

EXECUTIVE SUMMARY

of

EIA/EMP REPORT

for

Expansion of Alumina Refinery Plant

From 1 MMTPA to 6 MMTPA

Of



VEDANTA ALUMINIUM LIMITED

LANJIGARH, KALAHANDI, ORISSA

Prepared By

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Introduction

Vedanta Aluminium Ltd (VAL), Lanjigarh is operating 1 MMTPA Alumina Refinery at Lanjigarh, Dist. Kalahandi, Odisha state since August 2007. This alumina refinery is the first zero discharge alumina refinery and meeting all Environmental norms with regards to air, water & noise pollution. The refinery is accredited by BSI for ISO-9001:2008, ISO14001:2004, OHSAS 18001:2007 and EnMS 50001:2011.

Kalahandi is one of the most backward areas of the country but rich in resources like bauxite. Vedanta Alumina Refinery is the first mega unit which has come up in the Kalahandi District of Odisha after independence. Looking into vast bauxite reserves available in Odisha and particularly around Kalahandi, VAL applied for environmental clearance for expansion of the Alumina Refinery from 1MMTPA to 6 MMTPA on 3rd October 2007 for which TOR was approved on 8th February 2008. As per the conditions of the Terms of Reference, Public Hearing was conducted by the State Pollution Control Board and Local Administration on 29th April 2009 where the project was supported by majority of the people of the area and accordingly the expansion was recommended by SPCB for issue of environmental clearance. The comprehensive EIA incorporating the issues / concerns raised during Public Hearing and action plan to mitigate the same was submitted to MoEF. Based on the comprehensive EIA, the project was placed before the 2nd EAC meeting on 17th August 2009 and it was decided to undertake a site visit to assess the effectiveness of the Environmental Management Plan in place at Lanjigarh so that additional measures if any required for expansion can be included as a part of EC condition. The EAC sub-committee made a visit to the site on 9th July 2010 and recommended updation of EIA based on the observations as recorded in 13th EAC meeting held on 26 – 28 August 2010.

During this time, a progress of nearly 50 – 55% was already achieved at site and the same was communicated to MoEF post 2nd EAC meeting. MoEF vide letter dated 2nd February 2012 issued new conditions and advised for submitting the EIA again as some construction was undertaken before issue of final Environmental Clearance.

The present EIA report is an updation of EIA report earlier submitted with respect to the following:

1. Incorporation of points raised during site visit of EAC undertaken on 9th July 2010 and as recorded in 13th EAC meeting held on 26 – 28th August 2010.
2. The additional studies recommended by MoEF as a part of new conditions issued vide letter dated 2nd February 2012.
3. The additional points and analysis suggested by MoEF as a part of new conditions issued vide letter dated 2nd February 2012.

As there is no change in project capacity, site, scope of work, technology, process, environmental loadings and land use pattern as envisaged in the earlier EIA report, no remodeling has been made to assess the ground level concentration and environmental impacts.

It is estimated that the proposed Alumina refinery expansion will have a capital expenditure to the tune of around Rs. 8,000 Crore. The Bauxite supply to the plant will be met partly from the mine located at Lanjigarh around 3.7 km (aerial) from the plant site and balance will be met

either from other bauxite deposits located around the plant as well as by outsourcing bauxite from other part of the country.

The executive summary represents a brief outline of Comprehensive Environmental Impact Assessment of the proposed expansion project.

HIGHLIGHTS

A. PROJECT

Product	:	a) Alumina b) Power for captive consumption
Site	:	Lanjigarh, Dist- Kalahandi, Orissa
Production capacity	:	Expansion of Alumina Refinery by from 1 MMTPA to 6 MMTPA and Power from 75 MW to 285 MW
Raw materials	:	Bauxite, Caustic Soda, Lime
Fuel	:	Fuel Oil will serve as fuel for kiln and Coal for Co-generation plant
Water	:	River Tel
Power & other utilities	:	Additional Captive Power Plant of capacity 210 MW
Employment Potential due to Expansion	:	Construction – Approx. 8000 Operation – 3500
Estimated Project Cost	:	Rs. 8000 Crores

B. ENVIRONMENTAL ASPECTS

Based on the reconnaissance survey and the following considerations, the sampling locations for baseline data generation were identified:

- Predominant wind directions in the study area as recorded by India Meteorological Department (IMD) at Bhawanipatna and site specific data at Lanjigarh;
- Topography, location of surface water bodies like ponds, canals and rivers;
- Location of villages/towns/sensitive areas;
- Accessibility, power availability and security of monitoring equipment, pollution pockets in the area;
- Areas which represent baseline conditions.

Field studies were conducted to determine existing conditions of various environmental attributes as outlined below.

