer chapter 5)
2. **In situ conservation of Tree fern and its associates falling in Project area (75. 0 Ha) Ex situ conservation of Tree fern and its associates falling outside Project area (75 Ha.)** (For details, please refer chapter 5)
3. **In-situ Conservation of RET species in PF/RF of study area and its maintenance one plot of 10 Ha. Each year for 5 years (5 Plots= 50 Ha.) Ex-situ Conservation of RET species and its maintenance for 5 years (50 Ha)** (For details Please refer chapter 5)
4. **Nursery Development for RET species for plantation of 50 Ha. In Impact / Buffer area.** (For details, please refer chapter 5).

5. **Monitoring of EX-SITU and IN-SITU Conservation activities for Tree Fern and RET species (Experts are to be appointed by The Chhattisgarh Bio Diversity board)**
6. Biodiversity development park is proposed to develop at Dantewada district HQ for Education purpose of Front-line staff and People and students.
7. Development of Training and Interpretation center- Construction of center
8. Provision for Training & Awareness for BMC Members at Village level in Buffer area.
9. Budgetary provision for Grass and leaf fodder species in common land, /farmers land area in 24 affected villages in Impact / Buffer zone (total 120 Ha). Grass land plan and rotational grazing shall be prepared by forest department, Budgetary provision for Additional 100 Ha grass and leaf fodder plot in adjoining forest area (10 Ha each from 6th year onward) including maintenance. Grass land plan and rotational grazing plan shall be prepared by forest department.
10. Plantation of Horticulture species and Ethno- botanical/ medicinal importance species in affected 24 villages and their maintenance for 3 years
11. Organizing study tour and exposure visit within country for Experts/ Scientists/ People/ Villagers/ Students etc.
12. Provision for Providing and fixing of Bird nesting boxes
13. Provision for Development of Butterfly habitat development in 5 areas (near human habitations)
14. Soil, Water and Moisture conservation in respect of Tree Fern area fall in ML area. Please refer Part B and Chapter IV
15. Provision for Chain link fencing 6feet height for the protection of tree fern area in Buffer Zone (10 Kms radius from ML area) and other area having tree fern species.
16. Provision for Biodiversity Conservation and management Plan (BCMP) (Faunal Component) for 5 years i.e., provision for field experts.
17. Monitoring and Evaluation of works

Works to be carried out from CSR fund

Following Suggested works to be carried out in villages in Impact and nearby area from CSR fund: These activities shall be taken up from **CSR fund of User agency** , plan for this shall be prepared by concerned DFO and utilize the fund.

Development of Biodiversity used by the local communities, like vegetable andfruits organic farming i.e. apiculture and aqua culture, particularly and their associated

(i) Organic Vegetable and fruit farming Program in 24 villages
(ii) Village level Fish Farming in adjacent 24 villages
(iii) Apiculture - Honeybee Farming in 24 villages for 35 villagers each

The financial requirement of various interventions suggested in the plan is considered as per current labor wage rate in the Dantewada district and financial norms of various forestry activities.

Escalation in budgetary provision shall be proposed as per the prevailing future rate of inflation and Divisional Forest officer Dantewada division shall demand it from User agency as and when required.

Plan period: The Plan period of 15 years proposed from the date of approval of this plan.

Financing: All the activities given in the financial outlay of plan will be implemented by State Forest Department with budgetary provision arranged by user agency NCL

Proposed financial provisions – **Rs**. **3107.733 Lacs** (Year wise proposed expenditure given in table below)

IMPORTANT NOTE FOR DIVISIONAL FOREST OFFICER:

i) All the activities given in the financial outlay of plan will be implemented by State Forest Department through Divisional Forest Officer Dantewada with availability of budgetary provision by user agency

ii) Area for development as suggested in plan shall be finalized by the Divisional Forest Officer of Dantewada Forest division after thorough field visit and verification for site specific development plan.

iii) Any changes in proposed plan shall be allowed to the Divisional Forest Officer of Dantewada Forest division after getting due approval from Chief Conservator of Forest Jagdalpur Circle/ APCCF Bio Diversity / PCCF

iv) Utilization of such budget should be well planned by Divisional Forest Officer Dantewada Division and done after taking due approval from Chief Conservator Of Forest Jagdalpur Circle.

Other recommendations which are to be carried out by **user agency** are as follows

- **Wetland Habitat Development in Back Filled Area if any**
- **Management Of Overburden Dumps**
- **Safety Barrier and Green Belt Around Mine and Other Built-Up Area**
- **Biological Reclamation After Back Filling in The Mined-Out Pits**
- **Monitoring Soil and water Testing of Galli nalla as explained in Chapter 5-point no. 5.16 (Testing shall be done in every three month)**

The budgetary provisions for these activities shall be made by User agency NMDC-CMDC Ltd. (NCL)

Formation of Research, Monitoring and Evaluation Committees:

As per the recommendation in the plan there is need to engage many subject experts/ specialists/ expert NGOs to monitor and evaluate the execution of plan for which financial provisions are in made herewith.

As suggested in the plan a thorough action plan for research, monitoring and evaluation activities are to be prepared by the department. Periodical reports on progress of the recommendations shall be prepared and published.

For people's participation, a monitoring committee will be formed in Division level under the Chairmanship of the D.F.O. The other members will be concerned SDO, Range Officers and a representative of Village Forest Committee.

Monitoring committee will meet at least twice in a year to review implementation of the prescriptions of this plan and sort out bottlenecks also the committee will evaluate level of human-animal conflict indicators like human injuries and death of human in the zone of influence, incident and extent of fire, area burnt, grazing pressure and illegal felling.

Special monitoring of Water analysis of Galli Nalla and Other Water flows falling in Core and Buffer Zone of the Project:

The current management plan mentions about the quality soil and water monitoring of Galli nalla like Ph, TDS and temperature etc. as mentioned in chapter 5-point no. 5.16 It is recommended user agency NCL now submit a testing report of all the parameters as mentioned in chapter 5-point no. 5.16 prior to start of mining operation or within one month of approval of the plan whichever is earlier that subsequently all parameters are to be checked properly at the interval of every three month by the user agency till entire mining operation period and a detail report should be submitted to Divisional; Forest Officer Dantewada for assessment. If change in any parameter, immediate corrective action shall be taken by the User agency NCL based on the recommendations by expert committee and such committee shall be constituted by the Divisional Forest Officer, Dantewada Forest Division.

Proposed Expenditure For Bio Diversity Conservation
In Iron Ore Mines Area NMDC CMDC Ltd. Deposit 4
Dantewada Forest Division

Sr. No	ITEM	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total (Rs. In Lacs)
1	Cost of Infrastructure development for nursery for tree fern and REET spp.	50.00	20.00	10.00	10.00	10.00	0	0	0	0	0	0	0	0	0	0	**100.00**
	Nursery Development for Tree Fern and RET species for plantation of 125 Ha. In Impact / Buffer area Please Refer Chapter 5, point 5.11	47.4375	12.9375	4.7438	1.2938	0	0	0	0	0	0	0	0	0	0	0	**66.4126**
2	**Conservation of Tree Fern (For details Please refer chapter 5)** In situ conservation & Protection of Tree fern and its associates falling in Project area Within ML area and along Galli nalla (75. 0 Ha)	10	10	10	10	10	5	5	5	5	5	5	5	5	5	5	**100**

	Ex situ conservation of Tree fern and. its associates falling outside Project area (Within 10 Km from periphery of ML area) (75 Ha.)	0	0	0	20	20	20	5	5	5	5	5	5	5	5	5	**105**
3	Budgetary provision for RET species (For details Please refer chapter 5) (i) Nursery Development for RET species for plantation of 50 Ha. In Impact / Buffer area. Please refer chapter 5	29.90	7.47	2.99	0.299	0	0	0	0	0	0	0	0	0	0	0	**40.659**
	(ii) In-situ Conservation of RET species in PF/RF of (Within 10 Km from periphery of ML area) and its maintenance one plot of 10 Ha. Each year for 5 years (5 Plots = 50 Ha.)	20.0 1 Plot (10Ha.)	20.0 1 Plot (10Ha.)	20.0 1 Plot (10Ha.)	20.0 1 Plot (10 Ha.)	20.0 1 Plot (10 Ha.)	0	0	0	0	0	0	0	0	0	0	**100.00**
	(iii) Maintenance of RET species in-situ plots (5years) (50 Ha.)	0	3.0 1 plot (10 ha)	6.0 2 plots (20Ha.)	9.0 3 plots (30Ha.)	12.0 4 Plots (40Ha.)	15.0 5 plots (50Ha.)	12.0 4 plots (40Ha.)	9.0 3 plots (30Ha.)	6.0 2 plots (20Ha.)	3.0 1 plot (10Ha.)	0	0	0	0	0	**75.00**

	(iv)Ex-situ Conservation of RET species and including maintenance for 5 years (Within 10 Km from periphery of ML area) (50 Ha)	0	0	0	30.0 10 Ha	30.0 10 Ha	30.0 10 Ha	30.0 10 Ha	30.0 10 Ha	0	0	0	0	0	0	0	**150.0**
4	Budgetary provision for Biodiversity Conservation & protection of Forest. (Watch and Ward for 15 years	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**75.00**
5	Biodiversity Park is proposed to develop at Dantewada district for Education purpose of Front-line staff, Miners and People and students.	150.0	50.0	0	0	0	0	0	0	0	0	0	0	0	0	0	**200. 0**
6	Budgetary provision for Research Monitoring and Evaluation of plan including cost of subject specialist/ experts/ expert NGO.	0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0	2.0	1.0	1.0	**35.00**

7	Development of Training and Interpretation center A. Construction of center	100.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**100.00**
	B. Regular Training, Awareness program, Seminar, Lectures and Orientation program on Biodiversity Conservation	0	10	10	10	10	5	5	5	5	5	5	5	5	5	5	**90.00**
8	Budgetary provision for Training & Awareness for BMC Members at Village level in Buffer area.	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	**90.0**
9	I) Budgetary provision for Grass and leaf fodder species in common land, /farmers land area in 24 affected villages in Impact / Buffer zone (total 120 Ha). Grass land plan and rotational grazing shall be prepared by forest department.	10.0	10.0	10.0	10.0	8.0	0	0	0	0	0	0	0	0	0	0	**48.00**
		25 Ha (5 village)	25 Ha (5 village)	25 Ha (5 village)	25 Ha (5 village)	20 Ha (4 village)											

	II) Additional budgetary provision for Maintenance of grass and leaf fodder plots 5 years	0	1.0	2.0	3.0	4.0	4.8	3.8	2.8	1.8	1.0	0.8	0	0	0	0	**25.00**
			25 Ha	50 Ha	75 Ha	100 Ha	120 Ha	95 Ha	70 Ha	45 Ha	25 Ha	20 Ha					
	(III) Budgetary provision for Additional 100 Ha grass and leaf fodder plot in adjoining forest area (10 Ha each from 6th year onward) including maintenance. Grass land plan and rotational grazing shall be prepared by forest department.	0	0	0	0	0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**50.00**
							10 Ha	10 Ha	10 Ha	10 Ha	10 Ha	10 Ha	10 Ha	10 Ha	10 Ha	10 Ha	
10	Plantation of Horticulture species and Ethno-botanical/ medicinal importance species in affected 24 villages and their maintenance for 3 years	40.0	40.0	40.0	0	0	0	0	0	0	0	0	0	0	0	0	**120.0**
11	Organizing study tour and exposure visit within country for Experts/ Scientists/ People/ Villagers/ Students etc.	10.0	10.0	10.0	10.0	10.0	0	0	0	0	0	0	0	0	0	0	**50.00**

12	**Monitoring of EX-SITU and IN-SITU Conservation activities:** A panel of Expert team shall monitor the EX-SITU and IN-SITU Conservation activities. The budget shall be deposited in Chhattisgarh Biodiversity Board's account.	40.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**40.0**
13	(I) Budgetary provision for Providing and fixing of Bird nesting boxes (50 boxes in 4 locations and replicate after 2 years) i.e., 400 boxes	4.00 200 Boxes	0	4.0 200 Boxes	0	0	0	0	0	0	0	0	0	0	0	0	**8.00**
	(II) Budgetary provision for Monitoring activity after 2 years	0	0	1.00	0	1.00	0	0	0	0	0	0	0	0	0	0	**2.00**
14	Budgetary provision for Development of Butterfly habitat development in 5 areas (near human habitations)	9.0 3 areas	6.0 2 areas	0	0	0	0	0	0	0	0	0	0	0	0	0	**15.00**
15	Estimated cost of Soil, Water and Moisture conservation in respect of Tree Fern area fall in ML area. Please refer Part B and Chapter IV	**910.1382**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**910.1382**

16	Repair and Maintenance of SWM Conservation Structure After Every Third year till Plan Period	0	0	0	10	0	0	10	0	0	10	0	0	10	0	0	**40.00**
17	Provision for Chain link fencing 6feet height for the protection of tree fern area in Buffer Zone (10 Kms radius from ML area) and other area having sporadic occurrence of tree fern species.	50.0	50.0	50.0	40.0	0	0	0	0	0	0	0	0	0	0	0	**190.0**
	Total	**1491.476**	**264.4075**	**194.7338**	**197.5928**	**149**	**98.8**	**89.8**	**75.8**	**41.8**	**48**	**33.8**	**33**	**43**	**32**	**32**	**2825.212**
	10% Escalation	**149.1476**	**26.44075**	**19.47338**	**19.75928**	**14.9**	**9.88**	**8.98**	**7.58**	**4.18**	**4.8**	**3.38**	**3.3**	**4.3**	**3.2**	**3.2**	**282.5212**
	Grand Total	**1640.623**	**290.8483**	**214.2072**	**217.3521**	**163.9**	**108.68**	**98.78**	**83.38**	**45.98**	**52.8**	**37.18**	**36.3**	**47.3**	**35.2**	**35.2**	**3107.733**

Annexures

No. IA-J-11015/104/2021-IA-II (NCM)
Government of India
Ministry of Environment, Forest and Climate Change
Impact Assessment Division
***

2nd Floor, Prithvi Wing,
Indira Paryavaran Bhavan,
Jor Bagh Road, Aliganj,
New Delhi-110 003

Dated: 11th March, 2022

To,

M/s NMDC-CMDC Ltd (NCL),
Green Villey City, Housing Board Colony,
Boriyakala, Sejbahar, Raipur,
Chhattisgarh – 492 015.

Subject:- Proposal for Terms of Reference (ToR) of M/s National Mineral Development Corporation - Chhattisgarh Mineral Development Corporation Limited (NCL), a joint venture of National Mineral Development Corporation Limited (a Central Government Public Sector Undertaking under the administrative control of Ministry of Steel), and Chhattisgarh Mineral Development Corporation Limited (a Government of Chhattisgarh Public Sector Undertaking) is for mining of Iron ore in Bailadila Iron Ore Deposit-4 Mine with production capacity of 7.0 MTPA ROM Iron ore and 6.41 MTPA Waste Excavation (Total Excavation 13.41 MTPA) along with 2000 TPH Crushing plant in the mine lease area of 646.596 ha, located at Village & Tehsil Bacheli, District Dantewada, Chhattisgarh – [File. No: IA-J-11015/104/2021-IA-II(NCM) Proposal No: IA/CG/MIN/251288/2021; Consultant: M/s Ecomen Laboratories Pvt Limited] - Terms of Reference (ToR) regarding.

Sir,

This has reference to the online proposal no. IA/CG/MIN/251288/2021 of M/s National Mineral Development Corporation - Chhattisgarh Mineral Development Corporation Limited (NCL), a joint venture of National Mineral Development Corporation Limited (a Central Government Public Sector Undertaking under the administrative control of Ministry of Steel), and Chhattisgarh Mineral Development Corporation Limited (a Government of Chhattisgarh Public Sector Undertaking) is for mining of Iron ore in Bailadila Iron Ore Deposit-4 Mine with production capacity of 7.0 MTPA ROM Iron ore and 6.41 MTPA Waste Excavation (Total Excavation 13.41 MTPA) along with 2000 TPH crushing plant in the mine lease area of 646.596 ha, located at Village & Tehsil Bacheli, District Dantewada, Chhattisgarh. The mine lease area is located between Latitude 18°41'26.17920"N to 18°43'38.52758"N and Longitude 81°12'02.90192"E to 81°13'07.02661"E. The mine lease area falls under the Survey of India Toposheet No: 65F/2 and falls in Seismic Zone-II. The Project Proponent presented the KML file during the presentation to indicate the location of mine lease on Google Earth.

2. The Project Proponent initially made an online application vide proposal no: IA/CG/MIN/241426/2021 dated 30.11.2021 and submitted Form1 and Prefeasibility report under the provisions of the EIA Notification, 2006. The proposal was earlier considered in the 43rd EAC (Non-Coal Mining) meeting held during 14th – 16th December, 2021. During the meeting, the Committee noted that the Project Proponent informed that the Mineral beneficiation plant is proposed outside the mine lease area. The Committee observed that the instant proposal is covered under category of 2(b) of EIA notification, 2006, which is standalone and outside the mine lease area and hence the EAC (Non-Coal Mining) Committee cannot appraise the instant project proposal. Therefore, the Committee returned the proposal in present form and was of the view that the Project Proponent should revise the Form1 and PFR accordingly with the factual information and data.

3. Now, the Project Proponent submitted a fresh proposal vide proposal no: IA/CG/MIN/251288/2021 dated 14.01.2022 and submitted Form1 and Prefeasibility report under the provisions of the EIA Notification, 2006. The proposed project activity is listed at schedule no. 1(a) Mining of Minerals under Category "A" of the schedule of the EIA Notification, 2006 as the mining lease area is greater than 100 ha and appraised at Central level.

4. **Details of Mine lease:**

S.no	Lease particulars	Date of the grant	Name of the Mineral	Validity	Granted by	Mine lease area in Ha
1	Ministry of Mines vide Notification G.S.R. 697(E) reserves an area of 646.596ha in Bailadila reserve forest, Deposit No. 4, District South Bastar, Chhattisgarh for mineral iron ore for undertaking prospecting or mining operations	30.09.2019	Iron ore	5 years	Ministry of Mines, GoI	646.596
2	Letter of Intent for grant of mining lease vide Lr No: F-2-2-/2005/12	26.06.2021	Iron ore	5 years	Mineral Resource Department, Government of Chhattisgarh	646.596

3	Amendment in Letter of Intent granted vide Lr No 2-20/ 2005/12 prescribing the requirement of approved Mining Plan	07.08.2021	Iron ore	5 years	Mineral Resource Department, Government of Chhattisgarh	646.596

5. The Project Proponent submitted that Approval of Mining Plan including Progressive Mine Closure Plan approved by Indian Bureau of Mines vide Lr No Dantewada /Fe/Khanij-1292/2021/-Raipur dated 24.09.2021 over an area of 646.596ha.

6. The Project Proponent submitted that fully mechanized opencast method of mining will be adopted. PP submitted it is proposed to deploy 150 mm dia rotary percussive drills along with crawler drills of 100mm dia for mine development and bench preparation of mines during 1st five years of operation. Charge per hole is around average of 140 kg for 150 mm dia hole & around average of 400 kg for 250 mm dia hole in ore and waste. PP reported that the mineable reserves estimated about 109.01 MT which will last for about 21 years with proposed production capacity of 7 MTPA. PP also reported that bench height of 12m and bench width of 30m will be maintained during operation phase. The ultimate pit slope will be 45°. Ore production and waste removal will be done by 3.2 cum bucket excavator. 4.0 cu.m Front-end loaders will be used for loading purposes including final products. PP submitted that the haulage of blasted ore from mining faces to the mobile ore dressing plant will be done by means of conventional off high way heavy duty dumpers having a payload capacity of 25 T. The same capacity truck will be used for waste transportation to waste dump. PP also submitted that the during the 1st five years of mining operations, mobile ore dressing plant will be installed at the mine site for production of CLO/Lump (-40+10mm size & -20mm +10mm) & Fines (-10 mm). Once the Crushing plant along with Downhill Conveyor facilities are installed the ore will be Crushed in the Crusher and subsequently transported through Downhill conveyor for further processing. The crushing plant proposed to be installed at hilltop within the mine lease boundary. To connect Primary Stockpile at hilltop and Screening Plant at foothill, various options of downhill conveyor system have been worked out. The crushed ore will be transported through downhill closed conveyor belt system to the screening plant. Once, these facilities are installed, ROM ore, (-) 1,200 mm, from the mine shall be fed to the crushing plant with the help of dumpers at the truck dumping position. The crushed ore of (-) 350mm after being passed through the metal detector is fed to a scalping screen for separation of (-) 150mm size material. The oversize (+150mm) from the scalping screen will pass through secondary cone crusher and reduce to (-) 150mm size. During the plan period, only dry process will be adopted. There will not be any generation of sub-grade middling's and rejects. ROM excavated from the pit will be directly fed to the ore dressing plant. Hence, quantity of the ROM excavation and feed to the plant will be same. Since, dry process is proposed to be adopted during first five year plan period, product grade will be same as feed grade of the plant. The products, i.e., CLO (-40+10 mm) & Fines (-10 mm) generated at mine head by mobile ore dressing plant installed temporarily during this mining plan period will be

transported to loading plant proposed near Bhansi Railway Station for onward dispatch to NMDC Steel Plant at Nagarnar, Jagdalpur (C.G.) and other customers. PP reported that the waste generation till the life of the mine will be 68.173 Million Tonne (MT). Waste (Shale and Banded Hematite Quartzite) will be dumped in the waste dump at top level of 1040 MRL (dump1) and 995MRL (dump2) during this plan period which is outside ultimate pit limit. Remaining amount of waste will be backfilled in the North block after extracting all the ores and associated waste materials during the life of the mine. PP reported that the mining activity will not intersect the ground water table during life of the mine.

7. The Project Proponent reported that the water requirement envisaged to be around 4,250 cu.m per day which will be met from the source of existing Sankini Nalla at EL. (+) 1025.00 at Hill-top and Nerli Nalla at EL. (+) 450.00 at Foot-Hill. PP also submitted that Permission for withdrawal of water from Sankini Nalla and Nerli Nalla will be obtained from Water Resource Department, Government of Chhattisgarh.

8. Nearest village / town/ highway/railway station / water bodies:

Particulars	Particular's Name	Distance & Directions
Village	Nerli	4.7 km, NE
	Bhansi	7.5 km, NE
	Hiroli	7.8 km, W
	Gyatapara	5.0 km, E
	Padhapur	4.5 km SE
Town	Bacheli Town	3.1 km, ESE
	Kirandul Town	6.3 km, SE
Highway	SH-5	3.7 km, E
Railway station	Bacheli Railway station ,	2.7 km, E
	Bhansi Railway station,	7.5 km, NNE
	Kirandul Railway station	7.7 km, SE
Water bodies	Tumka Nala	3.0km, W
	Berudi Nadi	6.0km, W
	Mari Nadi	3.2km, NW
	Pali Nadi	5.3km, NW
	Sankani Nadi	5.4km, E,
	Koyar Nadi	8.2km, SE
	Kadampal Dam	8.2km, SE

9. The Project Proponent reported that the entire mine lease area of 646.596 ha is forest land. PP submitted that the forest clearance will be obtained for a total area of 570.1 ha [646.596ha - 76.496ha (tree fern area not to be diverted)] inside the mining lease area and 100.077ha outside the mining lease area. PP also submitted that application for Stage-I Forest Clearance applied vide proposal no. FP/CG/MIN/146694/2021 dated 04.10.2021 and is under process. PP also reported that there are no National Park, Wildlife Sanctuary, Eco Sensitive Areas, Elephant/Tiger Reserve, Biosphere Reserve within 10km radius of the mining lease area.

10. The Project Proponent submitted that during plan period of first five years greenbelt/plantation will be developed over an area of 58.48 ha. Greenbelt will be

undertaken once the mining operation commences and will be developed over 7.5 m (8.488ha) around the mining lease boundary. PP also submitted that afforestation will be carried out on 144.59 Ha of left out excavation area. At conceptual stage, total afforested area will be 521.321 Ha. (Including gap plantation) excluding the Tree fern area. Soil binding species like *Agave Sislan* (Sisal), *Dendrocalmus Strictus* (Kanta Bamboo) etc., will be planted to stabilize the slope. Densification to the extent of 2700 saplings per hectate of native and pioneer species like *Albizza lebbek* (Siris), *Anilotica* (Babul), *Acateshu* (Karanji), *Dendrocalmus Strictus* (Bamboo), *Phoenix lumilis* (Khajur) etc., succeeded by leguminoseae variety will be planted on the terraces. PP submitted that plantation will be undertaken in consultation with the Forest Department. PP earmarked a budget of Rs 3.20 Cr towards green plant & plantation till the end of life of mine. PP also earmarked a budget of Rs 1.0 Cr towards nursery.

11. The Project Proponent submitted that the mine lease area does not cover any habitation and the mining activities do not involve any displacement of human settlement.

12. The Project Proponent submitted that there is no any litigation pending against the project and/or land in which the project is proposed to be set up.

13. The Project Proponent submitted that the estimated total capital cost of the project is Rs 4091.33 Cr. The mine will provide employment to 700 persons.

14. Observation and Recommendation of the Committee:

The proposal for Terms of Reference was considered in the 46th EAC (Non-Coal Mining) meeting held during 15th-17th February, 2022. After detailed deliberations made by the Project Proponent and the Consultant, the Committee **recommended** the proposal for grant of Terms of Reference (ToR) for M/s National Mineral Development Corporation - Chhattisgarh Mineral Development Corporation Limited (NCL), a joint venture of National Mineral Development Corporation Limited (a Central Government Public Sector Undertaking under the administrative control of Ministry of Steel), and Chhattisgarh Mineral Development Corporation Limited (a Government of Chhattisgarh Public Sector Undertaking) for mining of Iron ore in Bailadila Iron Ore Deposit-4 Mine with production capacity of 7.0 MTPA ROM Iron ore and 6.41 MTPA Waste Excavation (Total Excavation 13.41 MTPA) along with 2000 TPH crushing plant in the mine lease area of 646.596 ha, located at Village & Tehsil Bacheli, District Dantewada, Chhattisgarh for undertaking detailed EIA/EMP study subject to the specific conditions in addition to the standard ToR conditions applicable for non-coal mining projects.

15. The matter was examined in the Ministry in accordance with the Environmental Impact Assessment Notification, 2006 and further amendments thereto and the undersigned is directed to say that the Ministry of Environment Forest & Climate Change after accepting the recommendation of EAC during its 46th EAC (Non-Coal Mining) meeting held during 15th-17th February, 2022 hereby accords Specific and Standard Terms of Reference (ToR) for M/s National Mineral Development Corporation - Chhattisgarh Mineral Development Corporation Limited (NCL), a joint venture of National Mineral Development Corporation Limited (a Central Government Public Sector Undertaking under the administrative control of

Ministry of Steel), and Chhattisgarh Mineral Development Corporation Limited (a Government of Chhattisgarh Public Sector Undertaking) for mining of Iron ore in Bailadila Iron Ore Deposit-4 Mine with production capacity of 7.0 MTPA ROM Iron ore and 6.41 MTPA Waste Excavation (Total Excavation 13.41 MTPA) along with 2000 TPH crushing plant in the mine lease area of 646.596 ha, located at Village & Tehsil Bacheli, District Dantewada, Chhattisgarh for undertaking detailed EIA/EMP study subject to the following specific conditions in addition to the standard ToR conditions applicable for non-coal mining projects:-

A. SPECIFIC TERMS OF REFRERENCE

i. The Project Proponent should install the continuous ambient air quality monitoring stations in such numbers as per the scientific study and in consultation with CPCB.

ii. The Project Proponent needs to carry out the cumulative impact assessment by considering all the mining activity of the adjoining mines, crusher and beneficiation plant in the study area and should indicate the capacity of the each mine considered for predication of air quality modeling. The control case and worst-case scenario needs to be demonstrated with controlling factor and GLCs values for all the pollutants needs to be clearly mentioned. The input parameters used for the modeling also needs to be submitted.

iii. The Project Proponent should prepare the EMP considering the scenario of pollution to be generated for normative and peak total excavation for assessing air and noise pollution by considering all the mining activity.

iv. The Project Proponent needs to submit the restoration plan for waste dumps to be located in the forest land. PP should also submit the map demarcating the mineralized and non-mineralized zone in the forest land and non-forest land in the mine lease area.

v. The Project Proponent needs to carry out the Public Hearing as per provisions of EIA Notification, 2006. PP should also submit the time bound action plan on concerns of the public through proper separate budget for the concerns of the local people in terms of health care facilities for COVID, betterment of schools nearby and to facilitate the online education system by providing Wi-Fi connectivity, smart classrooms and desktops/tablets, infrastructure, and environment protection.

vi. The Project Proponent should submit the detailed plantation/greenbelt plan in tabular format (year wise for entire life of mine) with proper capital and recurring cost. PP shall undertake the adequate plantation with the seedling of 10 ft height with at least 90% survival rate and the peripheral plantation shall be completed within 6 months from the start of mining operations. The causalities of each year shall be replaced every year with new saplings and such number of saplings shall not be counted in the number of saplings proposed to plant in that year. PP shall undertake the progressive

bench plantation up to HFL for eco restoration of water bodies. Undertaking in this regard needs to be submitted by the PP.

vii. The Project Proponent needs to submit the certificate obtained from Forest Department regarding tree fern area not to be diverted at the time of appraisal of EC.

viii. The Project Proponent needs to submit the certified EC compliance report of adjacent mines for Deposit 5 & Deposit 10 at the time of appraisal of EC.

B. STANDARD TOR FOR MINING PROJECT

1) Year-wise production details since 1994 should be given, clearly stating the highest production achieved in any one year prior to 1994. It may also be categorically informed whether there had been any increase in production after the EIA Notification 1994 came into force, w.r.t. the highest production achieved prior to 1994. The production details need to submit since inception of mine duly authenticated by Department of Mines & Geology, State Government.
2) A copy of the document in support of the fact that the Proponent is the rightful lessee of the mine should be given.
3) All documents including approved mine plan, EIA and Public Hearing should be compatible with one another in terms of the mine lease area, production levels, waste generation and its management, mining technology etc. and should be in the name of the lessee.
4) All corner coordinates of the mine lease area, superimposed on a High-Resolution Imagery/toposheet, topographic sheet, geomorphology and geology of the area should be provided. Such an Imagery of the proposed area should clearly show the land use and other ecological features of the study area (core and buffer zone).
5) Information should be provided in Survey of India Toposheet in 1:50,000 scale indicating geological map of the area, geomorphology of land forms of the area, existing minerals and mining history of the area, important water bodies, streams and rivers and soil characteristics.
6) Details about the land proposed for mining activities should be given with information as to whether mining conforms to the land use policy of the State; land diversion for mining should have approval from State land use board or the concerned authority.
7) It should be clearly stated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/ violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large, may also be detailed in the proposed safeguard measures in each case should also be provided.

8) Issues relating to Mine Safety, including subsidence study in case of underground mining and slope study in case of open cast mining, blasting study etc. should be detailed. The proposed safeguard measures in each case should also be provided.

9) The study area will comprise of 10 km zone around the mine lease from lease periphery and the data contained in the EIA such as waste generation etc. should be for the life of the mine / lease period.

10) Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the mine lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given.

11) Details of the land for any Over Burden Dumps outside the mine lease, such as extent of land area, distance from mine lease, its land use, R&R issues, if any, should be given.

12) A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any, in the project area. In the event of any contrary claim by the Project Proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which, the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for representative of the State Forest Department to assist the Expert Appraisal Committees.

13) Status of forestry clearance for the broken-up area and virgin forestland involved in the Project including deposition of net present value (NPV) and compensatory afforestation (CA) should be indicated. A copy of the forestry clearance should also be furnished.

14) Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.

15) The vegetation in the RF / PF areas in the study area, with necessary details, should be given.

16) A study shall be got done to ascertain the impact of the Mining Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly, detailed mitigative measures required, should be worked out with cost implications and submitted.

17) Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar site Tiger/Elephant Reserves/(existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated, supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above, should be obtained from the Standing Committee of National Board of Wildlife and copy furnished.

18) A detailed biological study of the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and

fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduled-I fauna found in the study area, the necessary plan along with budgetary provisions for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost.

19) Proximity to Areas declared as 'Critically Polluted' or the Project areas likely to come under the 'Aravali Range', (attracting court restrictions for mining operations), should also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB or State Mining Dept. Should be secured and furnished to the effect that the proposed mining activities could be considered.

20) Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL. HTL, CRZ area, location of the mine lease w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Mining Projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority).

21) R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need-based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectoral programmes of line departments of the State Government. It may be clearly brought out whether the village(s) located in the mine lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects should be discussed in the Report.

22) One season (non-monsoon) [i.e. March - May (Summer Season); October - December (post monsoon season); December - February (winter season)] primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data so compiled presented date-wise in the EIA and EMP Report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the mine lease in the pre-dominant downwind direction. The mineralogical composition of PM10, particularly for free silica, should be given.

23) Air quality modelling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modelling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any, and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map.

24) The water requirement for the Project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the Project should be indicated.
25) Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be provided.
26) Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided.
27) Impact of the Project on the water quality, both surface and groundwater, should be assessed and necessary safeguard measures, if any required, should be provided.
28) Based on actual monitored data, it may clearly be shown whether working will intersect groundwater. Necessary data and documentation in this regard may be provided. In case the working will intersect groundwater table, a detailed Hydro Geological Study should be undertaken and Report furnished. The Report inter-alia, shall include details of the aquifers present and impact of mining activities on these aquifers. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of ground water should also be obtained and copy furnished.
29) Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and the impact of the same on the hydrology should be.
30) Information on site elevation, working depth, groundwater table etc. Should be provided both in AMSL and BGL. A schematic diagram may also be provided for the same.
31) A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the Project. Phase-wise plan of plantation and compensatory afforestation should be charted clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be given. The plant species selected for green belt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to pollution.
32) Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered. Project Proponent shall conduct Impact of Transportation study as per Indian Road Congress Guidelines.
33) Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA Report.
34) Conceptual post mining land use and Reclamation and Restoration of mined out areas (with plans and with adequate number of sections) should be given in the EIA

report.

35) Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area may be detailed.

36) Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.

37) Measures of socio-economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.

38) Detailed environmental management plan (EMP) to mitigate the environmental impacts which, should inter-alia include the impacts of change of land use, loss of agricultural and grazing land, if any, occupational health impacts besides other impacts specific to the proposed Project.

39) Public Hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan with budgetary provisions to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.

40) Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.

41) The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.

42) A Disaster Management Plan shall be prepared and included in the EIA/EMP Report.

43) Benefits of the Project if the Project is implemented should be spelt out. The benefits of the Project shall clearly indicate environmental, social, economic, employment potential, etc.

44) Activity-wise time-bound action plan on the issues raised and commitment made during public hearing to be submitted as part of the final EMP Report in compliance of the Ministry's OM F.No.22-65/2017-IA.III dated 30th September, 2020.

16. Besides the above, the below mentioned general points are also to be followed: -

a) All documents to be properly referenced with index and continuous page numbering.
b) Where data are presented in the Report especially in Tables, the period in which the data were collected and the sources should be indicated.
c) Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the Project.
d) Where the documents provided are in a language other than English, an English translation should be provided.
e) The Questionnaire for environmental appraisal of mining projects as devised earlier by the Ministry shall also be filled and submitted.
f) While preparing the EIA report, the instructions for the Proponents and instructions for the Consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II (I) dated

4th August, 2009, which are available on the website of this Ministry, should be followed.

g) Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of MoEF&CC with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation.

h) As per the circular no. J-11011/618/2010-IA.II (I) dated 30.5.2012, certified report of the status of compliance of the conditions stipulated in the environment clearance for the existing operations of the project, should be obtained from the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable.

i) The EIA report should also include (i) surface plan of the area indicating contours of main topographic features, drainage and mining area, (ii) geological maps and sections and (iii) sections of the mine pit and external dumps, if any, clearly showing the land features of the adjoining area.

17. The prescribed TOR would be valid for a period of four years for submission of the EIA/EMP report, as per the notification S.O 751 (E) dated 17.02.2020. The instant TOR is valid up to four years from the date of issuance of TOR.

18. The Project Proponent should submit the EIA/EMP report as per the generic structure prescribed in Appendix-III of the EIA Notification, 2006 after incorporating the details of public hearing conducted and covering the above-mentioned issues, to take further necessary action for obtaining environmental clearance in accordance with the procedure prescribed under the EIA Notification, 2006.

19. This issues with the approval of the Competent Authority.

Yours faithfully,

Pankaj Verma

(Pankaj Verma)
Scientist 'E'

Copy to:

1. **The Secretary,** Ministry of Mines, Government of India, Shastri Bhawan, New Delhi-110 001.
2. **The Secretary,** Department of Environment, Government of Chhattisgarh.
3. **The Secretary,** Department of Mines and Geology, Government of Chhattisgarh, Chhattisgarh.
4. **The Chairman,** Chhattisgarh Environment Conservation Board, Nanak Niwas, Civil Lines, Raipur, Chhattisgarh.

5. **The Additional Principal Chief Conservator of Forests(C),** Ministry of Environment, Forest and Climate Change, Regional Office (WCZ), Ground Floor, East Wing, New Secretariat Building, Civil Lines, Nagpur - 440001.
6. **The Controller General,** Indian Bureau of Mines, Indira Bhavan, Civil Lines, Nagpur-440 001.
7. **Regional Officer,** Ministry of Environment, Forest and Climate Change, Integrated Regional Office, Ground Floor, East Wing, New Secretariat Building, Civil Lines, Nagpur - 440001.
8. **The Chairman,** Central Pollution Control Board, Parivesh Bhawan, CBD-Cum-Office Complex, East Arjun Nagar, New Delhi-110 032.
9. **The Member Secretary,** Chhattisgarh State Pollution Control Board, Commercial Complex, Chhattisgarh Housing Board Colony, Kabir Nagar, Raipur, Chhattisgarh.
10. **The Member Secretary,** Central Ground Water Authority, 18/11, Jam Nagar House, Man Singh Road, New Delhi-110011.
11. **The Chief Wildlife Warden,** Govt. of Chattisgarh, Aranya Bhavan, Jail Road, Fafadih Chowk, Raipur - 492001.
12. **The District Collector,** District Dantewada, Govt. of Chhattisgarh.
13. **Guard File.**
14. **PARIVESH Portal.**

Pankaj Verma

(Pankaj Verma)
Scientist 'E'

LIST OF RARE AND THREATENED PLANTS OF CHHATTISGARH

Sl. No.	Botanical Name/Local Name	Family
1	*Acampe praemorsa* (Roxb.) Blatter & McCann	Orchidaceae
2	*Acorus calamus* L./ Vacha, Khodvach	Araceae
3	*Alocasia decipiens* Schott	Araceae
4	*Ammannia cordata* Wight & Arn.	Lythraceae
5	*Ampelocissus divaricata* (Wall. ex M.A.Lawson) Planch.	Vitaceae
6	*Aphyllodium biarticulatum* (L.) Gagnep.	Malvaceae
7	*Ardisia quinquegona* Blume	Primulaceae
8	*Argyreia nervosa* (Burm. f.) Bojer	Convolvulaceae
9	*Aristolochia indica* L./ Iswari, Iswarmool, Eswaramooli	Aristolochiaceae
10	*Artemisia japonica* Thunb.	Asteraceae
11	*Atalantia monophylla* (L.) Correa	Rutaceae
12	*Bacopa hamiltoniana* (Benth.) Wettst.	Plantaginaceae
13	*Blepharispermum subsessile* DC./ Rasna	Asteraceae
14	*Blumea hirsuta* (Less.) M.R.Almeida	Asteraceae
15	*Boehmeria depauperata* Wedd.	Urticaceae
16	*Breynia retusa* (Dennst.) Alston	Phyllanthaceae
17	*Cajanus rugosus* (Wight & Arn.) Maesen	Leguminosae
18	*Canscora heteroclita* (L.) Gilg	Gentianaceae
19	*Carex stramentitia* Boott ex Boeckeler	Cyperaceae
20	*Celastrus paniculatus* Willd./ Malkangni, Angul	Celastraceae
21	*Celtis timorensis* Span.	Cannabaceae
22	*Ceropegia bulbosa* Roxb.	Apocunaceae
23	*Chlorophytum tuberosum* Baker/ Safed-musli	Asparagaceae
24	*Cissampelopsis corymbosa* (Wallich ex DC.) C. Jeffrey & Y.L. Chen	Asteraceae
25	*Clematis roylei* Rehder	Ranunculaceae
26	*Cochlospermum religiosum* (L.) Alston/ Kumbi, Gabdi, Ganiar, Galgal, Galgala	Bixaceae
27	*Combretum nanum* Buch.-Ham. ex D.Don/ Nagarcana	Combretaceae
28	*Cordia macleodii* Hook.f. & Thomson/ Dahiman, Dahipalas, Dhengan, Kuhman	Boraginaceae
29	*Cosmostigma racemosum* Wight	Apocynaceae
30	*Crotalaria evolvuloides* Wight	Leguminosae
31	*Crotalaria notonii* Wight & Arn.	Leguminosae
32	*Cryptostegia grandiflora* Roxb. ex R.Br.	Apocynaceae
33	*Curcuma ferruginea* Roxb./ Jangli Haldi	Zingiberaceae
34	*Curcuma petiolata* Roxb./ Jangli Haldi	Zingiberaceae
35	*Cyanotis arachnoidea* Clarke	Commelinaceae
36	*Cymbopogon pendulus* (Nees ex Steud.) Will.Watson	Poaceae
37	*Decaschistia crotonifolia* Wight & Arn.	Malvaceae
38	*Dinebra polystachyos* (R.Br.) E.A. Kellogg	Poaceae
39	*Dichrocephala integrifolia* (L.f.) Kuntze	Asteraceae
40	*Dillenia aurea* Sm./ Kalle	Dilleniaceae
42	*Dillenia pentagyna* Roxb./ Karmal, KallaKarmeta	Dilleniaceae

43	*Dioscorea hispida* Dennst./ Baichadi, Karodi	Dioscoreaceae
44	*Dioscorea spicata* B.Heyne ex Roth	Dioscoreaceae
45	*Dracaena terniflora* Roxb.	Asparagaceae
46	*Drimia indica* (Roxb.) Jessop/ Janglipiyaz, Kande, Koli-kanda,	Asparagaceae
47	*Embelia ribes* Burm. f./ Baibrang	Primulaceae
48	*Embelia basaal* (Roem. & Schult.) A. DC./ Babrang, Baibrang, Baya Birang	Primulaceae
49	*Entada rheedei* Spreng./ Devseari	Leguminosae
50	*Eriosema chinense* Vogel	Leguminosae
51	*Erythropalum scandens* Blume	Olacaceae
52	*Eulalia hirtifolia* (Hack.) Kuntze	Poaceae
53	*Eulophia herbacea* Lindl./ Munjataka, KukadKand, Goruma, Balkard	Orchidaceae
54	*Euphorbia acaulis* Roxb./ Dudh mongra	Euphorbiaceae
55	*Euphorbia caducifolia* Haines	Euphorbiaceae
56	*Eurya nitida* Korth.	Theaceae
57	*Ficus lanceolata* Buch.-Ham. ex Roxb.	Moraceae
58	*Fimbristylis hookeriana* Boeckeler	Cyperaceae
59	*Flemingia grahamiana* Wight & Arn.	Leguminosae
60	*Flemingia stricta* Roxb.	Leguminosae
61	*Gamphostemma parviflorum* Wall.ex Benth.	Lamiaceae
62	*Gloriosa superba* L./ Languli, Kalihari	Colchicaceae
63	*Gymnema inodorum* (Lour.) Decne.	Apocynaeae
64	*Gymnema sylvestre* R.Br./ Gudmar, Gurmar	Apocynaeae
65	*Gymnosporia bailadillana* Narayan. & Mooney	Celastraceae
66	*Gymnosporia senegalensis* (Lam.) Loes.	Celastraceae
67	*Habenaria roxburghii* Nicolson	Orchidaceae
68	*Hedychium coronarium* Koening	Zingiberaceae
69	*Huberantha cerasoides* (Roxb.) Chaowasku	Annonaceae
70	*Lepisanthes tetraphylla* (Vahl) Radlk.	Sapindaceae
71	*Lespedeza juncea* (L.f.) Pers.	Leguminosae
72	*Litsea glutinosa* (Lour.) Robinson/ Garbijaur, Maida, Maidalakri	Lauraceae
73	*Macaranga peltata* Boivin ex Baill.	Euphorbiaceae
74	*Mitrephora heyneana* (Hook.f. & Thomson) Thwaites	Annonaceae
75	*Moullava spicata* (Dalzell ex Wight) Nicolson	Leguminosae
76	*Mucuna pruriens* (L.) DC./ Kavach, Kiwach	Leguminosae
77	*Nogra filicaulis* (Kurz) Merr.	Leguminosae
78	*Nogra grahamii* (Wall. ex Benth.) Merr.	Leguminosae
79	*Operculina turpethum* (L.) Silva Manso/ Nisoth, Nukpatar, Pitohri, Tarbal, Tarbud	Convolvulaceae
80	*Oroxylum indicum* (L.) Vent. / Arlu, Assarsauna, Fari, Syonaka	Bignoniaceae
81	*Peucedanum nagpurense* (C.B. Clarke) Prain	Apiaceae
82	*Phrynium placentarium* (Lour.) Merr.	Marantaceae
83	*Phrynium pubinerve* Blume	Marantaceae
84	*Piper longum* L./ Pippali, pipari	Piperaceae
85	*Plantago asiatica* L.	Plantaginaceae
86	*Portulaca pilosa* L.	Portulacaceae
87	*Premna tomentosa* Willd./ Arni	Lamiaceae
88	*Pterocarpus marsupium* Roxb./ Bijasal, Vijayasar	Leguminosae

89	Pueraria tuberosa (Willd.) DC./ Vidharikand, Vidari, Patal Kumbha	Leguminosae
90	*Pycnospora lutescens* (Poir.) Schindl.	Leguminosae
91	*Radermachera xylocarpa* (Roxb.) K. Schum.	Bignoniaceae
92	*Rauvolfia serpentina* (L.) Benth. ex Kurz	Apocynaceae
93	*Rotheca serrata* (L.) Steane&Mabb./ Bharangi	Lamiaceae
94	*Rubia cordifolia* L./ Manjit, Pilia	Rubiaceae
95	*Sarcostemma acidum* Wight. &Arn./ Soma, Somalatha	Apocynaceae
96	*Seseli alboalatum* (Haines) Pimenov & Kljuykov	Apiaceae
97	*Setaria plicata* (Lam.) T. Cooke	Poaceae
98	*Solanum erianthum* D. Don	Solanaceae
99	*Stephania glabra* (Roxb.) Miers	Menispermaceae
100	*Sterculia villosa* Roxb. ex Sm./ Katira, God-gudala, Udal	Sterculiaceae
101	*Stereospermum chelonoides* (L.f.) DC./ Padol, Pandri, Paral, Padar	Bignoniaceae
102	*Stereospermum colais* (Dillwyn) Mabberley/ Padar	Bignoniaceae
103	*Strobilanthes jeyporensis* Bedd.	Acanthaceae
104	*Symplocos racemosa* Roxb./ Loadh, Loadhra	Symplocaceae
105	*Thalictrum foliolosum* DC./ Mamera, Pitranga, Pilzari	Ranunculaceae
106	*Trachyspermum roxburghianum* (DC.) Craib	Apiaceae
107	*Trichilia connaroides* (Wight & Arnott) Bentv.	Meliaceae
108	*Tylophora macrantha* Hook.f.	Apocynaceae
109	*Uraria picta* (Jacq.) Desv. ex DC./ Dabra, Pitvan, Shankaraja	Leguminosae
110	*Viola betonicifolia* Sm.	Violaceae
111	*Zanthoxylum armatum* DC. / Tejbal, Masala paudha	Rutaceae
112	*Zanthoxylum rhetsa* (Roxb.) DC./ Tejam	Rutaceae

Part B

Soil, Water and Moisture Conservation Plan

For Tree Fern area falling in Bailadila Iron ore Deposit No.-4

For NMDC – CMDC, Chhattisgarh

PART B

INDEX - SOIL, WATER AND MOISTURE CONSERVATION PLAN FOR TREE FERN AREA FALLING IN BAILADILA IRON ORE DEPOSIT NO.-4

CHAPTER I

FRAMEWORK FOR IMPLEMENTATION AND MANAGEMENT

1.1 INTRODUCTION:

Special care is being proposed to conserve Tree Fern area which is a part of Deposit 4 mines area (Not included for diversion) in respect of Soil, Water and Moisture conservation. This elaborated report has focussed to protect Galli Nalla around which majorly Tree Fernin existence.

