

**VVM PRODUCT SPECIFIC (MINERAL BASED)
SEZ PROJECT ENVIRONMENT IMPACT
ASSESSMENT REPORT**

OF



**VVM SEZ PROJECT
SPECIAL ECONOMIC ZONE
THIRUVAMBALAPURAM
RADHAPURAM TALUK
TIRUNELVELI DISTRICT**

PREPARED BY

**ENVIRONMENTAL CELL
COASTAL ENVIRONMENTAL AND ECOLOGICAL
CONSERVATION COMMITTEE
TISAYANVILLAI 627 657**

INDEX

S.NO	TOPIC	PAGE NO.
1.	EXECUTIVE SUMMARY	7-29
2.	INTRODUCTION	30-47
3.	PROJECT DESCRIPTION	48-77
4.	EXISTING ENVIRONMENTAL SCENARIO	78-157
5.	ENVIRONMENT IMPACT ASSESSMENT	158-182
6.	ENVIRONMENT MANAGEMENT PLAN	183-192
7.	IMPLEMENTATION OF MONITORING SYSTEM	193-196
8.	ANNEXURE I	197-201
9.	ANNEXURE A	202-205
10.	APPENDIX I - FORM I	206-223
10.	ANNEXURE IV - FORM I	224-234
11.	QUESTIONNAIRE	235-246

LIST OF TABLES

TABLE 1.1	PROPOSED VVM SEZ SUPPORTING INFRASTRUCTURE FACILITIES DEVELOPMENT INTO STAGES
TABLE 2.1	PROPOSED PROJECT ELEMENTS OF VVM SEZ
TABLE 2.2	DETAILS ON LAND USE IN DEVELOPMENT PLAN – VVM SEZ
TABLE 2.3	SEA WATER RO SYSTEM DISCHARGE WATER CHARACTERISTICS
TABLE 2.4	CETP RAW EFFLUENT CHARACTERISTICS
TABLE 2.5	TREATED EFFLUENT CHARACTERISTICS PERMISSIBLE LIMIT FOR DISCHARGE
TABLE 2.6	MAN POWER REQUIREMENT
TABLE 3.1	SOCIO ECONOMIC SURVEY – GENERAL DETAILS
TABLE 3.2	SOCIO ECONOMIC SURVEY – BASIC AMENITIES
TABLE 3.3	LOCATION OF SELECTED AAQM STATIONS
TABLE 3.4	STANDARD TECHNIQUES USED FOR AAQM
TABLE 3.5	STATUS OF PARTICULATE MATTER IN CORE AND BUFFER ZONE
TABLE 3.6	STATUS OF GASEOUS POLLUTANTS IN CORE AND BUFFER ZONE
TABLE 3.7	TEMPERATURE AND RELATIVE HUMIDITY DATA OF SELECTED STATIONS
TABLE 3.8	WIND ROSE DATA
TABLE 3.9	STATIONS SELECTED FOR GROUND WATER QUALITY MONITORING
TABLE 3.10	GROUND WATER - PHYSICAL CHARACTERISTICS
TABLE 3.11	GROUND WATER - CHEMICAL CHARACTERISTICS
TABLE 3.12	SURFACE WATER – PHYSICAL CHARACTERISTICS
TABLE 3.13	SURFACE WATER – CHEMICAL CHARACTERISTICS
TABLE 3.14	LOCATION OF SELECTED ANLM STATIONS

TABLE 3.15	STATUS OF AMBIENT NOISE LEVEL IN STUDY AREA DURING STUDY PERIOD
TABLE 3.16	DAY AND NIGHT NOISE LEVEL IN CORE AND BUFFER ZONES
TABLE 3.17	LOCATION OF SELECTED SQM STATIONS
TABLE 3.18	PHYSICO CHEMICAL CHARACTERISTICS OF SOIL AT PROJECT SITE
TABLE 4.1	PRIMARY WATER CRITERIA FOR CLASS SW –IV WATERS
TABLE 4.2	PRIMARY WATER QUALITY CRITERIA FOR CLASS SW – IV WATER AND OBSERVED CONCENTRATION
TABLE 4.3	LIST OF PERSONNEL PROTECTIVE EQUIPMENTS
TABLE 4.4	ENVIRONMENT IMPACT MATRIX WITHOUT PROTECTION MEASURES
TABLE 5.1	ENVIRONMENT IMPACT MATRIX WITH PROTECTION MEASURES

LIST OF FIGURES

- FIGURE 2.1 PERCENTAGES OF PROPOSED INDUSTRIES IN VVM SEZ
- FIGURE 2.2 FLOW SHEET OF THE MINERAL PROCESSING PLANT
- FIGURE 2.3 WATER BALANCE OF VVM SEZ
- FIGURE 6.1 ORGANIZATION CHART FOR ENVIRONMENTAL CONTROL

LIST OF MAPS

1. CADASTRAL PLAN OF THIRUVAMBALAPURAM SEZ AREA
2. STATIONS SELECTED FOR AMBIENT AIR QUALITY MONITORING
3. STATIONS SELECTED FOR WATER QUALITY MONITORING
4. STATIONS SELECTED FOR NOISE LEVEL MONITORING
5. STATIONS SELECTED FOR SOIL QUALITY MONITORING



EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Introduction to VV Mineral

VV Mineral is a registered Partnership firm. V.V.Mineral is a two decade old company dealing with Mining, Manufacturer and Exporter of Garnet, Ilmenite and associated heavy minerals have achieved significant market share all over the world. V.V. Mineral (VVM) is India's largest Exporter of Garnet and Ilmenite, has obtained number of mining leases in Tirunelveli, Tuticorin and Kanyakumari Districts.

V. V. Mineral is the first company in India to have been conferred the '**STAR EXPORT HOUSE**' status for export of heavy minerals issued by Govt., of India, Ministry of Commerce.

Since 1990, VVM has been continuously receiving prestigious awards and recognition from various chambers of commerce and industry, and the government. VVM are the winners of '**Special Export Award**' from CAPEXIL of Ministry of Commerce, Govt., of India consecutively for the past 22 years (from 1990- '91 to 2010- 11). **MADITSIA** Award, National Productivity Award, Highest Exporter Award through Tuticorin Port etc., is also received by V.V.Mineral.

VVM SEZ Project

To promote export, Govt., of India, enacted an act in the name of Special Economic Zone Act (SEZ Act., 2005). Accordingly VV Mineral proposed to set up a product Specific (Mineral Based) Special Economic Zone over an extent of 166.66.5 ha for producing various mineral based products such as cracking of monazite, production of

rare earth oxide, Titanium pigments, Synthetic Rutile, Slag, Scandinium etc., and processing of Garnet, Ilmenite, Rutile, Zircon Sillimanite and other associated heavy minerals by using the industrial heavy minerals mined from their own mining lease area.

The other activities proposed in the SEZ are

1. Erection of Wind turbine in and around the project area
2. Port facilities to handle 4.5 million TPA (Tons Per Annum) cargo
3. Solar Power Energy for every Plant
4. Repairing of ship facilities
5. Desalination Plant etc.

The capital cost of the project is 870 crores into stages.

Inception of VVM SEZ

VVM has applied for permission to set up SEZ in Thiruvambalapuram village of Radhapuram Taluk. All the lands are their own land. The Govt., of Tamilnadu approves the above said proposal and forwarded to Govt., of India for notification under SEZ Act. Copy of the above said letter is vide **Annexure - A**.

Purview

The following activities will be carried out within the SEZ area.

- 1) Processing of heavy Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals cracking of monazite and production of Rare Earth Oxide, solvent extraction, magnets, Titanium Pigments, Synthetic Rutile, Slag, Scandinium etc in stage by stage with or without joint venture with technical knowhow of Canada, Australia, Japan and other developed countries.
- 2) Construction of wind turbine and solar power plant altogether of total 450 MW into stages.
- 3) Port and other related buildings for handling 4.5 million TPA cargo
- 4) Repairing of ship facilities

- 5) Construction of desalination Plant
- 6) Construction of Transport Vehicle shed and workshop
- 7) Fabrication workshop and maintenance workshop and industrial library
- 8) Workers rest shed, canteen, dining hall, First aid Centre, smoking zone
- 9) Statutory amenities buildings and play grounds
- 10) Installation of water supply and sanitation and sewage systems
- 11) Power Distribution System
- 12) Telecom facilities
- 13) Construction of factory buildings and warehouses

Hence, the Environmental Impact Assessment Report covers the various impacts (environmental as well as socio-economic) expected from the developmental, processing, infrastructure and amenities are considered under the purview of VVM SEZ.

If the industries to be set up in the VVM SEZ generate any kind of environmental pollution in the form of air, water and / or solid, they shall have to appropriately manage and handle the same in compliance with the prevailing environmental norms of the Tamil Nadu State Pollution Control Board and all applicable laws. This responsibility shall entirely lie with the corresponding industries.

Location

The site of VVM SEZ is located in Thiruvambalapuram Village, Radhapuram Taluk, in the district of Tirunelveli, bordered by the Southern coastline of the Gulf of Mannar between latitude 8°24'26" N and Longitude 77°78'97" E. Valliyoor railway station is the nearest passenger rail head 25 km away. Tuticorin air port (about 100 km) is in the vicinity. Thiruvambalapuram is a small village with meager agriculture activities and mostly full of wind turbine and a small section of fishermen people which all are away from the proposed SEZ.

Salient Features of VVM SEZ

The capital cost of the project is 870 crores into stages

Project Site : Thiruvambalapuram Village

Taluk : Radhapuram

District : Tirunelveli

Total Area under the project : 166.66.5 Ha

Latitude : 8°24''26' N

Longitude : 77°78''97' E

Connectivity

Nearest town : Tisaiyanvillai (14 km)

Nearest railway station : Valliyoor approximately 25 km

Nearest sea port : Tuticorin Port (90 km)

Nearest air port : Tuticorin Air Port (100 km)

Access roads : Rameshwaram – Kanyakumari Coastal Road (1 km)

Socio Economic Settings

Basic Amenities

Medical : PHCs and lower facilities, RMP doctors

Educational : Primary schools and few secondary schools and polytechnics college

Transport : State Transport Buses and local service providers

Water Supply : Thamirabarani drinking water supply scheme operated by TWAD Board. Few dependent on Bore wells and dug wells

Power Supply : All villages are electrified, no industrial users

Irrigation : Very few. Mostly on well irrigation. It is a rain shadow area.

Features of Impact Zone

Present Land Use : Mainly barren land

Land area Identified as VVM SEZ – 166.66.5 ha,

Water bodies - River Nambiyar, Gulf of Mannar

Forests : No Reserved forests are present in or around the proposed site

Vegetative Classification - 100 % non vegetative area

Geology	- Undifferentiated fluvial /Aeolian / Coastal Sediments
Soil Type	- Mainly sandy soil
Crops	- Coconut, Pulses, Banana
Seismic Zone	: Zone II as per 1893 - 1984

Meteorological data

Ambient air temperature

Climate : Dry, Arid Coastal Climate

Highest daily maximum temperature : 40 °C

Max. dry & wet bulb temperature 37.7 / 26.8 °C

Min. dry & wet bulb temperature 16.2 / 11.5 °C

Wind Regime Summer - SW and W, Monsoon - NW, W Winters - N, NE

Rainfall

Average annual rainfall : 180 mm

Period of water scarcity April to June, in summer season the area is drought prone

Wind velocity

Max. wind velocity 32.4 km/hr study period (Jan 2011 – Dec 2011).

Predominant Wind direction N, NE and SW (Study Period)

Relative humidity

Annual mean humidity 60%

Max. Humidity 85%

Min. Humidity 40%

Purpose of Environment Impact Assessment

The proposed Product specific (Mineral based) activities in the Special Economic Zone is specified as: Project / Activity – 7 (C), Category – B, in Notification vides S.O. 3067(E) dated 1st December, 2009 issued by the Ministry of Environment and Forests. It is proposed to use sea water for industrial purpose such as desalination, cooling purpose, and for separation of heavy minerals etc., Construction of port comes within CRZ area.

As it is water front industry and directly need foreshore facilities these activities comes under permissible activity under CRZ notification.

Other permissible activities proposed within CRZ are

Activities	Provision No.
Port	Para 3(i) (a) - Water front industry and directly needing foreshore facilities.
Desalination Plant	3 (i) (c) setting up of desalination plants in the area not classified as CRZ I based on the impact assessment study
Construction involving more than 20,000 sq.mts build of Area	4 (i) (d)

The project is a designated project under Schedule and falls under category 'B' of the Environment Impact Assessment (EIA) Notification dated 1st December, 2009.

Activities	Category
wind turbine and solar power plant with altogether 450MW capacity	Category B
Mineral Beneficiation 0.095 million TPA	Category B
Port with 4.5 million TPA cargo handling capacity	Category B
Common Effluent Treatment Plant	Category B
Sewage Treatment Plant	Category B
Buildings and construction of plants more than 20,000 sq.meters	Category B

Heavy mineral processing plants will be setup out side CRZ. Hence all the activities proposed in the SEZ project of VVM falls under category B, State EIA and CRZ clearance is enough and therefore it is not required to obtain prior Environmental Clearance form the Ministry of Environment and Forests, Govt. of India. The present Environmental Impact Assessment Report has been prepared for obtaining

Environmental clearance from State Environment Impact Assessment Authority (SEIAA).

This Environmental Impact Assessment Report has been prepared based on the study of impacts due to all the possible activities from the developmental, Processing and infrastructure facilities to be provided by VVM in the SEZ. The report has been prepared based on the guidelines recommended by the Ministry of Environment and Forests (MoEF). For the preparation of this report, the **study area** has been identified as the area falling within a radius of 10 km with the proposed site at the center. The base-line data was collected over a period of one year, starting from January 2011 through December 2011.

PROJECT DESCRIPTION

The project has five major components viz., Processing plants for heavy Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals cracking of monazite and production of Rare Earth Oxide, solvent extraction, magnets, Titanium Pigments, Synthetic Rutile, Slag, Scandinium etc., wind turbine, solar energy Plant, captive port and desalination plant. The specific details of the project are provided in the following sections.

Processing Plants for Heavy Minerals

It is proposed to process the Industrial heavy minerals mined from own mining lease area for the separation of Garnet, Ilmenite, Rutile, Zircon, Sillimanite, Leucosene, Monazite and other associated heavy minerals. VVM SEZ will implement the eco friendly processing technique accepted world wide for mineral beneficiation. The proposed Heavy Mineral Processing Plants will comprise the following features.

1. Wet gravity separation (Spirals)
2. Magnetic Separation
3. Electrostatic separator
4. Gravity Separator

5. Rare Earth Drums
6. Enhanced field separators
7. Electrostatic Plate Separators
8. Solvent extraction
9. Cracking of Monazite
10. Titanium pigments, synthetic Rutile and slag Plant
11. Scandium Plant
12. Magnets production

Wind Turbine

Technology

In wind energy generation, kinetic energy of the wind is converted into mechanical energy and subsequently into electrical energy. Wind turbines capture the wind's energy with two or three propeller like blades, which are mounted on a rotor, to generate electricity. The turbines sit high atop towers, taking advantage of the stronger and less turbulent wind at 100 feet (30 meters) or more above ground. When the wind blows through the blades of the wind mill, a pocket of low-pressure air forms on the downwind side of the blade. The low-pressure air pocket then pulls the blade towards it, causing the rotor to spin. The rotor turns the shaft that further spins the connected generator. The spinning of this generator produces the required electricity.

Technical details

High-speed asynchronous generator with a multi-stage intelligent switching compensation system delivers power factor up to 0.99 will be used. The generated power is free from harmonics and is grid friendly.

Operating Data:

1. Rotor Height : 64 m
2. Hub Height : 65 m
3. Cut in Speed : 3 m/s
4. Rated Speed : 12 m/s
5. Cut out speed : 25 m/s

6. Survival Speed : 67 m/s

Rotor:

1. Blade : 3 Blade Horizontal Axis
2. Swept Area : 3217 m²
3. Rotational Speed : 13.9 to 20.8 rpm
4. Regulation : Pitch Regulated

Generator:

1. Type : Asynchronous 4 / 6 Poles
2. Rated Output : 250 / 1250 kW
3. Rotational Speed : 1006 / 1506 rpm
4. Frequency : 50 Hz

Gear Box:

1. Type : Integrated (1 Planetary & 2 Helical)
2. Ratio : 74.971:1

Yaw System:

1. Drive : 4 electrically driven planetary gearbox
2. Bearings : Polyamide slide bearings

Braking System:

1. Aerodynamic Brake : 3 independent systems with blade pitching
2. Mechanical Brake : Hydraulic fail safe disc braking system

Control Unit:

3. Type: Programmable microprocessor based; high speed data communication, active multilevel security, sophisticated operating software, advance data collection remote monitoring & control option, UPS backup, Real time operating indication

Solar power Plant

The proposed solar power plant will consist of two functional elements:

- A solar field
- A power block

A power block consisting of heat exchangers, turbines, generators and cooling block (the height of the power block is estimated to be between two to five storeys high);

- Collection field –this could either include trough mirrors (trough technology) or heliostats (power tower technology) depending on the final technology selected for project;
- Distribution power lines and associated structures (pylons)

Captive Port

In order to export the processed heavy minerals a captive port with enabling infrastructure along with other plants and machinery is proposed.

The details of the captive port facilities are as follows

1	Length of North Breakwater	2,100 m
2	Length of South Breakwater	1,150 m
3	Length of Approach Channel	3,300 m
4	Width of Approach Channel	160 m
5	Depth at Approach Channel (below CD)	16.1 m
6	Depth at Maneuvering Areas (below CD)	15.5 m
7	Diameter of Turning Circle	500 m
8	No. of berths (length in m)	3 (600m)
9	Dredged depth at berth	15.5 m CD
10	Dredging quantity	11 million m ³

Captive Desalination Plant

The fresh water requirement for the proposed Heavy mineral processing plants, captive port and other domestic uses is estimated as 100 MLD. In order to meet the water demand, a captive desalination plant of 100 MLD capacities is proposed. The desalination plant typically comprises of the following:

- Sea water intake/outfall system
- Process operations
- Chemical dosing system
- RO system
- Post treatment system

Salient Features of the Proposed Project

S.No	Item	Description
Heavy Mineral Processing Plants		
1.	Capacity	0.095 MTPA processed heavy minerals
2.	Technology	Physical and Chemical Separation
3.	No. of units	Eight
4.	Installation locale	Out side CRZ
Wind Turbine and Solar power plant		
5.	Capacity	450 MW
6.	Technology	Grid friendly technology
7.	Installation locale	Wind turbine – In and around the project site Solar power plant – on the top of every building
Captive Port		
8.	Capacity	About 4.5 MTPA cargo handling capacity
9.	Type	All weather Port
10.	No of Berths	3
11.	Length of Breakwaters	North : 2,100 m, South : 1,150 m
12.	Set up locale	Within CRZ

Desalination Plant		
13.	Capacity	100 MLD
14.	Technology	Reverse Osmosis
15.	Installation locale	Within CRZ
General		
1.	Land	166.66.5 hectare
2.	Water Requirement	100 MLD
3.	Source	Desalination Plant
4.	Environmental aspects	<ul style="list-style-type: none"> • All the processed heavy minerals are natural mineral hence Non – Hazardous and Non – Dangerous cargo according to criterion NOHSC : 1008 (2004) • Individual heavy mineral processing will be done by ecofriendly techniques by make use of its physical properties without chemical treatment to reduce air and water pollution • Fire Protection System • High Recovery RO Technology to minimize the rejects • Disposal of waste water through marine diffuser 1500 meters deep into the sea • Disposal of dredged material at 12 -14 km deep into sea at 30 m depth level.

Utilities and Services

Water supply

Water requirement during the initial stage is expected to be 2.5 MLD and in full fledge operation the requirement would be 100 MLD which will be met by the proposed Desalination Plant. The estimation of sea water required for desalination plant during the operation phase, is 7,680 m³/hr, which will be sourced from Gulf of Mannar.

Power Supply

The expected power demand is predicted as 250 MW both for Industrial and domestic usage will be sourced at first from TNEB subsequently from the proposed VVM SEZ Power plants (Wind Turbine and Solar Power Energy) into stages.

Waste water / waste management

Sewage generated will be drained through common drainage network line to the proposed Sewage Treatment Plant (1.2MLD) for treatment. The treated water will be used for horticulture purposes and the sludge generated from the STP will be dried and used as manure to the green belt. Storm water drainage system shall be provided for management of storm runoff. The sludge from the bottom of the sea water clarifier is discharged to a sludge pit from where it is partly re circulated back to the clarifier inlet. The used/spent oil to be generated from the DG sets shall be sent to TNPCB approved ventors or recycler for suitable treatment.

Fire Protection System

Fire fighting and rescue facilities with adequate well trained fire personnel will be provided with in the Plant premise. The plant fire protection system will consist of hydrant system, high/medium velocity water sprinkler and portable fire extinguishers. All buildings will be fitted with fire valve with a facility to fit fire hoses. The fire protection system will be designed as per standards prescribed by the National Fire Protection Association (NFPA)/ Tariff Advisory Committee of India.

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) STUDY

EIA study for the proposed VVM SEZ project covers both terrestrial and marine environment.

Study Area and Study Period

An area within 10 km radius with project site has been earmarked for the study. The baseline environmental data was generated over a period of one year starting from January 2011 to December 2011.

Description of the Environment

The environmental settings of the project site is given below

S.No	Particulars	Details
1.	Plan Site Latitude and Longitude	82°4'26"N and 77°78'97' E
2.	Plant site elevation above mean sea level (MSL)	4 m
3.	Present land use at the site	Barren Land
4.	Plant site boundary to coast	More than 0.5 km and away from the HTL on land side
5.	Hills/Valley	Nil
6.	Topography	Coast flat terrain sloping towards the coast
7.	Archeologically Important Places	Nil within 10 km zone
8.	National Parks/ Wild life Sanctuaries	Nil within 10 km zone
9.	Reserved Forest /Protected Area	Nil within 10 km zone
10.	Defence Installation	Nil within 10 km zone
11.	Seismicity	Zone II as per 1893-1984

Compatibility of Coastal Regulation Zone (CRZ)

Physical demarcation of high tide level (HTL), low tide level (LTL) and delineation of CRZ boundaries for the project site were carried out by Remote Sensing Department, Anna University which is one of the MoEF-authorized agencies. The project site proposed for Captive port lies between the open coast of Gulf of Mannar on the East and Nambiyar canal on the West. The project development area does not fall or contain

the environmentally sensitive area as specified in the CRZ Notification. The CRZ classification of the project area meets the requirements of CRZ-I (ii) and CRZ-III.

Baseline Environmental Conditions

Baseline environmental studies for various environmental attributes were carried out over a period of one year starting from January 2011 to December 2011.

Marine environment

Marine environmental quality monitoring studies were carried out to collect base line data on water quality, sediment quality and marine ecology in project region covering the extent between the proposed seawater intake and marine outfall for the desalination plant.

- The presence of a good plankton community structure, good benthic structure and higher oxygen levels indicate that the waters are free from pollution and also support good aquatic life.
- Observations in terms of chemical and biological parameters reflect ambient coastal processes which are at normal levels analogous to the basic bio-geochemical process of the coastal environment. The levels of hydrocarbon (Oil & Grease) and heavy metals are found to be within the permissible limits.

Terrestrial environment

Ambient air quality

The prime objective of the baseline air monitoring is to evaluate the existing air quality of the area. This will also be useful for assessing the conformity to standards of the ambient air quality during the operation of the proposed VVM SEZ project activities. Ambient Air Quality Monitoring (AAQM) stations were set up at eleven locations. The samples were collected twice in a week every month suspended particulate matter (SPM), Respirable suspended particulate matter (RSPM), oxides of Sulphur (SO₂), oxides of Nitrogen (NO_x) were collected on a 24-hourly basis. The values of SPM,

RSPM, Oxides of Sulphur (SO₂) and oxides of Nitrogen (No_x) were found to be well within the limits prescribed by Central Pollution Control Board.

Ambient noise levels

Noise levels were monitored at Eleven (11) locations for assessing the existing noise levels in and around the project site. The monitoring was carried out once in every month for 24 hours. The equivalent values for day and night time noise levels are well within the stipulated CPCB standards at all monitoring locations.

Inland Water Quality

Eleven (11) monitoring locations were identified for ground and surface water quality assessment in different villages around the project site. The samples were collected once in every season TDS, Hardness and chloride content is higher than the permissible limit (IS: 10500, 1991) in most of the samples.

Soil Quality

The proposed site of SEZ is mostly barren with sparse vegetation. The proposed SEZ Project shall convert this into a collage of industrial, commercial, residential and other units interspersed with green patches and green-belt shall be developed so as to cover up to 30 % of the entire proposed land area for SEZ. Thus the land use pattern of the proposed site shall be improved, creating scope for improved flora-fauna in the region.

The soil found in the coastal region is of the erinaceous type (sandy) which is suitable for casuarina plants. Considering the soil profile in the study area, 11 sampling locations have been selected. The pH of the soils ranged between 6.7 and 9.04 indicating neutral to alkaline in nature. Loamy sandy texture soils dominated the study area with Sand (%) range from 21.57 to 41.91, Silt (%) range from 30.56 to 53.37 and Clay (%) range from 12.58 to 48.46. Bulk Density of the soils ranged from 1.33 to 1.47 gm/cm³. The Infiltration Rate was found to be between 1.31 and 2.95 cm/hr. The Water Holding

Capacity of the soils varied from 29.9 to 45.56%. Porosity of the soils varied from 17.69 to 29.45%.

Flora and Fauna

Detailed flora and fauna study was carried out in the study area. The detailed common flora and fauna status of the study area is given in Chapter III. There is no endemic or threatened species of flora and fauna observed in the project region.

Baseline socio-economic conditions

Primary survey was carried for assessing the existing social conditions of the villages and hamlets falling within the study area.

About 11 villages were surveyed.

The survey covered about an overall population of 75,264.

Total occupation pattern constitutes of 48.3% in the total population. Agriculture activities and fishing is meager in the study area, wind turbine operation associated works is the primary activity.

Almost all the villages in the study area have basic school facilities i.e., primary schools. Few villages have upper primary and high school facilities and Polytechnic college.

The main occupation of the people is Industrial workers in Wind turbine. Cultivators, agricultural laborers, household workers, construction workers, fishermen, etc represent the marginal workers.

Protected water supply is available in almost all villages in the study area

Most of the villages have power supply for domestic purposes, and agriculture through TNEB.

Almost all villages in the study area are well connected by village or major district roads.

There are no notified archaeological or cultural monuments in the study area.

ENVIRONMENTAL IMPACT ASSESSMENT AND CONTROL MEASURES

The anticipated impacts on the environmental and social attributes, which are likely to arise due to construction and operation of the project were identified, predicted and evaluated.

Construction Phase

Developmental activities such as construction of intake/outfall systems, capital dredging, dredge spoil disposal and development of offshore structures will result in disturbance to the marine environment. Site grading and development, civil construction and mechanical erection of facilities, onsite infrastructure, environmental management facilities and back up area development are likely to cause impacts on the terrestrial environment. The impacts during construction are short-term in nature and will cease on completion of construction activities.

Operation Phase

Mathematical modeling for brine discharge, littoral drift transport and air pollutant dispersion was also carried out to identify the significance of impacts. The models engaged were:

Offshore and Coastal Dispersion (OCD) Model: OCD model is an extension of the classical Gaussian plume model, specifically designed to evaluate the impact of coastal or offshore emission sources including the fumigation episodes. For the impact assessment due to proposed project, OCD5 model has been simulated for the point sources with the onsite observed meteorological condition during the study period.

MIKE 21 HD-AD Model: The disposal of brine from desalination plant and dredged material from port activities into the marine environment may exert impact, if not scientifically disposed. In order to study the impacts of the sediment transport due to the proposed port, hydrodynamic modelling studies have been carried out using MIKE 21 HD-AD model.

COSMOS – 2D Model: The mathematical modelling studies for the littoral drift were carried out by using COSMOS-2D, which is designed for several purposes including calculations of longshore and cross-shore sediment transport rates. In each case, the wave, current and sediment transport parameters are calculated at grid points along a shore-normal line extending from the upper part of the beach to depths beyond the surf zone.

Environmental Monitoring Programme

Environmental Monitoring Programme is an important component during environmental management of the project. Mitigation measures during construction and operation phases can be revised based on monitoring results.

Budgetary Estimate for Environmental protection

The total capital cost for installation of pollution control equipments and implementing the Environmental Management Plan during construction phase is estimated as Rs. 50 lakhs and the annual recurring cost including the environmental monitoring programme during the operation phase is estimated as Rs. 25 lakhs per annum.

Risk Analysis and Disaster Management Plan (DMP)

Preliminary risk analysis was carried out for the various risks associated with the construction and operation of the proposed Heavy mineral Processing Plant, wind turbine, solar power plant, desalination plant and captive port. The analysis covered the following.

- Hazard Identification including potential release events
- Modelling of release rate, atmospheric dispersion in order to estimate the possible effects of the expected events.
- Risk reducing measures

The risk analysis thus carried out also provides inputs for formulating the onsite DMP. As the proposed project has five components viz., Heavy mineral processing plants, wind turbine, solar power plant, captive port and desalination plant; five specific DMPs were formulated with an integrated approach. The specific component team where the emergency has arisen would be in charge of the situation while the other four teams would assist them as and when required. The plan will include the following elements:

- Assessment of the magnitude and nature of the events foreseen and the probability of their occurrence
- Formulation of the plan and liaison with outside authorities, including the emergency services
- Procedures for raising the alarm and communication both within and outside the heavy mineral processing plant, port and desalination plant
- Appointment of key personnel and their duties and responsibilities (organizational structure)
- Emergency control centre
- Action on site and off site

The DMP is prepared in conjunction with and taking into consideration all technical reviews and suggestions, as per acceptable norms and hence, will meet any eventuality.

Social Impact

Land acquisition

The project will be constructed in own patta land and there will not be any rehabilitation involved due to land outsets. VVM SEZ is in possession of 166.66.5 ha own patta land which is contiguous and free from all encumbrances. There is no habitation or encroachment in and around the proposed SEZ area.

Fishing activity

The proposed project area at present is not used as an access to the sea or access to the berthing area, net mending sites and storage area by fisher men. The small section of fishermen people recorded within 10 km radius of the study area is away from the proposed SEZ area.

Construction Workers Camp

The construction of the project would require a large work force. To ensure that there is no strain on the existing infrastructure, the worker camps will be self-sufficient would not rely on any local resources. This would also ensure that there is no conflict with the local population. Further, the worker camps will be located away from the coast and habitations and will be within the project site. To mitigate the impact, particularly health hazards, proper sanitation facilities will be provided.

Employment potential

The project will provide a direct employment potential of 2,500 persons during construction phase and 5,750 persons during the operation phase of the project.

Environmental Management Plan

The effective implementation and close supervision of the environmental management activities to mitigate the environmental impacts, which are likely to arise due to the construction and operation phases of the project could be achieved through a suitable institutional mechanism. During construction and operational phase, VVM SEZ will adopt an Environmental Management System to assess, monitor and manage environmental performances, which can be used to promote continued environmental improvement and prevention of pollution.

GREENBELT DEVELOPMENT

Afforestation is a key element in environment conservation and protection. The establishment of a vegetation cover in and around the proposed Heavy mineral processing plants, and captive port, will result in many direct and indirect benefits. With a view to attenuate noise propagation and mitigate fugitive air pollution impacts, it is planned to develop a greenbelt all along the periphery of project site. Compatible species have been identified for greenbelt. Saplings will be suitably nurtured. Regular watering, soil conditioning and fertilizer application will be undertaken.

PROJECT BENEFITS

The proposed VVM SEZ Project will bring significant benefits, primarily include:

- Positive impact on the socio-economic profile of the Project region, in particular and Radhapuram Taluk in general, both in terms of overall employment and skill development of the local workforce.
- Augmentation in the infrastructure resources due to the project in the region in respect of transport, communication, health facilities and other basic facilities etc.

CORPORATE SOCIAL RESPONSIBILITY

VVM SEZ is committed towards fulfilling its social obligations of conducting business. The following are the initiatives towards CSR.

- Public health centers and conducting medical camps
- Educational facilities for the poor children in surrounding villages
- Vocational training institutes for building up of skill force

- Afforestation and environment preservation activities – women empowerment in the surrounding villages
- Supporting sports and heritage preservation etc.

Considering all the above aspects of employment, environment and economic concerns, the proposed SEZ project envisaged by VVM can be justified.



INTRODUCTION

CHAPTER - I

INTRODUCTION

BACKGROUND

In April 2000 Government of India announced the policy for setting up of Special Economic Zones, (SEZ) in India. The SEZ policy aims at creating competitive, convenient and integrated Zones offering World Class Infrastructure facilities, Utilities and Services for globally oriented businesses. SEZs have been declared as "**Deemed Foreign territories**" to be duty free enclaves with no restrictions on investments and import of goods and services. To attract foreign investors and Corporates, the Government has offered several incentives such as access to the Domestic Tariff Area (DTA), 100 per cent Foreign Direct Investment under the automatic route, greater flexibility with respect to foreign exchange earnings and procedural ease.

The State Government of Tamil Nadu has accorded approval to VV Mineral to Develop, Operate and Maintain a SEZ at Thiruvambalapuram, in Tamil Nadu. The Project is referred to as "**VVM SEZ**". The capital cost of the Project is 870 crores.

VVM SEZ would provide integrated infrastructure encompassing all infrastructure relating to business, living, learning, as well as recreation facilities so as to make the zone self-sufficient. VVM SEZ will have world-class Industrial, Business, and Social infrastructure like development of Industries, Commercial and Residential buildings, Entertainment, Sports and Recreation facilities. The SEZ will have all essential utilities such as power generation, transmission and distribution network, water desalination plant and supply network, sewage, water recycling plant, telecom network and multi-modal connectivity viz. roads, sea port etc.

SPECIAL ECONOMIC ZONES

The Kyoto Convention of GATT describes the “free zone” as a part of the territory of a State where any goods introduced are generally recorded, in so far as import duties and taxes are concerned, as being outside the customs territory and are not subject to the usual customs control”. The special Economic Zone is a more evolved and integrated version of the free zones.

The minimum features of free zones are :

- The entry and exit points are supervised
- The zones are treated as a territory beyond the jurisdiction of the customs authorities of the host country
- The economic activities of this territory to the extent it exploits the international markets are exempted from the various duties, tariffs, levies of the federal, state and local governments.

Beginning at Shannon in Ireland in 1956 these zones under varying names have Evolved to become the gateway of the global trade in each country.

The various versions of the Free Zones include :

- Export Processing Zones
- Free Trade Zones / Free Port
- Economic and Technology Development Zones
- Activities Specific Export Promotion Zones/ Parks (Garments, Gems, Electronics, Software, Biotech, etc.

The most evolved and robust of these zones in the version commonly referred to as Special Economic Zones (SEZ). Essential difference between other Free Zones and the SEZ is in its integrated nature.

SEZ POLICY OF THE GOVT. OF INDIA

The Government of India through the SEZ Policy has made available a basket of Incentives, Exemptions, Concessions and Privileges (IECP) to the **SEZ “Developers”** and the **SEZ “Units”**. The benefits available under the SEZ Policy essentially translate

into Reduced Cost of Infrastructure, Utilities, Raw Material, Capital, Manpower and Operation Ease. These Baskets of Benefits available to the Developer and the Units are aimed at enabling Global competitiveness.

Requirement of more than 100 hectares of contiguous land and provision of 35% land for processing area are the broad basis of approval for a multi product SEZ.

LEGISLATION GOVERNING SEZs

The SEZs in India are governed under the following legislation of the Govt. of India.

- SEZ Act of the Govt. of India, June 2005
- SEZ Rules, February 2006 (under the SEZ Act, June 2005)

VVM SEZ in addition to the above is also regulated by the Tamil Nadu State SEZ Act, August 2005.

Project Site

The project site is own Patta land (except the port area) in Thiruvambalapuram Village, Radhapuram Taluk, Tirunelveli District. There is no Forest land/ Govt. Land envisaged in and around the project area. The land is contiguous with no through fare. River Nambiyar is confluencing Gulf of Mannar at Thiruvambalapuram. Due to the active sedimentation/siltation at the river mouth, a naturally protected Harbour Environment Exists at the confluence region. The project site is in the southern bank of Nambiyar river which is under the tidal influence of Gulf of Mannar (Falls in CRZ I).

Thiruvambalapuram is located about 14 km from the Nearest town, Tisayanvillai, Tirunelveli is the headquarter, about 87 km away form the project site. Thiruvambalapuram is directly linked to the Rameshwaram – Kanyakumari East Coast Road (1 km). Valliyoor railway station is the nearest passenger rail head 25 km away. Tuticorin air port (about 100 km) is in the vicinity. Thiruvambalapuram is a small village

with meager agriculture activities and mostly full of wind turbine and a small section of fishermen people which all are away from the proposed SEZ.

VVM - THE PROMOTERS OF VVM SEZ

The Prime Promoter of VVM SEZ, the VV Mineral Company has the expertise and experience in the key components of the SEZ. VV Mineral today is one of the fastest growing entrepreneur in India, consists of a professionally managed network of companies and assets, across the country and abroad.

PRIVATE INFRASTRUCTURE DEVELOPMENT

Heavy Mineral Processing Plant

VVM SEZ is developing a separate processing plant for Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, cracking of monazite etc.,

VVM also proposed to produce Scandium, Titanium slag, Rutile grade pigments and other mineral based products by registering one or more subsidiary companies.

VVM proposed to produce rare earth oxides, solvent extraction, and manufacturing of magnet by registering one or more subsidiary companies.

While cracking Monazite, Thorium and Uranium will be generated in small quantities. They are radioactive materials hence will be stored in a separate place as per the direction of AERB (Atomic Energy Regulatory Board) and it will be disposed of to the Nuclear Power Corporation of DAE (Department of Atomic Energy) and if they do not require it with their permission it will be disposed to other parties. Already VVM has obtained proper license under Radiation Protection Rules and has appointed Radiation Safety Officers duly licensed by AERB.

Captive Port

VVM SEZ proposed to develop mechanized, multipurpose all weather sea -port at Thiruvambalur by registering a separate subsidiary company for this purpose. The Port infrastructure will be set up with three multipurpose mechanized jetties, over 2 km continuous quay berths, port backup operations such as open storages and hard stands, godowns, and several Container Freight Stations (CFS) operated by VVM SEZ. The Board of Approvals of Ministry of Commerce and Industry, Govt. of India has accorded VVM SEZ, the status of an SEZ owing to 166.66.5 Ha Land under its possession.

Power Plant

VVM SEZ is developing wind turbine and solar power plant in the VVM SEZ as a dedicated power source by registering a separate subsidiary company for better administration. All this activities are effected in to stages. The total capacity of the proposed Power plants altogether shall be 450 MW.

VVM SEZ COMPANY

VVM has been registered under Indian Partnership Act, 1932 for the development, operation and maintenance of the **VVM SEZ**.

Regulatory Permission to the VVMSEZ

The State Govt., has approved the SEZ project and forwards the same to Govt., of India for formal notification. The project activity will be commenced only after getting the formal notification from Govt., of India.

Status of Land Holding

VVM SEZ is in possession of 166.66.5 ha. Own patta Land, contiguous and free from all encumbrances. There is no habitation or encroachment in and around the proposed SEZ area.

