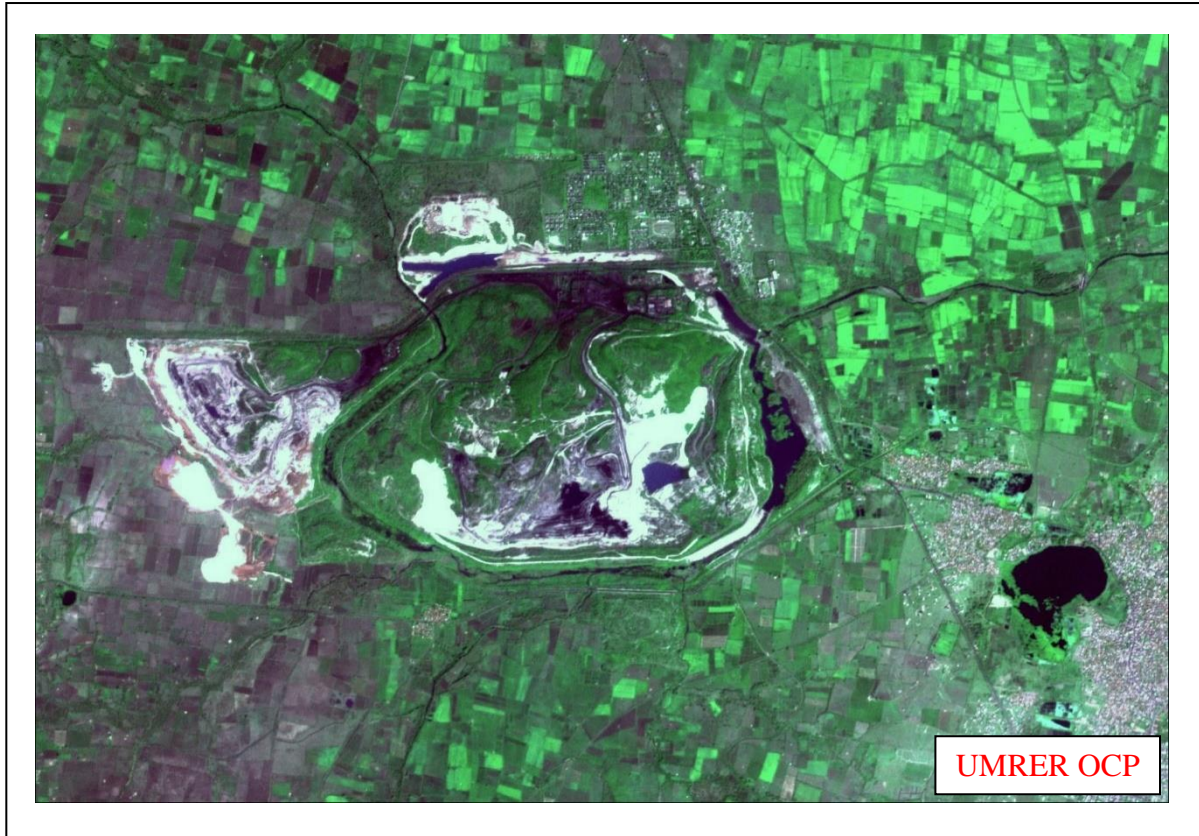


**Land Restoration/Reclamation Monitoring of more than
5 million cu.m (Coal+OB) Capacity Opencast Coal Mines of Western
Coalfields Limited based on Satellite Data of the Year 2015**



Submitted to
Western Coalfields Limited



cmpdi
A Mini-Ratna Company

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Coalfields Limited based on Satellite Data of the Year 2015**

March 2016



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

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Executive Summary

- 1.0 Project** Land restoration / reclamation monitoring of 10 opencast coal mines of Western Coalfields Ltd. (WCL) producing 5 million cu.m. and more (Coal+OB) per year based on satellite data, regularly on annual 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 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 95.01 Km² of the 10 opencast projects of WCL viz. Sasti, Padmapur, Durgapur, Mugoli, Umrer, Ukni, Niljai, New Majri, Pimpalgaon and Ghugus considered for monitoring during 2015-16; total excavated area is 65.66 Km² (69.11%), out of which 28.48 Km² area (43.37%) has been planted, 26.28 Km² area (40.02%) is under backfilling and 10.90 Km² area (16.60%) is under active mining. It is evident from the analysis that 83.40% areas of the OC projects is under reclamation (biological and technical) and balance 16.60% area is under active mining. Project wise details are given in Table-1 & Fig-1.
 - On comparing the status of land reclamation for the year 2015 with respect to the year 2014 in different projects, it is evident from the analysis that area under land reclamation has increased from 53.67 Km² (Yr. 2014) to 54.76 Km² (Yr.2015). Out of 10 projects of WCL, Umrer OC ranks on top for land reclamation (89.49%) followed by Sasti OC (88.99%) and Durgapur OC (88.68%).
 - Area of biological reclamation (plantation) has increased from 28.44 Km² (Yr.2014) to 28.48 Km² (Yr.2015) whereas area of technical reclamation (area under backfilling) has increased from 25.23 Km² (Yr. 2014) to 26.28 Km² (Yr.2015) in WCL. This increase of 1.09 Km² in area of plantation and area under backfilling is the result of the efforts of the Western Coalfields Ltd. taken up towards environmental protection.

Table - 1

(Area in Sq Km)

Projectwise Land Reclamation Status in Opencast Projects of WCL
based on Satellite Data of the year 2015

% Calculated in terms of Total Excavated Area

Sl. No.	Project		Biological Reclamation		Technical Reclamation		Active Mining		Total Excavated Area		Total Area Under Reclamation		
	Name	Leasehold (i)		Plantation/Vegetation		Under Backfilling							
		ii		iii		iv		ii+iii+iv		ii+iii			
		2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
1	SASTI	12.69	12.69	3.38	3.38	2.39	2.60	0.68	0.74	6.45	6.72	5.77	5.98
				52.40	50.30	37.05	38.69	10.54	11.01	89.46	88.99		
2	PADMAPUR	7.34	7.34	2.17	2.17	3.03	3.03	0.86	0.93	6.06	6.13	5.20	5.20
				35.81	35.40	50.00	49.43	14.19	15.17	85.81	84.83		
3	DURGAPUR	8.88	8.88	3.49	3.49	3.11	3.25	0.76	0.86	7.36	7.60	6.60	6.74
				47.42	45.92	42.26	42.76	10.33	11.32	89.67	88.68		
4	MUGOLI	7.88	7.88	1.60	1.60	2.22	2.27	1.55	1.55	5.37	5.42	3.82	3.87
				29.80	29.52	41.34	41.88	28.86	28.60	71.14	71.40		
5	UMRER	9.45	9.45	5.63	5.63	1.84	2.12	1.10	0.91	8.57	8.66	7.47	7.75
				65.69	65.01	21.47	24.48	12.84	10.51	87.16	89.49		
6	UKNI	9.30	9.30	2.27	2.27	2.59	2.75	1.51	1.37	6.37	6.39	4.86	5.02
				35.64	35.52	40.66	43.04	23.70	21.44	76.30	78.56		
7	NEELJAI	15.30	15.30	2.35	2.35	2.59	2.69	2.36	2.36	7.30	7.40	4.94	5.04
				32.19	31.76	35.48	36.35	32.33	31.89	67.67	68.11		
8	NEW MAJRI	9.05	9.05	3.70	3.70	3.06	3.19	0.85	0.94	7.61	7.83	6.76	6.89
				48.62	47.25	40.21	40.74	11.17	12.01	88.83	87.99		
9	PIMPALGAON	4.92	4.92	1.68	1.72	1.60	1.56	0.53	0.53	3.81	3.81	3.28	3.28
				44.09	45.14	41.99	40.94	13.91	13.91	86.09	86.09		
10	GHUGUS	10.20	10.20	2.17	2.17	2.80	2.82	0.59	0.71	5.55	5.70	4.97	4.99
				39.10	38.07	50.45	49.47	10.63	12.46	89.55	87.54		
TOTAL (WCL)		95.01	95.01	28.44	28.48	25.23	26.28	10.79	10.90	64.46	65.66	53.67	54.76
				44.12	43.37	39.14	40.02	16.74	16.60	67.85	69.11	83.26	83.40

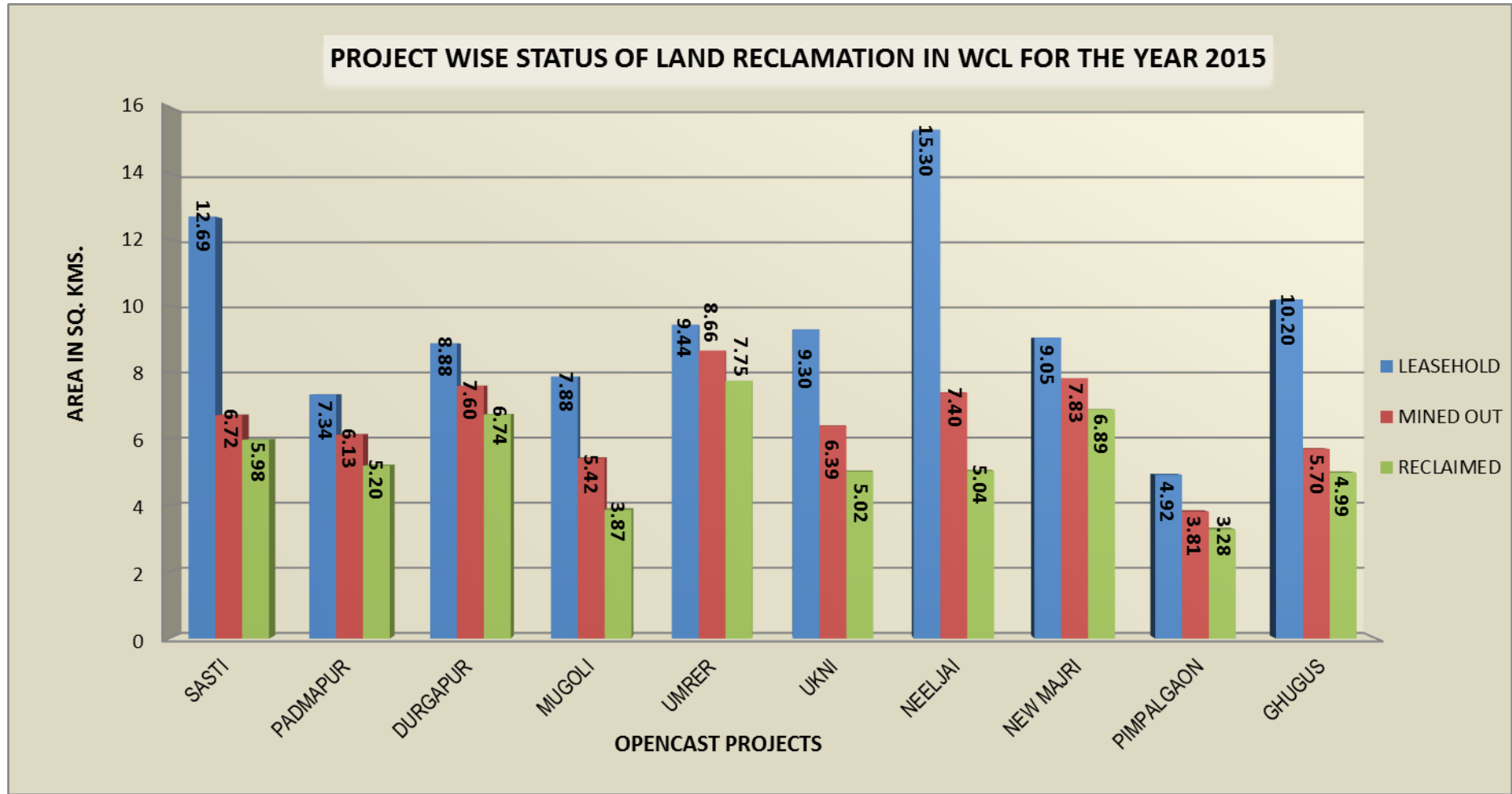


Fig.1: Land reclamation status in OC projects of WCL for the year 2015

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./2011 dated 23/08/11 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. This order has been renewed in CIL letter no. CIL/WBP/Env/2011/4706 dated 12.10.2012 for the next five years. The result of land reclamation status of all such mines will be uploaded on the website of 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 2015 carried out for all the OC projects producing more than 5 mcm (Coal+OB) for Western Coalfields Ltd.