Soil, Water and Moisture retention structures are scientifically assessed and proposed in suitable locations in Galli Nalla and its tributaries of various stream orders. The details are explained in the report.

Even after the state is endowed with forest wealth, mineral wealth and cultural wealth, the marginal and small farmers here have to depend on rain water.

One has to deal with anomalies like untimely rains, excessive rains, sporadic rains. Even after heavy rains in the state, due to lack of proper management of rain water burning, the underground water level is decreasing day by day. Now the time has come, when it has become necessary for us to save every single drop of water received from nature. If there is water, then there is tomorrow, otherwise it is tomorrow, for the saying, intensive water harvesting efforts and management have become necessary. The need of the hour is that now necessary and scientific management will have to be done to make water sources, Nalla, small river and drain alive.

Reducing the speed of water flowing at a fast speed of rain, stopping the water flowing at a slow speed will only fulfill the motto “Water is the basis of life”.

There is good rainfall in the state. On the basis of geographical structure, we can divide the state into three parts. There is mountainous region in the North, plain region in the middle and plateau and plain region in the South.

Thus the Northern region forms parts of the Ganga valley, the central region Mahanadi valley and the Southern region Mahanadi and Godavari valleys. The configuration of geological strata of these areas affects the availability of ground water here and its distribution.

In terms of water resources, the state of Chhattisgarh has a large network of river channels, in which Korea and Surguja districts of the northern border come under the catchment area of the Ganges alluvium. The mountain plateau chain of the state divides the Ganges alluvium and the Mahanadi alluvium like a wall. The most extended area of Mahanadi alluvium is from Mainpat-Lahsun Pat of Surguja to the plateau of Amarkantak, from where all the rivers and drains flow

towards the south. The natural story of the origin of Mahanadi is due to the structure, texture and ground slope of the rocks, in which the remains of its ancient stream flowing towards Kharun river are still visible around Dhamtari city.

In the northern part of the state of Chhattisgarh, the flow of streams and rivers flowing in Surguja and Koriya districts is towards the north and northwest direction from the plateau part of Pandrapat and Jamirapat. Prominent among them are Kanhar, Mahan and Rehan. Their water dividing line is in the north-east direction. This catchment area is the southern extension of the Ganges alluvium. The water divide line of the Ganga alluvium is very narrow from Mainpat to the north and runs almost east-west from Surajpur-Baikkuthpur to the Soenhat plateau. The three rivers that flow south from the Soenhat plateau are the Hasdo, Bango and Ib, which flow south from the plateaus of Mainpat and Pandrapat, respectively. Leelagarh, Kurung, Arpa, Maniyari, Hap and Agar rivers flow from the plateau of Amarkantak towards the southeast. Sankari, Dotu and Amner rivers originating from the Mekal mountain range are the main ones. It is a tributary of Shivnath river.

The flat plains of Chhattisgarh itself are surrounded by the incessant flow of Mahanadi, the biggest river of this state, whose flow is in west-east direction before the confluence of Shivnath river and it seems to be controlled by rock structure. The flow line of Mahanadi from Charama to the east of Balodabazar is also controlled by rock formation and its flow is in north east direction. Mahanadi Shivnath, Tandula, Kharun, Pari, Sondhur etc. all the rivers flow north from the dividing line of the plateau parts of Nawagarh, Vishrampuri, Keshkal, Amabeda, Tarandul. All the rivers and streams flow from a height of about 700 m to the northeast or north as tributaries of the Mahanadi alluvium. The water dividing line of the Mahanadi alluvium extends up to the Keshkal plateau in the south.

The underground aquifers from the Southern part of the Keshkal Plateau to the Dandakaranya Plateau in the Southern region of the Chhattisgarh Cachhar are also controlled by the rock and rock formations there. There is an abundance of surface water in the Dandakaranya plateau. The tributaries of Indravati flowing from North to South are Markandi/Narangi, Bhunvardig, Kotri, Nivra, Madin river etc. Apart from the rivers flowing above the bed of Indravati, Sankani, Dankani, Mingachal etc. are among the rivers flowing north from Bailadila. The rivers flowing north from Bailadila are Sankani, Dankani, Mingachal etc. Kangeer, Sabari, Gorli, Talperu and Chintavagu are the main rivers flowing south from Bailadila mountain range and southern part of Indravati Cachar. All these rivers fall in the Northern catchment area of Godavari Cachhar.

1.2 DRAINAGE LINE:

An outlet is an essential part of a water body through which runoff (flow) and sediment (all substances carried along with the water) are carried. These can be of various forms, such as outlet channels, gullies (tributary minor drains), natural/artificial waterways streams, rivers or storm drains. The network of these drainage channels is mostly prone to erosion problems due to (uncontrolled runoff) non-digital discharge, which may further increase and can also erode (subsidence) the adjacent lands. The lands adjacent to these drains are usually intensively cultivated due to their good moisture content and high nutrient levels. Special importance has been given in the treatment plan.

1.3 PURPOSE OF SOIL AND WATER CONSERVATION: -

- Preventing soil erosion in the drain bed and adjacent areas.
- Improving moisture for organic produce.
- Protecting bank slopes from erosion.
- Ground water recharge (increase in ground water level by recharging)
- Storing water wherever possible and required.
- Run-off control in storm drains (Flow control), protection of banks (Protection of banks) and land reclamation (Land development).

On the basis of location specific and objectives, the evacuation route treatment measures can be divided into the following groups: -

- Gully / drain rehabilitation measures.
- Permanent structures for street rehabilitation/water harvesting.
- Erosion control of storm drains and stream banks.

1.4 SOIL AND WATER CONSERVATION AREA: Its actually such a region on the ground surface, in which, due to the specificity of the slope, the rain water of the entire region flows through small drains, drains and rivers, and ultimately from a common point , comes out Its smallest unit is called micro watershed, which is about 500 hectares, and the largest is milli watershed, which consists of about 10 micro watersheds, its area is 5000 hectares on average. There are a total of 2349 milli waters and 17623 micro watersheds in the state.

1.5 BOUNDARY:

Wherever water comes in any drainage line, that area is called its Catchment area. The Catchment region can be seen as a valley. When it rains, water starts flowing from the upper

part, which collects in the lower part of the valley. In rough terrain, there may be several such units of Catchment area. One special thing to understand is that the size and area of some areas are pre-determined, such as state, district, farm, etc. Similarly, on the contrary, the size and area of the catchment area is not pre-determined. It depends on which point of the drainage line you demarcate of the water source area by considering it as the base. The area of the area of Catchment will also keep changing at different points. Means if we make the point of Catchment area up or down, then according to that the area of water source area can also be less or more. For this reason, it becomes necessary to demarcate the Catchment area on the map.

Although we have different types of maps available, it would be most appropriate to demarcate the Catchment area on the toposheet, as it contains information about the elevation contours (the height of the contour lines is clear), all drainage lines.

1.6 COMPONENTS:

The state of Chhattisgarh is the tenth largest state in India, 44% of which is covered by forests. Chhattisgarh is divided into three agro-climatic zones:-

1. Hilly region of the north,
2. Plain region of the middle and
3. Plateau region of the south.

There are about 36,000 small and big drains in Chhattisgarh, most of whose water flows through Mahanadi basin, South Ganga basin, Godavari basin, Narmada basin and Brahmani basin and falls into Bay of Bengal and Arabian Sea. In the said 05 basin, small and big dams have been built by various departments of the central and state government, which are mostly drains of order 04 (more wide drains), but before reaching the water in those drains, order no. Passes through drains of 01, 02 and 03 (narrow drains). It depends on the slope of these drains, the type of soil, the presence of vegetation, the condition of the catchment area, etc., that how much soil will be cut by the high intensity of rainfall and get absorbed in the rainwater and collected in the big drains through small drains. After soil erosion, proper treatment (soil conservation) of these narrow drains (Order-01, 02 and 03) is necessary to prevent erosion of soil in large drains. After this, water management is necessary for ground water enrichment and recharge by stopping water at various places by constructing proper water storage structures at appropriate places in drains.

In this sequence, more emphasis is being given by the state government on proper water management component (Narva treatment components) for proper water management.

1.7 BENEFITS OF SOIL AND WATER CONSERVATION:

1. Soil erosion reduction
2. Reduction in the speed of siltation in dams (reduction in rate of siltation)
3. Increase in water level due to groundwater recharge
4. New life to rivers and water streams
5. Increase in soil moisture condition

1.8 IDEAL TREATMENT:

Water flow in drains and Nalla has to be revived. Abundance of water stream near drains and other water sources ensures ground water and bio-diversity.

- Construction of water storage structures to improve water holding capacity.
- Disruption of natural/man-made drains.

1.9 RESULTS:

- Decrease in ground water over a long period of time (about 30 to 35 years).
- Drying up of drains, rivers and other water sources.
- Increase in surface and sub-surface salinity due to excessive exploitation of ground water through tube wells for irrigation facilities.
- In future, there will be a need to dig borewells to great depths.
- To remove the salinity, alkalinity and acidity of the soil, necessary water will be required for better Bio diversity.
- Extreme lack of moisture in the micro climate available for Bio deversity.
- Difficulty in the living environment of cattle and humans and as a result they migrate to green places.
- There is a possibility of increase in fallow land due to less irrigation availability.
- Reduction in the livelihood level of the local people.
- Reduction in the value of land.

1.10 PROPOSAL AND TREATMENT:

- Selecting drains, treating them and reviving them.
- Taking advice from local administration and public representatives, selecting target drains and proposing works.

Remote Sensing and Geographical Information System (RS & GIS) to select a suitable site for structure construction.

1.11 STANDARD OPERATING PROCEDURE (SOP):

1. Determination of baseline survey/benchmark. After selection, a baseline survey of the selected drains will be done, in which all the points will be included, on the basis of which the results can be measured after the work.
2. Possible activities include underground dykes, drain dams, pond deepening, renovation of old drains, new stop dams, check dams on the basis of Ridge to Valley (Ridge to Valley) using RS/GIS techniques and on the basis of Land Capability Classification (LCC). Works like construction of flood protection wall, drain pitching etc. can be done between Upper Reach to Lower Reach.
3. Multi-level plantation of local species (root, medicinal, fruit and timber) will be done.
4. The technical approval of the DPR made in forest areas will be given by the competent officer of the Forest Department and the technical approval of the DPR made in non-forest areas will be given by the Rural Engineering Service.
5. The structures to be constructed in forest areas will be financed from the CAMPA head of the Forest Department. The financial support of the structures to be built in non-forest areas will be done through suitable agency, if it's in preview of Forest area then should be implemented by Forest department.
6. Studying the old structures and preparing an action plan to increase their utility.
7. All the structures that will be built, an effective action plan will also be prepared for their use and maintenance in the coming years.
8. Various works will be implemented on the basis of mission mode.
9. GIS technology will be used for monitoring work.

1.12 STANDARD OPERATING (SOP) PROCEDURE PROHIBITED ACTIVITIES:

1. Illegal mining of sand in drains.
2. Encroachment in the catchment area
3. Wrong location for the structure
4. Personal use of built structures
5. Violation of Forest Conservation Act 1980

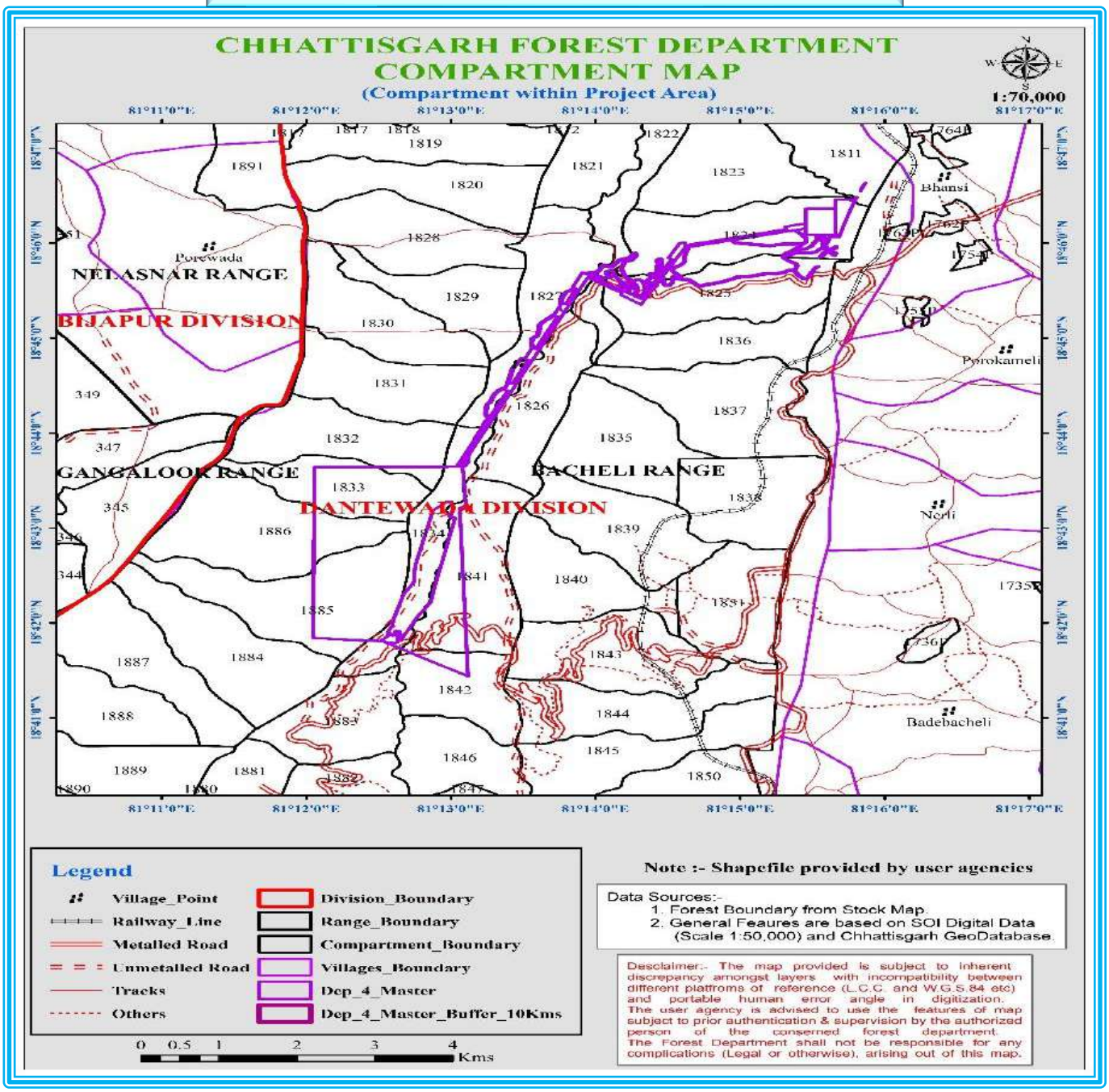
CHAPTER II

REMOTE SENSING FOR SITE SELECTION FOR MANAGEMENT AND ROLE OF G.I.S.

2.1 FOREST COMPARTMENT BASED MAP:

The main objective of the forest cell-based map is to give information about all the forest cells under management and along with it the contour line has been displayed at 05-meter intervals. The map shows the land number of the forest cell, which is the primary unit of that location. In the context of the forest cell coming under the area, the information about the forest cell number in which the marked structures are to be constructed can be obtained from the following maps:

MAP 2.1 FOREST COMPARTMENT BASED MAP



A) Forest Compartment No. 1826, 1832, 1833, 1834, 1841, 1842, 1885, 1886

B) Forest Range

Bacheli Forest Range,

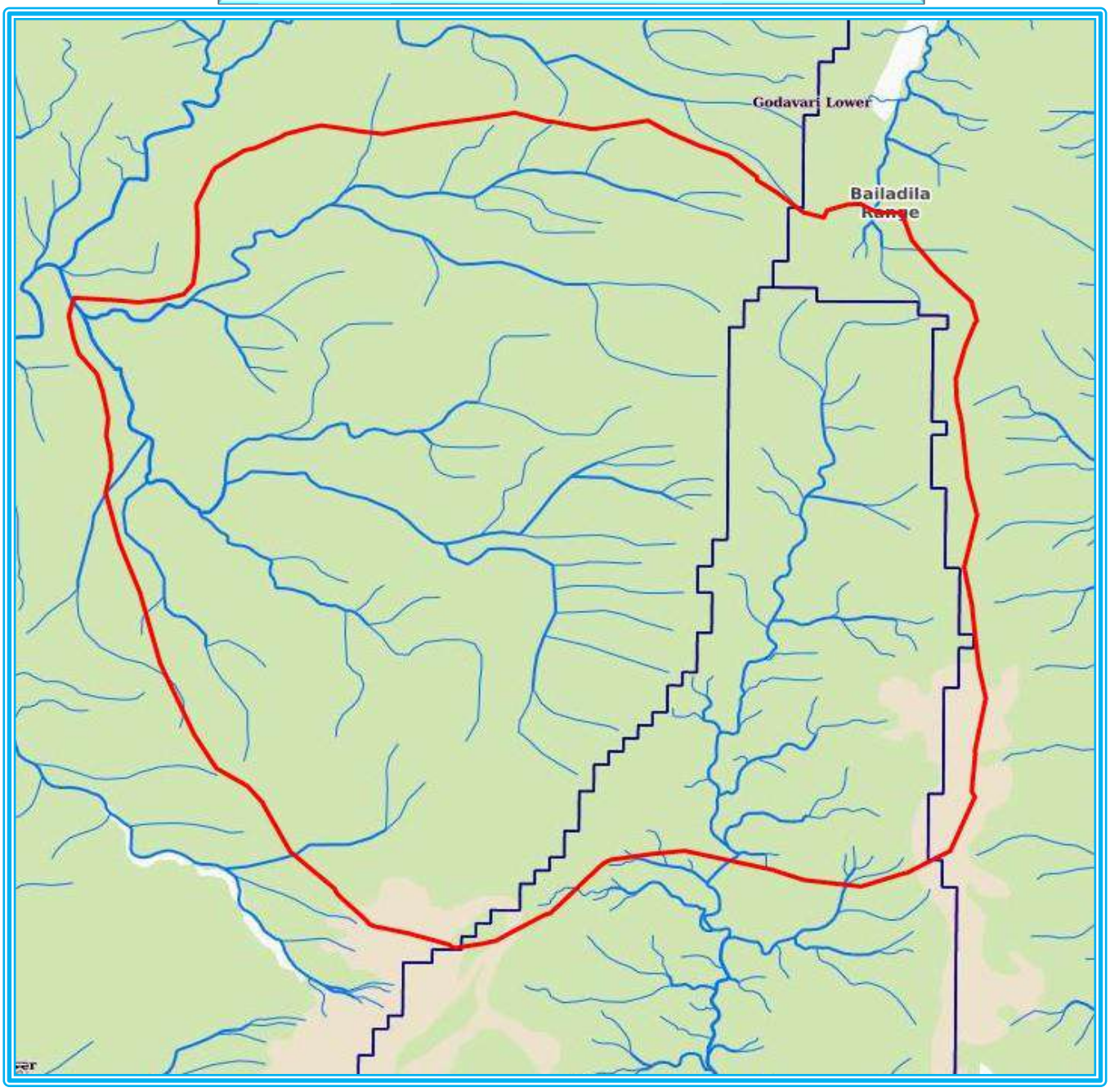
c) Post affected Compartments after Implementation of the project

1832, 1833, 1826, 1885, 1886 1834, 1842, 1841,

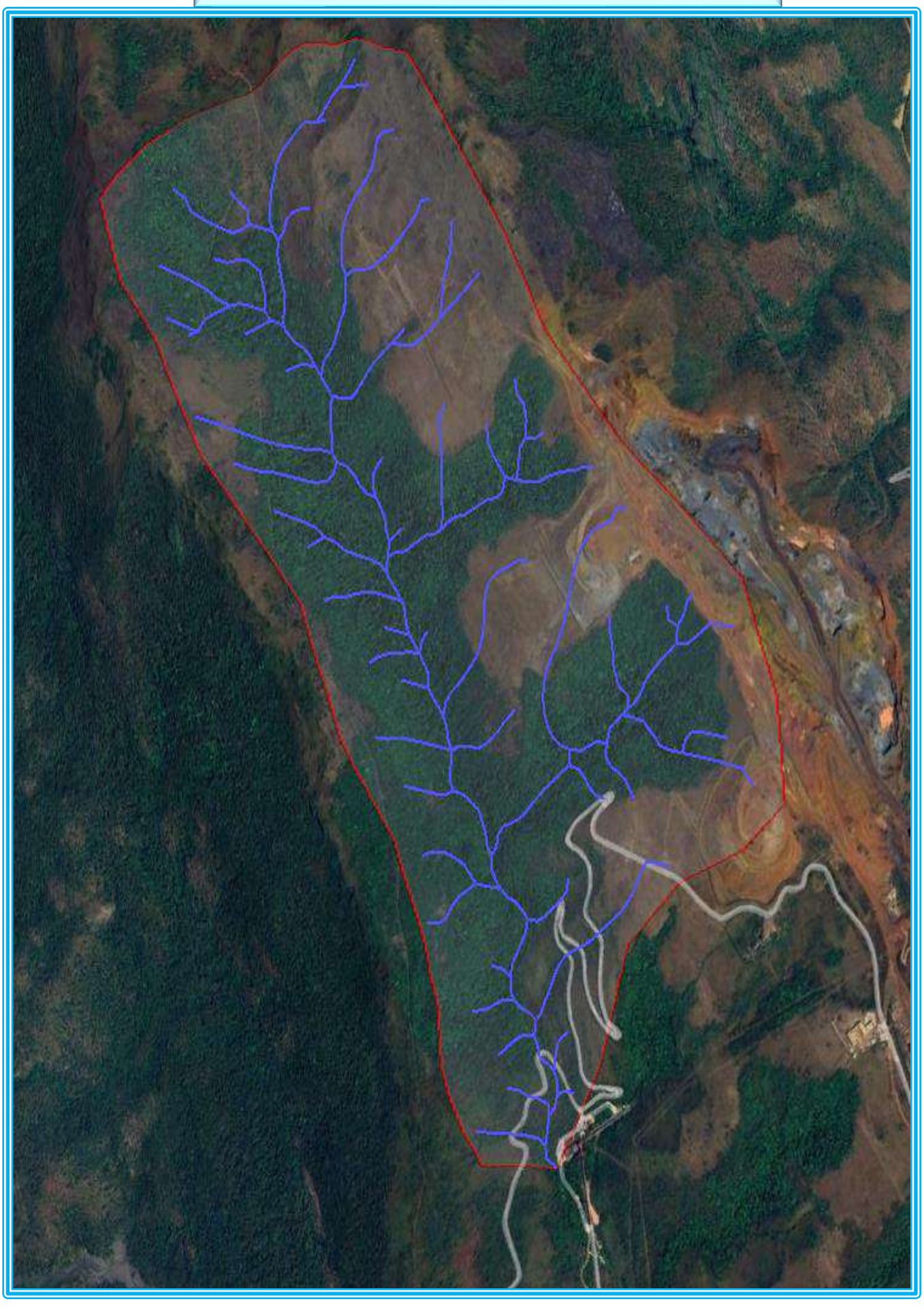
2.2 DRAINAGE LINE:

Through the drainage map, it has been shown that the direction of water flow, availability and how and at what place water should be combined and what type of structure should be built, so that groundwater can be conserved as much as possible. The level can be increased.

MAP 2.2 DRAINAGE LINE BASED MAP (A)



DRAIN LINE MAP (B)



2.3 LAND USE:

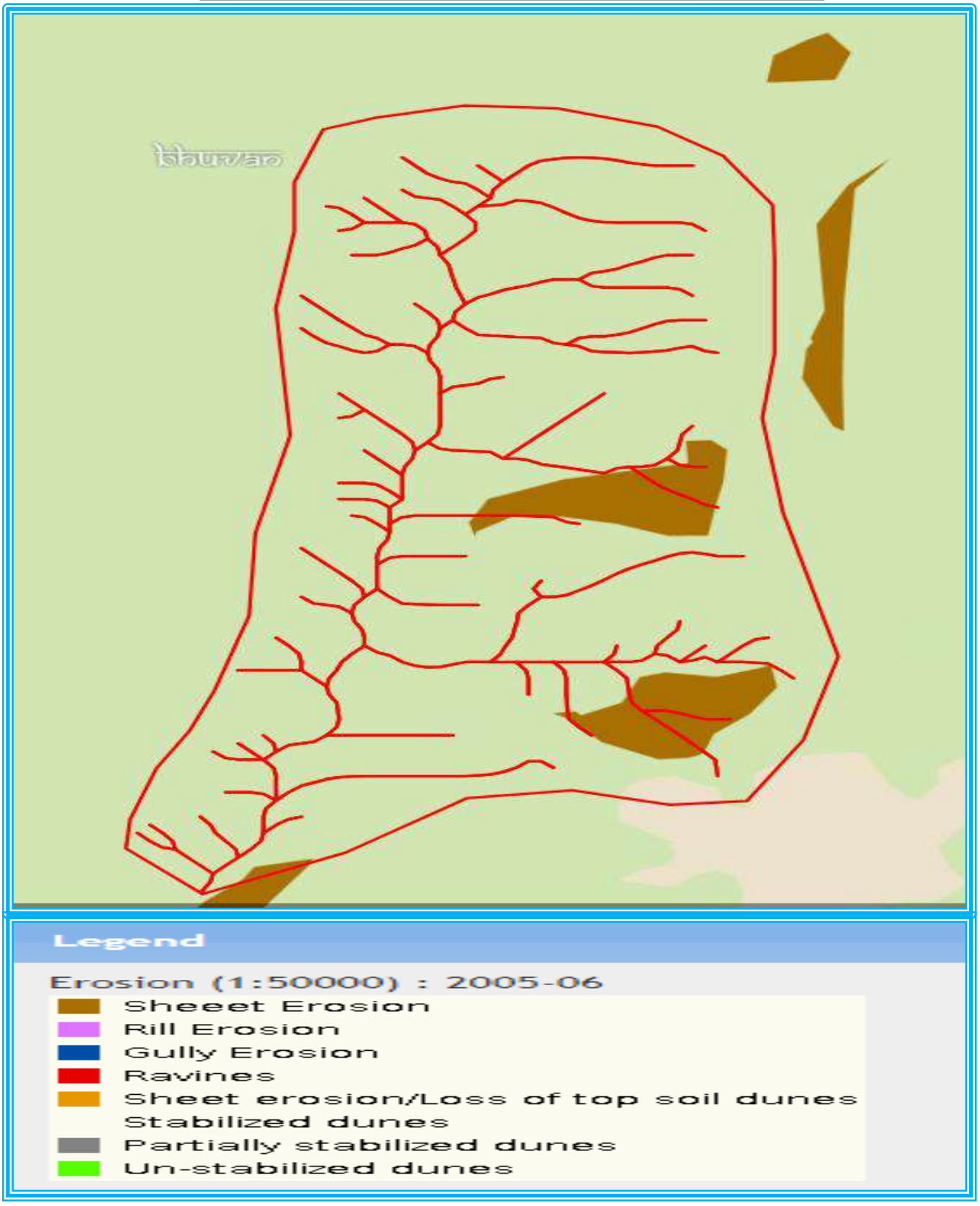
The use of land is the basis of the development of human civilization. Information on existing land use is important information. Based on this, the correct position of the proposed structures can be ensured.

MAP 2.3 LAND USE MAP

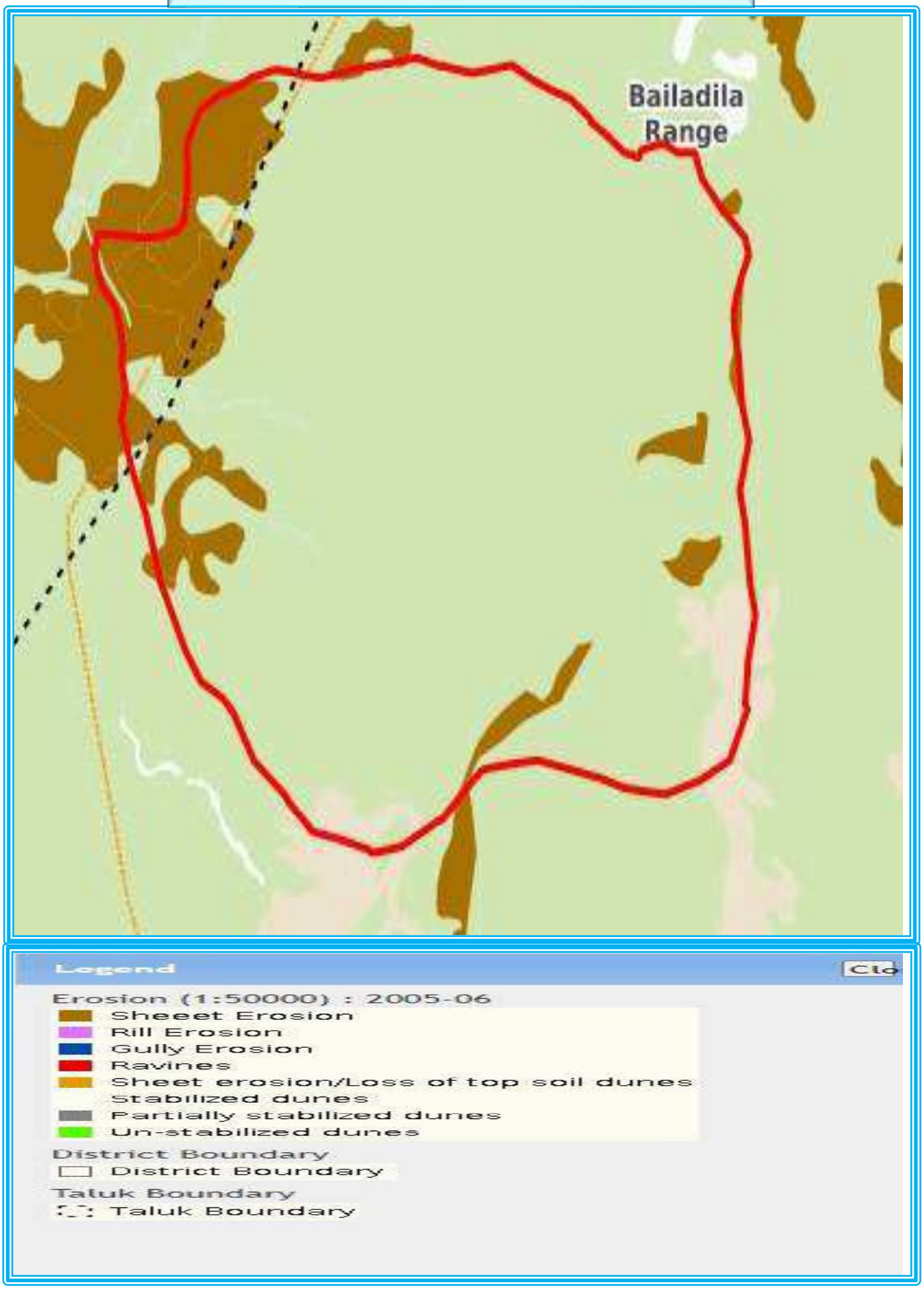
2.4 SOIL EROSION:

Soil erosion is a naturally occurring physical process that primarily involves the carrying away of particles of the top soil of a land by natural physical forces such as water and wind. It affects all types of landforms.

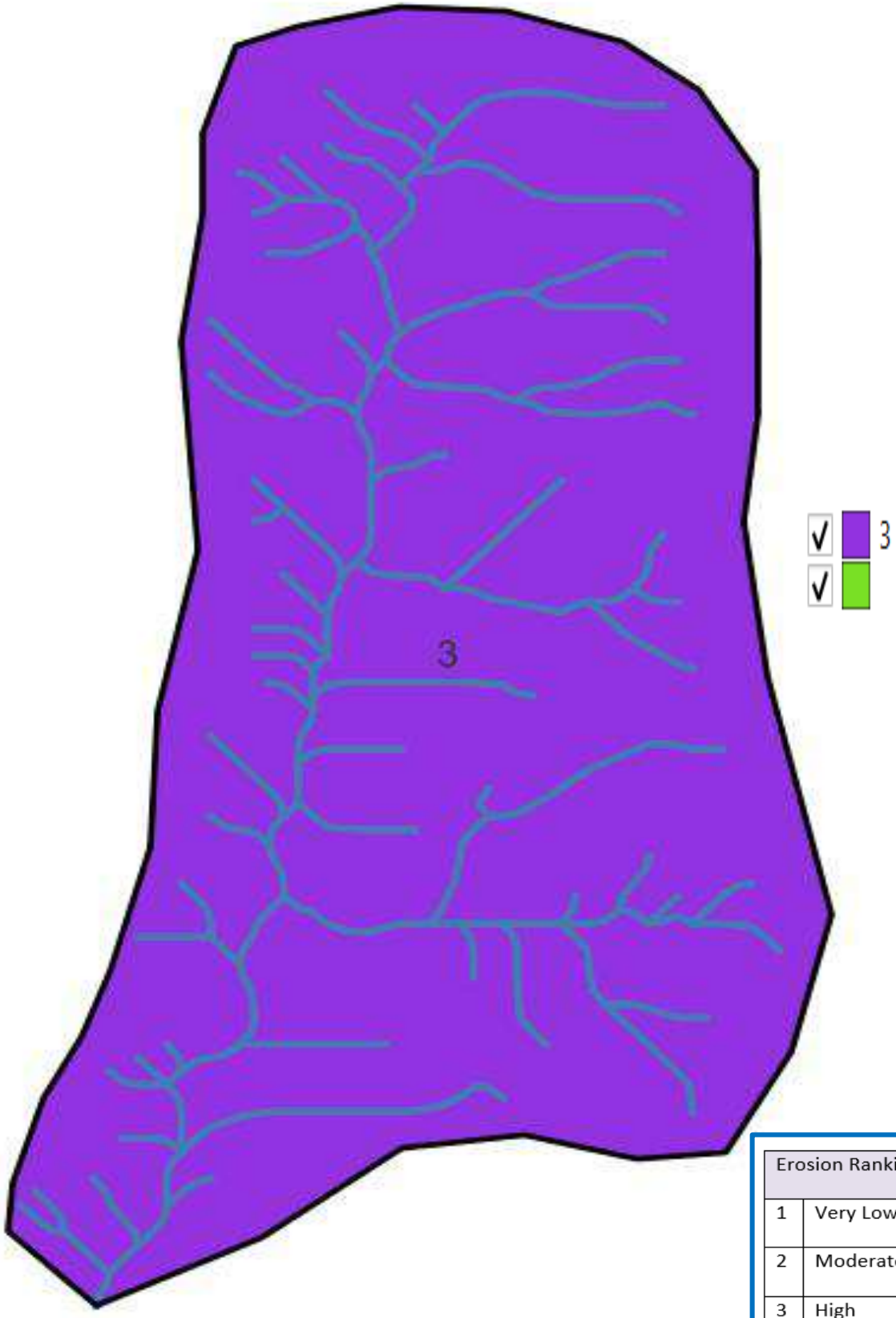
MAP 2.4 SOIL EROSION MAP (A)



SOIL EROSION MAP (B)



SOIL EROSION RANKING MAP

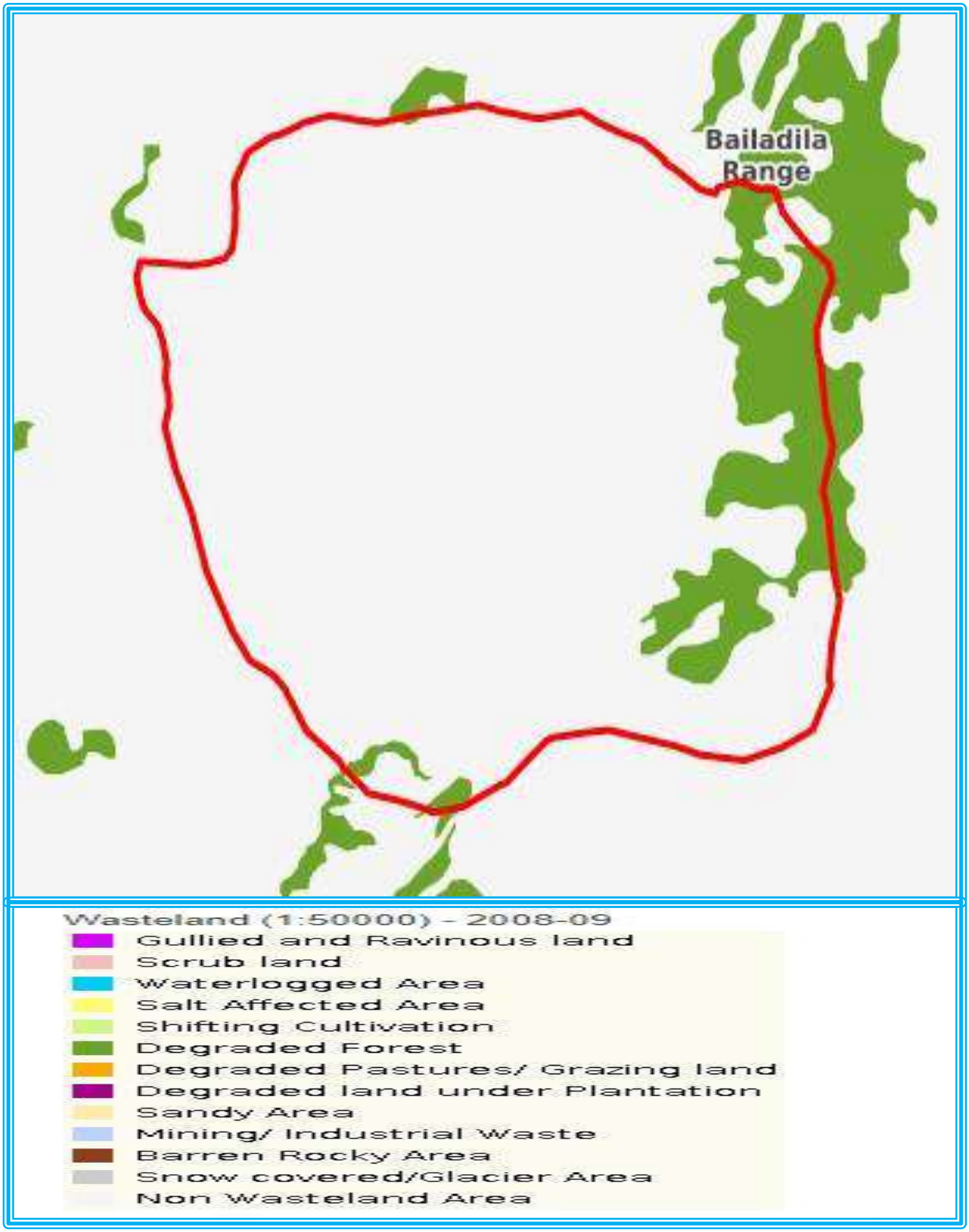


Erosion Ranking	
1	Very Low
2	Moderate
3	High
4	Severe

2.5 WASTELANDS:

It is the land in which there is an excess of salts (especially sodium salts). Nothing or very little is produced in such land.

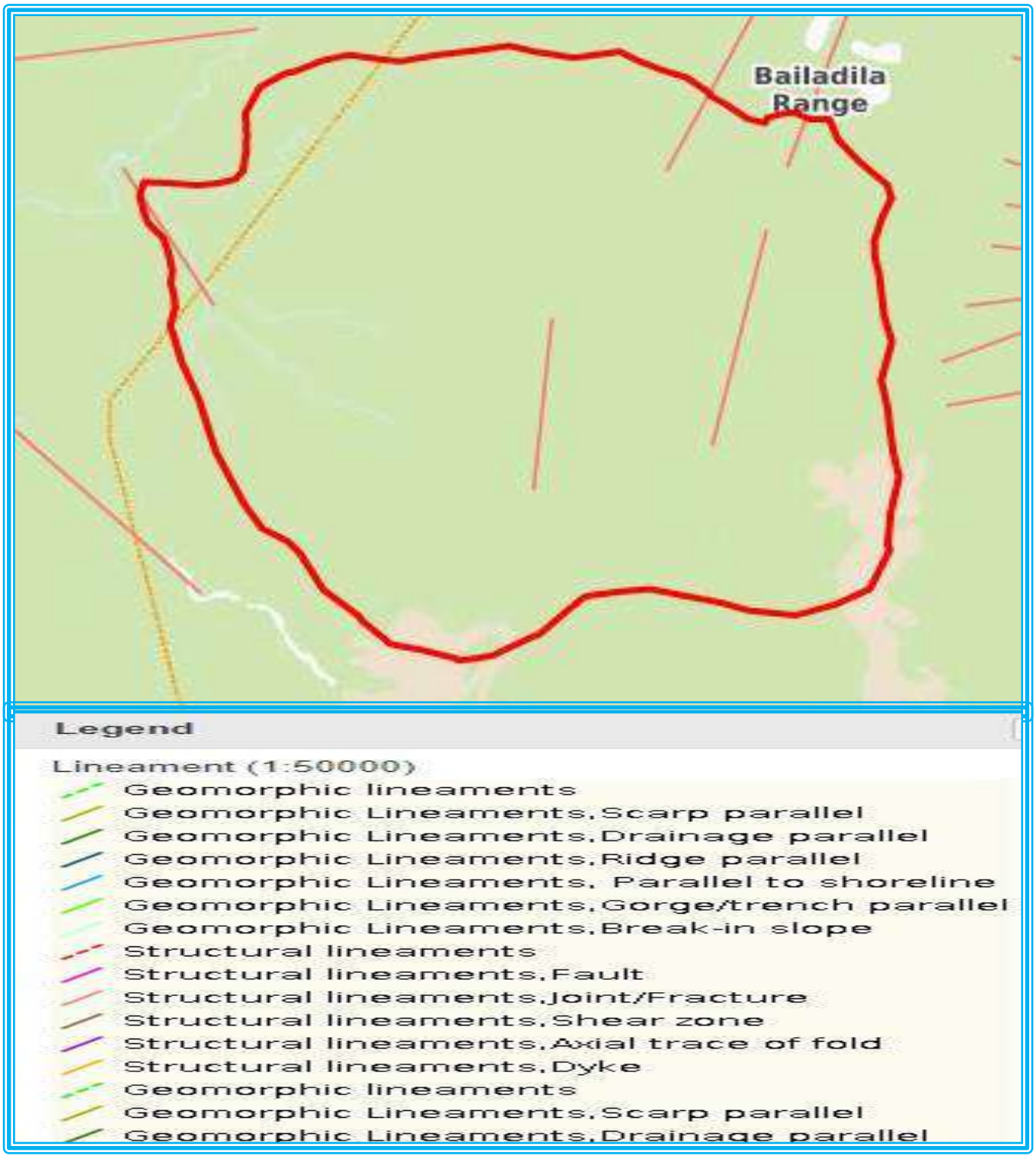
MAP 2.5 WASTELAND MAP



2.6 SUBDUCTION LAYER:

A subduction layer is a linear feature in a landscape that is an expression of an underlying geological structure such as a fault. Typically a dyke will appear as a fault-aligned valley, a series of fault- or fold-aligned hills, a straight coastline, or indeed a combination of these features. Dikes such as fracture zones, shear zones and igneous intrusions can also be expressed as geomorphic lineages.