Scope of VVM SEZ

The developmental activities viz., Processing of Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent extraction, Construction of captive port and other related buildings, wind turbine, solar power plant, desalination plant, and infrastructure in the SEZ shall be provided, operated and maintained by VVM. Hence, the Environmental Impact Assessment Report covers the various impacts (environmental as well as socio-economic) expected from the developmental, processing, infrastructure and amenities are considered under the purview of VVM SEZ.

If the industries to be set up in the VVM SEZ generate any kind of environmental pollution in the form of air, water and / or solid, they shall have to appropriately manage and handle the same in compliance with the prevailing environmental norms of Tamil Nadu State Pollution Control Board and all applicable laws. This responsibility shall entirely lie with the corresponding industries.

VVM SEZ Implementation Plan

VVM SEZ enjoys several unique advantages over the other existing and planned SEZs in the country. VVM SEZ is visualized to transform an arid, brown-field site into a vibrant, thriving, modern, eco-friendly, state-of-the-art, self sufficient city with world class standards of infrastructure for the best in industrial, modern business and living

environment. VVM SEZ would soon become a self-contained industrial hub having trading centers along with institutions with social, cultural and recreational activities.

The VVM SEZ is expected to achieve its full physical development into stages, during which the realities of today may undergo unforeseen planning changes. Therefore, flexibility in the entire planning, development and management process is incorporated, so that the development can respond to changing scenario without sacrificing the basic concept of structure, the environmental paradigms, or socio-economic concerns. In case any model latest eco friendly technologies available it will be implemented to protect the environment.

The underlying philosophy of VVM SEZ is to be able to attract investment, particularly relating to industrial development, from both domestic as well as international entrepreneurs, by offering not only financial tax incentive, which are inherent in the Government of India policies for SEZs, but also the physical infrastructure facilities of international standards.

Project Completion Schedule

The estimated period over which the VVM SEZ shall be commence its first operation within 3 years. Other activities will be implemented into stages.

The proposed development of VVM SEZ is covering the following activities

- Processing of Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent extraction etc.
- The Captive Port development
- Supporting Infrastructure including road utility corridors to the Port.
- Wind turbine and solar power plant altogether to a total capacity of 450 MW

- A Desalination Plant with a capacity of 100 MLD for Bulk users.
- Sea-water Intake for Desalination Plant.
- Common Disposal site is proposed for disposing the rejects from Desalination plant and for other treated effluents.
- Other utilities and amenities along with fire fighting facilities and safety.

Table 1-1 Proposed VVM SEZ supporting infrastructure facilities development into stages

Sr.No.	Supporting Infrastructure facilities	Brief Description
1	Social Infrastructure	<ul style="list-style-type: none"> • Residential Quarters for approx. 150-200 Mainly for executives and higher grade officers spread over an area of 1 ha will come up in sectors • Associated amenities to match the facilities meeting the best standards in terms of urban planning design. • The social infrastructure will have a well planned Transportation Network having 50m Arterial Road, 30m Sub Arterial Road and 15m Collector Streets adding total up to 2.60 ha of land area. • Other facilities like IT and Telecommunication network will follow to meet the demands.
2	Common Effluent Treatment Plants for Industrial wastes	<ul style="list-style-type: none"> • CETPs are proposed in a phase wise manner to treat the effluent that would be generated from the proposed multi-product SEZ. • The CETPs with a total capacities that are envisaged are as under;

		<p>1. 25 MLD</p> <p>2. 50 MLD</p> <ul style="list-style-type: none"> • These CETPs are phased out would initially be constructed based on the actual effluent discharges from the industries. • The effluents required to be treated would be brought through a dedicated pipeline network at the CETPs which eventually after treatment would be discharged at an identified location into sea. • The sludge formed after the treatment would be discharged to a sludge pit from where it is partly re circulated back to the clarifier inlet.
3	Sewage Treatment Plants	<p>A sewage treatment plant is proposed in a phase wise manner to treat the effluent generated from the proposed social infrastructure facilities. For supporting the entire population of the VVM SEZ, STPs of 1.2 MLD capacity is required. In the first phase STP with an initial size of 0.4 MLD will take care of the sewerage and the recycled water would be helpful for horticulture purpose.</p> <ul style="list-style-type: none"> • All the suspended solids would be filtered and disposed as per the MSW guidelines 2000 at an identified site.
4	Desalination Plant	<p>Fresh water requirement will be met by desalination plant to meet the demands of the processing, non processing zones as well as the social infrastructure facilities.</p>

		<ul style="list-style-type: none"> • The desalination plant proposed in the SEZ is of 100 MLD capacity which would come up in modular and expandable manner. • The plant capacities are based on the fresh water requirement as a part of master planning exercise that would come up in a phase wise manner to meet fresh water demands. • The immediate fresh water requirement in the coming 5 years would be ~50 MLD.
5	Drainage Network	<ul style="list-style-type: none"> • A drainage network would be proposed to discharge the treated effluents and RO reject from the CETPs and Desalination plants. • A dedicated drainage network at the social infrastructure facilities leading to STP for further treatment. • The treated effluents and rejects from the plants would be discharged to the sea at a suitable location.
6	Rain/Storm water harvesting plan	<p>Rain water harvesting techniques would be adopted for water conservation.</p> <ul style="list-style-type: none"> • Storm water would be canalized in a systematic manner to avoid any clogging during natural disasters.
7	Waste management & Disposal	<ul style="list-style-type: none"> • The SEZ and its supported infrastructure would generate solid wastes approx. 80 t/day that would be disposed as per the guidelines of CPCB
8	Power supply Network	<ul style="list-style-type: none"> • Power demand of 250MW would be met at first from TNEB. Subsequently from the

		<p>proposed VVM SEZ Power Plant into stages.</p> <ul style="list-style-type: none"> • Electrical transmission and distribution would be through an overhead and underground cable network spread across the entire SEZ area there by meeting the demands on need basis.
9	IT-Telecommunication network	<ul style="list-style-type: none"> • In order to have efficient communication spread throughout the proposed SEZ, IT along with telecommunication network will be spread to various zones on need basis.
10	Storage tank for safe custody of Uranium and Thorium	<p>It will be constructed as per the advice and norms of Atomic Energy Regulatory Board (AERB) in an isolated place with in SEZ area fenced with compound wall and fire fencing with lock and key system. The Uranium will be supplied to Govt., of India, Atomic Energy Department for using as fuel in their Nuclear Power plant. The Thorium will be disposed as per the advice of the AERB / Atomic Energy Department.</p>

SCOPE OF ENVIRONMENTAL IMPACT ASSESSMENT STUDY

The Special Economic Zone is specified as:

- Project / Activity – 7 (C)

- Category – B

- in Notification vide S.O. 3067(E) dated 1st December, 2009 issued by the Ministry of Environment and Forests, therefore it is not required to obtain prior Environmental Clearance from the Ministry of Environment and Forests, Govt. of India. Hence all the activities proposed in the SEZ project of VVM falls under category B State EIA and CRZ clearance is enough and therefore the present Environmental Impact Assessment

Report has been prepared for obtaining Environmental clearance from State Environment Impact Assessment Authority (SEIAA). The present Environmental Impact Statement has been prepared for the perusal of the SEIAA.

Study Area and Study Period

The Environmental Impact Assessment (EIA) for the proposed VVM SEZ has been carried out for the identified stretch of land as per Map -1. Owing to geographical spread of the development, the identified boundary of the VVM SEZ has been considered as a core **study area** and impacts to the adjacent habitations receptors within 10 km band from the identified VVM SEZ boundary are termed as buffer study area.

The base-line for environmental parameters and site specific meteorology has been collected for one Year during the **study period** (January 2011 to December 2011) as per the EIA Guidelines issued by the MoEF.

In the core and buffer zones several stations were selected to study the baseline Air, Water, Noise and soil quality. In all the Air quality monitoring stations suspended particulate matter, respirable suspended particulate matter, sulphur di oxide, Nitrogen oxide were monitored to assess the existing status of air quality and pollution dispersion pattern over the whole air basin of the proposed VVM SEZ project.

Micro-meteorological data like temperature, relative humidity, wind speed, wind direction and rainfall have been collected throughout the study period on hourly basis on the selected sites.

On studying the details of the proposed project, all possible significant, non significant, positive, negative, short term and long term impacts have been identified, predicted and assessed. Finally an Environmental Management Plan (EMP) has been prepared recommending measures to be implemented for mitigation of adverse impacts, as described in chapter V.

METHODOLOGY FOR EIA STUDY

The methodology adopted for carrying out this study is based on the guidelines recommended by Ministry of Environment and Forests (MoEF). The total EIA study can be divided into the following three phases :

- (i) Identification of significant environmental parameters and preparing baseline data of the existing status within the study area with respect to air, noise, water, land and socio-economic environment.
- (ii) Prediction of impacts due to the proposed VVM SEZ on the identified environmental parameters.
- (iii) On evaluation of total impacts by super-imposing the predicted impacts over the baseline data, Environmental Management Plan (EMP) has been prepared, which would help in incorporating proper mitigation measures wherever necessary for preventing deterioration in environmental quality.

SALIENT FEATURES OF THE PROJECT - VVM SEZ

The cost of the project is 870 crores

Project Site : Thiruvambalapuram Village

Taluk : Radhapuram

District : Tirunelveli

Total Area under the project : 166.66.5 Ha

Latitude : 8°24'26' N

Longitude : 77°78'97' E

Connectivity

Nearest town : Tisaiyanvillai (14 km)

Nearest railway station : Valliyoor approximately 25 km

Nearest sea port : Tuticorin Port (90 km)

Nearest air port : Tuticorin Air Port (100 km)

Access roads : Rameshwaram – Kanyakumari Coastal Road (1 km)

Socio Economic Settings

Basic Amenities

- Medical : PHCs and lower facilities, RMP doctors
- Educational : Primary schools and few secondary schools and polytechnics college
- Transport : State Transport Buses and local service providers
- Water Supply : Thamirabarani drinking water supply scheme operated by TWAD Board. Few dependent on Bore wells and dug wells
- Power Supply : All villages are electrified, no industrial users
- Irrigation : Very few. Mostly on well irrigation. It is a rain shadow area.

Features of Impact Zone

- Present Land Use : Mainly barren land
- Land area Identified as VVM SEZ – 166.66.5 ha,
- Water bodies - River Nambiyar, Gulf of Mannar
- Forests : No Reserved forests are existing in or around the proposed site
- Vegetative Classification - 100 % non vegetative area
- Geology - Undifferentiated fluvial /Aeolian / Coastal Sediments
- Soil Type - Mainly sandy soil
- Crops - Coconut, Pulses, Banana
- Seismic Zone : Zone II as per 1893-1984

Meteorological data

Ambient air temperature

- Climate : Dry, Arid Coastal Climate
- Highest daily maximum temperature : 40 °C
- Max. dry & wet bulb temperature 37.7 / 26.8 °C
- Min. dry & wet bulb temperature 16.2 / 11.5 °C
- Wind Regime Summer - SW and W, Monsoon - NW,W Winters - N, NE

Rainfall

- Average annual rainfall : 180 mm
- Period of water scarcity April to June, in summer season the area is drought prone

Wind velocity

Max. wind velocity 32.4 km/hr study period (Jan 2011 – Dec 2011).

Predominant Wind direction N, NE and SW (Study Period)

Relative humidity

Annual mean humidity 60%

Max. Humidity 85%

Min. Humidity 40%

Site Approach

Thiruvambalapuram is located about 14 km from the Nearest town, Tisayanvillai, Tirunelveli is the headquarter, about 87 km away from the project site. Thiruvambalapuram is directly linked to the Rameswaram – Kanyakumari East Coast Road (1 km) Valliyoor railway station is the nearest passenger rail head 25 km away. Tuticorin air port (about 100 km) is in the vicinity.

Siting Criteria

The core points of the proposed VVM SEZ are the fully operational Heavy mineral processing area specifically for processing of minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent extraction etc., VVM captive port, VVM Wind turbine and solar power plant and other related activities.

VVM SEZ is developing a separate processing plant for Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, cracking of monazite etc., by registering one or more subsidiary companies.

VVM also proposed to produce Scandium, Titanium slag, Rutile grade pigments and other mineral based products by registering one or more subsidiary companies.

VVM proposed to produce rare earth oxides, solvent extraction, and manufacturing of magnet by registering one or more subsidiary companies.

While cracking Monazite, Thorium and Uranium will be generated in small quantities. They are radioactive materials hence will be stored in a separate place as per the direction of AERB (Atomic Energy Regulatory Board) and Uranium will be supplied to Atomic Energy Department as fuel material for its Nuclear Power Plants and Thorium will be disposed of to The Nuclear Power Corporation of DAE (Department of Atomic Energy) and if they do not require it, it will be disposed of as per the advice of the competent authority. Already VVM has obtained proper license under Radiation Protection Rules and has appointed Radiation Safety Officers duly licensed by AERB.

VVM Port is an all-weather port with deep draught, comprising three operational multi-purpose terminal, with mechanized handling and storage facilities for various cargo types.

VVM SEZ is developing wind turbine and solar power plant in the VVM SEZ as a dedicated power source by registering a separate subsidiary company for better administration. All this activities are effected in to stages and the total power production capacity altogether would be 450 MW.

The Special Economic Zone at VVM will further intensify the development of this otherwise marginal-economy stretch of the Thiruvambalapuram region. The infrastructure and living standard of the residents of the VVM SEZ will be at par with international SEZs. The development of this magnitude and character can be made possible only by a developer with commensurate project implementation experience and financial resources.

The land identified for the VVM SEZ is non-agricultural, saline and in-fertile land. This can be better utilized for Processing of Heavy minerals such as Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent extraction etc. for captive port, wind turbine and Power plant development, in the VVM SEZ. **There are no issues of Resettlement and Rehabilitation on the identified stretch of land.**

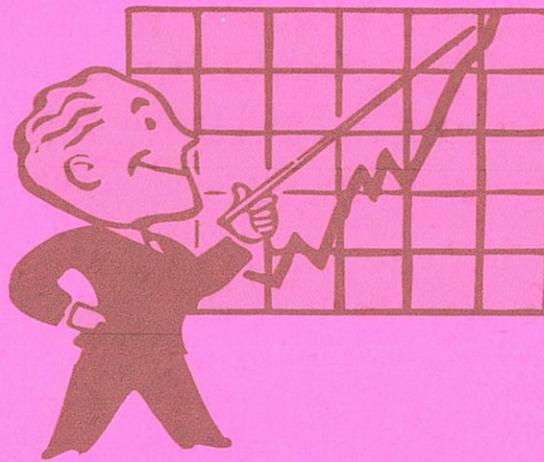
The climatic conditions of VVM SEZ will ensure pleasant and non-extreme weather condition throughout the year. Due to meager rainfall, minimum interruption in traffic, production or living is expected in comparison to any place on the main land. The region has had no events of social unrest in the past. The SEZ development being on the landward side does not envisage any land reclamation.

Major Components of VVM SEZ

The major components involved for VVM SEZ are pointed out below, however these Components are described in depth in Chapter -II.

- Heavy mineral Processing Plant for Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent extraction etc.
- Captive port Development
- Wind turbine and Solar Energy development
- Desalination Plant 100 MLD capacity
- Social infrastructure
- Roads network
- Storm water drainage
- Water supply network
- Power supply network
- Effluent collection network

- Distributed Common Effluent Treatment Plant
- Recycled water supply network
- Municipal solid waste management facility 80 tonnes/day
- Telecommunication network etc.,



PROJECT DESCRIPTION

CHAPTER – II

PROJECT DESCRIPTION

VISION

VVM SEZ has been conceived as a model industrial development of international standards, with emphasis on Heavy mineral Processing Plant for Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent extraction etc., Captive Port development, desalination plant and Wind turbine and solar power plants oriented important activities as the hub. This zone will be enjoying free trade status, having the following features:

- Modern port with potential for progressive quantitative and qualitative up gradation
- Comprehensive and integrated infrastructure within the SEZ comparable to the best practices of planning and provision of infrastructure in similar situations.
- Infrastructure sensitive to local conditions as well as conducive to conduct international business.
- Ideal living and working conditions for its working and complementary population. Endeavoring to preserve and enhance the natural ecosystem of the area.

VVM SEZ shall offer to its users the best infrastructure available in the surroundings that shall be sensitive to local conditions as well as conducive to conduct international business. At the same time, it shall strive to preserve the natural ecosystem of the area and offer ideal living and working conditions for its inhabitants. Hence VVM SEZ is conceived as a rich mix of state-of-the-art services and amenities and green environs.

PROJECT DETAILS

The proposed VVM SEZ project land (166.66.5 ha) is under the possession of the developers and has been notified by Thasildhar, Radhapuram Taluk. The own patta Land of VVM SEZ is contiguous and free from all encumbrances. There is no habitation or encroachment in and around the proposed SEZ area.

The proposed developments in the VVM SEZ are Heavy Mineral Processing Plants for Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandium, cracking of Monazite for production of magnets, solvent extraction etc..and a fully operational VVM Port, VVM Wind turbine abd Solar Power Plant, Desalination Plant etc.,

VVM SEZ is developing a separate processing plant for Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, cracking of monazite etc., by registering one or more subsidiary companies.

VVM also proposed to produce Scandium, Titanium slag, Rutile grade pigments and other mineral based products by registering one or more subsidiary companies.

VVM proposed to produce rare earth oxides, solvent extraction, and manufacturing of magnet by registering one or more subsidiary companies.

While cracking Monazite, Thorium and Uranium will be generated in small quantities. They are radioactive materials hence will be stored in a separate place as per the direction of AERB (Atomic Energy Regulatory Board) and it will be disposed of to the Nuclear Power Corporation of DAE (Department of Atomic Energy) and if they do not require it, will be disposed of as per the direction of the competent authority. Already VVM has obtained proper license under Radiation Protection Rules and has appointed Radiation Safety Officers duly licensed by AERB.

VVM Port is an all-weather port with deep draught, comprising an operational multi-purpose terminal, with mechanized handling and storage facilities for various cargo types.

VVM SEZ is developing wind turbine and solar power plant in the VVM SEZ as a dedicated power source by registering a separate subsidiary company for better administration. All this activities are effected in to stages. The total power production capacity altogether would be 450 MW.

The Special Economic Zone at VVM will further intensify the development of this otherwise marginal-economy stretch of Thiruvambalapuram region. The infrastructure and living standard of the residents of the VVM SEZ will be at par with international SEZs.

Existing Elements

At present the proposed SEZ project area is a barren waste land with no major development.

Proposed Elements

In order to meet with the projected demand of VVM SEZ, the following elements may require as under:

Table 2.1 Proposed project elements of VVM SEZ

S.No.	Elements	Capacity Required
1.	Heavy Mineral Processing Plant for Garnet, Ilmenite, Rutile, Zircon,	0.095 million TPA (Tons Per Annum) of finished products

	Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent extraction	
2.	Captive Port	4.5 million ton per annum cargo handling facilities All weather port with deep draught, comprising three operational multi-purpose terminal, with mechanized handling and storage facilities for various cargo types.
3.	Power Plant (450 MW)	Wind turbines in and around the project area and Solar Power plant for all buildings altogether will generate 450 MW power, which shall be sufficient to cater for the entire calculated power required for VVM SEZ
4.	Water Supply (Desalination Plant, CETP)	Approximately 100 MLD, depending on industries within VVM SEZ. Approx. 75 MLD of CETP facilities so as to cater to effluents that are generated by the SEZ industries.
	Transport Infrastructure	
5.	Roads Network	The existing roads outside the CRZ will be sufficient. Within the CRZ area road facility will arrange by the developer at their own cost.

	Social Infrastructure	<p>Hence it is an Industrial Development Project. Importance will be given to promote Industrial activity rather than residential development. Housing facilities will be provided only to the executives and higher grade officers approx. 150 -200 numbers.</p> <p>Municipal infrastructure like water supply and sewerage (STP), solid waste collection, treatment and disposal, power supply, domestic transport infrastructure (roads) communication network (phone and data), and amenities like medical and educational facilities will be provided.</p>
--	--------------------------	---

INDUSTRIAL DEVELOPMENT

The estimated period over which the VVM SEZ shall be commence its first operation within 3 years. Other activities will be implemented into stages.

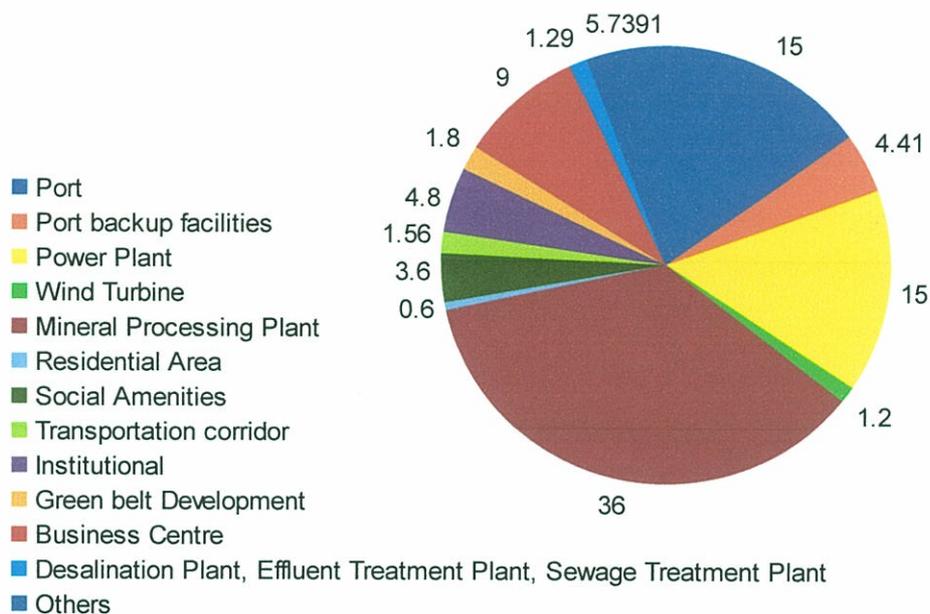
Details of land use for the proposed activities within VVM SEZ such as Processing of heavy minerals such as Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent extraction etc., Port operation, desalination plant and Wind turbine and solar power plants development is tabulated as Table 2.2

Table 2-2 : Details on land use in development plan -VVM SEZ

Land Use	Approx. Area in Ha	% Area
Port	25.00	15.00
Port backup facilities	7.35	4.41
Power Plant	25.00	15.00
Wind Turbine	2.00	1.2
Mineral Processing Plant	60.00	36.00
Residential Area	1.00	0.6
Social Amenities	6.00	3.6
Transportation corridor	2.60	1.56
Institutional	8.00	4.8
Green belt Development	3.00	1.8
Business Centre	15.00	9.0
Desalination Plant, Effluent Treatment Plant, Sewage Treatment Plant	2.15	1.29
Others	9.565	5.7391

The VVM SEZ is expected to achieve its full physical development into stages, during which the realities of today may undergo unforeseen planning changes. Therefore, flexibility in the entire planning and development management process is incorporated, so that the development can respond to changing scenario without sacrificing the basic concept of structure, the environmental paradigms, or socio-economic concerns. In case any model latest eco friendly technologies available it will be implemented to protect the environment then and there.

Figure 2.1 Percentages of Land use by Proposed Industries in VVM SEZ



RESIDENTIAL DEVELOPMENT

The major aim of VVM SEZ is to promote Product specific (mineral based) Industrial Development in the project area hence emphasis will be given to Industrial development rather than Residential Development. Residential quarters facility will be provided only to the executives and higher grade officers approximately to 150 -200 numbers.

Institution Development

The primary objective of providing sufficient and high quality social institutions within VVM SEZ is to be able to give a better quality and modern life style to the Workers. Necessary land have been set aside for institutional uses such as community centers, polyclinic, and library, religious institution, swimming complex, sports complex and an indoor stadium.

Following strategies were formulated to optimize the available land for better Industrial Development

PROCESSING PLANT

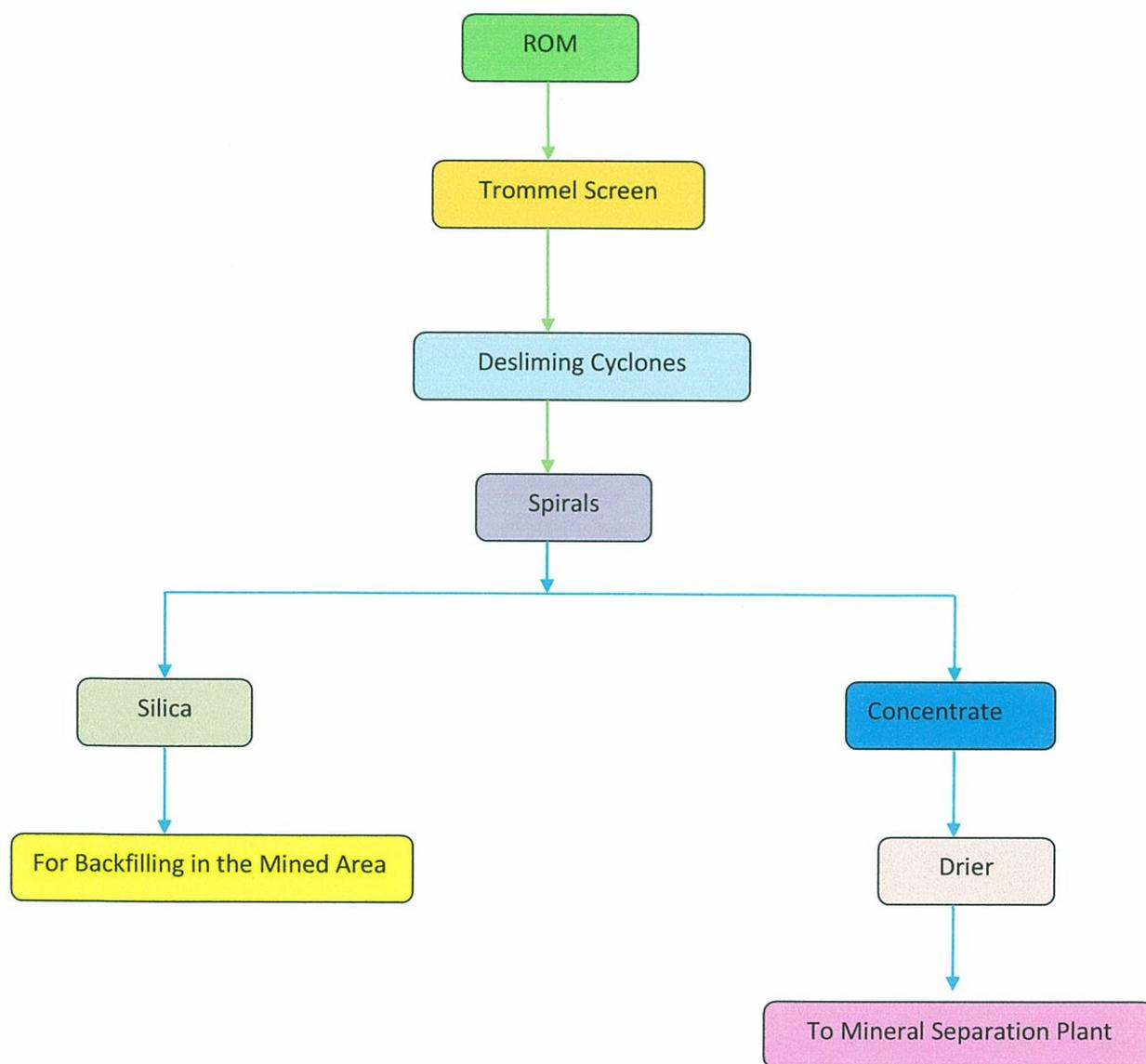
The processing of Industrial heavy mineral sand for segregation of heavy minerals is primarily a mechanical operation. As the heavy minerals have different magnetic susceptibilities, relative variations in the magnetic and conductive properties of heavy minerals sand are taken advantage in their sub section in dry state. The processing and mineral separation is normally done in 2 stages.

Stage I : Pre concentration Plant

The heavy mineral bearing sand will be subjected to spiraling. The heavies containing Ilmenite, Rutile, Zircon, Sillimanite, Garnet will be separated as concentrate for further treatment in the Mineral Separation Plant. The lights containing Silica, quartz and shell fragments etc. is the balance sand after removing the heavies in the Pre concentration Plant, which will be back filled in the mined blocks and levelled.

The List of equipments to be used in the Pre concentration Plant

1. Spirals (10 tonnes per hour capacity) : 800 numbers
2. Trommel Screen (12' length x 8' diameter) : 4 numbers
3. Pumps (25 HP capacity) : 8 numbers

FLOW SHEET OF PRECONCENTRATION PROCESS

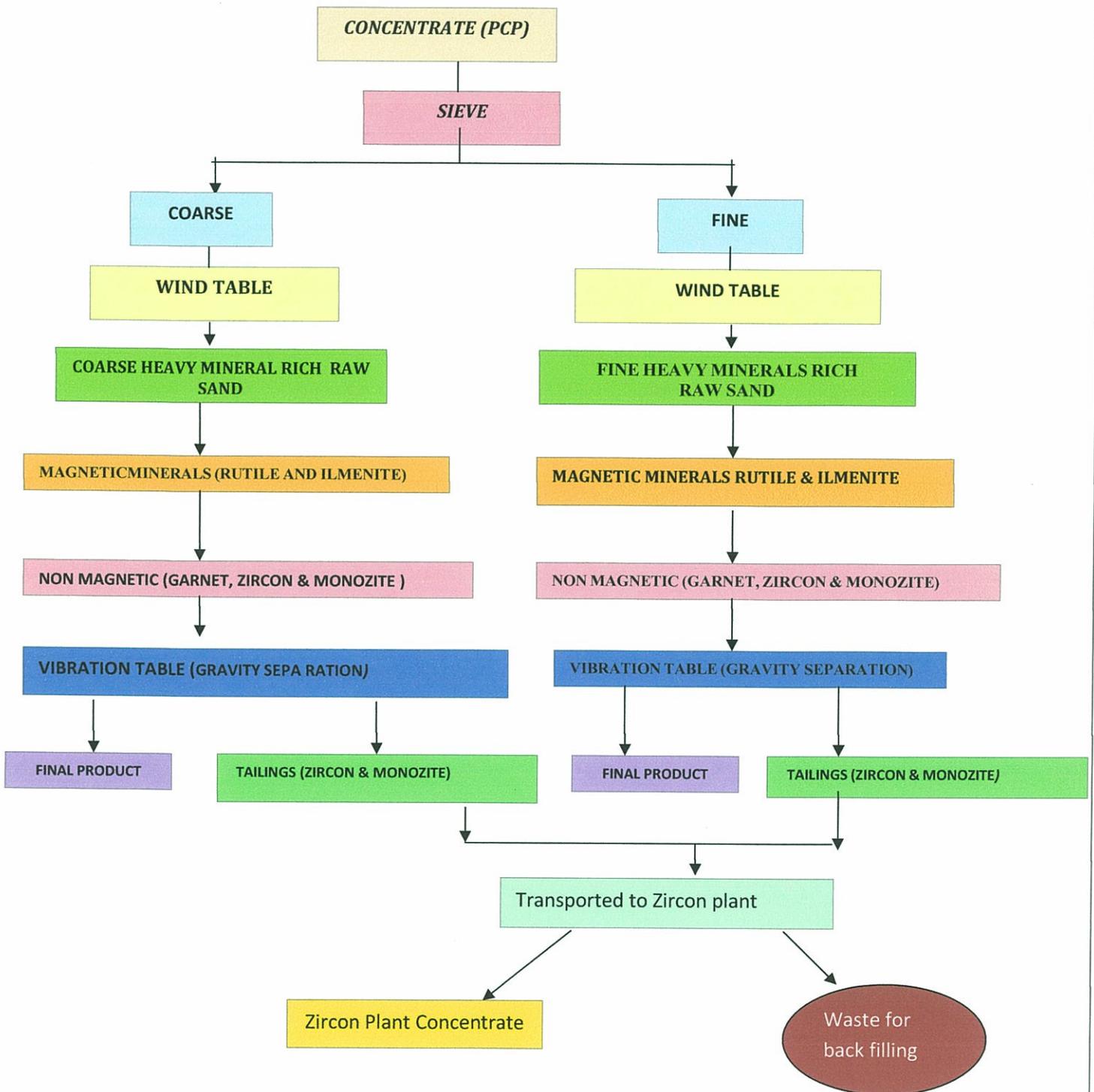
Stage II

The concentrate from the Pre concentration plant will be routed to the Mineral Separation Plant (MSP) for further processing and separation of individual minerals. By using electrostatic separator, the minerals which are primary conductors and the non conductors will be separated out. The primary conductors minerals will pass through Rare Earth Drums to separate the Ilmenite and the Rutile. The non conductors will pass through high intensity Roll Magnetic Separators and various other processes to liberate Garnet, Sillimanite, Zircon etc.

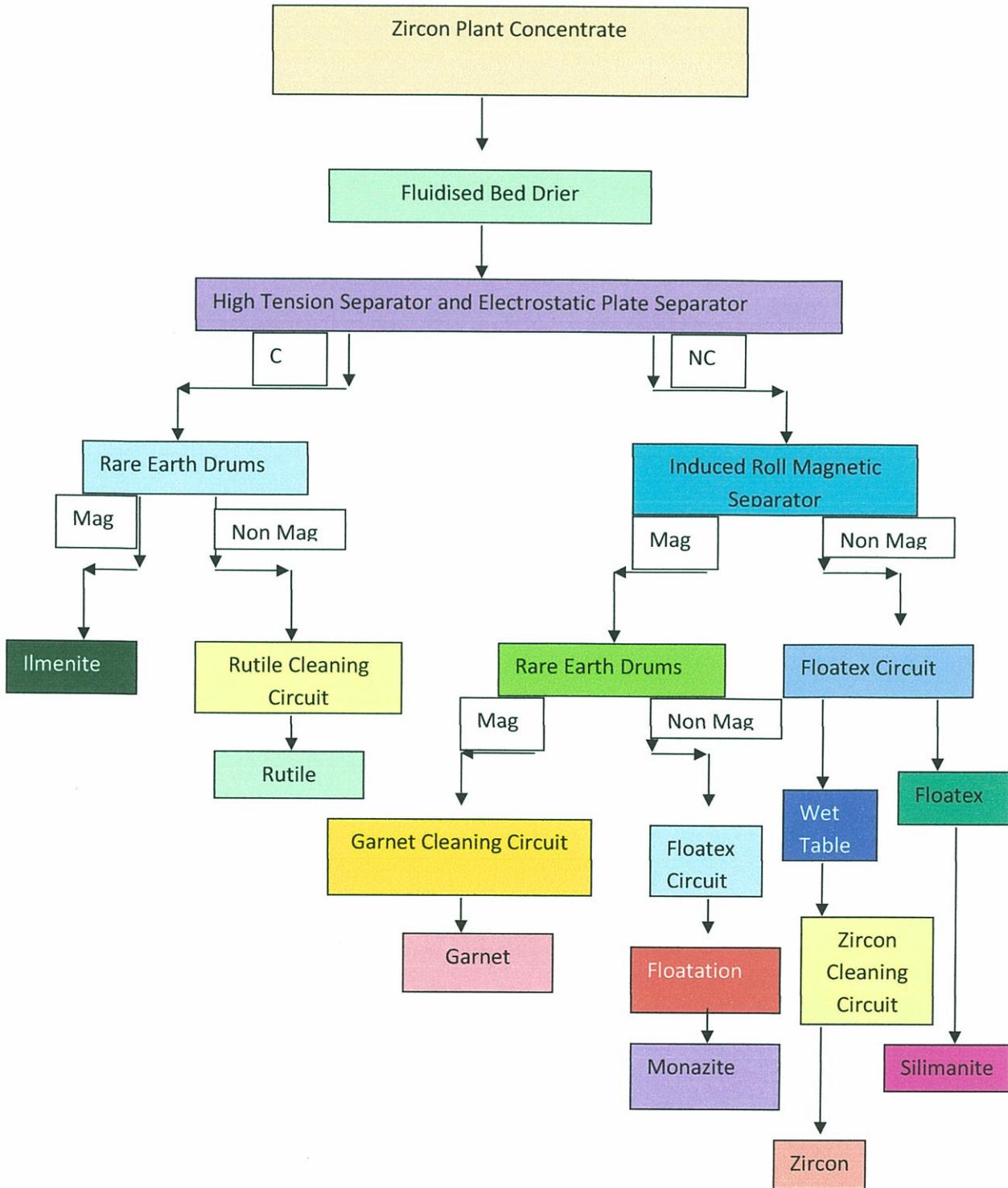
The List of equipments to be used are given below

- | | |
|---|--------------|
| 1. Electrostatic Separators (10 tonnes per hour capacity) | : 12 numbers |
| 2. Magnetic Rolls (5,000 gauge approx.) | : 40 numbers |
| 3. Magnetic Separators (20,000 gauge approx.) | : 40 numbers |
| 4. Bucket Conveyors (12' height) | : 48 numbers |
| 5. Belt Conveyors (500 m length x 1 meter width approx.) | : 20 numbers |
| 6. Vibrating Screens (10 tonnages per hour capacity) | : 12 numbers |

FIG. 2-2 FLOW SHEET OF THE MINERAL PROCESSING PLANT

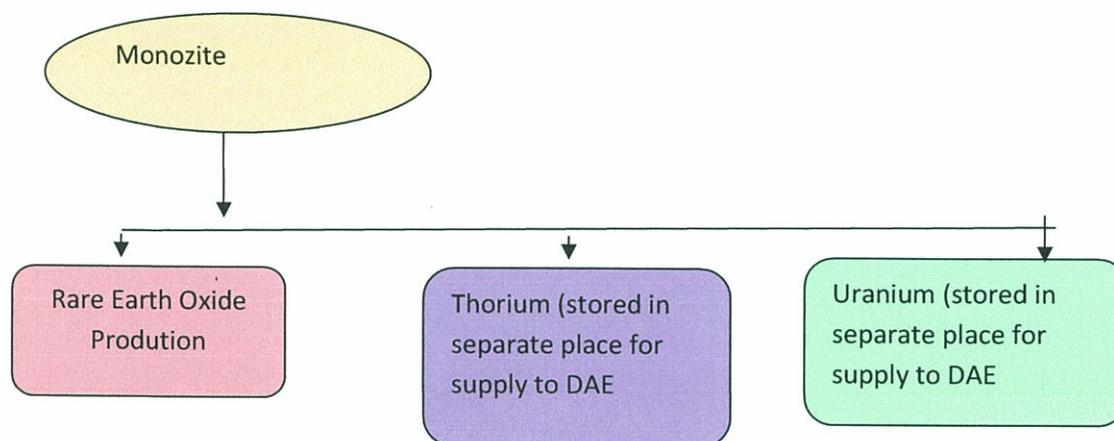


FLOW SHEET OF MINERAL PROCESSING PLANT

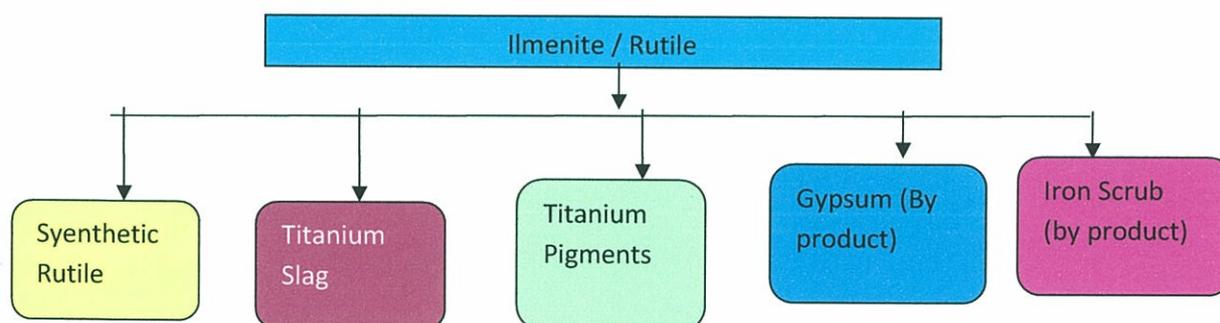


The monazite separated will be stored in separate storage yard.

