EXECUTIVE SUMMARY

of

REIA/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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M/s Vedanta Aluminium Limited (VAL) a part of the US$ 6 billion Vedanta Resources Plc, a London Stock Exchange listed FTSE 100 diversified metals and mining company, which has set up an Alumina Refinery of 1 MMTPA capacity at Lanjigarh, Dist. - Kalahandi, Orissa is proposing for its expansion to 6 MMTPA Alumina production.

The summary presents a brief outline of Rapid Environmental Impact Assessment (REIA) findings of the proposed expansion project of M/s Vedanta Aluminium Limited.

HIGHLIGHTS

A. PROJECT

Product	:	a) Alumina b) Power for captive consumption
Site	:	Lanjigarh, Dist- Kalahandi, Orissa
Production capacity	:	Expansion of Alumina Refinery by 5 MMTPA and 210 MW Power
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	:	Captive Power Plant of capacity 210 MW
Employment Potential	:	Total manpower-3700 including associates
Estimated Project Cost	:	Rs. 6500 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, Bandagruha, Kapagruha, Basantapara & 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 2007.72 Ha. No forest land will be utilized for the project. The proposed expansion would require additional land to be acquired (about 1343 Ha) for accommodating the additional facility of the plant, red mud pond, ash pond, township and railway corridor.

Existing land (1.0 MMTPA)			**Additional land (6MMTPA)**		**Total Land Usage**	
Purpose	**Ac**	**Ha**	**Ac**	**Ha**	**Ac**	**Ha**
Main Plant	691.58	279.87	348	140.84	1039.58	420.71
Red Mud	452.06	182.94	2200	890.34	2652.06	1073.28
Ash Pond	235.79	95.42	541	218.94	776.79	314.36
Township	129.61	52.45	70	28.33	199.61	80.78
Railway	132.96	53.81	160	64.75	292.96	118.56
Total	**1642**	**664.49**	**3319**	**1343.2**	**4961**	**2007.69**

(c) **General process Description:** The proposed expansion of Alumina refinery is to utilize the 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 m^3/day and after expansion the water requirement will be 56,250 m^3/day which includes water for the proposed mines.

(e) **Man Power:** The total man power requirement for VAL would be around 1200 and its associate partners would be around 2500.

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

RAW MATERIALS	**UOM**	**1 MMTPA (Existing)**	**6 MMTPA (After Expansion)**
Bauxite (Dry Basis)	T/T	2.61	2.58
Caustic Soda (as Na_2O)	Kg/T	70	65
Lime (CaO – 70%)	Kg/T	44	50

(g) **Project Cost:** The capital cost estimation for this proposed expansion of Alumina Refinery plant will be around Rs. 6500 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 Rapid EIA/EMP report. Global Experts has generated baseline data from 1st March 2007 to 29th February 2008 and accordingly prepared the EIA/EMP report.

PRESENT ENVIRONMENTAL SETTING

For the purpose of preparation of rapid EIA, the base line data on ambient air, water, soil, noise environment of the study area were collected during the study period of 1st March 2007 to 29th February 2008 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.

(a) The study area covers an area of 227.02 sq. km (22702.73 ha) within the circle encompassed by 10 km radius around the proposed plant site. The land use pattern has the general features having irrigated land-1.9%, un-irrigated land-42%, Cultivable waste land-13.4%, Area not available for cultivation-28.8% and forest land-14%.

(b) During the pre monsoon season (March - May) the temperature was found to be 41.5^{0}C in April (maximum) & 15.0^{0}C in March (minimum). During the monsoon season (June - September) the maximum temperature was 41.5^{0}C in June and minimum 21.0^{0}C in August and during Post Monsoon season (October - November) it has been observed that the maximum temperature was 39.0^{0}C in October and minimum temperature was found to be 15.0^{0}C in November. During winter season (December - February) maximum temperature was 32.7^{0}C in February and minimum temperature was 8.4^{0}C in January.