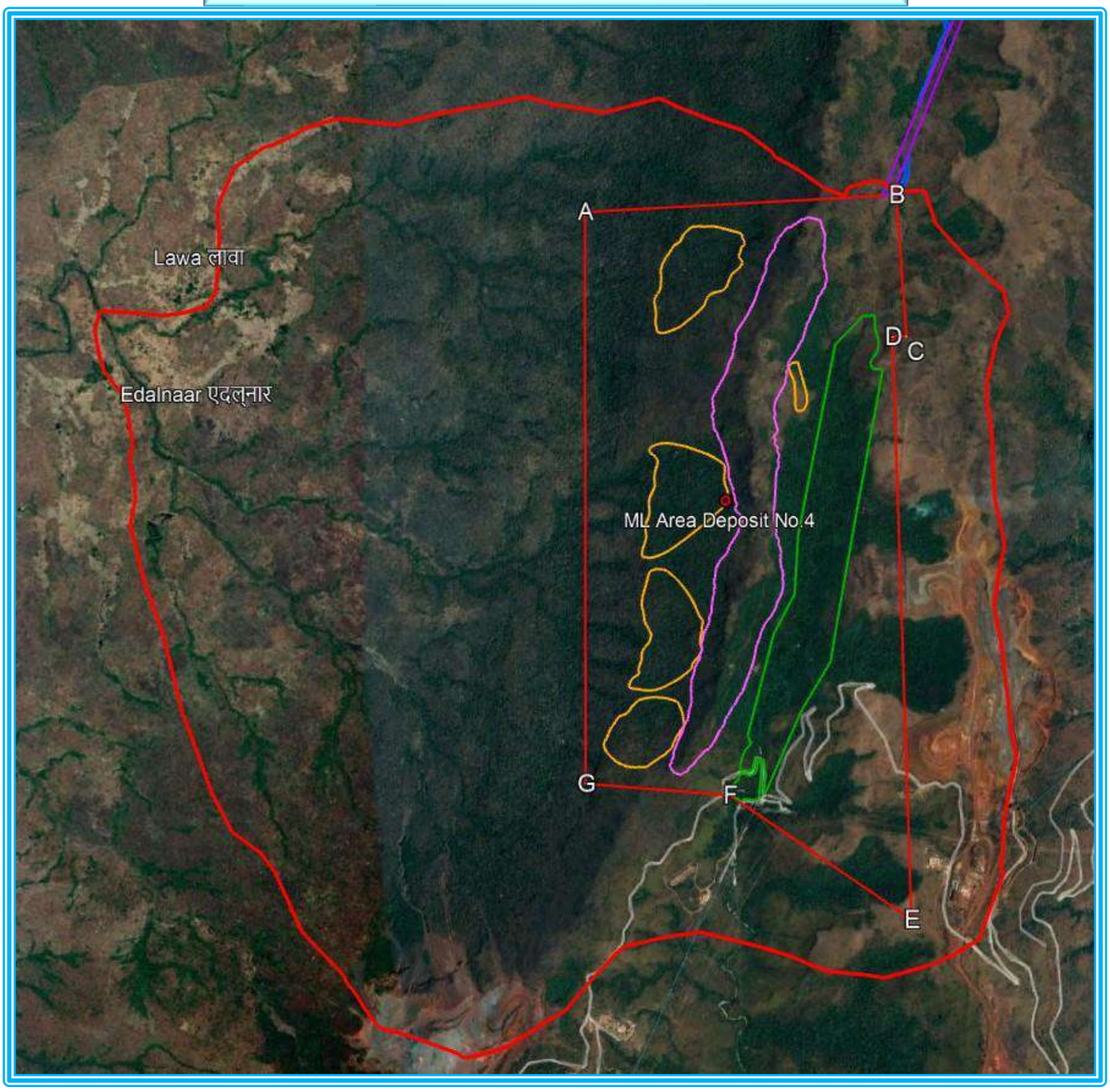
MAP 2.6 SUBDUCTION LAYER MAP



2.7 SATELLITE IMAGERY:

Satellite images (also Earth observation imagery, spaceborne photography, or simply satellite photos) are images of Earth collected by imaging satellites operated by governments and businesses around the world. Satellite images have many applications in meteorology, oceanography, fishing, agriculture, biodiversity conservation, forestry, landscaping, geology, cartography, regional planning, education, intelligence and warfare. Less mainstream uses include anomaly hunting, a critical investigation technique that involves searching satellite images for unexplained phenomena. (5) Images can be in visible colors and other spectra. They are also height maps, usually created from radar images. Image interpretation and analysis of satellite imagery is done using specialized remote sensing software.

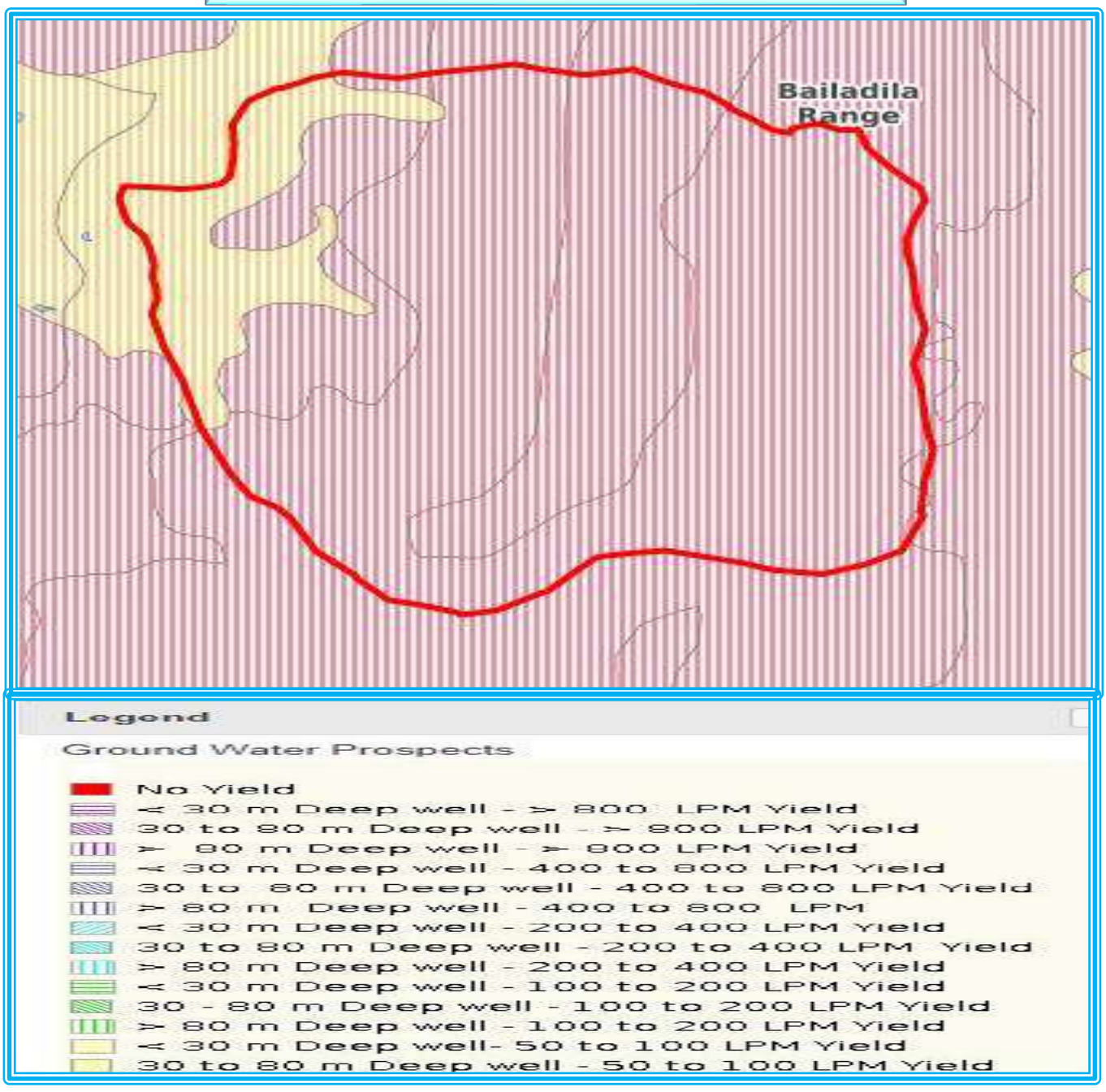
MAP 2.7 SATELLITE IMAGERY MAP



2.8 GROUNDWATER SECURITY:

The decline in groundwater level is a major concern in India as it is the primary source of drinking water. Some of the major reasons for groundwater depletion in India include over-exploitation of groundwater for irrigation, urbanization and climate change. According to the Central Ground Water Board of India (Central Ground Water Board & CGWB), about 70% of the total water used in India is obtained from groundwater sources. CGWB also estimates that about 25% of the country's total groundwater extraction is unsustainable, ie the rate of extraction is higher than recharge. Overall, groundwater depletion in India is a serious problem that needs to be addressed through improved irrigation techniques such as sustainable water management practices and conservation efforts.

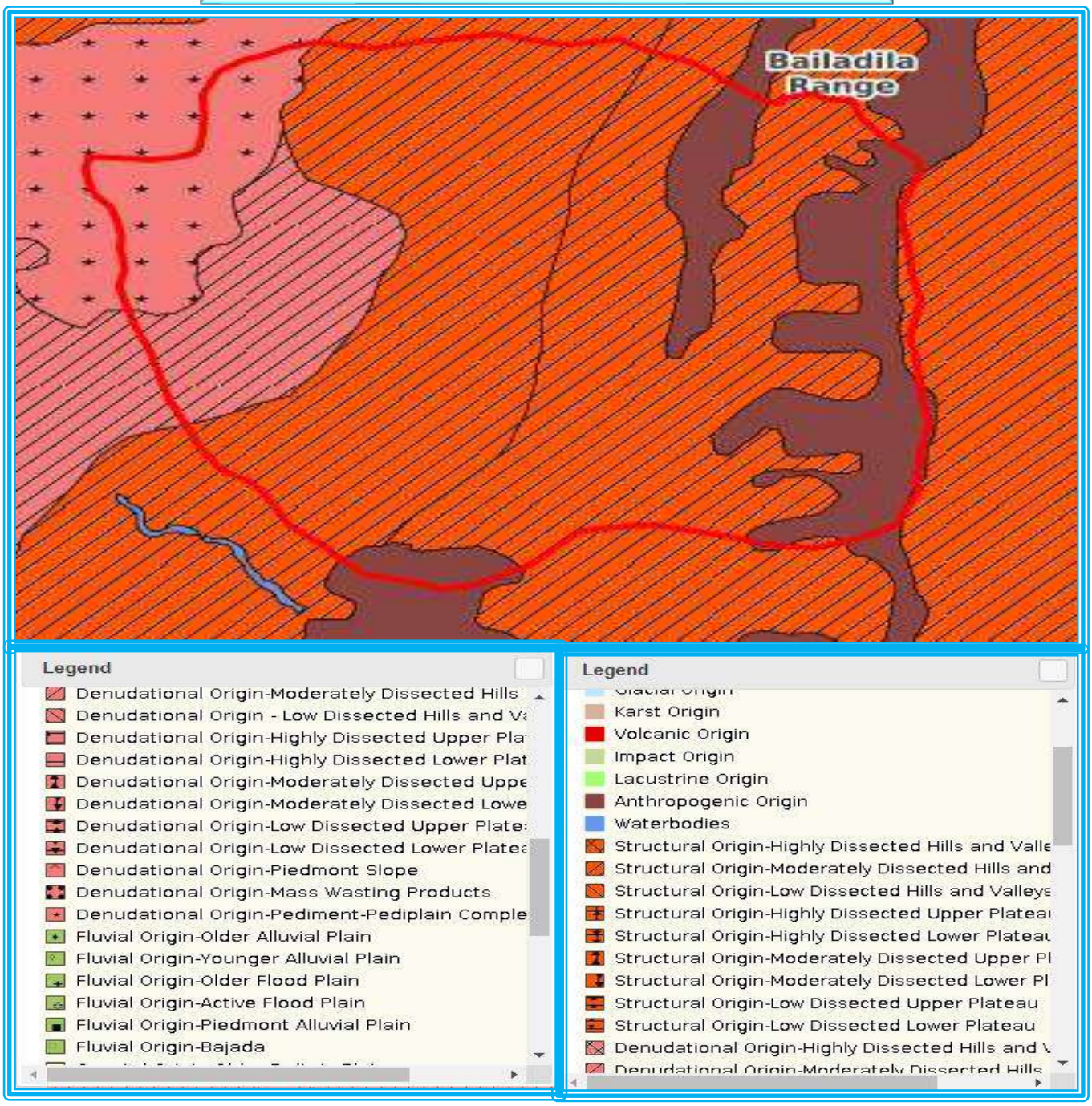
MAP 2.8 GROUND WATER SECURITY MAP



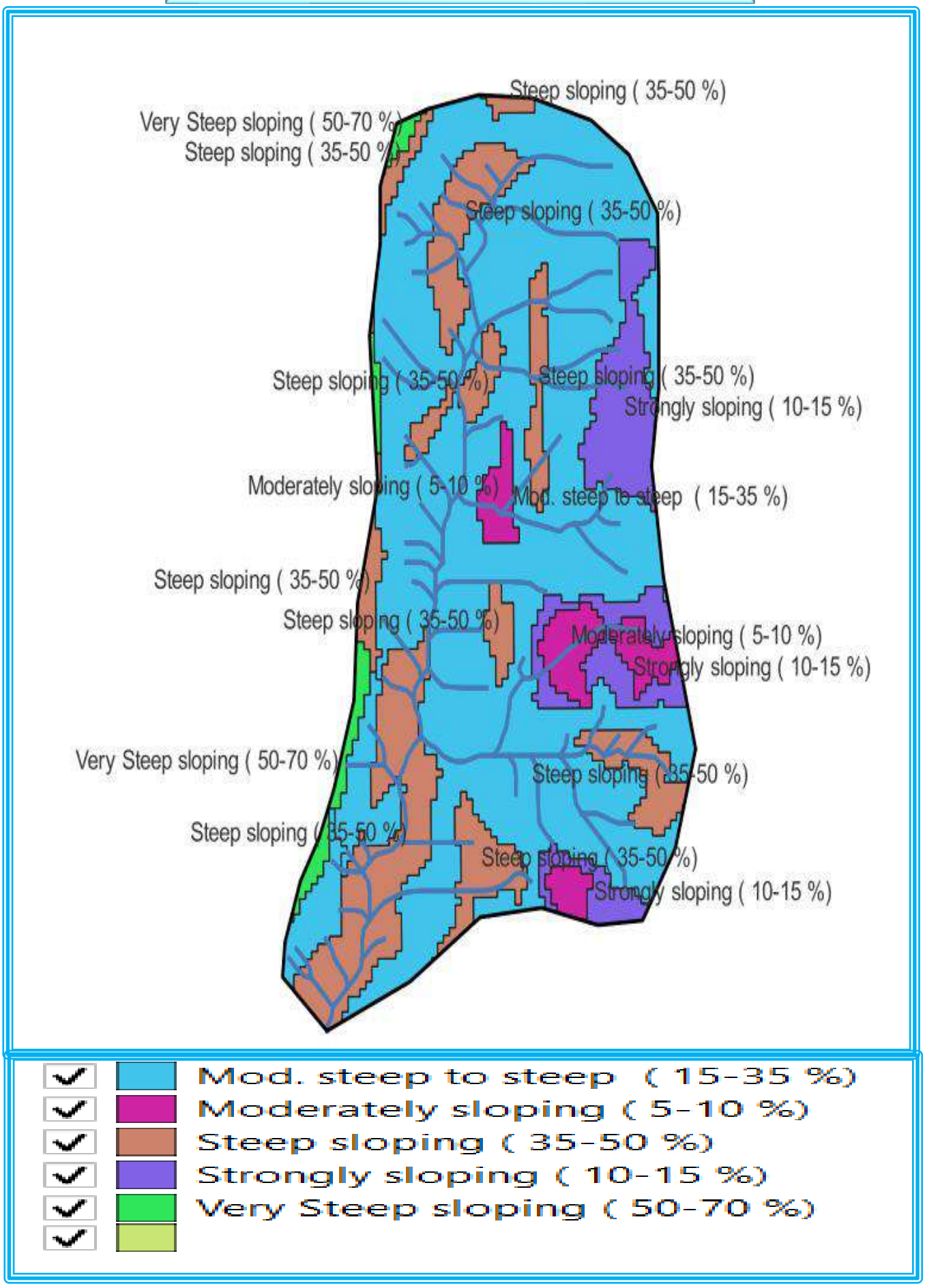
2.9 GEOMORPHOLOGY:

Geomorphology is the scientific study of landforms and the processes that shape them; and more broadly, the study of the processes that control the relief and landforms of any planet. Geomorphologists try to understand what causes landforms to appear the way they do, try to learn the history and dynamics of landforms, and use land observations, physical tests, and numerical modelling. Let's forecast future changes through a conjunction. Geomorphology is studied in geography, geology, geodesy, engineering geology, archeology and geotechnical engineering, and this broad base of interest gives rise to a wide variety of research styles and interests within the subject. Peshal is considered the father of geomorphology.

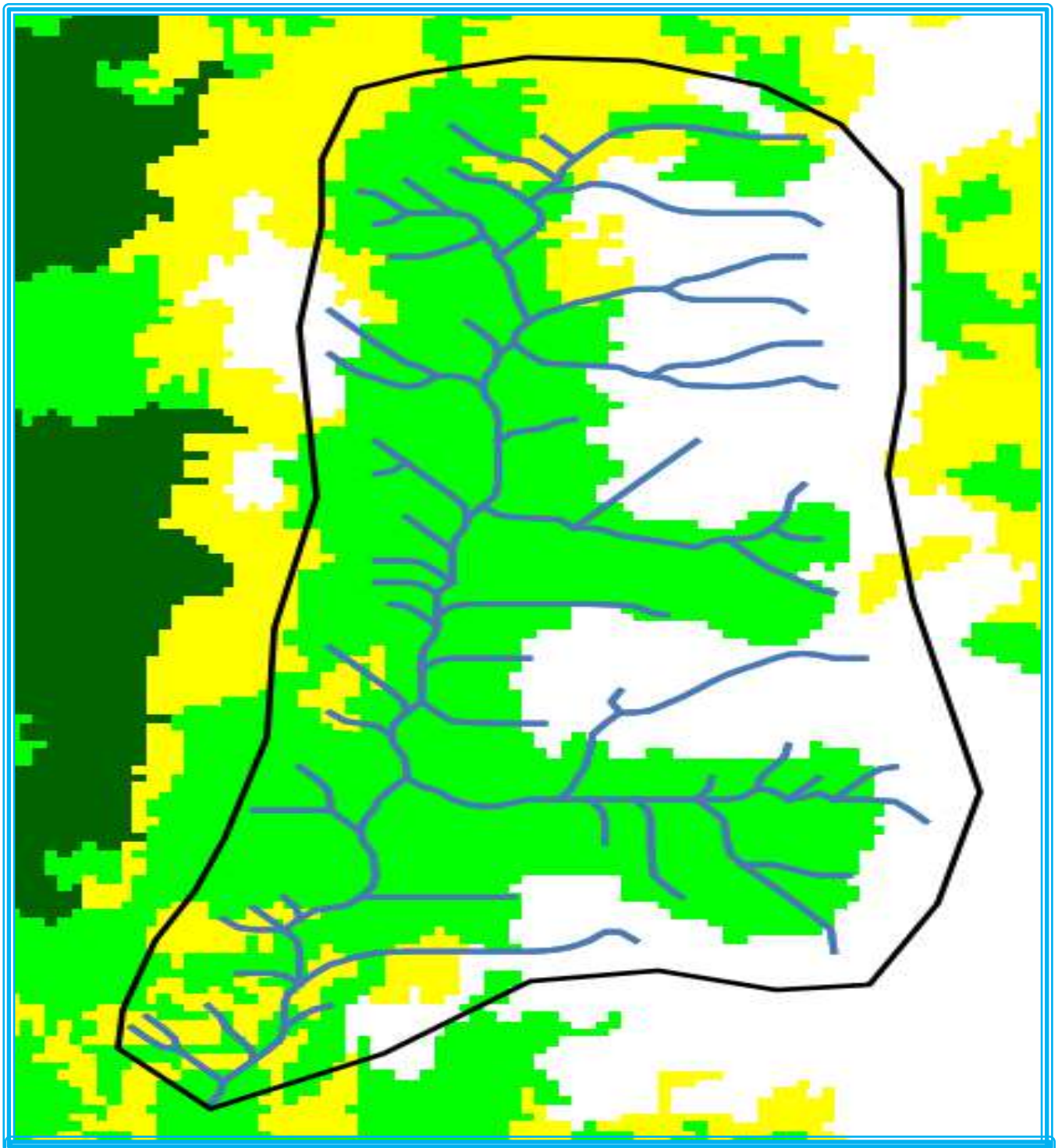
MAP 2.9 GEOMORPHOLOGICAL MAP



MAP 2.10 SLOPE MAP

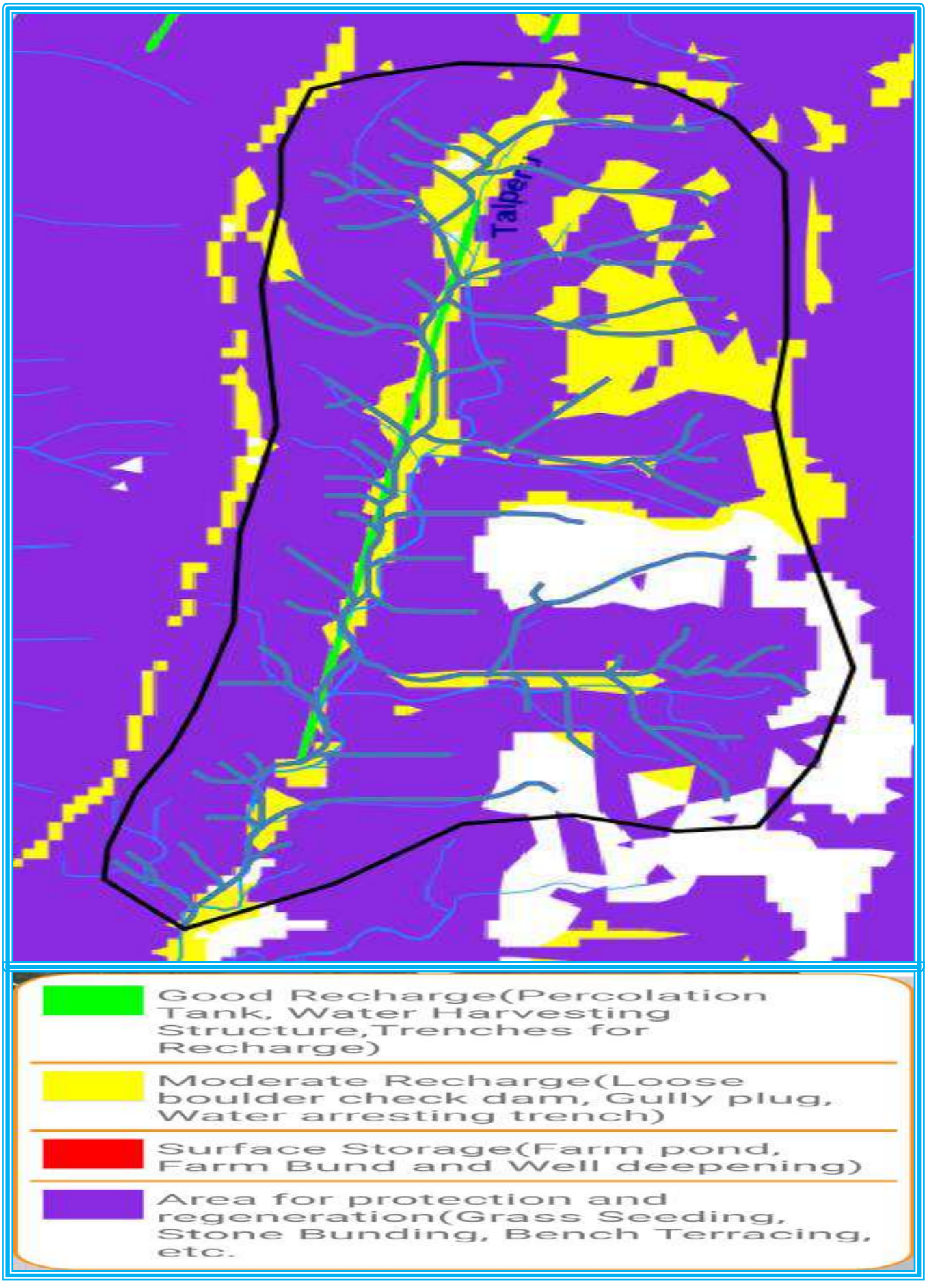


MAP 2.11 FOREST COVER MAP

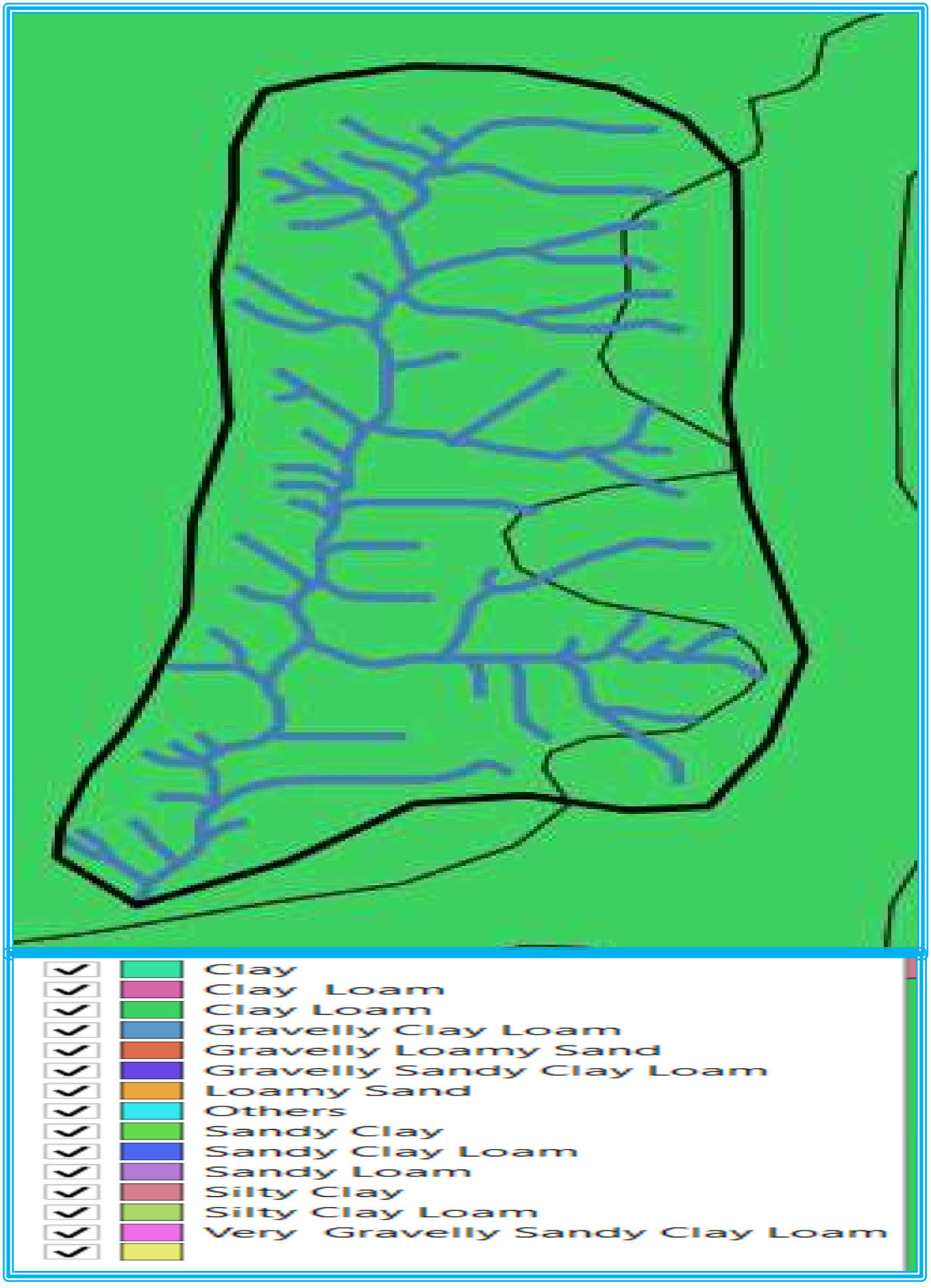


VDF	
MDF	
OF	
SCRUB	
Water	

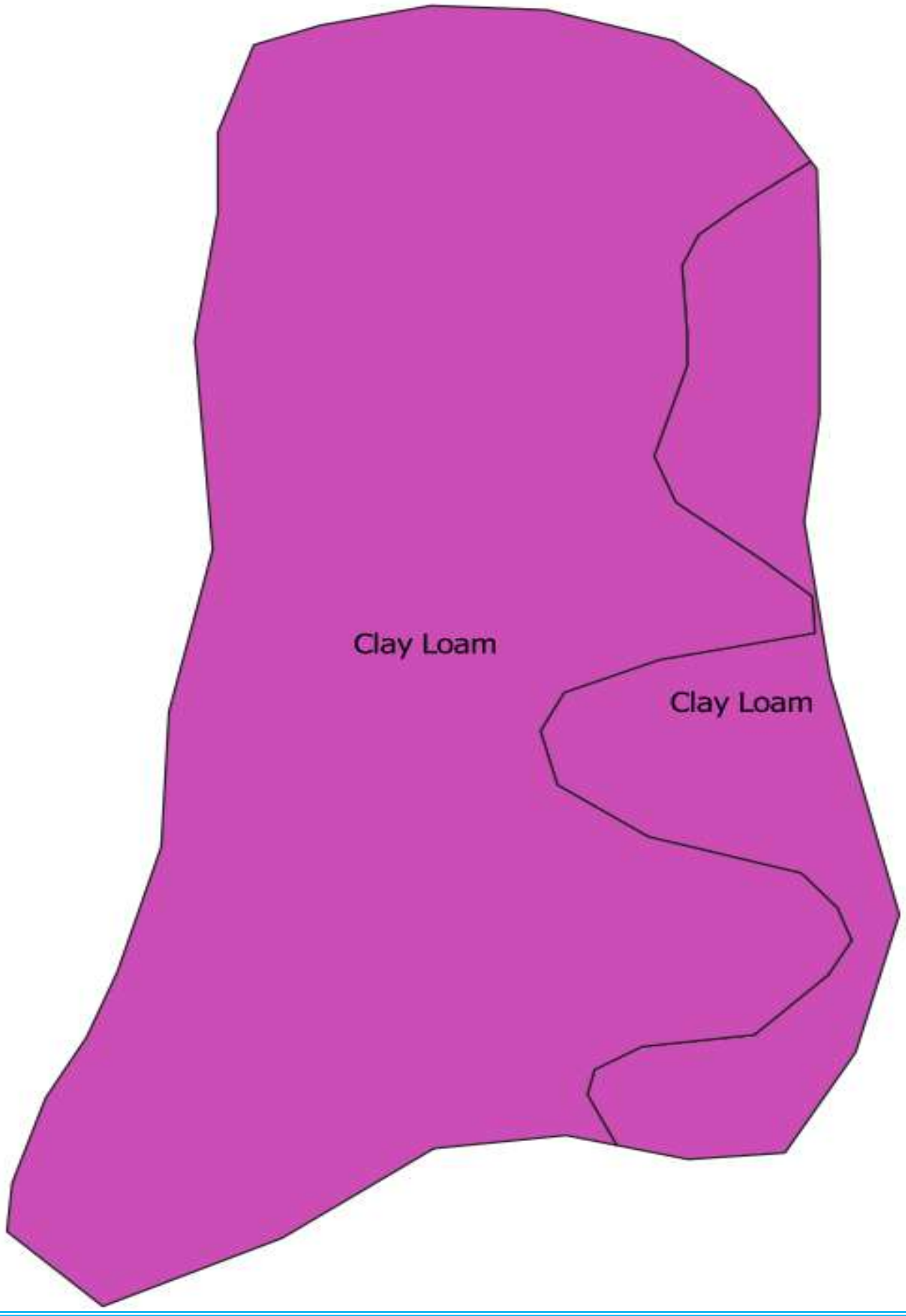
MAP 2.12 CLART MAP



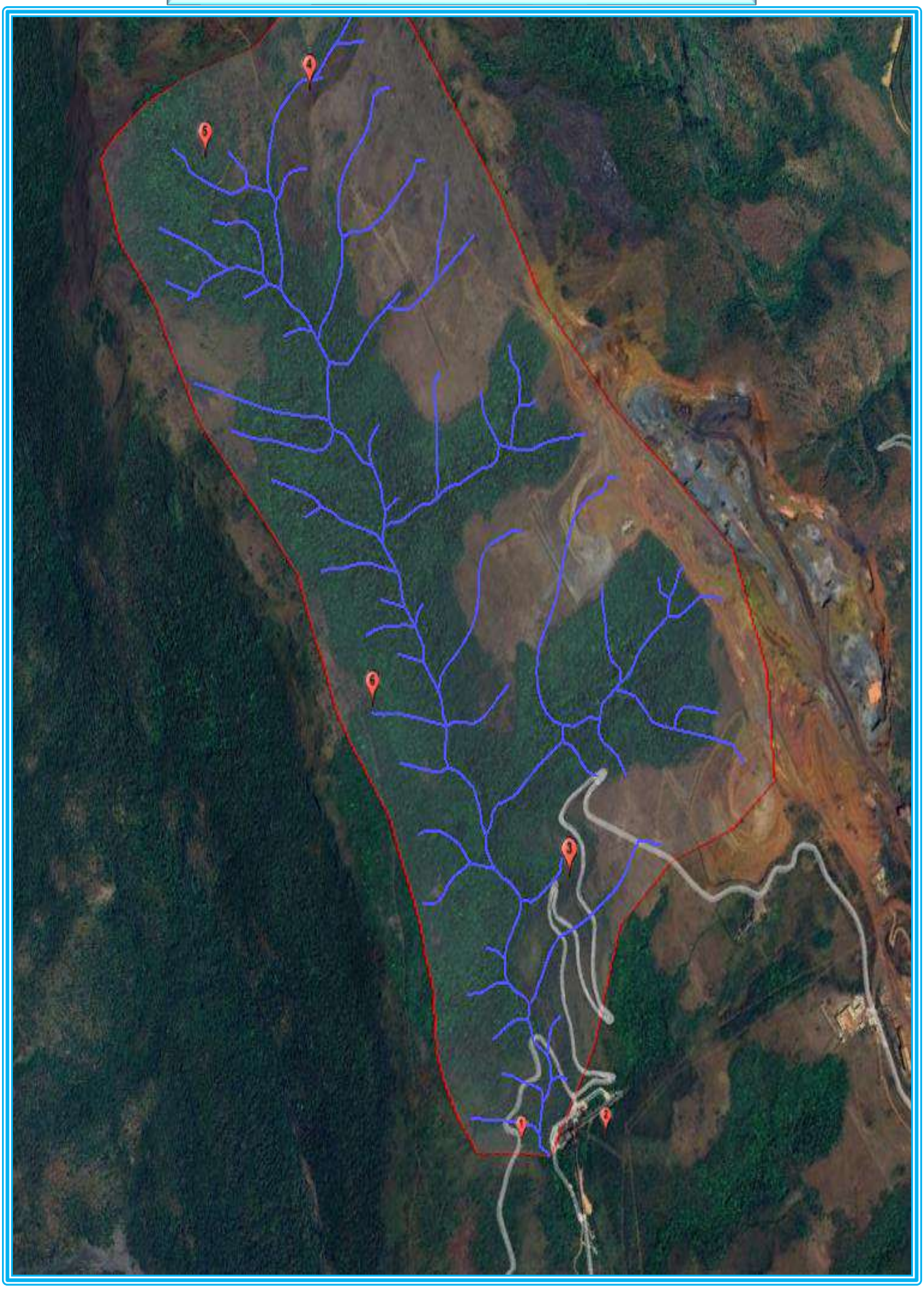
MAP 2.13 SOIL TEXTURE MAP (A)



SOIL TEXTURE MAP (B)