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 1. Following steps are involved in land reclamation /restoration monitoring:

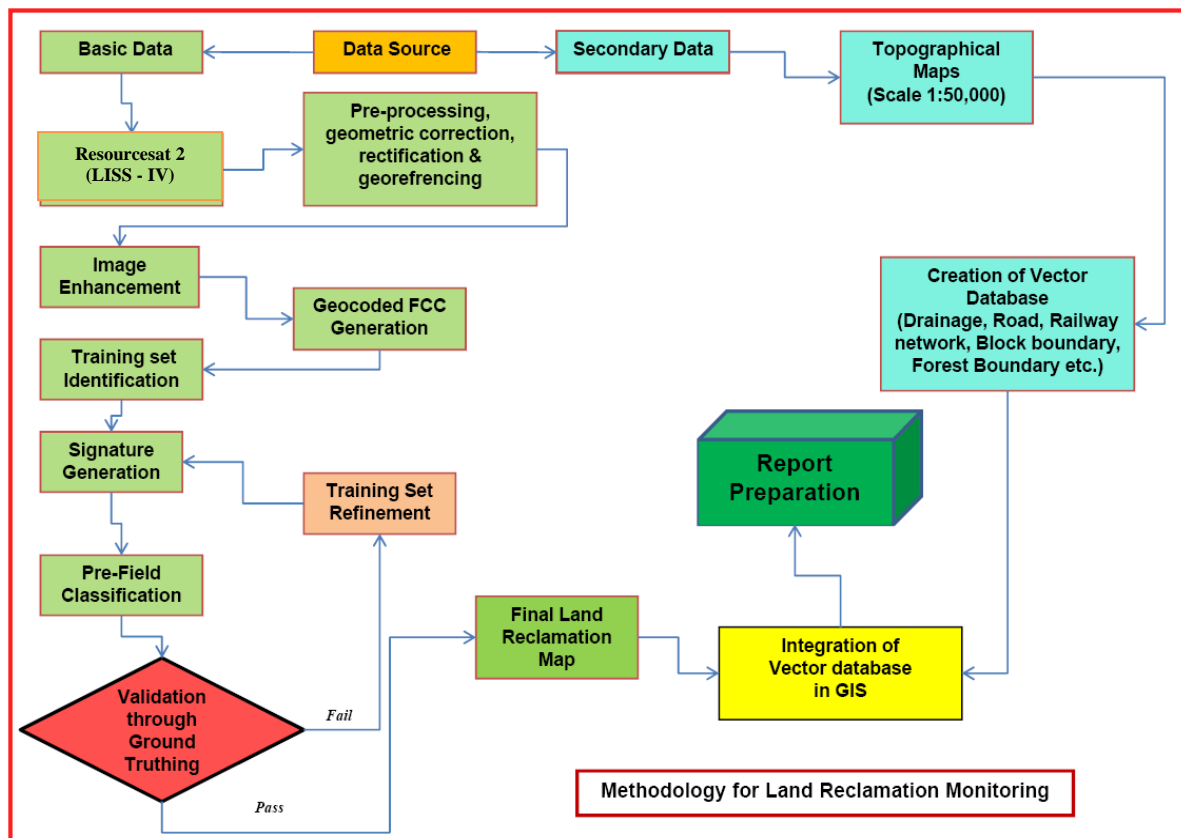


Figure: 2 - **Methodology for Land Reclamation Monitoring**

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 2014 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 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 2014 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.2014 software.

- **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 10.2 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-of dates.

4.0 Land Reclamation Status in Western Coalfields Limited

4.1 Following ten opencast projects of WCL producing more than 5 million cubic meter and more (Coal + OB) were taken up for land reclamation monitoring during year 2015-16 based on satellite data of the year 2015.

- Sasti
- Padmapur
- Durgapur
- Mugoli
- Umrer
- Ukni
- Niljai
- New Majri
- Pimpalgaon
- Ghugus

4.2 Area statistics of different land use class present in the mine leasehold of the above projects for the year 2015 are shown in the Table - 2. Land use maps derived from satellite data are shown in Plate 1 - 10. Land reclamation status of the above mentioned 10 projects, were also prepared for the year 2013, 2014 and 2015. Year wise changes in the different land use classes based on satellite data are depicted in Bar Charts in Fig. 3 - 12

4.3 Study reveals that 83.40% of mining area has already been under reclamation by WCL out of which 43.37% area has been revegetated and 40.02% area is under backfilling. There is an increase of 1.09 Km² area under reclamation in WCL with respect to the year 2014, out of which 0.04 Km² increase in biological reclamation (plantation) and 1.05 Km² increase in the technical reclamation (backfilling).

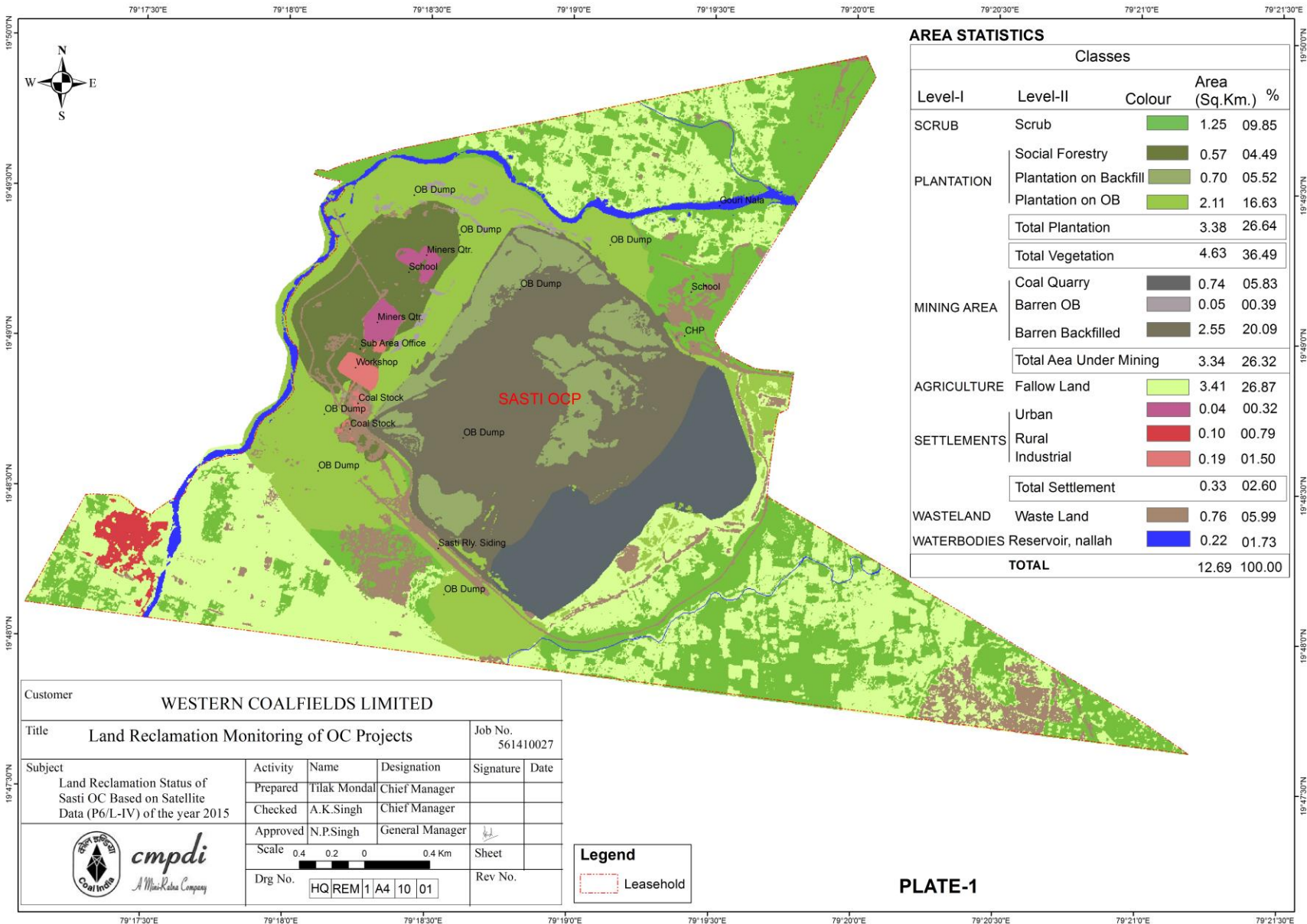
- 4.4** Analysis of satellite data indicates that area of plantation has increased from 28.44 Km² (2014) to 28.48 Km² (2015). This increase of 0.04 Km² plantation areas in one year indicates that WCL is committed for reclamation of mine land for maintaining the ecological balance in the region. It has been observed in some of the projects natural vegetation has also started growing on stabilized old backfilled areas and OB dumps due to increase in soil fertility.
- 4.5** On comparing the status of land reclamation for the year 2015 with respect to the year 2014 in different projects, it is evident that area of land reclamation has increased from 53.67 Km² (Yr. 2014) to 54.76 Km² (Yr.2015).
- 4.6** Out of 10 projects of WCL, Umrer OC ranks on top for land reclamation (89.49%) followed by Sasti OC (88.99%) and Durgapur OC (88.68%).

Table-2

STATUS OF LAND USE/ RECLAMATION IN OC MINES (>5mcu.m) OF WESTERN COALFIELDS LTD BASED ON SATELLITE DATA OF THE YEAR 2015

(Area in Sq Km)

