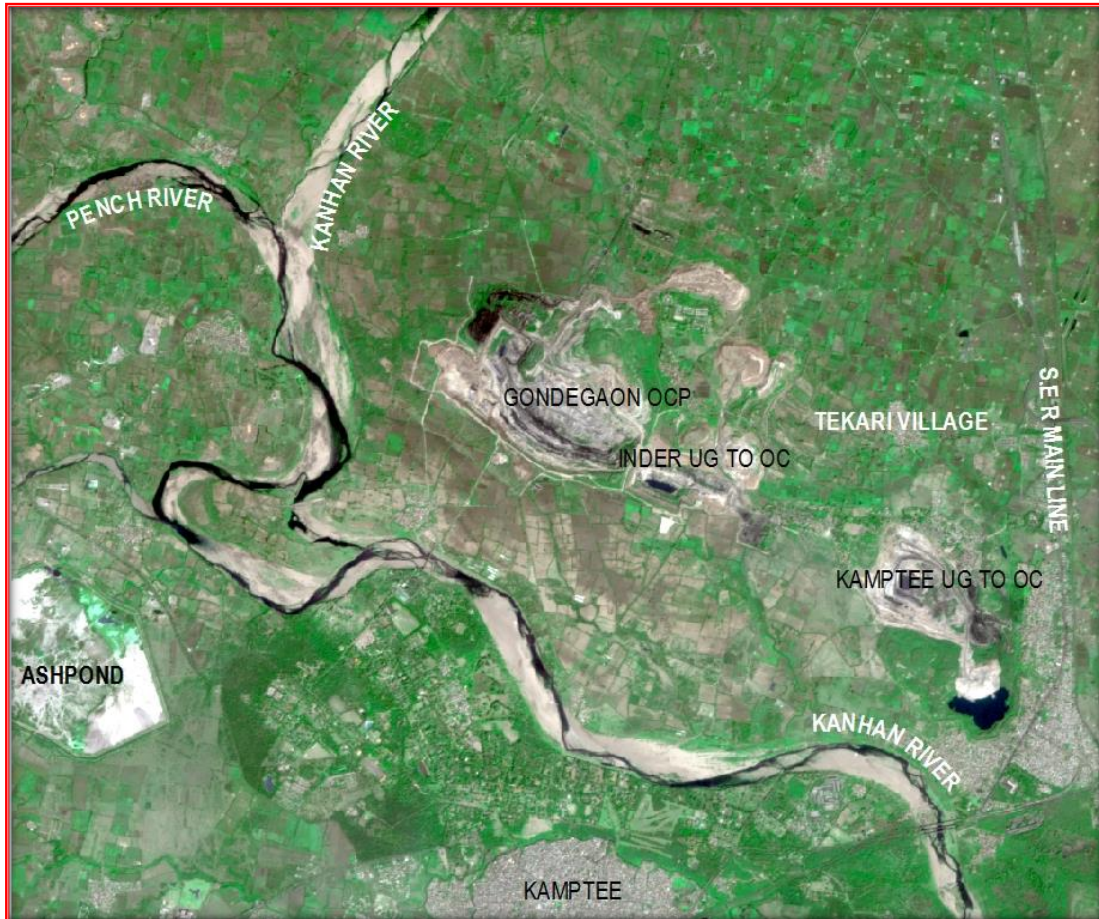


Land Restoration / Reclamation Monitoring of less than 5 million Cu. M. (Coal+OB) Capacity Opencast Coal Mines of Western Coalfields Limited based on Satellite Data for the Year 2015



**Submitted to
WESTERN COALFIELDS LIMITED**



cmpdi
A Mini Ratna Company

**Land Restoration / Reclamation Monitoring of less than 5 million
Cu. M. (Coal+OB) Capacity Opencast Coal Mines of Western
Coalfields Limited based on Satellite Data for 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 12 opencast coal mines of Western Coalfields Ltd. (WCL) producing less than 5 million cu.m. (Coal+OB) per year based on satellite data, regularly basis 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 6515.73 Hectare of the 12 projects Viz. Inder UG to OC, Kamptee UG to OC, Navin Kunada, Shivpuri, Pauni Expn OC, HLOCM, Ghorawari, Dhorwasa, Damua, Barkui, Makardhokra-I, Ambara OC mine considered for monitoring during year-2015; total excavated area is 2085.89 Ha (32.01%) of which 738.85 Ha area (35.42%) has been planted, 907.53 Ha area (43.51%) is under backfilling and 439.51Ha area (21.07%) is under active mining. It is evident from the analysis that 78.93% area of the above OC projects have already been reclaimed (biologically and technically) and balance 21.07% 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 2012 with respect to the year 2015 in different projects, it is evident from the analysis that area under land reclamation has increased from 1413.80 Ha. (Yr. 2012) to 1646.38 Ha (Yr. 2015). Out of 12 projects of WCL, maximum land reclamation has been carried out in Damua OC project (96.75%) followed by Ambara (88.46%) Ghorawari (85.35%) and HLOCM Opencast Project (84.63%).

- Area under biological reclamation (plantation) has increased from 663.02 Ha (Yr. 2012) to 738.85 (Yr. 2015) where as area of technical reclamation (area under backfilling) has increased from 750.78 Ha (Yr. 2012) to 907.53 Ha (Yr.2015) in WCL. This increase of 75.83 Ha in area of plantation and 156.75 Ha area under backfilling is the result of the efforts of the Western Coalfields Ltd taken up towards environmental protection.

Table -1
Project wise Land Reclamation Status in Opencast Projects of WCL based on Satellite Data of the year 2015

Sl. No.	Project		(% Calculated in terms of Total Excavated Area)						Area in Hectare				
			Plantation/ Vegetation		Under Backfilling		Active Mining		Total Excavated		Total Area under reclamation		
	Name	Leasehold (i)(Ha)		ii	ii	iii	iii	iv	iv	ii+iii+iv	ii+iii+iv	ii+iii	ii+iii
		2012	2015	2012	2015	2012	2015	2012	2015	2012	2015	2012	2015
1	Inder UG to OC	527.65	617.84	64.26	65.24	94.41	136.44	124.52	80.78	283.19	282.46	158.67	201.68
				22.69	23.10	33.34	48.30	43.97	28.60			56.03	71.40
2	Kamptee UG to OC	462.63	462.63	80.32	92.52	58.90	65.35	67.18	69.47	206.40	227.34	139.22	157.87
				38.91	40.70	28.54	28.75	32.55	30.56			67.45	69.44
3	Navin Kunada	373.00	373.00	93.74	102.48	135.28	157.25	82.80	54.09	311.82	313.82	229.02	259.73
				30.06	32.66	43.38	50.11	36.15	17.24			73.45	82.76
4	Shivpuri	336.29	336.29	33.75	35.78	53.77	74.77	34.78	40.51	122.30	151.06	87.52	110.55
				27.60	23.69	43.97	49.50	28.44	26.82			71.56	73.18
5	Pauni Exp OC	255.00	255.00	25.89	44.60	97.36	79.18	36.97	37.43	160.22	161.21	123.25	123.78
				16.16	27.67	60.77	49.12	23.07	23.22			76.93	76.78
6	HLOCM	311.66	311.66	92.54	92.61	91.60	118.56	33.27	38.36	217.41	249.53	184.14	211.17
				42.56	37.11	42.13	47.51	15.30	15.37			84.70	84.63
7	Ghorawari	1175.11	1175.11	26.39	34.12	56.91	71.56	14.34	18.14	97.64	123.82	83.30	105.68
				27.03	27.56	58.29	57.79	14.69	14.65			85.31	85.35
8	Dhorwasa	229.56	229.56	42.80	51.33	100.95	105.01	49.27	37.64	193.02	193.98	143.75	156.34
				22.17	26.46	52.30	54.13	34.27	19.40			74.47	80.60
9	Damua	1080.92	1080.92	130.86	139.82	27.36	31.14	0.00	5.75	158.22	176.71	158.22	170.96
				82.71	79.12	17.29	17.62	0.00	3.25			100.00	96.75
10	Barkui	237.51	237.51	7.21	8.73	13.94	16.01	9.01	12.98	30.16	37.72	21.15	24.74
				23.91	23.14	46.22	42.44	29.87	34.41			70.13	65.59
11	Makardhokra-1	660.70	660.70	0.00	0.00	0.00	6.69	0.00	29.07	0.00	35.76	0.00	6.69
				0.00	0.00	0.00	0.00	0.00	81.29			0.00	0.00
12	Ambara	775.51	775.51	65.26	71.62	20.30	45.57	40.62	15.29	126.18	132.48	85.56	117.19
				51.72	54.06	16.09	34.40	32.19	11.54			67.81	88.46
TOTAL (WCL)		6425.52	6515.73	663.02	738.85	750.78	907.53	492.76	439.51	1906.56	2085.89	1413.80	1646.38
				34.78	35.42	39.38	43.51	25.85	21.07	29.26	32.01	74.15	78.93

Project wise status of Land Reclamation in WCL for the Year 2015

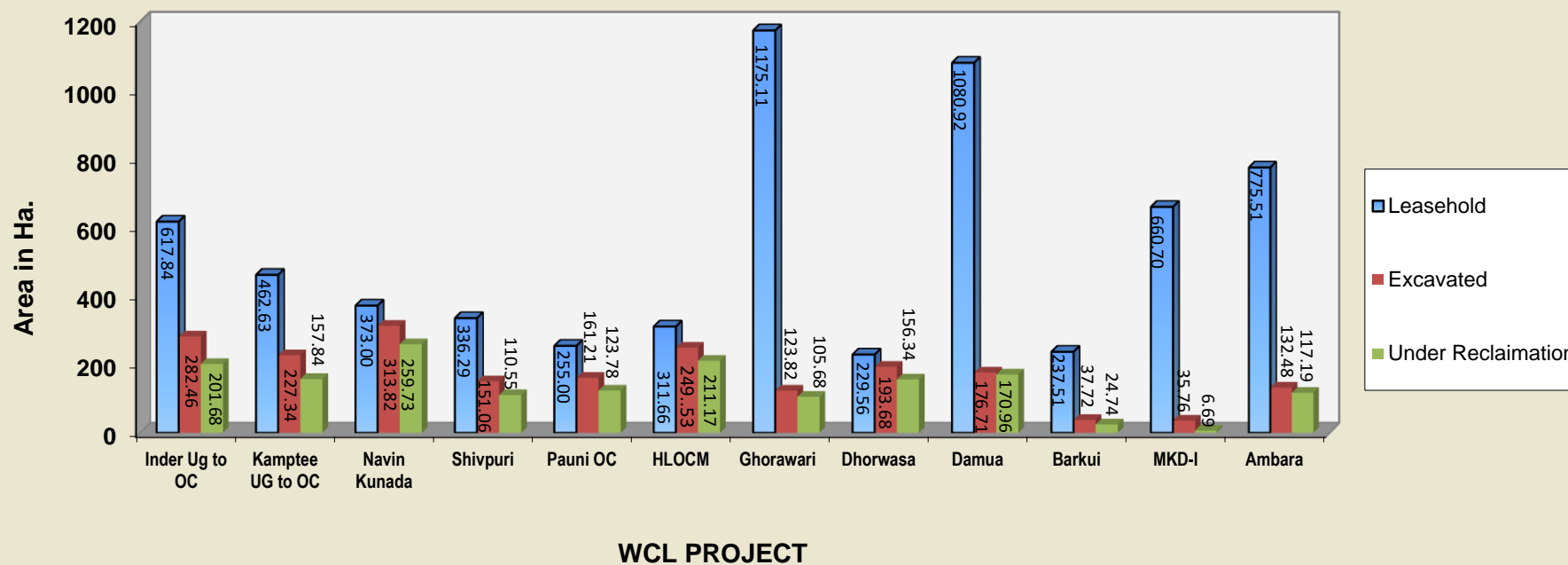


Fig 1 Land Reclamation status in OC Projects producing less than 5 mcm (cola+OB) of WCL in the year -2015

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/2011/4706 dated 12.10.12 to Central Mine Planning & Design Institute (CMPDI), Ranchi, for monitoring land reclamation status of all the opencast coal mines having production of less than 5 million m³ per annum (coal + OB taken together per annum) regularly on annual basis and less than 5 million m³ per annum (coal + OB taken together per annum) at interval of three years based on remote sensing satellite data, for sustainable development of mining. 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 March 2015 carried out for all the OC projects producing less 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 figure-2. Following steps are involved in land reclamation /restoration monitoring:

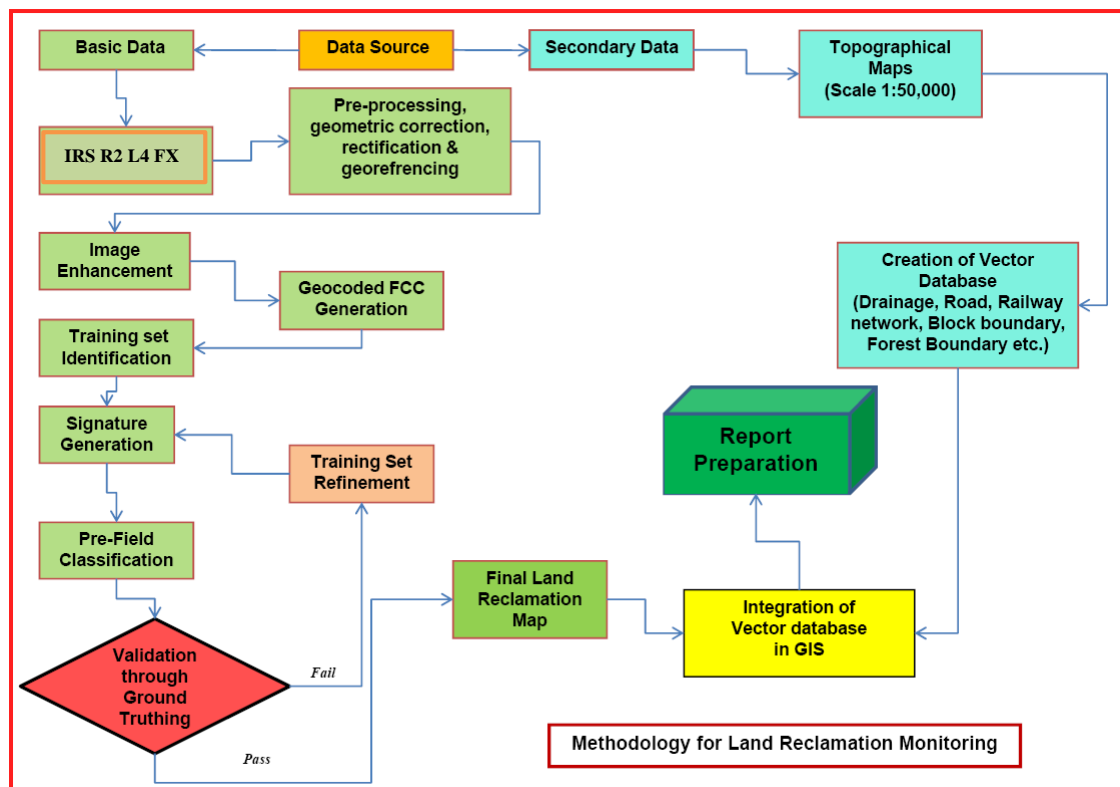


Figure :2 Methodology for Land Reclamation Monitoring

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 version 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. 2012 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 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 Ltd.