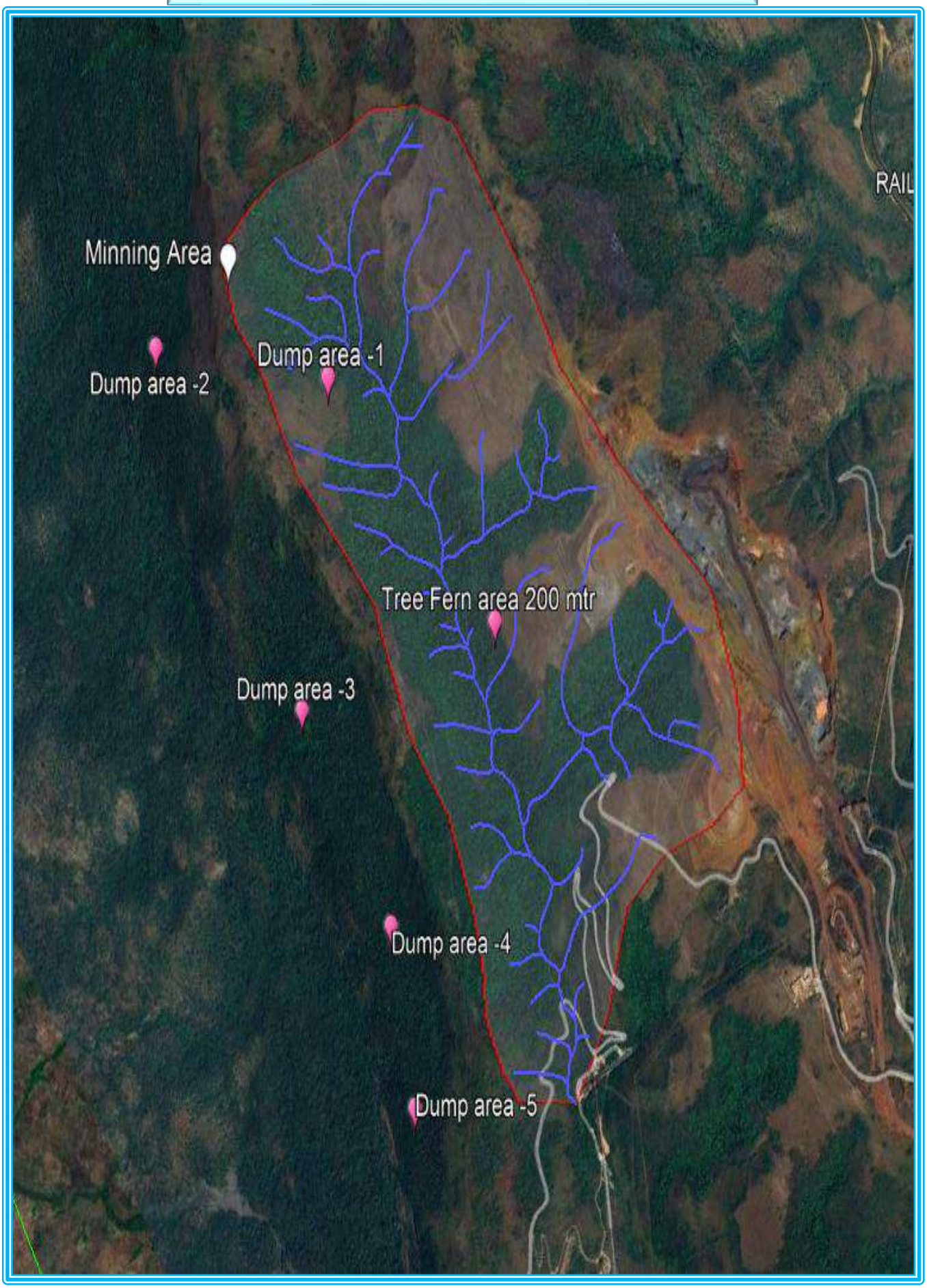


MAP 2.14 MINING AREA MAP

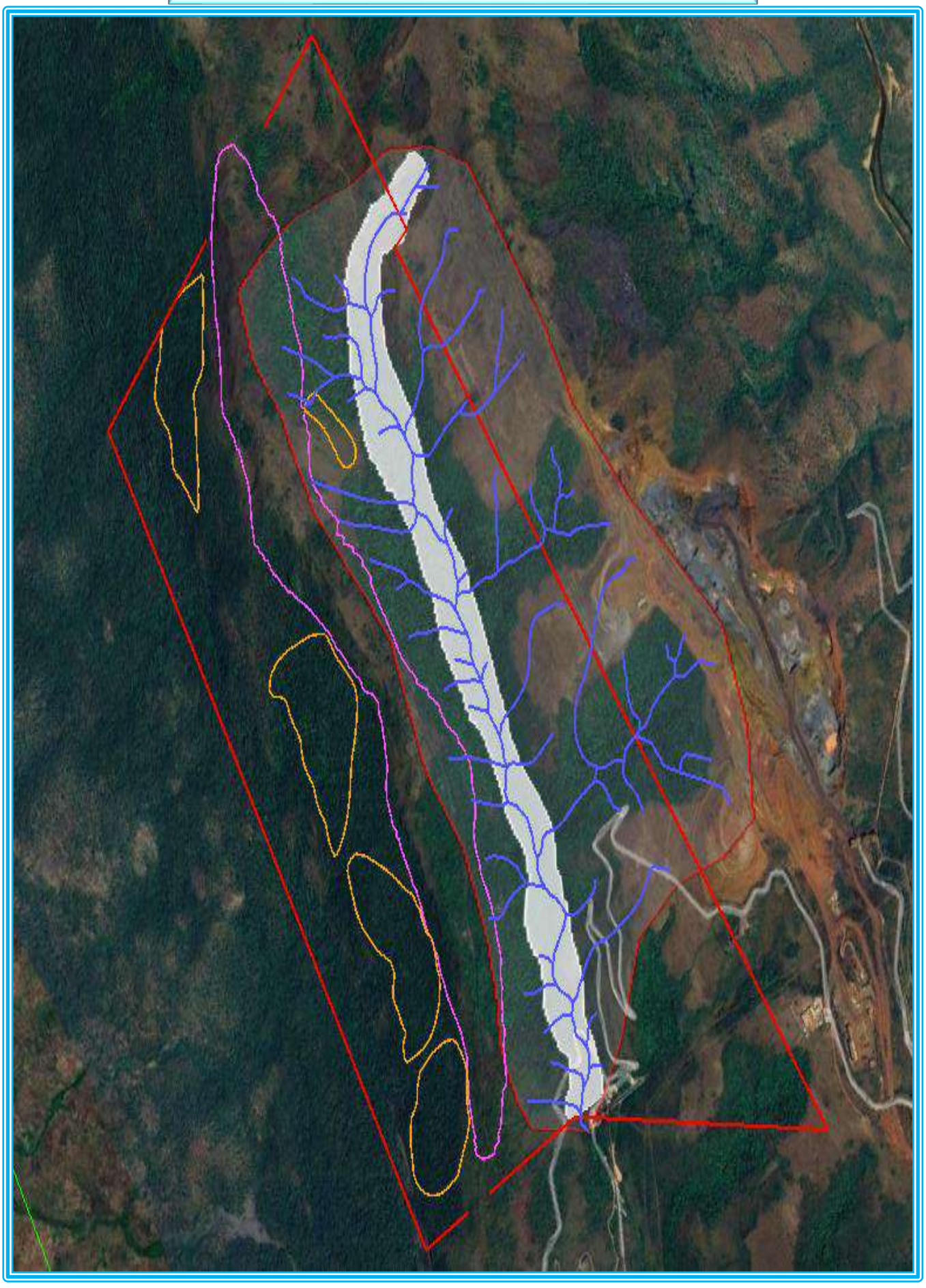


MAP 2.15 200 M DISTANCE FROM THE 4TH ORDER

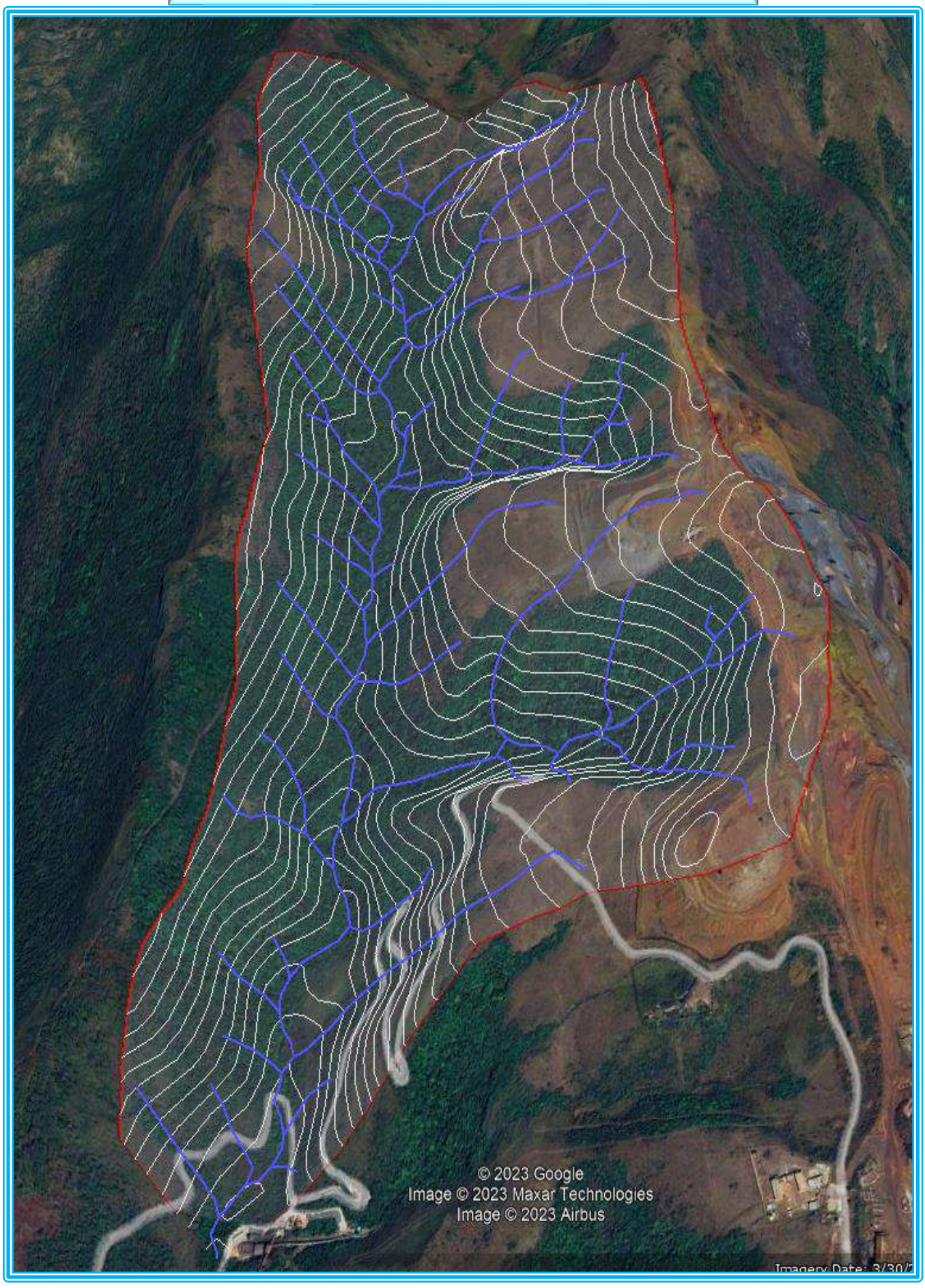
MAP 2.16 DUMP AND FERN AREA DRAIN LINE



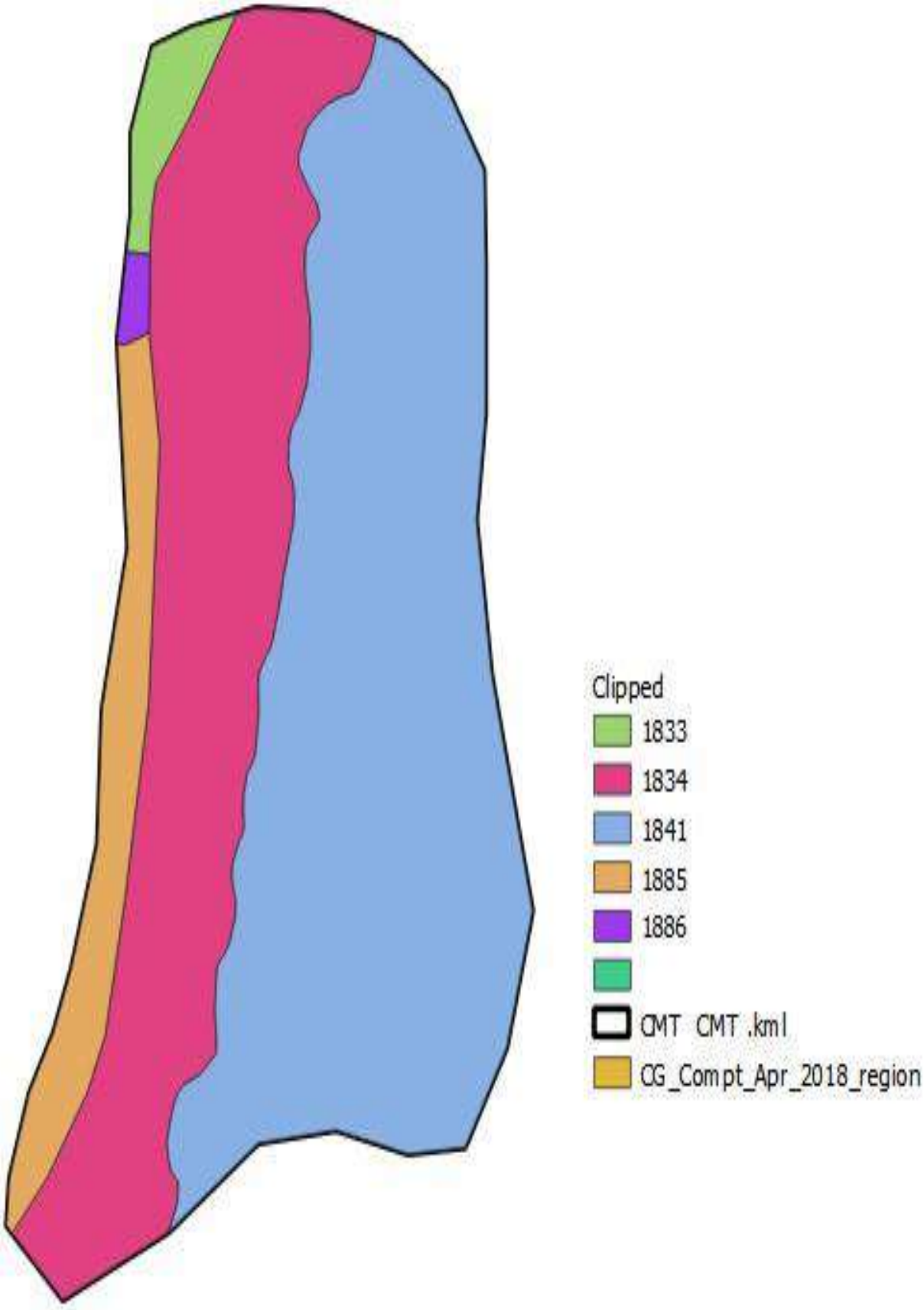
MAP 2.17 POLYGON OF THE EFFECTED AREA



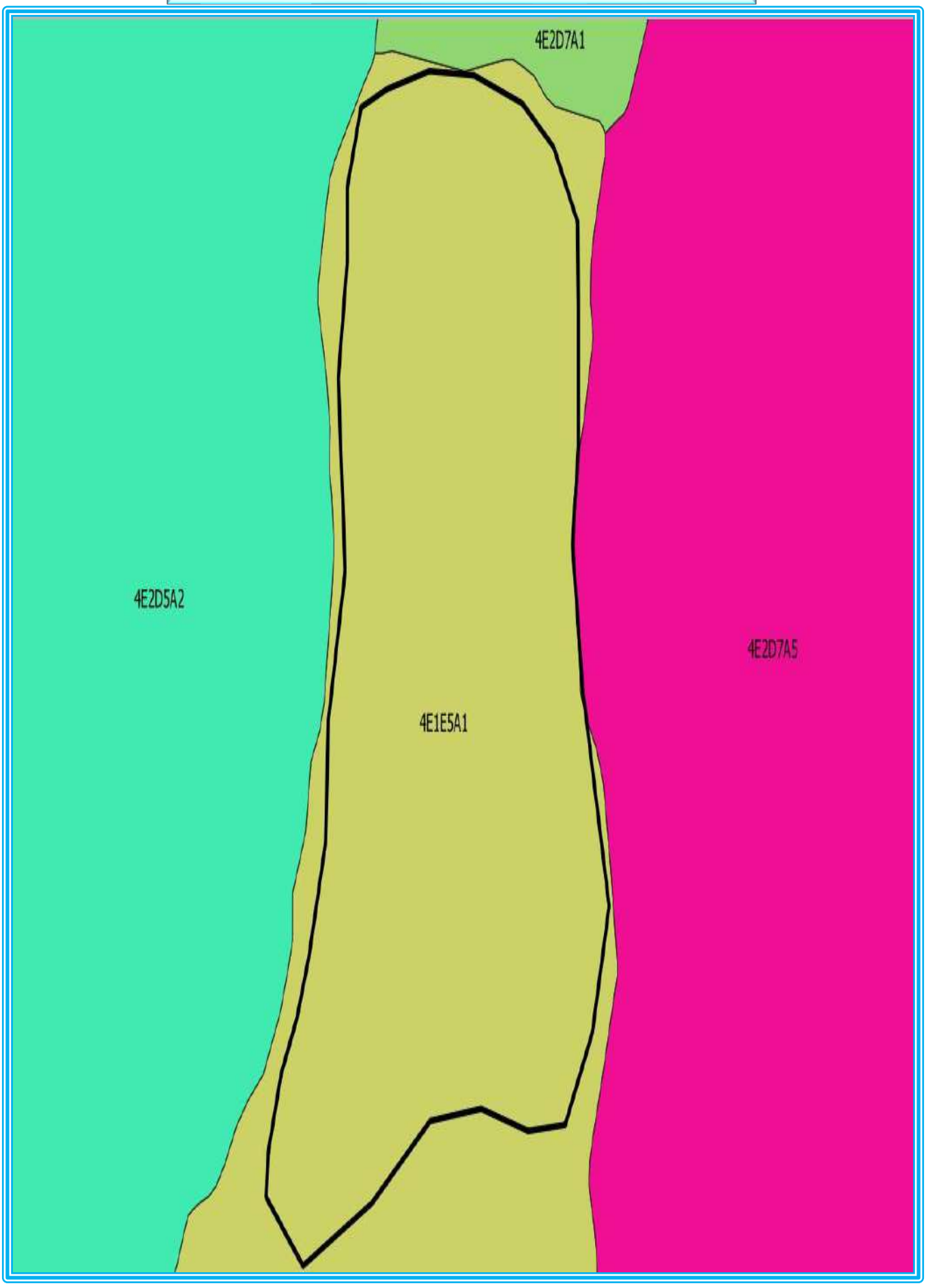
MAP 2.18 10 M DATA OF THE CONTOUR



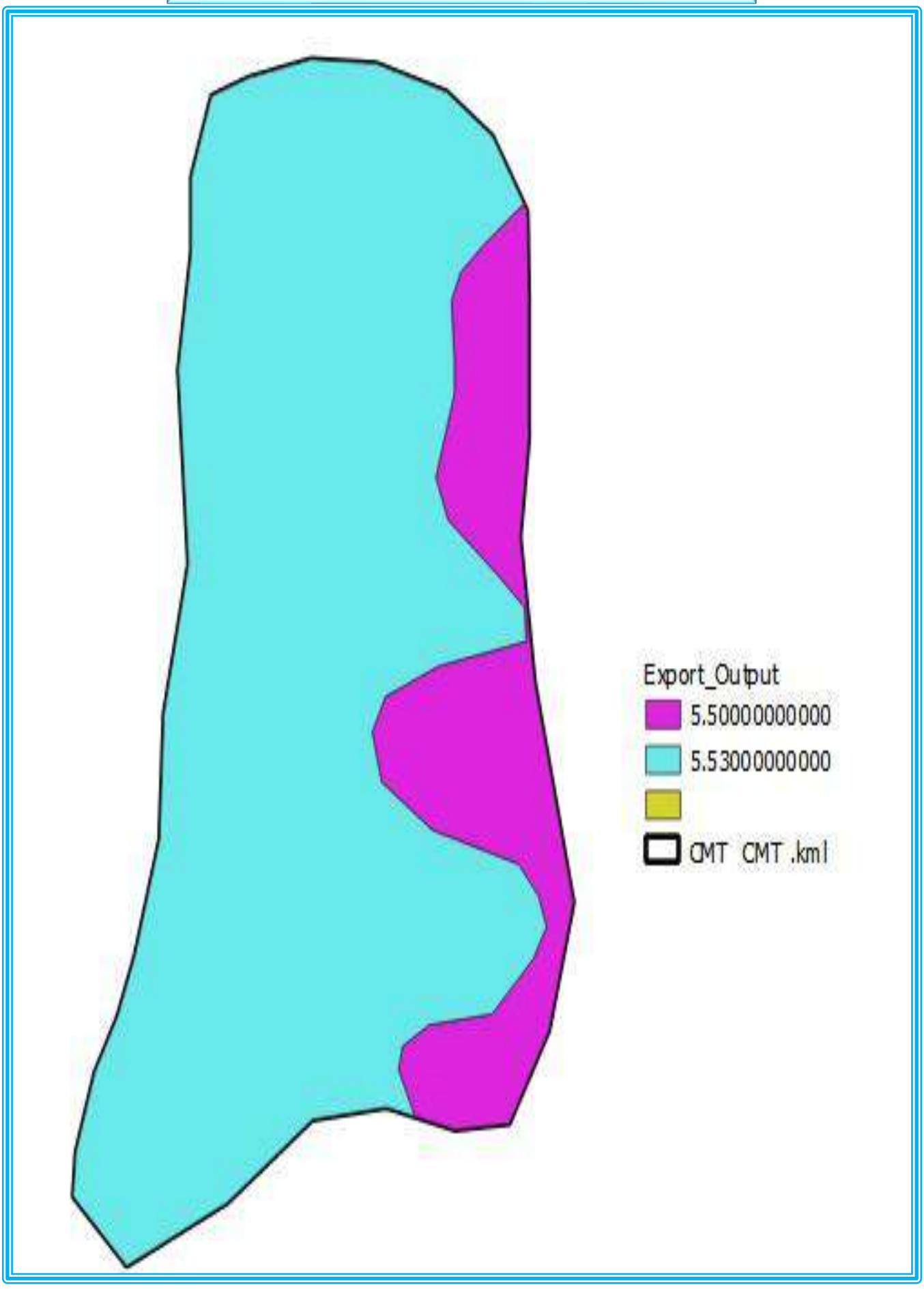
MAP 2.19 COMPARTMENT MAP



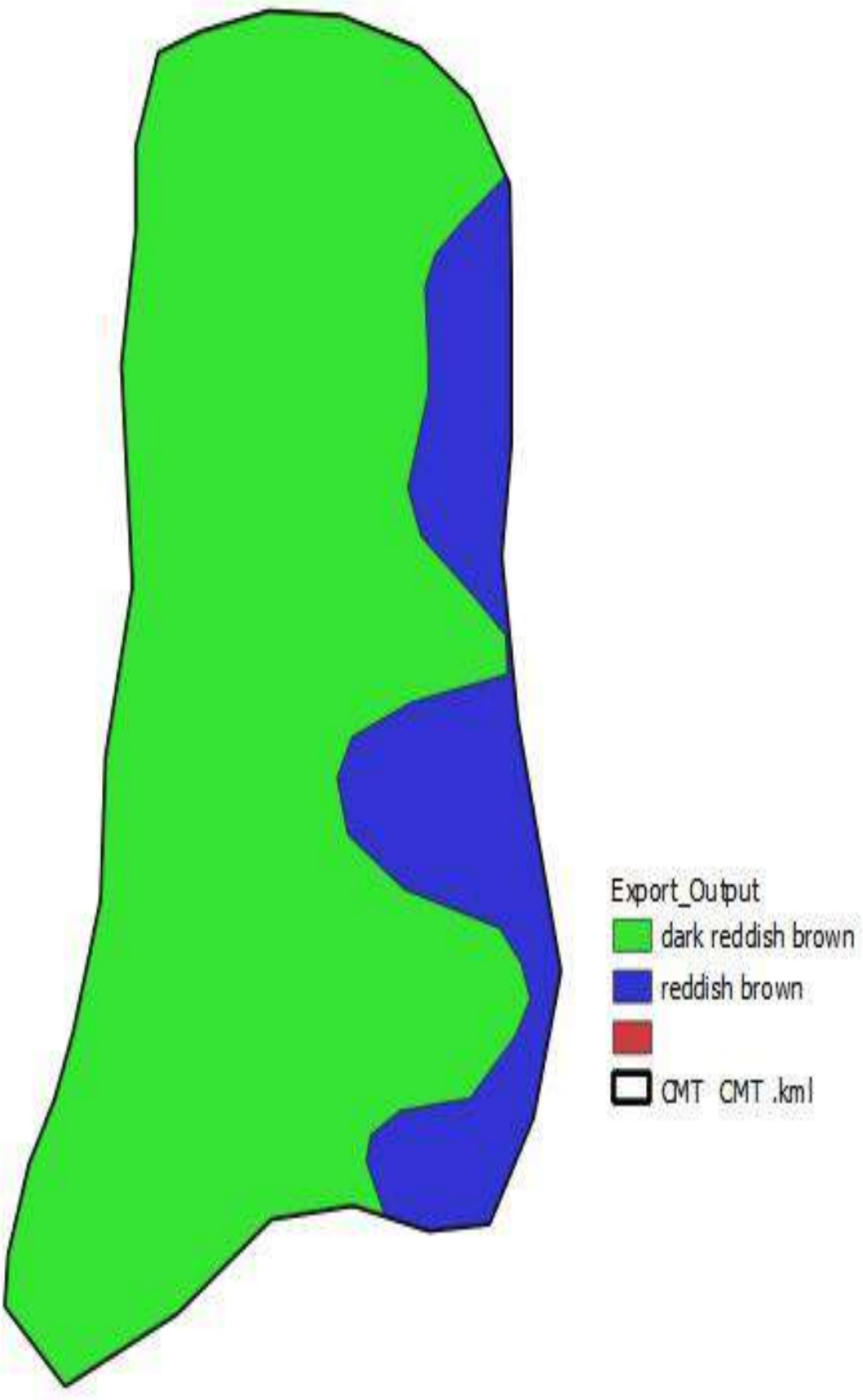
MAP 2.20 MINI WATER SHED



MAP 2.21 PH. VALUE OF SOIL



MAP 2.22 SOIL COLOR



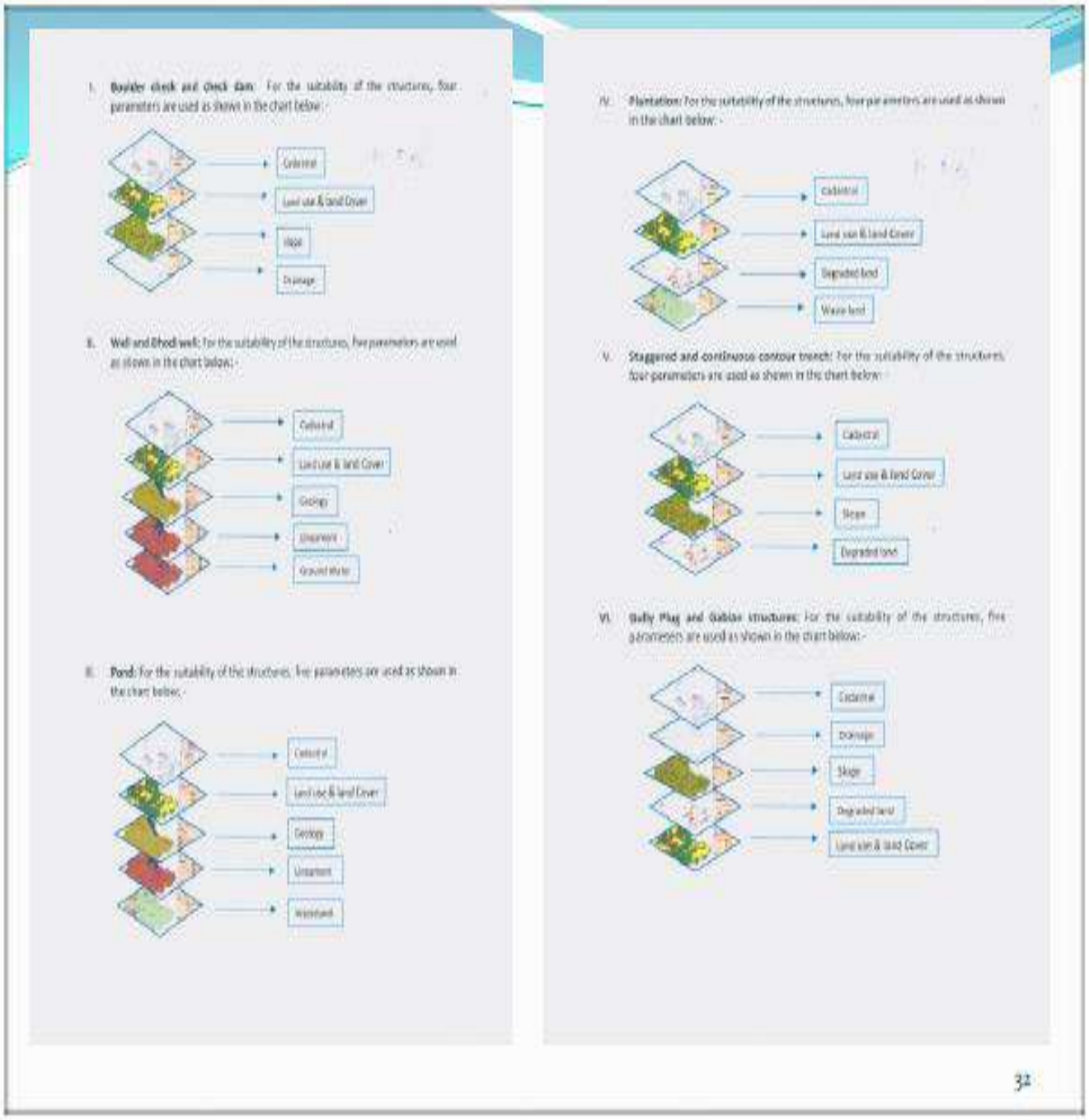
2.10 DETERMINATION OF STRUCTURES:

Geocoded Satellite Map based Proposed Soil and Water conservation Planning Map describes many aspects as given below.

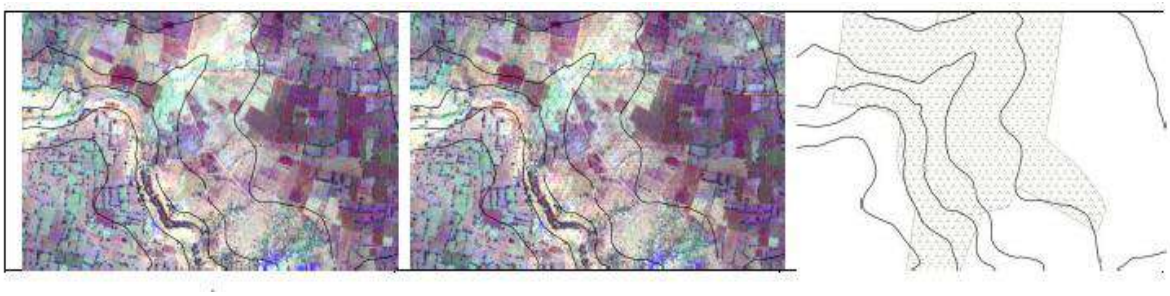
- Percolation tank
- Gabion structures of various sizes (A type of boulder check dam)
- RCC Toe wall towards mines site
- Stop Dam

The role of GIS is very important for building structures using different types of GIS layers for building structures.

2.10.1 REQUIREMENT OF GIS LAYER FOR CONSTRUCTION OF STRUCTURE

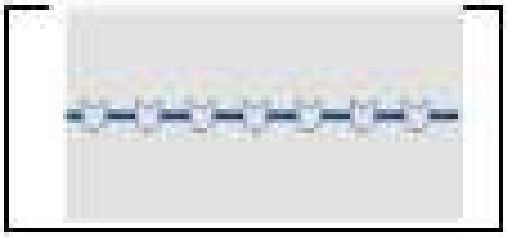


2.10.2 FIELD BUND / BRUSH WOOD CHECK DAM (BWCD)- Field Bund is constructed to prevent soil erosion and water flowing towards the slope in the field. It is shown on the map as follows.

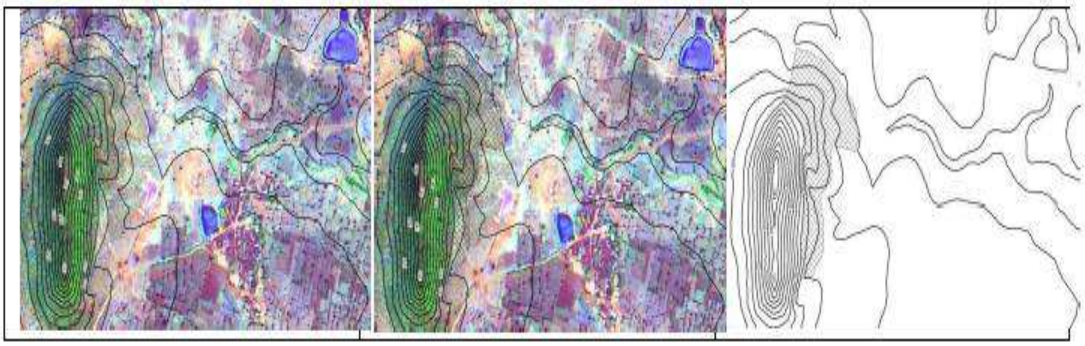


2.10.3 STONE BUND (LOOSE BOULDER CHECK DAM) - Construction of this type of structures prevents soil erosion and wasteful flow of water in the direction of flow of water of small rivers. It is shown on the map as follows.

2.10.4 WATER ABSORPTION TANK (PERCOLATION TANK) - These structures are constructed to increase the percolation of water inside the ground in favor of the stream. It is shown on the map as follows.



2.10.5 CONTOUR DRAIN CONSTRUCTION (CONTOUR TRENCHING) - Contour trenching is constructed in high slope areas to prevent soil erosion and erosion, with the help of which soil erosion and water flow are also prevented. By stopping the flow of water, the water seeps inside the ground and increases the ground water level. It is shown on the map as follows.



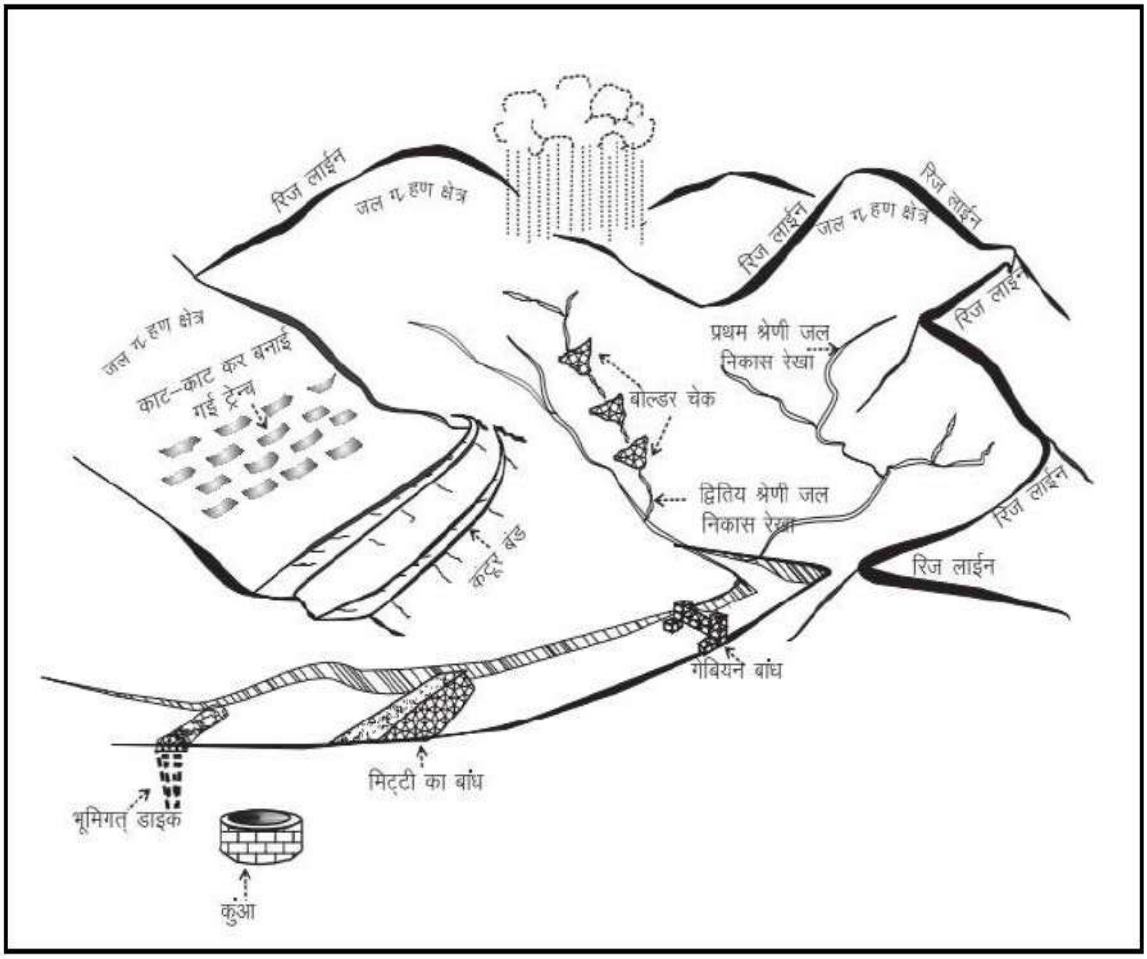
2.11 SUITABLE SITE FOR CONSTRUCTION OF STRUCTURE:

In the development area (catchment area), mainly order 04 drains are selected for treatment, for which order-01 drains (the narrowest drain originating from the top) are selected on the peak to valley concept. In the beginning, the treatment work is done up to Order-04 drain (Wider drain).

2.12 PEAK TO VALLEY CONCEPT:

- Afforestation in the summit area (Upper Reach / Ridge Zone) keeping in view the peak to valley concept for treatment; Loose Boulder Check, Gully-plug, Brushwood Check, Vegetative Bunds, Stone Terracing/Bench Terracing etc. are carried out. The purpose of treatment of summit area is to conserve soil and moisture.

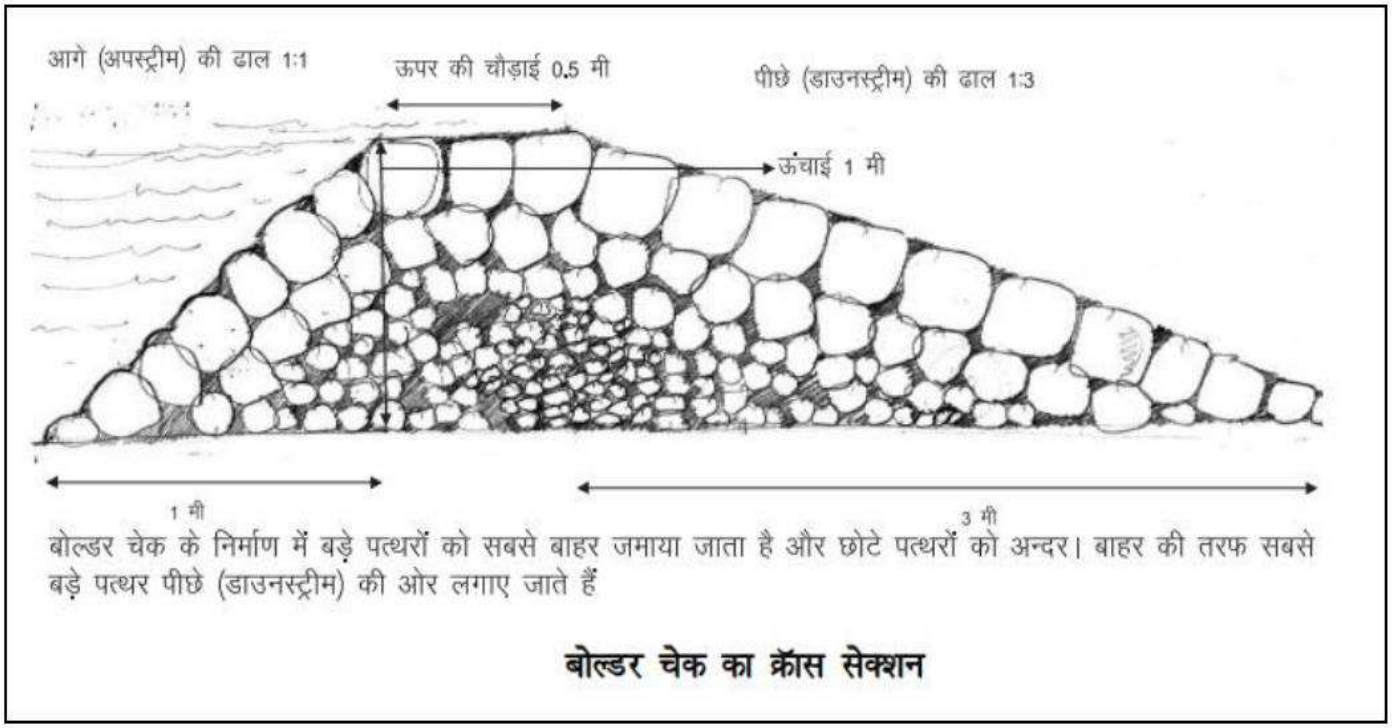
2.12.1 CONCEPT OF PEAK TO VALLEY:



- In valley region (Lower Reach-Valley Zone) Earthen and concrete based structures (Earthen Structures) such as Earthen Dam, stop dam, Farm Ponds etc. are used in valley area (. The purpose of the treatment of the valley area is to use the said water for to maintain moisture level for surface use and to increase the ground water level by percolation by building water storage structures.

2.13 BOULDER CHECK DAM:

Blocks made of stones on small drains are called boulder checks or gully plugs. These dams are built on those drains whose depth is 3 m. where the catchment area is less than 50 hectares.



बोल्डर चेक के निर्माण में बड़े पत्थरों को सबसे बाहर जमाया जाता है और छोटे पत्थरों को अन्दर। बाहर की तरफ सबसे बड़े पत्थर पीछे (डाउनस्ट्रीम) की ओर लगाए जाते हैं

बोल्डर चेक का क्रॉस सेक्शन

2.13.1 OBJECTIVES:

The main purpose of making boulder check is to reduce the speed of water flowing in the drain. Reducing the speed of water serves many purposes: -

1. soil erosion reduction
2. arresting soil runoff, reducing siltation in downstream ponds/dams
3. More quantity of water could percolate under the ground and there should be an increase in ground water re-storage.
4. The flow of the canal should last for a long time, so that rain water can be used in the village for a long time and the ponds/dams below can be filled many times.

2.13.2 CONSTRUCTION SITE:

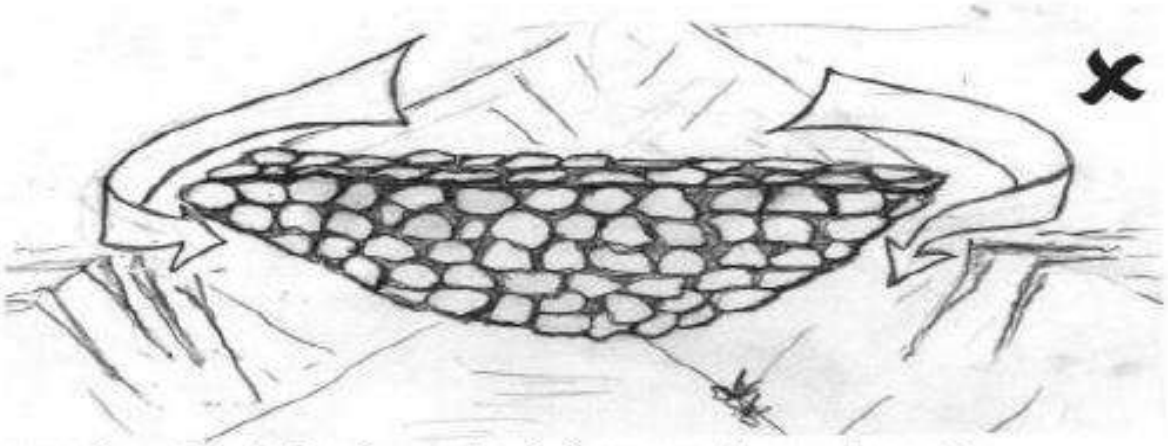
These small dams of stones are made in series on the drains one after the other, so that the catchment area of the drain is divided into small pieces.

1. Make boulder checks only where stones are easily available.
2. The catchment area of any boulder check should not be more than 1-2 hectares. A catchment area larger than 1-2 hectare will release water at a higher rate and rate, for which a very large size boulder check will have to be made to stop it. It is not suitable from a greater point of view.
3. Do not make boulder check where the slope of the drain bed is more than 20 percent. On slopes higher than this, boulders will have to be made much larger than behind the check. It will prove costly if given suitable shield.
4. Build stone dams only where the bank of the drain is strong. The banks should be so high that the stagnant water does not climb over them at the time of maximum rainfall.
5. The less the slope of the drain at the place of making boulder check, the more water it will be able to store.
6. The bed of the drain above the boulder check should be permeable to some extent, so that water percolation can occur and the rate of groundwater recharge can be increased.

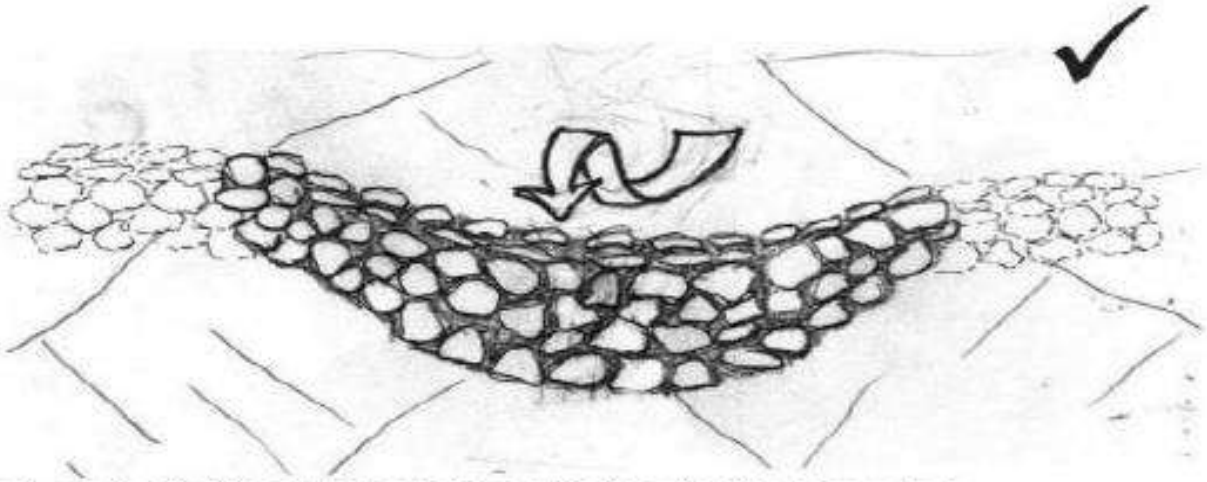
2.13.3 SPACING BETWEEN BOULDER CHECKS:

The minimum vertical gap between two boulder checks should be equal to the height of the boulder check so that the water held by it reaches the bottom of the upper check. Keeping less interval than this will not make full use of the capacity of boulder check. By creating more gap than this, we will not be able to stop as much water as is possible. On fixing the vertical spacing, the vertical spacing between two checks depends on the slope of the channel bed. For example, keeping a vertical gap of 1 meter in a drain with a slope of 5 percent will be 20 meters and a drain with a slope of 10 percent will be 10 meters. This relation can be understood from the following formula: -

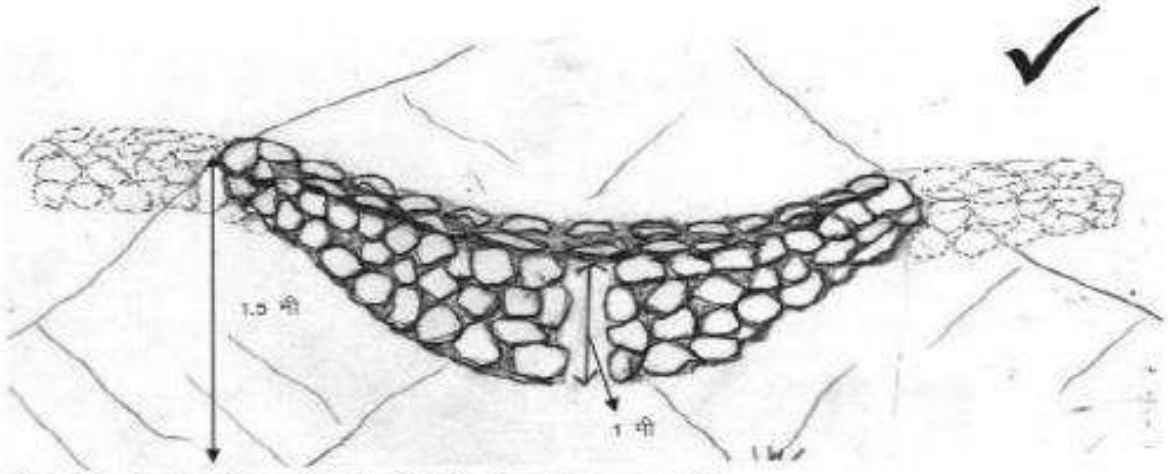
But follow this rule carefully. Also take care of the catchment area. Otherwise, on a drain with a high gradient, we will unnecessarily make too many checks while the catchment area of each check will be very small. Therefore, it would be appropriate to have maximum and minimum limits of mutual distance between boulder checks.



अगर बोल्डर चेक के बीच के भाग की उंचाई कम न रखी जाए और उसके दोनो छोरों को नाली के किनारों में न गाड़ा जाए, तो पानी दोनों किनारों को काट देगा



बोल्डर चेक के बीच के हिस्से को नीचा रखें और उसे दोनो ओर नाली के किनारों में गाड़ दें। तब पानी बीच के भाग के उपर से गुज़र जाएगा। न नाली के किनारे पानी से कटेंगे और न ही बोल्डर चेक के टूटने का खतरा होगा



बीच की उंचाई को बाकी हिस्सों की उंचाई से कम रखें

चित्र : **बोल्डर चेक के मध्य भाग की ऊंचाई बाकी भाग से कम रखें**

2.14 LET'S LEARN BY DOING:

Now on the basis of following information we plan boulder check for a river/watershed.
In this way all the micro watersheds will be planned. Later, with the help of survey equipment, a detailed survey will be done and the actual number of boulder checks will be compared with the number extracted from the toposheet. During the detailed survey, after measuring the width of the drain at different places, it will also be noted that how many boulder checks of what length will be made? In this way we will know the number of boulder checks of different lengths (8m, 10m, 13m).

2.14.1 SHAPE:

After the experience of rainfall, it has been generally decided that the maximum height of the middle of the boulder check should be kept at 1 meter. The width of the top is generally 40 cm. Keep it Since the angle of rest of the stones is more, so keep the upward slope. The higher the flow the higher the speed, the lower the slope.
For the safety of the structure, it is necessary to ensure that maximum water passes over the central part of the boulder check. The more the water touches the sides of the drain, the greater the risk of soil erosion. That's why it is necessary to make the middle part of the check low and both the edges high. But the edge of the check is 105 cms. It should not be higher than this. Yes, if the edge of the drain is 105 cm. If it is less than 100 cm, then keep the edge of the check equal to the edge of the drain. 50 cm of check Bury both the sides till 10 cm, so that there is no soil erosion in the part of the separation. If the bottom of the drain is made of stones, then no need to give any special foundation, otherwise dig a 25 cm deep foundation.

2.14.2 TO FIND THE HEIGHT OF DIFFERENT POINTS OF BOULDER CHECK IN A CHANNEL CROSS SECTION:

The cross section of the drain was shown at the location. At this place, know the method of the height of the boulder check at different points in the drain.

1. First of all, a scale of scale level does not go upwards slowly on the drain.
2. When the difference between the readings of both the scales comes to 1 meter, then that point. We mark it and take its reading.
3. Also b. In between take the reading at another point.
4. Similarly, on the other side of the drain, readings are taken at point K and MK. 5. The flat distance between each of the points is measured with a tape measure.

With the help of the above readings, all the points are taken out.

2.14.3 CONSTRUCTION METHOD:

1. At the check construction site, draw a chosen line on both the sides of the drain till the height of the sides is 1.5 meters above the floor of the drain. Yes, if the edge is less than 1.5 meters high, this line will only reach the edge. 20 cm of this line. above and 20 cm. Draw one parallel line below. These two lines mark the peak boundaries of the check. Let the upward slope be fixed at 1:1 and the downward slope at 1:3. Mark a point at a distance of 1 meter on the perpendicular drawn from the center point of the top crest line. These two points mark the upper and lower limits of the cheque. Connect these points to the edges of their respective vertices.
2. Boulder check holes are not dug in the bottom of the drain. The trenches are dug only for burying the checks in the sides of the shift. Dig this trench 20 cm wide and 50 cm deep. Where the top of the check meets the edge of the drain, dig trenches up to 50 cm and beyond. If the bottom of the drain is made of sand or soil, dig a foundation of 25 cm. Now start the stone age. Set the stones - set layer by layer. Fill stones in Khanti also. Keep in mind the top and bottom slope while filling. Also keep in mind that the height of the edges of the check should be more than the height of its central part so that the water can drain conveniently from the central part.

2.14.4 MATERIAL:

1. Large stones should be placed 25 cm on the outer surface of the downstream side of the check. Dig up and collect.
2. Deposit small stones in the inner part of the cheque.
3. 15 cm Do not use stones smaller in diameter or weighing less than 1 kg.
4. Corner stones are more convenient to sit than round stones.
5. Do not use rough stones like limestone, clay lumps, shell stones etc. as they dissolve on contact with water.

2.14.5 DO'S AND DON'TS:

- Keep the height of the check less in the middle and more on the edges.
- Keep the height of the middle part maximum 1 meter from the floor
- Keep the height of the sides maximum 1.5 meters from the floor
- Up slope 1:1 Down slope 1:2 to 1:4
- Dig the foundation till 25 CMS
- Bury the check in both sides of the drain at 50 cm.
- Deposit large stones on the outer surface towards the downstream.

