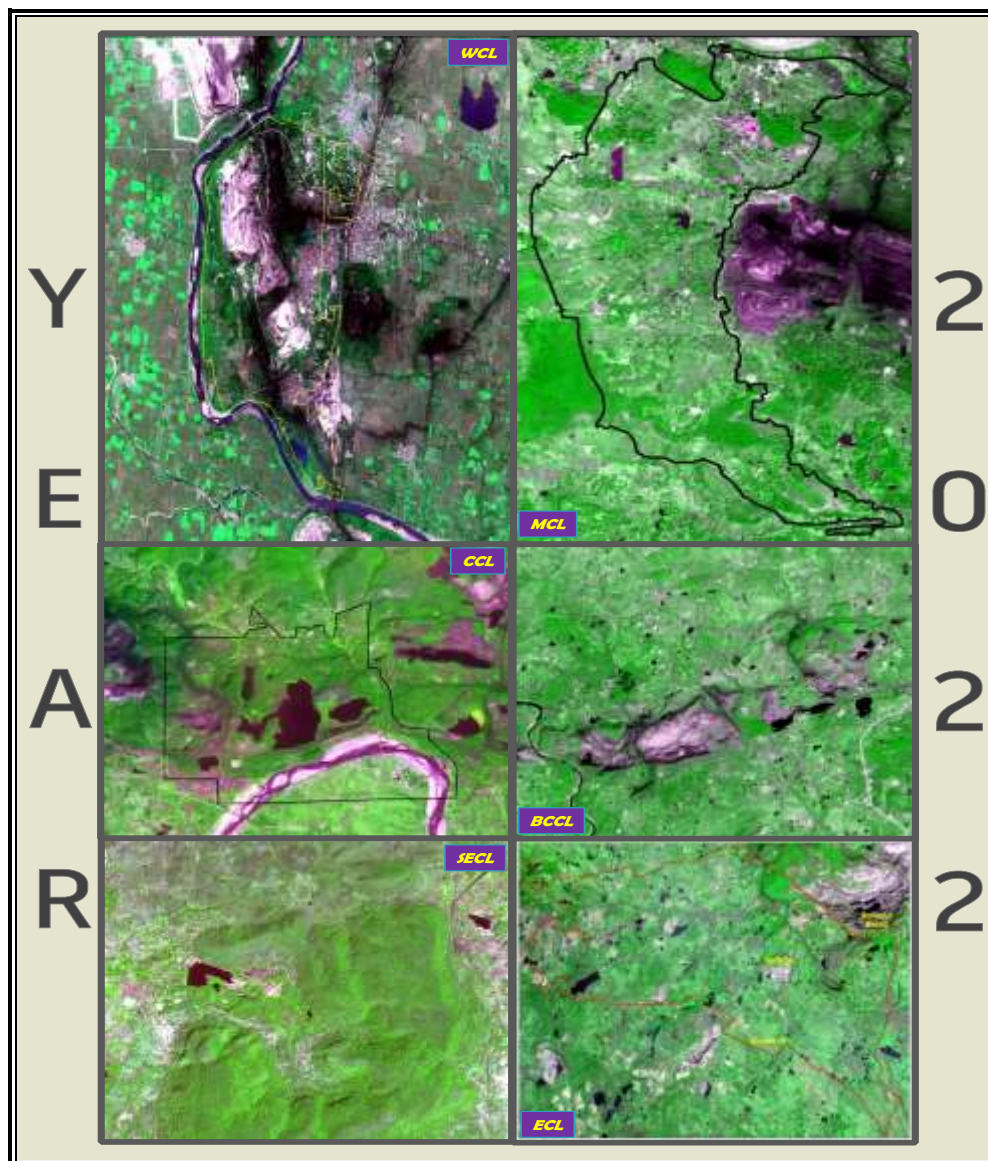


Land Restoration / Reclamation Monitoring of 25 Opencast Projects producing less than 5 million m³ (Coal + OB) per annum & 09 Clusters of Coal Mines based on Satellite Data for the Year 2022



Submitted to
Coal India Limited



**Land Restoration / Reclamation Monitoring of 25 Opencast Projects
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Coal Mines based on Satellite Data for the Year 2022**

March- 2023



**Remote Sensing Cell
Geomatics Division
CMPDI, Ranchi**

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Executive Summary

- 1.0 Project** Monitoring of Land restoration / reclamation of 25 opencast projects producing less than 5 mcm (coal +OB) & 09 clusters of coal mines in different subsidiaries of Coal India Ltd (CIL) based on satellite data regularly at an interval of three years.
- 2.0 Objective** Objective of the land restoration / reclamation monitoring is to assess the area of backfilled, plantation, social forestry, active mining area, water bodies, and distribution of wasteland, agricultural land and forest in the leasehold area of the project. This will help in assessing the progressive status of mined land reclamation and to take up remedial measures, if any, required for environmental protection.
- 3.0 Salient Findings** Out of the total mine leasehold area of 52087.61 hectares of the 25 Opencast projects producing less than 5 m.cm (coal +OB) & 09 clusters taken together in different subsidiaries of CIL considered for monitoring during 2022-23; total excavated area is only 5478.15 hectares out of which 872.21 hectares (15.92%) has been planted (*Biologically Reclaimed*), 2610.57 hectares area (47.65%) is under backfilling(*Technically Reclamation*) and balance 1995.37 hectares (36.42%) is under active mining. It is evident from the analysis that 3482.78 hectares (63.58%) area of the 25 OC projects and 09 clusters taken together for study in the year 2022-23 under different subsidiaries of CIL is under reclamation and balance 1995.37 hectares (36.42%) area is under active mining. Subsidiary wise details are given in Table-1& Fig-1.
- The projects selected for land reclamation monitoring in the year 2022-23 are subdivided into two groups viz- Group (A) includes 25 opencast projects belonging to WCL, SECL, CCL & MCL. Group (B) includes 09 cluster of mines of BCCL and ECL respectively.
- For Group A, out of total mine leasehold area of 13869.37 hectare of the 25 OC projects considered for land reclamation monitoring during 2022-23: Total excavated area is 2645.51 hectares out of which 558.01 hectares (21.09%) has been planted (*Biologically Reclaimed*), 1035.42 hectares (39.14%) is under backfilling (Technical Reclamation) and balance 1052.08 hectares (39.77%) is

under active mining .Subsidiary wise detail of land reclamation of the above 25 projects is given in Table-1(A) & Fig (1).

- The similar set of mines was monitored in the year 2019-20. On comparing the status of land reclamation monitoring based on satellite data for 25 nos. of opencast projects in WCL, SECL, CCL & MCL carried out in year 2022-23 with respect to previous cycle study done in the year 2019-2020, it is evident from the analysis that area under land reclamation has increased from 1290.02 hectares (57.31%) in Yr. 2019-20 to 1593.43 hectares (60.23%) in the Yr. 2022-23. This includes both plantation (Biological Reclamation) and areas under backfilling (Technical Reclamation). This increase of 303.41 hectares area of land reclamation in a period of three years is the result of the efforts made by CIL's subsidiary companies towards land reclamation.
- It has been observed that in all opencast projects of WCL, SECL, CCL and MCL taken for monitoring of land reclamation in 2022-23: technical and biological reclamation has increased or remained static in the leasehold areas of selected opencast projects in the year 2022-23 as compared to the year 2019-20.
- For Group B, out of the total mine leasehold of 38218.24 hectare for total 09 cluster of mines; 05 clusters in BCCL and 04 clusters in ECL respectively considered for monitoring during the year 2022-23 consisting of mostly underground and few opencast mines; total excavated area is 2832.64 hectare ,out of which 314.20 hectare (11.09%) has been planted on backfill (Biologically Reclaimed), 1575.15 hectare (55.61%) area is under backfilling (Technical Reclamation) and balance 943.29 hectare (33.30%) area is under active mining. It is evident from Table-1(B) that 1889.35 hectare (66.70%) area is under reclamation and balance 943.29 hectare (33.03%) area is under active mining.
- It is evident from analysis that for 09 clusters of mines belonging to BCCL and ECL, taken for land reclamation monitoring based on satellite data, total area under plantation (Green cover) is 2230.34 hectare (5.84%).
- It has also been observed from Table-1(B) that Biological Reclamation for 09 clusters of mines in BCCL and ECL is 314.20 hectares (11.09%) in the year 2022-23.

TABLE-1
SUBSIDIARY WISE LAND RECLAMATION STATUS IN 25 OC PROJECTS AND 09 CLUSTERS OF MINES BASED ON
SATELLITE DATA OF YEAR 2022
(Projects producing less than 5 million cu.m. Coal +OB)

Sl. No.	Coal Company (No. of OC Projects and Cluster of mines)			Area in Hectare (% calculated in respect of total excavated area)																			
				Leasehold Boundary	Technical Reclamation		Plantation						Area under Active Mining	Total Excavated Area	Total Area under Plantation (% Green Cover generated in Leasehold)		Total Area under Reclamation						
							Biological Reclamation		Other Plantation														
					Area under Backfilling	Area under Plantation on backfill		Plantation on External OB Dumps		Social Forestry, Avenue Plantation etc.													
1	2			3		4		5		6		7		8		9 (=4+5+8)		10 (=5+6+7)		11 (=4+5)			
	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022			
(A)	PROJECT WISE (OC)																						
1	WCL (08)	WCL (08)	3461.72	3461.72	422.14 50.77%	462.47 47.96%	88.96 10.70%	103.38 10.72%	345.42	357.09	215.53	275.85	320.37 38.53%	398.34 41.31%	831.47	964.19	649.91 18.77%	736.32 21.27%	511.10 61.47%	565.85 58.69%			
2			SECL (04)	2439.61	2439.61	173.71 47.74%	169.77 46.10%	116.51 32.02%	154.47 41.95%	1.45	5.29	93.70	93.70	73.61 20.23%	43.99 0.00%	363.83	368.23	211.66 8.68%	253.46 10.39%	290.22 79.77%	324.24 88.05%		
3				MCL (01)	1141.43	1141.43	0.00 0.00%	0.00 0.00%	0.00 0.00%	0.00 0.00%	0.00	0.00	0.00	0.00	0.00 0.00%	0.00 0.00%	0.00	0.00	0.00 0.00%	0.00 0.00%	0.00 0.00%	0.00 0.00%	
4					CCL (12)	6733.48	6826.61	310.20 29.38%	403.18 30.70%	178.50 16.91%	300.16 22.86%	402.92	308.61	308.23	335.02	567.03 53.71%	609.75 46.44%	1055.73	1313.09	889.65 13.21%	943.79 13.83%	488.70 46.29%	703.34 53.56%
TOTAL (A) (25)		TOTAL (A) (25)				13776.24	13869.37	906.05 40.25%	1035.42 39.14%	383.97 17.06%	558.01 21.09%	749.79	670.99	617.46	704.57	961.01 42.69%	1052.08 39.77%	2251.03	2645.51	1751.22 12.71%	1933.57 13.94%	1290.02 57.31%	1593.43 60.23%
(B)		CLUSTERS WISE																					
1	BCCL (04)	BCCL (05)	6519.02	8140.24		624.23 61.83%	621.40 60.28%	111.78 11.07%	115.10 11.17%	62.48	70.30	306.55	360.84	273.50 27.09%	294.35 28.55%	1009.51	1030.85	480.81 7.38%	546.24 6.71%	736.01 72.91%	736.50 71.45%		
2			ECL (04)	30078.00	30078.00	786.00 50.00%	953.75 52.93%	186.00 11.83%	199.10 11.05%	100.00	181.20	1260.00	1303.80	600.00 38.17%	648.94 36.02%	1572.00	1801.79	1546.00 5.14%	1684.10 5.60%	972.00 61.83%	1152.85 63.98%		
TOTAL (B) (08)		TOTAL (B) (09)		36597.02	38218.24	1410.23 54.63%	1575.15 55.61%	297.78 11.54%	314.20 11.09%	162.48	251.50	1566.55	1664.64	873.50 33.84%	943.29 33.30%	2581.51	2832.64	2026.81 5.54%	2230.34 5.84%	1708.01 66.16%	1889.35 66.70%		
TOTAL CIL (A+B) (33) Less than 5 MCM		TOTAL CIL (A+B) (34) Less than 5 MCM		50373.26	52087.61	2316.28 47.93%	2610.57 47.65%	681.75 12.29%	872.21 15.92%	912.27	922.49	2184.01	2369.21	1834.51 37.96%	1995.37 36.42%	4832.54	5478.15	3778.03 7.50%	4163.91 7.99%	2998.03 62.04%	3482.78 63.58%		

Note: In reference of the above Table, different parameters are classified as follows:

1. Area under **Biological Reclamation** includes Areas under Plantation done on Backfilled Area Only.
2. Area under **Technical Reclamation** includes Area under Barren Backfilling only
3. Area under Active Mining Includes Coal Quarry, Advance Quarry Site, Quarry filled with water etc., if any.
4. Social Forestry and Plantation on External OB Dumps are not included in Biological Reclamation and are put under separate categories as shown in the Table above.
5. (%) calculated in the above Table is in respect to Total Excavated Area except for "Total Area under Plantation" where % is in terms of "Leasehold Area".

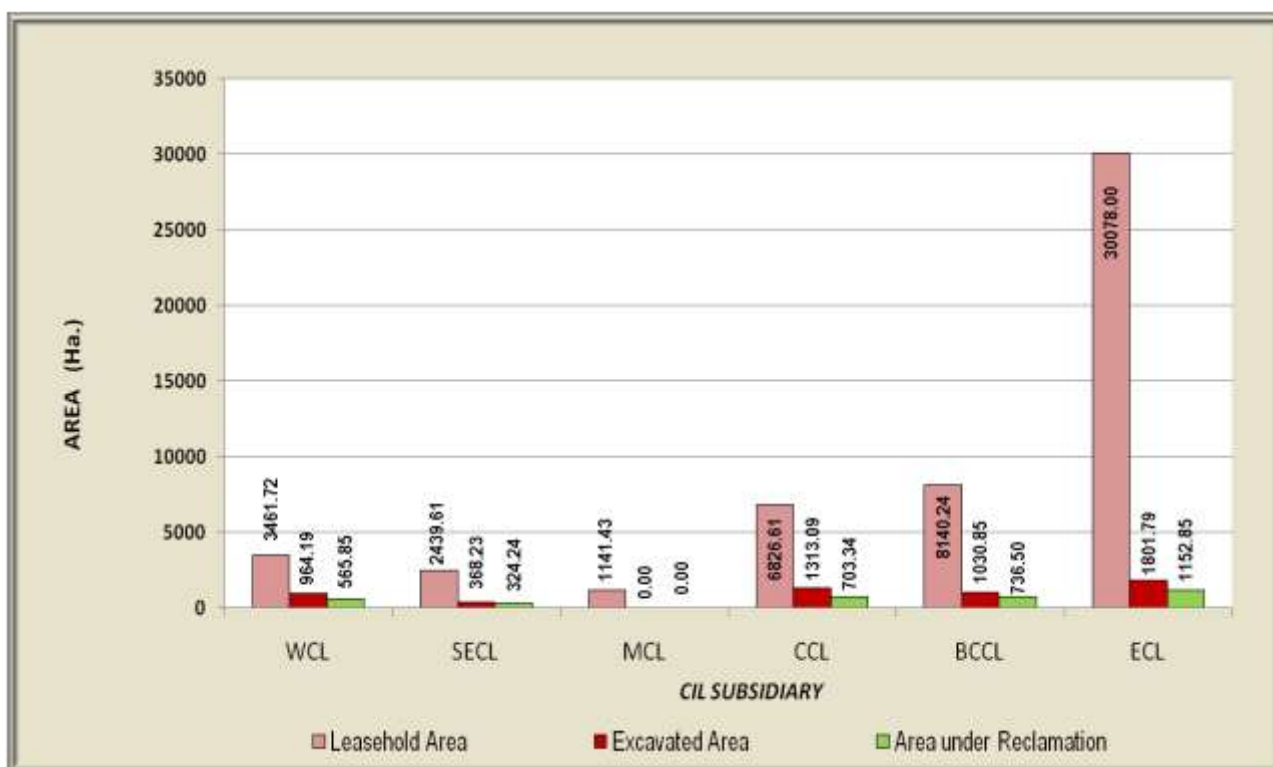


Figure 1: Land Reclamation Status in Opencast and Cluster of mines for the year 2022

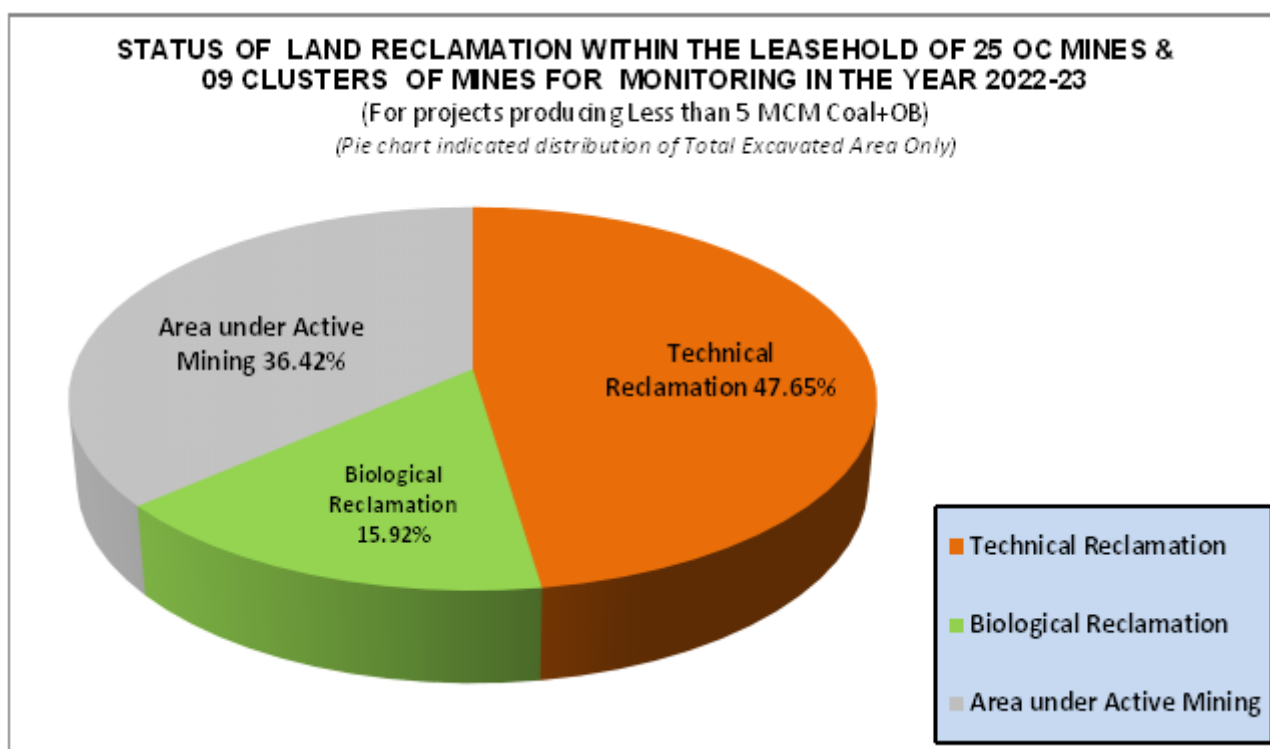


Figure 2: Chart indicating Land Reclamation Status in the year 2022

Background

- 1.1** Land is the most important natural resource which embodies soil, water, flora, fauna and total ecosystem. All human activities are based on the land which is the scarcest natural resource in our country. Mining is a site specific industry and it could not be shifted anywhere else from the location where mineral occurs. It is a fact that surface mining activities do effect the land environment due to ground breaking. Therefore, there is an urgent need to reclaim and restore the mined out land for its productive use for sustainable development of mining. This will not only mitigate environmental degradation, but would also help in creating a more congenial environment for land acquisition by coal companies in future.
- 1.2** Keeping above in view, Coal India Ltd. (CIL) issued a work order vide letter no. CIL/WBP/Env/2009/2428 dated 29.12.2009 to Central Mine Planning & Design Institute (CMPDI), Ranchi, for monitoring land reclamation status of all the opencast coal mines having production of more than 5 million m³ per annum (coal + OB taken together per annum) based on remote sensing satellite data, regularly on annual basis for sustainable development of mining. Further, a revised work order was issued vide letter no. CIL/WBP/Env/2011/4706 dated 12.10.2012 from Coal India Limited for the period 2012-13 to 2016-17 which was subsequently followed by another work order vide letter no. CIL/WBP/Env/2017/DP/8477 dated 21.09.2017 from Coal India Limited for the period 2017-18 to 2021-22 for land reclamation monitoring of opencast projects and vegetation cover monitoring of 19 major coalfields. According to this work order, all mines in CIL with output capacity of 5 million cu. m (coal +OB) shall be monitored every year and all mines below this capacity shall be monitored at an interval of 3 years. All coalfields in CIL shall also be monitored at an interval of 3 years as per a defined plan. Further, a revised work order was issued vide letter no. CIL/ENV/2022-23/W.O/10899 dated 06.07.2022 from Coal India Limited for the period 2022-23 to 2023-24. According to this work order, 76 OC projects

having more than 5 million cu. m (coal +OB) per annum capacity shall be monitored every year and also land reclamation monitoring of 33 OCPs having less than 5 million cu. m. (coal +OB) per annum capacity, totaling 109 OC mines and vegetation cover mapping of 06 coalfields for 2022-23 & totaling 123 (76+47) OC mines and vegetation cover mapping of 07 coalfields for 2023-24, covering all the subsidiaries of Coal India Ltd. The result of land reclamation status of all such mines to be put on the website of CIL, (www.coalindia.in), CMPDI (www.cmpdi.co.in) and the concerned coal companies in public domain. Detail report to be submitted to Coal India and respective subsidiaries.

- 1.3** Land reclamation monitoring of all opencast coal mining projects would also comply the statutory requirements of Ministry of Environment & Forest (MoEF). Such monitoring would not only facilitate in taking timely mitigation measures against environmental degradation, but would also enable coal companies to utilize the reclaimed land for larger socio-economic benefits in a planned way.
- 1.4** CMPDI undertook the above study and the present report is embodying the findings in nutshell carrying out for the 25 opencast projects and 09 clusters of different subsidiaries producing less than 5 million cubic m. coal + OB in the year 2022-23 for baseline data generation / updation of these projects so that progressive changes in the status of land reclamation could be assessed in future.

2.0 Objective

Objective of the land reclamation/restoration monitoring is to assess the area of backfilled, plantation, OB dumps, social forestry, active mining area, settlements and water bodies, distribution of wasteland, agricultural land and forest land in the leasehold area of the project. This is an important step taken up for assessing the progressive status of mined land reclamation and for taking up remedial measures, if any, required for environmental protection.

3.0 Methodology

There are number of steps involved between raw satellite data procurement and preparation of final map. National Remote Sensing Centre (NRSC) Hyderabad, being the nodal agency for satellite data supply in India, provides only raw digital satellite data, which needs further digital image processing for extracting the information and map preparation before uploading the same in the website. Methodology for land reclamation monitoring is given in fig 3. Following steps are involved in land reclamation /restoration monitoring:

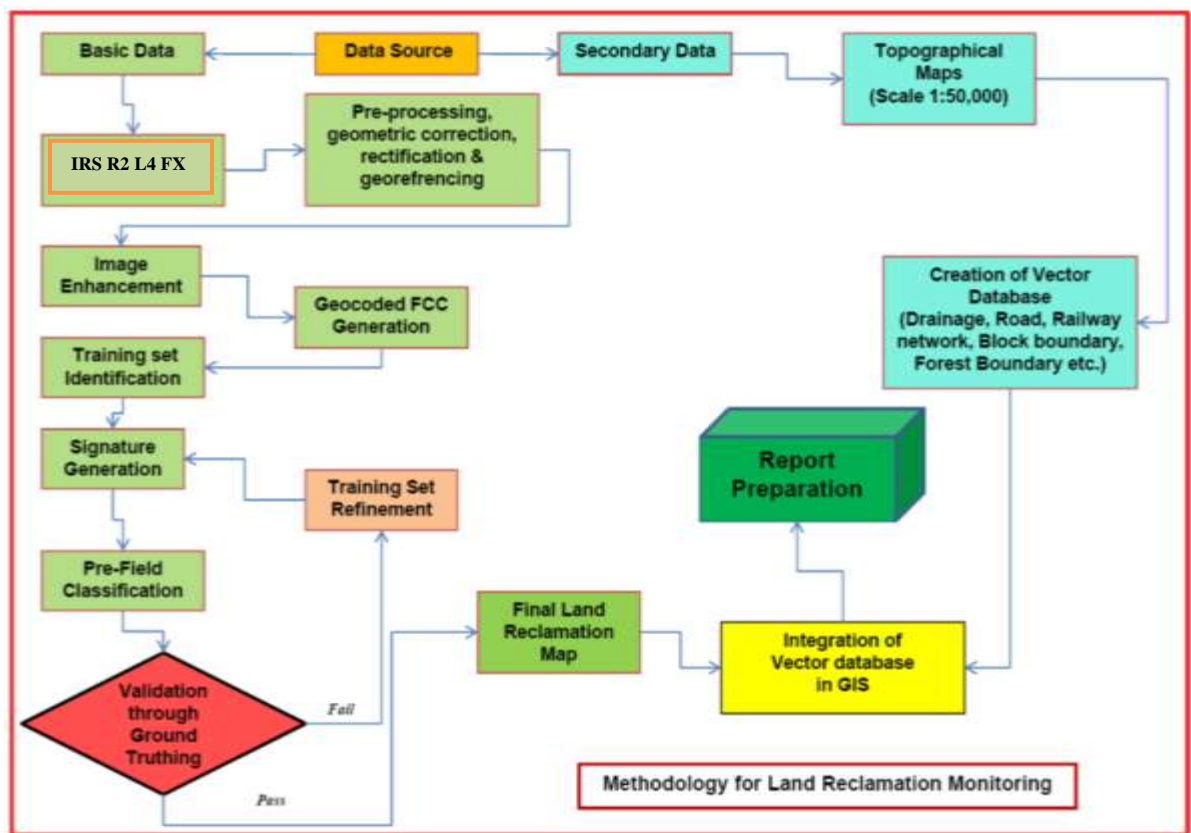


Figure 3: Methodology for Land Reclamation Monitoring

3.1 Data Procurement: After browsing the data quality and date of pass on internet, supply order for data is placed to NRSC. Secondary data like leasehold boundary, topo-sheets are procured for creation of vector database.

3.2 Satellite Data Processing: Satellite data are processed using ERDAS IMAGINE v 2022 s/w / PCI Geomatica v 10.1 s/w digital image processing s/w. Methodology involves the following major steps:

- **Rectification & Geo-referencing:** Inaccuracies in digital imagery may occur due to 'systematic errors' attributed to earth curvature and rotation as well as 'non-systematic errors' attributed to satellite receiving station itself. Raw digital images contain geometric distortions, which make them unusable as maps. Therefore, geo-referencing is required for correction of image data using ground control points (GCP) to make it compatible to Sol toposheet.
- **Image enhancement:**

To improve the interpretability of the raw data, image enhancement is necessary. Local operations modify the value of each pixel based on brightness value of neighbouring pixels using ERDAS IMAGINE v 2022 s/w / PCI Geomatica s/w and enhance the image quality for interpretation.
- **Training set selection**

Training set requires to be selected, so that software can classify the image data accurately. The image data are analysed based on the interpretation keys. These keys are evolved from certain fundamental image-elements such as tone/colour, size, shape, texture, pattern, location, association and shadow. Based on the image-elements and other geo-technical elements like land form, drainage pattern and physiography; training sets were selected/identified for each land use/cover class. Field survey was carried out by taking selective traverses in order to collect the ground information (or reference data) so that training sets are selected accurately in the image. This was intended to serve as an aid for classification.

- **Classification and Accuracy assessment**

Image classification is carried out using the maximum likelihood algorithm. The classification proceeds through the following steps: (a) calculation of statistics [i.e. signature generation] for the identified training areas, and (b) the decision boundary of maximum probability based on the mean vector, variance, covariance and correlation matrix of the pixels. After evaluating the statistical parameters of the training sets, reliability test of training sets is conducted by measuring the statistical separation between the classes that resulted from computing divergence matrix. The overall accuracy of the classification was finally assessed with reference to ground truth data.

- **Area calculation**

The area of each land use class in the leasehold is determined using ERDAS IMAGINE v2022 s/w.

- **Overlay of Vector data base**

Vector data base created based on secondary data. Vector layer like drainage, railway line, leasehold boundary, forest boundary etc. are superimposed on the image as vector layer in the Arc GIS database.

- **Pre-field map preparation**

Pre-field map is prepared for validation of the classification result.

3.3 Ground Truthing:

Selective ground verification of the land use classes was carried out in the field and necessary corrections if required, are incorporated before map finalization.

3.4 Land reclamation database on GIS:

Land reclamation database is created on GIS platform to identify the temporal changes identified from satellite data of different cut-off dates.

4.0 Work Plan

- 4.1** Total 25 opencast projects subsidiaries producing less than 5 million cubic m (Coal +OB) and 09 clusters of different subsidiaries were taken up for the study during the year 2022 -23. Based on the RESOURCESAT-2 satellite data, land reclamation /mine closure monitoring was carried out using ERDAS IMAGINE digital image processing s/w and Arc-Info GIS.
- 4.2** The list of 25 opencast project producing less than 5 mcm (Coal and OB together) annually of different CIL subsidiaries and 09 clusters of BCCL & ECL taken up for Land Reclamation monitoring based on satellite data of year 2022 is given in table below:

Subsidiary (No. of Projects)	Opencast Projects (For Less than 5 million cu.m. Coal +OB per annum category mines)
WCL (08)	Gokul, Singhori, Bhanegaon, Makardhokra-II, New Sethia, Ghugus, Pimpalgaon and Datla OCPs.
SECL (04)	Kotma, Mahan, Amgaon and West Chirimiri.
CCL (12)	Ara, Bhurkunda, Pichri, Pindra, Sirka, Dhori, Bokaro, Kargali, Rajhara, Religera, Sarubera and Kedla.
BCCL (05)	Cluster-II, Cluster-VI, Cluster –XIV, Cluster–XV and Cluster-XVI.
ECL (04)	Cluster-IX, Cluster-X, Cluster –XI and Cluster –XII.
MCL (01)	Gopalji OC.
TOTAL (34)	

Subsidiary wise land reclamation status of the above mentioned 25 OC projects and 09 clusters of BCCL & ECL derived from satellite data for the year 2022 are given in the following pages:

WESTERN COALFIELDS LIMITED

5.0 Land Reclamation Status in Western Coalfields Ltd.

5.1 Following 8 OC Projects of WCL producing less than 5 million m³ (Coal +OB) annually were taken up for Land Reclamation monitoring based on satellite data of the year 2022.

- Bhanegaon
- Singhori
- Makardhokra-II
- New Sethia
- Ghugus
- Pimpalgaon
- Datla
- Gokul

5.2 Area statistics of different land use class present in the mine leasehold of the above projects for the year 2022 are shown in the Table-2. Land use maps derived from satellite data are shown in Plate 1-8. Status of land reclamation monitoring for the above mentioned 08 opencast projects were also prepared for the year 2016, 2019. Year wise changes in the different land use classes based on satellite data of the year 2016, 2019 and 2022 are depicted in Bar Charts in Figure 3-10

5.3 Study reveals that out of total mine leasehold area of 3461.72 Ha of 08 OC projects in WCL Viz Bhanegaon, Singhori, Makardhokra-II ,New Sethia ,Ghugus, Pimpalgaon, Datla and Gokul OC considered for monitoring during year 2022-23 ; total excavated area is 964.19 Ha (27.85%),out of which 103.38 Ha (10.72%) area has been revegetated (Biologically reclaimed) and 462.47 Ha (47.96%) area is under backfilling (Technically reclaimed) and balance 398.34 Hectare (41.32%) area is under active mining. It is evident from analysis that 565.85 Hectare (58.69%) area of above OC projects is under total reclamation in WCL. Project wise details are given in Table-1.

- 5.4** It is evident from analysis that area under land reclamation has increased from 511.10 Ha (Yr.2019) to 565.85 Ha (Yr.2022) which includes both plantation on backfill (Biological Reclamation) and area under backfilling (Technical Reclamation). This increase of 54.75Ha area under total reclamation for 08 opencast mine of WCL in the period of three years is due to increase in area under Technical reclamation and Biological Reclamation to the tune of 40.33 Ha and 14.42 Ha respectively. Project wise status of Land reclamation for 08 OC mines area is shown in bar chart (Figure-1).
- 5.5** There has been overall increase in area under Technical reclamation (area under backfilling) in all projects of WCL except in Bhanegaon, Ghugus and Datla OC where area under technical reclamation has decreased from 2.46 Ha (Yr.2019) to 1.18 Ha(Yr.2022).This decrease of 1.28 Ha area under backfilling in Bhanegaon OC during year 2022 as compared to the year 2019 is due to rehandling of backfill whereas decrease of 8.96 Ha and 2.89 Ha area under backfilling in Ghugus OC and Datla OC are due to more backfilling area occupied with plantation over backfill area.
- 5.6** After analyzing the satellite data of year 2019 vs. 2022, it is evident that total area under plantation (Green Cover) carried out on backfilled area, OB dumps as well as area under social forestry in all the mines of WCL has increased from 649.91 Ha area (Yr.2019) to 736.35 Ha area (Yr.2022). This increase of 86.44 Hectare area under total plantation (Green Cover) during three years is due to more plantation has been carried out on backfill, OB dump and under social forestry within leasehold area of the mines.
- 5.7** MKD-II OC mine has been closed and backfilling process is in progress, hence active mining is zero whereas area under backfilling (Technical Reclamation) has increased from 44.61 Hectare in the year 2019 to 57.75 Hectare in the year 2022.

- 5.8** In Datla OC, mine area under backfilling (Technical Reclamation) has decreased from 28.21 Ha in the year 2019 to 25.32 Ha in the year 2022. This decrease of 2.89 Ha in area under backfilling is due to more plantation carried out in backfill area resulting which area of plantation on backfill (Biological Reclamation) has increased from 7.10 Ha in the year 2019 to 11.24 Ha in the year 2022.
- 5.9** Out of 08 projects of WCL ,maximum land reclamation has been carried out in MKD-II OC projects (100%) followed by Ghugus (92.51%), Datla OC (75.37%), New Sethia (54.34%) and Gokul (29.76%) respectively.

Table 5.1: Project wise Land Reclamation Status in Opencast Projects of WCL based on the Satellite data of the year 2022

(Area in Ha)

Sl.No	Project	Total Leasehold Area		Technical Reclamation		Plantation						Area under Active Mining		Total Excavated Area		Total Area under Plantation (% Green Cover Generated in Leasehold)		Total Area under Reclamation	
						Biological Reclamation		Other Plantations											
				Area under Backfilling		Plantation on Excavated / Backfilled Area		Plantation on External Over Burden Dumps		Social Forestry, Awanue Plantation Etc.									
1	2	3		4		5		6		7		8		9 (=4+5+8)		10 (=5+6+7)		11(=4+5)	
		2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022
1	Bhanegaon	347.46	347.46	2.45	1.18	0.00	0.00	8.75	16.54	16.11	20.74	31.82	34.86	34.27	36.04	24.86	37.28	2.45	1.18
				7.15%	3.27%	0.00%	0.00%					92.85%	96.73%			7.15%	10.73%	7.15%	3.27%
2	Singhori	425.04	425.04	0.00	0.00	0.00	0.00	0.00	0.00	4.59	7.63	26.82	50.56	26.82	50.56	4.59	7.63	0.00	0.00
				0.00%	0.00%	0.00%	0.00%					100.00%	100.00%			1.08%	1.80%	0.00%	0.00%
3	Makardhokra-II	258.23	258.23	44.61	57.75	2.90	0.00	58.76	47.14	2.57	2.57	6.91	0.00	54.42	57.75	64.23	49.71	47.51	57.75
				81.97%	100.00%	5.33%	0.00%					12.70%	0.00%			24.87%	19.25%	87.30%	100.00%
4	New Sethia	144.45	144.45	25.99	30.65	23.58	18.92	6.80	7.01	9.53	10.15	40.81	41.65	90.38	91.22	39.91	36.08	49.57	49.57
				28.76%	33.60%	26.09%	20.74%					45.15%	45.66%			27.63%	24.98%	54.85%	54.34%
5	Ghugus	1020.00	1020.00	267.70	258.74	55.38	73.22	135.00	136.64	84.91	125.20	35.77	26.89	358.85	358.85	275.29	335.06	323.08	331.96
				74.60%	72.10%	15.43%	20.40%					9.97%	7.49%			26.99%	32.85%	90.03%	92.51%
6	Pimpalgaon	451.87	451.87	13.33	13.34	0.00	0.00	136.11	149.76	80.32	79.62	46.25	54.23	59.58	67.57	216.43	229.38	13.33	13.34
				22.37%	19.74%	0.00%	0.00%					77.63%	80.26%			47.90%	50.76%	22.37%	19.74%
7	Datla	57.75	57.75	28.21	25.32	7.10	11.24	0.00	0.00	0.00	0.00	13.21	11.95	48.52	48.51	7.10	11.24	35.31	36.56
				58.14%	52.20%	14.63%	23.17%					27.23%	24.63%			12.29%	19.46%	72.77%	75.37%
8	Gokul	756.92	756.92	39.85	75.49	0.00	0.00	0.00	0.00	17.50	29.97	118.78	178.20	158.63	253.69	17.50	29.97	39.85	75.49
				25.12%	29.76%	0.00%	0.00%					74.88%	70.24%			2.31%	3.96%	25.12%	29.76%
	TOTAL	3461.72	3461.72	422.14	462.47	88.96	103.38	345.42	357.09	215.53	275.88	313.46	398.34	831.47	964.19	649.91	736.35	511.10	565.85
				50.77%	47.96%	10.70%	10.72%					37.70%	41.32%	24.02%	27.85%	18.77%	21.27%	61.47%	58.69%

(% is calculated with respected to Excavated Area as applicable)

Note : In reference of the above Table-1, different parameters are classified as follows

- 1.Area under Biological Reclamation includes area under plantation done on backfilled area only.
- 2.Area under Technical Reclamation includes areas under barren backfill only.
- 3.Area under Active Mining includes coal quarry, advance quarry & quarry filled with water etc.
- 4.Social forestry and plantation on external OB dump are not included in biological reclamation and are put under other plantation.
- 5.% claculated in respect to total excavated area except for "Total area under plantation" where % has been calculated in terms of leasehold area.