ENVIRONMENTAL ATTRIBUTES AND FREQUENCY OF MONITORING ADOPTED

Sr. No.	Attribute	Parameters	Frequency of Monitoring
1	Ambient air quality	TSPM, RPM, SO ₂ and NO _x	The monitoring was carried out at ten locations at a frequency of 24 hourly samples twice a week for four seasons.
2	Meteorology	Wind Speed and Direction, Temperature, Relative Humidity, Rainfall & duration and other non instrumental observations like visibility, hail, thunder storms, dust storms, fog and smog.	a] Continuous with hourly recording through setting up of site specific meteorological station; b] Data collected from secondary sources like IMD station at Bhawanipatna
3	Water quality	Physical, Chemical and Bacteriological Parameters	Twice during the study period at Sixteen locations covering seven surface water and nine ground water locations
4	Ecology	Existing terrestrial and aquatic flora and fauna	Through field visits
5	Noise levels	Noise levels in dB(A)	Twice during study period at Twelve locations
6	Soil characteristics	Soil profile, characteristics, soil type and texture, heavy metal, NKP value etc	Twice during study period at ten locations
7	Land use	Land use for different categories	Based on data published in latest published district census handbooks and satellite imagery.
8	Socio-economic aspects	Socio-economic characteristics, labour force characteristics and R&R measures proposed	Based on data published in latest published district census handbooks and the R & R finalized with the State Govt.
9	Geology	Geological history	Based on data collected from secondary sources
10	Hydrology (Surface and Ground)	Drainage area and pattern, nature of streams, aquifer characteristics, recharge and discharge areas	Based on data collected from secondary sources and satellite imagery
11	Risk assessment, Disaster Management Plan and Occupational Health and Safety	Identify areas where disaster can occur and identify areas of occupational hazards.	Based on assessment

PROJECT PROFILE

(a) **Location:** M/s Vedanta Aluminium Limited (VAL) proposes to expand the existing Alumina Refinery from 1 MMTPA to 6 MMTPA by adding capacity of 5 MMTPA. The expansion project will be setup within and adjacent to the premises of VAL in Lanjigarh, Orissa. The existing plant site is about 3.7-km (aerial distance) from Lanjigarh and the nearby villages are Kinari, Bandagraha, Kapagraha, Basantapara, Rengopali, Bundel & Sindhabahal. The plant is located on the road connecting state highway SH-6 (Bhawanipatna-Rayagada) to Lanjigarh. Small villages, agricultural lands and grazing lands, mainly surround the site. The nearest railway station is at Muniguda at a distance about 25 km (by road).

(b) **Land Requirement:** The total land requirement for the proposed expansion including the existing plant would be 1552.49 Ha. No forest land will be utilized for the project. The proposed expansion would require additional land to be acquired (about 888 Ha) for accommodating the red mud pond, ash pond, township, railway corridor and green belt as expansion will be limited within the existing plant boundary.

S. No.	Land Use Pattern	Area Existing Plant (Ha)	Area After Expansion (Ha)
1	Main Plant (including storages and green belt)	279.87	420
2	Red mud including green Belt	182.94	783
3	Ash Pond including green Belt	95.42	175.42
4	Township and miscellaneous including green Belt	52.45	80.45
5	Railway line including green Belt	53.81	93.81
	Total	664.49	1552.49

(c) **General process Description:** The proposed expansion of Alumina refinery is to utilize the existing Bayer process, which dissolves the alumina component of bauxite ore in sodium hydroxide (caustic liquor), removes impurities from the liquor and precipitates aluminium-trihydrate, which is then calcined to produce Aluminium oxide (alumina) for use in smelter and other downstream purposes.

(d) **Water Requirement:** Water requirement of the plant, mines and township will be met entirely from Tel River near Kesinga located at about 67-km from the plant site. The existing water requirement of the alumina refinery and township is 14,895 m³/day and after expansion the water requirement will be 56,500 m³/day.

(e) **Man Power:** The total man power requirement for VAL would be around 1200 and its associate partners would be around 2300.

(f) **Raw material:** (Annual usage figures in T/T of Alumina Production)

SPECIFIC RAW MATERIAL CONSUMPTION

PARAMETERS	UOM	1 MMTPA (Existing)	6 MMTPA (After Expansion)
Bauxite (Dry Basis)	T/T	3.1	2.58
Caustic Soda (as Na ₂ O)	Kg/T	110	65
Lime (CaO – 70%)	Kg/T	55	50
Flocculant	Kg/T	0.50	0.40
Furnace Oil / LDO	L/T	72	70
Steam	T/T	2.1	1.9
Coal (3500 Kcal/Kg)	T/T	0.67	0.67
Energy (Aluminium)	KWh/T	280	220

(g) **Project Cost:** The capital cost estimation for this proposed expansion of Alumina Refinery plant will be around Rs. 8000 Crores including the environment management cost.

(h) In view to obtain Environmental Clearance from MoEF, M/s VAL has entrusted the assignment to Global Experts, Bhubaneswar for preparing Comprehensive EIA report. Global Experts has generated baseline data from 1st November 2011 to 29th February 2012 and EIA/EMP report is based on the above baseline data & ToR conditions..

PRESENT ENVIRONMENTAL SCENARIO

For the purpose of preparation of EIA, the base line data on ambient air, water, soil, noise environment of the study area were collected during the study period of 1st November 2011 to 29th February 2012 for 10 km radius considering the plant location as the center. A detailed study of the socio-economic aspects of the study area was also carried out during the said period. The latitude of the place is 19° 43'North and longitude is 83° 24'East The average altitude of the place is 425m.

The site is located at Lanjigarh, Dist Kaladandi in the state of Odisha. The location is well connected with road and rail. As river Vamsadhara is flowing nearer to the location As river Vamsadhara is not perennial , company is presently drawing water from the Tel river which is located 67KM from the site.

The climate in the study region is generally dry and hot and its characteris with seasonal variation of temp ,humidity, rainfall etc.

The maximum and the minimum temperatures recorded during the study period were 34^o OC and 3.9^o C. respectively. The relative humidity varied between MIN 50.3% - MAX 77.50 during the study period.

