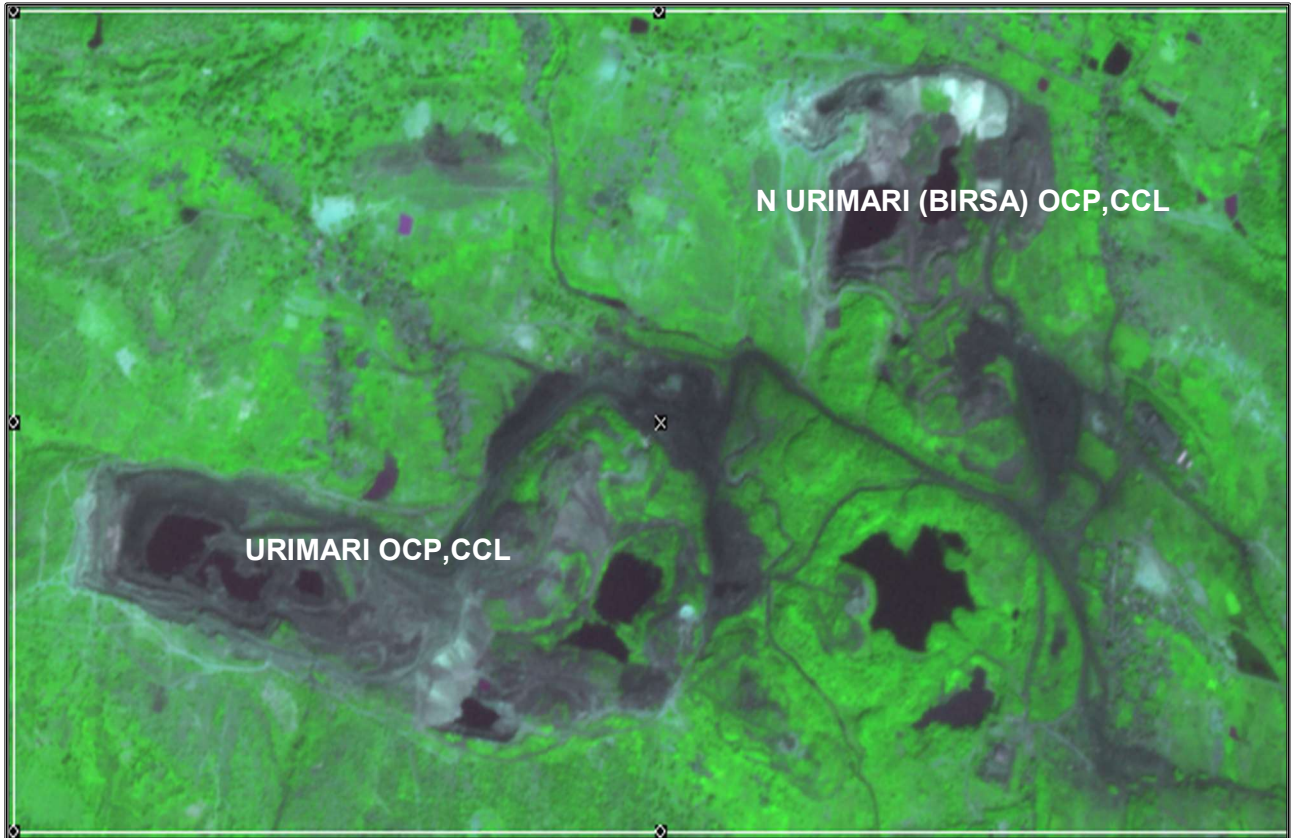


**Land Restoration / Reclamation Monitoring of less than
5 m cu. m. (Coal + OB) Capacity Open Cast Coal Mines of Central
Coalfields Limited Based on Satellite Data for the Year 2017**



Submitted to:

**Central Coalfields Limited
Ranchi, Jharkhand**



cmpdi
A Mini Ratna Company

**Land Restoration / Reclamation Monitoring of less than 5 m. cu. m (Coal + OB) capacity Open Cast Coal Mines of Central Coalfields Limited
Based on Satellite Data for the Year 2017**

March-2018



cmpdi

A Mini Ratna Company

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

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Executive Summary

- 1.0 Project** Land restoration / reclamation monitoring of 13 opencast coal mines of Central Coalfields Ltd. (CCL) producing less than 5 million cu. m. (Coal + OB) per year based on satellite data, on every three year basis.
- 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 land in the leasehold area of the various projects. This will help in assessing the progressive status of mined out 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 **6376.05** hectares of the 13 OC projects Viz. Rohini, Purnadih, Tapin, Jharkhand, Topa, Urimari, North Urimari, New Giddi-C, Govindpur, Khasmahal, Amlo, Selected Dhorri and Tarmi considered for monitoring during year 2017; total excavated area is only **1362.97** ha (**21.38%**) out of which **291.08** ha area (**21.36%**) has been planted, **475.16** ha area (**34.86%**) has been backfilled and **596.76** ha area (**43.78%**) is under active mining. It is evident from the analysis that **56.22%** area of the OC projects have already been reclaimed and balance **43.78%** area is under active mining. Project wise details are given in Table-1 & Fig -1.
 - Of the total area reclaimed by the Coal companies, **21.38%** is under biological reclamation (plantation) and **34.86%** is under technical reclamation.

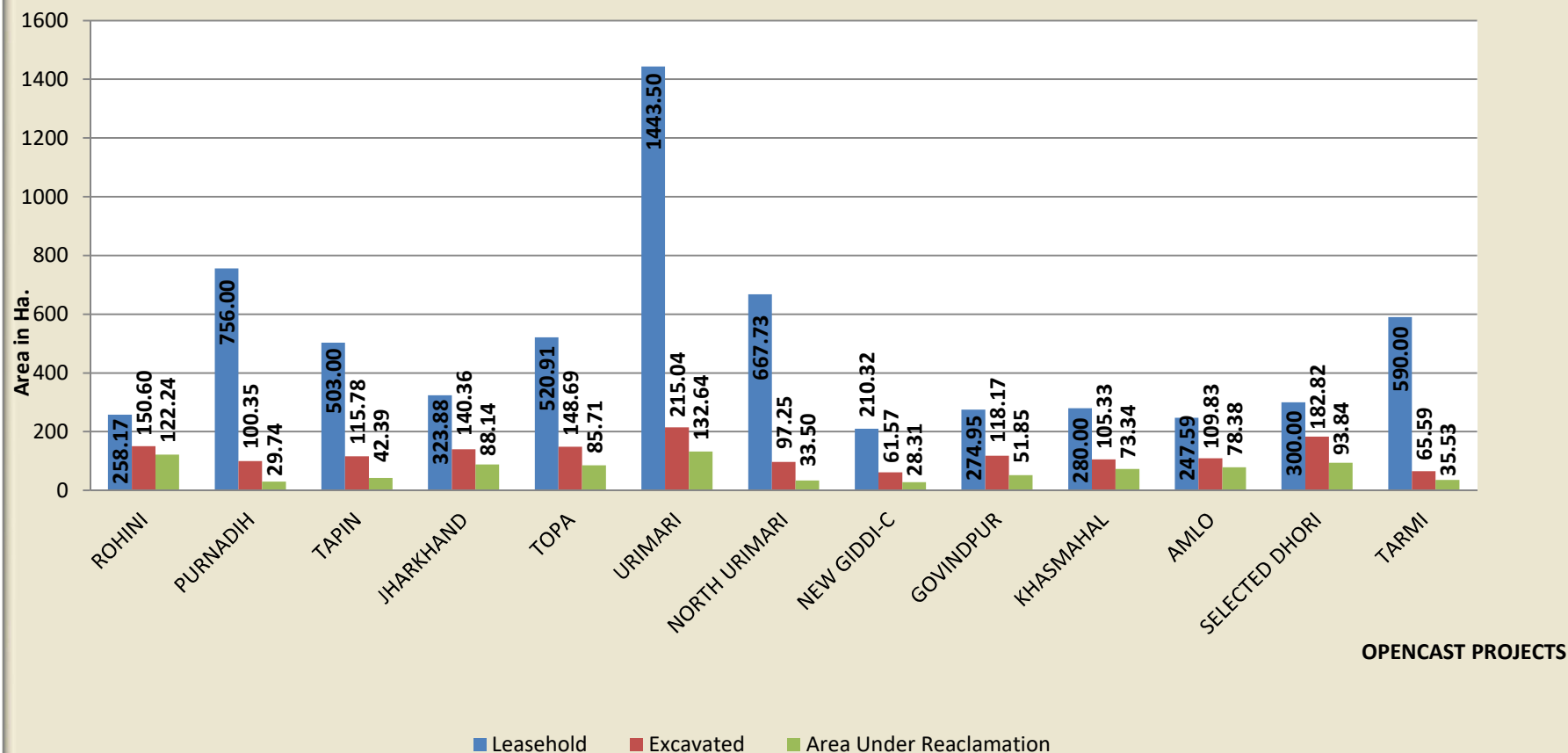
TABLE-1

**Project wise Land Reclamation Status in OC projects of Central Coalfields Ltd
Based on Satellite data of the Year 2017**

(% Calculated in terms of Total Mined-Out Area)

Sl. No.	Project		(% Calculated in terms of Total Excavated Area)				Total Excavated Area	Area under Reclamation
			Plantation/ Vegetation	Under Backfilling / OB	Under Active Mining			
	Name	Leasehold (i)	ii	iii	iv	ii+iii+iv	ii+iii	
			2014	2014	2014	2014	2014	
1	Rohini	258.17	34.33	87.91	28.36	150.60	122.24	
			22.80	58.37	18.83		81.17	
2	Purnadih	756	1.84	27.90	70.61	100.35	29.74	
			1.83	27.80	70.36		29.64	
3	Tapin	503	22.09	20.30	73.39	115.78	42.39	
			19.08	17.53	63.39		36.61	
4	Jharkhand	323.88	33.11	55.03	52.22	140.36	88.14	
			23.59	39.21	37.20		62.80	
5	Topa	520.91	40.04	45.67	62.98	148.69	85.71	
			26.93	30.71	42.36		57.64	
6	Urimari	1443.5	70.18	62.46	82.40	215.04	132.64	
			32.64	29.05	38.32		61.68	
7	North Urimari	667.73	10.26	23.24	63.75	97.25	33.50	
			10.55	23.90	65.55		34.45	
8	New Giddi- C	210.32	7.65	20.66	33.26	61.57	28.31	
			12.42	33.56	54.02		45.98	
9	Govindpur	274.95	9.72	42.13	66.32	118.17	51.85	
			8.23	35.65	56.12		43.88	
10	Khasmahal	280	37.76	35.58	31.99	105.33	73.34	
			35.85	33.78	30.37		69.63	
11	Amlo	247.59	24.10	54.28	31.45	109.83	78.38	
			21.94	49.42	28.64		71.36	
12	Selected Dhuri	300	5.03	88.81	88.98	182.82	93.84	
			2.75	48.58	48.67		51.33	
13	Tarmi	590	14.94	20.59	30.06	65.59	35.53	
			22.78	31.39	45.83		54.17	
TOTAL (CCL)		6376.05	311.05	584.56	715.77	1611.38	895.61	
			19.30	36.28	44.42	25.27	55.58	

Fig. 1: PROJECT WISE STATUS OF LAND RECLAMATION IN CCL FOR THE YEAR 2017



OPENCAS PROJECTS

1.0 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 most scarce 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, another work order vide letter no. CIL/WBP/ENV./2011dated23/08/11 was issued by CIL for monitoring of less than 5 million m³ per annum capacity (Coal +OB) projects from the year 2011 at interval of three years. 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 Present report is embodying the finding of the study based on satellite data of the year 2017 carried out for 13 OC projects of Central Coalfields Ltd. producing less than 5 mcm (Coal+OB) per annum.

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 given in fig 2. Following steps are involved in land reclamation /restoration monitoring:

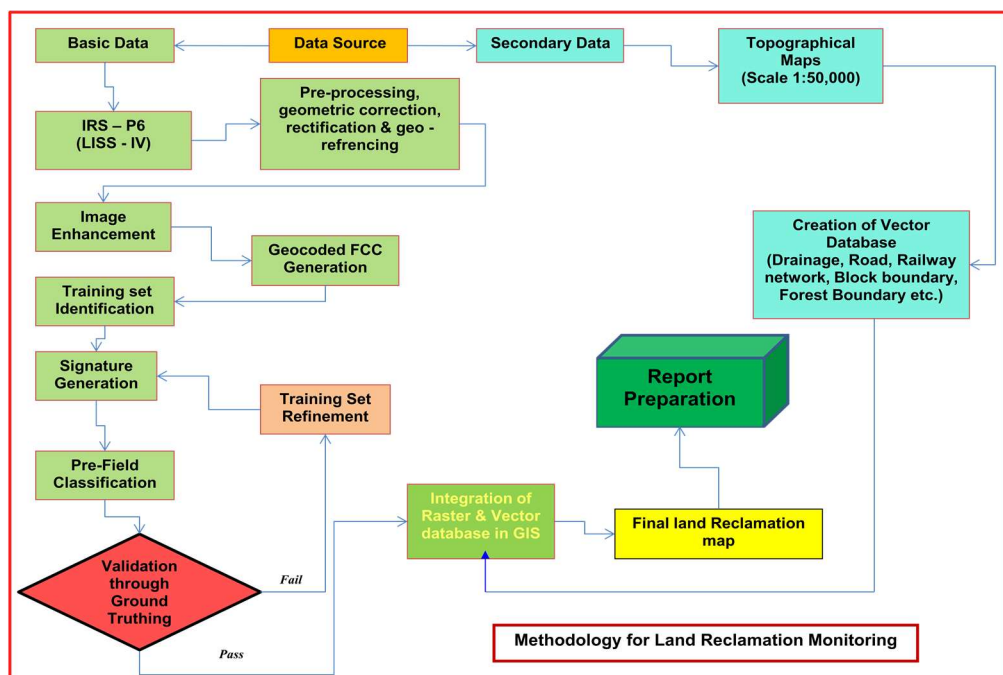


Figure: 2 Methodology for Land Reclamation Monitoring

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 digital image processing s/w. Methodology involves the following major steps:

- **Rectification & Georeferencing:** 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, georeferencing is required for correction of image data using ground control points (GCP) to make it compatible to SOI 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 14.0 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 v. 14.0 software and given in table 2.

- **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 are 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 Land Reclamation Status in Central Coalfields Ltd.

4.1 Following 13 OC projects producing less than 5 million m³. (Coal + OB together) of Central Coalfields Ltd. have been taken up during the year 2017 for land reclamation monitoring:

- Rohini
- Purnadih
- Tapin
- Jharkhand
- Topa
- Urimari
- North Urimari
- New Giddi-C
- Govindpur
- Khasmahal
- Amlo
- Selected Dhori
- Tarmi

4.2 Area statistics of different land use classes present in OC projects in the year 2017 is given in Table 2. Land use maps derived from the satellite data is given in Plate no. 1 to 13. Land use status are shown in Fig. 3 – 7 and field photographs showing plantation and backfilled area in mining projects are shown in photos 1-9.

4.3 Study reveals that **56.22%** of excavated area has already been reclaimed by CCL in the OC projects, out of which **21.36%** area has been revegetated and **34.86%** area are backfilled.