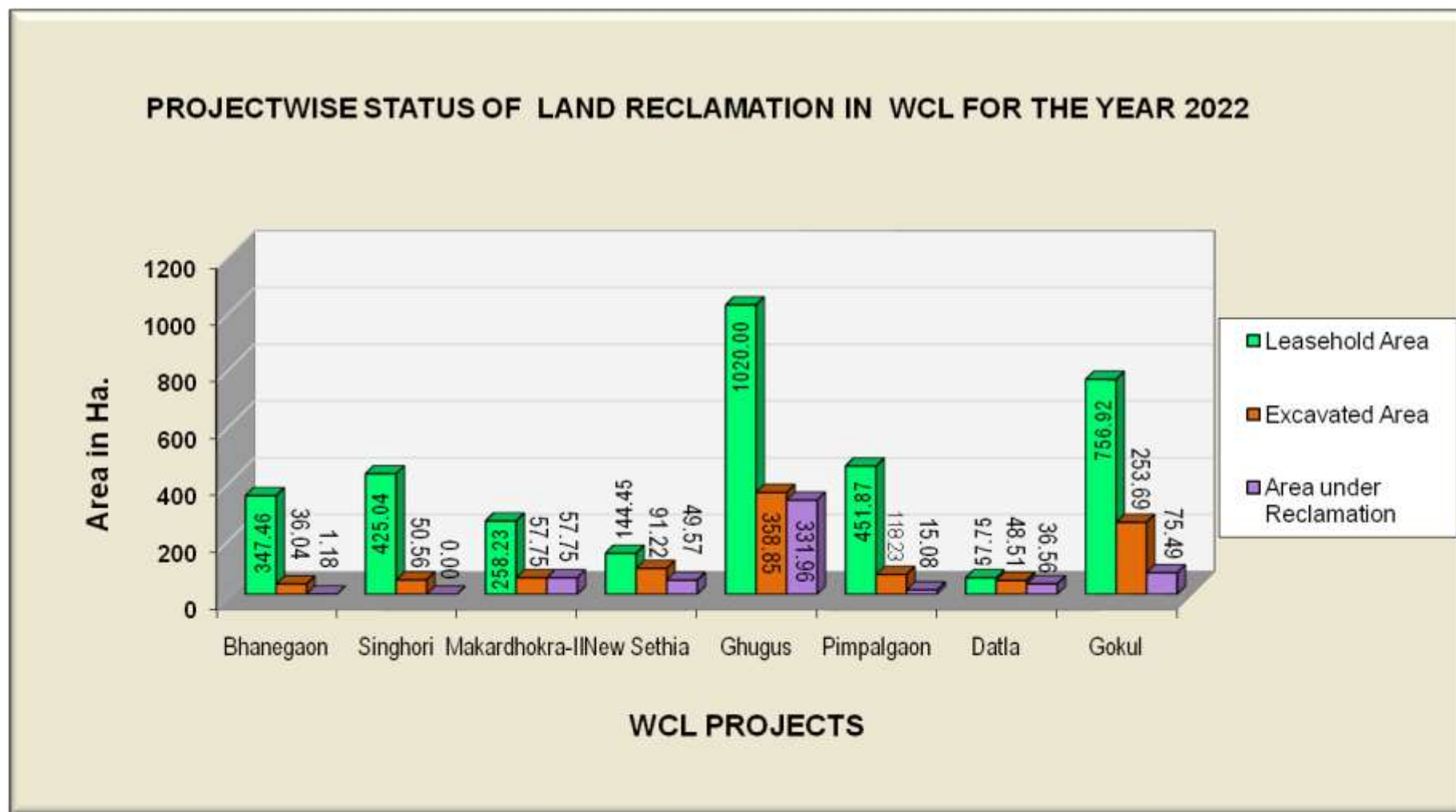




















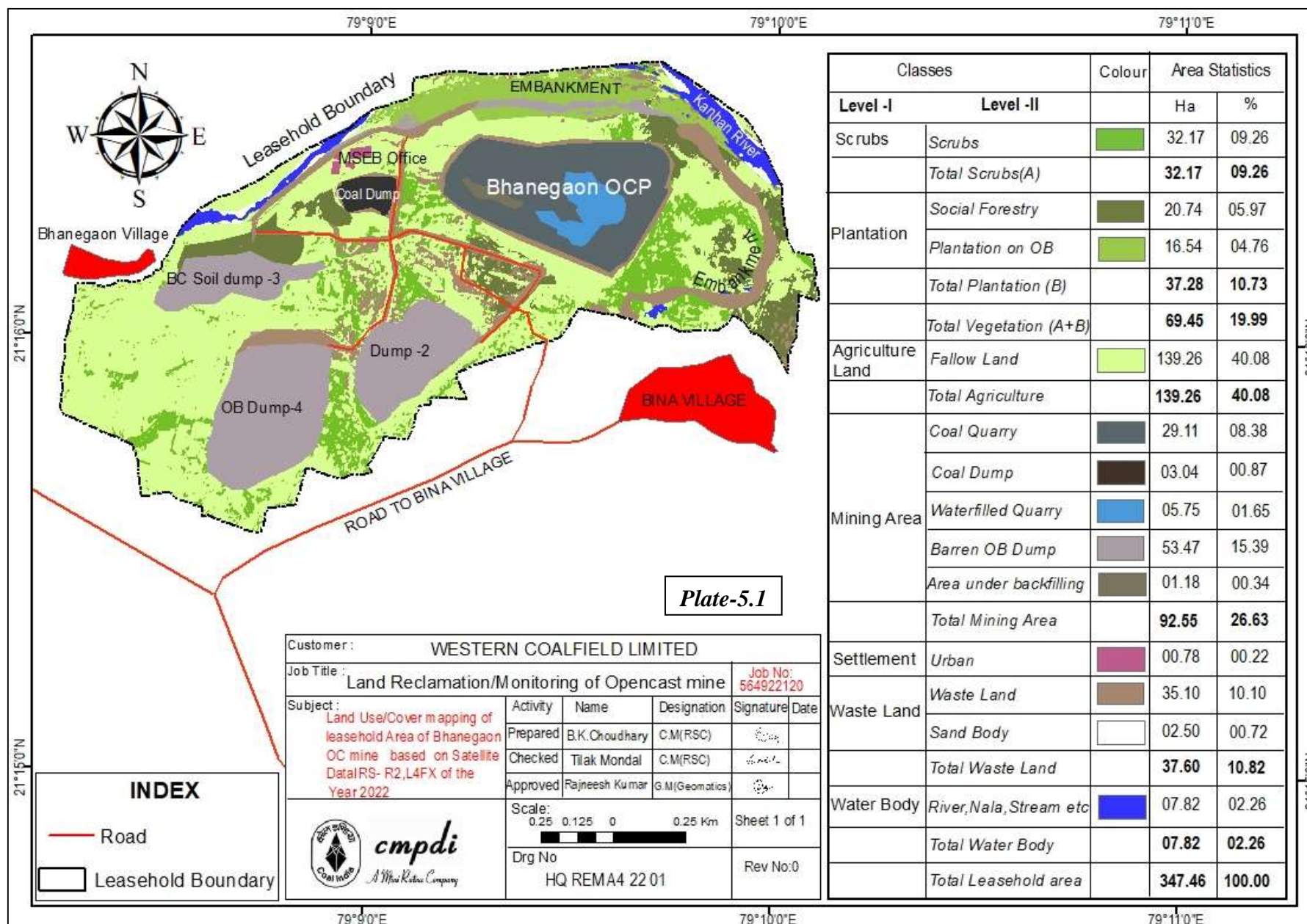


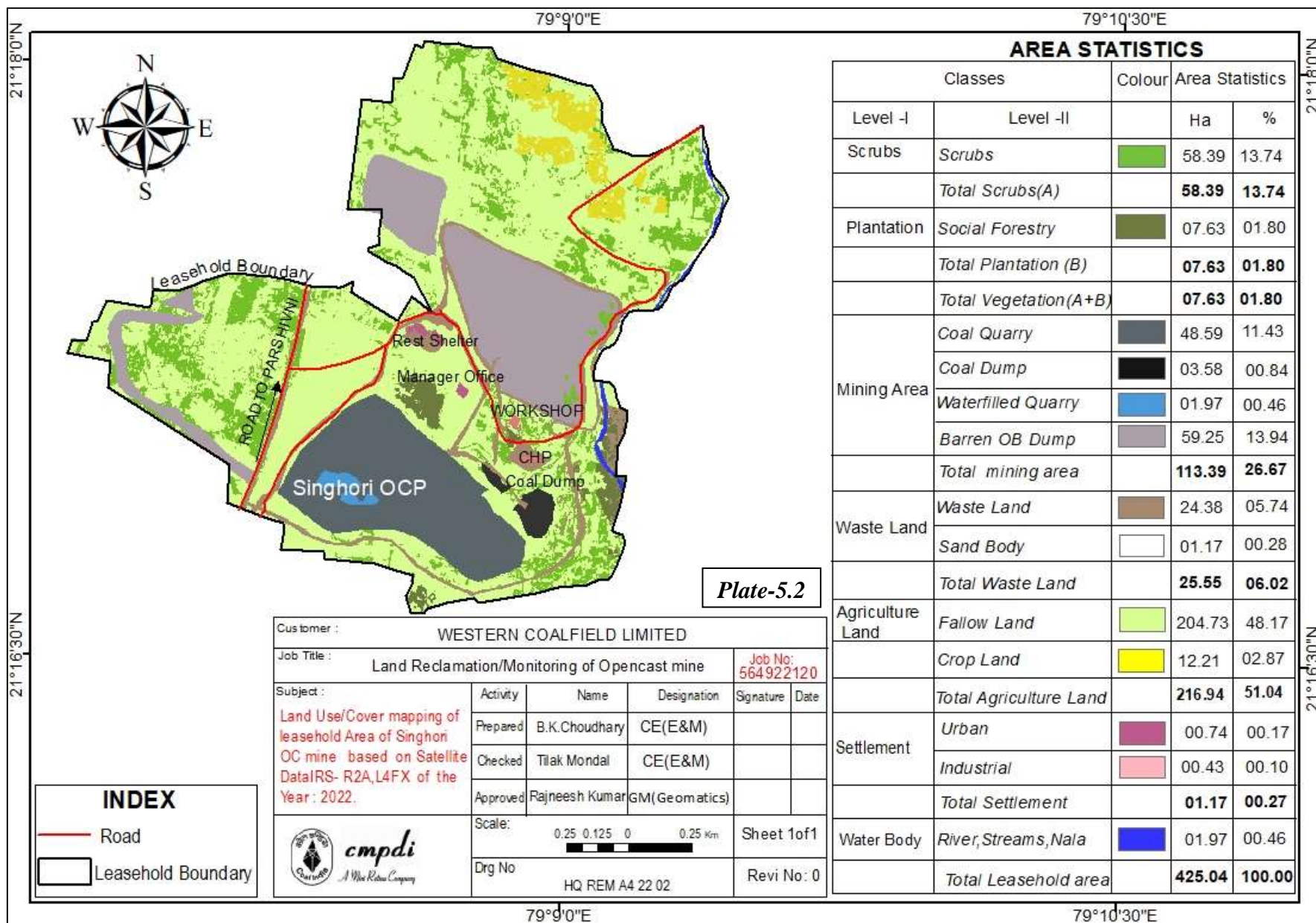
Figure 5.1: Land Reclamation status in OC projects producing less than 5mcm (Coal+ OB) of WCL in the year-2022

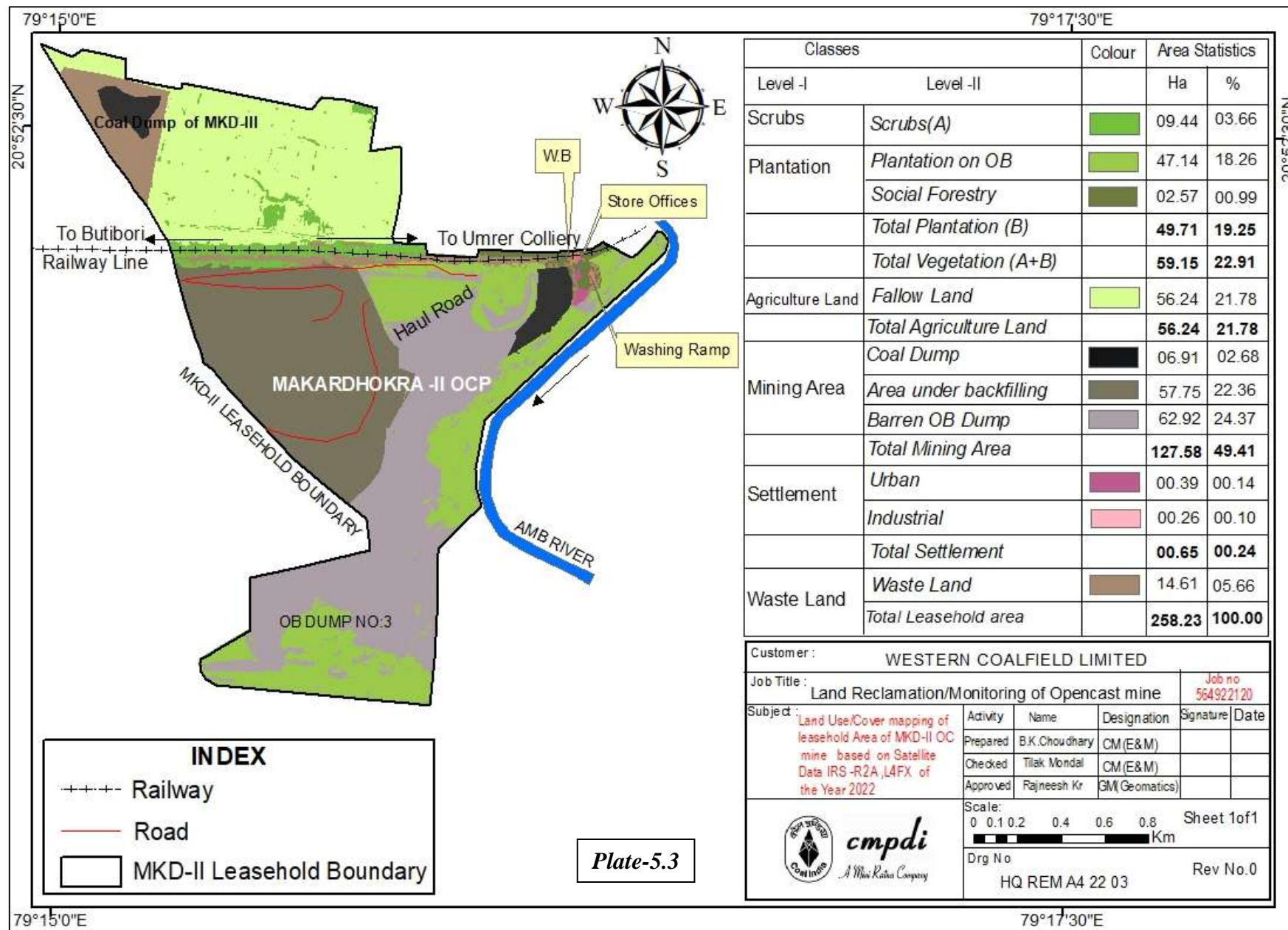
Table 5.2: STATUS OF LAND RECLAMATION IN WESTERN COALFIELDS LIMITED BASED ON SATELLITE DATA OF THE YEAR 2022

(Area in Hectare)

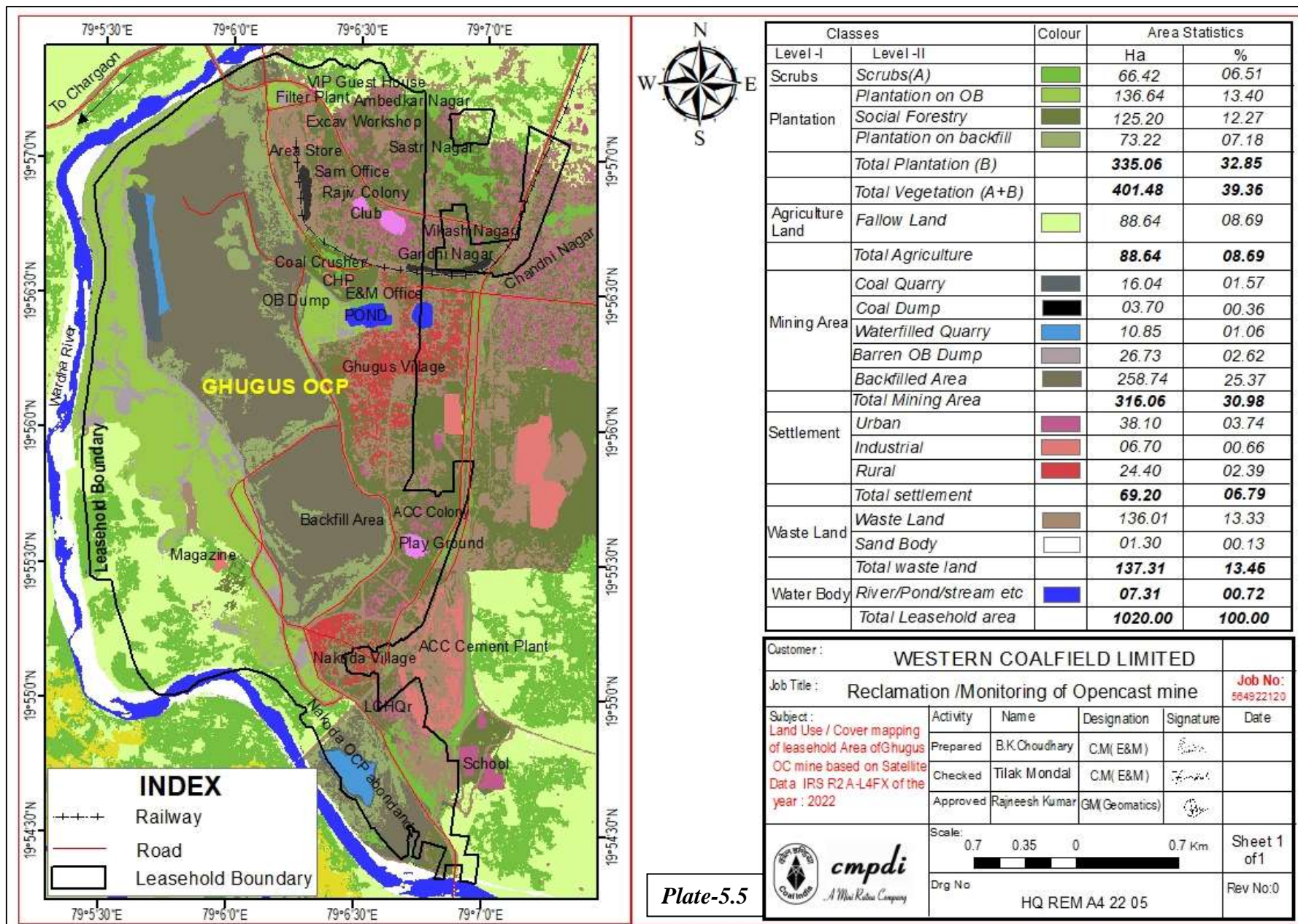
		BHANEGAON		SINGHORI		MKD-II		NEWSETHIA		GHUGUS		PIMPALGAON		DATLA		GOKUL		TOTAL	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest 	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Open Forest 	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Forest/Tree plantation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCRUBS	Scrubs 	32.17	9.26	58.39	13.74	9.44	3.66	9.76	6.71	66.42	6.51	21.74	4.81	0.56	0.98	55.07	7.28	253.55	7.32
	Total Scrubs	32.17	9.26	58.39	13.74	9.44	3.66	9.76	6.71	66.42	6.51	21.74	4.81	0.56	0.98	55.07	7.28	253.55	7.32
PLANTATION	Social Forestry 	20.74	5.97	7.63	1.80	2.57	0.99	10.15	6.98	125.20	12.27	79.62	17.62	0.00	0.00	29.97	3.95	275.88	7.97
	Plantation on OB Dump 	16.54	4.76	0.00	0.00	47.14	18.26	7.01	4.82	136.64	13.40	149.76	33.14	0.00	0.00	0.00	0.00	357.09	10.32
	Plantation on Backfill 	0.00	0.00	0.00	0.00	0.00	0.00	18.92	13.01	73.22	7.18	0.00	0.00	11.24	19.47	0.00	0.00	103.38	2.99
	Total Plantation (Green Cover Generated)	37.28	10.73	7.63	1.80	49.71	19.25	36.08	24.81	335.06	32.85	229.38	50.76	11.24	19.47	29.97	3.95	736.35	21.28
	Plantation on Backfill(Biologically reclaimed)	0.00	0.00	0.00	0.00	0.00	0.00	18.92	13.01	73.22	7.18	0.00	0.00	11.24	19.47	0.00	0.00	103.38	2.99
	Total Vegetation Cover	69.45	19.99	66.02	15.54	59.15	22.91	45.84	31.52	401.48	39.36	251.12	55.57	11.80	20.45	85.04	11.23	989.90	28.60
ACTIVE MINING	Coal Quarry 	29.11	8.38	48.59	11.43	0.00	0.00	10.50	7.22	16.04	1.57	29.09	6.44	2.68	4.65	121.49	16.05	257.50	7.44
	Coal Dump 	3.04	0.87	3.58	0.84	6.91	2.68	1.21	0.83	3.70	0.36	2.44	0.54	0.00	0.00	17.16	2.27	38.04	1.10
	Advance Quarry Site 	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.98	7.40	55.98	1.62
	Quarry Filled With Water 	5.75	1.65	1.97	0.46	0.00	0.00	31.15	21.42	10.85	1.06	22.70	5.02	9.27	16.06	0.73	0.10	82.42	2.38
	Total Area under Active Mining	37.90	10.90	54.14	12.73	6.91	2.68	42.86	29.47	30.59	2.99	54.23	12.00	11.95	20.71	195.36	25.82	433.94	12.54
RECLAIMED	Barren OB Dump 	53.47	15.39	59.25	13.94	62.92	24.37	3.74	2.57	26.73	2.62	85.64	18.95	0.00	0.00	148.68	19.64	440.43	12.72
	Barren Backfilled Area 	1.18	0.34	0.00	0.00	57.75	22.36	30.65	21.07	258.74	25.37	13.34	2.95	25.32	43.85	75.49	9.97	462.47	13.36
	Total Area under Technical Reclamation	1.18	0.34	0.00	0.00	57.75	22.36	30.65	21.07	258.74	25.37	13.34	2.95	25.32	43.85	75.49	9.97	462.47	13.20
	Total Area Under Mine Operation	92.55	26.63	113.39	26.67	127.58	49.41	77.25	53.11	316.06	30.98	153.21	33.90	37.27	64.56	419.53	55.43	1336.84	38.46
WASTELAND	Waste Lands 	35.10	10.10	24.38	5.74	14.61	5.66	12.75	8.77	136.01	13.33	41.61	9.21	7.53	13.03	50.16	6.63	322.15	9.31
	Fly Ash Pond / Sand Body 	2.50	0.72	1.17	0.28	0.00	0.00	3.78	2.60	1.30	0.13	0.00	0.00	0.59	1.02	0.00	0.00	9.34	0.27
	Total Wasteland	37.60	10.82	25.55	6.02	14.61	5.66	16.53	11.37	137.31	13.46	41.61	9.21	8.12	14.05	50.16	6.63	331.49	9.58
WATERBODIES	Reservoir, nallah, ponds 	7.82	2.26	1.97	0.46	0.00	0.00	2.66	1.84	7.31	0.72	0.00	0.00	0.56	0.94	4.60	0.61	24.92	0.72
	Total Waterbodies	7.82	2.26	1.97	0.46	0.00	0.00	2.66	1.84	7.31	0.72	0.00	0.00	0.56	0.94	4.60	0.61	24.92	0.72
AGRICULTURE	Crop Lands 	0.00	0.00	12.21	2.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.98	1.05	20.19	0.58
	Fallow Lands 	139.26	40.08	204.73	48.17	56.24	21.78	1.03	0.70	88.64	8.69	0.00	0.00	0.00	0.00	172.16	22.74	662.06	19.13
	Total Agriculture	139.26	40.08	216.94	51.04	56.24	21.78	1.03	0.70	88.64	8.69	0.00	0.00	0.00	0.00	180.14	23.79	682.25	19.71
SETTLEMENTS	Urban Settlement 	0.78	0.22	0.74	0.17	0.39	0.14	1.91	1.30	38.10	3.74	1.99	0.44	0.00	0.00	1.08	0.14	43.99	1.27
	Rural Settlement 	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.40	2.39	1.73	0.38	0.00	0.00	0.36	0.05	26.49	0.77
	Industrial Settlement 	0.00	0.00	0.43	0.10	0.26	0.10	0.23	0.16	6.70	0.66	2.21	0.50	0.00	0.00	16.01	2.12	25.84	0.75
	Total Settlement	0.78	0.22	1.17	0.27	0.65	0.24	2.14	1.46	69.20	6.79	5.93	1.32	0.00	0.00	17.45	2.31	96.32	2.79
	Grand Total	347.46	100.00	425.04	100.00	258.23	100.00	145.45	100.00	1020.00	100.00	451.87	100.00	57.75	100.00	756.92	100.00	3461.72	100.00