The average annual rainfall of the study area is 1525 mm & rainfall recorded during the study period in Dec 2011 and Jan 2012 are 5.5mm & 13.5 mm respectively.

AMBIENT AIR QUALITY

Ambient air quality monitoring has been carried out for one season i.e. from 1st November 2011 – 29th February 2012 with a frequency of twice a week for the entire study period. The baseline data of the air environment is generated for the following parameters :

- Particulate matter(PM10 &PM 2.5)
- Sulphur Dioxide (SO₂)
- Oxides of Nitrogen (NO_x)
- Carbon Monoxide

Ambient Air Quality Sampling Locations were chosen based on the predominant wind direction and local topography of the area. The locational details of the sampling stations are as follows:

Code	Name of Sampling	Distance (Km)	Direction	Type of Area
		w.r.t Project site		
A1	Plant Site(Project office)	-	-	Core zone
A2	Plant site (Power Block)	-	-	Core zone
A3	Lanjigarh	4	W	Rural, residential environmental setting with local traffic with cross wind conditions
A4	Kasibari	3.5	NW	Rural, residential environmental setting representing road side (Lanjigarh to Bhawanipatna) crosswind conditions.
A5	Rehab colony	2.5	SW	Rural, residential environmental setting representing road side crosswind conditions.
A6	Rengopali* (Red mud pond)	1.5	SW	Rural, residential environmental setting representing road side crosswind conditions.
A7	Balabhadrapur	6.2	SW	Rural, residential environmental setting representing road side crosswind conditions.
A8	Harikrishnapur	3.8	N	Rural, residential environmental setting representing road side crosswind conditions.
A9	Bijabandali	5.5	E	Rural, residential environmental setting representing road side crosswind conditions.
A10	Mines area (East of Tentulipadar)	3.5	SW	Rural, residential environmental setting representing road side crosswind conditions.

* This location is situated towards down wind direction of the project site.

Summarized Ambient air quality of the study area for WINTER season study period 1st November, 2011 to 29th February, 2012

Locations	PM ₁₀ (µg/m ³)			PM _{2.5} (µg/m ³)			SO ₂ (µg/m ³)			NO _x (µg/m ³)		
	Max	Min	98%	Max	Min	98%	Max	Min	98%	Max	Min	98%
Project Office	51.3	38.2	51.2	27.7	19.3	27.5	8.3	7.3	8.2	9.5	8.1	9.4
Plant site (Power Block)	58.8	52.2	58.6	29.8	22.5	29.7	9.5	8.1	9.4	10.2	9	10.1
Lanjigarh	44.1	36.6	44	18.2	15.5	18.1	7.6	6.5	7.5	8.3	7.4	8.2
Kasibari	33.5	29.5	33.5	13.8	11.1	13.7	6.9	6.1	6.7	6.5	5.7	6.4
Rehab colony	35.6	30.5	35.4	12.2	11.3	12.1	6.9	5.7	9.9	6.8	5.9	6.7
Rengo palli (Red mud)	34.4	30.8	34.2	15.3	12.8	15.2	7.1	6.2	7	6.2	5.4	6.1
Balabhadrapur	33.9	29.4	39.7	15.6	13	15.6	7	6.1	6.9	5.9	4.5	5.8
Harikrishnapur	45.4	37.1	45.4	16.3	14.4	16.2	7.5	6.4	7.4	7.5	6.4	7.4
Bijabandeli	47.3	37.8	47.1	17.9	15.1	17.8	8.1	7.2	8	7.9	7	7.9
Mines Area	46.7	36.3	46.5	16.1	13.7	16	7.8	6.8	6.7	7.6	6.8	7.5
Ranged value	29.4-58.8			11.1-29.8			5.7-9.5			4.5-10.2		
NAAQS	100			60			80			80		

OBSERVATION

Particulate matter (PM₁₀)

The ambient air status observed during the study period is presented in the table above. During the study period, the concentrations of PM₁₀ varied between 29.4-58.8 µg / m³ In core zone the maximum value of PM₁₀ was found in the plant site and in the buffer zone the maximum value was recorded in the Bijabandeli village The 98th percentile values of PM₁₀ ranged between 33.5-58.6 µg / m³ . The value of PM₁₀ was observed to be highest at the Site due to industrial activities. Besides this high, level of PM₁₀ was observed due to heavy vehicular movement. All other sampling station shows that there is slight increase in pm10 concentration in the study area due to local phenomena viz. unpaved roads, heavy vehicular traffic on roads & agricultural activities leading the generation of dust.

Particulate matter (PM_{2.5})

The minimum and maximum concentrations of PM_{2.5} varied between 11.1 (Kasibari)– 29.8 µg / m³(plant site) . The 98th percentile values of PM_{2.5} ranged between 12.1 to 29.7 µg / m³ in the study area.

The 24 hourly average values of PM₁₀ & PM_{2.5} were compared with the national ambient air quality standards and it was found that all the sampling stations recorded values was lower than the NAAQ standard of CPCB. It was observed that during the assessment of ambient air quality status the slight increase of PM₁₀ & PM_{2.5} value were observed at most of the locations due to the local phenomena like dust emanating from unpaved village roads, vehicular activities and dust generating from agricultural activities rather than industrialization.

Sulfer Dioxide (SO₂)

The monitoring value shows that the concentration of SO₂ at all location varied from 5.7(Rehab colony)-9.5 µg / m³(Plant site). The 98th percentile values of SO₂ varied between 6.7 to 9.4 µg / m³ in all the locations.