4.1 Following Twelve opencast projects producing less than 5 million cubic m. (Coal + OB together) of Western Coalfields Ltd. have been taken up for land reclamation monitoring during the year 2015:

- Inder UG to OC
- Kamptee UG to OC
- Navin Kunada
- Shivpuri
- Pauni Expn
- HLOCM
- Ghorawari
- Dhorwasa
- Damua
- Barkui
- Makardhokra-I
- Ambara

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 – 12. Land reclamation status of the above mentioned 12 opencast projects were also prepared for the year 2012 and 2015. Year wise changes in the different land use classes based on satellite data are depicted in Bar Charts in Fig. 3 - 14

4.3 Study reveals that 78.93% of mining area has already been under reclamation by WCL out of which 35.42% area has been revegetated and 43.51% area is under backfilling. There is an increase of 232.58 Hectare area under reclamation in WCL with respect to the year 2012, out of which 75.83 Hectare increase in biological reclamation (plantation) and 156.75 Hectare increase in the technical reclamation

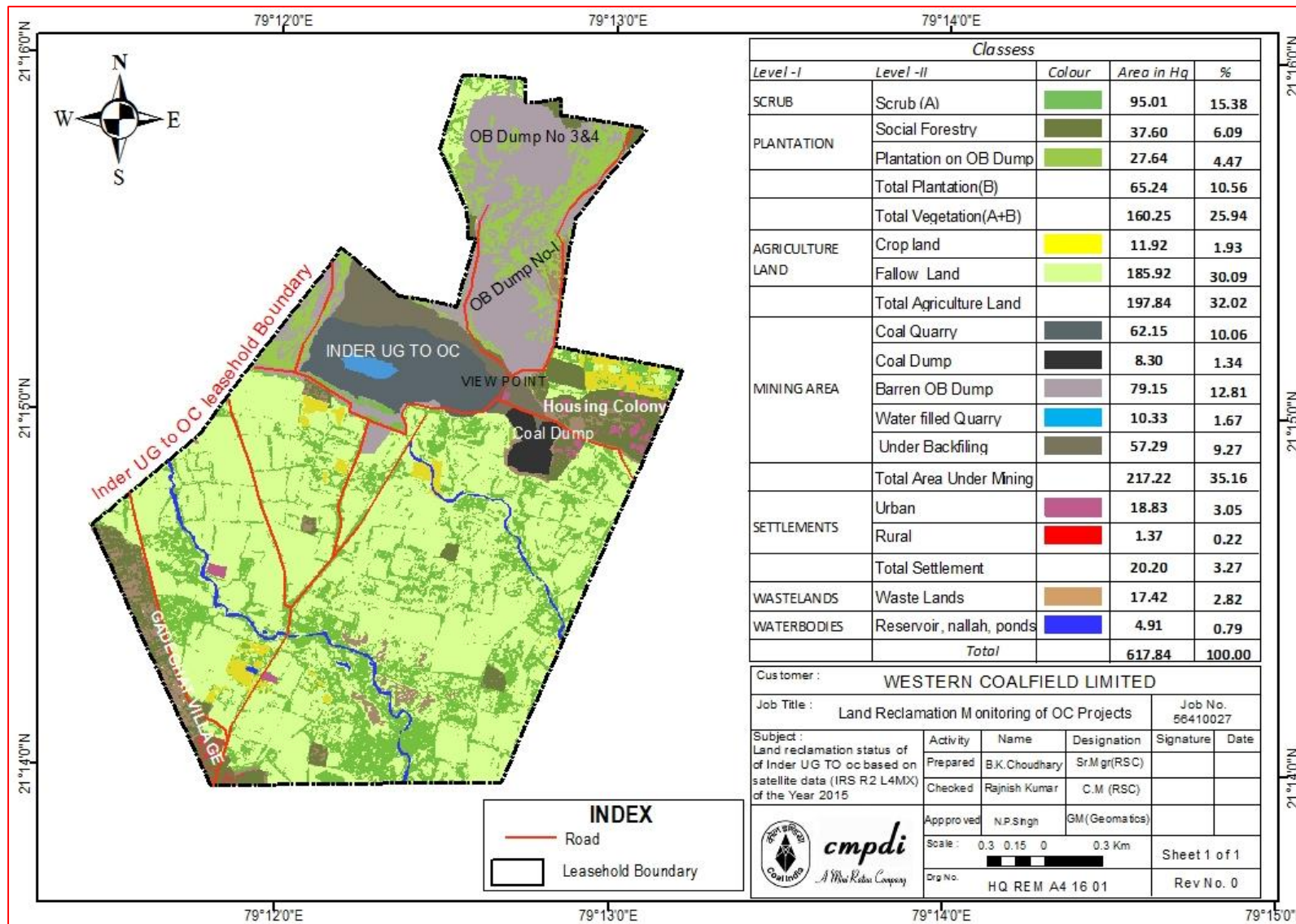
(backfilling). However, overall percentage of plantation / vegetation has increased from 34.78 % in 2012 to 35.42% in 2015 .There is marginal increase of 0.64% in biological reclamation.

- 4.4** After analyzing the satellite data of year 2012 vs. 2015 it is evident that plantation carried out on backfilled area, OB dumps as well as under social forestry in all the mines of WCL has increased from 663.02 Hectare to 738.85 Hectare in span of last three year. This increase of 75.83 Hectare area of plantation in three year time is due to the sincere efforts of WCL towards mine land reclamation.
- 4.5** Out of 12 projects of WCL, maximum land reclamation has been carried out in Damua OCP Patches(96.75)%followedby Ambara(88.46)%, Ghorawari(85.35%) and HLOCM (84.63)%.

TABLE -2
STATUS OF LAND USE / RECLAMATION IN OC MINES (<5Mcu.M) OF WESTERN COALFIELD LTD BASED ON SATELLITE DATA OF THE YEAR 2015

(Area in Hectare)

	Inder UG to OC		Kamptee UG to OC		Navin Kunada		Shivpuri		Pauni Expn OC		HLOCM		Ghorawari		Dhorwasa		Damua		Barkui		Makardhokra-I		Ambara		Total		
	Area	%	Area	%	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	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	127.55	10.85	0.00	0.00	62.19	5.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	189.74	2.91
	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	127.55	10.85	0.00	0.00	62.19	5.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	189.74
SCRUBS	Scrubs	95.01	15.38	61.51	13.30	20.41	5.47	45.16	13.43	42.42	16.63	9.89	3.17	392.34	33.40	13.83	6.01	309.23	28.61	45.48	19.15	169.05	25.59	128.66	16.58	1332.99	20.46
	Social Forestry	37.60	6.09	28.48	6.16	4.59	1.23	16.53	4.91	10.00	3.92	33.06	10.61	13.09	1.12	10.76	4.69	125.11	11.57	8.73	3.67	0.00	0.00	58.47	7.54	346.42	5.32
PLANTATION	Plantation on OB Dump	27.64	4.47	61.09	13.21	84.92	22.76	19.25	5.72	32.36	12.69	59.55	19.11	21.03	1.80	35.69	15.55	8.37	0.77	0.00	0.00	0.00	0.00	0.00	0.00	349.90	5.37
	Plantation on Backfill	0.00	0.00	2.95	0.64	12.97	3.48	0.00	0.00	2.24	0.88	0.00	0.00	0.00	0.00	4.88	2.13	6.34	0.59	0.00	0.00	0.00	0.00	13.15	1.70	42.53	0.65
	Total Plantation (Biological Reclamation)	65.24	10.56	92.52	20.01	102.48	27.47	35.78	10.63	44.60	17.49	92.61	29.72	34.12	2.92	51.33	22.37	139.82	12.93	8.73	3.67	0.00	0.00	71.62	9.24	738.85	11.34
Total Vegetation	160.25	25.94	154.03	33.31	122.89	32.94	80.94	24.06	87.02	34.12	102.50	32.89	554.01	47.17	65.16	28.38	511.24	47.29	54.21	22.82	169.05	25.59	200.28	25.82	2261.58	34.71	
ACTIVE MINING	Coal Quarry	62.15	10.06	43.34	9.37	39.26	10.53	28.00	8.32	31.01	12.16	35.93	11.53	15.19	1.30	33.60	14.64	3.35	0.31	9.72	4.09	29.07	4.40	7.89	1.02	338.51	5.20
	Coal Dump	8.30	1.34	10.88	2.35	5.10	1.37	3.49	1.04	4.43	1.74	2.03	0.65	1.16	0.10	2.60	1.13	0.00	0.00	1.45	0.61	0.00	0.00	0.00	0.00	39.44	0.61
	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	0.00	0.00	0.00	0.00
	Quarry Filled With Water	10.33	1.67	15.25	3.30	9.73	2.61	9.02	2.68	1.99	0.78	0.40	0.13	1.79	0.15	1.44	0.63	2.40	0.22	1.81	0.76	0.00	0.00	7.40	0.95	61.56	0.94
	Total Area under Active Mining	80.78	13.07	69.47	15.02	54.09	14.51	40.51	12.04	37.43	14.68	38.36	12.31	18.14	1.55	37.64	16.40	5.75	0.53	12.98	5.46	29.07	4.40	15.29	1.97	439.51	6.75
RECLAIMED	Barren OB Dump	79.15	12.81	16.43	3.55	66.19	17.74	62.38	18.55	52.64	20.64	49.47	15.87	42.40	3.61	47.93	20.88	21.72	2.01	13.28	5.60	6.69	1.01	0.00	0.00	458.28	7.03
	Barren Backfilled Area	57.29	9.27	48.92	10.57	91.06	24.41	12.39	3.70	26.54	10.41	69.09	22.17	29.16	2.50	57.08	24.87	9.42	0.87	2.73	1.15	0.00	0.00	45.57	5.88	449.25	6.89
	Total Area under Technical Reclamation	136.44	22.08	65.35	14.12	157.25	42.15	74.77	22.25	79.18	31.05	118.56	38.04	71.56	6.11	105.01	45.75	31.14	2.88	16.01	6.75	6.69	1.01	45.57	5.88	907.53	13.93
Total Area Under Mine Operation	217.22	35.15	134.82	29.14	211.34	56.66	115.28	34.29	116.61	45.73	156.92	50.35	89.70	7.66	142.65	62.15	36.89	3.41	28.99	12.21	35.76	5.41	60.86	7.85	1347.04	20.67	
WATERBODIES	Waste Lands	17.42	2.82	24.83	5.37	13.65	3.66	19.31	5.74	29.47	11.56	25.29	8.11	296.56	25.14	8.08	3.52	184.81	17.10	2.07	0.87	1.45	0.22	49.41	6.37	672.35	10.32
	Fly Ash Pond / Sand Body	0.00	0.00	0.00	0.00	0.00	0.00	2.08	0.62	3.32	1.30	0.00	0.00	0.55	0.06	1.22	0.53	16.14	1.50	0.00	0.00	1.62	0.25	0.00	0.00	24.93	0.38
	Total Wasteland	17.42	2.82	24.83	5.37	13.65	3.66	21.39	6.36	32.79	12.86	25.29	8.11	297.11	25.20	9.30	4.05	200.95	18.60	2.07	0.87	3.07	0.47	49.41	6.37	697.28	10.70
	Reservoir, nallah, ponds	4.91	0.80	2.64	0.55	1.09	0.29	0.43	0.13	0.60	0.24	7.55	2.42	5.20	0.44	6.16	2.68	9.46	0.87	5.45	2.30	5.76	0.87	6.06	0.78	55.31	0.85
Total Waterbodies	4.91	0.80	2.64	0.55	1.09	0.29	0.43	0.13	0.60	0.24	7.55	2.42	5.20	0.44	6.16	2.68	9.46	0.87	5.45	2.30	5.76	0.87	6.06	0.78	55.31	0.85	
AGRICULTURE	Crop Lands	11.92	1.93	13.03	2.82	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	2.01	0.85	17.40	2.63	2.45	0.32	46.81	0.72	
	Fallow Lands	185.92	30.09	115.22	24.90	19.57	5.25	111.05	33.02	17.23	6.76	6.19	1.99	222.25	18.92	5.84	2.54	270.80	25.05	140.81	59.29	429.66	65.03	422.23	54.45	1946.77	29.88
	Total Agriculture	197.84	32.02	128.25	27.72	19.57	5.25	111.05	33.02	17.23	6.76	6.19	1.99	222.25	18.92	5.84	2.54	270.80	25.05	142.82	60.14	447.06	67.66	424.68	54.77	1993.58	30.60
SETTLEMENTS	Urban Settlement	18.83	3.05	17.66	3.82	0.56	0.15	3.20	0.95	0.43	0.16	11.59	3.72	5.06	0.43	0.32	0.14	50.55	4.68	3.36	1.42	0.00	0.00	32.89	4.24	144.45	2.22
	Rural Settlement	1.37	0.22	0.00	0.00	0.00	0.00	2.36	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.07	0.50	0.20	0.00	0.00	1.33	0.17	6.37	0.10
	Industrial Settlement	0.00	0.00	0.40	0.09	3.90	1.05	1.64	0.49	0.32	0.13	1.62	0.52	1.78	0.18	0.13	0.06	0.23	0.03	0.10	0.04	0.00	0.00	0.00	0.00	10.12	0.16
	Total Settlement	20.20	3.27	18.06	3.91	4.46	1.20	7.20	2.14	0.75	0.29	13.21	4.24	6.84	0.61	0.45	0.20	51.58	4.78	3.96	1.66	0.00	0.00	34.22	4.41	160.94	2.47
Grand Total	617.84	100.00	462.63	100.00	373.00	100.00	336.29	100.00	255.00	100.00	311.66	100.00	1175.11	100.00	229.56	100.00	1080.92	100.00	237.50	100.00	660.70	100.00	775.51	100.00	6515.73	100.00	