(c) During the Pre- Monsoon period it has been observed that Relative Humidity was 76.0% (maximum), 13.5% (minimum) respectively. During the Monsoon period the relative humidity was found to be 92.2 % (maximum) & 63.6 % (minimum). During the post monsoon period the maximum and minimum Relative Humidity varied between 88% & 32% respectively and during the winter season maximum and minimum Relative Humidity varied between 81.8% and 38.3% respectively.

(d) During pre-monsoon period the total rainfall recorded was 107 mm. During the monsoon period the maximum rainfall recorded was 802 mm (i.e. during the month of August) and minimum was 146 mm (i.e. during the month of July). During the post-monsoon period the total rainfall recorded at the project site was 234 mm and during the winter season total rain fall recorded was 15 mm.

(e) The overall study of the meteorology of the area has about 25%-30% deviation from the nearest meteorological station at Bhawanipatna. This variation is attributable to the distance and topographical characteristics of the study area as compared to the area of the IMD Station. The summarized wind pattern data for the whole year is as follows:

Period: 1st March 2007 to 29th Feb 2008 **Location**: At Plant Site

Season	**First Predominant Wind Direction**	**Location**	**Second Predominant Wind Direction**	**Predominant Wind Speeds (Kmph)**	**Calm (%)**
Pre-monsoon	SE [15.5%]	Plant Site	ESE [12.8%]	0.92 to 3.54 0.63 to 14.29	6.34
Monsoon	SW [27.5%]	Plant Site	SE [10%]	7.56 to 20.5 7.56 to 8.28	8.30
Post-monsoon	SW [14.5%]	Plant Site	SE [11.2%]	0.82 to 3.12 0.72 to 11.29	15.10
Winter	NNE [50.4%]	Rangopalli	NE [27.5%]	0.5 to 2.1	14.10

(f) 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 Stations	Distance (Km) w.r.t Project site	Direction	Type of Area
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 (Annual) Ambient air quality status of RPM and SPM Of the study area

Locations	SPM(µg/m^3)					RPM(µg/m^3)			
	Max	Min	Avg	98%	PAH*	Max	Min	Avg	98%
Project Office	325.1	110.6	217.85	295.3	BDL	98.8	60.4	79.6	98.4
Plant site (Power Block)	396.2	141.2	268.7	365.3	BDL	145.4	64.3	104.85	125.7
Lanjigarh	193.1	82.8	137.95	162.5	BDL	88.3	42.8	65.55	72.8
Kasibari	116.5	48.6	82.55	96	BDL	66.6	22.4	44.5	57.5
Rehab colony	150.6	130.5	140.55	146	BDL	73.4	70.7	72.05	72
Rengo palli (Red mud)	192.4	102.6	147.5	191.4	BDL	94.6	64.8	79.7	92.8
Balabhadrapur	209.9	97.7	153.8	197.9	BDL	91.8	63.8	77.8	86.2
Harikrishnapur	174.9	121.4	148.15	172.8	BDL	76.4	54.2	65.3	75.8
Bijabandeli	206.8	148.6	177.7	189.5	BDL	98.8	68.8	83.8	97.8
Mines Area	146.7	54.8	100.75	120.8	BDL	65.5	30.8	48.15	51.4