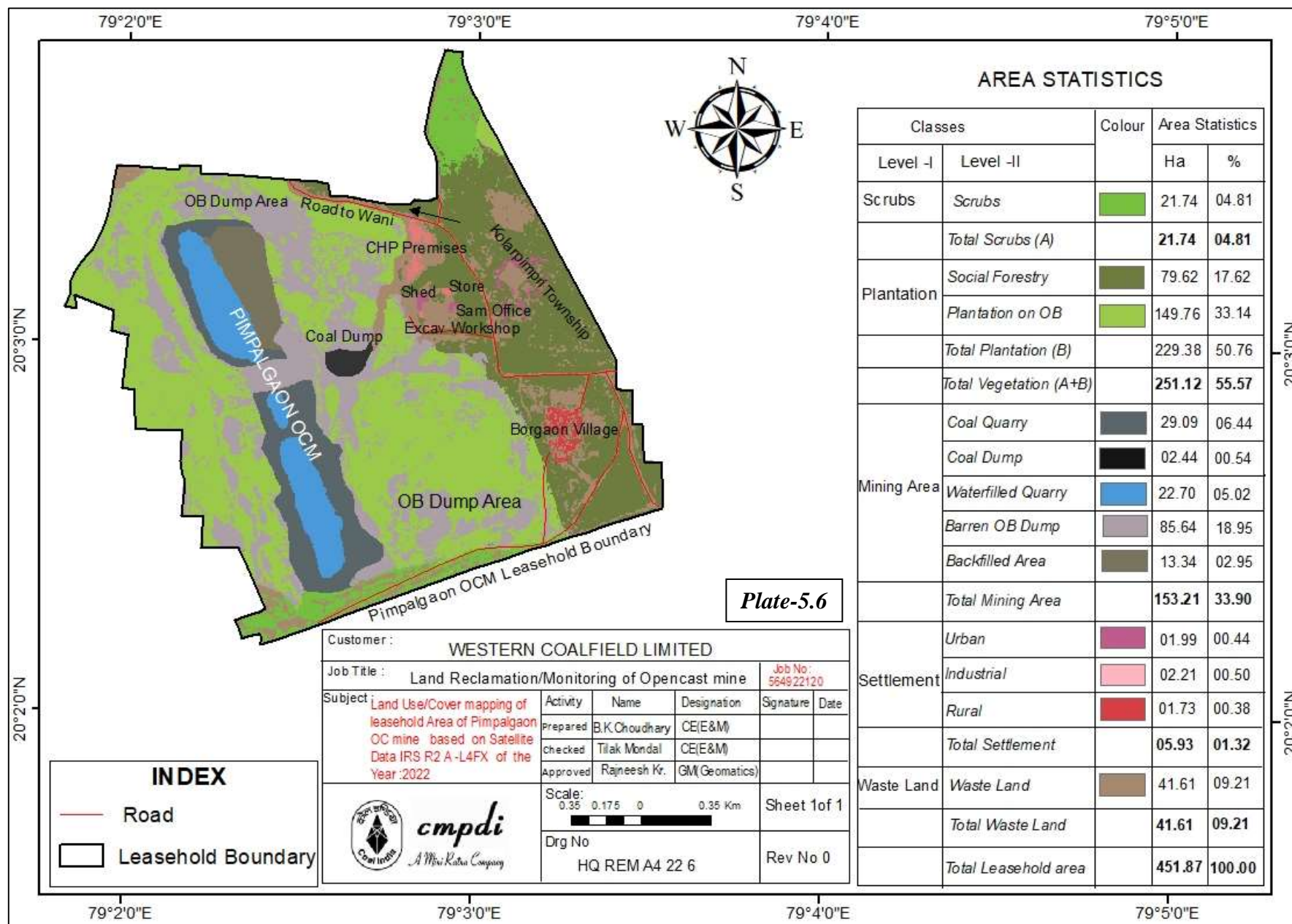


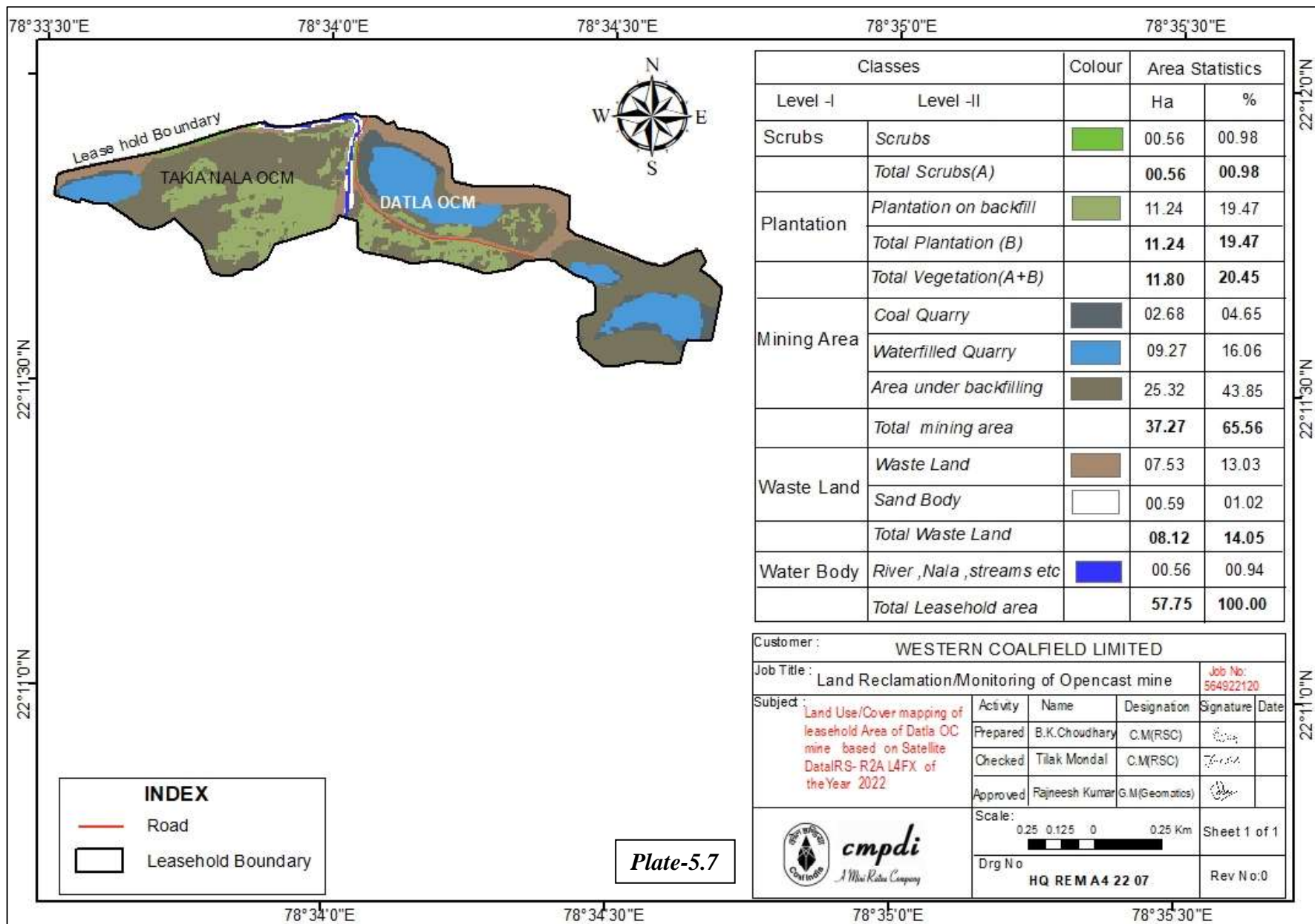


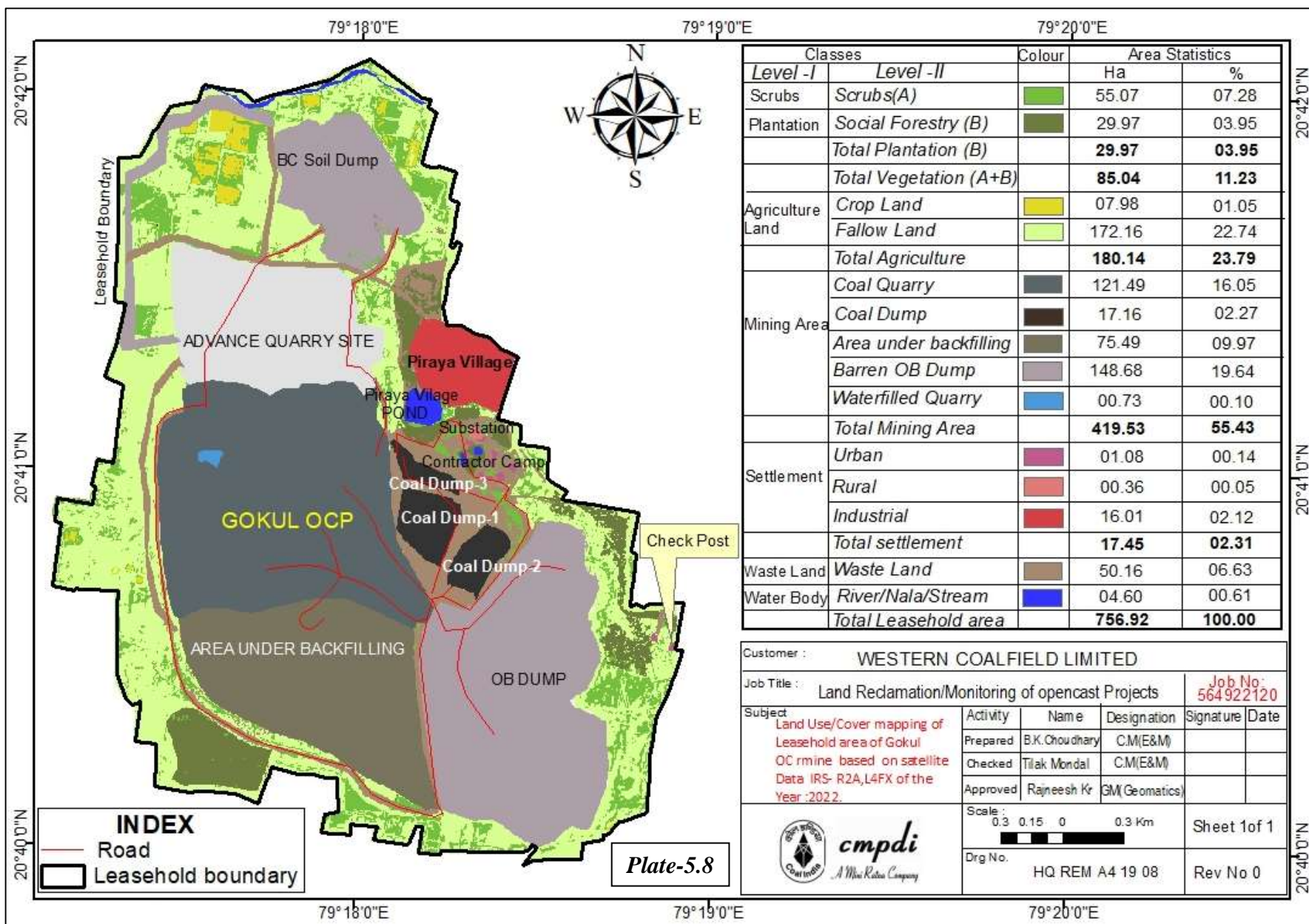












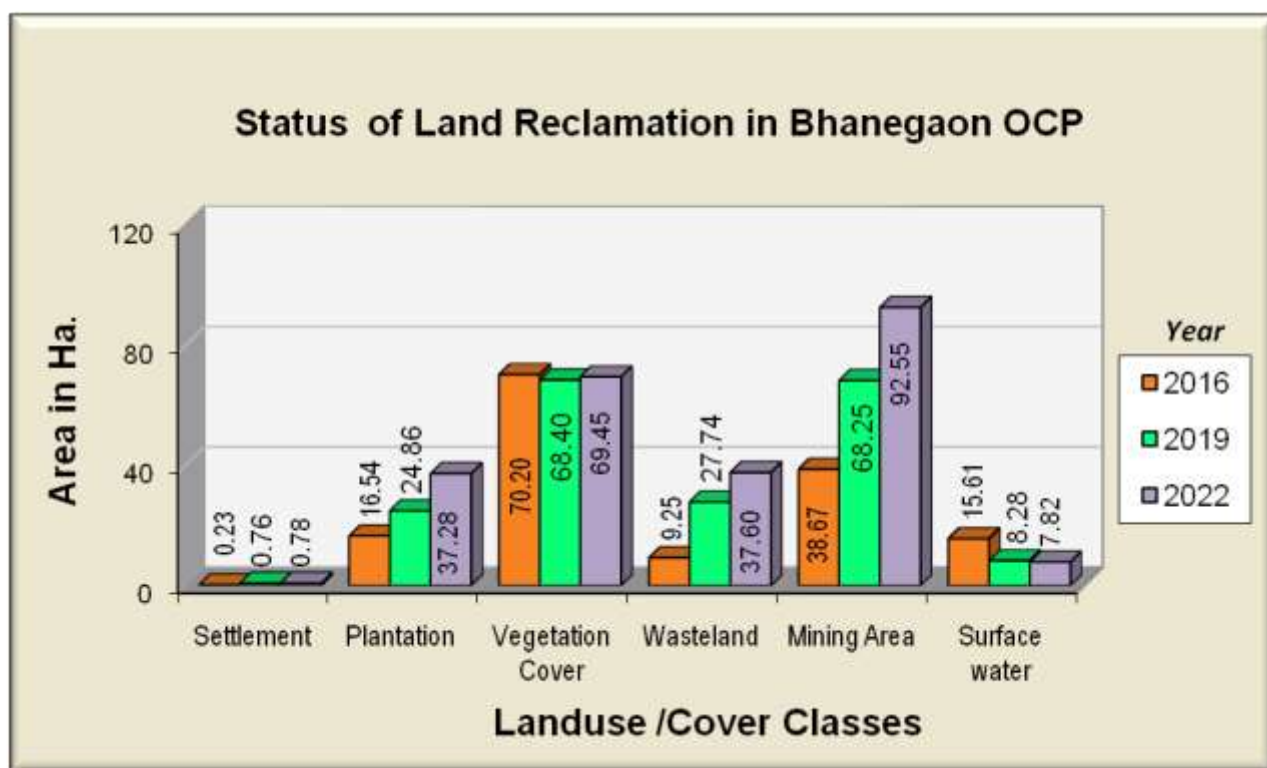


Figure- 5.2

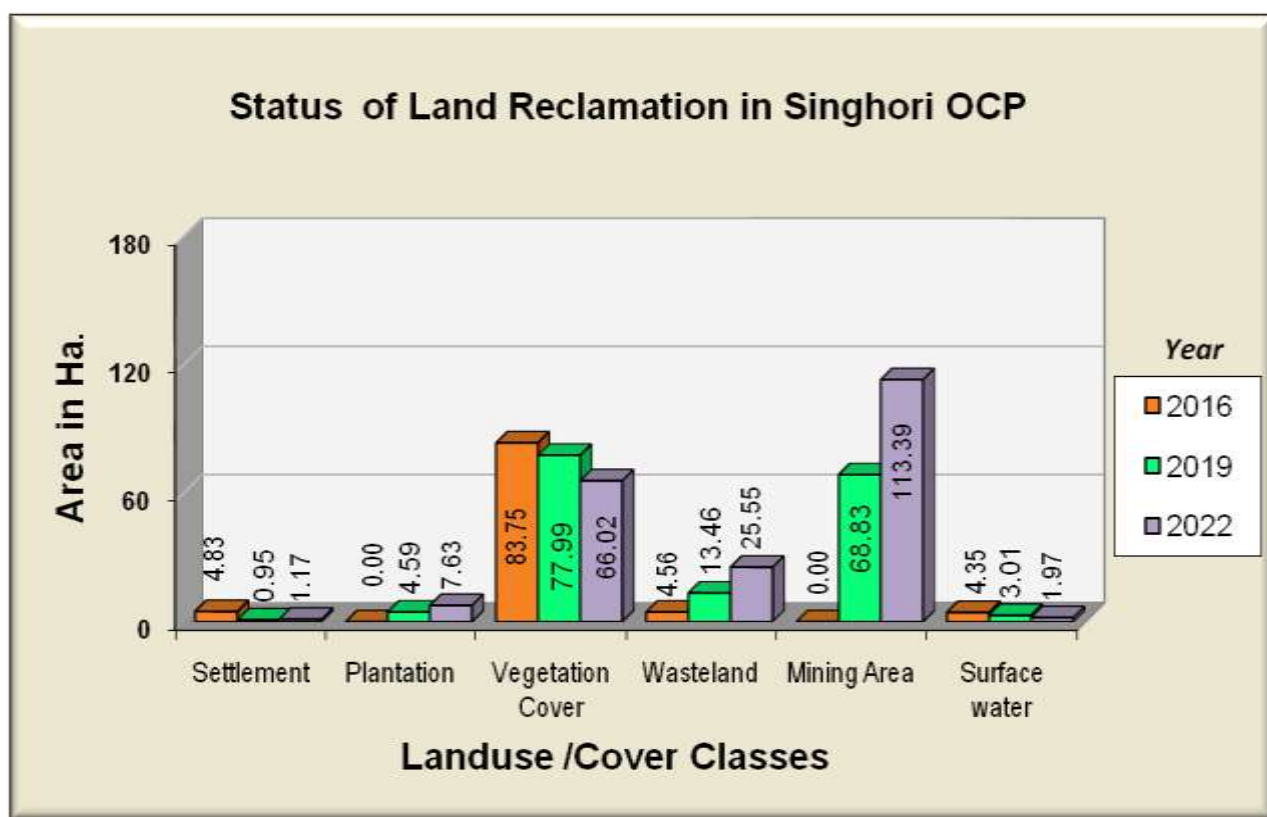


Figure- 5.3

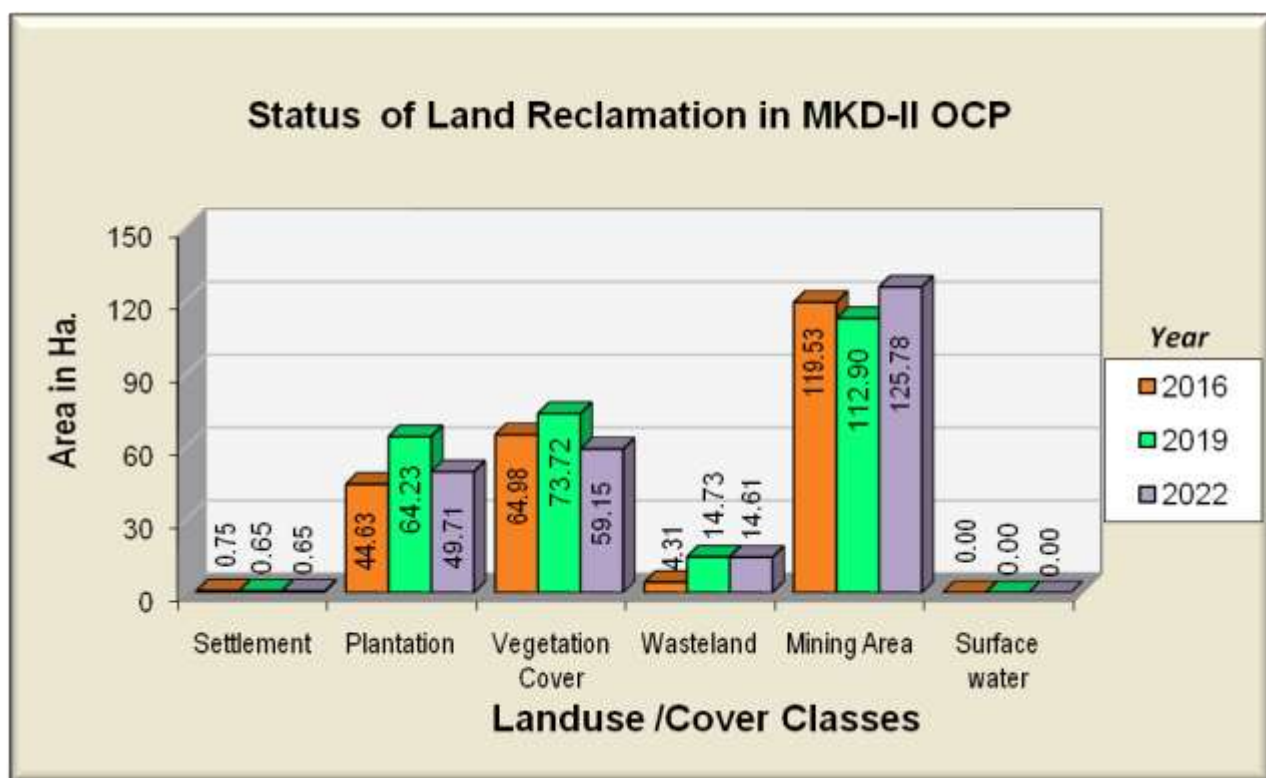


Figure- 5.4

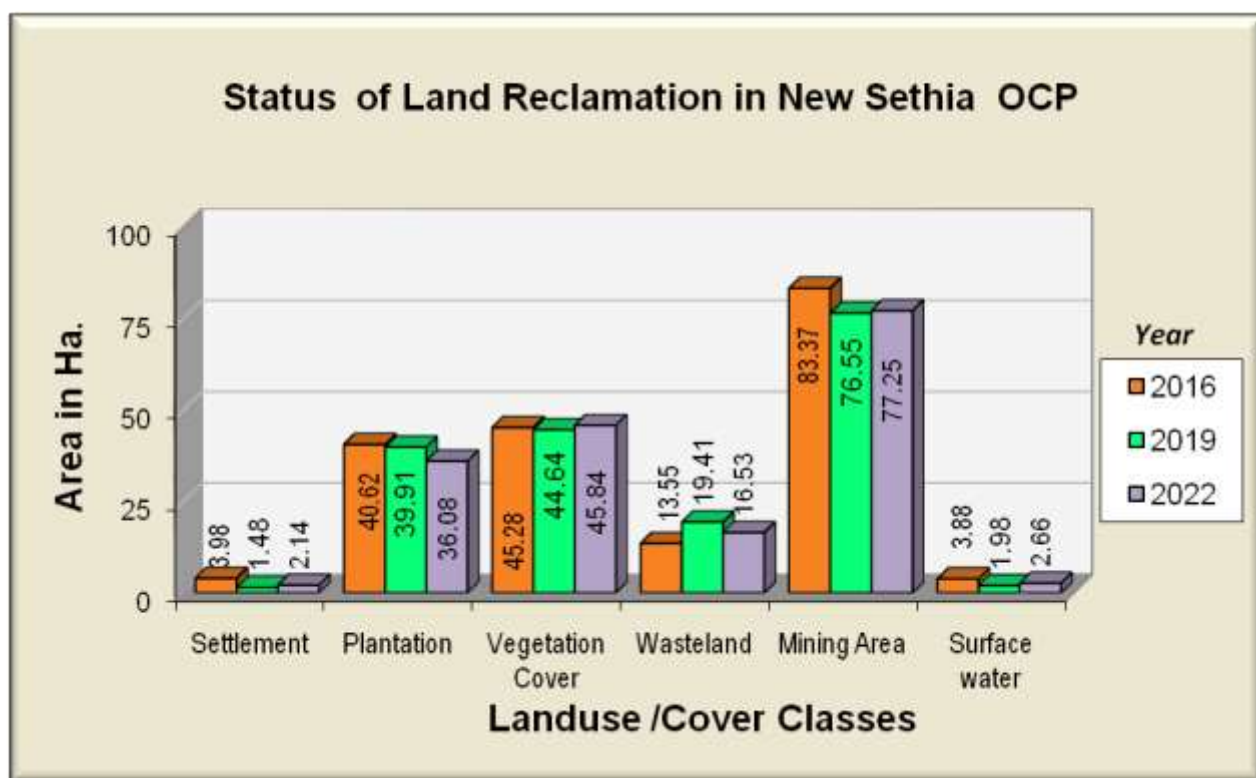


Figure- 5.5

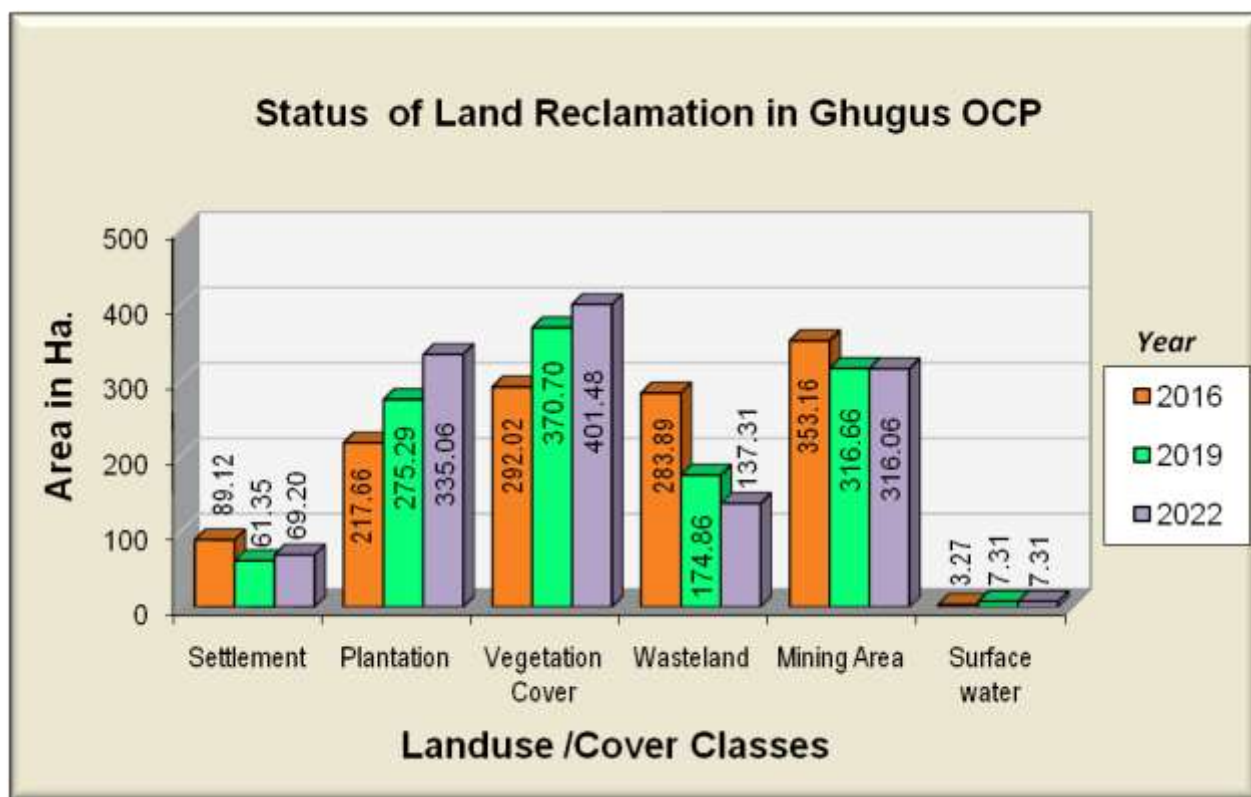


Figure- 5.6

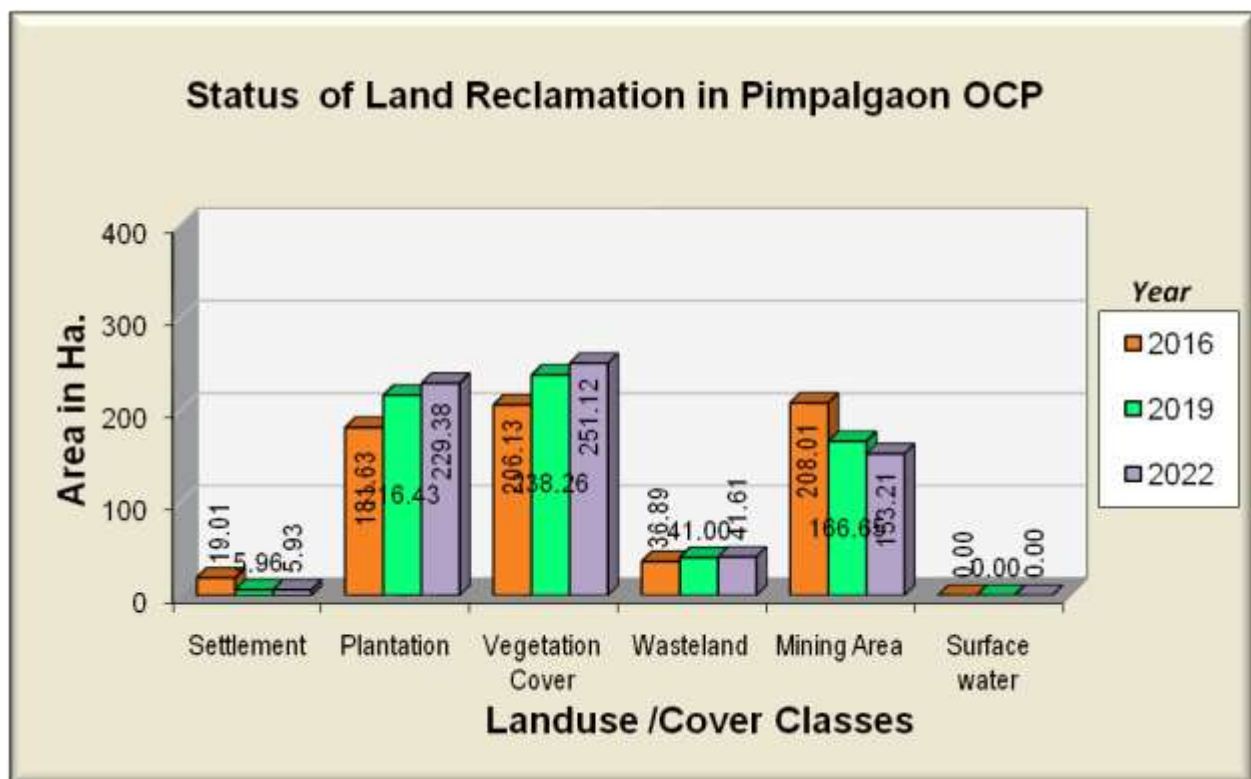


Figure- 5.7

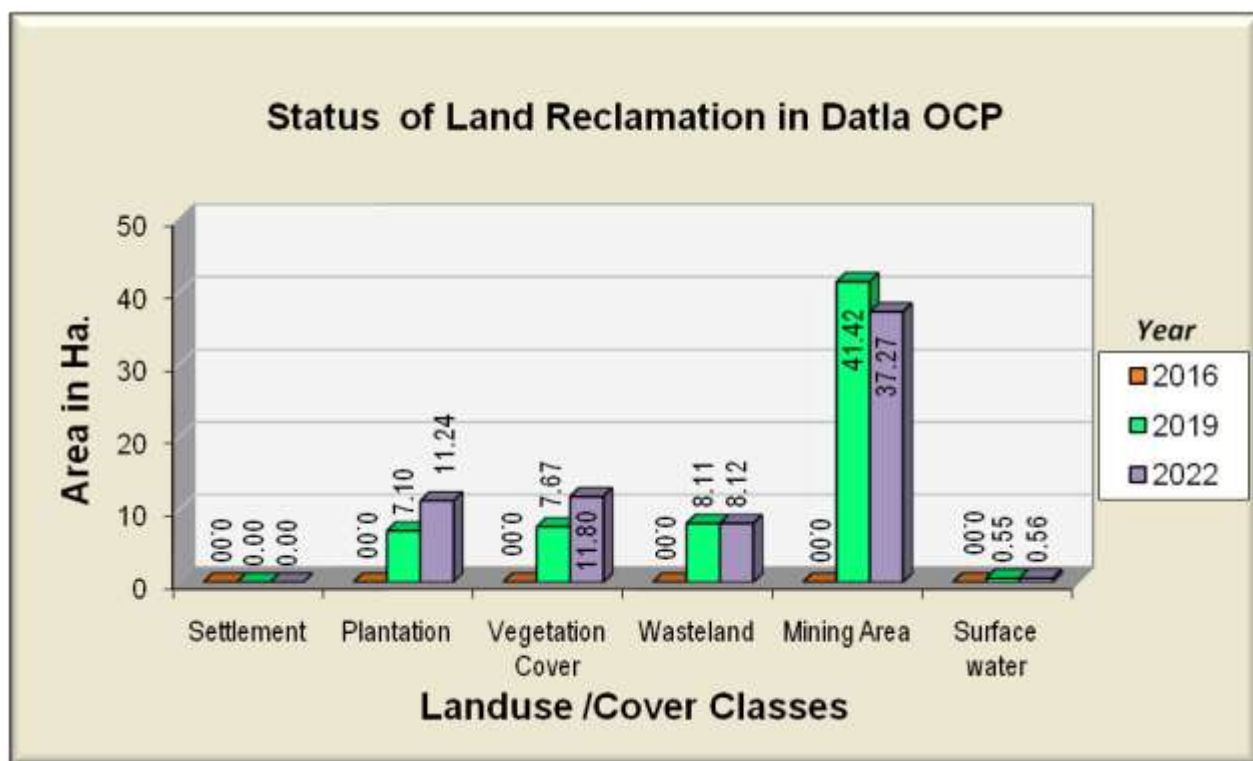


Figure- 5.8

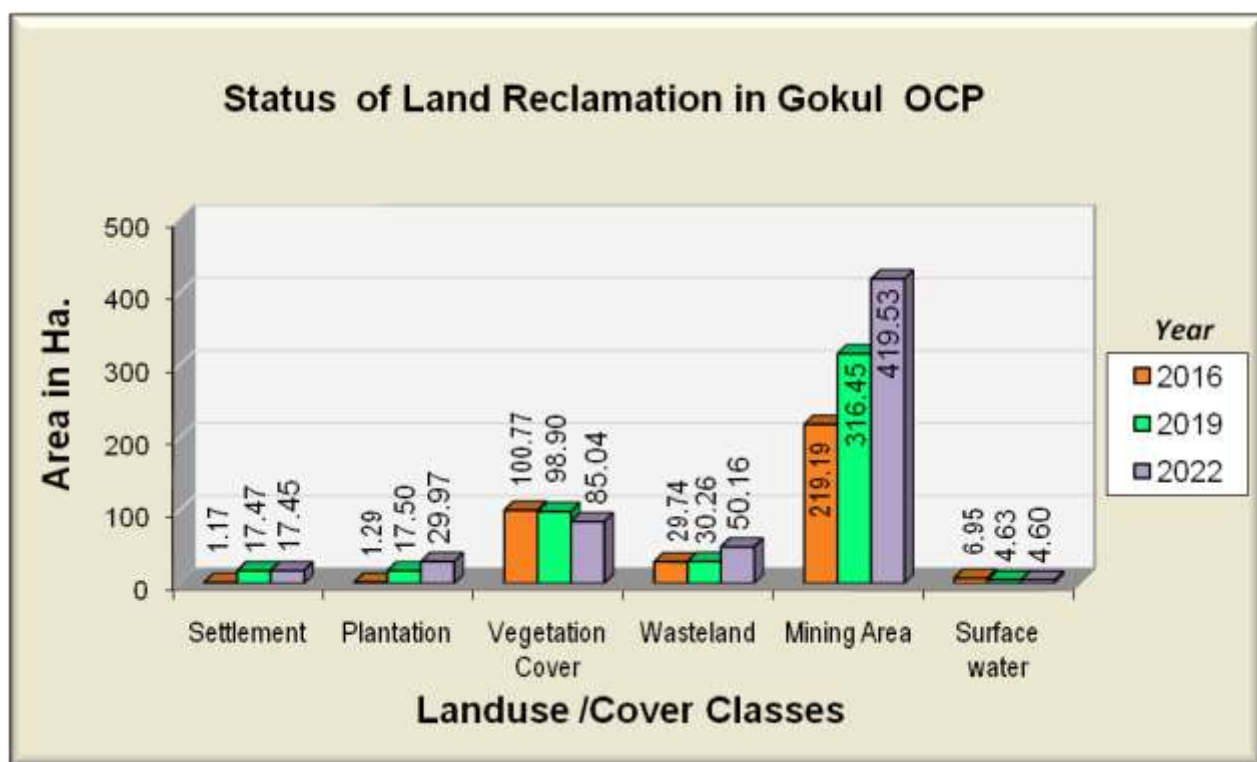


Figure- 5.9



Photo-5.1: Plantation on embankment in Bhanegaon OCM



Photo-5.2: Plantation along charcoal transportation Road in Singhori OCM



Photo-5.3: Plantation along coal transportation Road in Singhori OCM



Photo-5.4: Plantation on Barren OB in Makardhokra-II OCM

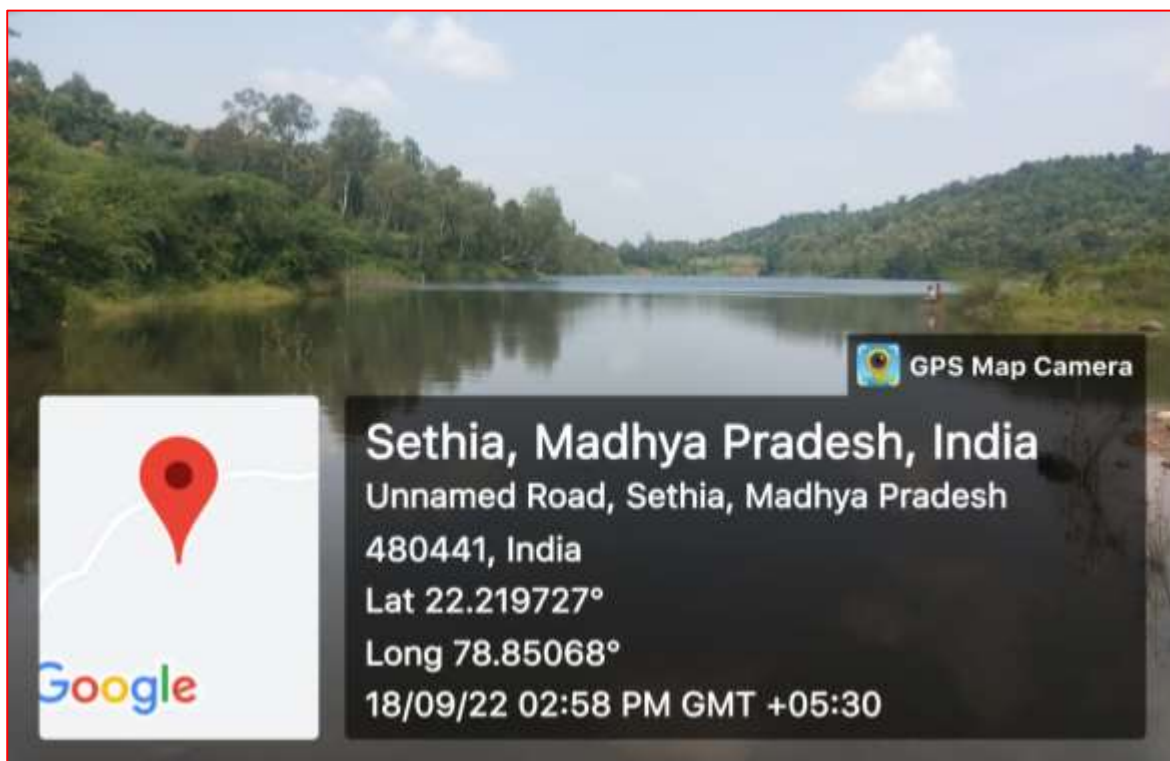


Photo-5.5: Plantation near mansarovar in New Sethia OCM



Photo-5.6: Eco park developed on Backfill in New Sethia OCM



Photo-5.7: Plantation on Barren OB dump in Ghugus OCM



Photo-5.8: Plantation on embankment in Ghugus OCM



Photo-5.9: Plantation on embankment in Ghugus OCM

SOUTH EASTERN COALFIELDS LIMITED

6.0 Land Reclamation Status in South Eastern Coalfields Limited

6.1 Following 04 opencast projects of SECL producing less than 5million cubic m. (Coal +OB) together p.a., were taken up for land reclamation monitoring based on satellite data of the year 2022:

- Amgaon
- Kotma
- Mahan
- West Chirimiri

6.2 Project wise Land Reclamation status in SECL is given in Table 6.1 and also shown graphically in Fig 6.1. Area statistics of different land use class present in the mine leasehold of the above projects for the year 2022 are shown in the Table - 6.2. Land use maps derived from satellite data are shown in Plate 6.1 – 6.4. Different land use classes based on satellite data are depicted in Bar Charts in Fig.6.3 – 6.6.

6.3 Study reveals that out of total mine leasehold area of 2439.61 Ha of the 04 OC projects of SECL mentioned above taken for this study in 2022-23; total excavated area is only 368.23 Ha, out of which 154.47 Ha. (41.95%) has been planted on backfill (Biologically Reclaimed), 169.77 Ha (46.10%) is under backfilling (Technical Reclamation) and balance 43.99 Ha (11.95%) is under active mining. There is an increase of 34.02 Ha in overall area under reclamation in the above projects of SECL as compared to previous study undertaken in the year 2019-2020. This is due to increase in plantation on backfill (Biological Reclamation).

6.4 Study indicates that overall the projects of SECL considered for this study indicate increasing trend in biological reclamation (plantation on backfill) with respect to the year 2019.

- 6.5** After analyzing the satellite data of the year 2019 and 2022, It is evident that total area under plantation (Green Cover) carried out on backfill area, OB dumps as well as under social forestry in all the mines of SECL has increased from 211.66 Ha to 253.46 Ha in span of last three years. This increase of 41.80 Hectare area of plantation (Green cover) in three years is due to sincere effort of SECL towards mine land reclamation and environment protection.
- 6.6** There has been increase in area under technical reclamation in two projects i.e. Amgaon OCP and Mahan OCP, whereas in West Chirimiri OCP and Kotma OCP, area under technical reclamation has reduced as more area came under plantation.
- 6.7** Out of 4 projects of SECL, West Chirimiri OCP tops with 94.49% reclamation followed by Mahan OCP (93.88%), Kotma OCP (91.10%) and Amgaon (81.05%).

Table 6.1: Project wise Land Reclamation Status in Opencast Projects of SECL based on the Satellite data of the year 2022

(Area in Hectare)																			
Sl. No.	Project		Total Leasehold Area 2022	Technical Reclamation		Plantation						Area Under Active Mining		Total Excavated Area		Total Area Under Plantation (%Green Cover Generated in Leasehold)		Total Area Under Reclamation	
						Biological		Other Plantation											
				Area under Backfilling	Plantation on Excavated/Backfilled Area	Plantation on External Over Burden Dump	Social Forestry, Avenue Plantation Etc.												
1	2	3	4	5		6		7		8		9		10(=5+6+9)		11(=6+7+8)		12(=5+6)	
				2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022
1	Kotma	826.11	826.11	8.07	3.17	55.59	60.49	0.00	0.00	42.98	42.98	6.22	6.22	69.88	69.88	98.57	103.47	63.66	63.66
				11.55%	4.54%	79.55%	86.56%					8.90%	8.90%			11.93%	12.52%	91.10%	91.10%
2	Mahan	194.63	194.63	38.22	44.92	0.61	4.19	1.45	5.29	0.00	0.00	9.11	3.20	47.94	52.31	2.06	9.48	38.83	49.11
				79.72%	85.87%	1.27%	8.01%					19.00%	6.12%			1.06%	4.87%	81.00%	93.88%
3	Amgaon	690.48	690.48	92.39	99.15	10.61	27.59	0.00	0.00	35.79	35.79	53.34	29.63	156.34	156.37	46.40	63.38	103.00	126.74
				59.10%	63.41%	6.79%	17.64%					34.12%	18.95%			6.72%	9.18%	65.88%	81.05%
4	West Chirimiri	728.39	728.39	35.03	22.53	49.70	62.20	0.00	0.00	14.93	14.93	4.94	4.94	89.67	89.67	64.63	77.13	84.73	84.73
				39.07%	25.13%	55.43%	69.37%					5.51%	5.51%			8.87%	10.59%	94.49%	94.49%
Total(SECL)		2439.61	2439.61	173.71	169.77	116.51	154.47	1.45	5.29	93.70	93.70	73.61	43.99	363.83	368.23	211.66	253.46	290.22	324.24
				47.74%	46.10%	32.02%	41.95%					20.23%	11.95%			8.68%	10.39%	79.77%	88.05%

Note: In reference to above table different parameters as classified as follows:

1. Area under Biological Reclamation includes Area under plantation done on Backfilled Area only.
2. Area under Technical Reclamation includes Area under Backfill only.
3. Area under Active mining includes Coal Quarry, Advance Quarry site and Quarry filled with water etc. if any.
4. Social Forestry and Plantation on External OB Dumps are not included in Biological Reclamation and are put under separate categories as shown in above Table.
5. (%) calculated in above Table is in respect to Total Excavated area except for "Total Area under plantation" where (%) is in terms of "Leasehold Area".

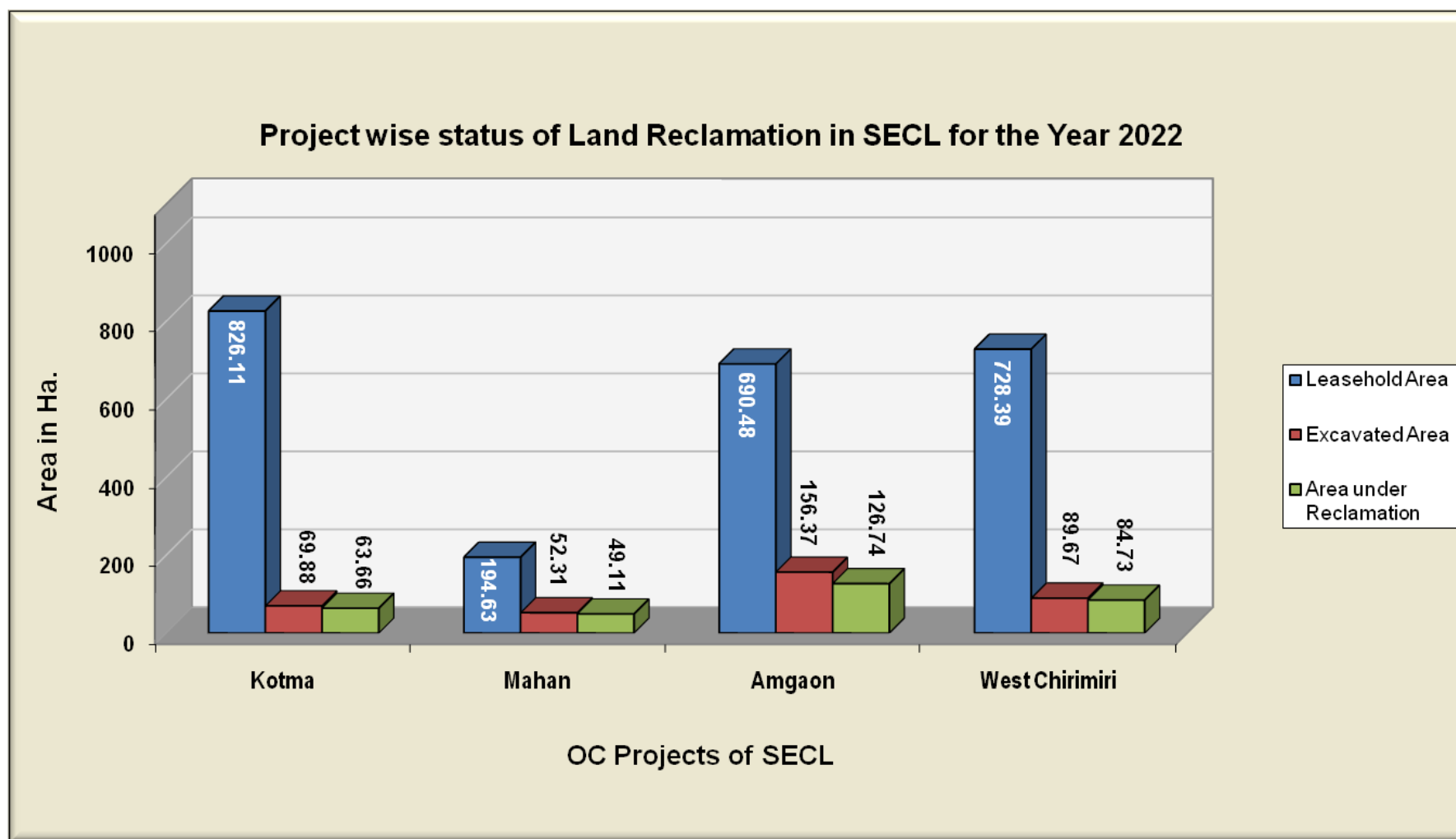




















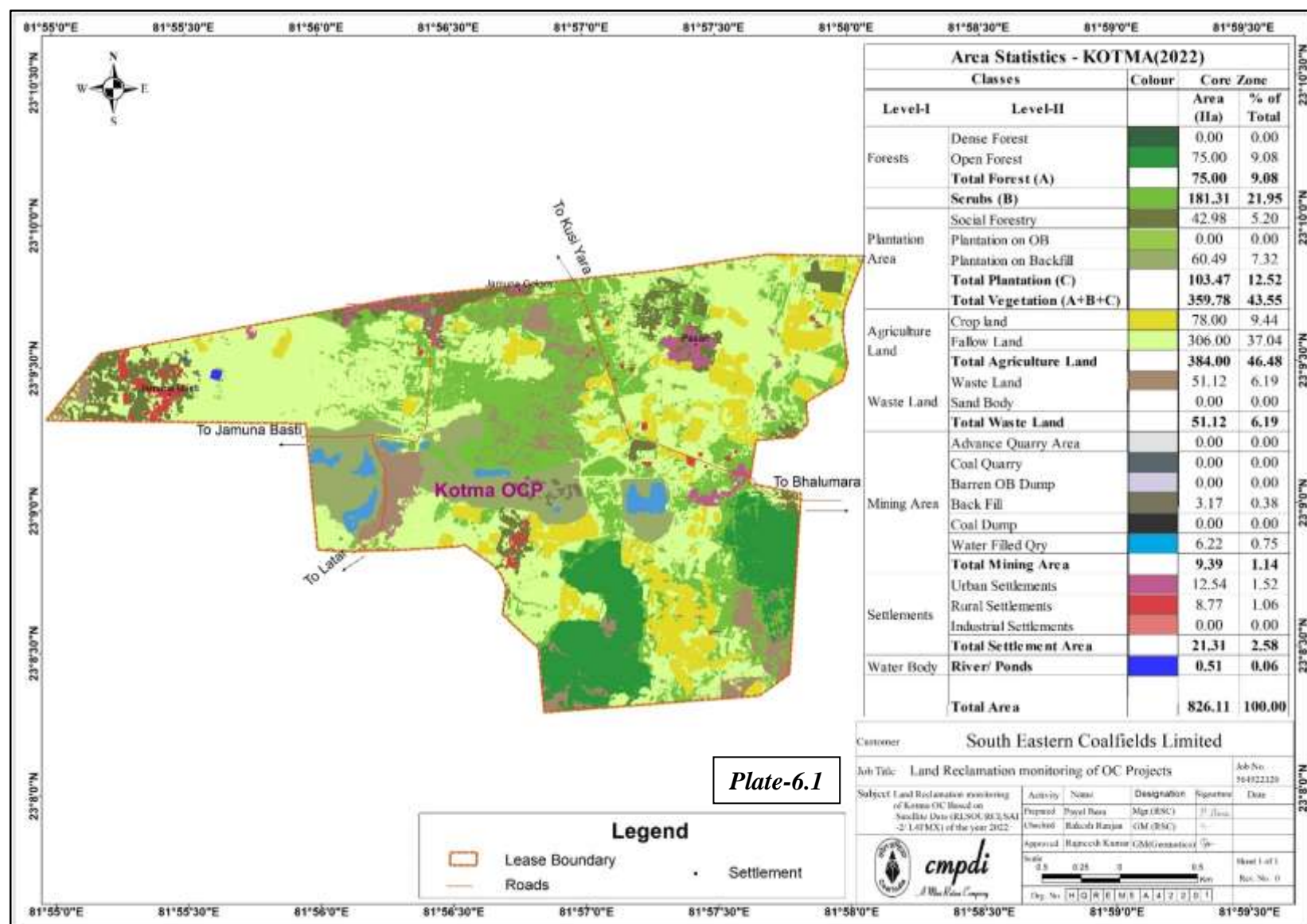


Figure 6.1: Land Reclamation status in OC projects producing less than 5mcm (Coal+ OB) of SECL in the year-2022

Table 6.2: STATUS OF LAND RECLAMATION IN SOUTH EASTERN COALFIELDS LIMITED BASED ON SATELLITE DATA OF THE YEAR 2022

			KOTMA		MAHAN		AMGAON		WEST CHIRIMIRI		TOTAL	
			Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Open Forest		75.00	9.08	0.00	0.00	15.20	2.20	478.27	65.66	568.47	23.30
	Total Forest		75.00	9.08	0.00	0.00	15.20	2.20	478.27	65.66	568.47	23.30
SCRUBS	Scrubs		181.31	21.95	5.11	2.63	30.00	4.34	85.70	11.77	302.12	12.38
PLANTATION	Social Forestry/Avenue Plantation		42.98	5.20	0.00	0.00	35.79	5.18	14.93	2.05	93.70	3.84
	Plantation on OB Dump		0.00	0.00	7.75	3.98	0.00	0.00	0.00	0.00	7.75	0.32
	Plantation on Backfill (Biological Reclamation)		60.49	7.32	4.61	2.37	27.59	4.00	62.20	8.54	154.89	6.35
	Total Plantation (Green Cover)		103.47	12.52	12.36	6.35	63.38	9.18	77.13	10.59	256.34	10.51
	Total Vegetation		359.78	43.55	17.47	8.98	108.58	15.73	641.10	88.02	1126.93	46.19
ACTIVE MINING	Coal Dump		0.00	0.00	1.23	0.63	0.00	0.00	0.00	0.00	1.23	0.05
	Coal Quarry		0.00	0.00	0.00	0.00	5.43	0.79	0.00	0.00	5.43	0.22
	Advance Quarry Site		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Quarry Filled With Water		6.22	0.75	3.20	1.64	24.20	3.50	4.94	0.68	38.56	1.58
	Total Area under Active Mining		6.22	0.75	3.20	1.64	29.63	4.47	4.94	0.68	43.99	1.80
	Barren OB Dump		0.00	0.00	27.20	13.98	20.88	3.02	0.00	0.00	48.08	1.97
RECLAIMED	Area Under Backfilling (Technical Reclamation)		3.17	0.38	44.88	23.06	99.15	14.36	22.53	3.09	169.73	6.96
	Total Area under Technical Reclamation		3.17	0.38	44.88	23.06	99.15	14.36	22.53	3.09	169.73	6.96
	Total Area under Mine Operation		9.39	1.14	76.51	39.31	149.66	21.67	27.47	3.77	263.03	10.78
WASTELAND	Waste Lands		51.12	6.19	35.35	18.16	62.54	9.06	14.84	2.04	163.85	6.72
	Fly Ash Pond / Sand Body		0.00	0.00	0.00	0.00	0.00	0.00	8.70	1.19	8.70	0.36
	Total Wasteland		51.12	6.19	35.35	18.16	62.54	9.06	23.54	3.23	172.55	7.07
WATERBODIES	Reservoir, nallah, ponds		0.51	0.06	0.00	0.00	4.10	0.59	0.67	0.09	5.28	0.22
	Total Waterbodies		0.51	0.06	0.00	0.00	4.10	0.59	0.67	0.09	5.28	0.21
AGRICULTURE	Crop Lands		78.00	9.44	1.60	0.82	113.98	16.51	0.00	0.00	193.58	7.93
	Fallow Lands		306.00	37.04	60.00	30.83	235.66	34.13	17.18	2.36	618.84	25.37
	Total Agriculture		384.00	46.48	61.60	31.65	349.64	50.64	17.18	2.36	812.42	33.30
SETTLEMENTS	Urban Settlement		12.54	1.52	0.00	0.00	0.00	0.00	17.51	2.40	30.05	1.23
	Rural Settlement		8.77	1.06	3.70	1.90	15.65	2.27	0.58	0.08	28.70	1.18
	Industrial Settlement		0.00	0.00	0.00	0.00	0.31	0.04	0.34	0.05	0.65	0.03
	Total Settlement		21.31	2.58	3.70	1.90	15.96	2.31	18.43	2.53	59.40	2.44
	Grand Total		826.11	100.00	194.63	100.00	690.48	100.00	728.39	100.00	2439.61	100.00





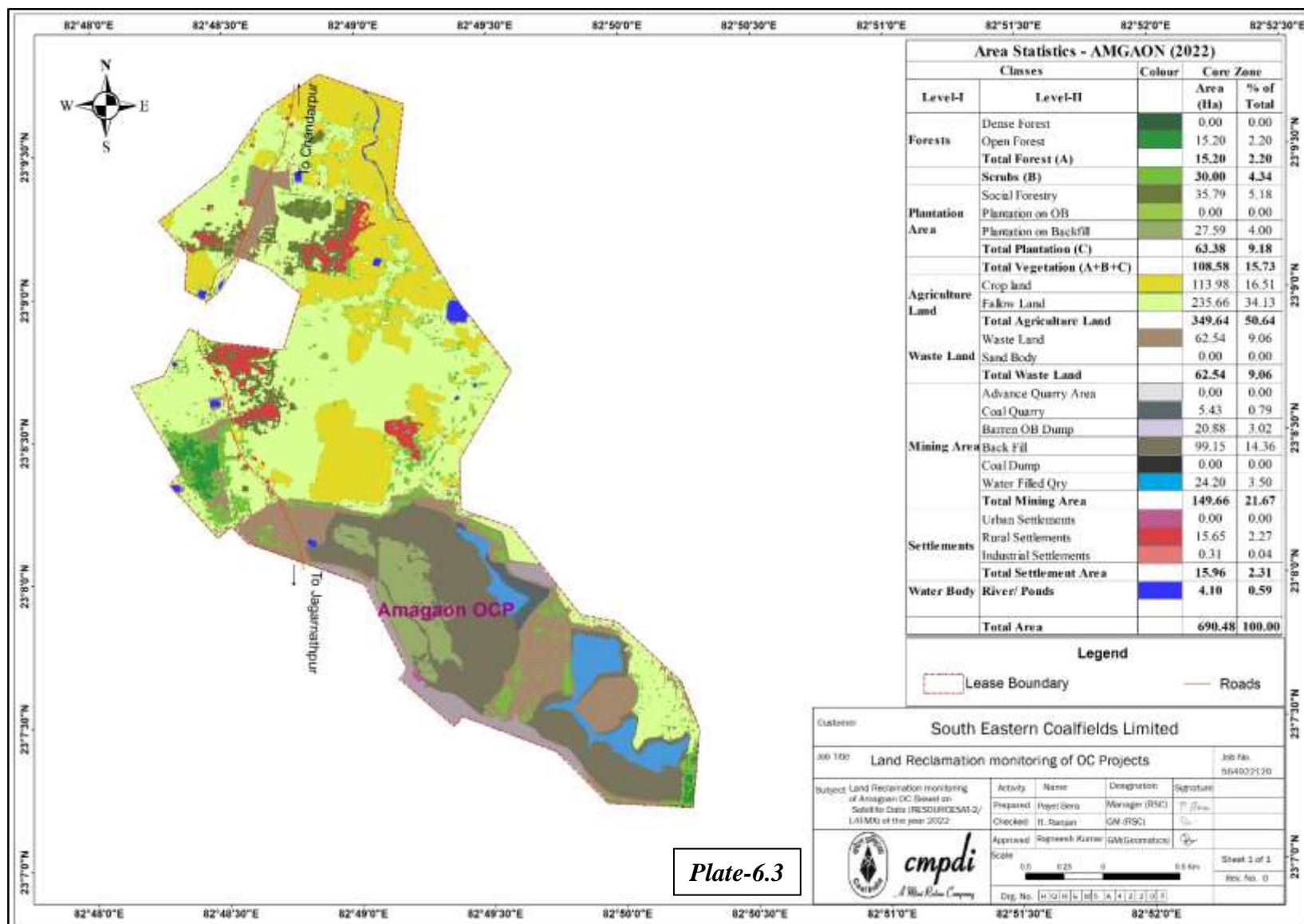
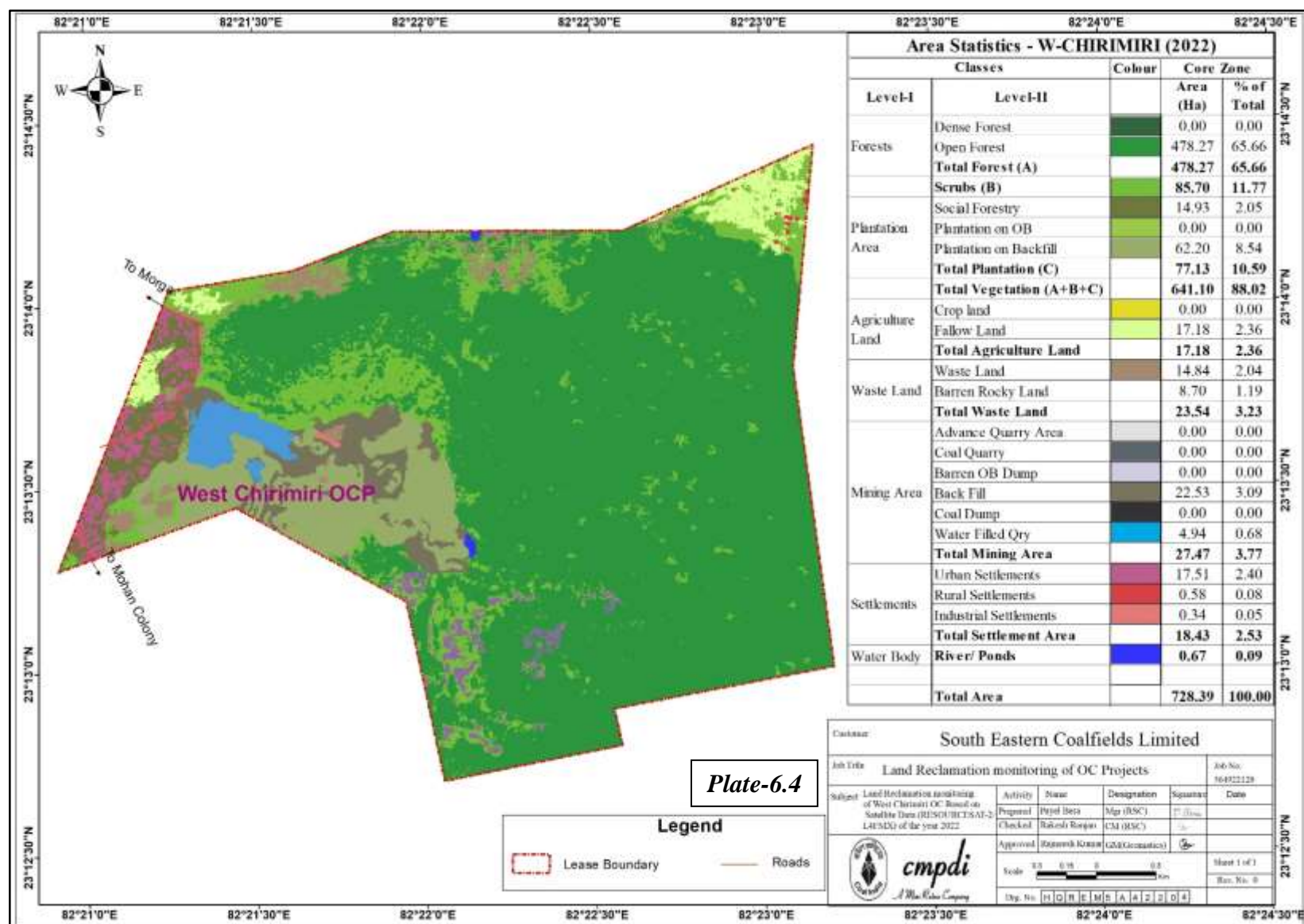