Classess		Colour	Area in Hq	%
SCRUB	Scrub (A)		95.01	15.38
PLANTATION	Social Forestry		37.60	6.09
	Plantation on OB Dump		27.64	4.47
	Total Plantation(B)		65.24	10.56
	Total Vegetation(A+B)		160.25	25.94
AGRICULTURE LAND	Crop land		11.92	1.93
	Fallow Land		185.92	30.09
	Total Agriculture Land		197.84	32.02
MINING AREA	Coal Quarry		62.15	10.06
	Coal Dump		8.30	1.34
	Barren OB Dump		79.15	12.81
	Water filled Quarry		10.33	1.67
	Under Backfilling		57.29	9.27
	Total Area Under Mining		217.22	35.16
SETTLEMENTS	Urban		18.83	3.05
	Rural		1.37	0.22
	Total Settlement		20.20	3.27
WASTELANDS	Waste Lands		17.42	2.82
WATERBODIES	Reservoir, nallah, ponds		4.91	0.79
	Total		617.84	100.00

Customer : WESTERN COALFIELD LIMITED					
Job Title : Land Reclamation Monitoring of OC Projects				Job No. 56410027	
Subject : Land reclamation status of Inder UG TO oc based on satellite data (IRS R2 L4MX) of the Year 2015	Activity	Name	Designation	Signature	Date
	Prepared	B.K.Choudhary	Sr.Mgr(RSC)		
	Checked	Rajnish Kumar	C.M (RSC)		
Approved	N.P.Singh	GM(Geomatics)			
Scale : 0.3 0.15 0 0.3 Km				Sheet 1 of 1	
Dig.No. HQ REM A4 16 01				Rev.No. 0	

Plate -1

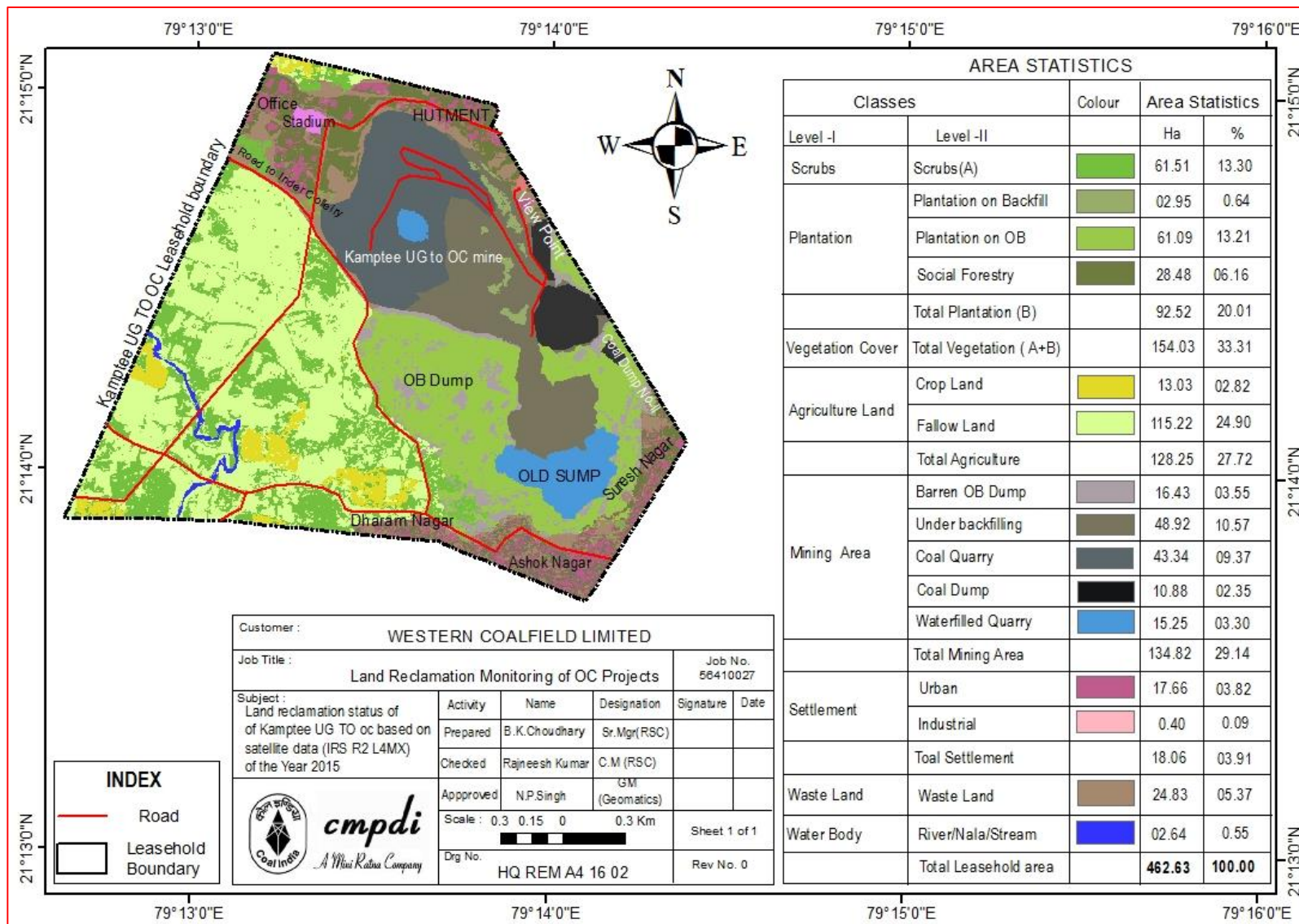


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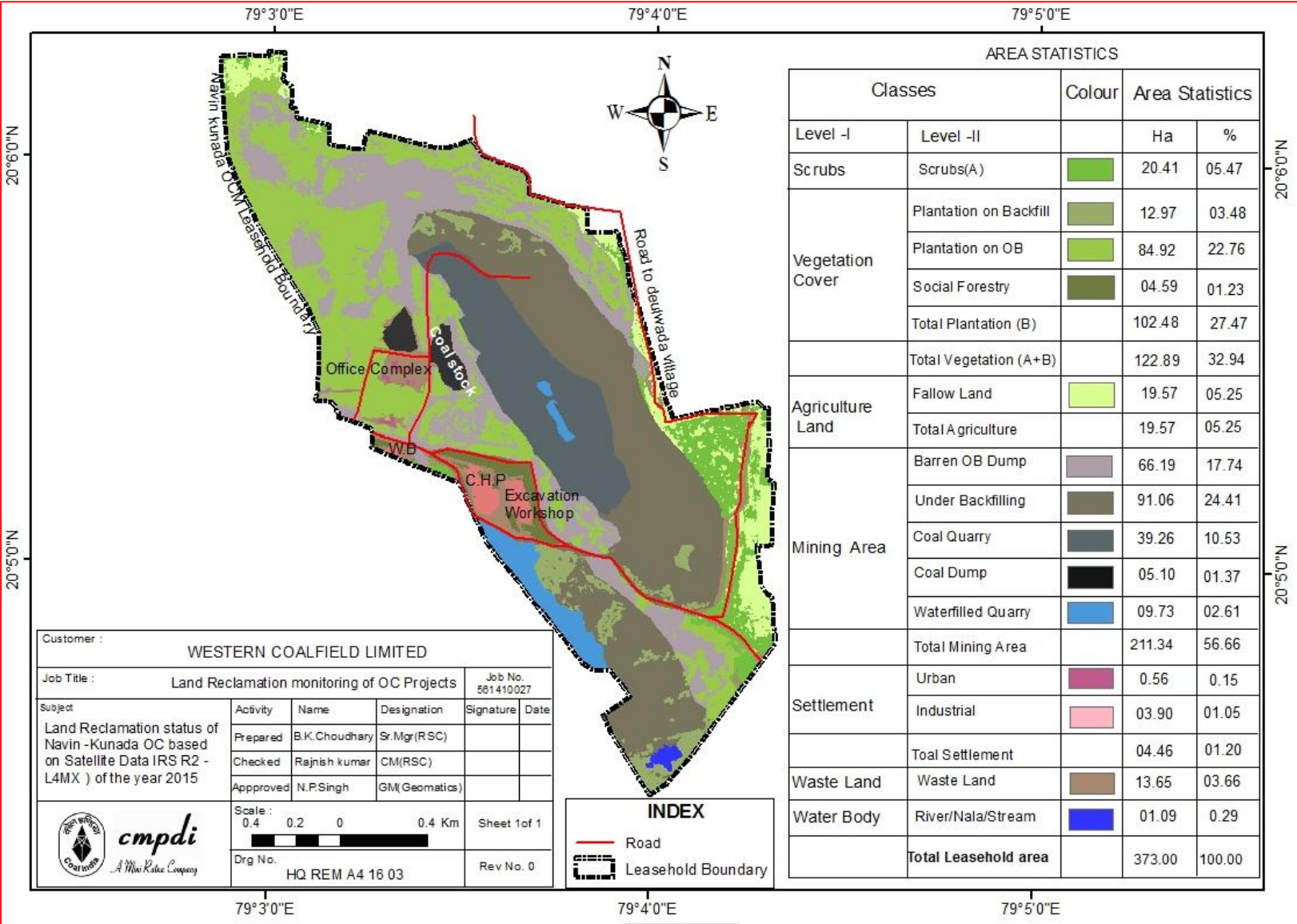


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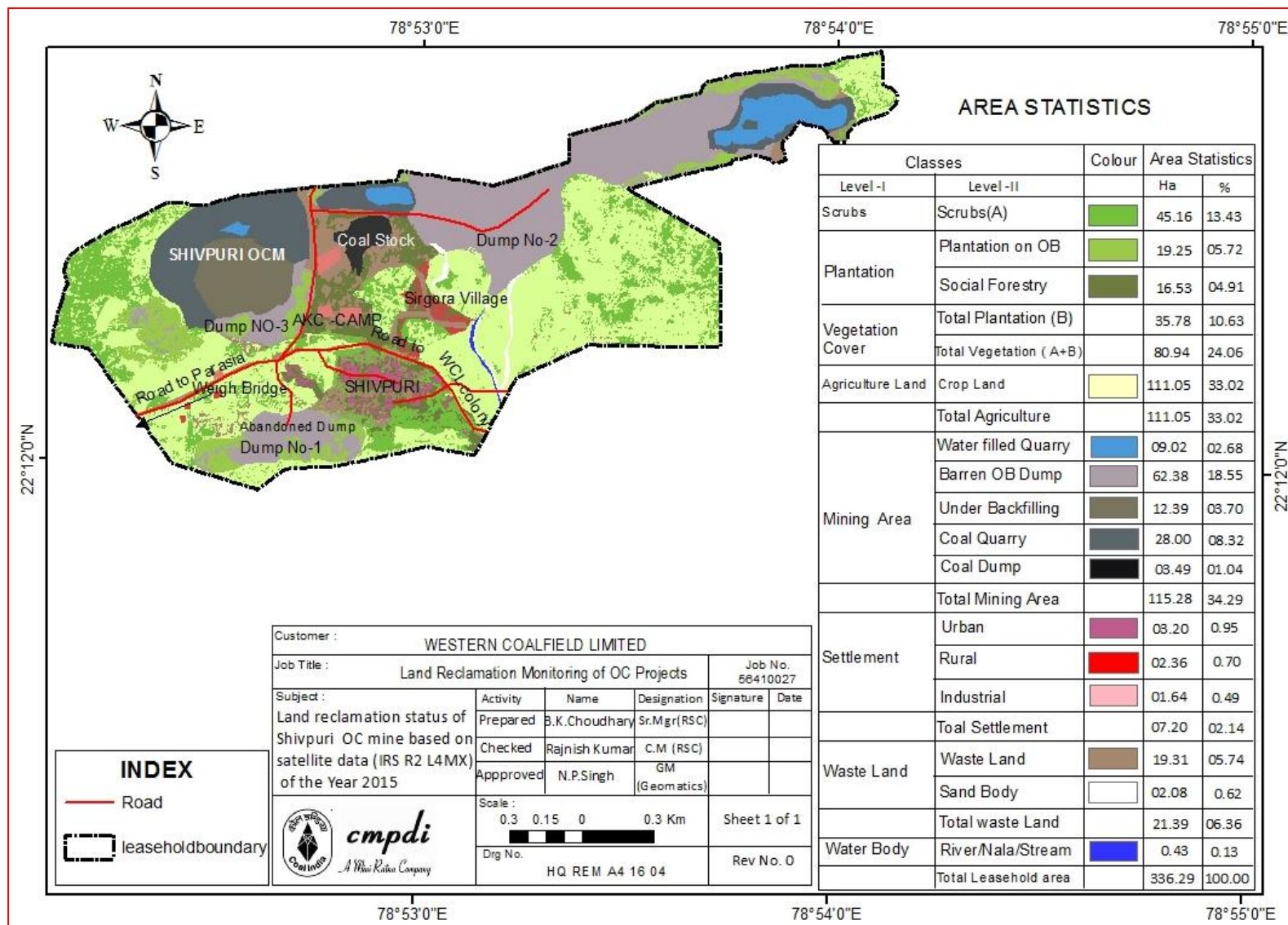