- Use angular stones to store small stones in the interior
- Do not make boulder check on drains with more than 20 percent gradient
- Do not make boulder check on unstable and low-lying drains.
- Never make a boulder check by digging out the stones buried in the ground. This will further increase land erosion.
- 15 cm Do not use stones of less than 15 cms. Dia. . Stone not less than 1 Kg of weight. Do not use rough stones like limestone, clay lumps, shell stones etc.

2.15 SMALL DAM OR CHECK DAM:

Check dams are constructed over drains where the flow of water is not too intense and it proves useful for preventing soil erosion in the catchment area. At the same time rain water is stored and used for protective irrigation and it is useful for increasing the ground water level.

A small dam or "check dam" is a barrier or dam made of mud, stone or cement-clay, which is erected in the direction of the water flow of any drain. The main purpose of small dams is to bind the excess water of monsoon rains, so that it can be used. This water can be used during and after rainy season and it increases the level of ground water. This water source is also very useful for fish farming.

2.15.1 SITE SELECTION:

As far as the cost is concerned, the mini dam/check dam is an economical structure. Before making any mini dam, it is very important to choose the right place. First of all, it has to be seen whether there will be a lot of rain water standing in the particular place or not. Along with water

harvesting capacity, the structure should be such that it can hold water for a long time. There should be a large amount of cultivated area on both sides of the collected water. There should be minimum risk of submerging agriculture due to flash floods. Ultimately, the benefits of building it should be many times greater than the cost.

2.15.2 ABOUT CHECK DAM:

Check dams are constructed in small and medium-flowing streams, the main purpose of making this structure is to prevent soil flow and erosion. This structure prevents the soil from flowing into the drain by reducing the flow of water in case of excessive rainfall. This structure can be made permanently or temporarily. There are two types of permanent structures. Size stone and ruble stone are used for the construction of 1. Boulder Check Dam and 2. Cement Masonry Structure Boulder Check Dam. Gravel 20UU and cement are used for construction of cement masonry structure. Mix concrete of 1:3:6 or 1:4:8 is used for the construction of this structure, special attention has to be paid in the construction of machinery structure, that when the construction works are in progress, the use of mixer machine is necessary to make mix concrete and the structure For key durability it is necessary to use a vibrator. The temporary structure is constructed by gunny bag and stone dam.

2.15.3 CHECK DAM TO CHECK RUNOFF:

If the slope of the channel is so steep that the flow velocity approaches the erosion, it is necessary to reduce the runoff velocities to bring them within the permissible limits. A series of check dams can be used to turn a slope into a series of flat terraces of low gradient (ktvach). These check dams help to hold water and debris upstream. Appropriate type of check dam can be selected on the basis of size of outlet, its slope, runoff area, land use, head runoff flow and severity of the problem.

2.15.4 CHECK DAM DISTANCE:

Theoretically, a series of check dams should be made in such a way that the level of the check dam on the upper side is equal to the upper level of the check dam on the lower side. However, in channels with steep gradients, the cost of construction in this way will be very high, so as a general rule, to reduce the check dams and consequently to reduce the cost, a small amount of gradient called compensating slope is used and which reduces the flow velocities to the permissible values. The limit within the channel bed between two consecutive check dams is normally allowed. Generally, 3 percent slope can be allowed for steep slope and rocky exit routes and up to 0.5 percent slope in silt and clayey soils.

The parallel distance between check dams can be determined by using the following equation:-

$$L = \frac{100 \times H}{M-N}$$

Where

L = Horizontal distance between Check dam

M= Percentage of original Gully slope

N= Percentage of proposed Gully slope after Siltation

H = Height of Check dam upto Weir

Alternatively, the distance between check dam and slope emplacement structures can be determined from the following formula: -

Distance = $h/k(\tan\theta \cos\theta)$

where

h = Check dam height from ground level to top level

k = Constant, k = 0.3 for $\tan\theta<0.20$ and k = 0.5 for $\tan\theta> 0.20$

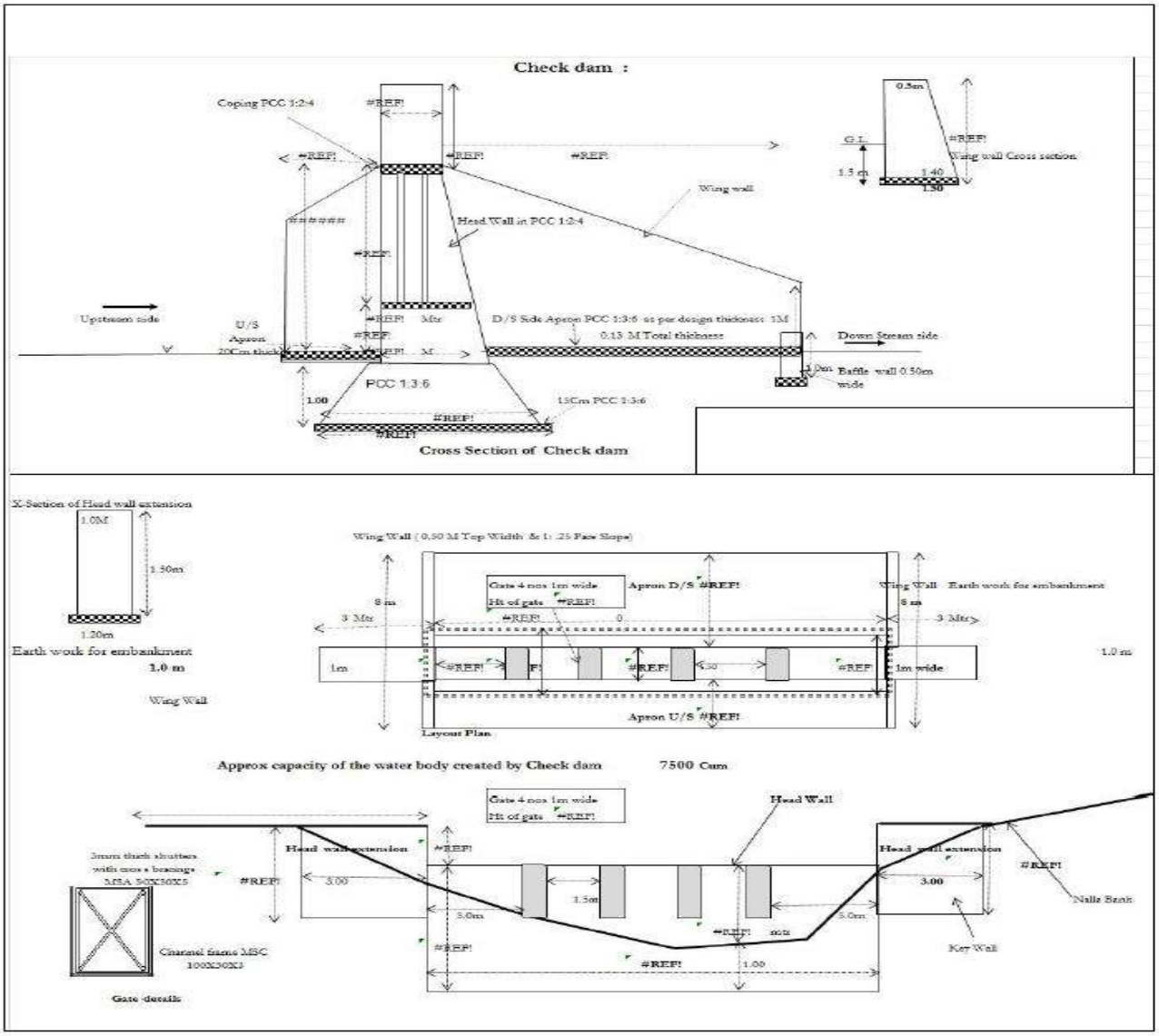
and

θ = angle of base of nalla with horizontal

The spacing between check dams for different slopes and dam heights is shown in the table

land gradient percentage	Distance between check dams for different heights (m)		
	0.45	**0.75**	**1.00**
1	152	253	337
2	75	125	167
3	50	83	111
4	58	63	83
5	30	50	67
6	25	42	56
7	21	36	48
8	19	31	42
9	17	28	37
10	15	25	34
11	14	23	30
12	13	21	28

13	12	19	26
14	11	18	24
15	10	17	22
16	9	16	21
17	9	15	20
18	8	14	19
19	8	13	18
20	8	13	17
21	4	7	10
22	4	7	9
23	4	7	9
24	4	6	9
25	4	6	8



2.15.5 TYPES OF CHECK DAMS:

The following types of check dams are commonly used:

- Temporary check dam (LBCD)
- Gabion check dam

2.16 GABION STRUCTURES:

Gabion structures are executed mainly in the purpose of soil stabilization behind the wall, but it can also be executed as a cover wall. The wall is made from gabion baskets that are stacked in one or more rows, depending on the height of the wall. Baskets have a cage shape and are closed on all sides. They are made from a galvanized hexagonal meshes and brocken rock that are placed in the baskets. Retaining structures are formed by stacking gabion baskets in a proper schedule and present an alternative solution for concrete structures in the area of soil stabilization.

Benefits:

- **Compatibility with the environment** – using the material made by excavations the costs of acquisition and transport are significantly reduced
- **Water permeability** – gabion walls are permeable and are not damaged by passing water
- **Efficiency of gabion walls can increase in time**, since the vegetation fills voids and strengthens the wall structure
- **Soil movements don't negatively influence** gabion walls, which is an advantage in regard to stiffer structures (reinforced concrete walls)
- **Longevity** – stone blocks are materials that are frequently used beacuse of their longevity, durability and stability. Usually, the stone is selected beacuse of aesthetic attributes or the possibility of excavation produced material usage.

CHAPTER III
PROPOSED STRUCTURES AND ITS LOCATIONS

An exhaustive field visit by Experts, Forest official and Engineers had taken place in order to understand the demand and requirement of the Tree Fern area in respect of its long-term conservation. Several rounds of meetings and discussions took place and a moderate model of Soil, Water and Moisture conservation was finalized.

After due site visit and observation of the geographical features found around Galli nalla, assessment of the orders of the streams, tributaries and sub tributaries was done with the help of remote sensing technology (GIS technology).

Keeping in view the conservations aspect of Tree Fern area, the following design considerations are taken into account

3.1 DESIGN CONSIDERATION

Structures suggested are taken for annual nature of streams and its order.

- Boulder Gabion Structure in two rows are proposed on Western side of Galli nalla towards Mines site buffer area. This shall be built adjoining to the boundary demarcation of the mine site towards Galli nala.

- A RCC toe wall has been suggested towards Mines site (Western side) from Galli nala just below the Boulder Gabion Structure in order to check the runoff water which can be originated from the mines area and flow into Galli nala.

- Stone Machinery Check dam, Gabion boulder Dam, Gabion Structure are suggested in all streams leading towards Galli Nalla which is main source of water and moisture for Tree Fern. These are suggested in Forest area with good amount of vegetative density and in slopy area. Mini Percolation tank is suggested in relatively in plain area for moisture retention. Percolation tanks are suggested in plains where water level can be maintained near to Galli Nalla.

3.1.1 MAINTENANCE OF STRUCTURE:

- Minor repair work of structures can be done after two years of the construction if the structures are not in the ongoing mining area.

3.1.2 TIME OF CONSTRUCTION OF THE STRUCTURE:

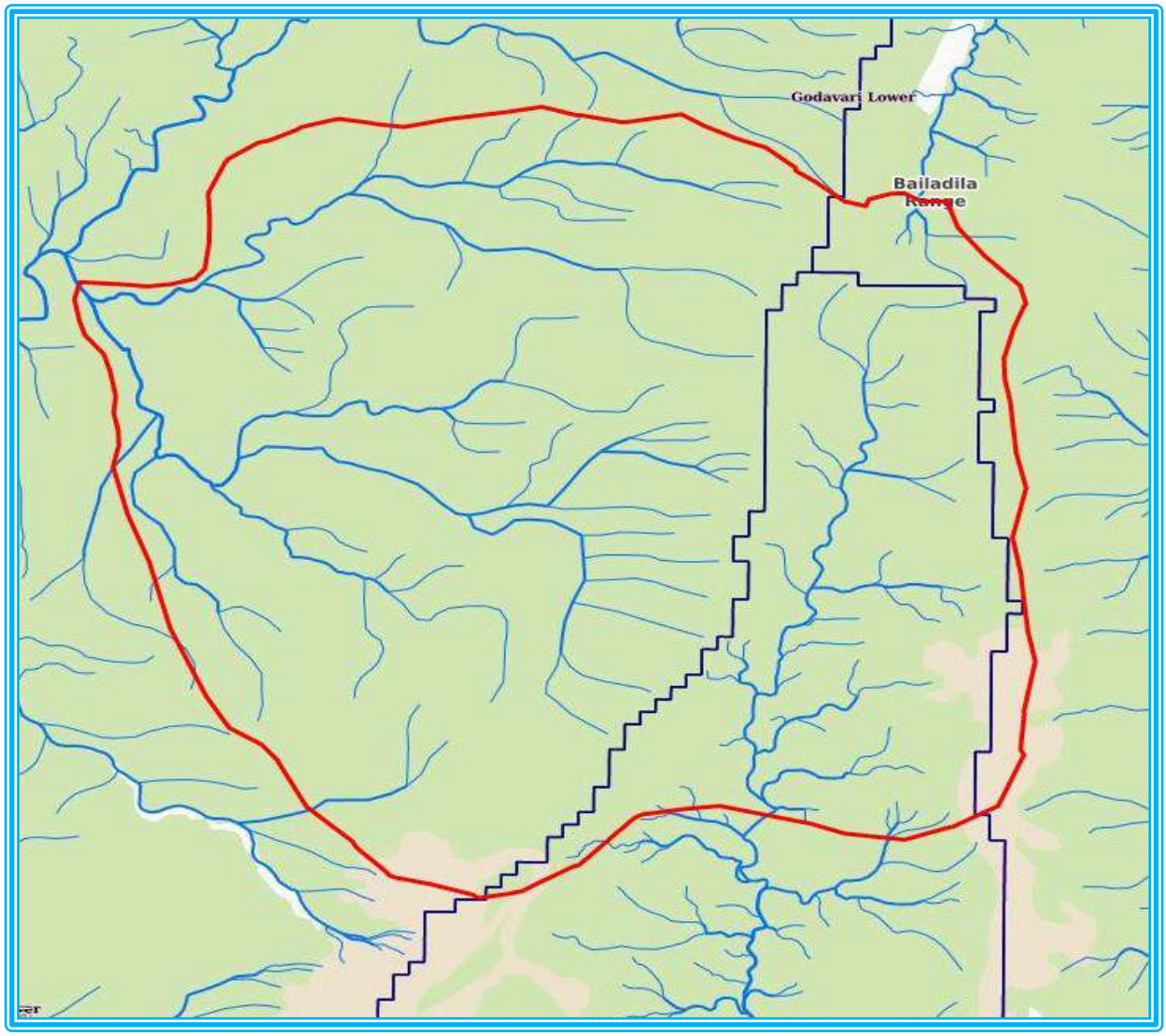
- All the structures suggested in the areas adjoining to mining area are to be built before start of the mining operations. (Probably within 9 to 12 months from the approval of the plan)

3.2 LOCATION OF THE STRUCTURES IN FOREST COMPARTMENTS

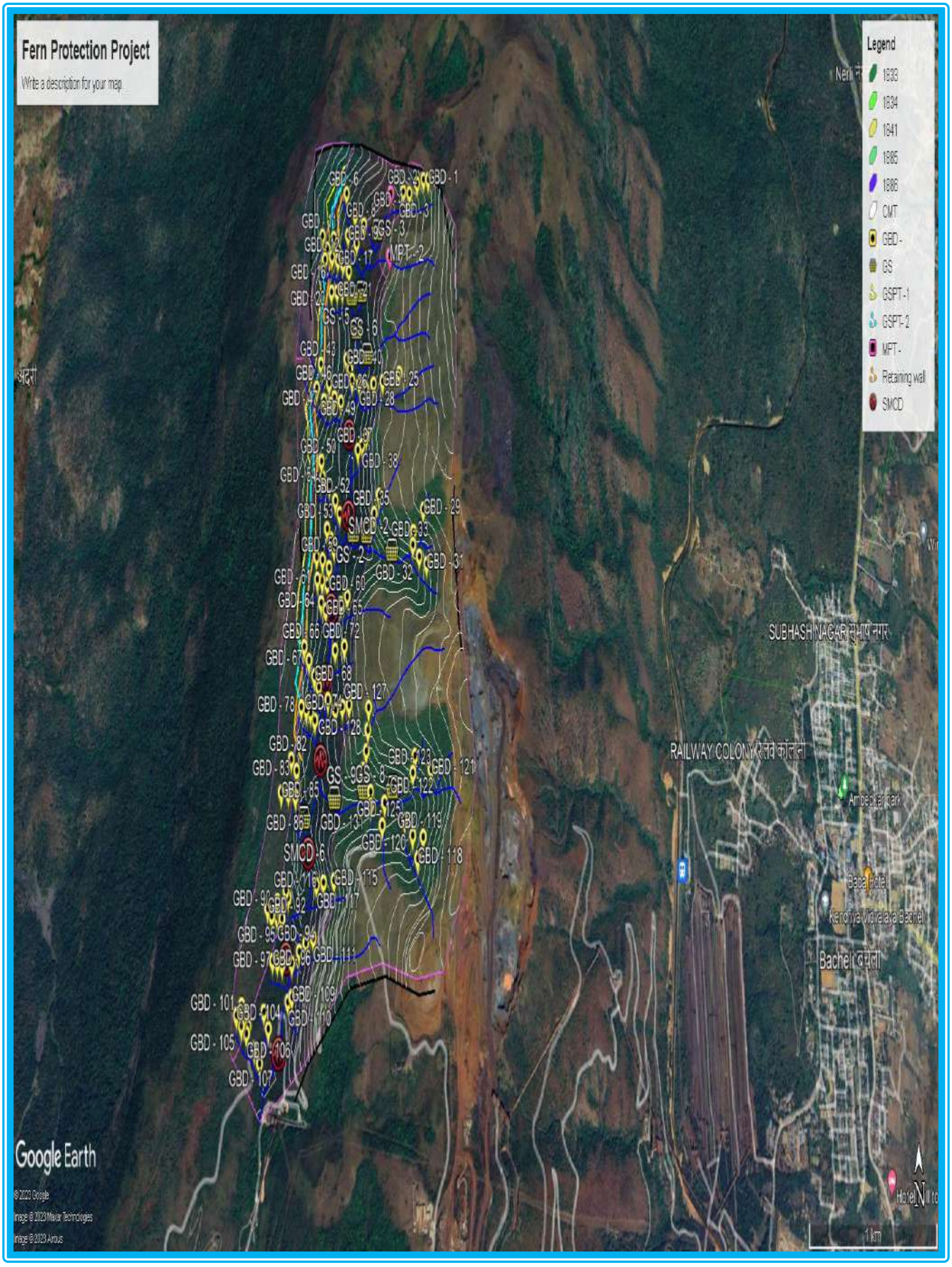
Division: Dantewada, Range: Bacheli

Sr. No	Structures	Compartment no.
1	Gabion Wall	1885, 1834, 1886, 1833
2	Retaining Wall	1885, 1834, 1886, 1833
3	Gabion	1834, 1841
4	Stone Masonry Check Dam	1834,
5	Mini Percolation Tank	1834, 1841
6	Gabion boulder Dam	1814, 1834, 1885,

MAP 3.1 SHOWING THE AREA AROUND GALLI NALA FOR SOIL, WATER AND MOISTURE CONSERVATION



MAP 3.2 SHOWING LOCATIONS OF THE STRUCTURES



Details of Indicated structures can be referred in Table no. 4.1 of Chapter 4 of this plan

CHAPTER IV

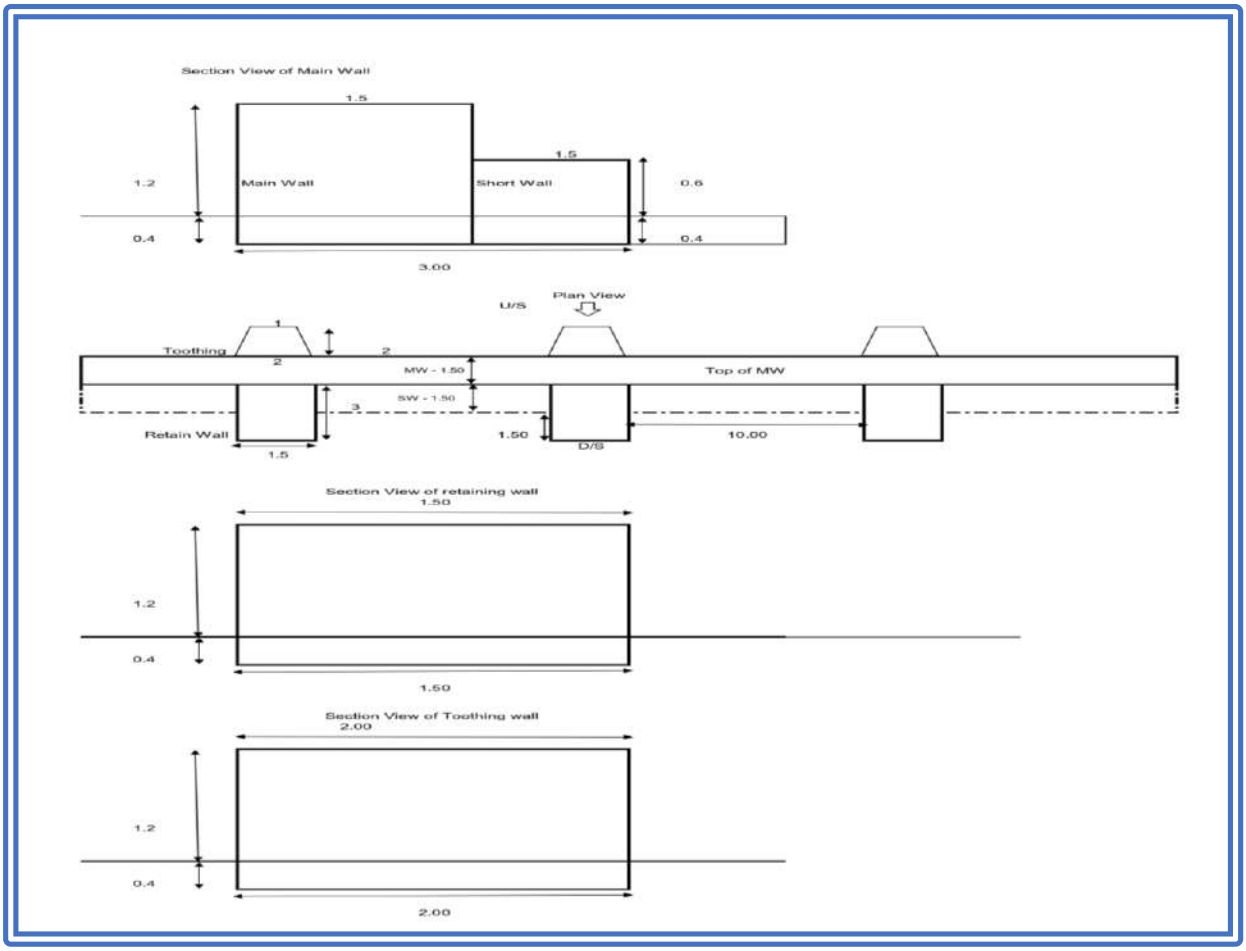
DESCRIPTION OF STRUCTURES, INPUT DATA , DESIGN AND COST ESTIMATION

Here are the Input data, Design and Cost Estimate of various structures proposed in forest area adjoining to Tree Fern area (Within ML area, now not diverted) to ensure Soil, Water and Moisture conservation of the microclimatic condition persist around Galli Nalla.

Based on the Input data, Design and Cost Estimate of various suitable structures, the financial implications are calculated and proposed.

4.1 GABION WALL (Input data, Design and Cost Estimate)

INPUT DATA: - DESIGN OF GABION WALL			
S.no	**Particulars**	**Measurement**	**unit**
1	Total no of similar structures	**1**	
2	Length of Main Wall	**1500.0**	m
3	Height of Main Wall	1.2	m
4	Width of Main Wall	1.5	m
5	Width of Short Wall	1.5	m
6	Depth of Excavation	0.4	m
7	No of toothing	151	
8	No of Retain wall	151	



COST ESTIMATION											
Name of Structure: -			**GABION WALL**					**Length**		**1500**	**m**
Sl no	**SOR item no.**	**Work Description**	**No**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	0101	Site cleaning, mowing, stacking and removal from premises									
		Land Clearance	1		1500.00	3.00	75%	3375.0	Sq. M.	4.00	13500
2	317	Single spade row, at least 75 mm deep									
	(A)	Main Wall	2		1500			3000.0			
		Retain Wall	151		7.50			1132.5			
		For Toothing	151		5.00			755.0			
								4887.50	Ru. M.	0.60	2932.5
3	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to									
	(B)	In Hard soil / Murrum Soil									
		Main wall excavation	1		1500.00	1.50	0.40	900.0			
		Short Wall	1		1500.00	1.50	0.40	900.0			
		Retain Wall	151		3.00	1.50	0.40	271.8			
		For Toothing	151		2.00	1.50	0.40	181.2			
					Total			2253	Cu. M.	247.70	558068.1

4	CSIDC item Code-70000 0105	G.I. Wire - 3.15 mm thick wire having mesh size of 50 mm (multiple) by 50 mm holes and net weight of not less than 2.94 kg per square meter to be provided and provided with the cost of transportation. (Choose the width of wire mesh bundle 1m and 1.2m.)									
		(In estimate, Rate provisioning per kg 76/Kg and GST @18%= 13.68, So Total cost of GI wire will be Rs 89.68/kg and per sqm rate will be Rs 263.66 of 2.94 Kg of wire									
		Main Wall	2		1500.00		1.60	4800.0			
			2		1500.00	1.50		4500.0			
		MW Panals	1501			1.50	1.60	3602.4			
		Short Wall	2		1500.00		1.60	4800.0			
			2		1500.00	1.50		4500.00			
		SW Panals	1501			1.50	1.6	3602.4			
		Retain Wall	151	2	3.00		1.6	1449.6			
			151	2	3.00	1.50		1359.0			
		Retain Wall Panals	151	3		1.50	1.6	1087.2			
		Toothing	151	2	2.00		1.6	966.4			
			151	2	2.00	1.50		906.0			
			151	2		1.50	1.6	724.8			
								32297.8			
		Deducting over lap of Retain Wall with Short wall	151			1.50	1	266.5			
								32031.3	Sq. M.	263.66	8445372.5

5	502	In foundation and plinth of walls, of stone of approved grade, dry unbaked door-masonry, well bound, with front and selected stones and both toda or bond-stones are evenly spaced in progress square meter.									
		Main Wall	1		1500.00	1.50	1.60	3600.0			
		Short Wall	1		1500.00	1.50	1.00	2250.0			
		Retain Wall	151		3.00	1.50	1.60	1087.2			
		For Toothing	151		2.00	1.50	1.60	724.8			
		Deducting over lap of Retain Wall with Short wall	151		1.50	1.50	1.00	339.75			
								7340.25	Cu. M.	1607.70	11800910
6	1902+ 1903+ 1904 (03)	Haulage work, distance from mine to site/lead/……km.									
		22 cm thick grouted stone 15 km. (after 30 km up to 50 km)	80%					5872.2	Cu. M.	518.53	3044912
7	LMR	Provision for Binding wire 10 Kg per 10 M Panal						1500	KG	95.00	142500
								Total			
							1	**Total Amount for Piece**			**23930971.5**
	Grand Total (Rs.)						**2**	**For Piece**			**47861943**

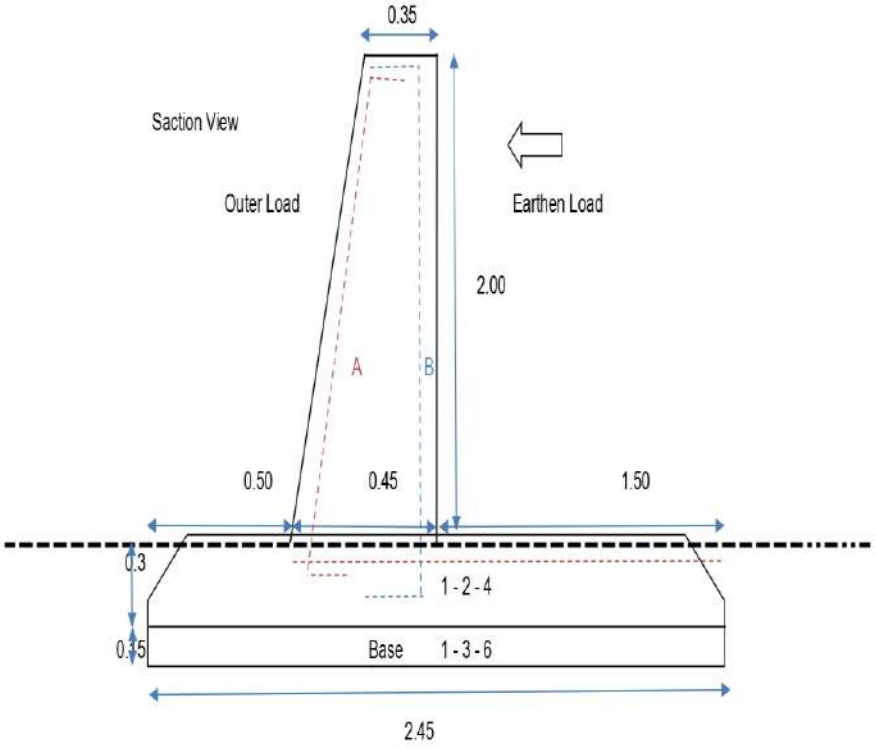
4.2 RETAINING WALL, SUPPORT WALL (Cost Estimate and Design)

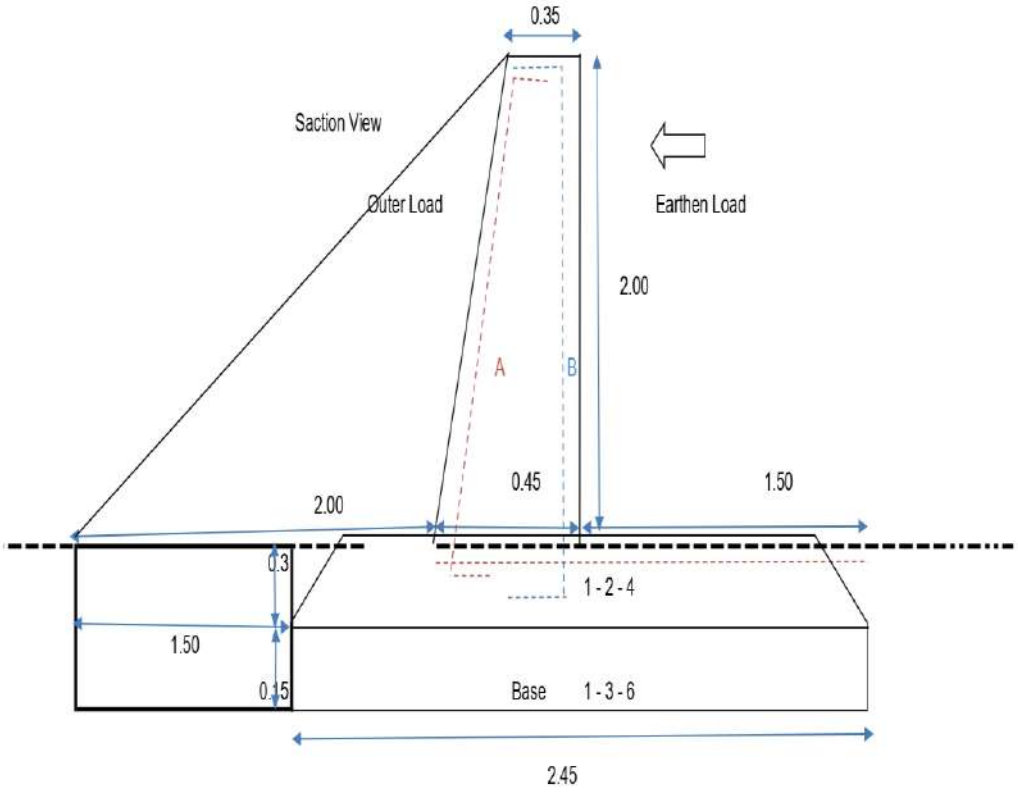
Cost estimation										
Name of Structure: - Retaining Wall							**Length**	**20.00**		**m**
Sl no	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amount**
1	2		4	5	6	7	8	9	10	11
1	101	Site cleaning, mowing, stacking and removal from premises								
			1	20.0	2.65	100%	53.0	Sq. M.	4.00	212
2	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
		In Hard soil / Murrum Soil								
		For foundation of main wall	1	20.0	2.65	0.45	23.85	Cu. M.		
		Total Qty. of E/W				Total	23.85	Cu. M.		
3	301 (ख)	Of which, soft soil/hard soil…. @				100%	23.85	Cu. M.	247.70	5908
5	402	Filling of hard mortar in trenches, plinths, sides of foundations etc., threshing with hammer and water-irrigation.								
							23.85	Cu. M.	87.60	2089
6	413 (ख)	Arrangement and pouring of cement-concrete under the floors in foundations and plinth, including terai in proportioned mix of 40 mm nominal size of stone but excluding the cost of dhula-bandhi (b) Cement concrete 1:3:6 (1 cement, 3 sand, 6 ballast).								
		For foundation of stop dam main wall - upto plinth	1	20.0	2.65	0.15	8.0	Cu. M.		
		Total Qty. of PCC 1:3:6				Total	8.0	Cu. M.	3775.10	30012
7	425 (ग) 426	Providing special grade reinforced cement-concrete in lintels, pillars, pillars, walls, roofs etc. and laying it properly. In addition to molded, sheathing reinforcement and reinforcing steel. Including terai and cleaning. Cost of cement								

		concrete 1:2:4 (1 cement, 2 sand, 4 stone of 20 mm nominal size)								
		Footing	1	20.0	2.45	0.30	14.7			
		For Main Retaining Wall	1	20.0	0.40	2.00	16.0			
							30.7	Cu. M.	4827.60	148207
9	430 - 431	For reinforced cement concrete and plain cement concrete works in foundations and plinths including decking and decking, supports, supports etc. and opening of decks.								
		Farm work for all other structures……								
		Footing	2	20.0		0.30	12.00	Sq. M.		
			2	2.45		0.30	1.47	Sq. M.		
		For Main Retaining Wall	2	20.0		2.00	80.00	Sq. M.		
			2		0.40	2.00	1.60	Sq. M.		
		Total Farm work					95.07	Sq. M.	288.30	27409
11	904 (ख)	Arranging, bending, tying and placing of mild tested steel reinforcement for reinforced cement concrete work up to floor level 2 as per drawings, complete including cost and wastage of tying wire. (b) Cold twisted / hot rolled deformed / thermo mechanical treated steel bar.								
		Main Retaining Wall	100	2.65	@	0.888	235.32	K.G.		
			100	2.45	@	0.888	217.56	K.G.		
			100	2.65	@	0.888	235.32	K.G.		
		Footing	133	2.65	@	0.888	312.98	K.G.		
			133	2.70	@	0.888	318.88	K.G.		
			10	20.00	@	0.617	123.40	K.G.		
			3	20.00	@	0.888	53.28	K.G.		
			14	20.00	@	0.888	248.64	K.G.		
			17	20.00	@	0.617	209.78	K.G.		
			13	20.00	@	0.617	160.42	K.G.		
							2115.5764	K.G.	80.6	170515
		Grand Total								**384352**
		For total No of Panels	75							**28826400**
		Adding the Cost of Support wall Amount								**462800**
		Sub Total								**29289200**
		Adding 10 % for the transportation to the Elevated working area								**2928920**
		Grand Total								**32218120**
									In lakhs	**322.18**

Cost estimation										
Name of Structure: - Support wall							**Length**	**20.00**		**m**
Sl no	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amount**
1	2		4	5	6	7	8	9	10	11
1	101	Site cleaning, mowing, stacking and removal from premises								
			1	1.5	0.30		0.5	Sq. M.	4.00	2
2	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
		In Hard soil / Murrum Soil	1	1.50	0.30	0.45	0.203			
		Total Qty. of E/W					0.203	Cu. M.		
3	301 (ख)	Of which, soft soil/hard soil…. @					0.203	Cu. M.	247.70	50
5	402	Filling of hard mortar in trenches, plinths, sides of foundations etc., threshing with hammer and water-irrigation.								
							0.20	Cu. M.	87.60	18
6	413 (ख)	Arrangement and pouring of cement-concrete under the floors in foundations and plinth, including terai in proportioned mix of 40 mm nominal size of stone but excluding the cost of dhula-bandhi (b) Cement concrete 1:3:6 (1 cement, 3 sand, 6 ballast).	1	1.50	0.30	0.15	0.07			
		Total Qty. of PCC 1:3:6					0.07	Cu. M.	3775.10	255

7	425 (ग) 426	Providing special grade reinforced cement-concrete in lintels, pillars, pillars, walls, roofs etc. and laying it properly. In addition to molded, sheathing reinforcement and reinforcing steel. Including terai and cleaning. Cost of cement concrete 1:2:4 (1 cement, 2 sand, 4 stone of 20 mm nominal size)								
		Footing	1.00	1.50	0.30	0.30	0.14			
		For Main Retaining Wall	1.00	0.75	0.30	2.00	0.45			
							0.59	Cu. M.	4827.60	2824
9	430-431	For reinforced cement concrete and plain cement concrete works in foundations and plinths including decking and decking, supports, supports etc. and opening of decks.								
		Farm work for all other structures……								
		Footing	2.00	1.50		0.30	0.90			
		For Main Retaining Wall	2.00	0.75		2.00	3.00			
		Total Farm work					3.90	Sq. M.	288.30	1124
11	904 (ख)	Arranging, bending, tying and placing of mild tested steel reinforcement for reinforced cement concrete work up to floor level 2 as per drawings, complete including cost and wastage of tying wire. (b) Cold twisted / hot rolled deformed / thermo mechanical treated steel bar.								
		Main Retaining Wall	4.00	2.90	@	0.888	2.58	K.G.		
			14.50	0.40	@	0.617	0.25	K.G.		
		Footing	4.00	1.50	@	0.888	1.33	K.G.		
			7.50	0.40	@	0.617	0.25	K.G.		
							4.40	K.G.	80.60	355
		Total								4628
		For total No of Panels	100				**Grand Total**			**462800**


0.35
Saction View
Outer Load
Earthen Load
2.00
A
B
0.50
0.45
1.50
0.3
1 - 2 - 4
0.15
Base
1 - 3 - 6
2.45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Earthen Load
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Base
1 - 3 - 6
2.45

2.10 2

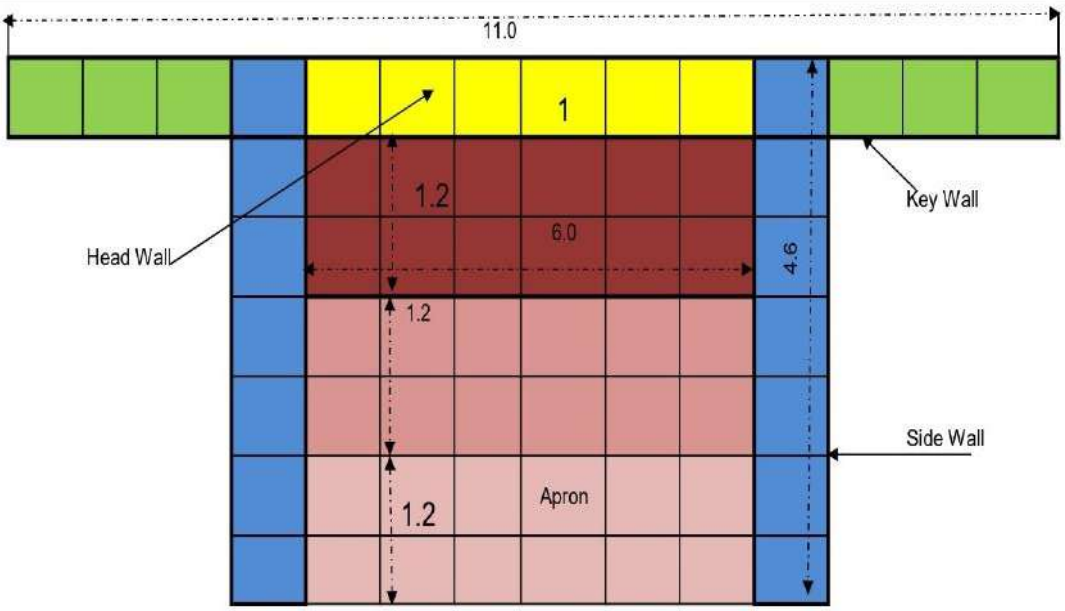
4.3 GABION STRUCTURE 6M (Input data, Design and Cost Estimate)

INPUT DATA: - DESIGN OF GABION STRUCTURE			
	Division	**Dantewada**	
	Range	**Bacheli**	
	Name of Nala	**Galli Nalla and Tributary**	
S.no	**Particulars**	**Measurement**	**unit**
1	Total no of similar structures	**1**	
2	Length of Head Wall	**6.0**	m
3	Height of Head Wall	1.2	m
4	Top Width of Head Wall	1.0	m
5	Bottom Width of Head Wall	1.0	m
6	Width of Apron	3.6	m
7	Thickness of Apron	0.6	m
8	Length of Side Wall	4.6	m
9	Height of Side Wall	2.7	m
10	Thickness of Side Wall	1.0	m
11	Length of Key Wall	1.5	m
12	Total Length of Structure	11.0	m
13	Steps (V:H)	1.2	:1

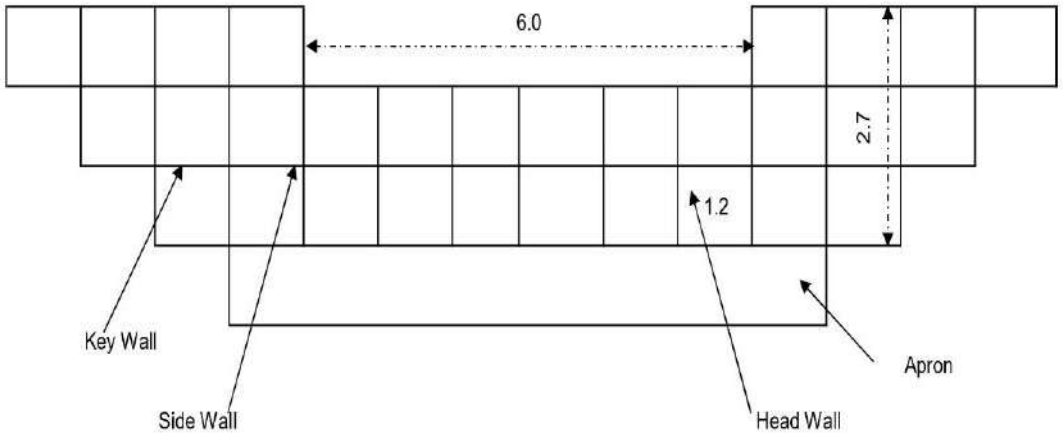
BOQ FOR GABION STRUCTURE			
Dimension for Construction & Costing of Gabion Structure			
S.no	**Particulars**	**Measurement**	**unit**
1	Length of Head Wall	6.0	m
2	Height of Head Wall	1.2	m
3	Top Width of Head Wall	1.0	m
4	Bottom Width of Head Wall	1.0	m
5	Width of Apron	3.6	m
6	Thickness of Apron	0.6	m
7	Length of Side Wall	4.6	m
8	Height of Side Wall	2.7	m
9	Thickness of Side Wall	1.0	m
10	Length of Key Wall	1.5	m
11	Total Length of Structure	11.0	m
12	Steps (V:H)	1.2	:1

Quantity & Cost Estimation of Gabion Structure						
S.no	**Particular**	**No.**	**Length**	**Width**	**H/D/T**	**Quantity**
0101	Cleaning of work site and heaping and transportation etc.					
		1	**11.0**	**4.6**		**50.60**
317	Marking and Layout of Site					
(d)	Single line spade marking up to 75cm deep	1	**40.4**			**40.40**
1	**Excavation**					
1.1	Below head wall excavation	1	8.0	1.5	0.6	7.2
1.2	Below Apron excavation	1	12.0	4.5	0.3	16.2
1.3	For Key ecavation	2	1.5	1.0	1.62	4.9
2	**Quantity of boulder**					**28.27**
2.1	Below head wall foundation	1	8.0	1.0	0.6	4.8
2.2	Apron foundation	1	8.0	3.6	0.3	8.64
2.3	Head Wall	1	8.0	1	1.2	9.6
2.4	Key Walls	2	1.5	1.0	1.62	4.9
2.5	Side Walls	2	3.6	1	1.164	8.4
2.6	Head Wall step 1	1	6.0	1.2	0.8	5.6
2.7	Head Wall step 2	1	6.0	1.2	0.5	3.7
	Total Quantity of boulder (Cum)					**45.56**
3	**Wire mesh**					
3.1	Head wall Foundation front side	2	8.0	0.6		9.6
3.2	Head wall Foundation-bottom & Top	2	8.0	1.0		16
3.3	Head wall Foundation - LR sides,	2	1.0	0.6		1.2
3.4	Apron foundation front side	2	8.0	0.3		4.8
3.5	Apron foundation-LR side	2	3.6	0.3		2.16
3.6	Apron foundation-Top bottom	2	8.0	3.6		57.6
3.7	Head Wall Sides	2	8.0	1.2		19.2
3.8	Head Wall Top	1	8.0	1.0		8
3.9	Head Wall Boxing pannels	9	1.0	1.0		9
3.10	Side Wall Sides	2	3.6	1.164		8.38
3.11	Side Wall Top Bottom	2	3.6	1.0		7.2
3.12	Side Wall Boxing pannels	3.6	1.0	1.0		3.6
3.13	Key Wall Sides	2	3.0	1.6		9.7
3.14	Key Wall Top Bottom	2	3.0	1.0		6.0
3.15	Key Wall Boxing pannels	2	1.0	1.0		1.5
	Quantity of G.I. Wire mesh (Sqm)					**163.98**

