

Ref. ACH/EMD/F-20/05(01)/2020

28 May, 2020

**Dr. Bhardwaj Adiraju,
MoEF&CC,
Regional Office (NCZ), 25
Subhash Road,
Dehradun – 248001.**

Sub: Compliance Status for Expansion of Kashlog Limestone Mining Project of M/s Gujarat Ambuja Cement Ltd. Located in parts of Village(s) Kashlog, Mangu, Pati, Chola, Gyana, Rauri and Sangoi, Tehsil Arki, District Solan, Himachal Pradesh- environmental clearance reg. – J- 11015 /200/2005-IA.II (M) for the period from October, 2019 to March, 2020.

Dear Sir,

Please find the enclosed point-wise compliance of Specific and General Conditions of above mentioned Environmental Clearances.

List of tables attached are as below:

1. Gyana Khad water analysis report is enclosed as table – 1.
2. Results of Ambient Air Quality monitored at 4 locations in mines area are given in table- 2.

List of annexure attached are as below:

1. Expenditure details for Environmental Protection activities- annexure 1.
2. Consent compliance Kashlog Limestone Mines- annexure 2.
3. Digital processing of land area report - annexure 3.

This point wise compliance of specific and general conditions of EC is being forwarded along with relevant/ready reference **photographs & annexures** to your kind goodself in a systematic context, please.

Thanking you,

Yours Faithfully,

For Ambuja Cements Ltd., (Kashlog Limestone Mines)



**(Sandeep Bhimta)
Head, Environment**

CC to:

(i) Zonal Office (North) PICUP Bhawan, Vibhuti Khand, Gomti Nagar, Lucknow - 226 010

(ii) Regional Officer, H P State Pollution Control Board, S.C.F. 6, 7 and 8, Sector – IV, PARWANOO, Distt. Solan (H.P.)

Encl.: (i) As above

(ii) Soft copy through e-mail



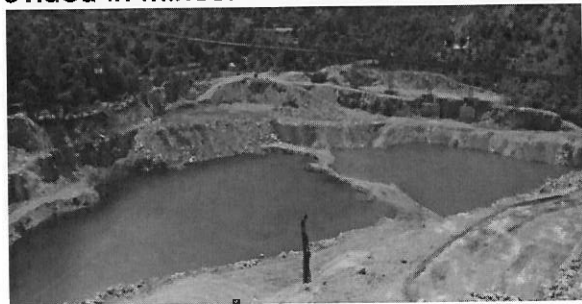
**AMBUJA CEMENTS LIMITED
(UNIT RAURI)**

P. O. Darlaghat - 171 102, Tehsil Arki, Distt. Solan (H.P.)
Phone : 01796-306190, 306468 Fax : 248335, 248316, Website : www.ambujacement.com
(Regd. Off. : P. O. Ambuja Nagar, Taluka - Kodinar, Distt. - Junagarh, Gujarat - 362715)


**COMPLIANCE OF CONDITIONS LAID DOWN BY MoEF IN NOC GRANTED FOR THE EXPANSION OF
KASHLOG LIMESTONE MINES OF AMBUJA CEMENTS LIMITED (3.3-5.5MTPA)
J-11015 /200/2005-IA.II (M)**

Sr. No.	STIPULATION	ACTION
2A. Specific Conditions		
(i)	All the conditions stipulated by the State Pollution Control Board in their Consent should be effectively implemented.	Implemented.
(ii)	The project proponent shall obtain prior approval of the Chief Wildlife Warden before enhancing the production from the mine.	Necessary permission / No Objection Certificate for increase in the rate of limestone extraction from the existing Mining Lease area located in parts of village(s) Kashlog, Mangu, Pati Chola, Gyana, Rauri and Sangoi has been obtained.
(iii)	The project proponent shall obtain requisite forestry clearance for diversion of entire forestland involved in the project from the competent authority prior to start of enhanced production from the mine. No mining work shall be carried out in the forest area for which forestry clearance has not been obtained.	Required Forestry clearance for diversion of forestland has been obtained.
(iv)	The project proponent should prepare a comprehensive plan to combat environmental degradation including landslide keeping in view the location of mine in seismically active zone IV and landslide prone zone. The proponent should identify critically degraded areas in terms of hectares and prepare the area maps along with time bound action plan for their improvement including details of protective structures using perennial soil binding native grass species, shrubs and tree species and earmark separate budgetary provision for this activity. Details in this regard shall be submitted to this Ministry and its Regional Office located at Chandigarh within 3 months.	A comprehensive plan to combat environmental degradation has been made and submitted vide our office letter No. ACH/EMD/F-13/01-70 dated 31 st January 2007.
(v)	The environmental clearance is subject to approval of the State Landuse Department, Government of Himachal Pradesh for diversion of agricultural land for non-agricultural use.	Noted
(vi)	The mining operations shall not intersect groundwater table. Prior approval of the Ministry of Environment & Forests and Central Ground Water Authority shall be	Mining does not intersect ground water.


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	obtained for mining below water table.	
(vii)	<p>Topsoil should be stacked separately at earmarked sites and should not be kept active for long period. It should be used for reclamation and rehabilitation of the mined out areas.</p>	<p>Availability of Topsoil is very less in quantity. However, this quantity of Top soil is being used for plantation.</p>  <p align="center">Top soil stacked separately for reclamation and rehabilitation</p>
(viii)	<p>Catch drains and siltation ponds of appropriate size should be constructed for the working pit, and soil dump to arrest flow of silt and sediment. The water so collected should be utilized for watering the mine area, roads, green belt development etc. The drains should be regularly desilted particularly after monsoon and maintained properly.</p> <p>Garland drain (size, gradient and length) shall be constructed for mine pit and soil dumps and sump capacity should be designed keeping 50 % safety margin over and above peak sudden rainfall (based on 50 years data) and maximum discharge in the area adjoining the mine site. Sump capacity should also provide adequate retention period to allow proper settling of silt material. Sedimentation pits should be constructed at the corners of the garland drains and desilted at regular intervals.</p>	<p>Check dams & check filters have already been provided surrounding to mines area for water quality management. Except these retaining walls and Surface drains etc. are also constructed.</p>  <p align="center">Check Dam/Check Walls</p> <p>To harvest rainwater for ground water recharging three rainwater harvesting reservoirs of capacity 73457m³ have been provided in Mines.</p>  <p align="center">A Rainwater harvesting pond at mines.</p>
(ix)	<p>Dimension of the retaining wall at the OB benches within the mine to check run-off and siltation should be based on the rainfall data.</p>	<p>No Over Burden shall be generated.</p>

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(x)	Plantation shall be raised in an area of 239.06 ha including a green belt around ML area, roads etc. by planting the native species in consultation with the local DFO / Agriculture Department. The density of the trees should be around 2000 plants per ha.	<p>As per the EMP, 239.06 area shall come under plantation once the mining activities area completed in the ML area. This comprises 196 ha of mined and reclaimed area and 43.06 ha of virgin non mineralised area. Out of total ML area of 469.00 ha, post mining, a total of 225 ha area would be available for reclamation and rehabilitation. It has been envisaged to convert 29 ha reclaimed area to water bodies. Rest of the reclaimed areas i.e., 196 ha would be rehabilitated in the form of afforestation and orchards. At the end of mine life, out of the balance 244 ha area which is not amenable for excavation for mineral raising, plantation would be carried out in phases over 43.06 ha of this area while remaining area would remain undisturbed and shall form a part of safety zone and other statutory barriers. As on date, 1 ha out of 196 ha area has been reclaimed and plantation has been done on 7.48 ha out of 43.06 ha. area in consultation with local DFO.</p>  <p align="center">Plantation in Mines</p>
(xi)	Regular monitoring of the flow rate of the springs and perennial nallah will be carried out and records maintained.	Regular monitoring is being carried out and records are maintained. Water quality monitoring reports are enclosed as table 1 .
(xii)	Regular monitoring of ground water level and quality should be carried out by establishing a network of existing wells and constructing new piezometers at suitable locations by the project proponent in and around project area in consultation with Regional Director, CGWB. The frequency of monitoring should be four times a year, pre-monsoon (April / May), monsoon (August), post-monsoon (November), and winter (January). Data	Ground water level and quality monitoring is being carried out by third party (NABL accredited lab). A letter in regard to installation of piezometers & ground water augmentation has already been written to Regional Director, CGWB seeking their advice on the issues vide letter no. ACL:MR:HP:CGWA:2015:1 dated 30-06-2015. A letter from CGWB North has been received vide TC-04/NHR/STI/State/10-643 dated 2/12/2015. Three piezometers

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	thus collected should be sent at regular intervals to MoEF, CGWA and Regional Director, CGWB.	monitoring bores have been installed.
(xiii)	Suitable conservation measures to augment groundwater resources in the area shall be planned and implemented in consultation with Regional Director, CGWB	Regional Director, CGWB is being approached to suggest conservation measures vide letter no. ACL:MR:HP:CGWA:2015:1 dated 30-06-2015. A letter from CGWB North has been received vide TC-04/NHR/STI/State/10-643 dated 2/12/2015. Three piezometers monitoring bores have been installed.
(xiv)	Only wet drilling shall be adopted. Drills should either be operated with dust extractors or equipped with water injection system.	Being complied.
(xv)	Blasting operation should be carried out only during the daytime. Controlled blasting should be practiced. The mitigative measures for control of ground vibration and to arrest fly rocks and boulders should be implemented.	<p>(a). Blasting operation is being carried out in daytime only.</p> <p>(b). We use IKON digital energy control system to blast in critical areas. This system is more precise and accurate and generates less ground vibrations, fly rock and give better fragmentation.</p> <p>Advanced controlled blasting technique is practiced such as use of NTD, Excel, muffled blasting, optimum quantity of blasting material are practiced to avoid dust generation, fly rock, noise level and ground vibration because of the activity.</p> <p>Secondary blasting is avoided by use of hydraulic breaker.</p>  <p align="center">Hydraulic Breaker</p>
(xvi)	Minerals handling plant should be provided with adequate number of high efficiency dust extraction system. Loading and unloading areas including all transfer points should also have efficient dust control arrangements. These should be properly maintained and operated.	Minerals handling plant are being provided with bag filters. Bag filters are attached at all the transfer points to arrest the dust. The dust so collected is automatically recycled in the process.
(xvii)	Vehicular emissions should be kept under control and regularly monitored. Measures	Regular maintenance of vehicles is carried out to keep vehicular emission under

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	shall be taken for maintenance of vehicles used in mining operations and in transportation of mineral. The vehicles should be covered with a tarpaulin and shall not be overloaded.	control. PUC monitoring of the vehicles is done regularly. Raw material is fed to the crusher located within the mine from which it is sent to plant through fully covered Overland Belt Conveyor. So, vehicles are not required to be covered.
(xviii)	The project proponent should take all precautionary measures during mining operation for conservation and protection of endangered fauna such as leopard, wild dog etc. reported in the study area. Action plan for conservation of flora and fauna shall be prepared and implemented in conservation with the State Forest and Wildlife Department. Necessary allocation of funds for implementation of the conservation plan shall be made and the funds so allocated shall be included in the project cost. Copy of action plan may be submitted to the Ministry and its Regional Office within 3 months.	Wildlife Conservation Plans have been prepared in consultation with State Forest & Wildlife Department and the same are authenticated by PCCF (Wildlife) vide letters dated WL(Misc)-73/Mining/VI/8295 dated 14/1/2014 and WL(Misc)-73/Mining/VI/7473 dated 24-12-2013. The allocated necessary funds for the purpose have already earmarked in the Conservation plan and Rs. 97,10,000/- (Rupees ninety seven lakh ten thousand only) have already been submitted for the wildlife conservation activities vide letter no. ACL/CORP. AFFAIRS/WL CESS/2015 Dated 17-01-2015. Rs 47.90 lacs has been submitted as part of commitment in WLCP to State Wildlife Forest Deptt. through CAMPA Account (RTGS) on 18/03/2016 for year 2016. Recently we have submitted Rs 10 lacs to State State Wildlife Forest Deptt. through CAMPA Account. Total amount submitted Rs. 1.55 crores for WLCPs.
(xix)	Digital processing of the entire lease area using remote sensing technique should be done regularly once in three years for monitoring land and pattern and report submitted to MoEF and its regional office.	Digital processing of the lease area is enclosed as annexure 3.
(xx)	Land oustees should be rehabilitated as per the Resettlement and Rehabilitation plan approved by the Government of Himachal Pradesh.	Land oustees are being rehabilitated as per the Resettlement and Rehabilitation plan approved by the Government of Himachal Pradesh.
(xxi)	Consent to operate should be obtained from SPCB before starting enhanced production from the mine.	Consent to operate has been granted by HPSPCB.
(xxii)	Sewage treatment plant should be installed for the colony. ETP should also be provided for workshop and mineral separation plant wastewater.	Sewage treatment plant has been provided for colony. Being a dry process no effluent is generated however a settling tank and oil & grease trap has been provided for workshop.
(xxiii)	A Final Mine Closure Plan along with details of Corpus Fund should be	The point has been noted and shall be taken care well within time.

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	submitted to the Ministry of Environment & Forest 5 Years in advance of final mine closure for approval.	
B. General conditions		
(i)	No change in mining technology and scope of working should be made without prior approval of the Ministry of Environment & Forests.	If there is any change in mining technology and scope of working, prior approval shall be taken from Ministry of Environment and Forests.
(ii)	No change in the calendar plan including excavation, quantum of mineral limestone and waste if any should be made.	There is no change. If any, prior approval shall be taken from MoEF.
(iii)	Four ambient air quality - monitoring stations should be established in the core zone as well as in the buffer zone for RPM, SPM, SO ₂ , NO _x monitoring. Location of the stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets and frequency of monitoring should be under taken in consultation with the State Pollution Control Board.	Ambient air quality is being carried out at four locations & reports of the same are being submitted to HPSPCB. Same are enclosed as table 2 .
(iv)	Data on ambient air quality (RPM, SPM, SO ₂ , NO _x) should be regularly submitted to the Ministry including its Regional office located at Chandigarh and the State Pollution Control Board / Central Pollution Control Board.	Data is regularly being submitted to HPSPCB, CPCB and MoEF Dehradun on regular basis.
(v)	Fugitive dust emissions from all the sources should be controlled regularly. Water spraying arrangement on haul roads, loading and unloading and at transfer points should be provided and properly maintained.	<p>To control the fugitive dust emission from various sources we have installed the bag filters. Restricted speed limits for the vehicles inside plant & mines also help to reduce the fugitive dust emission. Water spraying arrangement on haul roads, loading and unloading and at transfer points have been provided and properly maintained.</p>  <p style="text-align: center;">Water Sprinkling on Haul Roads</p>

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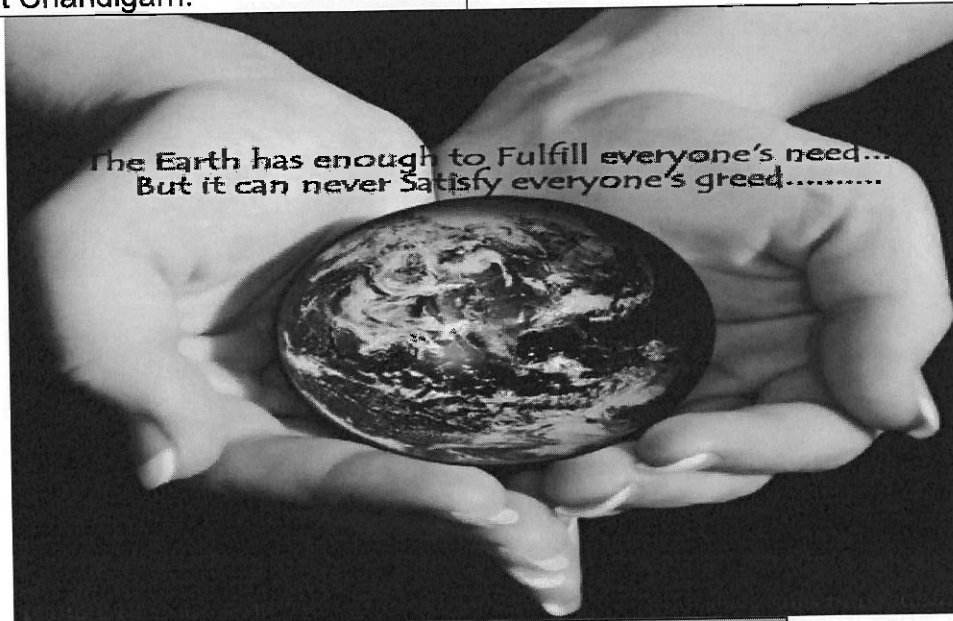
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(vi)	Measures should be taken for control of noise levels below 85 dBA in the work environment. Workers engaged in operations of HEMM, etc should be provided with ear plugs / muffs.	All the precautionary measures have been taken to keep the noise levels within limits. The noise level inside the cabin of HEMM is very low however the workers engaged in operations of HEMM are provided with ear plugs/ muffs.
(vii)	Industrial waste water (workshop and waste water from the mine) should be properly collected, treated so as to conform to the standards prescribed under GSR 422 (E) dated 19 th May, 1993 and 31 st December, 1993 or as amended from time to time. Oil and grease trap should be installed before discharge of workshop effluents.	Settling tank and Oil & Grease Trap has been provided.
(viii)	Personnel working in dusty areas should wear protective respiratory devices and they should also be provided with adequate training and information on safety and health aspects Occupational health surveillance programme of the workers should be undertaken periodically to observe any contractions due to exposure to dust and take corrective measures, if needed.	Company is very much conscious about the occupational health and safety of employees and workers. Different types of health and house keeping programmes are regularly being organized by the company and the records are maintained. All the workers and employees are trained about the use of Personal Protective Equipments. Being a conscious company about the safety of employees the company has its own five cardinal rules for safety which each and everyone have to follow.
(ix)	A separate environment management cell with suitable qualified personnel should be set up under the control of a senior executive, who will directly report to the Head of the Organisation.	(a) A separate Environmental Management Division has already been set up to look after environment related activities. (b) EMS awareness program & other regular eco-green activities are being carried out as per our scheduled targets.
(x)	The project authorities should inform to the Regional Office located at Chandigarh regarding date of financial closures and final approval of the project by the concerned authorities and the date of start of land development work.	The production was started from 28 th March 2010.
(xi)	The funds earmarked for environmental protection measures should be kept in separate account and should not be diverted for other purpose. Year wise expenditure should be reported to the Ministry and its Regional Office located at Chandigarh.	The Funds earmarked for environmental protection measures are taken as a separate budget and six monthly expenditure is reported to the Regional office of MoEF.
(xii)	The Regional Office located at Chandigarh shall monitor compliance of	Officer(s) of Regional Office is/ are always fully co-operated.