	SASTI		PADMAPUR		DURGAPUR		MUGOLI		UMRER		UKNI		NILJAI		NEW MAJRI		PIMPALGAON		GHUGUS		TOTAL	
	Area	%	Area	%	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	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	0.00	0.00	0.00	0.00
Total 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
SCRUBS																						
Scrubs	1.25	9.85	0.65	8.86	0.43	4.84	1.46	18.53	2.62	27.72	0.99	10.65	1.69	11.05	0.20	2.21	0.29	5.89	0.56	5.49	10.14	10.67
Social Forestry	0.57	4.49	0.59	8.04	0.95	10.70	0.26	3.30	0.47	4.97	0.16	1.72	0.43	2.81	0.00	0.00	0.78	15.85	1.06	10.39	5.27	5.55
Plantation on OB Dump	2.11	16.63	1.58	21.53	2.54	28.60	0.95	12.06	1.01	10.69	0.97	10.43	0.97	6.34	2.39	26.41	0.94	19.11	0.81	7.94	14.27	15.02
Plantation on Backfill	0.70	5.52	0.00	0.00	0.00	0.00	0.42	5.33	1.53	16.19	1.14	12.26	0.95	6.21	1.31	14.48	0.00	0.00	0.30	2.94	6.35	6.68
Total Plantation (Biological Reclamation)	3.38	26.64	2.17	29.56	3.49	39.30	1.63	20.69	3.01	31.85	2.27	24.41	2.35	15.36	3.70	40.88	1.72	34.96	2.17	21.27	25.89	27.25
Total Vegetation	4.63	36.49	2.82	38.42	3.92	44.14	3.09	39.21	5.63	59.58	3.26	35.05	4.04	26.41	3.90	43.09	2.01	40.85	2.73	26.76	36.03	37.92
ACTIVE MINING																						
Coal Quarry	0.74	5.83	0.93	12.67	0.69	7.77	1.55	19.67	0.91	9.63	1.37	14.73	2.36	15.42	0.94	10.39	0.46	9.35	0.71	6.96	10.66	11.22
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Quarry Filled With Water	0.00	0.00	0.00	0.00	0.17	1.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	1.42	0.00	0.00	0.24	0.25
Coal Dump	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 Area Under Active Mining	0.74	5.83	0.93	12.67	0.86	9.68	1.55	19.67	0.91	9.63	1.37	14.73	2.36	15.42	0.94	10.39	0.53	10.77	0.71	6.96	10.90	11.47
Area under Backfilling	2.55	20.09	0.58	7.90	1.55	17.45	1.26	15.99	1.23	13.02	1.38	14.84	1.43	9.35	1.73	19.12	0.62	12.60	1.33	13.04	13.66	14.38
Barren OB Dump	0.05	0.39	2.45	33.38	1.70	19.14	0.98	12.44	0.89	9.42	1.37	14.73	1.39	9.08	1.46	16.13	0.94	19.11	1.49	14.61	12.72	13.39
Total Area Under Technical Reclamation	2.60	20.49	3.03	41.28	3.25	36.60	2.24	28.43	2.12	22.43	2.75	29.57	2.82	18.43	3.19	35.25	1.56	31.71	2.82	27.65	26.38	27.77
Total Area Under Mine Operation	3.34	26.32	3.96	53.95	4.11	46.28	3.79	48.10	3.03	32.06	4.12	44.30	5.18	33.86	4.13	45.64	2.09	42.48	3.53	34.61	37.28	39.24
WASTELANDS																						
Waste Lands	0.76	5.99	0.32	4.36	0.42	4.73	0.60	7.61	0.12	1.27	0.67	7.20	1.79	11.70	0.58	6.41	0.42	8.54	3.02	29.61	8.70	9.16
Sand Body	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 Wasteland	0.76	5.99	0.32	4.36	0.42	4.73	0.60	7.61	0.12	1.27	0.67	7.20	1.79	11.70	0.58	6.41	0.42	8.54	3.02	29.61	8.70	9.16
WATERBODIES																						
Reservoir, nallah, ponds	0.22	1.73	0.08	1.09	0.00	0.00	0.00	0.00	0.38	4.02	0.00	0.00	0.00	0.00	0.10	1.10	0.00	0.00	0.03	0.29	0.81	0.85
Total Waterbodies	0.22	1.73	0.08	1.09	0.00	0.00	0.00	0.00	0.38	4.02	0.00	0.00	0.00	0.00	0.10	1.10	0.00	0.00	0.03	0.29	0.81	0.85
AGRICULTURE																						
Crop Lands	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
Fallow Lands	3.41	26.87	0.00	0.00	0.00	0.00	0.27	3.43	0.00	0.00	0.90	9.68	3.73	24.38	0.00	0.00	0.24	4.88	0.00	0.00	8.55	9.00
Total Agriculture	3.41	26.87	0.00	0.00	0.00	0.00	0.27	3.43	0.00	0.00	0.90	9.68	3.73	24.38	0.00	0.00	0.24	4.88	0.00	0.00	8.55	9.00
SETTLEMENTS																						
Urban Settlement	0.04	0.32	0.00	0.00	0.43	4.84	0.00	0.00	0.24	2.54	0.00	0.00	0.17	1.11	0.34	3.76	0.09	1.83	0.32	3.14	1.63	1.72
Rural Settlement	0.10	0.79	0.00	0.00	0.00	0.00	0.05	0.63	0.00	0.00	0.11	1.18	0.13	0.85	0.00	0.00	0.02	0.41	0.34	3.33	0.75	0.79
Industrial Settlement	0.19	1.50	0.16	2.18	0.00	0.00	0.08	1.02	0.05	0.53	0.24	2.58	0.26	1.70	0.00	0.00	0.05	1.02	0.23	2.25	1.26	1.33
Total Settlement	0.33	2.60	0.16	2.18	0.43	4.84	0.13	1.65	0.29	3.07	0.35	3.76	0.56	3.66	0.34	3.76	0.16	3.25	0.89	8.73	3.64	3.83
Grand Total	12.69	100.0	7.34	100.0	8.88	100.0	7.88	100.0	9.45	100.0	9.30	100.0	15.30	100.0	9.05	100.0	4.92	100.0	10.20	100.0	95.01	100.00

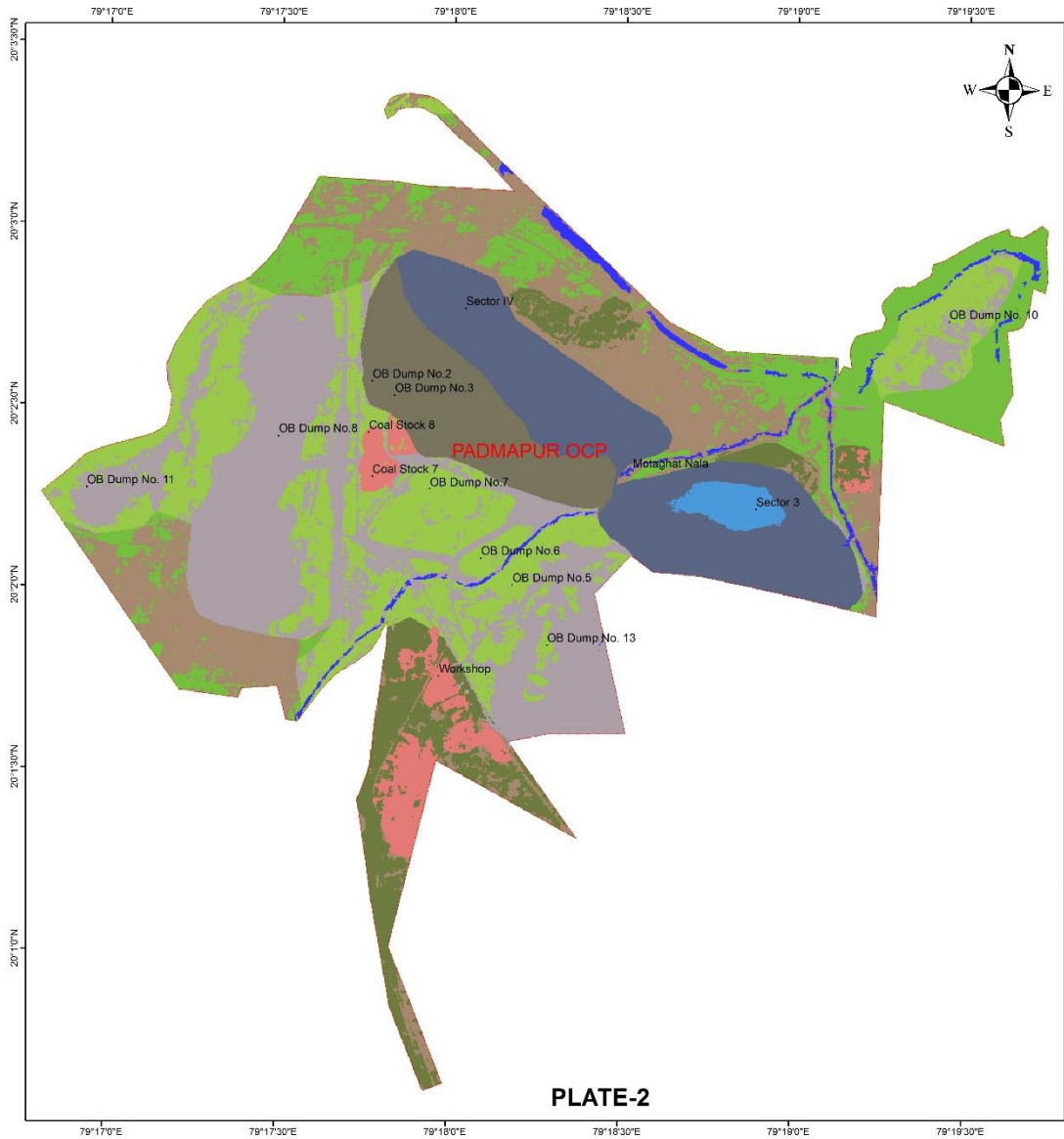


Customer	WESTERN COALFIELDS LIMITED				
Title	Land Reclamation Monitoring of OC Projects			Job No.	561410027
Subject	Activity	Name	Designation	Signature	Date
	Prepared	Tilak Mondal	Chief Manager		
	Checked	A.K.Singh	Chief Manager		
	Approved	N.P.Singh	General Manager		
Scale		0.4 0.2 0 0.4 Km			Sheet
Drg No.		HQ REM 1 A4 10 01			Rev No.



Legend
 Leasehold

PLATE-1



AREA STATISTICS

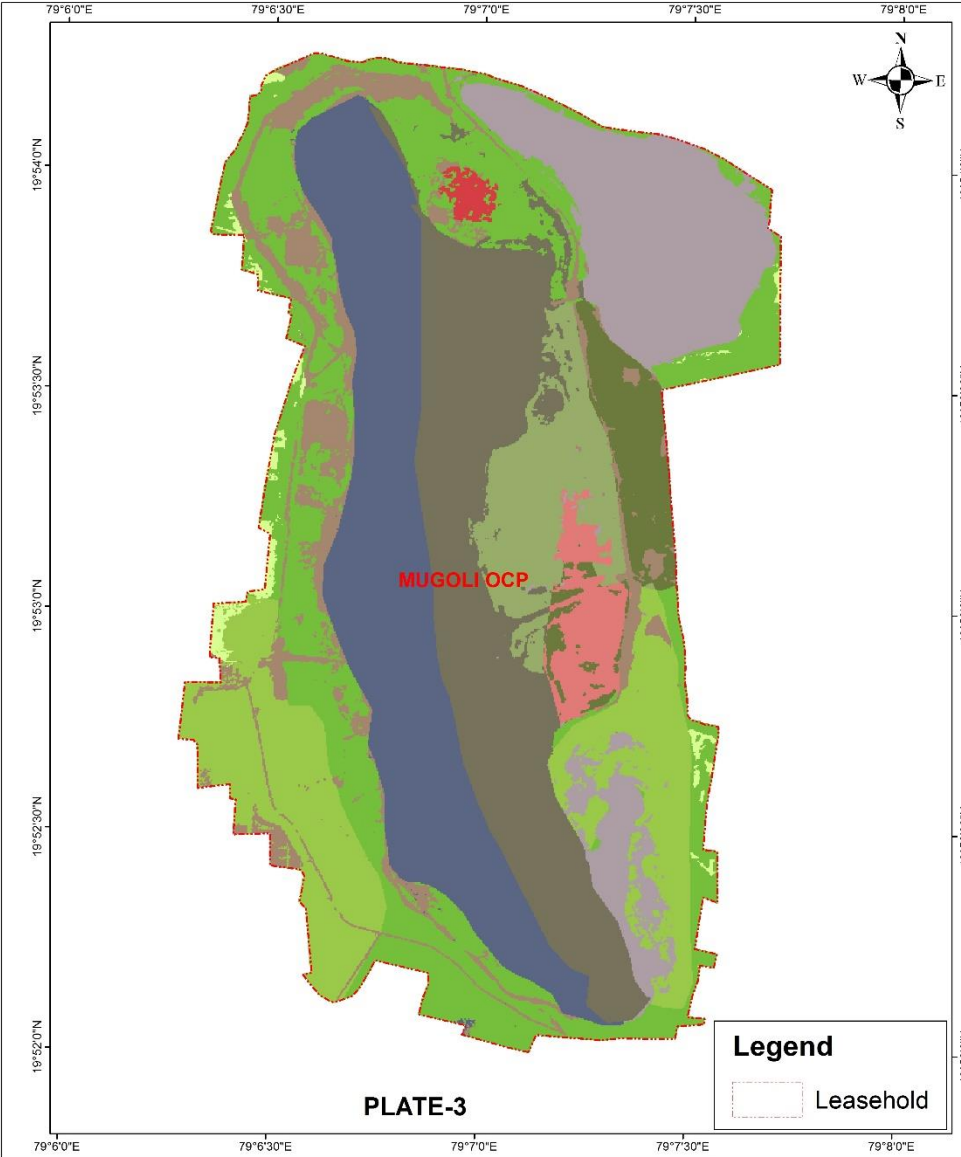
Classes				
Level-I	Level-II	Colour	Area (Sq.Km.)	%
PLANTATION	Scrub		0.65	08.86
	Social Forestry		0.59	08.04
	Plantation on OB		1.58	21.53
Total Plantation			2.17	29.56
Total Vegetation			2.82	38.42
MINING AREA	Coal Quarry		0.93	12.67
	Barren OB		2.45	33.38
	Barren Backfilled		0.58	07.90
Total Aea Under Mining			3.96	53.95
SETTLEMENTS	Industrial		0.16	02.21
WASTELAND	Waste Land		0.32	04.36
WATERBODIES	Reservoir, nallah		0.08	01.09
TOTAL			7.34	100.00

Legend

leasehold

Customer						WESTERN COALFIELDS LIMITED									
Title						Land Reclamation Monitoring of OC Projects						Job No. 561410027			
Subject						Activity		Name		Designation		Signature		Date	
Land Reclamation Status of Padmapur OC Based on Satellite Data (P6/L-IV) of the year 2015						Prepared		Tilak Mondal		Chief Manager					
						Checked		A.K.Singh		Chief Manager					
						Approved		N.P.Singh		General Manager					
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Drg No. HQ/REM/1/A4/10/02						Rev No.									