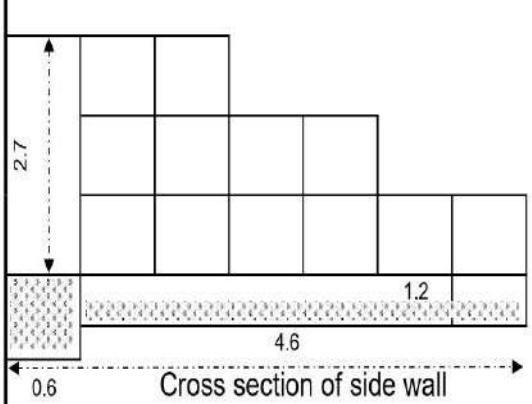
Detail Drawing of Gabion Structure



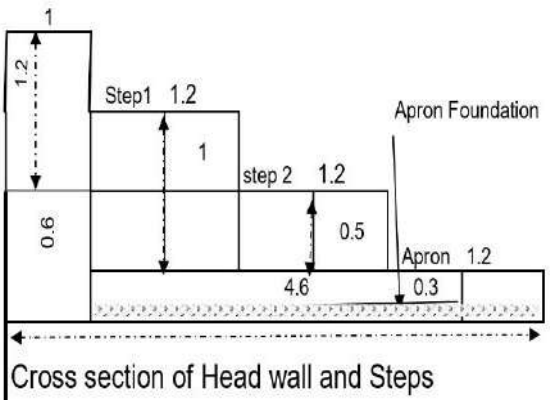
Plan view of Gabian Structure



Longitudnal section of Gabion



Cross section of side wall



Cross section of Head wall and Steps

Notes :- All Dimension Are in m

Not to Scale

COST ESTIMATION										
Name of Structure: -			**GABION STRUCTURE**				**Length**		**6**	**m**
Sl no	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt.**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	0101	Site cleaning, mowing, stacking and removal from premises								
		Land Clearance	1	11.00	4.60	75%	37.95	Sq. M.	4.00	151.8
2	317	Single spade row, at least 75 mm deep								
	(A)						40.40	Ru. M.	0.60	24.24
3	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
	(B)	In Hard soil / Murrum Soil								
		Below head wall excavation	1.00	8.00	1.50	0.60	7.20			
		Below Apron excavation	1.00	12.00	4.50	0.30	16.20			
		For Key ecavation	2.00	1.50	1.00	1.62	4.87			
				Total			28.27	Cu. M.	247.70	7002
4	CSIDC item Code-70000105	G.I. Wire - 3.15 mm thick wire having mesh size of 50 mm (multiple) by 50 mm holes and net weight of not less than 2.94 kg per square meter to be provided and provided with the cost of transportation. (Choose the width of wire mesh bundle 1m and 1.2m.)								
		(In estimate, Rate provisioning per kg 76/Kg and GST @18%= 13.68, So Total cost of GI wire will be Rs 89.68/kg and per sqm rate will be Rs 263.66 of 2.94 Kg of wire								
		Head wall Foundation front side	2.00	8.00	0.60		9.60			
		Head wall Foundation-bottom & Top	2.00	8.00	1.00		16.00			
		Head wall Foundation - LR sides,	2.00	1.00	0.60		1.20			
		Apron foundation front side	2.00	8.00	0.30		4.80			
		Apron foundation-LR side	2.00	3.60	0.30		2.16			
		Apron foundation-Top bottom	2.00	8.00	3.60		57.60			
		Head Wall Sides	2.00	8.00	1.20		19.20			
		Head Wall Top	1.00	8.00	1.00		8.00			
		Head Wall Boxing pannels	9.00	1.00	1.00		9.00			

		Side Wall Sides	2.00	3.60	1.16		8.38			
		Side Wall Top Bottom	2.00	3.60	1.00		7.20			
		Side Wall Boxing pannels	3.60	1.00	1.00		3.60			
		Key Wall Sides	2.00	3.00	1.62		9.74			
		Key Wall Top Bottom	2.00	3.00	1.00		6.00			
		Key Wall Boxing pannels	1.50	1.00	1.00		1.50			
							163.98	Sq. M.	263.66	43234
5	502	In foundation and plinth of walls, of stone of approved grade, dry unbaked door-masonry, well bound, with front and selected stones and both toda or bond-stones are evenly spaced in progress square meter.								
		Below head wall foundation	1	8	1	1	5			
		Apron foundation	1	8	4	0	9			
		Head Wall	1	8	1	1	10			
		Key Walls	2	2	1	2	5			
		Side Walls	2	4	1	1	8			
		Head Wall step 1	1	6	1	1	6			
		Head Wall step 2	1	6	1	1	4			
							45.56	Cu. M.	1607.70	73240
6	1902+ 1903+ 1904 (03)	Haulage work, distance from mine to site/lead/……km.	80%	of Qty			36.44	Cu. M.	518.53	18898
		22 cm thick grouted stone 15 km. (after 30 km up to 50 km)								
7	LS Amt.	Provision for Binding wire					10.00	KG		6500
							Grand Total			149050
						1	**Total Amount for Piece**			**149050**

Note:	Particular	Quantity	**Unit**
1	GI Wire	4.82	Quintal
2	Stone	45.56	Cum

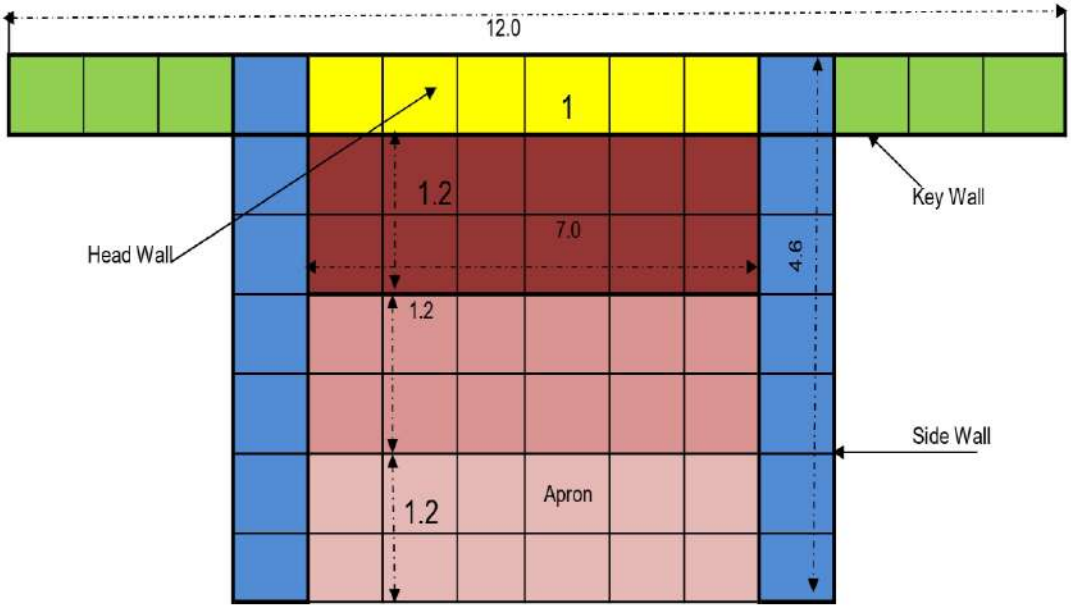
4.4 GABION STRUCTURE 7M (Input data, Design and Cost Estimate)

INPUT DATA: - DESIGN OF GABION STRUCTURE			
	Division	**Dantewada**	
	Range	**Bacheli**	
	Name of Nala	**Galli Nalla and Tributary**	
S.no	**Particulars**	**Measurement**	**unit**
1	Total no of similar structures	**1**	
2	Length of Head Wall	**7.0**	m
3	Height of Head Wall	1.2	m
4	Top Width of Head Wall	1.0	m
5	Bottom Width of Head Wall	1.0	m
6	Width of Apron	3.6	m
7	Thickness of Apron	0.6	m
8	Length of Side Wall	4.6	m
9	Height of Side Wall	2.7	m
10	Thickness of Side Wall	1.0	m
11	Length of Key Wall	1.5	m
12	Total Length of Structure	12.0	m
13	Steps (V:H)	1.2	:1

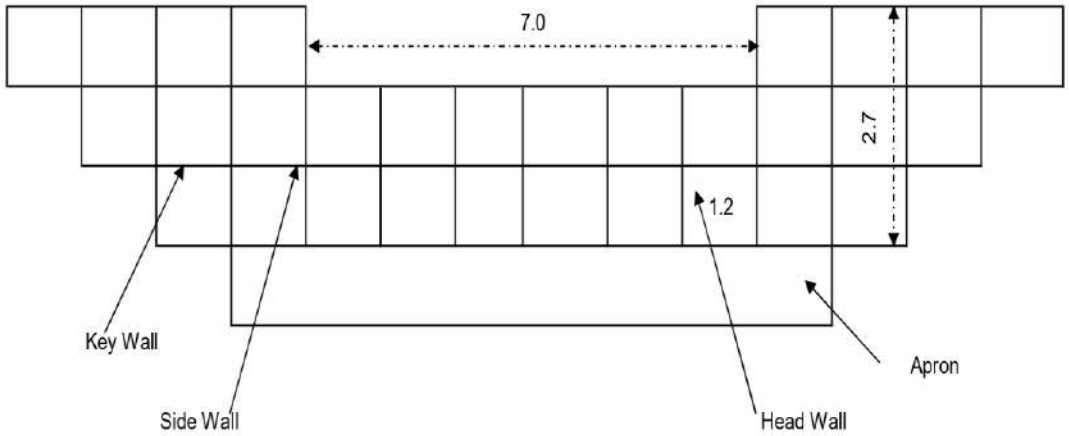
BOQ FOR GABION STRUCTURE			
Dimension for Construction & Costing of Gabion Structure			
S.no	**Particulars**	**Measurement**	**unit**
1	Length of Head Wall	7.0	m
2	Height of Head Wall	1.2	m
3	Top Width of Head Wall	1.0	m
4	Bottom Width of Head Wall	1.0	m
5	Width of Apron	3.6	m
6	Thickness of Apron	0.6	m
7	Length of Side Wall	4.6	m
8	Height of Side Wall	2.7	m
9	Thickness of Side Wall	1.0	m
10	Length of Key Wall	1.5	m
11	Total Length of Structure	12.0	m
12	Steps (V:H)	1.2	:1

QUANTITY & COST ESTIMATION OF GABION STRUCTURE						
S.no	**Particular**	**No.**	**Length**	**Width**	**H/D/T**	**Quantity**
0101	Cleaning of work site and heaping and transportation etc.					
		1	**12.0**	**4.6**		**55.20**
317	Marking and Layout of Site					
(d)	Single line spade marking up to 75cm deep	1	**42.4**			**42.40**
1	**Excavation**					
1.1	Below head wall excavation	1	9.0	1.5	0.6	8.1
1.2	Below Apron excavation	1	12.0	4.5	0.3	16.2
1.3	For Key ecavation	2	1.5	1.0	1.62	4.9
2	**Quantity of boulder**					**29.17**
2.1	Below head wall foundation	1	9.0	1.0	0.6	5.4
2.2	Apron foundation	1	9.0	3.6	0.3	9.72
2.3	Head Wall	1	9.0	1	1.2	10.8
2.4	Key Walls	2	1.5	1.0	1.62	4.9
2.5	Side Walls	2	3.6	1	1.164	8.4
2.6	Head Wall step 1	1	7.0	1.2	0.8	6.6
2.7	Head Wall step 2	1	7.0	1.2	0.5	4.3
	Total Quantity of boulder (Cum)					**49.98**
3	**Wire mesh**					
3.1	Head wall Foundation front side	2	9.0	0.6		10.8
3.2	Head wall Foundation-bottom & Top	2	9.0	1.0		18
3.3	Head wall Foundation - LR sides,	2	1.0	0.6		1.2
3.4	Apron foundation front side	2	9.0	0.3		5.4
3.5	Apron foundation-LR side	2	3.6	0.3		2.16
3.6	Apron foundation-Top bottom	2	9.0	3.6		64.8
3.7	Head Wall Sides	2	9.0	1.2		21.6
3.8	Head Wall Top	1	9.0	1.0		9
3.9	Head Wall Boxing pannels	10	1.0	1.0		10
3.10	Side Wall Sides	2	3.6	1.164		8.38
3.11	Side Wall Top Bottom	2	3.6	1.0		7.2
3.12	Side Wall Boxing pannels	3.6	1.0	1.0		3.6
3.13	Key Wall Sides	2	3.0	1.6		9.7
3.14	Key Wall Top Bottom	2	3.0	1.0		6.0
3.15	Key Wall Boxing pannels	2	1.0	1.0		1.5
	Quantity of G.I. Wire mesh (Sqm)					**179.38**

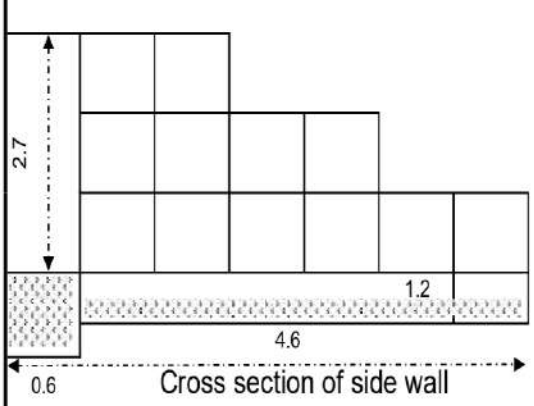
Detail Drawing of Gabion Structure



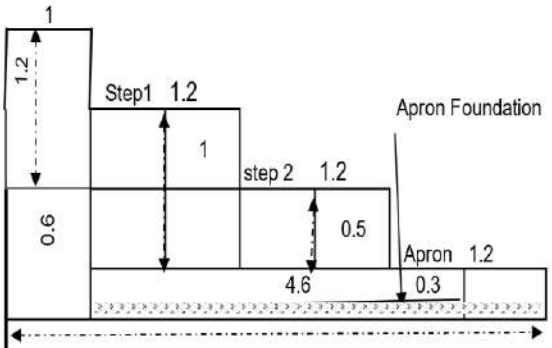
Plan view of Gabian Structure



Longitudnal section of Gabion



Cross section of side wall



Cross section of Head wall and Steps

Notes :- All Dimension Are in m

Not to Scale

COST ESTIMATION										
Name of Structure: -			**GABION STRUCTURE**				**Length**		**7**	**m**
Sl no	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt.**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	0101	Site cleaning, mowing, stacking and removal from premises								
		Land Clearance	1	12.00	4.60	75%	41.40	Sq. M.	4.00	165.6
2	317	Single spade row, at least 75 mm deep								
	(A)						42.40	Ru. M.	0.60	25.44
3	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
	(B)	In Hard soil / Murrum Soil								
		Below head wall excavation	1.00	9.00	1.50	0.60	8.10			
		Below Apron excavation	1.00	12.00	4.50	0.30	16.20			
		For Key ecavation	2.00	1.50	1.00	1.62	4.87			
				Total			29.17	Cu. M.	247.70	7225
4	CSIDC item Code-700000105	G.I. Wire - 3.15 mm thick wire having mesh size of 50 mm (multiple) by 50 mm holes and net weight of not less than 2.94 kg per square meter to be provided and provided with the cost of transportation. (Choose the width of wire mesh bundle 1m and 1.2m.)								
		(In estimate, Rate provisioning per kg 76/Kg and GST @18%= 13.68, So Total cost of GI wire will be Rs 89.68/kg and per sqm rate will be Rs 263.66 of 2.94 Kg of wire								
		Head wall Foundation front side	2.00	9.00	0.60		10.80			
		Head wall Foundation-bottom & Top	2.00	9.00	1.00		18.00			
		Head wall Foundation - LR sides,	2.00	1.00	0.60		1.20			
		Apron foundation front side	2.00	9.00	0.30		5.40			
		Apron foundation-LR side	2.00	3.60	0.30		2.16			
		Apron foundation-Top bottom	2.00	9.00	3.60		64.80			
		Head Wall Sides	2.00	9.00	1.20		21.60			

		Head Wall Top	1.00	9.00	1.00		9.00			
		Head Wall Boxing pannels	10.00	1.00	1.00		10.00			
		Side Wall Sides	2.00	3.60	1.16		8.38			
		Side Wall Top Bottom	2.00	3.60	1.00		7.20			
		Side Wall Boxing pannels	3.60	1.00	1.00		3.60			
		Key Wall Sides	2.00	3.00	1.62		9.74			
		Key Wall Top Bottom	2.00	3.00	1.00		6.00			
		Key Wall Boxing pannels	1.50	1.00	1.00		1.50			
							179.38	Sq. M.	263.66	47295
5	502	In foundation and plinth of walls, of stone of approved grade, dry unbaked door-masonry, well bound, with front and selected stones and both toda or bond-stones are evenly spaced in progress square meter.								
		Below head wall foundation	1	9	1	1	5			
		Apron foundation	1	9	4	0	10			
		Head Wall	1	9	1	1	11			
		Key Walls	2	2	1	2	5			
		Side Walls	2	4	1	1	8			
		Head Wall step 1	1	7	1	1	7			
		Head Wall step 2	1	7	1	1	4			
							49.98	Cu. M.	1607.70	80353
6	1902+ 1903+ 1904 (03)	Haulage work, distance from mine to site/lead/……km.	80%	of Qty			39.98	Cu. M.	518.53	20733
		22 cm thick grouted stone 15 km. (after 30 km up to 50 km)								
7	LS Amt.	Provision for Binding wire					10.00	KG		6500
							Total			162296
						1	**Total Amount for Piece**			**162296**

Note:	Particular	Quantity	**Unit**
1	GI Wire	5.27	Quintal
2	Stone	49.98	Cum

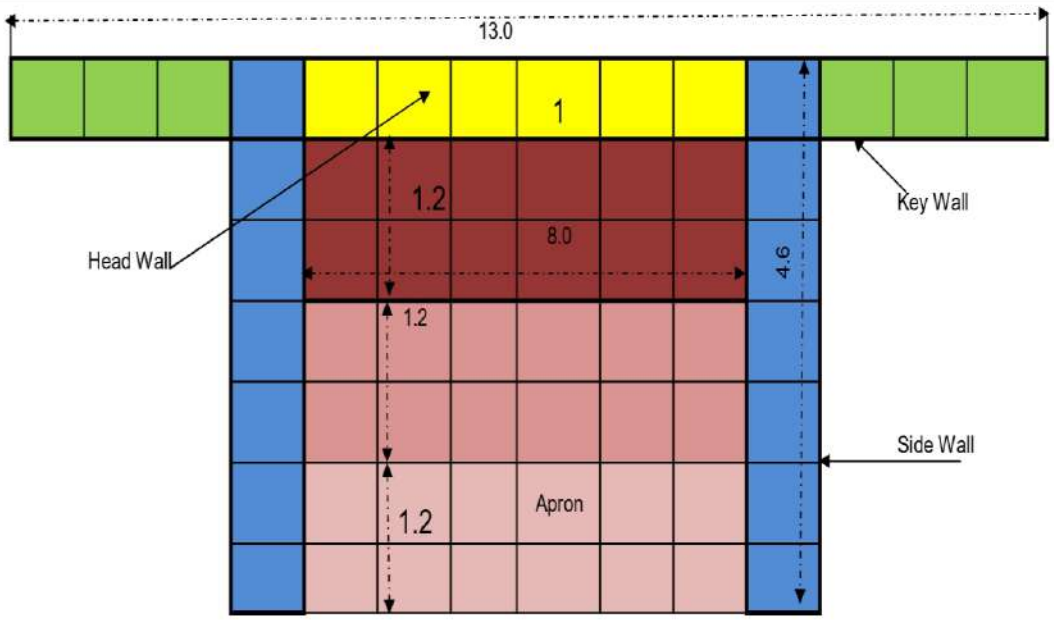
4.5 GABION STRUCTURE 8M (Input data, Design and Cost Estimate)

INPUT DATA: - DESIGN OF GABION STRUCTURE			
	Division	**Dantewada**	
	Range	**Bacheli**	
	Name of Nala	**Galli Nalla and Tributary**	
S.no	**Particulars**	**Measurement**	**unit**
1	Total no of similar structures	**1**	
2	Length of Head Wall	**8.0**	m
3	Height of Head Wall	1.2	m
4	Top Width of Head Wall	1.0	m
5	Bottom Width of Head Wall	1.0	m
6	Width of Apron	3.6	m
7	Thickness of Apron	0.6	m
8	Length of Side Wall	4.6	m
9	Height of Side Wall	2.7	m
10	Thickness of Side Wall	1.0	m
11	Length of Key Wall	1.5	m
12	Total Length of Structure	13.0	m
13	Steps (V:H)	1.2	:1

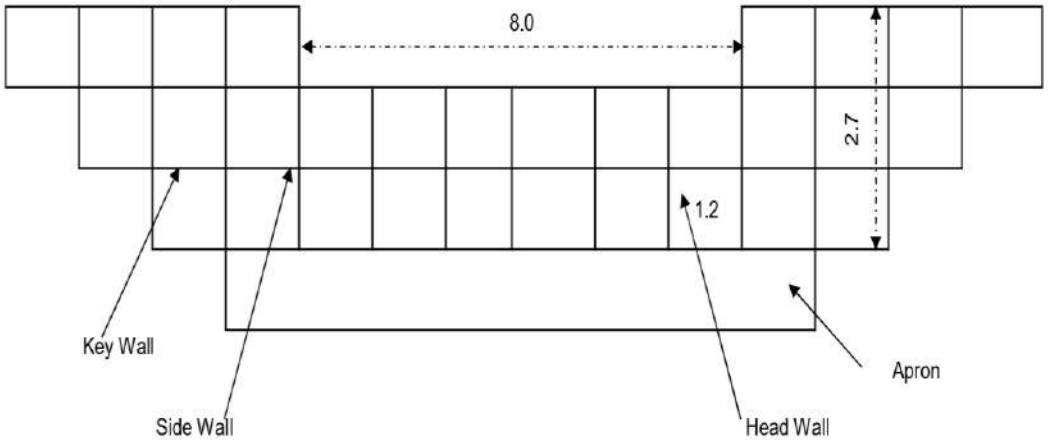
BOQ FOR GABION STRUCTURE			
Dimension for Construction & Costing of Gabion Structure			
S.no	**Particulars**	**Measurement**	**unit**
1	Length of Head Wall	8.0	m
2	Height of Head Wall	1.2	m
3	Top Width of Head Wall	1.0	m
4	Bottom Width of Head Wall	1.0	m
5	Width of Apron	3.6	m
6	Thickness of Apron	0.6	m
7	Length of Side Wall	4.6	m
8	Height of Side Wall	2.7	m
9	Thickness of Side Wall	1.0	m
10	Length of Key Wall	1.5	m
11	Total Length of Structure	13.0	m
12	Steps (V:H)	1.2	:1

QUANTITY & COST ESTIMATION OF GABION STRUCTURE						
S.no	**Particular**	**No.**	**Length**	**Width**	**H/D/T**	**Quantity**
0101	Cleaning of work site and heaping and transportation etc.					
		1	**13.0**	**4.6**		**59.80**
317	Marking and Layout of Site					
(d)	Single line spade marking up to 75cm deep	1	**44.4**			**44.40**
1	**Excavation**					
1.1	Below head wall excavation	1	10.0	1.5	0.6	9.0
1.2	Below Apron excavation	1	12.0	4.5	0.3	16.2
1.3	For Key ecavation	2	1.5	1.0	1.62	4.9
2	**Quantity of boulder**					**30.07**
2.1	Below head wall foundation	1	10.0	1.0	0.6	6
2.2	Apron foundation	1	10.0	3.6	0.3	10.8
2.3	Head Wall	1	10.0	1	1.2	12
2.4	Key Walls	2	1.5	1.0	1.62	4.9
2.5	Side Walls	2	3.6	1	1.164	8.4
2.6	Head Wall step 1	1	8.0	1.2	0.8	7.5
2.7	Head Wall step 2	1	8.0	1.2	0.5	4.9
	Total Quantity of boulder (Cum)					**54.40**
3	**Wire mesh**					
3.1	Head wall Foundation front side	2	10.0	0.6		12
3.2	Head wall Foundation-bottom & Top	2	10.0	1.0		20
3.3	Head wall Foundation - LR sides,	2	1.0	0.6		1.2
3.4	Apron foundation front side	2	10.0	0.3		6
3.5	Apron foundation-LR side	2	3.6	0.3		2.16
3.6	Apron foundation-Top bottom	2	10.0	3.6		72
3.7	Head Wall Sides	2	10.0	1.2		24
3.8	Head Wall Top	1	10.0	1.0		10
3.9	Head Wall Boxing pannels	11	1.0	1.0		11
3.10	Side Wall Sides	2	3.6	1.164		8.38
3.11	Side Wall Top Bottom	2	3.6	1.0		7.2
3.12	Side Wall Boxing pannels	3.6	1.0	1.0		3.6
3.13	Key Wall Sides	2	3.0	1.6		9.7
3.14	Key Wall Top Bottom	2	3.0	1.0		6.0
3.15	Key Wall Boxing pannels	2	1.0	1.0		1.5
	Quantity of G.I. Wire mesh (Sqm)					**194.78**

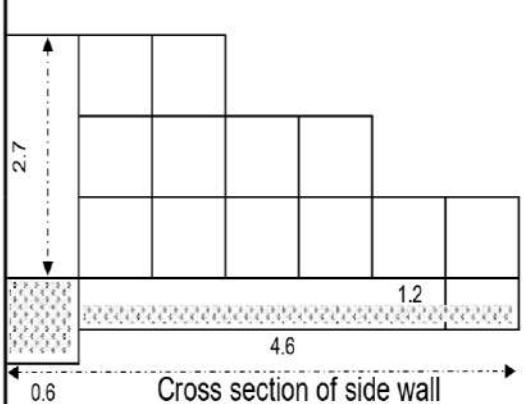
Detail Drawing of Gabion Structure



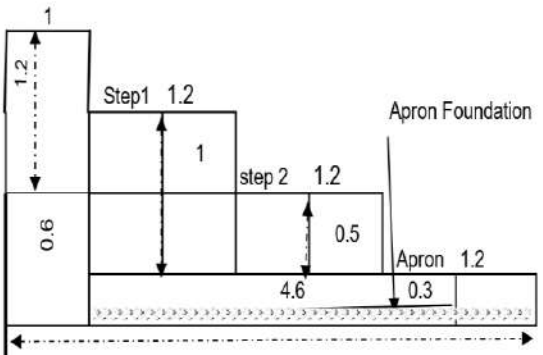
Plan view of Gabian Structure



Longitudnal section of Gabion



Cross section of side wall



Cross section of Head wall and Steps

Notes :- All Dimension Are in m

Not to Scale

Cost estimation										
Name of Structure: -			**GABION STRUCTURE**				**Length**		**8**	**m**
Sl no	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	0101	Site cleaning, mowing, stacking and removal from premises								
		Land Clearance	1	13.00	4.60	75%	44.85	Sq. M.	4.00	179.4
2	317	Single spade row, at least 75 mm deep								
	(A)						44.40	Ru. M.	0.60	26.64
3	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
	(B)	In Hard soil / Murrum Soil								
		Below head wall excavation	1.00	10.00	1.50	0.60	9.00			
		Below Apron excavation	1.00	12.00	4.50	0.30	16.20			
		For Key ecavation	2.00	1.50	1.00	1.62	4.87			
				Total			30.07	Cu. M.	247.70	7448
4	CSIDC item Code-700000105	G.I. Wire - 3.15 mm thick wire having mesh size of 50 mm (multiple) by 50 mm holes and net weight of not less than 2.94 kg per square meter to be provided and provided with the cost of transportation. (Choose the width of wire mesh bundle 1m and 1.2m.)								
		(In estimate, Rate provisioning per kg 76/Kg and GST @18%= 13.68, So Total cost of GI wire will be Rs 89.68/kg and per sqm rate will be Rs 263.66 of 2.94 Kg of wire								
		Head wall Foundation front side	2.00	10.00	0.60		12.00			
		Head wall Foundation-bottom & Top	2.00	10.00	1.00		20.00			
		Head wall Foundation - LR sides,	2.00	1.00	0.60		1.20			
		Apron foundation front side	2.00	10.00	0.30		6.00			
		Apron foundation-LR side	2.00	3.60	0.30		2.16			
		Apron foundation-Top bottom	2.00	10.00	3.60		72.00			
		Head Wall Sides	2.00	10.00	1.20		24.00			
		Head Wall Top	1.00	10.00	1.00		10.00			
		Head Wall Boxing pannels	11.00	1.00	1.00		11.00			

		Side Wall Sides	2.00	3.60	1.16		8.38			
		Side Wall Top Bottom	2.00	3.60	1.00		7.20			
		Side Wall Boxing pannels	3.60	1.00	1.00		3.60			
		Key Wall Sides	2.00	3.00	1.62		9.74			
		Key Wall Top Bottom	2.00	3.00	1.00		6.00			
		Key Wall Boxing pannels	1.50	1.00	1.00		1.50			
							194.78	Sq. M.	263.66	51355
5	502	In foundation and plinth of walls, of stone of approved grade, dry unbaked door-masonry, well bound, with front and selected stones and both toda or bond-stones are evenly spaced in progress square meter.								
		Below head wall foundation	1	10	1	1	6			
		Apron foundation	1	10	4	0	11			
		Head Wall	1	10	1	1	12			
		Key Walls	2	2	1	2	5			
		Side Walls	2	4	1	1	8			
		Head Wall step 1	1	8	1	1	7			
		Head Wall step 2	1	8	1	1	5			
							54.40	Cu. M.	1607.70	87466
6	1902+ 1903+ 1904 (03)	Haulage work, distance from mine to site/lead/……km.	80%	of Qty			43.52	Cu. M.	518.53	22568
		22 cm thick grouted stone 15 km. (after 30 km up to 50 km)								
7	LS Amt	Provision for Binding wire					10.00	KG		6500
							Total			175543
						1	**Total Amount for Piece**			**175543**

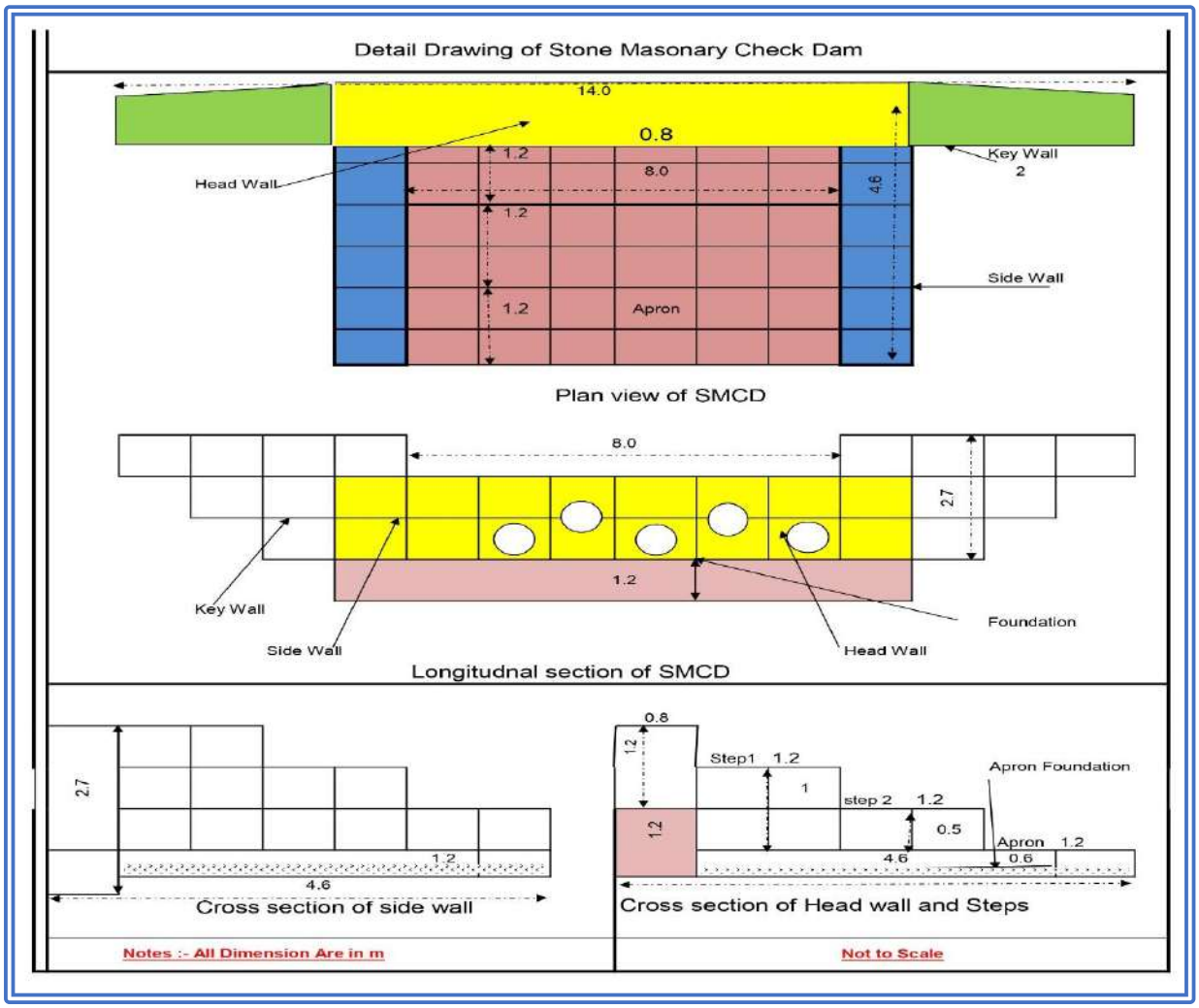
Note:	Particular	Quantity	**Unit**
1	GI Wire	5.73	Quintal
2	Stone	54.40	Cum

4.6 STONE MASONARY CHECK DAM 8M (Input data, Design and Cost Estimate)

INPUT DATA: - DESIGN OF STONE MASONARY CHECK DAM			
	Division	**Dantewada**	
	Range	**Bacheli**	
	Name of Nala	**Galli Nalla and Tributary**	
S.no	**Particulars**	**Measurement**	**unit**
1	Total no of similar structures	**1**	
2	Length of Head Wall	**8.0**	m
3	Height of Head Wall	1.2	m
4	Top Width of Head Wall	1.0	m
5	Bottom Width of Head Wall	1.0	m
6	Width of Apron	3.6	m
7	Thickness of Apron	0.6	m
8	Length of Side Wall	4.6	m
9	Height of Side Wall	2.7	m
10	Thickness of Side Wall	1.0	m
11	Length of Key Wall	2.0	m
12	Total Length of Structure	14.0	m
13	Foundation of Head Wall	1.2	m

BOQ FOR GABION STRUCTURE			
Dimension for Construction & Costing of Gabion Structure			
S.no	**Particulars**	**Measurement**	**unit**
1	Length of Head Wall	8.0	m
2	Height of Head Wall	1.2	m
3	Top Width of Head Wall	1.0	m
4	Bottom Width of Head Wall	1.0	m
5	Width of Apron	3.6	m
6	Thickness of Apron	0.6	m
7	Length of Side Wall	4.6	m
8	Height of Side Wall	2.7	m
9	Thickness of Side Wall	1.0	m
10	Length of Key Wall	2.0	m
11	Total Length of Structure	14.0	m
12	Foundation of Head Wall	1.2	m

Quantity & Cost Estimation of Stone Masonary Check Dam						
S.no	**Particular**	**No.**	**Length**	**Width**	**H/D/T**	**Quantity**
0101	Cleaning of work site and heaping and transportation etc.					
		1	**14.0**	**4.6**		**64.40**
317	Marking and Layout of Site					
(d)	Single line spade marking up to 75cm deep	1	**46.4**			**46.40**
1	**Excavation**					
1.1	Below head wall excavation	1	10.0	1.0	1.2	12.0
1.2	Below Apron excavation	1	12.0	4.5	0.3	16.2
1.3	For Key ecavation	2	2.0	1.0	1.62	6.5
2	**Quantity of boulder**					**34.69**
2.1	Below head wall foundation	1	10.0	1.00	1.2	12
2.2	Apron foundation	1	10.0	3.6	0.6	21.6
2.3	Head Wall	1	10.0	0.8	1.2	9.6
2.4	Key Walls	2	2.0	1.0	1.62	6.5
2.5	Side Walls	2	3.6	1	1.164	8.4
2.6	Head Wall step 1	1	8.0	1.2	0.8	7.5
2.7	Head Wall step 2	1	8.0	1.2	0.5	4.9
	Total Quantity of boulder (Cum)					**70.43**



COST ESTIMATION

Name of Structure: -		Stone Masonary Check Dam					Length		8	m
Sl no	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	0101	Site cleaning, mowing, stacking and removal from premises								
		Land Clearance	1	14.00	4.60	75%	48.30	Sq. M.	4.00	193.2
2	317	Single spade row, at least 75 mm deep								
	(A)						46.40	Ru. M.	0.60	27.84
3	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
	(B)	In Hard soil / Murrum Soil								
				Total			34.69	Cu. M.	247.70	8593
4	502	In foundation and plinth of walls, of stone of approved grade, dry unbaked door-masonry, well bound, with front and selected stones and both toda or bond-stones are evenly spaced in progress square meter.					70.43	Cu. M.	1607.70	113226
5	508	Ragged door-masonry of hard stone in foundations and plinth, (second grade)								
	(C)	Cement Mixture in 1:4 (1 cement, 4 sand)					70.43	Cu. M.	3720.20	262003
6	1035	Tipping with 1:4 cement mortar on ridged or bayonet masonry								
	(D)	pointed tip					30.60	Sq. M.	192.70	5897
7	PWD SOR 18.77	Providing and fixing on wall face UV stabilized Unplasticised - PVC moulded fittings/ accessories having 3.2mm wall thickness for Rigid PVC pipes conforming to IS : 13592 (heavy) jointing with seal ring conforming to IS : 5382 leaving 10 mm gap for thermal expansion4 inch HDPE Drain pipe								
	18.77.1.2	110 MM					4.00	Ru. M.	154.00	616
8										
6	1902+ 1903+ 1904 (03)	Haulage work, distance from mine to site/lead/……km.	80%	of Qty			56.34	Cu. M.	518.53	29215
		22 cm thick grouted stone 15 km. (after 30 km up to 50 km)								
						Grand Total				419771

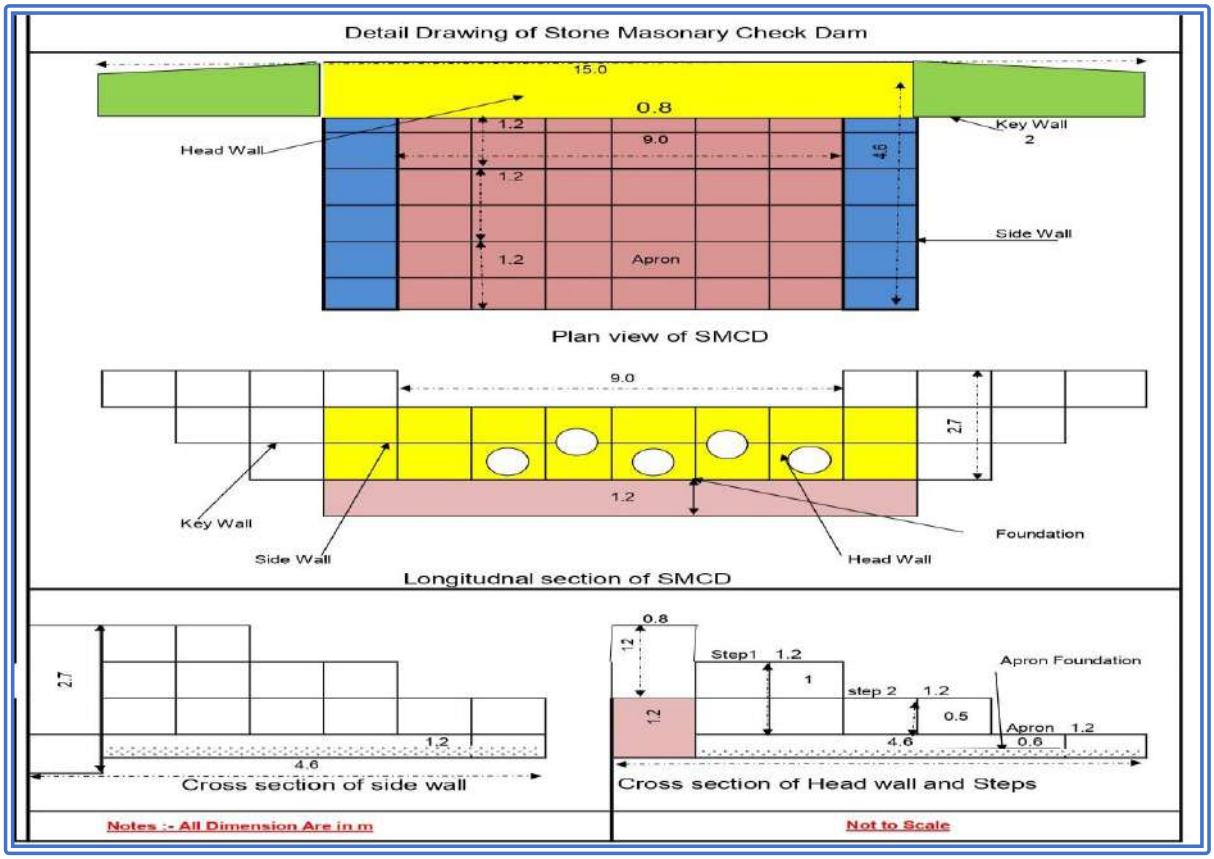
Note:	Particular	Quantity	**Unit**
1	Cement	126.77	Bag
2	Sand	17.61	Cum

4.7 STONE MASONARY CHECK DAM 9M (Input data, Design and Cost Estimate)

INPUT DATA: - DESIGN OF STONE MASONARY CHECK DAM			
	Division	**Dantewada**	
	Range	**Bacheli**	
	Name of Nala	**Galli Nalla and Tributary**	
S.no	**Particulars**	**Measurement**	**unit**
1	Total no of similar structures	**1**	
2	Length of Head Wall	**9.0**	m
3	Height of Head Wall	1.2	m
4	Top Width of Head Wall	1.0	m
5	Bottom Width of Head Wall	1.0	m
6	Width of Apron	3.6	m
7	Thickness of Apron	0.6	m
8	Length of Side Wall	4.6	m
9	Height of Side Wall	2.7	m
10	Thickness of Side Wall	1.0	m
11	Length of Key Wall	2.0	m
12	Total Length of Structure	15.0	m
13	Foundation of Head Wall	1.2	m

BOQ FOR GABION STRUCTURE			
Dimension for Construction & Costing of Gabion Structure			
S.no	**Particulars**	**Measurement**	**unit**
1	Length of Head Wall	9.0	m
2	Height of Head Wall	1.2	m
3	Top Width of Head Wall	1.0	m
4	Bottom Width of Head Wall	1.0	m
5	Width of Apron	3.6	m
6	Thickness of Apron	0.6	m
7	Length of Side Wall	4.6	m
8	Height of Side Wall	2.7	m
9	Thickness of Side Wall	1.0	m
10	Length of Key Wall	2.0	m
11	Total Length of Structure	15.0	m
12	Foundation of Head Wall	1.2	m

Quantity & Cost Estimation of Stone Masonary Check Dam						
S.no	**Particular**	**No.**	**Length**	**Width**	**H/D/T**	**Quantity**
0101	Cleaning of work site and heaping and transportation etc.					
		1	**15.0**	**4.6**		**69.00**
317	Marking and Layout of Site					
(d)	Single line spade marking up to 75cm deep	1	**48.4**			**48.40**
1	**Excavation**					
1.1	Below head wall excavation	1	11.0	1.0	1.2	13.2
1.2	Below Apron excavation	1	12.0	4.5	0.3	16.2
1.3	For Key ecavation	2	2.0	1.0	1.62	6.5
2	**Quantity of boulder**					**35.89**
2.1	Below head wall foundation	1	11.0	1.00	1.2	13.2
2.2	Apron foundation	1	11.0	3.6	0.6	23.76
2.3	Head Wall	1	11.0	0.8	1.2	10.6
2.4	Key Walls	2	2.0	1.0	1.62	6.5
2.5	Side Walls	2	3.6	1	1.164	8.4
2.6	Head Wall step 1	1	9.0	1.2	0.8	8.4
2.7	Head Wall step 2	1	9.0	1.2	0.5	5.5
	Total Quantity of boulder (Cum)					**76.29**



COST ESTIMATION

Name of Structure: -			Stone Masonary Check Dam				Length		9	m
Sl no	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	0101	Site cleaning, mowing, stacking and removal from premises								
		Land Clearance	1	15.00	4.60	75%	51.75	Sq. M.	4.00	207
2	317	Single spade row, at least 75 mm deep								
	(A)						48.40	Ru. M.	0.60	29.04
3	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
	(B)	In Hard soil / Murrum Soil								
				Total			35.89	Cu. M.	247.70	8890
4	502	In foundation and plinth of walls, of stone of approved grade, dry unbaked door-masonry, well bound, with front and selected stones and both toda or bond-stones are evenly spaced in progress square meter.					76.29	Cu. M.	1607.70	122654
5	508	Ragged door-masonry of hard stone in foundations and plinth, (second grade)								
	(C)	Cement Mixture in 1:4 (1 cement, 4 sand)					76.29	Cu. M.	3720.20	283820
6	1035	Tipping with 1:4 cement mortar on ridged or bayonet masonry								
	(D)	pointed tip					30.60	Sq. M.	192.70	5897
7	PWD SOR 18.77	Providing and fixing on wall face UV stabilized Unplasticised - PVC moulded fittings/ accessories having 3.2mm wall thickness for Rigid PVC pipes conforming to IS : 13592 (heavy) jointing with seal ring conforming to IS : 5382 leaving 10 mm gap for thermal expansion4 inch HDPE Drain pipe								
	18.77.1.2	110 MM					4.50	Ru. M.	154.00	693
8										
6	1902+1903+1904 (03)	Haulage work, distance from mine to site/lead/……km.	80%	of Qty			61.03	Cu. M.	518.53	31648
		22 cm thick grouted stone 15 km. (after 30 km up to 50 km)								
						Grand Total				453838