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	stipulated conditions. The project authorities should extend full co-operation to the officer (s) of Regional Office by furnishing the requisite data / information / monitoring reports.	
(xiii)	A Copy of clearance letter will be marked to concerned panchayat / local NGO, if any, from whom suggestion / representation has been received while processing the proposal.	A Copy of clearance letter has been marked to concerned authorities.
(xiv)	State Pollution Control Board should display a copy of clearance letter at the Regional Office, District Industry Centre and Collector's Office / Tehsildar's office for 30 days.	-
(xv)	The project authorities should advertise at least in two local newspapers widely circulated, one of which should be in the vernacular language of the locality concerned, within 7 days of the issue of the clearance letter informing that the project has been accorded environmental clearance and a copy of the clearance letter is available with the State Pollution Control Board and also at website of the Ministry of Environment and Forests at http://envfor.nic.in and a copy of the same should be forwarded to the Regional Office of this ministry located at Chandigarh.	Advertisement has been made in two local local news papers, a copy of which has already been submitted to MoEF, Chandigarh.



**Save Environment, Save Earth
FMD- Team ACI Darlaohat**

AMBUJA CEMENTS LIMITED (UNIT-RAURI)

Table -4

Monthly Average of Gyana Khad Water Quality Analysis Report
(From October 2019 to March 2020)

MONTH	SAMPLING POINTS	PARAMETERS			
		pH	TSS	TDS	DO
Oct-19	1	7.4	29.5	327.3	4.5
	2	7.7	47.1	360.5	4.0
	3	7.6	44.1	343.6	4.9
	4	7.4	38.7	335.6	4.8
Nov-19	1	7.4	25.2	312.4	4.9
	2	7.7	39.3	344.5	4.4
	3	7.6	32.8	332.3	5.0
	4	7.4	27.5	322.1	5.2
Dec-19	1	7.3	21.3	309.6	5.0
	2	7.6	38.6	340.3	4.4
	3	7.5	35.2	321.7	5.2
	4	7.4	31.1	322.2	5.5
Jan-20	1	7.4	19.9	294.0	6.6
	2	7.7	39.4	321.1	5.7
	3	7.6	31.1	313.6	6.5
	4	7.5	25.3	306.3	7.2
Feb-20	1	7.3	30.1	304.0	5.3
	2	7.6	49.3	356.7	4.9
	3	7.4	43.9	336.5	5.8
	4	7.5	35.9	321.3	6.0
Mar-20	1	7.4	45.6	301.1	4.6
	2	7.8	59.4	342.9	3.7
	3	7.7	54.1	322.3	4.2
	4	7.4	49.5	313.1	4.8

AVERAGE 7.5 37.2 325.2 5.1

Except pH all the parameters are in mg/lit.

Sampling Points

1. 500mts. Upstream of First Nallah before joining Gyana Khad.
2. 500mts. Upstream of Second Nallah before joining Gyana Khad.
3. V-Notch installed in Gyana Khad. (SE Side of ML Area)
4. 500mts. Downstream from V-Notch of Gyana Khad.

Monthly Average of Ambient Air Quality Monitoring Results Mining Area
(PM 10, PM 2.5, SO₂ and NO_x CONCENTRATION IN µg/m³)
(From Oct 2019 To March 2020)

Table 2

MONTH	Mines Dormitory				Rathoh				Mangoo				Chandi			
	PM 2.5	PM 10	SO ₂	NO _x	PM 2.5	PM 10	SO ₂	NO _x	PM 2.5	PM 10	SO ₂	NO _x	PM 2.5	PM 10	SO ₂	NO _x
Oct-19	28.76	57.53	4.86	10.56	31.24	46.59	5.84	13.00	33.69	58.98	4.96	10.68	29.51	40.46	3.64	8.09
Nov-19	29.35	40.07	5.73	13.00	27.52	63.93	4.94	12.43	18.19	55.35	4.63	9.70	24.48	39.42	4.00	8.36
Dec-19	34.19	67.96	7.04	15.70	36.05	59.91	7.05	15.34	26.91	46.09	6.60	13.28	28.62	56.20	3.50	7.74
Jan-20	31.34	67.21	5.06	8.19	31.15	56.96	4.26	11.20	18.29	54.69	3.85	10.26	21.24	43.94	3.55	7.66
Feb-20	30.17	64.22	5.04	8.09	27.12	64.05	5.38	12.50	22.33	59.77	4.26	9.83	17.53	45.27	3.65	7.57
Mar-20	35.69	51.02	5.28	9.40	26.42	63.97	5.38	11.65	20.49	59.58	4.00	9.92	16.98	54.24	3.65	7.87

Monthly Average of Ambient Air Quality Monitoring Results Mining Area
(Lead, Nickel, Arsenic and CO)
(From Oct 2019 To March 2020)

MONTH	Mines Dormitory				Rathoh				Mangoo				Chandi			
	Lead µg/m ³	Nickel ng/m ³	Arsenic ng/m ³	CO mg/m ³	Lead µg/m ³	Nickel ng/m ³	Arsenic ng/m ³	CO mg/m ³	Lead µg/m ³	Nickel ng/m ³	Arsenic ng/m ³	CO mg/m ³	Lead µg/m ³	Nickel ng/m ³	Arsenic ng/m ³	CO mg/m ³
Oct-19	ND	ND	ND	0.46	ND	ND	ND	0.67	ND	ND	ND	0.52	ND	ND	ND	0.43
Nov-19	ND	ND	ND	0.56	ND	ND	ND	0.78	ND	ND	ND	0.51	ND	ND	ND	0.41
Dec-19	ND	ND	ND	0.78	ND	ND	ND	0.59	ND	ND	ND	0.7	ND	ND	ND	0.52
Jan-20	ND	ND	ND	0.82	ND	ND	ND	0.67	ND	ND	ND	0.58	ND	ND	ND	0.46
Feb-20	ND	ND	ND	0.86	ND	ND	ND	0.58	ND	ND	ND	0.62	ND	ND	ND	0.44
Mar-20	ND	ND	ND	0.9	ND	ND	ND	0.61	ND	ND	ND	0.58	ND	ND	ND	0.42

Environmental Expenditure – RAURI and Kashlog Limestone Mines(Oct 2019 - Mar 2020)

Sr. No.	Environmental Expenditure Area	Capital/Recurring	Amount(Rs)
1	Air pollution control equipments maintenance(Bag Filters etc.), STP maintenance, Analyzers and other monitoring equipments maintenance.	Recurring	67,68,909
2	Monitoring and analysis of environmental parameters, studies, purchase of small new equipments, plantation, fees, salaries & Site cleaning etc.	Recurring	44,98,033
3	Air pollution control equipments running expenses	Recurring	3,15,81,184
4	Mines – construction of check dams/ check filters, Toe walls etc, Water spraying on haul roads, use of IKON, plantation, soil conservation works, water harvesting etc.	Recurring Capital	15,63,972 3,47,636
5	Depreciation on Environmental assets	Capital	4,32,05,354
6	Community development works	Recurring Capital	2,98,99,459 9,13,406

Total Capital Cost: - Rs 4,44,66,396/-

Total Recurring Cost:- Rs 7,43,11,557/-

Total Cost Recurring + Capital Cost :- Rs 11,87,77,953/-

(Rs. Eleven Crore Eighty Seven Lakh Sevnty Seven Thousand Nine Hundred Fifty Three only)

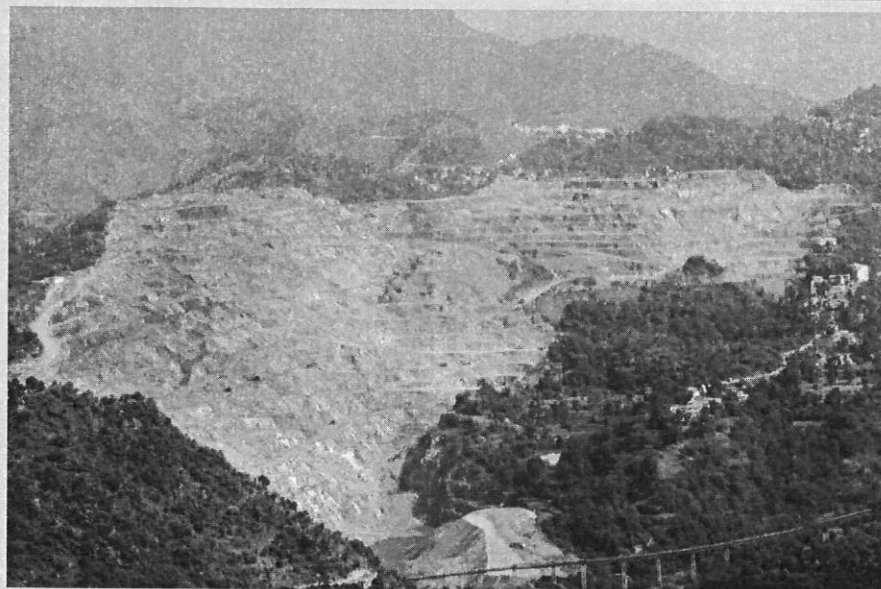
Compliance of Renewal of Consent conditions imposed by HPSPCB Kashlog Limestone Mines – 7.6
MTPA - No HPSPCB/PCBID-10920/16427-29 dated 17/09/2018

S.No.		
1.	<p>This Consent /Renewal of Consent is for</p> <p>a) The emission conforming to the norms as prescribed in schedule-1 of environment (protection) Rules, 1986 as may be prescribed by the Board.</p> <p>b) Noise and ambient air quality to be maintained within Ambient Air Quality Standards for Noise as specified in schedule III of aforesaid Rules.</p> <p>c) The effluent (domestic / industrial) conforming to the limits as prescribed in Schedule – I or Schedule – VI of Environment Protection Rules 1986 as amended or as may be prescribed by the Board.</p>	Being complied.
2.	Pollution Control Devices provided by the unit shall be operated and maintained to achieve the norms as prescribed in Environment (Protection) Act, 1986 as amended from time to time.	Being complied.
3.	The State Board reserves the right to revoke/review and alter the conditions of consent as the case may be.	Noted.
4.	Unit shall not undertake any expansion activity / or additional product in the existing unit without obtaining consent from State Board.	Noted.
5.	The project proponent shall be liable to clear any past/current liability on account of difference consent fees if detected at any subsequent stage.	Noted.
6.	The emission / effluent shall be got sampled and tested by the unit as well as concerned Regional Officer as prescribed and further renewal shall be dependent up on the results of samples so collected and tested.	Noted
7.	Unit shall have to apply for RCTO for further period with requisite fees in the concerned Regional Office within a month before expiry of consent.	Noted.
8.	This consent is subject to EC granted to	Noted.

Compliance of Renewal of Consent conditions imposed by HPSPCB Kashlog Limestone Mines – 7.6
MTPA - No HPSPCB/PCBID-10920/16427-29 dated 17/09/2018

	the project by MoEF & CC, Govt. of India vide letter dated 8-09-2015.	
9.	Unit shall strictly adhere to the capacity as approved by the industries department and RO to ensure the same. This consent is subject to ratification of the State Board or any litigation pending at any court of Law.	Noted.
10.	The permission included 3 nos. of Stone crushers with capacities @100X2 TPH and 1200 TPH.	Noted.
11.	This consent is subject to approval of modified mining plan by IBM vide letter dated 21/11/2016. The mining shall be strictly carried out as per the approved mining plan.	Mining is being carried out as per approved mining plan.
12.	Unit shall ensure that regular water sprinkling shall be done by the unit to control dust emission and shall conform to the norms as prescribed under EP (Act), 1986 and rules there under.	Water sprinkling is being carried out on haul roads and wherever necessary to control the fugitive dust emission.
13.	Unit shall plant and raise identified species of Pollution Abating Plants in the vicinity of the stone crusher at least in 3 layers in order to control air and noise pollution. The list of identified plants is available in the State Boards website - http://hppcb.nic.in/plantationguide.pdf .	The plantation will be raised in the upcoming monsoon.

**Land Use / Land Cover Analysis for Mining Lease and
Buffer Zones of Kashlog Limestone Mine of Ambuja Cements Ltd,
using Remote Sensing Techniques.**



**Client :
Ambuja Cements Ltd.**

**Prepared By :
CompuSense Automation, Ahmedabad**

October 2019

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EXECUTIVE SUMMARY

Systematic and comprehensive compilation of Land Use / Land Cover maps and data is necessary for planned development of agriculture, forests, grasslands, rural settlements, urban spread, industries and host of land based programs and activities. The existing information on Land Use / Land Cover is largely in the form of statistics based on compilation of village records. Whatsoever information available in the form of maps, suffers from problem of spotty coverage, lack of consistency and a large time gap between data compilation and map publication. Further most of these maps have been generated to serve specific objectives.

Remote sensing offers unique advantages in Land Use / Land Cover studies, of synoptic, comprehensive and repetitive coverage of an area. It is the only source of real time and objective assessment of distribution and condition of Land Use/ Land Cover of an area or region. The present study has been carried out for M/S Ambuja Cements Limited.

Main objectives of this study are:

- Main objective of this study is to prepare Land Use / Land Cover map with remote sensing technique i.e. using latest satellite images.
- To procure suitable data from National Remote Sensing Center, carry out analysis using digital image processing and GIS software.
- To generate statistics of Land Use / Land Cover classes for limestone mine lease area and buffer zones of 500m, 5Km and 10Km and prepare thematic map.
- To study terrain by using Digital Elevation Model (DEM) and generate watershed boundaries using digital image processing technique.
- Prepare report incorporating above mapping, analysis and compare with previous reports available with company.

Study areas and extents :-

The study area consists of Kashlog Limestone Mine and buffer zones of 500m, 5Km and 10Km from periphery of mine lease area. The study area falls in districts of Bilaspur, Mandi,

Solan and Shimla, Himachal Pradesh. The study area falls between longitude 76° 51' 07.4943"E to 77° 06' 25.6030"E latitude 31° 08' 35.0187"N to 31° 20' 40.9498"N.

Multi temporal digital data for kharif and rabi season for year 2018-2019 were used. The following remote sensing data as per details given below was procured online. The dates were selected for Kharif and Rabi seasons for deriving Land Use.

Satellite	Sensor	Sub scene	Path-Row	Season	Date
Resource sat-2	L4FMX	A	95-49	Kharif	02 nd October 2018
Resource sat-2A	L4FMX	B	95-49	Rabi	31 st March 2019
Resource sat-2A	L4FMX	A	95-49	Rabi	24 th April 2019
Cartosat-1	PANA	-	520-254	-	29 th December 2018

Data has been corrected geometrically and radiometrically. This corrected data has been used for classifying the image. A thematic map is also generated depicting various classes with different symbols. In the present study, Land Use / Land Cover information of the study area i.e the mine lease area (MLA) and buffer zones of 500m, 5Km and 10Km of mine lease in districts of Bilaspur, Mandi, Solan and Shimla, Himachal Pradesh has been mapped using the digital data referred above.

Various major categories like agriculture, wasteland, water body, etc. were identified and mapped. Area statistics was calculated for different Land Use / Land Cover categories and pie charts were generated.

The methodology comprises the following:

- Data loading and sub image extraction.
- Demarcation of study area, i.e. mining lease area and different buffer zones.
- Mapping of base map feature like roads, railway, canals, river, water bodies and drainage.
- Stratified classification of the two seasons separately.
- Refinement
- Aggregation of rabi and kharif classification for two seasons.
- Ground truth verification

- Finalization of Land Use map
- Statistics and final output

Statistics of Land Use / Land Cover of mine lease area, 500m, 5Km and 10Km buffer from periphery of mine lease near Darlaghat village, as generated by digital analysis of remote sensing data and Geographic Information system(GIS), is summarized in following table show distribution of classes in mine lease and buffer area.