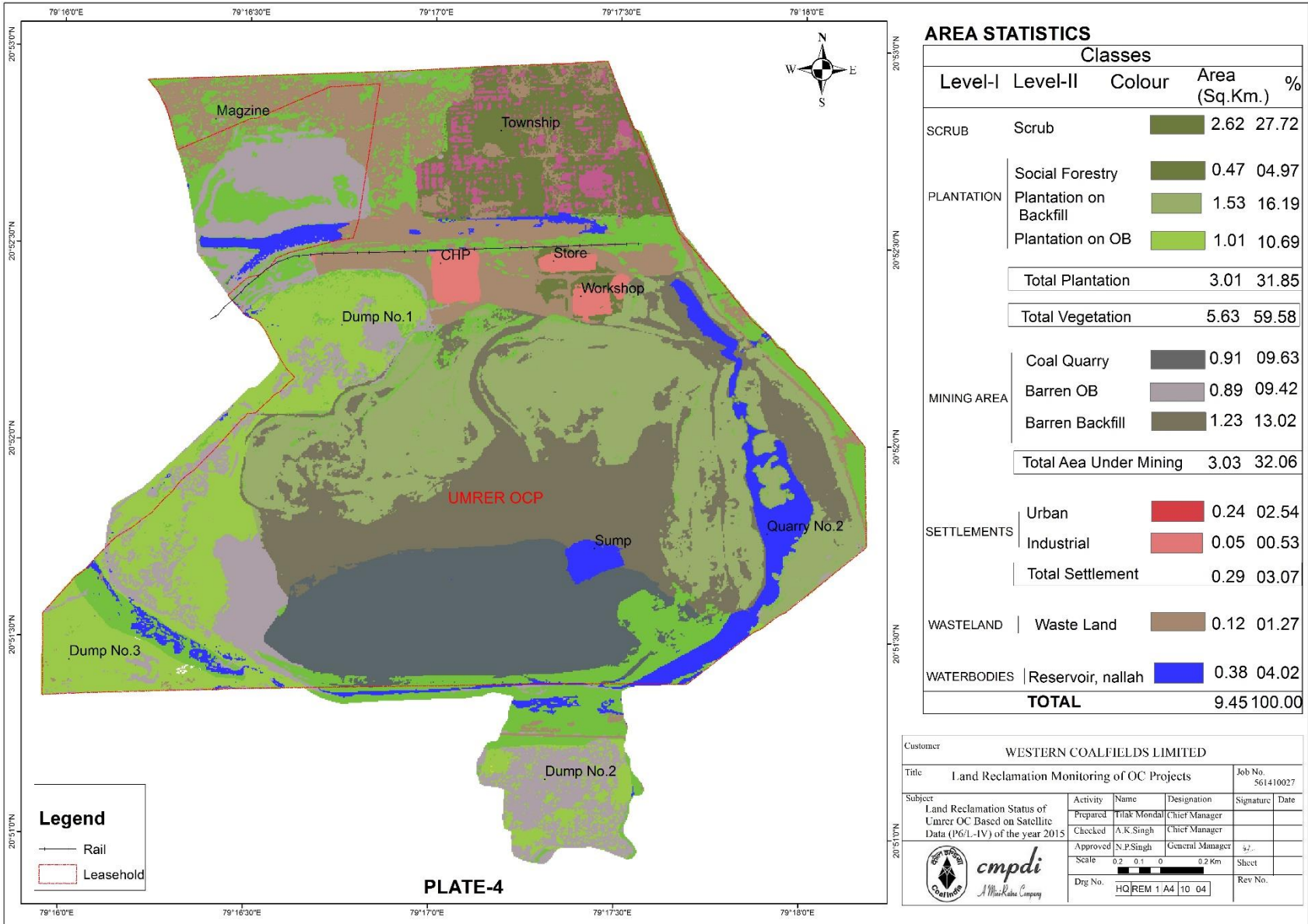
PLATE-2

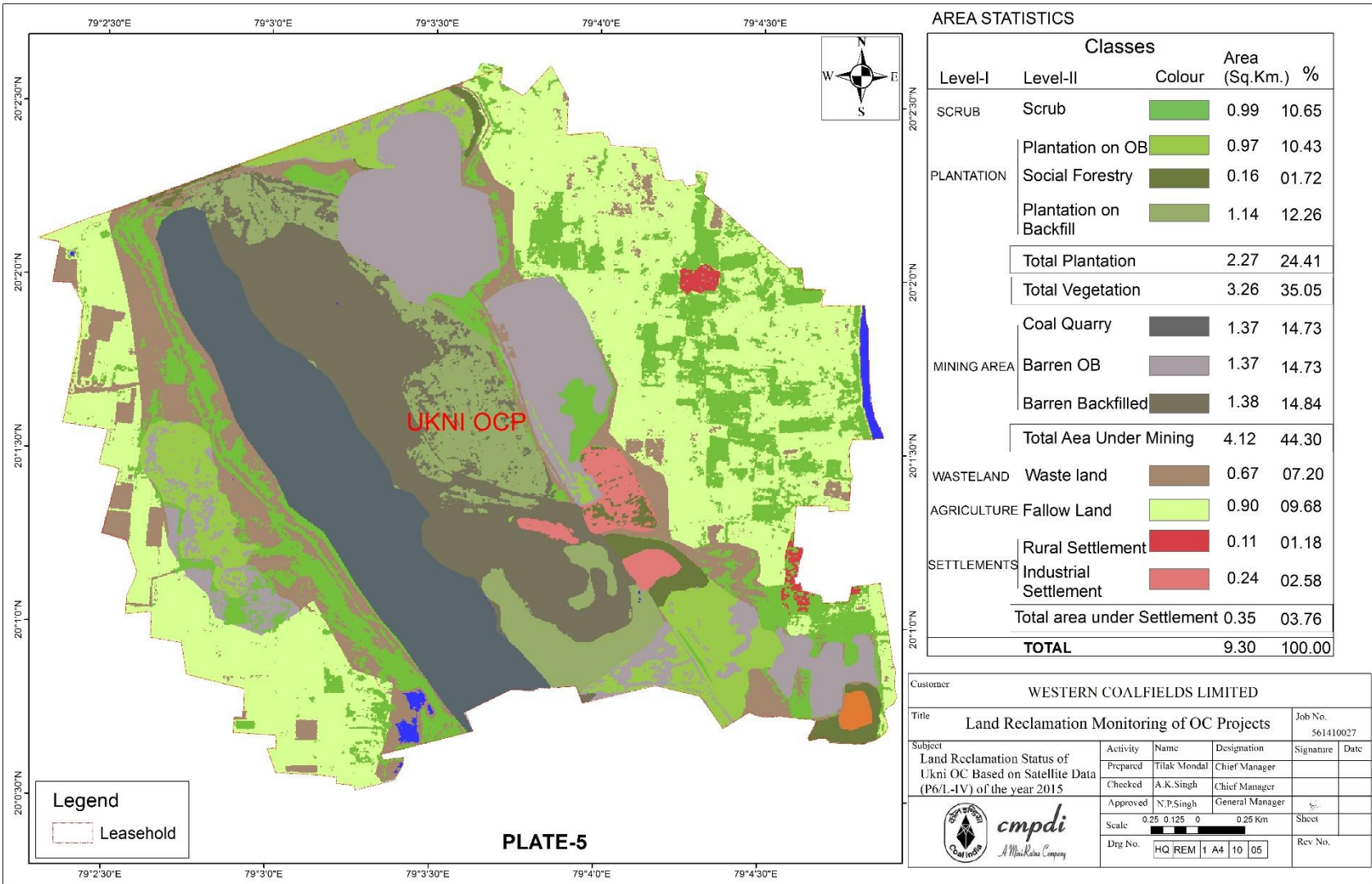


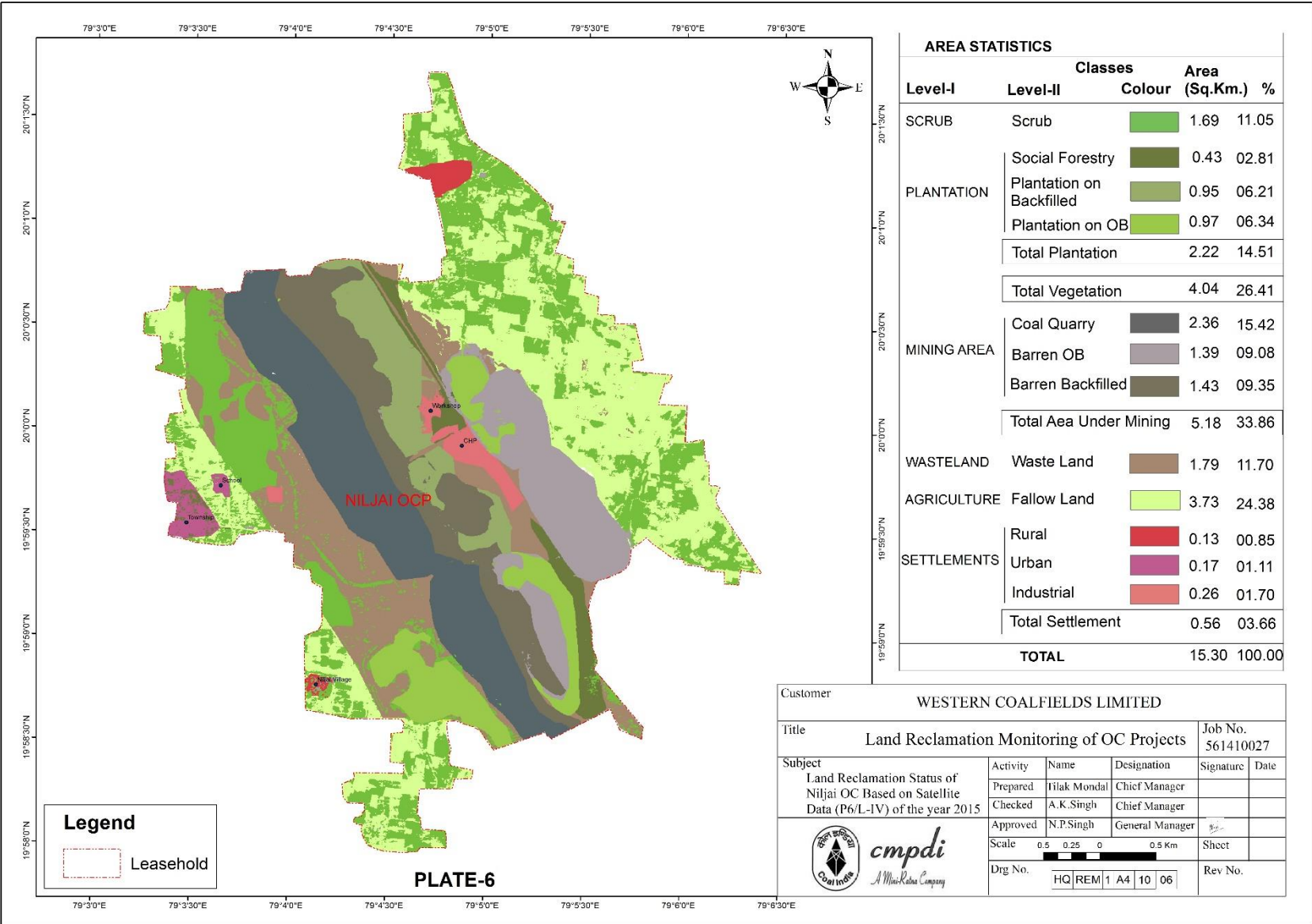
AREA STATISTICS

Classes		Area (Sq.Km.)	%
Level-I	Level-II	Colour	
SCRUB	Scrub		1.46 18.53
	Social Forestry		0.26 03.30
PLANTATION	Plantation on OB		0.95 12.06
	Plantation on Backfill		0.42 05.33
	Total Plantation		1.63 20.69
Total Vegetation		3.09	39.21
MINING AREA	Coal Quarry		1.55 19.67
	Barren Backfilled		1.26 15.99
	Barren OB		0.98 12.44
Total Aea Under Mining		3.79	48.10
AGRICULTURE	Fallow Land		0.27 03.43
WASTELAND	Waste Land		0.60 07.61
	Rural		0.05 00.63
SETTLEMENTS	Industrial		0.08 01.02
	Total Settlement		0.13 01.65
TOTAL		7.88	100.00