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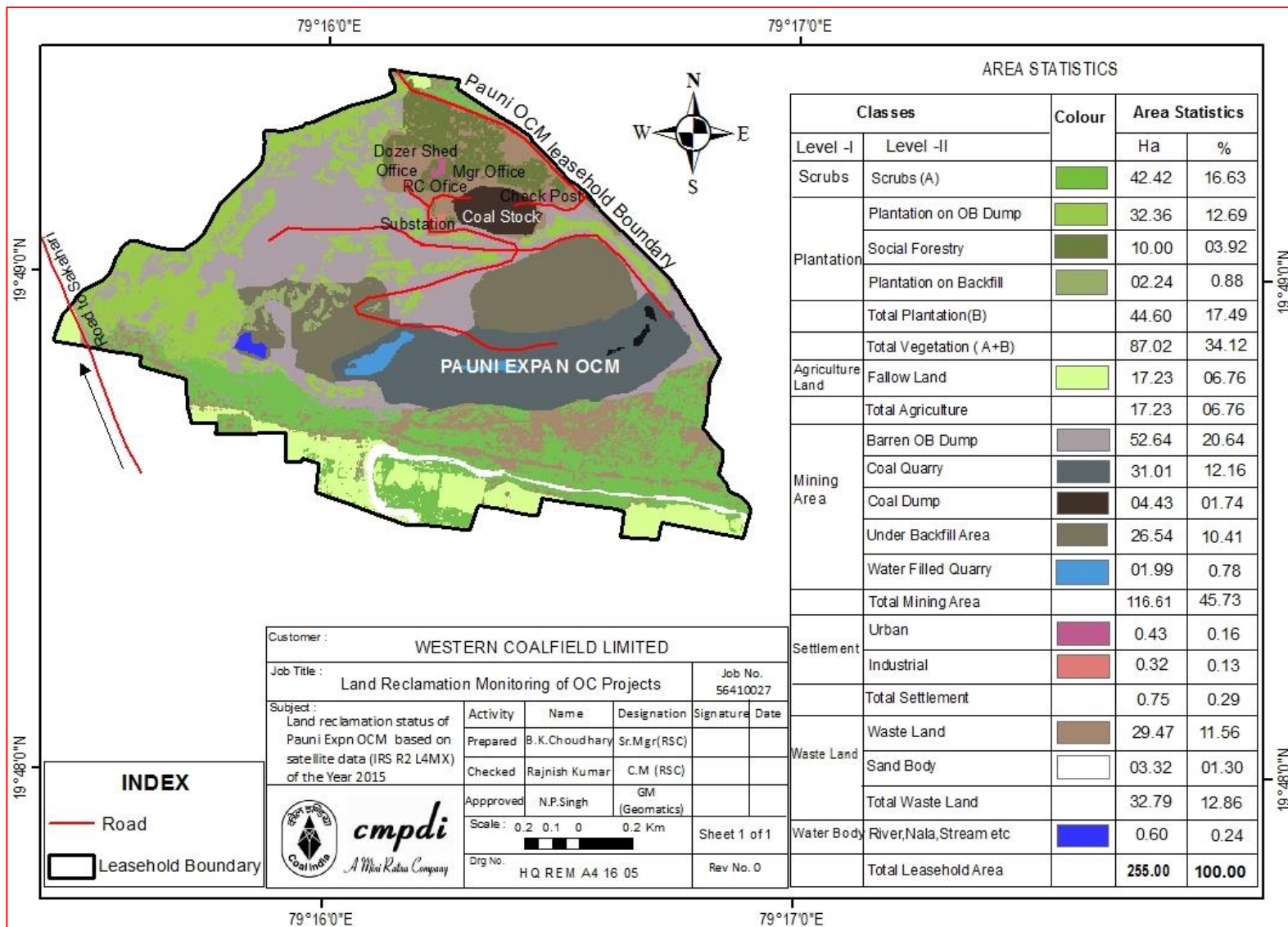
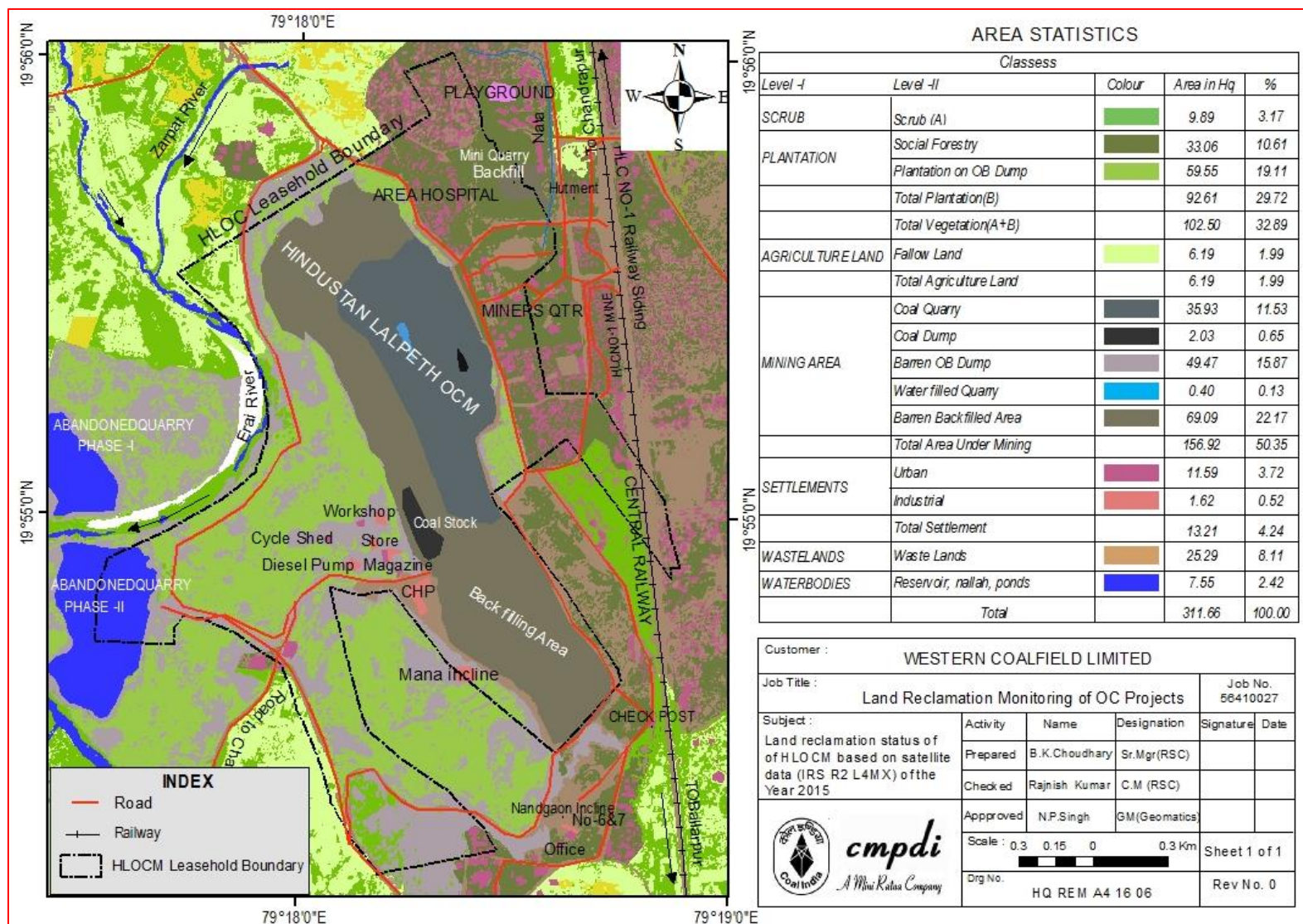


Plate-5



AREA STATISTICS

Classess		Colour	Area in Hq	%
Level -I	Level -II			
SCRUB	Scrub (A)		9.89	3.17
	Social Forestry		33.06	10.61
PLANTATION	Plantation on OB Dump		59.55	19.11
	Total Plantation(B)		92.61	29.72
	Total Vegetation(A+B)		102.50	32.89
AGRICULTURE LAND	Fallow Land		6.19	1.99
	Total Agriculture Land		6.19	1.99
MINING AREA	Coal Quarry		35.93	11.53
	Coal Dump		2.03	0.65
	Barren OB Dump		49.47	15.87
	Water filled Quarry		0.40	0.13
	Barren Backfilled Area		69.09	22.17
	Total Area Under Mining		156.92	50.35
SETTLEMENTS	Urban		11.59	3.72
	Industrial		1.62	0.52
	Total Settlement		13.21	4.24
WASTELANDS	Waste Lands		25.29	8.11
WATERBODIES	Reservoir, nallah, ponds		7.55	2.42
	Total		311.66	100.00

Customer : WESTERN COALFIELD LIMITED

Job Title : Land Reclamation Monitoring of OC Projects Job No. 56410027

Subject :	Activity	Name	Designation	Signature	Date
Land reclamation status of of HLOC M based on satellite data (IRS R2 L4MX) of the Year 2015	Prepared	B.K.Choudhary	Sr.Mgr(RSC)		
	Checked	Rajnish Kumar	C.M (RSC)		
	Approved	N.P.Singh	GM(Geomatics)		

Scale : 0.3 0.15 0 0.3 Km Sheet 1 of 1

Org No. : HQ REM A4 16 06 Rev No. 0

Plate-6

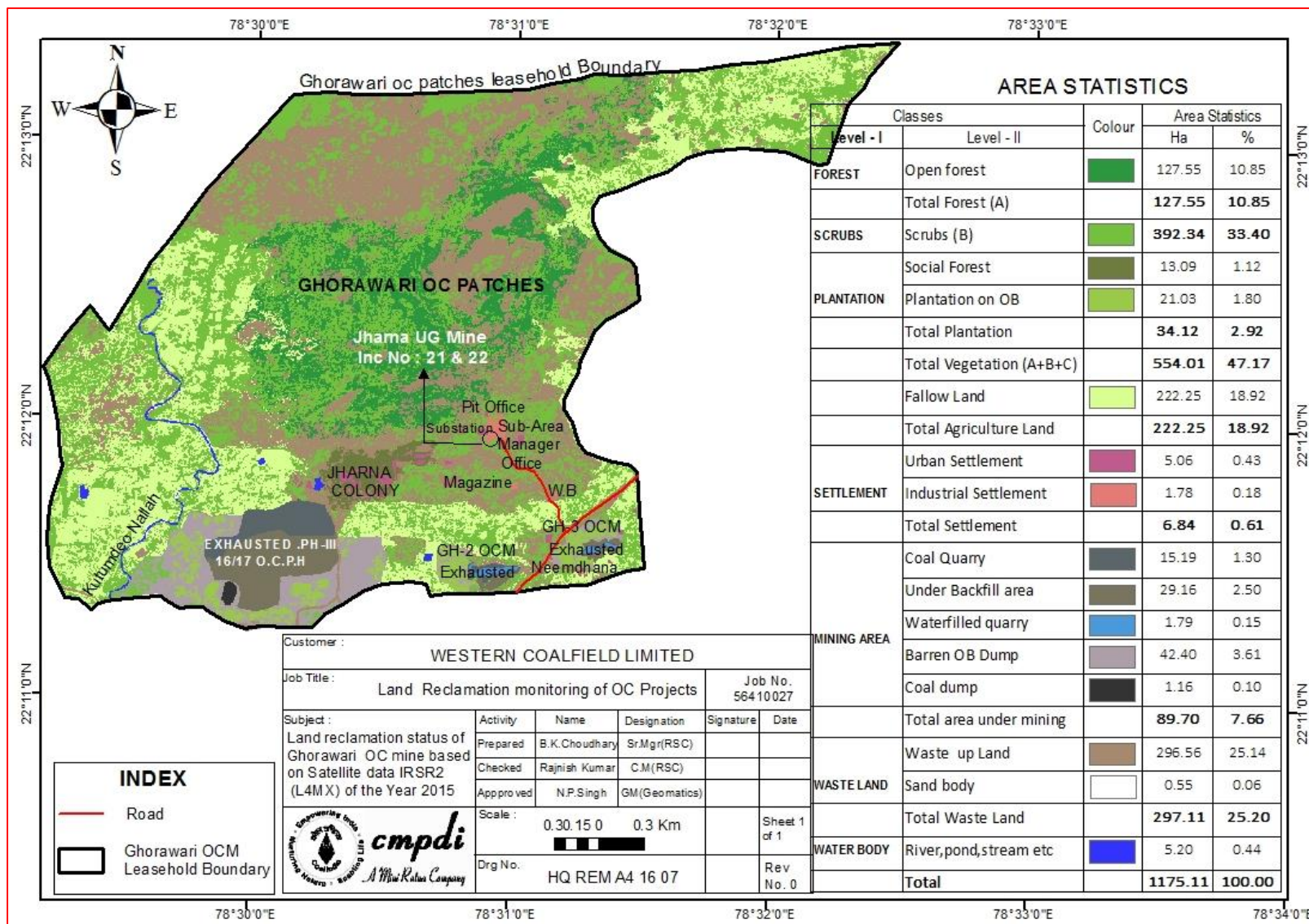


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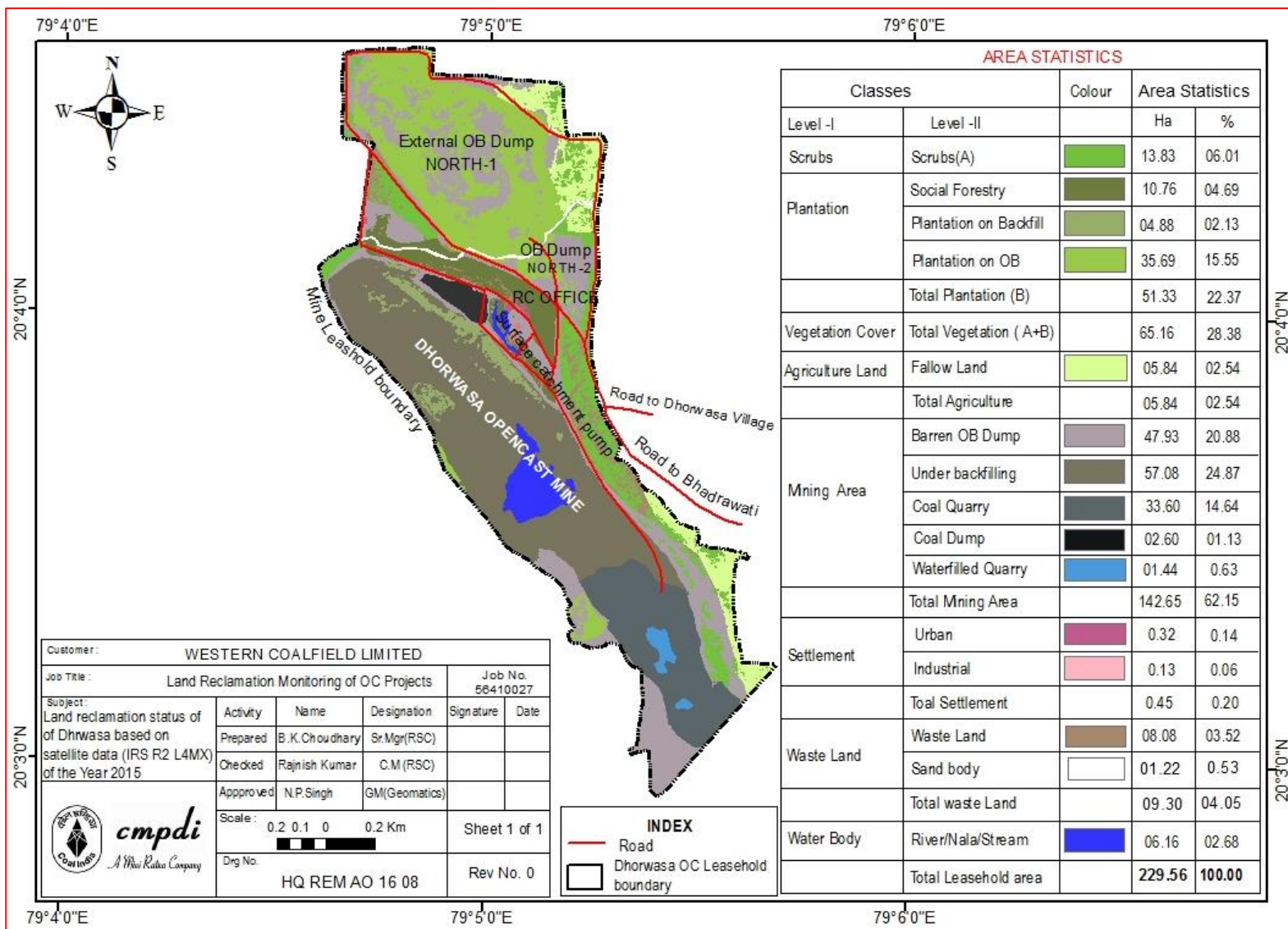