Kashlog Mine Lease Area									
Sr. No.	Class	Within Mine Lease		Buffer Zone 500m		Buffer Zone 5Km		Buffer Zone 10Km	
		% Area	Area in Ha.	% Area	Area in Ha.	% Area	Area in Ha.	% Area	Area in Ha.
1	Built-up Residential	0.63	2.96	3.18	39.03	2.29	316.01	2.16	921.04
2	Built-up Industry	0.94	4.42	0.37	4.56	0.39	54.26	0.15	63.58
3	Transportation	2.12	9.95	1.29	15.82	0.12	16.23	0.04	16.23
4	Kharif Crop	7.49	35.11	18.69	229.73	10.80	1487.56	13.53	5756.59
5	Rabi Crop	0.18	0.86	0.39	4.83	0.59	80.74	0.84	355.94
6	Kharif + Rabi Crop	1.26	5.92	1.09	13.39	5.49	756.96	4.87	2072.50
7	Fallow Land	0.00	0.00	0.08	1.01	0.21	28.32	0.34	143.37
8	Afforestation	3.92	18.37	1.50	18.40	0.16	21.46	0.05	21.46
9	Very Dense Forest	12.28	57.57	4.68	57.56	13.41	1847.83	8.32	3540.59
10	Dense Forest	1.92	8.99	0.73	9.03	4.11	566.82	2.38	1011.42
11	Open Forest	1.32	6.21	0.92	11.36	2.25	309.37	1.12	477.33
12	Scrub Forest	2.44	11.46	0.50	6.15	1.90	261.72	1.05	446.97
13	Dense Vegetation	1.62	7.61	15.34	188.50	21.87	3012.27	24.86	10577.63
14	Dense Scrub	22.37	104.92	26.27	322.81	20.75	2858.20	22.10	9400.76
15	Open Scrub	22.62	106.10	17.75	218.13	14.02	1931.68	16.56	7046.65
16	River	0.00	0.00	0.00	0.00	0.90	123.48	1.24	527.06
17	Nala	0.00	0.00	0.00	0.00	0.11	14.98	0.17	71.25
18	Mine Sump	0.43	2.00	0.16	2.00	0.01	2.00	0.005	2.00
19	Excavated Area(Mining Pits)	17.22	80.76	6.57	80.76	0.59	80.76	0.20	86.52
20	Dump	1.23	5.78	0.47	5.78	0.04	5.78	0.01	5.79
	Total	100.00	469.00	100.00	1228.86	100.00	13776.42	100.00	42544.66

Satellite Image Showing Boundaries of Kashlog Limestone Mine and Plant



Legend

- Mine Lease Boundary
- Plant Boundary



Client : Ambuja Cements Limited (Unit : Suli & Rauri Cement Works)
Prepared By : CompuSense Automation, Ahmedabad
Data Source : Reausera-2, L450K, Dated - 31st March 2019 and 24th April 2023

1. Introduction

Present study of mapping Land Use / Land Cover using remote sensing data for Kashlog Limestone Mine near Darlaghat village in Arki tehsil of Solan district, Himachal Pradesh is carried out on behalf of M/s Ambuja Cements Limited. Now a days, it has become mandatory to carry out a Land Use / Land Cover analysis of the project site using satellite data similar to preliminary site survey. Comprehensive and chronological Land Use / Land Cover information is very vital for management of land. Accurate & precise compilation of this information helps in deciding the proper use of the land. Optimum economic use in accordance with minimal disturbance of the present ecology should be the prime objective of any industrial activity. Remote Sensing technology because of synoptic, repetitive and multi spectral characteristics becomes very vital technology for mapping Land Use / Land Cover. In addition to this, the study provides the facility of constant monitoring and past history of any particular area. Geographic Information System (GIS) is a tool, which allows the integration of spatial data with non - spatial data.

Systematic and comprehensive compilation of Land Use / Land Cover maps and data is necessary for planned development of agriculture, forest, grasslands, rural settlements, urban spread, Industries and a host of other land based programs and activities. Land Use refers to the various ways, the land is being utilized for different purposes by man mainly to generate income as well as for residential purpose. Whereas, 'Land Cover' refers to the natural surrounding present on the area under study. The existing information on Land Use / Land Cover is largely in the form of statistics based on compilation of village records. Whatever information available in the form of maps, suffers from the problems of spotty coverage, lack of consistency and a large time gap between data compilation and map publication.

In the present study, Land Use / Land Cover information of the study area i.e. within mine lease area (MLA), 500m, 5Km and 10Km buffer around the mine lease has been mapped using the digital data dated 02nd October 2018 of Satellite Resourcesat-2 , Sensor-L4FMX, Path - 95, Row - 49, Subscene-A and 31st March 2019, 24th April 2019 of Satellite Resourcesat-2A, Sensor-L4FMX, Path - 95, Row - 49, Subscene - A&B having resolution of 5

meter and satellite Cartosat-1, Sensor PANA, Path-520, Row-254 dated 29th December 2018 having resolution 2.5 meter.

Data has been corrected geometrically and radiometrically. This corrected data has been used for classifying the image. Various major categories like agriculture, wasteland, water body, forest, etc. were identified and mapped. Area statistics is calculated for different Land Use / Land Cover categories along with generating of pie charts. A thematic map is also generated depicting various classes with different symbols.

2. Objectives

Main objectives of this analysis are:

- To analyze Land Use / Land Cover of the study area using latest remote sensing satellite data.
- To generate statistics of Land Use / Land Cover classes and thematic map.

3. Study Area

The study area consists of limestone mine lease area and its buffer zones of 500m, 5Km and 10Km from periphery of mine lease. The study area falls in districts of Bilaspur, Mandi, Solan and Shimla, Himachal Pradesh.

Extents of study areas

Extents of study area as per following table.

Table : 1 Location and Extent

Core / Buffer Zone	Extents		Area in Ha.	SOI Toposheet Reference
	Latitude	Longitude		
	From/To	From/To		
Within Mine Lease	31° 13' 52"N	76° 57' 33"E	469.00	53A/15 & 53A/16
	31° 15' 19"N	76° 59' 58"E		
500m Buffer	31° 13' 38.1278" N	76° 57' 12.4049" E	1228.86	53A/15, 16 & 53/E3,4
	31° 15' 38.3222" N	77° 00' 19.7527" E		
5Km Buffer	31° 11' 14.5894" N	76° 54' 19.4721" E	13776.42	53A/15, 16 & 53/E3,4
	31° 18' 01.7122" N	77° 03' 12.9693" E		
10Km Buffer	31° 08' 35.0187" N	76° 51' 07.4943" E	42544.66	53A/15, 16 & 53/E3,4
	31° 20' 40.9498" N	77° 06' 25.6030" E		

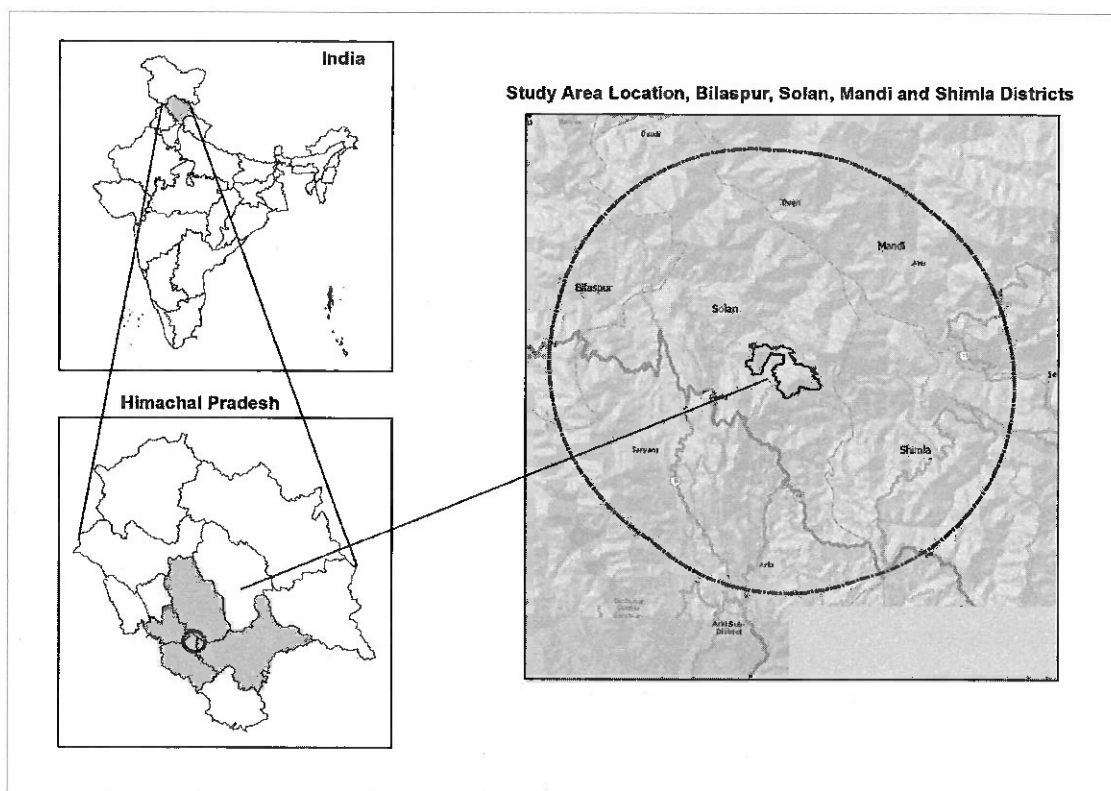
4. Data used

Digital remote sensing data as per details given below was procured online through National Remote Sensing Centre. The dates were selected for Kharif and Rabi seasons for deriving Land Use.

Table : 2 Data used

Satellite	Sensor	Sub scene	Path-Row	Season	Date
Resource sat-2	L4FMX	A	95-49	Kharif	02 nd October 2018
Resource sat-2A	L4FMX	B	95-49	Rabi	31 st March 2019
Resource sat-2A	L4FMX	A	95-49	Rabi	24 th April 2019
Cartosat-1	PANA	-	520-254	-	29 th December 2018

Figure : 1 Study area location map



5. General Description of the study area

5.1 Location and Extent

The detail of study area as defined in table 1, falls in Bilaspur, Mandi, Solan and Shimla districts of Himachal Pradesh. The tehsil headquarter Arki is about 11 km from the mine lease area. Another town Darlaghat, is about 19 km from the mine lease area. The mining lease area is about 18Km from plant via Karara ghat. The plant is about 2.5 Km north of NH 88 connecting Bilaspur and Shimla. Nearest Railway Station and Air port is Shimla at a distance of 49 Km.

5.2 Physiography, Relief and Drainage

The area of mining is situated in hilly terrain, varying in altitude from 1230m to 1739m above Mean Sea Level (M.S.L), with the Kashlog and Mangu deposits on the flanks of two hills and the Pati area extending into northern hill range. The topography of the study

area is highly undulating terrain transverse by hills. The physiography consists of alternating valleys, hill slopes and hill tops. The maximum and minimum elevation occurs in northeast region with minimum of 505m in Satluj river and maximum of 2144m in hills north of Ropru village.

The orogeny is young and the formations are being affected severely by the denudational agencies. The multi-directional stress has affected the formations resulting in intricate structure. The difference in hardness and composition can be contributed to the fact that the ranges are not of definite pattern and of no definite formational wise ranges.

The drainage of the study area is controlled by River Satluj. There are several ephemeral streams, which finally drain into the river Satluj. The Satluj river flows at a distance of about 8Km in the north of the mining area. Its flow direction in the study area is from NW to SE.

5.3 Climate

The climate of the area is sub-tropical to temperate. The average annual rainfall in the area is about 1450mm with an average of 64 rainy days in a year. The extreme temperature variation ranges from 2°C to 38°C. The annual mean temperature values are a low of 10.1°C and a maximum of 17.1°C. Relative humidity varies from 28% to 92%.

5.4 Geology of the study area

Regional Geology

Regionally the lease area belongs to the Lesser or Lower Himalayas, wedged in between the low lying Sub-Himalayas and the mountain range of the Higher Himalayas. The individual ranges are separated by major thrust belts. The geological age of the formations is Upper Pre-Cambrian. The age of the rocks date from Pre-Cambrian to the Miocene and are mostly made up of sedimentary and metasedimentary rocks. Generally, the structure is characterized by folding, faulting and thrusting.

Regional Geology and stratigraphic succession of the Outer Shimla Group of rocks is given below.

Regional Geology of the area

Group/Formation/Series	Age
Upper to lower Siwaliks	Upper Pliocene to Upper Miocene
Kasauli Beds	Miocene
Dagshai beds	Oligocene
Subathu series	Eocene
Kakara series	Paleocene
Unconformity	
Krol	Permo-Triassic
Unconformity	
Blaini	Carboniferous
Unconformity	
Shimla Group (Sanjauli, Chhaosa, Kunihar, Basantpur)	Lower Paleozoic to Pre-Cambrian
Unconformity	
Shail/Sundernagar Formations with Mandi-Darla volcanics	Pre-Cambrian
Outer Granite Belt	Early Pre-Cambrian
Jutogh Formation	Archaean

5.4.2 Local Geology

Geologically, the litho units of the area belong to C and D members of Basantpur Formation falling under Outer Shimla Group of Rocks. The geological age of the formations is Upper Pre-Cambrian. Litho-stratigraphic classification of the area is given below.

Formation	Member	Lithology
Sanjauli	Upper	Conglomerate, sand stone, shale
	Lower	Sand Stone, Siltstone, Shale
Chhaosa	----	Shale, Siltstone, Ortho Quartzite
Kunihar	----	Shale, Siltstone with Lime Stone interbeds
Basantpur	D	Limestone with interbedded shales
	C	Limestone and Dolomite
	B	Shale, Siltstone with interbeds of lenticular limestone, dolomite

	A	Quartzite and conglomerate
Unconformity		
Mandi-Darla Volcanics		

Structure

Generally, the rocks in the region are folded, fractured and at places faulted. As a consequence, the limestone bearing ridges are confined to a narrow belt. The general strike of the formations is NE-SW, dipping moderately with dips of 30-45 degrees in a southeasterly direction. A few minor faults are observed on the surface but their effect in depth has not been determined yet.

The joints in the area are tight in nature and their separation varies between 1 to 10 mm. The spacing of joints varies between 0.1 to 0.6m and their dip varies in the range of 5 to 90 degrees in different directions. In general, the joints are filled with soil or shaly material and in such areas the quality of cement grade limestone is deteriorated. In the western part of lease area, volcanic trap formation belonging to Mandi-Darla volcanic also occurs. Overall, the limestone overlies shales which in turn overlies volcanic substratum

5.5 Soils

Study area presents an intricate mosaic of high mountain ranges, hills and valleys with altitude ranging from 500 to 2400 m above MSL. The altitude of the hill ranges is higher in northern parts whereas south-western part of the district is represented by low denuded hill ranges of Shiwalik. In the areas underlain by high hill ranges of Himalayas, the valleys are narrow and deep with steep slopes trending in NW-SE direction. The terrain is moderately to highly dissected with steep slopes. The soil forming factors i.e. physiography and parent material are dominating. Accordingly soils are moderately deep to deep, sandy loam to sandy clay loam in narrow valley areas. These soils belong to Mangu and Kajiara soil series. In rest of the hilly and mountainous area soils are skeletal to very shallow to shallow.

According to soil properties soils belong to taxonomy order Entisol (hilly and mountainous area) and Inceptisol (narrow valley). The soils are prone to severe to very severe soil erosion and are suitable for grass pastures and forest. However, suitable soil and water conservation measures are to be taken.