Cracking of Monozite



Production of Titanium Slag / Pigments



VVM proposed to produce Scandinium, rare earth oxides, solvent extraction, and manufacturing of magnet by registering one or more subsidiary companies.

While cracking Monazite, Thorium and Uranium will be generated in small quantities. They are radioactive materials hence will be stored in a separate place as per the direction of AERB (Atomic Energy Regulatory Board) and it will be disposed of to The Nuclear Power Corporation of DAE (Department of Atomic Energy) and if they do not require it, it will be disposed as per the advice of the competent authority. Already VVM has obtained proper license under Radiation Protection Rules and has appointed Radiation Safety Officers duly licensed by AERB.

VVM CAPTIVE SEA PORT

VVM proposed to establish a port within VVM SEZ area. VVM Port shall be an all-weather port with deep draught, comprising an operational multi-purpose terminal, with mechanized handling and storage facilities for various cargo types.

It will handle VVM's cargo as well as any other cargo required by Export Oriented Units / Exporter / Importer with proper permission from competent authority.

Outward - 1000 TPH of 3700 m length connecting godowns to jetty, Ship Loader – all type of permissible mercantile goods (1000 to 2500 TPH).

Dry Bulk Cargo Coal and Coke and building materials and all type of permissible mercantile goods will be handled in separate yard.

VVM will establish separate container terminal for handling of 40 feet, 20 feet and other specialized containers.

The details of the captive port is as follows

1	Length of North Breakwater	2,100 m
2	Length of South Breakwater	1,150 m
3	Length of Approach Channel	3,300 m
4	Width of Approach Channel	160 m
5	Depth at Approach Channel (below CD)	16.1 m
6	Depth at Maneuvering Areas (below CD)	15.5 m
7	Diameter of Turning Circle	500 m
8	No. of berths (length in m)	3 (600m)
9	Dredged depth at berth	15.5 m CD
10	Dredging quantity	11 million m ³

- **Power supply** – The required power will be met out by TNEB at first stage and when VVM power plant comes to operation own power will be utilized and the surplus power will be exported. The initial power demand is estimated as 250 MW.

POWER PLANT

To meet the power requirement of VVM SEZ, wind turbine and solar power plants shall be installed in the VVM SEZ. The ultimate capacity altogether would be 450 MW implemented into stages by registering one or more subsidiaries.

TRANSPORTATION

Own transportation arrangement will be done for transportation of materials as well as staffs. For other exporters Cargo handling, private vehicles with valid fitness certificate and registration from the competent authority will be utilized.

Road Network

Existing road network outside the VVM SEZ is sufficient for transportation. Within the SEZ area, road with latest technology will be erected at developers own fund.

Water Requirement and Source:

SOURCES

The water requirement will be met out by its own source by desalination of sea water and harvesting of rain water and recycling of treated water.

The details and estimated quantum of the above water resources are as under:

- 1. Desalinated Water:** It will be necessary to provide substantial volume of desalinated water, in phases, for assured uninterrupted water supply to VVM SEZ. Sea water shall

be treated by desalination plants to the standards of potable water and supplied primarily for domestic use. Water demand is initially 2.5 MLD and in full fledges operation 100 MLD.

3. Recycled Water: Domestic and other waste water shall be collected and treated at strategically placed treatment plants, up to tertiary treatment level and shall then be re-circulated for industry and non-domestic uses.

The wastewater treated shall be used to develop Green belt over the VVM SEZ there by reducing the net fresh water demand and minimize impacts on the competitive users.

DISTRIBUTION

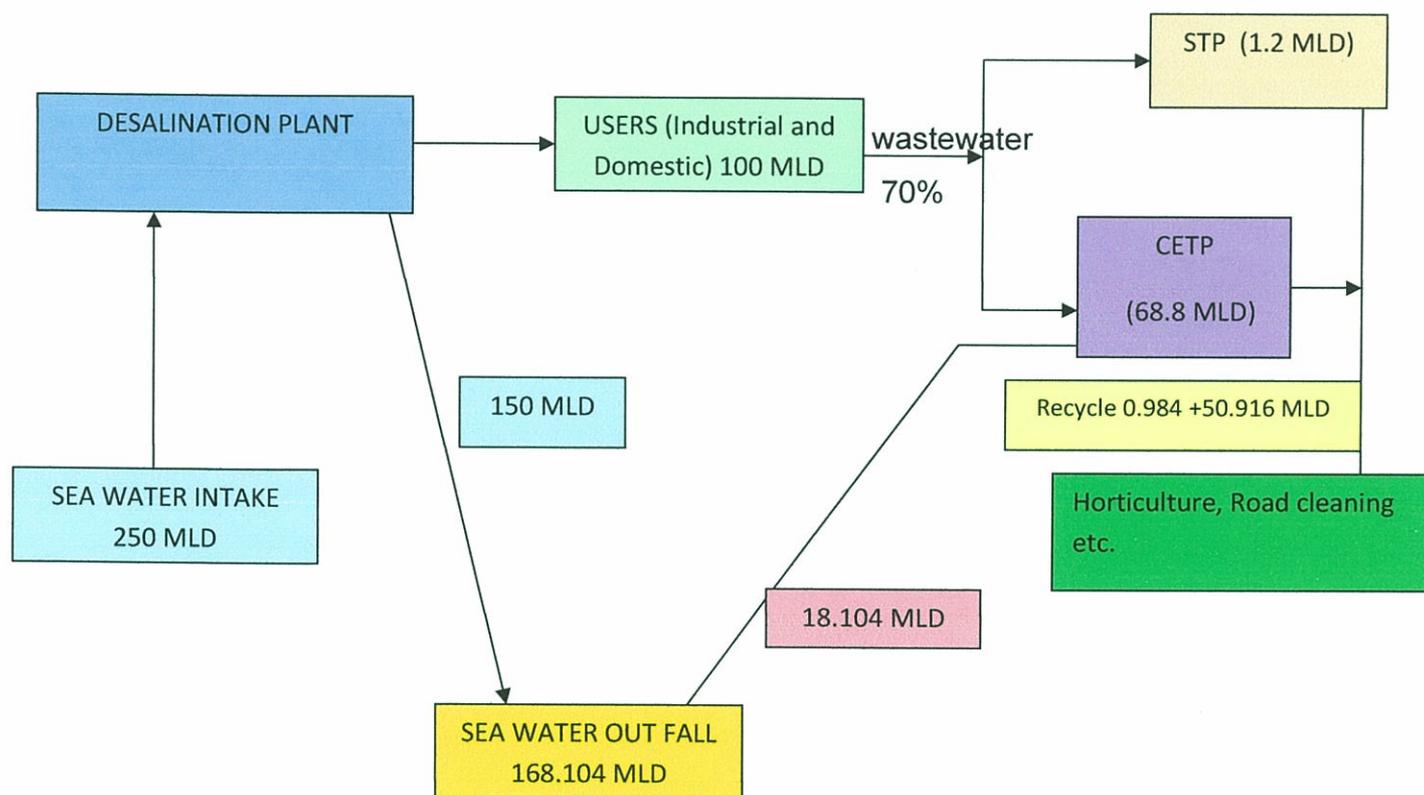
The water distribution scheme has been based on independent storage and distribution of treated water for different sources, for domestic, non-domestic and industrial uses. The water is being pumped into the distribution system by hydro-pneumatic pumps, which also ensure the desired residual pressure. Most part of the water supply is designed as loop system to ensure maximum head of water.

WATER REQUIREMENT

1. Daily Average Water Demand

Daily average water demand has been estimated initially as 2.5 MLD and in full fledge project operation the requirement would be 100 MLD, which will be met by its own source by desalination of sea water and harvesting of rain water and treated water as per demand into stages. The desalination plant will be built in modular and expandable manner.

FIG. 2-3 WATER BALANCE FOR VVM SEZ



2. Design Parameters for Distribution System

The planning for the proposed water supply and distribution system shall cater to phase wise development. In addition, the following parameters shall be adopted for water distribution network for VVM SEZ:

- a) Peak factor for transmission main - 1.5
- b) Peak factor for distribution system - 2.25 for Residential/Institutional and 1.5 for Industrial
- c) Water loss due to leakage - 15%
- d) Minimum residual pressure at ferrule point - 7m for single storey, 12m for two storey and 17m for three storey
- e) Pipe material proposed- Ductile Iron / Mild Steel / DI (K – 9) / and HDPE pipes (PE 100) pipes are used for water distribution.
- f) Minimum diameter- 100mm

3. Fire Protection Demand

The quantity of water required for fire fighting operations shall be planned based on the Manual on "Water Supply and Treatment", published by CPHEEO (Central Public Health and Environmental Engineering Organisation), Ministry of Urban Development, New Delhi, 1991, using the following empirical formula:

$$\text{Fire demand in liters per day} = Q = 100000 \times (P)^{0.5}$$

Where P = Workers/Population in thousands

Q = quantity in lpd (liters per day)

For SEZ project, the fire protection system shall be designed for a total worker population of 8250. Therefore,

$$P = 8.25$$

$$Q = 100000 \times (8.25)^{0.5}$$

$$= 412500 \text{ lpd}$$

$$= 0.4125 \text{ MLD}$$

DISTRIBUTION SCHEME

The water is being pumped into the distribution system by hydro-pneumatic pumps, which also ensure the desired residual pressure. Most part of the water supply is designed as loop system to ensure maximum head of water.

The water distribution pipes are laid along the defined utility corridor and away from sewerage system to avoid any possibility of contamination. A gridiron system of pipelines shall be used for water distribution network, compatible with the sector planning of SEZ. Within the gridiron system of pipe network, all arterial and secondary mains shall be looped and interconnected. This arrangement eliminates dead ends and permits water circulation such that a heavy discharge from one mains allows draining water from other pipes. This also helps in preventing water from developing tastes and odors due to stagnation. In addition to the water supply for domestic, non-domestic and industrial uses, piping system shall also cater for water supply for fire fighting, including necessary pressure boosting measures.

DETAILS ON DESALINATION PLANT USING REVERSE OSMOSIS (RO) SYSTEM

It will be necessary to provide substantial volume of desalinated water, in phases, for assured uninterrupted water supply to VVM SEZ. For this total 100 MLD of sea water desalination facilities will be developed. So to ensure continuous supply of quality water Desalination Plant of 100 MLD capacity is required to meet the estimated demand. The desalination plant will be built in modular and expandable manner.

Technical features of the plant

- Sea water intake
- Pre-treatment
- Filtration
- RO system
- Post treatment
- Automation

After reviewing various technology, VVM SEZ has chosen Sea Water Reverse Osmosis Desalination Technology to implement in this project.

The Reverse Osmosis process uses a semi-permeable membrane to separate and remove dissolved solids, organics, pyrogens, submicron colloidal matter, viruses, and bacteria from water. The process is called "reverse" osmosis since it requires pressure to force pure water across a membrane, leaving the impurities behind.

Reverse Osmosis is capable of removing 98%-99.5% of the total dissolved solids (TDS) and 99% of all bacteria, thus providing safe, pure water.

Pre-treatment

- From the pumping station, raw seawater flows to the pre-treatment facilities.
- Chlorination for effective disinfection is done in stilling chamber.
- The disinfected water is then flow to coagulation and flocculation chambers for chemical treatment using coagulants and flocculants.
- Clarification and gravity settlers are used to settle and remove the heavier suspended and settable solids.
- The sludge from the gravity settler are drawn into the sludge pit

Filtration

Filtration is performed in two stages, starting with gravity filters containing gravel, quartz sand and anthracite media. The filters, which have an automatic backwash facility, offer a 12.5% standby overcapacity and have a proven ability to cope with storm turbidity levels. Four parallel batteries of cartridge filters form the second stage, with a built-in spare capacity of 33% are employed to remove the finer suspended solids present in the seawater to achieve the required SDI (Silt Density Index).

- The clarified water from gravity settler passes through Gravity sand filter and the outlet water from the filter is stored and pumped to the horizontal Pressure filter

through the intermediate pumping station to remove the suspended solids of particle size greater than 5 microns.

- @1.8 MLD backwash effluent water generate from filter will mix with RO reject water and go to reject disposal tank.
- The three modules of 5 micron cartridge filters are used to remove the remaining suspended solids completely and some of the microorganisms present in the seawater before it enter into the RO system.

Figure 2-3 Seawater RO System Discharge Water Characteristics

Parameters	Permissible values	Ambient Values	Discharge Values
BOD	100 mg/l	5 mg/l	14.2 mg/l
COD	250 mg/l	50 mg/l	92.68 mg/l
Salinity	-	37 ppt	57.00 ppt

Post Treatment

- The 100 MLD product water produced is stored in a tank and again chlorinated to avoid microbial contamination during water distribution.
- The brine is drained into the sea along with the disposal system of treated effluent.

Automation

- The proposed 100 MLD desalination plant will be a fully automated plant with multiple PLC's (Programmable Logic Controller) controlled and by SCADA system (Supervisory Control and Data Acquisition) .

Layout of the Plant

The proposed Desalination Plant will remove the dependence of the VVM SEZ, and all its ancillary developments on the ground water and fresh water. Since VVM SEZ area is already a 'dark zone' from the ground water perspective, the desalination plant will protect this fragile area for salinity ingress. The VVM SEZ will thus be completely independent from the point of view of its water requirements.

The RO reject and the CETP treated discharge water will be discharged through a common outfall point into the sea.

Sewage Treatment System

Sewerage system comprising of sub-systems; each catering to a self-contained park/hub, shall consist of collection system of pipe network, lifting stations (LS), terminal sewage pumping stations (TSPS), sewage treatment plants (STP) and Common Effluent Treatment Plant (CETP) before recycling for non-domestic and industrial usages. Planning for the sewerage system for a particular development area shall be such so as to take into account the entire future development in order to avoid re-installation of sewer pipelines for anticipated ultimate flow.

The sewage shall be treated at the STP and treated effluent shall be recycled for non-domestic usages. Effluent from the wastewater shall be treated at the CETP and treated effluent shall be discharged in an appropriate manner. The quality of the effluent after treatment shall meet the standards, as prescribed by the Tamil Nadu Pollution Control Board.

The following planning criteria shall be adopted for the proposed sewerage system at VVM SEZ site:

- Sewage Flow: 70% of water supply shall be considered as sewage inflow.
- Peak Factor: Design peak flow shall be two times the average flow.
- Discharge Capacity: The sewers shall be designed for the discharge capacity

of Q to cater adequately for the estimated peak run off using Manning's formula:-

Where,

$$Q = 1/n.A.R^{2/3} S^{1/2} \text{ (m}^3\text{/sec)}$$

Q = Discharge capacity (cu.m/sec)

A = Flow area of sewer (m²)

R = Hydraulic mean radius (m)

S = Bed gradient

n = roughness coefficient, (assume n=0.015 for reinforced concrete pipes)

DETAILS OF SEWAGE TREATMENT PLANTS

To meet the waste water disposal standards, VVM SEZ envisages developing 1.2 MLD Sewage Treatment Plant for Social Infrastructures. The STP will be built in modular and expandable manner. It will be of high efficiency aerobic treatment schemes based on extended aeration system using fine bubble diffused aeration are proposed. These plants are compact, odor free and have an energy efficient process. STP shall generate water of high quality, suitable for use as process water for industries / warehouses / transportation / horticulture etc.

Activated sludge process is an aerobic treatment of sewage in which bacteria require oxygen for their existence, thrive in presence of light and bring about oxidation of the sewage. In this system, certain amount of oxidized or activated sludge is intimately mixed with the sewage, which greatly hastens the process of oxidation of organic matter. Aeration and activation is done through compressed air, which is introduced through diffusers into the sewage as it flows through tanks. Air is supplied through vertical pipes, which run longitudinally along the tank. Waste or excess sludge from the liquid stream is removed in the form of flocculent sludge in settling tanks. Also, pre-treatment of industrial waste is to be made essential before discharging into the main

sewers as these wastes may be of such composition as would damage the sewers or interfere with the treatment process.

DETAILS OF INDUSTRIAL WASTE WATER MANAGEMENT SYSTEM

To meet the waste water disposal standards, VVM SEZ envisages developing 75 MLD Common Effluent Treatment Plant (CETP) facilities. The CETP will be built in modular and expandable manner.

Technology

After reviewing various technology, VVM SEZ has chosen conventional treatment scheme of Activated Sludge Process to implement this project.

Treatment

The effluent will be collected in the equalization tanks after passing through screen chamber. The effluent is then pumped to common Effluent treatment plant to bring the effluent to the accepted level for disposal in marine coastal areas or into the sea.

Description of the Plant

- Effluent Characteristics
- Treatment Scheme
- Technical features of the plant

Effluent Characteristics

It is proposed to combine treatment of the wastewater from different industries of VVM Special Economic Zone in the proposed Common Effluent Treatment Plant (CETP) .

The expected effluent characteristics and those required after the treatment as per the guide lines of Tamil Nadu Pollution Control Board are as follows:

Table 2.4 : CETP Expected Raw Effluent Characteristics

S.No	Parameter	Unit	Value
1	pH		6.5-8.5
2	BOD	mg/l	100
3	COD	mg/l	250
4	Suspended solids	mg/l	100
5	Oil and Grease	mg/l	20
6	Cyanide	mg/l	0.2
7	Phenolic compounds	mg/l	5
8	Ammonical Nitrogen	mg/l	50
9	Residual Chlorine	mg/l	0.5

Treatment Scheme

Following is the list of units involved in the proposed common effluent Treatment Plant.

- Screen Channel with Mechanical Bar Screen.
- Equalization Tanks
- Neutralization Tanks
- Primary Settling tank with Mechanical sludge scrapper and scum removal.
- Sludge sump cum collection tank with pumps.(Dry well and wet well type Aeration Tank , with mechanical surface aerators (1st stage).
- Secondary Settling tank with mechanical Sludge scrapper (1st stage).
- Sludge sump with pumps (1st stage). (Dry well and wet well type)
- Aeration Tank, with mechanical surface aerators (2nd stage).
- Secondary Settling tank with mechanical Sludge scrapper (2nd stage).
- Sludge sump with pumps (2nd stage). (Dry well and wet well type)
- Aeration Tank , with mechanical surface aerators (3rd stage optional).
- Final Settling tank with mechanical sludge scrapper(3rd stage optional)

- Sludge sump with pumps (3rd stage optional). (Dry well and wet well type)
- Sludge drying Platforms.
- Decanters.
- Intermediate collection Tank.
- Chlorination Plant
- Guard Pond.
- Dried Sludge storage facility.

Table 2.5: Treated Effluent Characteristics Permissible limit for Discharge

Sr. No.	Parameter	Permissible Value for disposal into marine coastal areas	Permissible Value for on land irrigation
1	BOD	100 mg/l	100 mg/l
2	COD	250 mg/l	-
3	pH	5.5-8.5	5.5-9.0
4	Suspended solids	100 mg/l	200 mg/l
5	Oil and Grease	20 mg/l	10 mg/l
6	TDS	-	2100 mg/l

Solid Waste Management System

Solid waste can be classified into two main categories, namely municipal solid waste and Industrial waste. Solid waste shall be sorted out for recycling and non-recycling material. Recycling turns materials that would otherwise become waste into valuable resources. Materials like glass, metal, plastics and paper are collected, separated and sent to facilities that can process these into new material.

All biodegradable municipal solid waste shall be mixed with sewage sludge to undergo composting to produce saleable fertilizer. Composting is another form of recycling. Composting is the controlled biological decomposition of organic matter into humus.

Composting is nature's way of recycling organic waste into new soil, which can be used in vegetable and flower gardens, landscaping and many other applications.

Noise Management System

The industries to be set up in VVM SEZ have slightly noise generating equipment / machinery, however suitable acoustic hoods / enclosures will be provided such that the noise level in the vicinity shall conform to the national noise quality criteria.

The infrastructure facilities will not produce considerable noise. However, in case of emergency, DG sets shall be operated. Hence, they shall be installed in acoustic enclosures, to minimize noise pollution.

Table 2.6 : National Noise Quality Criteria

Area Code	Category of Area	Noise Levels dB(A) Leq	
		Day time	Night time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Note : Day time is from 06.00 AM to 10.00 PM and Night time from 10pm to 06.00 am.

** Silence zone is defined as area up to 100 meters around premises of hospitals, educational institutions and courts. Use of vehicle horns, loud speakers and bursting of crackers are banned in these zones.

ENVIRONMENTAL FRIENDLY MEASURES AT VVM SEZ DEVELOPMENT OF GREEN BELT

Land Zoning and Green Cover:

Through out the VVM SEZ project area a greenbelt will be maintained at appropriate places into stages.

Introduction:

The VVM SEZ region has dry arid conditions with Saline sandy soil, highly saline water (TDS 35000-45000) and with strong wind conditions. So to improve climatic condition and to change the environment, VVM SEZ has adopted a strategy to develop an ecofriendly Heavy Mineral Processing Plants, Port, Power plants, Desalination Plant, Social Infrastructure as well as greeneries in the Project Area.

VVM will develop a well planned Green belt with suitable plants in and around the project area to absorb air and water pollutants, arrest noise and soil erosion as well as creates favorable climate and aesthetic conditions.

Planning of Landscape\Green zone:

VVM is always consider following criteria While planning of each Landscape \Green zone.

1. To minimize\control the Noise and air pollution by planting of dense Screen tree
2. To minimize\control the Noise and air pollution by developing sloppy\undulating lawn feature in landscape.
3. To Control Soil Erosion by planting of dense saline resistant Ground cover.
4. To minimize water requirement in irrigation by using Hi-tech mechanized irrigation.
5. To save environment by utilizing treated STP\CETP water in irrigation in green zone development.
6. To use sloppy landscape for help in rain water harvesting collection without damage to landscape.

Planning of Landscape at Social Infrastructure for controlling noise and air pollution

1. **First Screen Tree** : Selected *Casuarina equisetifolia* as a dense Screen tree from ground level to upwards

2. Several rows of screen tree with plant to plant distance of 1m along the both side of main traffic road ,in front of social infrastructure, inside of all side boundary will be maintained from ground level to upwards (10m dense green zone).

2. **Second Screen Tree:** Selected *Cocus nucifera* as a dense second Screen tree from ground stem to upwards dense leafs . These trees will be planted with plant to plant distance of 3m along the inside of all boundary.

3. **Third base undulating landscape feature :** Selected undulating landscape feature as a third base of landscape feature from ground level to till 2m as a undulating lawn for controlling the base noise\air pollution along the inside of all boundary.

ELECTRIC POWER SUPPLY

POWER DEMAND

Power demand of 250 MW would be met at first from TNEB. Subsequently from the proposed VVM SEZ power plants.

Telecommunications/IT Network:

The different activities in Special Economic Zone will have modern telecommunication facilities, by linking communication flow in India and selected destinations throughout the world. A telecommunication service network having latest networking features like online, real time and convergence facilities shall be proposed, which shall be capable of transmitting voice, image and data networks.

Manpower Requirement

During the construction and for operation of the VVM SEZ, the estimated man power requirement shall be as follows in Table 2-7

Table 2-7: Manpower Requirement

STAGE	MAN POWER REQUIREMENT
First Stage	1000
Second Stage	1300
Third Stage	1700
Fourth Stage	2000
Fifth Stage	2250
Total	8250



EXISTING ENVIRONMENTAL SCENARIO

CHAPTER - III

EXISTING ENVIRONMENTAL SCENARIO

Preparation of EIA needs a baseline data about the environment on which impact prediction and evaluation can be done. It is therefore, necessary to collect data about different environmental attributes that are likely to be affected due to the proposed activity, which in turn defines an existing environmental quality to serve as the baseline data. Baseline data are also necessary to identify environmentally significant issues prior to initiation of proposed action as well as to enumerate the critical environmental changes likely to occur due to the implementation of the project. Hence an attempt has been made to collect the information about the existing environment on eight major environmental attributes viz.

- Socio-economic Profile
- Ambient Air Quality
- Climate and Meteorology
- Water Quality
- Noise Levels
- Soil Quality
- Ecological Status
- Aesthetics

SOCIO-ECONOMIC ENVIRONMENT

An integral part of EIA study is to collect base line information about the socio-economic profile of the study area (core and buffer zone) for the proposed VVM SEZ at Thiruvambalur. This database is based on Census of India 2001 thus, generated in the process include total population, caste, sex ratio, literacy rate, total main worker, marginal worker and non-worker etc. It is envisaged that this information would serve as

baseline while evaluation of likely impact which may occur on socio-economic environment because of proposed SEZ development.

DEMOGRAPHIC PROFILE:

POPULATION:

The population details of each village within the buffer zone with male, female classification as per 2001 census is provided in Table 3.1. Study of the statement shows that there is a total population of 75,264 in these villages where in 38,910 (51.70%) are female and 36,354 (48.30%) are male.

LITERACY LEVEL:

Village wise literacy level within the study zone is given in Table 3.1. Of the total population (75,264) only 45,660 (60.67%) are literates, of which 24,242 (32.21%) are male and 21,418 (28.46%) are female. Literacy level amongst women is lower than male.

TABLE 3.1

SOCIO – ECONOMIC SURVEY – GENERAL DETAILS

S.No	Name of the village	House hold	Male population	Female population	Total population	S.C (M)	S.C (F)	Total S.C	S.T (M)	S.T (F)	Total (S.T)	Male literate	Female literate	Total literate
1	Vijayapathi	1893	4577	4730	9307	398	468	866	0	0	0	3165	2965	6130
2	Kudankulam	2124	4462	4561	9023	407	428	835	4	6	10	2963	2451	5414
3	Udayathur	925	1807	2066	3873	558	612	1170	114	126	240	1006	844	1850
4	Radhapuram	1431	2819	3041	5860	1078	1153	2231	31	30	61	1892	1666	3558
5	Parameshwarapuram	410	791	882	1673	265	272	537	261	330	591	519	435	954
6	Danakkakulaam	1091	2200	2436	4636	566	607	1173	0	0	0	1499	1319	2818
7	Adankarkulam	685	1343	1532	2875	436	531	967	0	0	0	812	689	1501
8	Pazhavor	770	1540	1563	3103	657	667	1324	12	5	17	1155	915	2070
9	Karunkulam	734	1492	1628	3120	230	252	482	3	2	5	953	728	1681
10	Levinjiipuram	2376	5074	5470	10544	214	230	444	2	2	4	3853	3772	7625
11	Chettikulam	1834	4179	4456	8635	106	95	201	0	0	0	2645	2268	4913
12	Irukkunthuri	797	1595	1733	3328	700	723	1423	0	0	0	1058	855	1913
13	Kasthurirangapuram	683	1341	1517	2858	401	416	817	0	0	0	763	606	1369
14	Thiruvambalapuram	1380	3134	3295	6429	8	7	15	0	0	0	1959	1905	3864

OCCUPATIONAL STRUCTURE:

The occupational structure of the villages within the Buffer zone is given below.

S.No	Details of Occupation	Total	Percentage
1	Main Workers	15,548	42.77
	❖ Cultivators	2,541	6.99
	❖ Agricultural workers	4,675	12.86
	❖ House hold workers	2,832	7.79
	❖ Other workers (Wind Turbine)	5,500	15.13
2	Total Marginal Workers	1,658	4.56
3	Non Workers	19,148	52.67

It could be seen that the non workers strength comes to 52.67% and the main workers form 42.77% of the total population. Out of the 42.77% of main workers agricultural workers constitute 12.86%.

LAND USE PATTERN

The proposed VVM SEZ project land of 166.66.5 ha is under the possession of the developers and has been notified by Thasildhar, Radhapuram Taluk. The own patta Land of VVM SEZ is contiguous and free from all encumbrances. There is no Forest land, habitation or encroachment in and around the proposed SEZ area.

AMENITIES AVAILABLE WITHIN THE BUFFER ZONE:

The details of basic amenities like education, medical, drinking water, approach roads, facilities etc., in the rural villages within the Buffer zone, are illustrated in Table 3.2.

EDUCATIONAL FACILITY:

Most of the villages have got educational facilities at the primary level. There are primary schools, Middle Schools and High Schools in most of the villages selected with in the buffer zone. Polytechnic college is also present in the buffer zone village.

DRINKING WATER SUPPLY:

It is evident from the survey that there are adequate drinking water facilities in all the villages. Most of the villages depend on the Thamirabarani Drinking water project since the entire Radhapuram Taluk is rain shadow area and the ground water is mostly saline due to over extraction of ground water during summer and drought period.

POWER SUPPLY:

All villages within the Buffer zone have got electric power supply. Electricity is used for both domestic as well as for agricultural purposes.

MEDICAL FACILITIES:

The medical facilities available within the study zone includes maternity child welfare centers, dispensaries, registered practitioner and private hospitals as per the 1991 census. How ever presently the number of medical facilities have increased.

TABLE 3.2

SOCIO – ECONOMIC SURVEY – BASIC AMENITIES

	Name of the Village	Education	Medical	Drinking water	P.O/P.T.O	Communication	Road Approach	Nearest Town	Power supply	Staple food
1	Vijayapathi	PS(2) MS(2) HS(1)	A	W/HP	PO	Bus	Pukka. Road	Tisayanvilaii	EA	Rice
2	Kudankulam	HSS(1) MS(2) HS(1) PS(2)	A	W/HP	PO	Bus	Pukka. Road	Tisayanvilaii	EA	Rice
3	Udayathur	PS(4) HS(1)	A	W/HP	PO	Bus	Pukka. Road	Tisayanvilaii	EA	Rice
4	Radhapuram	PS(1) HS(1)	B	W/HP	PO	Bus	Pukka. Road	Tisayanvilaii	EA	Rice
5	Parameshwara puram	PS(1) HS(1)	B	W/HP	PO	Bus	Pukka. Road	Tisayanvilaii	EA	Rice
6	Danakakulam	PS(1) HS(1)	B	W/HP	PO	Bus	Pukka. Road	Tisayanvilaii	EA	Rice
7	Adangarkulam	HSS(1) HS(1)	B	W/HP	PO	Bus	Pukka. Road	Radhapuram	EA	Rice
8	Pazhavoore	HS(1) PS(2)	B	W/HP	PO	Bus	Pukka. Road	Radhapuram	EA	Rice
9	Karunkulam	HS(1) PS(2)	B	W/HP	PO	Bus	Pukka. Road	Radhapuram	EA	Rice
10	Levingipuram	PS(1)	A	W/HP	PO	Bus	Pukka. Road	Radhapuram	EA	Rice
11	Chettikulam	HSS(1) MS(2) PS(1)	A	W/HP	PO	Bus	Pukka. Road	Radhapuram	EA	Rice
12	Irukkanthurai	HSS(1) MS(2)	A	W/HP	PO	Bus	Pukka. Road	Radhapuram	EA	Rice
13	Kasthurirangapuram	PS(2) MS(2)	B	W/HP	PO	Bus	Pukka. Road	Tisayanvilaii	EA	Rice

RELIGION:

The population of the buffer zone consists of Hindus, Christians and Muslims. Chettiyars, Mudaliars, Devar, Nadars, etc., are the dominant communities followed by Harijans, Fernandes and Muslims. There is good communal harmony in the area amongst the various religious classes.

CROPPING PATTERN:

In general, agriculture is found to be the predominant income source in most of the rural villages. Pulses, coconut and banana are grown in this area. Irrigation in general is by rain fed tanks and wells.

AIR ENVIRONMENT

A methodically designed Air Quality Surveillance Program (AQSP) has formed the basis to determine the impact assessment on air environment that has helped in formulating a sound EMP. The basic considerations for designing such a program included :

- i. Representative selection of sampling locations primarily guided by the topography and micrometeorology of the region,
- ii. Adequate sampling frequency, and
- iii. Inclusion of all the major parameters.

The existing Ambient Air Quality Status (AAQS) within the study area (core and buffer zone) was characterized through in-situ monitoring. The scope of VVM SEZ is to develop and operate eco friendly Heavy mineral processing Plants for Processing heavy Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals cracking of monazite and production of Rare Earth Oxide, solvent extraction, magnets, Titanium Pigments, Synthetic Rutile, Slag, Scandinium etc, captive port development, Wind turbine and solar power plants, desalination plant and other associated infrastructure facilities within the VVM SEZ may release different types of gases in to the environment. Such industries shall provide stacks / vents of adequate

height along with appropriate air pollution control equipment, which shall be in line with the statutory requirements under the Air Act of State Pollution Control Board. Hence, no significant impact is likely on the air environment due to VVM SEZ's activity.

Reconnaissance Survey

The prime objective of this AAQ survey within the study area was to establish the existing regional background levels and baseline of air pollution status with present level of emissions from existing sources within the study area.

To assess the existing level of air quality in and around proposed Special Economic Zone (SEZ), Eleven Ambient Air Quality Monitoring Stations (AAQMS) were selected primarily on the basis of prevailing meteorological conditions analyzed through past meteorological data available for study area. While selecting the AAQMS, due consideration was given to local topography as well as the other landscape features of entire 10 km radius area from proposed SEZ as per MoEF guideline for the purpose. The location of selected AAQMS is presented in Table 3-3.

Table 3-3 : Locations of Selected AAQMS

AAQMS	LOCATION
AS 1	Thiruvambalapuram
AS 2	Navaladi
AS 3	Karichithu Pudur
AS 4	Parameshwarapuram
AS 5	Vijayapathy
AS 6	Koodankulam
AS7	Kasthurirangapuram
AS-8	Urumangulam
AS-9	Udayattur
AS-10	Islapuram
AS-11	Rammadupuram

Ambient Air Quality Status

Four major air pollutants i.e. Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), Sulphur Dioxide (SO₂) and Oxides of Nitrogen (NOX) representing the range of emissions from proposed industrial units to be set up in the SEZ were identified for AAQM. The samples were collected round the clock during study period. Gaseous pollutants i.e. SO₂ and NOX were collected on 24 hourly basis by drawing air at a flow rate of 0.5 lt/min through the absorbing media, whereas, SPM was collected as 24 hour average by drawing air at a flow rate of 1.0 - 1.5 m³/min through micro glass fibre filter paper. The standard techniques used for quantification of pollutants are highlighted in Table 3-4.

Table 3-4 : Standard Techniques used for AAQM

S.No	Parameter	Technique	Minimum Detectable Limit
1	Suspended Particulate Matter (SPM)	High Volume Sampler	1.0 µg/m ³
2	Respirable Suspended Particulate Matter (RSPM)	Respirable Suspended Particulate Matter Sampler	1.0 µg/m ³
3	Sulphur Dioxide (SO ₂)	Improved West and Gaeke Method	6.0 µg/m ³
4	Oxides of Nitrogen (NOX)	Modified Jacob and Hochheisor Method	3.0 µg/m ³

A total of 48 weekly cycles of air quality monitoring has been undertaken during the study period (January – December 2011) for every separate sampling stations. The status of air pollution within the study area in terms of criteria / major air pollutants i.e. SPM, RSPM, SO₂ as well as NOX recorded during the study period is presented in Tables 3-5 and 3-6.

Table 3-5 : Status of Particulate Matter in Core and Buffer Zone

S.No	Name of the sampling stations	SPM $\mu\text{g}/\text{m}^3$			RSPM $\mu\text{g}/\text{m}^3$		
		Min	Max	Mean	Min	Max	Mean
1	Thiruvambalapuram	147	249	196	46.3	79.1	64.0
2	Navaladi	166	209	188	51.9	70.7	60.5
3	Karichithu Pudur	163	243	184	52.3	82.9	60.0
4	Parameshwarapuram	174	186	180	57.4	61.2	59.3
5	Vijayapathy	146	184	170	42.1	56.5	51.1
6	Koodankulam	191	253	215	62.3	85.1	73.2
7	Kasthurirangapuram	192	259	232	62.4	84.7	75.8
8	Urumangulam	182	219	198	59.2	80.9	68.6
9	Udayattur	156	231	192	49.5	72.1	58.7
10	Islapuram	173	272	206	59.4	86.2	67.7
11	Rammadupuram	170	226	192	54.6	80.4	63.2

SPM concentrations within the study area varied from 146 - 272 $\mu\text{g}/\text{m}^3$, with the highest in Islapuram i.e. 272 $\mu\text{g}/\text{m}^3$ and the lowest in Vijayapathy i.e. 146 $\mu\text{g}/\text{m}^3$. The SPM concentration at the proposed SEZ was found to be well within the permissible limits of National Ambient Air Quality Standards (NAAQS) i.e. 500 $\mu\text{g}/\text{m}^3$.

RSPM concentrations within the study area varied from 42.1 – 86.2 $\mu\text{g}/\text{m}^3$, with the highest concentration found at Islapuram i.e. 86.2 $\mu\text{g}/\text{m}^3$ and the lowest in Vijayapathy i.e. 42.1 $\mu\text{g}/\text{m}^3$. The RSPM concentration at the proposed SEZ was found to be well within the permissible limit of National Ambient Air Quality Standards (NAAQS) i.e. 150 $\mu\text{g}/\text{m}^3$.

Table 3-6 : Status of Gaseous Pollutants in Core and Buffer Zone

S.No	Name of the sampling stations	SO ₂ µg/m ³			NO _x µg/m ³		
		Min	Max	Mean	Min	Max	Mean
1	Thiruvambalapuram	9.7	12.4	10.8	11.8	15.1	13.6
2	Navaladi	8.4	10.9	9.5	13.8	16.1	14.6
3	Karichithu Pudur	10.8	16.3	14.0	14.3	26.4	19.5
4	Parameshwarapuram	8.9	12.9	11.0	12.1	15.2	13.7
5	Vijayapathy	9.6	10.2	9.9	14.3	15.4	14.9
6	Koodankulam	8.7	14.2	11.6	11.3	15.2	13.6
7	Kasthurirangapuram	11.34	16.30	13.39	15.12	20.02	17.15
8	Urumangulam	10.8	16.3	14.0	14.3	26.4	19.5
9	Udayattur	8.7	14.2	11.6	11.3	15.2	13.6
10	Islapuram	14.9	20.6	17.1	18.1	28.9	20.4
11	Rammadupuram	10.6	16.1	12.9	10.1	15.6	13.1

SO₂ concentrations within the study area varied from 8.4 – 20.6 µg/m³ with the highest concentration found in Islapuram i.e. 20.6 µg/m³ and the lowest in Navaladi i.e. 8.4 µg/m³. The concentration of SO₂ in proposed SEZ study area was found to be well within the permissible limit of National Ambient Air Quality Standards (NAAQS) i.e. 120 µg/m³.

NO_x concentrations within the study area varied from 10.1 – 28.9 µg/m³ with the highest concentration found at Islapuram i.e. 28.9 µg/m³ and lowest at Rammadupuram i.e. 10.1 µg/m³. The concentration of NO_x in proposed SEZ study area was found to be well within the permissible limit of National Ambient Air Quality Standards (NAAQS) i.e. 120 µg/m³.