Plate-6.3



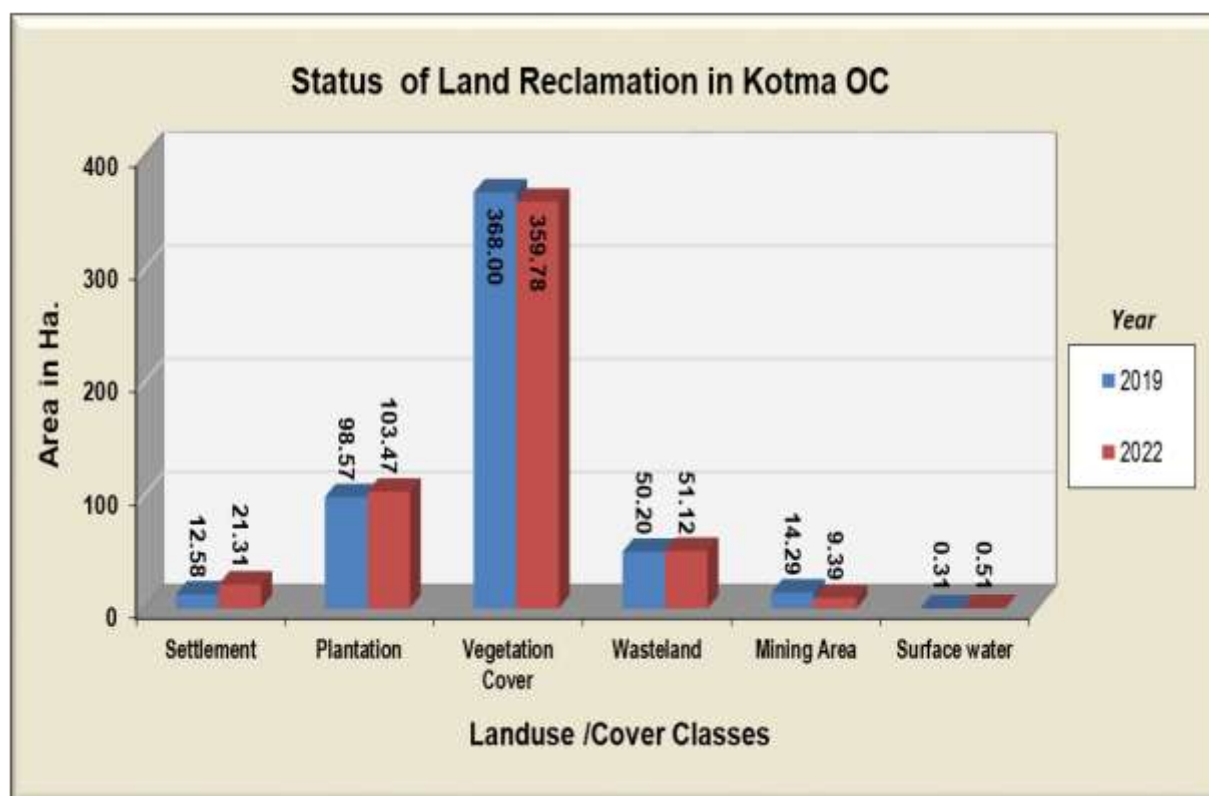


Figure- 6.2

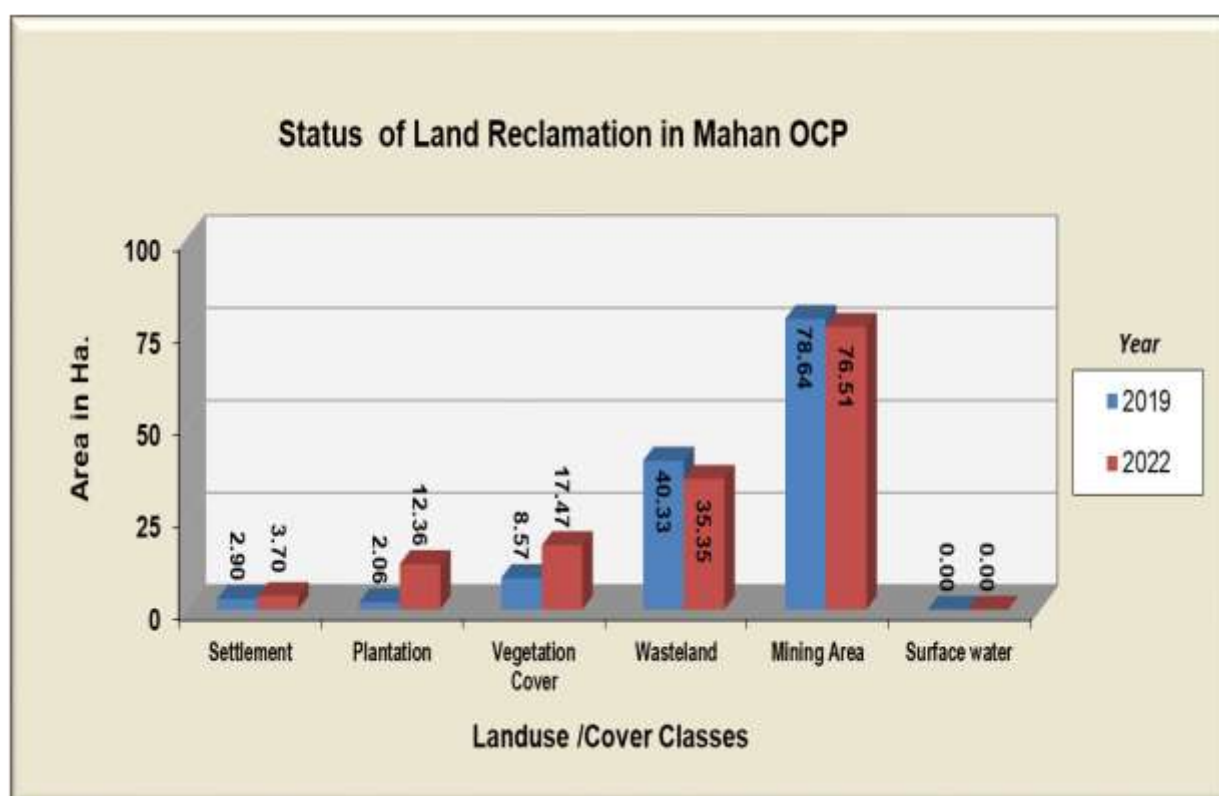


Figure- 6.3

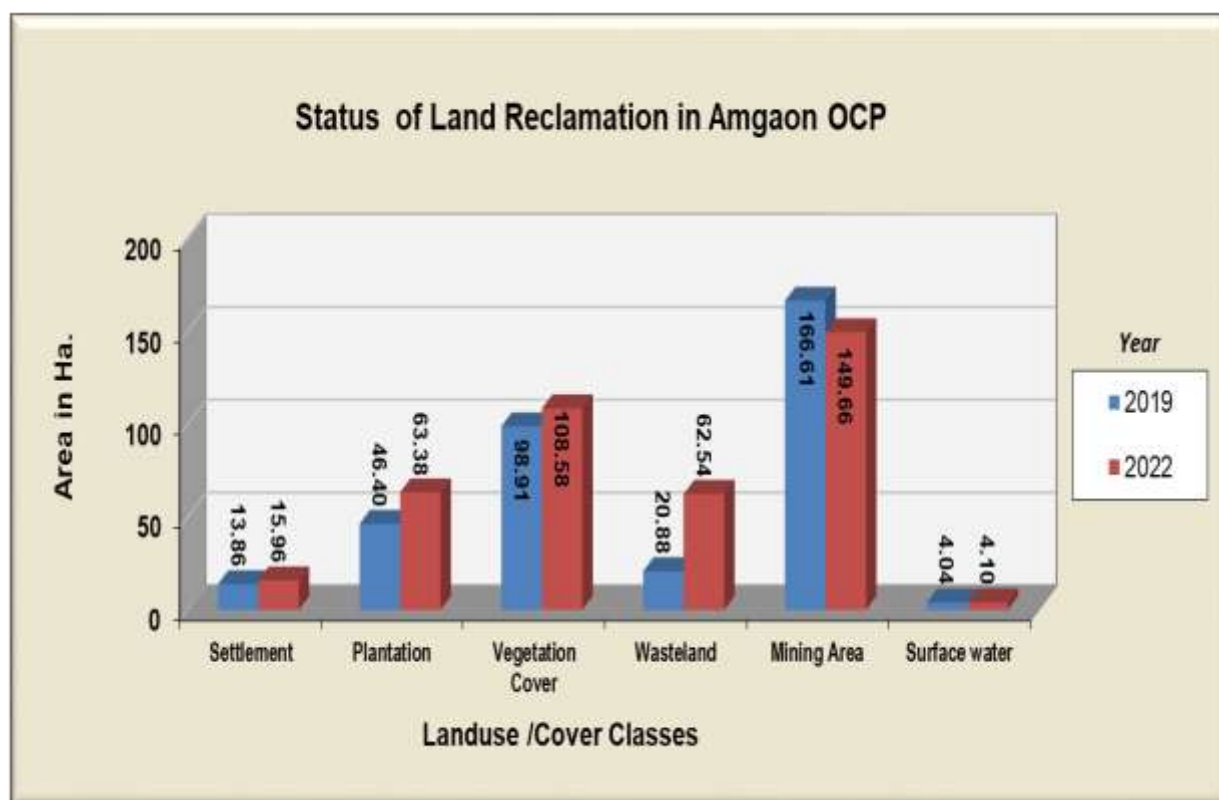


Figure- 6.4

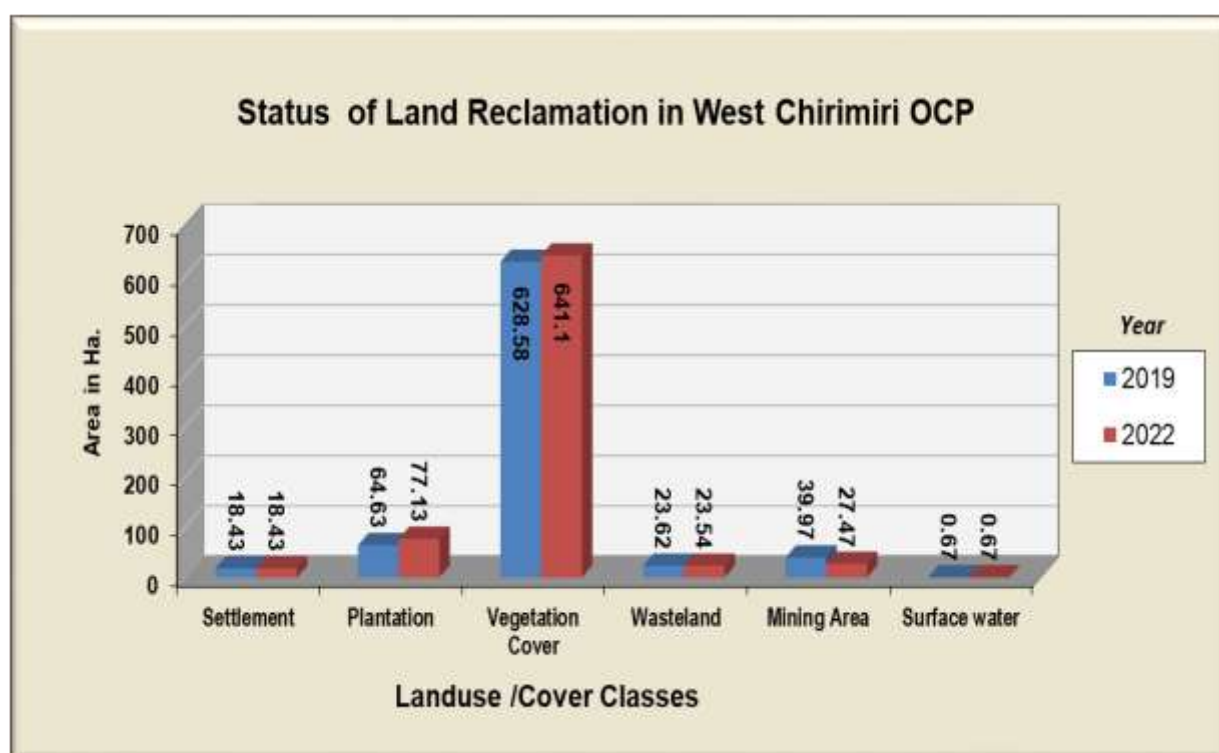


Figure- 6.5



Photo-6.1: Plantation on Backfill in Kotma OCP



Photo-6.2: Plantation on OB in Mahan OCP



Photo-6.3: Plantation on Backfill in Mahan OCP



Photo-6.4: Overview of Amgaon OCP



Photo-6.5: Plantation on Backfill in Amgaon OCP



Photo-6.6: Plantation on Backfill Area West Chirimiri OCP

CENTRAL COALFIELDS LIMITED

7.0 Land Reclamation Status in Central Coalfields Limited

7.1 Following 12 OC Projects of CCL producing less than 5 million m³ (Coal +OB) annually were taken up for Land Reclamation monitoring based on satellite data of the year 2022.

- Ara
- Bhurkunda
- Pichri
- Pindra
- Sirka
- Dhori
- Bokaro
- Kargali
- Rajhara
- Religera
- Sarubera
- Kedla

7.2 Project wise land reclamation status in CCL is given in Table 7.1 and also shown graphically in Fig 7.1. Area statistics of different land use classes present in the mine leasehold of the above projects for the year 2022 are shown in Table 7.2. Land use maps derived from the satellite data are shown in Plate 7.1 – 7.12. Different land use classes based on satellite data are depicted in bar charts in Fig. 7.2 – 7.13.

7.3 Study reveals that out of total mine leasehold area of 6826.61 hectares of the 12 OC projects of CCL mentioned above taken for this study in 2022-23; total excavated area is 1313.09 hectares, out of which 300.16 hectare area (22.86%) has been planted (*Biologically Reclaimed*), 403.18 hectare area (30.70%) is under backfilling (*Technically Reclaimed*) and balance 609.75 hectares (46.44%) is under active mining. There is an increase of 214.64

hectare in overall area under reclamation in the above projects of CCL as compared to previous study undertaken in the year 2019-20.

- 7.4** This increase of 168.38 Hectare in area under reclamation includes both 121.66 Ha increase in plantation on backfill (Biological Reclamation) and 92.98 Ha increase in area under backfilling (Technical reclamation).
- 7.5** Study indicates that overall all the projects of CCL considered for this study indicate increase or static trend in area under backfilling (Technical Reclamation) with respect to the year 2019 except in Kedla OC where area under technical reclamation has reduced from 90.56 hectare in the year 2021 to 83.28 hectare in the year 2022 resulting which area under reclamation has reduced from 90.56 Ha to 83.28 Ha. This decrease of 7.28 hectare area under backfilling in Kedla OC is due to some of the area under backfilling has been reclassified.
- 7.6** There has been increase in area under plantation on backfill (Biological Reclamation) in all projects of CCL considered for this study in the year 2022 except in Dhoru OC and Bhurkunda OC where minor decrease of 1.78 Hectare area under biological reclamation in Dhoru OC and 0.06 Hectare in Bhurkunda OC in the span of three year is due to expansion of mining area. Plantation on backfill (Biological Reclamation) in Ara OC, Pichri OC, Pindra OC Rajhara OC, Religera OC and Sarubera OC has not been started as yet. However, overall increase in Biological Reclamation is estimated to 300.16 hectare in the year 2022 as compared to 178.50 hectare in the year 2019.
- 7.7** After analysing the satellite data of the year 2019 and 2022, it is evident that total area under plantation (Green cover) carried out on backfill area, OB dumps as well as under social forestry in all the mines of CCL has increased from 889.65 Ha to 943.79 Ha in span of last three years. This increase of 54.14 Hectare area of plantation (Green cover) in three years is due to sincere effort of CCL towards mine land reclamation and environment protection.

- 7.8** The minor decrease of 1.78 Ha area under plantation on backfill in Dhorī OC is due to increase in active mining area.
- 7.9** Out of 12 projects of CCL taken for this study, Bokaro OCP ranks on top for land reclamation (73.94%) followed by Kargali OCP (70.86%) and Kedla OCP(70.56%).

Table 7.1: Project wise Land Reclamation Status in Opencast Projects of CCL based on the Satellite data of the year 2022
(Area in Hectare)

SLN o.	Project	Total Leasehold Area		Technical Reclamation		Plantation						Area under Active Mining		Total Excavated Area		Total Area under Plantation (% Green Cover Generated in Leashold)		Total Area under Reclamation	
						Biological Reclamation		Other Plantations											
				Area under Backfilling		Plantation on Excavated / Backfilled Area		Plantation on External Over Burden Dumps		Social Forestry, Avuanue Plantation Etc.									
1	2	3		4		5		6		7		8		9 (=4+5+8)		10 (=5+6+7)		11(=4+5)	
		2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022
1	Ara	525.75	525.75	0.00	0.00	0.00	0.00	82.35	82.35	1.93	1.93	51.72	51.72	51.72	51.72	84.28	84.28	0.00	0.00
				0.00%	0.00%	0.00%	0.00%					100.00%	100.00%			16.03%	16.03%	0.00%	0.00%
2	Bhurkunda	910.16	910.16	32.11	31.06	41.12	41.06	86.52	89.37	99.30	103.90	77.07	90.45	150.30	162.57	226.94	234.33	73.23	72.12
				21.36%	19.11%	27.36%	25.26%					51.28%	55.64%			24.93%	25.75%	48.72%	44.36%
3	Pichri	40.13	40.13	0.00	0.00	0.00	0.00	0.00	0.00	8.25	8.25	13.19	13.19	13.19	13.19	8.25	8.25	0.00	0.00
				0.00%	0.00%	0.00%	0.00%					100.00%	100.00%			20.56%	20.56%	0.00%	0.00%
4	Pindra	326.54	326.54	0.00	0.00	0.00	0.00	0.00	0.00	5.43	4.72	29.40	31.65	29.40	31.65	5.43	4.72	0.00	0.00
				0.00%	0.00%	0.00%	0.00%					100.00%	100.00%			1.66%	1.45%	0.00%	0.00%
5	Sirka	362.40	362.40	22.02	22.69	2.96	5.96	0.00	0.00	6.07	6.07	65.74	70.75	90.72	99.40	9.03	12.03	24.98	28.65
				24.27%	22.83%	3.26%	6.00%					72.46%	71.18%			2.49%	3.32%	27.54%	28.82%
6	Dhori	294.32	294.32	30.53	30.63	14.48	12.70	14.30	17.43	0.00	5.68	21.76	29.39	66.77	72.72	28.78	35.81	45.01	43.33
				45.72%	42.12%	21.69%	17.46%					32.59%	40.42%			9.78%	12.17%	67.41%	59.58%
7	Bokaro ⁵	607.30	775.00	58.84	90.04	97.96	124.44	13.22	16.94	58.79	79.67	60.72	75.61	217.52	290.09	169.97	221.05	156.80	214.48
				27.05%	31.04%	45.03%	42.90%					27.91%	26.06%			27.99%	28.52%	72.09%	73.94%
8	Kargali [^]	785.00	710.43	29.97	93.78	1.74	83.41	106.89	14.24	85.70	82.85	78.18	73.01	109.89	250.20	194.33	180.50	31.71	177.19
				27.27%	37.48%	1.58%	33.34%					71.14%	29.18%			24.76%	25.41%	28.86%	70.82%
9	Rajhara	736.36	736.36	8.66	8.66	0.00	0.00	7.63	7.63	2.27	2.27	32.27	32.27	40.93	40.93	9.90	9.90	8.66	8.66
				21.16%	21.16%	0.00%	0.00%					78.84%	78.84%			1.34%	1.34%	21.16%	21.16%
10	Religera	301.75	301.75	36.02	41.55	0.00	0.00	8.90	9.95	33.02	32.32	60.21	61.17	96.23	102.72	41.92	42.27	36.02	41.55
				37.43%	40.45%	0.00%	0.00%					62.57%	59.55%			13.89%	14.01%	37.43%	40.45%
11	Sarubera	686.35	686.35	1.49	1.49	0.00	0.00	50.50	50.46	6.01	6.01	29.17	32.19	30.66	33.68	56.51	56.47	1.49	1.49
				4.86%	4.42%	0.00%	0.00%					95.14%	95.58%			8.23%	8.23%	4.86%	4.42%
12	Kedla*	1157.42	1157.42	90.56	83.28	20.24	32.59	32.61	20.24	1.46	1.35	47.60	48.35	158.40	164.22	54.31	54.18	110.80	115.87
				57.17%	50.71%	12.78%	19.85%					30.05%	29.44%			4.69%	4.68%	69.95%	70.56%
TOTAL		6733.48	6826.61	310.20	403.18	178.50	300.16	402.92	308.61	308.23	335.02	567.03	609.75	1055.73	1313.09	889.65	943.79	488.70	703.34
				29.38%	30.70%	16.91%	22.86%					53.71%	46.44%			13.03%	13.83%	46.29%	53.56%

(% is calculated with respect to Excavated Area as applicable)

*Newly listed for year 2022-23. Lastly done for year 2021

⁵^Change in area for year 2022-23

Note: In reference to above table different parameters as classified as follows:

1. Area under Biological Reclamation includes Area under plantation done on Backfilled Area only.
2. Area under Technical Reclamation includes Area under Backfill only.
3. Area under Active mining includes Coal Quarry, Advance Quarry site and Quarry filled with water etc if any.
4. Social Forestry and Plantation on External OB Dumps are not included in Biological Reclamation and are put under separate categories as shown in above Table.
5. (%) calculated in above Table is in respect to Total Excavated area except for " Total Area under plantation " where % is in terms of "Leasehold Area ".

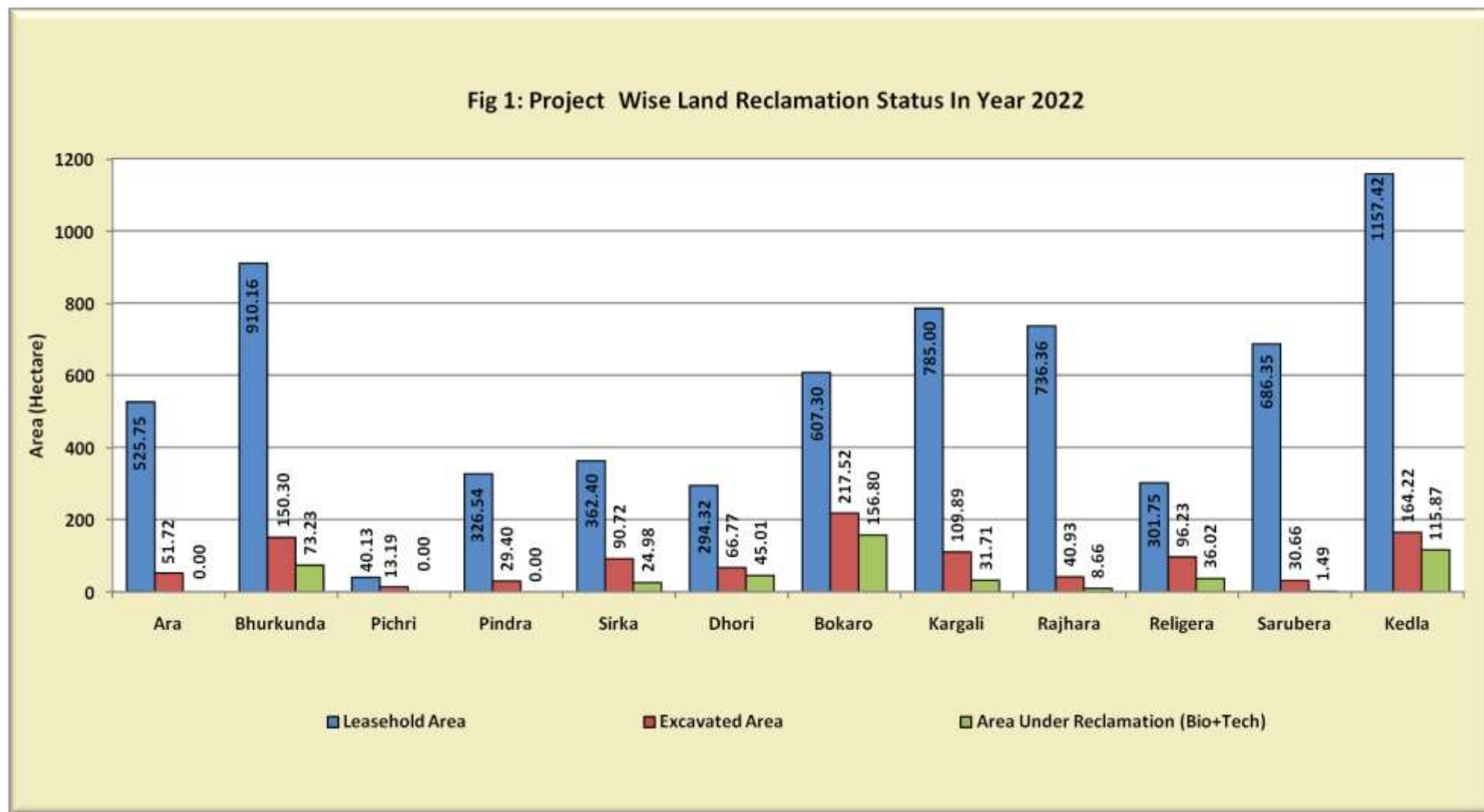
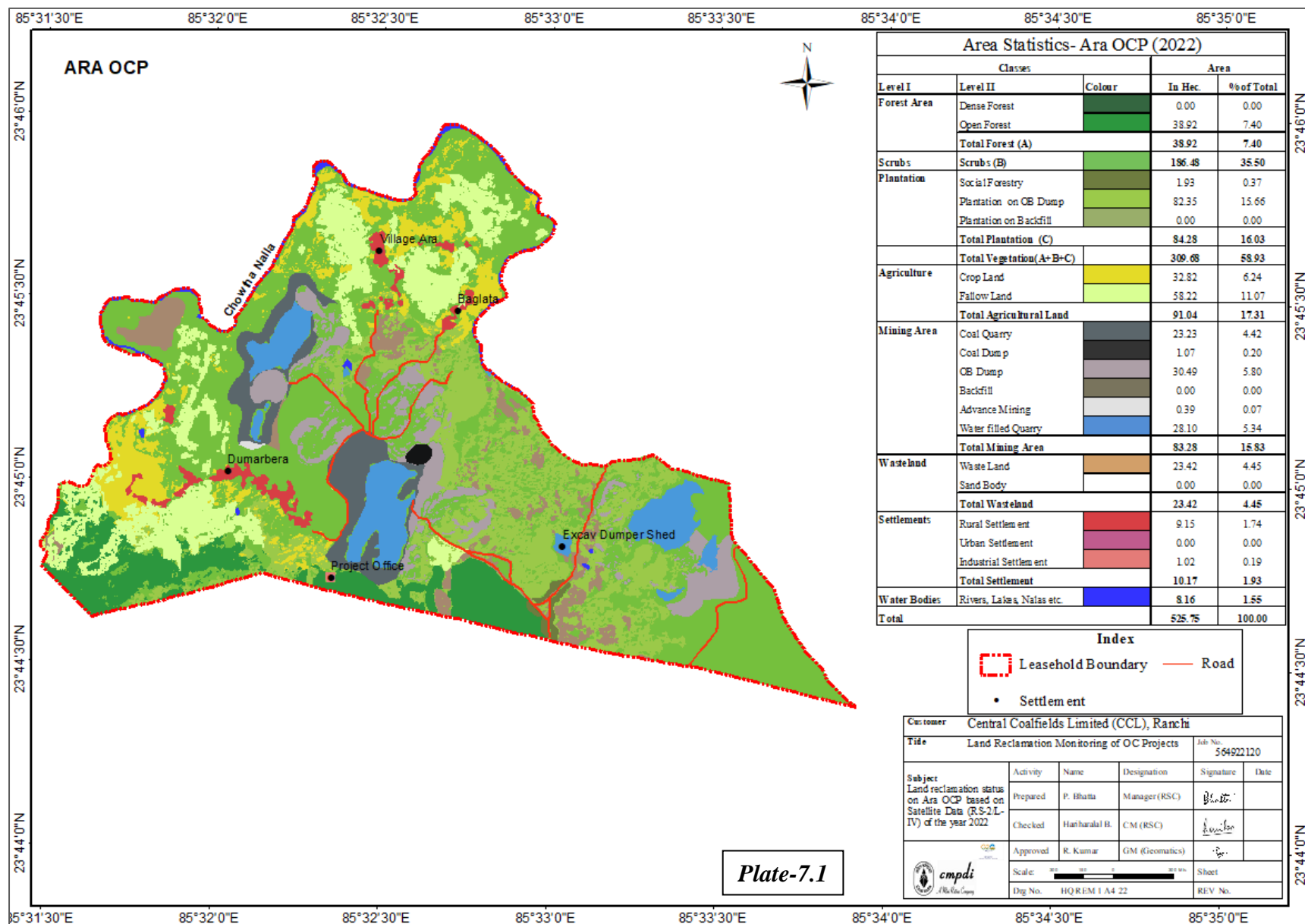


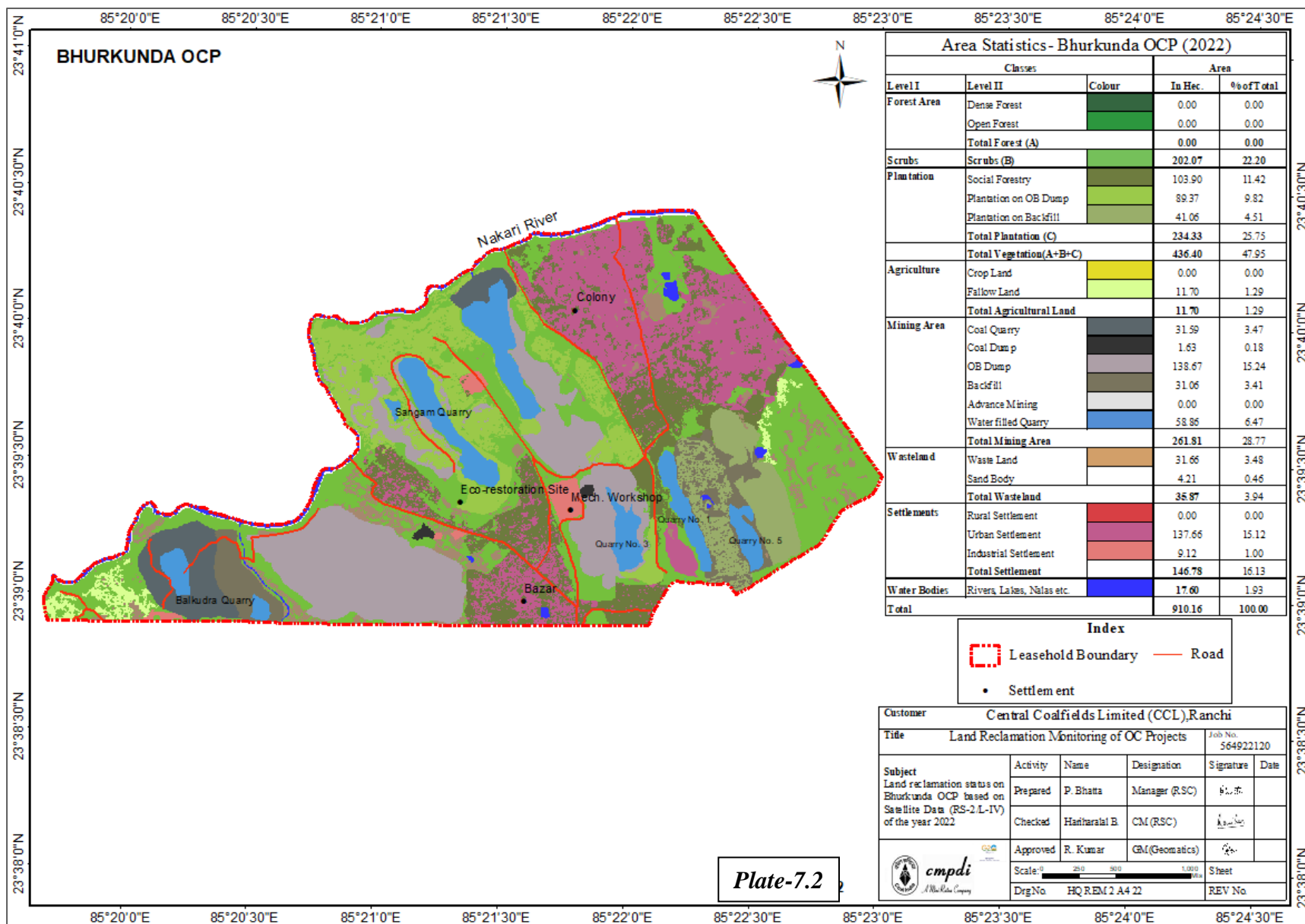
Figure 7.1: Land Reclamation status in OC projects producing less than 5mcm (Coal+ OB) of CCL in the year-2022

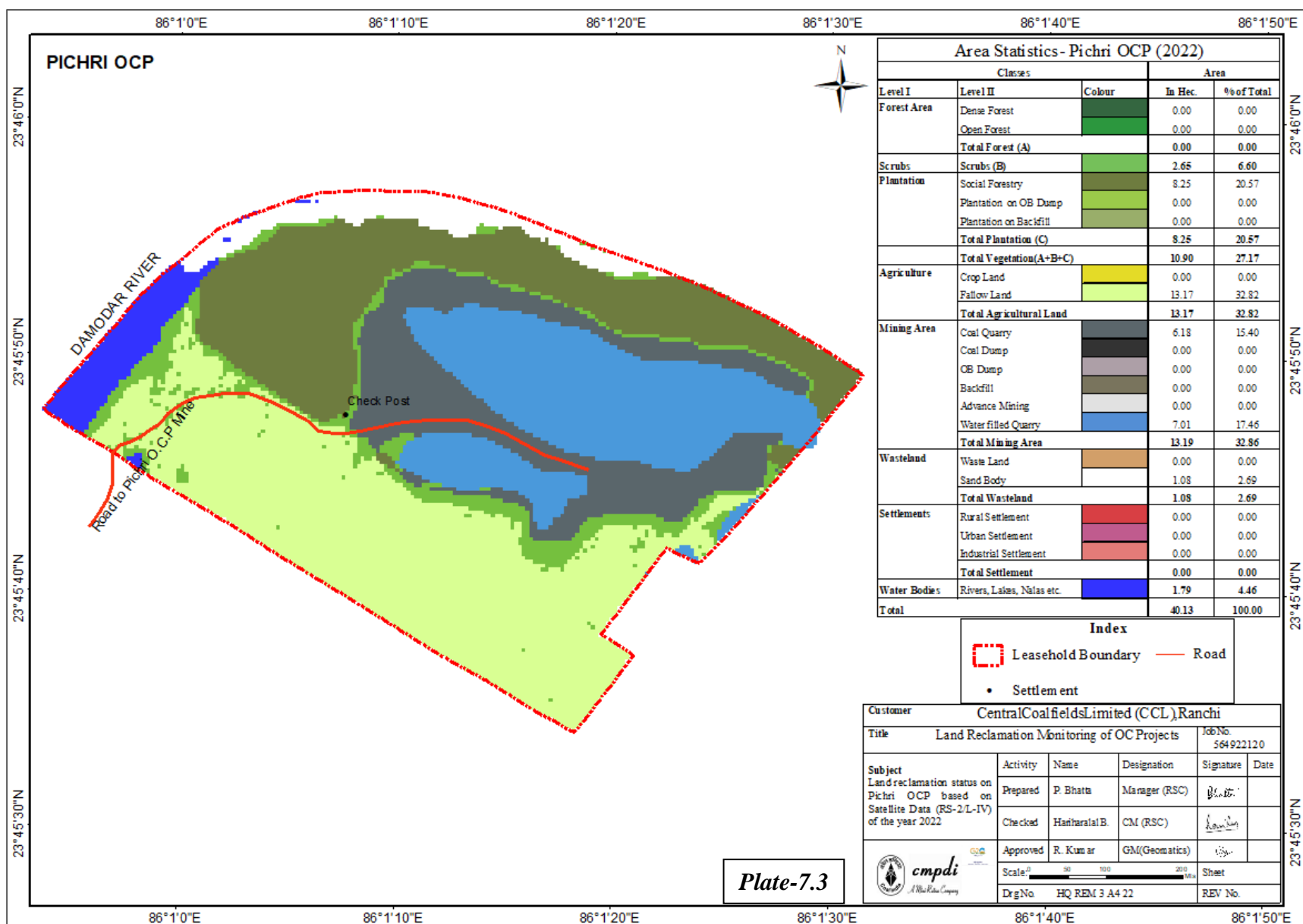
TABLE: 7.1 PROJECT WISE AREA STATISTICS OF LAND USE/ COVER CLASSES IN PROJECTS OF CCL BASED ON SATELLITE DATA OF THE YEAR 2022

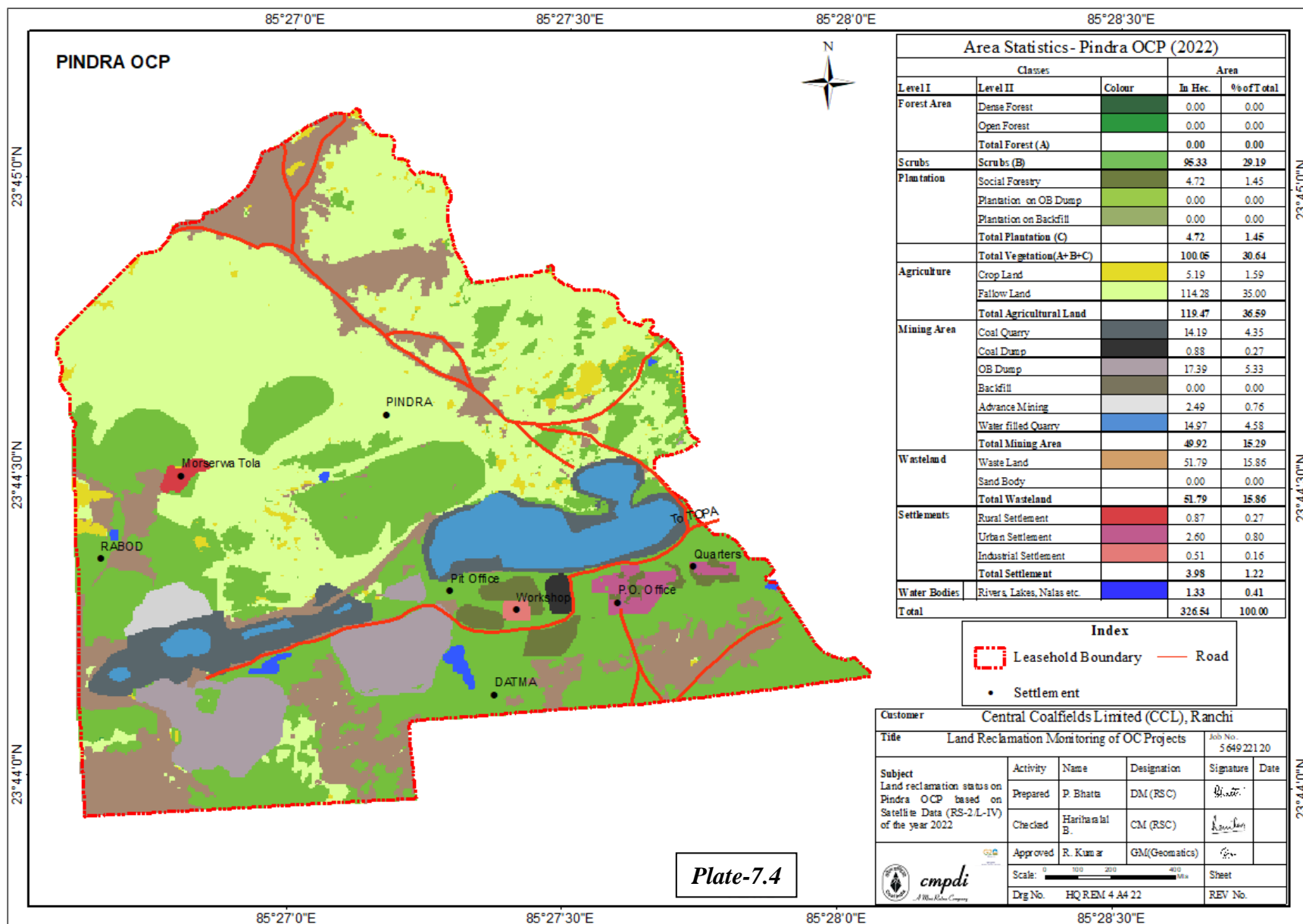
(Area in Hectare)

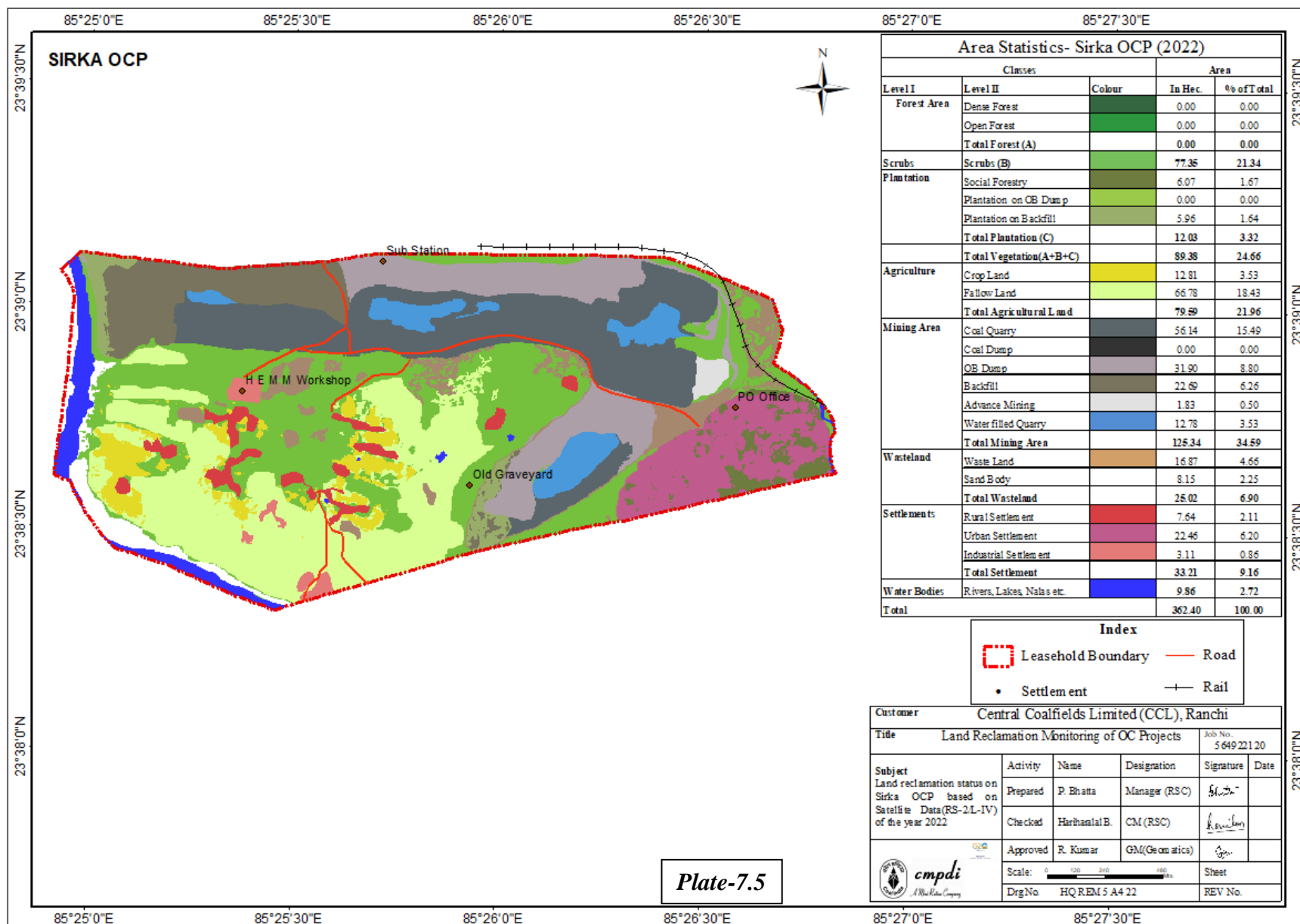
		ARA		BHURKUNDA		PICHRI		PINDRA		SIRKA		DHORI		BOKARO		KARGALI		RAJHARA		RELIGERA		SARUBERA		KEDLA		(Area in Hectare)		TOTAL	
FORESTS		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
	Dense Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Open Forest	38.92	7.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.69	1.59	0.00	0.00	54.32	7.91	174.07	15.04	279.00	4.09	
	Total Forest (A)	38.92	7.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.69	1.59	0.00	0.00	54.32	7.91	174.07	15.04	279.00	4.09	
SCRUBS	Scrubs (B)	186.48	35.50	202.07	22.20	2.65	6.60	95.33	29.19	77.35	21.34	79.51	27.01	127.09	16.39	118.78	16.72	215.75	29.29	62.14	20.59	132.18	19.26	375.41	32.44	1674.74	24.53		
PLANTATION	Social Forestry	1.93	0.37	103.90	11.42	8.25	20.57	4.72	1.45	6.07	1.67	5.68	1.93	79.67	10.28	82.85	11.66	2.27	0.31	32.32	10.71	6.01	0.88	1.35	0.12	335.02	4.91		
	Plantation on External OB Dump	82.35	15.66	89.37	9.82	0.00	0.00	0.00	0.00	0.00	0.00	17.43	5.92	16.94	2.19	14.24	2.00	7.63	1.04	9.95	3.30	50.46	7.35	20.24	1.75	308.61	4.52		
	Plantation on Backfill (Biological Reclamation)	0.00	0.00	41.06	4.51	0.00	0.00	0.00	0.00	5.96	1.64	12.70	4.32	124.44	16.06	83.41	11.74	0.00	0.00	0.00	0.00	0.00	0.00	32.59	2.82	300.16	4.40		
	Total Plantation (Green Cover) (C)	84.28	16.03	234.33	25.75	8.25	20.57	4.72	1.45	12.03	3.32	35.81	12.17	221.05	28.52	180.50	25.41	9.90	1.35	42.27	14.01	56.47	8.23	54.18	4.68	943.79	13.83		
	Total Vegetation (A+B+C)	309.68	58.93	436.40	47.95	10.90	27.17	100.05	30.64	89.38	24.66	115.32	39.18	348.14	44.91	299.28	42.13	237.34	32.23	104.41	34.60	242.97	35.40	603.66	52.16	2897.53	42.44		
ACTIVE MINING	Coal Dump	1.07	0.20	1.63	0.18	0.00	0.00	0.88	0.27	0.00	0.00	0.96	0.33	0.00	0.00	6.18	0.87	1.83	0.25	4.03	1.34	0.00	0.00	7.00	0.60	23.58	0.35		
	Coal Quarry	23.23	4.42	31.59	3.47	6.18	15.40	14.19	4.35	56.14	15.49	6.75	2.29	6.38	0.82	24.19	3.40	13.47	1.83	38.80	12.86	14.18	2.07	24.94	2.15	260.04	3.81		
	Advance Quarry Site	0.39	0.07	0.00	0.00	0.00	0.00	2.49	0.76	1.83	0.50	0.00	0.00	0.00	0.00	8.23	1.16	0.00	0.00	1.76	0.58	0.00	0.00	1.11	0.10	15.81	0.23		
	Quarry Filled with Water	28.10	5.34	58.86	6.47	7.01	17.46	14.97	4.58	12.78	3.53	22.64	7.69	69.23	8.94	40.59	5.71	18.80	2.55	20.61	6.83	18.01	2.62	22.30	1.93	333.90	4.89		
	Total Area under Active Mining	51.72	9.83	90.45	9.94	13.19	32.86	31.65	9.69	70.75	19.52	29.39	9.99	75.61	9.77	73.01	10.28	32.27	4.38	61.17	20.28	32.19	4.69	48.35	4.18	609.75	8.93		
	Barren OB dump	30.49	5.80	138.67	15.24	0.00	0.00	17.39	5.33	31.90	8.80	6.25	2.12	8.31	1.07	59.28	8.34	4.89	0.66	50.05	16.59	53.08	7.73	25.55	2.21	425.86	6.24		
	Area Under Backfilling (Technical Reclamation)	0.00	0.00	31.06	3.41	0.00	0.00	0.00	0.00	22.69	6.26	30.63	10.41	90.04	11.62	93.78	13.20	8.66	1.18	41.55	13.77	1.49	0.22	83.28	7.20	403.18	5.91		
	Total Area under Mine Operation	83.28	15.83	261.81	28.77	13.19	32.86	49.92	15.29	125.34	34.59	67.23	22.84	173.96	22.46	232.25	32.69	47.65	6.47	156.80	51.96	86.76	12.64	164.18	14.18	1462.37	21.42		
WASTELANDS	Waste Lands	23.42	4.45	31.66	3.48	0.00	0.00	51.79	15.86	16.87	4.66	8.27	2.81	15.14	1.95	9.66	1.36	140.65	19.10	3.08	1.02	160.34	23.36	75.20	6.50	536.08	7.85		
	Fly Ash Pond/Sand Body	0.00	0.00	4.21	0.46	1.08	2.69	0.00	0.00	8.15	2.25	4.97	1.69	41.11	5.30	0.00	0.00	26.82	3.64	0.00	0.00	0.00	0.00	0.66	0.06	87.00	1.27		
	Total Wastelands	23.42	4.45	35.87	3.94	1.08	2.69	51.79	15.86	25.02	6.90	13.24	4.50	56.25	7.26	9.66	1.36	167.47	22.74	3.08	1.02	160.34	23.36	75.86	6.55	623.08	9.13		
WATER	Reservoir, nallah, ponds etc.	8.16	1.55	17.60	1.93	1.79	4.46	1.33	0.41	9.86	2.72	5.21	1.77	41.24	5.32	2.59	0.36	26.64	3.62	0.38	0.13	5.77	0.84	16.51	1.43	137.08	2.01		
	Total Waterbodies	8.16	1.55	17.60	1.93	1.79	4.46	1.33	0.41	9.86	2.72	5.21	1.77	41.24	5.32	2.59	0.36	26.64	3.62	0.38	0.13	5.77	0.84	16.51	1.43	137.08	2.01		
AGRICULTURE	Crop Lands	32.82	6.24	0.00	0.00	0.00	0.00	5.19	1.59	12.81	3.53	0.00	0.00	0.00	0.00	0.00	0.00	55.93	7.60	0.00	0.00	29.38	4.28	1.48	0.13	137.61	2.02		
	Fallow Lands	58.22	11.07	11.70	1.29	13.17	32.82	114.28	35.00	66.78	18.43	7.44	2.53	85.18	10.99	3.82	0.54	150.88	20.49	4.73	1.57	136.14	19.84	225.48	19.48	877.82	12.86		
	Total Agriculture	91.04	17.31	11.70	1.29	13.17	32.82	119.47	36.59	79.59	21.96	7.44	2.53	85.18	10.99	3.82	0.54	206.81	28.09	4.73	1.57	165.52	24.12	226.96	19.61	1015.43	14.87		
SETTLEMENTS	Urban Settlement	0.00	0.00	137.66	15.12	0.00	0.00	2.60	0.80	22.46	6.20	78.10	26.54	46.56	6.01	121.28	17.07	0.00	0.00	12.26	4.06	0.00	0.00	26.71	2.31	447.63	6.56		
	Rural Settlement	9.15	1.74	0.00	0.00	0.00	0.00	0.87	0.27	7.64	2.11	5.60	1.90	21.65	2.79	19.38	2.73	49.36	6.70	17.47	5.79	9.23	1.34	32.39	2.80	172.74	2.53		
	Industrial Settlement	1.02	0.19	9.12	1.00	0.00	0.00	0.51	0.16	3.11	0.86	2.18	0.74	2.02	0.26	22.17	3.12	1.09	0.15	2.62	0.87	15.76	2.30	11.15	0.96	70.75	1.04		
	Total Settlements	10.17	1.93	146.78	16.13	0.00	0.00	3.98	1.22	33.21	9.16	85.88	29.18	70.23	9.06	162.83	22.92	50.45	6.85	32.35	10.72	24.99	3.64	70.25	6.07	691.12	10.12		
	GRAND TOTAL	525.75	100.00	910.16	100.00	40.13	100.00	326.54	100.00	362.40	100.00	294.32	100.00	775.00	100.00	710.43	100.00	736.36	100.00	301.75	100.00	686.35	100.00	1157.42	100.00	6826.61	100.00		