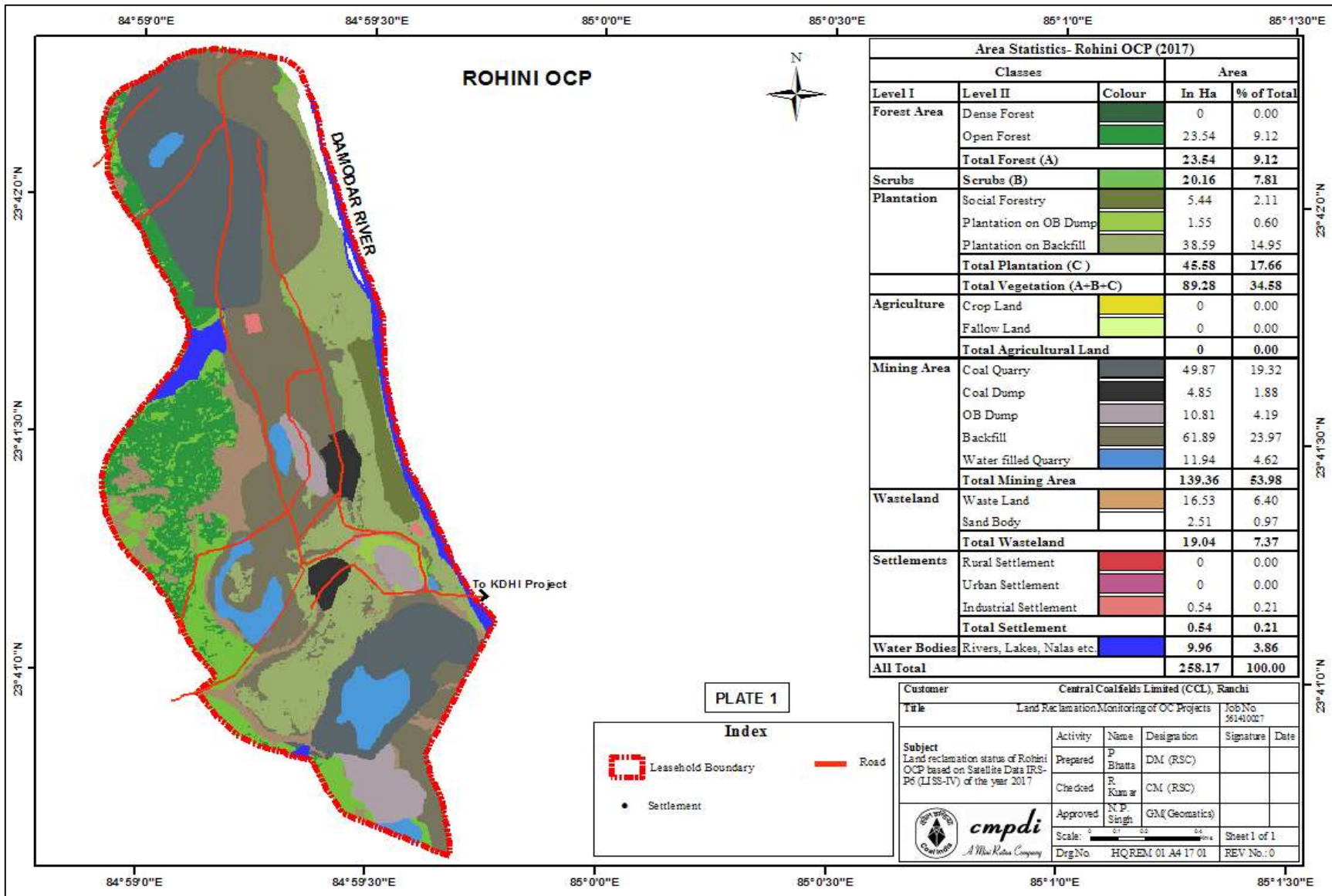
4.4 After analyzing the satellite data of year 2017, it is evident that plantation carried out on backfilled area, OB dumps as well as under social forestry in all the 13 mines of CCL taken up for study, has reached **21.36 %** till now. It can also be seen from the table.1 that the total area of reclamation has reached **56.22%** till the year 2017.

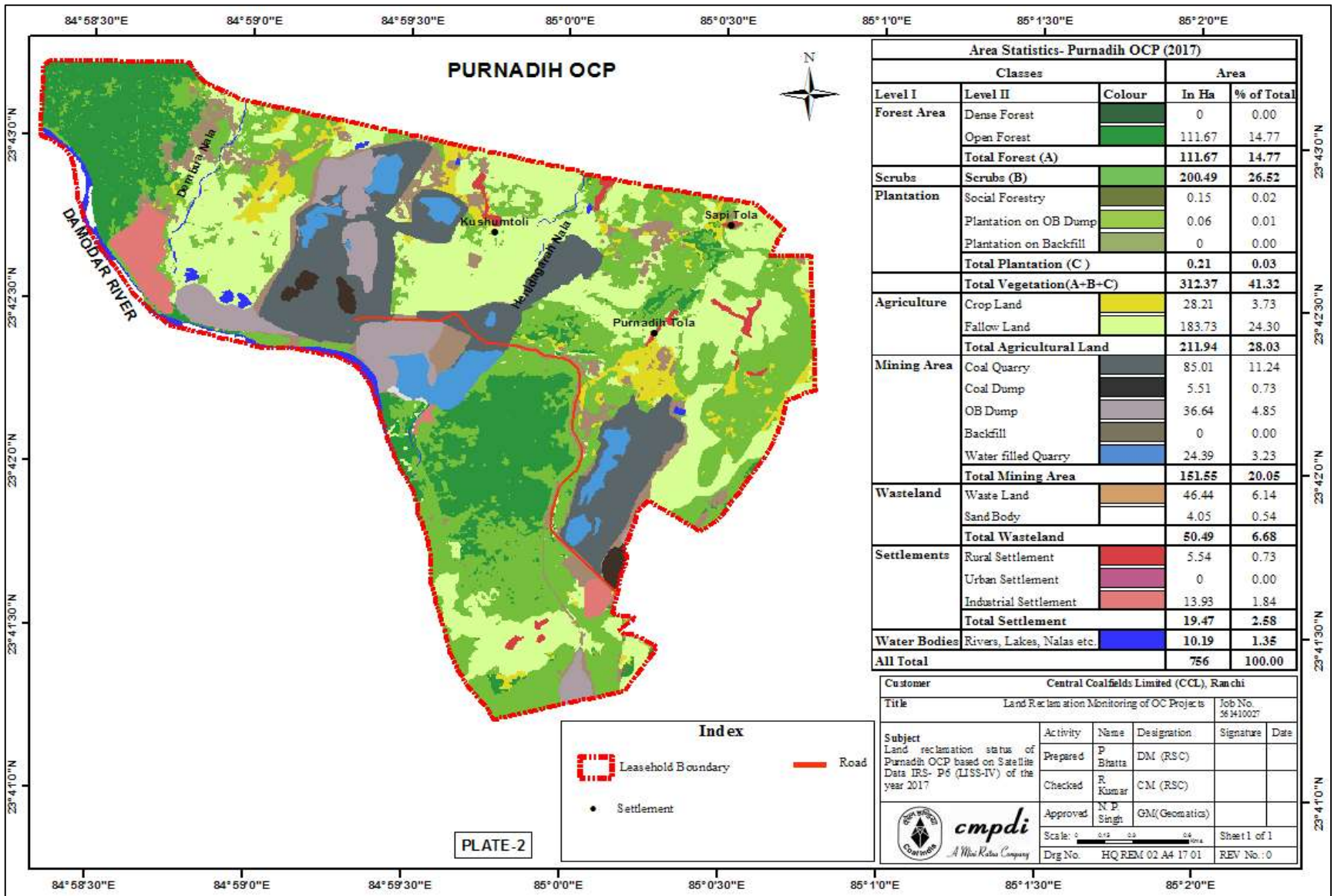
TABLE-2
Projectwise Land Reclamation Status in Opencast Projects of CCL based on Satellite Data of the year 2017

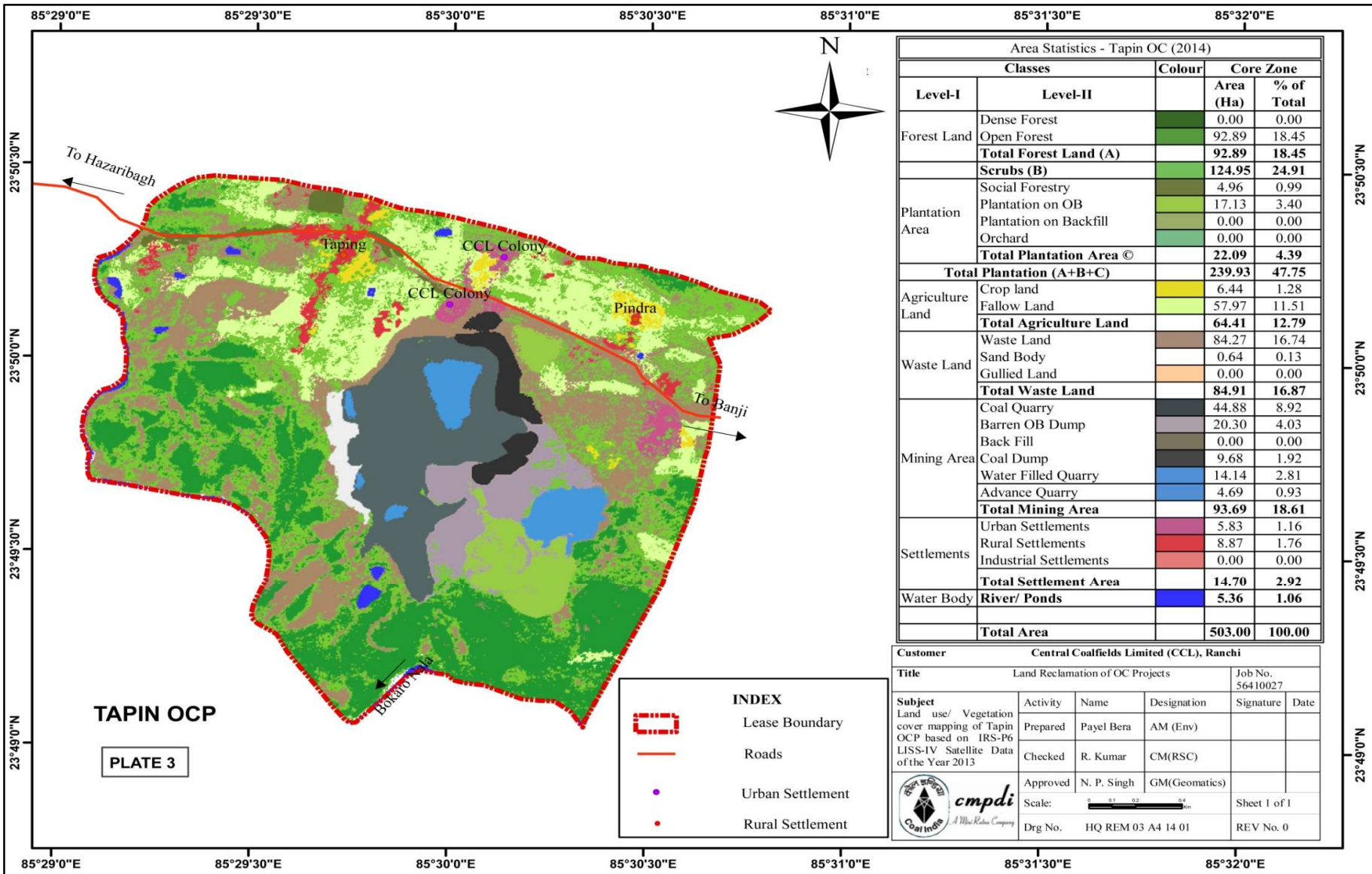
(Area in Ha.)

		ROHINI		PURNADIH		TAPIN		JHARKHAND		TOPA		URIMARI		NORTH URIMARI	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Open Forest	44.84	17.37	125.85	16.65	92.89	18.45	5.97	1.85	0.00	0.00	183.10	12.68	45.97	6.88
	Total Forest (A)	44.84	17.37	125.87	16.65	92.89	18.45	5.97	1.85	0.00	0.00	183.10	12.68	45.97	6.88
SCRUBS	Scrubs (B)	29.67	11.49	212.81	28.15	124.95	24.91	78.26	24.16	122.73	23.56	326.52	22.62	190.10	28.47
	Social Forestry	5.48	2.12	1.06	0.14	4.96	0.99	2.48	0.76	14.31	2.75	37.58	2.60	0.00	0.00
PLANTATION	Plantation on OB Dump	1.02	0.40	0.78	0.10	17.13	3.40	11.99	3.70	25.73	4.94	7.57	0.53	10.26	1.54
	Plantation on Backfill	27.83	10.78	0.00	0.00	0.00	0.00	18.64	5.75	0.000	0.00	25.03	1.73	0.00	0.00
	Total Plantation (Biological Reclamation C)	34.33	13.30	1.84	0.24	22.09	4.39	33.11	10.21	40.04	7.69	70.18	4.86	10.26	1.54
	Total Vegetation (A+B+C)	108.84	42.16	340.52	45.04	239.93	47.75	117.34	36.22	162.77	31.25	579.80	40.16	246.33	36.89
ACTIVE MINING	Coal Quarry	11.29	4.38	63.38	8.38	44.88	8.92	40.18	12.40	42.47	8.15	62.83	4.35	41.91	6.27
	Coal Face	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
	Coal Dump	1.78	0.69	1.68	0.23	9.68	1.92	9.18	2.83	3.95	0.76	5.92	0.41	14.81	2.22
	Advance Quarry Site	0.00	0.00	1.92	0.25	4.69	0.93	0.00	0.00	0.03	0.01	4.31	0.30	3.21	0.48
	Quarry Filled with Water	15.29	5.92	3.63	0.48	14.14	2.81	2.86	0.88	16.53	3.17	9.34	0.65	3.82	0.57
	Total Area under Active Mining	28.36	10.99	70.61	9.34	73.39	14.58	52.22	16.11	62.98	12.09	82.40	5.71	63.75	9.54
RECLAIMED	Barren OB dump	10.26	3.97	27.90	3.69	20.30	4.03	31.77	9.81	45.67	8.77	42.13	2.92	23.24	3.48
	Area Under Backfilling	77.65	30.08	0.00	0.00	0.00	0.00	23.26	7.19	0.00	0.00	20.33	1.41	0.00	0.00
	Total Area under Technical Reclamation	87.91	34.05	27.90	3.69	20.30	4.03	55.03	17.00	45.67	8.77	62.46	4.33	23.24	3.48
	Total Area under Mine Operation	116.27	45.04	98.51	13.03	93.69	18.61	107.25	33.11	108.65	20.86	144.86	10.04	86.99	13.02
WASTELANDS	Waste Lands	20.32	7.87	28.18	3.73	84.27	16.74	49.37	15.25	101.64	19.51	354.57	24.56	61.14	9.16
	Fly Ash Pond/Sand Body	2.53	0.98	0.13	0.02	0.64	0.13	1.10	0.34	0.00	0.00	32.11	2.23	0.00	0
	Total Wastelands	22.85	8.85	28.31	3.75	84.91	16.87	50.47	15.59	101.64	19.51	386.68	26.79	61.14	9.16
WATER	Reservoir, nallah, ponds etc.	10.06	3.89	2.32	0.31	5.36	1.06	7.39	2.28	2.32	0.44	52.07	3.61	4.73	0.71
	Total Waterbodies	10.06	3.89	2.32	0.31	5.36	1.06	7.39	2.28	2.32	0.44	52.07	3.61	4.73	0.71
AGRICULTURE	Crop Lands	0.00	0.00	44.44	5.88	6.44	1.28	15.03	4.64	0.03	0.01	0.00	0.00	43.72	6.55
	Fallow Lands	0.00	0.00	224.10	29.64	57.97	11.51	7.92	2.45	107.75	20.68	230.16	15.94	201.13	30.12
	Total Agriculture	0.00	0.00	268.54	35.52	64.41	12.79	22.95	7.09	107.78	20.69	230.16	15.94	244.85	36.67
SETTLEMENTS	Urban Settlement	0.00	0.00	1.43	0.19	5.83	1.16	14.72	4.55	25.66	4.93	18.43	1.28	0.00	0.00
	Rural Settlement	0.00	0.00	5.31	0.70	8.87	1.76	0.00	0.00	11.43	2.19	23.57	1.63	21.31	3.19
	Industrial Settlement	0.15	0.06	11.06	1.46	0.00	0.00	3.76	1.16	0.66	0.13	7.93	0.55	2.38	0.36
	Total Settlements	0.15	0.06	17.80	2.35	14.70	2.92	18.48	5.71	37.75	7.25	49.93	3.46	23.69	3.55
	GRAND TOTAL	258.17	100.00	756.00	100.00	503.00	100.00	323.88	100.00	520.91	100.00	1443.50	100.00	667.73	100.00