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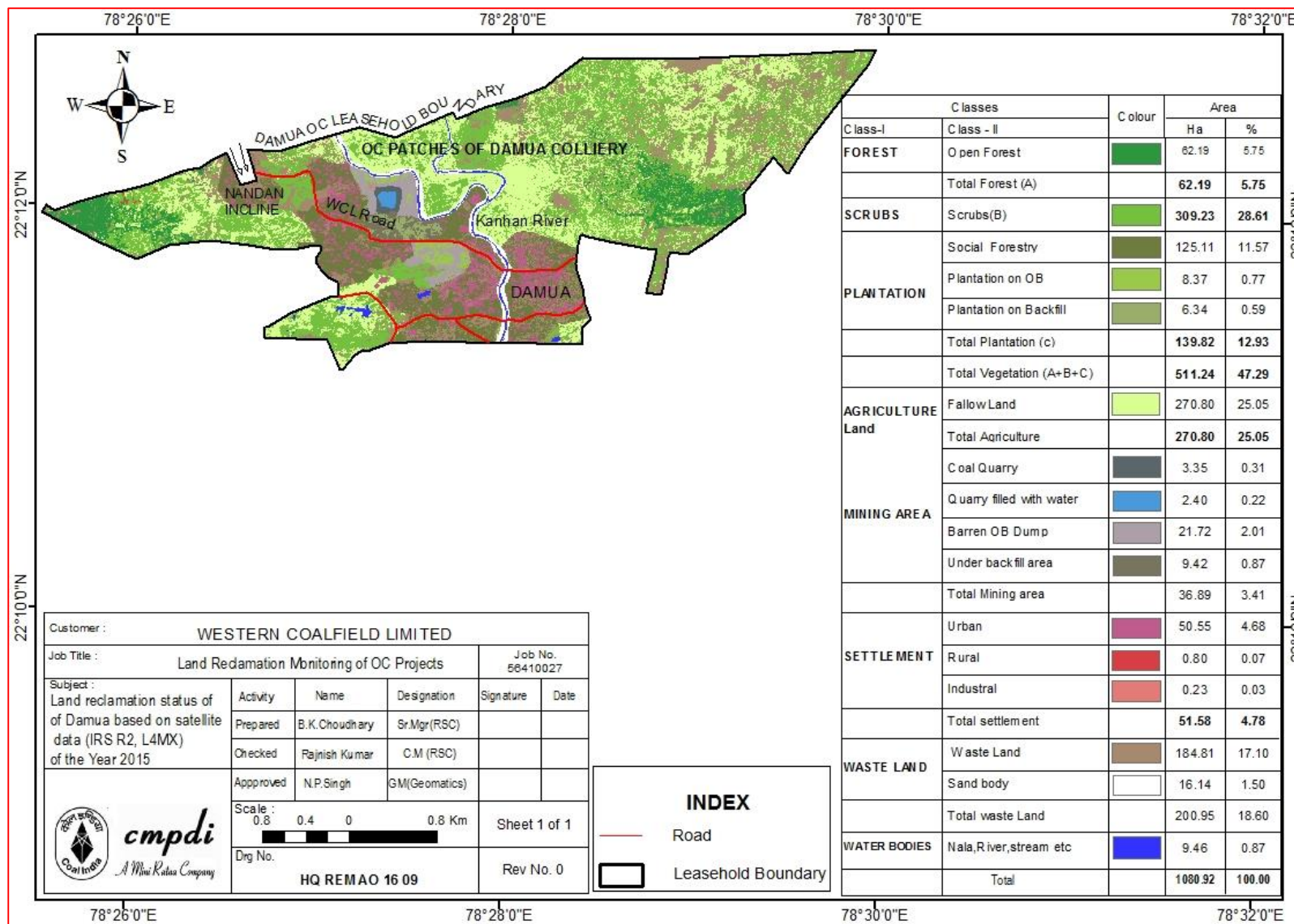


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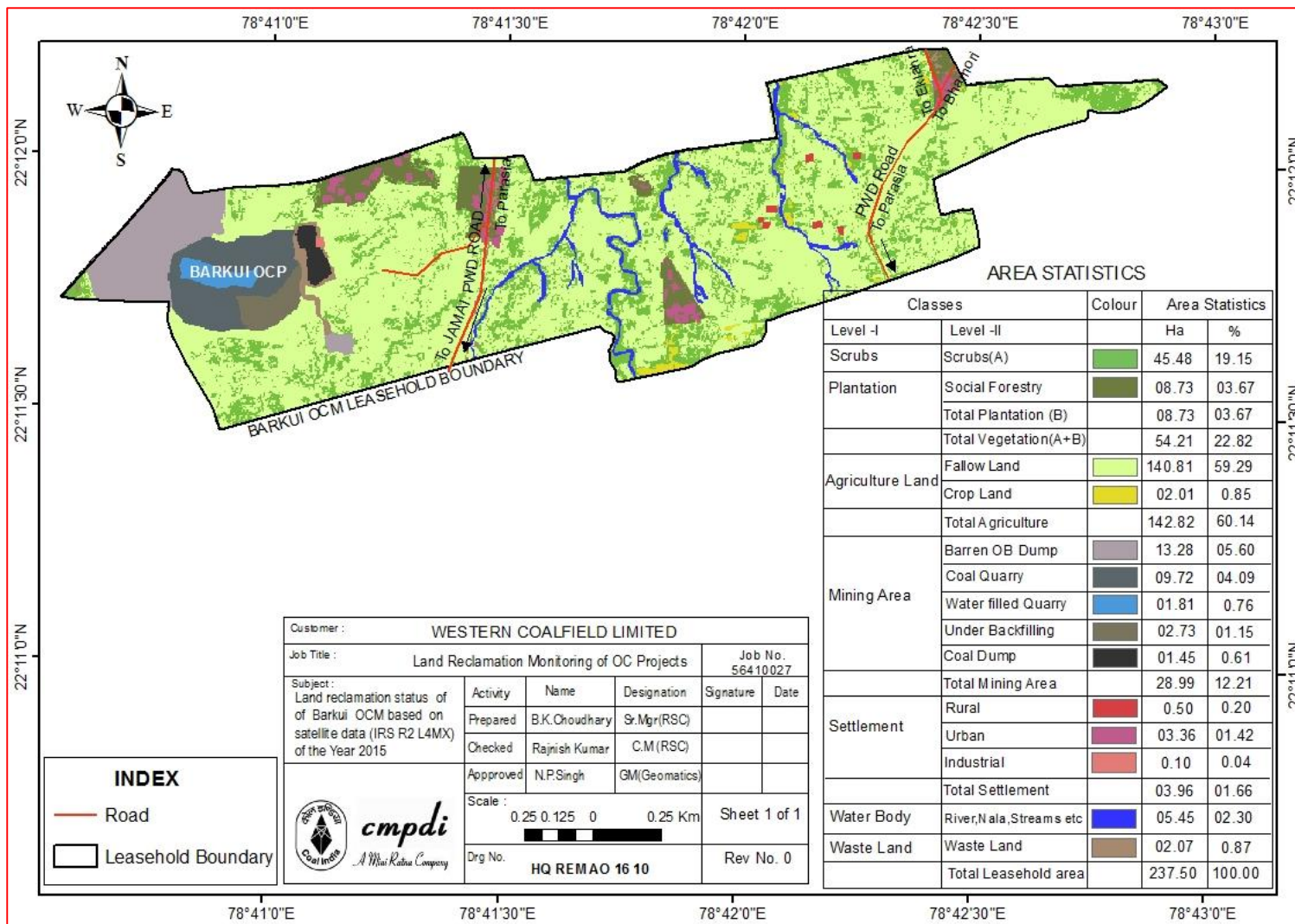
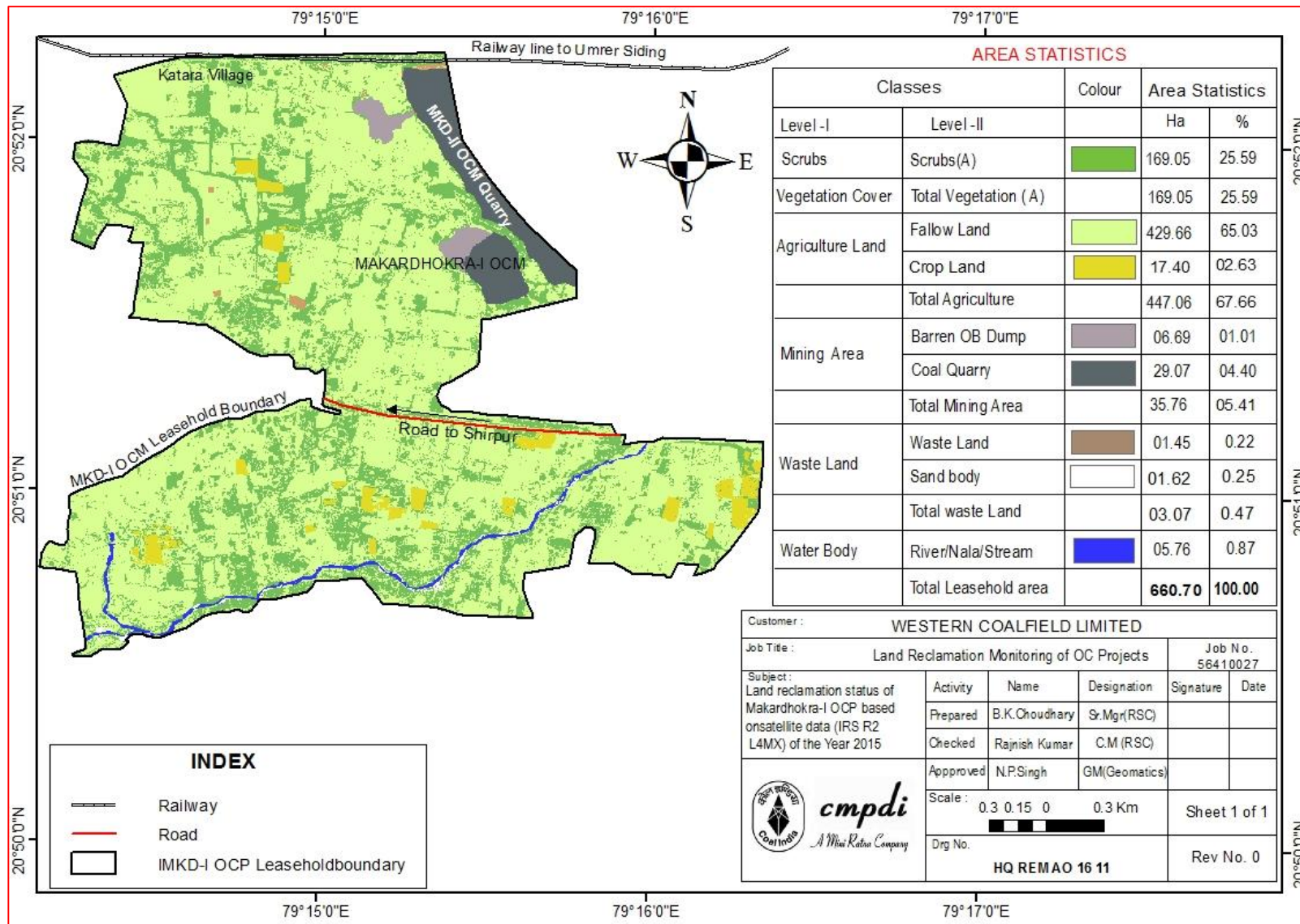


Plate-10



AREA STATISTICS

Classes		Colour	Area Statistics	
Level -I	Level -II		Ha	%
Scrubs	Scrubs(A)		169.05	25.59
Vegetation Cover	Total Vegetation (A)		169.05	25.59
Agriculture Land	Fallow Land		429.66	65.03
	Crop Land		17.40	02.63
	Total Agriculture		447.06	67.66
Mining Area	Barren OB Dump		06.69	01.01
	Coal Quarry		29.07	04.40
	Total Mining Area		35.76	05.41
Waste Land	Waste Land		01.45	0.22
	Sand body		01.62	0.25
	Total waste Land		03.07	0.47
Water Body	River/Nala/Stream		05.76	0.87
Total Leasehold area			660.70	100.00

INDEX

	Railway
	Road
	IMKD-I OCP Leasehold boundary

Customer : WESTERN COALFIELD LIMITED					
Job Title : Land Reclamation Monitoring of OC Projects				Job No. 56410027	
Subject : Land reclamation status of Makardhokra-I OCP based on satellite data (IRS R2 L4MX) of the Year 2015	Activity	Name	Designation	Signature	Date
	Prepared	B.K.Choudhary	Sr.Mgr(RSC)		
	Checked	Rajnish Kumar	C.M (RSC)		
	Approved	N.P.Singh	GM(Geomatics)		
Scale :			Sheet 1 of 1		
Drg No. HQ REMAO 16 11			Rev No. 0		