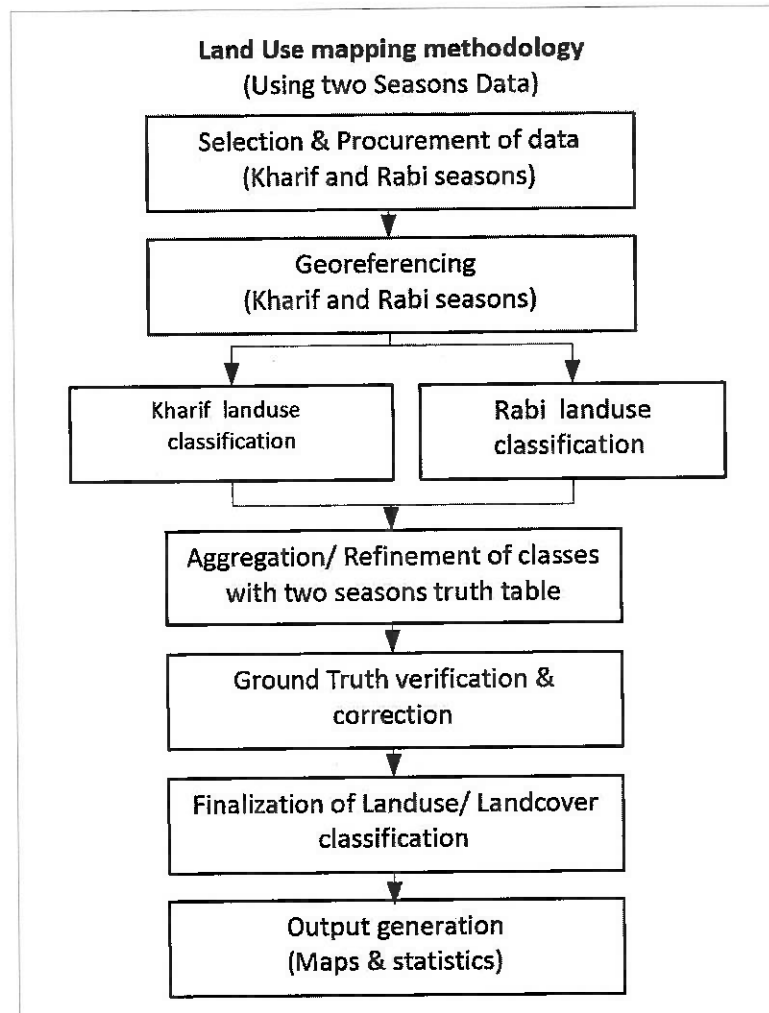
6. Land Use

Main crop of the region is wheat. However, maize, barley and rice are also mainly cultivated in the study area. The pulses like Cowpea, Rajmesh, Black gram etc are also grown. The cultivation is dependent on rain in monsoon season and allows only one crop in a year. The Soil quality is very much favorable for irrigation. Farming is done in river valleys and on terraces prepared on hill slopes. In the valleys double cropping is generally practiced. On higher terraces only one crop is possible. Apple is famous horticultural farming in Himachal Pradesh. However, due to unfavorable climatic conditions in the study area, the apple farming is not possible. The citrus fruits like lemon and vegetables are cultivated in the region in small scale. There are several reserved/ protected forests namely Bashiaru, Mansasher, Salaun, Hira beshak, Majhatal in study area.

Net Sown Area (NSA) represents the total area sown with crops and orchards. The area sown more than once in the same year is counted only once. **Gross Sown Area (GSA)** represents the total area sown once and/or more than once in a particular year, i.e. the area is counted as many times as there are sowings in a year. **Cropping Intensity (CI)** is the ratio of the GSA to the NSA. It depends on various factors like temperatures and rainfall, demand of fruits, vegetables, flowers etc in near by urban areas and availability of irrigation facilities, good quality seeds, fertilizers etc. These figures are calculated for core area and buffer zones.

7. Methodology

General methodology using Multi-temporal digital data for kharif and rabi season, to derive Land Use / Land Cover layer is shown in following diagram.



The methodology comprises the following functional component.

Data loading and image preparation

Three bands of data were downloaded from raw data and stacked to form a false colour composite (FCC). This raw data was georeferenced and projected in Universal Transverse Mercator (UTM), zone 43N projection. This projection was adopted from National Spatial Framework (NSF). Parameters for this projection are given in Annexure:1. This data was radiometrically enhanced for ease of interpretation.

Base map features mapping

Mapping of base map feature like roads, river, nala, water bodies and drainage were done using interpretation key in Annexure:2.

Digital classification of the two season data.

Base map feature classes were interpreted visually and masked out from digital image and a subset was derived using buffer boundaries. This image was classified using supervised classification method called Maximum Likelyhood classifier in IDRISI software. This comprised of creating signature files by identifying different classes and executing classifier. Data of both seasons were separately classified.

Refinement

Classified data of both seasons was refined using 5x5 Mode filter to remove noisy pixels.

Aggregation of classes

Classified data for two seasons was aggregated using two seasons truth table.

Rabi	Kharif	Integrated class
Crop	Crop	Double Crop
Crop	Fallow	Rabi
Fallow	Crop	Kharif
Fallow	Fallow	Fallow

Ground truth verifications

A limited ground truth was conducted on 19th & 20th September 2019, to verify certain spectrally confusing classes found during interpretation. During the traverse, Land Use / Land Cover classes were verified for their correctness with respect to interpreted map. Local informations regarding cropping pattern etc. were also collected. Map showing locations of ground verification points is given in Annexure: 3.

Finalization of map based on ground truth collection

Based on ground truth observations classified map was refined and finalized.

Maps and Statistics

Statistics for buffer zones was generated in Arc GIS software and different base maps, Land Use maps, reference and location maps were composed in Arc Map software.

8. Classification system

A three level classification system based on Environmental Impact Assessment Guidance Manual for mineral benefaction prepared by Administrative Staff College of India, Hyderabad. (February 2010) has been adopted /modified for this study area and shown in table 3. Classes found in study area are considered in classification system.

Table : 3 Land Use / Land Cover Classification System

	Level – I	Level - II	Level - III
8.1	Built-up land	Residential	
		Industrial	
		Transportation	
8.2	Agricultural land	Crop Land	Kharif
			Rabi
			Kharif + Rabi
		Fallow Land	
		Afforestation/Plantation	
8.3	Forest	Very Dense Forest	
		Dense Forest	
		Open Forest	
		Scrub Forest	
8.4	Waste land	Dense Scrub	
		Open Scrub	
8.5	Water bodies	River	
		Nala	
		Mine Sump	
8.6	Others	Dense Vegetation	
		Excavated area (Mining pits)	
		Dump	

Following sections describe various classes. Examples of these classes with photographs taken during ground truth verification visit and corresponding portion of satellite image are shown in subsequent pages.

8.1 Built up land

Built-up Residential

It generally refers to an area, which is not cultivated and is used for human residential purpose. Villages come under this category. Vacant land within or near by settlements used for industrial activities are also considered under this broad category.

Built-up Industrial

These are areas where the human activity is observed in the form of manufacturing along with other supporting establishments of maintenance. Heavy metallurgical industry, thermal, cement, petrochemical, engineering plants etc., are included under this. Certain built-up structures found in mining area like mine office, workshop are further classified in Infrastructure sub category.

Transportation

Land used for transportation and communication purpose like roads, railway and airport is also categories as built-up land. In this study area haulage road are also considered under this category.

8.2 Agricultural land

This areas are primarily used for raising agricultural crops, fiber, vegetables, fruits, cultivated fodder and other plant material of medicinal and commercial value. Three classes, crop land, fallow land and afforestation/plantation sites are identified in the study area. Croplands are sub classified as (1) Kharif (2) Rabi (3) Kharif + Rabi.

Crop land

Areas with standing crop in any or either of the two common growing seasons are classified as crop land. Crops grown in June-July and harvested during September-October are called as **kharif** crops. Crops sown during November-December and harvested during February-March are called **rabi** crops. Areas sown during both the seasons form double cropped area.

Fallow Land

The land not sown for current seasons which appears to be vacant is called 'Fallow Land'.

Afforestation / Plantation / Orchard

These areas are separable from cropland, especially with the data acquired during rabi / Jayad seasons. In this area horticulture plantation/orchard are not found. Only plantation found is that done by company. Afforestation appears in dark-red to red tone of different sizes with regular and sharp edges indicating the presence of a fence around. Forests are different from plantations characterized by big contiguous patches often having shape similar to natural or topographical features.

8.3 Forest Land

Forests are defined as, "all lands bearing vegetative association dominated by trees of any size, exploited or not, capable of producing wood or other forest products and exerting an influence on climatic or water regimes or providing shelter for wild life and live stock".

Very Dense Forest

This category includes all the areas where the canopy cover/crown density is more than 70%.

Dense Forest

This category includes all the forest areas where the canopy cover/crown density range between 40-70%.

Open Forest

This category includes all the forest areas where the canopy cover/crown density range between 10-40%.

Scrub Forest

This category includes all the forest areas where the canopy cover/crown density range less than 10 %.

8.4 Wastelands

Wasteland is described as degraded land which is currently not used for cultivation and is deteriorating for lack of appropriate water and soil management.

Dense Scrub

The area mainly covered by dense scrub classified under this category. This area is appears vegetated throughout the year.

Open Scrub

The area mainly covered by scrub which is sparse is classified as open scrub. It is land devoid of any vegetation and appears barren.

8.5 Water bodies

This class comprises areas of surface water found in the form of ponds, lakes, reservoirs.

River / Nala

This is a natural course of water flowing on the land surface along a definite channel and may be seasonal or perennial.

Mine Sump

Excavated area in mines where rain water is harvested.

8.6 Others

Dense Vegetation

It is tree clad area with dense vegetation outside notified forest boundaries.

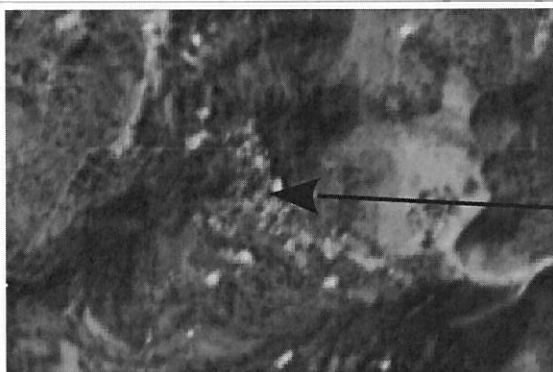
Excavated area (Mining pits)

These are the areas subjected to removal of different earth material or stone material (both surfacial and sub surfacial) by manual/mechanized operations.

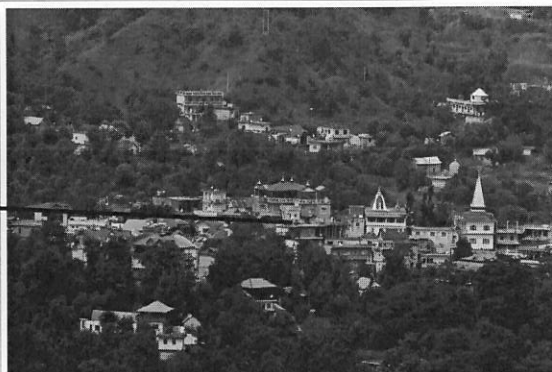
Dump

Dumps are those areas where debris is accumulated after extraction of required minerals. Generally, these lands are confined to the surrounding of the active mining area.

Class Photographs & Satellite Images



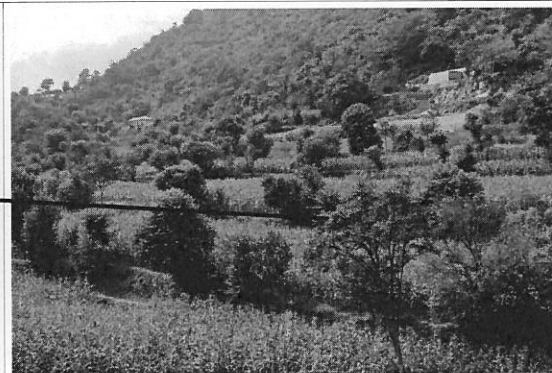
Habitation

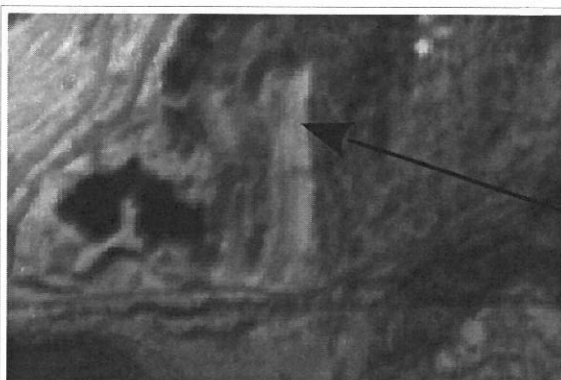


Industry

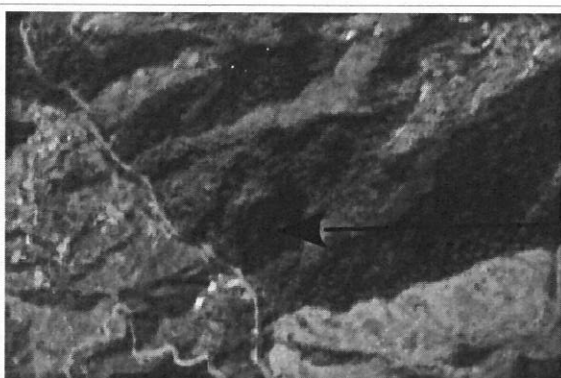
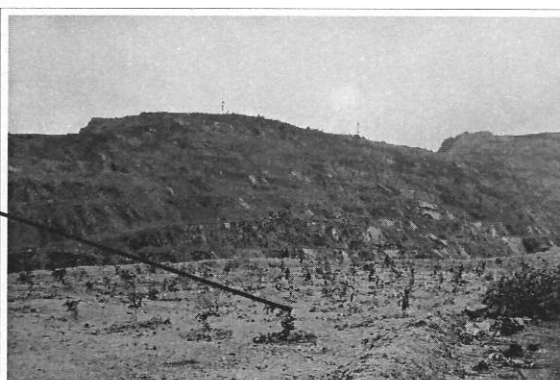


Crop

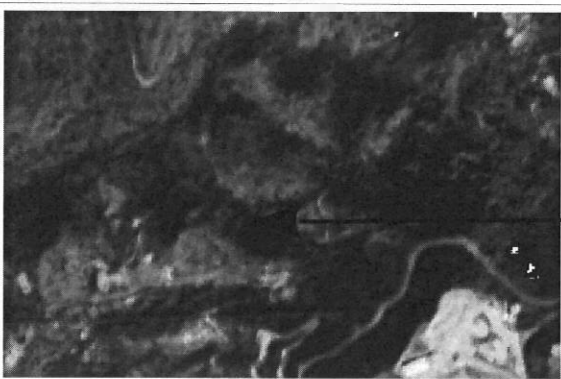
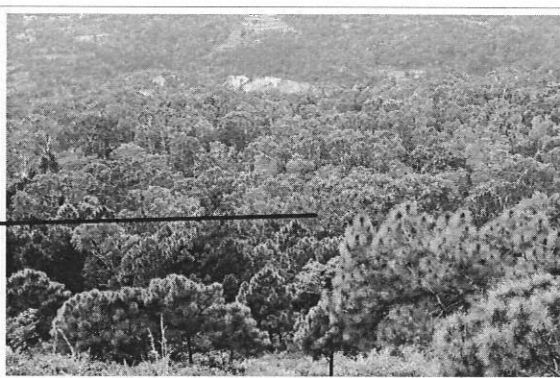




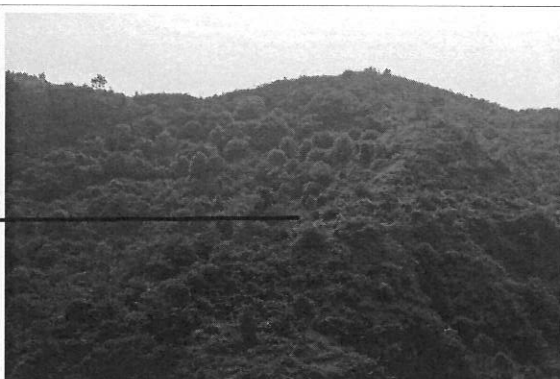
Plantation

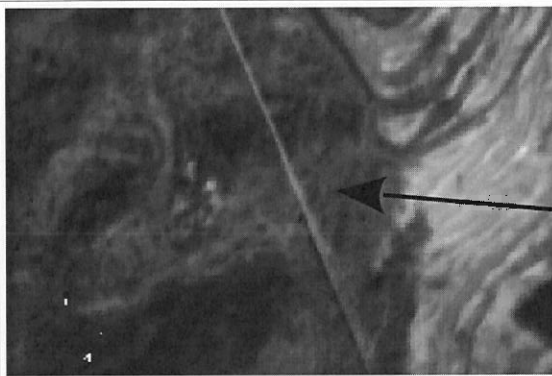


Very Dense Forest

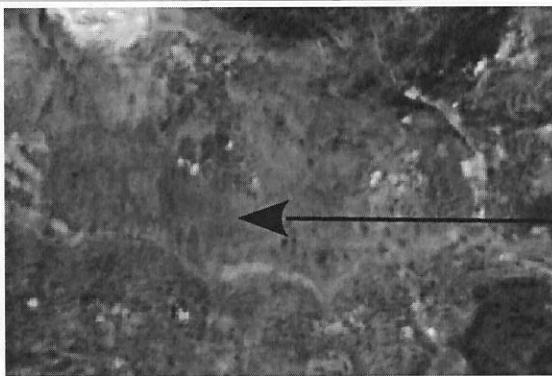
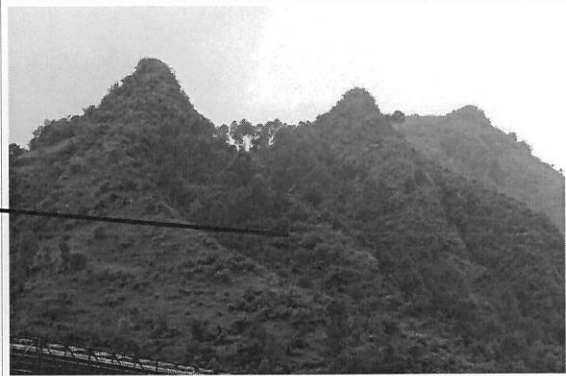