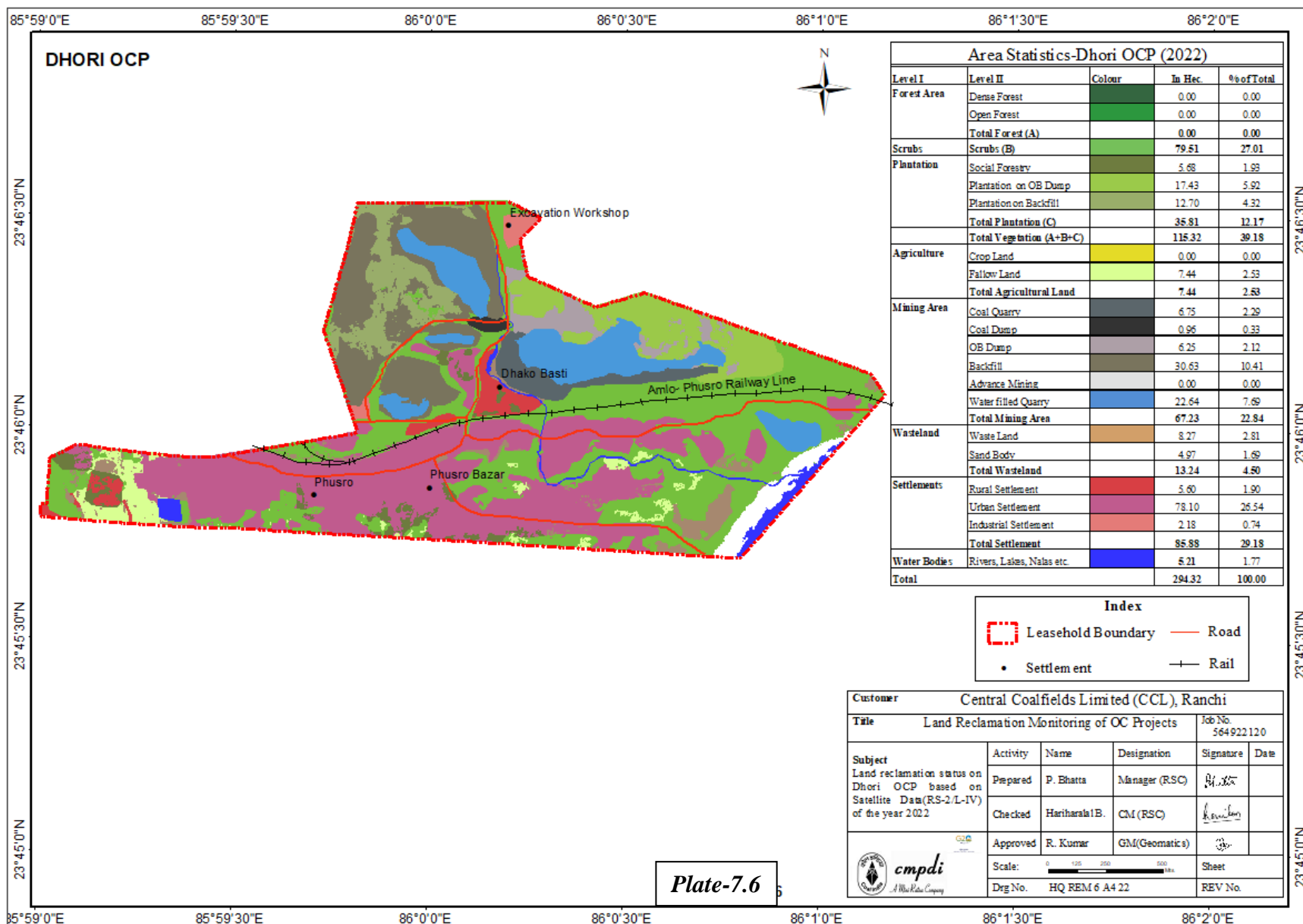


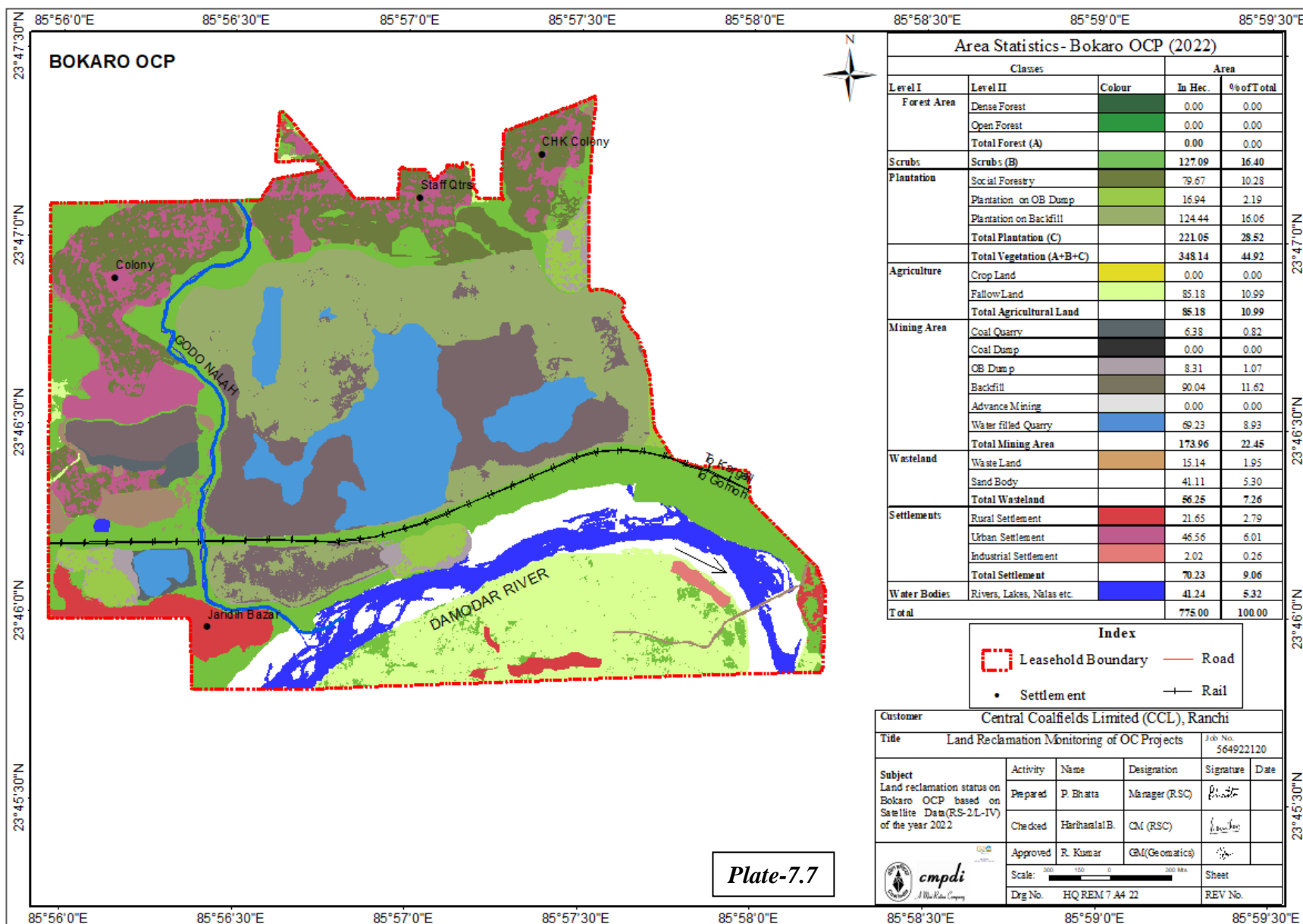


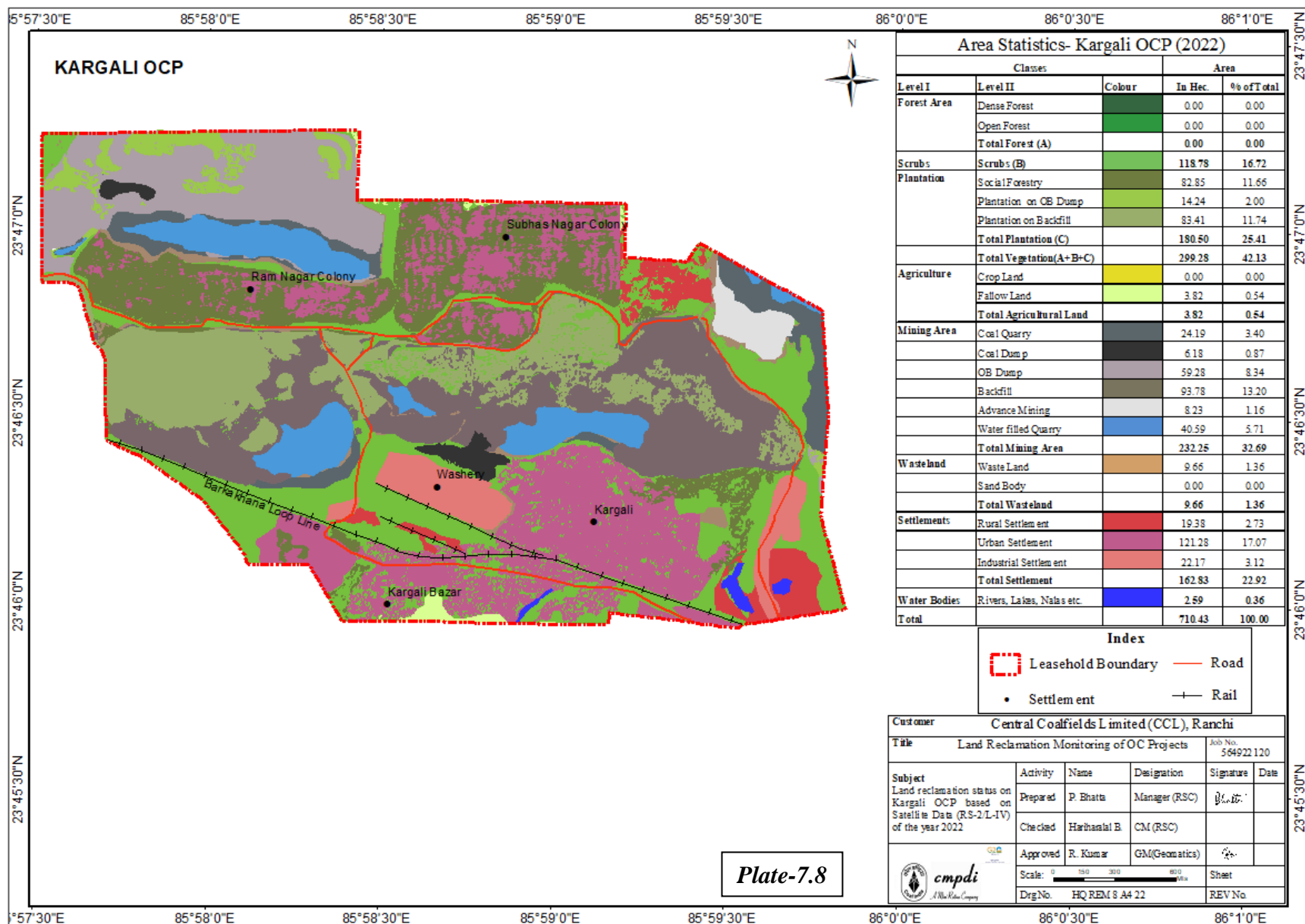


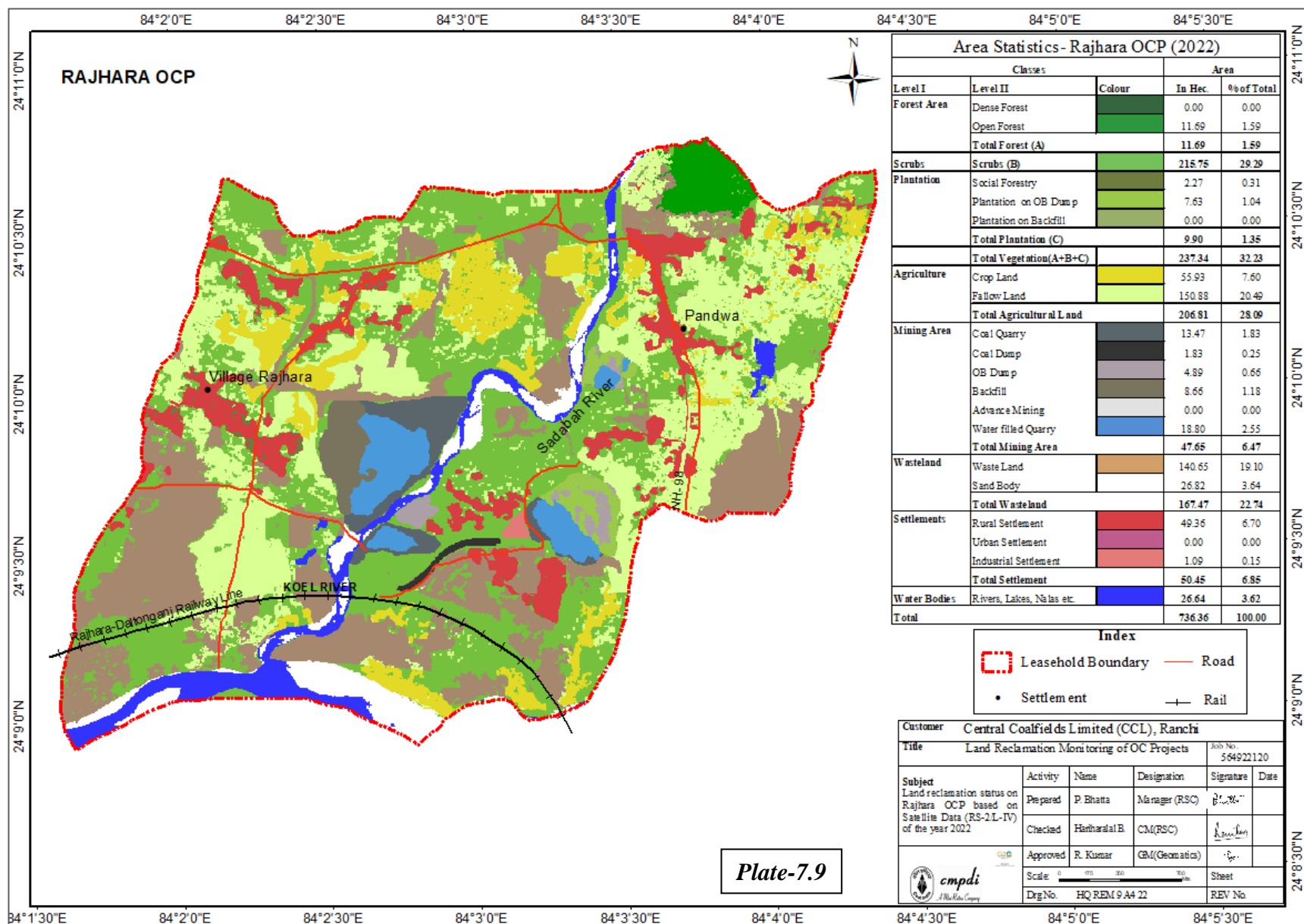


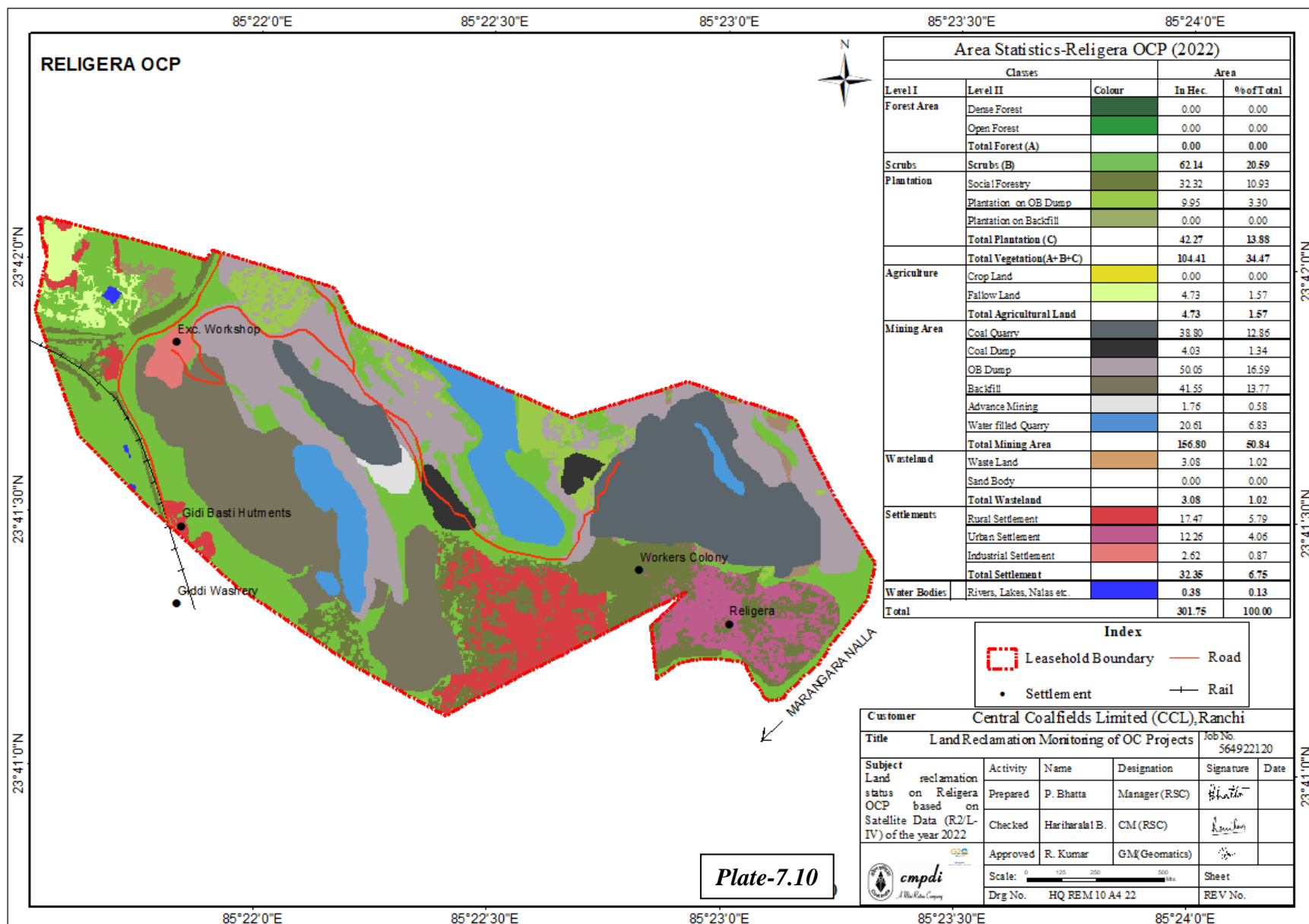


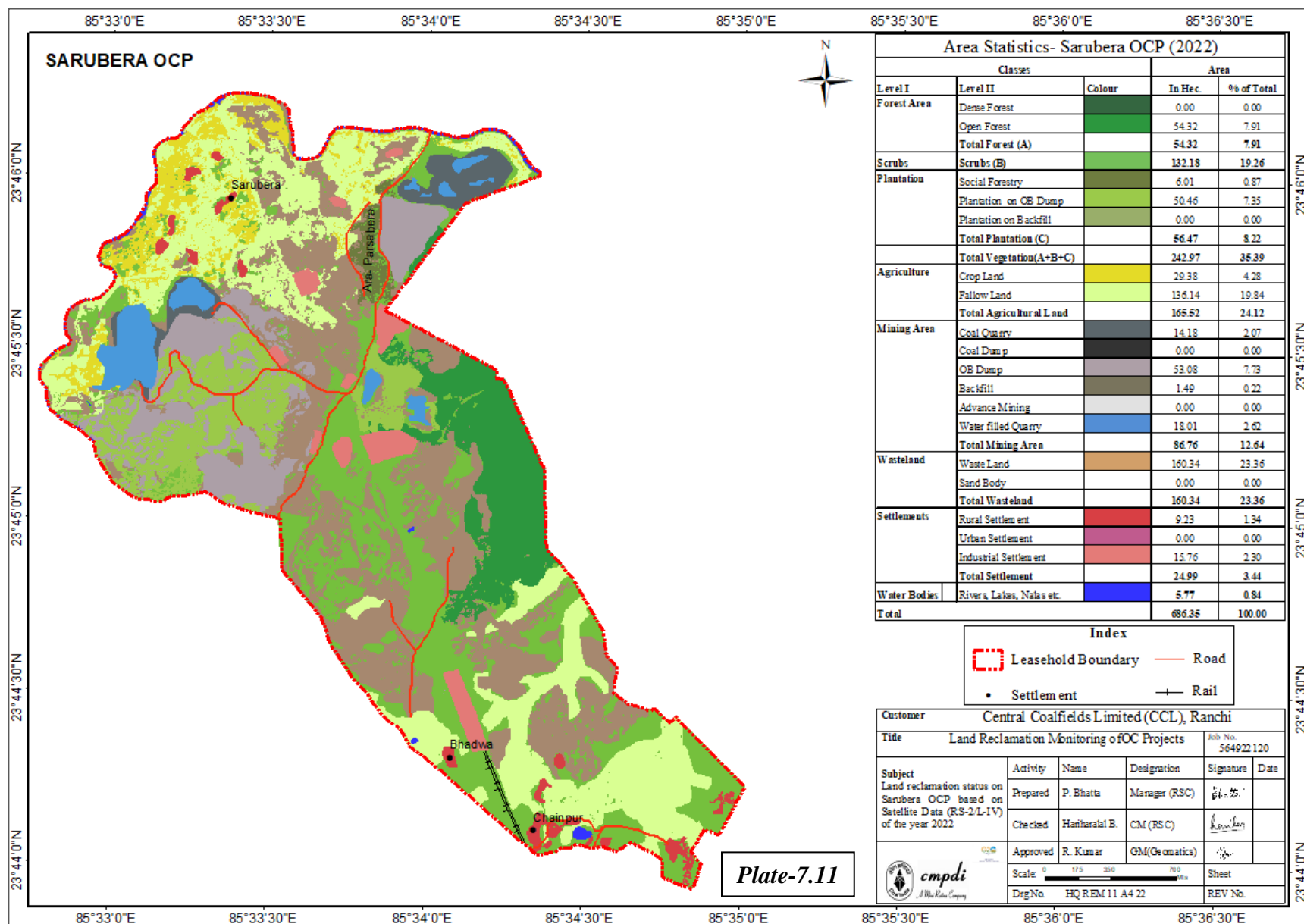


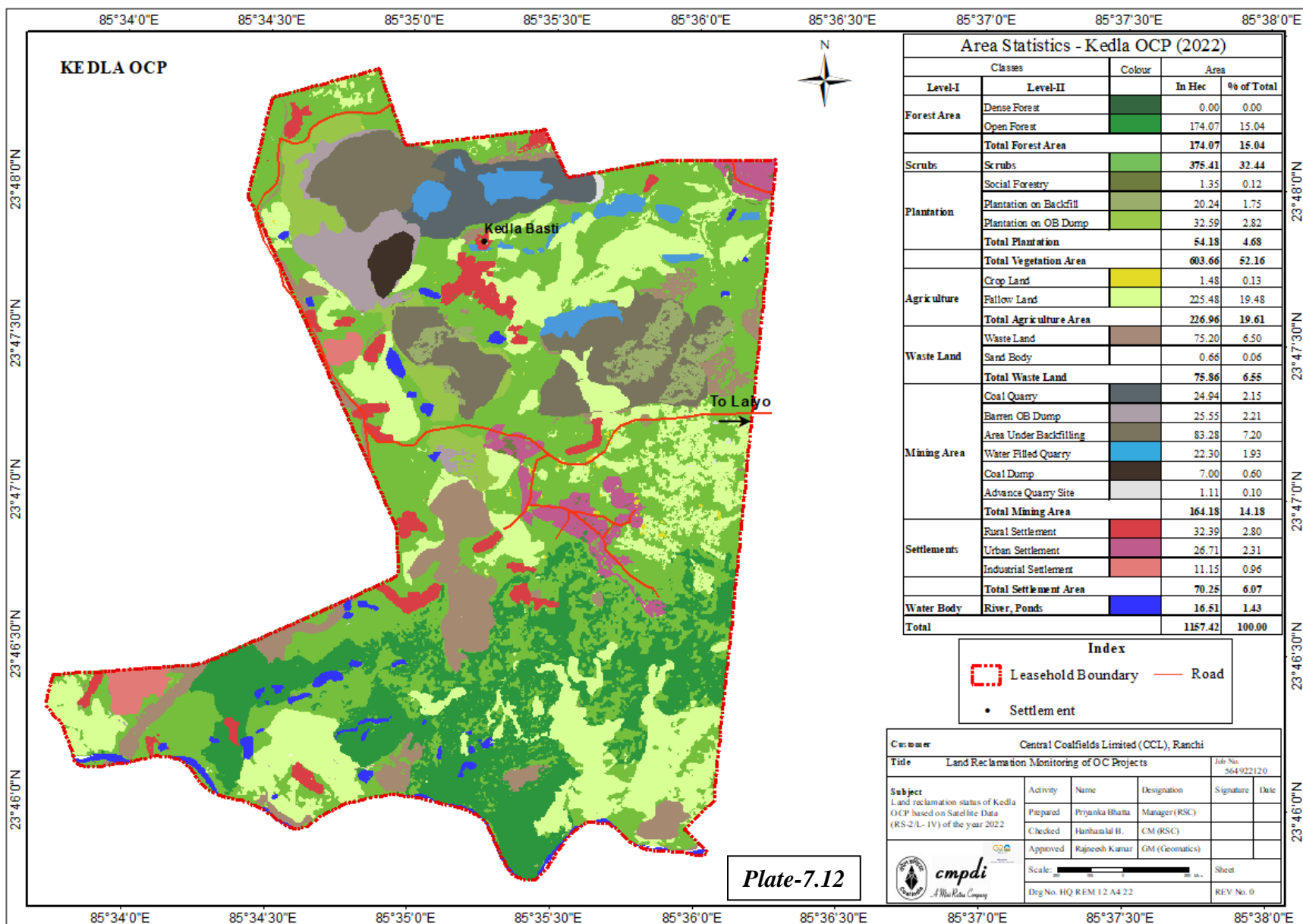












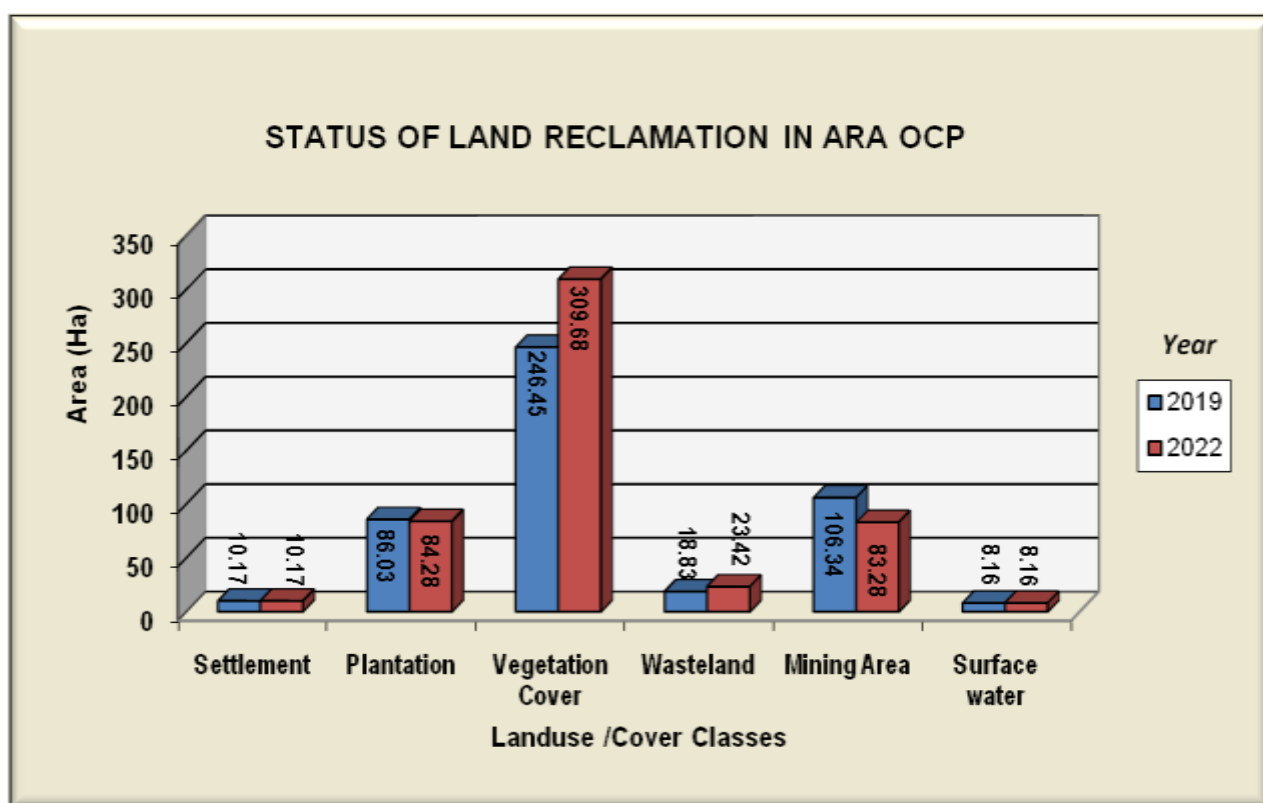


Figure- 7.2

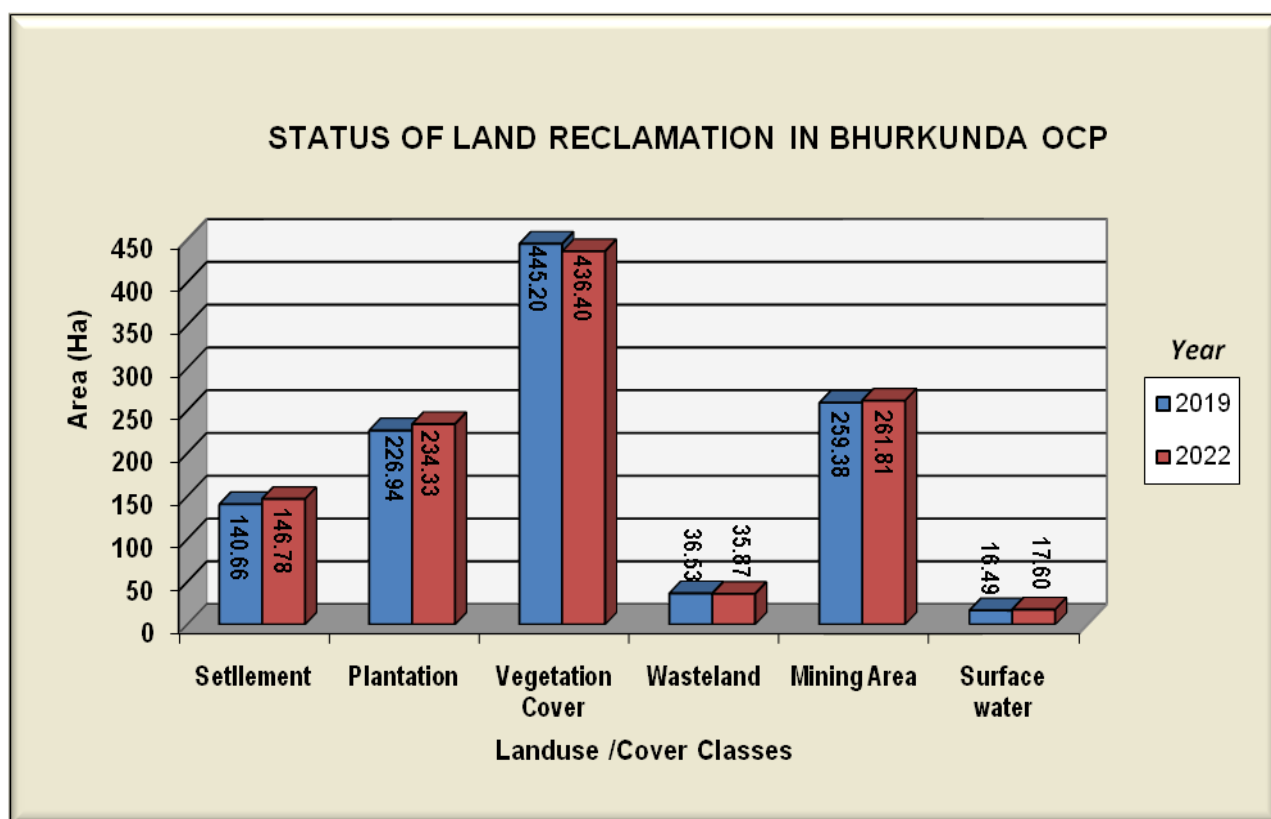


Figure- 7.3

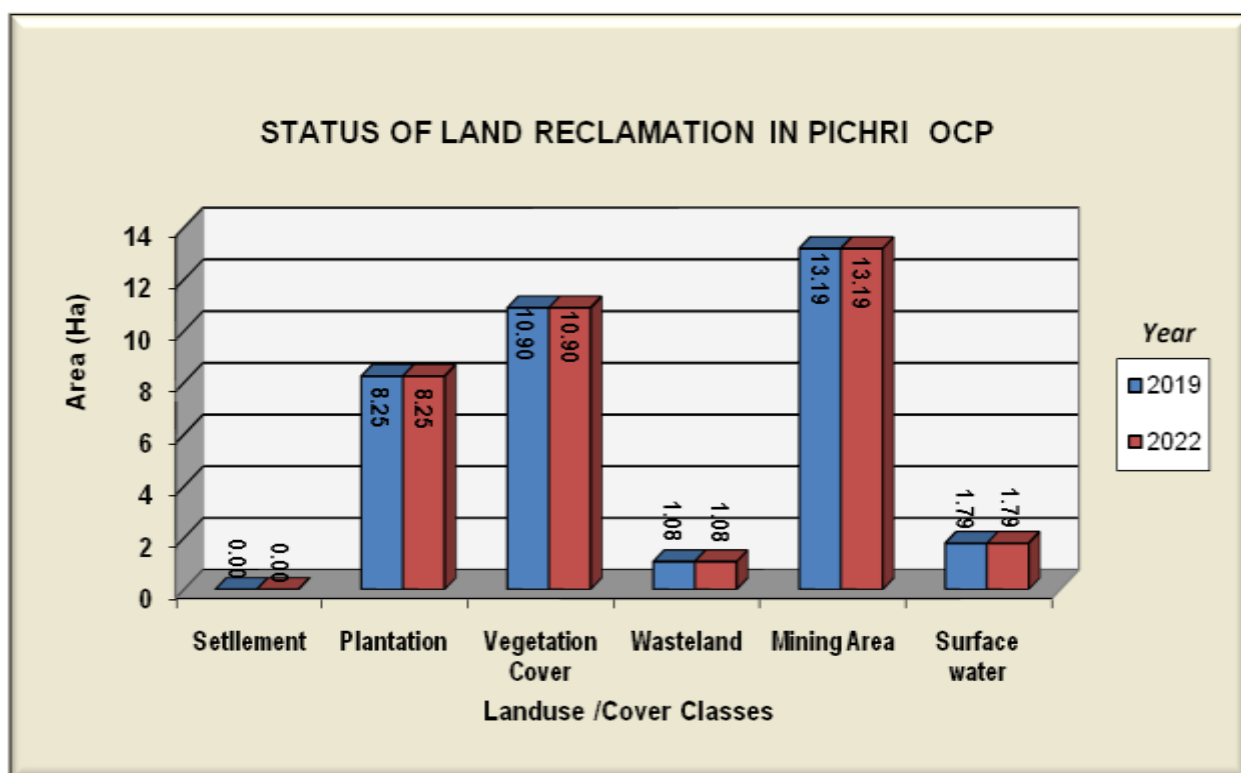


Figure- 7.4

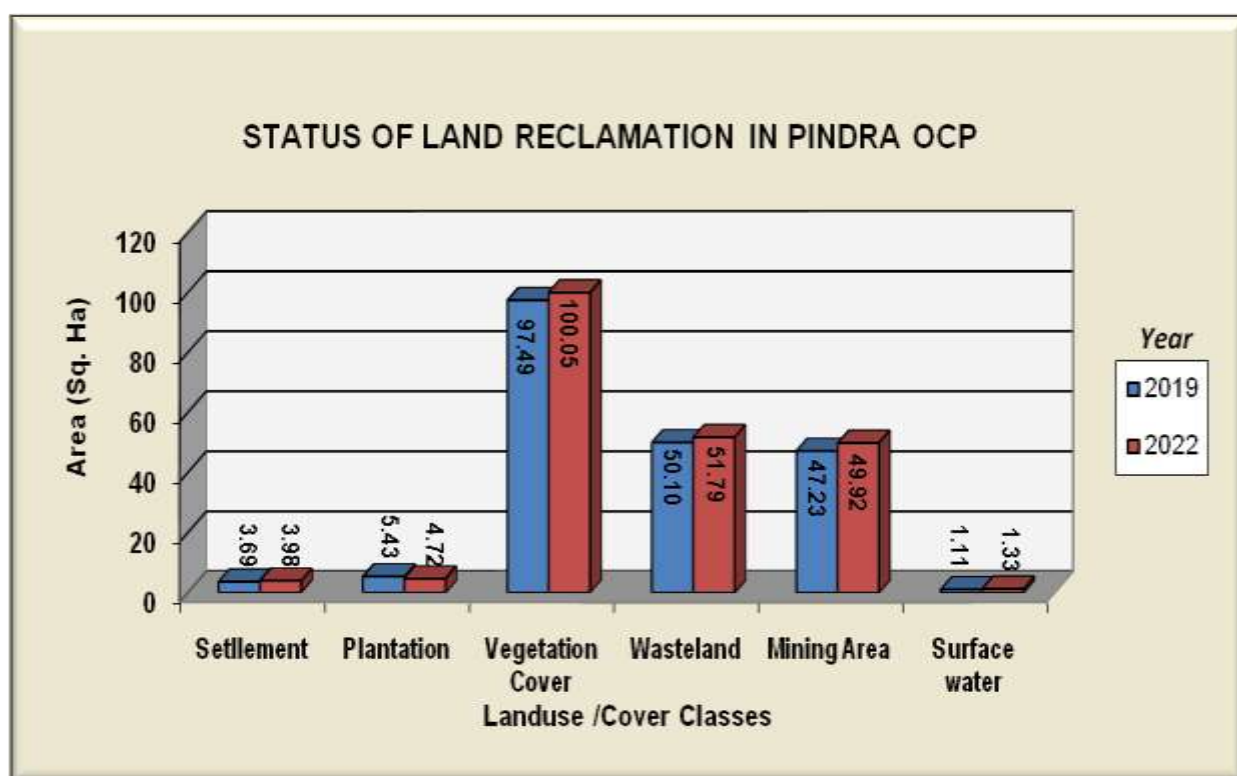


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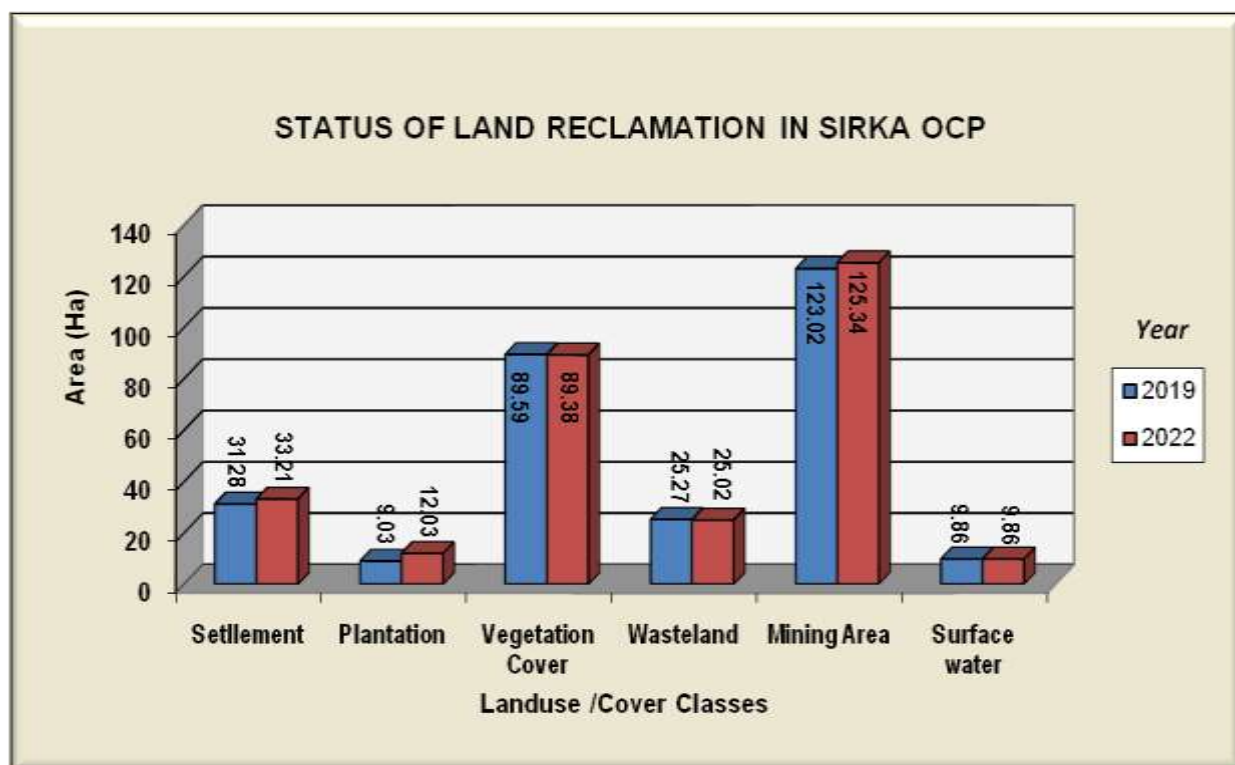