The 24 hourly average values of SO₂ were compared with the national ambient air quality standards and it was found that all the recorded values of all the sampling locations were much lower than the applicable limit of 80 µg/m³ for the Industrial/residential areas. The SO₂ values in the residential areas can be attributed to the vehicular traffic and unchecked domestic fuel burnings in the villages.

Nitrogen Oxide (NO_x)

The concentrations of NO_x values varied from 4.5 -10.2 µg/m³ the MAXIMUM WAS OBSERVED AT Plant site and the minimum value was observed at Balabhadrapur village. The 98th percentile values of NO_x ranged between 5.8 to 10.1 µg/m³ in the study area.

The 24 hourly average values of NO_x were compared with the National Ambient Air Quality standards and it was found that all the sampling stations recorded values much lower than the applicable limit of 80 µg/m³ for residential areas.

Conclusions

From the ambient air quality monitoring carried out for four months (Nov 2011 & Feb 12) during the study period shows that the critical pollutants like PM₁₀, PM_{2.5}, SO₂ and NO_x & CO are well within the permissible limits. Any slight increase in the pollutant concentrations in the study area may be attributed to vehicular traffic, unchecked domestic fuel burnings etc in the study area.

Summarized Noise Level in the study area

Station code	Location / Village	L _{day} (dBA)		L _{night} (dBA)		L _{daynight} (dBA)	
		Max	Min	Max	Min	Max	Min
N1	Plant site	64.9	58	59.8	46	67.4	57.3
N2	Lanjigarh	52.7	47.8	46.5	41.7	54.5	49.7
N3	Rehab Colony	53	48	45	42.4	53.86	51
N4	Balabhadrapur	54	46	45	42.6	54.4	50
N5	Harikrishnapur	46.2	40	39.7	36	47.8	43.26
N6	Bijabendeli	54	46	42	38.2	52.59	46.5
N7	Kasibari	48.9	46	42.3	41	50.4	47.9
N8	Chhatrapur	46.8	42	41.1	38.5	48.9	45.6
N9	Basanthapada	53.3	48	47.8	42	55.5	49.9
N10	Maskapadar	47.1	45	40.4	39	49	47.9
N11	Rangopali (Redmud)	53.5	50	46.1	45	55.1	52.6
N12	Plant Site (Power Block)	78.2	60	66.6	50	72.2	60

Standards with respect to Ambient Noise Level

Land use category	Limit in dB(A)	
	Day time (7 AM to 10 PM)	Night time(10 PM to 7 AM)
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence area	50	40

Discussions

As expected, the noise levels at plant locations are higher than the buffer zone locations. Both day time and night time noise levels are well within the limits as mentioned above. Further reduction of ambient noise level the newer technological implementation like installation of acoustic enclosure at high noisy area and better working environment will further reduce the work zone noise levels. Therefore no noise pollution is anticipated in any form from the proposed expansion project.

The Day-Night noise levels at Plant Site and the Lanjigarh Village are symptomatic of the operations at Plant Site and General Traffic conditions near the village areas. This is further to be noticed that including the operational phase in the plant, the noise levels are well within the permissible limit. Further the spiked increase of noise levels in Plant Site has little or no effect on the peripheral areas.

All the noise levels are well within the limits as specified in the Ambient Noise level standards. Hence it can be inferred that there is no deterioration in the ambient noise levels.

(h) Water Environment

Surface and Ground Water Sampling Locations

Sl. No.	Code	Location	Distance (KM)	Direction
			w.r. t proposed plant site	
Surface water				
1	SW1	Stream near. Tetulipadar	5.8	SW
2	SW2	Stream near Kenduguda	2.0	W
3	SW3	Stream near Rengopali [#]	2.0.	S
4	SW4	* Vansadhara river near Lanjigarh	4.0	W
5	SW5	Vansadhara river near Chatrapur	1.6	N
6	SW6	Vansadhara river near Balabhadrapur	4.0	E
7	SW7	Near Harikrishnapur	2.2	N
8	SW8	Near Maskapadar	2.1	NW
Ground water				
1	GW1	Plant Site		
2	GW2	Bore well at Lanjigarh	4	W
3	GW3	Bore well at Rengopali [#]	2	S

4	GW4	Bore well at Chhatrapur*	1	N
5	GW5	Bore well at Chanalima	1.7	WNW
6	GW6	Bore well at SW of Redmud pond	1.5	SW
7	GW7	Bore well at south of Ash pond	4.0	NW
8	GW8	Bore well at Process Water Lake	1.6	NW
9	GW9	Bore well at Batelima	4.0	E
10	GW10	Bore well at Basantpara	2.2	S

* upstream

downstream w.r.t. to plant site

Considering the location of the plant site, Chatrapur location (North of the core zone) is considered as downstream for both surface water and ground water and Rengopali location (South of the core zone) is considered as upstream for both groundwater and surface water quality studies with reference to the River Vamsadhara. The River Vamsadhara is referenced for the surface water quality study for pollutant load analysis due to the existing plant and for future estimation of the proposed expansion. The surface water quality varies with seasonal fluctuations in pH, Alkalinity, Hardness, considering the River Vamsadhara as reference. The adjacent groundwater locations have a similar trend in the water quality as the surface. Mostly the downstream water quality for both surface water and ground water shows a form of dilution in concentration, for which the downstream concentrations are lower than the upstream concentrations both in pre-monsoon and post-monsoon seasons. Therefore it can be inferred that the net effect from the proposed project will have a minimum impact on the water quality of the area.