** PAH was monitored in the month of May 2008.*

Summarized (Annual) Ambient air quality status of SO_2 and NOx of the study area

Locations	SO_2 (µg/m^3)				NOx (µg/m^3)			
	Max	Min	Avg	98%	Max	Min	Avg	98%
Project Office	18.8	11.6	15.2	17.3	29.8	15.2	22.5	29.6
Plant site (Power Block)	26.5	12.4	19.45	24.8	41.6	20.6	31.1	39.2
Lanjigarh	12.3	6.8	9.55	9.7	14.3	10.5	12.4	13
Kasibari	7.2	4.8	6	6.4	12.1	8.4	10.25	11.2
Rehab colony	8.2	6.3	7.25	7.9	14.1	11.4	12.75	13.2
Rengo palli (Red mud)	18.5	11.6	15.05	17.9	34.3	15.6	24.95	34.1
Balabhadrapur	10.4	5.2	7.8	8.1	14.9	10.2	12.55	13.1
Harikrishnapur	8.9	5.8	7.35	8.2	13.2	8.7	10.95	12.8
Bijabandeli	8.5	5	6.75	7.4	13.3	8.9	11.1	12.1
Mines Area	9.2	5	7.1	8.6	15.5	9	12.25	14.1

As observed from the ambient air quality monitoring in and around the plant site, it is observed that the SPM and RPM concentrations are within the Industrial permissible Limit at plant site and red mud pond areas mostly during post-monsoon and winter periods. In alignment with SPM & RPM, the SO_2 and NOx values are comparatively higher in the same areas during the same period but are well with in the standards prescribed for residential/rural areas. This is attributable to the heavy traffic and vehicular movements in construction zones and material handling areas within the plant site. The higher values of NOx in the same areas, where RPM and SPM values are comparatively higher subsidize the traffic conditions for the spiked values. There is no material that is used in the refinery which generates PAH. However, as advised in the TOR condition, the same has been measured in the month of May 2008 which is found to be BDL.

(g) The noise levels were studied for day-&-night conditions at the following locations and their summarized data is presented in the table below.

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

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 the newer technological implementation 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.

(h) **Water Environment**

Surface and Ground Water Sampling Locations

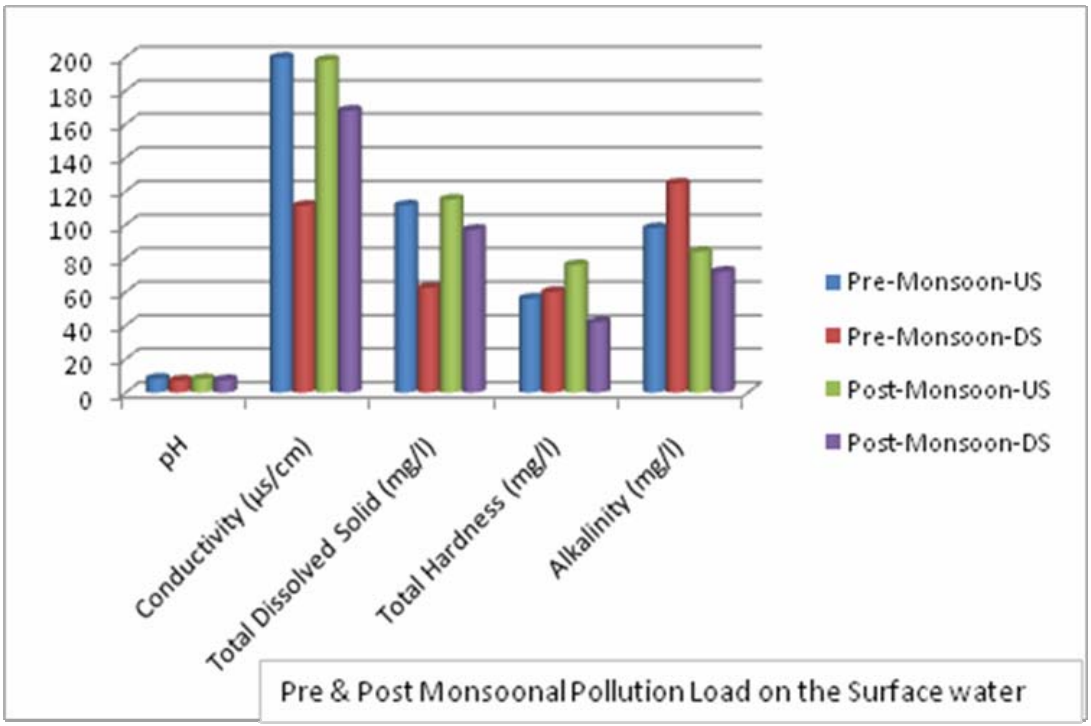
Sl. No.	Code	Location	Distance (KM)	Direction
			w.r. t proposed plant site	
Surface water				
1	SW1	River Vamsadhara near Lanjigarh	4.0	W
2	SW2	River Vamsadhara near Bundel	1.5	W
3	SW3	Stream near Tetulipadar	5.8	SW
4	SW4	River Vamsadhara near Chatrapur*	1.6	N
5	SW5	Stream near Rengopali#	2.0	S
6	SW6	Stream near Kenduguda	2.0	W
7	SW7	Stream near Bundel	4.0	E
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 Bundel	4.0	W