Figure- 7.6

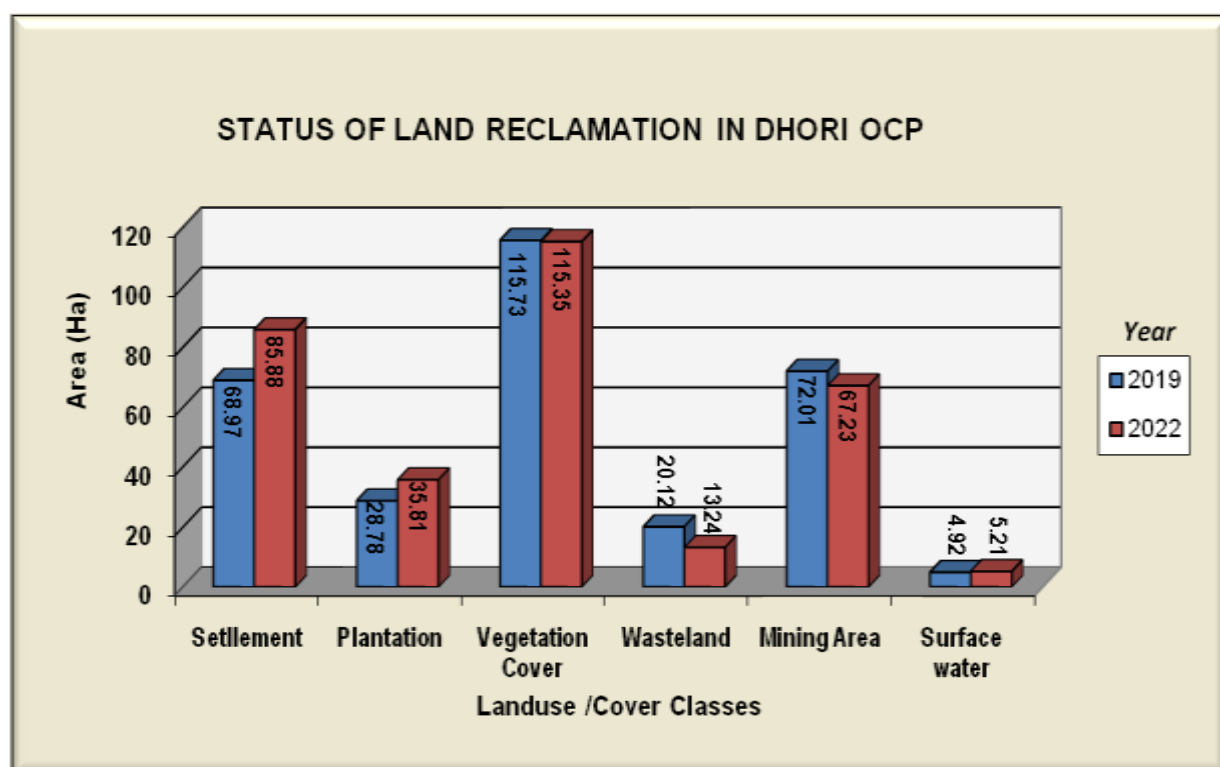


Figure- 7.7

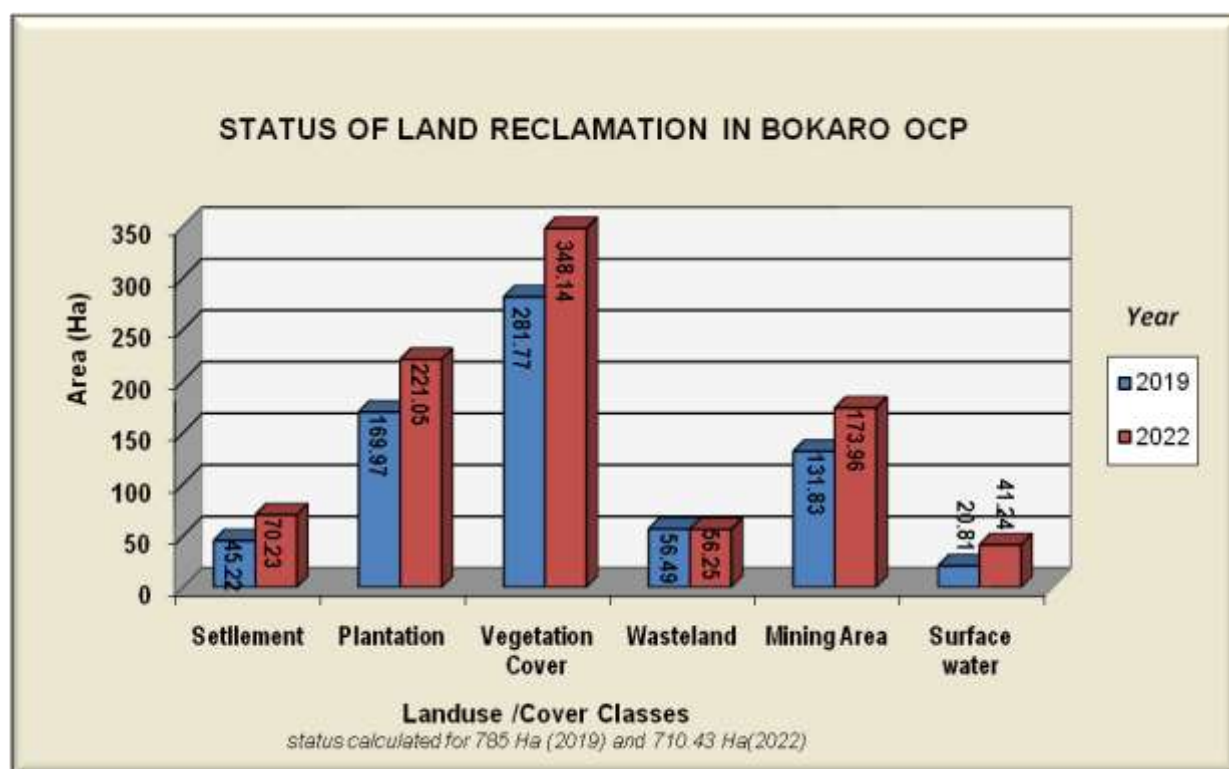


Figure- 7.8

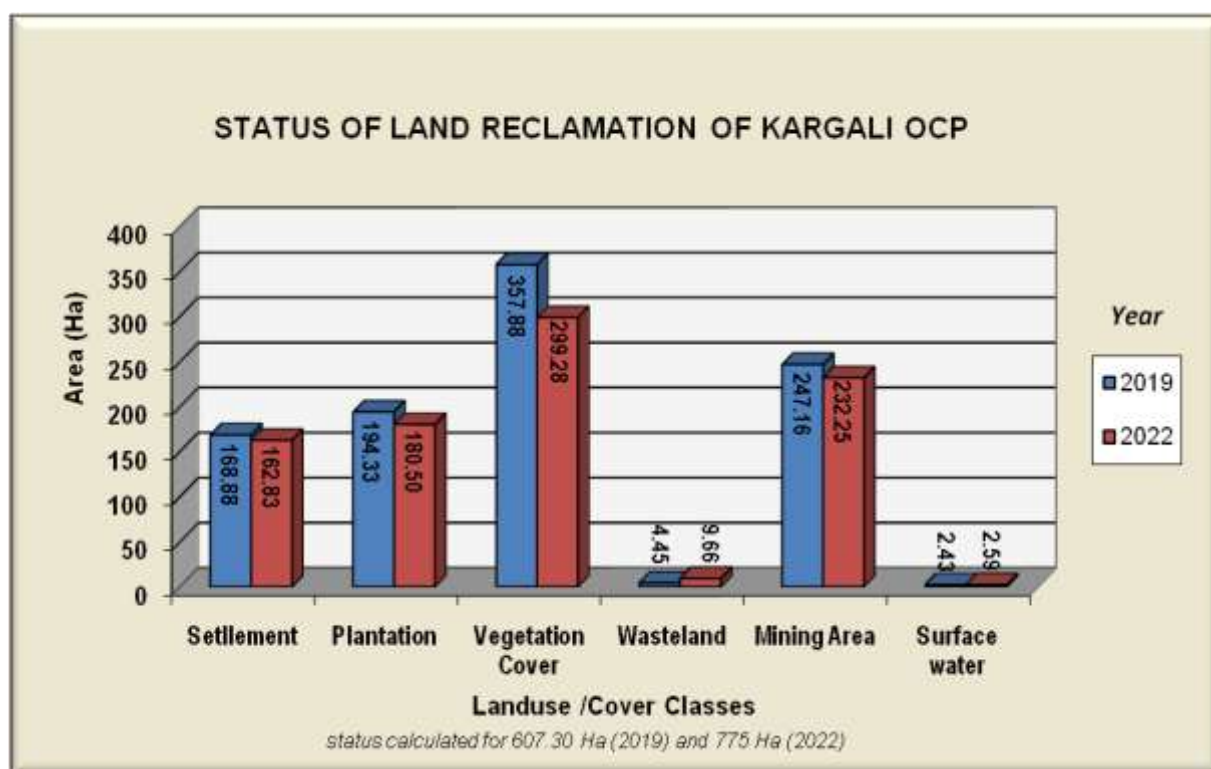


Figure- 7.9

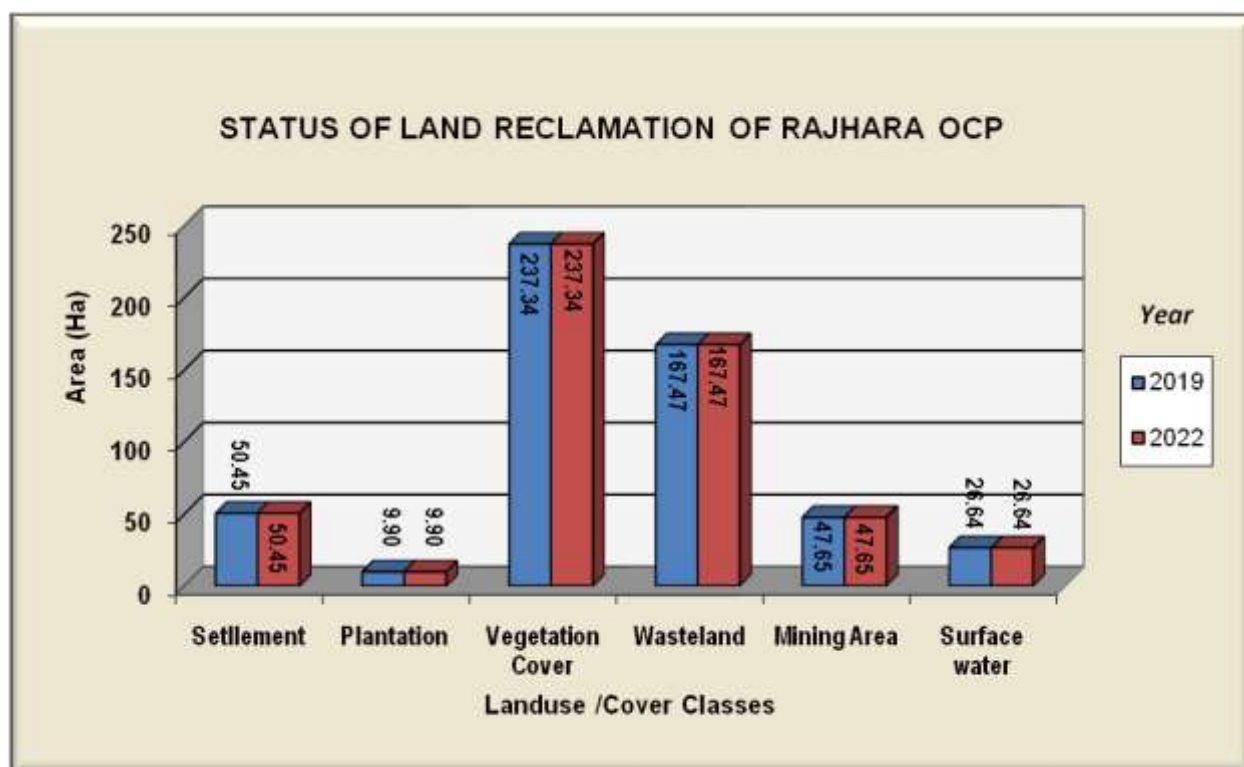


Figure- 7.10

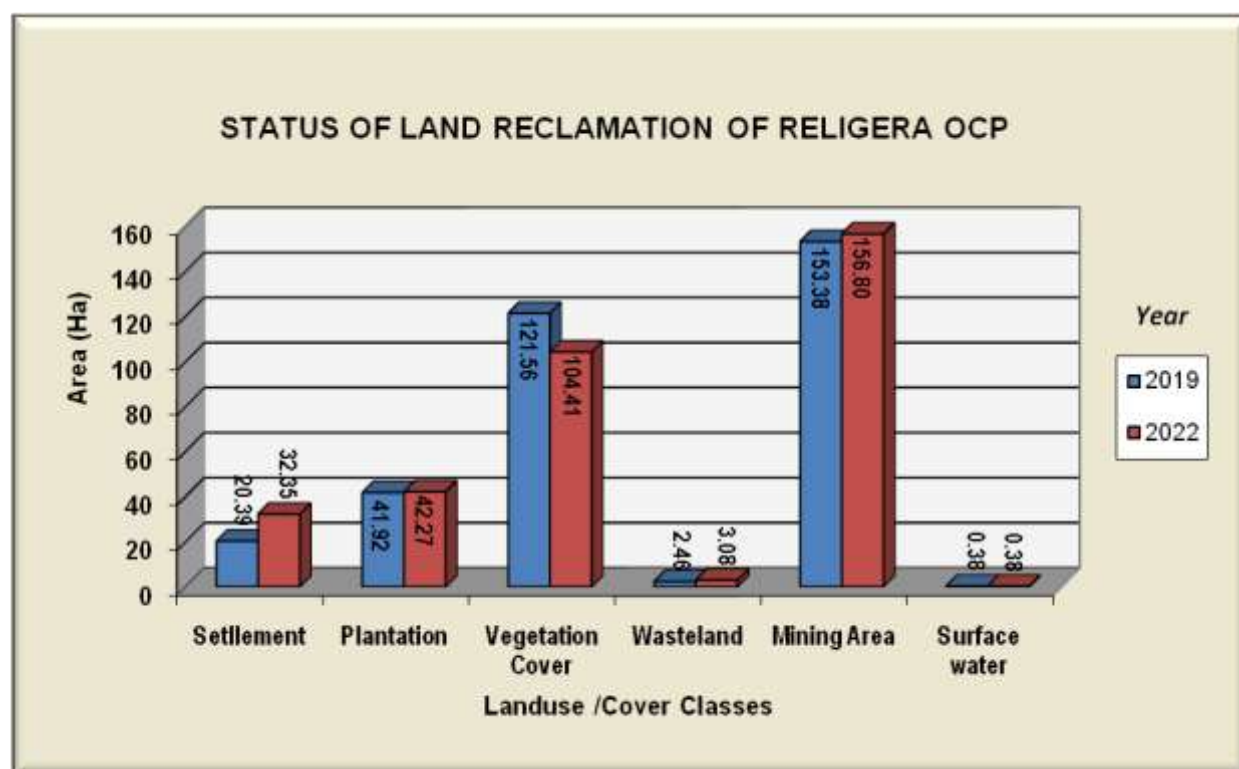


Figure- 7.11

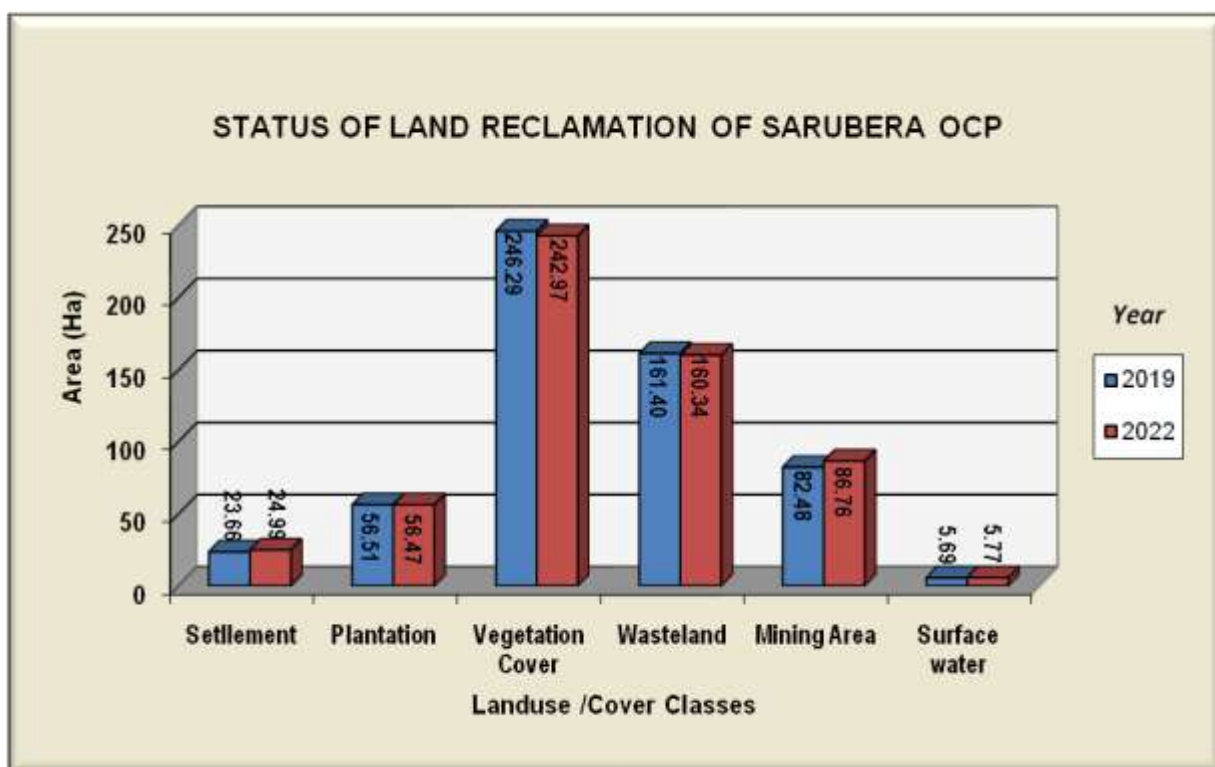


Figure- 7.12

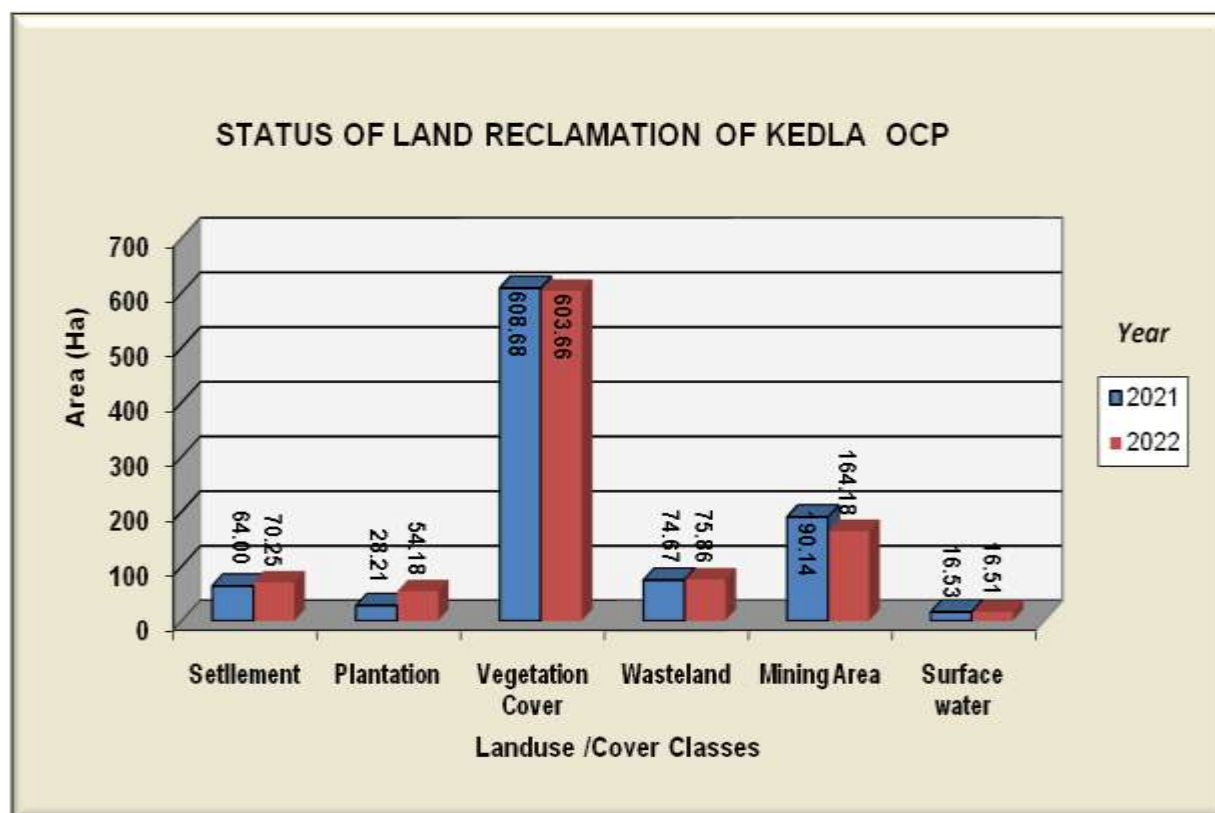


Figure- 7.13



Photo 7.1: Plantation at ecological site in Bhurkunda OCP



Photo 7.2: Plantation on External OB Dump in Bhurkunda OCP



Photo 7.3: Plantation on OB Dump in Religera OCP



Photo 7.4: Plantation on OB Dump in Sirka OCP



Photo 7.5: Plantation site in Selected Dhori OCP



Photo 7.6: Plantation on Backfill site in Bokaro OCP



Photo 7.7: Plantation along roadside in Kargali OCP



Photo 7.8: Plantation on Backfill site in Kargali OCP

BHARAT COKING COALLIMITED

8.0 Land Reclamation Status in Bharat Coking Coal Limited

8.1 Following 5 clusters of mines comprising both underground and opencast projects of Bharat Coking Coal Ltd. have been taken up for land reclamation monitoring based on satellite data of the year 2022:

- **Cluster II** (Block II Colliery, Jamunia OCP, Shatabdi OCP, Muraidih OCP, Phularitand OCP)
- **Cluster VI** (East Bassuriya Colliery, Bassuriya Colliery, Gondudih, Khaskusunda Colliery, Godhur Colliery)
- **Cluster XIV** (Lohapatti Colliery)
- **Cluster XV** (Kharkharee Colliery, Madhuband Colliery, Phularitand Colliery, Dharmaband Colliery)
- **Cluster XVI** (Dahibari Basantimata OCP, Basantimata UG mine, New Laikdih OCP (including Dahibari Coal Washery), Laikdih Deep UG, Chanch UG)

8.2 Cluster wise Land Reclamation status of above mentioned clusters in BCCL is given in Table 8.1 and also shown graphically in Fig 8.1. Area statistics of different land use classes present in the mine leasehold of the above clusters for the year 2022 are shown in Table 8.2. Land use maps derived from the satellite data are shown in Plate 8.1 - 5. Different land use classes based on satellite data are depicted in bar charts in Fig. 8.3 – 8.7.

8.3 Study reveals that out of total mine leasehold area of 8140.24 Ha. of the 5 clusters of mines (Underground + Opencast) of BCCL mentioned above taken for this study in 2022-23, total excavated area is 1030.85 Ha out of which 115.10 Ha. (11.17%) has been planted (*Biologically Reclaimed*), 621.40 Ha. (60.28%) is under backfilling (*Technically Reclaimed*) and balance 294.35 Ha. (28.55%) is under active mining.

-
- 8.4** Land reclamation monitoring for cluster XV of BCCL is taken up for the first time in the year 2022-23. Hence comparison of this cluster in year 2022 has not been made with respect to year 2019. The data thus generated in the year 2022 will be considered as base data for comparison of land reclamation of this cluster of mines at the interval of every three years.
- 8.5** Study indicates that cluster II and cluster XVI of BCCL considered for this study in the year 2022-23 indicate increase or static trend in Biological Reclamation (plantation on backfill) with respect to the year 2019.
- 8.6** After analyzing the satellite data of the year 2019 vs 2022, it reveals that area under total plantation (Green cover) carried out on backfilled area, OB dumps as well as under social forestry in all the clusters of BCCL has increased from 480.81 Ha (7.38%) to 546.24 Ha (6.71%) in span of last three years. This significant increase of 65.43 Ha area under total plantation (Green Cover) in the leasehold boundary during three years is due to increase in plantation on OB dump and social forestry in cluster VI and plantation on backfill in cluster XVI and addition of cluster-XV.
- 8.7** On comparing the status of land reclamation for the year 2022 with respect to the year 2019 in all cluster of mines of BCCL considered for land reclamation in the year 2022-23, it is evident from the analysis that area under total land reclamation has increased from 736.01 Ha (Yr 2019) to 736.50 Ha (Yr 2022).
- 8.8** In Cluster VI, it is seen that total excavated area has decreased from 211.90 Ha in the year 2019 to 204.51 Ha in the year 2022. This decrease of 7.39 Ha area is due to reduction in area under active mining which is due to change in shape and area of this cluster. The cluster boundary is updated as per EC.

8.9 Out of the 5 Clusters in BCCL considered for satellite data based land reclamation monitoring in 2022, Cluster II tops with 77.39% reclamation followed by Cluster VI with 65.60% and Cluster XVI with 55.29%. Cluster XIV and Cluster XV consist of UG mines, so there is no reclamation activity.

8.10 The area under total plantation (Green Cover) is maximum in Cluster II (12.97%) followed by Cluster XV with (4.76%), Cluster XVI with (4.70%), Cluster XIV with (4.59%) and Cluster VI with (4.35%).

Table 8.1

Land Reclamation Status in 5 Clusters (Underground + Opencast Mines) of BCCL based on Satellite Data of the Year 2022

Sl. No.	Cluster No.	Total Leasehold Area		Technical Reclamation		Plantation						Area under Active Mining		Total Excavated Area		Total Area under Plantation (% Green Cover Generated in Leasehold)		Total Area under Reclamation	
						Biological Reclamation		Other Plantations											
				Area under Backfilling		Plantation on Excavated / Backfilled Area		Plantation on External OB Dumps		Social Forestry, Avaneue Plantation Etc.									
1	2	3		4		5		6		7		8		9 (=4+5+8)		10 (=5+6+7)		11(=4+5)	
		2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022
1	Cluster II	2260.54	2025.71	422.51	422.00	86.42	87.42	43.28	47.29	154.37	128.03	129.98	148.85	638.91	658.27	284.07	262.74	508.93	509.42
				66.13%	64.11%	13.53%	13.28%					20.34%	22.61%			12.57%	12.97%	79.66%	77.39%
2	Cluster VI	831.83	876.55	134.15	134.15	0.00	0.00	5.89	9.70	26.79	28.41	77.75	70.36	211.90	204.51	32.68	38.11	134.15	134.15
				63.31%	65.60%	0.00%	0.00%					36.69%	34.40%			3.93%	4.35%	63.31%	65.60%
3	Cluster XIV	1418.25	1577.22	0.00	0.00	0.00	0.00	0.00	0.00	74.13	72.42	0.00	0.00	0.00	0.00	74.13	72.42	0.00	0.00
				0.00%	0.00%	0.00%	0.00%					0.00%	0.00%			5.23%	4.59%	0.00%	0.00%
4	Cluster XV	-	1696.55	-	0.00	-	0.00	-	0.00	-	80.72	-	0.00	-	0.00	-	80.72	-	0.00
					0.00%		0.00%						0.00%				4.76%		0.00%
5	Cluster XVI	2008.4	1964.21	67.57	65.25	25.36	27.68	13.31	13.31	51.26	51.26	65.77	75.14	158.70	168.07	89.93	92.25	92.93	92.93
				42.58%	38.82%	15.98%	16.47%					41.44%	44.71%			4.48%	4.70%	58.56%	55.29%
	TOTAL	6519.02	8140.24	624.23	621.40	111.78	115.10	62.48	70.30	306.55	360.84	273.50	294.35	1009.51	1030.85	480.81	546.24	736.01	736.50
				61.83%	60.28%	11.07%	11.17%					27.09%	28.55%			7.38%	6.71%	72.91%	71.45%
(% is calculated with respect to Excavated Area as applicable)																			

(% is calculated with respect to Excavated Area as applicable)

(Cluster XV started from current year)

Note: In reference to above table different parameters as classified as follows:

- 1 Area under Biological Reclamation includes Area under plantation done on Backfilled Area only.
- 2 Area under Technical Reclamation includes Area under Backfill only.
- 3 Area under Active mining includes Coal Quarry, Advance Quarry site and Quarry filled with water etc if any.
- 4 Social Forestry and Plantation on External OB Dumps are not included in Biological Reclamation and are put under separate categories as shown in above Table.
- 5 (%) calculated in above Table is in respect to Total Excavated area except for "Total Area under plantation" where % is in terms of leasehold Area."

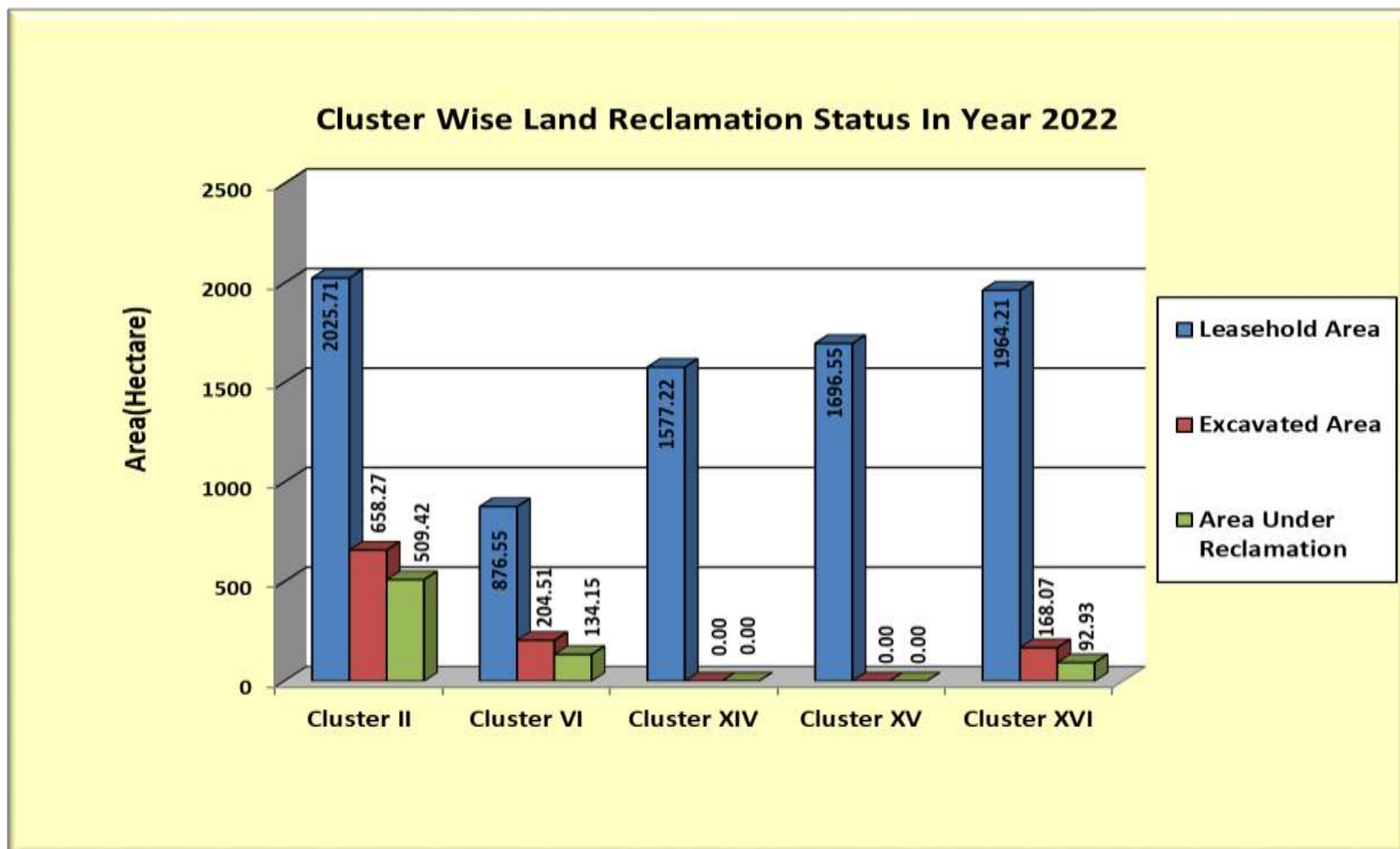


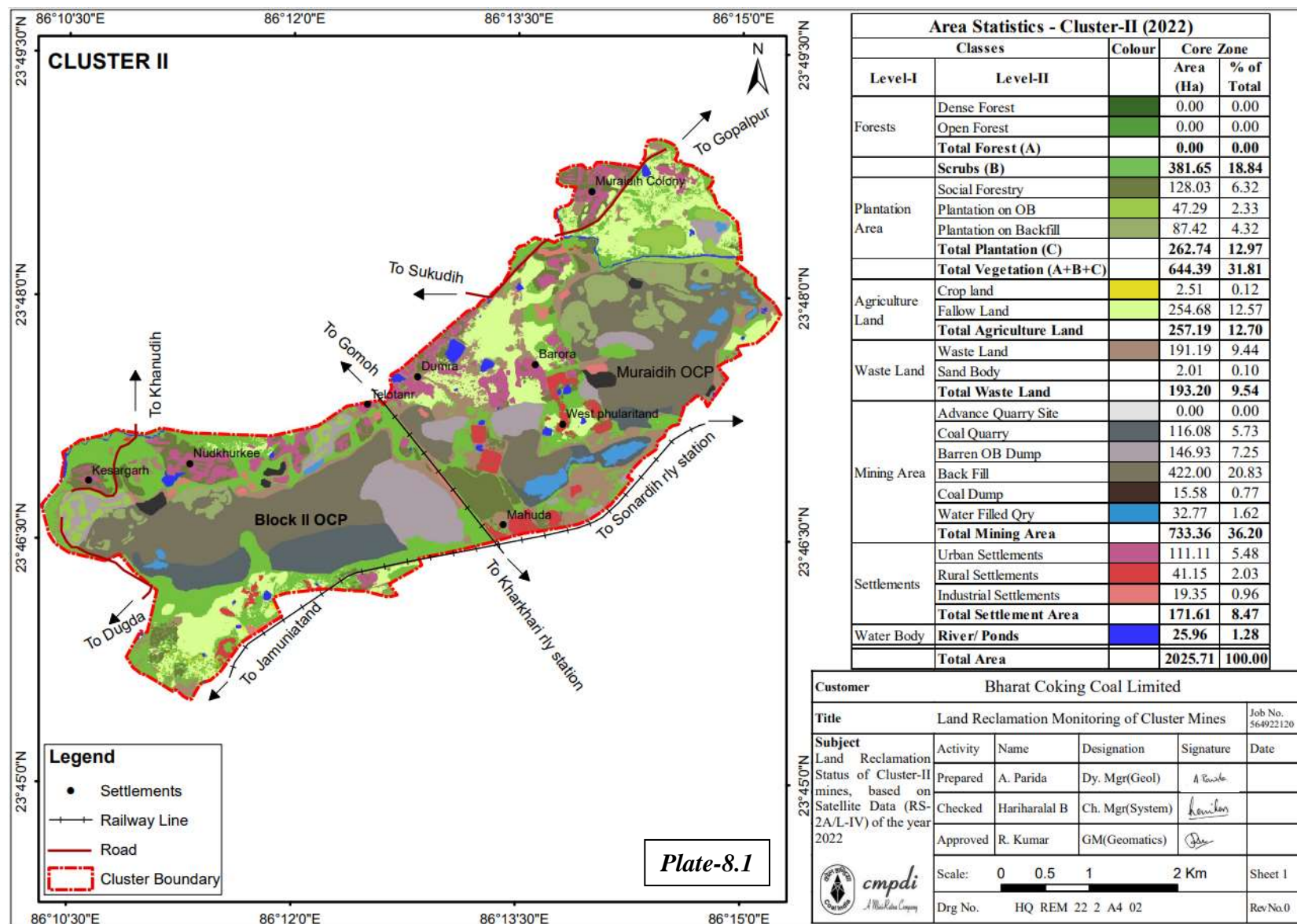
Figure 8.1: Cluster wise Land reclamation status based on Satellite data of the year 2022

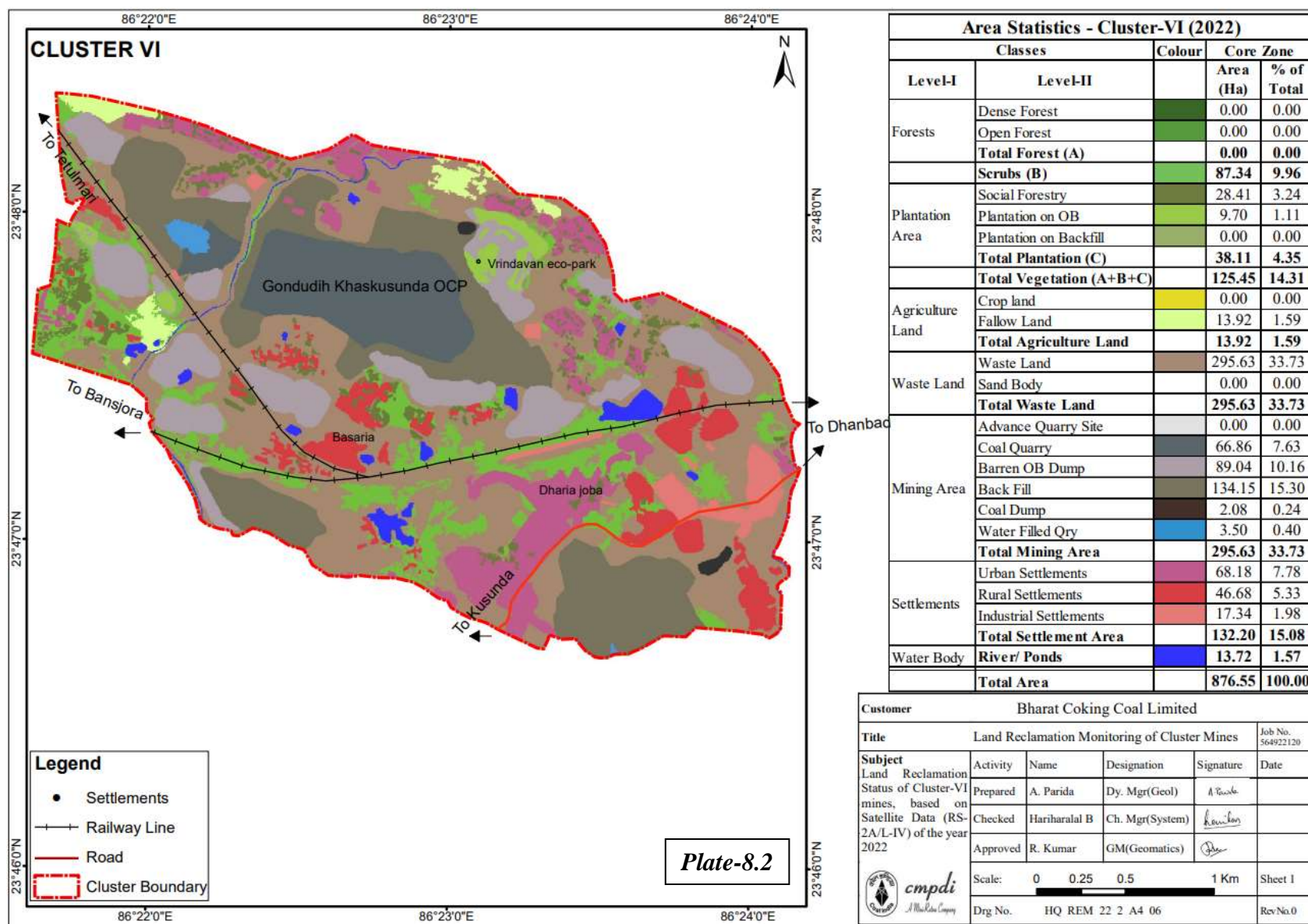
Table 8.2

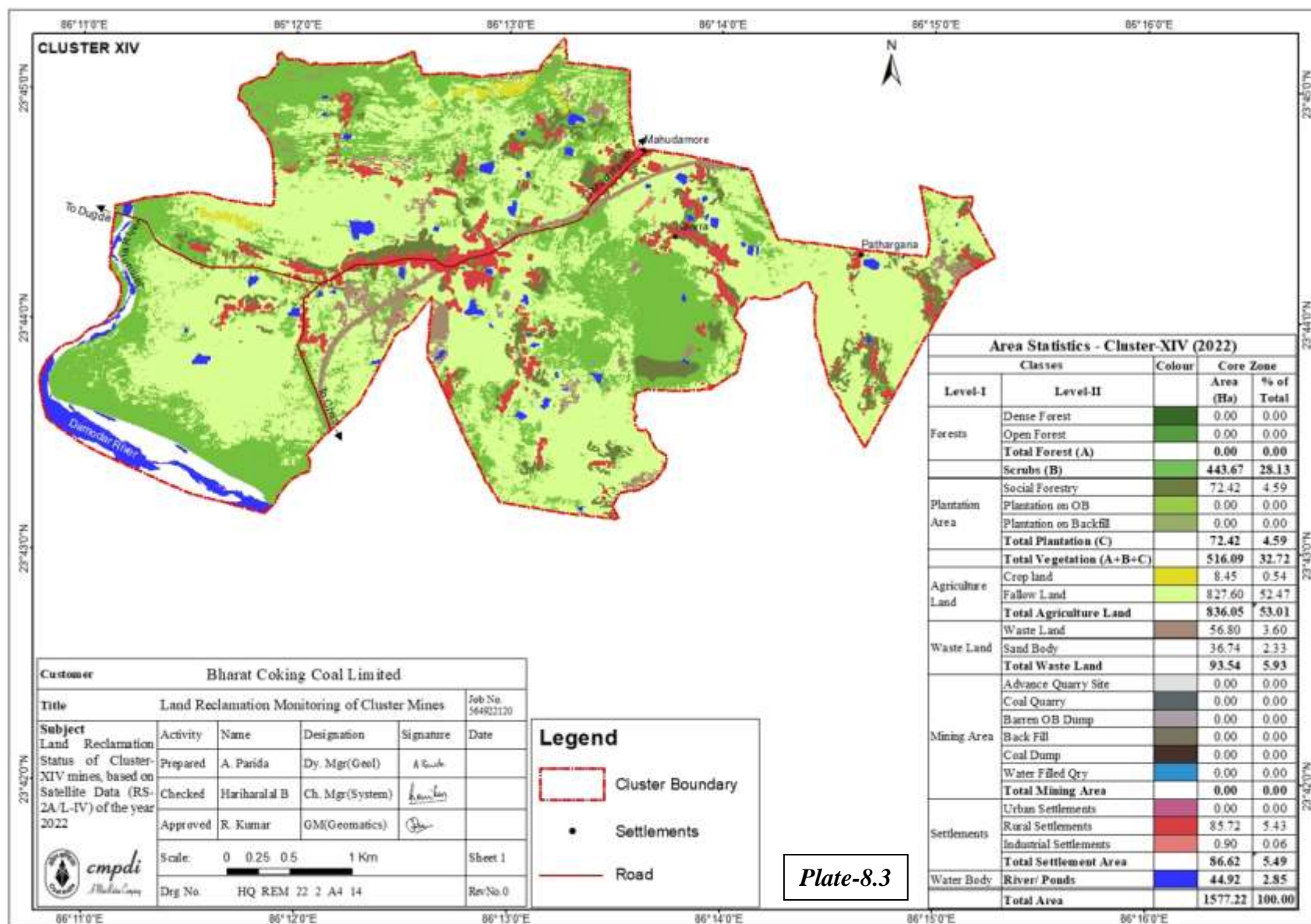
Cluster wise Area Statistics of Land Use/ Cover classes in five Clusters of (OC+UG) mines of BCCL based on Satellite Data of the year 2022