(i) Soil Quality

Sampling Locations for Soil

Sr. no.	Code	Location	Distance from plant(km)	Direction
1	S.S.L.1	Plant Site		
2	S.S.L.2	Lanjigarh	4.0	W
3	S.S.L.3	Rengopali	2.0	S
4	S.S.L.4	Chhatrapur	1.6	N
5	S.S.L.5	Chananlima	1.7	WNW
6	S.S.L.6	Redmud	1.5	S.W
7	S.S.L.7	Ashpond	4.0	NW
8	S.S.L.8	Process Water Lake	1.6	NW
9	S.S.L.9	Bundel	4.0	W
10.	S.S.L.10	Rehab colony	3.0	SW

It has been observed that the pH of the soil Quality ranges from 6.52-7.24 indicating the soil is Neutral in nature & good for cultivation. The Bulk density of soil ranges from 0.782 to 0.9248. The Electrical conductivity was observed to be in range of 122.7 -193.9 $\mu\text{s}/\text{cm}$, which is average for crop growth, with minimum 122.7 $\mu\text{s}/\text{cm}$ observed at Plant Site and maximum of 193.9 $\mu\text{s}/\text{cm}$ observed at Lanjigarh. Organic matter having the range between 1.4 – 2.11 indicate that the soil in the area contain sufficient quantity of organic carbon. The Nitrogen Values ranged between 2.1-3.0 mg/kg indicating that the soil contains good quantity of nitrogen that is considered as fertile. The phosphorus value ranging between 0.8- mg/kg indicating that the soil is having fair amount of phosphorous which is suitable for cultivation.

Overall soil quality of the area does not vary much within the whole buffer and core zone. Further the pH and nutrient content of the soil indicates that there is none or minimal effect

due to the existing red mud pond and ash pond. This further indicates that there is no leakage or overflow from the red mud pond and ash pond to any land mass nearby. Therefore it may be inferred that the proposed expansion will have none or minimal effect on soil pollution of the area and therefore any groundwater contamination as a subsequent result.

(j) Ecological Assessment

Details of Terrestrial Ecological Sampling Locations

Station Code	Name of the Station	Distance from the Plant Site (km)	Direction
TE-1	Lanjigarh village	4.0	W
TE-2	Kasibarhi village	3.5	NW
TE-3	Niyamgiri Vedanta nagar	2.5	SSW
TE-4	Balabdrapur village	6.2	SW
TE-5	Harikrishnapur village	3.8	NE
TE-6	Bijamendeli village	5.4	E
TE-7	Bhaliapadar village	11.0	SE
TE-8	Trilochanapur village	10.5	SW
TE-9	Hill Top(Mine area)	5.0	S

Details of Dominant Plant Species around Plant Site

Name of the Plant Species	Local Name
Shorea robusta	Sal
Acacia Arabica	Babul
Acacia auriculaeformis	Akasia
Albizia odoratissima	Tinia
Albizia procera	Tentra, Dhal siris
Anogeissus latifolia	Dhaura
Bambusa arundanacea	Daba bans
Bauhinia malabarica	Koteli
Bauhinia racemosa	Ambalata
Bauhinia variegata	Kanchana
Boswellia serrata	Salai
Cassia fistula	Sunari
Cassia siamea	Chakunda
Mangifera indica	Aam
Emblica officinalis	Anla
Euphorbia nivula	Sijju
Ficus hispida	Burgad
Terminalia arjuna	Kahun
Tamarindus indica	Imli
Terminalia chebula	Chebula
Citronella sp	Cironella
Raoulfia serpentina	sarpagandi
Androgarphis paniculata	Acanthaceae
Costus speciosus	Zingiberaceae
Crotalaria epunctata	Fabaceae
Curcuma angustifolia	Zingiberaceae
Curcuma aromatica	Zingiberaceae
Aregemone mexicana	Papaveraceae

Fauna and their conservation status from study area (10 km radius)

On comparison of the check list given in the Schedule-I of the Wild Life Protection Act (1972) and the list of wildlife recorded in the study area, it was found that 7 species of schedule-I and 9 species of schedule II exist in the study area.

Details of Aquatic Sampling Locations

Sr. No.	Code	Locations	Remarks
1	AE-1	River Vamsadhara near Lanjigarh village	Fresh water
2	AE-2	Nala near plant boundary	Freshwater

List of Planktonic Flora and Fauna in Study Area

Phytoplankton	Zooplankton
Gyrosigma sp	Keratella monospina
Achananthes affinis	Brachirous caudatus
Gyrosigma acuminiatus	Asplancha brighwell
Pandorina sp	Colpidium colpoda
Ankistrodesmus falcatus	Daphnia sp
Ankistrodesmus var.tumidus	Ceriodaphnia reticulata
Pediastrum boryanum	Mesocyclops leuckarti
Scenedesmus bijuga	Mesocyclops hyalinus
Melosira granulate	Coleps hirsutus
Cyclotella meneghiana	Arcella sp
Microcystis sp	Actinophyros sp
Navicula gracilis	Asplancha sp
Nitzschia gracilis	Ceriodaphnia sp
Chroococcus minutus	Mesocyclops sp
Spirulina princepes	-
Pinnularia braunii	-
Synedra tabulate	-
Amphora sp	-
Cymbella sp	-
Navicula radiosa	-
Chlorococcum sp	-
Pediastrum duplex	-
Pleurosigma sp	-
Facus sp	-
Euglena sp	-

During field survey, maximum 451 numbers of plant species are studied and their analysis is presented below.