Dense Forest

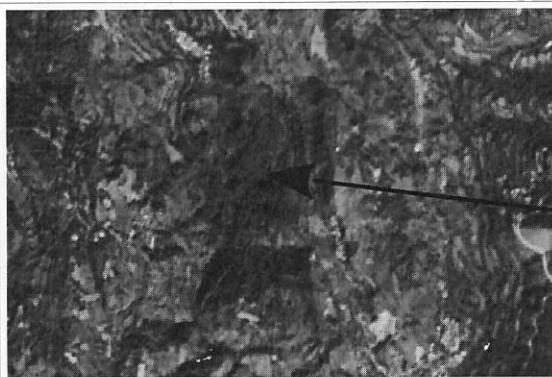
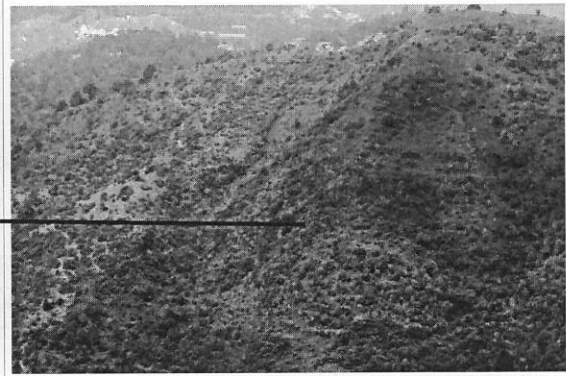




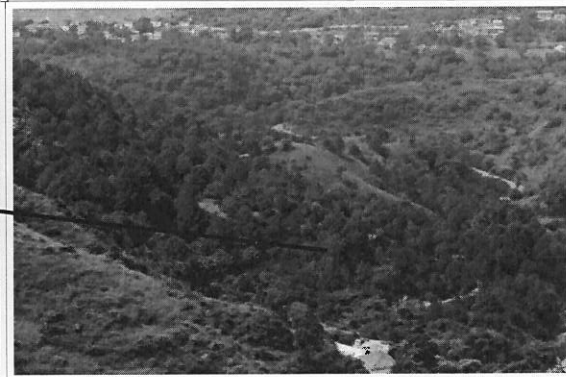
Open Forest

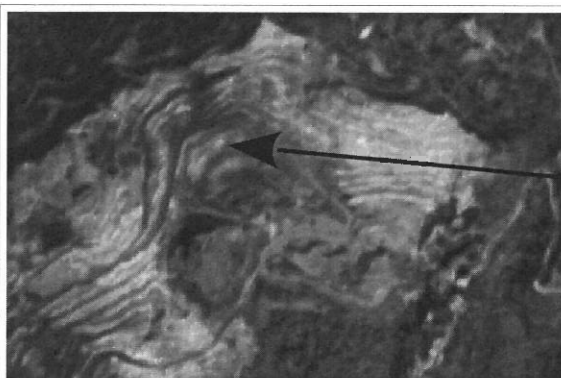


Scrub Forest

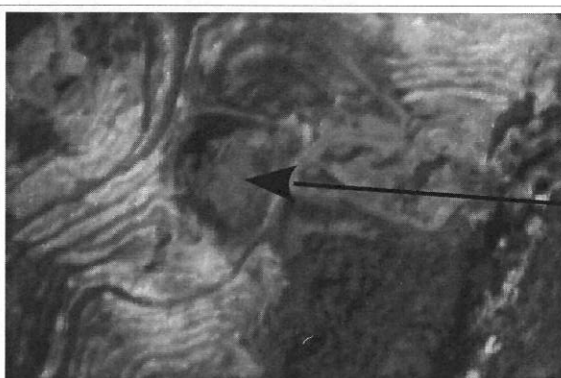
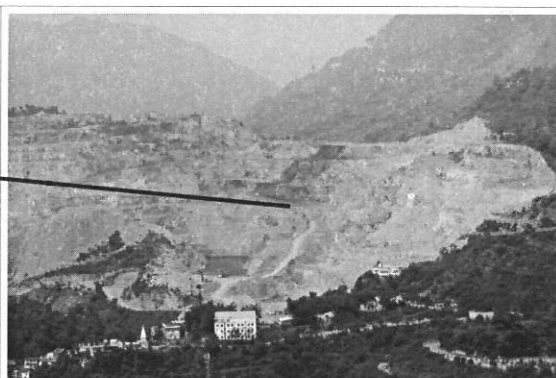


Dense Vegetation

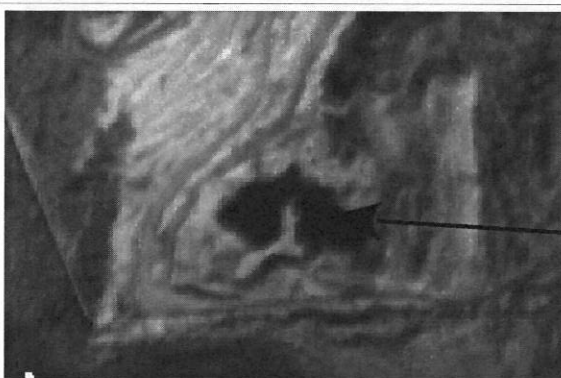




Excavated Area



Dump



Mine Sump

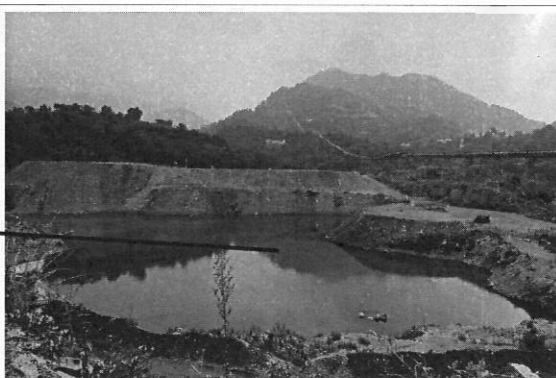
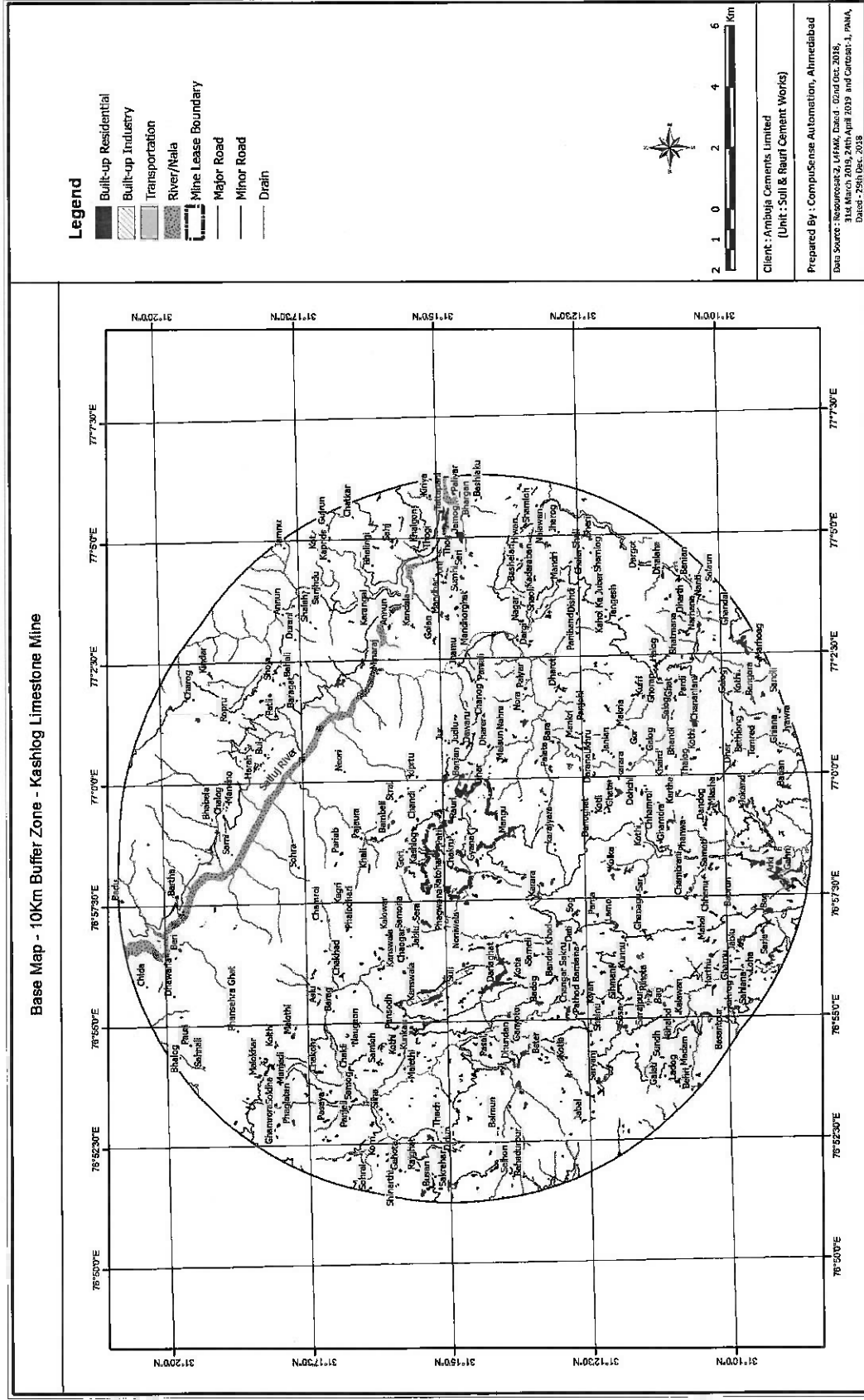
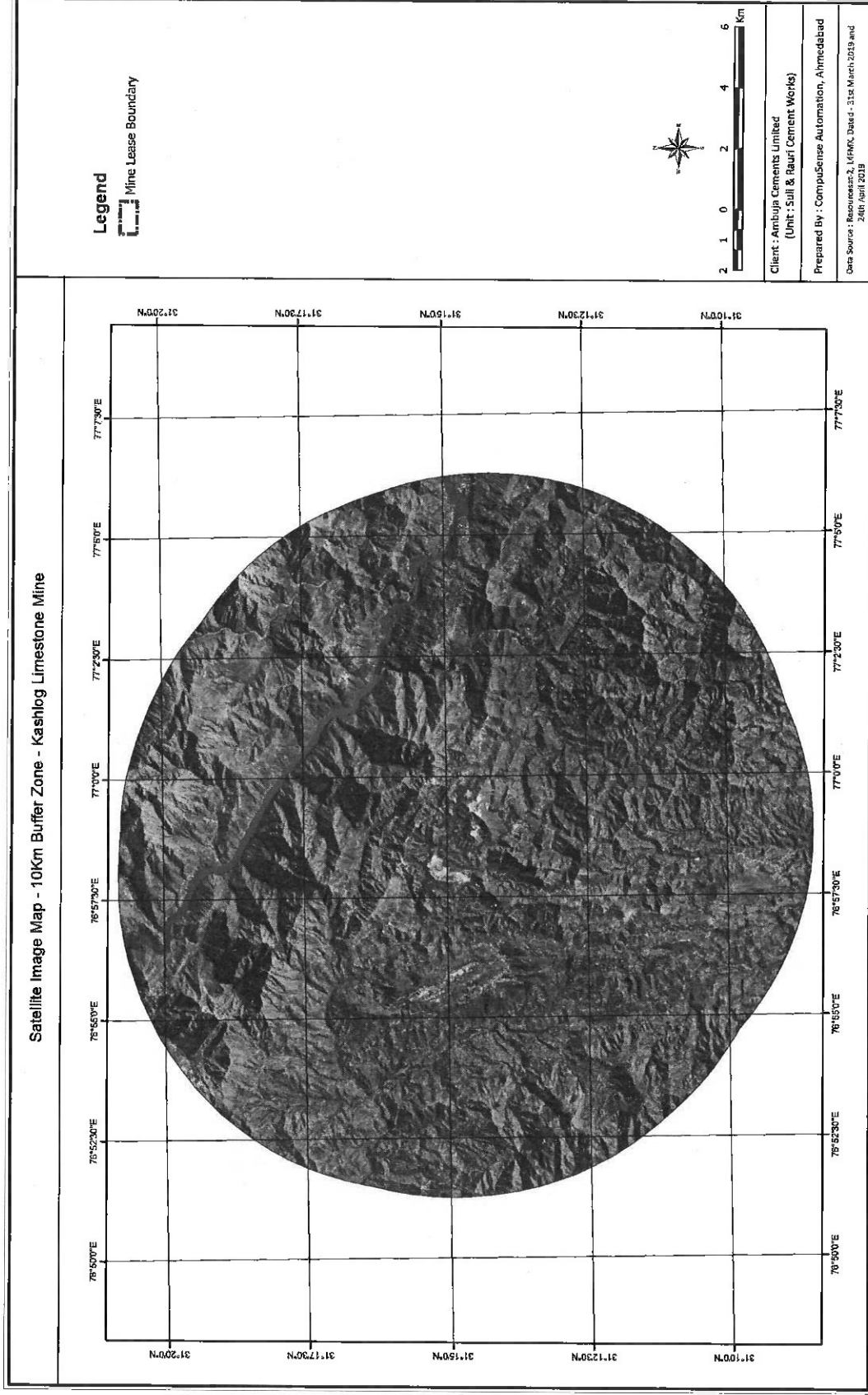


Figure : 2 Base Map and Satellite Image of Study Area

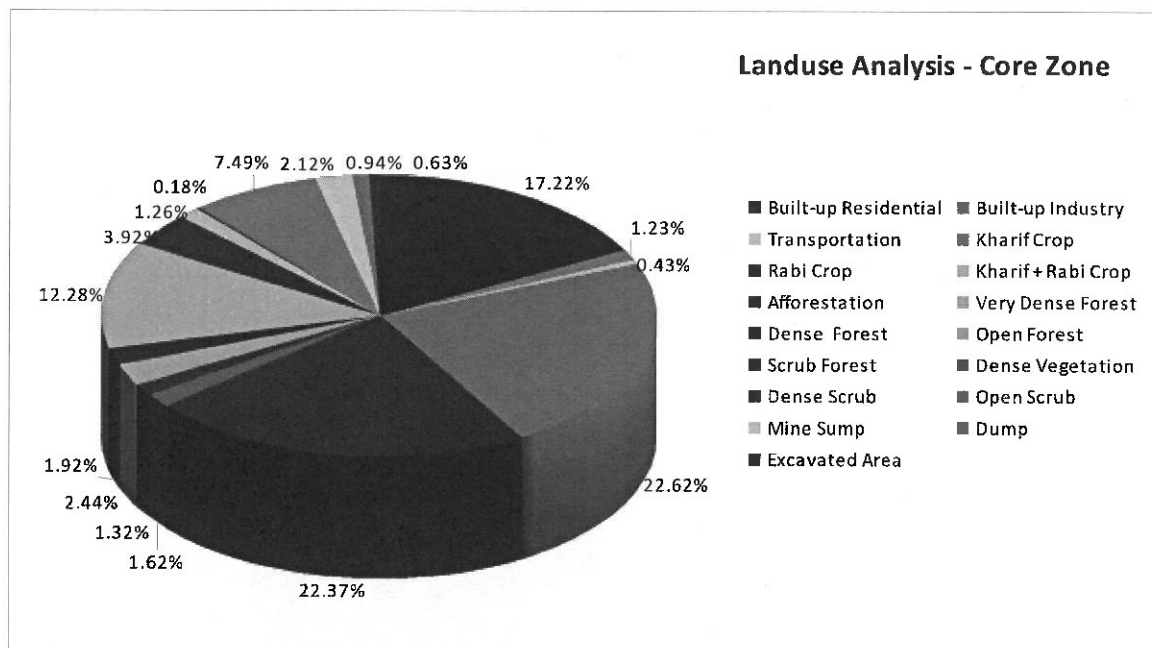




9. Result (Statistics)

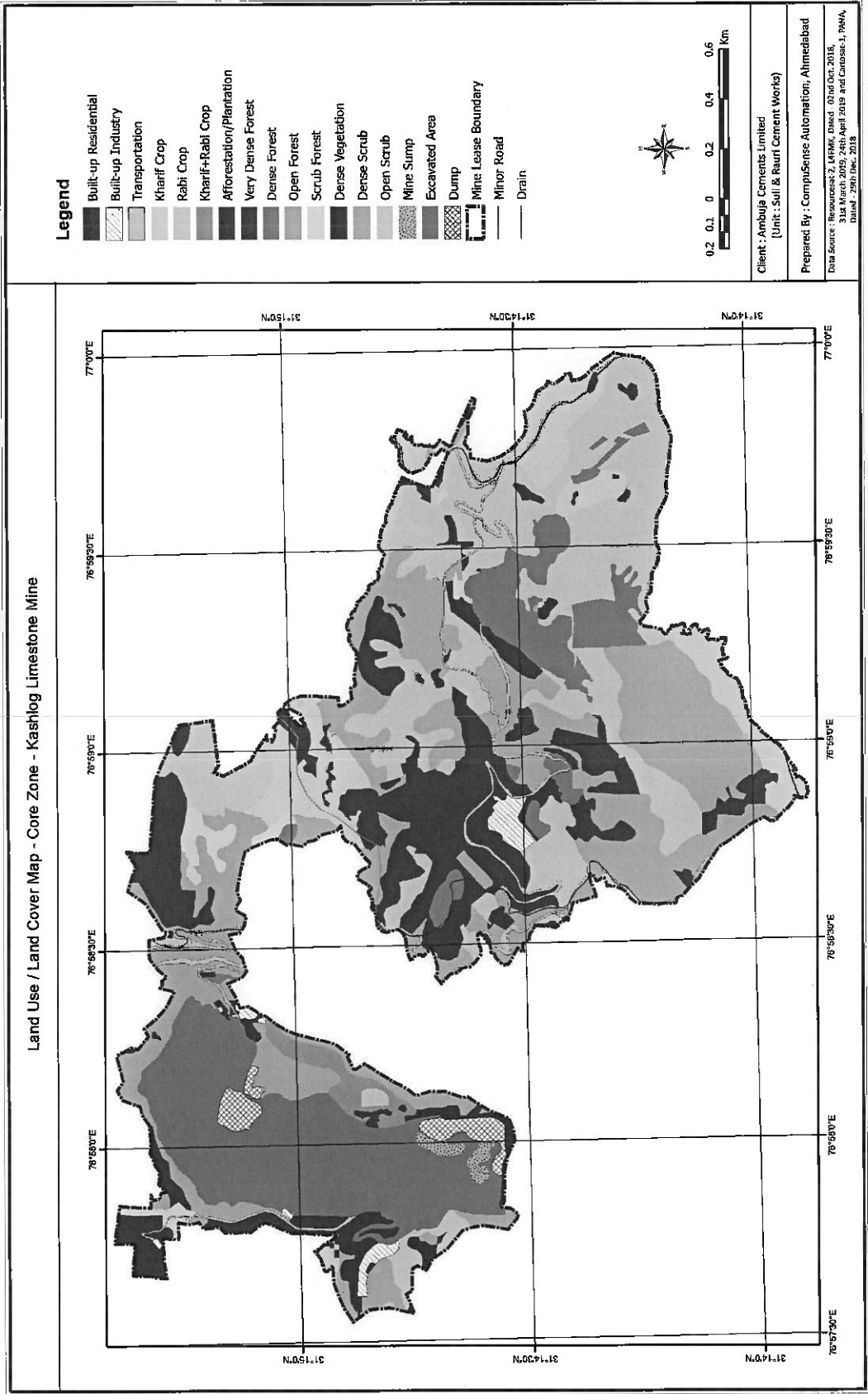
9.1 Within Mine Lease Area (MLA) (Core Zone)