Plate-11

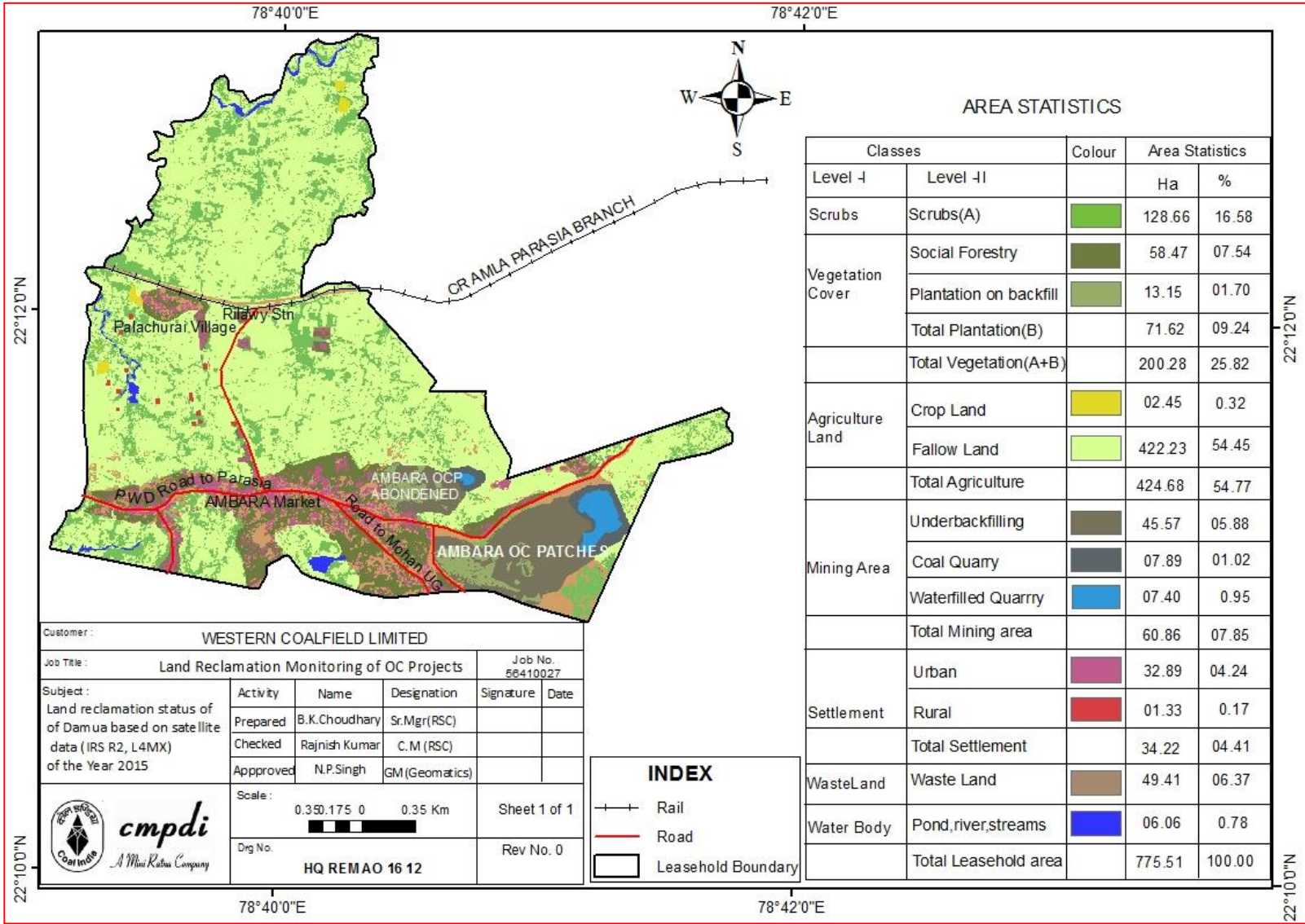


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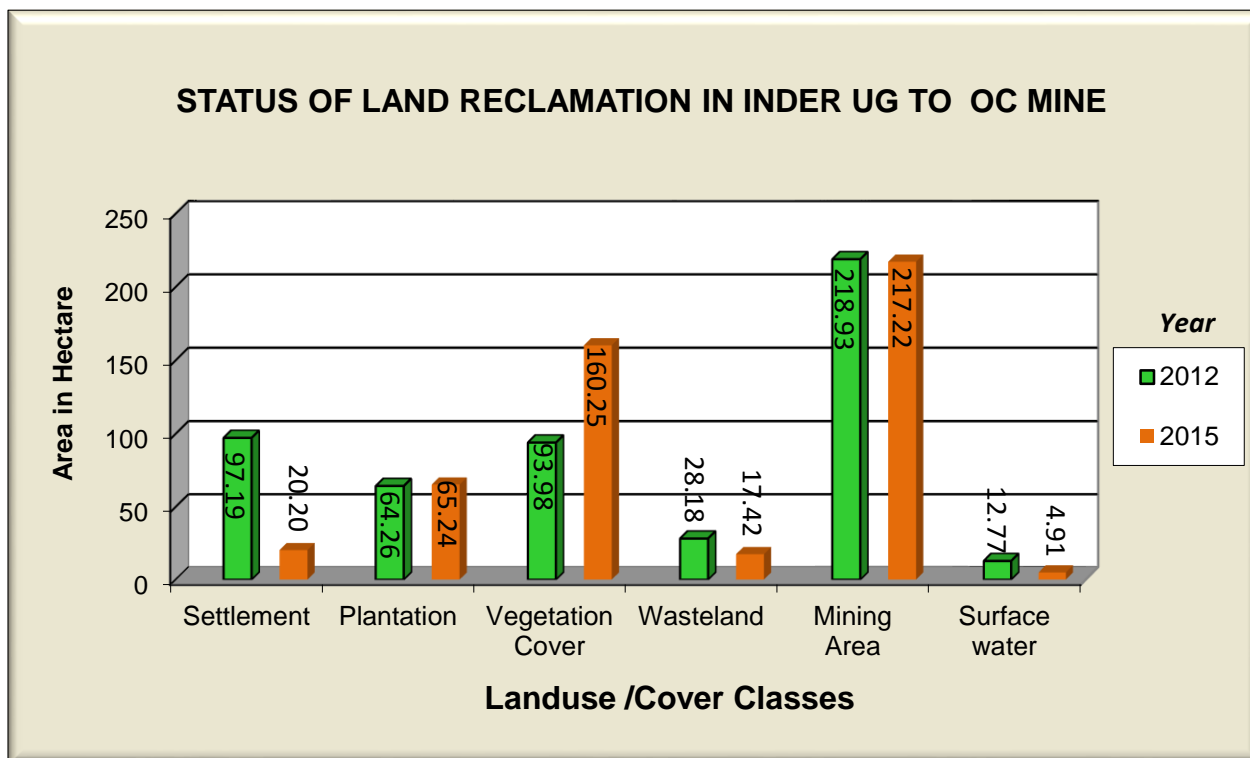


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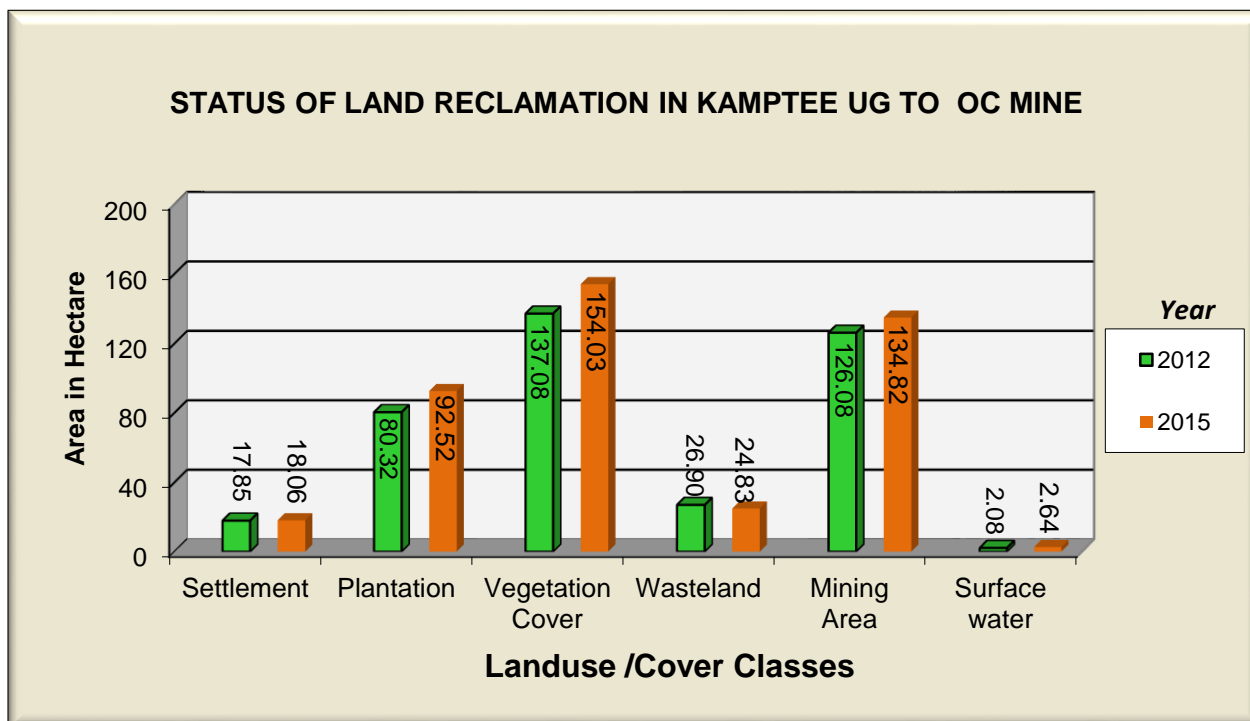


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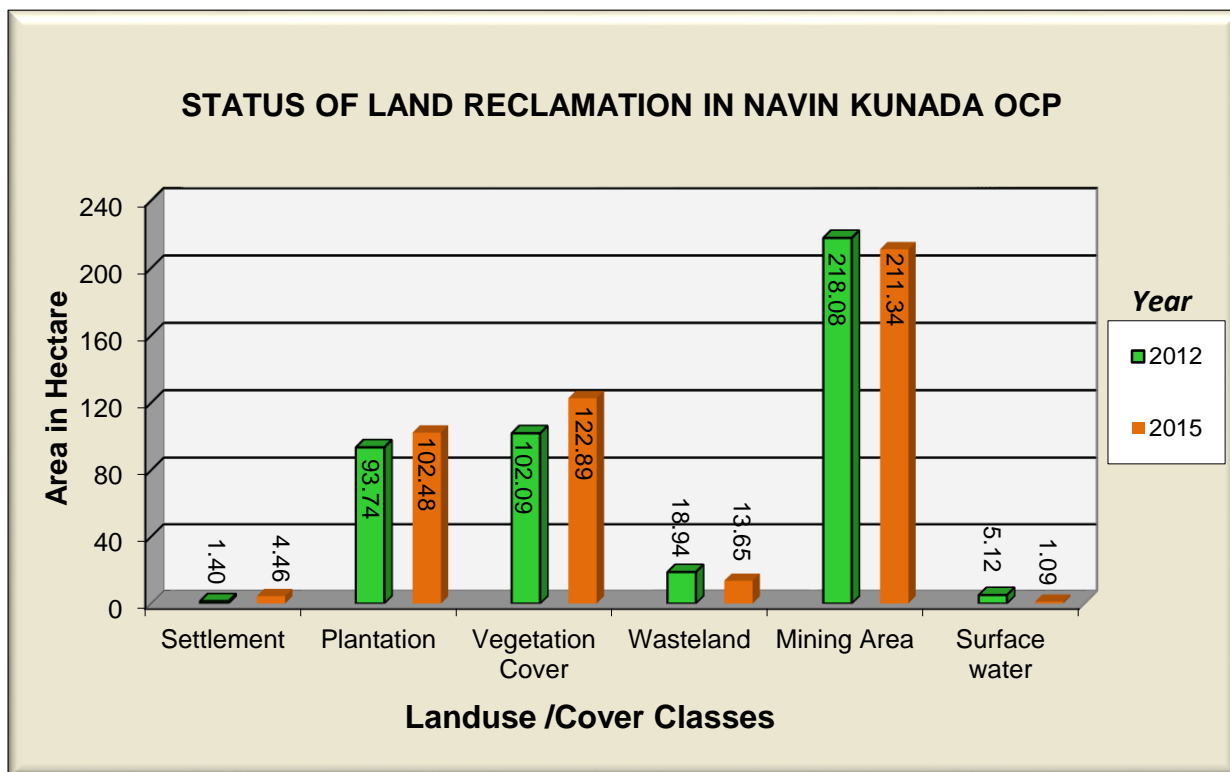


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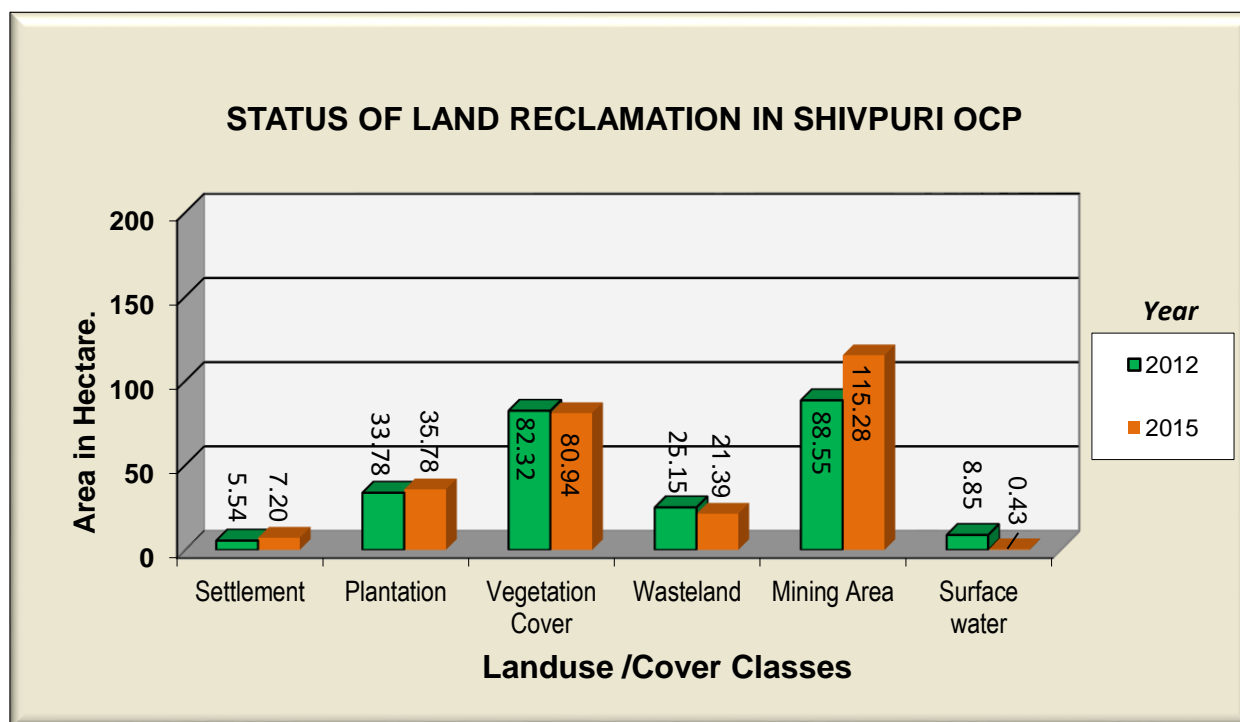