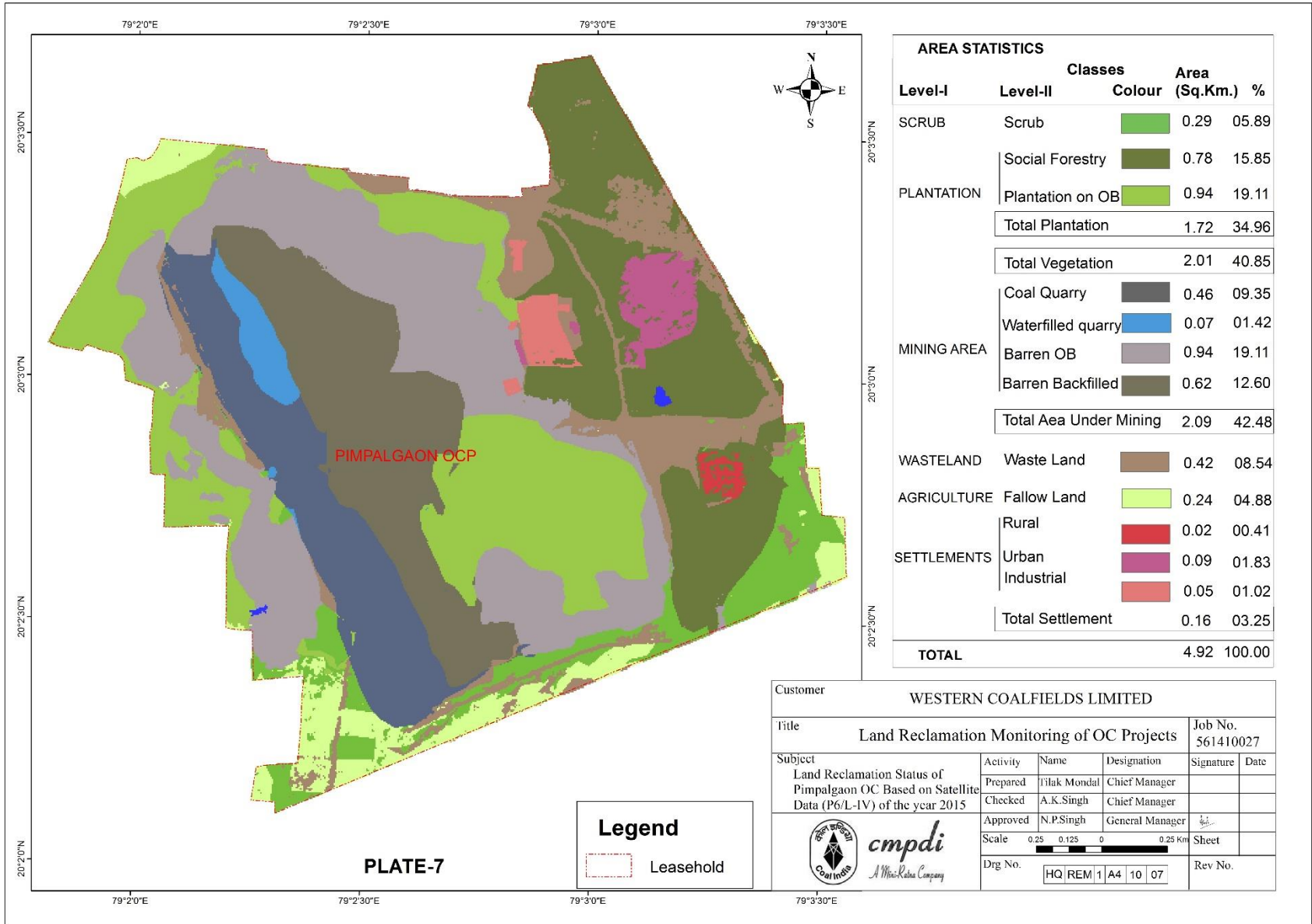
Customer						WESTERN COALFIELDS LIMITED									
Title						Land Reclamation Monitoring of OC Projects						Job No. 561410027			
Subject						Activity		Name		Designation		Signature		Date	
Land Reclamation Status of Mugoli OC based on Satellite Data (P6/I.-IV) of the year 2015						Prepared		Tilak Mondal		Chief Manager					
						Checked		A.K.Singh		Chief Manager					
						Approved		N.P.Singh		General Manager					
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Drg No.						HQ		REM		1 A4		10 03		Rev No.	





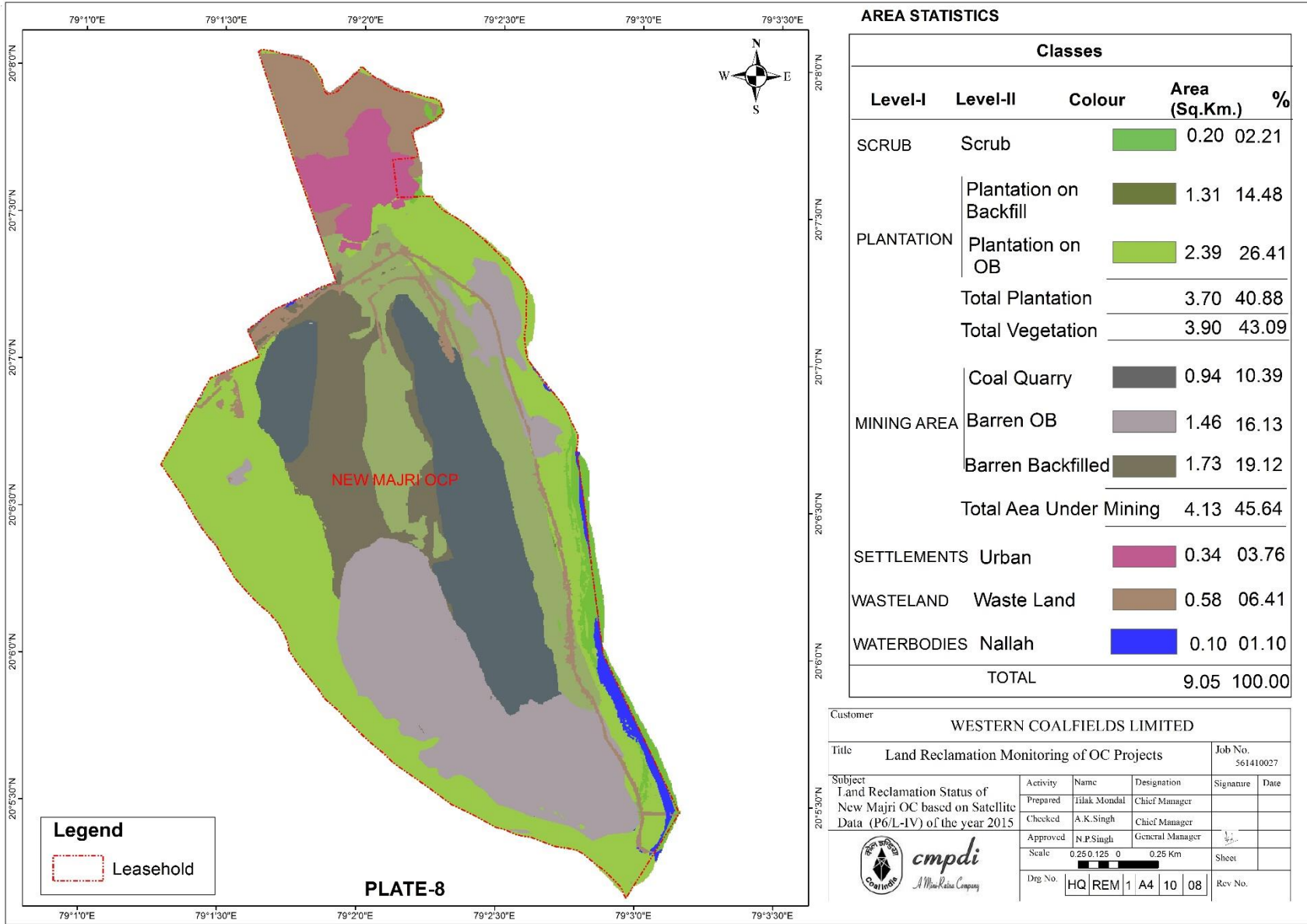


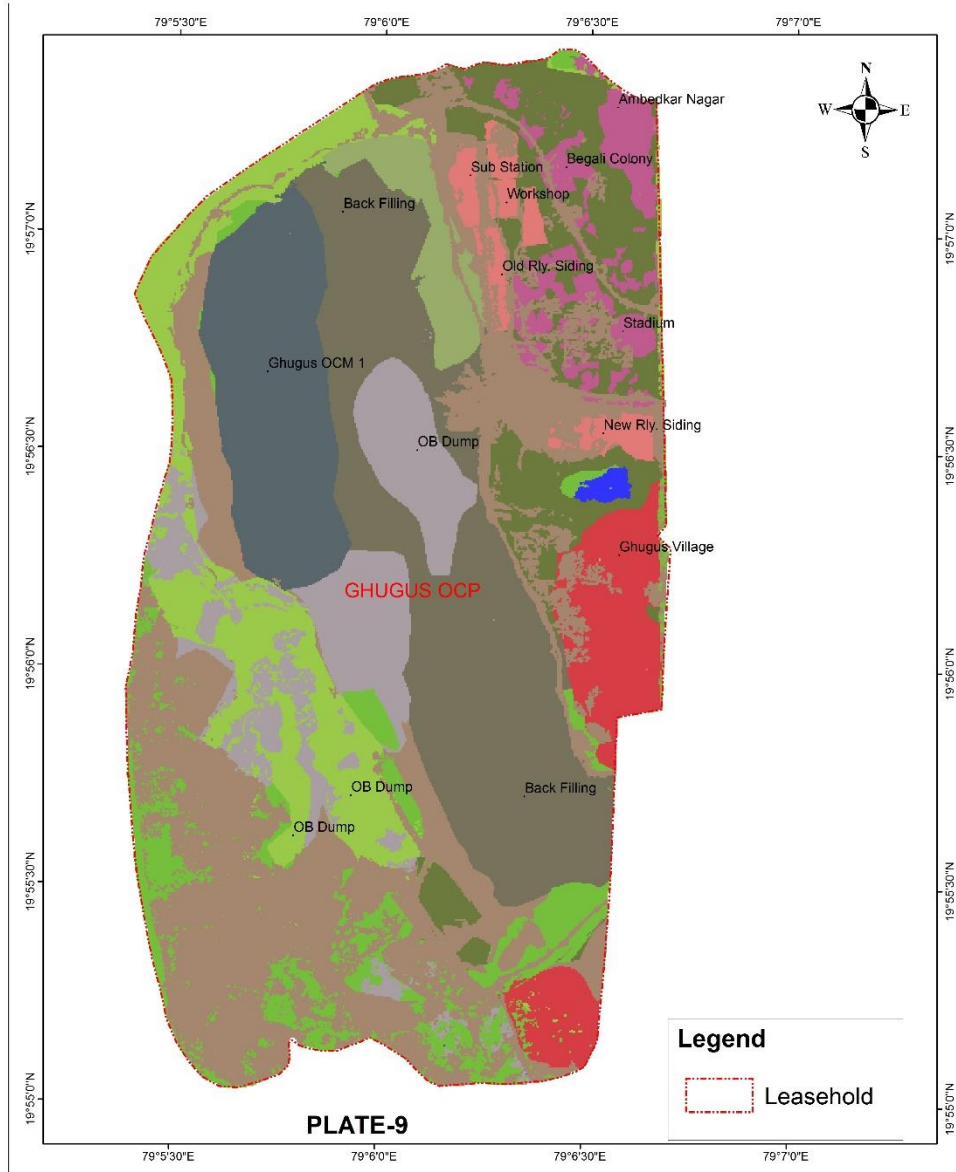
Customer	WESTERN COALFIELDS LIMITED			
Title	Land Reclamation Monitoring of OC Projects			Job No. 561410027
Subject Land Reclamation Status of Niljai OC Based on Satellite Data (P6/L-IV) of the year 2015	Activity	Name	Designation	Signature
	Prepared	Filak Mondal	Chief Manager	
	Checked	A.K.Singh	Chief Manager	
	Approved	N.P.Singh	General Manager	
Scale	0.5 0.25 0 0.5 Km			Sheet
Drg No.	HQ REM 1 A4 10 06			Rev No.