		NEW GIDDI-C		GOVINDPUR		KHAMMAHAL		AMLO		SELECTED DHORI		TARMI		TOTAL	
		Area	%	Area	%	Area	%	Area	%					Area	%
FORESTS	Dense Forest	0.00	0.00	0.00	0.00	0.01	0.00	0.61	0.25	0.02	0.01	0.10	0.02	0.76	0.01
	Open Forest	0.00	0.00	0.00	0.00	66.89	23.89	19.67	7.94	3.80	1.26	60.48	10.25	649.46	10.19
	Total Forest (A)	0.00	0.00	0.00	0.00	66.90	23.89	20.28	8.19	3.82	1.27	60.58	10.27	650.22	10.20
SCRUBS	Scrub (B)	93.07	44.26	102.72	37.36	54.91	19.61	46.40	18.74	35.01	11.67	166.86	28.28	1584.01	24.84
PLANTATION	Social Forestry	6.47	3.07	0.22	0.08	7.14	2.55	1.40	0.57	0.11	0.04	1.67	0.28	82.88	1.30
	Plantation on OB Dump	1.18	0.56	9.50	3.46	6.78	2.42	15.27	6.17	4.92	1.64	13.27	2.25	125.40	1.97
	Plantation on Backfill	0.00	0.00	0.00	0.00	23.84	8.51	7.43	3.00	0.00	0.00	0.00	0.00	102.77	1.61
	Total Plantation(Biological Reclamation C)	7.65	3.63	9.72	3.54	37.76	13.48	24.10	9.74	5.03	1.68	14.94	2.53	311.05	4.88
Total Vegetation (A+B+C)		100.72	47.89	112.44	40.90	159.57	56.98	90.78	36.67	43.86	14.62	242.38	41.08	2545.28	39.92
ACTIVE MINING	Coal Quarry	21.36	10.16	33.39	12.14	19.61	7.00	12.72	5.14	68.25	22.75	13.40	2.27	475.67	7.46
	Coal Face	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
	Coal Dump	6.30	3.00	3.58	1.31	6.51	2.33	7.07	2.86	7.96	2.65	5.72	0.97	84.14	1.32
	Advance Quarry Site	0.00	0.00	0.00	0.00	3.05	1.09	0.00	0.00	0.00	0.00	4.35	0.74	21.56	0.34
	Quarry Filled with Water	5.60	2.66	29.35	10.67	2.82	1.00	11.66	4.71	12.77	4.25	6.59	1.12	134.40	2.11
	Total Area under Active Mining	33.26	15.82	66.32	24.12	31.99	11.42	31.45	12.71	88.98	29.65	30.06	5.10	715.77	11.23
RECLAIMED	Barren OB dump	20.66	9.82	35.34	12.85	11.50	4.11	10.82	4.37	68.57	22.86	17.00	2.88	365.16	5.73
	Area Under Backfilling	0.00	0.00	6.79	2.47	24.08	8.60	43.46	17.55	20.24	6.75	3.59	0.61	219.40	3.44
	Total Area under Technical Reclamation	20.66	9.82	42.13	15.32	35.58	12.71	54.28	21.92	88.81	29.61	20.59	3.49	584.56	9.17
Total Area under Mine Operation		53.92	25.64	108.45	39.44	67.57	24.13	85.73	34.63	177.79	59.26	50.65	8.59	1300.33	20.40
WASTELANDS	Waste Lands	12.47	5.93	36.25	13.18	15.60	5.57	58.39	23.58	31.69	10.57	97.27	16.48	951.16	14.90
	Fly Ash Pond/Sand Body	0.00	0.00	0.08	0.03	0.00	0.00	0.00	0.00	9.31	3.10	16.97	2.88	62.87	0.99
	Total Wastelands	12.47	5.93	36.33	13.21	15.60	5.57	58.39	23.58	41.00	13.67	114.24	19.36	1014.03	15.89
WATER	Reservoir, nallah, ponds etc.	0.01	0	0.38	0.14	0.97	0.36	0.81	0.32	5.85	1.95	11	1.86	103.27	1.62
	Total Waterbodies	0.01	0	0.38	0.14	0.97	0.36	0.81	0.32	5.85	1.95	11	1.86	103.27	1.62
AGRICULTURE	Crop Lands	23.96	11.39	6.37	2.32	2.48	0.88	0.00	0.00	0.24	0.08	7.06	1.20	149.77	2.35
	Fallow Lands	13.58	6.46	9.49	3.45	23.04	8.23	1.50	0.61	22.89	7.63	135.55	22.97	1035.08	16.23
	Total Agriculture	37.54	17.85	15.86	5.77	25.52	9.11	1.50	0.61	23.13	7.71	142.61	24.17	1184.85	18.58
SETTLEMENTS	Urban Settlement	2.50	1.19	0.00	0.00	7.85	2.80	1.57	0.63	6.47	2.16	14.87	2.52	99.33	1.56
	Rural Settlement	3.11	1.48	0.77	0.28	1.39	0.50	4.08	1.65	0.48	0.16	8.91	1.51	89.23	1.40
	Industrial Settlement	0.05	0.02	0.72	0.26	1.53	0.55	4.73	1.91	1.42	0.44	5.34	0.91	39.73	0.62
	Total Settlements	5.66	2.69	1.49	0.54	10.77	3.85	10.38	4.19	8.37	2.79	29.12	4.94	228.29	3.58
GRAND TOTAL		210.32	100.00	274.95	100.00	280.00	100.00	247.59	100.00	300.00	100.00	590.00	100.00	6376.05	100.00

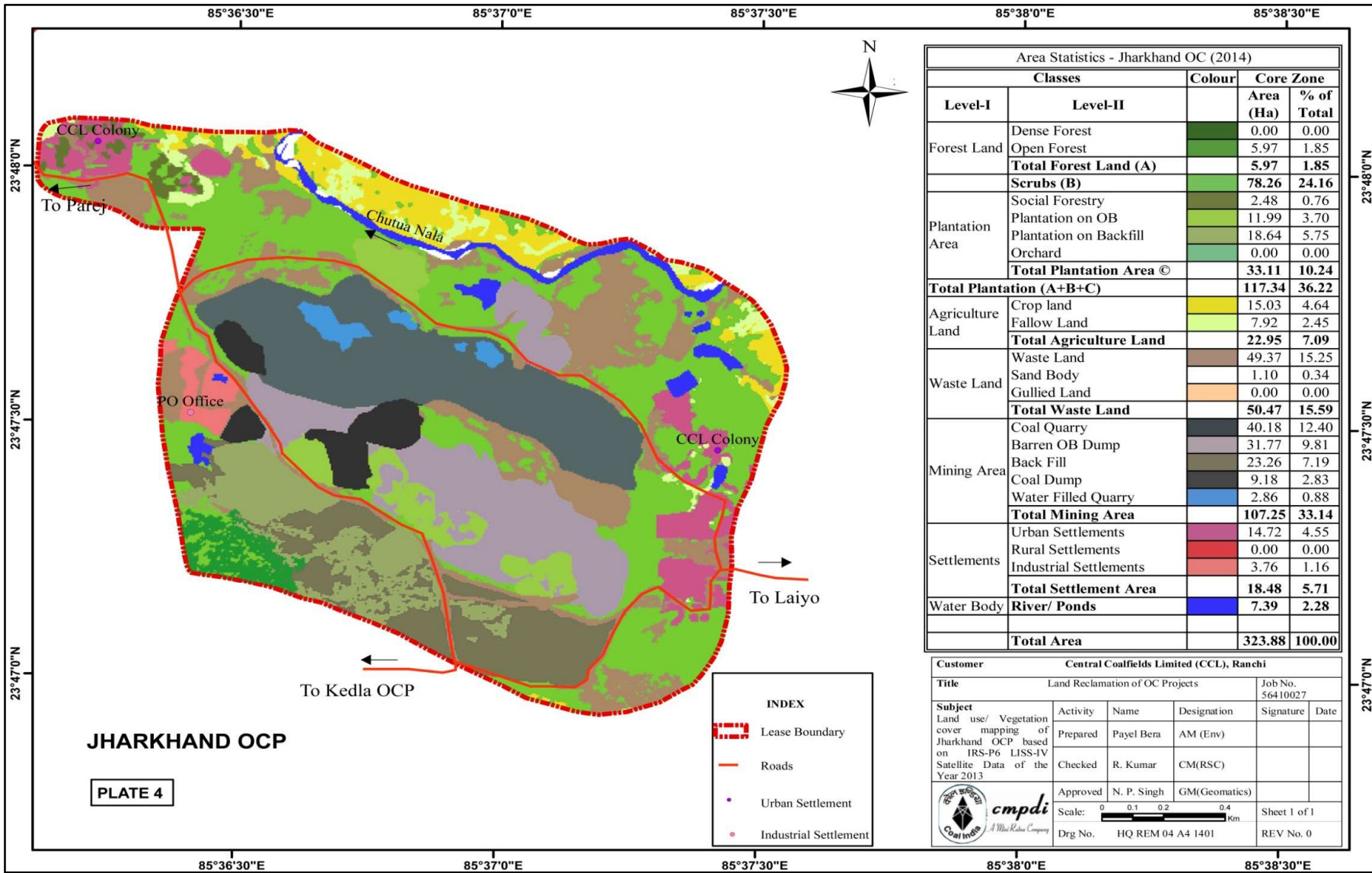






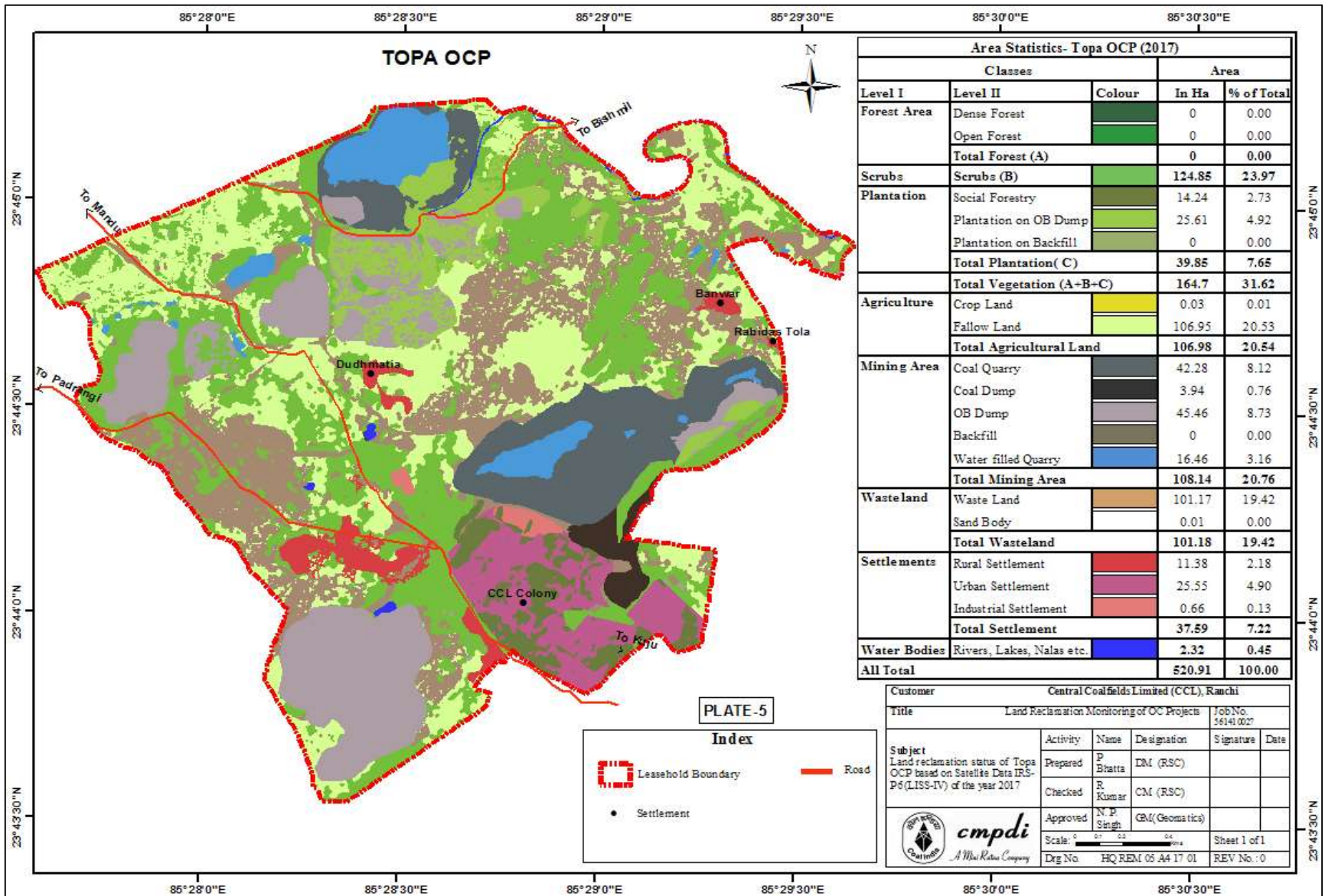
Area Statistics - Tapin OC (2014)				
Level-I	Level-II	Colour	Core Zone	
			Area (Ha)	% of Total
Forest Land	Dense Forest		0.00	0.00
	Open Forest		92.89	18.45
	Total Forest Land (A)		92.89	18.45
Scrubs (B)			124.95	24.91
Plantation Area	Social Forestry		4.96	0.99
	Plantation on OB		17.13	3.40
	Plantation on Backfill		0.00	0.00
	Orchard		0.00	0.00
Total Plantation Area ©			22.09	4.39
Total Plantation (A+B+C)			239.93	47.75
Agriculture Land	Crop land		6.44	1.28
	Fallow Land		57.97	11.51
	Total Agriculture Land		64.41	12.79
Waste Land	Waste Land		84.27	16.74
	Sand Body		0.64	0.13
	Gullied Land		0.00	0.00
	Total Waste Land		84.91	16.87
Mining Area	Coal Quarry		44.88	8.92
	Barren OB Dump		20.30	4.03
	Back Fill		0.00	0.00
	Coal Dump		9.68	1.92
	Water Filled Quarry		14.14	2.81
	Advance Quarry		4.69	0.93
Total Mining Area			93.69	18.61
Settlements	Urban Settlements		5.83	1.16
	Rural Settlements		8.87	1.76
	Industrial Settlements		0.00	0.00
Total Settlement Area			14.70	2.92
Water Body	River/ Ponds		5.36	1.06
Total Area			503.00	100.00