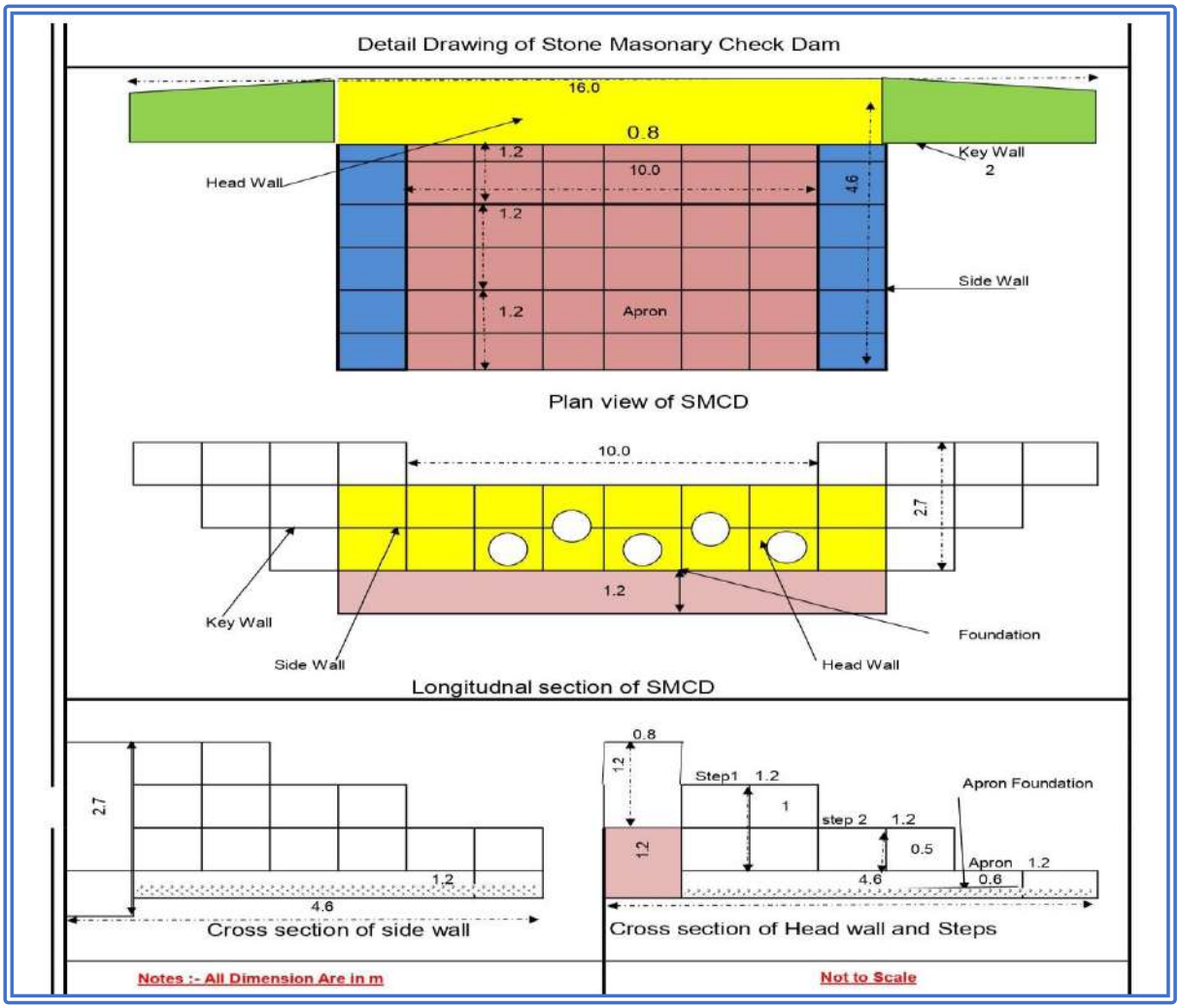
Note:	Particular	Quantity	**Unit**
1	Cement	137.32	Bag
2	Sand	19.07	Cum

4.8 STONE MASONARY CHECK DAM 10M (Input data, Design and Cost Estimate)

INPUT DATA: - DESIGN OF STONE MASONARY CHECK DAM			
	Division	**Dantewada**	
	Range	**Bacheli**	
	Name of Nala	**Galli Nalla and Tributary**	
S.no	**Particulars**	**Measurement**	**unit**
1	Total no of similar structures	**1**	
2	Length of Head Wall	**10.0**	m
3	Height of Head Wall	1.2	m
4	Top Width of Head Wall	1.0	m
5	Bottom Width of Head Wall	1.0	m
6	Width of Apron	3.6	m
7	Thickness of Apron	0.6	m
8	Length of Side Wall	4.6	m
9	Height of Side Wall	2.7	m
10	Thickness of Side Wall	1.0	m
11	Length of Key Wall	2.0	m
12	Total Length of Structure	16.0	m
13	Foundation of Head Wall	1.2	m

BOQ FOR GABION STRUCTURE			
Dimension for Construction & Costing of Gabion Structure			
S.no	**Particulars**	**Measurement**	**unit**
1	Length of Head Wall	10.0	m
2	Height of Head Wall	1.2	m
3	Top Width of Head Wall	1.0	m
4	Bottom Width of Head Wall	1.0	m
5	Width of Apron	3.6	m
6	Thickness of Apron	0.6	m
7	Length of Side Wall	4.6	m
8	Height of Side Wall	2.7	m
9	Thickness of Side Wall	1.0	m
10	Length of Key Wall	2.0	m
11	Total Length of Structure	16.0	m
12	Foundation of Head Wall	1.2	m

Quantity & Cost Estimation of Stone Masonary Check Dam						
S.no	**Particular**	**No.**	**Length**	**Width**	**H/D/T**	**Quantity**
0101	Cleaning of work site and heaping and transportation etc.					
		1	**16.0**	**4.6**		**73.60**
317	Marking and Layout of Site					
(d)	Single line spade marking up to 75cm deep	1	**50.4**			**50.40**
1	**Excavation**					
1.1	Below head wall excavation	1	12.0	1.0	1.2	14.4
1.2	Below Apron excavation	1	12.0	4.5	0.3	16.2
1.3	For Key ecavation	2	2.0	1.0	1.62	6.5
2	**Quantity of boulder**					**37.09**
2.1	Below head wall foundation	1	12.0	1.00	1.2	14.4
2.2	Apron foundation	1	12.0	3.6	0.6	25.92
2.3	Head Wall	1	12.0	0.8	1.2	11.5
2.4	Key Walls	2	2.0	1.0	1.62	6.5
2.5	Side Walls	2	3.6	1	1.164	8.4
2.6	Head Wall step 1	1	10.0	1.2	0.8	9.4
2.7	Head Wall step 2	1	10.0	1.2	0.5	6.1
	Total Quantity of boulder (Cum)					**82.16**



COST ESTIMATION

Name of Structure: -			Stone Masonary Check Dam				Length		10	m
Sl no	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	0101	Site cleaning, mowing, stacking and removal from premises								
		Land Clearance	1	16.00	4.60	75%	55.20	Sq. M.	4.00	220.8
2	317	Single spade row, at least 75 mm deep								
	(A)						50.40	Ru. M.	0.60	30.24
3	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
	(B)	In Hard soil / Murrum Soil								
				Total			37.09	Cu. M.	247.70	9187
4	502	In foundation and plinth of walls, of stone of approved grade, dry unbaked door-masonry, well bound, with front and selected stones and both toda or bond-stones are evenly spaced in progress square meter.					82.16	Cu. M.	1607.70	132082
5	508	Ragged door-masonry of hard stone in foundations and plinth, (second grade)								
	(C)	Cement Mixture in 1:4 (1 cement, 4 sand)					82.16	Cu. M.	3720.20	305637
6	1035	Tipping with 1:4 cement mortar on ridged or bayonet masonry								
	(D)	pointed tip					30.60	Sq. M.	192.70	5897
7	PWD SOR 18.77	Providing and fixing on wall face UV stabilized Unplasticised - PVC moulded fittings/ accessories having 3.2mm wall thickness for Rigid PVC pipes conforming to IS: 13592 (heavy) jointing with seal ring conforming to IS: 5382 leaving 10 mm gap for thermal expansion4 inch HDPE Drain pipe								
	18.77.1.2	110 MM					5.00	Ru. M.	154.00	770
8										
6	1902+ 1903+ 1904 (03)	Haulage work, distance from mine to site/lead/……km.	80%	of Qty			65.72	Cu. M.	518.53	34080
		22 cm thick grouted stone 15 km. (after 30 km up to 50 km)								
						Grand Total				487905

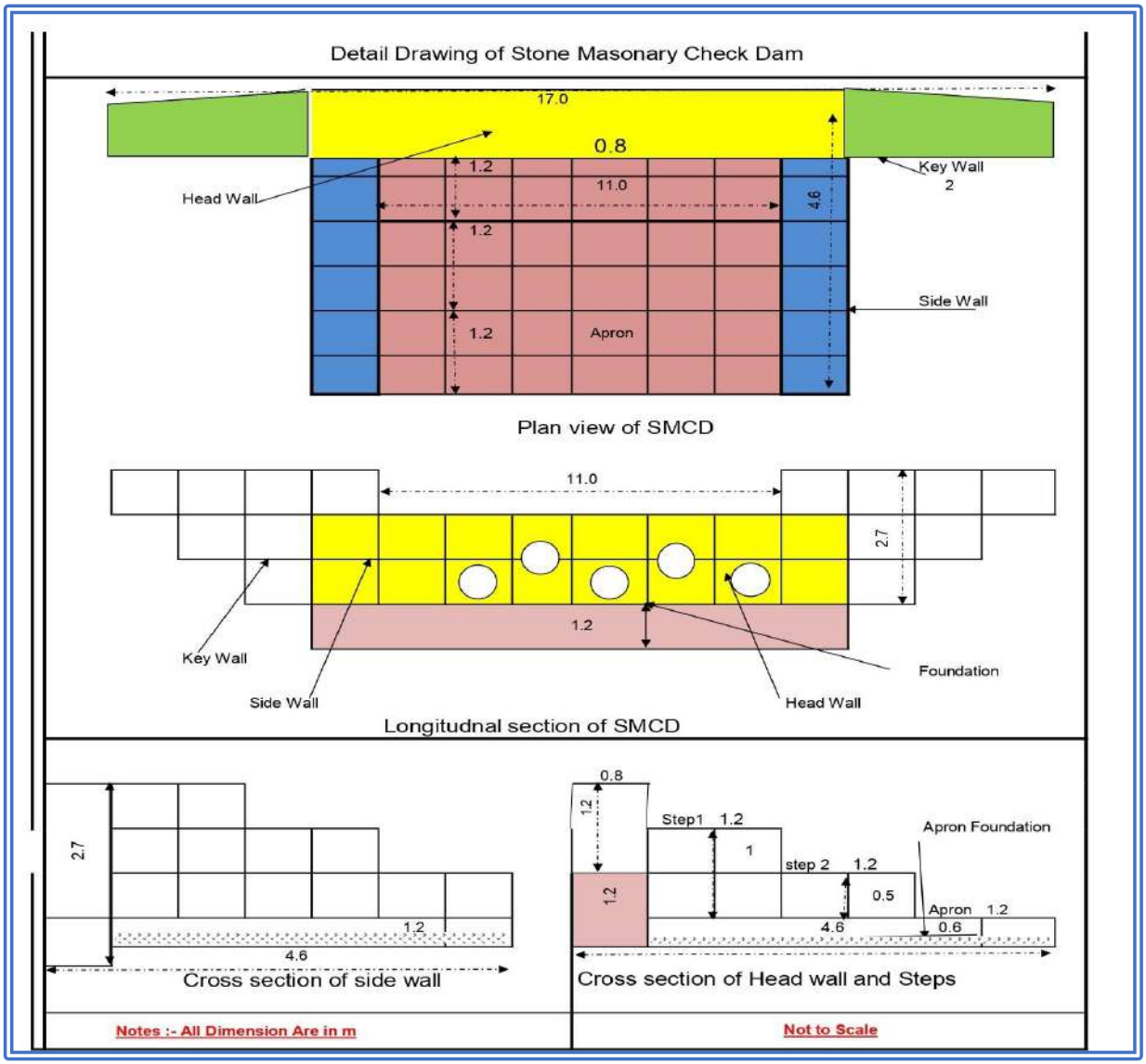
Note:	Particular	Quantity	**Unit**
1	Cement	147.88	Bag
2	Sand	20.54	Cum

4.9 STONE MASONARY CHECK DAM 11M (Input data, Design and Cost Estimate)

INPUT DATA: - DESIGN OF STONE MASONARY CHECK DAM			
	Division	**Dantewada**	
	Range	**Bacheli**	
	Name of Nala	**Galli Nalla and Tributary**	
S.no	**Particulars**	**Measurement**	**unit**
1	Total no of similar structures	**1**	
2	Length of Head Wall	**11.0**	m
3	Height of Head Wall	1.2	m
4	Top Width of Head Wall	1.0	m
5	Bottom Width of Head Wall	1.0	m
6	Width of Apron	3.6	m
7	Thickness of Apron	0.6	m
8	Length of Side Wall	4.6	m
9	Height of Side Wall	2.7	m
10	Thickness of Side Wall	1.0	m
11	Length of Key Wall	2.0	m
12	Total Length of Structure	17.0	m
13	Foundation of Head Wall	1.2	m

Dimension for Construction & Costing of Gabion Structure			
S.no	**Particulars**	**Measurement**	**unit**
1	Length of Head Wall	11.0	m
2	Height of Head Wall	1.2	m
3	Top Width of Head Wall	1.0	m
4	Bottom Width of Head Wall	1.0	m
5	Width of Apron	3.6	m
6	Thickness of Apron	0.6	m
7	Length of Side Wall	4.6	m
8	Height of Side Wall	2.7	m
9	Thickness of Side Wall	1.0	m
10	Length of Key Wall	2.0	m
11	Total Length of Structure	17.0	m
12	Foundation of Head Wall	1.2	m

Quantity & Cost Estimation of Stone Masonary Check Dam						
S.no	**Particular**	**No.**	**Length**	**Width**	**H/D/T**	**Quantity**
0101	Cleaning of work site and heaping and transportation etc.					
		1	**17.0**	**4.6**		**78.20**
317	Marking and Layout of Site					
(d)	Single line spade marking up to 75cm deep	1	**52.4**			**52.40**
1	**Excavation**					
1.1	Below head wall excavation	1	13.0	1.0	1.2	15.6
1.2	Below Apron excavation	1	12.0	4.5	0.3	16.2
1.3	For Key ecavation	2	2.0	1.0	1.62	6.5
2	**Quantity of boulder**					**38.29**
2.1	Below head wall foundation	1	13.0	1.00	1.2	15.6
2.2	Apron foundation	1	13.0	3.6	0.6	28.08
2.3	Head Wall	1	13.0	0.8	1.2	12.5
2.4	Key Walls	2	2.0	1.0	1.62	6.5
2.5	Side Walls	2	3.6	1	1.164	8.4
2.6	Head Wall step 1	1	11.0	1.2	0.8	10.3
2.7	Head Wall step 2	1	11.0	1.2	0.5	6.7
	Total Quantity of boulder (Cum)					**88.02**



COST ESTIMATION

Name of Structure: -		Stone Masonary Check Dam					Length		11	m
Sl no	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	0101	Site cleaning, mowing, stacking and removal from premises								
		Land Clearance	1	17.00	4.60	75%	58.65	Sq. M.	4.00	234.6
2	317	Single spade row, at least 75 mm deep								
	(A)						52.40	Ru. M.	0.60	31.44
3	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
	(B)	In Hard soil / Murrum Soil								
				Total			38.29	Cu. M.	247.70	9485
4	502	In foundation and plinth of walls, of stone of approved grade, dry unbaked door-masonry, well bound, with front and selected stones and both toda or bond-stones are evenly spaced in progress square meter.					88.02	Cu. M.	1607.70	141510
5	508	Ragged door-masonry of hard stone in foundations and plinth, (second grade)								
	(C)	Cement Mixture in 1:4 (1 cement, 4 sand)					88.02	Cu. M.	3720.20	327454
6	1035	Tipping with 1:4 cement mortar on ridged or bayonet masonry								
	(D)	pointed tip					30.60	Sq. M.	192.70	5897
7	PWD SOR 18.77	Providing and fixing on wall face UV stabilized Unplasticised - PVC moulded fittings/ accessories having 3.2mm wall thickness for Rigid PVC pipes conforming to IS: 13592 (heavy) jointing with seal ring conforming to IS: 5382 leaving 10 mm gap for thermal expansion4 inch HDPE Drain pipe								
	18.77.1.2	110 MM					5.50	Ru. M.	154.00	847
8										
6	1902+ 1903+ 1904 (03)	Haulage work, distance from mine to site/lead/……km.	80%	of Qty			70.42	Cu. M.	518.53	36513
		22 cm thick grouted stone 15 km. (after 30 km up to 50 km)								
						Grand Total				**521971**

Note:	Particular	Quantity	**Unit**
1	Cement	158.44	Bag
2	Sand	22.01	Cum

3.10 MINI PERCOLATION TANK (Input data, Design and Cost Estimate)

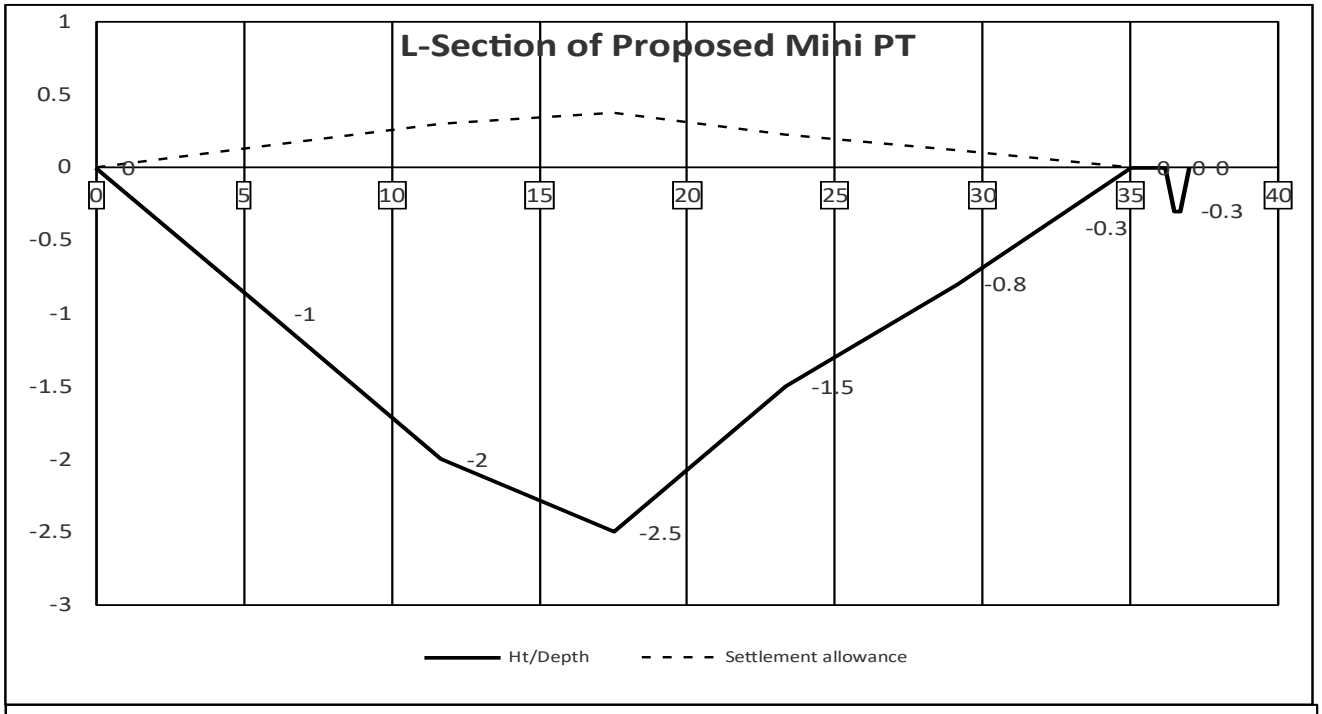
Design data for Proposed Mini Percolation Tank		
Division	**Dantewada**	
Range	**Bacheli**	
Name of Nala	**Galli Nalla and Tributary**	
Particular	**Quantity**	**Unit**
Total no of similar structures	**1**	
Total Length	**35**	m
Max. height	2.5	m
U/S Slope 1:	2	
D/S Slope 1:	3	
Top Width	2.5	m
Chainage	Height of X-section	
0	0	
5.8	1	
11.7	2	
17.5	2.5	
23.3	1.5	
29.2	0.8	
35	0	
Reading interval of nala X-Sec.	5.8	

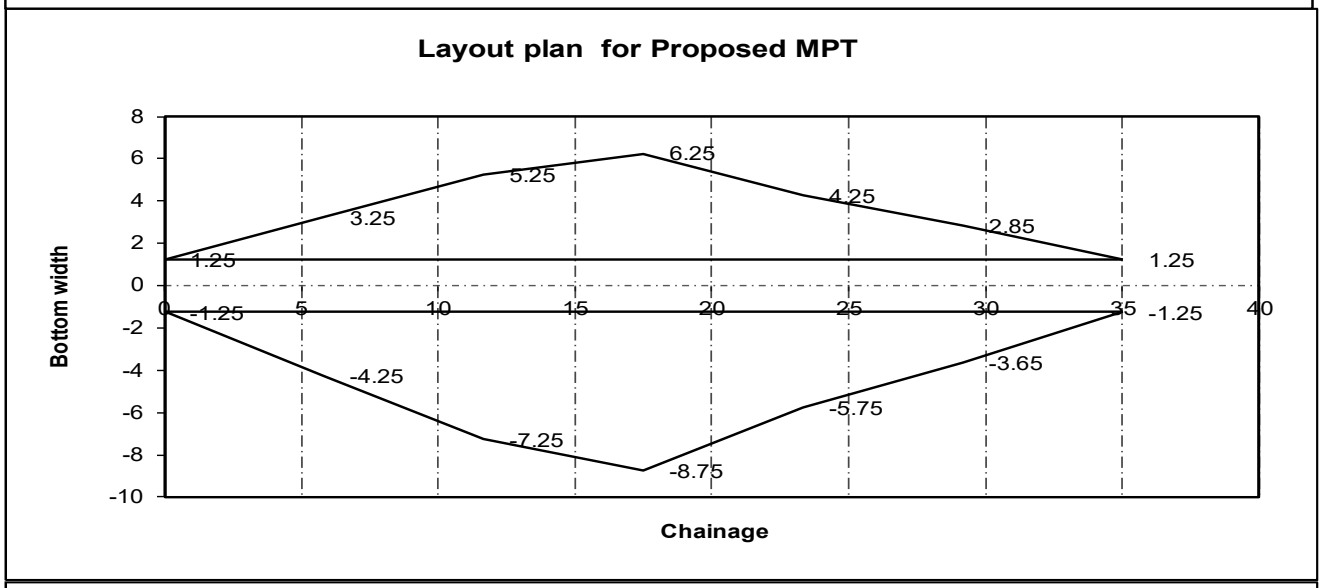
Note:

1. No EGP to be taken up in isolation, to be taken in series with catchment of individual EGP less than 2 ha.
2. MPT to be proposed only on smaller streams having catchment less than 25 ha.
3. Spacing of Two EGP should be in between 10m-30m, so that the submergence of lower EGP should not submerge the toe of upper EGP.

Mini PT Quantity Calculation									
Chainage	**Height**	**Average Width**	**Area of X-Section**	**Av. area of x-Section**	**Length**	**Quantity**	**width of stripping**	**Av. Width of stripping**	**Area of stripping**
			A= (TW+BW)/2 X Ht	**Av= (A1+A2)/2**	**L**	**Av X L**	**BW of sec.**	**Bev. = (Bw1+BW2)/2**	**LX Bav.**
0.00	0		0				2.5		
5.83	1	5	5	2.5	5.83	14.58333	7.5	5	29.17
11.67	2	7.5	15	10	5.83	58.33	12.5	10	58.33
17.50	2.5	8.75	21.875	18.4375	5.83	107.55	15	13.75	80.21
23.33	1.5	6.25	9.375	15.625	5.83	91.15	10	12.5	72.92
29.17	0.8	4.5	3.6	6.4875	5.83	37.84	6.5	8.25	48.13
35.00	0		0	1.8	5.83	10.50	2.5	4.5	26.25
Average	1.11	6.4			35	**319.96**			**315.00**
Add 15% for keying & exit weir						47.99			47.25
Total Quantity						**367.95**			**362.25**
						Cum			**Sqm**

Design data for Proposed EGP		
Particular	**Quantity**	**Unit**
Total Length	35	m
Max. height	2.5	m
U/S Slope 1:	2	
D/S Slope 1:	3	
Top Width	2.5	m





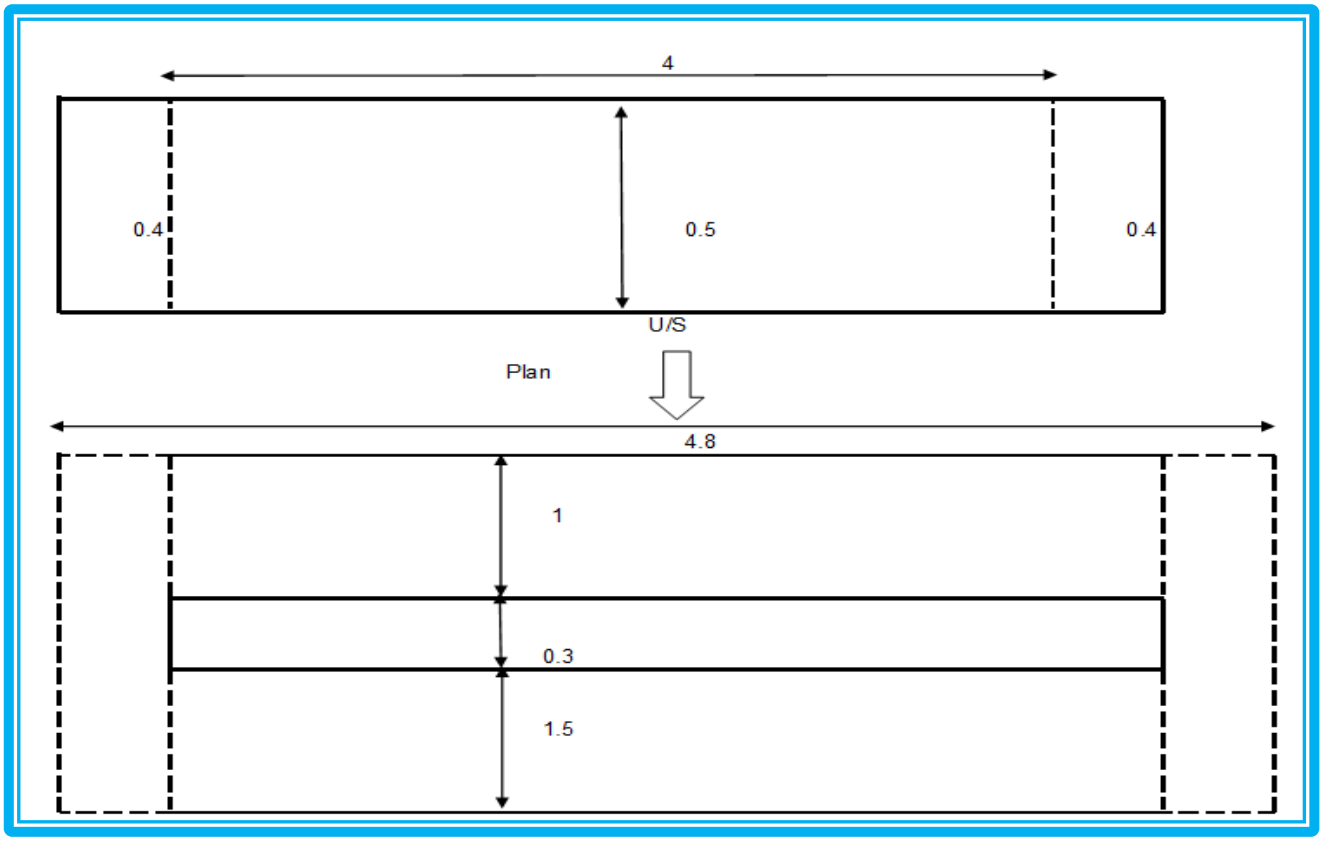
COST ESTIMATE

Name of Structure: - Mini PT									Length	35	m
Sl no	**SOR item no.**	**Work Description**	**No.**		**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	0101	Site cleaning, mowing, stacking and removal from premises									
		Land Clearance	1	1	35.00	15.00	75%	393.75	Cu. M.	4.00	1575
2	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to									
	(B)	In Hard soil / Murrum Soil						367.95	Cu. M.	247.70	91142
3	2302	Step-cutting in earthen embankment land with an average depth of 15 cm and slope of 1:12 and removal and hauling of material up to a distance of 50 meters.									
		Area of stripping			362.25		0.15	54.3375	Cu. M.	256.20	13921
4	2310	Construction of stone edge in earthen dam with laying and setting of stones by hand and preparing the surface									
	(A)	Boulder (for u/s pitching)			0.15	362.25		54.34	Cu. M.	814.20	44242
		Total					**1**	**For Piece**			150880
		Grand Total (Rs.)					**1**	**For Piece**			**150880**

Note:	**Particular**	**Quantity**	**Unit**
1	Boulder	54.34	Cum

4.11 GABION BOULDER CHECK DAM 4M (Input data, Design and Cost Estimate)

Input Data: - Design of Gabion Boulder Check Dam			
	Division	**Dantewada**	
	Range	**Bacheli**	
	Name of Nala	**Galli Nalla and Tributary**	
S.no	**Particulars**	**Measurement**	**Unit**
1	Total no of similar structures	**1**	
2	Length of Head Wall	**4.0**	M
3	Height of Head Wall	0.5	M
4	Length of Key Wall	0.4	M
5	Bottom Width of Head Wall	0.4	M
6	Width of Apron	1.5	M
7	Thickness of Apron	0.6	M
8	Length of Side Wall	1.9	M
9	Height of Side Wall	1.1	M
10	Thickness of Side Wall	1.0	M
11	Length of Key Wall	2.0	M
12	Total Length of Structure	10.0	M
13	Steps (V:H)	1.25	:1



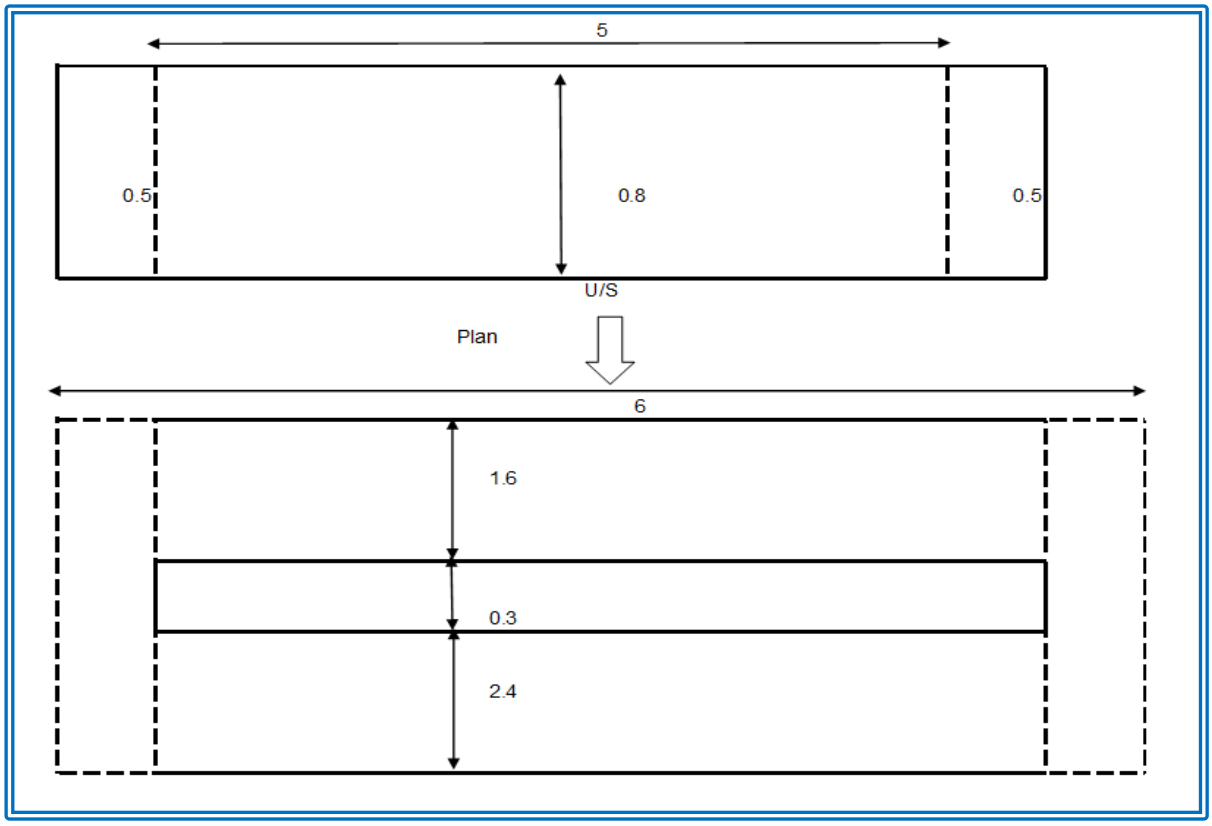
COST ESTIMATION										
Name of Structure: -			**GABION BOULDER CHECK DAM**				**Length**		**4**	**m**
Sl no	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt.**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	0101	Site cleaning, mowing, stacking and removal from premises								
		Land Clearance	1	4.00	2.80	75%	8.40	Sq. M.	4.00	33.6
2	317	Single spade row, at least 75 mm deep								
	(A)		3.00	4.80			14.40	Ru. M.	0.60	8.64
3	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
	(B)	In Hard soil / Murrum Soil								
		Excavaton to match the Max Depth	40%	4.80	2.80	0.50	2.69			
		For Key ecavation	2.00	0.40	2.80	0.50	1.12			
				Total			3.81	Cu. M.	247.70	943
4	CSIDC item Code-700000105	G.I. Wire - 3.15 mm thick wire having mesh size of 50 mm (multiple) by 50 mm holes and net weight of not less than 2.94 kg per square meter to be provided and provided with the cost of transportation. (Choose the width of wire mesh bundle 1m and 1.2m.)								

		(In estimate, Rate provisioning per kg 76/Kg and GST @18%= 13.68, So Total cost of GI wire will be Rs 89.68/kg and per sqm rate will be Rs 263.66 of 2.94 Kg of wire								
		Head Wall Boxing	2	4.80	2.80		26.88			
			2	4.80		0.50	4.80			
							31.68	Sq. M.	263.66	8353
5	502	In foundation and plinth of walls, of stone of approved grade, dry unbaked door-masonry, well bound, with front and selected stones and both toda or bond-stones are evenly spaced in progress square meter.								
		Head Wall	1	4.80	2.80	0.50	6.72			
							6.72	Cu. M.	1607.70	10804
							Total			20142
						1	**Total Amount for Piece**			**20142**
	Grand Total (Rs.)					**1**	**For Piece**			**20142**

Note:	Particular	Quantity	**Unit**
1	GI Wire	0.93	Quintal
2	Stone	6.72	Cum

3.12 GABION BOULDER CHECK DAM 5M (Input data, Design and Cost Estimate)

INPUT DATA: - DESIGN OF GABION BOULDER CHECK DAM			
	Division	**Dantewada**	
	Range	**Bacheli**	
	Name of Nala	**Galli Nalla and Tributary**	
S.no	**Particulars**	**Measurement**	**unit**
1	Total no of similar structures	**1**	
2	Length of Head Wall	**5.0**	m
3	Height of Head Wall	0.8	m
4	Length of Key Wall	0.5	m
5	Bottom Width of Head Wall	0.5	m
6	Width of Apron	2.4	m
7	Thickness of Apron	0.6	m
8	Length of Side Wall	2.9	m
9	Height of Side Wall	1.8	m
10	Thickness of Side Wall	1.0	m
11	Length of Key Wall	2.0	m
12	Total Length of Structure	11.0	m
13	Steps (V:H)	1.6	:1



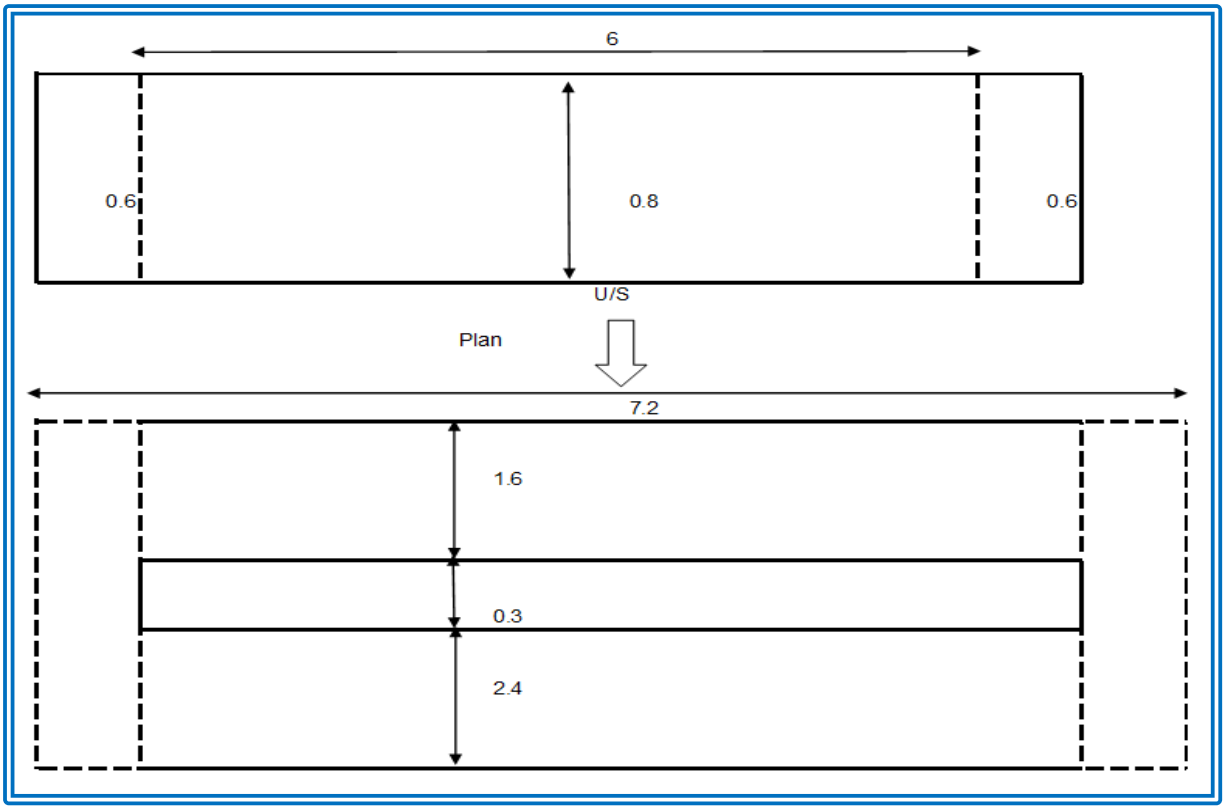
COST ESTIMATION										
Name of Structure: -			**GABION BOULDER CHECK DAM**				**Length**		**5**	**m**
Sl no	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt.**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	0101	Site cleaning, mowing, stacking and removal from premises								
		Land Clearance	1	5.00	4.30	75%	16.13	Sq. M.	4.00	64.5
2	317	Single spade row, at least 75 mm deep								
	(A)		3.00	5.80			17.40	rm	0.60	10.44
3	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
	(B)	In Hard soil / Murrum Soil								
		Excavaton to match the Max Depth	40%	5.80	2.80	0.50	3.25			
		For Key ecavation	2.00	0.40	2.80	0.50	1.12			
				Total			4.37	Cu. M.	247.70	1082
4	CSIDC item Code-70000000105	G.I. Wire - 3.15 mm thick wire having mesh size of 50 mm (multiple) by 50 mm holes and net weight of not less than 2.94 kg per square meter to be provided and provided with the cost of transportation. (Choose the width of wire mesh bundle 1m and 1.2m.)								

		(In estimate, Rate provisioning per kg 76/Kg and GST @18%= 13.68, So Total cost of GI wire will be Rs 89.68/kg and per sqm rate will be Rs 263.66 of 2.94 Kg of wire								
		Head Wall Boxing	2	5.80	2.80		32.48			
			2	5.80		0.50	5.80			
							38.28	Sq. M.	263.66	10093
5	502	In foundation and plinth of walls, of stone of approved grade, dry unbaked door-masonry, well bound, with front and selected stones and both toda or bond-stones are evenly spaced in progress square meter.								
		Head Wall	1	5.80	2.80	0.50	8.12			
							8.12	Cu. M.	1607.70	13055
							Total			24304
						1	**Total Amount for Piece**			**24304**
	Grand Total (Rs.)					**1**	**For Piece**			**24304**

Note:	Particular	Quantity	**Unit**
1	GI Wire	1.13	Quintal
2	Stone	8.12	Cum

4.13 GABION BOULDER CHECK DAM 6M (Input data, Design and Cost Estimate)

INPUT DATA: - DESIGN OF GABION BOULDER CHECK DAM			
	Division	**Dantewada**	
	Range	**Bacheli**	
	Name of Nala	**Galli Nalla and Tributary**	
S.no	**Particulars**	**Measurement**	**unit**
1	Total no of similar structures	**1**	
2	Length of Head Wall	**6.0**	m
3	Height of Head Wall	0.8	m
4	Length of Key Wall	0.6	m
5	Bottom Width of Head Wall	0.6	m
6	Width of Apron	2.4	m
7	Thickness of Apron	0.6	m
8	Length of Side Wall	3.0	m
9	Height of Side Wall	1.8	m
10	Thickness of Side Wall	1.0	m
11	Length of Key Wall	2.0	m
12	Total Length of Structure	12.0	m
13	Steps (V:H)	1.333333333	:1



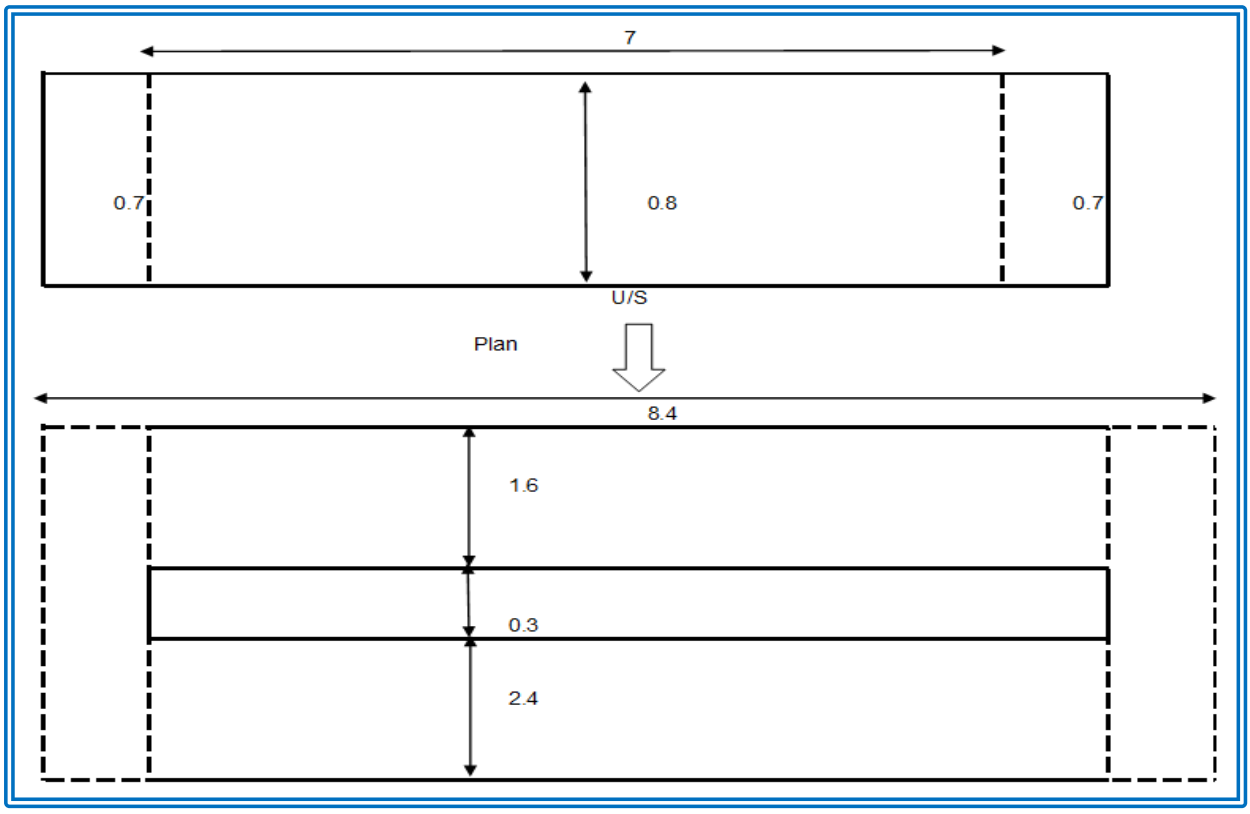
COST ESTIMATION										
Name of Structure: -			**GABION BOULDER CHECK DAM**				**Length**		**6**	**m**
Sl no	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt.**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	0101	Site cleaning, mowing, stacking and removal from premises								
		Land Clearance	1	6.00	4.30	75%	19.35	Sq. M.	4.00	77.4
2	317	Single spade row, at least 75 mm deep								
	(A)		3.00	6.80			20.40	Ru. M.	0.60	12.24
3	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
	(B)	In Hard soil / Murrum Soil								
		Excavaton to match the Max Depth	40%	6.80	2.80	0.50	3.81			
		For Key ecavation	2.00	0.40	2.80	0.50	1.12			
				Total			4.93	Cu. M.	247.70	1221
4	CSIDC item Code-700000105	G.I. Wire - 3.15 mm thick wire having mesh size of 50 mm (multiple) by 50 mm holes and net weight of not less than 2.94 kg per square meter to be provided and provided with the cost of transportation. (Choose the width of wire mesh bundle 1m and 1.2m.)								