AREA STATISTICS				
Level-I	Level-II	Classes Colour	Area (Sq.Km.)	%
SCRUB	Scrub		0.29	05.89
	Social Forestry		0.78	15.85
PLANTATION	Plantation on OB		0.94	19.11
	Total Plantation		1.72	34.96
Total Vegetation			2.01	40.85
MINING AREA	Coal Quarry		0.46	09.35
	Waterfilled quarry		0.07	01.42
	Barren OB		0.94	19.11
	Barren Backfilled		0.62	12.60
Total Aea Under Mining			2.09	42.48
WASTELAND	Waste Land		0.42	08.54
AGRICULTURE	Fallow Land		0.24	04.88
	Rural		0.02	00.41
SETTLEMENTS	Urban		0.09	01.83
	Industrial		0.05	01.02
Total Settlement			0.16	03.25
TOTAL			4.92	100.00

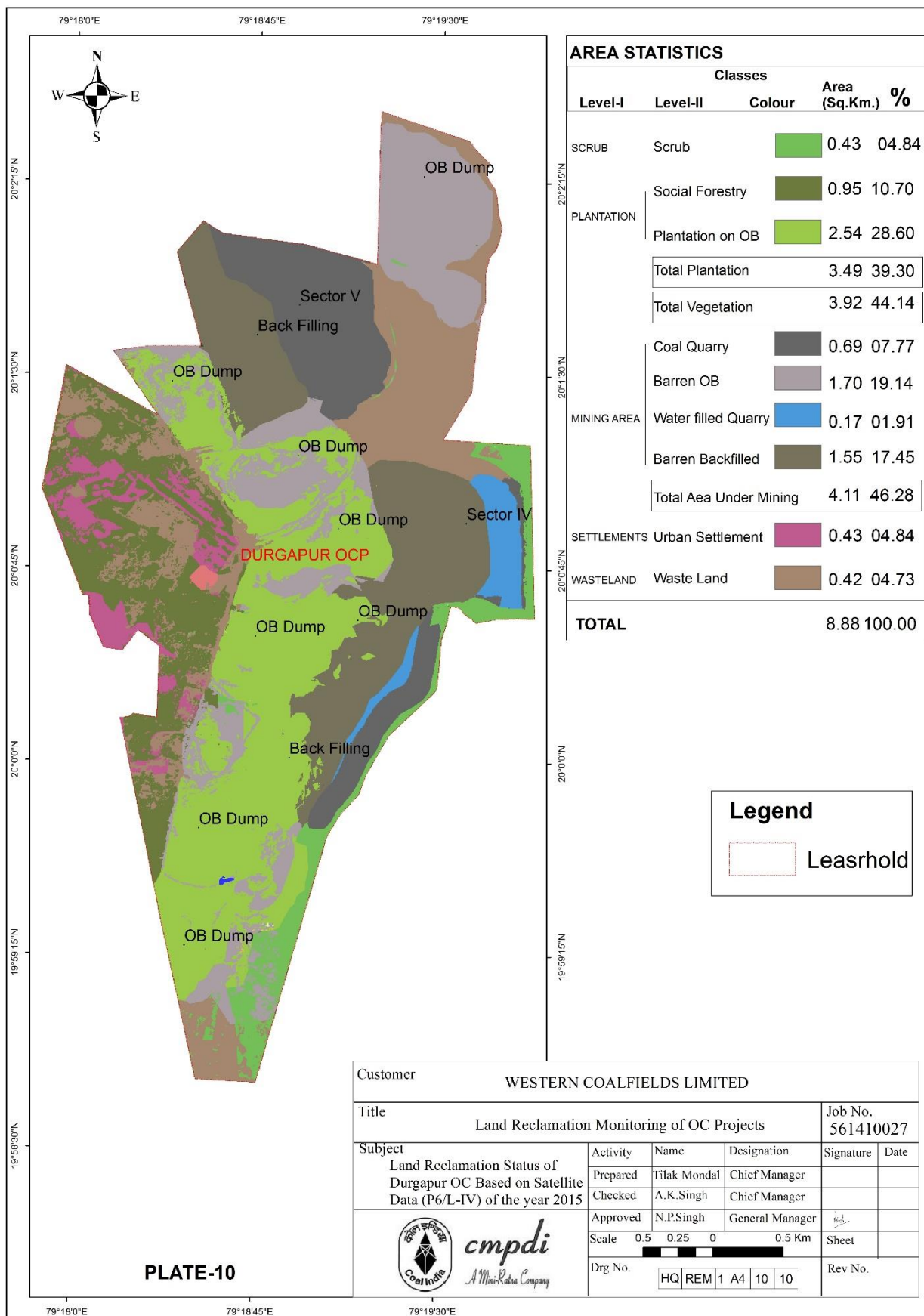
Customer						WESTERN COALFIELDS LIMITED									
Title						Land Reclamation Monitoring of OC Projects						Job No. 561410027			
Subject						Activity		Name		Designation		Signature		Date	
Land Reclamation Status of Pimpalgaon OC Based on Satellite Data (P6/L-IV) of the year 2015						Prepared		Tilak Mondal		Chief Manager					
						Checked		A.K.Singh		Chief Manager					
						Approved		N.P.Singh		General Manager					
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						Drg No.		HQ REM 1		A4 10 07		Rev No.			





AREA STATISTICS				
Level-I	Classes	Colour	Area (Sq.Km.)	%
SCRUB	Scrub		0.56	05.49
	Social Forestry		1.06	10.39
	Plantation on Backfill		0.30	02.94
	Plantation on OB		0.81	07.94
Total Plantation			2.17	21.27
Total Vegetation			2.73	26.76
MINING AREA	Coal Quarry		0.71	06.96
	Barren OB		1.49	14.61
	Barren Backfilled		1.33	13.04
Total Aea Under Mining			3.53	34.61
SETTLEMENTS	Rural		0.34	03.33
	Urban		0.32	03.14
	Industrial		0.23	02.25
WASTELAND	Waste Land		3.02	29.61
WATERBODIES	Pond		0.03	00.29
TOTAL			10.20	100.00

Customer						WESTERN COALFIELDS LIMITED									
Title						Land Reclamation Monitoring of OC Projects						Job No. 561410027			
Subject						Activity		Name		Designation		Signature		Date	
Land Reclamation Status of Ghugus OC Based on Satellite Data (P6/L-IV) of the year 2015						Prepared		Iitak Mondal		Chief Manager					
						Checked		A.K.Singh		Chief Manager					
						Approved		N.P.Singh		General Manager					
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						Drg No.		HQ REM 1 A4 10 09				Rev No.			



Customer						WESTERN COALFIELDS LIMITED									
Title						Land Reclamation Monitoring of OC Projects						Job No.		561410027	
Subject						Land Reclamation Status of Durgapur OC Based on Satellite Data (P6/L-IV) of the year 2015						Signature		Date	
Activity		Name		Designation		Signature		Date		Signature		Date			
Prepared		Tilak Mondal		Chief Manager											
Checked		A.K.Singh		Chief Manager											
Approved		N.P.Singh		General Manager											
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						Rev No.									