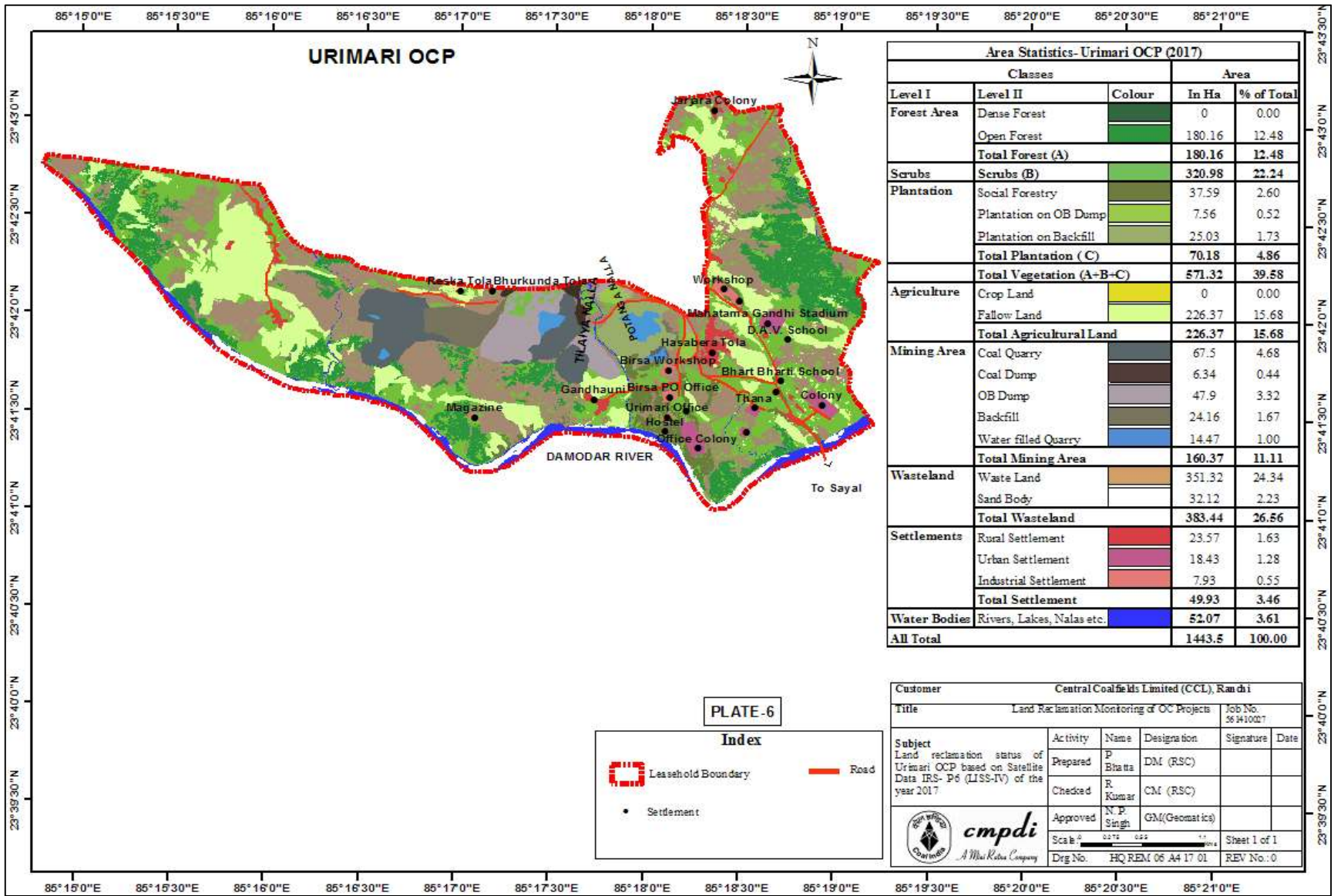
Customer					Central Coalfields Limited (CCL), Ranchi				
Title					Land Reclamation of OC Projects				
					Job No. 56410027				
Subject					Land use/ Vegetation cover mapping of Tapin OCP based on IRS-P6 LISS-IV Satellite Data of the Year 2013				
Activity	Name	Designation	Signature	Date					
Prepared	Payel Bera	AM (Env)							
Checked	R. Kumar	CM(RSC)							
Approved	N. P. Singh	GM(Geomatics)							
Scale:									
Drg No.					HQ REM 03 A4 14 01				
					Sheet 1 of 1				
					REV No. 0				



Area Statistics - Jharkhand OC (2014)				
Level-I	Level-II	Colour	Core Zone	
			Area (Ha)	% of Total
Forest Land	Dense Forest		0.00	0.00
	Open Forest		5.97	1.85
	Total Forest Land (A)		5.97	1.85
	Scrubs (B)		78.26	24.16
Plantation Area	Social Forestry		2.48	0.76
	Plantation on OB		11.99	3.70
	Plantation on Backfill		18.64	5.75
	Orchard		0.00	0.00
	Total Plantation Area ©		33.11	10.24
	Total Plantation (A+B+C)		117.34	36.22
Agriculture Land	Crop land		15.03	4.64
	Fallow Land		7.92	2.45
	Total Agriculture Land		22.95	7.09
Waste Land	Waste Land		49.37	15.25
	Sand Body		1.10	0.34
	Gullied Land		0.00	0.00
	Total Waste Land		50.47	15.59
Mining Area	Coal Quarry		40.18	12.40
	Barren OB Dump		31.77	9.81
	Back Fill		23.26	7.19
	Coal Dump		9.18	2.83
	Water Filled Quarry		2.86	0.88
	Total Mining Area		107.25	33.14
Settlements	Urban Settlements		14.72	4.55
	Rural Settlements		0.00	0.00
	Industrial Settlements		3.76	1.16
	Total Settlement Area		18.48	5.71
Water Body	River/ Ponds		7.39	2.28
	Total Area		323.88	100.00

Customer		Central Coalfields Limited (CCL), Ranchi			
Title		Land Reclamation of OC Projects		Job No. 56410027	
Subject Land use/ Vegetation cover mapping of Jharkhand OCP based on IRS-P6 LISS-IV Satellite Data of the Year 2013	Activity	Name	Designation	Signature	Date
	Prepared	Payel Bera	AM (Env)		
	Checked	R. Kumar	CM(RSC)		
	Approved	N. P. Singh	GM(Geomatics)		
Scale:		0 0.1 0.2 0.4 Km		Sheet 1 of 1	
Drg. No.		HQ REM 04 A4 1401		REV No. 0	





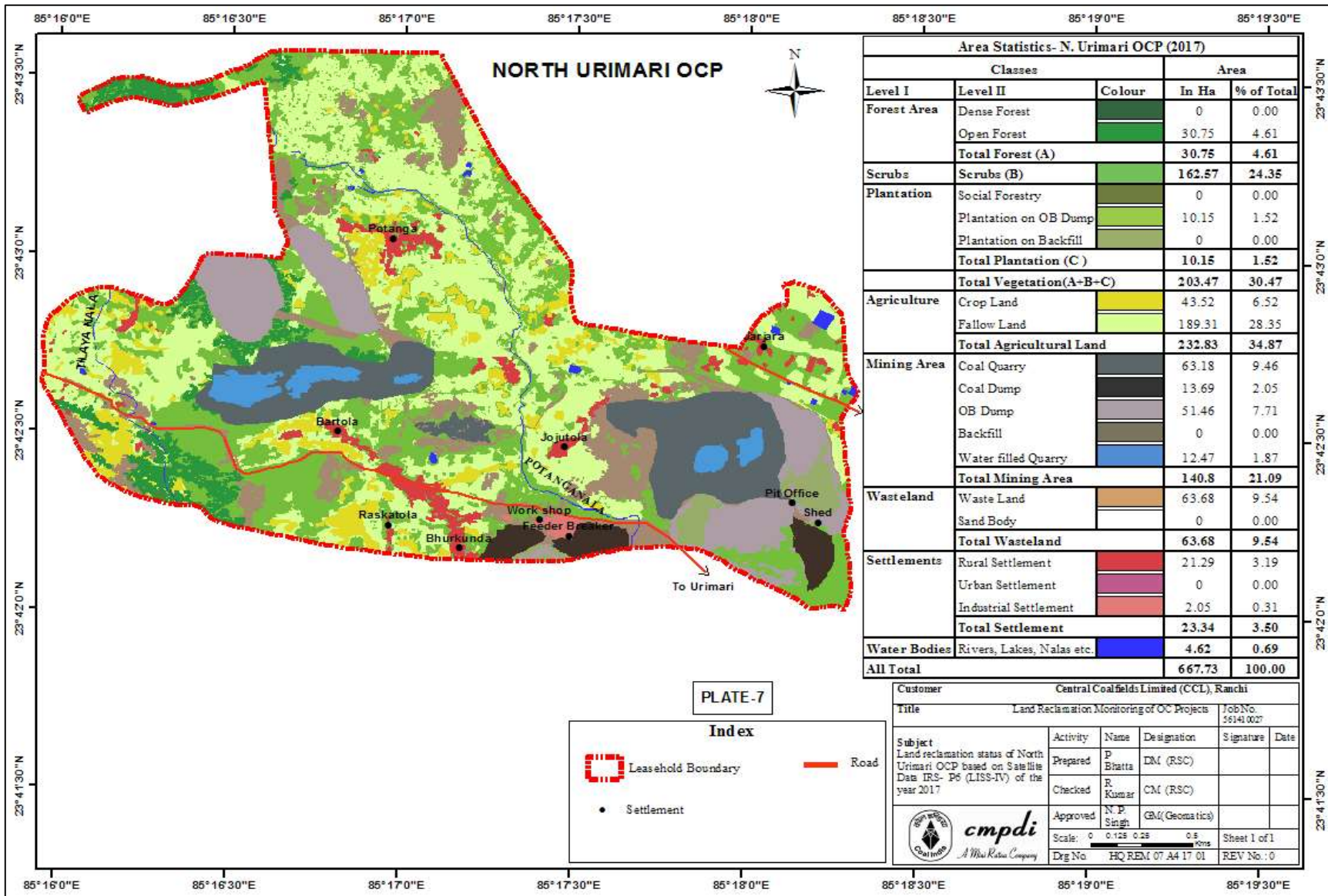
Area Statistics-Urimari OCP (2017)				
Classes			Area	
Level I	Level II	Colour	In Ha	% of Total
Forest Area	Dense Forest		0	0.00
	Open Forest		180.16	12.48
	Total Forest (A)		180.16	12.48
Scrubs	Scrubs (B)		320.98	22.24
Plantation	Social Forestry		37.59	2.60
	Plantation on OB Dump		7.56	0.52
	Plantation on Backfill		25.03	1.73
	Total Plantation (C)		70.18	4.86
Total Vegetation (A-B-C)			571.32	39.58
Agriculture	Crop Land		0	0.00
	Fallow Land		226.37	15.68
	Total Agricultural Land		226.37	15.68
Mining Area	Coal Quarry		67.5	4.68
	Coal Dump		6.34	0.44
	OB Dump		47.9	3.32
	Backfill		24.16	1.67
	Water filled Quarry		14.47	1.00
	Total Mining Area		160.37	11.11
	Waste Land			
Waste Land		351.32	24.34	
Sand Body		32.12	2.23	
Total Wasteland		383.44	26.56	
Settlements	Rural Settlement		23.57	1.63
	Urban Settlement		18.43	1.28
	Industrial Settlement		7.93	0.55
	Total Settlement		49.93	3.46
Water Bodies	Rivers, Lakes, Nalas etc.		52.07	3.61
All Total			1443.5	100.00

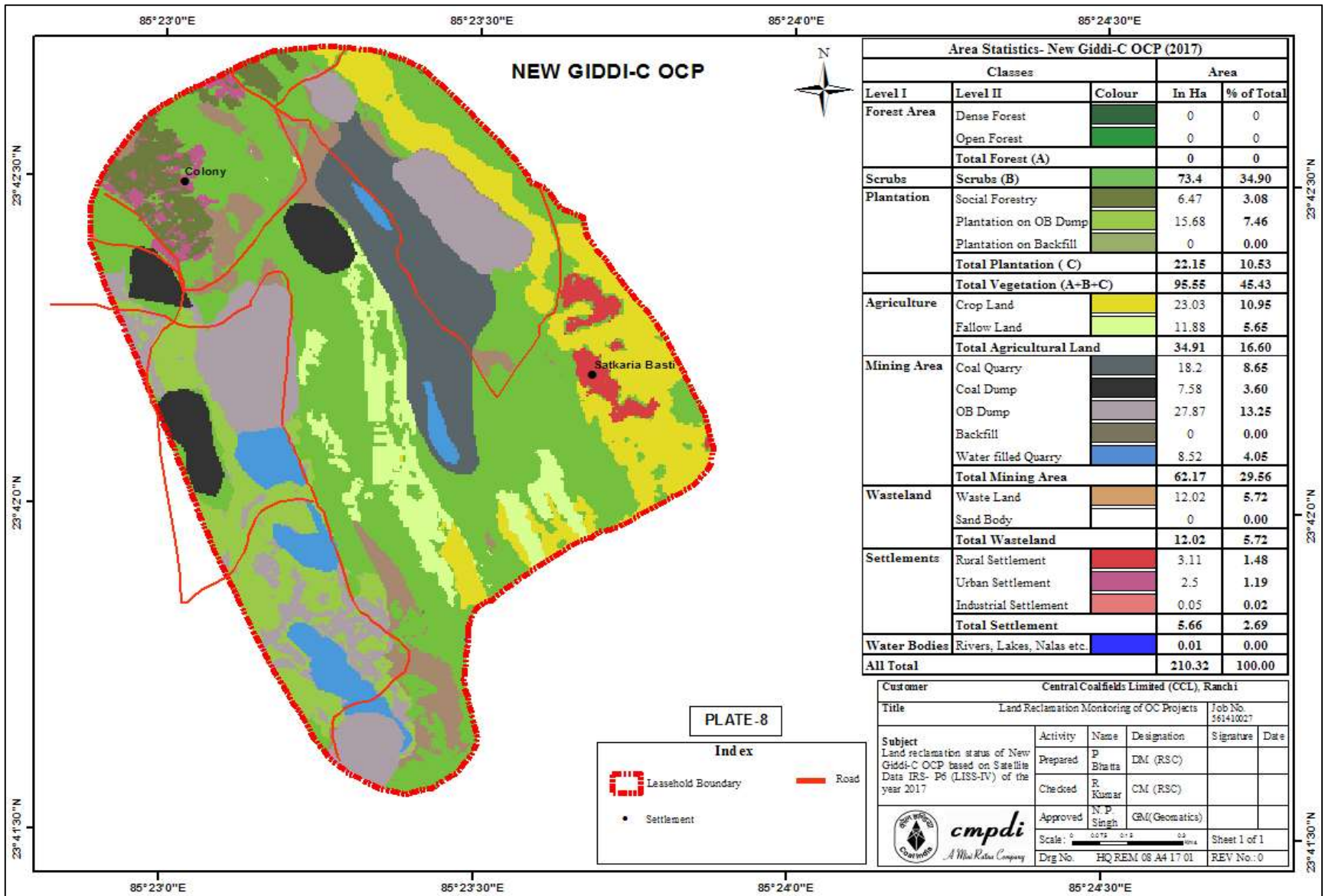
PLATE-6

Index

- Leasehold Boundary
- Road
- Settlement

Customer: Central Coalfields Limited (CCL), Ranchi					
Title: Land Reclamation Monitoring of OC Projects					
					Job No: 561410027
Subject: Land reclamation status of Urimari OCP based on Satellite Data IRS-P6 (LISS-IV) of the year 2017	Activity	Name	Designation	Signature	Date
	Prepared	P. Bhatta	DM (RSC)		
	Checked	R. Kumar	CM (RSC)		
Approved	N.P. Singh	GM(Geomatics)			
Scale: 1:50,000		Sheet 1 of 1			
Dwg No: HQREM/06/A4/17/01		REV No: 0			