** upstream # downstream w.r.t. to plant site*

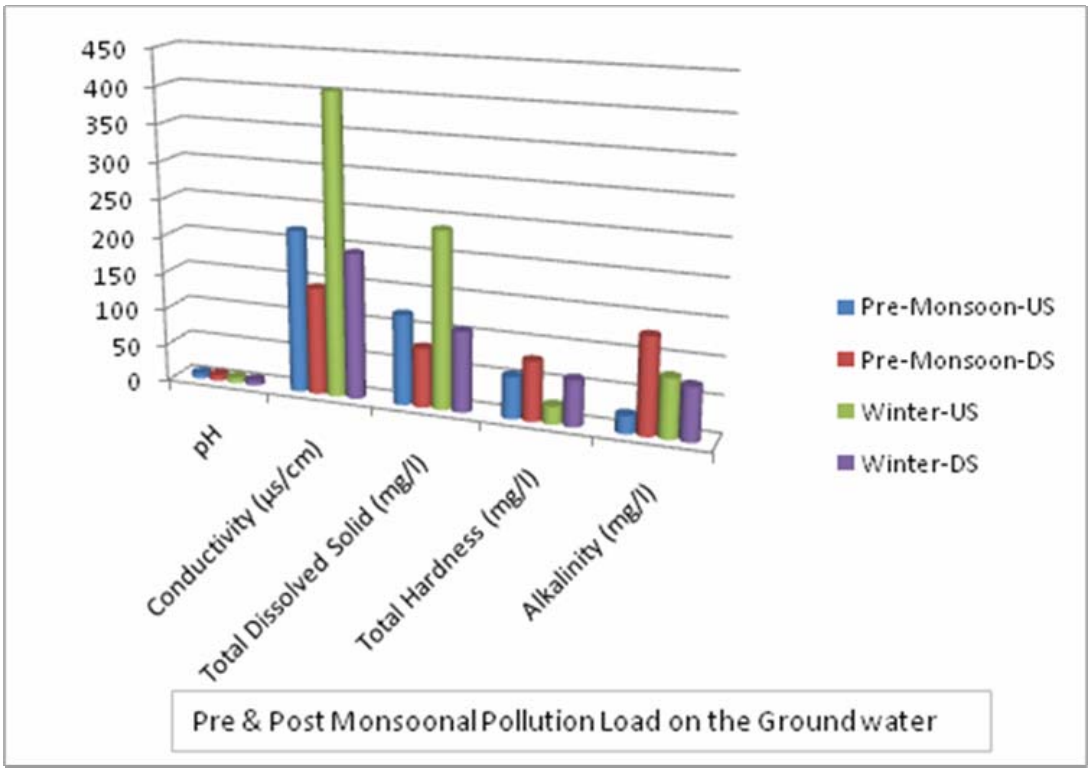
Considering the location of the plant site, Chatrapur location (North of the core zone) is considered as upstream for both surface water and ground water and Rengopali location(South of the core zone) is considered as downstream for both

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 downstream of River Vamsadhara has increased concentration of Alkalinity and hardness, and all other parameters have decreased values which indicate some form of dilution in the downstream river conditions. As there is no industrial discharge to this river, therefore the increased values of Alkalinity and Hardness could be due to some form of surfacial contamination at the downstream. 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.