Table : 4 Land Use/Land Cover Statistics – Core Zone				
CLASSIFICATION				
LEVEL – I	LEVEL – II	LEVEL-III	% Area	Area (Ha)
Built-up	Residential		0.63	2.96
	Industrial		0.94	4.42
	Transportation		2.12	9.95
		Sub-total	3.70	17.33
Agriculture Land	Crop Land	Kharif Crop	7.49	35.11
		Rabi Crop	0.18	0.86
		Kharif + Rabi Crop	1.26	5.92
	Fallow Land		0.00	0.00
	Afforestation/Plantation		3.92	18.37
		Sub-total	12.85	60.26
Forest	Very Dense Forest		12.28	57.57
	Dense Forest		1.92	8.99
	Open Forest		1.32	6.21
	Scrub Forest		2.44	11.46
		Sub-total	17.96	84.23
Wastelands	Dense Scrub		22.37	104.92
	Open Scrub		22.62	106.10
		Sub-total	44.99	211.02
Water bodies	River		0.00	0.00
	Nala		0.00	0.00
	Mine Sump		0.43	2.00
		Sub-total	0.43	2.00
Others	Excavated Area(Mining Pits)		17.22	80.76
	Dense Vegetation		1.62	7.61
	Dump		1.23	5.78
		Sub-total	20.08	94.16
		Total	100.00	469.00



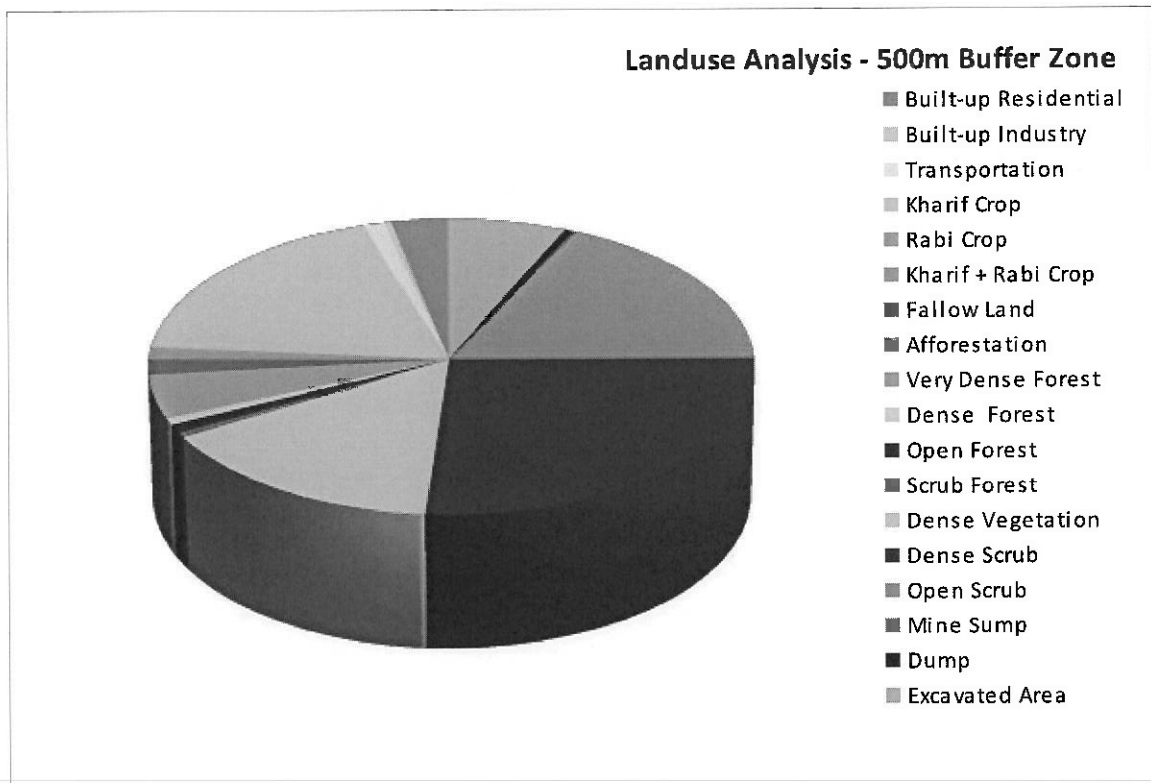
Out of total mine lease area of 469.00Ha., major class is wasteland (211.02Ha. or 44.99%). Mining activity covers (88.55Ha or 18.88%). Agriculture land covers 60.26Ha. of which 18.37Ha. is afforestation done by Ambuja Cements Limited. Other classes include built-up covering 17.33Ha., dense vegetation in 7.61Ha. and forest covering 84.23Ha.

Figure : 3 Land Use / Land Cover Map Core Zone



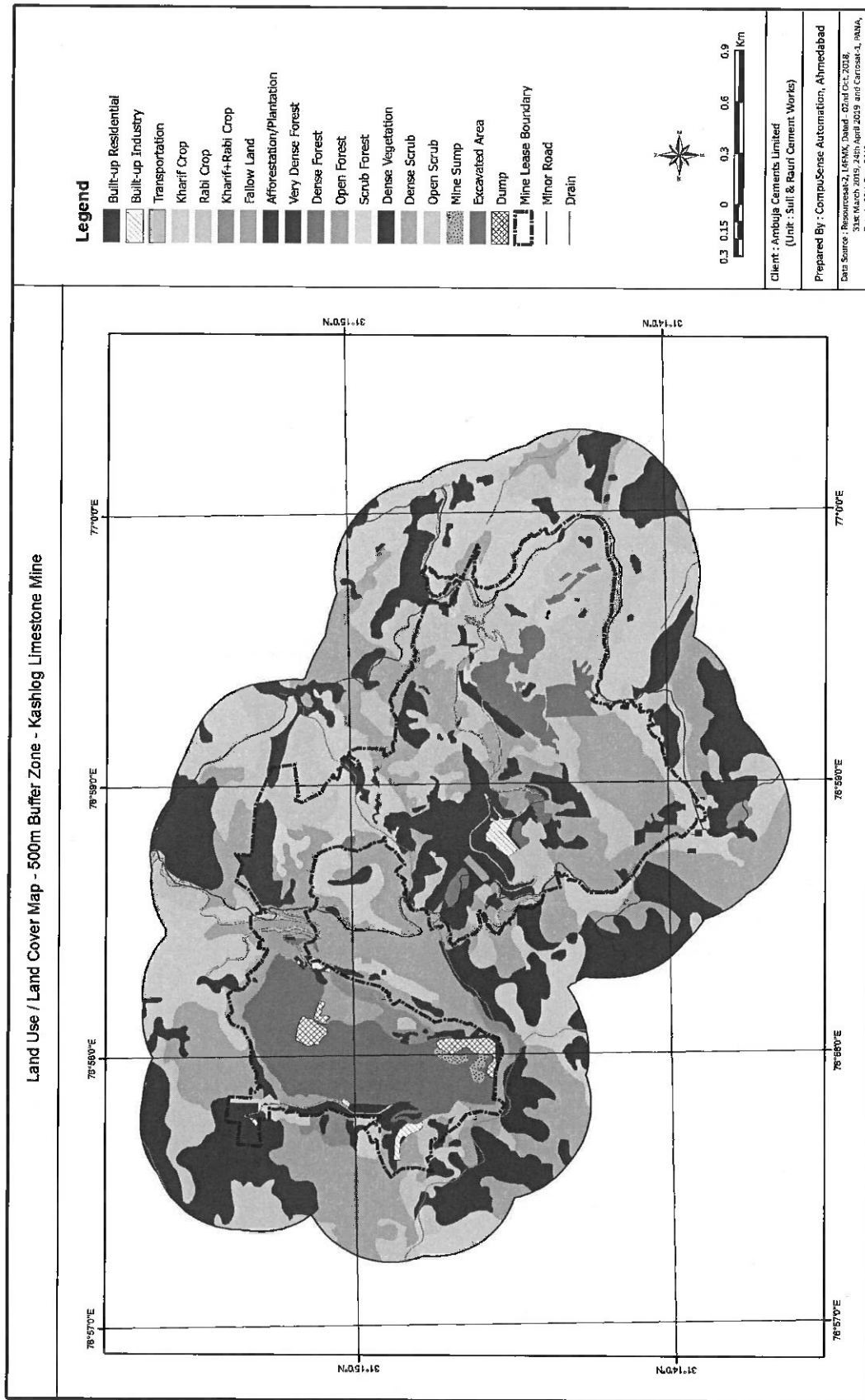
9.2 500m Buffer Zone

Table : 5 Land Use/Land Cover Statistics – 500m Buffer Zone				
CLASSIFICATION				
LEVEL – I	LEVEL – II	LEVEL-III	% Area	Area (Ha)
Built-up	Residential		3.18	39.03
	Industrial		0.37	4.56
	Transportation		1.29	15.82
		Sub-total	4.83	59.41
Agriculture Land	Crop Land	Kharif Crop	18.69	229.73
		Rabi Crop	0.39	4.83
		Kharif + Rabi Crop	1.09	13.39
	Fallow Land		0.08	1.01
	Afforestation/Plantation		1.50	18.40
		Sub-total	21.76	267.36
Forest	Very Dense Forest		4.68	57.56
	Dense Forest		0.73	9.03
	Open Forest		0.92	11.36
	Scrub Forest		0.50	6.15
		Sub-total	6.84	84.10
Wastelands	Dense Scrub		26.27	322.81
	Open Scrub		17.75	218.13
		Sub-total	44.02	540.95
Water bodies	River		0.00	0.00
	Nala		0.00	0.00
	Mine Sump		0.16	2.00
		Sub-total	0.16	2.00
Others	Excavated Area(Mining Pits)		6.57	80.76
	Dense Vegetation		15.34	188.50
	Dump		0.47	5.78
		Sub-total	22.38	275.04
		Total	100.00	1228.86



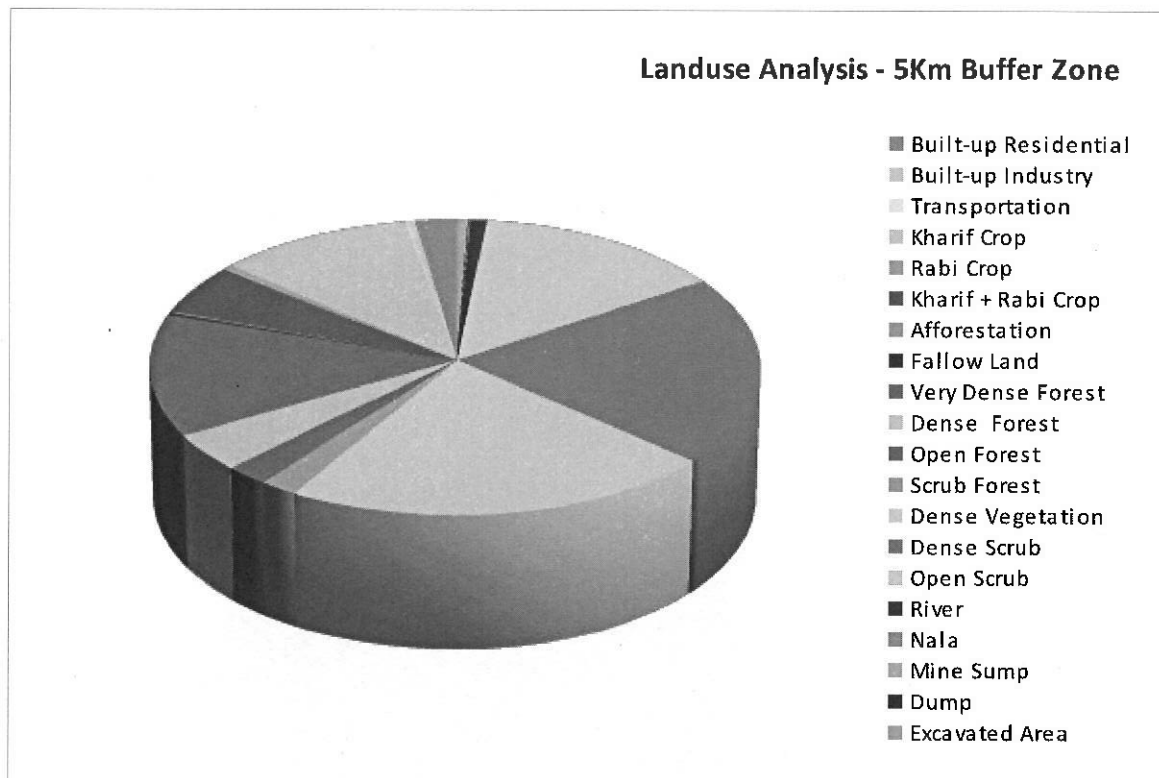
Major class in this buffer zone is also wasteland with 540.95Ha. (44.02%). Mining activity covers 88.55Ha. or 7.21%. Agriculture land consists 267.36Ha. (21.76%). Gross Sown Area (GSA) and Net Sown Area (NSA) of this buffer zone works out to be 261.33Ha. and 247.95Ha. resulting into Cropping Index (CI) of 1.05. meaning almost no double crop in a year. Other classes include, forest 84.10Ha. (6.86%), built-up 59.41Ha. (4.83%) and 2.00Ha. (0.16%) of water bodies.