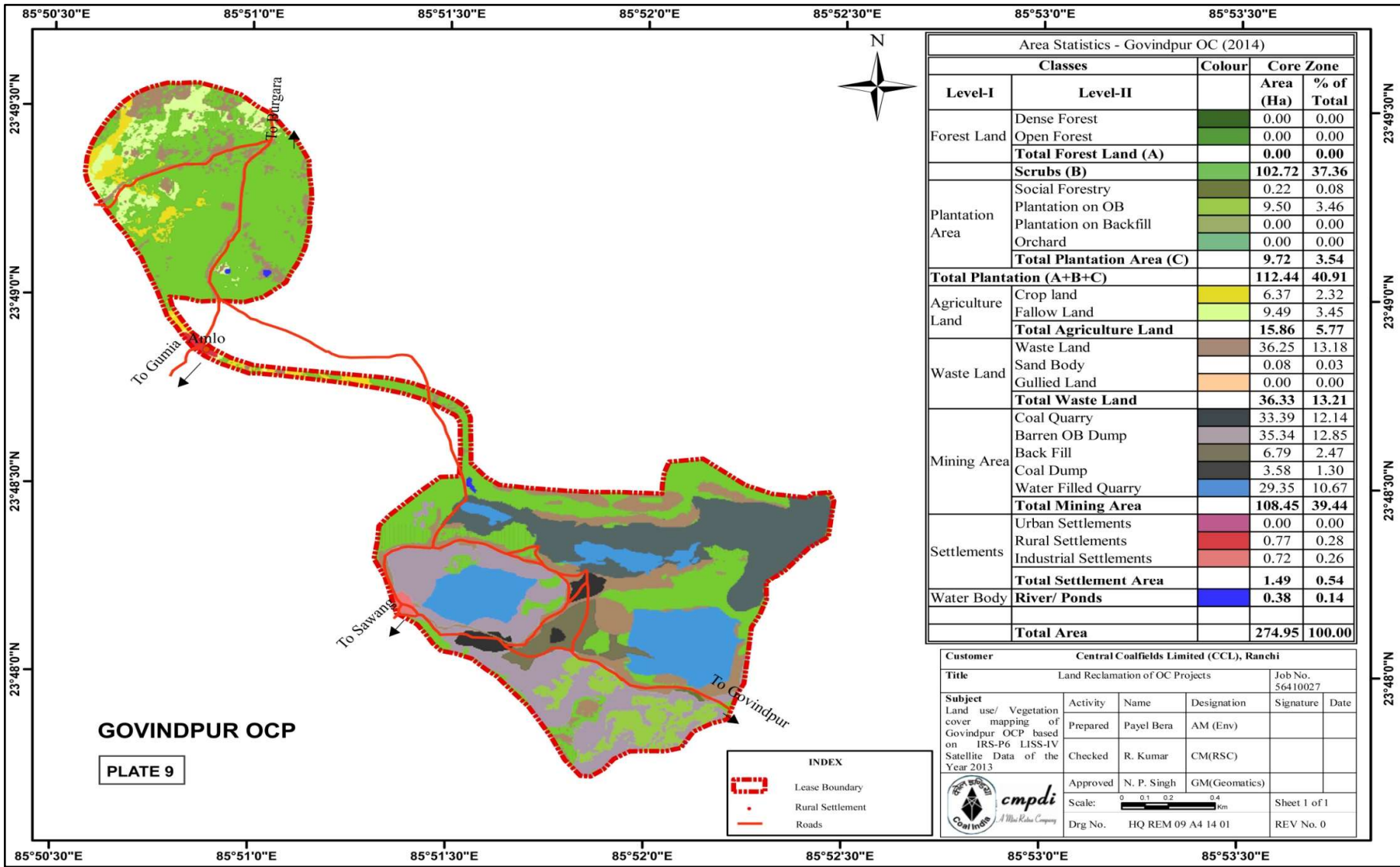
Area Statistics- New Giddi-C OCP (2017)				
Classes			Area	
Level I	Level II	Colour	In Ha	% of Total
Forest Area	Dense Forest	[Dark Green]	0	0
	Open Forest	[Light Green]	0	0
	Total Forest (A)		0	0
Scrubs	Scrubs (B)	[Medium Green]	73.4	34.90
Plantation	Social Forestry	[Dark Green]	6.47	3.08
	Plantation on OB Dump	[Light Green]	15.68	7.46
	Plantation on Backfill	[Medium Green]	0	0.00
	Total Plantation (C)		22.15	10.53
Total Vegetation (A+B+C)			95.55	45.43
Agriculture	Crop Land	[Yellow]	23.03	10.95
	Fallow Land	[Light Yellow]	11.88	5.65
	Total Agricultural Land		34.91	16.60
Mining Area	Coal Quarry	[Dark Grey]	18.2	8.65
	Coal Dump	[Medium Grey]	7.58	3.60
	OB Dump	[Light Grey]	27.87	13.25
	Backfill	[Brown]	0	0.00
	Water filled Quarry	[Blue]	8.52	4.05
	Total Mining Area		62.17	29.56
Wasteland	Waste Land	[Orange]	12.02	5.72
	Sand Body	[Light Orange]	0	0.00
	Total Wasteland		12.02	5.72
Settlements	Rural Settlement	[Red]	3.11	1.48
	Urban Settlement	[Purple]	2.5	1.19
	Industrial Settlement	[Pink]	0.05	0.02
	Total Settlement		5.66	2.69
Water Bodies	Rivers, Lakes, Nalas etc.	[Blue]	0.01	0.00
All Total			210.32	100.00

PLATE - 8

Index

- Leasehold Boundary
- Road
- Settlement

Customer: Central Coalfields Limited (CCL), Ranchi					
Title: Land Reclamation Monitoring of OC Projects					Job No. 561410027
Subject: Land reclamation status of New Giddi-C OCP based on Satellite Data IRS-P6 (LISS-IV) of the year 2017	Activity	Name	Designation	Signature	Date
	Prepared	P. Bhatta	DM (RSC)		
	Checked	R. Kumar	CM (RSC)		
Approved	N.P. Singh	GM (Geomatics)			
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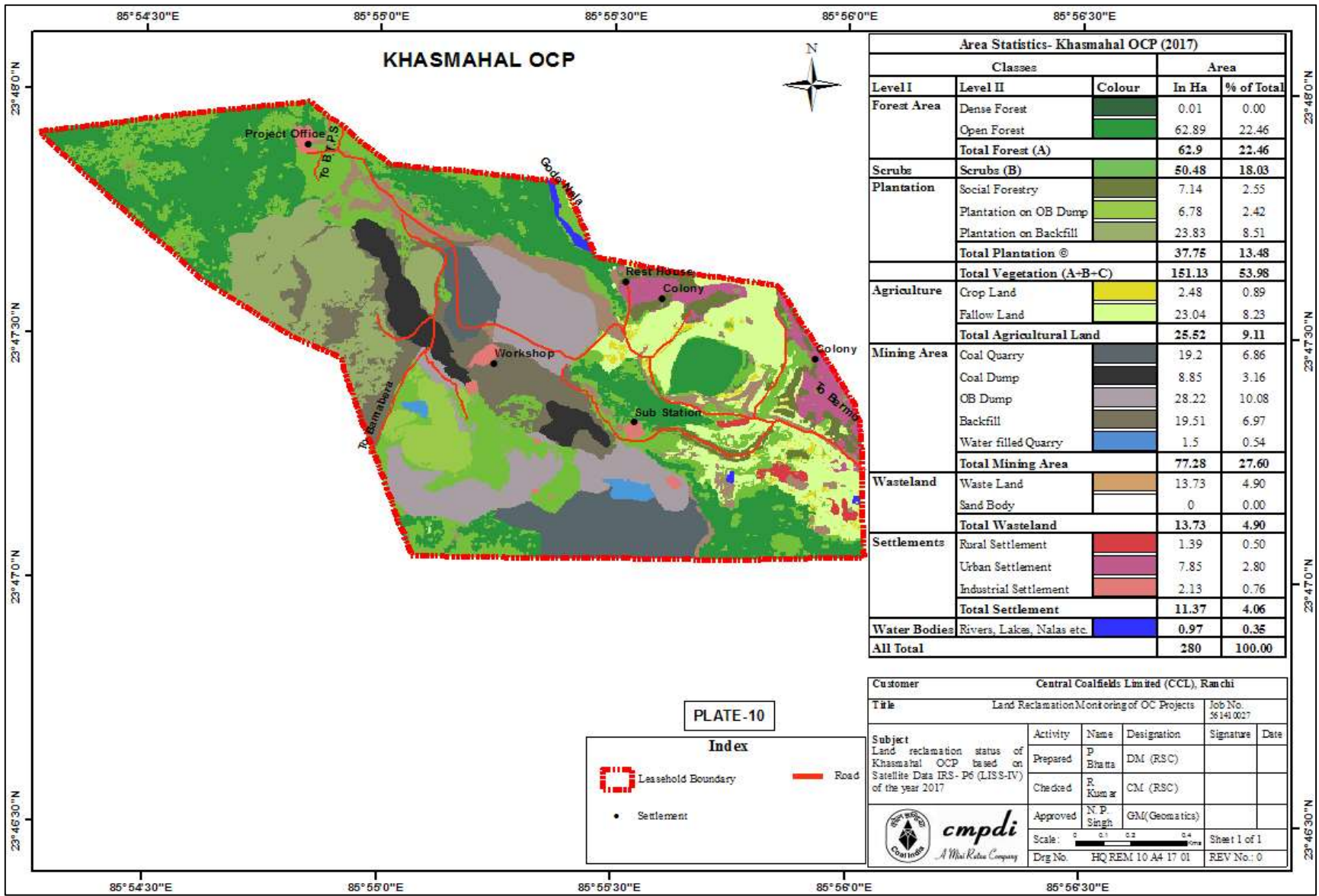
Area Statistics - Govindpur OC (2014)				
Classes		Colour	Core Zone	
Level-I	Level-II		Area (Ha)	% of Total
Forest Land	Dense Forest		0.00	0.00
	Open Forest		0.00	0.00
	Total Forest Land (A)		0.00	0.00
Scrubs (B)			102.72	37.36
Plantation Area	Social Forestry		0.22	0.08
	Plantation on OB		9.50	3.46
	Plantation on Backfill		0.00	0.00
	Orchard		0.00	0.00
Total Plantation Area (C)			9.72	3.54
Total Plantation (A+B+C)			112.44	40.91
Agriculture Land	Crop land		6.37	2.32
	Fallow Land		9.49	3.45
	Total Agriculture Land		15.86	5.77
Waste Land	Waste Land		36.25	13.18
	Sand Body		0.08	0.03
	Gullied Land		0.00	0.00
	Total Waste Land		36.33	13.21
Mining Area	Coal Quarry		33.39	12.14
	Barren OB Dump		35.34	12.85
	Back Fill		6.79	2.47
	Coal Dump		3.58	1.30
	Water Filled Quarry		29.35	10.67
	Total Mining Area		108.45	39.44
Settlements	Urban Settlements		0.00	0.00
	Rural Settlements		0.77	0.28
	Industrial Settlements		0.72	0.26
Total Settlement Area			1.49	0.54
Water Body	River/ Ponds		0.38	0.14
Total Area			274.95	100.00