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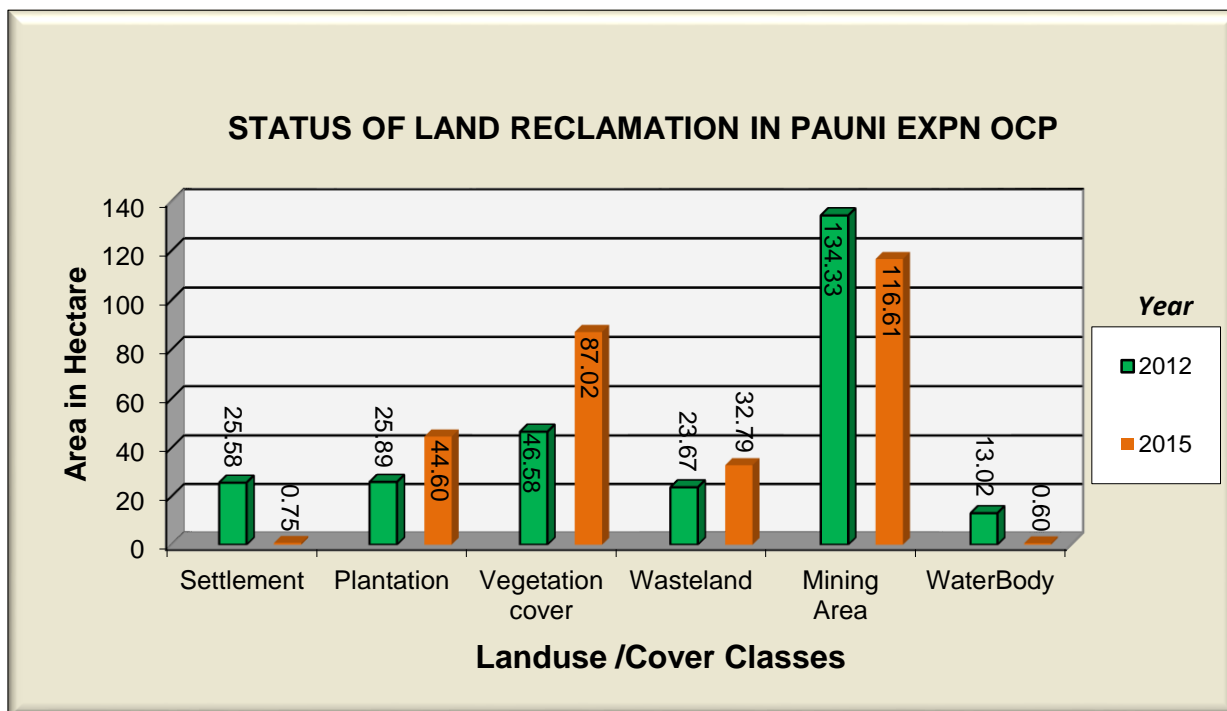


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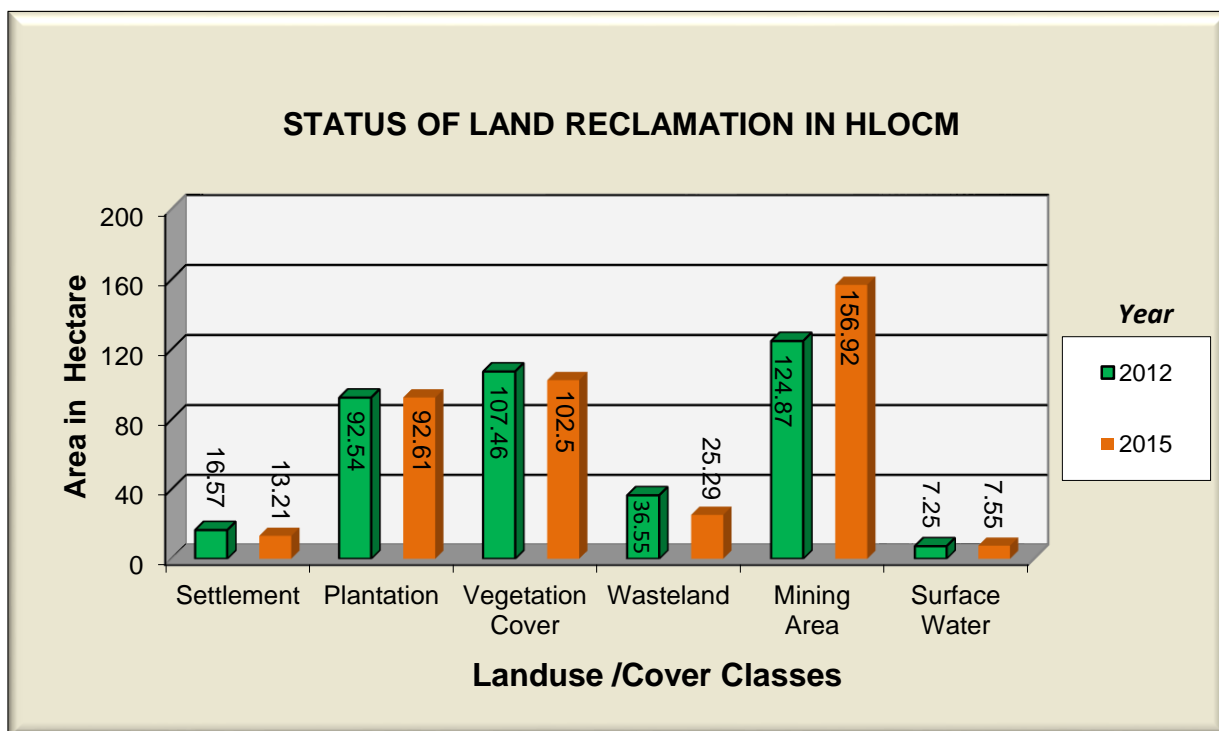


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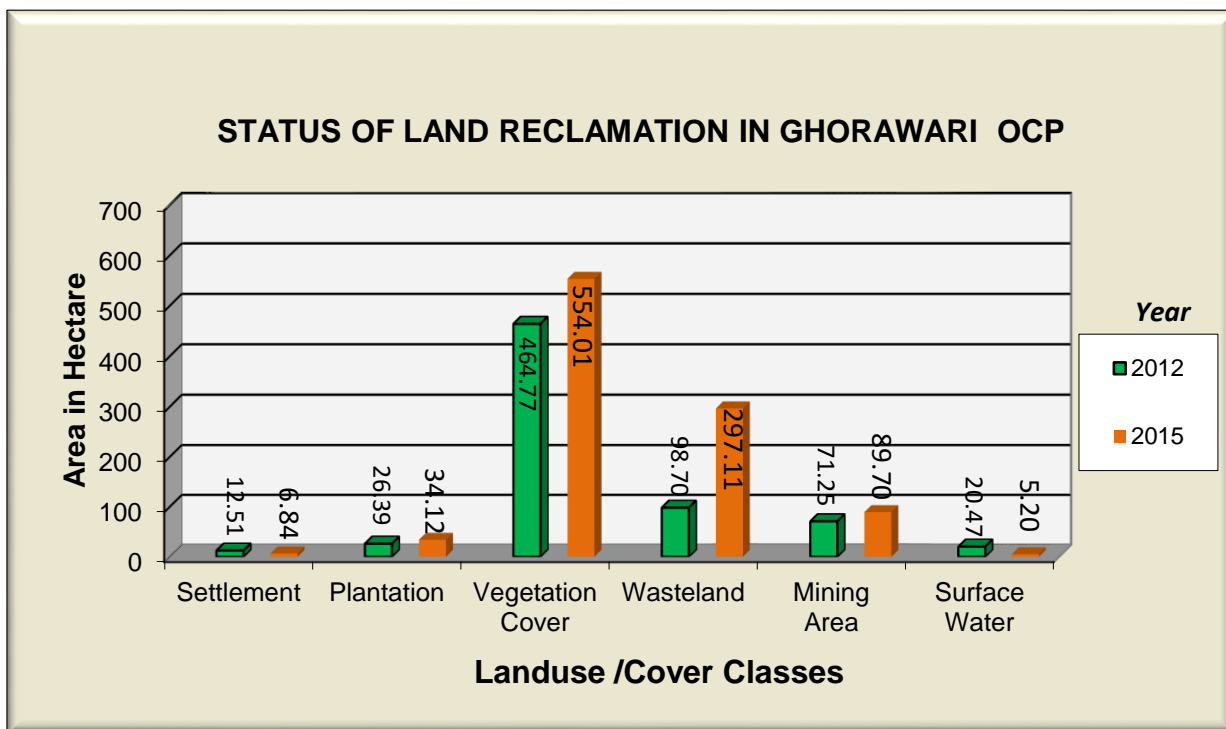


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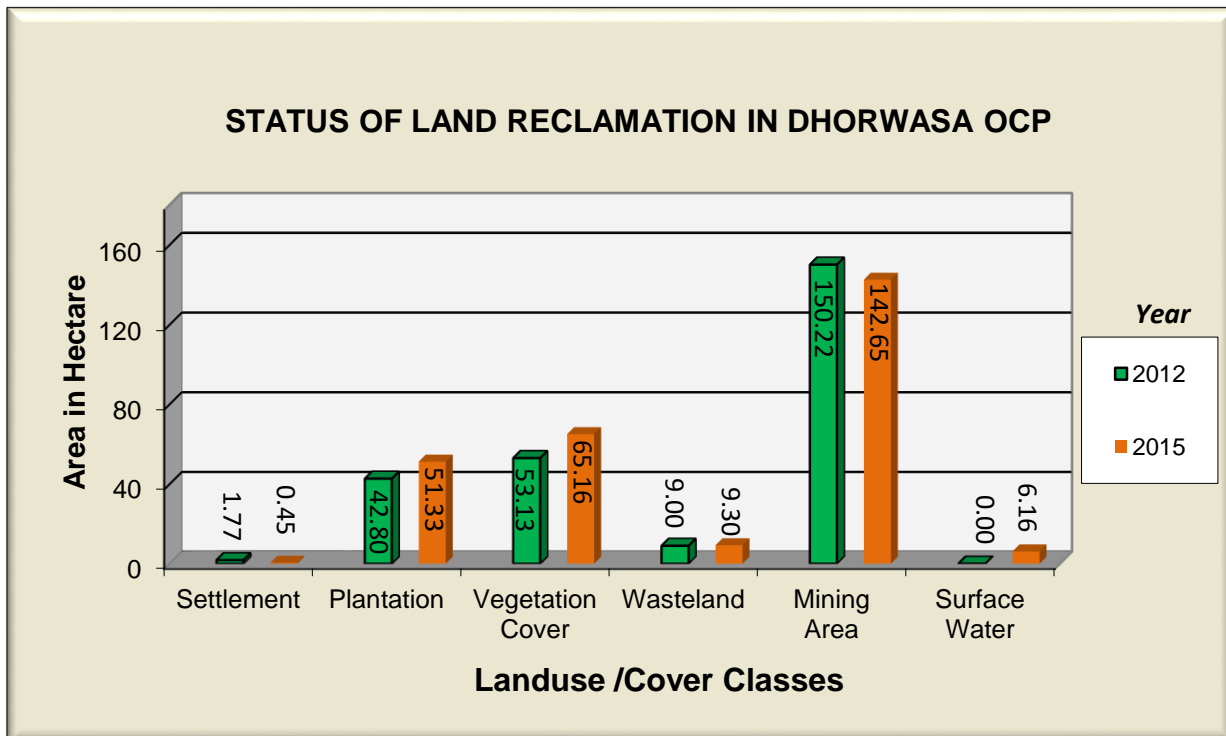


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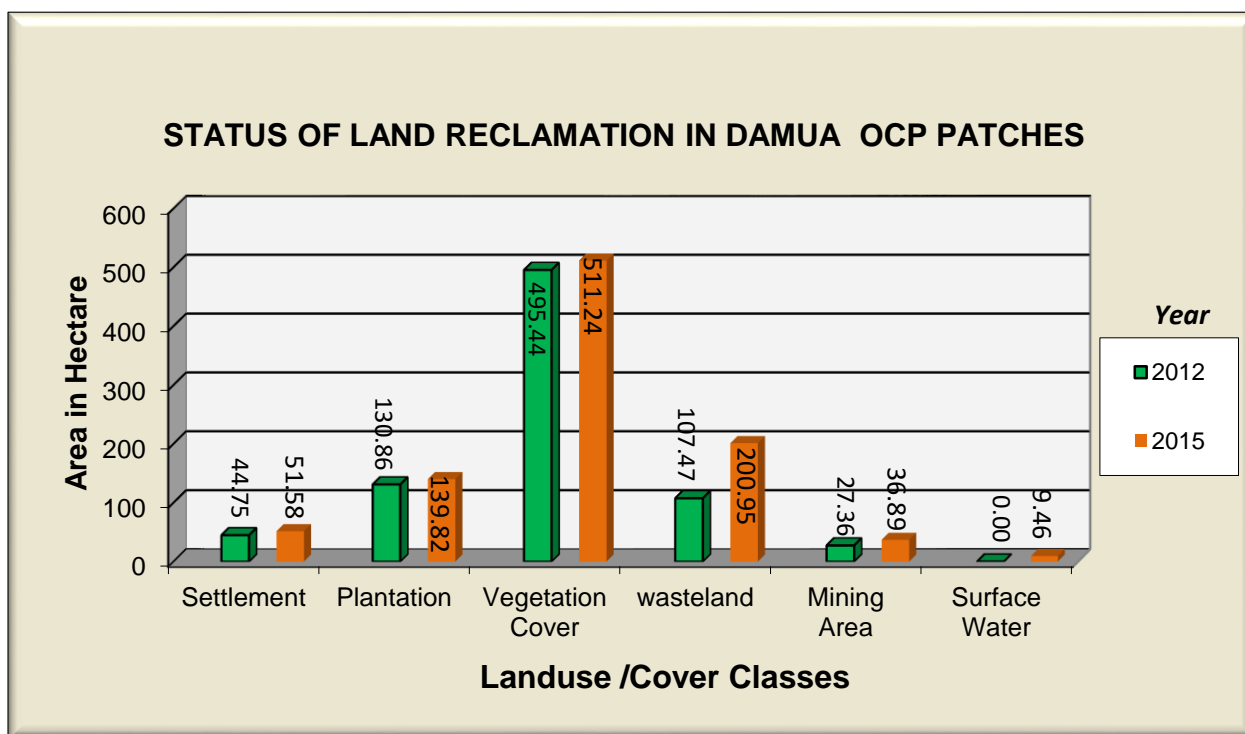