		(In estimate, Rate provisioning per kg 76/Kg and GST @18%= 13.68, So Total cost of GI wire will be Rs 89.68/kg and per sqm rate will be Rs 263.66 of 2.94 Kg of wire								
		Head Wall Boxing	2	6.80	2.80		38.08			
			2	6.80		0.50	6.80			
							44.88	Sq. M.	263.66	11833
5	502	In foundation and plinth of walls, of stone of approved grade, dry unbaked door-masonry, well bound, with front and selected stones and both toda or bond-stones are evenly spaced in progress square meter.								
		Head Wall	1	6.80	2.80	0.50	9.52			
							9.52	Cu. M.	1607.70	15305
							Total			28449
						1	**Total Amount for Piece**			**28449**
	Grand Total (Rs.)					**1**	**For Piece**			**28449**

Note:	Particular	Quantity	**Unit**
1	GI Wire	1.32	Quintal
2	Stone	9.52	Cum

4.14 GABION BOULDER CHECK DAM 7M (Input data, Design and Cost Estimate)

INPUT DATA: - DESIGN OF GABION BOULDER CHECK DAM			
	Division	**Dantewada**	
	Range	**Bacheli**	
	Name of Nala	**Galli Nalla and Tributary**	
S.no	**Particulars**	**Measurement**	**unit**
1	Total no of similar structures	**1**	
2	Length of Head Wall	**7.0**	m
3	Height of Head Wall	0.8	m
4	Length of Key Wall	0.7	m
5	Bottom Width of Head Wall	0.7	m
6	Width of Apron	2.4	m
7	Thickness of Apron	0.6	m
8	Length of Side Wall	3.1	m
9	Height of Side Wall	1.8	m
10	Thickness of Side Wall	1.0	m
11	Length of Key Wall	2.0	m
12	Total Length of Structure	13.0	m
13	Steps (V:H)	1.142857143	:1



COST ESTIMATION										
Name of Structure: -			**GABION BOULDER CHECK DAM**				**Length**		**7**	**m**
SL. No.	**SOR item no.**	**Work Description**	**No**	**Length**	**Width**	**Height**	**Quantity**	**Unit**	**Total Rate**	**Total Amt.**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	0101	Site cleaning, mowing, stacking and removal from premises								
		Land Clearance	1	7.00	4.30	75%	22.58	Sq. M.	4.00	90.3
2	317	Single spade row, at least 75 mm deep								
	(A)		3.00	7.80			23.40	Ru. M.	0.60	14.04
3	301	Soil Work ((30 cm in depth, 1.50 m in width and more than 10.00 Sq.m. in area) in the excavation of areas, 50 m. distance and 1.50 m. Including disposal of excavated soil and leveling and cleaning of dumped soil at height up to								
	(B)	In Hard soil / Murrum Soil								
		Excavaton to match the Max Depth	40%	7.80	2.80	0.50	4.37			
		For Key excavation	2.00	0.40	2.80	0.50	1.12			
				Total			5.49	Cu. M.	247.70	1359
4	CSIDC item Code-700000105	G.I. Wire - 3.15 mm thick wire having mesh size of 50 mm (multiple) by 50 mm holes and net weight of not less than 2.94 kg per square meter to be provided and provided with the cost of transportation.								

		(Choose the width of wire mesh bundle 1m and 1.2m.)								
		(In estimate, Rate provisioning per kg 76/Kg and GST @18%= 13.68, So Total cost of GI wire will be Rs 89.68/kg and per sqm rate will be Rs 263.66 of 2.94 Kg of wire								
		Head Wall Boxing	2	7.80	2.80		43.68			
			2	7.80		0.50	7.80			
							51.48	Sq. M.	263.66	13573
5	502	In foundation and plinth of walls, of stone of approved grade, dry unbaked door-masonry, well bound, with front and selected stones and both toda or bond-stones are evenly spaced in progress square meter.								
		Head Wall	1	7.80	2.80	0.50	10.92			
							10.92	Cu. M.	1607.70	17556
							Total			32593
						1	**Total Amount for Piece**			**32593**
	Grand Total (Rs.)					**1**	**For Piece**			**32593**

Note:	Particular	Quantity	**Unit**
1	GI Wire	1.51	Quintal
2	Stone	10.92	Cum

4.15 ABSTRACT OF COST ESTIMATION OF PROPOSED STRUCTURES:

Proposed Cost Estimation of Proposed Structures					
S.No.	**Name Of Structure**	**Size in Meter**	**Units**	**Rate Per Unite (In Lakhs)**	**Total Cost (In Lakhs)**
1	Gabion Wall	1500	1	47861943	478.61
2	Retaining Wall	1500	1	32218120	322.18
3	Gabion structure	6 M	3	1.49	4.47
4	Gabion structure	7 M	6	1.62	9.72
5	Gabion structure	8 M	3	1.76	5.28
6	Stone Masonry Check Dam	8 M	1	4.2	4.2
7	Stone Masonry Check Dam	9 M	4	4.54	18.16
8	Stone Masonry Check Dam	10 M	1	4.88	4.88
9	Stone Masonry Check Dam	11 M	2	5.22	10.44
10	Mini Percolation Tank	35m	2	1.51	3.02
11	Gabion boulder Check Dam	4 M	37	0.2	7.4
12	Gabion boulder Check Dam	5 M	77	0.24	18.48
13	Gabion boulder Check Dam	6 M	17	0.28	4.76
14	Gabion boulder Check Dam	7 M	1	0.33	0.33
		Total Unites	**156**	**Total =**	**892.2923**

4.16 DETAIL ESTIMATE OF STRUCTURES WITH PROPER LOCATION DETAILS ARE ELABORATED IN FOLLOWING TABLE NO.

TABLE 4.1 ESTIMATE AND LOCATION OF STRUCTURES

SL. No.	BEAT	COMPARTMENT NO.	STRUCTURE NAME	STRUCTURE CODE	SIZE IN METER	LATITUDE	LONGITUDE	Amount	In Lakhs
1	BACHELI	1885, 1834, 1886, 1833	Gabion Wall	GW	1500	18.699155, 81.207763	18.722019, 81.213688	47861943	478.61
2	BACHELI	1885, 1834, 1886, 1833	Retaining Wall	RW	1500	18.698742, 81.207648	18.721576, 81.213905	32218120	322.18
3	BACHELI	1834	Gabion structure	GS - 1	6	18.70328228	81.21166203	149050	1.49
4	BACHELI	1834	Gabion structure	GS - 2	7	18.71107778	81.21464219	162296	1.62
5	BACHELI	1834	Gabion structure	GS - 3	7	18.72019272	81.21597278	162296	1.62
6	BACHELI	1834	Gabion structure	GS - 4	8	18.71825657	81.21488849	175543	1.76
7	BACHELI	1834	Gabion structure	GS - 5	8	18.71712393	81.21460253	175543	1.76
8	BACHELI	1834	Gabion structure	GS - 6	8	18.71633423	81.21537967	175543	1.76
9	BACHELI	1834	Gabion structure	GS - 7	7	18.71095155	81.21559558	162296	1.62
10	BACHELI	1841	Gabion structure	GS - 8	6	18.70382365	81.21764335	149050	1.49
11	BACHELI	1841	Gabion structure	GS - 9	7	18.70386507	81.21571968	162296	1.62
12	BACHELI	1834	Gabion structure	GS - 10	7	18.70365824	81.21375936	162296	1.62
13	BACHELI	1841	Gabion structure	GS - 11	6	18.71026546	81.21739476	149050	1.49
14	BACHELI	1834	Gabion structure	GS - 12	7	18.71814194	81.21421693	162296	1.62
15	BACHELI	1834	Stone Masonry Check Dam	SMCD -1	8	18.71395232	81.21419029	419771	4.20
16	BACHELI	1834	Stone Masonry Check Dam	SMCD -2	9	18.71152959	81.21425833	453838	4.54
17	BACHELI	1834	Stone Masonry Check Dam	SMCD -3	9	18.70883279	81.21323841	453838	4.54
18	BACHELI	1834	Stone Masonry Check Dam	SMCD -4	9	18.70686494	81.21293776	453838	4.54
19	BACHELI	1834	Stone Masonry Check Dam	SMCD -5	9	18.70469538	81.21272407	453838	4.54
20	BACHELI	1834	Stone Masonry Check Dam	SMCD -6	10	18.70234847	81.2119428	487905	4.88
21	BACHELI	1834	Stone Masonry Check Dam	SMCD -7	11	18.69967236	81.21057814	521971	5.22
22	BACHELI	1834	Stone Masonry Check Dam	SMCD -8	11	18.69720612	81.2103211	521971	5.22
23	BACHELI	1834	Mini Percolation Tank	MPT - 1	35	18.72107046	81.21689788	150880	1.51

24	BACHELI	1841	Mini Percolation Tank	MPT - 2	35	18.71867285	81.21697528	150880	1.51
25	BACHELI	1841	Gabion boulder Check Dam	GBD - 1	4	18.7210907	81.21964734	20142	0.20
26	BACHELI	1841	Gabion boulder Check Dam	GBD - 2	4	18.72114177	81.21931475	20142	0.20
27	BACHELI	1841	Gabion boulder Check Dam	GBD - 3	5	18.7211571	81.21883372	24304	0.24
28	BACHELI	1841	Gabion boulder Check Dam	GBD - 4	5	18.72100909	81.2182629	24304	0.24
29	BACHELI	1841	Gabion boulder Check Dam	GBD - 5	5	18.72110361	81.21780662	24304	0.24
30	BACHELI	1834	Gabion boulder Check Dam	GBD - 6	4	18.72085348	81.21379869	20142	0.20
31	BACHELI	1834	Gabion boulder Check Dam	GBD - 7	4	18.72039405	81.21438073	20142	0.20
32	BACHELI	1834	Gabion boulder Check Dam	GBD - 8	4	18.72018739	81.21498923	20142	0.20
33	BACHELI	1834	Gabion boulder Check Dam	GBD - 9	4	18.7197165	81.21390636	20142	0.20
34	BACHELI	1834	Gabion boulder Check Dam	GBD - 10	5	18.71956817	81.21448978	24304	0.24
35	BACHELI	1834	Gabion boulder Check Dam	GBD - 11	4	18.71928966	81.21223007	20142	0.20
36	BACHELI	1834	Gabion boulder Check Dam	GBD - 12	4	18.71867362	81.21240402	20142	0.20
37	BACHELI	1834	Gabion boulder Check Dam	GBD - 13	4	18.71903556	81.21254477	20142	0.20
38	BACHELI	1834	Gabion boulder Check Dam	GBD - 14	4	18.71943963	81.21295113	20142	0.20
39	BACHELI	1834	Gabion boulder Check Dam	GBD - 15	4	18.71918774	81.21322936	20142	0.20
40	BACHELI	1834	Gabion boulder Check Dam	GBD - 16	5	18.71888801	81.21284574	24304	0.24
41	BACHELI	1834	Gabion boulder Check Dam	GBD - 17	5	18.71888542	81.21322841	24304	0.24
42	BACHELI	1834	Gabion boulder Check Dam	GBD - 18	5	18.71886994	81.21357378	24304	0.24
43	BACHELI	1834	Gabion boulder Check Dam	GBD - 19	5	18.71869947	81.21396833	24304	0.24
44	BACHELI	1834	Gabion boulder Check Dam	GBD - 20	4	18.71776796	81.21288249	20142	0.20
45	BACHELI	1834	Gabion boulder Check Dam	GBD - 21	5	18.71787428	81.21324628	24304	0.24
46	BACHELI	1834	Gabion boulder Check Dam	GBD - 22	5	18.71799061	81.21358364	24304	0.24
47	BACHELI	1834	Gabion boulder Check Dam	GBD - 23	5	18.71815325	81.21385881	24304	0.24
48	BACHELI	1841	Gabion boulder Check Dam	GBD - 24	5	18.71501367	81.21778534	24304	0.24
49	BACHELI	1841	Gabion boulder Check Dam	GBD - 25	5	18.71488586	81.21662905	24304	0.24
50	BACHELI	1834	Gabion boulder Check Dam	GBD - 26	5	18.71498508	81.21594537	24304	0.24
51	BACHELI	1834	Gabion boulder Check Dam	GBD - 27	5	18.71505174	81.21534843	24304	0.24

52	BACHELI	1834	Gabion boulder Check Dam	GBD - 28	5	18.71533671	81.21484168	24304	0.24
53	BACHELI	1841	Gabion boulder Check Dam	GBD - 29	5	18.71106834	81.2195217	24304	0.24
54	BACHELI	1841	Gabion boulder Check Dam	GBD - 30	5	18.71057781	81.21883598	24304	0.24
55	BACHELI	1841	Gabion boulder Check Dam	GBD - 31	5	18.70949424	81.21978442	24304	0.24
56	BACHELI	1841	Gabion boulder Check Dam	GBD - 32	5	18.70978658	81.21926203	24304	0.24
57	BACHELI	1841	Gabion boulder Check Dam	GBD - 33	5	18.71019424	81.21881721	24304	0.24
58	BACHELI	1841	Gabion boulder Check Dam	GBD - 34	5	18.71159426	81.21649569	24304	0.24
59	BACHELI	1841	Gabion boulder Check Dam	GBD - 35	5	18.71123105	81.21612048	24304	0.24
60	BACHELI	1841	Gabion boulder Check Dam	GBD - 36	6	18.71100887	81.2159076	28449	0.28
61	BACHELI	1834	Gabion boulder Check Dam	GBD - 37	6	18.71332069	81.21484219	28449	0.28
62	BACHELI	1834	Gabion boulder Check Dam	GBD - 38	5	18.71338253	81.21514747	24304	0.24
63	BACHELI	1834	Gabion boulder Check Dam	GBD - 39	5	18.71354876	81.21546941	24304	0.24
64	BACHELI	1834	Gabion boulder Check Dam	GBD - 40	4	18.71594312	81.21396593	20142	0.20
65	BACHELI	1834	Gabion boulder Check Dam	GBD - 41	6	18.71572579	81.21418015	28449	0.28
66	BACHELI	1834	Gabion boulder Check Dam	GBD - 42	6	18.71544364	81.21432519	28449	0.28
67	BACHELI	1834	Gabion boulder Check Dam	GBD - 43	4	18.71537425	81.21236004	20142	0.20
68	BACHELI	1834	Gabion boulder Check Dam	GBD - 44	5	18.71499063	81.212872	24304	0.24
69	BACHELI	1834	Gabion boulder Check Dam	GBD - 45	6	18.71470691	81.21319897	28449	0.28
70	BACHELI	1834	Gabion boulder Check Dam	GBD - 46	5	18.7146745	81.21209743	24304	0.24
71	BACHELI	1834	Gabion boulder Check Dam	GBD - 47	5	18.71445832	81.2125531	24304	0.24
72	BACHELI	1834	Gabion boulder Check Dam	GBD - 48	6	18.71448335	81.21296781	28449	0.28
73	BACHELI	1834	Gabion boulder Check Dam	GBD - 49	6	18.7147084	81.2136048	28449	0.28
74	BACHELI	1834	Gabion boulder Check Dam	GBD - 50	4	18.71282225	81.21240409	20142	0.20
75	BACHELI	1834	Gabion boulder Check Dam	GBD - 51	5	18.71222534	81.21293854	24304	0.24
76	BACHELI	1834	Gabion boulder Check Dam	GBD - 52	5	18.71182238	81.21335386	24304	0.24
77	BACHELI	1834	Gabion boulder Check Dam	GBD - 53	6	18.71146377	81.21366808	28449	0.28
78	BACHELI	1834	Gabion boulder Check Dam	GBD - 54	4	18.71237722	81.21249998	20142	0.20
79	BACHELI	1834	Gabion boulder Check Dam	GBD - 55	5	18.71092577	81.21287833	24304	0.24

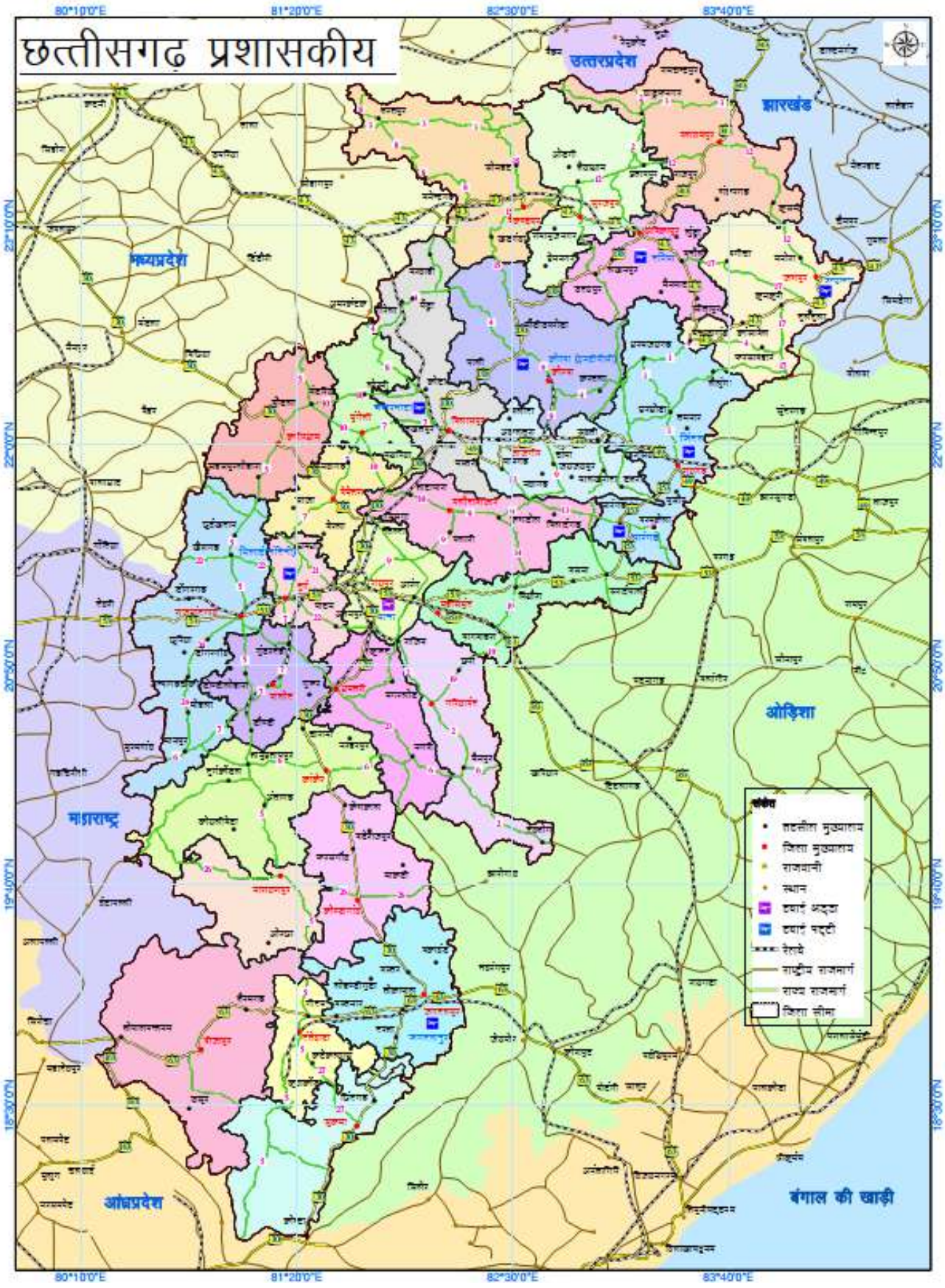
80	BACHELI	1834	Gabion boulder Check Dam	GBD - 56	5	18.71068569	81.21311277	24304	0.24
81	BACHELI	1834	Gabion boulder Check Dam	GBD - 57	7	18.71043623	81.21334528	32593	0.33
82	BACHELI	1834	Gabion boulder Check Dam	GBD - 58	4	18.71002961	81.21224975	20142	0.20
83	BACHELI	1834	Gabion boulder Check Dam	GBD - 59	5	18.71003274	81.21262174	24304	0.24
84	BACHELI	1834	Gabion boulder Check Dam	GBD - 60	5	18.70987976	81.21303945	24304	0.24
85	BACHELI	1834	Gabion boulder Check Dam	GBD - 61	5	18.70943213	81.21232678	24304	0.24
86	BACHELI	1834	Gabion boulder Check Dam	GBD - 62	5	18.70945448	81.21261344	24304	0.24
87	BACHELI	1834	Gabion boulder Check Dam	GBD - 63	6	18.7093894	81.21295131	28449	0.28
88	BACHELI	1834	Gabion boulder Check Dam	GBD - 64	4	18.70882145	81.21259497	20142	0.20
89	BACHELI	1834	Gabion boulder Check Dam	GBD - 65	5	18.70865605	81.21289609	24304	0.24
90	BACHELI	1834	Gabion boulder Check Dam	GBD - 66	4	18.70745182	81.21162941	20142	0.20
91	BACHELI	1834	Gabion boulder Check Dam	GBD - 67	5	18.70715771	81.21190569	24304	0.24
92	BACHELI	1834	Gabion boulder Check Dam	GBD - 68	5	18.70679973	81.2122565	24304	0.24
93	BACHELI	1834	Gabion boulder Check Dam	GBD - 69	5	18.70653366	81.21252739	24304	0.24
94	BACHELI	1834	Gabion boulder Check Dam	GBD - 70	5	18.70881407	81.21392199	24304	0.24
95	BACHELI	1834	Gabion boulder Check Dam	GBD - 71	4	18.70888621	81.21440064	20142	0.20
96	BACHELI	1834	Gabion boulder Check Dam	GBD - 72	4	18.70749509	81.21427553	20142	0.20
97	BACHELI	1834	Gabion boulder Check Dam	GBD - 73	5	18.70752277	81.21358775	24304	0.24
98	BACHELI	1841	Gabion boulder Check Dam	GBD - 74	4	18.7058274	81.21470284	20142	0.20
99	BACHELI	1834	Gabion boulder Check Dam	GBD - 75	5	18.70584999	81.21422855	24304	0.24
100	BACHELI	1834	Gabion boulder Check Dam	GBD - 76	6	18.70582563	81.21372148	28449	0.28
101	BACHELI	1834	Gabion boulder Check Dam	GBD - 77	6	18.70617818	81.21317173	28449	0.28
102	BACHELI	1834	Gabion boulder Check Dam	GBD - 78	4	18.70588604	81.21148533	20142	0.20
103	BACHELI	1834	Gabion boulder Check Dam	GBD - 79	5	18.70587203	81.21177454	24304	0.24
104	BACHELI	1834	Gabion boulder Check Dam	GBD - 80	5	18.70583501	81.21202818	24304	0.24
105	BACHELI	1834	Gabion boulder Check Dam	GBD - 81	5	18.70564353	81.21231071	24304	0.24
106	BACHELI	1885	Gabion boulder Check Dam	GBD - 82	5	18.7044929	81.21089607	24304	0.24
107	BACHELI	1834	Gabion boulder Check Dam	GBD - 83	6	18.70426895	81.2112022	28449	0.28

108	BACHELI	1834	Gabion boulder Check Dam	GBD - 84	6	18.70386098	81.21127073	28449	0.28
109	BACHELI	1885	Gabion boulder Check Dam	GBD - 85	4	18.70357731	81.21033157	20142	0.20
110	BACHELI	1885	Gabion boulder Check Dam	GBD - 86	5	18.70362562	81.21073361	24304	0.24
111	BACHELI	1834	Gabion boulder Check Dam	GBD - 87	6	18.7036306	81.21113219	28449	0.28
112	BACHELI	1834	Gabion boulder Check Dam	GBD - 88	4	18.70123639	81.21057442	20142	0.20
113	BACHELI	1834	Gabion boulder Check Dam	GBD - 89	5	18.70107723	81.21070072	24304	0.24
114	BACHELI	1885	Gabion boulder Check Dam	GBD - 90	4	18.7009427	81.21006323	20142	0.20
115	BACHELI	1834	Gabion boulder Check Dam	GBD - 91	5	18.70076946	81.21025226	24304	0.24
116	BACHELI	1885	Gabion boulder Check Dam	GBD - 92	4	18.70068818	81.20952755	20142	0.20
117	BACHELI	1885	Gabion boulder Check Dam	GBD - 93	5	18.70053918	81.20974529	24304	0.24
118	BACHELI	1834	Gabion boulder Check Dam	GBD - 94	5	18.7005531	81.21004556	24304	0.24
119	BACHELI	1834	Gabion boulder Check Dam	GBD - 95	6	18.7005505	81.21031694	28449	0.28
120	BACHELI	1834	Gabion boulder Check Dam	GBD - 96	4	18.69943083	81.20982343	20142	0.20
121	BACHELI	1834	Gabion boulder Check Dam	GBD - 97	5	18.6994222	81.21008796	24304	0.24
122	BACHELI	1834	Gabion boulder Check Dam	GBD - 98	5	18.69940006	81.21036081	24304	0.24
123	BACHELI	1834	Gabion boulder Check Dam	GBD - 99	4	18.69810616	81.20940076	20142	0.20
124	BACHELI	1834	Gabion boulder Check Dam	GBD - 100	5	18.69770179	81.20967812	24304	0.24
125	BACHELI	1885	Gabion boulder Check Dam	GBD - 101	4	18.69819523	81.20809915	20142	0.20
126	BACHELI	1834	Gabion boulder Check Dam	GBD - 102	5	18.69799513	81.20829243	24304	0.24
127	BACHELI	1834	Gabion boulder Check Dam	GBD - 103	5	18.69771855	81.20846592	24304	0.24
128	BACHELI	1885	Gabion boulder Check Dam	GBD - 104	5	18.69794748	81.20780043	24304	0.24
129	BACHELI	1834	Gabion boulder Check Dam	GBD - 105	5	18.69770581	81.20808	24304	0.24
130	BACHELI	1834	Gabion boulder Check Dam	GBD - 106	5	18.69753945	81.20837424	24304	0.24
131	BACHELI	1834	Gabion boulder Check Dam	GBD - 107	5	18.69719902	81.20882876	24304	0.24
132	BACHELI	1834	Gabion boulder Check Dam	GBD - 108	6	18.69684095	81.20915698	28449	0.28
133	BACHELI	1834	Gabion boulder Check Dam	GBD - 109	4	18.69854324	81.21108148	20142	0.20
134	BACHELI	1834	Gabion boulder Check Dam	GBD - 110	5	18.69842244	81.21082815	24304	0.24
135	BACHELI	1841	Gabion boulder Check Dam	GBD - 111	4	18.69999461	81.21244821	20142	0.20

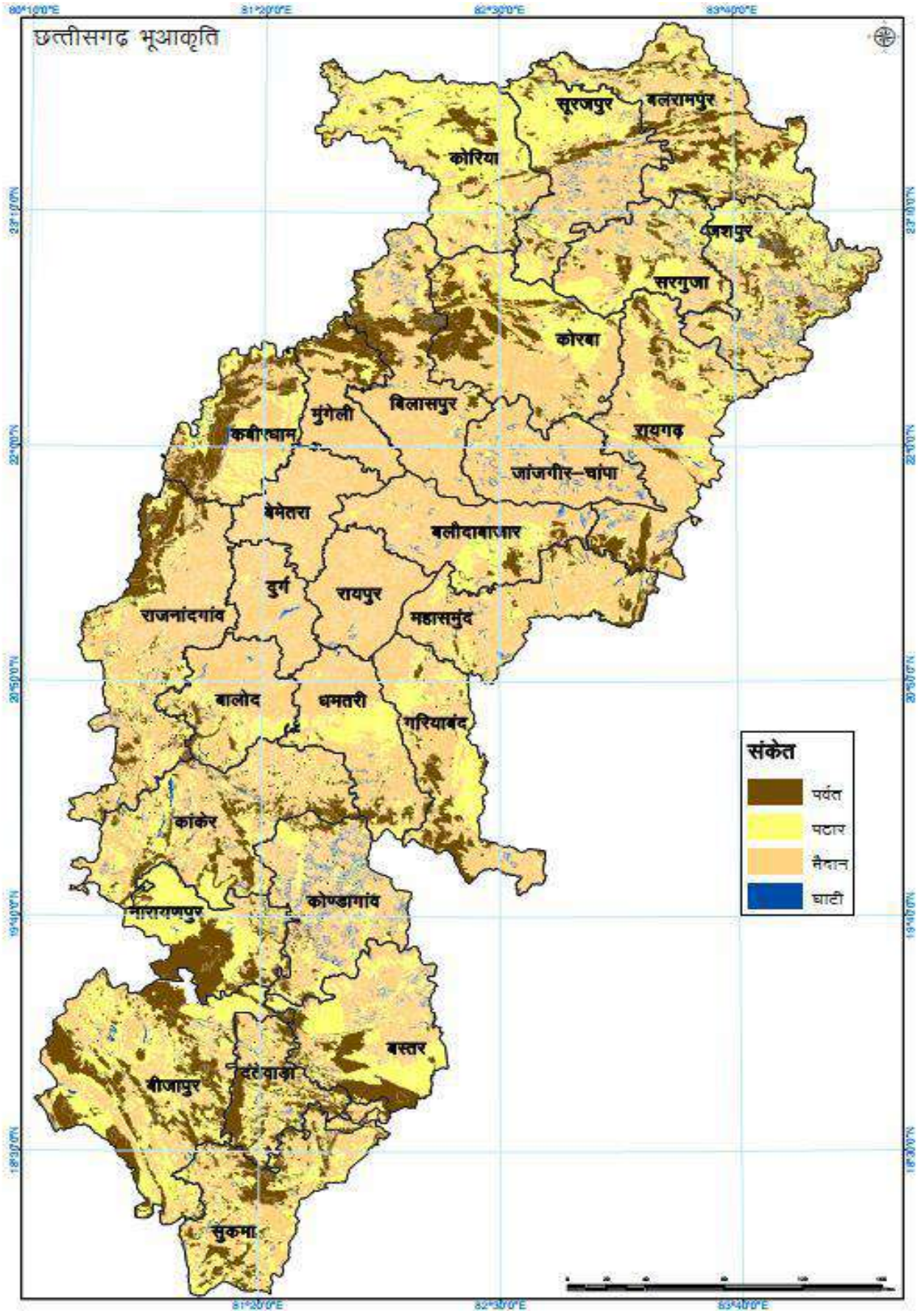
136	BACHELI	1834	Gabion boulder Check Dam	GBD - 112	5	18.69990729	81.21192396	24304	0.24
137	BACHELI	1834	Gabion boulder Check Dam	GBD - 113	5	18.69971621	81.21147328	24304	0.24
138	BACHELI	1834	Gabion boulder Check Dam	GBD - 114	6	18.69943294	81.21098288	28449	0.28
139	BACHELI	1841	Gabion boulder Check Dam	GBD - 115	4	18.70133742	81.21386499	20142	0.20
140	BACHELI	1834	Gabion boulder Check Dam	GBD - 116	5	18.70138434	81.21309535	24304	0.24
141	BACHELI	1834	Gabion boulder Check Dam	GBD - 117	5	18.70138976	81.21256677	24304	0.24
142	BACHELI	1841	Gabion boulder Check Dam	GBD - 118	4	18.70152551	81.21940206	20142	0.20
143	BACHELI	1841	Gabion boulder Check Dam	GBD - 119	4	18.70208826	81.21972859	20142	0.20
144	BACHELI	1841	Gabion boulder Check Dam	GBD - 120	5	18.70222372	81.21903405	24304	0.24
145	BACHELI	1841	Gabion boulder Check Dam	GBD - 121	5	18.70396041	81.22016779	24304	0.24
146	BACHELI	1841	Gabion boulder Check Dam	GBD - 122	5	18.70441647	81.21909427	24304	0.24
147	BACHELI	1841	Gabion boulder Check Dam	GBD - 123	5	18.70400836	81.21895273	24304	0.24
148	BACHELI	1841	Gabion boulder Check Dam	GBD - 124	5	18.7026897	81.21848381	24304	0.24
149	BACHELI	1841	Gabion boulder Check Dam	GBD - 125	5	18.70253472	81.21705035	24304	0.24
150	BACHELI	1841	Gabion boulder Check Dam	GBD - 126	5	18.70326172	81.21712067	24304	0.24
151	BACHELI	1841	Gabion boulder Check Dam	GBD - 127	4	18.70565451	81.21604453	20142	0.20
152	BACHELI	1841	Gabion boulder Check Dam	GBD - 128	5	18.70514128	81.21597458	24304	0.24
153	BACHELI	1841	Gabion boulder Check Dam	GBD - 129	5	18.70465371	81.21586087	24304	0.24
154	BACHELI	1841	Gabion boulder Check Dam	GBD - 130	5	18.70420905	81.21567846	24304	0.24
155	BACHELI	1841	Gabion boulder Check Dam	GBD - 131	4	18.70315846	81.21623145	20142	0.20
156	BACHELI	1841	Gabion boulder Check Dam	GBD - 132	5	18.70358124	81.21617602	24304	0.24
		Total SMC						**89229236**	**892.2923**
	Added 2 % for Contingency							**1784585**	**17.84585**
		Grand total						**91013821**	**910.1382**

Annexure 1

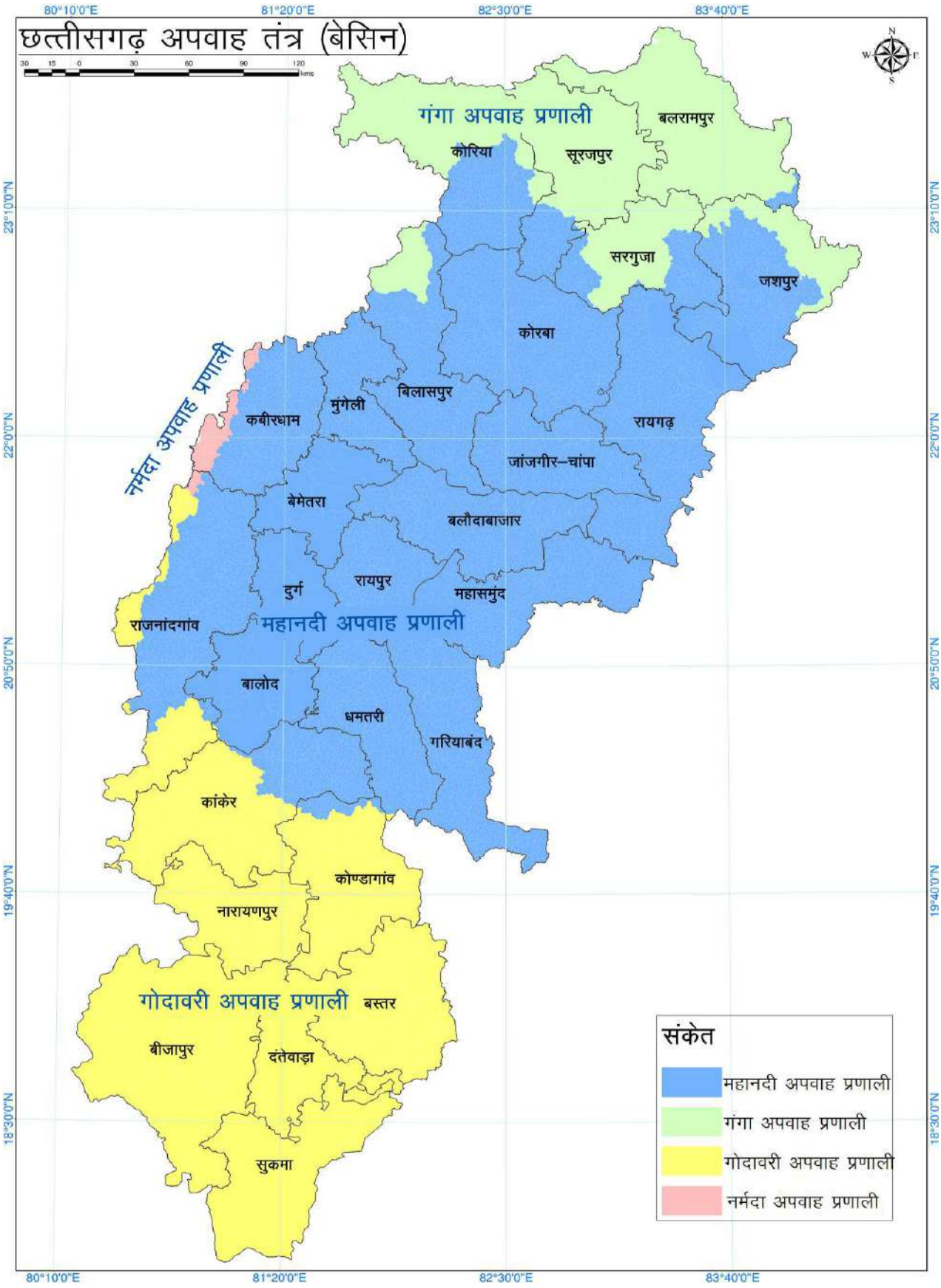
MAP 1. ADMINISTRATIVE MAP OF CHHATTISGARH



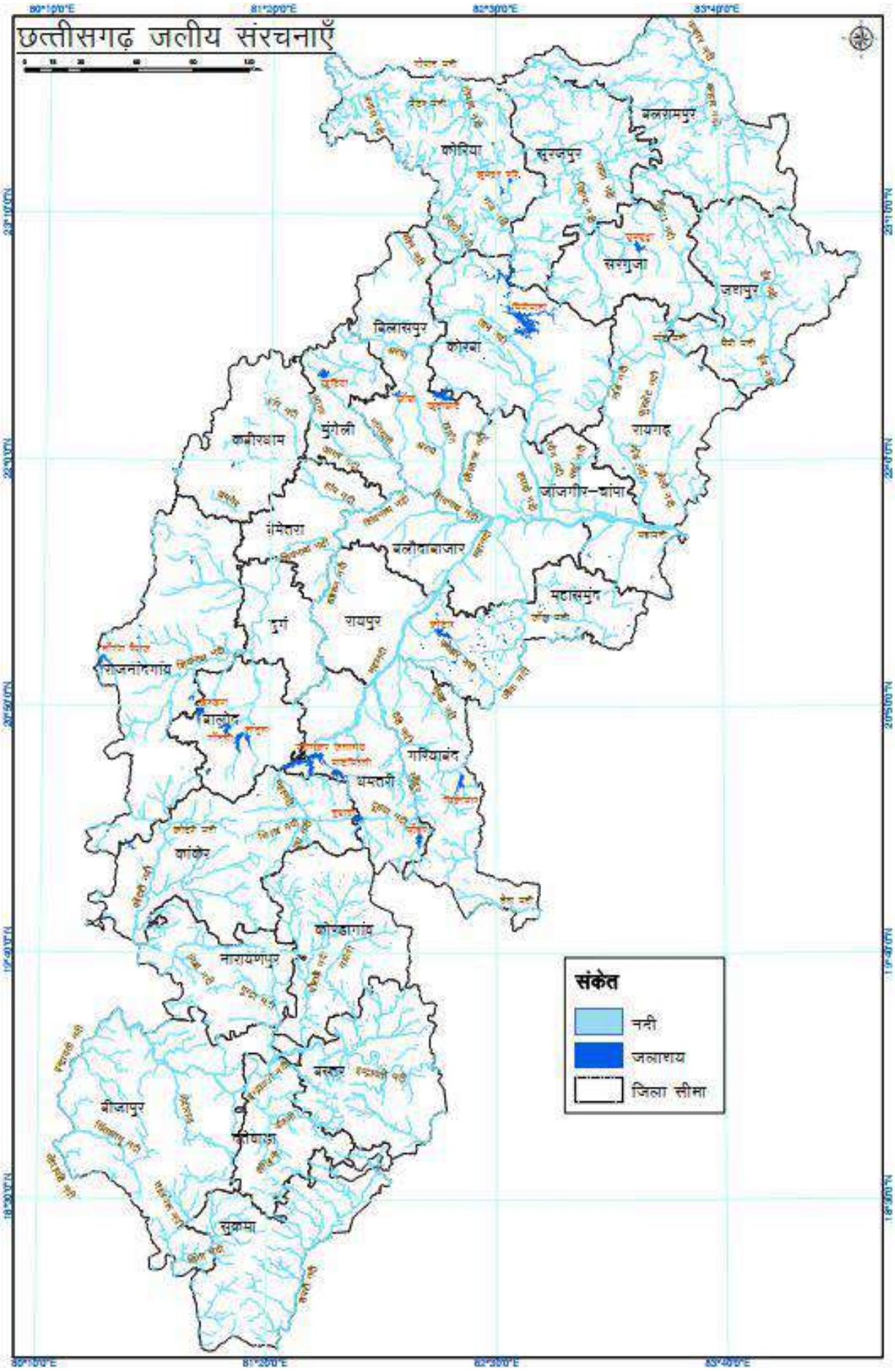
MAP 2. GEOLOGICAL MAP OF CHHATTISGARH

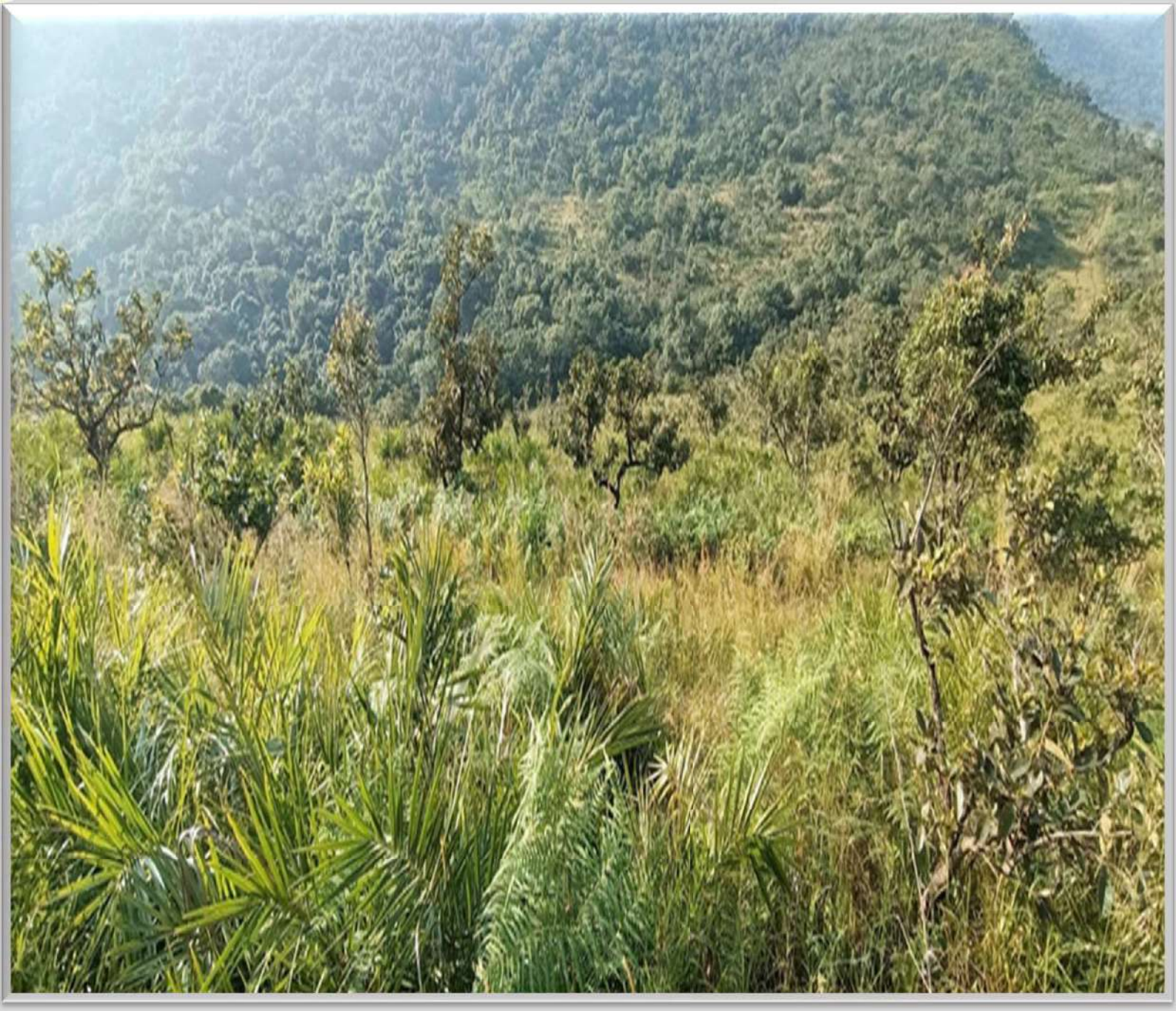


MAP 3. BASIN/TRIBUTARIES SYSTEM OF CHHATTISGARH



MAP 4. WATER STRUCTURES OF CHHATTISGARH





Project by

NMDC-CMDC LIMITED (NCL)