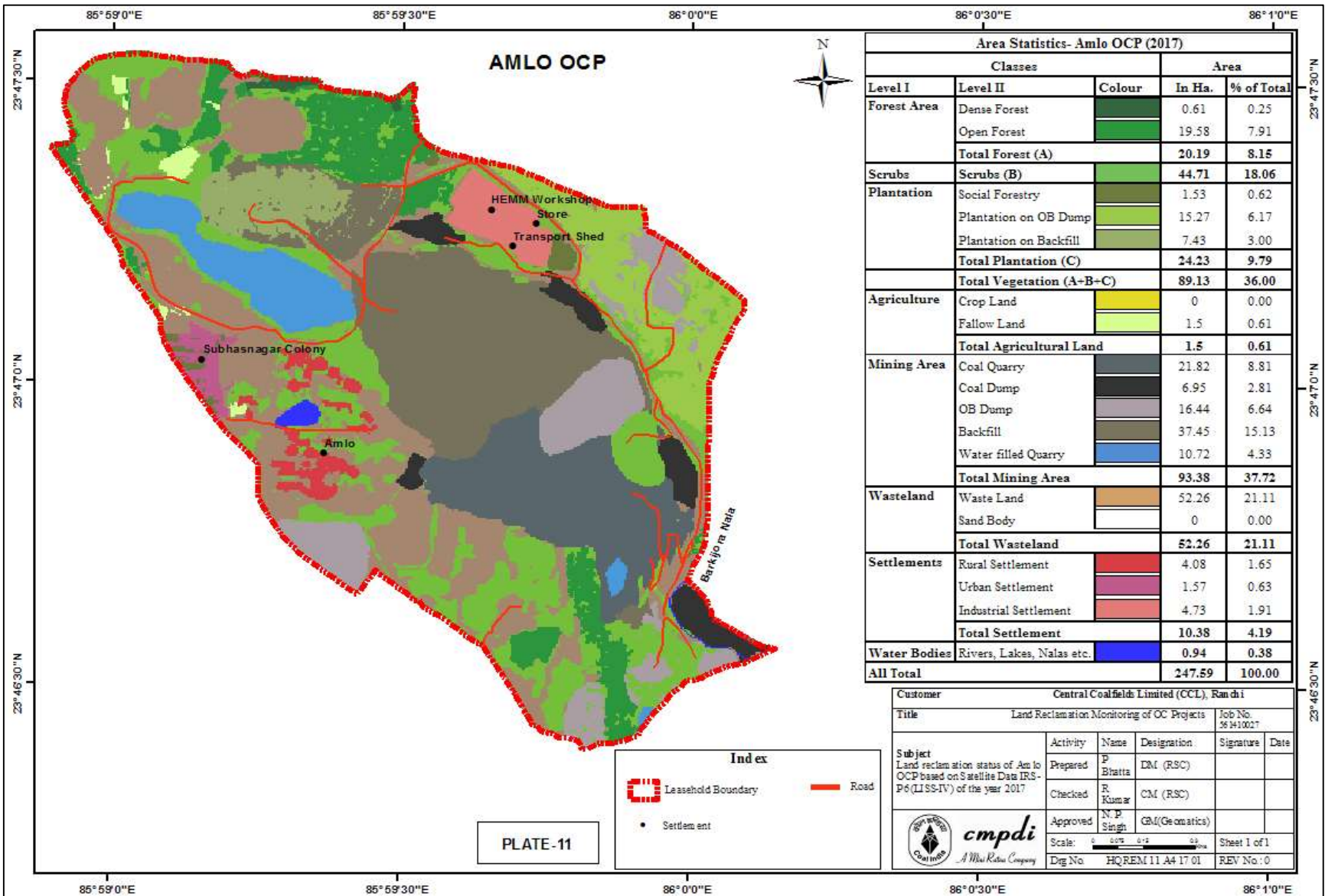
Customer		Central Coalfields Limited (CCL), Ranchi			
Title		Land Reclamation of OC Projects		Job No. 56410027	
Subject	Activity	Name	Designation	Signature	Date
	Prepared	Payel Bera	AM (Env)		
	Checked	R. Kumar	CM(RSC)		
	Approved	N. P. Singh	GM(Geomatics)		
Scale:		0 0.1 0.2 0.4 Km		Sheet 1 of 1	
Drg No.		HQ REM 09 A4 14 01		REV No. 0	

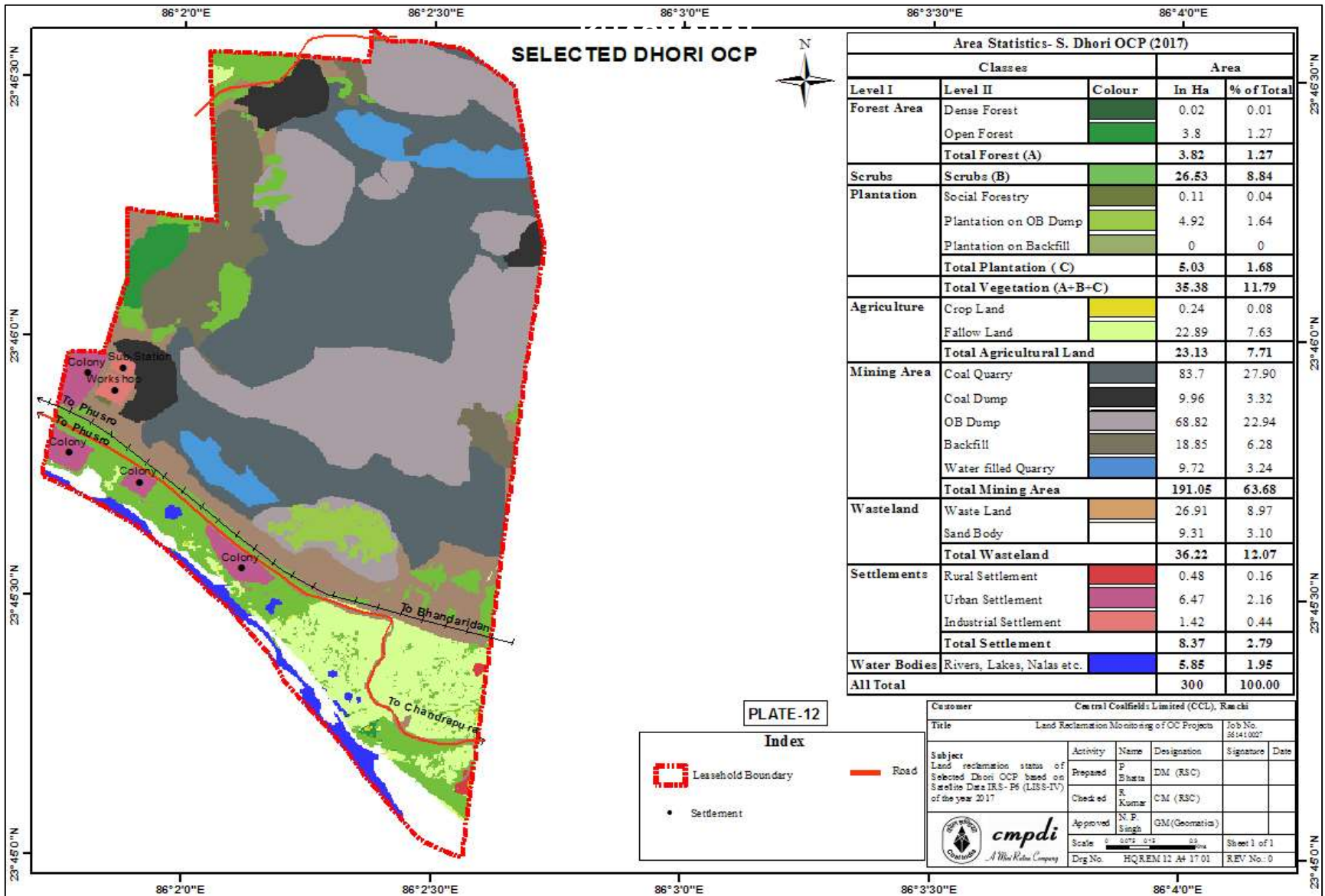
GOVINDPUR OCP

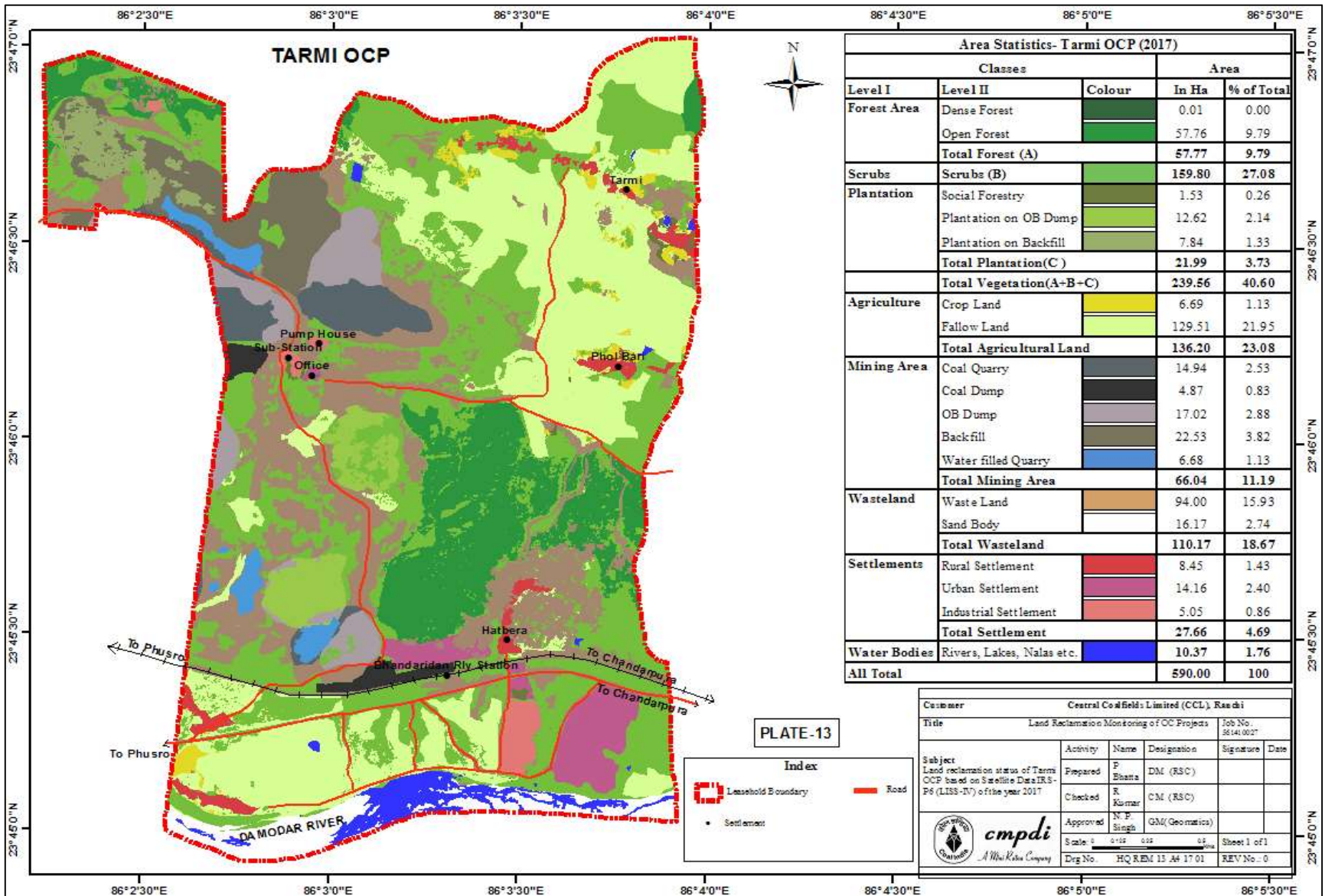
PLATE 9

INDEX	
	Lease Boundary
	Rural Settlement
	Roads









Area Statistics- Tarmi OCP (2017)				
Classes			Area	
Level I	Level II	Colour	In Ha	% of Total
Forest Area	Dense Forest		0.01	0.00
	Open Forest		57.76	9.79
	Total Forest (A)		57.77	9.79
Scrubs	Scrubs (B)		159.80	27.08
Plantation	Social Forestry		1.53	0.26
	Plantation on OB Dump		12.62	2.14
	Plantation on Backfill		7.84	1.33
	Total Plantation(C)		21.99	3.73
Total Vegetation(A+B+C)			239.56	40.60
Agriculture	Crop Land		6.69	1.13
	Fallow Land		129.51	21.95
	Total Agricultural Land		136.20	23.08
Mining Area	Coal Quarry		14.94	2.53
	Coal Dump		4.87	0.83
	OB Dump		17.02	2.88
	Backfill		22.53	3.82
	Water filled Quarry		6.68	1.13
	Total Mining Area		66.04	11.19
Wasteland	Waste Land		94.00	15.93
	Sand Body		16.17	2.74
	Total Wasteland		110.17	18.67
Settlements	Rural Settlement		8.45	1.43
	Urban Settlement		14.16	2.40
	Industrial Settlement		5.05	0.86
	Total Settlement		27.66	4.69
Water Bodies	Rivers, Lakes, Nalas etc.		10.37	1.76
All Total			590.00	100

PLATE-13

Index

- Leasehold Boundary
- Road
- Settlement

Customer		Central Coalfields Limited (CCL), Rasdki		
Title	Land Reclamation Monitoring of OC Projects		Job No.	561410027
Subject	Activity	Name	Designation	Signature
Land reclamation status of Tarmi OCP based on Satellite Data IRS-P6 (LISS-IV) of the year 2017	Prepared	P. Bhalla	DM (RSC)	
	Checked	R. Kumar	CM (RSC)	
	Approved	N. P. Singh	GM(Geomatics)	
Scale: 0 0.15 0.30 0.45 0.75		Sheet 1 of 1		
Dwg No. HQ.REM.13.A4.17.01		REV No. 0		