Class Wise Distribution of Plant Species in the Study Area

Type of Species	Winter season and pre-monsoon seasons	
	No.	%
Phanerophytes (P)	221	49.00
Therophytes (T)	134	29.71
Hydrophytes (H)	16	3.55
Hemicyptophytes (He)	50	11.09
Geophytes (G)	10	2.22
Epiphytes	20	4.43
Total	451	100

In the study area, maximum number of species are phanerophytes (49.00) followed by therophytes (29.71%). These classes are followed by hemicryptophytes (11.09%) and epiphytes (4.43%). Geophytes and hydrophytes were found in very few numbers.

Presence of large number of phanerophytes (shrubs and trees) and therophytes (annuals or herbaceous vegetation) indicates semiarid to tropical vegetation structure.

Hemicryptophytes (predominantly grasses and sedges) were found to be significant in the area. These indicate fertile and wet soil in upper layer of soil profile. Hydrophytes were present in both the seasonal and perennial water bodies. A study on biodiversity by www.ibatforbusiness.com indicates that Lanjigarh & 10 KM surrounding area does not fall under any of the IUCN category and thus, does not have any endangered species.

(k) Socio- Economic Analysis

From the Socio-economic survey it is found that total worker-51.2%, Non worker-48.71%.The literacy rate is 25.2%.

IMPACT IDENTIFICATION

The Construction, operation and future activities are considered to identify the possible impact. The proposed Alumina refinery plant expansion project will take up the debottlenecking of the existing plant including that of pollution control equipment and incorporation of latest innovative design features in the expansion project to increase production, to improve productivity and to minimise the adverse impacts of the environment pollution. The environmental attributes that may be affected due to the construction and operation of the proposed project are:

- Air Environment
- Noise Environment
- Surface Water Environment
- Ground Water Environment
- Discharge of wastewater
- Land environment
- Biological Environment
- Socio-Economic and Cultural Environment
- Infrastructure
- Aesthetics

The matrix method has been chosen to list the potential impacts of the proposed project. The activities have been arranged in columns and the environmental attributes in the row of the matrix.

ACTIVITY	CONSTRUCTION			OPERATION			POST OPERATION		
	Earth Work	Mechanical Fabrication	Labour Force	Raw Material Handling and storage	Manufacturing Process	Pollution Control and Env. Mgt.	Industrialisation	Transport	Urbanisation
Air	-			-	-	+	-	-	-
Surface water Quality	-		-	-	-	+	-		-
Ground water quality	-			-	-	-	-		-
Water resources			-		-		-		-
Noise	-	-		-	-		-	-	-
Soil	-			-	-	-			
Land Use	-			-		-	-		-
Ecology	-					-	-		
Economic benefits	+	+	+		+		+	+	+
Employment	+	+	+	+	+		+	+	+
Infrastructure development	+			+			+	+	+
Peripheral social development			+			+	+		+
Health safety	-	-	-		-		-	-	+
Aesthetic	-			-	-		-	-	-
Displacement and rehabilitation	-			-			-		-

- **Negative or adverse Impact**
+ **Positive or beneficial Impact**

IMPACT PREDICTION AND EVALUATION

Sources and Type of Pollution from the Proposed Project

Sr.	Unit	Emissions		
		SO ₂ (kg/hr)	NO _x (kg/hr)	SPM (kg/hr)
1	Calciner [from each stack]	575 (with 3.5% S)	37.5	7.8 (after ESP with 95% of efficiency)
2	Co-generation plant	1245 (with 0.5%S)	-	120 (after ESP with 95% efficiency)
3	Bauxite transport and crushing	-	-	Bauxite dust 3.2
4	Coal handling area	-	-	Coal dust 4.7
5	Lime handling area	-	-	Lime dust 0.68 based on the lime usage in T/T of Alumina production

ENVIRONMENTAL IMPACTS DURING CONSTRUCTION

Potential Impacts with Probable Source

Discipline	Potential Impacts	Probable Source
Water Quality	Increase in suspended solids due to soil run-off during heavy precipitation	Soil Erosion
Air Quality	Increase in dust and NO _x concentration	Heavy vehicular movement
Noise	Increase in noise level	Construction equipment
Terrestrial Ecology	Clearing of Vegetation	During construction
Aquatic Ecology	Impact on surface and ground water resources	No specific Impact is predicted

Impact on Air Quality

Resultant GLC at maximum predicted concentration location is as follows, which are well within the permissible limits.