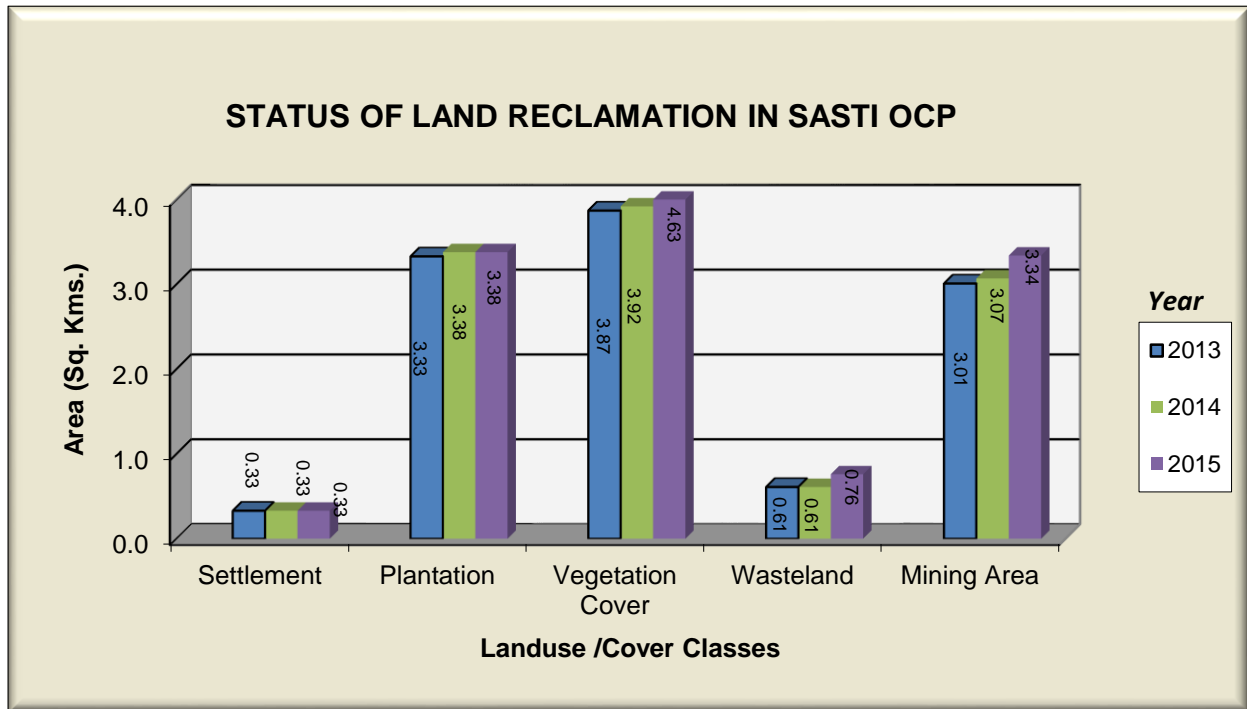


Figure 3

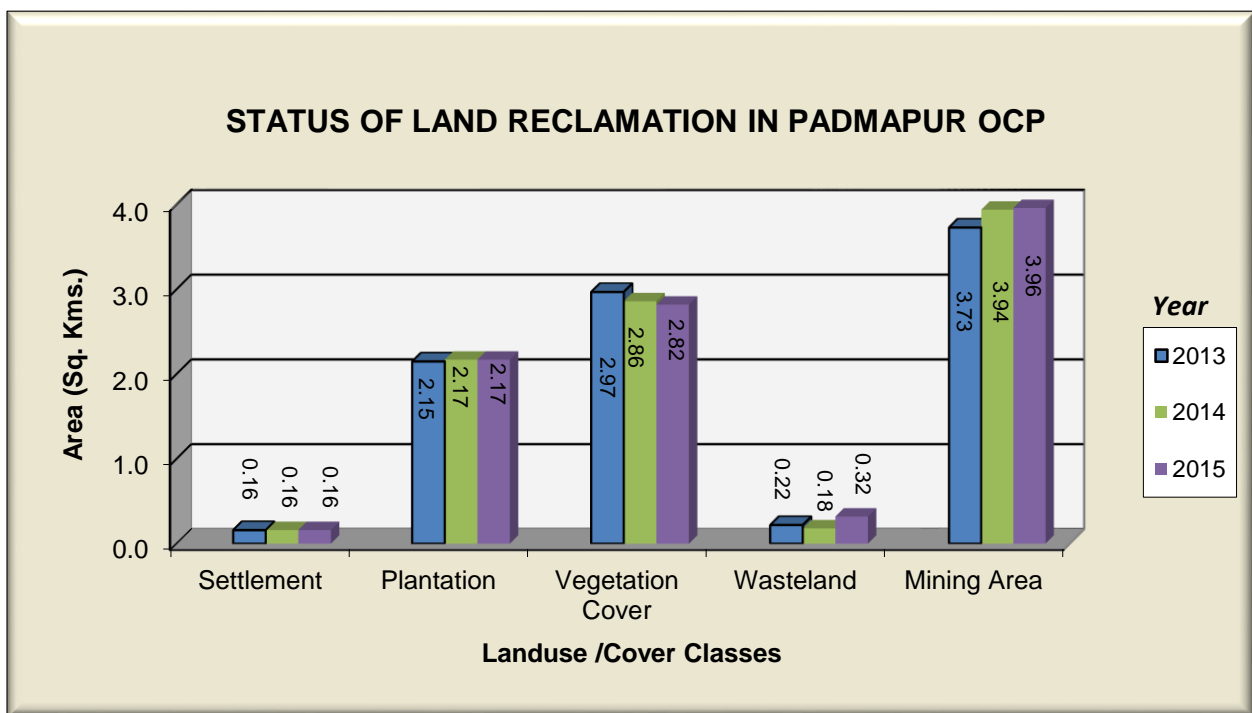


Figure 4

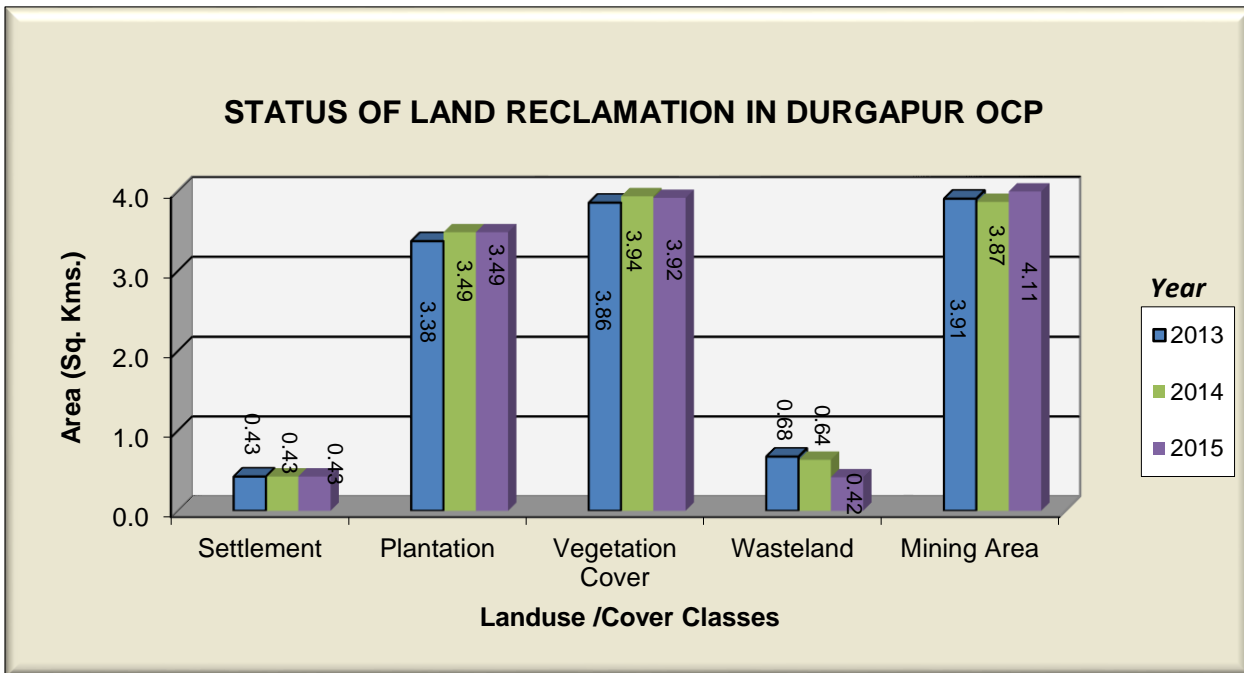


Figure 5

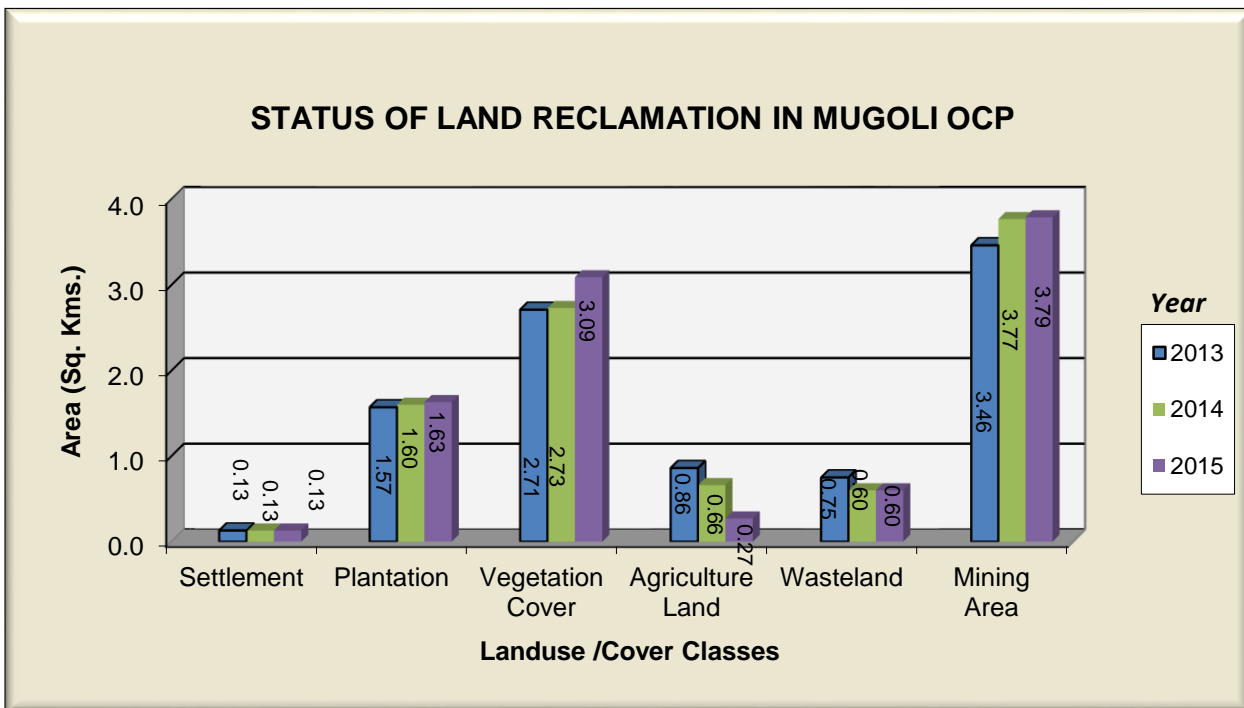


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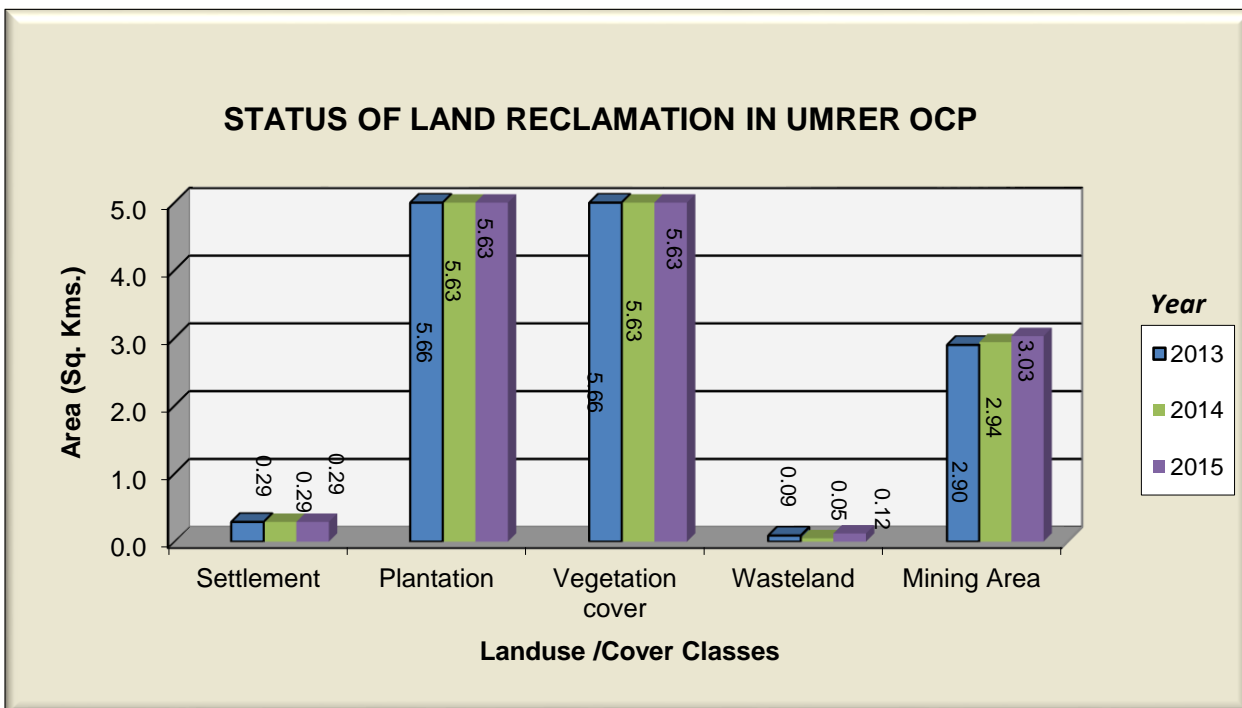


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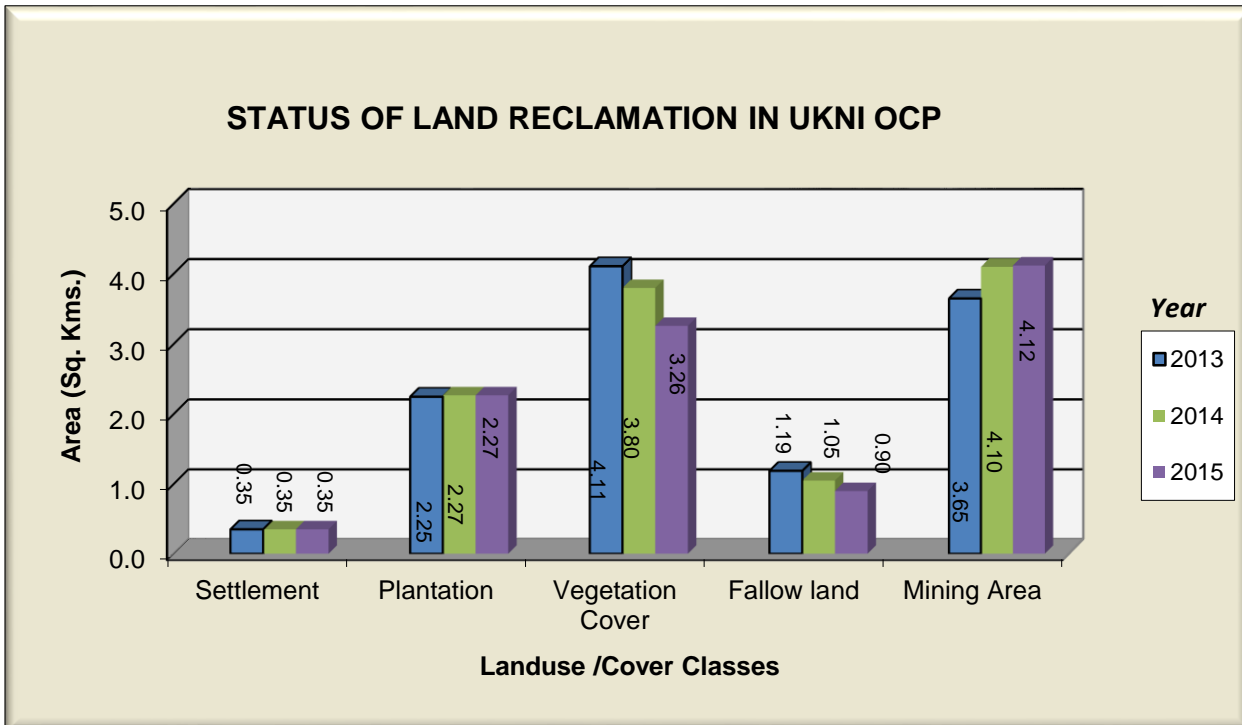