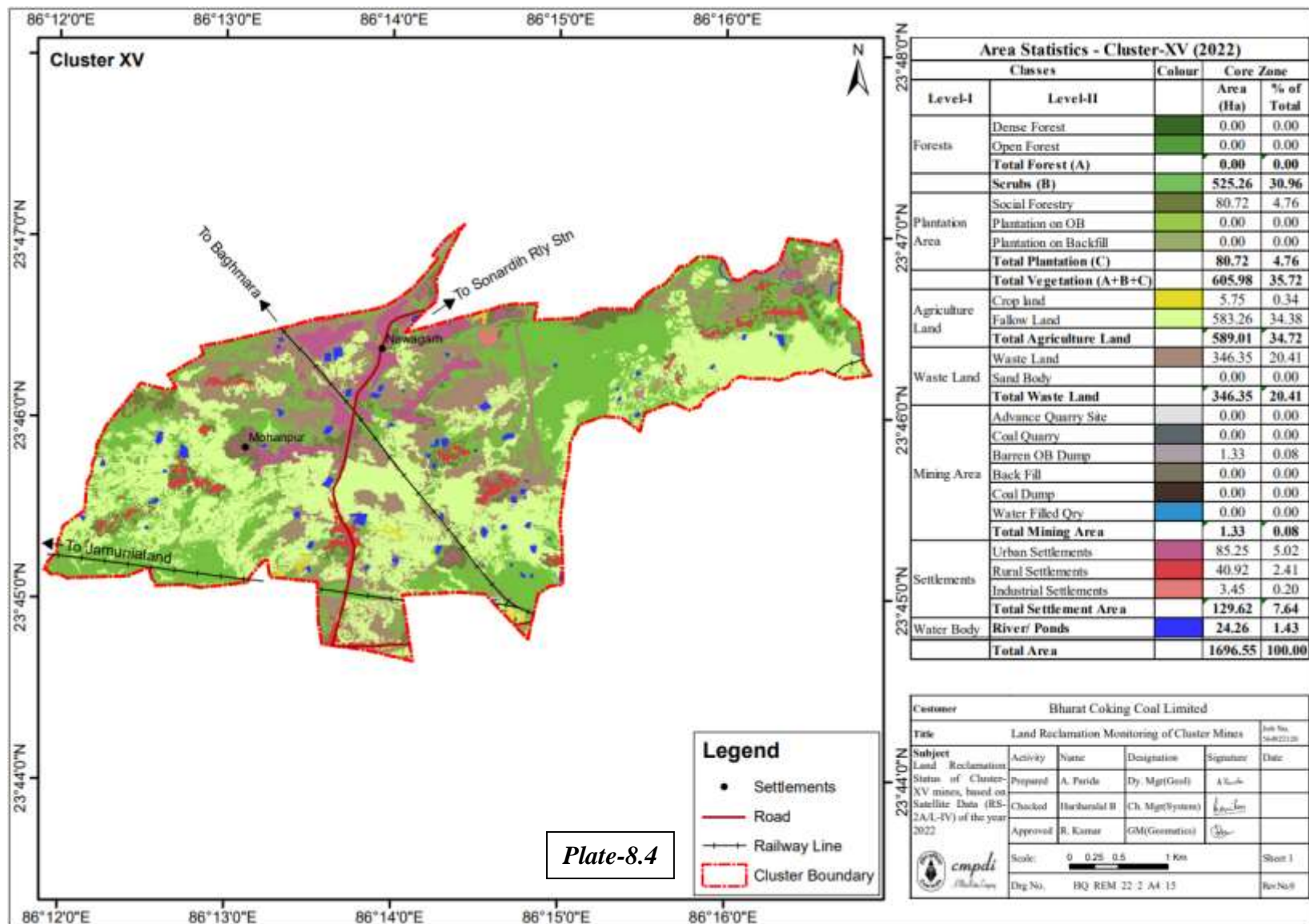
(Area in Hectare)

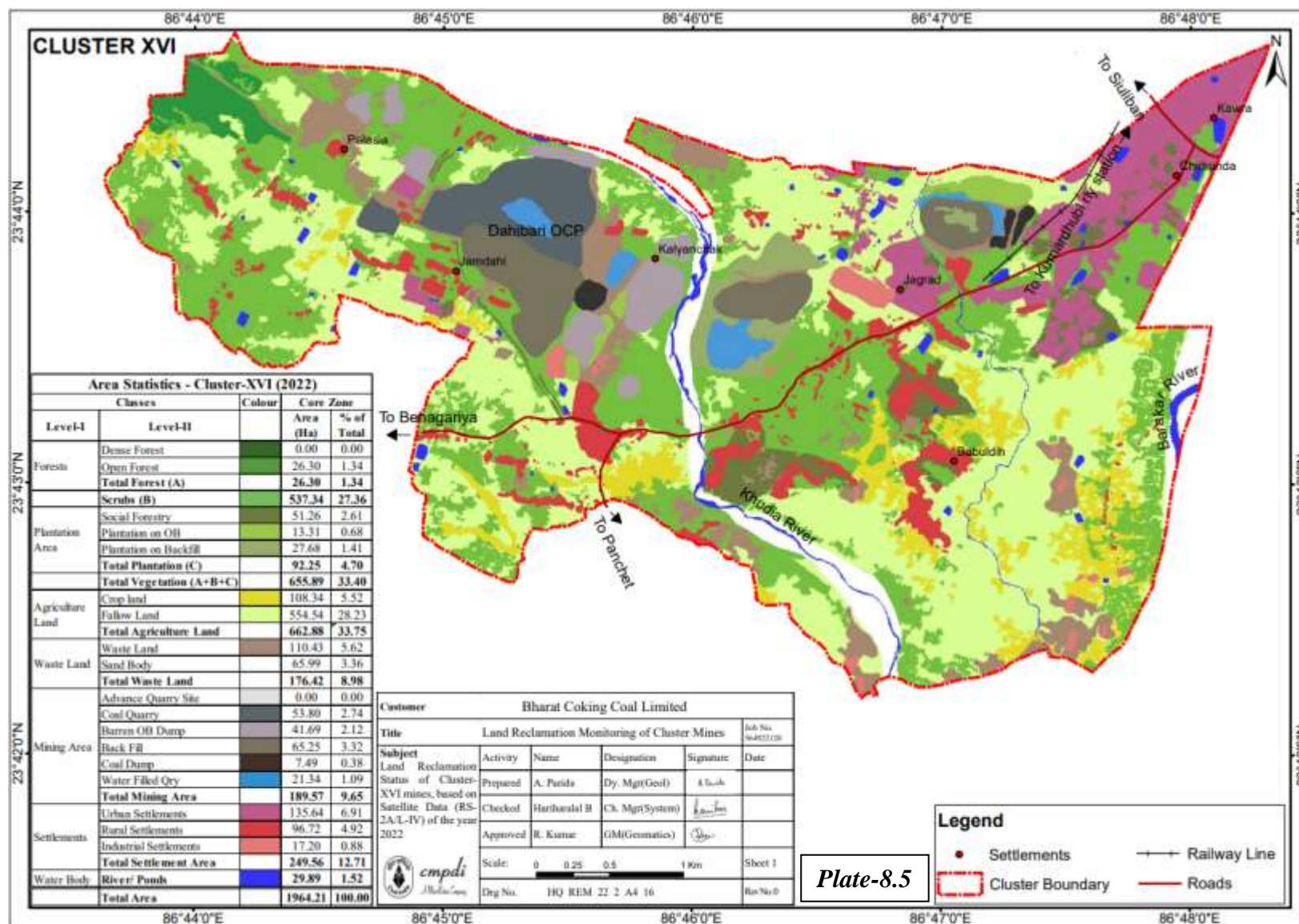
		CLUSTER II		CLUSTER VI		CLUSTER XIV		CLUSTER XV		CLUSTER XVI		TOTAL	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Open Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.30	1.34	26.30	0.32
	Total Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.30	1.34	26.30	0.32
SCRUBS	Scrubs	381.65	18.84	87.34	9.96	443.67	28.13	525.26	30.96	537.34	27.36	1975.26	24.27
	Social Forestry/Avenue Plantation	128.03	6.32	28.41	3.24	72.42	4.59	80.72	4.76	51.26	2.61	360.84	4.43
	Plantation on OB Dump	47.29	2.33	9.70	1.11	0.00	0.00	0.00	0.00	13.31	0.68	70.30	0.86
	Plantation on Backfill (Biological Reclamation)	87.42	4.32	0.00	0.00	0.00	0.00	0.00	0.00	27.68	1.41	115.10	1.41
	Total Plantation	262.74	12.97	38.11	4.35	72.42	4.59	80.72	4.76	92.25	4.70	546.24	6.71
Total Vegetation		644.39	31.81	125.45	14.31	516.09	32.72	605.98	35.72	655.89	33.40	2547.80	31.30
ACTIVE MINING	Coal Dump	15.58	0.77	2.08	0.24	0.00	0.00	0.00	0.00	7.49	0.38	25.15	0.31
	Coal Quarry	116.08	5.73	66.86	7.63	0.00	0.00	0.00	0.00	53.80	2.74	236.74	2.91
	Advance Quarry Site	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Quarry Filled With Water	32.77	1.62	3.50	0.40	0.00	0.00	0.00	0.00	21.34	1.09	57.61	0.71
	Total Area under Active Mining	148.85	7.35	70.36	8.03	0.00	0.00	0.00	0.00	75.14	3.83	294.35	3.62
RECLAIMED	Barren OB Dump	146.93	7.25	89.04	10.16	0.00	0.00	1.33	0.08	41.69	2.12	278.99	3.43
	Area Under Backfilling (Technical Reclamation)	422.00	20.83	134.15	15.30	0.00	0.00	0.00	0.00	65.25	3.32	621.40	7.63
	Total Area under Technical Reclamation	422.00	20.83	134.15	15.30	0.00	0.00	0.00	0.00	65.25	3.32	621.40	7.63
	Total Area under Mine Operation	733.36	36.20	295.63	33.73	0.00	0.00	1.33	0.08	189.57	9.65	1219.89	14.99
WASTELAND	Waste Lands	191.19	9.44	295.63	33.73	56.80	3.60	346.35	20.41	110.43	5.62	1000.40	12.29
	Fly Ash Pond / Sand Body	2.01	0.10	0.00	0.00	36.74	2.33	0.00	0.00	65.99	3.36	104.74	1.29
	Total Wasteland	193.20	9.54	295.63	33.73	93.54	5.93	346.35	20.41	176.42	8.98	1105.14	13.58
WATERBODIES	Reservoir, nallah, ponds	25.96	1.28	13.72	1.57	44.92	2.85	24.26	1.43	29.89	1.52	138.75	1.70
	Total Waterbodies	25.96	1.28	13.72	1.57	44.92	2.85	24.26	1.43	29.89	1.52	138.75	1.70
AGRICULTURE	Crop Lands	2.51	0.12	0.00	0.00	8.45	0.54	5.75	0.34	108.34	5.52	125.05	1.54
	Fallow Lands	254.68	12.57	13.92	1.59	827.60	52.47	583.26	34.38	554.54	28.23	2234.00	27.44
	Total Agriculture	257.19	12.70	13.92	1.59	836.05	53.01	589.01	34.72	662.88	33.75	2359.05	28.98
SETTLEMENTS	Urban Settlement	111.11	5.48	68.18	7.78	0.00	0.00	85.25	5.02	135.64	6.91	400.18	4.92
	Rural Settlement	41.15	2.03	46.68	5.33	85.72	5.43	40.92	2.41	96.72	4.92	311.19	3.82
	Industrial Settlement	19.35	0.96	17.34	1.98	0.90	0.06	3.45	0.20	17.20	0.88	58.24	0.72
	Total Settlement	171.61	8.47	132.20	15.08	86.62	5.49	129.62	7.64	249.56	12.71	769.61	9.45
Grand Total		2025.71	100.00	876.55	100.00	1577.22	100.00	1696.55	100.00	1964.21	100.00	8140.24	100.00











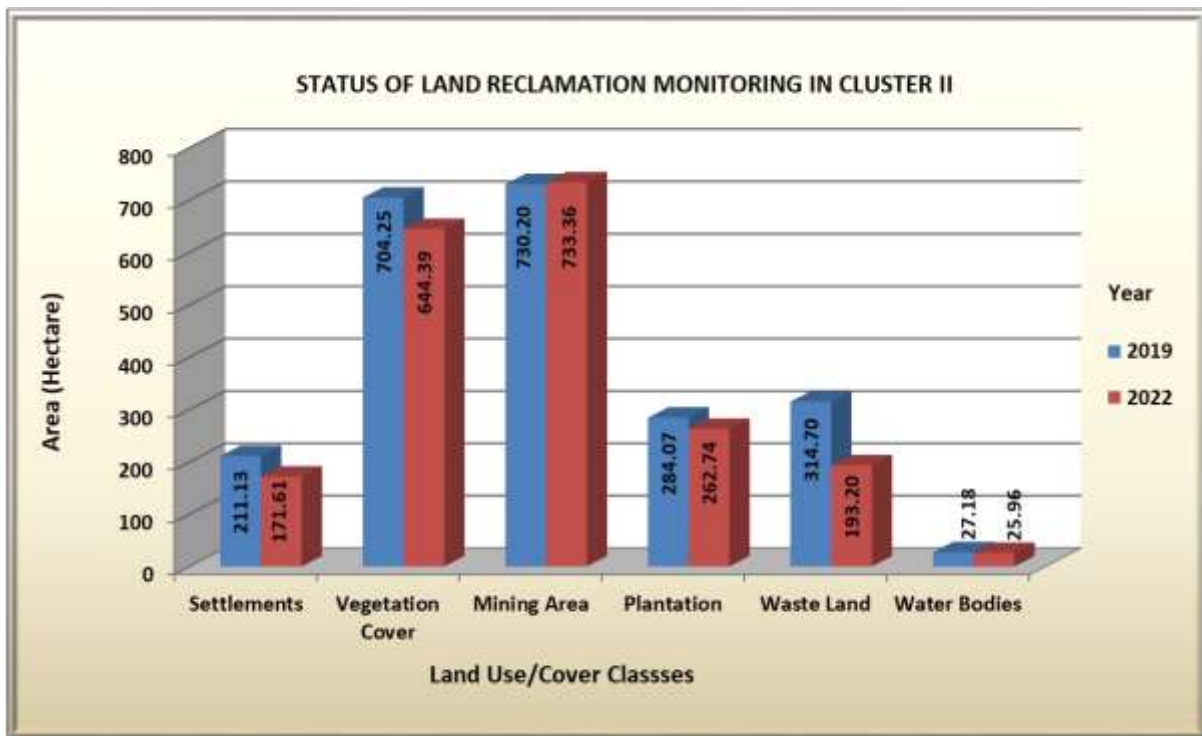


Figure- 8.2

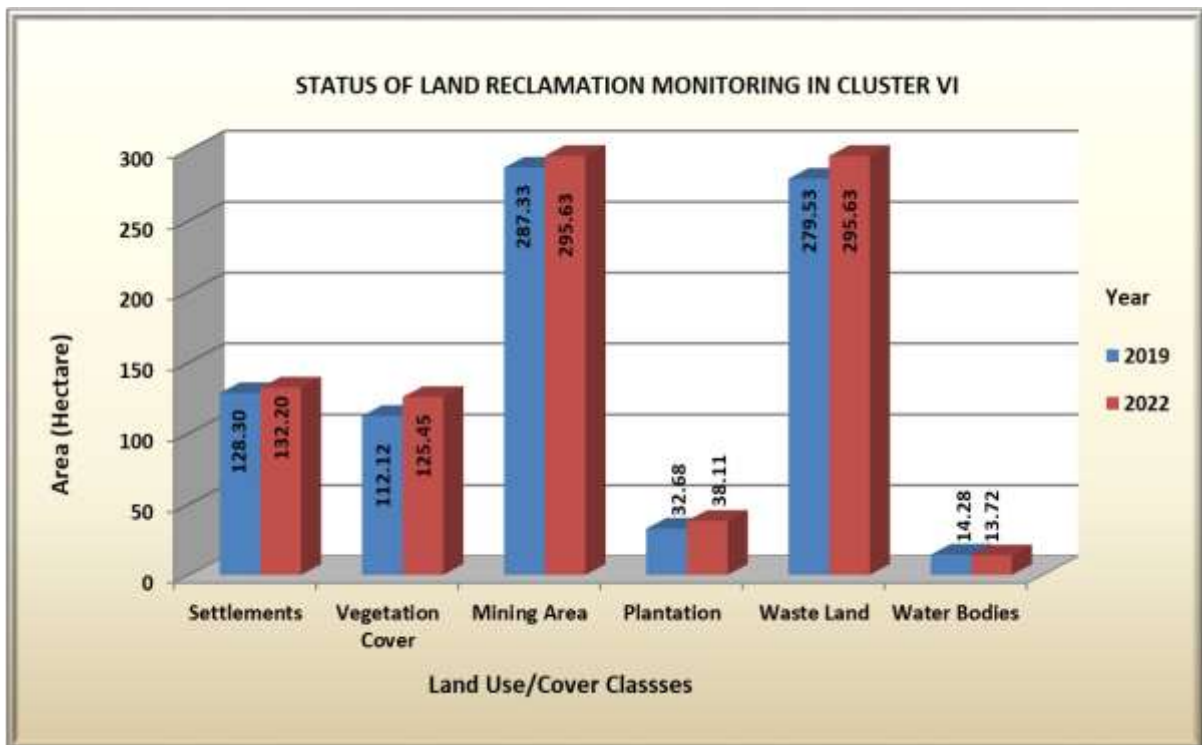


Figure- 8.3

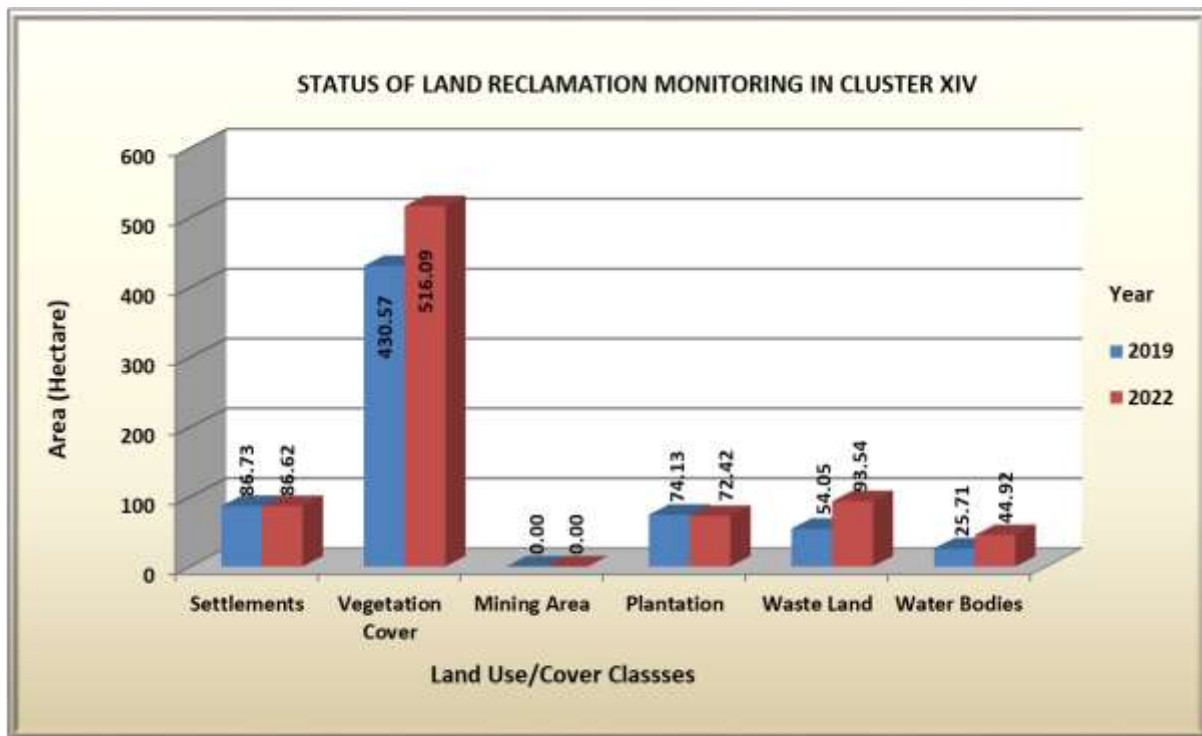


Figure- 8.4

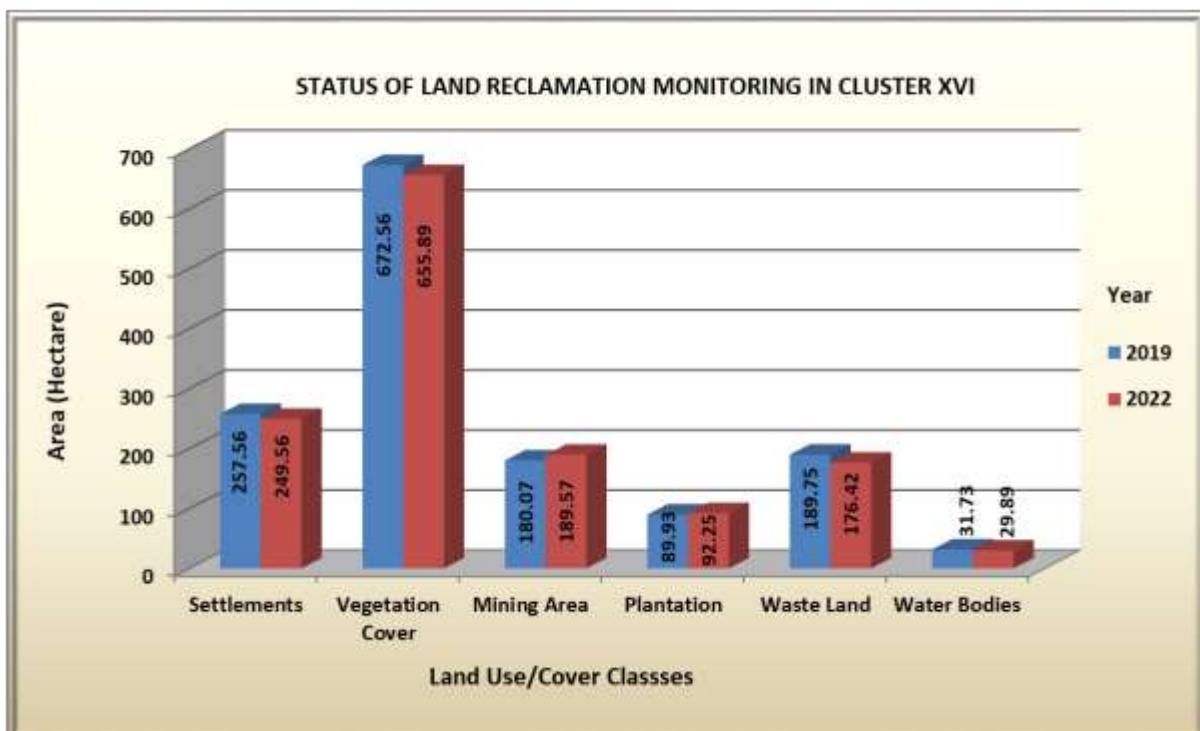


Figure- 8.5

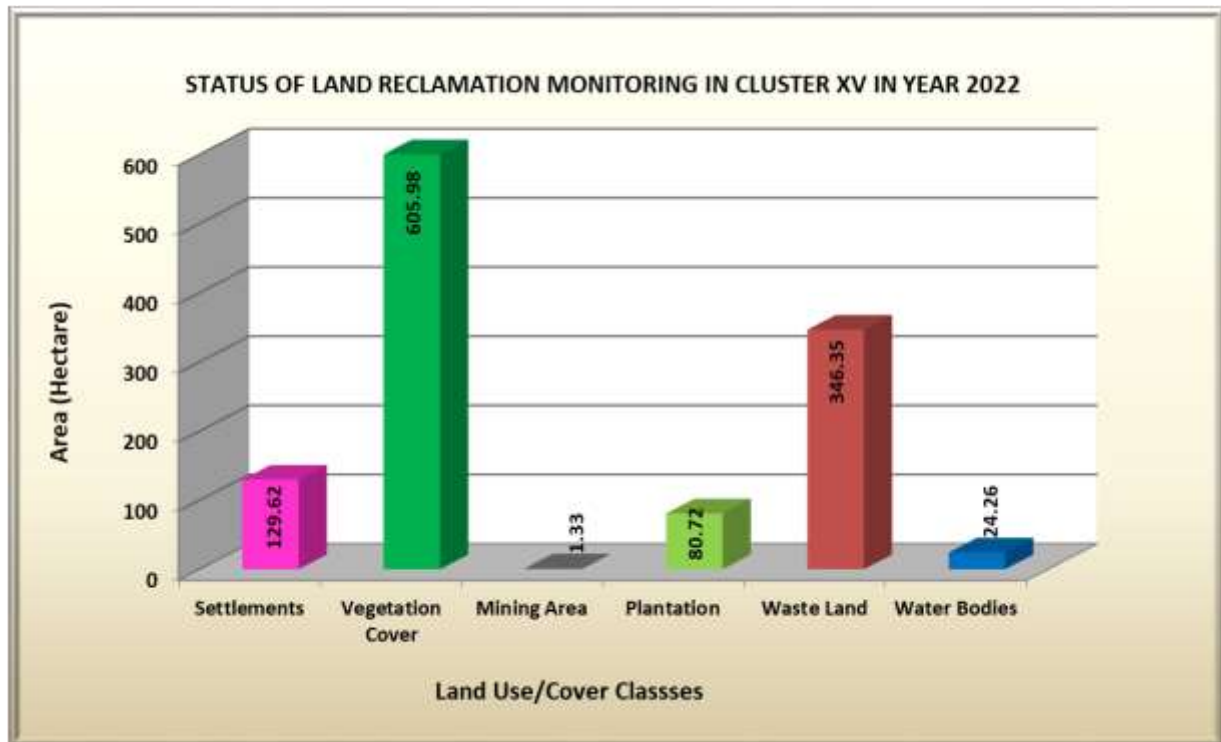


Figure- 8.6



Photo 8.1: Plantation on Backfill in Muraidih OCP, Cluster II



Photo 8.2: Plantation on OB Dump in Block II OCP, Cluster II



Photo 8.3: Vrindavan Eco-park in Cluster VI



Photo 8.4: Plantation on Backfill in Cluster XVI

EASTERN COALFIELDS LIMITED

9.0 Land Reclamation Status in Eastern Coalfields Limited

9.1 Following 04 clusters of mines comprising both underground and opencast mine of Eastern Coalfields Ltd. were taken up for land reclamation monitoring based on satellite data of the year 2022:

- **Cluster IX** (Narainkuri OC, J K Nagar UG)
- **Cluster X** (Kunustoria UG, Belbaid UG, Bansra OC, Jambad UG & OC and Madhabpur UG)
- **Cluster XI** (Shankarpur OC, Siduli UG, Khnadra UG and Jambad UG)
- **Cluster XII** (Kottadih UG & OCP, Nakrakonda UG, Sonepur Bazari OC, Bankola UG, Kumardih B UG & Pandabeshwar OC & UG)

9.2 Project wise Land Reclamation status of above mentioned projects in ECL is given in Table 9.1 and also shown graphically in Fig 9.1. Area statistics of different land use class present in the mine leasehold of the above projects for the year 2019 are shown in the Table - 9.2. Land use maps derived from satellite data are shown in Plate 9.1- 9.4. Different land use classes based on satellite data of the year 2019 are depicted in Bar Charts in Fig.9.2–9.5.

9.3 Study based on satellite data reveals that 1152.85 ha. (63.98%) of area have come under reclamation in ECL, out of which 953.75 ha. (52.93%) is under backfilling (Technical Reclamation) and 199.10 ha. (11.05%) is under Plantation (Biological reclamation).

9.4 On comparing the status of land reclamation for the year 2022 with respect to the year 2019, it is seen that the total area of land reclamation has increased from 972.00 ha (Yr. 2019) to 1152.85 ha (Yr. 2022).

9.5 Total plantation area increased from 1546 ha. (5.14%) in 2019 to 1684.10 ha. in 2022, which is 5.60% of the total leasehold area of the four clusters.

9.6 Cluster-XI tops with 70.65% reclamation followed by cluster- XII with 66.12% reclamation.

Table 9.2
Land Reclamation Status in Four Clusters of (Underground + Opencast) Mines of ECL based on Satellite Data of the Year 2022

(Area in hectare)

Sl. No.	Project	Total Leasehold Area		Technical Reclamation		Plantation						Area under Active Mining		Total Excavated Area		Total Area under Plantation (% Green Cover Generated in Leasehold)		Total Area under Reclamation	
						Biological Reclamation		Other Plantations											
				Area under Backfilling		Plantation on Excavated / Backfilled Area		Plantation on External Over Burden Dumps		Social Forestry, Avaneue Plantation Etc.									
1	2	3		4		5		6		7		8		9 (=4+5+8)		10 (=5+6+7)		11(=4+5)	
		2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022
1	Cluster IX	7145.00	7145.00	56.00	62.00	8.00	9.00	17.00	17.00	292	310.00	71.00	76.00	135.00	147.00	317.00	336.00	64.00	71.00
				41.48%	42.18%	5.93%	6.12%					52.59%	51.70%			4.44%	4.70%	47.41%	48.30%
2	Cluster X	5979.00	5979.00	60.00	112.00	0.00	0.00	30.00	38.00	405	402.00	61.00	88.50	121.00	200.50	435.00	440.00	60.00	112.00
				49.59%	55.86%	0.00%	0.00%					50.41%	44.14%			7.28%	7.36%	49.59%	55.86%
3	Cluster XI	4218.00	4218.00	55	64.50	60.00	65.00	4.00	5.00	154	159.00	42.00	53.80	157.00	183.30	218.00	229.00	115.00	129.50
				35.03%	35.19%	38.22%	35.46%					26.75%	29.35%			5.17%	5.43%	73.25%	70.65%
4	Cluster XII	12736.00	12736.00	615.00	715.25	118.00	125.10	49.00	121.20	409.00	432.80	426.00	430.64	1159.00	1270.99	576.00	679.10	733.00	840.35
				53.06%	56.28%	10.18%	9.84%					36.76%	29.35%			4.52%	5.33%	63.24%	66.12%
	TOTAL	30078.00	30078.00	786.00	953.75	186.00	199.10	100.00	181.20	1260.00	1303.80	600.00	648.94	1572.00	1801.79	1546.00	1684.10	972.00	1152.85
				50.00%	52.93%	11.83%	11.05%					38.17%	36.02%			5.14%	5.60%	61.83%	63.98%

(% is calculated with respected to Excavated Area as applicable)

Note: In reference to above table different parameters as classified as follows:

1. Area under Biological Reclamation includes Area under plantation done on Backfilled Area only.
2. Area under Technical Reclamation includes Area under Backfill only.
3. Area under Active mining includes Coal Quarry, Advance Quarry site and Quarry filled with water etc if any.
4. Social Forestry and Plantation on External OB Dumps are not included in Biological Reclamation and are put under separate categories as shown in above Table.
5. (%) calculated in above Table is in respect to Total Excavated area except for "Total Area under plantation" where % is in terms of leasehold Area .“

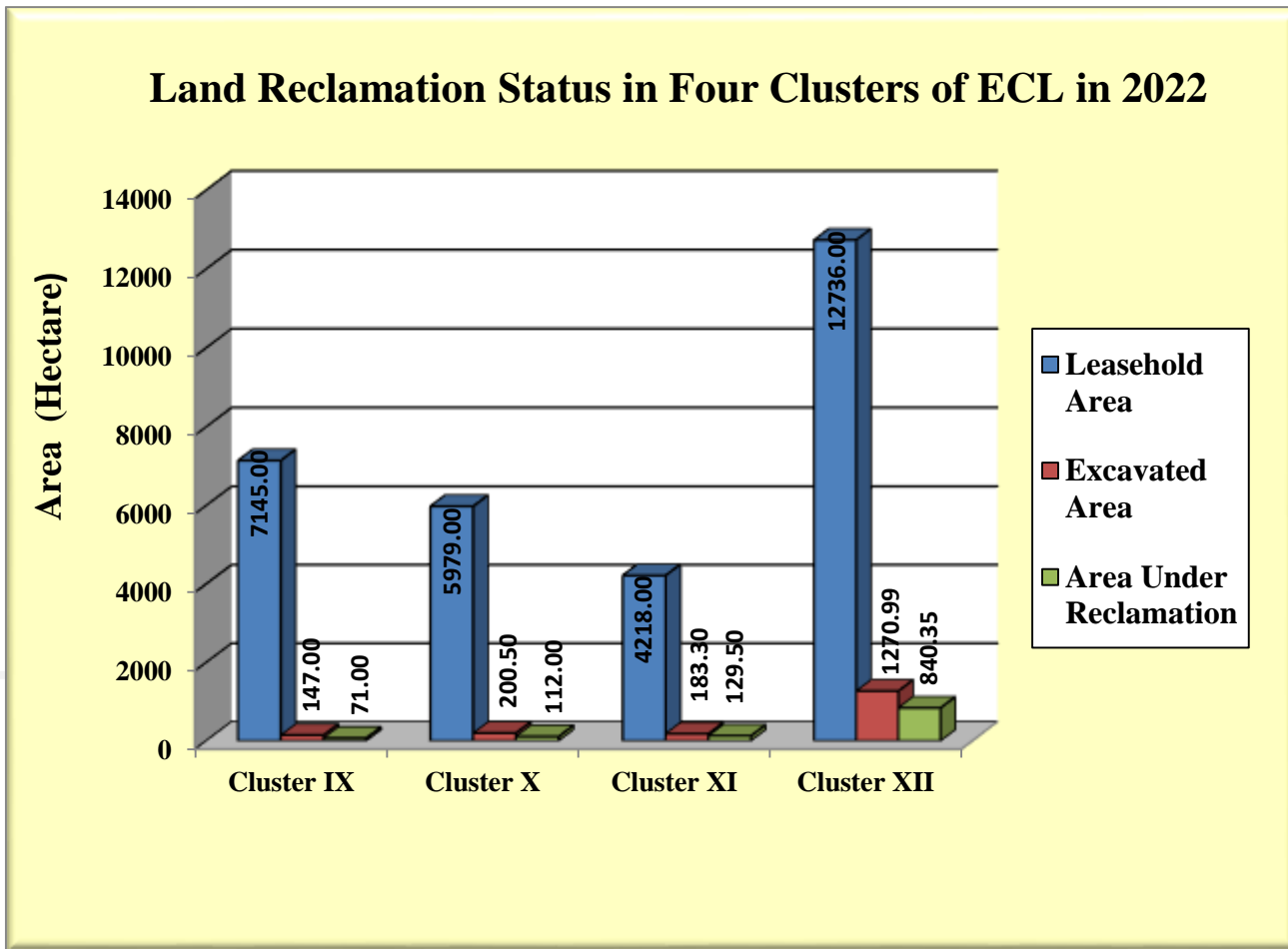




















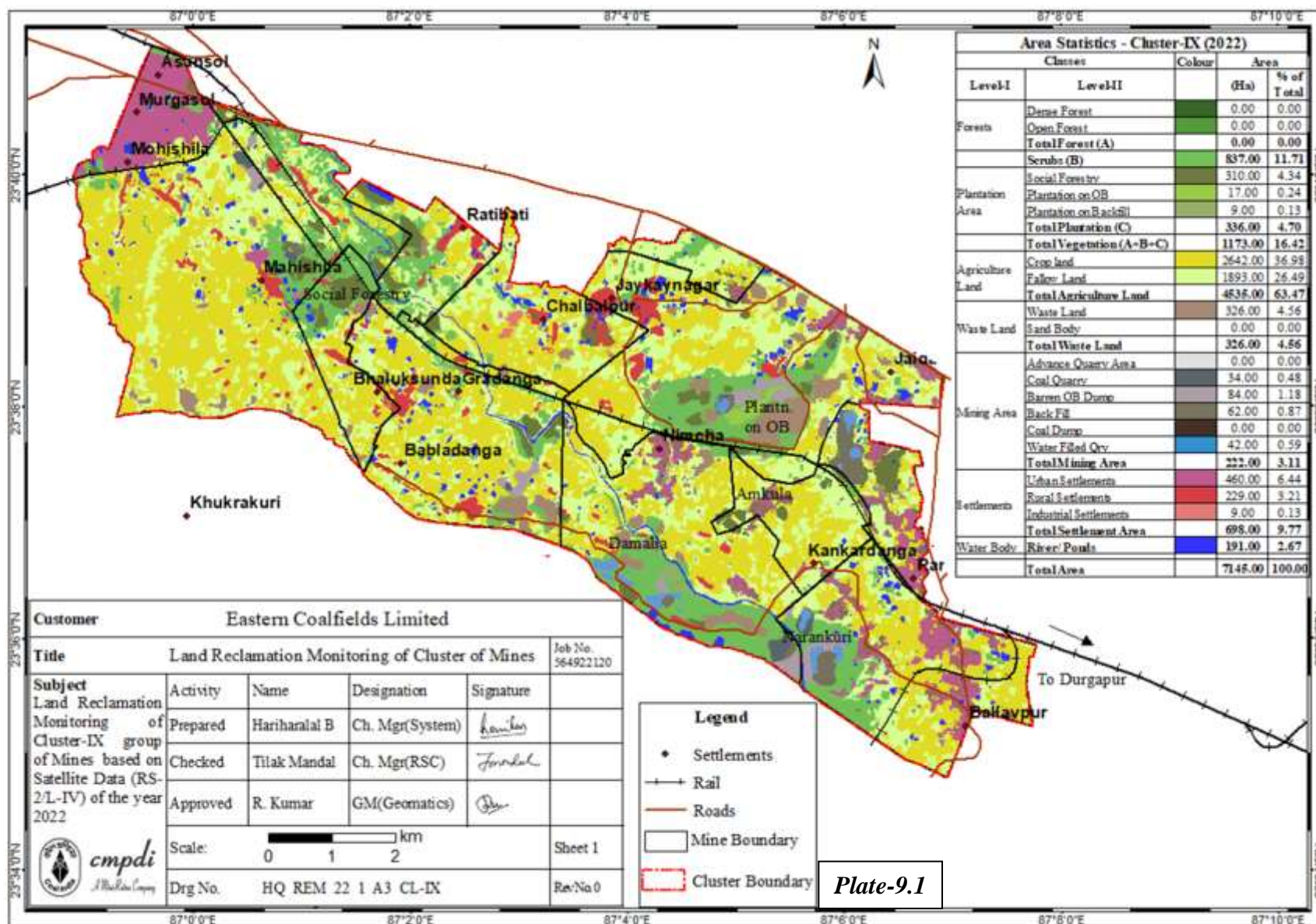
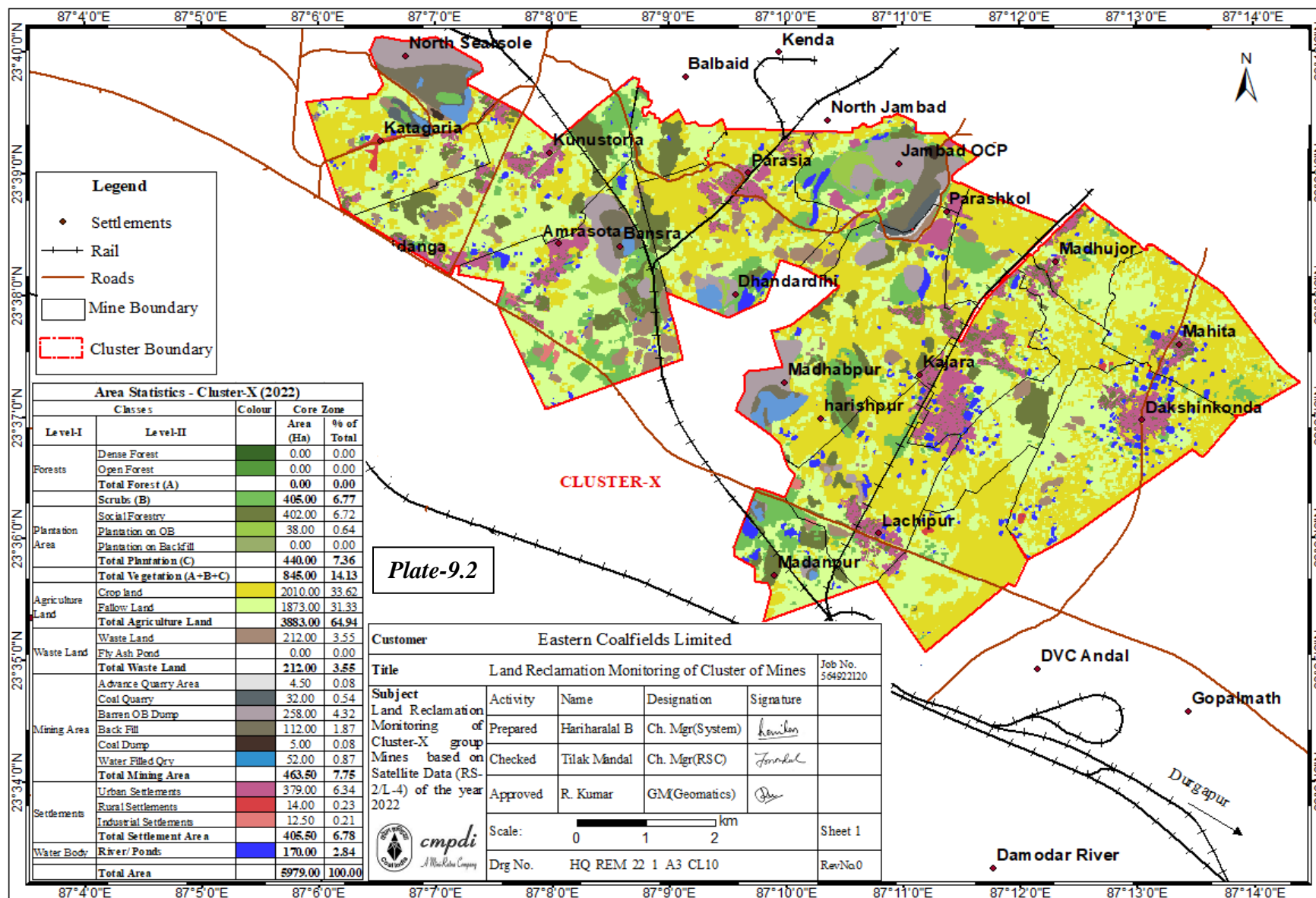