Thus, the concentration of major gaseous pollutants that is SO₂ and NO_x was found much below the permissible limit of 120 µg/m³.

MICRO-METEOROLOGICAL STATUS

Transport and diffusion of pollutants in the atmosphere are governed by micrometeorological factors. Micro-meteorology is defined as the study of minute variation in the atmospheric conditions to an area of few square kilometers and an elevation of 500 -1000 m. Meteorological data was collected from Tirunelveli IMD Observatory. The current micro-meteorological status like wind speed, wind direction, ambient temperature, relative humidity etc. for the study period have been monitored. Micro-meteorological features of the study area are given below :

Climate

The study area lies in the tropical region characterized by aggressive summer and scanty rainfall. Annual maximum temperature is 40°C while the minimum temperature is 25°C. Annual rainfall recorded at Tirunelveli IMD observatory at an aerial distance of 75 km) is 180 mm. The relative humidity ranges between 40 % and 85%. The predominant wind direction recorded was NNE.

TABLE 3.7
TEMPERATURE AND RELATIVE HUMIDITY

Project Site: Thiruvambalapuram				
Temperature (°C)				
	Summer	Winter	Monsoon	Post Monsoon
Min	30.0	27.0	26.2	28.0
Max	38.0	34.0	31.0	32.0
Relative Humidity (%)				
	Summer	Winter	Monsoon	Post Monsoon
Min	45	49	62	49
Max	65	78	82	68

Project Site: Navaladi				
Temperature (°C)				
	Summer	Winter	Monsoon	Post Monsoon
Min	32.8	30.0	28.0	29.8
Max	39.5	36.0	32.0	38.0
Relative Humidity (%)				
	Summer	Winter	Monsoon	Post Monsoon
Min	40	49	62	49
Max	65	78	82	68

Project Site: Karichithu Pudur				
Temperature (°C)				
	Summer	Winter	Monsoon	Post Monsoon
Min	30.0	27.5	25.0	28.0
Max	36.0	34.0	32.0	35.0
Relative Humidity (%)				
	Summer	Winter	Monsoon	Post Monsoon
Min	46	52	65	49
Max	65	78	82	66

Project Site: Parameshwarapuram				
Temperature (°C)				
	Summer	Winter	Monsoon	Post Monsoon
Min	31.0	28.5	26.0	29.0
Max	38.0	34.0	32.0	36.0
Relative Humidity (%)				
	Summer	Winter	Monsoon	Post Monsoon
Min	45	49	62	49
Max	65	78	82	68

Project Site: Vijayapathy				
Temperature (°C)				
	Summer	Winter	Monsoon	Post Monsoon
Min	32.5	29.0	27.0	30.5
Max	40.0	37.0	32.0	38.5
Relative Humidity (%)				
	Summer	Winter	Monsoon	Post Monsoon
Min	45	55	65	50
Max	68	79	85	68

Project Site: Koodankulam				
Temperature (°C)				
	Summer	Winter	Monsoon	Post Monsoon
Min	31.0	28.5	27.0	29.0
Max	38.5	36.0	34.0	36.0
Relative Humidity (%)				
	Summer	Winter	Monsoon	Post Monsoon
Min	45	49	62	49
Max	65	78	82	68

Project Site: Kasthurirangapuram				
Temperature (°C)				
	Summer	Winter	Monsoon	Post Monsoon
Min	31.0	27.5	26.0	29.0
Max	38.0	35.0	32.0	36.0
Relative Humidity (%)				
	Summer	Winter	Monsoon	Post Monsoon
Min	43	55	65	48
Max	68	79	85	68

Project Site: Urumangalam				
Temperature (°C)				
	Summer	Winter	Monsoon	Post Monsoon
Min	30.0	28.5	26.0	29.0
Max	39.0	35.0	32.0	36.0
Relative Humidity (%)				
	Summer	Winter	Monsoon	Post Monsoon
Min	43	55	65	48
Max	68	79	85	68

Project Site: Udayattur				
Temperature (°C)				
	Summer	Winter	Monsoon	Post Monsoon
Min	32.0	29.0	27.0	31.0
Max	40.0	37.0	32.0	39.0
Relative Humidity (%)				
	Summer	Winter	Monsoon	Post Monsoon
Min	45	56	66	50
Max	68	79	85	68

Project Site: Islapuram				
Temperature (°C)				
	Summer	Winter	Monsoon	Post Monsoon
Min	31.0	28.5	27.0	29.0
Max	38.5	36.0	34.0	37.0
Relative Humidity (%)				
	Summer	Winter	Monsoon	Post Monsoon
Min	45	49	63	49
Max	65	78	82	69

Project Site: Rammadupuram				
Temperature (°C)				
	Summer	Winter	Monsoon	Post Monsoon
Min	30.0	28.5	26.0	29.5
Max	39.0	35.0	33.0	36.0
Relative Humidity (%)				
	Summer	Winter	Monsoon	Post Monsoon
Min	43	55	65	49
Max	68	79	85	68

Precipitation

Precipitation at VVM SEZ core and buffer zone villages is mostly brought by the winds of the North East monsoon. In general, Rainfall is poor, the annual average rainfall recorded was 180 mm, out of which 60% falls during the North-east monsoon. The region being on the leeward side of the Western Ghats, receives very little rain during the South-west monsoon.

Winds

The wind pattern varies with different seasons throughout the year. The wind-roses for the analysis of wind direction and wind speed pattern for the study period were plotted on the basis of collected data and are shown in Table 3.8.

Table 3.8 WIND ROSE DATA

Wind Frequency Distribution in Winter Season (Day)

Direction	Velocity Ranges					Sum%
	1<V≤5	6<V≤10	11<V≤15	16<V≤20	V>20	
N	2.48	8.35	1.20	7.73	0.00	19.76
NNW	0.00	0.00	0.00	0.00	0.00	0.00
NW	3.00	1.20	0.59	0.00	0.00	4.79
WNW	0.00	0.00	0.00	0.00	0.000	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.59	0.00	0.00	0.00	0.00	0.59
SSW	0.00	0.00	0.00	0.00	0.00	0.00
S	3.57	10.11	0.00	3.57	0.00	17.25
SSE	0.00	0.00	0.00	0.00	0.00	0.00
SE	3.00	4.78	0.00	0.59	0.00	8.37
ESE	0.00	0.00	0.00	0.00	0.00	0.00
E	5.35	13.69	0.00	0.59	0.00	19.63
ENE	0.00	0.00	0.00	0.00	0.00	0.00
NE	3.00	7.14	0.59	1.20	0.00	11.93
NNE	0.00	0.00	0.00	0.00	0.00	0.00
Sum (%)	20.99	45.27	2.38	13.68	0.00	82.32
Calm	V<0.44m/s) = 17.68%					

Wind Frequency Distribution in Winter Season (Night)

Direction	Velocity Ranges					Sum%
	1<V≤5	6<V≤10	11<V≤15	16<V≤20	V>20	
N	3.48	6.35	1.20	7.73	0.00	18.76
NNW	0.00	0.00	0.00	0.00	0.00	0.00
NW	2.58	1.20	0.59	0.00	0.00	4.37
WNW	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.59	0.00	0.00	0.00	0.00	0.59
SSW	0.00	0.00	0.00	0.00	0.00	0.00
S	2.57	8.82	0.00	5.57	0.00	16.96
SSE	0.00	0.00	0.00	0.00	0.00	0.00
SE	3.00	4.78	0.00	0.59	0.00	8.37
ESE	0.00	0.00	0.00	0.00	0.00	0.00
E	3.35	10.69	0.00	0.59	0.00	14.63
ENE	0.00	0.00	0.00	0.00	0.00	0.00
NE	3.00	6.14	0.59	3.20	0.00	12.93
NNE	0.00	0.00	0.00	0.00	0.00	0.00
Sum (%)	18.57	37.98	2.38	17.68	0.00	76.61
Calm	V<0.44m/s) = 23.39%					

Wind Frequency Distribution in Winter Season (Overall)

Direction	Velocity Ranges					Sum%
	1<V≤5	6<V≤10	11<V≤15	16<V≤20	V>20	
N	2.48	8.35	1.20	7.73	0.00	19.76
NNW	0.00	0.00	0.00	0.00	0.00	0.00
NW	3.00	1.20	0.59	0.00	0.00	4.79
WNW	0.00	0.00	0.00	0.00	0.000	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.59	0.00	0.00	0.00	0.00	0.59
SSW	0.00	0.00	0.00	0.00	0.00	0.00
S	3.57	8.11	0.00	3.57	0.00	15.25
SSE	0.00	0.00	0.00	0.00	0.00	0.00
SE	3.00	4.78	0.00	0.59	0.00	8.37
ESE	0.00	0.00	0.00	0.00	0.00	0.00
E	5.35	13.69	0.00	0.59	0.00	19.63
ENE	0.00	0.00	0.00	0.00	0.00	0.00
NE	3.00	7.14	0.59	1.20	0.00	11.93
NNE	0.00	0.00	0.00	0.00	0.00	0.00
Sum (%)	20.99	43.27	2.38	13.68	0.00	80.32
Calm	V<0.44m/s) = 19.68%					

Wind Frequency Distribution in Summer Season (Day)

Direction	Velocity Ranges					Sum%
	1<V≤5	6<V≤10	11<V≤15	16<V≤20	V>20	
N	10.91	4.4	0.28	0.00	0.00	15.59
NNW	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.69	0.00	0.00	0.00	0.00	0.69
ESE	0.00	0.00	0.00	0.00	0.00	0.00
E	10.26	2.35	0.00	0.00	0.00	12.61
ENE	0.00	0.00	0.00	0.00	0.00	0.00
NE	15.69	10.27	0.14	0.00	0.00	26.1
NNE	0.00	0.00	0.00	0.00	0.00	0.00
Sum%	37.55	17.02	0.42	0.00	0.00	54.99
Calm	V<0.44m/s) = 45.01%					

Wind Frequency Distribution in Summer Season (Night)

Direction	Velocity Ranges					Sum%
	1<V≤5	6<V≤10	11<V≤15	16<V≤20	V>20	
N	16.91	4.4	0.28	0.00	0.00	21.59
NNW	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.69	0.00	0.00	0.00	0.00	0.69
ESE	0.00	0.00	0.00	0.00	0.00	0.00
E	8.26	2.35	0.00	0.00	0.00	10.61
ENE	0.00	0.00	0.00	0.00	0.00	0.00
NE	23.69	8.27	0.14	0.00	0.00	32.1
NNE	0.00	0.00	0.00	0.00	0.00	0.00
Sum%	49.55	15.02	0.42	0.00	0.00	64.99
Calm	V<0.44m/s) = 35.01%					

Wind Frequency Distribution in Summer Season (Overall)

Direction	Velocity Ranges					Sum%
	1<V≤5	6<V≤10	11<V≤15	16<V≤20	V>20	
N	16.91	4.4	0.28	0.00	0.00	21.59
NNW	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.69	0.00	0.00	0.00	0.00	0.69
ESE	0.00	0.00	0.00	0.00	0.00	0.00
E	8.26	2.35	0.00	0.00	0.00	10.61
ENE	0.00	0.00	0.00	0.00	0.00	0.00
NE	25.69	10.27	0.14	0.00	0.00	36.1
NNE	0.00	0.00	0.00	0.00	0.00	0.00
Sum%	51.55	17.02	0.42	0.00	0.00	68.99
Calm	V<0.44m/s) = 31.01%					

Wind Frequency Distribution in Post Monsoon Season (Day)

Direction	Velocity Ranges					Sum%
	1<V≤5	6<V≤10	11<V≤15	16<V≤20	V>20	
N	2.97	6.54	0.00	2.38	0.00	11.89
NNW	0.00	0.00	0.00	0.00	0.00	0.00
NW	2.97	1.20	0.00	0.00	0.00	4.17
WNW	0.00	0.00	0.00	0.00	0.00	0.00
W	1.20	1.20	0.00	0.00	0.00	2.40
WSW	0.00	0.00	0.00	0.00	0.00	0.00
SW	4.76	0.00	0.00	0.00	0.00	4.76
SSW	0.00	0.00	0.00	0.00	0.00	0.00
S	14.0	2.38	0.00	0.00	0.00	16.38
SSE	0.00	0.00	0.00	0.00	0.00	0.00
SE	5.35	2.38	0.00	0.00	0.00	7.73
ESE	0.00	0.00	0.00	0.00	0.00	0.00
E	7.73	15.47	0.59	8.92	0.00	32.71
ENE	0.00	0.00	0.00	0.00	0.00	0.00
NE	2.97	4.76	0.59	3.57	0.00	11.89
NNE	0.00	0.00	0.00	0.00	0.00	0.00
Sum%	41.95	33.93	1.18	14.87	0.00	91.93
Calm	(V<0.44m/s) = 8.07%					

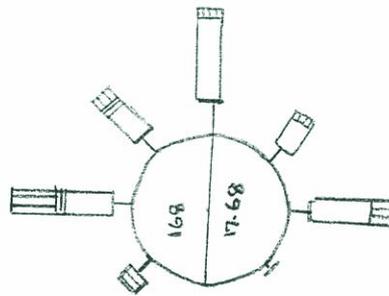
Wind Frequency Distribution in Post Monsoon Season (Night)

Direction	Velocity Ranges					Sum%
	1<V≤5	6<V≤10	11<V≤15	16<V≤20	V>20	
N	3.59	8.33	1.20	7.73	0.00	20.85
NNW	0.00	0.00	0.00	0.00	0.00	0.00
NW	3.57	1.20	0.59	0.00	0.00	5.36
WNW	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.59	0.59	0.00	0.00	0.00	1.18
SSW	0.00	0.00	0.00	0.00	0.00	0.00
S	6.54	10.11	0.00	3.57	0.00	20.22
SSE	0.00	0.00	0.00	0.00	0.00	0.00
SE	5.35	4.78	0.00	0.59	0.00	10.72
ESE	0.00	0.00	0.00	0.00	0.00	0.00
E	8.38	13.69	0.00	0.59	0.00	22.66
ENE	0.00	0.00	0.00	0.00	0.00	0.00
NE	4.16	7.14	0.59	1.20	0.00	13.09
NNE	0.00	0.00	0.00	0.00	0.00	0.00
Sum%	32.18	45.84	2.38	13.68	0.00	94.08
Calm	(V<0.44m/s) = 5.92%					

Wind Frequency Distribution in Post Monsoon Season (Overall)

Direction	Velocity Ranges					Sum%
	1<V≤5	6<V≤10	11<V≤15	16<V≤20	V>20	
N	3.57	8.33	1.20	7.73	0.00	20.83
NNW	0.00	0.00	0.00	0.00	0.00	0.00
NW	3.57	1.20	0.59	0.00	0.00	5.36
WNW	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.59	0.00	0.00	0.00	0.00	0.59
SSW	0.00	0.00	0.00	0.00	0.00	0.00
S	6.54	10.11	0.00	3.57	0.00	20.22
SSE	0.00	0.00	0.00	0.00	0.00	0.00
SE	5.35	4.78	0.00	0.59	0.00	10.72
ESE	0.00	0.00	0.00	0.00	0.00	0.00
E	8.33	13.69	0.00	0.59	0.00	22.61
ENE	0.00	0.00	0.00	0.00	0.00	0.00
NE	4.16	7.14	0.59	1.20	0.00	13.09
NNE	0.00	0.00	0.00	0.00	0.00	0.00
Sum%	32.11	45.25	2.38	13.68	0.00	93.42
Calm	(V<0.44m/s) = 6.58%					

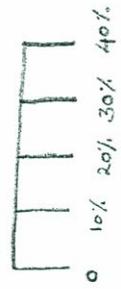
WIND ROSE AT STUDY AREA DURING WINTER SEASON (DAY)



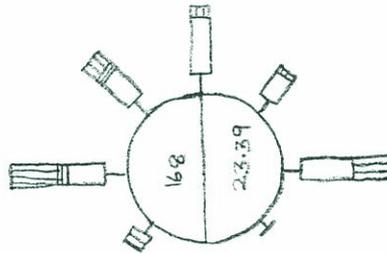
Wind Speed Km/hr
Scale



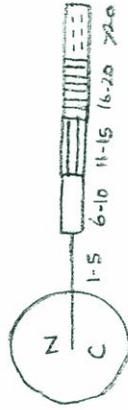
N -- Number of Observations
C -- Calm conditions %



WIND ROSE AT STUDY AREA DURING WINTER SEASON (NIGHT)



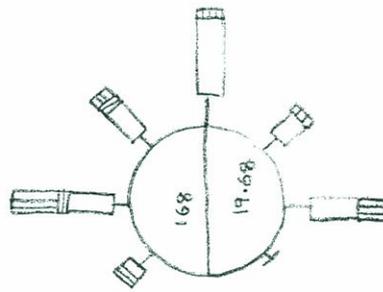
Wind Speed Km/hr
Scale



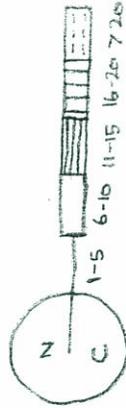
N - Number of Observations
C - Calm conditions %



WIND ROSE AT STUDY AREA DURING WINTER SEASON (OVERALL)



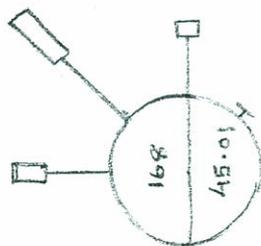
Wind Speed Km/hr
Scale



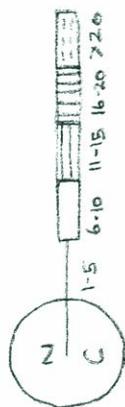
N = Number of Observations
C = Calm conditions %



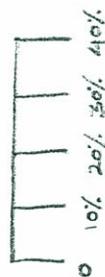
WIND ROSE AT STUDY AREA DURING SUMMER SEASON (DAY)



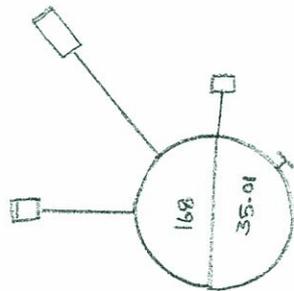
Wind Speed Km/hr
Scale



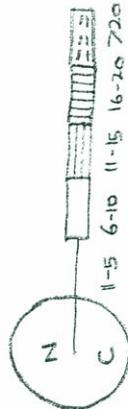
N - Number of Observations
C - Calm conditions %



WIND ROSE AT STUDY AREA DURING SUMMER SEASON (NIGHT)



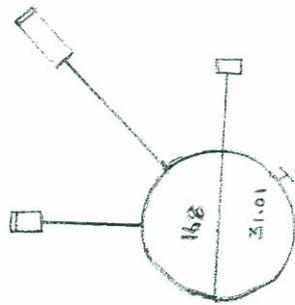
Wind Speed Km/hr
Scale



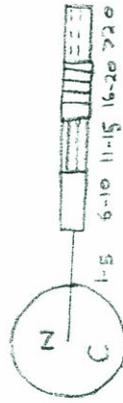
N = Number of Observations
C = Calm conditions %



WIND ROSE AT STUDY AREA DURING SUMMER SEASON (OVERALL)



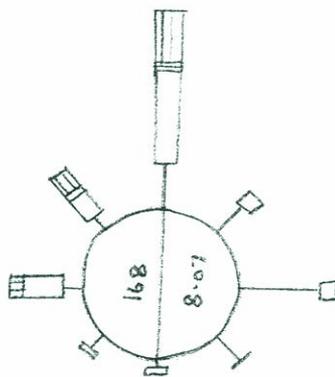
Wind Speed Km/hr
Scale



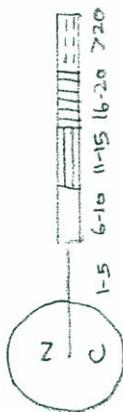
N - Number of Observations
C - Calm conditions %



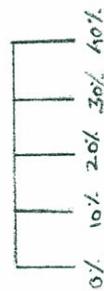
WIND ROS* AT STUDY AREA DURING POST MONSOON SEASON (DAY)



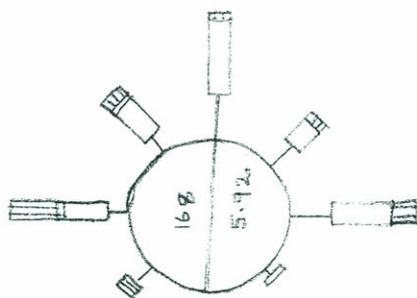
Wind Speed Km/hr
Scale



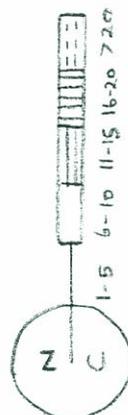
N - Number of Observations
C - Calm conditions %



WIND ROSE AT STUDY AREA DURING POST MONSOON SEASON (NIGHT)



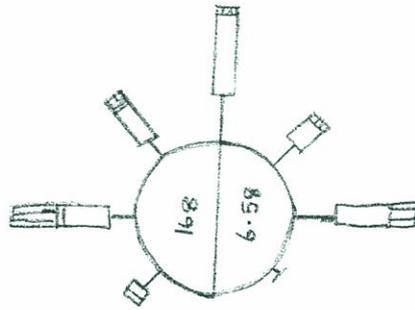
Wind Speed Km/hr
Scale



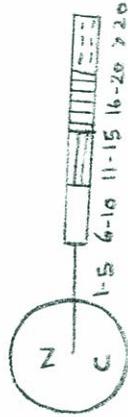
N = Number of Observations
C = Calm conditions %



WIND ROSE AT STUDY AREA DURING POST-MONSOON SEASON (OVERALL)



Wind Speed Km/hr
Scale



N - Number of Observations
C - Calm conditions %



WATER ENVIRONMENT

In connection with the assessment of baseline status for water environment, detailed studies have been undertaken for both surface water and ground water in and around proposed SEZ at VVM.

Reconnaissance Survey

Reconnaissance survey and field investigations were carried out to collect relevant information on the existing water resources (ground/surface) falling within the study area of the proposed SEZ area for their quantitative and qualitative assessment. The water quality of surface as well as ground water sources in the study area was analyzed for major physico-chemical and biological parameters.

Ground Water Quality Status

The ground water occurs under phreatic conditions within the upper 20 to 25 cm thick quaternary formations consisting of sands and sandstones. Water table occurs at depths normally varying between 7 m and 15 m with a gradient towards sea. Shallow wells generally ranging from 10 – 15 meters below ground level are found in the study area. The average yield of wells around the proposed study area was found to be 30 to 50 LPM. The water quality data of these shallow wells revealed that the water is saline in nature suggesting the marine origin of the underlying formations.

In order to assess the ground water quality within the study area, water samples were collected through bore well / well / hand pump from Eleven representative locations in study area (Table 3-9), during every season and analyses were carried out as per the Standard procedures of MoEF/CPCB. While selecting the GWMS (Ground Water Monitoring System) due consideration was given to depth aquifer i.e. shallow and deep besides the location the entire 10 km radius area from VVM SEZ as per MoEF guideline for the purpose. Analytical results are given in details in Table 3-10 and 3-11.

**Table 3.9 Stations Selected for Ground Water Quality
Monitoring in the study area**

STATION CODE	LOCATION
WS 1	Thiruvambalapuram
WS 2	Navaladi
WS 3	Karichithu Pudur
WS 4	Parameshwarapuram
WS 5	Vijayapathy
WS 6	Koodankulam
WS7	Kasthurirangapuram
WS8	Urumangulam
WS9	Udayattur
WS10	Islapuram
WS11	Rammadupuram

Table 3.10 GROUND WATER - PHYSICAL CHARACTERISTICS

STATIONS	pH	Temp. (°C)	Turbidity NTU	TDS (mg/l)	Colour
Thiruvambalapuram					
Summer	7.5	Ambient	3	3858	Colourless
Winter	7.2		3	3764	
Monsoon	7.0		4	2906	
Post monsoon	7.2		3	3100	
Navaladi					
Summer	7.4	Ambient	3	7847	Colourless
Winter	7.23		3	7819	
Monsoon	7.1		3	6935	

Post monsoon	7.5		2	7399	
Karichithu Pudur					
Summer	7.68	Ambient	3	6170	Colourless
Winter	7.2		2	6152	
Monsoon	7.0		3	5918	
Post monsoon	7.2		3	6006	
Parameshwarapuram					
Summer	7.6	Ambient	3	2648	Colourless
Winter	7.2		3	2586	
Monsoon	7.0		3	2300	
Post monsoon	7.2		3	2425	
Vijayapathy					
Summer	7.4	Ambient	3	6845	Colourless
Winter	7.2		3	6780	
Monsoon	7.1		4	6241	
Post monsoon	7.5		2	6499	
Koodankulam					
Summer	7.52	Ambient	1	5240	Colourless
Winter	7.2		1	5118	
Monsoon	7.0		3	4810	
Postmonsoon	7.2		2	5018	

Kasthurirangapuram					
Summer	7.38	Ambient	1	4385	Colourless
Winter	7.2		1	4200	
Monsoon	7.0		2	3512	
Post monsoon	7.1		1	3895	
Urumangalam					
Summer	7.5	Ambient	1	2390	Colourless
Winter	7.2		1	2160	
Monsoon	7.0		1	1808	
Post monsoon	7.2		1	1950	
Udayattur					
Summer	7.38	Ambient	1	2385	Colourless
Winter	7.2		1	2240	
Monsoon	7.0		2	1812	
Post monsoon	7.1		1	2103	
Islapuram					
Summer	7.4	Ambient	1	5388	Colourless
Winter	7.2		1	5120	
Monsoon	7.0		3	4912	
Post monsoon	7.2		2	5050	
Rammadupuram					
Summer	7.3	Ambient	1	3382	Colourless
Winter	7.2		1	3202	
Monsoon	7.0		2	2910	
Post monsoon	7.1		1	3027	

TABLE 3.11

GROUND WATER QUALITY – CHEMICAL CHARACTERISTICS

S.No	Chemical Parameter	Unit	Thiruvambaluram				Navaladi				Karichithu Pudur			
			S	W	M	PM	S	W	M	PM	S	W	M	PM
1)	Total Hardness	mg/l	1460	1450	1250	1350	2564	2550	2200	2350	4980	4950	4420	4605
2)	Calcium Hardness	mg/l	208	200	175	182	312	308	292	298	1125	1110	980	1050
3)	Magnesium Hardness	mg/l	1252	1250	1075	1168	2252	2242	1908	2052	3855	3840	3440	3555
4)	Phenolphthale in Alkalinity	mg/l	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
5)	Methyl Orange Alkalinity	mg/l	266	256	250	255	234	220	215	224	240	228	208	220
6)	Sulphates	mg/l	330	325	320	318	320	310	308	312	328	320	309	315
7)	Chlorides	mg/l	2148	2045	1840	1842	4280	4112	3850	3985	3825	3800	3785	3810
8)	Ammonica Nitrogen	mg/l	0.086	0.088	0.082	0.085	0.092	0.094	0.097	0.096	0.092	0.091	0.088	0.090
9)	Albuminoid Nitrogen	mg/l	0.076	0.075	0.073	0.075	0.104	0.098	0.092	0.10	0.098	0.096	0.092	0.097
10)	Nitrates as N	mg/l	0.88	0.79	0.95	0.92	0.8	0.81	0.85	0.82	0.78	0.80	0.84	0.82

11)	Nitrites as N	mg/l	0.10	0.12	0.15	0.14	0.22	0.24	0.27	0.25	0.22	0.25	0.29	0.27
12)	Fluorides as F	mg/l	0.72	0.76	0.81	0.78	1.0	1.1	1.5	1.3	0.81	0.83	0.88	0.85
13)	Phosphates	mg/l	0.75	0.77	0.82	0.79	0.82	0.84	0.88	0.86	0.75	0.78	0.84	0.80
14)	Iron	mg/l	0.031	0.033	0.037	0.035	0.576	0.582	0.596	0.593	0.02	0.023	0.028	0.025
15)	Manganese	mg/l	BDL	BDL	BDL	BDL	BDL							
16)	Silica (as SiO ₂)	mg/l	55	57	59	58	60	62	65	63	68	64	65	66
17)	Dissolved Oxygen	mg/l	5.2	5.4	5.8	5.6	4.8	5.4	5.8	5.5	4.2	5.2	5.9	5.5
18)	BOD at 20°C	mg/l	0.66	0.63	0.59	0.61	0.72	0.65	0.59	0.60	0.92	0.67	0.55	0.76
19)	COD	mg/l	16.5	17.1	17.8	17.6	15.1	17.2	18.0	17.5	12.8	15.9	18.0	17.5

BACTERIOLOGICAL PARAMETERS

20)	Total cfu/ml at 37°C on Agar plate		155	150	148	152	180	178	175	182	172	170	168	175
21)	MPN of coliform in 100 ml		Nil											
22)	Faecal coliforms		Absent											

GROUND WATER QUALITY – CHEMICAL CHARACTERISTICS

S.No	Chemical Parameter	Unit	Parameshwarapuram				Vijayapathy				Koodankulam			
			S	W	M	PM	S	W	M	PM	S	W	M	PM
1)	Total Hardness	mg/l	660	650	645	662	5464	5450	5420	5440	1080	1050	1020	1060
2)	Calcium Hardness	mg/l	75	70	68	78	1266	1250	1230	1220	175	160	150	168
3)	Magnesium Hardness	mg/l	585	580	577	584	4198	4200	4190	4220	905	890	870	892
4)	Phenolphthale in Alkalinity	mg/l	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
5)	Methyl Orange Alkalinity	mg/l	236	218	203	225	234	220	215	224	240	215	208	220
6)	Sulphates	mg/l	230	225	220	218	220	210	208	212	228	220	219	222
7)	Chlorides	mg/l	928	924	898	905	4812	4800	4675	4798	1125	1115	1092	1098
8)	Ammonica Nitrogen	mg/l	0.096	0.098	0.094	0.099	0.096	0.095	0.094	0.097	0.092	0.094	0.091	0.090
9)	Albuminoid Nitrogen	mg/l	0.096	0.098	0.093	0.095	0.104	0.098	0.092	0.100	0.098	0.096	0.092	0.097
10)	Nitrates as N	mg/l	0.60	0.62	0.69	0.66	0.62	0.65	0.69	0.67	0.58	0.6	0.65	0.63

11)	Nitrites as N	mg/l	0.14	0.12	0.18	0.16	0.15	0.13	0.11	0.14	0.15	0.12	0.10	0.14
12)	Fluorides as F	mg/l	0.9	0.98	0.97	1.0	1.0	0.98	0.99	0.96	0.89	0.91	0.96	0.92
13)	Phosphates	mg/l	Nil											
14)	Iron	mg/l	0.14	0.12	0.16	0.13	0.10	0.13	0.09	0.11	0.14	0.12	0.15	0.11
15)	Manganese	mg/l	BDL											
16)	Silica (as SiO ₂)	mg/l	63	60	58	61	62	64	61	65	66	64	65	68
17)	Dissolved Oxygen	mg/l	4.4	5.5	5.9	5.7	4.2	5.2	5.9	5.5	5.2	5.4	5.8	5.6
18)	BOD at 20°C	mg/l	0.90	0.75	0.55	0.66	0.92	0.67	0.55	0.76	0.66	0.63	0.59	0.61
19)	COD	mg/l	13.1	16.3	18.6	17.9	12.8	15.9	18.0	17.5	16.5	17.1	17.8	17.6

BACTERIOLOGICAL PARAMETERS

20)	Total cfu/ml at 37°C on Agar plate		175	170	178	172	180	178	175	182	172	170	168	175
21)	MPN of coliform in 100 ml		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
22)	Faecal coliforms		Absent	Absent	Absent	Absent	Nil	Absent						

GROUND WATER QUALITY – CHEMICAL CHARACTERISTICS

S.No	Chemical Parameter	Unit	Kasthurirangapuram				Urumangalam				Udayattur			
			S	W	M	PM	S	W	M	PM	S	W	M	PM
1)	Total Hardness	mg/l	1460	1450	1250	650	660	650	662	1080	1050	1020	1060	
2)	Calcium Hardness	mg/l	208	200	175	420	75	70	78	175	160	150	168	
3)	Magnesium Hardness	mg/l	1252	1250	1075	230	585	580	584	905	890	870	892	
4)	Phenolphthale in Alkalinity	mg/l	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
5)	Methyl Orange Alkalinity	mg/l	266	256	250	224	236	218	225	240	215	208	220	
6)	Sulphates	mg/l	330	325	320	322	230	225	218	228	220	219	222	
7)	Chlorides	mg/l	2148	2045	1840	1898	982	978	972	1125	1115	1092	1098	
8)	Ammonica Nitrogen	mg/l	0.086	0.088	0.082	0.096	0.096	0.098	0.099	0.092	0.094	0.091	0.090	
9)	Albuminoid Nitrogen	mg/l	0.076	0.075	0.073	0.100	0.096	0.098	0.095	0.098	0.096	0.092	0.097	
10)	Nitrates as N	mg/l	0.88	0.79	0.95	0.6	0.60	0.62	0.66	0.58	0.6	0.65	0.63	
11)	Nitrites as N	mg/l	0.10	0.12	0.15	<0.05	0.14	0.12	0.16	0.15	0.12	0.10	0.14	

12)	Fluorides as F	mg/l	0.72	0.76	0.81	0.99	0.9	0.98	0.97	1.0	0.89	0.91	0.96	0.92
13)	Phosphates	mg/l	0.75	0.77	0.82	Nil								
14)	Iron	mg/l	0.031	0.033	0.037	0.11	0.14	0.12	0.16	0.13	0.14	0.12	0.15	0.11
15)	Manganese	mg/l	BDL											
16)	Silica (as SiO ₂)	mg/l	55	57	59	63	63	60	58	61	66	64	65	68
17)	Dissolved Oxygen	mg/l	5.2	5.4	5.8	5.2	4.4	5.5	5.9	5.7	5.2	5.4	5.8	5.6
18)	BOD at 20°C	mg/l	0.66	0.63	0.59	6	0.90	0.75	0.55	0.66	0.66	0.63	0.59	0.61
19)	COD	mg/l	16.5	17.1	17.8	57	13.1	16.3	18.6	17.9	16.5	17.1	17.8	17.6
BACTERIOLOGICAL PARAMETERS														
20)	Total cfu/ml at 37°C on Agar plate		155	150	148	152	150	158	155	152	156	140	155	150
21)	MPN of coliform in 100 ml		Nil											
22)	Faecal coliforms		Absent											

GROUND WATER QUALITY – CHEMICAL CHARACTERISTICS

S.No	Chemical Parameter	Unit	Islapuram				Rammadapuram			
			S	W	M	PM	S	W	M	PM
1)	Total Hardness	mg/l	1080	1050	1020	1060	660	650	645	662
2)	Calcium Hardness	mg/l	175	160	150	168	75	70	68	78
3)	Magnesium Hardness	mg/l	905	890	870	892	585	580	577	584
4)	Phenolphthalein Alkalinity	mg/l	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
5)	Methyl Orange Alkalinity	mg/l	240	215	208	220	236	218	203	225
6)	Sulphates	mg/l	228	220	219	222	230	225	220	218
7)	Chlorides	mg/l	1125	1115	1092	1098	928	922	895	902
8)	Ammonica Nitrogen	mg/l	0.092	0.094	0.091	0.090	0.096	0.098	0.094	0.099
9)	Albuminoid Nitrogen	mg/l	0.098	0.096	0.092	0.097	0.096	0.098	0.093	0.095
10)	Nitrates as N	mg/l	0.58	0.6	0.65	0.63	0.60	0.62	0.69	0.66
11)	Nitrites as N	mg/l	0.15	0.12	0.10	0.14	0.14	0.12	0.18	0.16
12)	Fluorides as F	mg/l	0.89	0.91	0.96	0.92	0.9	0.98	0.97	1.0
13)	Phosphates	mg/l	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
14)	Iron	mg/l	0.14	0.12	0.15	0.11	0.14	0.12	0.16	0.13
15)	Manganese	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
16)	Silica (as SiO ₂)	mg/l	66	64	65	68	63	60	58	61

17)	Dissolved Oxygen	mg/l	5.2	5.4	5.8	5.6	4.4	5.5	5.9	5.7
18)	BOD at 20°C	mg/l	0.66	0.63	0.59	0.61	0.90	0.75	0.55	0.66
19)	COD	mg/l	16.5	17.1	17.8	17.6	13.1	16.3	18.6	17.9
BACTERIOLOGICAL PARAMETERS										
20)	Total cfu/ml at 37°C on Agar plate		150	158	155	152	152	150	148	152
21)	MPN of coliform in 100 ml		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
22)	Faecal coliforms		Absent	Abse nt						

Surface Water Quality Status

The surface water in the study area mainly includes Gulf of Mannar. As the Nambiyar river flow is obstructed by the Nambiyar tank no river water is found in the study area. To obtain a general idea about the quality of surface water, the water quality of the Gulf of Mannar was determined, which is tabulated in Table 3-12 and 3-13.

Table 3-12 : SURFACE WATER – PHYSICAL CHARACTERISTICS

Stations	Parameters					
	pH	Temp (°C)	Turbidity (NTU)	TDS (mg/l)	EC(μS/cm)	Colour
Gulf of Mannar						
S	8.3	Ambient	12	39,157	67,500	Sea blue
W	8.2	Ambient	14	40,000	67,480	Sea blue
M	8.2	Ambient	16	45,000	67,438	Sea blue
PM	8.1	Ambient	12	39,000	67,490	Sea blue

Table 3-13 SURFACE WATER – CHEMICAL CHARACTERISTICS

S.No	Chemical Parameter	Unit	Gulf of Mannar			
			S	W	M	PM
1)	Total Hardness	mg/l	5962	5900	5800	5900
2)	Calcium Hardness	mg/l	974	965	950	955
3)	Magnesium Hardness	mg/l	4988	4935	4850	4945
4)	Phenolphthalein Alkalinity	mg/l	Nil	Nil	Nil	Nil
5)	Methyl Orange Alkalinity	mg/l	109	110	105	98
6)	Sulphates	mg/l	2750	2800	2780	2760
7)	Chlorides	mg/l	19185	19190	19160	19178
8)	Ammonica Nitrogen	mg/l	0.08	0.082	0.079	0.084

9)	Albuminoid Nitrogen	mg/l	0.068	0.069	0.072	0.070
10)	Nitrates as N	mg/l	0.41	0.43	0.47	0.45
11)	Nitrites as N	mg/l	<0.05	<0.05	<0.05	<0.05
12)	Fluorides as F	mg/l	1.2	1.0	1.5	1.3
13)	Phosphates	mg/l	Nil	Nil	Nil	Nil
14)	Iron	mg/l	0.46	0.45	0.42	0.48
15)	Manganese	mg/l	BDL	BDL	BDL	BDL
16)	Silica (as SiO ₂)	mg/l	Nil	Nil	Nil	Nil
17)	Dissolved Oxygen	mg/l	4.0	4.8	5.2	4.9
18)	BOD at 20°C	mg/l	0.92	0.87	0.72	0.85
19)	COD	mg/l	14.2	13.6	13.0	13.5
20)	Total cfu/ml at 37°C on Agar plate		180	150	168	172
21)	MPN of coliform in 100 ml		Nil	Nil	Nil	Nil
22)	Faecal coliforms		Absent	Absent	Absent	Absent

NOISE ENVIRONMENT

The basic steps associated with impact assessment on the noise components of the environment involve identification, prediction and evaluation of the exposure status of the workers (occupational) as well as general population including sensitive receptors viz. school, hospital, post offices, phone etc.