Resultant GLC (Model output) for worst case scenario

Pollutant parameter	Back ground GLC in $\mu\text{g}/\text{Nm}^3$ at sampling site.(9000,11150) At vill Kasibari	Max. predicted incremental GLC $\mu\text{g}/\text{Nm}^3$	Max. predicted resultant values of GLC in $\mu\text{g}/\text{Nm}^3$	NAAQS/Industrial residential area norm $\mu\text{g}/\text{Nm}^3$
Existing plant facilities				
PM10	33.5	1.8	35.3	100
PM2.5	13.8	1.16	14.86	60
SO ₂	6.7	17.28	23.98	80
NO _x	9.5	8.25	17.75	80

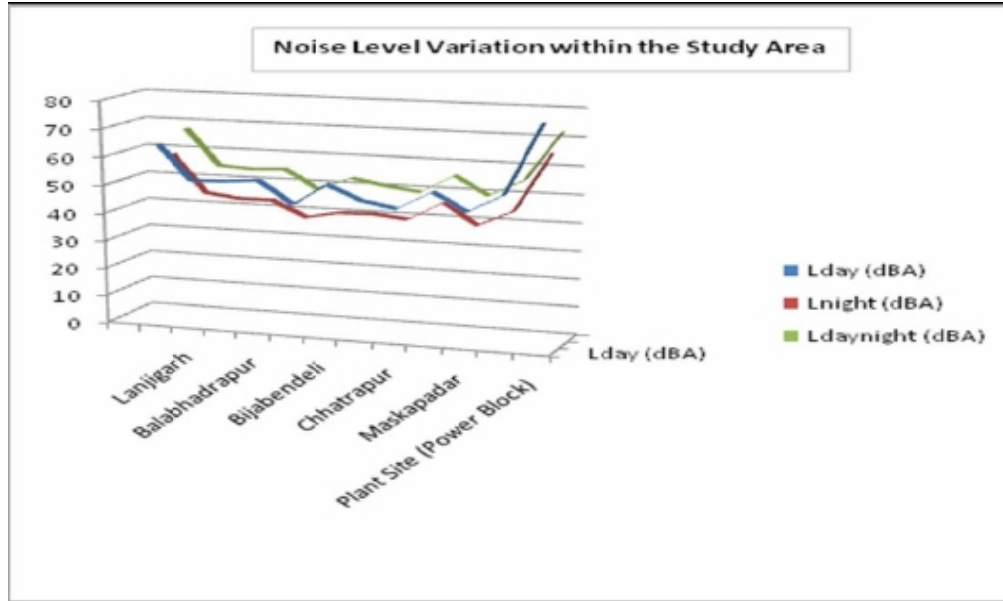
Modeling results after expansion				
PM10	33.5	3.29	36.79	100
PM2.5	13.8	2.14	15.94	60
SO ₂	6.7	20.16	26.86	80
NO _x	9.5	12.82	22.32	80

Impact on Noise Environment

The Day-Night noise levels at Plant Site and the Lanjigarh Village are symptomatic of the operations at Plant Site and General Traffic conditions near the village areas. This is further to be noticed that including the operational phase in the plant, the noise levels are well within the permissible limit. Further the spiked increase of noise levels in Plant Site has little or no effect on the peripheral areas.

The construction equipment may have high noise levels, which can affect the personnel, operating the machines. Use of proper personal protective equipment will mitigate any significant impact of the noise generated by such equipment.

Noise Level Variation within the study area



Impact on Water Environment

The entire treated wastewater will be reused in the process. Thus, the impact on water resources is not likely to be significant.

Impact of Solid Waste

The main source for solid waste generation is in the form of Red Mud and Ash from the refinery and CGPP respectively.

Process Solid Waste

Solid Waste	Source of Solid Waste	Unit of Measure	Quantity	Mode of Disposal
Red Mud	Settler & washer	MMTPA	7.5	Red Mud Pond via HCSD System
Ash	Coal Fired Boiler	MMTPA	0.86	It will be sold to down stream industries like cement, brick making and agriculture. The balance will be disposed off to ash pond using High Concentration Slurry Disposal system
MSW (Municipality Solid Waste)	Domestic	TPD	6.7	Composting Facility
Sewage Sludge	Domestic	Kg/day	60	The organic portion of solid generated in the STP will be used as manure in greenbelt development after composting

Non Process Hazardous Waste

SL No	Name of Hazardous Waste	Existing generated per year (Approximate)	To be generated per year (Approximate)	Disposal Method to be adopted
1	Used oil	150 KL	280 KL	Selling to Registered Recyclers
2	Oily cotton waste	2000 Kg	8000 Kg	Fire in Boiler
3	Used oil filters	150 nos	280 nos	Sold to recyclers
4	Used batteries	400 nos	900 nos	Buy Back System with the manufacturers
5	Spent Resins from DM Plant	4500 ltrs (within a period of 5 year)	10200 ltrs (within a period of 5 year)	Will be given to authorized reprocessors or disposed in Engineering Landfills

The company is not to acquire any forest land for any of its operation and activities purpose. Adequate green belt will be developed in and around the plant site which not only will act as pollution sink but also improve the ecology and aesthetics of the region. Hence no adverse impact would occur to terrestrial as well as aquatic ecology.

There will be appreciable beneficial impact on human environment. There will be lot of employment opportunity both in organized and unorganized sector. The company will give preference to local people with respect to employment. The project activity will infuse lot of funds in the area, which will generate lot of economic and business activities that will help local people. Because of flow of people, transportation of raw materials & product there will be lot of development work in the field of road network, communication and other infrastructure development. There will be other beneficial impacts in social sectors like health and education.

With respect to Impact quantification, the total Impact score (TIS) of the project without environment management plan (EMP) is found to be -503 indicating the need for comprehensive EMP. The TIS of the project action with EMP found to be 2404.76 indicating the acceptance of the project with suitable EMP measure.