Surface water quality comparison



Groundwater quality comparison



(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 µs/cm, which is average for crop growth, with minimum 122.7 µs/cm observed at Plant Site and maximum of 193.9 µs/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-

1.1 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	Balabadrapur 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 variegate	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
Raufulfia serpertiana	sarpagandi

Name of the Plant Species	Local Name
Androgarphis paniculata	Acanthaceae
Costus specieosus	Zingeberaceae
Crotalaria epunctata	Fabaceae
Curcuma angustifolia	Zingeberaceae
Curcuma aromatica	Zingeberaceae
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 accuminatus	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
Hemicryptophytes (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.

(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		
Attribute	Earth work	Mech. fabrication	Labour Force	Raw material handling & storage	Manufacturing process	Pollution control and Env. Mgt.	Industrialization	Transport	Urbanization
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. No.	Unit	Emissions		
		SO_2 (kg/hr)	NOx (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 NOx 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

The five maximum predicted GLC values are as listed below. The table represents the respective GLCs at locations for the parameters as mentioned in the column headings.

Rank	*Max.24 hr. Avg ($\mu g/m^3$) of Pollutants*			
	Location	*SPM*	*NO_X*	*SO_2*
1	Rengopali	2.65	6.9	22.34
2	Rehab colony	1.99	6.45	8.93
3	Kasibari	1.99	4.31	8.93
4	Mines area	1.99	4.31	4.47
5	Lanjigarh	1.99	6.45	4.47

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

Maximum Predicted GLCs Value at Rengopali

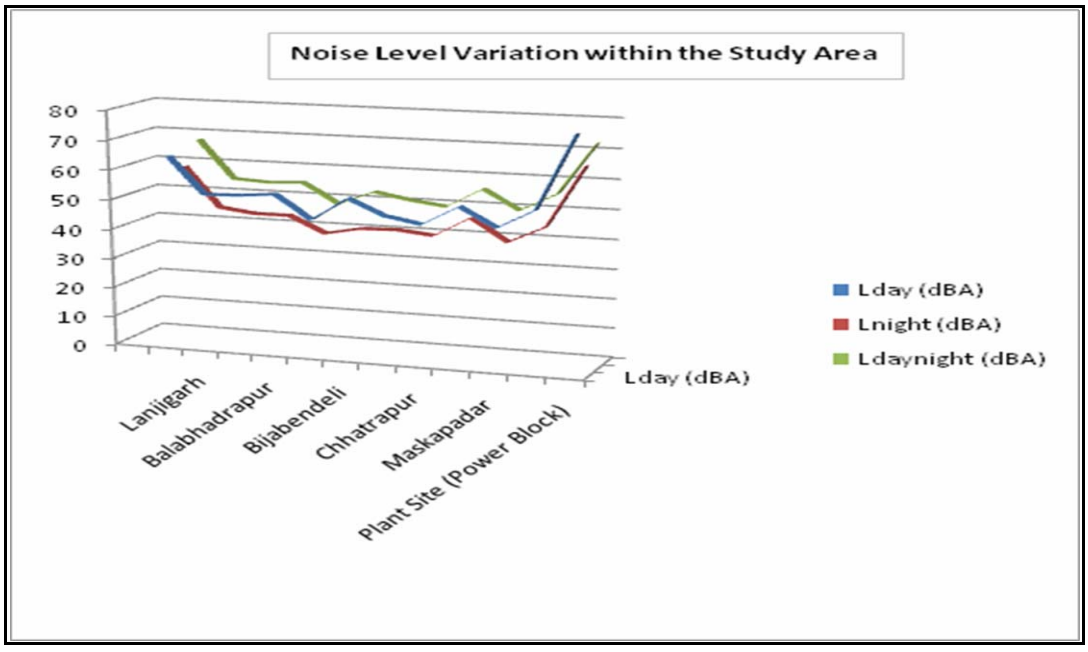
Pollution parameter	Baseline data in μg/ m^3	Max. predicted incremental values in μg/m^3	Max. predicted values in μg/m^3	Max. permissible value as per CPCB for residential area in μg/ m^3
SPM	187.2	2.65	189.85	200
SO_2	16.2	22.34	38.54	80
NO_X	25.1	6.9	32	80