Reconnaissance Survey

The scope of VVM SEZ is to develop and operate eco friendly Heavy mineral processing Plants for Processing heavy Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals cracking of monazite and production of Rare Earth Oxide, solvent extraction, magnets, Titanium Pigments, Synthetic Rutile, Slag, Scandinium etc., Port, wind and solar power plants and associated infrastructure facilities within the VVM SEZ have slightly noise generating equipment / machinery, however suitable acoustic hoods / enclosures will be provided such that the noise level in the vicinity shall conform to the national noise quality criteria.

The infrastructure facilities will not produce considerable noise. However, in case of emergency, DG sets shall be operated which will produce considerable noise. Hence, they shall be installed in acoustic enclosures, to minimize noise pollution.

To assess the existing noise level in and around proposed SEZ, Eleven Ambient Noise Level Monitoring Stations (ANLMS) have been selected primarily based on prevailing meteorological conditions. The noise level has been recorded at various strategic locations on highway as well as major sensitive receptors located within the study area viz. hospitals, schools, temples/mosques etc. At each ANLMS, hourly spot noise level has been recorded for 24 hours. The vehicular density in the study area has also been studied.

Baseline Status

Noise survey was conducted in and around the study area. Noise levels (A weighted) dB (A) were measured using precision noise level meters. The community noise sources including traffic and other activities were also monitored to determine the general noise pollution status. While selecting the ANLMS, due consideration was given to nature of the receptor i.e. commercial,

residential and sensitive as well as other landscape features in the study area, as per MoEF guideline for the purpose. The location of selected ANLMS is presented in Table 3-14.

Table 3-14 : Location of selected ANLMS

STATION CODE	LOCATION
NS 1	Thiruvambalapuram
NS 2	Navaladi
NS 3	Karichithu Pudur
NS 4	Parameshwarapuram
NS 5	Vijayapathy
NS 6	Koodankulam
NS 7	Kasthurirangapuram
NS 8	Urumangalam
NS 9	Udayattur
NS 10	Islapuram
NS 11	Rammadupuram

The sampling sites for community exposure survey were selected keeping in view the prevalent micro-meteorological condition at the time of survey. Diurnal variation of Ambient Noise levels for different locations for minimum, maximum and equivalent noise levels in the study area is given in Table 3-15.

Table 3-15 : Status of Ambient Noise Level in Study Area during Study Period

Station code	Location	Minimum Noise Level (dB)	Maximum Noise Level (dB)	Equivalent Noise Level (dB)
NS 1	Thiruvambalapuram	51.00	65.00	62.17
NS 2	Navaladi	41.00	49.00	44.80
NS 3	Karichithu Pudur	58.00	65.00	61.92
NS 4	Parameshwarapuram	54.00	62.00	58.76
NS 5	Vijayapathy	45.00	53.00	49.04
NS 6	Koodankulam	67.00	79.00	74.43
NS 7	Kasthurirangapuram	51.00	59.00	56.39
NS 8	Urumangalam	53.00	61.00	57.55
NS 9	Udayattur	56.00	63.00	58.87
NS 10	Islapuram	51.00	65.00	62.17
NS 11	Rammadapuram	41.00	49.00	44.80

Status of Noise Pollution

About Eleven major locations were identified in the study area. Noise levels were measured at these locations (within 1 to 3 m from major noise generation sources) to determine the strength of noise sources and status of noise in the study area.

Community Noise

Community noise includes all types of noise in the outdoor acoustic environment and it is essential to study its variation, magnitude and character at various locations. The ambient sound pressure level is defined as total noise at a given location due to all sources. The residual noise level is that level below which the

ambient noise does not seem to drop during a given time interval and due to distant unidentified sources.

The extent to which an individual is affected by intruding noise is a complex phenomenon. The impact of noise on the individual's strength depends on :

- a) Physical dose of noise, viz. Noise level, frequency spectrum, intermittency etc.
- b) Human factors, viz. Sex, age, health status, occupation during exposure period, etc.

The intensity of impact however, depends on :

- a) Psychological and physiological state of individual and
- b) The number of individual exposed.

Day vs. Night Noise Levels

The community noise is determined by recording the day-night noise levels (L_{dn}). L_{dn} is defined as the 24 hrs equivalent sound level except that weighting penalty of 10 db(A) is added to the measured instantaneous noise level for night time period i.e. from 22-00 to 07-00 hrs. This is because the same noise levels during the night time are more annoying than the daytime. L_{dn} for given location in a community is calculated from an hourly equivalent level (l_{eq}) by the following equation :

$$L_{dn} = 10 \log \left\{ \frac{1}{24} \left[15^{(10 L / 10)} \right] + 9 \left[10^{(L+10) / 10} \right] \right\}$$

where L_d = equivalent noise level during day time (07.00 to 22.00 hrs)

L_n = equivalent noise level during night time (22.00 to 07.00 hrs)

Hourly equivalent levels (l_{eq}) for eleven different locations were collected.

Table 3-16 : Day and night noise level in core and buffer zone

Station code	Location	Ld (dB)	Ln (dB)	Ldn (dB)
NS 1	Thiruvambalapuram	64.62	59.69	67.02
NS 2	Navaladi	50.43	41.44	50.79
NS 3	Karichithu Pudur	49.065	41.81	50.18
NS 4	Parameshwarapuram	49.53	42.33	50.68
NS 5	Vijayapathy	46.94	40.56	48.51
NS 6	Koodankulam	67.47	52.04	66.29
NS 7	Kasthurirangapuram	48.85	38.40	49.42
NS 8	Urumangalam	48.21	40.54	49.13
NS 9	Udayattur	67.45	52.04	66.29
NS 10	Islapuram	47.46	41.76	49.40
NS 11	Rammadupuram	49.45	41.09	50.07

LAND ENVIRONMENT

VVM SEZ is in possession of 166.66.5 ha. own patta Land, which is contiguous and free from all encumbrances. There is no habitation or encroachment in and around the proposed SEZ area.

Landuse Pattern in study Area

Due to proximity of the sea, despite the arid landscape, the temperature does not rise above 40° C or fall to very low level. Scarce rainfall, poor soil conditions do not promote good vegetation, which can act as a significant climate modifier.

The structure of soil profile also indicates that poor quality of soil that will not support major vegetation. Therefore, appropriate adoption of plantation and irrigation techniques may be able to transform this very arid landscape over a period of time.

Soil Characteristics

To assess the soil quality in and around proposed VVM Special Economic Zone (SEZ), eleven Soil Quality Monitoring Stations (SQMS) were selected. The location of selected SQMS is presented in Table 3-17. The collected soil samples were analyzed for texture analysis along with other physico-chemical characteristics of soil.

Table 3-17 : Locations of selected SQMS

Station code	Location
SS 1	Thiruvambalapuram
SS 2	Navaladi
SS 3	Karichithu Pudur
SS 4	Parameshwarapuram
SS 5	Vijayapathy
SS 6	Koodankulam
SS 7	Kasthurirangapuram
SS 8	Urumangalam
SS 9	Udayattur
SS 10	Islapuram
SS 11	Rammadupuram

The chemical composition of the soil samples taken from various parts of Core and buffer zone establish that there are no sources of heavy metals contamination (Table 3.18). The contents of sodium and potassium are, however very high - and the soil is saline which would warrant for adequate treatment.

Salinity

The soil characteristics of project site are mainly Category - L, P and K type of soil. The salinity of soil has prohibited the land area to be used for agriculture and thus, whatever small volume of agriculture is being practices is only in pockets

TABLE 3.18 PHYSICO CHEMICAL CHARACTERISTICS OF SOIL AT PROJECT SITE

Physical characteristics of soil in core and buffer zone

Sl.No	Parameters	SS1	SS2	SS3	SS4	SS5	SS6	SS7	SS8	SS9	SS10	SS11
1	Water Retention Capacity (%)	33.4	36.5	37.8	36.4	29.9	30.9	34.1	34.6	45.56	32.8	35.4
2	Bulk density g/cm ³	1.39	1.41	1.42	1.41	1.33	1.35	1.38	1.39	1.47	1.37	1.4
3	Porosity (%)	23.67	25.77	26.98	25.71	17.69	18.26	22.98	23.78	29.45	21.34	24.18
4	Texture Analysis											
	% of Sand	35.29	36.61	37.88	36.24	21.57	23.68	28.9	30.21	41.91	27.68	34.59
	% of Silt	41.37	44.87	47.98	45.01	30.56	34.28	37.19	38.67	53.37	36.44	42.38
	% of Clay	22.15	27.26	34.87	28.99	12.58	15.69	17.79	20.35	48.46	16.97	23.66

Chemical Characteristics of soil in core and buffer zone

Sl.No	Parameters	SS1	SS2	SS3	SS4	SS5	SS6	SS7	SS8	SS9	SS10	SS11
1	pH (10% Solution)	7.49	7.99	8.5	8.21	9.04	7.82	7.83	7.78	6.7	7.52	8.7
2	Loss on Ignition	14.1	10.5	11.4	12.6	12.3	11.2	11.7	9.7	13.8	13.4	11.5
3	Chloride (as Cl) in mg/kg	0.47	0.49	0.55	0.48	0.62	0.53	0.48	0.56	0.42	0.43	0.57
4	Calcium g/kg	0.56	0.57	0.51	0.62	0.47	0.55	0.53	0.48	0.51	0.49	0.52
5	Magnesium g/kg	0.16	0.17	0.22	0.15	0.29	0.17	0.19	0.18	0.12	0.18	0.24
6	Available Nitrogen g/kg	0.52	0.77	0.85	0.82	0.92	0.69	0.76	0.64	0.49	0.92	0.88
7	Available Phosphorous g/kg	0.36	0.35	0.21	0.29	0.16	0.2	0.18	0.18	0.30	0.19	0.23
8	Sodium (as Na) in g/kg	0.71	0.72	0.84	0.75	0.89	0.81	0.83	0.73	0.66	0.69	0.86
9	Potassium (as K) in g/kg	0.60	0.61	0.54	0.59	0.49	0.61	0.63	0.54	0.54	0.60	0.57
10	Organic Matter (as C) in %	0.44	0.33	0.25	0.48	0.19	0.27	0.28	0.24	0.41	0.32	0.28

Status of Heavy metals in soil of core and buffer zone

Sl.No	Parameters	SS1	SS2	SS3	SS4	SS5	SS6	SS7	SS8	SS9	SS10	SS11
1	Lead (Pb) in mg/kg	0.021	0.009	0.015	0.024	0.016	0.008	0.009	0.011	0.014	0.012	0.013
2	Nickel (as Ni) in mg/kg	0.017	0.009	0.011	0.012	0.007	0.012	0.014	0.014	0.012	0.009	0.009
3	Chromium (as Ch) in mg/kg	0.016	0.013	0.021	0.027	0.028	0.017	0.018	0.017	0.019	0.02	0.019
4	Iron (as Fe) in mg/kg	0.23	0.28	0.24	0.14	0.19	0.43	0.51	0.26	0.24	0.34	0.24
5	Zinc (as Zn) in mg/kg	0.12	0.16	0.13	0.07	0.09	0.16	0.19	0.016	0.14	0.14	0.14
6	Copper (as Cu) in mg/kg	0.018	0.019	0.012	0.016	0.018	0.018	0.012	0.012	0.016	0.002	0.016

with availability of good ground water quality areas. However, it would be necessary to indicate that the agricultural yield of these fields is very low.

ECOLOGICAL ENVIRONMENT

The study on ecological aspect is important for Environmental Impact Assessment in view of conservation of environmental quality and safety of natural flora and fauna. A biological community being dependent on the condition and resources of its location may change if there is a little change in the ecosystem. Such a community change is a reflection of changes in the plant and animal population that comprises of the community, because of the complex interrelationships of a changing condition of resource that causes one or more of the population to change, may cause many populations to change and be replaced by others. Since the environment of organisms are able to inhabit that location, the inhabitants should be biological inducers of environmental changes.

Reconnaissance Survey

The proposed VVM Special Economic Zone at Thiruvambalapuram is located in Tirunelveli district of Tamil Nadu covering an approximate area of 166.66.5 ha. The main objective of this survey is to assess the present status of ecological environment in the study area.

In the present study 10 km radius all around the proposed SEZ site was considered for both terrestrial and aquatic ecological analysis.

METHODOLOGY:

A thorough traverse study of the core and buffer zone was conducted and the occurrence of flora at various locations was recorded and plant specimens were collected for record. The morphology of the plants was recorded. The relative

density of plant species and their predominance in the study area are studied through quadrat method.

The list of flora observed in the buffer zone is given below

LIST OF FLORA IN THE BUFFER ZONE

List of plant species

Botanical Name	Family
<i>Abrus fruticulosus</i>	Fabaceae
<i>Abrus precatorius</i> L.	Fabaceae
<i>Abutilon indicum</i> L.	Malvaceae
<i>Acacia nilotica</i> (L.) Willd. Ex Del.	Mimosaceae
<i>Acacia pennata</i> , Willd.	Mimosaceae
<i>Acacia planifrons</i> Wight & Arn.	Mimosaceae
<i>Acalypha indica</i> L.	Euphorbiaceae
<i>Acanthospermum hispidum</i> DC.	Asteraceae
<i>Achyranthus aspera</i> L. var. <i>aspera</i>	Amaranthaceae
<i>Aegle marmelos</i> (L.) Correa.	Rutaceae
<i>Aerva lanata</i> (L.) Juss. ex	Amaranthaceae
<i>Aeschynomene aspera</i> L.	Fabaceae
<i>Adenostemma lavenia</i> , (L.) Kuntz.	Asteraceae
<i>Ageratum conyzoides</i> L.	Asteraceae
<i>Allium cepa</i> L.	Liliaceae
<i>Allmania nodiflora</i> , R.Br.	Amaranthaceae
<i>Aloe vera</i> (L.) Burm.f.	Liliaceae
<i>Albizia lebbek</i> , (L.) Benth.	Mimosaceae
<i>Alysicarpus monilifer</i>	Fabaceae
<i>Annona squamosa</i>	Annonaceae
<i>Anisomoles malabarica</i>	Lamiaceae
<i>Apluda mutica</i> L.	Poaceae
<i>Argemone maxicana</i> Linn.	Papaveraceae
<i>Aristida hystrix</i> L.f	Poaceae
<i>A. setacea</i> Retz.	Poaceae
<i>Atalantia monophylla</i> , W&A	Rutaceae
<i>Altenathera sessilis</i>	Amaranthaceae
<i>Amaranthus spinosus</i> L,	Amaranthaceae
<i>Ammania baccifera</i> L.	Lythraceae
<i>Anacardium occidentale</i>	Anacardiaceae
<i>Andrographis alata</i> , Nees.	Acanthaceae
<i>Andrographis paniculata</i> (Burm.f.) Wall ex Nees	Acanthaceae
<i>Anisomeles malabarica</i> (L.) R.Br.	Lamiaceae

<i>Aristolochia indica</i> L.	Aristolochiaceae
<i>Asparagus racemosus</i> Willd	Liliaceae
<i>Atylosia volubilis</i> , Gamb.	Fabaceae
<i>Azadirachta indica</i> A. Juss	Meliaceae
<i>Bulbostylis barbata</i>	Cyperaceae
<i>Barleria buxifolia</i> , Linn	Acanthaceae
<i>B. cristata</i>	Acanthaceae
<i>B. noctiflora</i>	Acanthaceae
<i>Boerhaavia diffusa</i> , Linn	Nyctaginaceae
<i>B. erecta</i>	Nyctaginaceae
<i>Borassus flabellifer</i> L.	Arecaceae
<i>Blepharis boerhaaviaefolia</i> , Rers	Acanthaceae
<i>Bidens pillosa</i> ,	Astraceae
<i>Brachiaria ramosa</i> (L.)Stapt.	Poaceae
<i>Cadapa indica</i> , Lam.	Capparidaceae
<i>Cadapa fruticosa</i> , W&A.	Capparidaceae
<i>Canavalia ensiformis</i> ,	Fabaceae
<i>Canthium parviflorum</i> , Lam.	Rubiaceae
<i>Capparis sepiaria</i> , L.	Capparidaceae
<i>Capparis zeylanica</i> , L.	Capparidaceae
<i>Calotropis gigantea</i>	Asclepiadaceae
<i>Canavalia cathartica</i> Tho.	Fabaceae
<i>Canavalia rosea</i> Sw. and Dc.	Fabaceae
<i>Cardiospermum halicacabum</i> L.	Sapindaceae
<i>Carissa spinarum</i> ,	Apocynaceae
<i>Carica papaya</i>	Caricaceae
<i>Cassia auriculata</i> ,L.	Caesalpiniaceae
<i>Casuarina equisetifolia</i> L.	Casuarinaceae
<i>Cassytha filiformis</i> , L.	Lauraceae
<i>Catharanthus roseus</i> G. Don	Apocyanaceae
<i>Centella asiatica</i>	Apiaceae
<i>Ceropegia juncea</i> , Roxb.	Asclepidiaceae
<i>Chloris inflata</i> Link.	Poaceae
<i>Cissus quadrangularis</i> L.	Vitaceae
<i>Cleome viscosa</i> L.	Cleomaceae
<i>C. gynandra</i>	Cleomaceae
<i>Clitoria ternata</i> , L.	Fabaceae
<i>Coccinia indica</i> , W&A	Cucurbitaceae
<i>Cocculus hirsutus</i> , Diels.	Minispermaceae
<i>Combretum ovalifolium</i> , Roxb.	Asclepidaceae
<i>Commelina benghalensis</i> Linn.	Commelinaceae
<i>Commiphora berryi</i> , Engl.	Burseraceae
<i>Corchorus trilobularis</i> L.	Tiliaceae
<i>Citrullus colocynthis</i> (L.) Sch.	Cucurbitaceae

<i>Crataeva magna</i>	Capparidaceae
<i>Crotalaria juncea</i>	Fabaceae
<i>Croton bonplandianus</i> Baillon	Euphorbiaceae
<i>Croton klotzschianus</i> , Thw.	Euphorbiaceae
<i>Cucumis trigonus</i> Roxb.	Cucurbitaceae
<i>Cynodon dactylon</i> (L.) Pers	Poaceae
<i>Cyprus arenarius</i>	Cyperaceae
<i>Cyprus articulatus</i>	Cyperaceae
<i>Cyprus bulbosus</i>	Cyperaceae
<i>Cyprus compressus</i>	Cyperaceae
<i>Cyprus difformis</i>	Cyperaceae
<i>Cyprus distans</i>	Cyperaceae
<i>Cyprus exallatus</i>	Cyperaceae
<i>Cyprus halpan</i>	Cyperaceae
<i>Cyprus iria</i> L.	Cyperaceae
<i>Cyprus procerus</i> Rottb	Cyperaceae
<i>Cyprus rotundus</i> L.	Cyperaceae
<i>Cyprus tenuiculmis</i>	Cyperaceae
<i>Cyprus triceps</i> (Rottb.) Endl.	Cyperaceae
<i>Cryptococcum trigonum</i> (Retz.) A.	Poaceae
<i>Dactyloctenium aegyptium</i> (L.)	Poaceae
<i>Daemia extensa</i> , N.E.Br.	Asclepidiaceae
<i>Datura metel</i> L.	Solanaceae
<i>Dichrostachyus cinerea</i> Wight et Arn.	Mimosaceae
<i>Dodonea viscosa</i> , L.	Sapindaceae
<i>Ecbolium linneanum</i>	Acanthaceae
<i>Eclipta prostrata</i> (L.) Hassk.	Asteraceae
<i>Enicostema littorale</i> , Bume	Gentianaceae
<i>Enteropogon dolichostachyus</i>	Poaceae
<i>Eragrostiella tenella</i> (L.) P.Beauv.ex.Rome &Schultes var.insularis	Poaceae
<i>Eragrostiella tenella</i> (L.) P.Beauv.ex.Rome &Schultes var.tenella	Poaceae
<i>Euphorbia antiquorum</i> L.	Euphorbiaceae
<i>Euphorbia hirta</i> L.	Euphorbiaceae
<i>Euphorbia rosea</i> , Retz.	Euphorbiaceae
<i>Euphorbia thymifolia</i> , L.	Euphorbiaceae
<i>Evolvulus alsinoides</i> , L.	Convolvulaceae
<i>Fluggea lecopyrus</i> , Willd.	Euphorbiaceae
<i>Ficus bengalensis</i> L.	Moraceae
<i>Ficus religiosa</i> L.	Moraceae
<i>F. tomentosa</i> , Roxb.	Moraceae
<i>Fimbristylis eregrostis</i>	Cyperaceae
<i>Gloriosa superba</i> L.	Liliaceae
<i>Gisekia pharnaceoides</i> L.	Molluginaceae

<i>Glinus oppositifolius</i> (L.) Aug. DC.,	Molluginaceae
<i>Gmelina asiatica</i> , L.	Verbenaceae
<i>Gymnema sylvestre</i> R.Br.ex Schultes	Asclepiadaceae
<i>Hemidesmus indicus</i> , R.Br.	Asclepidiaceae
<i>Heteropogon contortus</i> (L.) P.Beauv.ex Roemer & Schultes	Poaceae
<i>Hibiscus micranthus</i> , L.	Malvaceae
<i>Hyptis suaveolens</i>	Lamiaceae
<i>Ichnocarpus frutescens</i> R.Br	Apocynaceae
<i>Indigofrea aspalathoides</i> Vahl ex	Fabaceae
<i>Indigofrea linnaei</i> L.	Fabaceae
<i>Indigofrea tinctoria</i> L.	Fabaceae
<i>Indigofrea trita</i> L.	Fabaceae
<i>Indigofrea echinatus</i> (Willd). Benth.	Fabaceae
<i>Ipomea carnea</i>	Convolvulaceae
<i>Ipomea obscura</i> (L.) Ker Gawl.	Convolvulaceae
<i>Ipomea pes-carprae</i> L. R.Br.	Convolvulaceae
<i>Ipomea sepiaria</i>	Convolvulaceae
<i>Jasminum auriculatum</i> , Vahl.	Oleaceae
<i>Jatropha glandulifera</i>	Euphorbiaceae
<i>J.maheswarii</i>	Euphorbiaceae
<i>Justicia adhatoda</i> L.	Acanthaceae
<i>Kyllinga brevifolia</i>	Cyperaceae
<i>Kyllinga bulbosa</i>	Cyperaceae
<i>Lantana camara</i> L.	Verbenaceae
<i>Lawsonia inermis</i> L.	Lythraceae
<i>Lepidagathis pungens</i>	Acanthaceae
<i>Lettsomia aggregate</i> , Roxb.	Convolvulaceae
<i>Leucas aspera</i> (Willd) Link	Lamiaceae
<i>Leucaena glauca</i> , Benth.	Mimosaceae
<i>Ludwigia</i> sp	Onagraceae
<i>Maba buxifolia</i> , Pers.	Ebenaceae
<i>Maerva apetala</i>	Capparideaceae
<i>Mangifera indica</i>	Anacardiaceae
<i>Melia azadarach</i> , Linn.	Meliaceae
<i>Merremia 137ridentate</i> (Linn.) Hallier f	Convolvulaceae
<i>Monihot esculenta</i>	Euphorbiaceae
<i>Morinda pubecencs</i> J. E. Sm.	Rubiaceae
<i>Mimosa pudica</i> L.	Mimosaceae
<i>Miusops elengi</i>	Sapotaceae
<i>Mollugo cerviana</i> (L.) Ser.	Molluginaceae
<i>M.pentaphylla</i> , L.	Molluginaceae
<i>Mukia maderaspatana</i> (L.) M. Roem)	Cucurbitaceae
<i>Nieuhria apetala</i> , Dunn.	Capparidaceae
<i>Ocimum sanctum</i> , L.	Lamiaceae

<i>O. teneiflorum</i>	Lamiaceae
<i>Opuntia sp.</i>	Cactaceae
<i>Oldenlandia umbellata</i> , L.	Rubiaceae
<i>Possiflora foetida</i> L.	Possifloraceae
<i>Paspalidium flavidum</i> (Retz.) A.Camus	Poaceae
<i>Pavonia odorata</i> Willd	Malvaceae
<i>P. procumbens</i>	Malvaceae
<i>P. zylanica</i>	Malvaceae
<i>Paspalidium flavidum</i>	Poaceae
<i>Pedaliium murax</i> L.	Pedaliaceae
<i>Perularia daemia</i> (Forssk.) Chiov.	Asclepiadaceae
<i>Perotis indica</i>	Poaceae
<i>Phyllanthus amarus</i> Schum & Thonn.	Euphorbiaceae
<i>Phyllanthus murex</i>	Euphorbiaceae
<i>Phyllanthus emblica</i> L.	Euphorbiaceae
<i>Phoenix humilis</i> , Royle	Areaceae
<i>Phyllanthus amarus</i>	Euphorbiaceae
<i>P. maderaapatensis</i> L	Euphorbiaceae
<i>P. reticulatus</i>	Euphorbiaceae
<i>Physalis minima</i>	Solanaceae
<i>Plumbago zylanica</i> L.	Plumbaginaceae
<i>Polycarpaea corymposa</i> (L.) Lam	Caryophyllaceae
<i>Polygala chinensis</i> , L.	Polygalaceae
<i>Polygala jawana</i> DC.	Polygalaceae
<i>Polyalthia longifolia</i>	Annonaceae
<i>Pongamia pinnata</i> , (L.) Pierre	Fabaceae
<i>Pithocellobium dulce</i> (Roxb.) Benth	Mimosaceae
<i>Priva cordifolia</i>	Verbanaceae
<i>Prosopis juliflora</i> (Sw.)DC	Fabaceae
<i>Psidium guajava</i>	Myrtaaceae
<i>Randia dumetorum</i>	Rubiaceae
<i>Rhinacanthus communis</i>	Acanthaceae
<i>Ricinus communis</i> L.	Euphorbiaceae
<i>Rivea hypocrateriformis</i> (Desr. ex Lam.) Choisy.	Convolvunaceae
<i>Rothia indica</i> (L.) Druce	Fabaceae
<i>Rungia repens</i> , Nees.	Acanthaceae
<i>Santalum album</i> L.	Santalaceae
<i>Scoparia dulcis</i> L.	Scrophulariaaceae
<i>Securinega leucopyrus</i> Willd.	Euphorbiaceae
<i>Senna alata</i>	Caesalpiniceae
<i>Sesamum indicum</i> L.	pedaliaceae
<i>Sida acuta</i>	Malvaceae
<i>Sida cordifolia</i> L.	Malvaceae
<i>Sida rhombifolia</i> L.	Malvaceae
<i>Solanum insanum</i> L.	Solanaceae

<i>Sporobolus virginicus</i>	Poaceae
<i>Streblus asper</i> , Lore	Moraceae
<i>Striga angustifolia</i>	Scrophulariaceae
<i>Striga densiflora</i>	Scrophulariaceae
<i>Stylosanthes mucronata</i> , Willd.	Fabaceae
<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae
<i>Tamarantus indica</i> , Linn.	Caesalpinaceae
<i>Tectona grandis</i>	Verbenaceae
<i>Tephrosia purpurea</i> (L.) Pers.	Fabaceae
<i>Tephrosia villosa</i> (L.) Pers.	Fabaceae
<i>Terminalia chebula</i> Retz.	Combretaceae
<i>Thespesia populnea</i>	Malvaceae
<i>Tinospora cordifolia</i> (Willd.) Miers ex Hook.	Menispermaceae
<i>Trianthema portulacastrum</i>	Aizoaceae
<i>Tribulus terrestris</i> L.	Zygophyllaceae
<i>Trichodesma indicum</i> (L.) Sam.	Boraginaceae
<i>Tridax procumbens</i>	Asteraceae
<i>Triumfetta romboidea</i>	Tiliaceae
<i>Triumfetta pentandra</i> A.Rich.	Tiliaceae
<i>Triumfetta rotundifolia</i> Lam.	Tiliaceae
<i>Typha angustata</i> Bony et Chaub.	Typhaceae
<i>Ventilago maderaspatana</i> , Gaertn.	Rhamnaceae
<i>Vernonia cinerea</i> Less	Asteraceae
<i>Vitex negundo</i> L.	Verbanaceae
<i>V. trifolia</i>	Verbanaceae
<i>Waltheria indica</i> L.	Sterculiaceae
<i>Wrightia tinctoria</i> , (Roxb) R.Br.	Apocyanaceae
<i>Ziziphus oenoplia</i> , Mill.	Rhamnaceae
<i>Ziziphus jujuba</i> Mill.	Rhamnaceae
<i>Zornia diphylla</i> Pers.	Fabaceae

Agricultural field angiosperm plant species

Plant species
Acanthaceae
<i>Andrographis paniculata</i> (Burm.f.) Wall ex Nees
Aizoaceae
<i>Trianthema portulacastrum</i> L.
Amaranthaceae
<i>Achyranthes aspera</i> L.
<i>Aerva lanata</i> (L.) Juss. Ex Schult.
<i>Amaranthus spinosus</i> L.

<i>Amaranthus viridis</i> L.
Anacardiaceae
<i>Mangifera indica</i> L.
Annonaceae
<i>Annona squamosa</i> L.
<i>Polyalthia longifolia</i> (Sonn.) Thwaites
<i>Catharanthus roseus</i> (L.) G.Don
<i>Hemidesmus indicus</i> (L.) R.Br.
<i>Nerium oleander</i> L.
<i>Pergularia daemia</i> (Forssk.) Chiov.
Asclepiadaceae
<i>Calotropis giganteae</i> R.Br
Arecaceae
<i>Borassus flabellifer</i> L.
<i>Caryota urens</i> L.
<i>Cocos nucifera</i> L.
<i>Roystonea regia</i> (Kunth) O.F.Cook
Aristolochiaceae
<i>Aristolochia bracteolata</i> Lam.
Asparagaceae
<i>Asparagus racemosus</i> Willd.
Asteraceae
<i>Acanthospermum hispidum</i> DC.
<i>Tridax procumbens</i> L.
<i>Tagetes erecta</i> L
Bignoniaceae
<i>Millingtonia hortensis</i> L.f.
Boraginaceae
<i>Trichodesma indicum</i> R.Br.
Brassicaceae
<i>Cleome viscosa</i> L.
<i>Gynandropsis gynandra</i> (L.) Briq.
Caricaceae
<i>Carica papaya</i> L.
Casuarinaceae
<i>Casuarina equisetifolia</i> L.
Colchicaceae
<i>Gloriosa superba</i> L.
Combretaceae
<i>Terminalia catappa</i> L.
Commelinaceae
<i>Commelina benghalensis</i> L.
<i>Cyanotis axillaris</i> (L.) D.Don
Convolvulaceae
<i>Evolvulus species</i>

Cucurbitaceae
<i>Coccinia indica</i> L.
<i>Cucumis sativus</i> L
<i>Luffa acutangula</i>
<i>Momordica charantia</i> L
<i>Trichosanthes cucumerina</i> L
Cyperaceae
<i>Cyperus rotundus</i> L.
Euphorbiaceae
<i>Acalypha indica</i> L.
<i>Euphorbia hirta</i> L.
<i>Jatropha gossypifolia</i> L.
<i>Ricinus communis</i> L.
<i>Phyllanthus amarus</i> Schum & Thonn.
<i>Phyllanthus emblica</i> L.
Fabaceae
<i>Abrus precatorius</i> L.
<i>Acacia auriculiformis</i> A.Cunn. ex Benth.
<i>Albizia lebbek</i> (L.) Benth.
<i>Albizia saman</i> (Jacq.) F.Muell.
<i>Arachis villosolicarpa</i> Hoehne
<i>Caesalpinia pulcherrima</i> (L.) Sw.
<i>Cassia fistula</i> L.
<i>Cassia hirsuta</i> L.
<i>Cassia occidentalis</i> L.
<i>Cassia siamea</i> Lam.
<i>Cajanus cajan</i> (L). Milsp
<i>Clitoria ternatea</i> L.
<i>Crotalaria trifolium</i> Willd.
<i>Cyamopsis tetragonoloba</i> L.
<i>Delonix regia</i> (Bojer) Raf.
<i>Desmodium triflorum</i> (L.) DC.
<i>Leucaena leucocephala</i> (Lam.) de Wit.
<i>Lab labpurpureus</i> Var typicus
<i>Mimosa pudica</i> L.
<i>Pithecellobium dulce</i> (Roxb.) Benth.
<i>Pongamia pinnata</i> Merr.
<i>Prosopis juliflora</i> (Sw.) Dc.
<i>Senna alata</i> (L.) Roxb.
<i>Tamarindus indica</i> L.
<i>Tephrosia purpurea</i> (L.) Pers.
<i>Vigna mungo</i> (L). Hepper
<i>Vigna radiata</i> (L). R. Wilczek
Gisekiaceae

<i>Gisekia pharnaceoides</i> L.
Lamiaceae
<i>Leucas aspera</i> Link
<i>Ocimum tenuiflorum</i> L.
Lythraceae
<i>Lawsonia inermis</i> L.
Malvaceae
<i>Abutilon indicum</i> (L.) Sweet
<i>Abelmoschus esculentus</i> (L) Moench
<i>Gossypium hirsutum</i>
<i>Hibiscus rosa-sinensis</i> L.
<i>Thespesia populnea</i> (L.) Correa
Meliaceae
<i>Azadirachta indica</i> A.Juss.
Moraceae
<i>Ficus benghalensis</i> L.
<i>Ficus religiosa</i> L.
Moringaceae
<i>Moringa pterygosperma</i> Gaertn.
<i>Moringa oleifera</i> L
Musaceae
<i>Musa paradisiaca</i> L.
Myrtaceae
<i>Psidium guajava</i> L.
<i>Syzygium cumini</i> (L.) Skeels
Nyctaginaceae
<i>Boerhavia diffusa</i> L.
<i>Boerhavia erecta</i> L.
<i>Bougainvillea spectabilis</i> Willd.
Oleaceae
<i>Jasminum grandiflorum</i> L
<i>Jasminum sambac</i> Ait
Passifloraceae
<i>Passiflora foetida</i> L
<i>Ziziphus jujuba</i> Lam.
Rosaceae
<i>Rosa indica</i> L.
Rutaceae
<i>Aegle marmelos</i> Correa
<i>Citrus aurantiifolia</i> (Christm.) Swingle
<i>Citrus medica</i> L.
<i>Murraya koenigii</i> Spreng.
Sapindaceae
<i>Cardiospermum halicacabum</i> L.
Sapotaceae
Kilamniaceae

<i>Manilkhara achras</i>
Solanaceae
<i>Capsicum annuum</i> (L)
<i>Lycopersicum esculentum</i> Mill
<i>Solanum melongena</i> (L)

LIST OF CULTIVATED CROPS :

1. *Cocos nucifera* - Coconut
2. *Canna indica* - Banana
3. *Phaseolus mungo* - Black gram

FAUNA:

INTRODUCTION:

Industrialization normally causes adverse impact on the biotic and abiotic factors of the environment. This is mainly because of the impact the industry causes on air, water and soil components of the environment. The magnitude of the impact depends primarily on the amount of dislocation / degradation of the land right from the construction phase of the project and the changes in land use pattern consequent to the establishment of the project. Intensity of the individual operations and the concentration of gaseous, liquid and solid emissions from the industries also affect the fauna in a significant manner. This will be reflected in the fauna content, distribution, proliferation etc. The response of plants to the changes in environment is not so quick as animals since they are highly eco-sensitive. The status of the fauna of the region will reveal the degree of such impact if any due to the industrial activity. In this perspective, the study / survey of the fauna within the core and buffer zones of the proposed VVM SEZ area was undertaken.

METHOD OF STUDY:

The entire core and buffer zone was divided into 1 km blocks for the convenience of field study. By proper field traverses and observations, the terrestrial, arboreal and avian fauna were recorded. Personal enquiries / discussion with local inhabitants, villagers, forest department officials, etc. were conducted to get a fair idea of the existing fauna and flora status of the study area.

CORE ZONE:

The core zone of VVM SEZ comprises some common birds like crow, sparrow and a few insects pertaining to the area.

BUFFER ZONE:

In the buffer zone domestic animals like cows, buffaloes, dogs, cats etc. are found. The detailed list of fauna found in this zone is given below.

The core and buffer zones do not contain any wild animals like elephants, tigers etc. This area neither contains any biosphere, national parks, sanctuaries etc. nor breeding grounds for migrating fauna. The nearest marine national park is more than 100 kms away from the core zone.