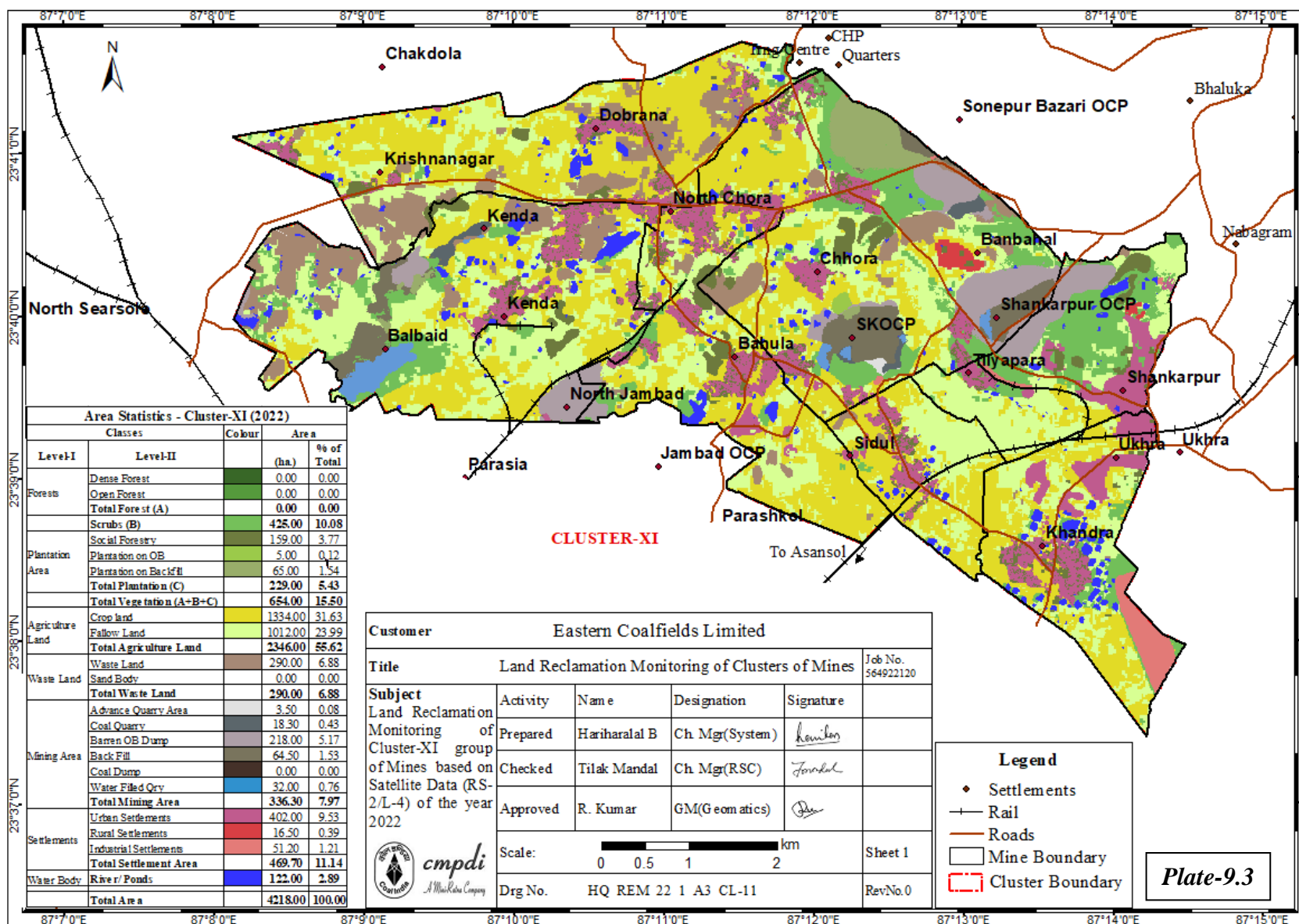
Figure 9.1: Cluster wise Land Reclamation Status based on satellite data of the year 2022

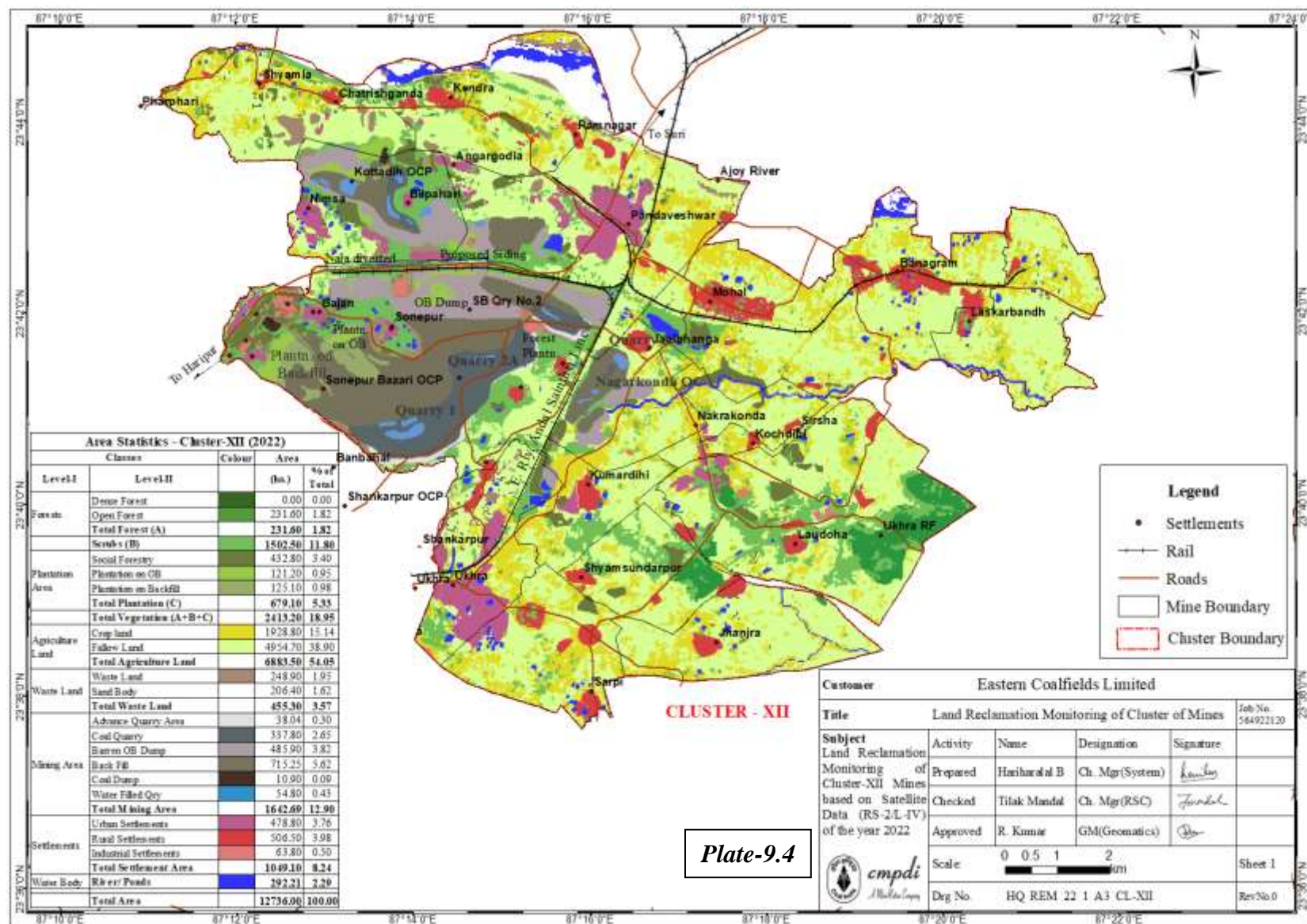
TABLE-9.2
CLUSTER WISE AREA STATISTICS OF LAND USE/ COVER CLASSES IN CLUSTER OF (OC+UG) MINES OF ECL BASED ON SATELLITE DATA OF THE YEAR 2022

Status of Land Reclamation in four Clusters of (UG+OC) Mines of Eastern Coalfields Ltd. based on Satellite data of the Year 2022												
<i>(Area in Hectare)</i>												
			CLUSTER IX		CLUSTER X		CLUSTER XI		CLUSTER XII		TOTAL	
			Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Open Forest		0.00	0.00	0.00	0.00	0.00	0.00	231.60	1.82	231.60	0.77
	Total Forest		0.00	0.00	0.00	0.00	0.00	0.00	231.60	1.82	231.60	0.77
SCRUBS	Scrubs		837.00	11.71	405.00	6.77	425.00	10.08	1502.50	11.80	3169.50	10.54
	Social Forestry/Avenue Plantation		310.00	4.34	402.00	6.72	159.00	3.77	432.80	3.40	1303.80	4.33
	Plantation on OB Dump		17.00	0.24	38.00	0.64	5.00	0.12	121.20	0.95	181.20	0.60
	Plantation on Backfill (Biological Reclamation)		9.00	0.13	0.00	0.00	65.00	1.54	125.10	0.98	199.10	0.66
	Total Plantation		336.00	4.70	440.00	7.36	229.00	5.43	679.10	5.33	1684.10	5.60
	Total Vegetation		1173.00	16.42	845.00	14.13	654.00	15.50	2413.20	18.95	5085.20	16.91
ACTIVE MINING	Coal Dump		0.00	0.00	5.00	0.08	0.00	0.00	10.90	0.09	15.90	0.05
	Coal Quarry		34.00	0.48	32.00	0.54	18.30	0.43	337.80	2.65	422.10	1.40
	Advance Quarry Site		0.00	0.00	4.50	0.08	3.50	0.08	38.04	0.30	46.04	0.15
	Quarry Filled With Water		42.00	0.59	52.00	0.87	32.00	0.76	54.80	0.43	180.80	0.60
	Total Area under Active Mining		76.00	1.06	88.50	1.48	53.80	1.28	430.64	3.38	648.94	2.16
	Barren OB Dump		84.00	1.18	258.00	4.32	218.00	5.17	485.90	3.82	1045.90	3.48
RECLAIMED	Area Under Backfilling (Technical Reclamation)		62.00	0.87	112.00	1.87	64.50	1.53	715.25	5.62	953.75	3.17
	Total Area under Technical Reclamation		62.00	0.87	112.00	1.87	64.50	1.53	715.25	5.62	953.75	3.17
	Total Area under Mine Operation		222.00	3.11	463.50	7.75	336.30	7.97	1642.69	12.90	2664.49	8.86
WASTELAND	Waste Lands		326.00	4.56	212.00	3.55	290.00	6.88	248.90	1.95	1076.90	3.58
	Fly Ash Pond / Sand Body		0.00	0.00	0.00	0.00	0.00	0.00	206.40	1.62	206.40	0.69
	Total Wasteland		326.00	4.56	212.00	3.55	290.00	6.88	455.30	3.57	1283.30	4.27
WATERBODIES	Reservoir, Nallah, Ponds		191.00	2.67	170.00	2.84	122.00	2.89	292.21	2.29	775.21	2.58
	Total Waterbodies		191.00	2.67	170.00	2.84	122.00	2.89	292.21	2.29	775.21	2.58
AGRICULTURE	Crop Lands		2642.00	36.98	2010.00	33.62	1334.00	31.63	1928.80	15.14	7914.80	26.31
	Fallow Lands		1893.00	26.49	1873.00	31.33	1012.00	23.99	4954.70	38.90	9732.70	32.36
	Total Agriculture		4535.00	63.47	3883.00	64.94	2346.00	55.62	6883.50	54.05	17647.50	58.67
SETTLEMENTS	Urban Settlement		460.00	6.44	379.00	6.34	402.00	9.53	478.80	3.76	1719.80	5.72
	Rural Settlement		229.00	3.21	14.00	0.23	16.50	0.39	506.50	3.98	766.00	2.55
	Industrial Settlement		9.00	0.13	12.50	0.21	51.20	1.21	63.80	0.50	136.50	0.45
	Total Settlements		698.00	9.77	405.50	6.78	469.70	11.14	1049.10	8.24	2622.30	8.72
Grand Total			7145.00	100.00	5979.00	100.00	4218.00	100.00	12736.00	100.00	30078.00	100.00









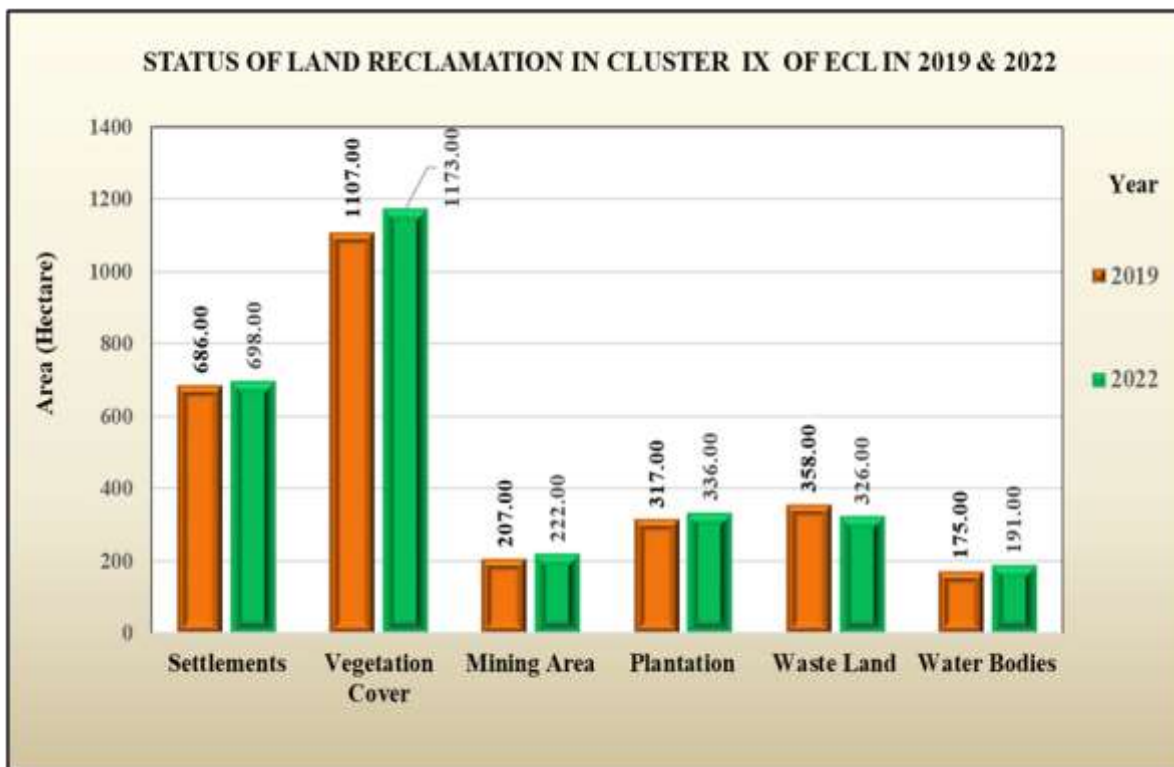


Figure- 9.2

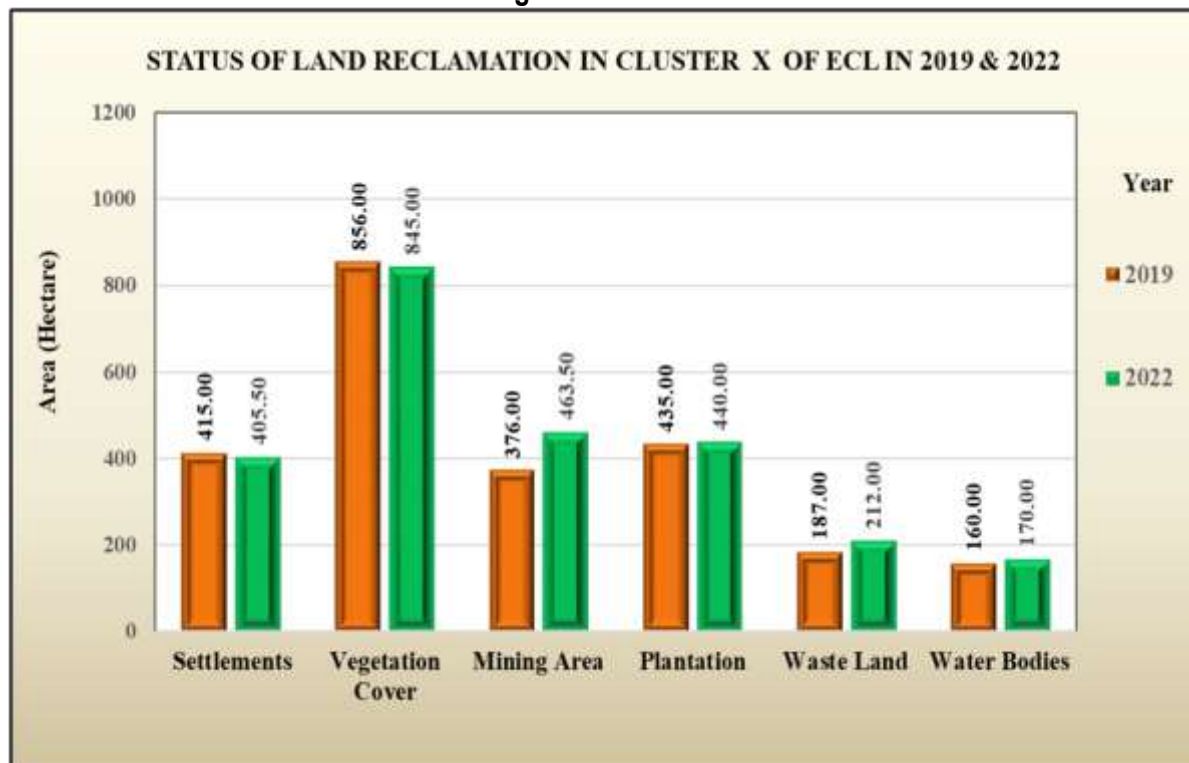


Figure- 9.3

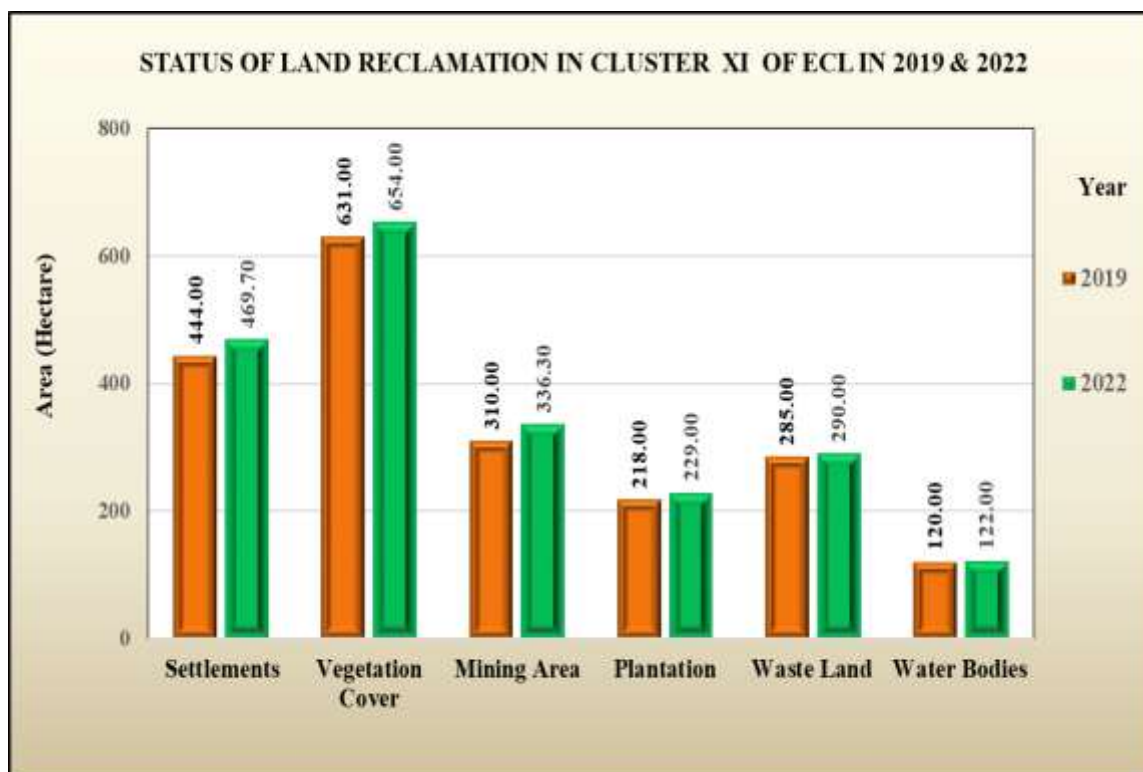


Figure- 9.4

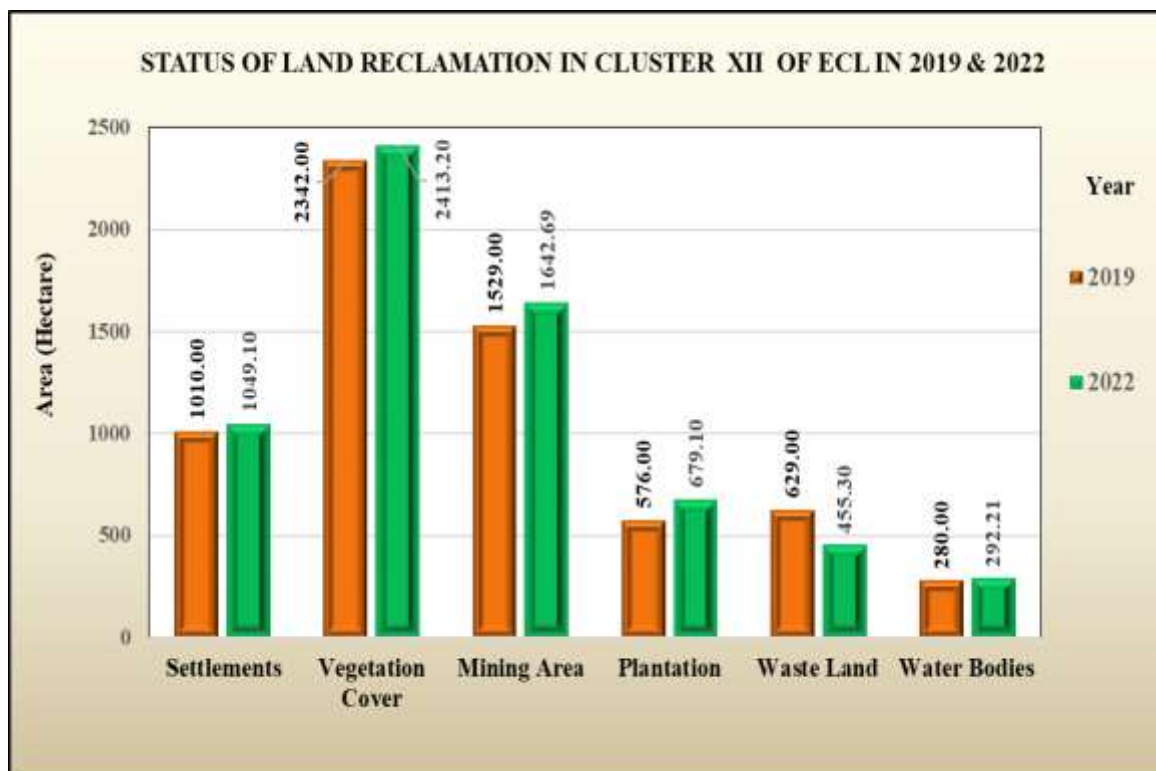


Figure- 9.5



Photo-9.1: Plantation Backfilled area in Kottadih OCP, Cluster XII, ECL



Photo-9.2: Plantation on External OB in Shankarpur OC, Cluster XII, ECL

MAHANADI COALFIELDS LIMIT

10.0 Land Reclamation Status in Mahanadi Coalfields Limited

- 10.1** Gopalji OCP producing less than 5 million m³. (Coal + OB) p.a. of Mahanadi Coalfields Ltd. has been taken up during the year 2022-23 for land reclamation/ Monitoring based on Satellite Data of the year 2022.
- 10.2** Land Reclamation status of above mentioned Gopalji OCP of MCL is given in Table-10.1 and also shown graphically in Fig-10.1. Area statistics of different land use class present in the mine leasehold of the above project for the year 2022 is shown in the Table-10.2. Land use map derived from satellite data is shown in Plate-10.1. Different land use classes based on satellite data are depicted in Bar Chart in Fig-10.3.
- 10.3** Mining operation of Gopalji OCP of MCL taken up for this study in the year 2022-23 has not been started yet. Study indicates that open forest covers an area of 88.12 ha., scrubs cover 286.36 ha., waste land covers 14.26 ha., water body covers 12.37 ha. Total agricultural land covers an area of 715.49 ha. and settlements cover 24.83 ha.

Table-10.1
LAND RECLAMATION STATUS IN OPENCAST MINE OF MCL BASED ON SATELLITE DATA OF THE YEAR 2022
 (PROJECT PRODUCING LESS THAN 5M.CM (COAL+OB) ANUALLY)

(Area in Hectare)																			
Sl. No.	Project	Total Leasehold Area		Technical Reclamation		Plantation						Area under Active Mining		Total Excavated Area		Total Area under Plantation (% Green Cover Generated in Leasehold)		Total Area under Reclamation	
						Biological Reclamation		Other Plantations											
				Area under Backfilling		Plantation on Excavated / Backfilled Area		Plantation on External Over Burden Dumps		Social Forestry, Avenue Plantation Etc.									
1	2	3		4		5		6		7		8		9 (=4+5+8)		10 (=5+6+7)		11(=4+5)	
		2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	2019	2022
1	Gopalji	1141.43	1141.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				0.00%	0.00%	0.00%	0.00%					0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	TOTAL	1141.43	1141.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				0.00%	0.00%	0.00%	0.00%					0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
(% is calculated with respect to Excavated Area as applicable)																			

(% is calculated with respect to Excavated Area as applicable)

- Gopalji OCP has not been started yet and Land Reclamation monitoring of this OCP taken up for the first time in the year 2019. Hence data obtained in the year 2019 will be treated as base data for comparison of land reclamation at the interval of three years.

Note: In reference to above table different parameters as classified as follows:

1. Area under Biological Reclamation includes Area under plantation done on Backfilled Area only.
2. Area under Technical Reclamation includes Area under Backfill only.
3. Area under Active mining includes Coal Quarry, Advance Quarry site and Quarry filled with water etc if any.
4. Social Forestry and Plantation on External OB Dumps are not included in Biological Reclamation and are put under separate categories as shown in above Table.
5. (%) calculated in above Table is in respect to Total Excavated area except for " Total Area under plantation " where % is in terms of "Leasehold Area ".

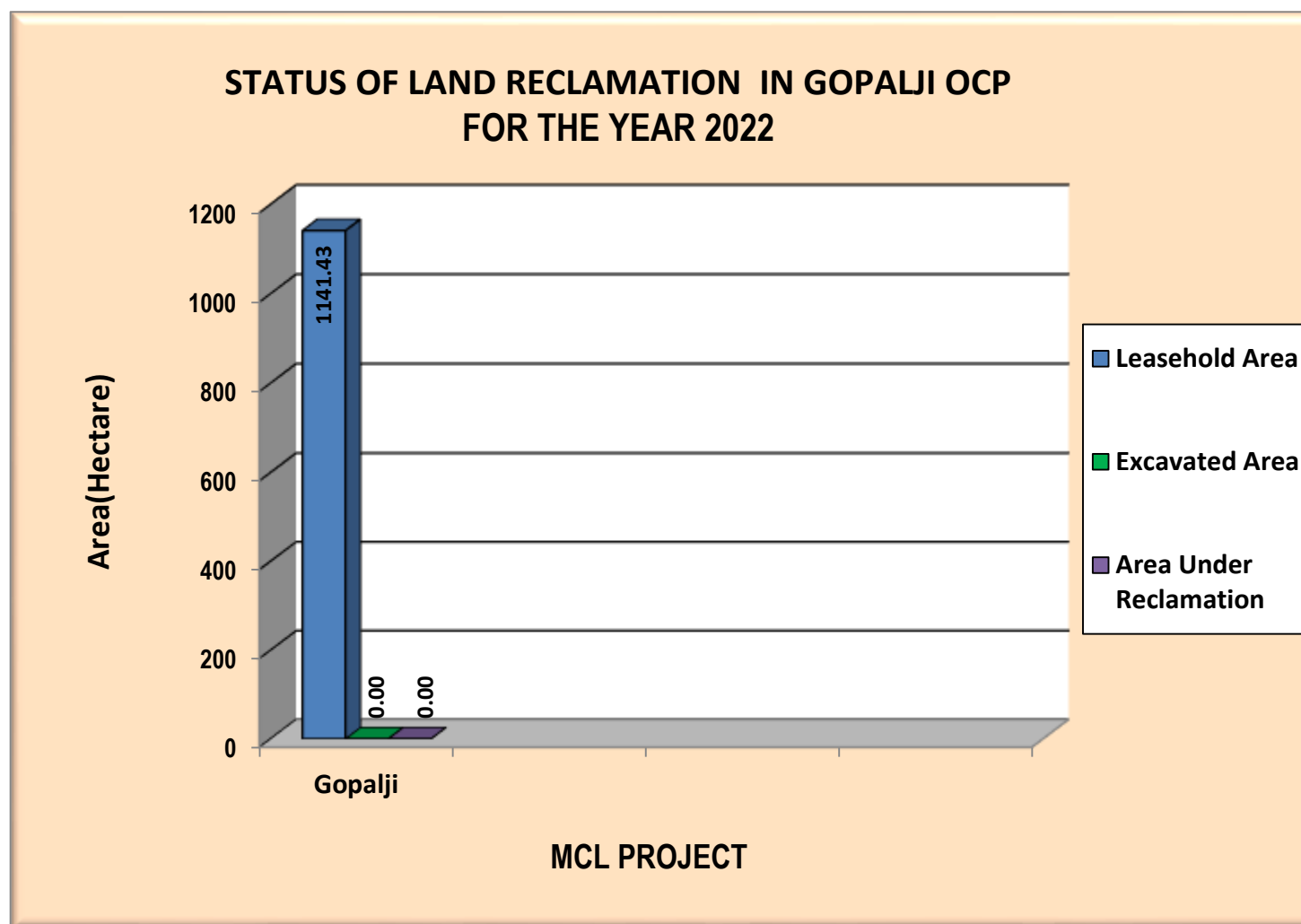




















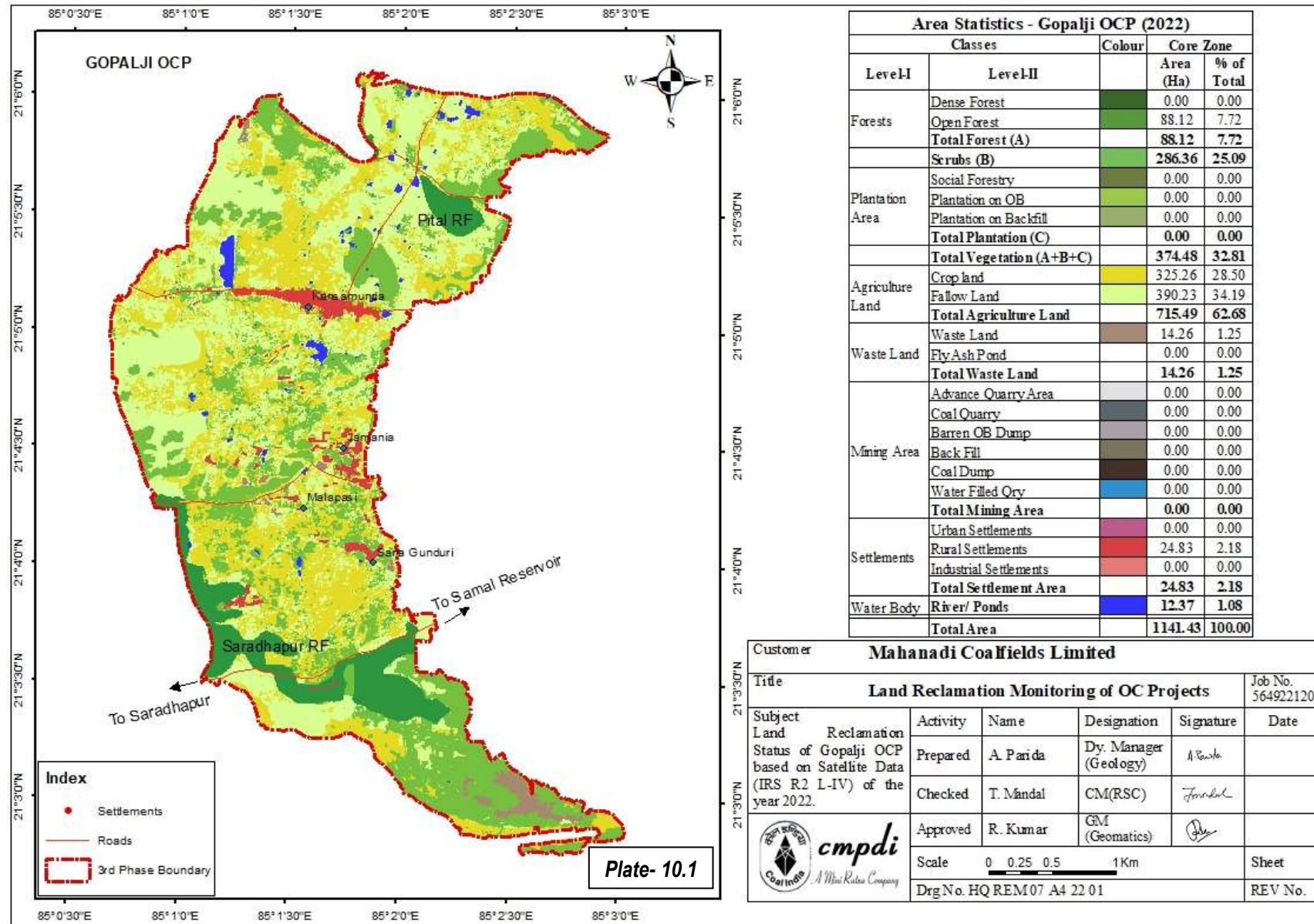


Fig. 10.1 : Status of Land Reclamation in Gopalji OCP based on Satellite data of the year 2022

TABLE-10.2
STATUS OF LAND RECLAMATION IN MCL BASED ON SATELLITE DATA OF THE YEAR 2022
Area in Hectares

			GOPALJI		TOTAL	
			Area	%	Area	%
FORESTS	Dense Forest		0.00	0.00	0.00	0.00
	Open Forest		88.12	7.72	88.12	7.72
	Total Forest		88.12	7.72	88.12	7.72
SCRUBS	Scrubs		286.36	25.09	286.36	25.09
PLANTATION	Social Forestry/Avenue Plantation		0.00	0.00	0.00	0.00
	Plantation on OB Dump		0.00	0.00	0.00	0.00
	Plantation on Backfill (Biological Reclamation)		0.00	0.00	0.00	0.00
	Total Plantation		0.00	0.00	0.00	0.00
	Total Vegetation		374.48	32.81	374.48	32.81
ACTIVE MINING	Coal Dump		0.00	0.00	0.00	0.00
	Coal Quarry		0.00	0.00	0.00	0.00
	Advance Quarry Site		0.00	0.00	0.00	0.00
	Quarry Filled With Water		0.00	0.00	0.00	0.00
	Total Area under Active Mining		0.00	0.00	0.00	0.00
	Barren OB Dump		0.00	0.00	0.00	0.00
RECLAIMED	Area Under Backfilling (Technical Reclamation)		0.00	0.00	0.00	0.00
	Total Area under Technical Reclamation		0.00	0.00	0.00	0.00
	Total Area under Mine Operation		0.00	0.00	0.00	0.00
WASTELAND	Waste Lands		14.26	1.25	14.26	1.25
	Fly Ash Pond / Sand Body		0.00	0.00	0.00	0.00
	Total Wasteland		14.26	1.25	14.26	1.25
WATERBODIES	Reservoir, nallah, ponds		12.37	1.08	12.37	1.08
	Total Waterbodies		12.37	1.08	12.37	1.08
AGRICULTURE	Crop Lands		325.26	28.50	325.26	28.50
	Fallow Lands		390.23	34.19	390.23	34.19
	Total Agriculture		715.49	62.68	715.49	62.68
SETTLEMENTS	Urban Settlement		0.00	0.00	0.00	0.00
	Rural Settlement		24.83	2.18	24.83	2.18
	Industrial Settlement		0.00	0.00	0.00	0.00
	Total Settlement		24.83	2.18	24.83	2.18
	Grand Total		1141.43	100.00	1141.43	100.00



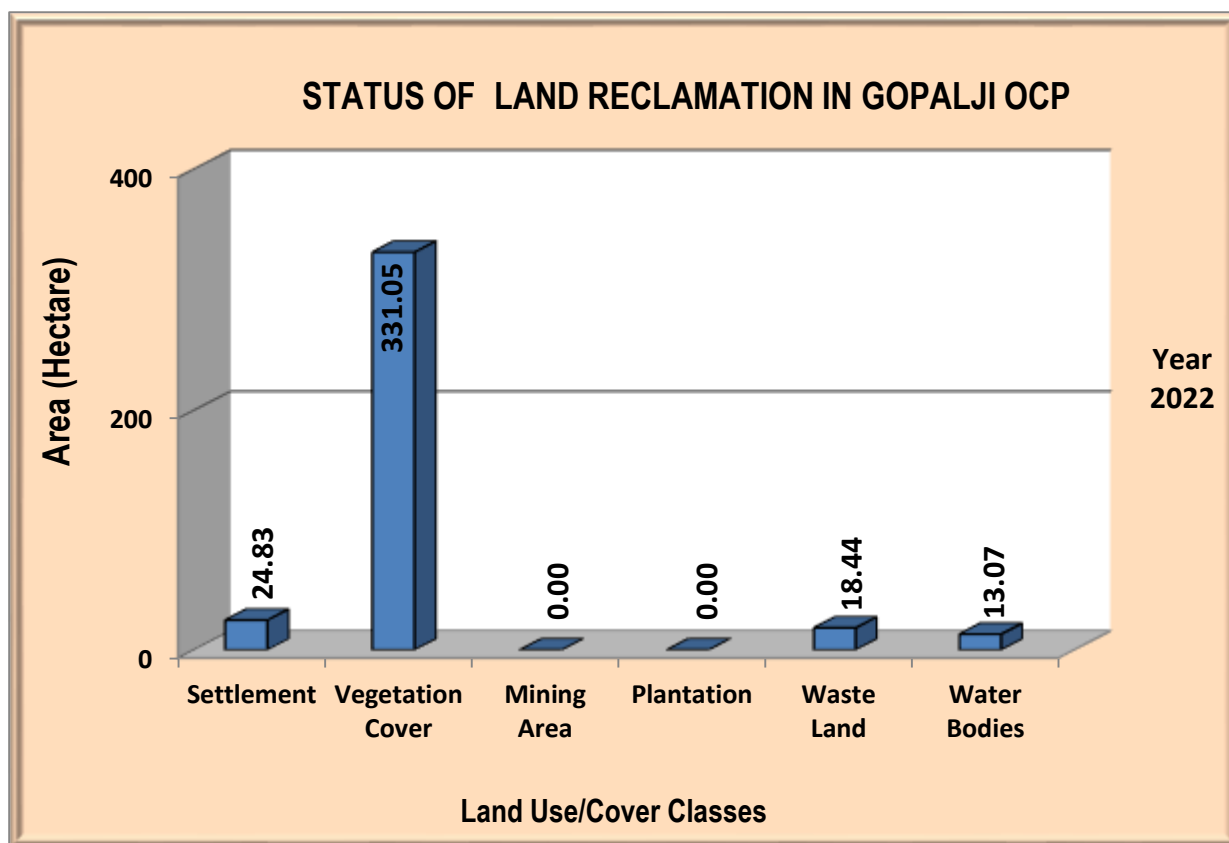


Figure- 10.2

ABBREVIATIONS

Sol	Survey of India
MoEF & CC	Ministry of Environment, Forest & Climate Change
CIL	Coal India Limited
ECL	Eastern Coalfields Limited
BCCL	Bharat Coking Coal Limited
CCL	Central Coalfields Limited
WCL	Western Coalfields Limited
SECL	South Eastern Coalfields Limited
NCL	Northern Coalfields Limited
MCL	Mahanadi Coalfields Limited
NEC	North Eastern Coalfields
CMPDIL	Central Mine Planning & Design Institute Ltd
NRSC	National Remote Sensing Centre
R2/ R2A	Resource-Sat Satellites
LISS - 4	Linear Imaging and Self Scanning Sensor
FCC	False Colour Composite
OCP	Opencast Project
UGP	Underground Project
OB	Over Burden
GCP	Ground Control points
GIS	Geographic Information System
WGS-84	World Geodetic System
UTM	Universal Transverse Mercator

GLOSSARY

Sl.	Term	Definition
1.	Land Reclamation	To manage, reclaim and restore mined out/ degraded land as close as possible to its original stage
2.	Over Burden	The material that lies above the coal seam/ deposit
3.	Monitoring	A process of evaluation to check or keep record for a period of time.
4.	Opencast Coal Mine	Open-pit mining, also known as opencast mining, is a surface mining technique that extracts minerals from an open pit in the ground.
5.	Social Forestry	Social forestry is the management and protection of forests and afforestation of barren and deforested lands with the purpose of helping environmental, social and rural development. Plantation (Social/ Avenue or other) carried out outside mining area.
6.	Biological Reclamation	Plantation on Backfilled areas (Stabilized Internal Dumps)
7.	Technical Reclamation	Area under backfilling (Over burden dumped inside the mine voids) in mining area.
8.	Green Cover Generation	Total Plantation carried out in the lease area of Project. This include Plantation on Backfill, Plantation on OB and Social Forestry
9.	Leasehold Area	The area, for which lease is granted for the purpose of undertaking mining and allied operations
10.	Excavated area	Mined out area which includes active mining, area under backfilling and plantation on backfilled areas
11.	Active Mining	Mining areas which include Coal Quarry, Advance Quarry, Quarry Filled with Water etc.
12.	Environmental Protection	It is the practice of protecting the natural environment by individuals, organizations and governments. Its objectives are to conserve natural resources and the existing natural environment and, where possible, to mitigate damage and reverse trends.
13.	Remedial Measure	Any measure or action required or undertaken to investigate, monitor, clean up, remove, treat, prevent, contain or otherwise remediate the presence or release of any hazardous substance or activity.
14.	Systematic Error	Every measurement differing from the true measurement in the same direction, and even by the same amount in some cases

15.	Geometric Distortion	It refers to the improper positioning of any image with respect to their true geographic position when viewed in a properly scaled common image display plane.
16.	Land Use/Cover Class	Land cover is what covers the surface of the earth and land use describes how the land is used.
17.	Accuracy	The closeness of agreement between a measured quantity value and a true quantity value.
18.	Environmental Clearance	Environmental Clearance (EC) for any developmental projects like coal mining projects etc. has been made mandatory by the Ministry of Environment, Forests and Climate Change (MoEF & CC) through its Notification issued on 27.01.1994 under the provisions of Environment (Protection) Act, 1986.
19.	Rectification and Geo-referencing	Geo-referencing is the assigning of absolute location of a data point or data points. Geo-rectification refers to the removal of geometric distortions between sets of data points, most often the removal of terrain, platform, and sensor induced distortions from remote sensing imagery
20.	Image Enhancement	It is the process of modifying digital images so that the results are more suitable for processing or further image analysis.
21.	Training set selection	It is a portion of a data set used to fit or train a model for prediction or classification of values that are known in the training set, but unknown in other (future) data
22.	Image Classification	It refers to the task of extracting information classes from a multiband raster image. The resulting raster from image classification can be used to create thematic maps.
23.	Temporal Changes	The 'temporal change' means the change in any entity with a period of time.
24.	Ground Truthing	Collection of primary/ basic information from ground realities for satellite image interpretation and thematic mapping.
25.	Cluster	Group of opencast and/ or underground mines clubbed together for administrative purposes.
26.	Arc GIS	GIS Software used for Map preparation
27.	ERDAS IMAGINE	Satellite Image Data Classification Software



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