Figure : 4 Landuse / Landcover Map 500m Buffer Zone



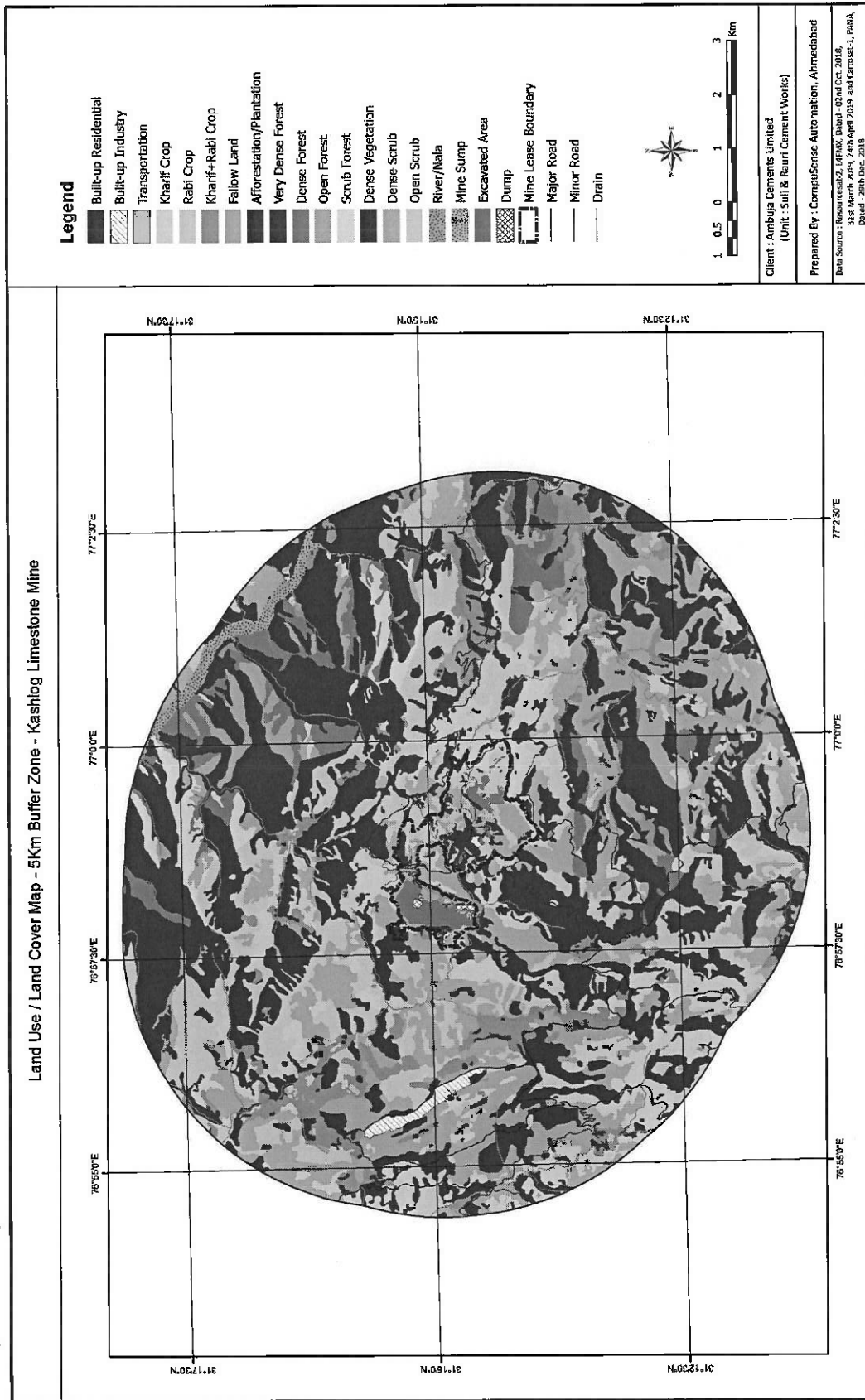
9.3 5Km Buffer Zone

Table : 6 Land Use/Land Cover Statistics - 5Km Buffer Zone				
CLASSIFICATION			% Area	Area (Ha)
LEVEL – I	LEVEL – II	LEVEL-III		
Built-up	Residential		2.29	316.01
	Industrial		0.39	54.26
	Transportation		0.12	16.23
		Sub-total	2.81	386.50
Agriculture Land	Crop Land	Kharif Crop	10.80	1487.56
		Rabi Crop	0.59	80.74
		Kharif + Rabi Crop	5.49	756.96
	Fallow Land		0.21	28.32
	Afforestation/Plantation		0.16	21.46
		Sub-total	17.24	2375.03
Forest	Very Dense Forest		13.41	1847.83
	Dense Forest		4.11	566.82
	Open Forest		2.25	309.37
	Scrub Forest		1.90	261.72
		Sub-total	21.67	2985.74
Wastelands	Dense Scrub		20.75	2858.20
	Open Scrub		14.02	1931.68
		Sub-total	34.77	4789.88
Water bodies	River		0.90	123.48
	Nala		0.11	14.98
	Mine Sump		0.01	2.00
		Sub-total	1.02	140.46
Others	Excavated Area(Mining Pits)		0.59	80.76
	Dense Vegetation		21.87	3012.27
	Dump		0.04	5.78
		Sub-total	22.49	3098.82
		Total	100.00	13776.42



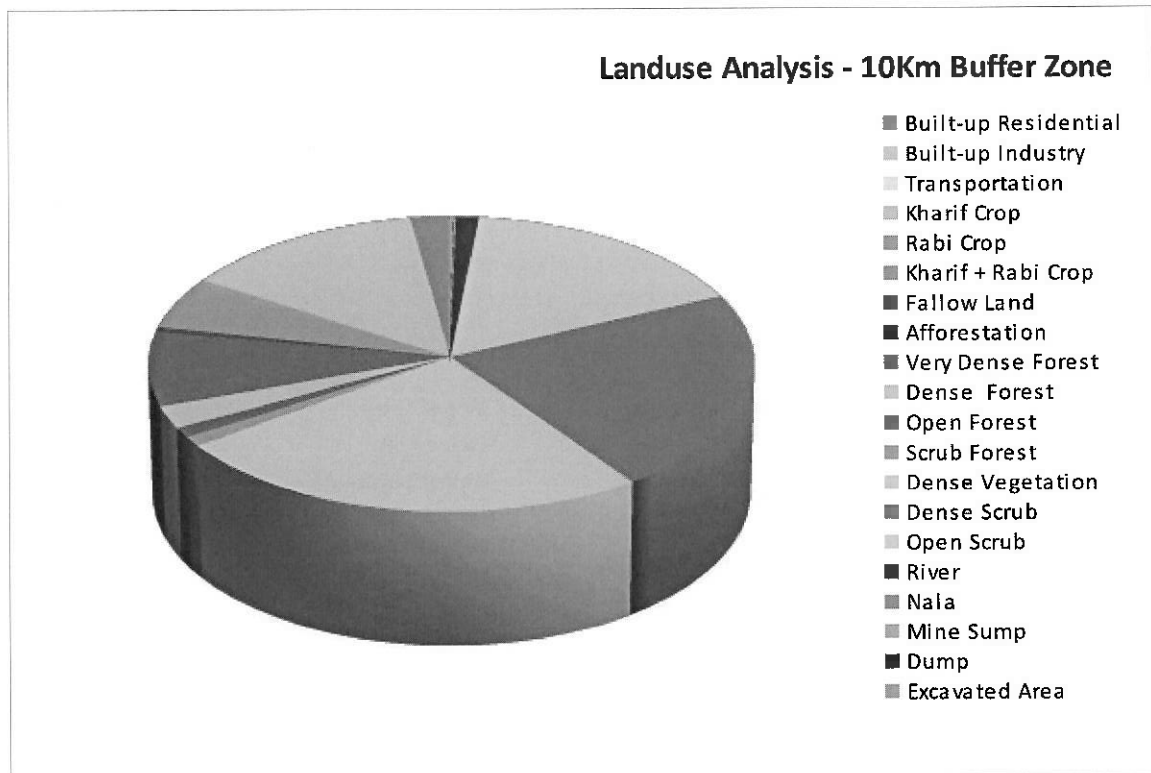
Although wasteland is a major class with 4789.88Ha. (34.77%). Next important class is forest covering 2985.74Ha. or 21.67%. Other classes include, built-up 386.50Ha. (2.81%), agricultural 2375.03Ha. (17.24%), mining activities covering 88.55Ha. (0.64%), 140.46Ha. (1.02%) of water bodies and dense vegetation in 3012.27Ha. (21.87%). GSA and NSA of this buffer zone works out to be 3082.21Ha. and 2325.26Ha. resulting into CI of 1.33 indicating some double crop area.

Figure : 5 Landuse / Landcover Map – 5km Buffer Zone



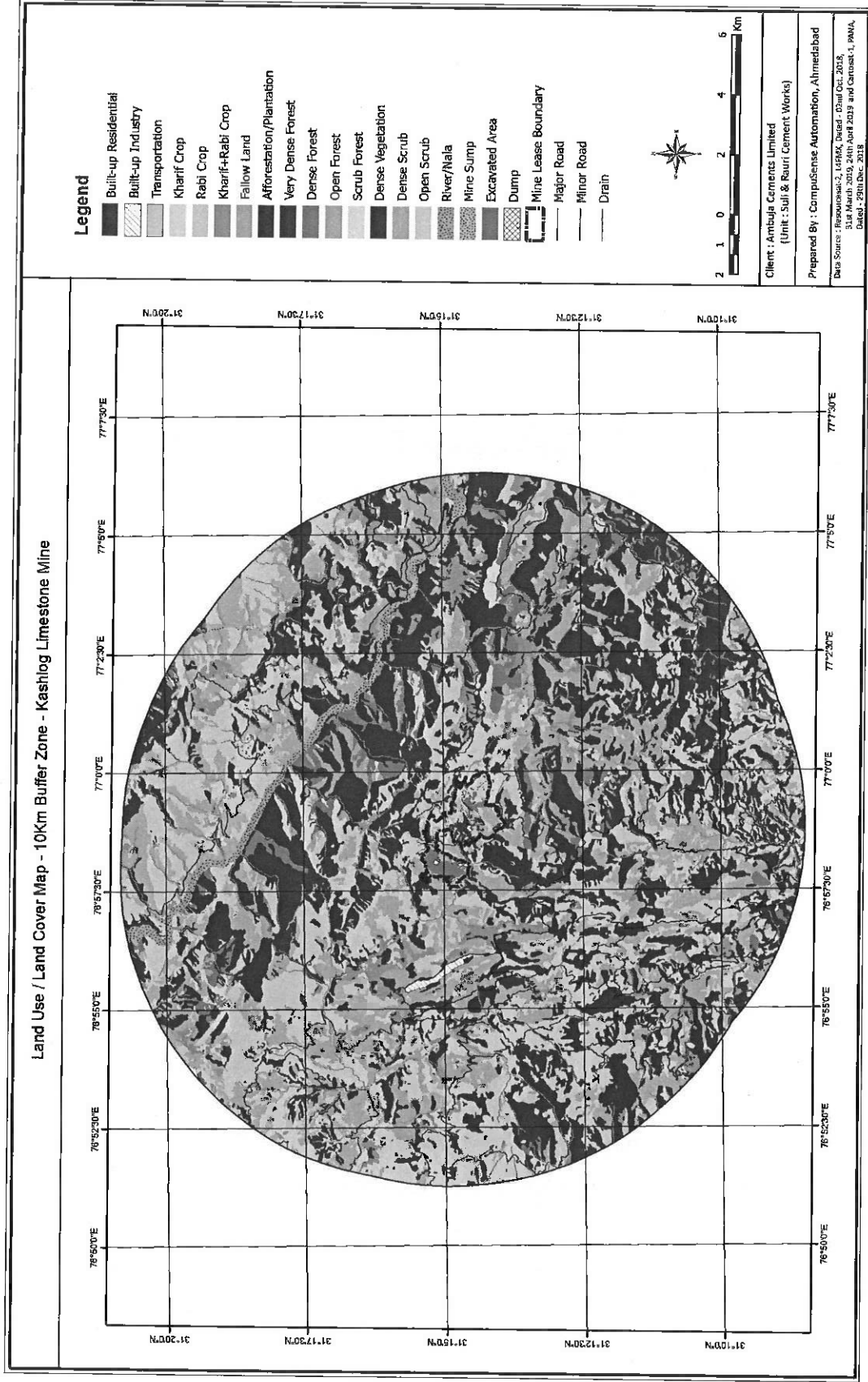
9.4 10Km Buffer Zone

Table : 7 Land Use/Land Cover Statistics - 10Km Buffer Zone				
CLASSIFICATION				
LEVEL – I	LEVEL – II	LEVEL-III	% Area	Area (Ha)
Built-up	Residential		2.16	921.04
	Industrial		0.15	63.58
	Transportation		0.04	16.23
		Sub-total	2.35	1000.85
Agriculture Land	Crop Land	Kharif Crop	13.53	5756.59
		Rabi Crop	0.84	355.94
		Kharif + Rabi Crop	4.87	2072.50
	Fallow Land		0.34	143.37
	Afforestation/Plantation		0.05	21.46
		Sub-total	19.63	8349.85
Forest	Very Dense Forest		8.32	3540.59
	Dense Forest		2.38	1011.42
	Open Forest		1.12	477.33
	Scrub Forest		1.05	446.97
		Sub-total	12.87	5476.31
Wastelands	Dense Scrub		22.10	9400.76
	Open Scrub		16.56	7046.65
		Sub-total	38.66	16447.40
Water bodies	River		1.24	527.06
	Nala		0.17	71.25
	Mine Sump		0.00	2.00
		Sub-total	1.41	600.31
Others	Excavated Area(Mining Pits)		0.20	86.52
	Dense Vegetation		24.86	10577.63
	Dump		0.01	5.79
		Sub-total	25.08	10669.94
		Total	100.00	42544.66



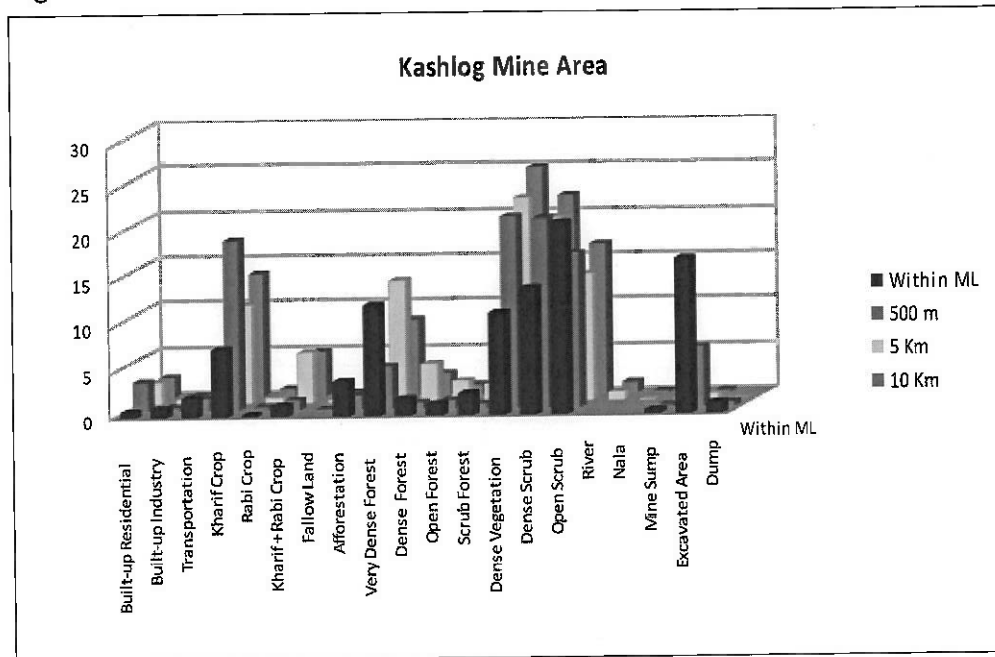
Major class in 10Km buffer area is wasteland covering 16447.40Ha. (38.66%). Next important class is dense vegetation covers 10577.63Ha. (24.86%). Agriculture land covers 8349.85Ha. (19.63%). GSA and NSA of this buffer zone works out to be 10257.52Ha. And 8185.02Ha. resulting into CI of 1.25. Forest covering 5476.31Ha. (12.87%), which are mainly very dense and dense category. Other classes include built up covering 1000.85Ha. (2.35%), 86.52Ha. (0.20%) of mining pits, which also includes mines of UltraTech Baga Cement and 600.31Ha. (1.41%) of water bodies.

Figure : 6 Landuse/Landcover Map – 10km Buffer Zone



10. Conclusion

Following charts show distribution of classes within mine lease area and buffer areas:



all figures in percentages

Land use / Land cover mapping using remote sensing data provides rapid, accurate and reliable information on various classes occurring within study area. This method is also cost effective & less time consuming. Main advantage of using GIS technique is to know the spatial distribution of classes which gives insight into its geographical spread. GIS techniques are also useful in visualizing data across various parameters and generating statistics.

The study area of Kashlog Limestone mine is predominantly hilly in nature. It is seen from the chart that all buffer zones and Limestone Mine Lease Area represents different land use pattern. As we examine different zones, we find that wasteland is dominant classes in Mining Lease, 500m buffer area, 5Km buffer area and 10Km buffer zone (44.99%, 44.02%, 34.77% and 38.66% respectively). Dense vegetation is next important class becomes dominant in buffer areas of 5 & 10km (21.87% and 24.86% respectively) and further decrease to 15.34% and 1.62% in 500m buffer and core area respectively. This report could serve as base line data for future studies, particularly for monitoring changes in land Use/ Land Cover pattern.