ENVIRONMENTAL MANAGEMENT PLAN

The comprehensive EMP as a management tool will take up the action plan starting from raw materials beneficiation stage to marketing of the products through series of action steps like process optimization, preventive maintenance, good house keeping, waste minimization, energy conservation, environmental awareness & training and adequate pollution control measures etc.

EMP at design stage will incorporate latest cost effective technology to maximize production and minimize waste generation.

The suitable EMP measures will be taken up to alleviate the short term pollution problems during construction phase. The alumina refinery and coal based power plant will be prone to major air pollution problems with regard for particulate matter, SO₂ and NO_x. The comprehensive EMP will take care of the problem with each individual unit.

The ESP's attached to calciner and Power Plant will effectively reduce the particulate emission within the statutory norms. Water sprinkling, provision of separate haul road for raw material carrying vehicles etc, will control the fugitive dust emissions.

SO₂ emission from power plants will be controlled with the use of low Sulphur coal and providing suitable stacks with adequate height as per CPCB norms. NO_x emission will be managed at the design stage with the use of low temperature design equipment.

The hot wastewater from different plant units will be cooled in respective cooling towers and the same is recirculated to the process system. Only make up water will be provided to closed circuit cooling system to compensate evaporation and transit losses.

The CGPP will consume lot of water for boiler water circuit, equipment cooling and ash handling. However closed circuit boiler condenser system will require much less amount of makeup water, so also makeup water will be required for closed circuit cooling water system. The wastewater from ash handling system will be treated in settling ash pond. The overflowing water is recirculated to ash handling system. The treated water from sewage treatment plant will be used for Green Belt Development.

Thus with suitable conservation techniques and water management practices VAL envisaged a zero discharge norm.

The Alumina refinery plant will consume considerable amount of bauxite and minerals and consecutively will generate large amount of solid waste. However VAL will take up a comprehensive solid waste management plan in the form of recycling, reuse and integrated land development plan.

The company will take up several ash utilization schemes to utilize ash generated from CGPP. Adequate land, if required, will be acquired for solid waste disposal and ash pond.

This will provide more direct and indirect employment to local population. The company will invest considerable amount of fund in infrastructure development, peripheral development, which will definitely improve the socio-economic condition of the people.

Green belt will be developed with native plant species in the 1/3rd of the total area. The green belt will be developed along the boundaries, vacant spaces. The green belt will not only act as a pollutant sink but will also attenuate noise level, reduce dust level but also improve ecology and aesthetics.

Risk Assessment & Disaster Management Plan

The environmental risk assessment will identify the potential area of hazardous and environmental disaster, which will enable for safety planning and design to minimize the accidents and disastrous events.

A well planned, disaster management program and on site emergency plan will be taken up to manage emergency situation of any disaster event if occurs during the plant operation. The existing DMP shall be suitably updated to take care of the expansion project.

Environment Management System & Implementation of EMP

The company has a department for Environment, Health & Safety (EHS) headed by a senior executive in the level of General Manager. The dept. has a full-fledged laboratory and

POST EMP SCORE

Environment Components	PIV	Civil Construction	Mechanical Work	Raw Material & Product Handling, Stores & Transportation	Plant Operation	Civic amenities	Total	Impact Score
Ambient air Quality	105	-	-	-1	--1	-	-2	-210
Surface water Quality	79	-	-	-1	-1	-	-2	-158
Surface water Resources	53	-	-	--	--	-	0	-
Ground water Quality	53	-	-	-1	-1	-	-2	-53
Noise Quality	53	-	-1	-1	-1	-	-3	-159
Soil Quality	79	-	-	-1	-1	-	-2	-158
Land use Pattern	53	-	-	-1	-1	+1	-1	-79
Flora & Fauna	53	-1	-	-1	-2	+1	-3	-159
Aesthetics	79	-	-	-1	-2	+1	-2	-158
Human Health & Safety	53	-	-1	-1	-1	+1	-2	-106
Total Impact Score (TIS)								-1240

Total Impact Score (TIS) for Project activities with comprehensive EMP and project benefits

<i>Project activities</i>	<i>PIV</i>	<i>Land acquisition</i>	<i>Mechanical Work</i>	<i>Raw material & product handling, stores & Transportation</i>	<i>Plant Operation</i>	<i>Civic amenities</i>	<i>Total</i>	<i>TIS Score</i>
<i>Environment Components</i>								
<i>TIS with EMP</i>								-1240
<i>Employment</i>	105	-	+1	+2	+2	-	+6	+525
<i>Trade & Commerce</i>	105	-	+1	+2	+2	-	+5	+525
<i>Infrastructure Development</i>	79	-	-	+1	+1	-	+3	+158
<i>Social & Educational Development</i>	26	-	-	-	+1	+2	+3	+78
Total Positive Impact Score								+1444
Final Total Impact Score								+46

Note: TIS: Total Impact Score Before EMP; Impact Score: Total Impact Score After EMP

VAL since its inception has been conscious about the environment protection in and around its industrial operation and in persuasion of this, it organizes environment protection awareness camps and observes plantation week ensuring participation of the community and the employees. Further as a responsible corporate, VAL always try to go beyond the regulatory requirements and always strive to achieve the best in the environmental and social field. Accordingly, an independent audit was carried out by world renowned consultant namely Environment Resource Management regarding the practices being followed at Lanjigarh with reference to International Best Practices recommended by institutions like IFC, EP, ICMM, EHS Guidelines & OECD and observed that majority of the guidelines have been recommended at Lanjigarh.