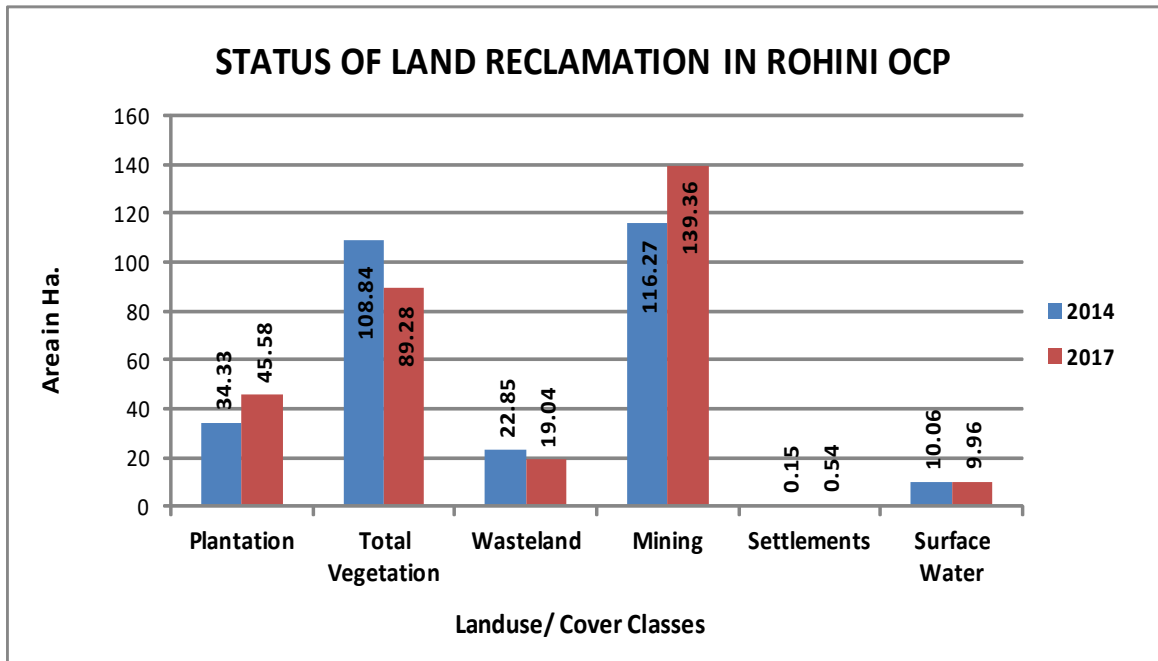


FIGURE - 3

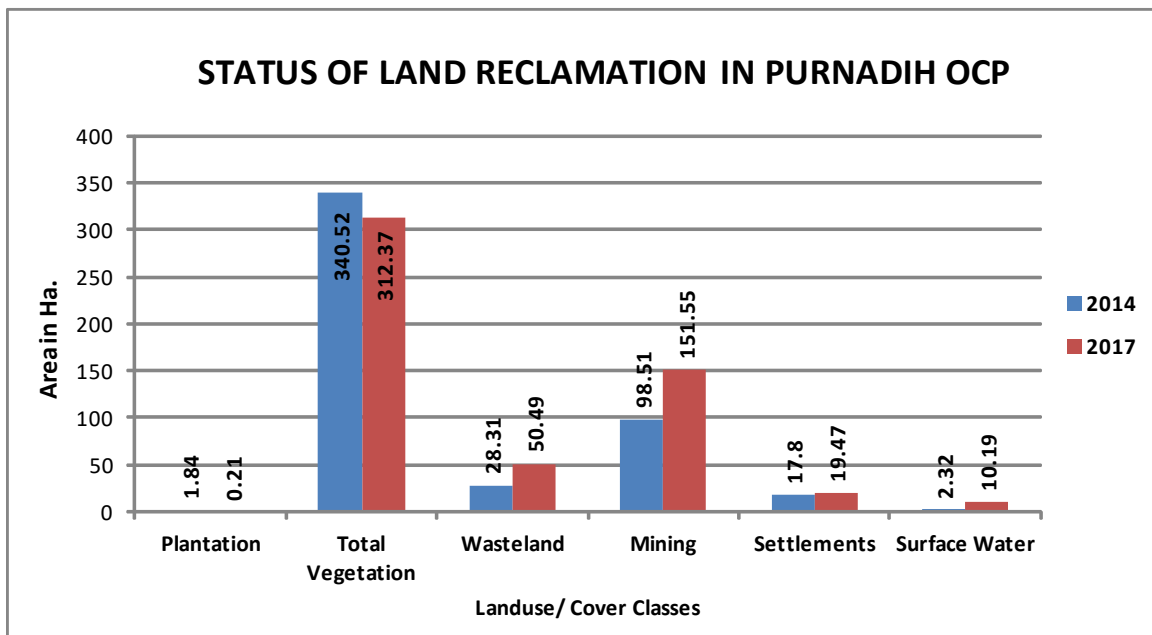


FIGURE - 4

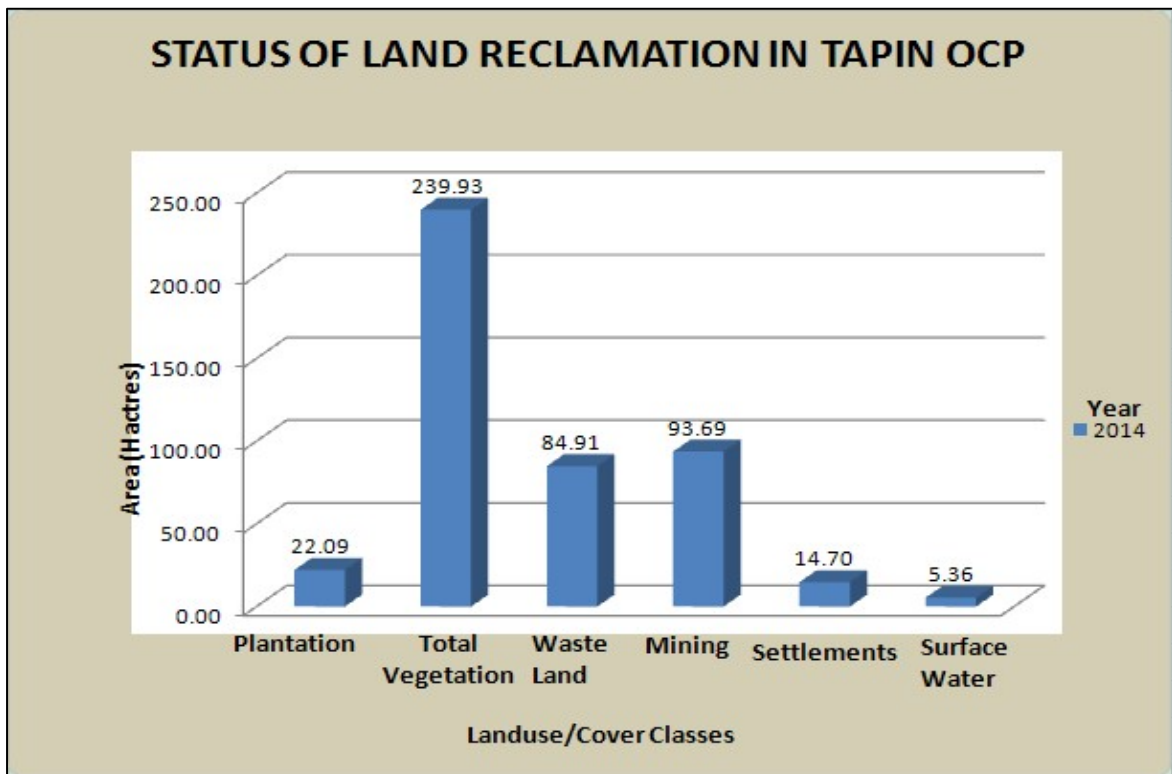


FIGURE – 5

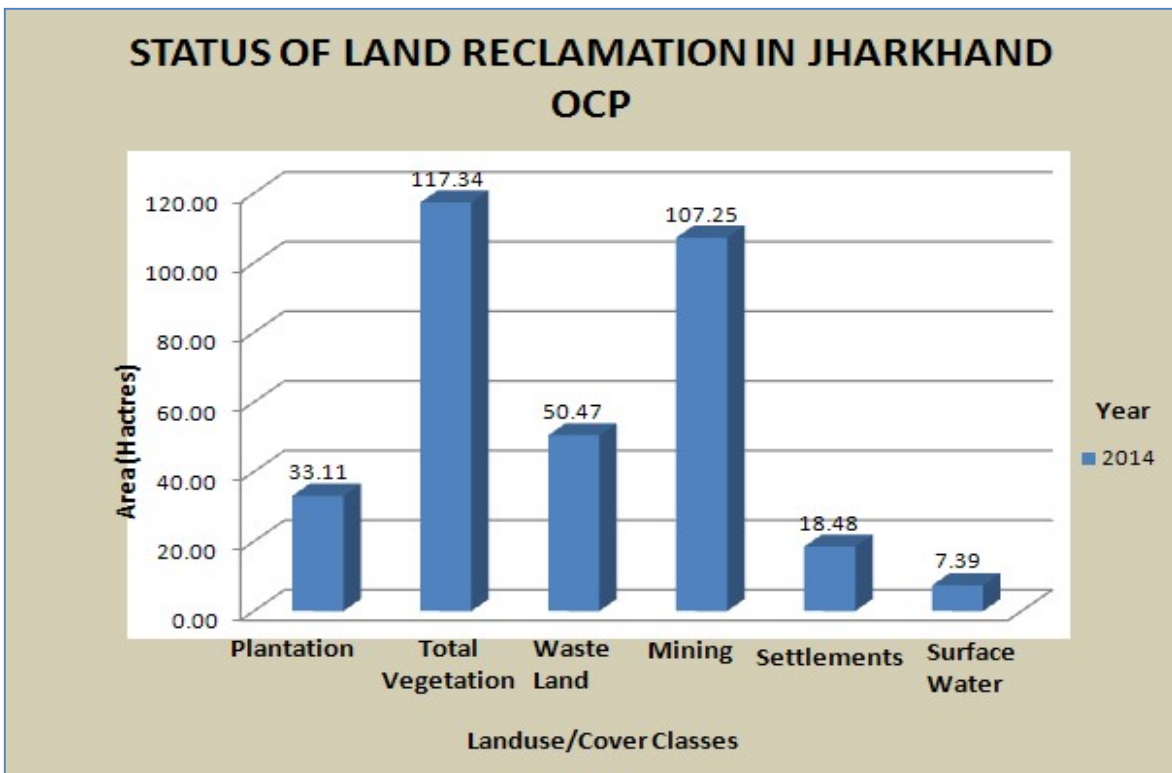


FIGURE - 6

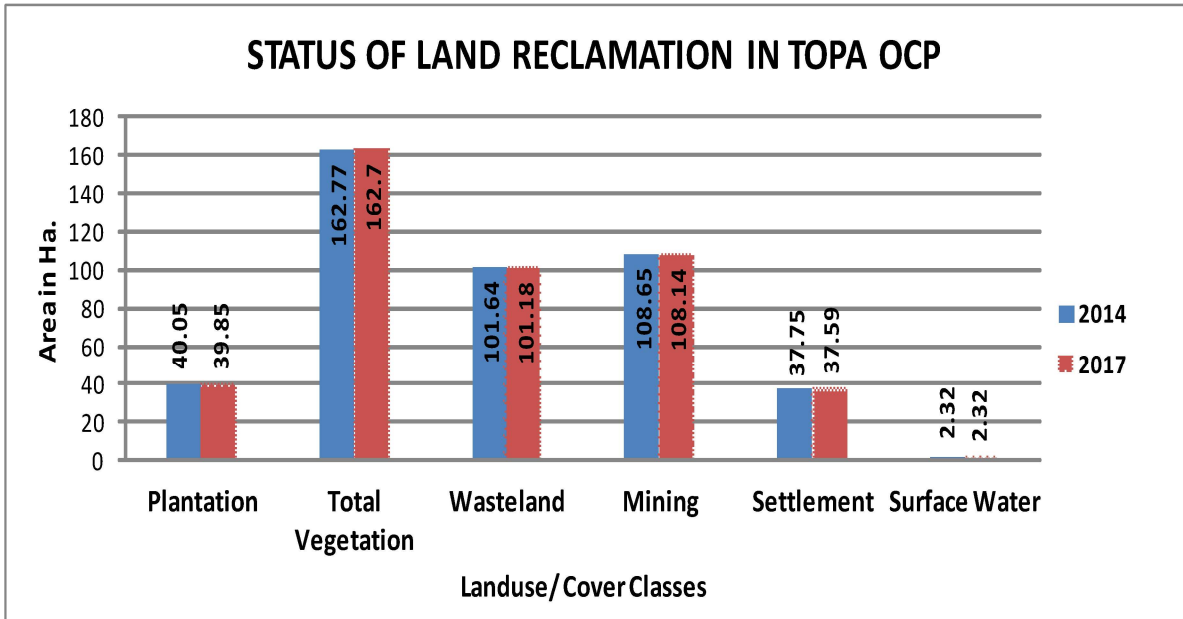


FIGURE - 7

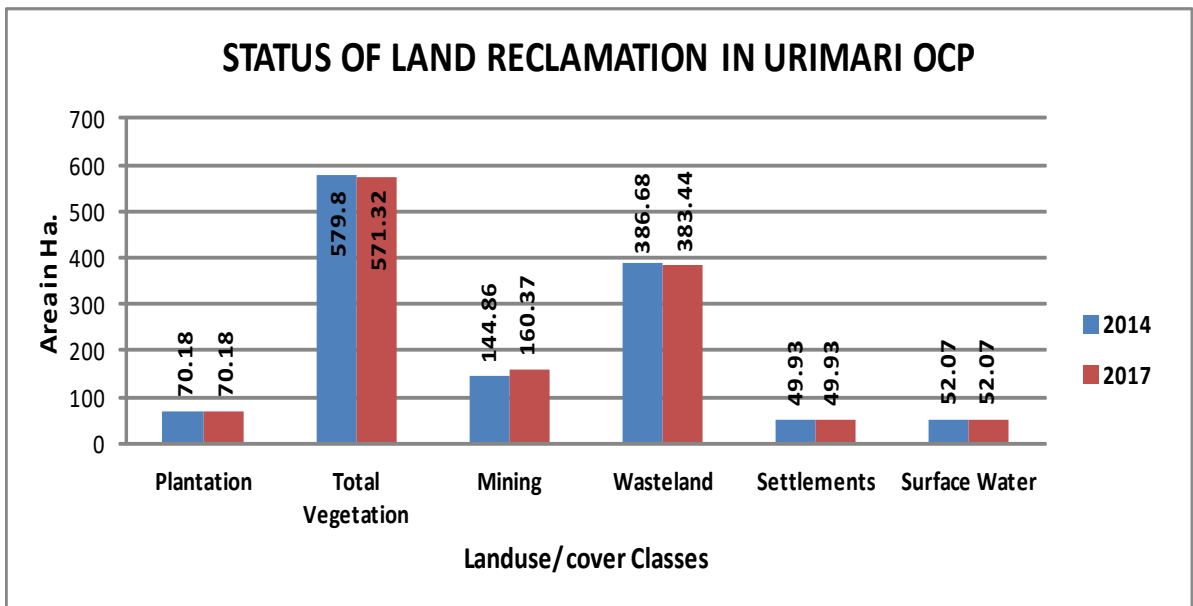


FIGURE – 8

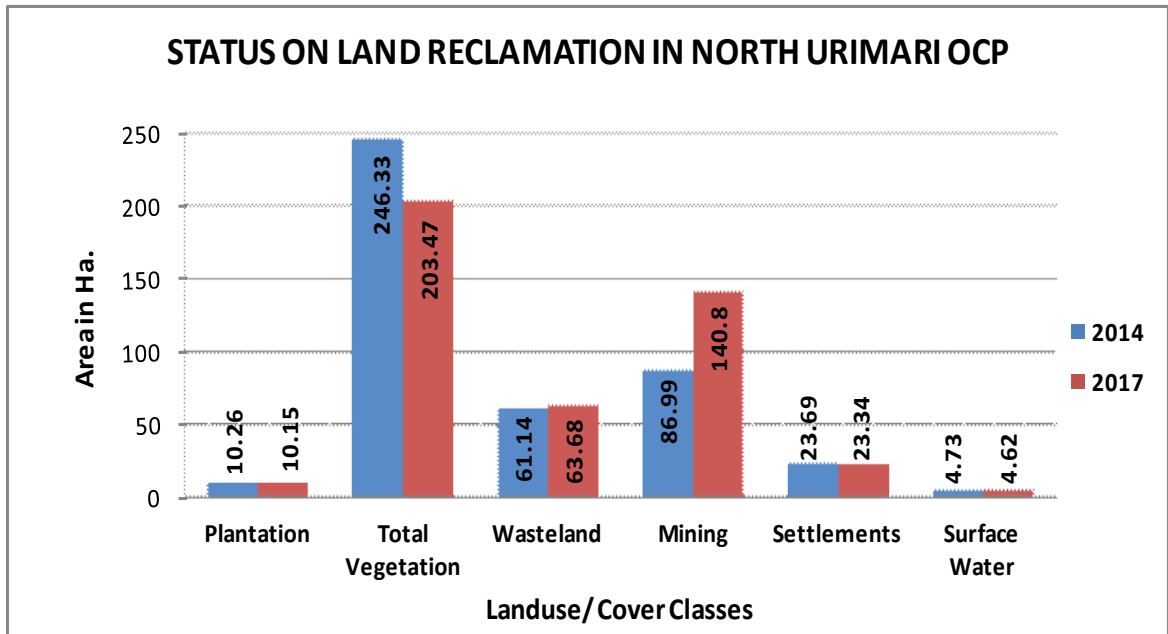


FIGURE – 9

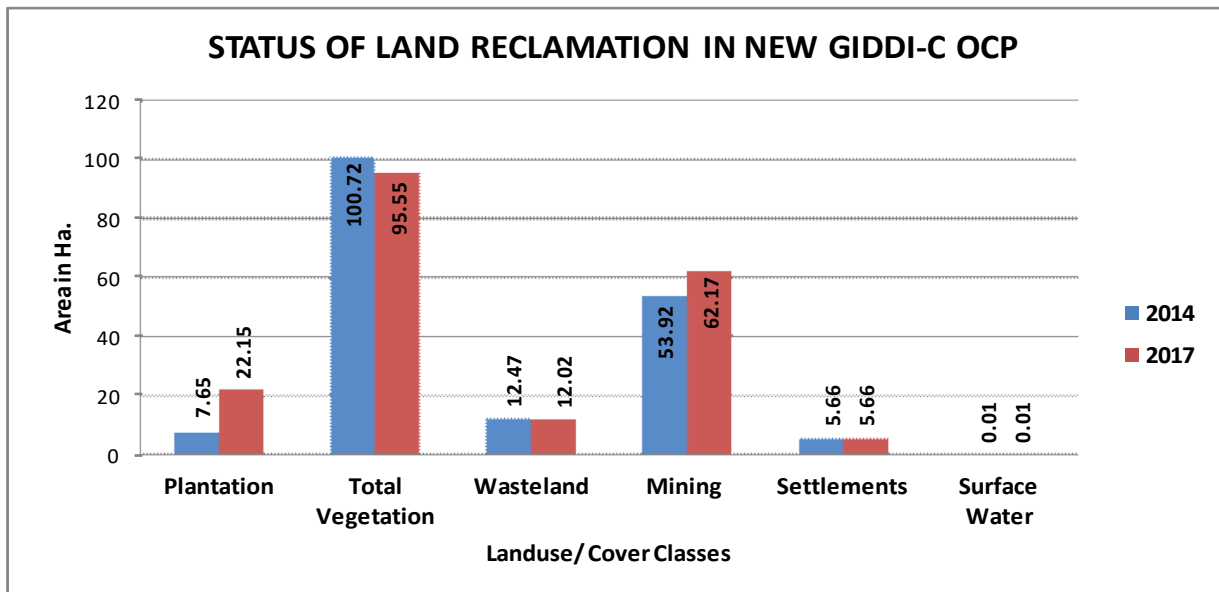


FIGURE – 10

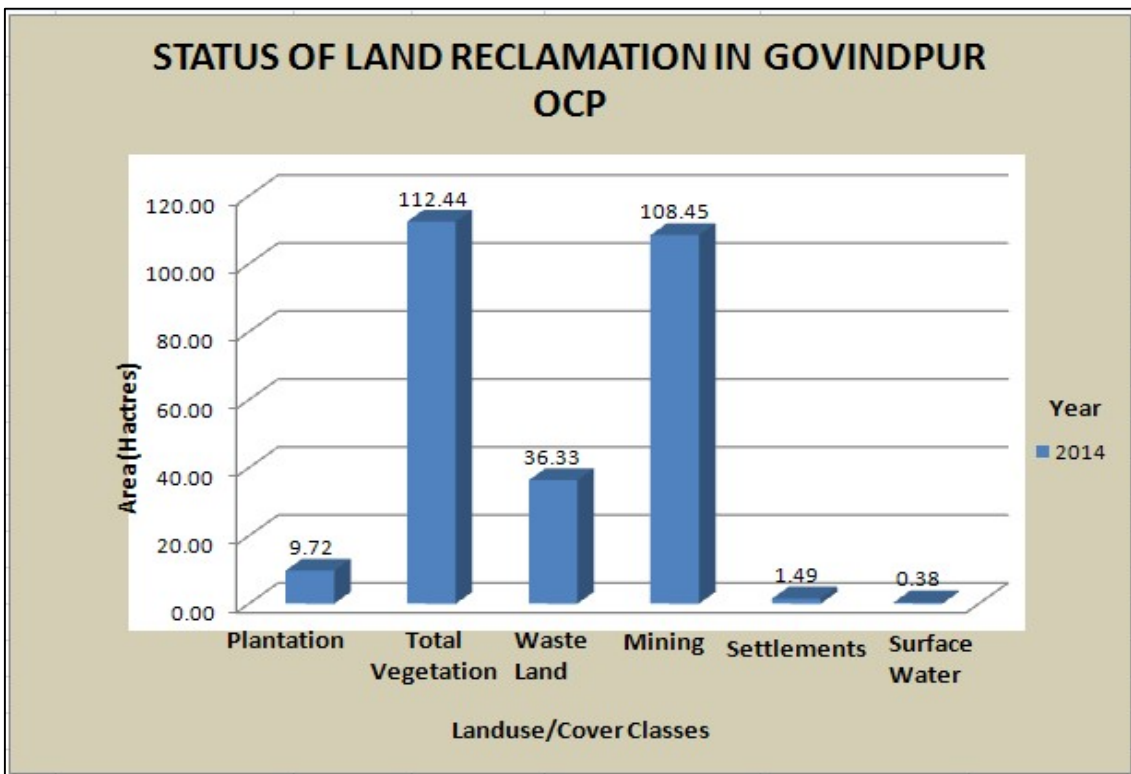


FIGURE – 11

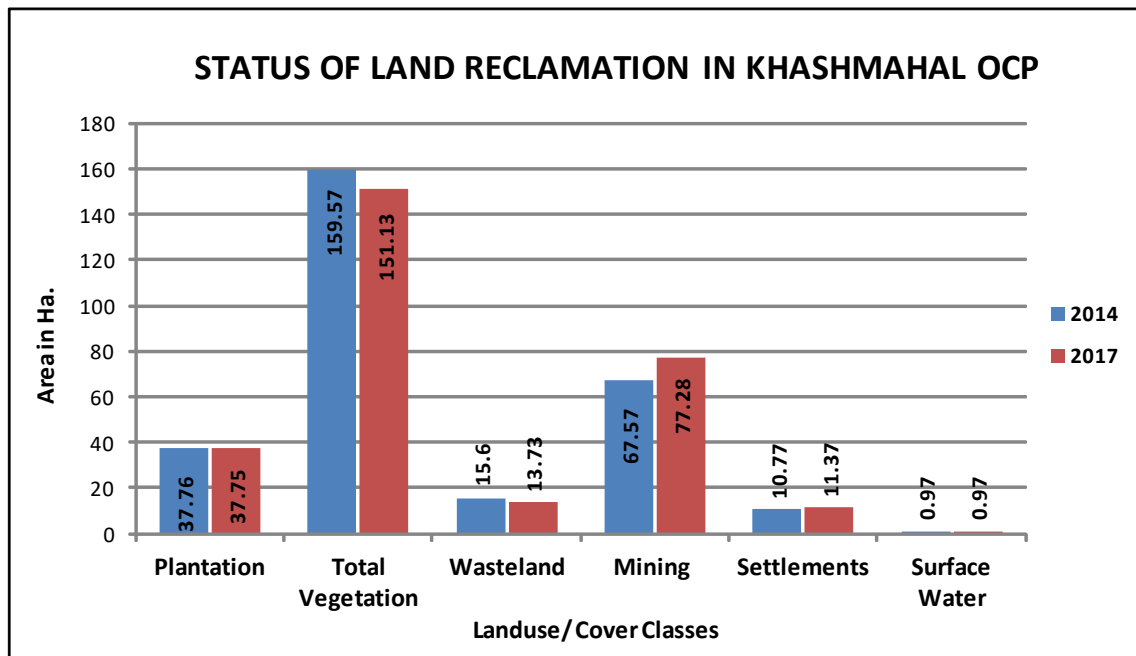


FIGURE – 12

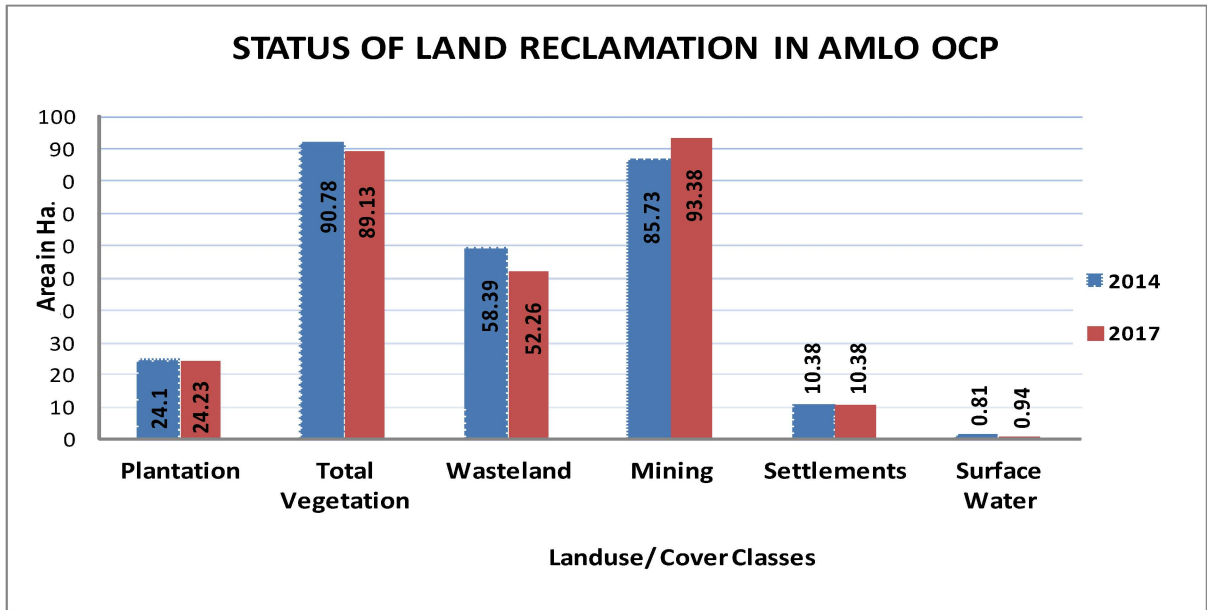


FIGURE – 13