FAUNA STATUS IN THE BUFFER ZONE AREA:**LIST OF INVERTEBRATES AND VERTEBRATES:****List of butterflies**

S.No	Family	Zoological Name	Common Name
1	Nymphalidae	<i>Danaus chrysippus</i> (Linnaeus, 1758)	Plain tiger
2	„	<i>Ariadne merione</i> (Cramer,1777)	Common caster
3	„	<i>Junonia lemonias</i> (Linnaeus, 1758)	Lemon pancy
4	„	<i>Neptis hylas</i> (Linnaeus, 1758)	Common sailor
5	„	<i>Danaus genutia</i> (Cramer,1779)	Striped tiger
6	„	<i>Phalanta phalantha</i> (Drury,17	Common leopard
7	„	<i>Hypolimnas bolina</i> (Linnaeus, 1758)	Great egg fly
8	„	<i>Acraea terpsicore</i> (Linnaeus, 1758)	Tawny caster

9	„	<i>Ariadne ariadne</i> (Linnaeus 1763)	Angled castor
10	„	<i>Ariadne merione</i> (Cramer, 1777)	Common castor
11	„	<i>Hypolimnas misippus</i> (Linnaeus, 1764)	Danaid egg fly
12	„	<i>Hypolimnas bolina</i> (Linnaeus, 1758)	Great eggfly
13	„	<i>Junonia iphita</i> (Cramer, 1779)	Chocolate pancy
14	„	<i>Cirrochora thais</i> (Fabricius, 1787)	Tamil yeoman
15	„	<i>Euploea core</i> (Cramer, 1780)	Common crow
16	„	<i>Junonia hierta</i>	Yellow pancy
17	„	<i>Tirumala septentrionis</i> (Butler, 1874)	Dark blue tiger
18	„	<i>Tirumala limniace</i> (Cramer, 1775)	Blue tiger
19	„	<i>Melanitis leda</i> (Linnaeus, 1758)	Common evening brown
20	„	<i>Mycalesis perseus</i> (Fabricius 1775)	Common bush brown
21	„	<i>Ypthima ceylonica</i> (Hewitson, 1865)	White four ring
22	„	<i>Junonia oithya</i> (Linnaeus 1758)	Blue pancy
23	„	<i>Euthala nais</i> (Forrstar, 1771)	Baronet
24	„	<i>Mycalesis mineus</i>	Dark brand bush brown
25	„	<i>Argynnis hyperbius</i> (1763)	Indian fritillary
26	„	<i>Byblia ilithya</i> (Drury, 1773)	Joker
27	Pieridae	<i>Colotis danae</i> (Fabricius, 1775)	Crimson tip
28	„	<i>Colotis etrida</i> (Boistival, 1836)	Small orange tip
29	„	<i>Ixias</i> sp (Cramer, 1779)	White orange tip
30	„	<i>Hebomoia glacippe</i> (Linnaeus, 1758)	Great orange tip
31	„	<i>Belenosis aurota</i> (Fabricius, 1793)	Pioneer
32	„	<i>Ixias pyrene</i> (Linnaeus, 1764)	Yellow orange tip
33	„	<i>Eurema hecabe</i> (Linnaeus, 1758)	Common grass yellow
34	„	<i>Catopsilia pyranthe</i> (Linnaeus, 1758)	Mottled emigrant,
35	„	<i>Catopsilia 145omona</i> (Fabricius, 1775)	Common emigrant or lemon emigrant
36	„	<i>Delias eucharis</i> (Drury, 1773)	Common Jezebel
37	„	<i>Cepora nerissa</i> (Fabricius, 1775)	Common gull
38	„	<i>Leptosia nina</i> (Fabricius, 1793)	Psyche
39	„	<i>Belonosis aurota</i> (Fabricius, 1793)	Pioneer
40	„	<i>Colisa croceus</i> (Geoffroy, 1785)	Dark clouded yellow
41	Lycaenidae	<i>Castalius rosimon</i> (Fabricius, 1775)	Common pierrot
42	„	<i>Arhopala centaurus</i> (Fabricius, 1775)	Centauroak blue
43	„	<i>Spindasis vulcanus</i> (Fabricius, 1775)	Common silver line
44	„	<i>Euchrysops cnejus</i> (Fabricius, 1798)	Gram blue
45	„	<i>Jamides celeno</i> (Grammer, 1775)	Common cerulin
46	„	<i>Freyeria trochylus</i> (Freyer, 1845)	Grass jewel
47	„	<i>Tarucus plinius</i> (Fabricius, 1793)	Zebra blue
48	„	<i>Zizina otis</i> (Fabricius, 1787)	Lesser grass blue
49	„	<i>Zizeeria knysna</i> (Trimen, 1862)	Dark grass blue
50	„	<i>Chilades parrhasius</i> (Fabricius, 1793)	Indian cupid
51	Papilionidae	<i>Papilio polytes</i> (Linnaeus, 1758)	Common mormon
52	„	<i>Graphium agamemnon</i> (Linnaeus)	Tailed jay

		1758)	
53	„	<i>Atrophaneura</i> (<i>pachliopta</i>) <i>aristolochiae</i> (Linnaeus, 1758)	Common rose
54	„	<i>Atrophaneura</i> (<i>Pachliopta</i>) <i>hector</i> (Linnaeus, 1758)	Crimson rose
55	„	<i>Papilio demoleus</i>	Lime butterflies
56	Hesperiidae	<i>Borbo cinnara</i> (Wallace, 1866)	Rice swift
57	„	<i>Sarangesa purendra</i> (Moore, 1882)	Spotted small flat
58	„	<i>Spialia galba</i> (Fabricius, 1793)	Indian skipper
59	„	<i>Suastus gremius</i>	Indian palm bob

List of ant

S.No	Ants
1	<i>Componotus compressus</i> (Fabricius, 1787)
2	<i>Componotus rufogloucus</i> (Jerdon, 1851)
3	<i>Recophylla samaragdina</i> ((Fabricius, 1777)
4	<i>Myrmicaria brunnea</i> (Saunders, 1842)
5	<i>Diacamma rugosum rugosum</i> (Leguilou, 1842)
6	<i>Meranoplus bicolor</i> (Guerin- meneville, 1884)
7	<i>Pochycondyla tesseronoda</i> (Emery, 1877)
8	<i>Camponotus rufoglaucus</i> (Jerdon, 1851)
9	<i>Crematogastes subnuda</i> (Mayr, 1879)

List of birds

S.No	Family	Common name	Scientific name	Order
1	Podicipedidae	Little grebe	<i>Tachybaptus ruficollis</i>	Podicipediformes
2	Ardeidae	Cattle egret	<i>Bubulcus ibis</i>	Pelecaniformes
3		Little egret	<i>Egretta garzetta</i>	Pelecaniformes
4		Grey heron	<i>Ardea cinerea</i>	Pelecaniformes
5		Median egret	<i>Mesophoyx intermedia</i>	Pelecaniformes
6		Great egret	<i>Ardea alba</i>	Pelecaniformes
7		Grey heron	<i>Ardea cinerea</i>	Pelecaniformes
8		Indian pond heron	<i>Ardeola grayii</i>	Pelecaniformes
9		Purple heron	<i>Ardea purpurea</i>	Pelecaniformes
10		Black – crowned Night Heron	<i>Nycticorax nycticorax</i>	Pelecaniformes
11	Pelecanidae	Spot-billed pelican	<i>Pelecanus philippensis</i>	Pelecaniformes
12		Little cormorant	<i>Microcarbo niger</i>	Pelecaniformes
13		Indian shag	<i>Phalacrocorax fuscicollis</i>	Phalacriiformes

14	Anhingidae	Oriental darter	<i>Anhinga melanogaster</i>	Pelecaniformes
15	Ciconiidae	Painted stork	<i>Mycteria leucocephala</i>	Ciconiiformes
16		Asian-open billed stork	<i>Anastomus oscitans</i>	Ciconiiformes
17	Threskiornithidae	Indian black ibis	<i>Pseudibis papillosa</i>	Pelecaniformes
18		Black-headed ibis	<i>Threskiornis melanocephalus</i>	Pelecaniformes
19		Glossy ibis	<i>Plegadis falcinellus</i>	Ciconiiformes
20		Straw necked ibis	<i>Threskiornis spinicollis</i>	Ciconiiformes
21		Eurasian spoonbill	<i>Platalea leucorodia</i>	Pelecaniformes
22	Alcedinidae	Small blue kingfisher	<i>Alcedo atthis</i>	Coraciiformes
23		White-breasted kingfisher	<i>Halcyon smyrnensis</i>	Coraciiformes
24		Lesser pied kingfisher	<i>Ceryle rudis</i>	Coraciiformes
25	Anatidae	Indian spot billed duck	<i>Anas poecilorhyncha</i>	Anseriformes
26		Northern Pintail	<i>Anas acuta</i>	Anseriformes
27		Garganey	<i>Anas querquedula</i>	Anseriformes
28		Common Teal	<i>Anas crecca</i>	Anseriformes
29		Comb duck	<i>Sarkidiornis melanotos</i>	Anseriformes
30		Cotton pygmy-goose	<i>Nettapus coromandelianus</i>	Anseriformes
31	Accipitridae	Brahminy kite	<i>Haliastur indus</i>	Accipitriformes
32		Black kite	<i>Milvus migrans</i>	Accipitriformes
33		Black shouldered kite	<i>Elanus axillaris</i>	Accipitriformes
34		Shikra	<i>Accipiter badius</i>	Falconiformes
35		Common buzzard	<i>Buteo buteo</i>	Accipitriformes
36	Rallidae	White breasted waterhen	<i>Amaurornis phoenicurus</i>	Gruiformes
37		Purple swamphen	<i>Porphyrio porphyrio</i>	Gruiformes
38		Common coot	<i>Fulica atra</i>	Gruiformes
39		Purple moorhen	<i>Porphyrio porphyrio</i>	Gruiformes
40	Phasianidae	Jungle bush quail	<i>Perdica asiatica</i>	Galliformes
41		Indian peacock	<i>Pavo cristatus</i>	Galliformes
42		Grey francolin	<i>Francolinus pondicerianus</i>	Galliformes
43	Jacanida	Pheasant-tailed jacana	<i>Hydrophasianus chirurgus</i>	Charadriiformes
44		Bronze-winged jacana	<i>Metopidius indicus</i>	Charadriiformes
45	Charadriidae	Red-wattled	<i>Vanellus indicus</i>	Charadriiformes

		lapwing		
46		Yellow-wattled labwing	<i>Vanellus malabaricus</i>	Charadriiformes
47		Little ringed plover	<i>Charadrius dubius</i>	Charadriiformes
48		Lesser sand plover	<i>Charadrius mongolus</i>	Charadriiformes
49		greater sand plover	<i>Charadrius leschenaultii</i>	Charadriiformes
50	Scolopacidae	Common sandpiper	<i>Actitis hypoleucos</i>	Charadriiformes
51		Common greenshank	<i>Actitis hypoleucos</i>	Charadriiformes
52	Recurvirostridae	Black-winged stilt	<i>Himantopus himantopus</i>	Charadriiformes
53	Burhinidae	Stone curlew	<i>Burhinus oedicephalus</i>	Charadriiformes
54	Laridae	Tern	<i>Actitis hypoleucos</i>	Charadriiformes
55		Common Tern	<i>Sterna hirundo</i>	Charadriiformes
56	Columbidae	Spotted dove	<i>Streptopelia chinensis</i>	Columbiformes
57		Eurasian collared dove	<i>Streptopelia decaocto</i>	Columbiformes
58		Rock pigeon	<i>Columba livia</i>	Columbiformes
59		Little brown dove	<i>Streptopelia senegalensis</i>	Columbiformes
60	Nectariniidae	Purple-rumped Sunbird	<i>Nectarinia zeylonica</i>	Passeriformes
61		Purple- Sunbird	<i>Cinnyris asiaticus</i>	Passeriformes
62		Small sunbird	<i>Leptocoma minima</i>	Passeriformes
63	Cuculidae	Asian Koel	<i>Eudynamis scolopaceus</i>	Cuculiformes
64		Pied Cuckoo	<i>Clamator jacobinus</i>	Cuculiformes
65		Indian roller	<i>Coracias benghalensis</i>	Cuculiformes
66		Blue faced Malhoha	<i>Phaenicophaeus viridirostris</i>	Cuculiformes
67		Common hawk- cuckoo	<i>Hieroccyx varius</i>	Cuculiformes
68		Common cuckoo	<i>Cuculus canorus</i>	Cuculiformes
69		Indian cuckoo	<i>Calculus micropterus</i>	Cuculiformes
70		Greater coucal	<i>Centropus sinensis</i>	Cuculiformes
71		Brain fever bird	<i>Hierococcyx varius</i>	Cuculiformes
72	Motacillidae	Large pied wagtail	<i>Motacilla maderaspatensis</i>	Passeriformes
73		Forest wagtail	<i>Dendronanthus indicus</i>	Passeriformes
74		Grey Wagtail	<i>Motacilla cinerea</i>	Passeriformes
75		Yellow wagtail	<i>Motacilla flava</i>	Passeriformes
76		Paddyfield wagtail	<i>Anthus rufulus</i>	Passeriformes
77	Estrildidae	Black headed munia	<i>lonchura atricapilla</i>	Passeriformes
78		Spotted Munia	<i>lonchura punctulata</i>	Passeriformes

79		White- throated Munia	<i>Lonchura malabarica</i>	Passeriformes
80		White- rumped Munia	<i>Lonchura striata</i>	Passeriformes
81	Passeridae	House sparrow	<i>Passer domesticus</i>	Passeriformes
82		Baya weaver bird	<i>Ploceus philippinus</i>	Passeriformes
83	Sturnidae	Common myna	<i>Acridotheres tristis</i>	Passeriformes
84		Jungle myna	<i>Acridotheres fuscus</i>	Passeriformes
85		brahmny myna	<i>Sturnus pagodarum</i>	Passeriformes
86	Pycnonotidae	Red – whiskered bulbul	<i>Pycnonotus jocosus</i>	Passeriformes
87		Red – ventrd bulbul	<i>Pycnonotus cafer</i>	Passeriformes
88	Meropidae	Green bee eater	<i>Merops orientalis</i>	Coraciiformes
89		Blue – tailed bee eater	<i>Merops philippinus</i>	Coraciiformes
90	Muscicapidae	Indian robin	<i>Saxicoloides fulicata</i>	Passeriformes
91		Oriental magpie- robin	<i>Copsychus saularis</i>	Passeriformes
92		Common tailorbird	<i>Orthotomus sutorius</i>	Passeriformes
93		Asian paradise- flycatcher	<i>Terpsiphone paradisi</i>	Passeriformes
94	Psittacidae	Rose ringed parakeet	<i>Psittacula krameri</i>	Psittaciformes
95	Alaudidae	Red winged bushlark	<i>Mirafra erythroptera</i>	Passeriformes
96		Indian small skylark	<i>Alauda gulgula</i>	Passeriformes
97	Oriolidae	Eurasian Golden oriole	<i>Oriolus oriolus</i>	Passeriformes
98	Upupidae	Common hoopoe	<i>Upupa epops</i>	Coraciiformes
99	Apodidae	House swift	<i>Apus affinis</i>	Apodiformes
100		Asian palm swift	<i>Cypsiurus balasiensis</i>	Apodiformes
101	Picidae	Black- rumped flameback	<i>Dinopium benghalense</i>	Piciformes
102	Pittidae	Indian pitta	<i>Pitta brachyura</i>	Passeriformes
103	Capitonidae	Copperamith	<i>Magalaima viridis</i>	Piciformes
104	Hirundinidae	Common swallow	<i>Hirundo rustica</i>	Passeriformes
105	Timaliidae	Yellow billed babbler	<i>Turdoides caudatus</i>	Passeriformes
106	Strigidae	Spotted owlet	<i>Athene brama</i>	Strigiformes
107	Irenidae	Common lora	<i>Aegithina tiphia</i>	Passeriformes
108	Acrocephalidae	Indian great reed warbler	<i>Acrocephalus orientalis</i>	Passeriformes
109	Corvidae	Rufous treepie	<i>Dendrocitta vagabunda</i>	Passeriformes

110		White- bellied treepie	<i>Dendrocitta leucogastra</i>	Passeriformes
111		House crow	<i>Corvus splendens</i>	Passeriformes
112		Jungle crow	<i>Corvus macrorhynchos</i>	Passeriformes
113		Black drongo	<i>Dicrurus macrocercus</i>	Passeriformes

List of earthworms

S.No	Scientific name
1	<i>Lampito maruitii</i>
2	<i>Eudrilus eugeniae</i>
3	<i>Eisenia foetida</i>
4	<i>Perionyx excavates</i>
5	Octochaetona sp
6	Lampito sp
7	<i>Pontascolex corethrutus</i>

List of reptiles

S.No	Common Name	Scientific Name	Order	Family
1	Garden lizard	<i>Calotes versicolor</i>	Squamata	Agrimidae
2	Fan throated lizard	<i>Sitana ponticeriana</i>	Squamata	Scincidae
3	Common skink	<i>Eutropis macularia</i>	Bronze Grass Skink	Scincidae
4	Snake-eyed lizard	<i>Ophisops leschenaultii</i>		
5	Russels's Viper	<i>Daboia Russelii daboia russ</i>	Squamata	Viperidae
6	Monitor lizard	<i>Varanus sp</i>	Squamata	Varanidae
7	Green vine or long nosed whip Snake	<i>Ahaetulla nasuta</i>	Squamata	Colubridae
8	Indian red snake	<i>Ptyas mucosus</i>		
9	Bark gecko	<i>Hemidactylus leschenaultia</i>		
10	Indian cobra	<i>Naja naja</i>	Squamata	Elopidae
11	Ant eater	-	-	-

List of Mammal

S.No	Order	Family	Scientific Name	Common Name
1	Sciuridae		<i>Funambulus palmarum</i>	Squirrels
2	Muridae		<i>Rattus sp</i>	Rat
3			<i>Rattus norvegicus</i>	Rat

4	Herpestidae		<i>Herpestes edwardsii</i>	Grey Mongoose
8	Chiroptera	Pteropodidae	<i>Cynopterus sphinx</i>	Short nosed fruit bat
9			<i>Rousettus leschenaulti</i>	Fulvous fruit bat
10			<i>Pteropus giganteus</i>	Indian flying fox
11			<i>Rhinopoma hardwickii</i>	Small mouse- tailed bat
12			<i>Taphozous melanopogan</i>	Black-bearded sheath-tailed bat
13			<i>Taphozous nudiventris</i>	Naked -rumped tomb bat
14			<i>Megaderma lyra</i>	Indian false vampire bat
15			<i>Hipposideros ater</i>	Dusky leaf- nosed bat
16			<i>Hipposideros fulvus</i>	Fulvous leaf nosed bat
17	Leporidae		<i>Lepus timidus</i>	Hare

Marine Ecology

As part of the marine ecological studies, studies were carried out in the sea both in the littoral and sub littoral zone of the proposed sea Port. Phytoplankton, Zooplankton, Primary productivity, Benthic organisms and Nekton studies were carried out. The methodology of the study is as follows

I. PLANKTON STUDIES

Qualitative and quantitative estimation of Phytoplankton

A known volume of sea water was filtered through phytoplankton net made of ultra fine cloth (0.1mm mesh size). Immediately after filtration, the filtered samples were fixed in 5% formalin. In the laboratory, the samples were allowed to stand in a measuring cylinder until all the materials settled to the bottom. The supernatant was siphoned out and the filtrate was reduced to a known volume. From this, sub samples were made (1 ml each) and they were placed in a Haemocytometer. The phytoplankton were counted numerically with the help of compound microscope at a magnification of 400x. Phytoplankton density was expressed in numbers per litre. For qualitative estimation of phytoplankton, the

plankton net was towed behind the boat at selected locations in the sea and the sample filtered was used.

Qualitative and quantitative estimation of zooplankton

Zooplankton samples were collected from selected stations using a zooplankton net having mesh size 0.3 mm. The net was towed behind the boat and the samples were transferred to a plastic container and were fixed in 5% formalin. In the laboratory the total volume of zooplankton was determined by settlement volume method. The zooplankton aliquots were pipetted out in to a Bogorov counting tray and counted numerically with a help of a binocular compound microscope at a magnification of 400x. Three aliquots in the replicates were examined and the final numerical estimates made following Wickstead (1974) and expressed as number/m³.

II PRIMARY PRODUCTIVITY STUDIES

Primary productivity in the sea was estimated following Light and Dark bottle method of Strickland and Parson (1972). To start with, oxygen content was estimated following Winkler's method. Then by using Photosynthetic Quotient (PQ) values, it was converted into carbon values.

III BENTHIC STUDIES

Benthic samples were collected from the littoral and sub littoral zones using a hand operated Petersen Grab and also with the help of scuba divers. The bottom sediments were washed with sea water. Sieves of different mesh size (0.1 – 2.0 μ) were used for separating benthic organisms from the substratum and the residue was fixed in 5% formalin and the samples were brought to the laboratory. In the laboratory the samples were rewashed and preserved in spirit. Then the samples were stained with Rose Bengal and the fauna was separated with the help of a binocular microscope and identified.

IV NEKTON STUDIES

Information about the availability of major species of fin fishes and shell fishes were collected from direct observation. Some information was collected from the fisherman engaged in fishing in the area, published accounts and also from scuba divers who made in – situ observations.

FLORA AND FAUNA OF THE STUDY AREA

Phytoplankton

In the proposed study area 24 genera of Phytoplankton from 15 families were recorded. Among these, genera like *Biddulphia*, *Lithodesmium* from the family Biddulphiaceae and *Peridinium* and *Ceratium* from family Dinophyceae, Genus *Trichodesmium* from Oscillatoriaceae, Genus *Pleurosigma* from Achnathaceae, *Leptocylindrus* from Leptocylindraceae, *Tintinnopsis* from Tintinnididae, *Epitocyllis* from Plyphocyladeae and *Chaetoceros* from Caetoceraceae, the genus *Hyalodiscus* from the family Melosiraceae, *Stephanophysis* belonging to the family Skeletonemaceae were uniformly present in the littoral and sub littoral area. Genus like *Thalassiosira* from Thalassiosiraceae, *Coscinodiscus*, *Planktoniella* and *Asteromphalus* from Coscinodiscaceae, *Bacteriastrum* from Bacteriastraceae, *Vitzschia* from Biddulphiaceae, *Fragilaria* and *Thalassiothrix* from Fragilariaceae, *Cocconeis* from Achnathaceae and *Rhizosolenia* from Rhizosoleniaceae were also present in less numbers in the sampled zones.

In the sea side transects, the density of phytoplankton was more in the littoral zones than in the sub littoral zones.

Table 3.19 Average Phytoplankton density (nos.x10³)

Sl.No	Family	Genus	Average Density	
			Littoral Zone	Sub Littoral Zone
1.	Melosiraceae	<i>Hyalodiscus</i>	20±0.4	10±0.25

2.	Skeletonemaceae	<i>Stephanophysis</i>	10±0.2	10±0.2
3.	Leptocylindraceae	<i>Leptocylindrus</i>	250±4.5	152±5.2
4.	Thalassiosiraceae	<i>Thalassiosira</i>	200±4.3	10±0.2
5.	Coscinodiscaceae	<i>Coscinodiscus</i>	160±3.0	140±3.0
		<i>Planktoniella</i>	80±1.7	40±0.8
		<i>Asteromphalus</i>	20±0.6	8±0.2
6.	Bacteriastreae	<i>Bacteriastrea</i>	80±1.4	10±0.2
7.	Chaetoceraeae	<i>Chaetoceros</i>	250±5.5	160±4.1
8.	Biddulphiaceae	<i>Nitzschia</i>	40±1.2	10±0.2
		<i>Biddulphia</i>	1080±19.1	760±16.1
		<i>Triceratium</i>	440±8.3	160±3.4
		<i>Lithodesmium</i>	1300±28.1	2060±52.7
9.	Acanthaceae	<i>Cocconeis</i>	120±2.1	80±1.7
		<i>Pleurosigma</i>	300±6.5	160±3.0
10.	Fragilariaceae	<i>Fragilaria</i>	40±0.8	-
		<i>Thalassiothrix</i>	80±1.4	360±7.6
11.	Oscillatoriaceae	<i>Trichodesmium</i>	320±6.9	20±0.5
12.	Dinophyceae	<i>Peridinium</i>	440±9.5	220±5.5
		<i>Ceratium</i>	1780±33.4	920±19.9
13.	Tintinnididae	<i>Tintinnopsis</i>	160±2.9	240±5.1
14.	Plychocylade	<i>Epitocyliis</i>	480±15.5	141±3.5
15.	Rhizosoleniaceae	<i>Rhizosolenia</i>	180±3.2	40±0.7

Zooplankton

In the study area, a total of 24 species of zooplankton were recorded. Of these copepods were the dominant group. Next to this Decapods, Polychaetes and Chaetognaths were found abundantly. Amphipods, Ostracods, Lucifer, fish eggs and larvae. Appendicularia larvae, Cladocerans, Veliger larvae, Ctenophore, Comanthus, Obelia sp., Mysis, Isopods, Trochophore larvae, Stomatopods, Bipinnaria larvae of Echinoderm and Doliolum were also present but in lesser numbers. The population details and distribution of zooplankton are given in Table 3.20.

Table 3.20 Zooplankton Abundance (nos./m³)

Sl.No	Species	Average Density	
		Littoral Zone	Sub Littoral Zone
1.	Copepods	45.0±18.7	46.0±20.08
2.	Decapod larvae	18.0±7.5	18.5±8.08
3.	Amphipoda	5.0±2.07	4.6±2.01
4.	Ostracoda	15.0±6.2	9.0±3.93
5.	Lucifer	4.3±2.0	4.6±2.5
6.	Polychaeta	17.2±7.2	14.0±6.11
7.	Fish eggs	7.5±3.1	4.6±2.01
8.	Fish larvae	2.5±1.03	14.0±6.11
9.	Chaetognatha	20.0±8.3	18.5±8.08
10.	Appendicularia	15.0±6.2	14.0±6.11
11.	Cladocera	2.5±1.03	4.6±2.01

12.	Veliger Larvae	10.3±4.3	9.0±3.93
13.	Ctenophora	2.5±1.03	9.0±3.93
14.	Comanthus	-	4.6±2.01
15.	Obelia	10.0±4.15	9.0±3.93
16.	Mysis	7.6±3.15	-
17.	Isopoda	7.5±3.1	-
18.	Trochophore larvae	10.0±4.15	9.0±3.93
19.	Stomatopoda	5.0±2.07	5.0±2.18
20.	Bipinnaria larvae	17.6±7.3	9.0±3.93
21.	Doliolum	7.5±3.1	4.5±1.97
22.	Sipnonophora	10.0±4.15	9.0±3.93
23.	Acetes larvae	5.0±2.07	4.5±1.97
24.	Tintinnids	-	4.0±1.75

Primary Productivity

Irrespective of the sampling area the Net Primary Productivity (NPP) in the littoral zone was higher than the values recorded for sub littoral zones. The highest NPP in the study area in littoral zone was 2.04g/m³/day and in the sub littoral zone was 1.5 g/m³

Nekton

A total of 18 species of nektons were observed. Species like Anchovies, Carangids, Silver Bellies, Mackerels, Oil Sardine, Lesser Sardine,

Ophisthopterus sp., Barracuda, squid, crab, *Portunus sp.*, Mullet, *Secuter sp.*, and Ribbon fish, were observed in all the sampling zones. Other species with restricted distribution in the area were *Parapenaeopsis stylifera*, Catfish, Penaeid shrimps, Lutjanus, cuttlr fidh youg ones, star fish, string ray and *Anandontostoma sps.*

There are no turtle nesting beaches any where in the study area.



ENVIRONMENT IMPACT ASSESSMENT

CHAPTER – IV

ENVIRONMENT IMPACT ASSESSMENT

IMPACT IDENTIFICATION

The potential impacts on the environment from the development of VVM SEZ have been identified considering the nature and extent of the activities associated with the project implementation and operation as well as the present scenario of the environmental quality at the project site.

Impact prediction is an important component in Environmental Impact Assessment process. Several techniques and methodologies are in vogue for impact prediction on physical, biological and socio-economic components of environment.

Component wise identification of qualitative and also semi quantitative impacts of the activities in the proposed project have been carried out. A simplex Matrix method has been used to predict impacts of construction and operation phases of the project. Impacts are categorized as positive and negative in nature as also long term and short terms on a time scale.

The impacts are predicted with respect to receptor locations like villages (habitat), ecologically sensitive areas, etc. The contribution of proposed Heavy mineral processing Plants for Processing heavy Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals cracking of monazite and production of Rare Earth Oxide, solvent extraction, magnets, Titanium Pigments, Synthetic Rutile, Slag, Scandinium etc., Sea Port, wind turbine and solar power plants, industries and social infrastructures are exhibited in the baseline environmental status presented in earlier chapter.

The proposed Product specific (Mineral based) Industrial activity would have short term impacts on varying environmental attributes such as air quality, water resources, solid waste generation, etc.,

The material handling, storage, movement of cargo and ship repairing yard, desalination Plant, have also been reflected in the baseline environmental quality.

Operations of port and associated utilities and Heavy mineral Processing plant will adopt Hi tech pollution abating preventive measures and maintain the environmental quality well within the prevailing national standards.

IMPACT PREDICTION AND ASSESSMENT DURING CONSTRUCTION PHASE

The construction phase of proposed VVM SEZ for Processing of heavy Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals cracking of monazite and production of Rare Earth Oxide, solvent extraction, magnets, Titanium Pigments, Synthetic Rutile, Slag, Scandinium etc., Sea Port development, wind turbine and solar power plant shall be done phase-wise into stages., depending upon the industrial and other development in the SEZ. This phase generally involves activities like

- Construction facilities for Processing of heavy Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals cracking of monazite and production of Rare Earth Oxide, solvent extraction, magnets, Titanium Pigments, Synthetic Rutile, Slag, Scandinium etc in stage by stage.
- Construction of Power plant (wind turbine power, solar power altogether of 450 MW into stages).

- Sea Port and other related buildings for handling 4.5 million TPA cargo
- Repairing of ship facilities
- Construction of desalination Plant.
- Construction of Transport Vehicle shed and workshop
- Fabrication workshop and maintenance workshop and industrial library
Workers rest shed, canteen, dining hall, First aid Centre, smoking zone
Statutory amenities buildings and play grounds
- Installation of water supply and sanitation and sewage systems
- Power Distribution System
- Telecom facilities
- Construction of factory buildings and warehouses
- Erection of civil structures, erection of new equipment and machinery,
green belt development etc.

The construction phase would bring in immediate but short term changes on various components of environment near the proposed site. The likely changes on starting the constructional activity would be in the following areas :

During this phase the following activities are considered significant.

- Material loading and unloading and storage
- Dust / Particulate Emission
- Equipment Operation
- Gaseous emissions
- Solid Waste Generation
- Green Belt Development

The impact prediction studies involves both marine and terrestrial environment.

MARINE ENVIRONMENT IMPACT PREDICTION

Construction Phase

Marine environmental impacts during the construction phase of the VVM captive sea port that would cater for raw materials and products may arise due to the following development operations:

- a) Mobilization and de-mobilization of construction equipment
- b) Dredging
- c) Reclamation
- d) Construction of breakwater
- e) Driving of piles
- f) Other miscellaneous activities such as mooring for navigational buoys, dumping of left over spoil, non-removal of discarded construction materials, etc.

The impact may potentially manifest in the form of

- (i) changes in physical processes (bathymetry, circulation pattern, littoral transport as well as accretional and erosional trends),
- (ii) deterioration in water quality and sediment texture,
- (iii) destruction of biotic communities of localized subtidal and intertidal areas,
- (iv) increase in noise level, and
- (v) reduction in aesthetic quality.
- (vi)

Environmental considerations have become a major significance to dredging and associated works. Generally, the environmental concerns associated with dredging are

- i) potential water column effects associated with the re-suspension of sediments during dredging and

- ii) potential benthic effects due to sedimentation of the re-suspended material.

The main areas of influence include:

1. Release of contaminants
2. Physical disturbance
3. Depleted oxygen supplies
4. Spillage
5. Increased water turbidity and
6. Blanket cover to sea bed

Construction of dykes to regulate the flow of material has been proposed by VVM SEZ at the reclamation area. The material to be pumped will be mostly comprises coarse to medium sand with less quantity of silt. The silty clay material if used for the reclamation, the back wash containing clay will pose threat to the environment.

Physical Processes

Dredging and marine constructions are unlikely to result in gross changes in tide levels, current speeds and circulation pattern in the nearshore region (open ocean). Deepening of the channels for providing new openings can increase the current speeds in the interior segments due to increase in volume of water entering these inlets during flood tide. This may result in increase in erosion of inner bank segments destabilizing the nearshore vegetation. The numerical study shows that the flow velocity reduces after deepening of the harbour basin. The flow velocity north of the north breakwater also reduces from 0.3 m/s to 0.2 m/s. The reduction in velocity is only around the proposed structures. Dredging and construction of breakwater alter the sediment budget, sediment supply to the shoreline and topographic changes.

Water Quality

Primary Water Quality Criteria: The primary water quality criteria for marine coastal waters developed by the Central Pollution Control Board and used for the use classes under classification scheme based on designated-best uses are given below as Table 4.1. Since the developmental activities envisaged here are mainly port facilities, primary water quality criteria for SW IV water (for harbour waters) are taken into account in the present study.

Table 4.1 Primary water quality criteria for Class SW-IV waters

S.No	Parameter	Criteria	Remark
1	pH range	6.5 - 9.0	To minimise corrosive and scaling effect.
2	Dissolved Oxygen	3 mg/l or 40% saturation value, whichever is higher	Considering bio-degradation of oil and inhibition to oxygen production through photosynthesis
3	Colour and Odour	No visible colour or Offensive odour	None from reactive chemicals which may corrode paints / metallic surfaces.
4	Floating materials, oil and grease and scum (including Petroleum Products)	10 mg/l	Floating matter should be free from excessive living organism which may clog or coat operative parts of marine vessels / equipment.
5	Faecal Coliform	1000/100 ml (MPN)	Not exceeding 2000/100 ml in 20 percent of samples in the year and in 3 consecutive samples in monsoon months.
6	Biochemical Oxygen	5mg/l	To maintain water relatively

	Demand (5 days at 200C)		free from pollution caused by sewage and other decomposable wastes.
--	-------------------------	--	---

The observed concentrations of some of the primary water quality criteria for class IV waters (Harbour waters) during the observation period are compared with the limits prescribed by the CPCB and are given in Table 4.2. An examination of the above analysis indicates that the concentrations of those parameters were found to be within the prescribed limits and the water quality conditions do not pose any threat to the area under investigation.

Table 4.2 Primary water quality criteria for Class SW-IV waters and observed Concentrations

Characteristics	CPCB	Observed
pH	6.5 -9.0	7.9-8.3
Dissolved oxygen	3.0 mg/l	4.85-6.17 mg/l
BOD ₅	5.0 mg/l	0.10-5.86 mg/l
Petroleum hydrocarbons	10.0 mg/l	BDL – 0.52 mg/l

Localized and temporary deterioration in water supply of near shore waters result due to dispersal of sediment during dredging, pile driving operations, point discharges from shore based settlements of work force and waste from barges and other construction machinery. Increased turbidity may result from disturbance and turbulence in the area of drag head, cutter head, bucket or blade. Subject to appropriate constraints these are generally not considered as serious problems.

Turbidity may also be caused by water draining from hoppers, containment areas

or reclamation sites. This may be more serious but is easily can be controlled. The sub-bottom strata in the project area consists of sand and silty sand. These sediments would generate fine suspended load when disturbed and may remain in suspension for a prolonged period under the influence of strong currents. This would be particularly significant during capital dredging operations.

There will not be much overflow from the reclamation area to the coastal waters, as the areas to be reclaimed will be surrounded by primary retaining bunds and are within the breakwaters. These bunds will have some dewatering sluices to enable return water (with the finer particles of the dredged soil) to return to the sea. The surface of the fill will be crowned and slope for drainage. All surface water will be collected and routed down the fill face in a manner that erosion of the reclamation fill be controlled and routed to appropriate drainage disposal points.

The discharges from ships and shore based sources if unchecked could introduce pathogens, BOD, Petroleum Hydro Carbon etc. to the coastal water which may degrade the water quality locally.

An overall assessment indicates that the water quality particularly in terms of an increase in turbidity and to a lesser extend with respect to pathogens, BOD, nutrients etc. would be influenced marginally and these perturbations would level out in due course termination of the construction phase. Hence, long term impact of construction activities on water quality of the project area is unlikely.

Sediment quality

The impact of construction activity on the sub tidal as well as intertidal sediment quality would be largely confined to the changes in the sediment texture. A considerable fraction of the fine grained excavated during dredging would not be

recovered. This sediment would be re-distributed over sub tidal and inter-tidal areas, which could alter the existing sediment texture particularly in regions prone to preferential deposition. The textural change however would be minor since most of the seabed sediments collected in the study area was mostly sandy. The concentrations of the trace metals in the sediments were within the threshold limits and no contamination was noticed in the bed sediments due to nearshore activities. The release of the domestic waste from land establishments of work force etc. can locally degrade the intertidal sediments by increasing BOD and population of pathogens. The impact however, would be minor and temporary and recovery would be quick when the sources of these wastes are terminated at the end of the construction phase.

Flora and fauna

The study area sustains fairly moderate biological productivity in terms of phytoplankton, zooplankton and benthos. The project activities will have effect on marine ecology during different phases of operation. During the construction phase the dredging will cause the destruction of the habitat at places in the harbour and nearshore regions. This will have both direct and indirect effect. Direct effect of this activity be seen in the death of fragile benthic organisms and the indirect effect will be in the form of changes in the circulation pattern and increase in suspended solid. Being a one time operation, any long term adverse impact is not envisaged. But bottom communities in the immediate periphery of activities will be disturbed/lost temporarily. The bottom communities along the north breakwater, south breakwater and in the harbour area will be disturbed during construction of port facilities. Bottom communities are expected to recolonise once the construction activities are completed.

Hectic construction activities in the intertidal and the subtidal areas would influence the local ecology. Negative impacts on intertidal and subtidal biota of degraded areas would be severe in this ecologically diverse habitat. The danger

of biota getting exposed to pollutants released from sediment pore water when the bed is disturbed is minimal since the sediments are free from gross contamination.

Phytoplankton: The damage to phytoplankton due to increase in turbidity would be minor, localized, temporary and reversible with the phytoplankton community structure recovering fully once the construction is completed. The increase in the concentration of oil and grease will lead to mortality of phytoplankton and zooplankton.

Zooplankton: The increase in suspended load may reduce the penetration of sunlight and affect photosynthetic activity. The low primary production will have effect on second trophic levels of zooplankton and benthos. A temporary and minor reduction in phytoplankton standing stock and an increase in turbidity is unlikely to produce measurable impact on zooplankton, although a localised and marginal change in community structure and population alterations may result.

Operational Phase

Environmental impact from vessels and ship traffic

During the operational phase there will be additional activities such as discharge of petroleum hydrocarbon and ship movement in the region. All these activities will directly or indirectly affect the life in the region including fish and fisheries.

Possible impacts on the environmental resources due to ship traffic are:

- Oil pollution from ship accidents.
- Ballast water.
- Illegal tank-washing.
- Ship grounding, physical damage of bottom community.

- Anchoring.
- Discharge of sewage from vessels.
- Discharge of solid waste.

Ship traffic poses a risk of oil pollution from the following sources:

- Small spills caused by the accidental or intentional release of oilcontaminated bilge or ballast-water from freighters.
- Minor spills caused by the release of bunker oil during terminal operations .
- Major spills caused by the rupture of a bunker oil tank in a bulk/cargo vessel
Collision, shipwreck of a bulk/cargo vessel

Marine environmental implications during routine operations at the port could be due to the following cases.

- a) Escapement of cargo during loading/unloading operations.
- b) Release of wastes generated from the ships including garbage, solid wastes, oily ballast and bilge water as well as sewage.

Chronic releases of such wastes in confined waters would lead to deterioration of the environmental quality. The cumulative effect of such perturbations may lead to modified ecosystems with the elimination of sensitive organisms and proliferation of a few opportunistic hardy species.

Marine Oil Spills

The various operations at port that can lead to the oil spill in sea are given below:

- Unloading of oil at jetty
- Discharging of oil through pipeline to oil storage facility
- Tanker accidents

Oil spill may vary from a small quantity from accidental spill to several thousands

of tonnes of oil during unexpected situations. However, it is required to have a fair understanding of the risks and probability of spills arising out of its operations and their consequences due to movement and landing along the coast. The extent of damage caused by an oil spill depends upon the quantity of oil spilled, type of oil involved in the spillage and the oceanographic and meteorological conditions prevailing in the location where the spill has occurred. When the oil spills in large quantity, it temporarily affects the air-sea interaction, thus preventing the entry of oxygen from the atmosphere. The first sets of organisms affected are the primary producers like phytoplankton, which are the basis of the marine food chain. The other free-swimming organisms such as fish larvae and fish also get affected. Further, when the oil sinks during the course of time, it affects the benthic organisms such as clams and mussels. The other amenities that are affected include mangrove forests and coral reefs.

Oil spills can also have a serious economic impact on coastal activities and resources of the sea. In most cases, such damage is temporary and is caused primarily by the physical properties of oil creating nuisance and hazardous conditions. The impact on marine life is compounded by toxicity and tainting effects resulting from the chemical composition of oil, as well as by the diversity and variability of biological systems and their sensitivity to oil pollution.

When oil is spilled at sea, it undergoes a number of physical and chemical changes, some of which lead to its disappearance from the sea surface, whilst others cause it to persist. Although spilt oil is eventually assimilated by the marine environment, the time involved depends upon such factors as the amount of oil spilled; its initial physical and chemical characteristics; the prevailing climatic and sea conditions and whether the oil remains at sea or is washed ashore.

A knowledge of the process involved, and how they interact to alter the nature and composition of the oil with time is valuable in preparing and implementing

contingency plan for oil spill response. On occasions, it may prove unnecessary to mount a clean-up response if it can be confidently predicted that the oil will drift away from vulnerable resources or dissipate naturally before reaching them.