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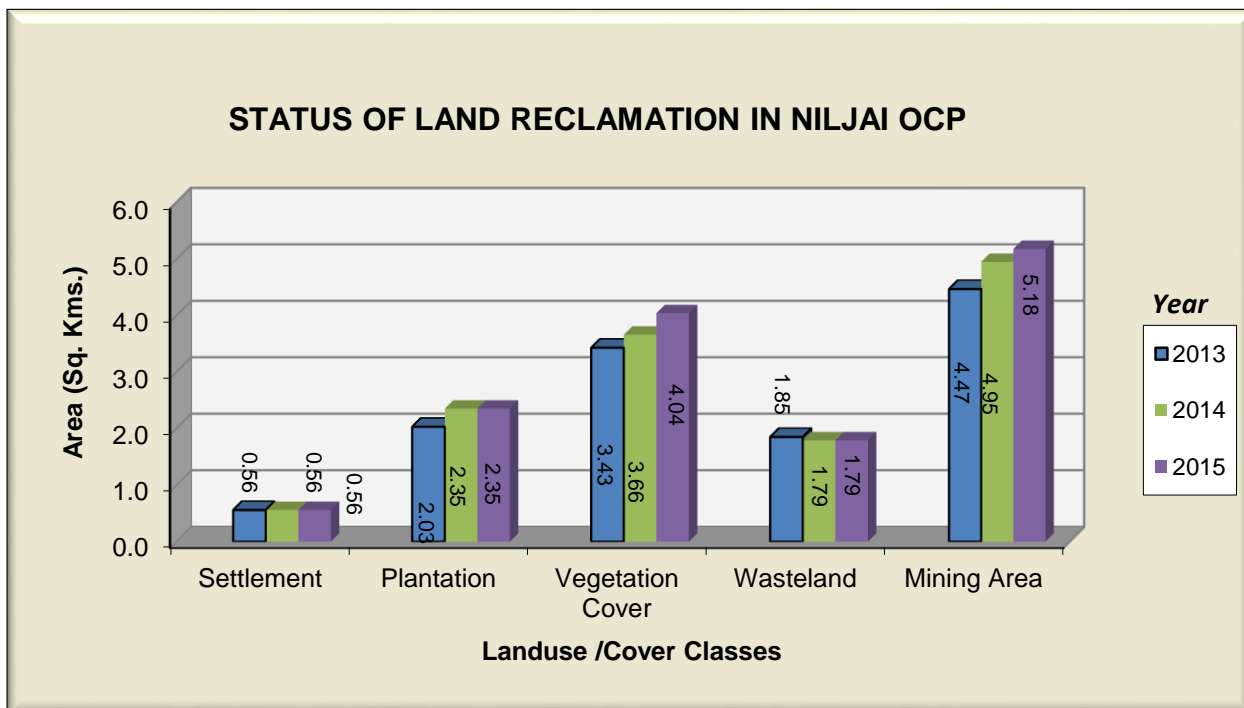


Figure 9

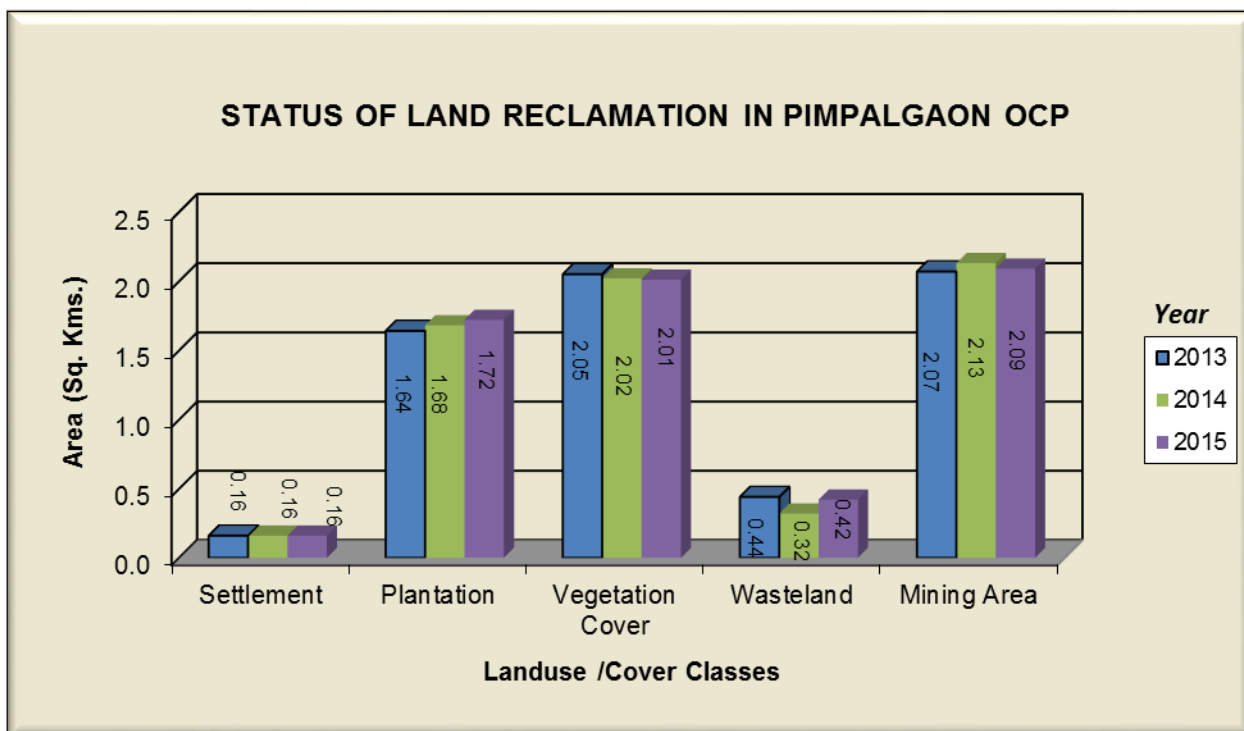


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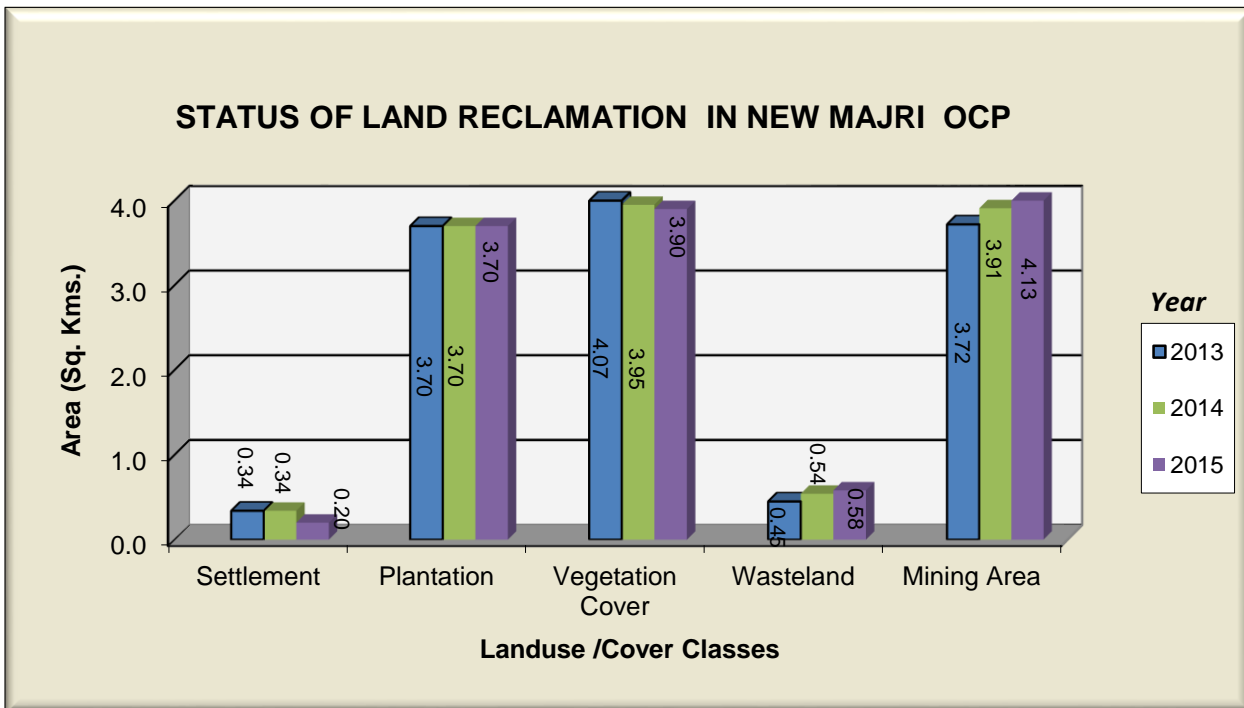


Figure 11

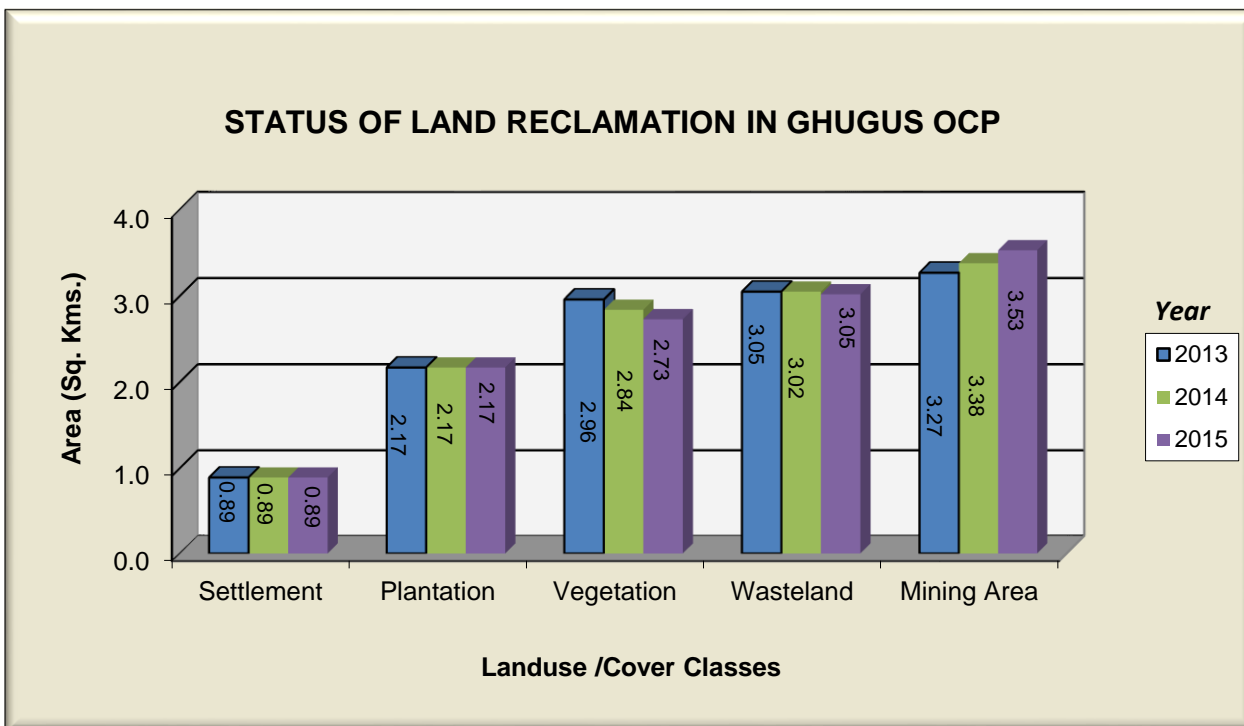


Figure 12



Photograph-1: Plantation on Internal OB/Backfill (Sasti OC mine)2015



Photograph-2: Plantation on External OB/Backfill (Ghugus OC Mine)2015



Photograph-3: Plantation on Internal OB/Backfill (Mugoli OC Mine) 2015



Photograph-4: Plantation on External OB (New Majri OC Mine) 2015



Photograph-5: Plantation along road side (Niljai OC Mine) 2015



Photograph-6: Plantation on Internal OB/Backfill (Pimpalgaon OC Mine)2015



Photograph-7: Plantation on Internal OB/Backfill (Ukni OC Mine) 2015



Photograph-8: Plantation on Internal OB/Backfill (Umrer OC Mine) 2015



Photograph-9: Plantation on Internal OB/Backfill (Durgapur OC Mine) 2015



Photograph-10: Plantation along road side (Padmapur OC Mine) 2015



cmpdi
A Mini-Ratna Company

Central Mine Planning & Design Institute Ltd.

(A Subsidiary of Coal India Ltd.)

Gondwana Place, Kanke Road, Ranchi 834031, Jharkhand

Phone : (+91) 651 2230001, 2230002, 2230483, FAX (+91) 651 2231447, 2231851

Website : www.cmpdi.co.in, Email : cmpdihq@cmpdi.co.in