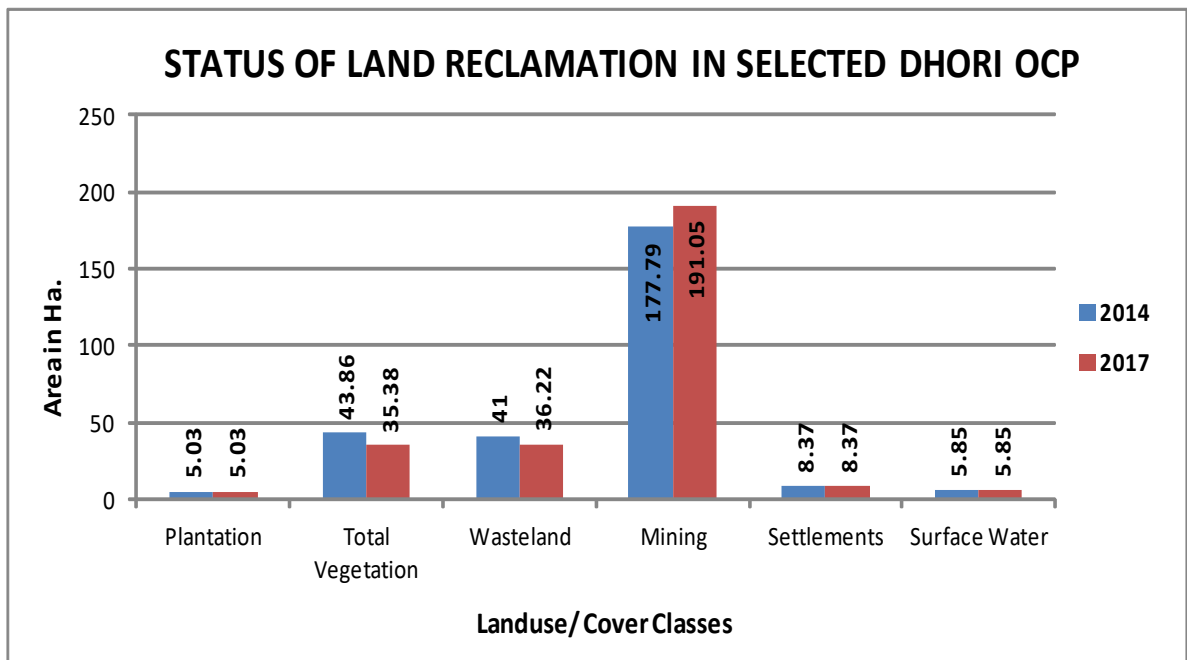


FIGURE – 14

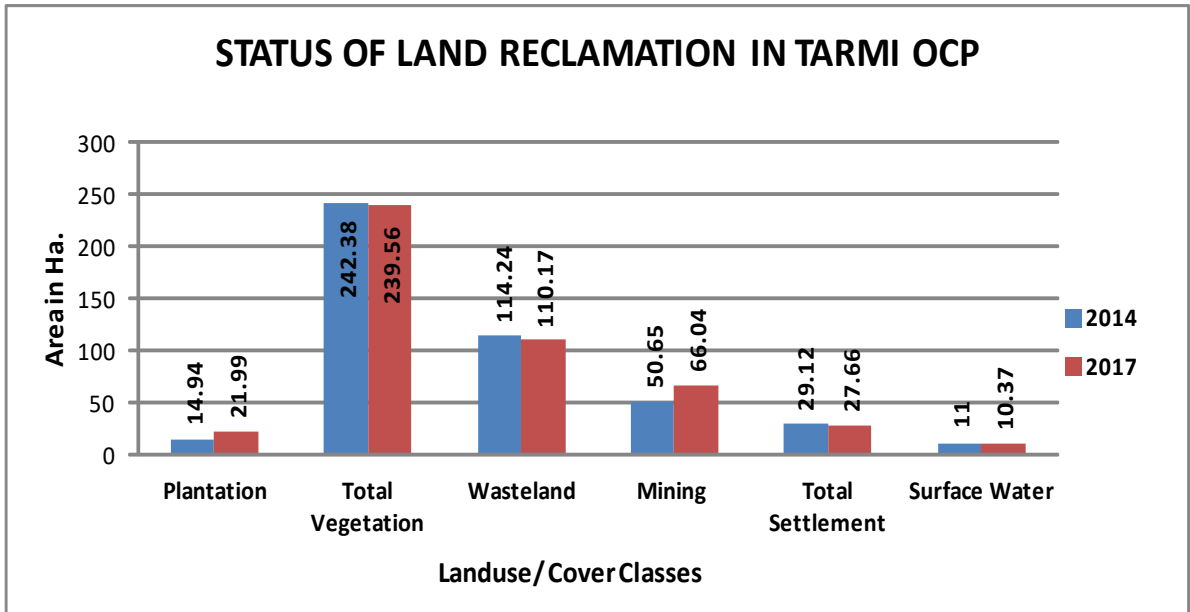


FIGURE – 15



Photo 1: Plantation on External OB Dump (Tapin OCP)



Photo 2: Plantation on Backfill (Jharkhand OCP)



Photo 3: Plantation on Backfill (Jharkhand OCP)



Photo 4: Plantation on Backfill (Urimari OCP)



Photo 5: Plantation on External OB Dump (North Urimari OCP)



Photo 6: Social Plantation along road side (New Giddi- C OCP)



Photo 7: Plantation on External OB Dump (Govindpur OCP)



Photo 8: Plantation on Internal OB Dump/Backfill (Khasmahal OCP)



Photo 9: Plantation on External OB Dump (Amlo OCP)