Often, however, an active response will be necessary, aimed either at accelerating the natural processes through the use of dispersants or limiting spreading by means of containment methods.

Risk of Ship Accidents

Ship collision, ship grounding, onboard fire, explosion etc. often lead to bulk releases of cargo and occasionally fuel, to the marine environment. The first two are relatively more frequent and invariably result from out of control ship movements. But the accidents involving ships are rare.

Bulk release of cargo can also result if a ship ground rupturing cargo holds. Channel length and its width are major factors controlling grounding. The ships are vulnerable to grounding in long and narrow channels particularly those, which have several bends. There are no sharp turns in the proposed navigational channel and hence the probability of grounding is less.

Extreme Events

Cyclones are associated with high-pressure gradients and consequent strong winds. These, in turn, generate storm surges. A storm surge is an abnormal rise of sea level near the coast caused by severe tropical cyclone; as a result, sea water inundates low lying areas of coastal regions, drowning human beings and live-stock, eroding beaches and embankments, destroying vegetation and reducing soil fertility. Wave action will be severe, causing damage to marine structures. Since the breakwater is a flexible structure, after the storm, the maintenance can be carried out.

Very strong winds may damage installations, dwellings, communication systems, resulting in loss of life and property. Heavy and prolonged rains due to cyclones may cause river floods and submergence of low-lying areas causing loss of life and property. Floods and coastal inundation due to storm surges pollute drinking water sources causing outbreak of epidemics.

IMPACT ON TERRESTRIAL ENVIRONMENT

Impacts during Construction Phase

During construction phase the activities related to land de-weeding, leveling of site and construction of related structures and installation of related equipment will have a slight impact on the environment.

Impact on Topography and Land Use

The topography within the project site is almost level with the grade level varying between -0.4-m to +0.4-m w.r.t. the MSL. The proposed plant area will be suitably elevated (from +1.5-m to 2.5-m above MSL) using the dredged material from port. Therefore, no major change in topography of the site is envisaged due to proposed plant erection.

The present land-use of the project site is waste land which would get transformed to industrial land after the project execution. The project land is own patta land of the developers which is contiguous and free from all encroachment in and around the proposed SEZ area. Apart from the change in land use pattern within the project site there will not be any adverse impact on the surrounding land use during the construction period.

Impact on Soil

The construction activities will result in loss of topsoil to some extent in the plant area. It is proposed to construct line drains for storm water to minimize the soil erosion. Apart from localized construction impacts at the plant site, no adverse impacts on soil in the surrounding area are anticipated.

Impact on Air Quality

The impact will be for short duration and confined within the project boundary and is expected to be negligible outside the plant boundaries. The impact will, however, be reversible, marginal and temporary in nature. Proper maintenance of vehicles and construction equipment will help in controlling the gaseous emissions. Water sprinkling on roads and construction site will prevent fugitive dust.

Impact on Water Quality

The construction will be more related to mechanical fabrication, assembly and erection; hence the water requirements would be meager. Temporary sanitation facilities (septic tanks and soak pits) will be set-up for disposal of sanitary sewage generated by the work force like drivers etc. The overall impact on water environment during construction phase due to proposed project is likely to be short term and insignificant.

Impact on Noise Levels

The noise generation during construction phase will be temporary and will be restricted mostly to daytime. The noise control measures during construction phase include provision of acoustic enclosures around the equipment and regular maintenance of the equipment.

Impact on Terrestrial Ecology

The initial construction works at the project site involves land clearance. Greenbelt will be developed during construction to improve the aesthetic value in the area and to screen out the fugitive dust generated during construction. The removal of vegetation from the soil and loosening of the topsoil generally causes soil erosion. However, such impacts will be confined to the project site and will be minimized through paving and water sprinkling.

Impacts during Operational Phase

Impact on Land Use

The present land use of the area falls under waste land category, which would get converted to industrial category after the project execution. Hence, there is no impact on land use due to the proposed project during the operational phase.

Impact on Soil

Most of the impacts of Heavy mineral processing plant project on soils are restricted to the construction phase, which will get stabilized during operational phase. The impact on the topsoil will be confined to the proposed main plant area. The air borne fugitive dust from the plant is likely to be deposited on the topsoil in the immediate vicinity of the plant boundary. However, the fugitive emissions are likely to be controlled to a great extent through proposed control measures like highly efficient electrostatic precipitators.

Impact on Air Quality

The impact on air quality is assessed based on combined emissions of the proposed VVM SEZ project activities along with the present baseline data. Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter

(RSPM), Sulphur dioxide (SO_2) and Oxides of Nitrogen (NO_x) are important pollutants emitted by the proposed plants.

Prediction of impacts on air environment has been carried out by Industrial Source Complex [ISC3] dispersion model for simulations from point sources and results reveals that incremental values after baseline concentration are well within the norms as per National Ambient Air Quality (NAAQ) standards.

Impact of Traffic on Air Quality

The major pollutants expected from the traffic are Carbon monoxide and Oxides of Nitrogen. The incremental concentration due to the additional trucks has been computed by using CALINE4 line source model developed by California Department of Transportation. It has been assessed that the impact on the present ambient air quality will be negligible due to the additional traffic from the proposed SEZ project.

Impact on Water Resources and Water Quality

No ground water source will be tapped for meeting the water requirements during operation of proposed plants. The entire water requirement of the project will be met from the sea. Hence, no adverse impact on ground water sources is envisaged.

The wastewater generated in the plant area will be utilized in various activities such as greenbelt development and as service water. The balance treated wastewater will be disposed into sea at about 1.0-km from the shore. No discharge is envisaged into any surface river water bodies; hence, no impact is envisaged on surface river water quality.

The storm water in the project area will be collected through storm water drains and collected in the storm water tank. The stored storm water will be utilized in the plant operation resulting in conservation of fresh water.

The guard pond of the common effluent treatment system will be provided with proper lining to prevent seepage and avoid contamination of groundwater. Hence, the impact on the groundwater bodies is not envisaged.

Impact of Solid Wastes

The sludge from sewage treatment plant will be dried and used as manure for greenbelt maintenance. Canteen waste will be composted and used as manure for greenbelt maintenance.

With the implementation of the above precautionary measures, the impacts on the environment due to solid waste disposal are insignificant.

Impact on Occupational Health

There are no high noise producing equipments in the proposed SEZ plants. However, impacts on the working personnel are not expected to be significant on account of the high level of automation of the plant, which means that workers will be exposed for short duration only that too intermittently. Equipments will be provided with silencers. Workers will be provided with necessary protection devices eg., ear plugs, ear muffs etc.

Prediction of Impacts on Socio-Economics

The requirement of unskilled manpower will be met from nearby villages during construction and operation phase. The project will also help in generation of indirect employment apart from direct employment. This will be a positive

socio-economic development for the region. There will be a general upliftment of standard of living in the region.

Impacts on Public Health and Safety

The discharge of waste materials (stack emission, wastewater and solid wastes) from process operations is expected to be insignificant and may not have potential impact on public safety and health.

IMPACT ON FLORA AND FAUNA STATUS:

As the proposed project area is devoid of forest area, question of damage to forest land does not arise.

No biospheres, sanctuaries or national parks, etc. are situated near by and the area does not serve as breeding ground for any migratory fauna. Even the only significant feature namely Marine National Park comprising of 21 small islands is situated more than 100 kms North-east of the project site. Under these circumstances, the question of impact on any sensitive areas due to this project will not arise. At present the flora richness in the area is very limited, as shown in CHAPTER-III. In this almost barren area, green belt will be developed with plantation of Casuarina sp, Coconut etc. which will improve the floristic and fauna status of the area.

With regard to terrestrial flora / fauna, the proposed project operations will have no impact, as no effluent discharge arises from the activities into the terrestrial systems.

In view of adopting appropriate remedial measures to control environmental pollution and to confirm the pollution load with in standards, harmful impact due to the proposed project operations on flora and fauna will be very less.

IMPACT ON SAFETY

The Project Developer will enforce well planned systematic safety management practices in all its operations. A full -fledged safety officer will be employed to attend to all aspects and problems regarding safety. Accident reviews and monitoring will be done strictly and regularly to prevent accidents.

Provision of personal protective equipments for body, legs, eyes, face, arms etc. will be supplied. The list of personal protective equipments proposed to provide the workers by the proponent is given in table 4.3.

Protection for	Equipment	Protection against
Hand	a) Leather gloves	Cuts due to handling
	b) Asbestos gloves	Heat radiation
	c) Acid/Alkali proof rubber gloves	Burns due to chemical handling
	d) Electric resistance gloves	Electrical shock
	e) Canvas gloves	Contact with oil and grease etc.
	f) Hand sleeves	Falling of hot slag
Leg	a) Leg – guard	Welding sparks striking by objects, fall of objects and stepping on
	b) Leather safety boots	
	c) Asbestos safety boots	Sharp or hot objects heat radiation, stepping hot or

		sharp objects
	d) Cum boots	Liquid splashing
Eye	a) Panorama goggles with clear plastic visor	Oil and paint splashes of dust and chips
	b) Leather mask goggles	Foreign bodies entering the eyes and smoke
	c) Spectacle type goggles with plain shatter	Foreign bodies entering the eyes and reflected arc rays
Head	a) Fiber Helmet	Fall of objects/hitting against objects during construction, maintenance etc.,
Ear	a) Ear plugs or muffs	High noise level
Nose	a) Dust respirators	Fine dust particles
	b) Light fume mask	Fine dust particles
	c) heavy fume mask	Acid fumes and vapor (0.1%)
	d) Canister gas mask	Toxic gases (0.1%) Acid fumes, vapors and gases (2.0%)

SIGNIFICANCE OF ENVIRONMENTAL IMPACT MATRIX:

To compare the impact of implementing the production technology adopted in the proposed project with or without mitigatory measures on the socio-economic

attributes and environmental factors, it is necessary first to estimate the impact when no remedial measures are taken up. To understand the significance of such comparison Environmental Impact Matrix is followed. The basis of the method is given in the following paragraphs. Though this method is considered subjective, it will give a reasonable measure for assessment.

ENVIRONMENTAL IMPACT MATRIX :

The Environmental Impact due to the VVM SEZ operation and allied activities has been analyzed with the help of an impact matrix tabulated in the following page. In this Impact Matrix, environmental attributes have been indicated on rows and activities having impacts on the attributes area placed in columns.

Positive or negative signs are assigned to the impact values to show the beneficial aspects or adverse effects.

Impact value has been allocated as per following norms:

Appreciable Impact	:	-1
Significant Impact	:	-2
Major Impact	:	-3
Severe Impact	:	-4

+ Sign indicates beneficial effect

- Sign shows adverse effect

Apart from this, each activity has been assigned a value depending on its importance for protection and improvement of environment known as weightage of the activity. Ultimately, final assessment has been made according to the significance as discussed below:

SIGNIFICANCE OF ENVIRONMENTAL IMPACT MATRIX :

MATRIX VALUE S	SIGNIFICANCE
(-) 1000	No appreciable impact on environment
(-) 1000 – (-) 2000	Appreciable impact. Appropriate environmental mitigative measures required.
(-) 2000 – (-) 3000	Significant impact. Major Environmental Control measures required.
(-) 3000 – (-) 4000	Major impact. Project site / Production technology to be reviewed.
(-) 4000 – (-) 5000	Not suitable. Alternative site to be considered.

Environmental Impact Matrix without mitigatory measures worked out on the above basis is given in TABLE-4-4. It works out to +800 points. This places the project in the category of "No Appreciable Impact". However proper environment management plan will be created and necessary steps will be taken to check and control the environmental pollution that may arise due to operations. These control measures area discussed in the next chapter.

TABLE 4-4 ENVIRONMENTAL IMPACT MATRIX WITHOUT PROTECTIVE MEASURES

Environmental Parameters	Weightage	Plants Construction	Manufacturing and Processing Activities	Transportation	Green Belt	Community Development	Net Impact	Score
Land Use	125	-1	--	-1	+2	--	--	--
Ecology/Forest	150	--	--	--	+2	--	+2	+300
Air Quality	100	--	-1	-1	+1	--	-1	-100
Major Surface Water Course	75	--	--	--	--	--	--	--
Water Quality	100	--	--	--	--	--	--	--
Noise	75	--	--	-1	+1	--	--	--
Health	100	--	-1	-1	+1	--	-1	-100
Population Migration	50	+1	+1	+1	--	--	+3	+150
Employment	75	+1	+2	+1	--	--	+4	+300
Literacy	50	--	--	--	--	+2	+2	+100
Services	50	--	+1	+1	+1	--	+3	+150
Aesthetic Value	50	--	-1	--	+1	--	--	--
TOTAL								+800



ENVIRONMENT MANAGEMENT PLAN

CHAPTER V

ENVIRONMENT MANAGEMENT PLAN

ENVIRONMENT MANAGEMENT POLICY

Although there shall not be any major environmental pollution from the developmental activities proposed by VVM SEZ, it proposes to make the SEZ highly environment friendly.

Common sewage treatment plants shall be provided to treat the sewage and the treated sewage water shall be recycled and reused within the SEZ premises.

No solid hazardous wastes generation has been envisaged from the VVM SEZ activities. Based on the nature of solid waste generation from the developmental activities in the SEZ, VVM shall implement appropriate solid waste management system. For the disposal of solid domestic waste, composting or disposal at approved MSW disposal facility or as per prevailing norms have been planned. The sludge from the CSTPs shall also be composted and used as manure within the SEZ premises. The small quantity of used / spent oil to be generated on the emergency operation of the DG sets shall be sent to MoEF approved recycler for suitable treatment and disposal.

Landscaping and green-belt have been planned within the entire SEZ to provide a major sink for any air, thermal and noise pollutions.

5.3 OBJECTIVES OF ENVIRONMENTAL MANAGEMENT PLAN

The main objectives in formulating this environmental management plan are:

- To treat all the pollutants viz. air, liquid, solid and, which contribute to the degradation of the environment, with appropriate technology.

- To comply with all regulations stipulated by the central / state pollution control boards related to liquid effluent, solid / hazardous wastes discharges as per water and environment pollution control laws / rules.
- To encourage support and conduct developmental work for the purpose of achieving environmental standards and to improve the methods of environmental management.
- To create good working conditions (devoid of air and noise pollution) for employees.
- To reduce fire and accident hazards.
- Perspective budgeting and allocation of funds for environment management expenditure.
- Continuous development and search for innovative technologies for a cleaner and better environment.

GENERAL

The various impacts likely to be caused on the existing environment due to proposed VVM SEZ project activities such as Construction of Port and other related buildings, wind turbine and solar power plant, desalination Plant, Processing of Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent extraction and infrastructure on Air, Water, Soil, Noise, Socio – economic profiles, Land use, Flora and Fauna etc., have been discussed in the earlier Chapter. Prompt control measures have to be planned in advance so as to mitigate the effects of even marginal impacts and preserve the ecological quality of the project area within sustainable limits. These environmental control measures are discussed below:

5.1 LAND USE STATUS

As the VVM SEZ is to be developed in the own patta land already purchased for industrial use, there is no question of private or agricultural land spoilage.

5.2 SOCIO – ECONOMIC PROFILE

5.2.1 EMPLOYMENT ARENA

The proposed VVM SEZ project will provide employment opportunities to about 2500 persons during construction phase and 5750 persons during operation phase directly and more than 15,900 persons indirectly by way of transportation, trading etc. The state and central exchequers will be benefited financially through receipt of royalty and Foreign Exchange.

5.2.2 STAFF WELFARE SERVICE

The following facility will be provided for the staff

- 1) Well accomplished canteen
- 2) Provision of uniforms, shoes, protective equipment etc.
- 3) Well maintained park and club for recreational purpose
- 4) Departmental stores to meet the house hold requirement
- 5) About 100 -200 independent residential quarters for the employees

5.2.2 COMMUNITY WELFARE SERVICE

The VVM SEZ Project shall also extend the following welfare and community service to the people in the area.

- 1) Sports activity shall be given financial assistance
- 2) Cash awards have been given to meritorious school students
- 3) Free eye camp and medical camps shall be held in nearby villages

5.3 ENVIRONMENTAL CONTROL MEASURES

5.3.1 AMBIENT AIR QUALITY

The existing level of Ambient Air Quality is given in CHAPTER III, which are found to be well within the limits prescribed by the CPCB for various parameters. However during the operational phase of the plant, it is likely that the air quality may be affected due to the process operation unless controlled.

As mentioned earlier the impact on air quality due to the proposed activities such as Processing of Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent extraction, Construction of Port and other related buildings, desalination Plant, wind turbine, solar power plant and infrastructure development operation will be minimal. The height and other parameters of the stack in the proposed Industries are designated as per statutory regulation and it will be strictly meet the stipulations of TNPCB and as such the emissions level will be within the prescribed limit.

5.4.2 CONTROL MEASURES FOR WATER QUALITY

The water quality data of the core and buffer zone villages is described in CHAPTER-III. The quality of the water is slightly brackish but confirm to the prescribed standards laid by CPCB and TNPCB. The proposed developmental activities such as Processing of Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent

extraction, Construction of sea Port and other related buildings, desalination Plant etc. will generate effluent. The effluent will be treated in Common Effluent Treatment Plant (CETP) facilities. The CETP will be built in modular and expandable manner. The treated effluent shall either be reused within SEZ premises or shall be discharged into the Gulf of Mannar with prior permission from the statutory bodies.

Due to the above reasons water regime in the area will not be affected by the project operations. Frequent water sampling and analysis will be carried out for monitoring water quality to ensure compliance with statutory limits.

5.4.3 CONTROL MEASURES FOR NOISE

The existing noise level in and around the proposed Project Area have been monitored and are found to be well within the prescribed limits of TNPCB, as mentioned in CHAPTER III.

The following steps will be adopted to maintain the noise levels within the prescribed limits, during the plant operation stage.

- 1) Regular preventive maintenance of all equipments and machinery so as to reduce the frictional noises
- 2) Noise absorbing pads at foundations of vibrating equipments
- 3) Supply of ear muffs to workman exposed to high noise levels.
- 4) Plantation and green belt development in a large scale

5.4.4 CONTROL MEASURES FOR SOLID WASTE

The VVM SEZ project activities such as Processing of Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandium, cracking of Monazite for production of magnets, solvent

extraction, Construction of Port and other related buildings, desalination Plant, wind turbine, solar power plant etc. would generate solid wastes approx. 80 t/day that would be disposed as per the MSW guidelines.

The solid waste generated in the final stage of heavy mineral processing would be stored in storage tanks. It will be constructed as per the advice and norms of Atomic Energy Regulatory Board (AERB) in an isolated place with in SEZ area fenced with compound wall and fire fencing with lock and key system. The Uranium will be supplied to Govt., of India, Atomic Energy Department for using as fuel in their Nuclear Power plant. The Thorium will be disposed as per the advice of the AERB / Atomic Energy Department.

In view of the above factors, impact of solid waste is not envisaged to be adverse.

5.4.5 GREEN BELT DEVELOPMENT

The remarkable attributes of vegetation in arresting various pollution sources and increasing the ecological characteristics of any area is well known. Green cover helps to intercept incoming and out going radiation. Besides, it helps to block the harmful effects of soil erosion due to heavy precipitation. Winds are also arrested by trees, thus preventing wind erosion and propagation of dust, gaseous pollutants and noise.

The filtering capacity of trees for dust is 32 – 80 T/Ha. Noise level abatement to the tune of 20 to 30 decibels can be achieved by a green barrier of 50 m wide. Soils under green cover have thin organic matter and recirculation of nutrients. Green belt area soils in comparison with barren land soils have greater porosity and tend to encourage infiltration and absorption of water and to increase under ground supplies. Green belt reduce extremes of soil temperature partly by canopy action and partly by the action of green floor. One hectare of well wooded green belt is said to

absorb 3.7 tonnes of carbon – di – oxide per annum for its photosynthesis and emits two tones of oxygen thus cleaning the atmosphere of the obnoxious and harmful gases.

Well developed green belt will develop a favorable micro-climate to support different micro organisms in the soil and as a result of which soil quality will be improved further. In green belt birds nest may be introduced to encourage more birds in those areas.

The green belt development plan for a particular Industry mainly depends on

- ❖ Nature and extent of air pollution
- ❖ Sink capacity of the eco system
- ❖ Climatic factors
- ❖ Soil and water quality
- ❖ Specific site background

So based on the regional background, extend of pollution load, soil quality, rainfall temperature and human interactions, follówing plan have been suggested to develop green belt in and around the proposed VVM SEZ Premises.

The project authorities have chosen poly culture as their mode of green belt development and will plant varieties of plant species in and around the proposed project site. The selection of suitable plant species for green belt development is based upon the following criteria

- ❖ The plant should be fast growing
- ❖ The plant should have thick canopy cover
- ❖ Preferably perennial and ever green
- ❖ Having large leaf area index
- ❖ Resistant to specific air pollutants
- ❖ Should have maximum height
- ❖ Indigenous

- ❖ Should maintain ecological, land and hydrological balance of the region

Selected Suitable plants will be planted along the roads, around the plant, around the colony area etc. Tall and leafy trees like *Azdirachta indica*, *Polyalthia longifolia*, *Pomgamia glabrae* etc. will be developed in this area. Around Administrative office ornamental varieties like *Gulmohar*, *Peltaphorum*, *Jacarandah* will be planted with the back drop of lawns.

5.4.6 CONTROL MEASURES ON OCCUPATIONAL HEALTH SERVICES

Regular health monitoring of staff and workers will be carried out to detect any occupational diseases so as to ensure taking prompt remedial measures.

- 1) Medical surveillance is aimed at identifying the health status of a potentially exposed employee, so that effects occurring could be identified in the early stages and appropriate measures could be taken to prevent exposures and subsequent development of an occupational disease.

A medical surveillance programme will be taken up in the unit after establishment to meet the requirements of factories Act and the suggestions of OSHA

5.4.7 CONTROL MEASURES ON SAFETY AND FIRE FIGHTING

Safety measures on melting vessels, storage tanks etc., will be done as per regulations. Safety Audit will be done regularly to find the problem areas with a view to take remedial measures immediately. Imparting safety

education and in – house and external training on safety aspects will be done periodically.

A good fire fighting code will be laid by the company for tackling any type of hazard. Sophisticated fire protection and control system will be installed in the plant.

5.4.8 ENVIRONMENTAL IMPACT MATRIX WITH PROTECTIVE

MEASURES :

Remedial measures as suggested in the EMP are expected to improve the environmental conditions by suitably reducing the negative effects and giving positive impacts on some of the environmental attributes. The Environmental Impact Matrix was prepared giving comparative weight age due to adoption of mitigatory measures as detailed in this CHAPTER and are tabulated in Table 5-1. Based on the above said control measures, Environmental Impact Matrix without protective measures is improved in rating from +800 to + 1250. Thereby showing that the project will have a positive effect on an overall basis.

TABLE 5-1 ENVIRONMENTAL IMPACT MATRIX WITH PROTECTIVE MEASURES

Environmental Parameters	Weightage	Plants Construction	Manufacturing and Processing Activities	Transportation	Green Belt	Community Development	Net Impact	Score
Land Use	125	-1	--	-1	+2	--	--	--
Ecology/Forest	150	--	--	--	+2	--	+2	+300
Air Quality	100	--	--	-1	+1	--	--	--
Major Surface Water Course	75	--	--	--	--	--	--	--
Water Quality	100	--	--	--	--	--	--	--
Noise	75	--	--	--	+1	--	+1	+75
Health	100	--	--	--	+1	--	+1	+100
Population Migration	50	+1	+1	+1	--	--	+3	+150
Employment	75	+1	+2	+1	+1	--	+5	+375
Literacy	50	--	--	--	--	+2	+2	+100
Services	50	--	+1	+1	+1	--	+3	+150
Aesthetic Value	50	-1	--	--	+1	--	--	--
TOTAL								+1250



IMPLEMENTATION OF MONITORING SYSTEM

CHAPTER – VI
IMPLEMENTATION OF MONITORING SYSTEM

=====

6.0 GENERAL :

In the earlier chapter, elaborate measures have been proposed to bring under control various adverse impacts likely to be caused by the proposed VVM SEZ project operations on account of possible environmental deterioration with respect to air and water qualities, noise levels, socio-economic factors, health status, safety aspects etc. In order to implement the control measures effectively, it is imperative that a multi-disciplinary approach involving dedicated participation from all concerned departments is essential. Regular, systematic and sustained programmed schedules for implementation and monitoring of various control measures are to be devised in advance with clear-cut guidelines for various concerned plants for keeping a continuous surveillance on the environmental quality of the area.

6.1 STATUTORY FULFILMENT:

The monitoring schedules will be planned to aim at regular and systematic study of various pollution levels with respect to air and water qualities, noise levels etc., to ensure that they conform to the standards laid down by the Environmental Protection Act and various Central and State Pollution

Control Board limits. The various methodologies and frequency of studies of all environmental quality parameters should be as prescribed by MoEF and Tamil Nadu State Pollution Control Board.

Whenever excess levels are noticed, prompt control measures will be immediately taken to bring the quality parameters within control.

Socio-economic status with respect to occupational health, communication, welfare measures etc. should be reviewed at least once in 5 years to bring them on par with the population growth, social development etc. Occupational health monitoring will also be undertaken periodically as required by statutes.

6.2 ORGANISATIONAL SET-UP :

The Senior Environmental Engineer/ Chemist at the project site will be directly responsible for various environmental activities connected with the plant operations. These activities will be reviewed by the Managing Director and the Manager in charge of the project will correlate and oversee the environmental activities and propose effective implementation in consonance with the guidelines in the EMP. Organisation chart of the Environmental cell is given in Figure-6-1.

Environmental control measures will cover various factors such as land degradation, soil erosion, air, water and soil quality, noise level, afforestation measures, etc. as detailed in CHAPTER-V. As far as air, water and noise pollution are concerned, continuous monitoring has to be done either by private agencies or by the project authority, when Project operations get intensified. The State Government Officials should also be involved at appropriate stages of Environmental Control.

6.3 **MONITORING SCHEME :**

For Baseline Data collection on the existing environment with respect to air, water, noise and soil, the configuration and number of sampling stations and other details have been delineated in CHAPTER-III. As the project operations intensify, additional or different sets of stations for study of environmental quality parameters will have to be fixed as per actual requirements and prevailing conditions of environmental factors.

6.4 **ENVIRONMENTAL CONTROL COST:**

For recurring environmental works as a general norm, about 25 lakh per year will be provided towards environmental control cost to carry out effectively the necessary control measures described earlier in CHAPTER-V. Proper monitoring mechanisms described above will help to find out promptly any changes in pollution level from the limits prescribed and to take immediate remedial measures so that environmental and ecological attributes in the area do not deteriorate from standards.

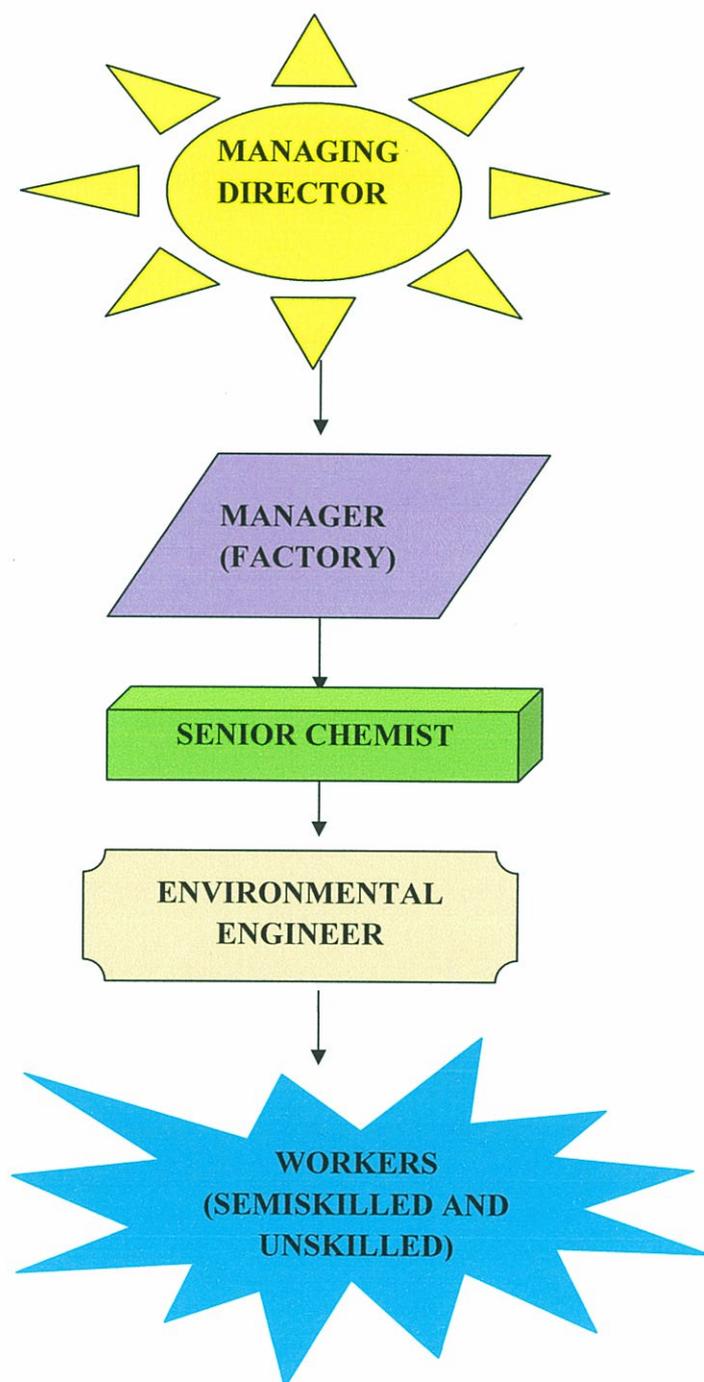
With the adoption of control measures listed in the report it can be ensured that industrial progress and environmental quality will go hand in hand without any harmful effects on human, flora and fauna and other ecological systems of the Core and Buffer zones.

Conclusion

As adequate environmental management system shall be provided, minimal adverse effect is expected from the proposed project. General trend of socio – economic environment due to the proposed SEZ is that it increases the population density within the area and in a few of the surrounding villages. This can be attributed to more job opportunities, direct and indirect, provided by the industry.

Thus, from both the economic as well as environmental point of view, the proposed VVM SEZ project is justified.

FIGURE 6-1 ORGANISATION CHART FOR ENVIRONMENTAL CONTROL



ANNEXURES

ANNEXURE I

LIST OF VVM SEZ APPLIED AREA IN THIRUVAMBALAPURAM VILLAGE,
RADHAPURAM TALUK, TIRUNELVELI DISTRICT

SL.NO	SURVEY NO & SUBDIVISION NO	EXTENT		CLASSIFICATION
		AC - CENT	HEC - AIRES	
1	363/1A	2.00	0.81.0	RAYAT PUNJAI
2	363/1B	6.08	2.46.0	RAYAT PUNJAI
3	347/1	14.35	5.81.0	RAYAT PUNJAI
4	347/2	4.73	1.91.5	RAYAT PUNJAI
5	352/1	2.30	0.93.0	RAYAT PUNJAI
6	352/2	7.76	3.14.0	RAYAT PUNJAI
7	353/1	1.10	0.44.5	RAYAT PUNJAI
8	353/2	1.26	0.51.0	RAYAT PUNJAI
9	353/3	5.16	2.09.0	RAYAT PUNJAI
10	354/3	5.20	2.10.5	RAYAT PUNJAI
11	354/4	5.62	2.27.5	RAYAT PUNJAI
12	358/3A4	2.28	0.92.0	RAYAT PUNJAI
13	358/3A5	2.27	0.91.5	RAYAT PUNJAI
14	358/3A6	1.32	0.53.0	RAYAT PUNJAI
15	360	11.15	4.51.0	RAYAT PUNJAI
16	361	21.80	8.82.5	RAYAT PUNJAI
17	362/1	17.60	7.12.5	RAYAT PUNJAI
18	362/2	3.05	1.23.5	RAYAT PUNJAI
19	364	2.02	0.81.5	RAYAT PUNJAI
20	365	10.08	4.08.0	RAYAT PUNJAI
21	366	3.38	1.36.5	RAYAT PUNJAI
22	367/1	12.36	5.00.5	RAYAT PUNJAI

50	386	3.00	1.21.5	RAYAT PUNJAI
51	326/7	1.66	0.67.0	RAYAT PUNJAI
52	327/1	0.87	0.35.0	RAYAT PUNJAI
53	327/2	0.82	0.33.0	RAYAT PUNJAI
54	327/3.	0.97	0.39.0	RAYAT PUNJAI
55	328/3B	7.80	3.15.5	RAYAT PUNJAI
56	329	7.33	2.96.5	RAYAT PUNJAI
57	330/1	1.68	0.68.0	RAYAT PUNJAI
58	330/2	1.26	0.51.0	RAYAT PUNJAI
59	330/3	1.24	0.50.0	RAYAT PUNJAI
60	332	6.94	2.81.0	RAYAT PUNJAI
61	333/1	1.08	0.43.5	RAYAT PUNJAI
62	333/10	3.48	1.41.5	RAYAT PUNJAI
63	333/11A	0.60	0.24.5	RAYAT PUNJAI
64	333/11B1	0.10	0.04.0	RAYAT PUNJAI
65	333/11B2	0.25	0.10.0	RAYAT PUNJAI
66	333/12	0.82	0.33.5	RAYAT PUNJAI
67	333/13	0.82	0.33.5	RAYAT PUNJAI
68	333/2	0.41	0.16.5	RAYAT PUNJAI
69	333/3	2.02	0.82.0	RAYAT PUNJAI
70	333/4	0.76	0.31.0	RAYAT PUNJAI
71	333/5	0.77	0.31.0	RAYAT PUNJAI
72	333/6	2.40	0.97.0	RAYAT PUNJAI
73	333/7	1.04	0.42.0	RAYAT PUNJAI
74	333/8	1.01	0.40.5	RAYAT PUNJAI
75	335/1	4.69	1.90.0	RAYAT PUNJAI
76	335/2	4.69	1.90.0	RAYAT PUNJAI

77	338/1A1B	6.42	2.60.0	RAYAT PUNJAI
78	338/1A1C	1.50	0.61.0	RAYAT PUNJAI
79	338/1A2	0.35	0.14.0	RAYAT PUNJAI
80	338/1B	2.12	0.86.0	RAYAT PUNJAI
81	338/1C	0.69	0.28.0	RAYAT PUNJAI
82	338/1D	4.74	1.92.0	RAYAT PUNJAI
83	338/1E	11.09	4.49.0	RAYAT PUNJAI
84	338/1F	1.43	0.58.0	RAYAT PUNJAI
85	338/1G	0.42	0.17.0	RAYAT PUNJAI
86	338/2A	0.40	0.16.0	RAYAT PUNJAI
87	338/2B	2.79	1.13.0	RAYAT PUNJAI
88	338/3	1.00	0.40.5	RAYAT PUNJAI
89	339/1	0.07	0.03.0	RAYAT PUNJAI
90	339/2A	0.86	0.35.0	RAYAT PUNJAI
91	339/2B	0.42	0.17.0	RAYAT PUNJAI
92	339/2C	1.37	0.55.5	RAYAT PUNJAI
93	339/2D	0.43	0.17.0	RAYAT PUNJAI
94	339/3A	0.61	0.25.0	RAYAT PUNJAI
95	339/3B	0.44	0.18.0	RAYAT PUNJAI
96	339/3C	0.35	0.14.0	RAYAT PUNJAI
97	339/4	1.36	0.55.0	RAYAT PUNJAI
98	339/5	2.55	1.03.0	RAYAT PUNJAI
99	339/6	1.80	0.73.0	RAYAT PUNJAI
100	339/7	3.38	0.37.0	RAYAT PUNJAI
101	339/9	0.13	0.05.0	RAYAT PUNJAI
102	341/2A	0.19	0.08.0	RAYAT PUNJAI
103	341/2B	0.12	0.05.5	RAYAT PUNJAI

104	341/3	2.22	0.89.5	RAYAT PUNJAI
105	341/4A1	0.97	0.39.0	RAYAT PUNJAI
106	341/4A2	0.15	0.06.0	RAYAT PUNJAI
107	341/4B	0.42	0.17.0	RAYAT PUNJAI
108	341/4C	0.25	0.10.0	RAYAT PUNJAI
109	341/4D	0.45	0.18.0	RAYAT PUNJAI
110	343/1	1.19	0.48.0	RAYAT PUNJAI
111	343/2	6.45	2.61.0	RAYAT PUNJAI
112	343/3	6.26	2.53.0	RAYAT PUNJAI
113	343/4	1.48	0.60.0	RAYAT PUNJAI
114	344/1A	1.29	0.52.0	RAYAT PUNJAI
115	344/1B	3.58	1.45.0	RAYAT PUNJAI
116	344/2	1.43	0.58.0	RAYAT PUNJAI
117	344/3	2.35	0.95.0	RAYAT PUNJAI
118	344/4	2.45	0.99.0	RAYAT PUNJAI
119	346/1	11.56	4.68.0	RAYAT PUNJAI
120	346/2	3.46	1.40.0	RAYAT PUNJAI
124	345	2.42	0.98.0	RAYAT PUNJAI
125	348	11.34	4.60.0	RAYAT PUNJAI
126	349	16.14	6.53.5	RAYAT PUNJAI
127	354/1A	6.20	2.51.0	RAYAT PUNJAI
128	355/1	7.23	2.92.5	RAYAT PUNJAI
129	355/2	2.12	0.85.5	RAYAT PUNJAI
130	355/3	3.75	1.52.0	RAYAT PUNJAI
TOTAL		411.67	166.66.5	



Industries (MIE2) Division
Secretariat, Chennai

Letter No.12688/MIE2/2009-6 Dated: 3-5-2012

From
Dr. N. Sundaradevan, I.A.S.,
Principal Secretary to Government

To,
The Director - SEZ,
Department of Commerce,
Ministry of Commerce and Industry, Government of India,
Udyog Bhavan, New Delhi - 110 011 (w.e.)

Sir,

Sub: Industries - Application of M/s. V.V. Mineral for setting up of a sector specific SEZ for Mineral and Mineral based products in Tiruvembalapuram Village, Radhapuram Taluk, Tirunelveli District. Recommending for grant of Formal Approval - Regarding.

- Ref: 1. From Mr. S. Vaikundarajan, Managing Partner, V.V. Mineral, Keeraikaranthattu, Tisaiyanvilai, Tirunelveli District, Tamil Nadu; Application dated: 25.7.2009
2. From the Director, Tamilnadu Industrial Guidance & Export Promotion Bureau Letter No. SEZ/WV Mineral/2009, dated: 20.11.2009 & Letter No. Dir/SEZ/2009, dated: 7.1.2010
3. From the Commissioner of Geology & Mining, Chennai-32 Letter No. Rc.No.5538/MM7/2011, dated: 18.7.2011
4. From Mr. S. Vaikundarajan, V.V. Mineral, Keeraikaranthattu, Tisaiyanvilai, Tirunelveli District, Letters dated: 30.8.2011 and dated: 19.9.2011

I am directed to state that M/s. V.V. Mineral has proposed to establish a sector specific SEZ for Mineral and Mineral based products at Thiruvembalapuram village, Radhapuram Taluk, Tirunelveli District.