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 recycle agents
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, SO_2 and NOx. 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.

- SO_2 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.

Environment Management System & Implementation of EMP

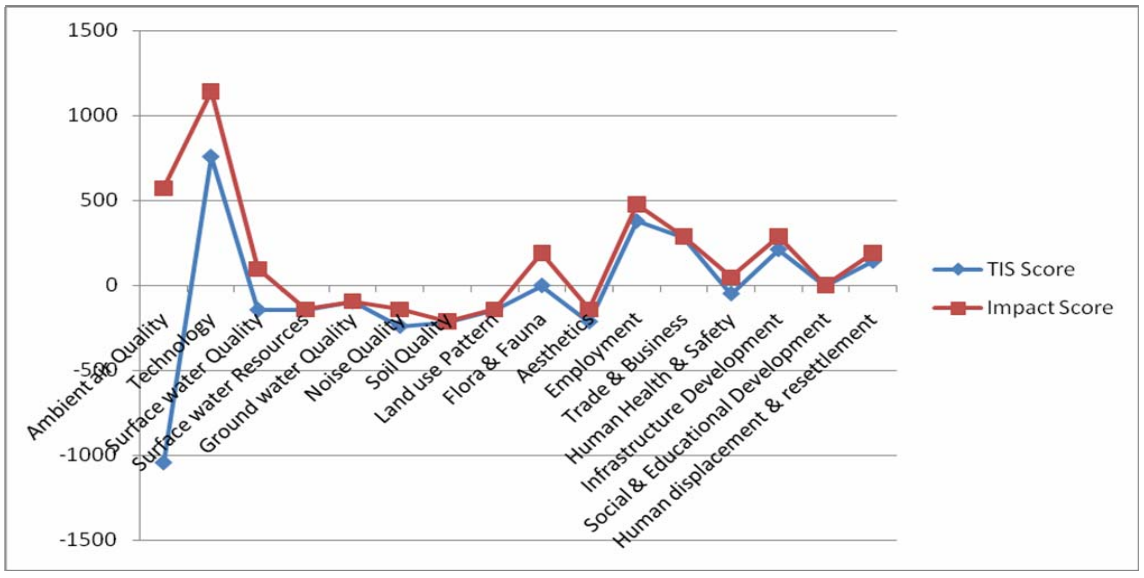
- The company will set up a department for Environment, Health & Safety (EHS) headed by a senior executive in the level of General Manager. The dept. will have a full-fledged laboratory and necessary technical staff for environmental monitoring. The dept. will be responsible for the implementation of EMP & safety and disaster management plan.

- The cost of implementation of EMP will be about 2% of the project cost i.e. Rs. 12.5 Crores in addition to the equipment costs at the design stage.

CONCLUSION

The total score of the impact on all the subjects as identified important for expansion project and changes from a negative score to a positive score. This change in the impact after implementation of EMP is due to appropriate installation of the pollution control equipments and taking care of the ecosystem with preservation and quality assurance. It is been observed that the air quality is the most important character in the assessment, with positive impact of employment, trade & business, health care, and eco-friendly technology been key players due to the proposed project. Although the air quality will have some impact on the environment, but considering the socio-economic importance of the project and for a better interest of the State and locals, the project has sustainable environmental impact attaining the projected growth in economy and social welfare.

Comparison of PRE & POST EMP Scores



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.