Annexure : 1 Projection Parameters

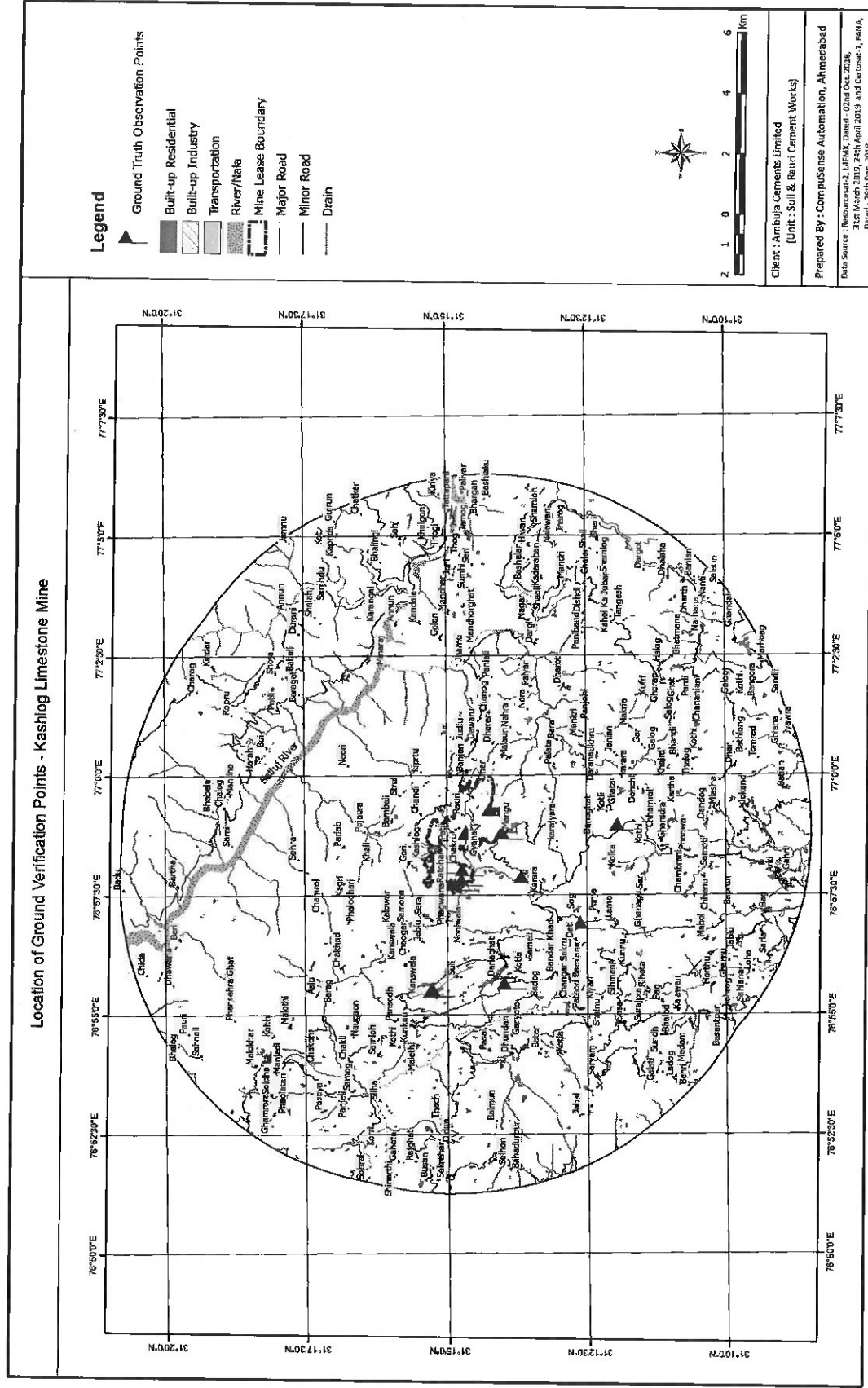
- **Projection Type** : Universal Transverse Mercator zone 43N
- **Spheroid Name** : WGS84
- **Datum** : WGS84
- **Parameters**
- **False_Easting** : 500000.000000
- **False_Northing** : 0.000000
- **Central_Meridian** : 75.000000
- **Scale_Factor** : 0.999600
- **Latitude_Of_Origin** : 0.000000
- **Linear Unit** : Meter (1.000000)
- **Geographic**
- **Coordinate System** : GCS_WGS_1984
- **Angular Unit** : Degree (0.017453292519943299)
- **Prime Meridian** : Greenwich (0.000000000000000000)
- **Datum** : D_WGS_1984
- **Spheroid** : WGS_1984
- **Semimajor Axis** : 6378137.000000000000000000
- **Semiminor Axis** : 6356752.314245179300000000
- **Inverse Flattening** : 298.257223563000030000

Annexure : 2 Interpretation Key
Land Use / Land Cover Interpretation Key Using Satellite Imagery

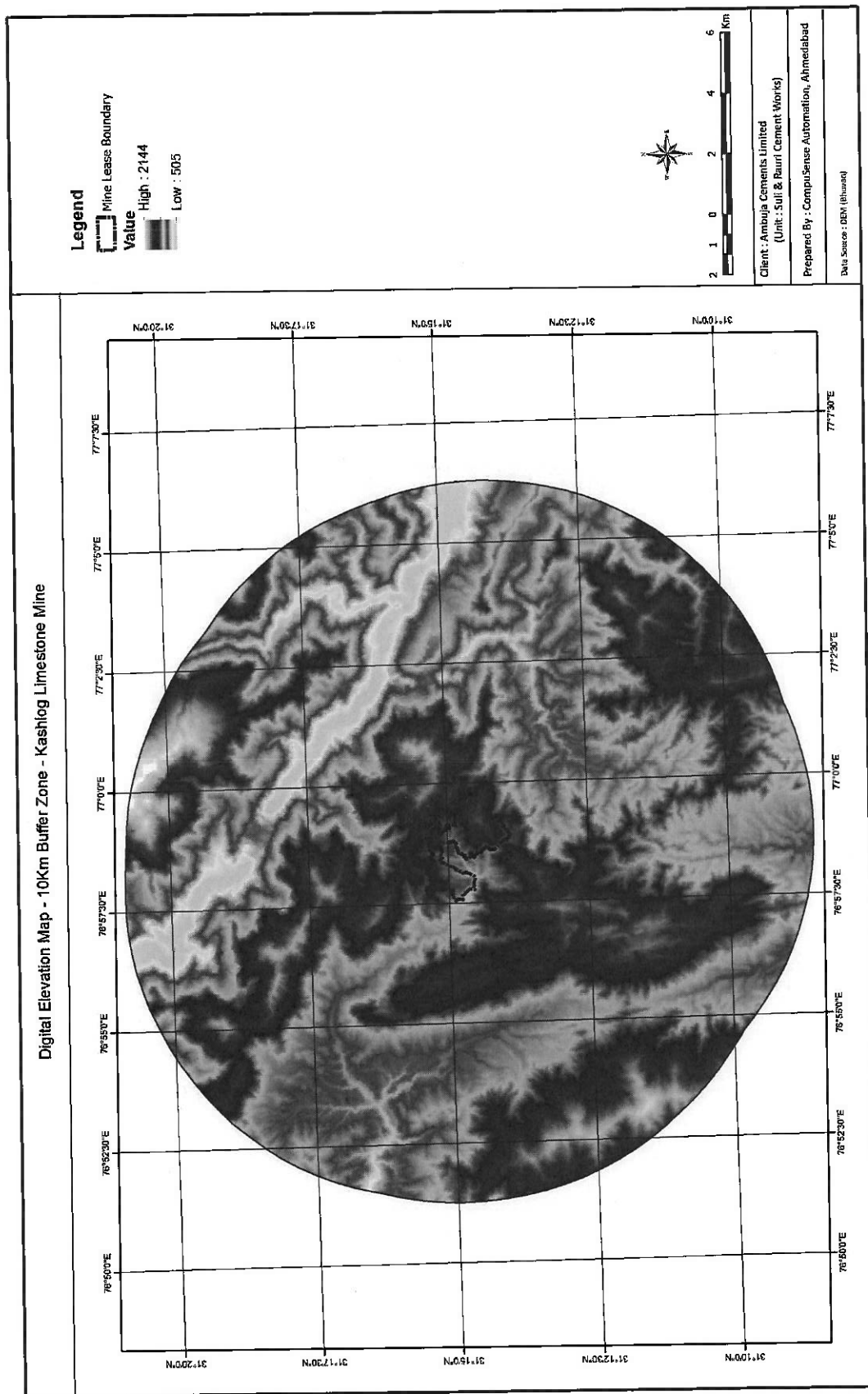
Sr. No.	Land Use / Land Cover Category	Tone / Colour	Size	Shape	Texture	Pattern
1	Built-up Land	Dark bluish green in the core and bluish on the periphery	Small to big	Irregular & Discontinuous	Coarse & mottled	Clustered to Scattered & non-contiguous
2	Transportation	Very dark to dark bluish green, light yellow for minor roads , red if vegetation along the road	Small in width for roads and narrow for rail	Regular with straight/sharp and smooth curves	Smooth to fine	Linear to sinuous and contiguous
3	Crop Land	Bright red to red	Varying in size	Regular to irregular	Medium to smooth	Contiguous to non-contiguous
4	Fallow Land	'Yellow to greenish blue (depending on soil type and moisture)	Small to large	Regular to irregular	Medium to smooth	Contiguous to non-contiguous
5	Afforestation (Plantation)	Dark red to red	Small to medium	Regular with sharp edges	Coarse to medium	Dispersed, contiguous
6	Dense Forest	Bright red to dark red	Varying in size	Irregular, discontinuous	Smooth to medium depending up on crown density	Contiguous to non contiguous
7	Open Forest	Light yellow to light brown	Small	Regular to irregular	Coarse to mottled	Non-contiguous dispersed /scattered
8	Land with or without scrub	Light yellow to brown to greenish blue(subject to surface moisture and cover	Varying in size	Irregular-discontinuous	Coarse to mottled (Subject to vegetation cover)	Contiguous dispersed in patches
9	River	Light blue to dark blue	Long narrow to wide	Irregular, Sinuous	Smooth to medium	Contiguous, nonlinear to dendritic/ sub-dendritic etc.
10	Lake/Pond	Light blue to dark blue(subject to weeds/vegetation)	Small/medium to large	Regular to irregular	Smooth to mottled	Non-contiguous dispersed

Interpretation keys may change for different satellite sensors depending upon their band combinations and enhancement made.

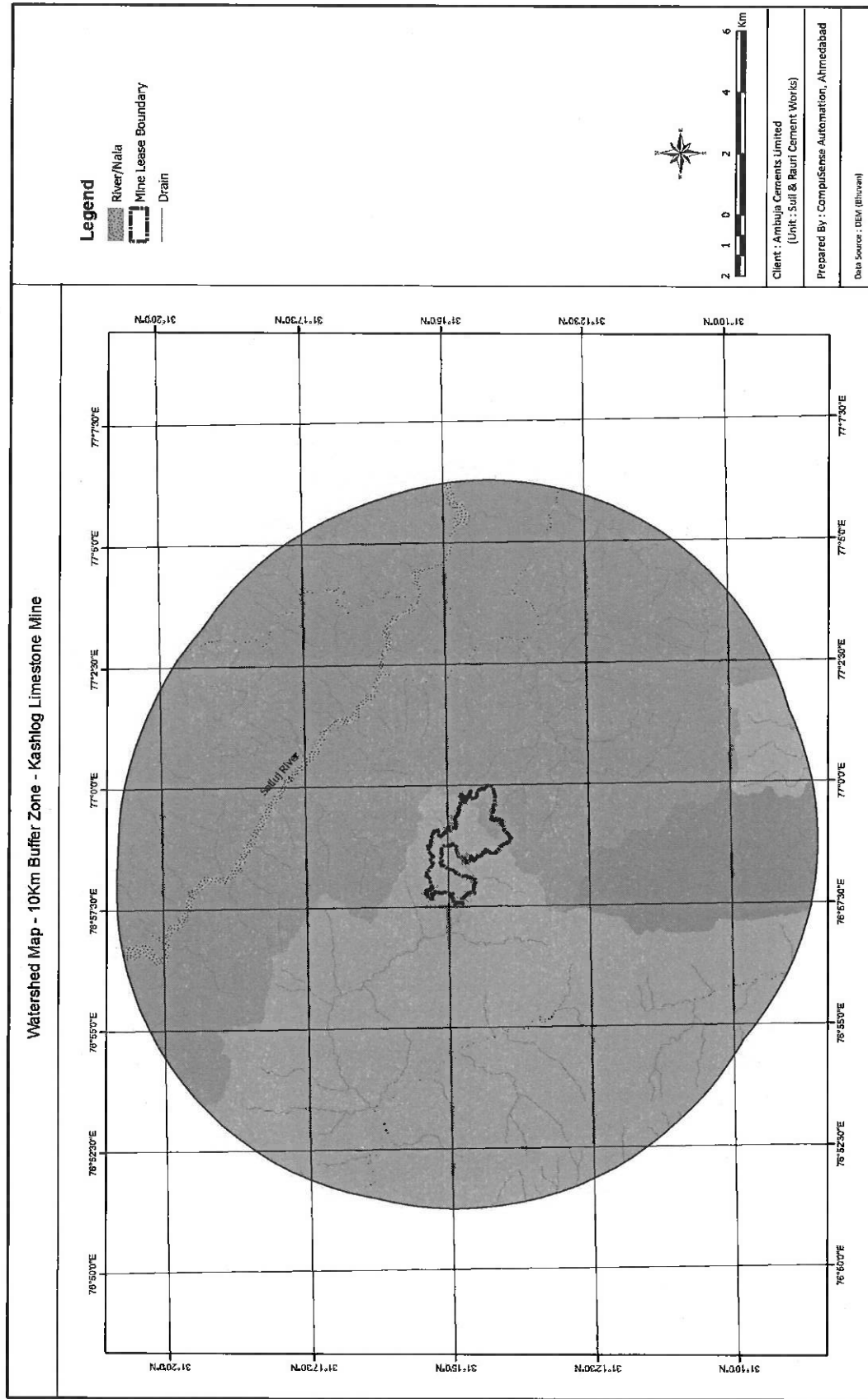
Annexure : 3 Ground Verification Points



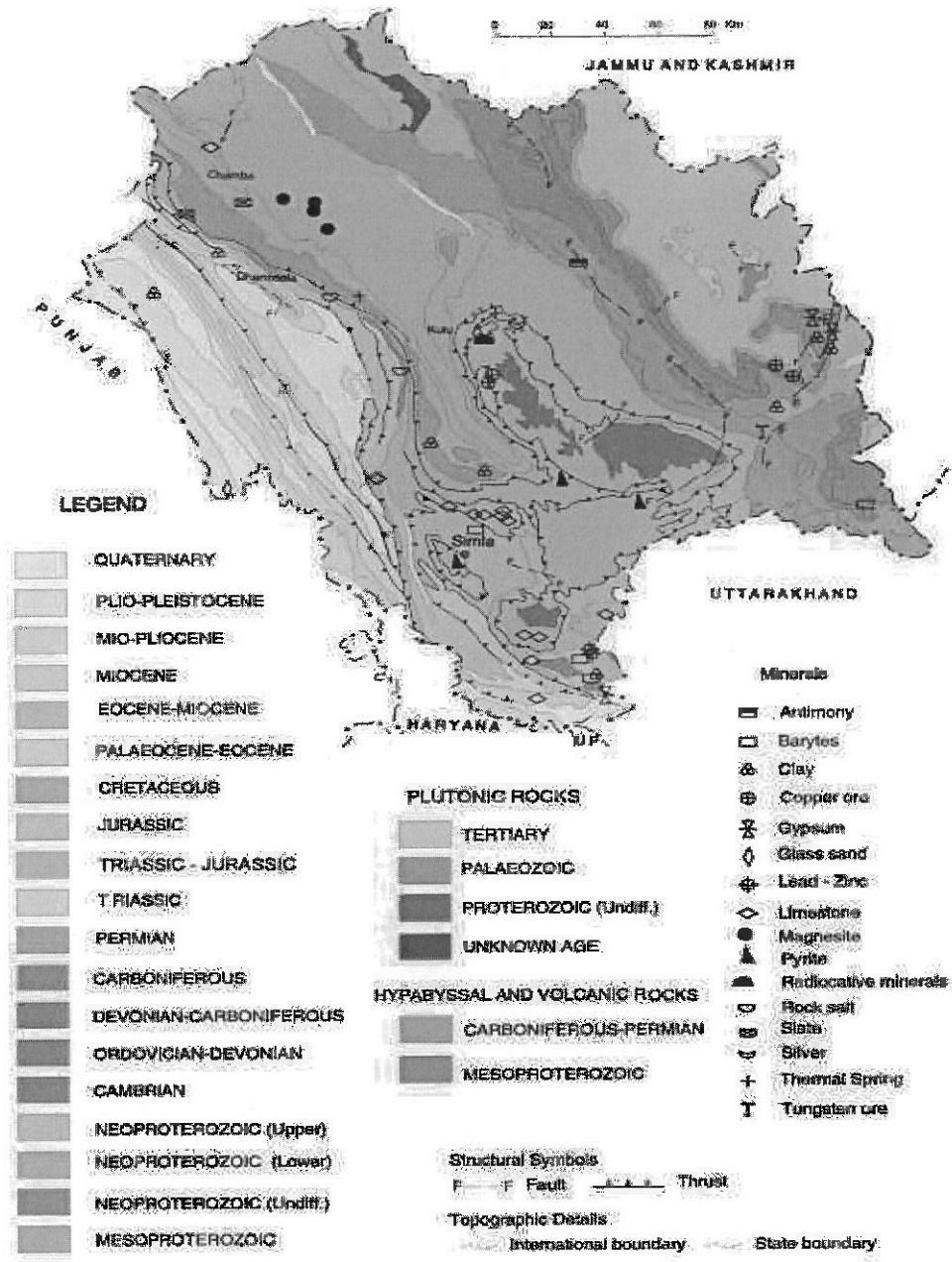
Annexure : 4 Digital Elevation Map



Annexure : 5 Watershed Map



Annexure : 6 Geological Map



References

1. Assessment Guidance Manual for mineral beneficiation prepared by Administrative Staff College of India, Hyderabad. (February 2010)
2. Geological Map of Himachal Pradesh
3. India State of Forest Report - 2017