2. The Director, Tamilnadu Industrial Guidance & Export Promotion Bureau in the letters second cited (copies enclosed) has reported the following regarding the Developer, Network and Investment proposed in the SEZ:

- (a) About M/s. V.V. Mineral: M/s. V.V. Mineral is a family Business Concern started in 1989. M/s. V.V. Mineral is promoted by Mr. S. Vaikundarajan, Managing Partner, Mr. S. Jagadeesan, Partner and Mr. S. Chandresan,

Partur. The Registered Office of this Firm is located at 17 C, Keeralvaranthattu, Tisayanvilal in Tirunelveli District. In the proposal submitted, it is said that they have considerable experience in mining, traditional man pocket shovel mining and mechanized mining of Garnet, Ilmenite, Rutile and Zircon etc.

- (b) Networth: M/s. Vairavanathan & Co. Chartered Accountants (Registered No. F 4736) vide their Certificate dated 10th February 2009 have certified that the networth of the Firm is Rs.84.06 crores as at the end of 31st March 2008.
- (c) Investment proposed in the SEZ infrastructure: The Developer Firm has proposed to invest Rs.870.00 crores in the proposed SEZ and this will be funded as follows:

Equity	Rs.376.00 crores
Term Loans	Rs.400.00 crores
Own source	Rs.95.00 crores
Total	Rs.453.0 crores

- (d) Land: The Developer Firm has proposed to develop this SEZ in an area of 133.70 hectares (330.30 Acres) at Tiruvembalapuram Village, Tirunelveli District. M/s. V.V.Mineral claim to have the entire 330.30 acres in their possession. The Developer has submitted a copy of the Certificate dated 14th September 2009 issued by Tahsildar, Radhapuram Taluk. In this Certificate, the Tahsildar, Radhapuram Taluk has certified that the Developer Firm viz. M/s.V.V. Mineral is in possession and enjoyment of 133.70 Hectares. Further, the Tahsildar has certified that the land is contiguous, there are no private lands/ poramboke lands, water bodies, canals, roads, railway lines, temples etc. within the proposed SEZ site, the land is not under acquisition of any Government agency and the land is not wet land or under cultivation.
- (e) The SEZ application of M/s. V.V. Mineral is in order and a perusal of networth, investment, land criteria indicates that M/s. V.V. Mineral qualifies for recommendation of "Formal Approval".

3. With reference to the above proposal, the Commissioner of Geology and Mining, Chennai was requested to clarify whether the company has enough raw materials available for the SEZ. In this connection, the Commissioner of Geology and Mining, Chennai in his letter third cited (copy enclosed) has reported the following:

- (i) The District Collector, Tirunelveli has stated that M/s. V.V. Mineral are having 26 mining leases in Tirunelveli District and also in Tuticorin and Kanniyakumari Districts. Their Group company Tvl. Transworld Garnet India is also having 14 mining leases in Tirunelveli District. Further he has reported that the Company according to them can get 11,00,043 M.Ton of Ilmenite, 66,311 M.Ton of Rutile as per the mining plan duly approved by Government of India.
- (ii) The District Collector has reported that the Company has enough raw material available for the SEZ.

4. The District Collector, Tirunelveli in his Letter dated:5.7.2011 (copy enclosed) addressed to the Commissioner of Geology and Mining, has observed that M/s.V.V Mineral have informed the following among others:

- (i) M/s. V.V. Mineral have obtained number of mining leases in Tirunelveli, Tuticorin, Kanyakumari Districts for Garnet, Ilmenite and other associated heavy minerals.
- (ii) With effect from 1.1.2007, the procedure of obtaining license from Department of Atomic Energy under Atomic Energy (Working of Mines and Minerals and Handling of Prescribed substances) Rules has been dispensed with. They have obtained license from Atomic Energy Regulatory Board under the provisions of Radiation Protection Rules for all their processing units.
- (iii) They have sent a statement showing the replenishable reserve per year mentioned in the approved mining plan. Accordingly they can be able to get more than one million M.Ton of Ilmenite, 66,000 M.Ton of Rutile per year as replenishable deposit. In addition to this, they will get Zircon, Silimanite and Monozite etc as tailings. They will use all the minerals, to produce value added products in their sites Specific Special Economic Zone. All type of mineral based industries will be set up in one roof. They are having sufficient mining leases with validity up to year 2035 which can be further renewed according to law.

Further, a copy of Networth Certificate has also been received along with the letter from the District Collector, Tirunelveli. In this Certificate, it has been mentioned that the total networth as on 31.3.2011 of M/s. V.V. Mineral is Rs.227,93,09,965 (Rupees two hundred and twenty seven crores ninety three lakhs nine thousand nine hundred and sixty five only).

5. M/s. V.V. Mineral, in their letter dated:30.8.2011 have stated that on the above SEZ area, only processing work will be carried out. They are already having number of mining leases for the feed material which may be transported to the SEZ area for further processing. M/s. V.V. Mineral have also stated that they have proposed to produce Garnet Abrasive Grit, Up-graded Ilmenite, Rare Earth Oxide, Titanium Pigments, Zircon Powder etc on stage by stage and they have not proposed to carryout mining operation. Further, M/s. V.V. Mineral have also furnished the revised/updated details of land proposed for the SEZ along with the Map and the Certificate obtained from the Tahsildar, Radhapuram Taluk for the revised / updated details of land. In this Certificate, the Tahsildar, Radhapuram Taluk has certified that the total extent of 166.66.5 Hectares of land in Thiruvembalapuram Village are belongs to Tvl. V.V. Mineral who are proposed to set up one 'Special Economic Zone' and the above lands are under the legal possession of the developer Company V.V. Mineral. Further, the Tahsildar has certified as follows:

- (1) The above lands are in legal possession of M/s. V.V.Mineral
- (2) The land is contiguous (one piece of land)
- (3) There are no private lands/ poramboke lands, water bodies, canals, roads, railway lines, temples etc. within the proposed SEZ site.
- (4) The land is not under acquisition of any Government agency.
- (5) The land is not wet land or under cultivation.

Subsequently, M/s. V.V. Mineral have stated that V.V. Mineral is a family run company managed by 3 brothers and their children and on the above Firm, now one of the brother Thiru. S. Chandresan and his children were retired from their firm with effect from 13.7.2011. Further, regarding their proposal, M/s. V.V. Mineral have also informed that 40% of the total area are earmarked for processing such as factory, drying yard, storage yard, godown etc which are more than the statutory requirement of 35 % processing area. Activities proposed in the SEZ are outlined in the application. Copies of the letters & Application from M/s. V.V. Mineral, project report, revised/updated details of land proposed for the SEZ along with the Map and the Certificate obtained from the Tahsildar, Radhapuram Taluk, have been enclosed herewith.

6. The State Government have examined the proposal of M/s. V.V. Mineral along with the recommendations of the Tamil Nadu Industrial Guidance & Export Promotion Bureau and it is observed that the application of M/s. V.V. Mineral satisfies the requirements prescribed for networth/investment, land availability to establish the sector specific SEZ. Further, it is also indicated that the project will generate direct employment opportunities to the tune of 4250 persons and indirect employment opportunities to 2000-3000 persons.

7. In the position mentioned above, the application of M/s.V.V.Mineral for setting up of a Sector Specific SEZ for Mineral and Mineral based products in an extent of 166.66.5 Hectares of land in Tiruvembalapuram Village, Radhapuram Taluk, Tirunelveli District is recommended to the Government of India, Ministry of Commerce & Industry for according 'Formal Approval'.

Yours faithfully,

R. Suresh Prabhakaran 3/5/12
for Principal Secretary to Government

Copy to:
The Development Commissioner,
MEPZ SEZ, Tambaram, Chennai-45

M/s. V.V. Mineral,
Keeraikaranthattu,
Tisaiyanvilai -627 657
Tirunelveli District

APPENDIX I FORM I

APPENDIX –I

Application for Preliminary Environmental Clearance of

M/s V.V.Mineral Product Specific (Mineral Based) SEZ Project[Vide Paragraph 6 of EIA Notification dated 14th September 2006 and Amendment dated 1st December 2009 vide S.O.3067 (E)]**FORM 1****(I) Basic Information**

S.No	Item	Details
1	Name of the Project/s	M/s V.V.Mineral Product Specific (Mineral Based) SEZ Project
2	S.No. in the Schedule	7 (c)
3	Proposed capacity / area / length/ tonnage to be handled /command area / lease area / number of wells to be drilled	Proposed area : 166.66.5 Ha.
4	New / Expansion Modernization	New
5	Existing Capacity / Area etc	Not Applicable
6	Category of Project i.e. 'A' or 'B'	B
7	Does it attract the general condition? If yes, Please specify	Yes
8	Does it attract the specific condition? If yes, please specify	No

9	Location Plot / Survey / Khasra No. Village Tehsil District State	Thiruvambalapuram Enclosed as Annexure I Thiruvambalapuram Radhapuram Tirunelveli Tamil Nadu
10	Nearest railway station / airport along with distance in kms.	Railway station : Valliyoor (35km) Air Port : Tuticorin (100km)
11	Nearest Town, city, District, Headquarters along with distance in kms.	Nearest Town : Tisayanvillai (14km) District : Tirunelveli (87 km) Head Quarters : Tirunelveli
12	Village Panchayats, Zilla Parishad, Municipal Corporation, Local body (complete postal addresses with telephone nos. to be given)	Village : Thiruvambalapuram Taluk : Radhapuram District : Tirunelveli State : Tamil Nadu Phone No. : 04637 273102
13	Name of the applicant	Thiru S. Vaikundarajan
14	Registered Address	S.Vaikundarajan Managing Director V.V.Mineral Keeraikaranthattu Tisayanvillai
15	Address for correspondence : Name Designation (Owner/Partner/CEO) Address	

	Pin Code	627 657
	Telephone No.	04637 273102
	Fax No.	04637 272802
	E-mail	vaikundarajan@vmineral.com
16	Details of Alternative Sites examined, if any. Location of these sites should be shown on a topo sheet.	Not considered
17	Interlinked Projects	Not Applicable
18	Whether separate application of interlinked project has been submitted?	Not Applicable
19	If yes, date of submission	Not Applicable
20	If no, reason	Not Applicable
21	Whether the proposal involves approval / clearance under; if yes, details of the same and their status to be given. (a) The Forest (Conservation) Act, 1980? (b) The Wildlife (Protection) Act, 1972? (c) The C.R.Z. Notification, 1991?	No No Yes. Since the project requires environmental clearance under EIA Notification, in terms of CRZ Notification, 2011 para 4(i)(b) clearance to be issued after getting recommendation of the State Coastal Zone Management Authority.

22	Whether there is any Government order / policy relevant / relating to the site?	No
23	Forest land involved (hectares)	None
24	Whether there is any litigation pending against the project and / or land in which the project is propose to be set up ? (a) Name of the Court (b) Case No. (c) Orders / directions of the Court, if any and its relevance with the proposed project.	No

(II) Activity

2. Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, etc.)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
1.1	Permanent or temporary change in land use, land cover or topography including increase in intensity of land use (with respect to local land use plan)	No	Not applicable, since no land use classification is fixed for this land
1.2	Clearance of existing land, vegetation and buildings?	No	The proposed project is coming up on barren land which sustains some local shrubs, removal of the

			same will not add significantly towards environment.
1.3	Creation of new land uses?	Yes	Development of SEZ Project
1.4	Pre-construction investigations e.g. bore houses, soil testing?	No	-
1.5	Construction works?	Yes	<p>Proposed to construct a Port facilities to handle 4.5 million TPA cargo.</p> <p>Power Plants viz., Wind Turbine and Solar power altogether to a total capacity of 450 MW into stages</p> <p>Heavy mineral processing plant for Minerals Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent extraction etc.</p> <p>Desalination Plant</p> <p>Ship repairing facilities</p>

1.6	Demolition works?	No	-
1.7	Temporary sites used for construction works or housing of construction workers?	No	Local workers will be engaged
1.8	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations	Yes	Proposed to install plants
1.9	Underground works including mining or tunneling?	No	-
1.10	Reclamation works?	No	-
1.11	Dredging?	No	-
1.12	Offshore structures?	No	-
1.13	Production and manufacturing processes?	Yes	<p>Altogether 450 MW Power generation from wind turbine and solar power energy</p> <p>Processing of Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals and production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of</p>

			magnets, solvent extraction etc. at a rate of 0.095 million TPA (Tons Per Annum) with Hi Tech Ecofriendly Operation
1.14	Facilities for storage of goods or materials?	Yes	For the storage of processed minerals, different types of cargo
1.15	Facilities for treatment or disposal of solid waste or liquid effluents?	Yes	<p>Solid waste and Liquid effluent will be recycled and reused. Sludge from the sewage treatment plant and effluent treatment plant will be used for composting and used as manure for Green belts.</p> <p>The mineral wastes will be used for back filling of the mined out pits situated outside the SEZ.</p>
1.16	Facilities for long term housing of operational workers?	No	Local Labors will be employed
1.17	New road, rail or sea traffic during construction or operation?	No	<p>The existing road network is adequate.</p> <p>Port and other related facilities will be developed to handle 4.5 million TPA cargo</p>

1.18	New road, rail, air waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc?	No	-
1.19	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?	No	-
1.20	New or diverted transmission lines or pipelines?	No	-
1.21	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?	No	-
1.22	Stream crossings?	No	-
1.23	Abstraction or transfers of water from ground or surface waters?	No	-
1.24	Changes in water bodies or the land surface affecting drainage or run-off?	No	-
1.25	Transport of personnel or materials for construction, operation or decommissioning?	Yes	Materials will be transported through trucks with valid fitness certificate
1.26	Long-term dismantling or decommissioning or restoration works?	No	-
1.27	Ongoing activity during decommissioning which could have an impact on the environment?	No	-
1.28	Influx of people to an area in either temporarily or permanently?	No	-

1.29	Introduction of alien species?	No	-
1.30	Loss of native species or genetic diversity?	No	-
1.31	Any other actions?	No	-

2. Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply):

S.No	Information/checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
	Land especially undeveloped or agricultural land (ha)	Yes	1.66.66.5 ha barren land Proposed for SEZ development
	Water (expected source & competing users) unit: KLD	Yes	100 MLD water from Desalination Plant will be used for all the Industrial activities proposed within the SEZ
	Minerals (MT)	Yes	By using the industrial heavy minerals mined from their own mining lease, Garnet, Ilmenite, Rutile, Zircon, Sillimanite and other associated heavy minerals are processed for the production of Rare Earth Oxide, Titanium Pigments, Synthetic Rutile, Slag, Scandinium, cracking of Monazite for production of magnets, solvent

			extraction etc. to a production capacity of 0.095 million TPA
	Construction material – stone, Aggregates, sand / soil (expected source – MT)	Yes	Bricks, sand, Cement, steel etc as per the requirement
	Forests and timber (source – MT)	No	-
	Energy including electricity and fuels (source, competing users) Unit: fuel (MT), energy (MW)	Yes	Power demand of 250MW would be met at first from TNEB. Subsequently from the proposed VVM SEZ Power Plants. 10 DG sets each with 750 KVA capacity Fuel 2950 liters HSD/day 4150 litres FO/day
	Any other natural resources (use appropriate standard units)	No	-

3. Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health.

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
3.1	Use of substances or materials, which are hazardous (as per MSIHC rules) to human health or the environment (flora, fauna, and water	No	-

	supplies)		
3.2	Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)	No	-
3.3	Affect the welfare of people e.g. by changing living conditions?	No	-
3.4	Vulnerable groups of people who could be affected by the project e.g. hospital patients, children, the elderly etc.,	No	-
3.5	Any other causes	No	-

4. Production of solid wastes during construction or operation or decommissioning (MT/month)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
4.1	Spoil, overburden or mine wastes	No	-
4.2	Municipal waste (domestic and or commercial wastes)	Yes	Daily 1.2 MLD toilet or sewage water is expected to discharge which will be treated in septic tank and soakpits
4.3	Hazardous wastes (as per Hazardous Waste Management Rules)	No	-
4.4	Other industrial process wastes	Yes	Daily 72 MLD effluent generation is expected which will be treated in Effluent

			Treatment Plant and the water will be recycled and reused
4.5	Surplus product	No	-
4.6	Sewage sludge or other sludge from effluent treatment	Yes	Will be composted and used as manure for Green belt development within SEZ Premise
4.7	Construction or demolition wastes	No	-
4.8	Redundant machinery or equipment	No	-
4.9	Contaminated soils or other materials	No	-
4.10	Agricultural wastes	No	-
4.11	Other solid wastes	No	-

5.0 Release of pollutants or any hazardous, toxic or noxious substances to air (Kg/hr)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources	Yes	To operate the DG set and dryer, 2950 liters HSD/day and 4150 litres FO/day is required. The ash content of HSD and Furnace oil is negligible. Due to the combustion of HSD and FO 0.25% and 4% sulphur respectively will be emitted.

5.2	Emissions from production processes	Yes	<p>Heavy mineral Processing Plant Operation</p> <p>* All the operation units shall be provided with appropriate stacks / vents and air pollution control equipment for all the gaseous emissions. The efficiency of the air pollution control system in every stacks will be checked regularly. All the levels will be conform to the standards laid down by the Environmental Protection Act and various Central and State Pollution Control Board limits</p>
5.3	Emissions from materials handling including storage or transport	No	-
5.4	Emissions from construction activities including plant and equipment	No	-
5.5	Dust or odours from handling of materials including construction materials, sewage and waste	No	-
5.6	Emissions from incineration of waste	No	-
5.7	Emissions from burning of waste in open air (e.g. slash materials, construction debris)	No	-
5.8	Emissions from any other sources	No	-

6 Generation of Noise and Vibration, and Emissions of Light and Heat:

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data with source of information data
6.1	From operation of equipment e.g. engines, ventilation plant, crushers	Yes	Leq. 62 -78 dB
6.2	From industrial or similar processes	Yes	Leq. 73-80 dB
6.3	From construction or demolition	No	-
6.4	From blasting or piling	No	-
6.5	From construction or operational traffic	Yes	Transport vehicle Leq. 65 – 72 dB
6.6	From lighting or cooling systems	No	-
6.7	From any other sources	No	-

7. Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea:

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
7.1	From handling, storage, use or spillage of hazardous materials	No	-
7.2	From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)	No	-

7.3	By deposition of pollutants emitted to air into the land or into water	No	-
7.4	From any other sources	No	-
7.5	Is there a risk of long term build up of pollutants in the environment from these sources?	No	-

8. Risk of accidents during construction or operation of the Project, which could affect human health or the environment

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
8.1	From explosions, spillages, fires etc from storage, handling, use or production of hazardous substances	No	-
8.2	From any other causes	No	-
8.3	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslides, cloudburst etc)?	No	-

9. Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality

S. No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
9.1	Lead to development of supporting facilities, ancillary development or development stimulated by the project which could have impact on the	No	-

	environment e.g.: <ul style="list-style-type: none"> • Supporting infrastructure (roads, power supply, waste or waste water treatment, etc.) • housing development • extractive industries • supply industries • other 	No	-
9.2	Lead to after-use of the site, which could have an impact on the environment	No	-
9.3	Set a precedent for later developments	No	-
9.4	Have cumulative effects due to proximity to other existing or planned projects with similar effects	No	-

III Environmental Sensitivity

S.No.	Areas	Name/Identity	Aerial distance (within 15 km.) Proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value	No	-
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains,	No	-

	forests		
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, overwintering, migration	No	-
4	Inland, coastal, marine or underground waters	Yes	Gulf of Mannar
5	State, National boundaries	No	-
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	No	-
7	Defence installations	No	-
8	Densely populated or built-up area	No	-
9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	No	-
10	Areas containing important, high quality or scarce resources (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	No	-
11	Areas already subjected to pollution or environmental damage. (those where existing legal environmental standards are exceeded)	No	-
12	Areas susceptible to natural hazard which could cause the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions)	No	-

- (IV) Proposed Terms of Reference for EIA studies
1. Field studies pertaining to air, water and soil quality, noise level, micro-meteorology, ecology etc. over a period of one year (January 2011 – December 2011)
 2. Survey / studies pertaining to socio-economic factors, land use pattern, flora and fauna, hydrological studies etc., covering an area of 10 km radius from the project site.
 3. Compilation and analyses of data and preparation of the report including impact assessment, control measures, management plan, etc.

"I hereby given undertaking that the data and information given in the application and enclosures are true to the best of my knowledge and belief and I am aware that if any part of the date and information submitted in found to be false or misleading at any stage, the project will be rejected and clearance give, if any to the project will be revoked at our risk and cost.

Date :

Place :



Signature of the applicant

With Name and Full Address

(Project Proponent / Authorized Signatory)

APPENDIX IV FORM I

Annexure-IVForm-I for seeking clearance for project attracting CRZ notification

Basic information:

Name of the Project : M/s V.V.Mineral Product Specific (Mineral Based) SEZ
Project

Location or site alternatives under consideration : Thiruvambalapuram ,
Radhapuram Taluk,
Tirunelveli District

Size of the Project (in terms of total area) : 166.66.5 Hect

CRZ Classification of the area : CRZ-I

Expected cost of the project : 870 Crores
(IN CRZ) , 480 Crores.

Contact information : S.Vaikundarajan – Managing Director
V.V.Mineral
Keeraikaranthattu
Tisayanvillai 627 657
04637 273102

(II) Activity

1. Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, and the like)

S. No.	Information/Checklist confirmation	Yes/No	Details thereof (with Approximate quantities/rates, wherever possible) with source of information data
1.1	Permanent or temporary change in land use, land cover or topography including increase in intensity of land use (with respect to local land use plan)	No	Not applicable. Since no land use classification is fixed for this land
1.2	Details of CRZ classification as per the approved Coastal Zone Management Plan?	Yes	CRZ-I
1.3	Whether located in CRZ-I area?	Yes	SEZ development
1.4	The distance from the CRZ-I areas.		Within CRZ I
1.5	Whether located within the hazard zone as mapped by Ministry of Environment and Forests/National Disaster Management Authority?	No	-
1.6	Whether the area is prone to cyclone, tsunami, tidal surge, subduction, earthquake etc.?	No	-
1.7	Whether the area is prone for saltwater ingress?	No	-
1.8	Clearance of existing land, vegetation and buildings?	No	The area is barren land
1.9	Creation of new land uses?	Yes	SEZ development
1.10	Pre-construction investigations e.g. bore hole, soil testing?	No	-
1.11	Construction works?	Yes	Port facilities, ship repairing/breaking facilities

1.12	Demolition works?	No	-
1.13	Temporary sites used for construction works or housing of construction workers?	No	-
1.14	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations	Yes	Installation for SEZ operation
1.15	Underground works including mining tunneling?	No	-
1.16	Reclamation works?	No	-
1.17	Dredging/reclamation/land filling/disposal of dredged material etc.?	No	-
1.18	Offshore structures?	No	-
1.19	Production and manufacturing processes?	No	-
1.20	Facilities for storage of goods or materials?	No	-
1.21	Facilities for treatment or disposal of solid waste or liquid effluents?	No	-
1.22	Facilities for long term housing of operational workers?	No	-
1.23	New road, rail or sea traffic during construction or operation?	Yes	Port and other related facilities
1.24	New road, rail, air waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc?	Yes	Port and other related facilities for handling 4.5 million TPA cargo
1.25	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?	No	-

1.26	New or diverted transmission lines or pipelines?	No	-
1.27	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?	No	-
1.28	Stream and river crossings?	No	-
1.29	Abstraction or transfers of water from ground or surface waters?	No	-
1.30	Changes in water bodies or the land surface affecting drainage or run-off?	No	-
1.31	Transport of personnel or materials for construction, operation or decommissioning?	Yes	For transporting goods, and rawmaterials to different plants in the SEZ
1.32	Long-term dismantling or decommissioning or restoration	No	-
1.33	Ongoing activity during decommissioning which could have an impact on the environment?	No	-
1.34	Influx of people to an area in temporarily or permanently?	No	-
1.35	Introduction of alien species?	No	-
1.36	Loss of native species or genetic diversity?	No	-
1.37	Any other actions?	No	-

2. Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply):

S. No.	Information/checklist confirmation	Yes/No	Details thereof (with Approximate quantities /rates, wherever possible) with source of information data
2.1	Land especially undeveloped or agricultural land (ha)	Yes	166.66.5 Hect undeveloped land for erection of different plants
2.2	Water (expected source & competing users) unit: KLD	Yes	Sea water for Desalination Plant
2.3	Minerals (MT)	No	-
2.4	Construction material – stone, aggregates, sand/soil (expected source – MT)	No	-
2.5	Forests and timber (source – MT)	No	-
2.6	Energy including electricity and fuels (source, competing users) Unit: fuel (MT), energy (MW)	Yes	For operating plant and machineries
2.7	Any other natural resources (use appropriate standard units)	No	

3. Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health.

S. No.	Information/Checklist confirmation	Yes/No	Details thereof (with Approximate quantities/rates, wherever possible) with source of information data
3.1	Use of substances or materials, which are hazardous (as per MSIHC rules) to human health or the environment (flora, fauna, and	No	-

3.2	Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)	No	-
3.3	Affect the welfare of people e.g. by changing living conditions?	No	-
3.4	Vulnerable groups of people who could be affected by the project e.g. hospital patients, children, the elderly etc.,	No	-
3.5	Any other causes, that would affect local communities, fisherfolk, their livelihood, dwelling units of traditional local communities etc	No	-

4. Production of solid wastes during construction or operation or decommissioning (MT/month)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with Approximate quantities/rates, wherever possible) with source of information data
4.1	Spoil, overburden or mine wastes	No	-
4.2	Municipal waste (domestic and or commercial wastes)	Yes	Domestic sewage and Industrial Effluent
4.3	Hazardous wastes (as per Hazardous Waste)	No	-
4.4	Other industrial process wastes	No	-
4.5	Surplus product	No	-
4.6	Sewage sludge or other sludge from effluent	Yes	Used for composting
4.7	Construction or demolition wastes	No	-
4.8	Redundant machinery or equipment	No	-
4.9	Contaminated soils or other materials	No	-
4.10	Agricultural wastes	No	-
4.11	Other solid wastes	No	-

5. Release of pollutants or any hazardous, toxic or noxious substances to air (Kg/hr)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with Approximat quantities/rates, wherever possible) with source of information data
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources	Yes	Emission from Industries, generator and Vehicles with fitness certificate
5.2	Emissions from production processes	No	-
5.3	Emissions from materials handling including storage or transport	Yes	Emission from Vehicles with valid FC
5.4	Emissions from construction activities including plant and equipment	No	-
5.5	Dust or odours from handling of materials including construction materials, sewage and waste	Yes	Dust from handling Raw material in different Plants
5.6	Emissions from incineration of waste	No	-
5.7	Emissions from burning of waste in open air (e.g. slash materials, construction debris)	No	-
5.8	Emissions from any other sources	No	-

6. Generation of Noise and Vibration, and Emissions of Light and Heat:

S. No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data with source of information
6.1	From operation of equipment e.g. engines, ventilation plant, crushers	Yes	From machinery and generator

6.2	From industrial or similar processes	Yes	"
6.3	From construction or demolition	No	-
6.4	From blasting or piling	No	-
6.5	From construction or operational traffic	No	-
6.6	From lighting or cooling systems	No	-
6.7	From any other sources	No	-

7. Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea:

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with Approximate quantities/rates, wherever possible) with source of information data
7.1	From handling, storage, use or spillage of hazardous materials	No	-
7.2	From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)	Yes	Domestic sewage discharge in sock pit. Industrial effluent recycled and reused
7.3	By deposition of pollutants emitted to air into the land or into water	No	-
7.4	From any other sources	No	-
7.5	Is there a risk of long term build up of pollutants	No	-

8. Risk of accidents during construction or operation of the Project, which could affect human health or the environment

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
8.1	From explosions, spillages, fires etc from storage, handling, use or production of hazardous substances	No	-
8.2	From any other causes	No	-
8.3	Could the project be affected by natural disasters causing environmental damage (e.g., floods, earthquakes, landslides, cloudburst etc)?	No	-

9. Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality

S. No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
9.1	Lead to development of supporting facilities, ancillary development or development stimulated by the project which could have impact on the environment e.g.: Supporting infrastructure (roads, power supply, waste or waste water treatment, etc.) housing development extractive industries supply industries others	Yes	Only positive impact

9.2	Lead to after-use of the site, which could have an impact on the environment	No	-
9.3	Set a precedent for later developments	No	-
9.4	Have cumulative effects due to proximity to other existing or planned projects with similar effects	No	-

III. Environmental Sensitivity

S.No.	Areas	Name/Identity	Aerial distance (within 15 km.) Proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value	No	-
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests	Yes	Within the CRZ area in CRZ-I
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	No	-
4	Inland, coastal, marine or underground waters	Yes	With in CRZ-I
5	State, National boundaries	No	-
6	Routes or facilities used by the public for access	No	-

7	Defense installations	No	-
8	Densely populated or built-up area	No	-
9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	No	-
10	Areas containing important, high quality or scarce Resources (ground water resources surface)	No	-
11	Areas already subjected o pollution or Environmental damage. (those where existing legal environmental standards)	No	-
12	Areas s usceptible to natural hazard which could cause the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding)	No	-

QUESTIONNAIRE

QUESTIONNAIRE TO BE SUBMITTED FOR NEW INDUSTRIAL ESTATES (IE)

A. GENERAL FEATURES

This information provides a profile of the estate to assist in identifying possible environmental issues.

• **Industrial estate**

Name: .VVM Product Specific (Mineral based) SEZ Project.

Address: . Murugananthapuram, Kootankuzhi cross road, Thiruvambalapuram
Village, Tamil Nadu, India.

Operations to start by Month - Year: .

The estimated period over which the VVM SEZ shall be commence its first operation within 3 years. All the proposed activities are effected in to stages.

• **Contact person for environmental aspects**

Name: . . Dr.T.Anitha M.Sc. Ph.D.

Function: . Environment Incharge.

Phone: . 0461 2355166

Fax: 0461 2357267.....

E-mail: anitha@vmineral.com

• **Ownership**

Public: . Not Applicable.

Private: V.V..Mineral, Keeraikaranthattu, Tisayanvillai 627 657.

Public/private partnership: . Not Applicable.

- **Scale of the project**

Total area of development (in hectares): . 166.66.5 ha

Total number of units/companies proposed: Eighteen

Total number of workers (approximate): . . 8250

- **Proposed land uses (Percentage of total area)**

Export processing zone . :36.0

General industrial zone . . .36.9

Commercial zone9.0

Residential zone 0.6

Landscaped green areas .1.8

Undeveloped areas5.7391

Roads. 1.56

Others (Social Amenities/Institutional) : 8.4

• *Nature of the industries proposed in the IE*

	<i>Number of Units</i>	<i>Likely no. of workers</i>	<i>Production volume</i>
Port	One	2250	4.5 million TPA
Heavy Mineral processing	Twelve	4500	0.95 million TPA
Processing of Garnet			
Processing of Ilmenite			
Processing of Rutile			
Processing of Zircon			
Processing of Silimanite			
Rare Earth Oxide production Plant			
Titanium Pigments production Plant			
Synthetic Rutile production Plant			
Synthetic slag production Plant			
Scandinium Production Plant			
Cracing of Monazite Plant			
Solvent Extraction			
Energy generation.....	Two	750	450 MW
Wind Turbine			
Solar Power Energy			
Construction industry	One	500	-----
Ship Repairing yard			
Desalination Plant	One	250	150 MLD
Others			

List of the human habitations nearby

Rural / urban area	Number of inhabitants	Distance (km)
Vijayapathy	9307	6
Parameshwarapuram	1673	5
Koodankulam	9023	9
Udayattur	3873	6
Kasthurirangapuram	2858	9
Karichithupudur	2347	6
Kuthankuzhi (Thiruvambalapuram)	700	1.5

• **Transport links**

Bus . . Rameshwaram – Kanyakumari East Coast Road (1 km)

Train . Nil

Others . Not Applicable

INFRASTRUCTURE FACILITIES PROPOSED IN THE IE

This identifies a number of services and features that may be linked to environmental performance. *Who provides or is responsible for the following services, tools or actions?*

- 1 o- **Industrial Estate Authority** - **VVMineral**
- 2 o- **Operational Units** - **V.V.Mineral and their subsidiaries**
- 3 o- **Government Authority** - **Nil**
- 4 o- **Private Sector** - **Nil**
- 5 o- **Other(Please specify)**

- **Energy (also State requirement in K Cal)**

Centralized energy supply	450 MW or 215105162.5 K.Cal
Individual energy supply	-
Supply and recovery of waste heat (cogeneration)	-
District heating system	-
Energy from waste facility	-
Energy from renewable resources facility	450MW

- **Water (also State requirement in KL)**

Municipal service	2.5 MLD
Tube wells	-
Treatment facilities (Desalination Plant)	100 MLD
Waste water disposal (Sewage)	1.2 MLD
Liquid waste disposal (Effluent)	70 MLD
Waste water recycling	53.1 MLD
Rain water harvesting	0.49 KLD

- **Solid waste (in Metric Tons)**

Solid waste disposal @	80t/day
Composting of biological waste @	20t/day
Industrial liquid waste disposal @	26.55 MLD
Hazardous waste disposal	Nil
Waste exchange clearing house	Nil
Multi-material resource recovery	Nil

@ Including collection, storage & treatment

- *Transport (attach traffic risk assessment report)*

Traffic and transport management plan

Own transportation arrangement will be done for transportation of materials as well as staffs. For other exporters Cargo handling, private vehicles with valid fitness certificate and registration from the competent authority will be utilized

Management

Environmental monitoring

Various pollution levels with respect to air water and soil qualities, noise levels etc., were regularly monitored by the Project Authority to ensure that they conform to the standards laid down by the Environmental Protection Act and various Central and State Pollution Control Board limits

Effluent monitoring

The inlet and outlet effluent quality will be checked periodically. Common sewage will be treated in the Sewage Treatment facilities and the treated water shall be recycled and reused within the VVM SEZ premises.

The industrial effluents shall be treated in the common effluent treatment plants (CETP). Monitoring will be done to confirm that all the operation units within VVM SEZ send their industrial effluent conforming to the CETP inlet norms.

Air emission monitoring

All the proposed operation units shall provide appropriate stacks / vents and air pollution control equipment for all the gaseous emissions. The efficiency of the air pollution control system in every stacks will be checked regularly. All the levels will be conform to the standards laid down by the Environmental Protection Act and various Central and State Pollution Control Board limits

Environmental auditing

To study the effect of the Proposed project on Environment, different sets of stations will be selected within and outside the VVM SEZ premise for study of air, water, soil and noise quality parameters every month conform to the standards laid down by the Environmental Protection Act and various Central and State Pollution Control Board limits. Half yearly report will be sent to the CPCB.

EMP & implementation of risk mitigation measures

Although there shall not be any major environmental pollution from the developmental activities proposed by VVM SEZ, it proposes to make the SEZ highly environment friendly.

Common sewage treatment plants shall be provided to treat the sewage and the treated sewage water shall be recycled and reused within the SEZ premises.

No solid hazardous wastes generation has been envisaged from the VVM SEZ activities. Based on the nature of solid waste generation from the developmental activities in the SEZ, VVM shall implement appropriate solid waste management system. For the disposal of solid domestic waste, composting have been planned. The sludge from the CSTPs shall also be composted and used as manure within the SEZ premises. The small quantity of used / spent oil to be generated on the emergency operation of the DG sets shall be sent to MoEF approved recycler for suitable treatment and disposal.

Landscaping and green-belt have been planned within the entire SEZ to provide a major sink for any air, thermal and noise pollutions.

The proposed areas being leeward of the Ceylon land mass, is less prone to cyclones. From Mandapam to Cape Comorin, the east coast is considered as ecologically non-sensitive in view of the uniform features of the coastal configuration.

A full-fledged fire station shall be provided with all necessary fire fighting equipments. All buildings will be fitted with fire valve with a facility to fit fire hose.

Proper fire detection and alarm system shall be installed. For fast and effective communication, an advanced communication system shall also be installed. For proper handling and management of any eventuality, an Emergency Control Center shall be established. Emergency power supply shall be provided at all vulnerable points.

First Aid cum dispensaries with the facilities of ambulance and staff nurses will be provided.

Environmental technology assessment

VVM SEZ will periodically update and implement the latest eco friendly technologies available to protect the environment.

Environmental training and education

Basic training will be provided to the freshly recruited employees. Orientation training for new or promoted officers will also be provided. Refresher course for all the technical people once in four years will be arranged to make them safety conscious and make them environmentally acquainted.

Emergency preparedness and response capability

Special training of first-aid and fire fighting by Loss Prevention Society shall also be arranged. Vocational training is imparted to all workers and supervisors as per statutes.

Finance and insurance services

An amount of Rs. 50 lakhs will be allotted as capital cost towards Environment Management Plan and recurring cost for the environmental facilities proposed by VVM SEZ works out to be Rs. 25 lakhs per year respectively.

- **Miscellaneous**

- Restoring natural features of the site : Not Applicable

Landscaping and gardening : Through out VVM SEZ project area
greenbelt will be maintained at
appropriate places into stages.

Analytical and laboratory services : World class quality check and
Environmental laboratory will be constructed

Protection and security system : International Ship and Port Safety (ISPS) Code would be implemented. Fire protection system will be designed as per standards prescribed by the National Fire Protection Association (NFPA)/ Tariff Advisory Committee of India.

MAIN STAKEHOLDERS

List of units requiring individual environmental clearance (in future) – Not Applicable since all the proposed activities are categorized as “Category B” since a single clearance is adequate.

Details of issues raised in the environmental public hearing - Not Applicable

Finance Arrangements –

Equity Capital (Rs. In Lakhs) : 37,600

Term Loan(Rs. In Lakhs) : 40,000

External Commercial Borrowing : Nil

ENVIRONMENTAL IMPACT ASSESSMENT – Appended on the EIA report

To cover

- ***Baseline Conditions***
- ***Impact Assessment including carrying capacity of the area***
- ***Social Impact Assessment including Rehabilitation Action Plan (if any)***
- ***Risk Assessment and Onsite and offsite Emergency Response Planning***
- ***Environmental Management Plan***
- ***Details of environmental parameters to be monitored (frequency and implementation agency)***

POTENTIAL ENVIRONMENTAL THREATS

This assessment is for the entire estate, not for individual units

- **Areas of concern**

1. 'Imminent threats' to human health and/or the environment ('imminent' means high-risk threats that require immediate action to reduce risks and liabilities)

<i>Threat</i>	<i>Actions proposed to be taken</i>
. Such threat will not arise.	Not Applicable.

.2. Likely Environmental 'trouble spots'

<i>Trouble spot</i>	<i>Actions proposed to be taken</i>
... Nil Not Applicable.

3. Major sources & quantities of wastes (solid, air, liquid) likely to be generated in the IE

<i>Sources</i>	<i>Inventory</i>	<i>Actions proposed to be taken</i>
----------------	------------------	-------------------------------------

Solid and liquid wastes generated will be recycled and reused

Habitat/wildlife

<i>Issues of concern</i>	<i>Action proposed to be taken</i>
--------------------------	------------------------------------

Nil	Not Applicable.
-----	-----------------

4. Potential sources of industrial accidents, explosions and fires, health and safety issues

Potential sources

Actions proposed to be taken

Nil

Not Applicable.

5. Sources of environmental threats in adjacent areas

Sources

Action proposed to be taken

Nil

Not Applicable..