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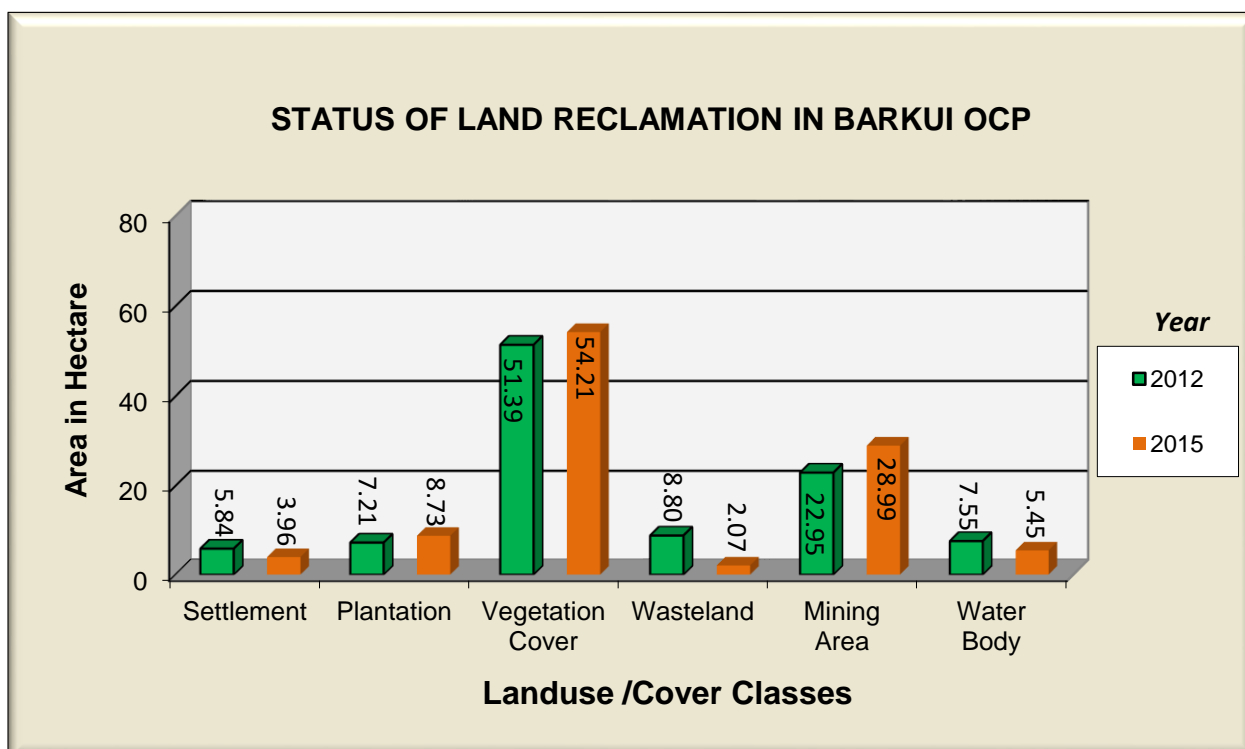


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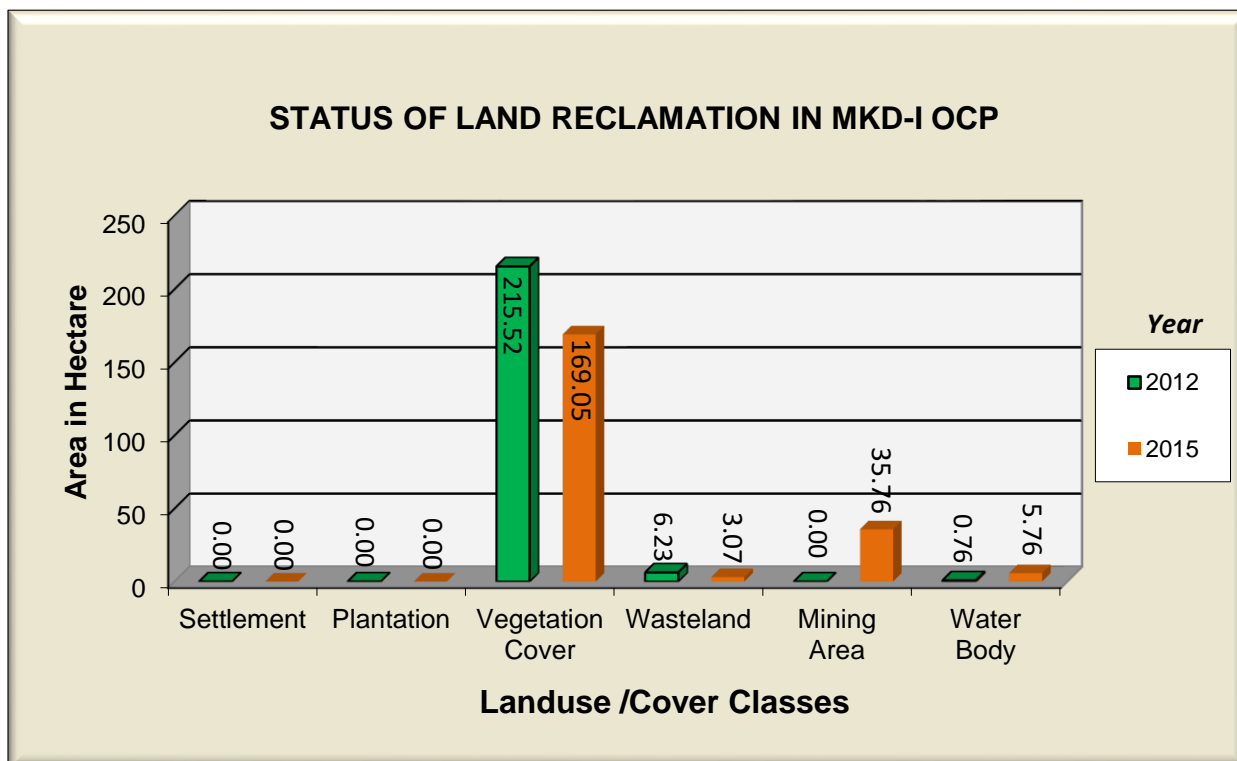


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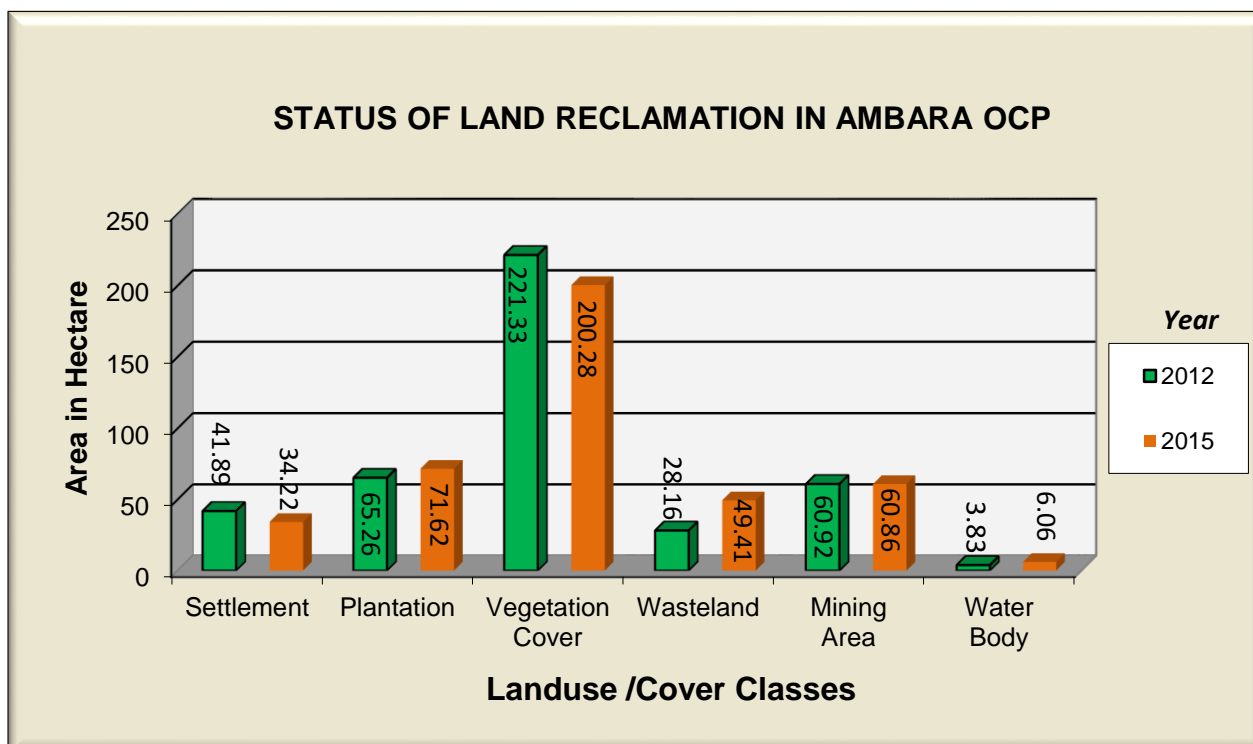
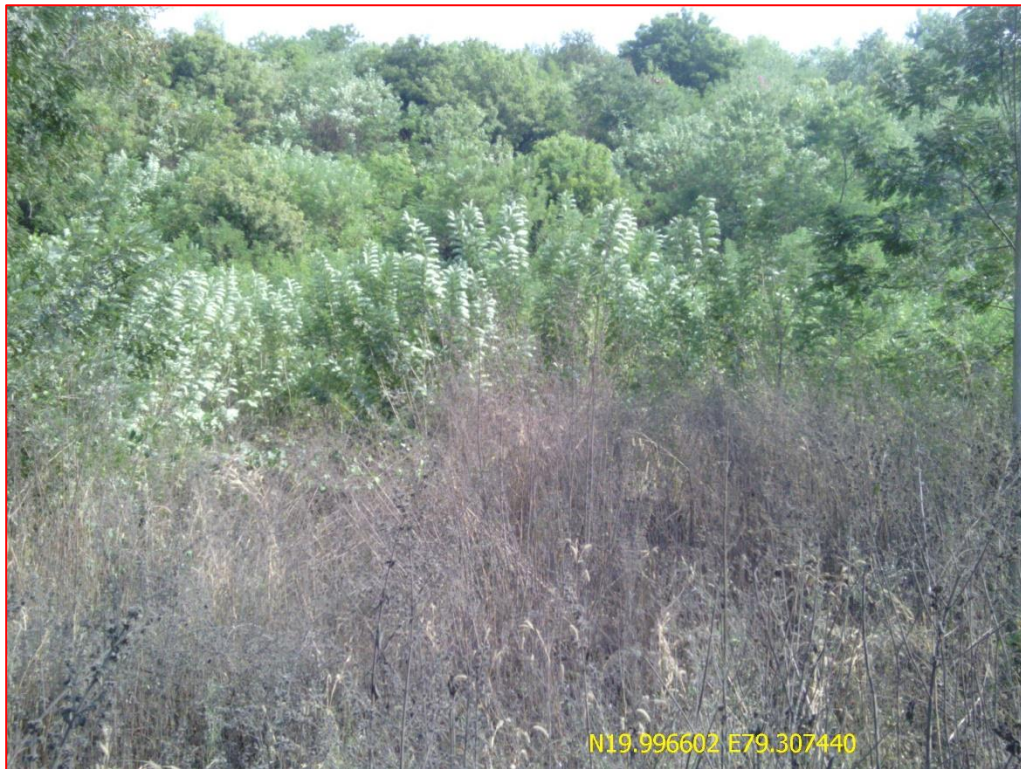


Figure -14



Photograph -1 Plantation on OB Dump in Hindustan Lalpeth opencast mine



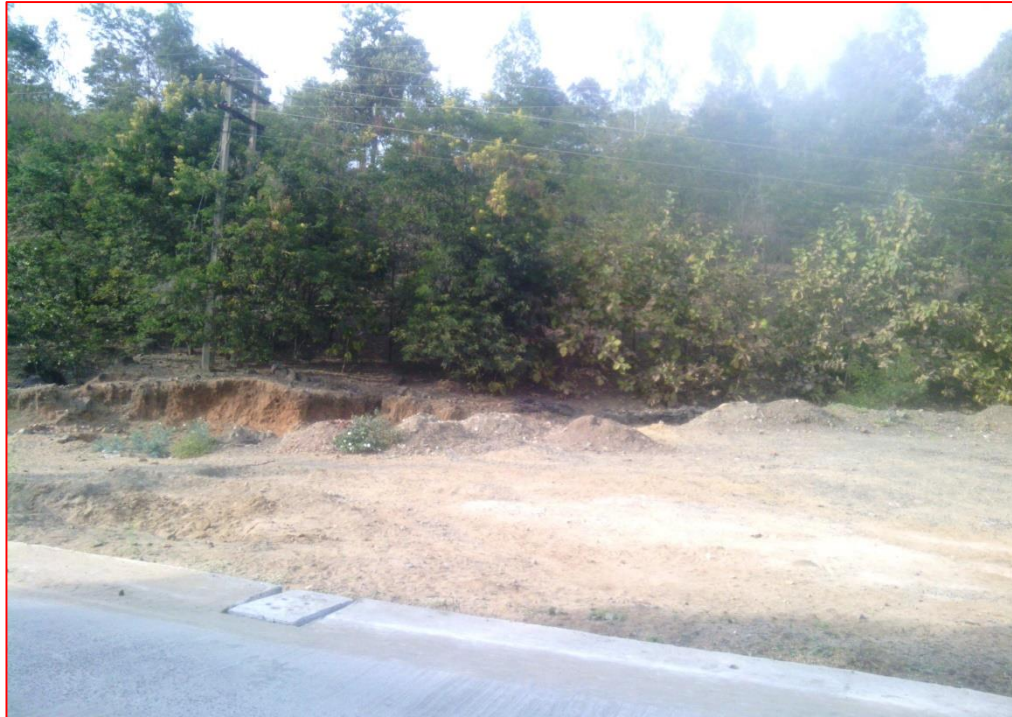
Photograph -2 Plantation on OB Dump in Navin Kunada opencast mine



Photograph 3- Plantation on OB carried out in Dhorwasa open cast mine



Photograph 4- Plantation carried out under Social Forestry in MKD-1 OCP



Photograph 5- Plantation Carried out under Social Forestry in Damua OCP



Photograph 6- Plantation carried out on backfilled area in Pauni expn OCP



Photograph 7: Planatation carried out under Social Forestry in Ambara OCP



Photograph 8- Plantation carried out under Social forestry in Ghorawari OCP



Photograph-9 Backfilling is in progress in Ghorawari oc patched in Kanhan Area



Photograph10: Plantation on backfilling area in Navin-Kunada OCM



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